Review of the genus Hasarius (Araneae: Salticidae) - a taxonomic fiasco

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Abstract
The genus Hasarius Simon, 1871, is revised following methodology recommended by “Pragmatic classification” of Prószyński (2017). Structure of the genus is insufficiently known, containing at present single cosmopolite species and a few of uncertain congener.

The paper introduces the following nomenclatorical corrections:


Species: kwelimenesis Prószyński, 1992, orientale Zabka, 1985, dactyloides Xie, Peng & Kim, 1993 listed variably in combinations with generic names Habrocestum, Habrocestoides, Hasarius and Chinattus seem to be misplaced in these genera and deserve transfer to own new genus.

Qualification of 6 species of Hasarius as “nomina dubia” by the WSC (ver. 18.5) after Roewer's (1954[1955]: 1523-1524) is changed to “pending revision” because of existence of preserved type specimens.

Synonymy of the genera Gedea Simon, 1902 and Meata Zabka, 1985 proposed recently by Maddison (2015) without published documentation are not recognized here until proof will appear printed.

Key words: pragmatic classification, molecular classification, molecular phylogeny, chain of morphological similarities, Chinattus, Habrocestoides, Habrocestum, Hasarius, Salticidae, system, taxonomy.

Introduction

History of research on genus Hasarius Simon, 1871 reflects changing approach to taxonomic research. Wanless (1983[1984]: 471) writes that Hasarius comprises "about 45 species", Prószyński (1971: 412) lists 38 "species" labeled as Hasarius in various collections of spiders, the Salticidae Database of Prószyński (2016b: 16) gives lists of 32 species and of 70 synonyms, which is not much different from joint number of 98 species and synonyms given by the WSC (ver. 18.5, assessed November 2017) but in the last paper Prószyński (2017b: 16) gives number of species as 16.

The present paper purports to revise diagnostic properties of species identified in the literature as belonging to *Hasarius* (Figs 1-2) and that gives surprising results: there are only 3 species belonging possibly to *Hasarius* (*H. adansoni*, *H. insularis* and *H. kulczyński*), and one species photographed but not yet described and named. All remaining nominal species seem to be misplaced or, at least, unrecognizable. The species structure of the genus *Hasarius* is unusual: single cosmopolite species spread over the world, and there are two other poorly known local congeneres. From evolutionary point of view the monotypic genera can be old survivors, at the end of their history, but such species could be expected to survive in limited environment on remote geographic spot, which hardly correspond with resilient *Hasarius adansoni*. Opposite situation - newly originated species, not yet proliferating, could be, possibly, also strictly localized geographically. The third possibility, the most probable, is that congeners of *Hasarius* are neither recognized yet nor collected. The example of other genus represented by "sole" cosmopolite species - *Plexippus* C. L. Koch, 1846, has none the less a background of 19 other local congeneres, distributed over three continents and multitude of islands.

There is also disagreement about position and relationships of the genus *Hasarius*. Similarities with other genera, selected in agreement with "pragmatic classification" of Prószyński (2017b) are shown of Fig. 5, relations proposed by "molecular phylogeny" of Maddison (2015) are presented on Figs 6-7. Questions of inter generic similarities and relationships may appear academic, but their value for taxonomic research cannot be overestimated. There is always possibility of misinterpretation of identification, so this paper provides survey of diagnostic characters of all "Hasarius" species.

**Taxonomy**

*Gen. Hasarius Simon, 1871*

*Type species Attus adansoni Audouin, 1826 = Hasarius adansoni* (Audouin, 1826)

*Documentation studied.* Summary of world's literature provided in "Monograph of Salticidae (Araneae) of the World 1995-2016", part I & II, by Prószyński (2016a, b) and current literature.

**Diagnosis.** Medium size jumping spiders of average appearance and dimensions (Fig. 1), males instantly recognizable by mané of white setae stretching dorsally over palps - from distal end of femur to mid-length of tibia, ending distally by characteristic oblique bunch of longer white setae (Figs 1B, E, I, L, N1, P), accompanied by lighter broad belt along abdomen and a pair of small, but striking white spots posteriorly. Palpal organ very generic (Fig. 1M, 2C, F-G), resembling to certain extent palps of other genera of informal group CHRYSSLINES by short, anterior embolus atop of triangular fleshy basis extending obliquely over the whole bulbus, leaving visible only part of spermophor - anterior bend and a part running on retrolateral side. Whole palps are unusually long, due especially to length of tibia, which is longer than the distal segment - cymbium, but also long patella and femur. Habitus of female resembles males but is devoid of distinct recognition pattern, epigyne nondescript sclerotized plate (Fig. 1K, 2D, G) devoid of noticeable sculpture, internal structure consists of sclerotized chamber, developed towards interior of abdomen, perpendicularly to plate, and shortened optically when looking at, hence its shape is not reproduced reliably, the position shown (Fig. 2C, G) is perhaps the best presentation of its structure, but departing from that seen on average drawings.

**Description.** General appearance is shown on Figs 1 and 2A-B, the background of diversity of genitalic characters in related genera is presented on Fig. 5. Due to similarity of palps and epigyne in known species, the separating characters could, perhaps, be found in details of color pattern, but this require more studies on inter-populational variation, which may lead to delimitation of independent species. It seems that basic components of body coloration in *Hasarius* are semiarch white band of setae around dorsal edge of thorax

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2 Evaluation of striking white pedipalpal mané is generally accepted by arachnologists, see Maddison (2015, Journal of Arachnology 43: 247 and 278) who wrote "... Monophyly: Hasarines are compact-bodied, often with distinctly white-edged palps that are held across the face ...". The same character, however, is discovered on new colour photographs of *Euophrys frontalis* (Walckenaer, 1802), *E. herbigrada* (Simon, 1871) and *E. sulphurea* (L. Koch, 1867) (Prószyński, 2018 – in press) which calls for further research

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and stretching anteriorly beneath eyes lateral, its optical frontal extension is white mane on palps, usually held horizontally by a male *Hasarius* (Fig. 1B, E, I, L, N1, P). Abdominal pattern consists of semilunar white line along anterior edge, broad median lighter belt along the whole length of abdomen, accompanied in posterior third of length by a pair of minute, contrasting pair of white dots (Figs 1A, D-F, 2B). That color pattern may appear variable, be either striking or barely discernible, white lines may be thin or broadened along their course, in preserved specimens may partially disappear (Fig. 1G). There seems to be difference in the hue of the background body coloration, which typically may be relatively light (Fig. 1A) or almost black (Fig. 1L) or fawn (Fig. 1D). Color pattern of face in males may be very significant, with presence of red, red and white, or yellow rings of scales around eyes I, red lower lateral bands entering eye field (Fig. 1N1), or a pair of small red dots beneath eyes I lateral and small white triangle above touching point of eyes I median (Fig. 1P). The taxonomic significance of these markings deserves revision, which however cannot be undertaken without photographic documentation. It should be noted that shape of embolus and its basis is somewhat variable and deserves more attention (Figs 1B, J, M, 2C, F-H).

**Distribution.** *H. adansoni* is commonly accepted as cosmopolite in warmer parts of the world and as an invader of hothouses in cooler countries. It is now clear, that majority of species placed at some times in *Hasarius*, were misplaced, and should be transferred elsewhere (Fig. 3). While placement of *H. tropicus* (Figs 1N1-O) is uncertain (male palp indicates rather *Chinattus*), discovery of unnamed "tadpole eating" *Hasarius* species (Figs 1P-Q) in S India suggest that distributional center (a "home land") of the genus may be located in tropical Asia, different coloration of specimen from Kenya (Figs 1L, but note difference in embolus -1M) may ultimately be recognized as another separate species. So there is a possibility of discovery of other local species in other warm areas of the Old World.

**Composition.** Type species - *Hasarius adansoni* (Audouin, 1826), other species are *H. kuleczyński* Zabka, 1985 and *H. insularis* Wesolowska & van Harten, 2002. Placement of *H. tropicus* Jastrzębski, 2010 is problematic, pending further research.

**Species pending placement elsewhere:** *H. egaenus* Thorell, 1895, *H. glaucus* Hogg, 1915 (Fig. 3D), *H. insignis* Simon, 1885, *H. mulciber* Keyserling, 1881 (Fig. 3B), *H. obscurus* Keyserling, 1881 (Fig. 3E), *H. pauciaceuleis* Caporiacco, 1941 (Fig. 3K), *H. rufociliatus* Simon, 1898 (Fig. 3G), *H. testaceus* (Thorell, 1877), *H. trivialis* (Thorell, 1877), *H. validus* (Thorell, 1877)

**Species names "nicht zu deuten"**

Platnick's Catalog, predecessor of the present the World Spider Catalog, cultivated unshakable respect to the nomenclatorical decisions's of otherwise distinguished C. F. Roewer, rather not shared by the immediate collaborators of the latter. One of rather harmful manifestations of that was listing of some names as "nicht zu deuten" ("not interpretable"), effectively eliminating such names from attention, and therefore from further research. The WSC (ver. 18.5, accessed November 2017) follows Roewer's (1954[1955]: 1523-1524) mistake listing the following nominal species of "Hasarius" as "nomina dubia", in spite of preservation of their type species in several collections, listed in the Prószyński's (1971e) "Catalogue of Salticidae (Aranei) specimens kept in major collections of the world". Species having type specimens are not "nomina dubia" of course, but pending taxonomic revision - or "species inquirenda" (in the wording of Salticidae Database by Prószyński (2016b)).


*Hasarius scylax* Thorell, 1892: 413 (Sumatra) - Roewer, 1954[1955]: 1524 - Prószyński 1971: 412 - Coll. Goa (=Genova) - *Hasarius scylax*


**Color patterns in Hasarius**

![Figure 1A-N](image)

**Figure 1A-N.** Habitus of *Hasarius adansoni* and related species from various areas of the World. **A-C** - Exemplary documentation of *H. adansoni* from Slovakia (A-B - male habitus and palp, C - female habitus and cleared epigyne), **D** - *H. adansoni* male from Singapore, **E** - *H. adansoni* from Borneo: Brunei, **F** - *H. adansoni* from Japan, **G-K** - *H. adansoni* from Philippines: Manila-Park, **L-M** - *H. adansoni* from Kenya, **N** - *H. adansoni* female from India.

**SOURCES:** **A-C** - ©Photo A, Sestakova, **D** - © Photo H.K. Tang, **E** - ©Photo Koh J. 2013, **F** - © Ono, Ikeda, Kono. Salticidae of Japan, **G-K** - ©Photo Freudenschuss, **L-M** - © Phot J. Holstein, **N** - ©Photo by Marashetty Seenappa. All ©copyrights are retained by the original authors and copyright holders, used here by their courtesy.
REVIEW OF THE GENUS HASARIUS


Comments on some species included into genus Hasarius

H. albocircumdatus (L. Koch, 1880) is certainly a Hasarius because of white color and length of segments of palps, as well as incomplete median white mark on abdomen (Fig. 2L). There is a chance that Zabka (1991: 29) was right synonymizing Jotus albocircumdatus L. Koch, 1880: 1250, pl. 107, f. 4 (= Hasarius albocircumdatus Simon, 1903a: 795) from Tahiti with H. adansoni, but he did not provide documentation for that, and the original drawings are not precise enough.

H. inhonestus Keyserling, 1881 was examined by Zabka (1992: 29-30) but there is no documentation left and the original drawings by Keyserling (Fig. 3C) are not unequivocal proof of that classification.

Hasarius insularis Wesolowska & van Harten, 2002 - shape of thick walled spermatheca and ducts (Fig. 2M) corresponds with the same structures in H. adansoni (Fig. 2D), but no other diagnostic characters are known in females of this genus, confirmation of classification of this species must be delayed until male will be known.

H. kulczyński Zabka, 1985 - the enclosed drawing (Fig. 2K) is not clear - it resembles Hasarius, but that requires revision.

H. tropicus Jastrzebski, 2010 from Phuntsoling in Bhutan was described from male specimen, presumably because of typical white mane on palps, in spite of different body color pattern, especially striking red coloration of lower anterior angle of carapace (Fig. 1N1). The original description is illustrated, however, by
very different palps (Fig. 2I), not resembling other species of *Hasarius*. It was discovered recently that palpal white mane occurs also in some species of *Euophrys* C. L. Koch, 1834 (*E. frontalis* (Walckenaer, 1802), *E. herbigrada* (Simon, 1871) and *E. sulphurea* (L. Koch, 1867) – for documentation see Prószyński (2018c – in press). Therefore the white hairs on palps may be less useful character than it was expected. The matter should be checked on other specimens and species, documented by both color photos of habitus and drawings/photos of palps, epigyne and spermathecae. Female collected from the same locality and by the same expedition was misidentified as *H. adansonii* from which differs by color pattern (Fig. 1O) and details of epigyne (Fig. 2J), unfortunately spermathecae were not documented - it is assumed provisionally that it is matching the male *H. tropicus* and tentatively transferred to that species.

Nomenclatorical corrections


*Hasarius adansonii* (Audouin, 1826)

**Type specimen** - collected [presumably by Etienne Geoffrey Saint-Hilaire] from unspecified locality in "Egypt and Syria" (which, at the time of Napoleonic Invasion 1798–1801, extended to the present day Israel) documented on original drawings (Fig. 2A). Present location of type specimen is unknown, presumed lost.

**Designation of neotype.** Due to diversity shown in existing documentation (Figs 1A-N, 2A-H) of the cosmopolite species assumed to be *Hasarius adansonii* (being simultaneously type species of the genus *Hasarius*), there is particular need to designate neotype, to stabilize understanding of the species and to replace lost original type specimen. Good candidate for that is male specimen from Israel [possible terra typica, or adjacent to it], documented by Prószyński (2003: 68, f. 256-257) (Fig. 2B-C), which agrees with characters shown in the original drawing (Fig. 2A). The proposed neotype specimen is accompanied by matching female (Fig. 2D) from the same area. The proposed neotype specimen is preserved in the Israel National Arachnid Collection at Hebrew University, Givat Ram Campus, Jerusalem, Israel.

**Documentation studied.** Summary of world's literature provided in "Monograph of Salticidae (Araneae) of the World 1995-2016", part I & II, by Prószyński (2016a, b, and current literature).

**Diagnosis and description** - see Prószyński (2003 Annales Zoologici 53: 68, f. 256-260). Diagnostic drawings see Figs 1A-C, 2B-E.

**Remarks.** The diagnoses, descriptions and graphic documentation of *Hasarius adansonii*, available in the literature, contain characters pertaining, in fact, to the whole genus, but insufficient to subdivide it into possible partial species. Solution of that hypothesis and writing eventual differentiating diagnoses must be delayed until next revision.

**Distribution.** *Hasarius adansonii* is accepted as cosmopolite in warmer parts of the world, invader of hothouses in cooler countries. It is now clear, that majority of species placed at some times in *Hasarius*, were misplaced, and should be transferred elsewhere (Fig. 3). Discovery of supposed *Hasarius* (with bunch of white setae on palps - Fig. 1N) - *H. tropicus* in Bhutan suggests, however, possibility of discovery of other local species in other areas of the Old World.
Figure 2. Diagnostic characters of representatives of genus Hasarius. A - *Attus adansonii* from Egypt, original drawing of 1826, B-E - *H. adansonii* from Israel - habitus, palp, internal structure of epigyne (spermatheca developed vertically to surface of epigyne, here lies in horizontal position), cheliceral dentition, F - *H. adansonii* from Jaffa-Rehovot, G - *H. adansonii* - Thorell's specimen from "Birmanie", H - *H. adansonii* from Seychelles Isl., I - "*H*. tropicus" - palp mismatched, apparently *Chinattus* sp.(compare Fig. 1N), J - *H. adansonii* (mistake!) - possibly *H. tropicus*, K - *H. kulczynskii*, L - *H. albocircumdatus* (note white palpal tibia and patella), M - *H. insularis*.

Misidentified “Hasarius” species

Figure 3. Misidentified and misplaced nominal species of “Hasarius” pending revision. A - Hasarius pumilio, B - H. mulciber, C - H. inhonestus, D - H. glaucus, E - H. obscurus, F - H. mahensis, G - H. rufociliatus, I - H. cheliceroideus, J - H. firmus, K - H. pauciaculeis - maturing palp, still covered by the tegument of previous instar, L - H. “adansoni” - misplaced [true H. adansoni also is documented from Philippines (see Fig. 1G-K)], M - palp of the same, quick sketch by Prószyński, N - H. rusticus - type from “Birmania”.


Correct placement of *Hasarius kweilinensis* and related species. Species *kweilinensis* is listed now in the WSC (ver. 18.5, assessed December 2017) in combination with the genus name *Hasarius* - is that correct? Placement of *Habrocestum kweilinensis* Prószyński, 1992 was uncertain right from the first description, which begun from the disclaimer "the present classification is only provisional" (Fig. 4A). That initial placement was influenced by some resemblance of its spermathecae (Fig. 4A1) to *Habrocestum orientale* Zabka, 1985 (Fig. 4C). Peng & Xie (1995a: 58) added observation on similar Chinese species *Habrocestoides dactyloides* Xie, Peng & Kim, 1993 (Fig. 4D), in which male resembles *Habrocestoides sinensis* Prószyński, 1992 but female rather *Habrocestum kweilinensis*, they chosen placement in *Habrocestoides* as appropriate for both species (Fig. 4H). Their move appeared closer to acceptable, although not fully convincing. At the same time D. V. Logunov (1999: 148) (Fig. 4I-J) expressed opinion that the species should be rather moved to the genus *Hasarius*, unsupported by comparison of diagnostic drawings, but based on following reasoning (Fig. 4K):

1) "this species (*Hasarius orientalis*) cannot be placed in *Habrocestum*, *Habrocestoides* or *Chinattus*, as it belongs, as does *H. kweilinensis*, to the so-called fissidentate salticids ... while all the above genera are unidentate";

2) "the groundplan of the genitalia in the discussed species (*H. orientalis*, *H. kweilinensis* and *H. dactyloides*) clearly corresponds to that in *Hasarius adansoni* ..., the type of species of the fissidentate *Hasarius*. It therefore seems better to transfer all these species to *Hasarius.*"

These arguments are wrong. 1) Types of cheliceral dentition (pluridentate, unidentate, fissidentate) (Fig. 4K) were popularized by Simon (1901-1903) as a tool for division of the whole family Salticidae (over 4800 species) into three groups of genera, but are largely abandoned in modern arachnology and cannot be used as a proof of affinities of genera. 2) Nobody ever confirmed similarity of the "groundplan" of spermathecae, ducts and palps of *Hasarius adansoni* with genera discussed by Logunov (Figs 4A1 compare with 4E, also D, M). In spite of that, name "Hasarius" stuck with the discussed species. Recently similar species *H. dactyloides* was transferred to *Chinattus* by Suguro (2014: 10, f. 11-18) (compare Figs 4N-O with 4L-M), a solution not fully satisfactory. The problem obviously cannot be solved with so incomplete data available and the group of species* deserves full revision. Species *dactyloides, kweilinensis* and *orientalis* deserve transfer to a new genus of their own.

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2 More drawings of unpublished species of *Habrocestoides* and *Chinattus*, from Bhutan, Iran and Nepal by Prószyński can be compared at http://www.peckhamia.com/salticidae/specimen.php?id=3817.
Similarity of Hasarius to other genera
according to Prószyński (2016a)

Figure 5. Genera similar to Hasarius (therefore possibly related) according to “pragmatic classification” of Prószyński (2016a, 2017b) (genera shown on this plate contain together 222 recognizable species). A-B - H. adansoni from Israel - palp and internal structure of epigyne, C - Nandicus mussooriensis Prószyński, 2016 (6 species), D - Nycerella volucripes Galiano, 1982 (16 species), E - Freya regia (Peckham & Peckham, 1896) (24 species), F - Epocilla praetextata Thorell, 1887 (14 species), G - Chrysilla lauta Thorell, 1887 (15 species), H - Phintella versicolor (Koch C.L., 1846) (62 species), I - Bristowia heterospinosa Reimoser, 1934 (3 species), J - Carrhotus viduus (Koch C.L., 1846) (29 species), K - Plexippus paykullii (Audouin, 1826) (20 species), L - Frigga coronigera (Koch C.L., 1846) (9 species), M - Phiale crocea (21 species). (In brackets - number of species having similar genitalic characters).


4 Synonymy of genera *Gedeastaffflavogularis* and *Meata*, proposed recently by Maddison (2015) without published documentation, are not recognized here until proof will appear printed.
REVIEW OF THE GENUS HASARIUS

Placement and relationship of the genus Hasarius

There are two different proposals of placement of the genus Hasarius (Figs 5 and 6 below). Pragmatic classification proposed by Prószyński (2016a, 2017b) points at similarity of palps, and in a lesser degree of epigynes. That methodology is based on comparison of morphological characters, and is aimed primarily at identification of genera and species of Salticidae, it is not a phylogeny guide but may help in understanding phylogeny of particular taxa as a side effect. It requires:

1) usage of existing, or preparation of new, diagnostic graphic documentation, of high quality and in a standardized way;

2) charting that documentation into comparative plates containing all relevant recognizable species (or genera, or super generic taxa, whichever are needed for particular case), always checked with type species of relevant genera;

3) all findings should be transparent and open to permanent scrutiny at all time.

Molecular phylogeny and classification, as developed in publications on Salticidae by papers of Maddison et al. (since 2003), could be understood as a system permitting quick establishing phylogenetical relationships among large number of taxa, a system based on selected fragments of DNA, processed with appropriate computer programs. Its visible output are phylogeny trees, grouping genera according to highly sophisticated indices. The morphological premises for these relationships of Hasarius were quoted but not documented, it may be suspected that the arrangement presented includes component of previous knowledge.

Figure 6O-V. Genera considered by Maddison (2015) as related to Hasarius - tribe Hasariini (genera shown on this plate contain together 82 recognizable species). O-P-Q - Habrocestoides bengalensis Prószyński, 1992 (13 species), R - Madhyattus jabalpurensis Prószyński, 1992 (single species), S-T - Imperceptus minutus Prószyński, 1992 (single species), U - Mikrus ugandensis Wesolowska, 2001 (single species), V - Uxuma impudica Simon, 1902 (single species). (In brackets - number of species having similar genitalic characters).

of morphology, applied intuitively in part. Valuable comments to tribus Hasariini, pertaining to Hasarius and related genera, are give by Maddison (2015, Journal of Arachnology 43: 246-247 and 278), compilation of diagnostic characters of these genera are shown in the present paper on Figs 6-7. Due to different approach, comparison of these characters are not fully compatible with conclusions drawn from morphological studies presented in Fig. 5. Further research may, perhaps, resolve these discrepancies. It is not clear which mutual properties are shared by genera illustrated on these plates.

Figure 7–1. Genera considered by Maddison (2015) as related to Hasarius - his tribe Hasariini. ATTENTION: genera Gedea (males) and Meata (females) considered congeneric by Maddison (2015: without published documentation - see facsimile of description Fig. 7-2 – below). A - Diplocanthopoda s., B - Chinattus, C - Gedea. SOURCES: Maddison 2015: 269, f, 100-102. All ©copyrights are retained by the original authors and copyright holders, used here by their courtesy.

Figure 7-2. Facsimile of description of Hasariini by Maddison (2015: 269).

Conclusion

Analysis of literature data on the genus Hasarius does not yield a coherent picture of a biological taxon, a constellation of diverse but related species, having own summary areal consisting of ranges of particular species, displaying similar biological and ecological properties, own history of evolution and spreading, different from majority of other biological units of a genus rank. Apart from poor state of knowledge of fauna of Salticidae, this is probably a result of general conviction that Hasarius adansoni is a cosmopolite species and assumption that every Hasarius-like species is H. adansoni. The present paper confirms existence of at least two other distinct species: “H”.[?] tropicus in Bhutan (Fig. 1N1), and undescribed "tadpole-eating" species (Fig. 1P-Q) photographed in the West Ghats Range in India. Enclosed photographs show black bodied specimen photographed in Kenya (Fig. 1D), brownish specimens from Singapore (Fig. 1D), lighter colored immigrant in Slovakia (Fig. 1A, C) - are these really conspecific? Palp of Israel specimen (Fig. 2B) is slightly different from that in Slovakian specimen (Fig. 1B), and manifestly different
from that of Bhutani species (Fig. 2I) (dismissed as mismatched - but is that sure?). These are problems demanding answer from future revision.

NOTICE
Permissions of illustrations used in this paper are displayed in the Internet "Monograph of Salticidae (Araneae) of the World 1995-2016" Prószyński (2016 b)

References
Attention: only selected references are listed here, other references can be found in the Internet "Monograph of Salticidae (Araneae) of the World 1995-2016" Prószyński (2016a, b) at http://www.peckhamia.com/salticidae/, or in the WSC at http://www.wsc.nmbe.ch/


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