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Discovery of the Critically Endangered Tarantula Species of the Genus *Poecilotheria* (Araneae: Theraphosidae), *Poecilotheria hanumavilasumica*, From Sri Lanka

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ABSTRACT

The arboreal spiders in the genus *Poecilotheria* is represented by 16 species and restricted to India and Sri Lanka. Each country has eight endemic species. During a survey on mygalomorph spiders in the Northern Province of Sri Lanka, the critically endangered species of Theraphosidae *Poecilotheria hanumavilasumica* was discovered for the first time outside of its native habitat in India, expanding its range to northern Sri Lanka. The discovery of *P. hanumavilasumica* is unique, as it used to be a critically endangered and endemic species of the genus *Poecilotheria* found in India, and it is evident that during the land bridge connection between India and Sri Lanka, when the Pleistocene epoch biotic exchange took place between the two countries, taxa were dispersed through the land connections.

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Introduction

The exploration of Sri Lanka's spider fauna dates back to 1869, which began with Pickard–Cambridge closely followed by Karsch and Pocock, followed mainly by the French arachnologist Simon who visited the island in 1892 to collect spiders (Benjamin et al 2012; Pethiyagoda 2007). Although the study of Arachnids was instigated nearly 2 centuries ago, very little is known of the actual number of spiders found on the island, with a mere 501 plus species being recorded so far (Benjamin et al 2012; Nanayakkara 2014a). This number reflects the paucity of research on spiders in Sri Lanka. Further, the mygalomorph spider fauna of the country is relatively poor in species. A total of 20 species, classified under 11 genera, *Diplothele*, *Plagiobothrus*, *Sason*, *Sipalolasma*, *Indothele*, *Haligmomerus*, *Scalidognathus*, *Atmelochilus*, *Chilobrachys*, *Plesiophrictus*, and *Poecilotheria*, have been reported (MOE 2012; Nanayakkara and Vishvanath 2013). By far, the largest representation of mygalomorphs in Sri Lanka is by the genus *Poecilotheria*.

The old world genus of arboreal spiders *Poecilotheria* is represented by 16 species, and is restricted to India and Sri Lanka (Nanayakkara et al 2012a, 2012b; Nanayakkara 2013; Platnick 2014).

Within the genus *Poecilotheria*, the species *Poecilotheria hanumavilasumica* Smith, 2004 was reported from India. This species is an Indian endemic, and according to the current International Union for Conservation of Nature listing, the species is categorized as critically endangered, as it is restricted to a few tamarind, casuarina, and mixed dry deciduous trees, and palm plantations on the Island of Rameshwaram and Mandapam area on the mainland close to the island (Siliwal et al 2008). *P. hanumavilasumica* up until now has not been found in any other parts of India or Sri Lanka. This paper is based on the observations and collections from Mannar Island, Northwest Sri Lanka. The presence of this critically endangered Theraphosidae, *P. hanumavilasumica*, has been recorded for the first time outside of India, expanding its range to northern Sri Lanka.

Materials and methods

A survey on mygalomorph spiders was conducted in the Northern Province of Sri Lanka (Figure 1) in December 2012. During the survey, all possible microhabitats of mygalomorph spiders were subjected to scan sampling (in which complete scanning of probable habitats on trees as well as on the ground for mygalomorph burrows

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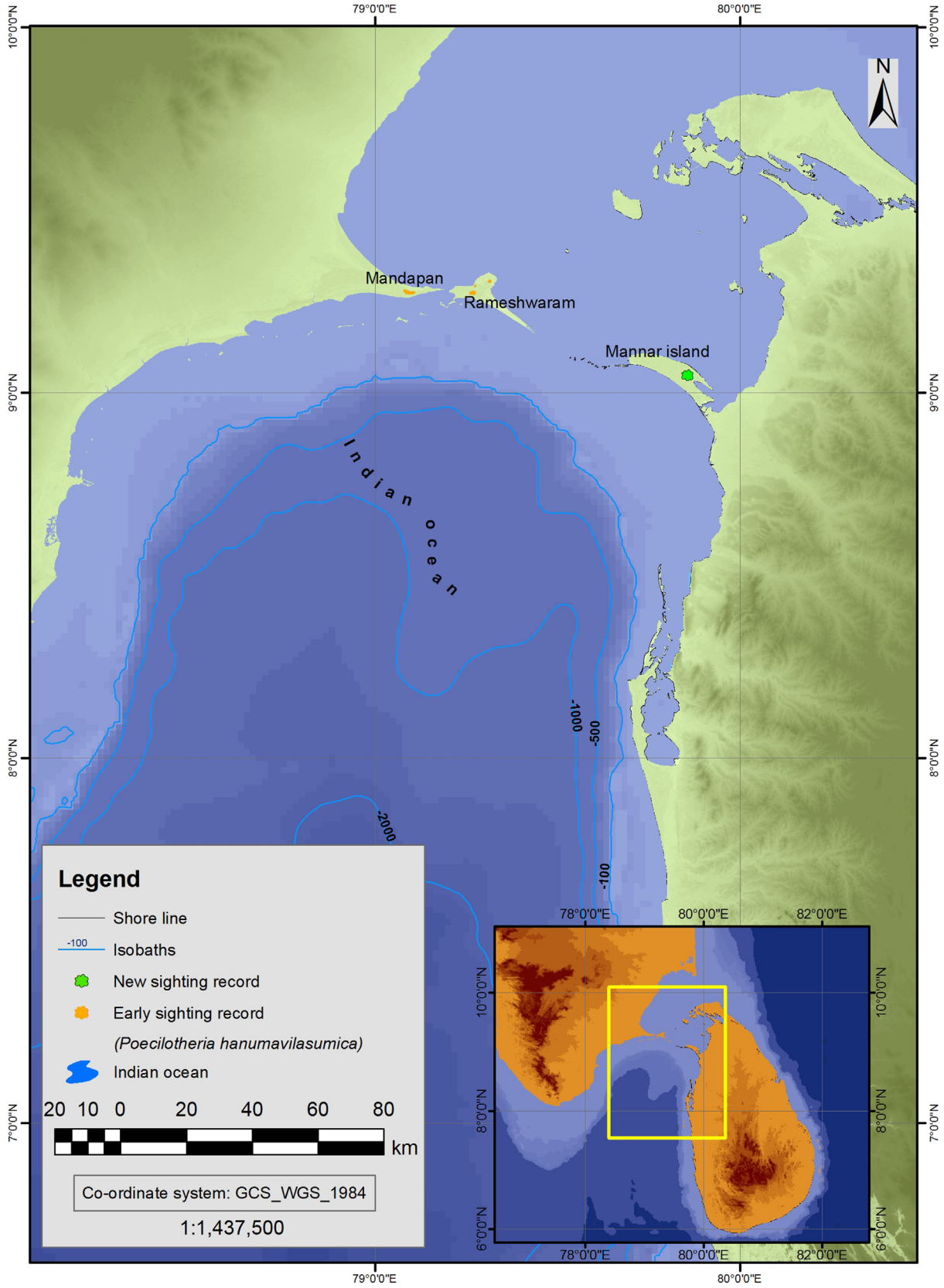

Figure 1. Distribution of *Poecilotheria hanumavilasumica* in India and Sri Lanka.

was performed). Initially, surveys were conducted during daylight hours, and recorded active microhabitats were observed at night. At times, spiders from active burrows were teased out during daylight hours to identify the species. Upon capture/sighting, the spiders were photographed *in situ*, inside the hollow/burrow (Figure 2), using a Canon 450 DSLR (Canon Inc., Tokyo, Japan) fitted with an 18–55 mm standard lens fitted with macrorings. Depth and height of the microhabitat from ground level were measured using a yard stick. Mygalomorph spiders were identified using published keys by Pocock (1900) and Nanayakkara (2014b), and the original description of *P. hanumavilasumica* by Smith (2004).

One adult female specimen was collected and deposited to the National Wildlife Research and Training Centre (Department of Wildlife Conservation–DWC) in Giritale. The specimen was measured using a digital Vernier Caliper (Mitutoyo, Japan) and documented in millimeters. Other observed spiders were captured, photographed, and released to the same site without harm. The Global Positioning System (GPS) coordinates were recorded using a Garmin Etrex GPS receiver (Garmin International, Inc., USA), and the distribution was mapped using ArcGIS version 9.2 (Esri, USA). The material examined here is now deposited to the National Wildlife Research and Training Centre (DWC) in Giritale.

Systematic accounts
Order Araneae
Family Theraphosidae

Poecilotheria hanumavilasumica Smith, 2004
Poecilotheria hanumavilasumica Smith, 2004: 48–61. Type locality: Rameshwaram Island, India

Diagnosis. P. hanumavilasumica belongs to the radiation of *Poecilotheria* with intense yellow coloring on legs I and II. This encompasses *Poecilotheria fasciata*, *Poecilotheria rajaei*, *Poecilotheria striata*, and *Poecilotheria regalis* from Sri Lanka and India. *P. hanumavilasumica* closely resembles its sister species *P. fasciata*. The two species are set apart by the following features: band on the femur of leg I of *P. hanumavilasumica* is much broader than that in *P. fasciata*. The band on the femur of leg IV is continuous in *P. hanumavilasumica*, whereas it is disjointed in *P. fasciata*. It is easily set apart from the other species of the radiation, as *P. regalis* and *P. rajaei* have a ventral abdominal band. In *P. striata*, the banding is thicker on all four legs. However, *P. hanumavilasumica* clearly differs from its sister species *P. fasciata* by the shape of the spermatheca organ (Figure 5C).

Figure 2. *Poecilotheria hanumavilasumica* in hollow of Katu Andara (*Dichrostachys cinerea*).

Figure 3. Dorsal aspect of *Poecilotheria hanumavilasumica* in life DWC-SLMS 2014-001.

Color in life (Figure 3). Carapace and chelicerae are black at the base, covered with a dense mat of short, wavy golden hairs, more dense toward the margins and concentrated along the interstitial ridge radiating from the fovea, long curved light brown hairs at the periphery; mid dorsal black patch surrounding a patch of pallid/gray hairs around the fovea and caput; chelicerae with two black vertical hairless bands running along its length. Legs hairy, covered with a mat of grayish and black small hairs intermixed with long brown hairs with pallid tips; dorsal grayish with black annulations and white markings; ventral (Figure 4), black and intense yellow bands on legs I and II with white and black bands on palps and legs III and IV. Abdomen: dorsally, gray with black chevron mark running along its length, and ventrally, coffee brown.

Prosoma (Figure 5A). Length 22.03, width 21.22, and length-to-width ratio 1.03. Bristles: six between the anterior median eyes (AMEs), 10 long, and 12 short between the posterior median eyes (PMEs); 26 long and 19 short on the clypeus edge. Mat of fine hairs on the anterior and posterior ocular areas, fine golden hairs at the base of the posterior lateral eyes (PLEs). Fovea deep and slightly procurved. Caput not much higher than the cephalic and thoracic regions.

Eyes. Group occupying 4.25 of the head, width 13.36; ratio of the group width to length 2.59. AMEs clearly larger than rest, PMEs clearly smaller than rest. Eyes are on low ocular tubercle. Eye diameter: anterior lateral eyes (ALEs), 0.94; AMEs, 1.01; PLEs, 0.75; PMEs, 0.32; distance between eyes: AME–AME, 0.67; PME–PLE, adjacent; AME–ALE, 0.55; and PME–PME, 2.01. Ocular quadrate 1.64 long and 4.25 wide. Median ocular area or quadrangle length, 1.53; anterior width, 2.04; and posterior width, 2.85. Clypeus absent.

Maxillae. Anterior length 7.34, posterior length 8.56, and width 4.73. Posterior ventral edge gently rounded for whole length. Cuspules: ca. 273 sparsely arranged in a triangular shape in anterior corner. On the prolateral face, two bands of thick brushes of grayish black hairs above and below the maxillary suture. Maxillary lyra (Figure 5B) consists of one thick tooth-like black tubercles with many paddle-shaped setae in three to four rows on the prolateral face, all paddle setae are reddish brown except for the base and swollen tips which are black, two small thick setae present above

Figure 4. Ventral aspect of *Poecilotheria hanumavilasumica* in life DWC-SLMS 2014-001.

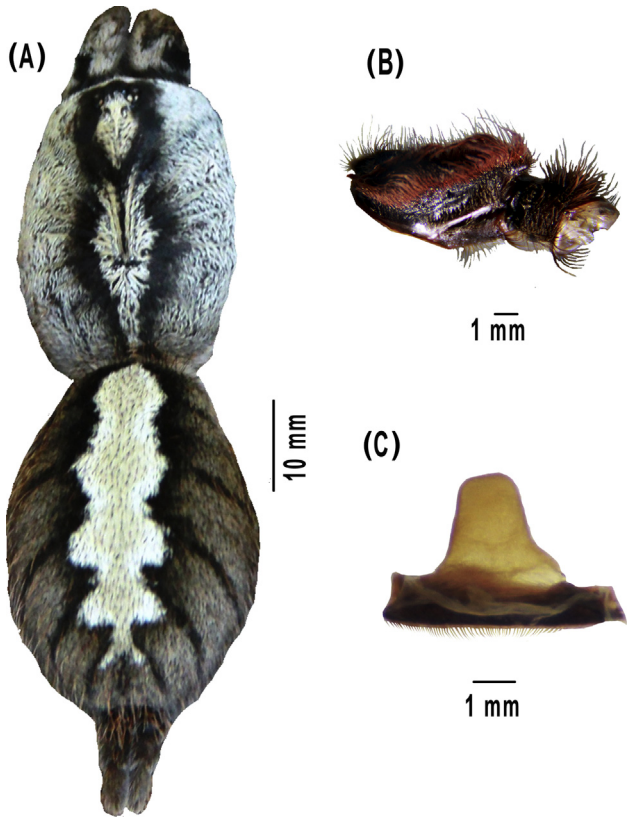

Figure 5. Some organs of *Poecilotheria hanumavilasumica* (DWC-SLMS 2014-001), A. Cephalothorax and Prosoma; B. Maxillary lyra; C. Spermatheca organ.

the paddle setae; and two broad bands of gray long hair. Retrolateral face is reddish brown, glabrous in the center with thin short spines in the distal and retroventral edge. Serrula broad, curved band behind anterior lobe running down posteriorly.

Labium. 2.22 long and 3.10 wide; ca.76 cuspules in band for one-fourth of the length anteriorly; cuspules ca. similar in size to the maxillary. Basal groove is shallow and distinct. Labiosternal groove is convex. One pair of large sterna sigilla is present in the labiosternal groove.

Chelicerae. Length 8.53, intercheliceral spines are absent; covered with a mat of gray, pallid hairs intermixed with long black hairs on the dorsal and lateral sides. Chelicerae lyra, with short thorn spines arranged in an oval shape on the proximal lower retrolateral face. Prolateral face is glabrous and reddish brown; and 14 promarginal teeth, 50 basomesal teeth in two to four rows.

Sternum. 9.58 long and 8.45 wide. Almost round, high in the center, sloping gradually, covered with long and short brown hairs. Posterior tip short, not very sharp and not separating coxae IV. Posterior edge is clearly visible. Prostrate hair mat is strong, dense, of pallid hairs intermixed with long black hairs, few with pallid tips. Two to three rows of long black hair are present on the margins. Pedicel pallid and not clearly visible.

Sigilla. Three pairs: posterior pair—oval, 0.56 diameter, ca. 3.13 apart, 0.78 from margin; middle pair—oval, 0.33 diameter, 5.74 apart, 0.38 from margin; anterior pair—very small, round, marginal.

Legs. Anterior legs slightly thicker than posterior legs, but overall all of similar thickness. Basifemoral thorns are absent on all legs. Metatarsi on legs longer than the tarsi. Spines are absent on all legs (Table 1).

Claws. Paired claws on all legs with unequal bifid tooth. Palp with a single bare claw.

Opisthosoma. Length 30.32 and width 25.15; cuticle not exposed dorsally and ventrally; dorsally covered with a thick mat of black and gray hairs, fine layer of black, long hair with many pallid tips; ventrally and ventrilateral uniformly black, thick mat of fine black hair, and intermixed uniformly with long black hairs with pallid tips.

Spinnerets. Posterior medial spinnerets: length 2.55 and width 0.74, apart 0.67; posterior lateral spinnerets (PLS): basal 3.18, PLS middle 2. 30, PLS apical 3.95, PLS total length 9.43, two pairs, digitiform, yellowish, covered with a mat of gray and brown hairs intermixed with many long black hairs with pallid tips.

Spermatheca (Figure 5C). Simple, fused seminal receptacles, broader at the base, gradually narrowing down to half the width toward the apex.

Material examined. 1♀, Mannar Island, Mannar District, Northern Province, Sri Lanka, elevation 5 m. Collectors: R.P. Nanayakkara and N. Vishvanath, December 2012 (DWC-SLMS 2014-001).

Distribution. Sri Lanka, India

Discussion

On December 27, 2012, at 09:12 hours, a single female specimen of *P. hanumavilasumica* was discovered from Mannar Island,

Table 1. Measurement of legs and pedipalp (mm).

	Leg I	Leg II	Leg III	Leg IV	Palp
Femur	20.02	17.45	14.34	16.18	12.33
Patella	7.22	7.34	4.56	5.05	4.1
Tibia	16.43	13.24	11.53	13.34	9.29
Metatarsus	14.2	12.2	11.32	12.44	
Tarsus	7.03	7.23	7.43	5.5	7.22
Total	64.9	57.46	49.18	52.51	32.94

Northwest of Sri Lanka (Figure 1) in a hollow of a tree that was identified as *Dichrostachys cinerea* (Figure 2), locally known as Katu Andara, which belongs to the family Fabaceae, a thorny shrub. The tree hole was situated fairly low, 1.2 m from the ground level, and the hollow was 35–40 cm deep.

Later, the site was visited at 18:30 hours when the spiders of the genus *Poecilotheria* are active, and a specimen was collected for detailed investigation. The next consecutive days yielded several other specimens of *P. hanumavilasumica*, three females and eight spiderlings, one female was with an egg sac. They were captured, photographed, and released to the same site without damaging them. No males of *P. hanumavilasumica* were recorded. Incidentally, during the survey, a female of *Poecilotheria fasciata* was also found in a hollow of a Mango tree (*Mangifera indica*), approximately 5 km away from the location of *P. hanumavilasumica*; the specimen was captured, photographed, and released back to the original location.

The present discovery of *P. hanumavilasumica* is unique, as it is the first species of the genus *Poecilotheria* that is found in both India and Sri Lanka. Due to its restricted distribution, small population size, and anthropogenic pressure to its natural habitats, the species is classified under the critically endangered category of the IUCN. Further, the red list states that the entire estimated extent of occurrence is less than 100 km^2, with the actual area of occupancy being < 6 km^2. Currently, *P. hanumavilasumica* has been recorded from eight subpopulations and < 15 severely fragmented locations in India.

Nonetheless, the current distribution limit record of *P. hanumavilasumica* suggests positive prospects for its conservation status, which has generally been considered dire. Our observations were consistent with the occurrence of viable breeding populations in Mannar Island. However, both populations need to be reassessed, but the major challenge will be to establish the extent of continuity of its distribution between these geographically scattered records. Surveys in appropriate habitats along the northwestern coastal belt in Sri Lanka will be required to determine whether this new record represents an isolated population or whether the species is continuously distributed at low densities.

Based on the present-day submarine topography, a functional land bridge between Sri Lanka and India (Mannar Island and the island of Rameshwaram) requires a sea-level lowering of only ~10 m. Sea levels were ~120 m below the present-day levels at the last glacial maximum, ca. 20,000 ybp (Siddall et al 2003), thus facilitating a > 80 km-wide terrestrial connection. It is likely that sea levels were sufficiently depressed during the final ~200,000 years of the Pleistocene to have supported a land connection between Sri Lanka and India for all or most of the time (Bossuyt et al 2004) and probably until 5000–10,000 ybp (Deraniyagala 1992; Anderson 1998). Thus, it is not surprising that *P. hanumavilasumica* is found on the island of Mannar, although biotic exchange between the island and the mainland appears to have been restricted for 10,000 ybp, resulting in several remarkable insular radiations. Protracted desiccation experienced by the climates of peninsular India and Sri Lanka during Pleistocene glacial maxima (Deraniyagala 1992; Pant and Rupa Kumar 1997) possibly resulted in desertification of the land bridge between the two countries for much of that time. Even during the present relatively pluvial period, southern India and northern Sri Lanka are remarkably dry, precipitation being seasonal and rarely exceeding 1500 mm per year, with a vegetation of tropical dry shrub-land, a habitat associated with *P. hanumavilasumica*. Although the overall morphological and geographical proximity and prevailing biogeography patterns support the likelihood that the recorded species represented here represent a population undifferentiated from *P. hanumavilasumica* population of south India. However, hypothetically given the potentially disjunct nature of this population, a genetic comparison should be made to assess its taxonomic status relative to *P. hanumavilasumica*.

The presence of *P. hanumavilasumica* in Mannar Island is an important criterion for establishing a wildlife protected area in this region. *Poecilotheria*, as with mygalomorph spiders, are long lived and have poor dispersals, and hence are highly susceptible to threats such as deforestation. The issues highlighted in this paper should be addressed coherently with a sense of urgency, prior to the next wave of "development" overwhelm areas such as the north and east of Sri Lanka. Conservation planning for these areas should not be done piece-meal or on a short-term basis, but landscape level that takes long-term impacts into consideration. Appropriate buffer zones and corridors including multispecies home gardens, where appropriate, can be used to link the different ecosystems and forest types in this region. A certain part of Mannar Island is being cleared to make way for development in the form of garment factories and other establishments of commerce; as such, in the area adjoining the forest where *P. hanumavilasumica* was found, a large development project will start in the near future.

In summary, the observation reported here suggests that much more surveys are required from the area to understand the conservation needs and status of these mygalomorph spiders. Further, it is required to identify those areas that may hold viable populations, especially because *P. hanumavilasumica* is considered critically endangered. The investigation of coastal habitats in the country is also required to establish the distribution of the species in Sri Lanka. The report of this species in Mannar Island further infers the need to conserve this habitat, as it may shelter hitherto unrecorded species, as very little research has been carried out in the area.

Conclusion

Documentation of biodiversity has become a very important aspect for the conservation of that particular ecosystem. The unique shrub and deciduous forest of Mannar Island and its environments share many similarities with those of south India. This area has been neglected for the past 30 years due to the hostility that prevailed due to the insurgency. Further, no arachnological studies have been carried out in the area. Hence, the forest of the area is largely unexplored with reference to arachnofauna or any other taxa. Further studies may yield information on hitherto unrecorded species of spiders and many new site records for the same.

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