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Diversity and Identification Key to the Species of Scorpions (Scorpiones: Arachnida) from Jaffna Peninsula, Sri Lanka

Veronika K**ABSTRACT**

Taxonomic record on scorpion (Scorpiones: Arachnida) revealed the presence of three species of scorpions from Jaffna Peninsula during a field survey. They belong to two families, three genera and three species: the Buthids *Hottentotta tumulus* (Fabricius, 1798) and *Isometrus (Isometrus) maculatus* (DeGeer, 1778), and the Scorpionid *Heterometrus swammerdami* (Simon, 1872). *Isometrus (Isometrus) maculatus* and *Heterometrus swammerdami* are reported for the first time from Jaffna peninsula. Identification key of all three species with notes on distribution and ecology are provided.

Keywords: Scorpiones: Arachnida, *Heterometrus*, *Isometrus*, *swammerdami*.

1. Introduction

The faunal surveys of vertebrate has yielded high number than invertebrate to date in Sri Lanka. For instance, dung beetles, corals, echinoderms, centipedes, bivalves and gastropods are included as lesser known faunal groups in the National Red List 2012 of Sri Lanka. Even few selected groups such as butterflies, dragonflies and land snails are listed as most evaluated species. Furthermore other invertebrate group of Arachnida that includes especially spiders and scorpions. The Red List contains 501 spider species (including 257 endemics). Unlike scorpion fauna is largely neglected taxonomic records in Jaffna Peninsula as well as Sri Lanka ^[1].

Distribution of the scorpion fauna in the northern part of Sri Lanka remained under pressure of severe habitat degradation at frequent rate due to war until 2009 ^[2]. Conservation of biodiversity depends on the identification and maintenance of the taxonomic records of its biotic components ^[3]. Though this area is poorly known for invertebrate fauna, and extensive field surveys are needed to get a preliminary data of the scorpion diversity of these area.

The Jaffna Peninsula (9°40'0"N 80°0'0"E) is located at the northernmost region of the Island of Sri Lanka, with area of about 1,025.6km². It is in close proximity to the sub-continent of India and separated from it by the Palk Strait and the Bay of Bengal. The peninsula is actually almost an island; much of it covered by shallow lagoons, and has a number of interesting islands dotted offshore. Most of the area is dry and sandy. Elephant Pass is the narrow causeway, connects Jaffna with the rest of Sri Lanka. Jaffna features a tropical rainforest climate with no true dry season month. The average annual temperature is 27.190°C. The average rainfall is 1,811.8 mm ^[4].

The topography of this area is almost flat and of low elevation except in the area around Tellippalai, where the elevation rises to 10.5 m above sea level. The flat Jaffna peninsula is made of limestone, unlike most other parts of Sri Lanka, which is the main feature of Jaffna Peninsula's geography ^[5]. According to Pocock (1900) 11 species of scorpions under 3 families, namely Scorpionidae, Charilidae and Buthidae occur in Sri Lanka. Vachon (1982) made inventories of the scorpions of Sri Lanka (studies on the scorpions deposited in the collection of the Natural History Museum Geneva III) comprising of 11 species: 3Scorpionidae, 7Buthidae and Chaerillidae along with a key to their identification of these species and a map of their distribution. Additionally, four species has been recorded from Sri Lanka during the last decade by several researchers ^[6, 7, 8, 9, 10, 11]. These members of scorpions were reported only from Yala national park, Willpattu National Park, Kandy, Anurathdhapura, Trincomalee, Mannar and Mullaittivu ^[12].

Ranawana (2013) has reviewed the current list of scorpions, including the total count up to 16 species found in Sri Lanka. When compared to other parts of the country, the scorpion fauna of Jaffna Peninsula is poorly documented. Recently, Ranawana et al (2013) discovered a medically important new species *Hottentotta tamulus* within the family Buthidae. However, there is one species of family Buthidae recorded in Jaffna Peninsula. This study is made a first attempt to provide a detailed systematic account of scorpion fauna of Jaffna, mainly from Northern province of Sri Lanka. The present study includes 3 species

belonging to 2 families. Two species *Isometrus maculatus* (De Geer, 1778), *Heterometrus swammerdami* (Simon, 1872) are reported here for the first time from Jaffna. Ranwana (2013) did not include these two species in their work and no further specimens were reported from Jaffna Peninsula by other authors as well. The aim of this study was to establish the composition of scorpion fauna with identification key to scorpions of Jaffna Peninsula, and to contribute further knowledge of scorpion fauna in Sri Lanka.



Fig 1: Map of Jaffna Penninsula, showing the localities of scorpion species (triangle, *Isometrus maculatus*; circle, *Heterometrus swammerdami*; star, *Hottentotta tumulus*).

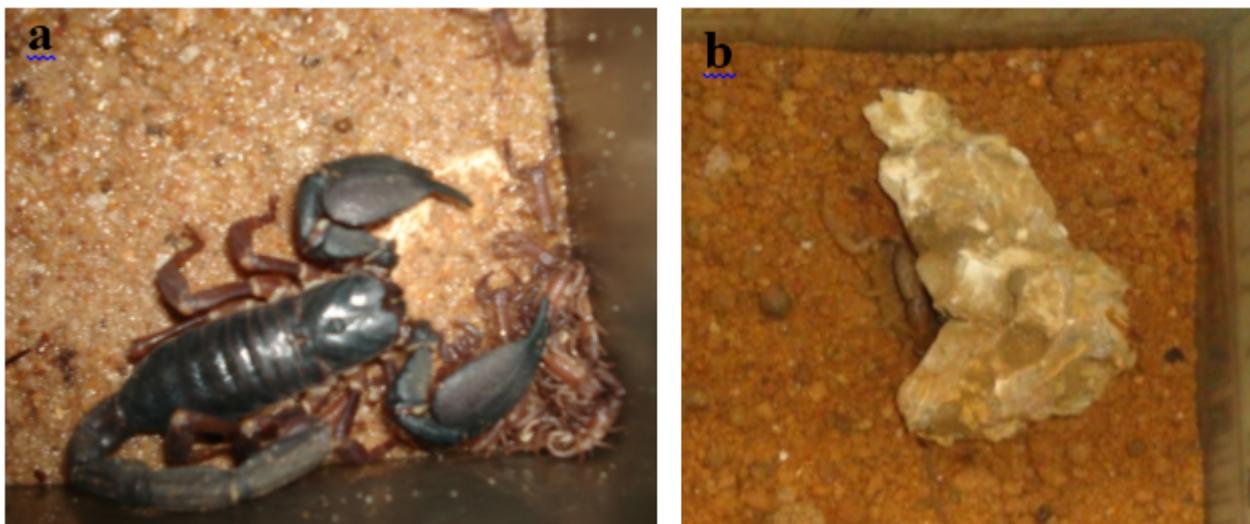


Fig 2: Live scorpions from Jaffna Peninsula, in captivity: (a) *Heterometrus swammerdami*; (b) *Hottentotta tumulus*

2. Material and Methods
2.1 Collection of scorpion

Field survey was carried out during the period from September 2010 to August 2011. Random search method was done during the survey and scorpions were searched under rocks, gap of soil, leaf litter, under bark, and within vegetation. In particular, we surveyed from Jaffna town (9°40'0"N 80°0'0"E) to Vadamaradchi area (9°48' 21. 97" N 80° 12' 16. 77"E) (Fig. 1). Scorpions were collected with the help of forceps, transferred to the plastic jar and preserve

in 70 % ethyl alcohol. Most of the scorpions were collected by "rock rolling" [13]. Furthermore, we did nocturnal observations in above localities. The temperature of air and substrate was taken at the collection sites. The air temperature ranged between 26 °C and 33 °C, whereas the soil values ranged between 27 °C and 32 °C. All the collected specimens were deposited after identification, in the faunal holding of Museum of Dept of Zoology, University of Jaffna.

2.2 Identification of scorpion

Photographs of live specimens were taken with a digital camera, while photos for morphological characters of preserved material were taken with a same camera mounted on the eye piece of Olympus microscope. Digital images were slightly processed with Adobe Photoshop® 7.0, only to optimize brightness and contrast. Measurements (in mm) follow Sissom et al. (1990) and descriptive terminology mostly follows Hjelle (1990). Morphological investigation and Counts of pectinal teeth were carried out under dissecting microscope (kyowa, ×20, ×40).

3. Systematics

3.1 Order Scorpiones C. L. Koch, 1850

Family **Scorpionidae** Latreille, 1802

Subfamily **Scorpioninae** Latreille, 1802

3.1.1 *Heterometrus swammerdami* (Simon, 1872) (Fig 3–8; Tables 1)

Heterometrus swammerdami Simon, 1872: 56.

Heterometrus (Gigantometrus) swammerdami: Fet, 2000: 443; Prendini, 2000: 44; Bastawade, 2002: 295; Kovařík, 2002: 17; Lourenço & Huber, 2002: 273; Kovařík, 2004: 42 (complete references and synonymy list until 2004).

= *Heterometrus (Gigantometrus) swammerdami titanicus* Couzijn, 1981: 165; Vachon, 1982: 79; Kovařík, 1997: 183; Kovařík, 1998: 137; Fet, 2000: 444 (syn. by Kovařík, 2004: 42).

= *Pandinus asper* Thorell, 1876b: 199 (syn. by Pocock, 1890: 237).

= *Pandinus kochii* Karsch, 1879: 127; Karsch, 1887: 68; Karsch, 1892: 307; Moritz & Fischer, 1980: 316 (syn. by Pocock, 1890: 237).

= *Scorpio lucidipes* Simon, 1885: 38 (syn. by Pocock, 1890: 237).

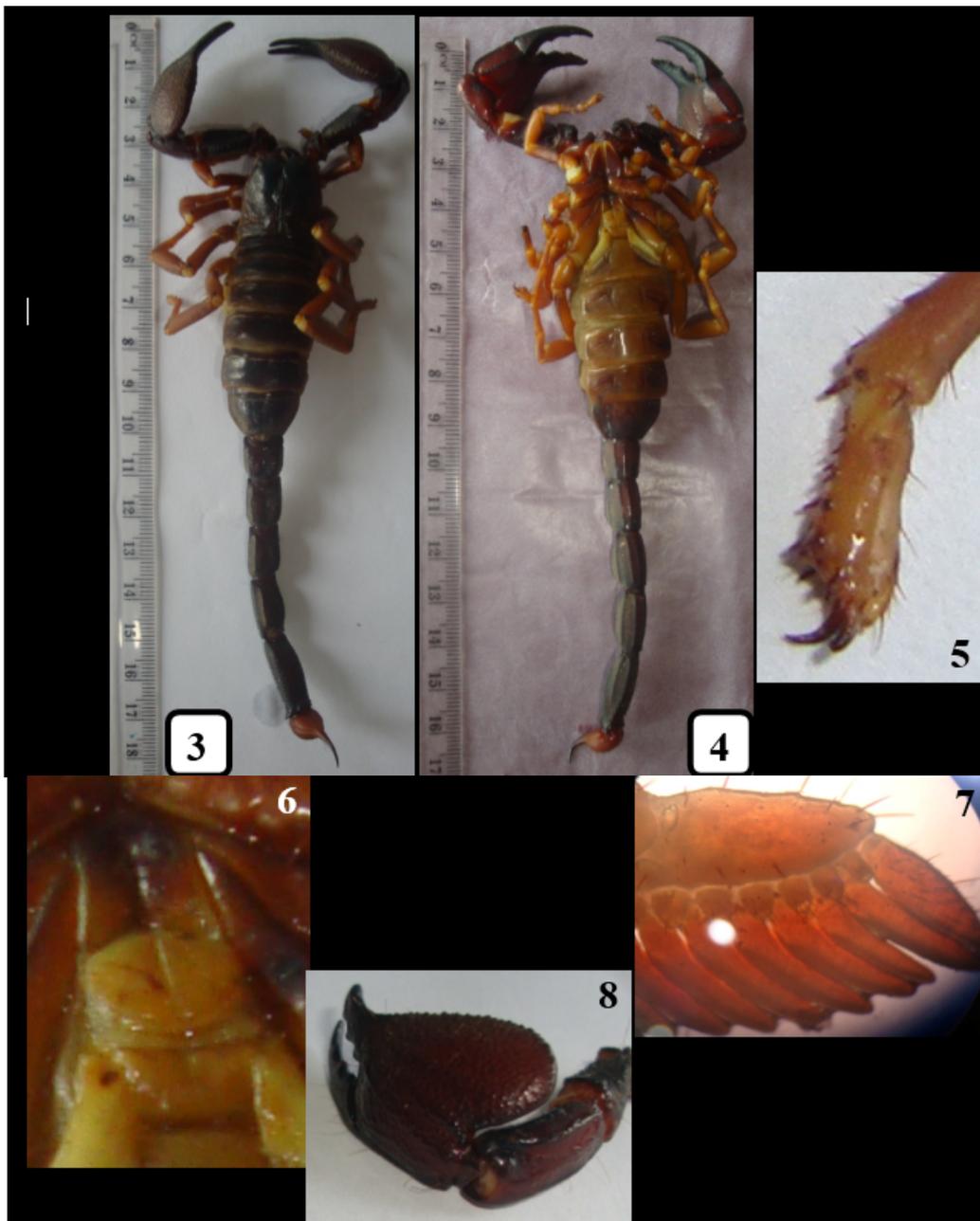


Fig 3-8: *Heterometrus swammerdami*, 3-4, Dorsal and ventral views, 5. Single anterior pedal spur on leg 6. 6. Sternum. 7. Pectinal teeth 8. Right pedipulp chela, lateral aspect from Thirunelveli, Jaffna.

Table 1: Measurements (in millimeters) of type specimens of *Heterometrus swammerdami*, *Hottentotta tumulus* and *Isometrus maculatus* from Jaffna Peninsula. Deposited in Department of Zoology, Faculty of Science, University of Jaffna, Sri Lank

	<i>Heterometrus swammerdami</i>	<i>Hottentotta tumulus</i>	<i>Isometrus maculatus</i>
Carapace, length	19	9	6
Carapace, anterior width	18	5	
Carapace, posterior width	19	10	
Mesosoma, length	39	24	9
Metasomal segment I			
Length	10	4	
Width	7	5	4
Metasomal segment II			
Length	11	5	
Width	6	5	5
Metasomal segment III			
Length	13	5	7
Width	6	5	-
Metasomal segment IV			
Length	14	6	7
Width	6	4	-
Metasomal segment V			
Length	17	9	10
Width	5	4	-
Metasoma length	65	29	33
Telson length	17	8	5
Aculeus length	10	3	-
Pedipalp, femur Length	13	6	8
Width	6	2	-
Pedipalp, patella Length	15	8	8
Width	19	3	-
Pedipalp, chela Length	31	3	10
Width	22	2	-
Movable finger, Length	19	10	6
Total body length	140	70	53
Pectinal teeth count			
Left/Right	18/18	30/30	19/18

3.1.2 Type Locality and Type Repository: East Indies, designated by Kovařík, 2004: 42; deposited in Museum National d'Histoire Naturelle, Paris, France.

3.1.3 Diagnosis: Adults 130–176 mm long. Base color uniformly reddish brown to reddish black. Juveniles may be red with yellow telson. Pectinal teeth number 16–20. Sexual dimorphism in proportions of pedipalps not noticeable. Chela strongly lobiform, its length to width ratio 1.6–1.8 in both sexes. Entire manus covered by large, rounded granulae that do not form true carinae. Patella of pedipalp without pronounced internal tubercle. Carapace with disc smooth, margins and posterior portion granulate, and anterior portion granulate and tuberculate; occasionally entire surface sparsely granulate. Fifth segment of metasoma longer than femur of pedipalp, fourth segment of metasoma approximately as long as femur of pedipalp. Telson bulbous, vesicle as long as or longer than aculeus.

3.1.4 Habitat: This is a common species. They are found in the gap of soil, leaf litter and under the stones.

3.1.5 Distribution: India, Sri Lanka: Puttalam, Anuradhapura, Kandy, Jaffna (first record).

Family **Buthidae** C. L. Koch, 1837

Sub family: **Buthinae** C. L. Koch, 1837

3.2 *Hottentotta tamulus* (Fabricius, 1798)

(Figures 9-14, Table 1)

Scorpio tamulus Fabricius, 1798: 294.

Hottentotta tamulus: Kovařík & Whitman, 2005: 108; Kovařík, 2007: 76 (complete references and synonymy list until 2007); Teruel & Rein, 2010: 7.

= *Buthus nigrolineatus* Dufour, 1856: 570 (syn. by Kraepelin, 1899: 20).

= *Buthus grammurus* Thorell, 1889: 567; Kraepelin, 1899: 20; Vachon, 1940: 248 (syn. by Pocock, 1900: 23).

= *Buthus tamulus concanensis* Pocock, 1900: 25 (syn. by Kovařík, 2007: 76).

= *Buthus tamulus sindicus* Pocock, 1900: 25 (syn. by Kovařík, 2007: 76). = *Buthus tamulus gujaratensis* Pocock, 1900: 25 (syn. by Kovařík, 2007: 76).

= *Buthus tamulus gangeticus* Pocock, 1900: 25 (syn. by Kovařík, 2007: 76).

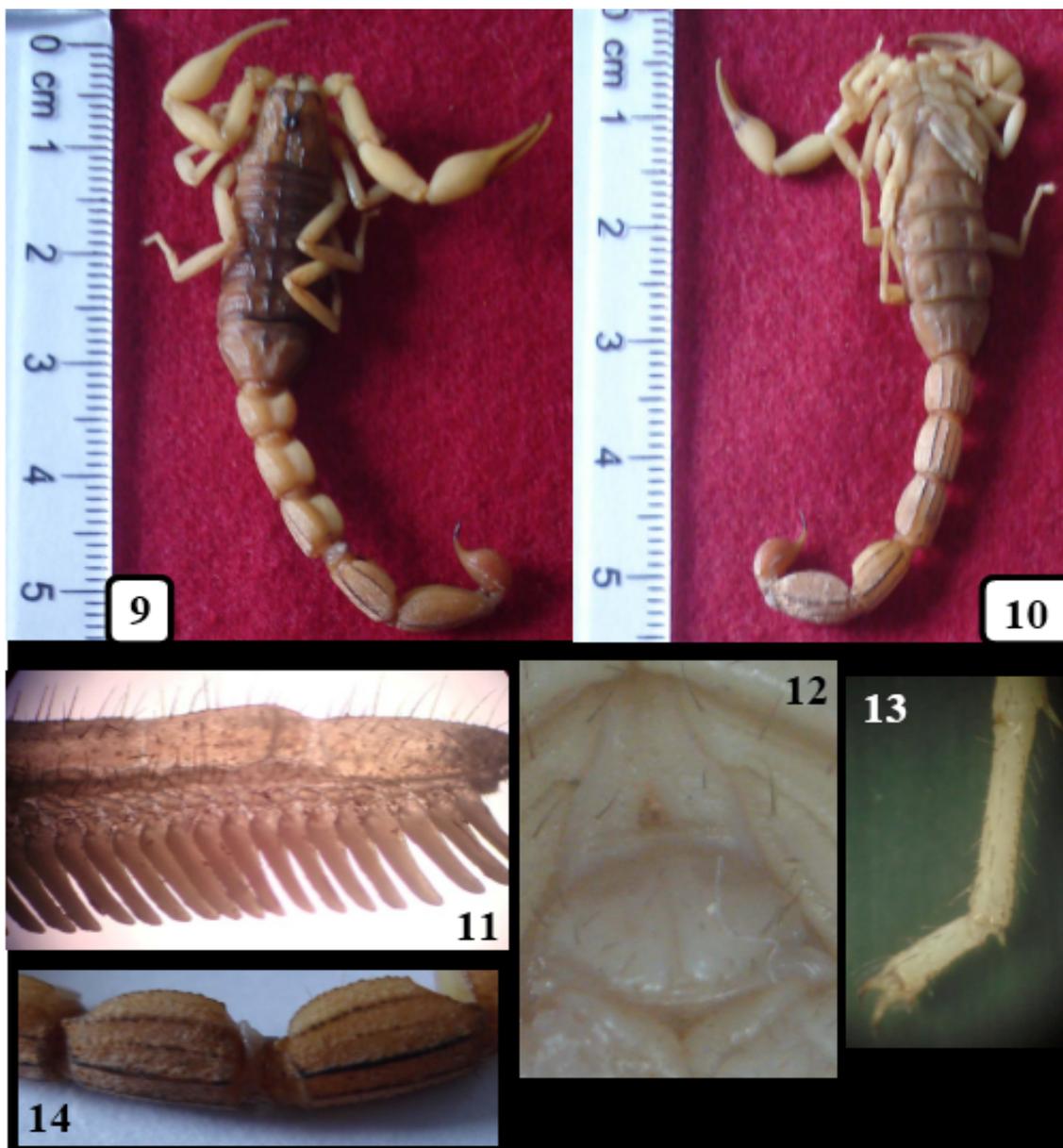


Fig 9-14: *Hottentotta tumulus*, 9-10, Dorsal and ventral views, 11. Pectinal teeth 12. Sternum 13. Tibial spur on 4th leg 14. Lateral view of metasomal segments II–III from Uddupiddy, Jaffna.

3.2.1 Type Locality and Type Repository: “India orientalis”; original type lost. Neotype from India, Maharashtra State, Bombay env, designated by Ko-vařík, 2007: 76; deposited in National Museum (Natural History) of Prague, Czech Republic.

3.2.2 Diagnosis: Total length 50–90 mm. Trichobothrium db on the fixed finger of pedipalp chela situated between trichobothria et and est, may be level with est. Male with fingers proximally twisted, manus of pedipalps wider than female. Pectinal teeth number 30–39 in males, 27–34 in females. Chelicerae yellow, reticulate. Pedipalps densely hirsute, legs and metasoma sparsely hirsute. Setae on patella of pedipalps are short. Color uniformly yellow to reddish, mesosoma dark. Ventral carinae on metasomal segments usually black. Femur of pedipalp with 5 carinae. Patella with two or 4 carinae on internal surface, no other carinae. Chela

lacks carinae. Movable fingers of pedipalps with 13–15 rows of granules and 5 or 6 terminal granules. Seventh sternite with 4 well marked black carinae. First to third metasomal segments with 10 carinae; fourth metasomal segment with 10 or rarely 8 carinae; fifth segment with 5 or 7 carinae. Metasoma sparsely to densely granulate between carinae. Dorsal surface densely and very finely granulated, often bears two short, inconspicuous marginal carinae. Telson also granulated. Dorsal carinae of metasomal segments bear terminal granules of size approximately equal to preceding granules. First metasomal segments of adult female wider than long (in male usually as long as wide), second metasomal segment longer than wide for both sexes. Second to fourth metasomal segment width ratio about 1.1. Length to width ratio of fourth metasomal segment about 1.5. Telson bulbous, especially in large females.

3.2.3 Habitat: It was observed under rocks and in crevices.

3.2.4 Distribution: India, Pakistan, Sri Lanka: (mentioned the occurrence of this species in Jaffna, Palali, Karainagar, Achchuveli) Karaveddy and Iddaikadu (first record).

3.3 *Isometrus (Isometrus) maculatus* (DeGeer, 1778) (Figures 15–20; Tables 1)

Scorpio maculatus DeGeer, 1778: 346.

Isometrus maculatus: Thorell, 1876: 8; Vachon, 1982: 90; Kovařík, 1997: 362.

Isometrus (Isometrus) maculatus: Vachon, 1972: 177; Vachon, 1976: 38; Kovařík, 1994: 197; Kovařík, 1995: 187; Kovařík, 1997: 8; Fet & Lowe, 2000: 147; Kovařík, 2003: 2 (complete references and synonymy list until 2003). *Isometrus (Isometrus) madagassus*: Vachon, 1972: 177; Vachon, 1976: 38; Vachon, 1982: 90; Kovařík, 1994: 202. *Isometrus (Raddyanus) europaeus*: Tikader & Bastawade, 1983: 286.

3.3.1 Type Locality and Type Repository: “Suriname and Pennsylvania”, designated by Kovařík, 2003: 2; deposited in Naturhistoriska Riksmuseet, Stockholm, Sweden.

3.3.2 Diagnosis: Moderate to large size, measuring up to 60 mm in adult male and about 50 mm in adult females. General coloration yellowish to pale yellow with symmetrical blackish-brown patterns in both adults and juveniles. Carinae and granulations moderately marked. Carapace strongly emarginate, with an open V-shaped angle. Pectines moderately long; pectinal tooth count 16–19 in both sexes. Dentate margins of fixed and movable fingers of pedipalp chela with 7 almost linear rows of granules. Trichobothrium db on chela of pedipalp situated between trichobothria dt and et. Subaculear tubercle strongly developed and triangular, with two ventral granules.

3.3.3 Habitat: Endemic species in Sri Lanka (Lourenco and Huber, 2002). It is found in wild conditions inland from Sri Lanka (Lourenco and Huber, 2002). It was collected close to human dwelling and under barks of large trees.

3.3.4 Distribution: Cosmopolitan (Fet & Lowe, 2000), Sri Lanka: Matala, Mannar, Anuradhapura, Jaffna (first record). However, it was rare record from Jaffna Peninsula.

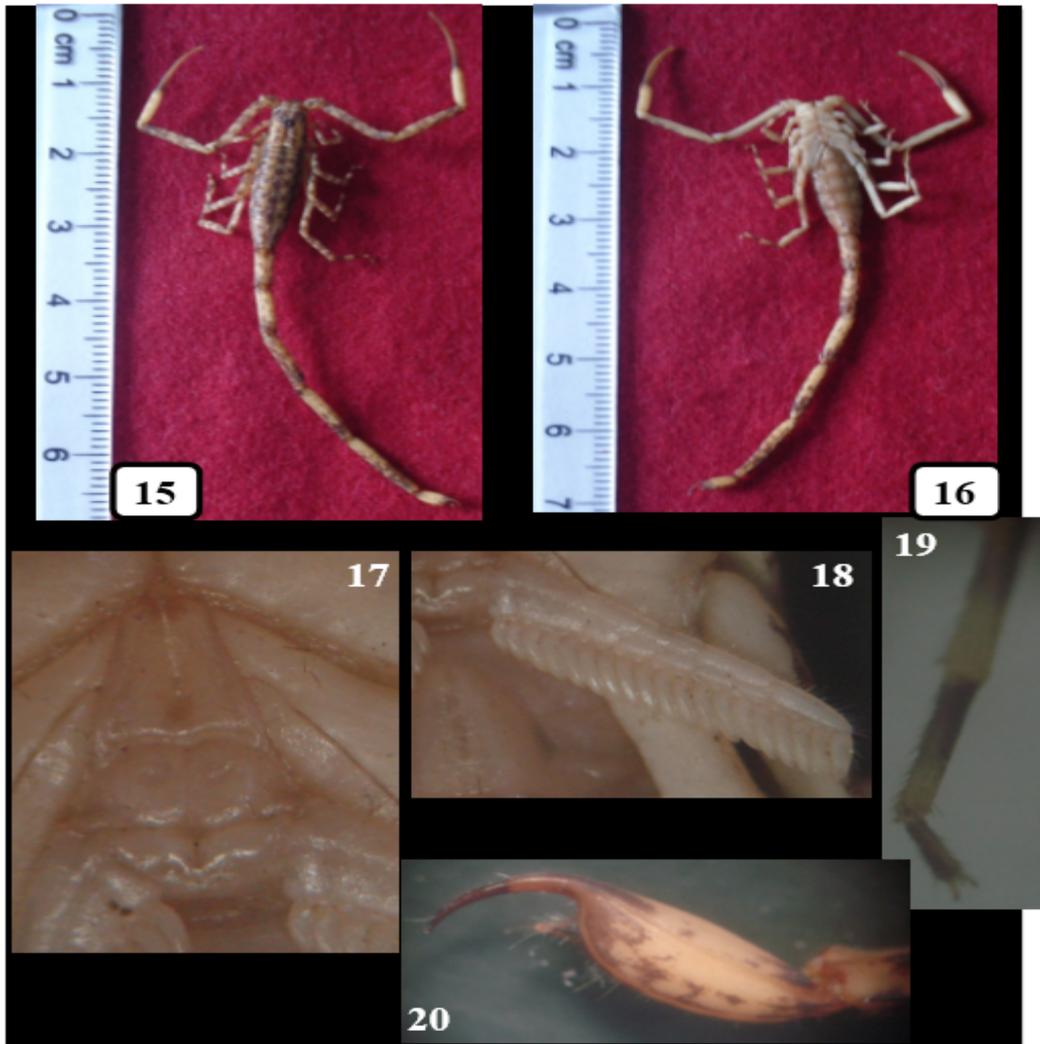


Fig 15-20: *Isometrus maculatus*, 15-16, Dorsal and ventral views, 17. Sternum 18. Pectinal teeth 19. Fourth leg (absence of tibial spur) 20. Telson, lateral aspects from Kopay

4. Discussion

Preliminary field survey revealed the occurrence of three species of scorpions belonging to two families, namely, Buthidae and Scorpionidae from the northern part of Sri Lanka. Among the species reported here, *Heterometrus swammerdami* (Simon, 1872), appears to be widely distributed in the leaf litter and gap of soil in Jaffna Peninsula. Two species *Isometrus (Isometrus) maculatus* and *Heterometrus swammerdami* are reported here for the first time from Jaffna. The species *Heterometrus swammerdami* (Simon, 1872) is the most common species to Sri Lanka (Kovařík, 2004). Which was distributed over the whole area of Jaffna Peninsula, represented by a fairly good number of specimens. *Isometrus (Isometrus) maculatus* (DeGeer, 1778) is an endemic species to Sri Lanka (Lourenco and Huber, 2002). Whereas, this species is widely distributed as cosmopolitan (Fet & Lowe, 2000). Though this species was reported here as rare species from Jaffna district. Therefore their occurrence in this area needs conformation by further collection of specimens. The recent discovery of a medically important alien species *Hottentotta tamulus* (Fabricius, 1798) from the Jaffna Peninsula (Ranawana et al., 2013) indicate the possible occurrence of further venomous taxa in this area. Here we presented the taxonomic records on the diversity and distribution of scorpion fauna. While, the key will be intended for a wide range of conservation managers to easily identify the scorpions from Jaffna Peninsula.

5. Key to the species of scorpions occurring in Jaffna Peninsula [10, 11, 14, 15]

Abdomen very long, consisting of twelve distinct somites, of which the posterior five are narrowed and compressed to form, with the post anal sclerite or vesicle, a distinct tail; post anal sclerite with two poison-glands; a posterior of comb like abdominal appendages.....**SCORPIONE.**

5.1. Pedipalps and metasoma short and robust. Coloration basically brown, densely spotted with black, so the scorpion looks uniformly dark to blackish to unaided eye. Trichobothrial pattern C: femur with only three tricho-bothria, patella with three ventral trichobothria. Sternum type 2: widely hexagonal, with a posterior emargination and convex lateral lobes. Legs furnished with a single anterior pedal spurs, posterior always absent**SCORPIONIDAE----- (3)**

-Pedipalps and metasoma long and slender. Coloration basically yellow, sparsely spotted with light to dark brown, so the scorpion looks pale and striped to unaided eye. Trichobothrial pattern A: femur with 10 trichobothria, patella without ventral trichobothria. Sternum type 1: narrowly pentagonal, with a posterior depression that does not bisect the posterior edge. Legs furnished with a pair of pedal spurs, one in front and one behind ; third 3rd and 4th legs usually furnished with tibial spurs**BUTHIDAE----- (2)**

5.2. Pedipalp fingers dark brown to black, conspicuously darker than hand. Trichobothrium *db* on chela of pedipalp situated between trichobothria *dt* and *et*. Manus of pedipalp very thin, width of male manus equals width of patella and femur. Pattern on mesosomal segments light colored. First basal middle lamella of female pecten quadrangular. Telson with subaculear tubercle very large, sharp and triangular.....**Isometrus**

(Isometrus) maculatus (DeGeer, 1778).

-Color uniformly yellow to reddish, mesosoma dark. Chela of pedipalp of same color as femur of pedipalp, not darker. Male has markedly broader manus than female. Inferior median keels present on 2nd and 3rd caudal segments. Total length 50–90 mm. Pectinal teeth number 30–39 in males, 27–34 in female.....**Hottentotta tamulus** (Fabricius, 1798).

5.3. -Dorsal surface of chela covered by pointed or rounded granules. Fifth segment of metasoma longer than femur of pedipalp, fourth segment of metasoma about as long as femur of pedipalps. Chela of pedipalp of adults colored similarly to body.....**Heterometrus swammerdami** (Simon, 1872).

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