A life caught in a spider's web

Papers in arachnology in honour of Christo Deltshev

Edited by

Pavel Stoev, Jason Dunlop & Stoyan Lazarov



Sofia–Moscow 2009 ZooKeys 15 (Special Issue)

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First published 2009 ISBN 978-954-642-@@@-@ (paperback)

Pensoft Publishers Geo Milev Str. 13a, Sofia 1111, Bulgaria Fax: +359-2-870-42-82 info@pensoft.net www.pensoft.net

Printed in Bulgaria, August 2009

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RESEARCH ARTICLE



Fifty years of devotion to spiders: a concise biography of Christo Deltshev, with a complete list of his publications and described taxa

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Academic editor: Jason Dunlop | Received 6 June 2009 | Accepted 15 July 2009 | Published @@ August 2009

Citation: Stoev P, Popov A, Blagoev G, Lazarov S (2009) Fifty years of devotion to spiders: a concise biography of Christo Deltshev, with a complete list of his publications and described taxa. In: Stoev P, Dunlop J, Lazarov S (Eds) A life caught in a spider's web. Papers in arachnology in honour of Christo Deltshev. ZooKeys %%: 1-14. doi: 10.3897/ zookeys.%%.@@@

Abstract

This paper provides an overview of the life and scientific work of Dr Christo Deltshev, the doyen of Bulgarian araneology. It also analyses his more important research contributions and provides a list of his scientific publications and the species he described.

Keywords

Biography, Christo Deltshev, spiders, bibliography, Bulgaria

It is both difficult and easy to write about the doyen of Bulgarian araneology Christo Deltshev. It is difficult because his work, though in one area – the study of spiders, is rather varied. And yet it is easy because we, the authors of this biography, know our colleague and friend Christo Deltshev and his development as a zoologist very well. We have witnessed how before our very eyes the enthusiastic lover of spiders, caves and mountains gradually turned into an erudite araneologist enjoying the respect of his colleagues from many countries. The seventieth anniversary of Christo Deltshev is reason enough to look back on his achievements in science and life and outline his position in the international arachnological community and among Bulgarian zoologists. This we did during the celebration of his anniversary at the National Museum of Natural History.

Christo Deltshev was born on January 15, 1939 in Sofia. More than two thirds of the seventy years, which have passed since then, he devoted to the study of spiders, first as a speleologist and then as a professional scientist with the Institute of Zoology. His father Deltcho Deltshev was from Komotini (now in northern Greece) and his mother Victoria Gospodinova was from Sofia. Even as a pupil Christo (or Itso as most of his friends and colleagues call him) showed great interest in nature, and in the parks of Sofia and Vitosha Mountain he collected different insects and spiders, which then he brought home in shoe boxes to look after them. At school his interest in animals grew stronger and he became the head of the biology group. The anti-communist inclinations of his father had a negative affect on the way Christo's life would turn out. At the time of fierce repressions by the Communist party the son of the former convict was subject to great pressure. Despite his wish, he was not allowed to study at the university and after he served in the army from 1957 to 1959 he was forced to start as a common worker.

Luckily, at that particular time the law was changed and after successfully passing the exams in 1960, Christo Deltshev was accepted as a student at the University of Sofia. It was then that he met a group of ardent speleologists – Vassil Guéorgiev, Petar Beron, Vladimir Beshkov, Tanyu Michev, Stoitze Andreev and Alexi Popov – and with them he started exploring the caves of Bulgaria and their fauna. This helped him make an important decision – to devote his scientific interests to spiders. Almost fifty years have passed since then and Christo Deltshev is still collecting, observing, describing and studying spiders with the same vigour and passion.

He received his first instructions on the organization and conduct of scientific research and an acquaintance with different methods from Dr. Ivan Buresch, member of the Bulgarian Academy of Sciences and founder of contemporary zoology and biospeleology in Bulgaria. He acquainted him with the work of Associate Professor, Dr. Pencho Drensky, and gave Christo reprints of the publications by this eminent Bulgarian arachnologist and part of his bibliography files on spiders. Years later, as a sign of respect to his mentor Dr. Deltshev named a newly discovered cave spider *Troglohyphantes bureschianus* (Deltshev 1976 [12]¹). At the same time, at the beginning of 1962, he got to know Pencho Drensky himself, who gave him his first lessons in araneology. Unfortunately, due to the death of P. Drensky just a few months later, Christo lost the opportunity to share with him his ideas on spider studies and hear his advice.

Christo Deltshev received his degree from the Invertebrate Zoology Department of the St. Kliment Ohridsky University of Sofia in 1965 with a thesis entitled "The spiders (Araneae) of Vitosha Mountain". That same year he was appointed as a biologist at the Institute of Zoology with the Bulgarian Academy of Sciences (then

¹ The number in the square brackets after each citation designates the serial number from the List of Christo Deltshev's publications at the end of the paper.



Figure 1. Christo Deltshev in the Zmeyova Dupka Cave near the village of Zimevitsa, Bulgaria in 1961 (photo Petko Nedkov).

the Institute of Zoology plus museum), where he still works to this day. From 1972 to 1985 he was an Assistant Professor. His PhD thesis, which he defended in 1977, was entitled "Faunistic, taxonomic, ecological and zoogeographical investigations on the cave spiders of Bulgaria (Araneae)". Since 1985 he has been an Associate Professor. The management of the Institute of Zoology appreciated his organizational and management skills and in 1995 Christo Deltshev was elected head of the Department of Taxonomy, Faunistics and Zoogeography. He has occupied this position ever since. Two years later he was appointed Secretary of the Scientific Council of Zoology and Ecology with the High Attestation Commission. As an administrator he is still involved with the organization and procedures for thesis defense by zoologists and ecologists in Bulgaria. His work for the Council puts him in touch with many young people who share with him their passion for zoology. With his typical responsiveness and friendliness he was able to help many of them on different occasions; indeed it is hard to find anyone among the Bulgarian zoological community who doesn't know Christo Deltshev.

His valuable scientific results derive from his qualities and perseverance as a field researcher. He has been connected with nature his whole life and is well acquainted with the Bulgarian mountains. We, the authors of this biography, had to overcome together with him storms, fog and hail and we know that his desire for explorations of caves and mountains is inextinguishable. In sunny and in stormy weather he never loses his good spirits.

The head of the Institute of Zoology, Professor Alexander Valkanov, took Christo, just after he started work, to his summer expeditions to explore the high-mountain lakes of Rila and Pirin. During one of these expeditions to the Seven Rila Lakes, together with German hydrobiologists, one evening at the camp fire he found out that Christo was a fire-dancer. Fire-dancing is an ancient folk custom from Strandzha Mountain in south-east Bulgaria during which the dancers – in a trance-like state – dance bare-foot over live coals. To the professor's question "Will you do it?" Christo took off his shoes, set the glowing embers ready, went around them and then several times walked over the still glowing coal. "I have lived to see this miracle as well.", Professor Valkanov exclaimed, and was amazed to see there were no burn marks on Christo's feet.

Christo's participation in professor Valkanov's expeditions stirred his interest in the fauna of the high-mountain spiders of Bulgaria. He established cooperation with prominent arachnologists from other countries (Carl Friedrich Roewer and Hermann Wiehle from Germany, Pierre Bonnet and Louis Fage from France, Josef Kratochvil and František Miller from the former Czechoslovakia, Herbert Levi from the USA). In 1972 he described his first spider *Protoleptoneta bulgarica*, which turned out to be both a new genus and species. To make sure he was not mistaken he sought the opinion of Paolo Marcello Brignolli and František Miller, who were at the time among of the best taxonomists of this group in Europe. Years later, already an established spider expert himself, Dr. Deltshev advised young zoologists during their first steps in araneology and confirmed the new species they had discovered.

Christo's love for caves started during his university years. The first cave he visited was Kolkina Dupka at the village of Zimevitza around the Iskar defile in the Stara Planina Mountain. When entering this precipice cave in 1960, he had to clamber over the corpses of several dead pigs. The more experienced speleologists who were leading him saw that he did not shrink at the unpleasant sight and realized the boy would turn out to be a true speleologist. And so he did. His infatuation with caves did not diminish with time, even after an incident of almost tragic proportions took place. In August 1964, when he was climbing down the Bankovitsa abyss at Karlukovo village near Lukovit, several of the rungs of the self-made rope ladder broke and Christo fell 12 metres. His hip was broken in five pieces and he had to spend four months in cast, with recovery taking another four months. From then on, throughout his life the injury tormented him whenever the weather got worse or when he strained himself, but it did not stop Christo from continuing his researches in high mountains and caves and precipices or from enjoying nature as a tourist with his family and friends.

Thus it was no wonder that it was in a cave that Christo held his wedding. It happened in 1968 in Temnata Doupka cave at Iskar Gorge near Lakatnik. Christo had already graduated and started working as a researcher and thought it was time to start a family. And so Elena entered his life and she would become the pillar and support of his further progress. They had three children, one after another, which was a rare case for a family of intellectuals in Bulgaria during the second half of the 20th century.



Figure 2. Christo Deltshev's wedding in the Temnata Dupka Cave in Iskar Gorge, with the official announcement hung on the Lakatnik rocks close to the cave's entrance, November, 1968 (photo Konstantin Spassov).



Figure 3. Christo with his wife Elena, his daughter Victoria and sons Delyan and Ivan in front of the Svirchovitsa Cave near the village of Karlukovo, Bulgaria in 1983 (photo Christo Deltshev).

So far Dr. Deltshev has visited and studied the fauna of several hundred caves in Bulgaria. He discovered some of them and for many he was among their first explorers. He participated in the organization of many international, national and club caving expeditions. As well as Bulgaria, Christo also took part in international caving expeditions in Slovenia (1963), the Caucasus (1967), Austria (1968) and the Moravian karst in the Czech Republic (1980). His achievements in speleology were largely due to the influence which the inspirer of the speleological movement in Bulgaria, Petar Tranteev, had on him. Christo proposed to him his idea to make ascenders, which



Figure 4. Christo collecting spiders in the Vorontsovska Cave, Abkhazia in July, 1967 (photo Stoitse Andreev).

were produced by Vesselin Gyaurov, and Christo tested them himself. His speleological organizational work concerns the Bulgarian Federation of Speleology – of which he was the vice-chairman from 1968 until 1993 – as well as the Academic Students' Speleological Club of which he was the chairman in the period 1978-1996. Since 1972 Christo Deltshev has taught a speleology course in the National Sports Academy and is the author of a textbook on speleology.

Christo is a friendly guy. He likes to entertain his colleagues and friends with stories of his expeditions and interesting things he had witnessed. For many years he used to dress like Santa Claus and give away presents to speleologists in some mountain hut, and now he is doing this for the children and grandchildren of his colleagues.

One of the aspects of Christo Deltshev's international activities is his participation in the major arachnological and related associations. He became a member of the International Society of Arachnology (ISA), now seated in Berlin, almost from its beginnings 45 years ago, and he is currently the regional representative for Bulgaria for this most prestigious organization of arachnologists. Christo is also a member of the European Society of Arachnology (ESA), seated in Nancy (France), where he is now a member of the society's Council. In the European Invertebrate Survey (EIS), registered in Netherlands, he is a member of the organization's Committee and he is also member of Arachnologische Gesellschaft (AraGes) seated in Bayreuth (Germany).

His international debut came at the 5th International Congress of Arachnology in Brno in 1971. Since then he participated in 23 international congresses, conferences and symposia; at eleven of which he was an invited speaker. Most of them were arachnological, such as eight international congresses of arachnology between 1971 (Brno) and 2004 (Gent), six European colloquia of arachnology between 1988 (Berlin) and 2008 (Bern). Other congresses were devoted to speleology (Olomouc, 1973; Budapest, 1989), invertebrate studies (Saarbrücken, 1995), mountain ecosystems (Abisco, 1997) and biodiversity of the Balkans fauna (Ohrid, 1998; Koper, 2001).

Christo Deltshev's organizational skills were fully employed during the preparations for the 22nd European Colloquium of Arachnology, held in Blagoevgrad in August 2005. A total of 115 participants from 27 countries came to Bulgaria. The results of the symposium were published in a special edition of Acta zoologica bulgarica (Deltshev C., Stoev P. (eds). 2006. European Arachnology 2005. Proceedings of the 22nd European Colloquium of Arachnology, Blagoevgrad 2005. Acta zoologica bulgarica, Suppl. 1: 1-343). The participants brought home unforgettable memories of the colloquium, as well as the joys of the Melnik earth pyramids, and the Rhozhen and Rila monasteries, which they visited during a post-colloquium excursion.

In his more than 40 years of scientific research the araneological contributions of Christo Deltshev have been many in number. The main areas of his work and publications are taxonomy, faunistics, zoogeography and ecology of spiders in Bulgaria and the other Balkan countries. He has described as new the genera *Protoleptoneta* and *Cryphoecina*, as well as 34 species and 2 subspecies of spiders from 8 families. The largest number of taxa described by him belong to the families Linyphiidae (17 species and 2 subspecies), Agelenidae (6 species), Leptonetidae (1 genus and 3 spe-



Figure 5. Christo Deltshev at his first International Arachnological Congress in Brno, Czechoslovakia, August, 1971 (congress photo).



Figure 6. Christo at the 22nd European Colloquium of Arachnology, Blagoevgrad showing the first prize for best presentation given by young scientist (photo Dmitri Logunov).

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cies) and Amaurobiidae (3 species). If we look at the genera, the largest number of newly described taxa belong to Centromerus (4 species and 1 subspecies), Malthonica (4 species), Lepthyphantes and Eurocoelotes (3 species each). Christo is a skilled illustrator and this gift largely helps his taxonomic work. The scale of his contributions can be judged by the fact that all but one of the 38 taxa have been described by him alone. And the quality of his contribution can be estimated by the validity of all the described taxa; again with only one exception (Lepthyphantes gueorguievi has been synonymized). The newly described taxa all come from the Balkan Peninsula. In terms of localities of holotypes they are distributed across the countries of the regions as follows: Bulgaria (1 genus, 25 species and 2 subspecies), Greece (7 species), Serbia (2 species), Montenegro (1 genus and 1 species). Almost an equal number of the new taxa have been found in caves (16 species) and in mountains (17 species and subspecies), and another 3 species along the coast and in the valleys. His permanent interest in taxonomy is evident from the even distribution of newly described taxa throughout time: 1970s (12 taxa), 1980s (10 taxa), 1990s (9 taxa) and the first decade of the 21st century (9 taxa).

Christo Deltshev has conducted some other taxonomic modifications such as the establishment of 25 new synonyms and designation of lectotypes of 7 species. He revised the genus Tenuiphantes, the European species of Bolyphantes, the species Centromerus in the caves of the Balkan Peninsula, and the genera Erigone, Tegenaria, *Coelotes* and *Zodarion* in Bulgaria. He also critically revised the spider species of the Balkan Peninsula described by Dr P. Drensky (Deltshev 2003 [111]). Considerable too is Dr. Deltshev's faunistic contributions to our understanding of the distribution of spiders across the Balkan countries. Due to his research over many years the number of known species in Bulgaria increased by 237, in Serbia - by 73, in Macedonia (FYROM) - by 22 and in Greece by 11. He also discovered two families (one still unpublished) new for the fauna of Bulgaria. Another aspect of his contribution is the complex research and analysis of the araneofauna from the different regions of Bulgaria. An excellent field researcher, he conducted and published his studies on the spiders of the mountains Central Stara Planina, Rila, Pirin, the Eastern Rhodopes, Lyulin, Vitosha and Sashtinska Sredna Gora; of plain areas in Bulgaria such as the Black Sea Coast and Ludogorie; of some small but zoogeographically interesting territories such as Srebarna Lake, Shabla-Ezerets wetland, the Sofia Region, Zemen and Kresna gorges and Sandanski-Petrich Kettle.

The climax of Christo Deltshev's work on the study of spiders in the northern part of the Balkan Peninsula are the critical checklist of Bulgarian spiders (Deltshev and Blagoev 2001 [103]) and the monograph "The Spiders of Serbia" (Deltshev et al. 2003 [113]). The checklist contains 910 species according to data based on 173 publications. It has been updated with an online list (Blagoev et al. 2002 [106]) containing up-to-date current information on 1007 species in 41 families based on the review of 226 items of literature. This monograph constitutes a critical catalogue of 618 species of 36 families based on all the literature findings and new data from intensive faunistic research in Serbia. The locations of each species are plotted on a UTM map.



Figure 7. Christo, Peter van Helsdingen and Konrad Thaler in Szombathely, Hungary July, 2002 (photo Stoyan Lazarov).

Zoogeography has always interested Christo Deltshev and because of this almost all of his taxonomic works is accompanied by a zoogeographic analysis. In his analysis of spiders of the Balkan Peninsula (Deltshev 1999 [87]) he concentrated on 1409 species from 47 families and selected the regions with the greatest species diversity. In this research he established that 26.9 % of spiders (379 species) are endemic for the region and proved the important role of the Balkan Peninsula as a speciation center in Europe. Similar zoogeographic analyses have been published on the spiders of Bulgaria as well (Deltshev 2005 [125]), on endemic spiders of Bulgaria (Deltshev 1996 [67]) and the Balkan Peninsula (Deltshev 2000 [94]), and on troglobitic spiders of the Balkan Peninsula (Deltshev 1978 [20], 2008 [133]).

Some ecological problems also received Christo Deltshev's attention. He studied the population structure of spiders inhabiting cave entrances (Deltshev 1973 [7]) and researched the impact of pasture management on the number and biomass of spiders (Deltshev and Kajak 1974 [11]). He is interested in the factors which determine the assemblage structure of spiders (Popov et al. 2000 [101]). In the sphere of applied zoology he compared the biodiversity of spiders in genetically modified and regular potato fields (Kalushkov et al. 2008 [135]).

In the last 15 years Dr Deltshev has carried out intensive studies on the issues regarding the protection of invertebrates in Bulgaria. He is one of the leading experts in drafting the National Strategy for Biodiversity Conservation of Invertebrates (Deltshev et al. 1998 [82]) and identified the conservation significance of spiders in the main protected territories in Bulgaria: the three national parks and some of the nature parks.

The overall number of publications by Dr. Deltshev as of June 2009 (including those in press) is 141. It includes the monograph "Spiders of Serbia" (Deltshev et al. 2003 [113]), a textbook on speleology and caving (Deltshev 1979 [23]) and books of popular science "The Ancestors of Arachna" (Deltshev 1988 [47]) and "Biodiversity of Pirin National Park" (Popov et al. 2005 [123]).

In his many years of work for the Institute of Zoology, Christo Deltshev took part in several dozen research projects. For many of them he was the initiator, or he was the head of the invertebrate research teams. It began in 1968 with a five-year joint project with the Institute of Ecology of the Polish Academy of Sciences in Dziekanów Leśny for comparative ecological investigations on the spiders in grassland ecosystems of Poland and Bulgaria. Within the framework of other projects in 1988 the spider collections of Władysław Kulczyński with the Museum and Institute of Zoology of the Polish Academy of Sciences in Warsaw were revised, as well as those of Imre Loksa with the Hungarian Natural History Museum in Budapest. A more permanent collaboration was established with the University of Innsbruck (1981-1992) for comparative taxonomic investigations on the spiders of Bulgaria and Central Europe and with the Museum für Naturkunde am der Humboldt-Universität in Berlin (2000-2008) and the Senckenberg Forschungsinstitut und Naturmuseum in Frankfurt (2005-2008) for revisions of spiders collected on the Balkan Peninsula and in Turkey. In recent years Dr Deltshev has been the head of invertebrate research teams on projects of national importance. Such projects include The National Biological Diversity Conservation Strategy (United States Agency of International Development, 1993), Biodiversity of Central Balkan, Rila and Pirin national parks (Global Environmental Facility, Bulgarian-Swiss Biodiversity Conservation Program, 1994-1998, 2001-2002) and Vitosha and Rila Monastery nature parks (Bulgarian Ministry of Environment and Waters, 1999-2000; GEF, 2001). He had the same functions on several of the most important projects in Bulgaria regarding nature preservation in recent years: e.g. the National System for Biodiversity Monitoring (2004), NATURA 2000 (2004-2008) and Red Data Book of Bulgaria (2004-2008). They were all funded by the Bulgarian Ministry of Environment and Waters

Several practical faunistic methods have been introduced into Bulgaria by Christo Deltshev. He introduced UTM mapping (Lehrer and Deltshev 1978 [21]), which is actively used even now by Bulgarian zoologists. Together with colleagues he proposed methods of collecting, managing and recording faunistic information (Deltshev et al. 1998 [86]), which are also widely used, particularly in studies of biodiversity protection.

There are not so many Bulgarian zoologists who, like Dr. Deltshev, have established their own school of followers. A group has emerged which jointly continues the study of spiders in Bulgaria. He has been the advisor of 4 PhD and 8 graduate students. Two of his PhD students have successfully defended their theses on araneological topics and are currently research associates with the Institute of Zoology in Sofia and the Biodiversity Institute of Ontario in Guelph, Canada. Christo is also an advisor to young zoologists from other Balkan countries.

Not only his Bulgarian and foreign colleagues pay respect to Christo Deltshev. Different Bulgarian state and scientific institutions have presented him with awards. For his contribution to speleology Dr Deltshev was awarded an Aleko medal (1972) and a medal for Special Merits (1984). He also received insignia of honour from the State Agency for Youth and Sports, the Bulgarian Tourist Council, the Bulgarian Federation of Speleology, the National Museum of Natural History, and the Institute of Zoology.

Arachnologists and biospeleologists from different countries have described species which they named after Christo Deltshev in acknowledgement of his work. Altogether, one genus and 13 species bear Christo's name (the genus and 8 of these species are described in this book). Ten of the species are spiders, there is one harvestman, one millipede and 2 beetles.

The celebration of Christo Deltshev's anniversary at the National Museum of Natural History took place in the hall with a temporary exhibition called Spider Museum – an appropriate backdrop for the evaluation of his work. The results of his work reveal Dr Deltshev to be an excellent araneologist, acknowledged as one of the most promi-



Figure 8. Christo and his students Stoyan Lazarov and Gergin Blagoev, April, 2002 (photo Boris Andreev).

nent European spider taxonomists. It is thanks to him that the Institute of Zoology possesses a perfectly arranged collection of spiders and database on their distribution across the Balkan countries.

In the year of Christo Deltshev's anniversary we wish him further success as a researcher, administrator and mentor to young researchers. New spider species are yet to be discovered and described by Christo, and more territories on the Balkan Peninsula await his study.



Figure 9. Christo Deltshev on a collecting trip to Samothraki Island, Greece, May, 2008 (photo Lyubomir Alexiev).

List of scientific publications by Christo Deltshev

- Deltshev C [Delchev C] (1967) On the studies of spiders (Araneae) in the Vitosha Mountain. Bulletin de l'Institute de zoologie et musée, Sofia 24: 51-56. [in Bulgarian, with English and Russian summaries]
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- Deltshev C (1972) A review of spiders (Araneae) from Bulgarian caves. In: Folk C (Ed.) Proceedings of the 5th International Congress of Arachnology, Brno, 99-104.
- Deltshev C [Delshev C] (1972) A contribution to the study of spiders (Araneae) from the caves in Bulgaria. Bulletin de l'Institute de zoologie et musée, Sofia 34: 171-175. [in Bulgarian, with English and Russian summaries]
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- Deltshev C (1977) A new *Protoleptoneta* from Bulgarian caves (Araneae, Leptonetidae). Acta zoologica bulgarica 6: 3-7.
- Deltshev C (1977) Genus *Nesticus* (Nesticidae, Araneae) from Bulgarian caves. In: Panoš V (Ed.) Proceedings of the 6th International Congress of Speleology, Olomouc 5, 73-78.
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List of taxa described by Christo Deltshev

AGELENIDAE

Histopona tranteevi Deltshev, 1978 Acta zoologica bulgarica 10: 57. Type locality: Bulgaria: Rhodopes Mts., Zmeini borun Cave, village of Mostovo, Plovdiv Distr.

Malthonica bozhkovi Deltshev, 2008 Zootaxa 1872: 38. Type locality of holotype: Bulgaria: Rhodopy Mts., Byala Cherkva, 1250 m.

- *Tegenaria montana* Deltshev, 1993 Berichte des naturwissenschaftlich-medizinischen Vereins in Innsbruck 80: 168.
- Type locality of holotype: Bulgaria: Pirin Mts., [near] Ribno ezero, 2400 m.
- Current status: The species is now assigned to genus *Malthonica* (see Guseinov et al. 2005, Arthropoda Selecta 14 (2): p. 164).
- *Tegenaria rilaensis* Deltshev, 1993 Berichte des naturwissenschaftlich-medizinischen Vereins in Innsbruck 80: 171.
- Type locality of holotype: Bulgaria: Rila Mts., Granchar Cottage, 2200 m.
- Current status: The species is now assigned to genus *Malthonica* (see Guseinov et al. 2005, Arthropoda Selecta 14 (2): p. 164).
- *Malthonica spinipalpis* Deltshev, 1990 in Deltshev and Paraschi, Biologia Gallo-Hellenica 17 (1): 10.
- Type locality: Greece: Peloponnese, Epidavros.

Tegenaria paragamiani Deltshev, 2008 Zootaxa 1872: 40. Type locality: Greece: East Rhodopy Mts., village of Maronia, Maronia Cave, 250 m.

AMAUROBIIDAE

Coelotes brevispinus Deltshev et Dimitrov, 1996 Revue Arachnologique 11 (7): 77. Type locality: Bulgaria: Slavyanka Mts., Hambar Dere, 1500 m.

Current status: The species is now assigned to genus *Eurocoelotes* (cf. Wang 2002 Bulletin of the American Museum of Natural History 269, p. 76).

Coelotes drenskii Deltshev, 1990 Acta zoologica bulgarica 40: 30. Type locality: Bulgaria: Stara Planina Mts., Drenovska peshtera Cave, Kotel Town. Current status: The species is now assigned to genus *Eurocoelotes* (cf. Wang 2002 Bulletin of the American Museum of Natural History 269, p. 76).

Eurocoelotes xinpingwangi Deltshev, 2009 Zoosystematics and Evolution 85(2): 293. Type locality of holotype: Bulgaria: Rila Mts., Rila Monastery, Kirilova polyana, 1460 m.

CYBAEIDAE

Cybaeus balkanus Deltshev, 1997 Reichenbachia 32 (1): 1. Type locality of holotype: Bulgaria: Sredna gora Mts.

GNAPHOSIDAE

Zelotes balcanicus Deltshev, 2006 In: Deltshev, Bosmans, de Spigelaere, Provoost, Revue suisse de Zoologie 113(4): 711.Type locality of holotype: Bulgaria: Shabla Town, dunes.

HAHNIDAE

Cryphoecina Deltshev, 1997 Revue suisse de Zoologie 104(3): 485. Typus generis: *Cryphoecina deelemanae* Deltshev, 1997

Cryphoecina deelemanae Deltshev, 1997 Revue suisse de Zoologie 104(3): 487. Type locality: Montenegro: Petrovac-Virpazar, Petrovacka Gora, oak woodland, 600 m.

LEPTONETIDAE

Leptonetela andreevi Deltshev, 1985 Acta zoologica bulgarica 7: 41. Type locality: Greece: Paros Island: village of Drios, Kalabaki Cave.

Protoleptoneta Deltshev, 1972 International Journal of Speleology 4: 275. Typus generis: *Protoleptoneta bulgarica* Deltshev, 1972

Protoleptoneta beroni Deltshev, 1977 Acta zoologica bulgarica 7: 3. Type locality: Bulgaria: Belimelska Cave, village of Beli Mel, Mihailovgrad Distr.

Protoleptoneta bulgarica Deltshev, 1972 International Journal of Speleology 4: 276. Type locality of holotype: Bulgaria: Bezimenna 22 Cave, village of Karlukovo, Lovech Distr.

LINYPHIIDAE

Araeoncus clivifrons Deltshev, 1987 Reichenbachia 25 (19): 97. Type locality of holotype: Bulgaria: Pirin Mts., [near] Tevno ezero, 2500 m.

- *Centromerus acutidentatus* Deltshev, 2002 In: Deltshev and Ćurčić, Revue suisse de Zoologie 109(1): p. 171.
- Type locality of holotype: Serbia: entrance of Monastery Cave I, village of Selacka near Minicevo.

Centromerus milleri Deltshev, 1974 International Journal of Speleology 6: 81. Type locality: Bulgaria: Karangil Cave near the town of Kardzhali, East Rhodopes Mts.

Centromerus serbicus Deltshev, 2002 In: Deltshev and Ćurčić, Revue suisse de Zoologie 109(1): p. 168.

Type locality of holotype: Serbia: Zlotska Pećina (Lazareva Pećina) Cave, village of Zlot near Bor.

Centromerus sylvaticus paucidentatus Deltshev, 1983 Acta zoologica bulgarica 21: p. 54. Type locality of holotype: Bulgaria: Pirin Mts., [near] Prevala lake, 2300 m.

Centromerus valkanovi Deltshev, 1983 Acta zoologica bulgarica 21: p. 53. Type locality: Bulgaria: Varna, Asparuhovo, forest.

Diplocephalus altimontanus Deltshev, 1984 Reichenbachia 22(11): 91. Type locality of holotype: Bulgaria: Pirin Mts., Vihren Peak, 2914 m.

Drepanotylus pirinicus Deltshev, 1992 Berichte des naturwissenschaftlich-medizinischen Vereins in Innsbruck 79: 173.Type locality: Bulgaria: Pirin Mts., Vihren Peak, 2550 m.

Erigone longipalpis pirini Deltshev, 1983 Acta zoologica bulgarica 22: p. 72. Type locality of holotype: Bulgaria: Pirin Mts., [near] Tevno ezero.

Hypomma aemonicum Deltshev, 2005 Revue suisse Zoologie 112(1): 115. Type locality of holotype: Bulgaria: Stara Planina Mts., Vezhen Peak, 2170 m.

Lepthyphantes beroni Deltshev, 1979 Acta zoologica bulgarica 13: 61. Type locality: Greece: Thera Island: Zoodochus Cave, village of Kamari.

Lepthyphantes beshkovi Deltshev, 1979 Acta zoologica bulgarica 13: 57. Type locality: Greece: Crete: Tzani Cave, village of Omalos.

Lepthyphantes brignolianus Deltshev, 1979 Acta zoologica bulgarica 13: 54. Type locality of syntypes: Greece: Crete: village of Omalos, Tzani Cave; village of Psychro, Dikteon Antron Cave; village of Cermadion, Trapezas Cave; village of Catholiko, Arkandas Cave.

Lepthyphantes rectilamellus Deltshev, 1988 Acta zoologica bulgarica 36: 53. Type locality: Bulgaria: Pirin Mts., Tijacite, 2200 m. Current status: The species is now assigned to genus *Mansuphantes*.

Metopobactrus orbelicus Deltshev, 1985 Bulletin of the British Arachnological Society 6: 363. Type locality of holotype: Bulgaria: Pirin Mts., Vihren Peak, 2914 m.

Lepthyphantes lithoclasicolus Deltshev, 1983 Acta zoologica bulgarica 23: 25. Type locality of holotype: Bulgaria: Pirin Mts., Vihren Peak. Current status: The species is now assigned to genus *Mughiphantes* (-recte: *M. lithoclasicola*). *Lepthyphantes gueorguievi* Deltshev, 1980 Acta zoologica bulgarica 16: 48. Type locality of holotype: Bulgaria: Dupcheto Cave near Velingrad Town. Current status: junior synonym of *Palliduphantes spelaeorum* (Kulczyński, 1914), see

Deeleman-Reinhold 1985, Mémoires de Biospéologie 12: p. 39.

Troglohyphantes bureschianus Deltshev, 1975 Acta zoologica bulgarica 3: 99. Type locality: Bulgaria: Western Rhodopes Mts.: Zmeini borun Cave near village of Mostovo, Plovdiv Distr.

Troglohyphantes drenskii Deltshev, 1973 International Journal of Speleology 5: 103. Type locality: Bulgaria: Suhata pestera Cave near Velingrad Town, Pazardzhik Distr.

NESTICIDAE

Nesticus beroni Deltshev, 1973 Proceedings of the 6th International Congress of Speleology, Olomouc 5: 75.

Type locality: Bulgaria: Dupkata pot [Cave] near village of Mostovo, Plovdiv Distr.

Nesticus beshkovi Deltshev, 1979 Acta zoologica bulgarica 13: 53. Type locality: Greece: Crete: Trapezas Cave, village of Cermadion.

List of genera and species named in honour of Christo Deltshev

Genus

Deltshevia Marusik & Fet, 2009 Genotype: *Deltshevia danovi* Marusik & Fet, 2009 – Turkmenistan

Species

Duvalius (Paraduvalius) zivkovi deltshevi Guéorguiev, 1965 (Coleoptera) – Bulgaria, now junior synonym of D. (Paraduvalius) zivkovi (Knirsch, 1925)
Agrilus (Duttus) delchevi Curletti & Sakalian, 2009 (Coleoptera) – Kenya
Prodicus delcevi Strasser, 1973 (Diplopoda) – Bulgaria, now Anamastigona delcevi
Protoleptoneta deltshevi Brignoli, 1979 (Araneae) – Turkey, now Leptonetela deltshevi
Coelotes deltshevi Dimitrov, 1996 (Araneae) – Bulgaria, now Eurocoelotes deltshevi
Harpactea deltshevi Dimitrov & Lazarov, 1999 (Araneae) – Bulgaria
Saraina deltshevi Azarkina, 2009 (Araneae) – Democratic Republic of Congo
Amilenus deltshevi Dunlop & Mitov, 2009 (Opiliones) – Germany, Palaeogene, Oligocene: Chattian
Lepthyphantes christodeltshev Helsdingen, 2009 (Araneae) – Greece
Sparianthina deltshevi Logunov, 2009 (Araneae) – Madagascar
Halodromus deltshevi Muster, 2009 (Araneae) – Yemen
Ectatosticta deltshevi Platnick & Jäger, 2009 (Araneae) – China

RESEARCH ARTICLE



The Ebo-like running crab spiders in the Old World (Araneae, Philodromidae)

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Academic editor: Jason Dunlop	Received 19 February 2009 Accepted 26 April 2009	Published @@ August 2009					
urn:lsid:zoobank.org:pub:							

Citation: Muster C (2009) The *Ebo*-like running crab spiders in the Old World (Araneae, Philodromidae). In: Stoev P, Dunlop J, Lazarov S (Eds) A life caught in a spider's web. Papers in arachnology in honour of Christo Deltshev. ZooKeys %%: 1-14. doi: 10.3897/zookeys.%%.@@@

Abstract

A recent phylogenetic analysis within Philodromidae has shown that *Ebo* Keyserling, in its current limits, is a paraphyletic assemblage of spiders characterized by a strongly elongated second pair of legs and by enlarged anterior median eyes. Here a generic revision of *Ebo*-like philodromid spiders is provided, with the genera *Ebo*, *Titanebo* Gertsch (re-elevated to genus rank), *Halodromus* gen. n. and *Philodromus* Walckenaer ad. part. (the *histrio* species group = *Rhysodromus* Schick) being redefined and diagnosed. *Ebo* and *Titanebo* are Nearctic taxa whose occurrence in the Old World remains doubtful. Old World species with a long patellar apophysis on the male palp are included in *Halodromus* gen. n. (*H. patellaris* (Wunderlich, 1987), *H. patellidens* (Levy, 1977), both ex. *Ebo*). Three new species are described from both sexes, *Halodromus barbarae* sp. n. from the Arabian Peninsula, Egypt and Spain, *H. deltshevi* sp. n. from Yemen, and *H. gershomi* sp. n. from Eritrea. *Ebo eremus* Levy, 1999 is a new subjective synonym of *Halodromus patellaris* (Wunderlich, 1987). *Halodromus* is presumably an Afro-Syrian element with wide distribution in the Eremial of northern Africa and the Middle East. The Israeli species *Philodromus halophilus* (Levy, 1977), comb. n. ex. *Ebo* is transferred to the *Philodromus histrio* species group.

Keywords

Afroeremial region, generic revision, Halodromus, phylogeny, Rhysodromus, taxonomy, Titanebo

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Introduction

Ebo is a diverse genus of philodromid spiders in North America (Keyserling 1884, Sauer and Platnick 1972). Their characteristic trait is the conspicuously elongated second pair of legs, which can be more than twice as long as the other legs. Further diagnostic characters include a flattened prosoma which is wider than long or as wide as long, and the eye configuration: AME (anterior median eyes) are distinctly larger than the other eyes, both rows slightly recurved, medians of both rows closer to the laterals than to each other (Schick 1965, Sauer and Platnick 1972, Levy 1977). Based on this set of characters, Tikader (1965), Levy (1977, 1999), Wunderlich (1987) and Lyakhov (1992) included new Philodromidae from India, Israel, the Canary Islands and the mountains of South Siberia in *Ebo*. However, even a loose examination of the genital traits (cf. Fig. 1 versus Figs 2, 3) shows that the Old World *Ebo* species have little in common with the Nearctic representatives. Furthermore, the above mentioned combination of characters is also found in other taxa of Philodromidae, e.g. in most species of the Philodromus histrio group (Dondale and Redner 1975, Szita and Logunov 2008). Thus, it seems that elongation of leg II and enlargement of the AME coevolved independently several times within the family, and *Ebo* apparently became a paraphyletic taxon through inclusion of the Old World species. This view is corroborated by a thorough examination of the leg spination pattern. Recent comprehensive studies within Philodromidae have shown that leg spination, in particular that of the tibiae and metatarsi, is presumably the most useful morphological criterion for delineation of supraspecific taxa in this family (Muster 2009). Concerning leg spination in *Ebo*, I found not only the Old World species to be more similar to spiders of the *Philodromus histrio* group (= *Rhysodromus* Schick, 1965) than to North American congeners, but also striking differences between the Nearctic subgenera Ebo and Titanebo Gertsch, 1933. A first quantitative cladistic analysis of phylogenetic relationships within Philodromidae (Muster 2009) provided further evidence: Ebo emerged as the most basal clade within the family, while *Titanebo* grouped with *Rhysodromus*, Old World *Ebo* and the Thanatini in a clade that was sister to the remaining *Philodromus* species. The aim of this study is a generic revision of the *Ebo*-like philodromid spiders (those with markedly elongated leg II and enlarged AME) in order to achieve a better concordance of genera with phylogenetic lineages. A group of Old World species with an elongated apophysis at the patella of the male palp is described as a new genus Halodromus gen. n. A taxonomic revision of the included species is provided.

Material and methods

Material from the following institutions and private collections was examined (institutional abbreviations follow Evenhuis 2007):

AMNH American Museum of Natural History, New YorkCB Coll. Robert Bosmans, Gent



Figures 1-6. 1, 4 Halodromus patellaris from Monastir; 2 Ebo pepinensis from Utah Lake; 3 Titanebo albocaudatus from Abilene; 5-6 Titanebo andreaannae from Tucson. 1-3 Left male palp, ventral view; 4 Tarsal claws and scopulae; 5 Epigyne, dorsal view, showing schematic course of the internal ducts (broken black line) and the demarcation between bursa copulatrix and copulatory ducts (white line); 6 Details of receptacula, showing numerous pores in the torus region.

CM	Coll. Christoph Muster, Putbus
CTh	Coll. Konrad Thaler & Barbara Knoflach, Innsbruck
CJW	Coll. Jörg Wunderlich, Hirschberg-Leutershausen
MNHN	Muséum National d'Histoire Naturelle, Paris
MHNG	Muséum d'Histoire Naturelle, Genève
NHMB	Naturhistorisches Museum, Basel
SMF	Forschungsinstitut Senckenberg, Frankfurt a. M.
SZMN	Siberian Zoological Museum, Novosibirsk
TAU	Tel Aviv University, Tel Aviv
ZMUM	Zoological Museum of the Moscow State University, Moscow

Specimens were examined and measured using a Zeiss STEMI 2000 stereoscopic microscope with a micrometer eyepiece. All measurements are in millimetres. For leg measurements, the variation is given for the entire leg followed by average values for the leg segments femur, patella, tibia, metatarsus and tarsus in squared brackets. The following morphometric indices turned out to be most useful for delineation of the *Ebo*-like genera: (i) the Leg II length index, which is the length of femur II divided by length of femur I, (ii) the AME size index, which is the diameter of AME divided by the width of the cephalothorax, (iii) the PME interdistance index, which is the distance between the PME divided by the distance PME-PLE (Schick 1965: 8), and (iv) the clypeus height index, which is the height of the clypeus divided by the width of the system of Ono (1988) was adopted. As the most distal pair of ventral spines is often shifted dorsally to a rather lateral position, this distal pair was ascribed to the ventral pairs of spines up to a lateral shift of 90°.

Male and female genitalia were dissected and studied as temporary mounts in Hoyer's solution (Kraus 1984) under a Nikon Eclipse E600 microscope with a drawing tube at the MNHN. Montage images were taken at the Zoological institute of the University of Greifswald with a Leica DFC 320 digital camera operating on a Leica Stereomicroscope MZ125. Images taken at different focal planes were assembled with the Helicon Focus Pro software (Helicon Soft Limited). SEM images were taken by the team of Peter Michalik (University of Greifswald) using the following protocol: specimens were dehydrated in graded ethanols, dried in a BAL-TEC CPD 030 critical point dryer using amylacetate as the intermedium, coated with gold-palladium in a Quorum Technologies SC7620 sputtering device and examined in a Leo DSM 940A scanning electron microscope.

Terminology of the genital organs largely follows the recent studies by Muster et al. (2007) and Szita and Logunov (2008). Glandular heads are treated as synonymous with spermathecal organs. As the use of the term "Bursa copulatrix" has been controversial in the past, I here applied a rigid definition as proposed by Muster (2009): the "bursa copulatrix" is a canal or three-dimensional region of the vulva that is passed by the embolus during copulation before it enters the receptacula and that is *not* connected with the duct leading to the glandular heads. If the intromittent canal is merged with the ducts of the glandular heads, this structure is called a "copulatory duct". In this meaning "bursa copulatrix" is synonymous with "insemination duct" as used by

Szita and Logunov (2008). The white line in Fig. 5 demarcates the transition from bursa copulatrix to copulatory ducts according to this definition. The various parts of the cephalothorax were named according to Schick (1965: 9).

Abbreviations used in text and figures: AGP – anterior guide pockets; ALE – anterior lateral eyes; AME – anterior median eyes; BC – bursa copulatrix; bE – basal embolus; CD – copulatory duct; CL – cephalothorax length; ClyH – clypeus height; Co – conductor; CW – cephalothorax width; CyL – cymbium length; CyW – cymbium width; dE – distal embolus; EG – epigynal groove; ES – epigynal suture; FD – fertilisation duct; Fem – femur; GH – glandular head; MS – median septum; OL – opisthosoma length; OW – opisthosoma width; PatApo – patellar apophysis of male palp; PGP – posterior guide pockets; PFem – length of palpal femur; PLE – posterior lateral eyes; PME – posterior median eyes; PPat – length of palpal patella; PTA – philodromid tegular apophysis; SD – sperm duct loop; ST – subtegulum; Teg – tegulum; VTA – ventral tibial apophysis

Taxonomy

Key to genera of *Ebo*-like Philodromidae (VMA enlarged, leg II elongated)

1	Tibiae and metatarsi of legs without pro- and retrolateral spines
_	Tibiae and metatarsi of legs with pro- and retrolateral spines
2	Prosoma longer than wide (or at least as long as wide), leg II moderately
	elongated, at most 1.4 times longer than leg I
	Philodromus histrio group (Rhysodromus)
_	Prosoma wider than long (or at least as wide as long, Figs 11-16), leg II
	strongly elongated, more than 1.4 times longer than leg I
3	Leg IV longer or as long as leg I, male palp without patellar apophysis and
	PTA, embolus curved, with filiform tip pointing to palpal tibia (Fig. 3), epi-
	gyne without sclerotised guide pockets
_	Leg IV shorter than leg I, male palp with patellar apophysis and PTA, embo-
	lus stout, its tip pointing to cymbium tip (Figs 1, 21), epigyne with sclero-
	tised guide pockets (Figs 27, 35) Halodromus gen. n.

Genus Ebo Keyserling, 1884

Ebo Keyserling, 1884: 678. – Simon 1895: 1063; Schick 1965: 84 (subgenus *Ebo*); Sauer and Platnick 1972: 36-37 (subgenus *Ebo*); Dondale and Redner 1978: 29-30 (ad part.).

Type species. Ebo latithorax Keyserling, 1884 by monotypy

Material examined. *Ebo evansae* Sauer and Platnick, 1972: USA: Utah: 4∂, 4♀, Salt Lake City, dry canyon, 40° 46'N, 111° 50'W, 11 March 1944, leg. W. Ivie

(AMNH). *Ebo latithorax:* USA: Pennsylvania: 23° , Rector, 40° 12'N, 79° 14'W, 20 June 1967, leg. B. Vogel (AMNH). *Ebo* cf. *latithorax:* USA: Kansas: 13° , 59° , Ellsworth, 38° 34'N, 98° 14'W, 23 August 1935, leg. W. Ivie (AMNH). *Ebo pepinensis* Gertsch, 1933: USA: Utah: 33° , 39° , west side of Utah Lake, 40° 16'N, 111° 56'W, 11 March 1934, leg. W. Ivie (AMNH).

Diagnosis. Philodromid spiders with enlarged AME (AME size index 0.067-0.08) and extremely elongated leg II (Leg II length index 1.5-2.2). Prosoma wider than long (Fig. 11). Clypeus low (Clypeus height index < 0.1, Fig. 7). Leg formula 2143. Spination of legs generally reduced with species-specific modifications (males of *E. latithorax* are completely spineless), tibiae and metatarsi always without pro- and retrolateral spines. Metatarsus III and IV ventral 2-2-2 (except *E. latithorax*). Patella of male palp without apophysis, tibia with indistinct VTA (sometimes completely reduced) and small, weakly sclerotized RTA. Embolus curved, its tip flexible, pointing to retrolateral side (Fig. 2). Tegulum without apophysis. Conductor a retrolateral shallow groove. Epigyne weakly sclerotized, without atrium or grooves, epigynal suture entirely shifted to epigastric furrow. Glandular heads separated from receptacula, connected by thin ducts.

Remarks. The Nearctic *Ebo* species were thoroughly revised by Schick (1965) and Sauer and Platnick (1972). In both these studies *Titanebo* described by Gertsch (1933) was regarded a subgenus of *Ebo*. All Nearctic species indeed share a number of characters, e.g. the lack of PTA, the curved embolus with a flexible tip and the constitution of the conductor. However, the leg spination pattern is strikingly different, with *Titanebo* resembling *Rhysodromus* (the *Philodromus histrio* group) and *Halodromus* gen. n. *Ebo* and *Titanebo* are also different in the structure of the female genitalia and in some morphometric indices (Table 1). In none of the phylogenetic analyses performed by Muster (2009) did *Titanebo* emerge as sister to *Ebo*. In conclusion, *Titanebo* clearly deserves generic re-establishment.

	Ebo	Titanebo	Halodromus	<i>Philodromus</i> <i>histrio</i> group
males				
leg II length index	1.6 - 2.1	1.5 - 1.7	1.4 - 1.5	1.1 - 1.4
AME size index	0.071 - 0.077	0.054 - 0.076	0.063 - 0.084	0.035 - 0.058
PME interdistance index	1.88 - 2.11	1.80 - 2.07	1.56 - 2.00	1.63 - 3.00
clypeus height index	0.08 - 0.10	0.14 - 0.18	0.12 - 0.21	0.16 - 0.18
females				
leg II length index	1.5 - 2.2	1.4 - 1.7	1.3 - 1.6	1.1 - 1.3
AME size index	0.067 - 0.068	0.060 - 0.067	0.061 - 0.087	0.038 - 0.053
PME interdistance index	1.88 - 2.26	1.69 - 1.87	1.35 - 2.09	1.46 - 2.33
clypeus height index	0.09 - 0.10	0.15 - 0.18	0.11 - 0.18	0.16 - 0.18

Table I. Morphometric indices in *Ebo*-like philodromid genera. Leg II length index = length femur II/femur I; AME size index = diameter AME/CW; PME interdistance index = PME-PME/PME-PLE; clypeus height index = ClyH/CW.
Composition and distribution. The centre of diversity is undoubtly North America. Sauer and Platnick (1972) included seven Nearctic species in the subgenus *Ebo: E. contrastus* Sauer and Platnick, 1972, *E. evansae* Sauer and Platnick, 1972, *E. iviei* Sauer and Platnick, 1972, *E. lathithorax* Keyserling, 1884, *E. merkeli* Schick, 1965, *E. pepinensis* Gertsch, 1933, and *E. punctatus* Sauer and Platnick, 1972. Two further species were added by Platnick (1972) and Cokendolpher (1978), *E. bucklei* Platnick, 1972, and *E. redneri* Cokendolpher, 1978. Old World species described in *Ebo* are either transferred to *Halodromus* gen. n. or *Philodromus*, or they are regarded together with three Neotropical species as incertae sedis.



Figures 7-16. 7, 11 Ebo pepinensis from Utah Lake; 8, 12 Titanebo parabolis from Utah; 9, 15 Halodromus patellaris, from Monastir; 10 Philodromus lepidus from Kebili, Tunisia; 13 Halodromus patellidens from Kuwait; 14 Halodromus barbarae sp. n. from Cartagena; 16 Halodromus gershomi sp. n. from Massawa. 7-10 Female clypeus and chelicerae, frontal view; 11-16 Female cephalothorax, dorsal view. Scale lines = 0.5 mm.

Genus Titanebo Gertsch, 1933

Titanebo Gertsch, 1933: 10-11.

Ebo (*Titanebo*) Gertsch, 1933 – Schick 1965: 73-75 (relegated to subgenus level); Sauer and Platnick 1972: 36.

Ebo Keyserling, 1884 – Dondale and Redner 1978: 29-30 (ad part.).

Type species. *Titanebo macyi* Gertsch, 1933 by original designation.

Material examined. *Titanebo albocaudatus* (Schick, 1965): USA: Texas: 1Å, Abilene, 32° 27'N, 99° 46'W, June 1962, leg. K. W. Haller (AMNH); 1 \bigcirc , Quemado, 28° 56'N, 100° 37'W, leg. W. J. Gertsch et al. (AMNH). MEXICO: Coahuila: 1Å, La Gloria, 26° 41'N, 101° 22'W, 24 August 1947, leg. W. J. Gertsch (AMNH). *Titanebo andreaannae* (Schick, 1965): USA: Arizona: 1Å, 3 \bigcirc , Tucson, 32° 15'N, 110° 57'W, leg. O. Bryant (AMNH). *Titanebo mexicanus* (Banks, 1898): USA: Arizona: 1Å, 1 \bigcirc , Welton-Mohawk, 32° 44'N, 113° 46'W, 9 December 1955, leg. V. Roth (AMNH). MEXICO: Chihuahua: 1Å, 4 \bigcirc , 2 juv. Samalayuca Dunes, 31° 21'N, 106° 28'W, 25 June 1947, leg. W. J. Gertsch (AMNH). *Titanebo parabolis* (Schick, 1965): USA: Utah: 4Å, 6 \bigcirc , American Fork Canyon, 40° 25'N, 111° 45'W, 12 May 1934, leg. W. Ivie (AMNH).

Diagnosis. Philodromid spiders with moderately enlarged AME (AME size index 0.054-0.076) and strongly elongated leg II (Leg II length index 1.4-1.7). Prosoma as wide as long (Fig. 12). Clypeus of intermediate height (Clypeus height index 0.14-0.18, Fig. 8). Leg formula 2413 (occasionally 2143, but then leg IV almost as long as leg I). Spination of leg I: femur dorsal 0-1-1, prolateral 0-1-1-[01]; tibia ventral 2-2-0, pro- and retrolateral [01]-1-1, dorsal 0-0-1; metatarsus ventral 2-2-0, pro- and retrolateral [01]-1-1, dorsal 0-[01]. Metatarsus III and IV ventral 2-2-2. Patella of male palp without apophysis, tibia with two well developed apophyses, VTA a colourless lobe in close contact to the heavily sclerotized RTA, tip of RTA pointed and dentated. Embolus curved, its elongated, filiform tip pointing to RTA (Fig. 3). Tegulum without apophysis. Conductor in form of elongate retrolateral groove. Epigyne weakly sclerotized, without atrium or grooves. Vulva (Fig. 5) lateral and anterior of receptacula with long, sclerotised introductory tubes (= bursa copulatrix) on which the glandular heads (=spermathecal organs) sit, thus becoming copulatory ducts in the distal part. Receptacula with glandular mounds (=torus, Fig. 6).

Remarks. *Titanebo* is herewith re-elevated to full genus status; for a justification see remarks on *Ebo. Titanebo* species from North America were thoroughly revised by Schick (1965) and Sauer and Platnick (1972).

Composition and distribution. The genus comprises 14 Nearctic species: *Ti-tanebo albocaudatus* (Schick, 1965), *T. andreaannae* (Schick, 1965), *T. californicus* Gertsch, 1933, *T. cantralli* (Sauer and Platnick, 1972), *T. cresotis* (Schick, 1965), *T. dispar* (Schick, 1965), *T. dondalei* (Sauer, 1968), *T. macyi* Gertsch, 1933, *T. magnificus* Chamberlin and Ivie, 1942, *T. mexicanus* (Banks, 1898), *T. oblongus* (Simon, 1895), *T. parabolis* (Schick, 1965), *T. redneri* (Cokendolpher, 1978), and *T. texanus* Gertsch, 1933. The primary centre of distribution is presumably the desert and shrub region of the southwestern Nearctic (Schick 1965).

Genus Philodromus Walckenaer, 1826 ad part. (the Philodromus histrio species group)

Rhysodromus Schick, 1965: 67.

Philodromus histrio species group – Dondale and Redner 1975: 370, 372; Szita and Logunov 2008: 25-27.

Type species of *Rhysodromus*: *Thomisus histrio* Latreille, 1819.

Diagnosis. *Philodromus* spiders with some *Ebo*-like characters: AME larger than other eyes (AME size index 0.035-0.06), leg II moderately elongated (Leg II length index 1.1-1.4). Prosoma longer than wide (or at least as wide as long). Clypeus high (Clypeus height index > 0.16, Fig. 10). Spination of legs similar to *Halodromus* and *Titanebo*, but more variable. Metatarsus III and IV ventral 2-2-2 (if always?). Patella of male palp usually without apophysis, in subgenus *Locupletes* Schick, 1965 with small apical apophysis (< 1/4 length of patella), palpal tibia with 0-2 apophyses. Embolus stout, its tip pointing to cymbium tip. PTA present or absent. Conductor a membraneous outgrowth at anterior margin of tegulum. Female genitalia not clearly distinguishable from *Halodromus*.

Remarks. The eastern-Palaearctic species of the *Philodromus histrio* group were recently reviewed by Szita and Logunov (2008), but delineation of the taxon remained vague and no evidence for monophyly of the included species was provided. The *histrio* group in its current limits is most likely an artificial assemblage of superficially similar species. A recent cladistic analysis within Philodromidae (Muster 2009) has shown that *histrio* and related species are more closely related to the Thanatini (*Thanatus* and *Tibellus*) than to other *Philodromus* species groups. Thus, *Rhysodromus* clearly deserves re-elevation to genus rank, but the urgently required revision of the *histrio* group from a phylogenetic perspective is beyond the scope of this study.

Composition and distribution. Szita and Logunov (2008) include 16 species from the eastern Palearctic in the *Philodromus histrio* group. In the Nearctic the taxon is represented by three polytypic species (Schick 1965, Dondale and Redner 1975). The group also occurs in the Mediterranean and in (northern) Africa, but species from this region still await a proper revision. *Philodromus halophilus* (Levy, 1977) comb. n. is transferred from *Ebo* to this group. The male lacks a patellar apophysis and the morphometric indices fall well within the range of the *histrio* group.

Genus Halodromus, gen. n. urn:lsid:zoobank.org:pub:

Ebo Keyserling, 1884 – Levy 1977: 207-208 (ad part.); Wunderlich 1987: 261.

Type species. *Ebo patellidens* Levy, 1977

Etymology. The name *Halodromus* refers to the habit of hiding in salt tolerant dwarf shrubs and the relationship to some *Philodromus* (*Rhysodromus*) species. Gender masculine.

Diagnosis. Philodromid spiders with enlarged AME (AME size index 0.063-0.087) and strongly elongated leg II (Leg II length index 1.3-1.6). Prosoma wider than long (Figs 13-16). Clypeus of intermediate height (Clypeus height index 0.11-0.21, Fig. 9). Leg formula 2143. Spination of leg I: femur dorsal 0-1-1, prolateral 0-1-1; tibia ventral 2-2-0, pro- and retrolateral 0-1-1, dorsal 0-0-1; metatarsus ventral 2-2-0, pro- and retrolateral 1-1.1. Metatarsus IV ventral 2-2-2. Patella of male palp with long apophysis (at least half the length of patella), tibia with rounded RTA (Figs 17, 21, 25, 29, 33). Embolus stout, its tip pointing to cymbium tip (Fig. 1). PTA present. Conductor a narrow membrane accompanying distal embolus (Fig. 1). Epigyne with pair of both anterior and posterior guide pockets (Figs 19, 23, 27, 31, 35). Glandular heads without ducts, sitting at main body of receptacula.

Description. Somatic features. Small to moderately sized philodromid spiders, total length (3/, n=14/25) 2.0-3.7 / 2.6-5.1, cephalothorax width 0.95-1.75 / 1.15-1.85. Cephalothorax (Figs 13-16) slightly wider than long (CW/CL = 1.03-1.32), dorsal shield brownish with light median band that extends to posterior declivity, metadiscus a whitish V-sign, mesodiscus with conspicuous pattern, allatum usually with reticulating dark lines, posterior edges whitish with pubescence. Eyes in two slightly recurved rows, the second row almost straight, AME distinctly larger than other eyes (AME/ PME 1.25-1.8), AME size index (AME/CW) 0.063-0.087, AME closer to ALE than to each other, PME interdistance index (PME-PME/PME-PLE) 1.35-2.09, PME almost equidistant to PLE and ALE, lateral eves larger than medians. Clypeus 1.5 to 3 times as high as diameter of AME (Fig. 9), clypeus height index (ClyH/CW) 0.11-0.21, often with light patch. Cheliceral furrow without promarginal teeth. Leg formula 2143, leg II strongly elongated, Fem II 1.4-1.55 times longer than Fem I (length femur I 1.15-2.2 / 1.25-2.25, length fem II 2.25-3.25 / 1.85-3.1). Spination of leg I: femur dorsal 0-1-1, prolateral 0-1-1; tibia ventral 2-2-0, pro- and retrolateral 0-1-1, dorsal 0-0-1; metatarsus ventral 2-2-0, pro- and retrolateral 1-1-1. Spination of other legs similar, only metatarsus IV ventral 2-2-2. Tarsi and distal half of metatarsi densely covered with scopulae (Fig. 4). Legs yellowish to orange brown, usually mottled and with twofold annulations at femora, threefold annulations at tibiae and weak annulation at metatarsi. Opisthosoma oval, widest near middle, sides smoothly rounded, posteriorly tapering. Dorsum grey with conspicuous black cardiac mark, flanks often darkish, in posterior half with four to five chevrons.

Pedipalp (Figs 1, 17-18, 21-22, 25-26, 29-30, 33-34). Patella with long retrolateral apophysis that is 0.4 to 1.2 times as long as tibia. Tibia with relatively short, broadly rounded RTA, VTA absent, tibia approximately half as long as cymbium. Cymbium drop-like, cymbial tip relatively short, covered with chemosensitive hairs. Cymbium length (CyL) 0.44-0.74, width (CyW) 0.2-0.44, ratio CyL/cephalothorax width 0.36-0.46. Subtegulum visible in ventral view. Tegulum with large, hooked PTA in retrolateral-distal position. Sperm duct opening between 7 and 9 o'clock position. Conductor a narrow, membranous distal outgrowth of tegulum, partially hidden behind embolus. Embolus at prolateral side of tegulum, divided in basal and distal embolus. Basal embolus widely merged with tegulum, distally often bulged. Distal embolus a stiff, thorn-like structure, pointing to cymbial tip.

Epigyne-vulva (Figs 19-20, 23-24, 27-28, 31-32, 35-36). Median septum divides the atrium in two epigynal grooves (e.g. Fig. 27), or epigynal sutures may be covered by lateral plates, leaving no atrium visible (Fig. 35). Epigyne with two pairs of lateral guide pockets, the posterior guide pockets may be indistinct, anterior guide pockets are heavily sclerotised. Anterior guide pockets may serve for fixation of palpal patella during copulation, the intromittant orifice is presumably situated at the anterior end of the epigynal suture. Receptacula of variable shape, situated near the epigastric furrow (Fig. 32) or shifted anteriorly (Figs 24, 36), touching each other (Figs 20, 36) or well separated (Fig. 32). Glandular heads in anterior position at receptacula, ducts very short or absent, independent from intromittent canal. No glandular mounds appreciable at walls of receptacula.

Composition and distribution. Five species from Northern Africa (including the Canary and Cape Verde Islands) and the Middle East (one presumably reaching the Iberian Peninsula) are included in the new genus. Two of them were hitherto placed in the genus *Ebo*, three species are newly described. While all species are present in the region around the Red Sea, three are rather widespread in the area outlined above (Fig. 37).

Key to Halodromus species

1	Males	
_	Females	
2	Patellar apophysis longer than tibia of male palp, PTA laminate, projecting beyond retrolateral margin of tibia (Figs 33-34)	
_	Patellar apophysis not longer than ³ / ₄ the length of tibia of male palp, PTA hooked, not projecting beyond retrolateral margin of tibia (e.g. Fig. 17) 3	
3	Embolus with distinct prolateral bulge at basis of distal embolus (Figs 21, 25, 29), RTA a wide, rounded projection	
_	Embolus without distinct prolateral bulge at basis of distal embolus, RTA reduced to a small hump (Figs 17-18)	
4	Distal embolus stout, curved to retrolateral side, PTA narrow (Figs 1, 29-30) <i>H. patellaris</i>	
_	Distal embolus a thin spur, PTA large (Figs 21, 25)	
5	Patellar apophysis with distinct bulge at base of ventral margin (Figs 21-22) <i>H. deltshevi</i> sp. n.	
_	Patellar apophysis at ventral margin only with inconspicuous groove (Figs 25-26)	
6	Median septum with parallel margins (Figs 19, 31)7	
_	Median septum triangular (Figs 23, 27, 35)	
7	Epigyne longer than wide, glandular heads in lateral-distal position at recep- tacula (Figs 19-20)	
-	Epigyne wider than long, glandular heads in mid-distal position at recep- tacula (Figs 31-32)	

8	Epigyne without grooves, anterior guide pockets covered by receptacula in
	dorsal view (Figs 35-36)
_	Epigyne with extended grooves, anterior guide pockets visible in dorsal view
	(Figs 23, 27)
9	Epigyne longer than wide, epigynal sutures sigmoid (Fig. 23)
	H. deltshevi sp. n.
_	Epigyne wider than long, epigynal sutures straight (Fig. 27)
	H. gershomi sp. n.
	0 1

Halodromus barbarae, sp. n.

urn:lsid:zoobank.org:pub: Figs 14, 17-20

Etymology. The species is named after Dr Barbara Thaler-Knoflach in recognition of her merits in the exploration of theridiid spiders of the Mediterranean basin and beyond. Noun in genitive case.

Material examined. Holotype. Male. SPAIN: Murcia: Cartagena, 37° 36'N, 0° 59'W, leg. E. Simon, specimen in ethanol with left palp dissected, with hand-written labels as follows "13388 Cartagena!" "Halodromus barbarae Muster Holotype" (MNHN ES 13388). *Paratypes.* EGYPT: Aswan: 1 \bigcirc , Assuan synanthropic, 24° 4'N, 32° 55'E, 22 June 1975, leg. Kübelböck (MNHG). ISRAEL: Southern District: 1 \bigcirc , Arava Valley, 'Iddan, 30° 47'N, 35° 17'E, 2 September 2008, D-Vac leg. V. Hochmann (TAU). SAUDI ARABIA: Eastern Province: 1 \circlearrowleft , Al-Khobar, 26° 17'N, 50° 12'E, 12 January 1983, leg. E. Heiss (MNHG). SPAIN: Murcia: 3 \bigcirc , 2 juv., Cartagena, 37° 36'N, 0° 59'W, leg. E. Simon (MNHN ES 13388).

Diagnosis. Males are characterized by the shape of the embolus ("foxtailed") and by the RTA reduced to a small bulge (Fig. 17). Females show a unique shape of the receptacula (Fig. 20).

Description. Measurements. Male (n=2): total length 2.05-3.0, CL 0.9-1.39, CW 0.95-1.45, ClyH 0.11-0.21, OL 1.25-1.9, OW 1.0-1.4. Leg I 3.77-6.2 [1.45, 0.55, 1.25, 1.1, 0.64], FemII 2.65. Eye sizes and interdistances: AME 0.08-0.11, PME 0.04-0.06, AME–AME 0.1-0.14, AME–ALE 0.05, PME–PME 0.16-0.21, PME–PLE 0.09-0.12, ALE–PME 0.1-0.13. Pedipalp: PFem 0.36-0.56, PPat 0.15-0.24, PatApo 0.8-0.13, PTib 0.18-0,26, CyL 0.44-0.58, CyW 0.2-0.3. AME size index: 0.073-0.084. PME interdistance index: 1.72-1.76. Clypeus height index: 0.12-0.15. Leg II length index: 1.51.

Female (n = 5): total length 3.6 (2.6-5.1), CL 1.2 (1.05-1.35), CW 1.36 (1.15-1.55), ClyH 0.18 (0.16-0.22), OL 2.55 (1.8-3.2), OW 2.07 (1.45-2.7). Leg I 5.26 (4.18-6.15) [1.58, 0.58, 1.31, 1.08, 0.71], FemII 2.29 (1.85-2.7). Eye sizes and inter-

Ebo spec. (*?patellaris* Wunderlich, 1987) – Schmidt and Krause 1996: 267-268, fig. 7 (misidentification).

distances: AME 0.1, PME 0.064, AME–AME 0.1, AME–ALE 0.046, PME–PME 0.21, PME–PML 0.12, ALE–PME 0.13. AME size index: 0.075 (0.061-0.087). PME interdistance index: 1.78 (1.59-2.09). Clypeus height index: 0.14 (0.11-0.15). LegII length index: 1.47 (1.46-1.48).

Colour. Pale species. Dorsal shield of prosoma (Fig. 14) light brown with yellowish median band that extends to posterior margin, posterior edges with whitish pubescence, allatum with radiating, furcated stripes of dark spots, whitish patches along longitudinal allatal stripes, metadiscus a central whitish W-sign, mesodiscus with inconspicuous pattern. Clypeus whitish, chelicerae uniformly beige. Sternum uniformly whitish with long pubescence. Legs yellowish-brown, mottled (particularly at prolateral-ventral side of femora), faint annulations distal at femora and basal and distal at tibia. Opisthosoma whitish grey with lanceolate cardiac mark, some dark patches and four to six chevrons in posterior half. Venter whitish grey.

Pedipalp (Figs 17-18). Patella with shortest apophysis among all known congeners, barely half as long as tibia. Tibia with RTA reduced to a low bulge. Cymbial tip less than one third of CyL. Cymbium length (CyL) 0.44-0.58, width (CyW) 0.2-0.3,



Figures 17-20. *Halodromus barbarae* sp. n. from Cartagena. **17-18** Left male palp (**17** ventral, **18** retrolateral); **19** Epigyne, ventral; **20** Vulva, dorsal. Scale line = 0.1 mm.

ratio CyL/cephalothorax width 0.40-0.46. Subtegulum visible in ventral view. Anterior border of tegulum bulged, PTA situated near this bulge, hooked, tip pointing ventrally. Sperm duct symmetric, opening in 7:30 o'clock position. Conductor largely hidden behind embolus, in ventral view protruding at prolateral side of embolus. Embolus not clearly divided in basal and distal part, foxtail-shaped, embolus tip straight, projecting beyond anterior border of bulb, pointing to cymbial tip.

Epigyne-vulva (Figs 19-20). Median septum with almost parallel margins, more than three times as long as wide, stretched grooves at both sides of median septum. Posterior guide pockets wide at epigastric furrow, anterior guide pockets small, moderately sclerotized. Receptacula kidney-shaped, in close contact. Glandular heads in lateral-distal position.

Remarks, distribution and habitat. Specimens from the Middle East are considerably smaller than those from Cartagena. However, there are no differences in the structure of the male and female genitalia, consequently there is no reason to doubt their conspecifity. The occurrence on the Iberian Peninsula needs to be confirmed, since the original labels of the type series from the Simon collection contained no other information than "13388 Cartagena!". This locality is somehow suspect because it is the single record of the genus from Europe. Given the wide range of *H. patellaris* and *H. patellidens*, this distribution is not entirely implausible, but at the same time it can not be excluded that Simon referred to the ancient city of Carthage in Tunisia. The species may also occur on the eastern Canary Islands. Schmidt and Krause (1996) illustrated the epigynum of a female from El Jable, Fuerteventura (mounted epigynum lost, Schmidt and Krause 1996: 268) that they provisionally allocated to *Ebo patellaris*, but they referred to differences from the original description by Wunderlich (1987). This figure corresponds well to *H. barbarae*, while it certainly does not show *H. patel*laris. No details on habitat were available from any of the original labels accompanying the specimens.

Halodromus deltshevi, sp. n.

Figs 21-24

Etymology. The species name is dedicated to the Bulgarian arachnologist Dr Christo Deltshev on occasion of his 70th anniversary. Noun in genitive case.

Material examined. Holotype. Male. YEMEN: 'Adan: Aden, 12° 48'N, 45° 02'E, 1889, leg. E. Simon, specimen in ethanol with three legs missing, with hand-written labels as follows "19099 Aden!" "Halodromus deltshevi Muster Holotype" (MNHN ES 19099). *Paratypes.* 5 $^{\circ}$, 11 $^{\circ}$, same data as holotype (3 $^{\circ}$, 4 $^{\circ}$ MNHN ES 10779; 2 $^{\circ}$, 7 $^{\circ}$ MNHN ES 19099).

Diagnosis. Males are characterized by the prominent bulge at the base of the patellar apophysis (Figs 21-22), females are unique in the shape of the epigynal grooves (Fig. 23).

Description. Measurements. Male (Holotype): total length 3.25, CL 1.58, CW 1.65, ClyH 0.28, OL 1.9, OW 1.4. Leg I 7.4 [2.1, 0.75, 2.0, 1.6, 0.95], FemII 3.25.

Eye sizes and interdistances: AME 0.12, PME 0.09, AME–AME 0.14, AME–ALE 0.055, PME–PME 0.27, PME–PLE 0.16, ALE–PME 0.14. Pedipalp: PFem 0.66, PPat 0.28, PatApo 0.28 PTib 0.32, CyL 0.66, CyW 0.34. AME size index: 0.073. PME interdistance index: 1.69. Clypeus height index: 0.17. Leg II length index: 1.55.

Female (n = 5): total length 3.2 (2.8-3.5), CL 1.34 (1.25-1.4), CW 1.51 (1.4-1.6), ClyH 0.24 (0.23-0.26), OL 2.08 (1.7-2.2), OW 1.69 (1.4-1.9). Leg I 5.56 (5.4-5.75) [1.69, 0.6, 1.43, 1.13, 0.71], FemII 2.42 (2.3-2.65). Eye sizes and interdistances: AME 0.1, PME 0.07, AME–AME 0.11, AME–ALE 0.06, PME–PME 0.23, PME–PML 0.14, ALE–PME 0.13. AME size index: 0.068 (0.064-0.076). PME interdistance index: 1.65 (1.35-1.92). Clypeus height index: 0.16 (0.15-0.17). LegII length index: 1.43 (1.35-1.56).

Colour. Dorsal shield of prosoma brown with orange-brown median band that extends to posterior margin, posterior edges with whitish pubescence, allatal stripes discontinuous, metadiscus a central whitish V-sign, mesodiscus with conspicuous pattern (similar to Fig. 16). Clypeus brown with whitish patch, chelicerae light brown with black spots. Sternum whitish with dots and brown patches at the margin. Legs yellow-ish-brown, mottled and with double annulations at femora, single annulations at patel-



Figures 21-24. *Halodromus deltshevi* sp. n. from Aden. **21-22** Left male palp (**21** ventral, **22** retrolateral); **23** Epigyne, ventral; **24** Vulva, dorsal. Scale line = 0.1 mm.

lae, threefold annulations at tibiae and weak annulations at metatarsi. Opisthosoma densely covered with whitish pubescence, interspersed with dark setulae. Dorsum grey with lanceolate cardiac mark, two posterior dots are usually fused with the cardiac mark, flanks darkish. Venter whitish with grey patches and sometimes grey median stripe.

Pedipalp (Figs 21-22). Patella with bifid apophysis: a rounded bulge at ventral base and a long (three quarters the length of the tibia), blunt dorsal process. Tibia with short, rectangular processing RTA with rounded tip. Cymbial tip approximately one third of CyL. Cymbium length (CyL) 0.66, width (CyW) 0.34, ratio CyL/cephalothorax width 0.4. Subtegulum visible in ventral view. Anterior border of tegulum indistinct, PTA originating in central position, hooked, tip pointing to RTA. Sperm duct symmetric, opening in 7:30 o'clock position. Conductor largely hidden behind embolus, in ventral view protruding at retrolateral side of embolus. Embolus at transition from basal to distal part with distinctive prolateral bulge that projects above prolateral margin of bulb, embolus tip a thin, slightly curved spur.

Epigyne-vulva (Figs 23-24). Epigyne longer than wide. Median septum narrowed posteriorly, epigynal sutures sigmoid. Epigynal grooves almost as wide as median plate at epigastric furrow. Posterior guide pockets relatively small, anterior guide pockets externally only moderately sclerotized, in dorsal view visible as voluminous pockets. Receptacula bagpipe-shaped, separated from epigastric furrow by approximately their diameter. Glandular heads in inner-distal position, almost touching one another.

Distribution and habitat. Only known from the type locality (Fig. 37), no information on habitat available.

Halodromus gershomi, sp. n. *urn:lsid:zoobank.org:pub:* Figs 16, 25-28

Etymology. The species is named in honour of Dr Gershom Levy, who described the first species of the genus from Israel and unfortunately passed away during preparation of this manuscript. Noun in genitive case.

Material examined. Holotype. Male. ERITREA: Semienawi Kayih Bahri [Northern Red Sea]: Massawa, 15° 36'N, 39° 27'E, 1889, leg. F. Jousseaumme, specimen in ethanol with four legs missing, with hand-written labels as follows "11889 Massaua Philodromus" "Halodromus gershomi Muster Holotype" (MNHN ES 11889). *Paratypes.* 1° , 12° , 6 juv., same data as holotype (MNHN ES 11889).

Diagnosis. Males are distinguishable from similar species by the shape of patellar apophysis and PTA (Figs 25-26). The epigynum is wider than long with exceptionally wide posterior guide pockets (Fig. 27).

Description. Measurements. Male (Holotype): total length 3.3, CL 1.58, CW 1.65, ClyH 0.3, OL 2.15, OW 1.55. Leg I 7.55 [2.2, 0.9, 2.0, 1.5, 0.95], FemII 3.1. Eye sizes and interdistances: AME 0.1, PME 0.08, AME–AME 0.16, AME–ALE 0.088, PME–PME 0.29, PME–PLE 0.16, ALE–PME 0.15. Pedipalp: PFem 0.68,

PPat 0.3, PatApo 0.2 PTib 0.3, CyL 0.6, CyW 0.3. AME size index: 0.063. PME interdistance index: 1.81. Clypeus height index: 0.18. LegII length index: 1.41.

Female (n = 5): total length 3.0 (2.8-3.5), CL 1.28 (1.1-1.4), CW 1.46 (1.4-1.55), ClyH 0.23 (0.22-0.24), OL 1.97 (1.85-2.1), OW 1.6 (1.45-1.85). Leg I 5.09 (4.78-5.85) [1.54, 0.56, 1.28, 0.98, 0.73], FemII 2.18 (1.95-2.4). Eye sizes and interdistances: AME 0.1, PME 0.07, AME–AME 0.11, AME–ALE 0.06, PME–PME 0.24, PME–PML 0.14, ALE–PME 0.12. AME size index: 0.068 (0.061-0.076). PME interdistance index: 1.80 (1.66-2.0). Clypeus height index: 0.16 (0.15-0.18). Leg II length index: 1.42 (1.3-1.5).

Colour. Dorsal shield of prosoma (Fig. 16) brown with wide orange-brown median band that extends to posterior margin, median band wider than the dark sides which show blackish venation, posterior edges with whitish pubescence, allatal stripes discontinuous, metadiscus a central whitish V-sign, mesodiscus with inconspicuous pattern. Clypeus brown with bi-humped beige area, chelicerae brown with black spots, distally more light. Sternum whitish with dots and brown patches at the margin. Legs yellowish-brown, mottled and with double annulations at femora, single annulations at patellae, threefold annulations at tibiae and weak annulations at metatarsi. Opisthosoma



Figures 25-28. *Halodromus gershomi* sp. n. from Aden. 25-26 Left male palp (25 ventral, 26 retrolateral); 27 Epigyne, ventral; 28 Vulva, dorsal. Scale line = 0.1 mm.

densely covered with whitish pubescence, interspersed with dark setulae. Dorsum grey with conspicuous black cardiac mark, followed by a separated black dot and grey chevrons posteriorly, flanks darkish. Venter whitish with a conspicuous, grey median stripe.

Pedipalp (Figs 25-26). Patellar apophysis less than two thirds the length of the tibia, with inconspicuous groove at ventral border, tip rounded, pointing to dorsal margin of tibia. Tibia with rectangular processing RTA with rounded tip which merges with a second, more dorsally situated bulge. Cymbial tip relatively long and narrow, approximately one third of CyL. Cymbium length (CyL) 0.6, width (CyW) 0.3, ratio CyL/cephalothorax width 0.36. Subtegulum visible in ventral view. PTA in central position, hooked, tip pointing in ventral-proximal direction, not reaching lateral margin of cymbium. Sperm duct symmetric, opening in 7 o'clock position. Conductor largely hidden behind embolus, in ventral view protruding at both sides of embolus. Embolus at transition from basal to distal part with distinctive prolateral bulge that projects above prolateral margin of bulb, embolus tip a thin, almost straight spur.

Epigyne-vulva (Figs 27-28). Epigyne distinctly wider than long. Median septum triangular, narrowed posteriorly, epigynal sutures straight. Epigynal grooves large. Posterior guide pockets exceptionally wide and well developed, anterior guide pockets externally moderately sclerotized, in dorsal view visible as voluminous pockets. Receptacula bagpipe-shaped, somewhat separated from epigastric furrow, not touching each other. Glandular heads in inner-distal position, pointing in lateral-distal direction.

Distribution and habitat. Only known from the type locality (Fig. 37), no information on habitat available.

Halodromus patellaris (Wunderlich, 1987)

Figs 1, 4, 9, 15, 29-32

- *Ebo patellaris* Wunderlich, 1987: 261-262, figs 679-680 (description male, holotype not examined).
- *Ebo eremus* Levy, 1999: 188, figs 22-23 (description female). **Syn. n.** Levy 2007: 19, figs 47-48.

Material examined. CANARY ISLANDS: Lanzarote: 1, 2, Playa Famara, dunes, 29° 67'N, 13° 33'W, March, leg. J. Wunderlich (CJW). TUNISIA: Kairouan: 2, salt vegetation 12 km E Kairouan, 35° 40'N, 10° 9'E, 26 April 2007, leg. C. Muster (CM). Monastir: 12, 10, 2 juv., salt marsh near Monastir Airport, 35° 45'N, 10° 47'E, 27 April 2007, leg. C. Muster (CM).

Diagnosis. Males are characterized by the triangular shape of the patellar apophysis and the small, narrow PTA (Figs 29-30), females by the parallel anterior guide pockets (Fig. 31).

Description. Measurements. Largest species of the genus. **Male** (n=5): total length 3.26 (2.9-3.7), CL 1.54 (1.45-1.7), CW 1.62 (1.55-1.75), ClyH 0.28 (0.24-0.34), OL 1.88 (1.55-2.2), OW 1.47 (1.15-1.7). Leg I 7.08 (6.55-7.55) [1.98, 0.67,

1.94, 1.53, 0.96], FemII 2.91 (2.75-3.0). Eye sizes and interdistances: AME 0.11, PME 0.08, AME–AME 0.13, AME–ALE 0.052, PME–PME 0.23, PME–PLE 0.14, ALE–PME 0.16. Pedipalp: PFem 0.69 (0.64-0.75), PPat 0.26 (0.24-0.27), PatApo 0.18 (0.14-0.20), PTib 0.27 (0.24-0.28), CyL 0.71 (0.68-0.74), CyW 0.41 (0.38-0.44). AME size index: 0.07 (0.067-0.074). PME interdistance index: 1.63 (1.5-1.81). Clypeus height index: 0.17 (0.16-0.21). Leg II length index: 1.48 (1.45-1.53).

Female (n = 5): total length 3.16 (2.9-3.5), CL 1.27 (1.05-1.45), CW 1.4 (1.15-1.6), ClyH 0.23 (0.18-0.27), OL 2.09 (1.8-2.3), OW 1.87 (1.6-2.1). Leg I 5.16 (4.2-5.9) [1.56, 0.55, 1.35, 1.05, 0.65], FemII 2.29 (1.95-2.6). Eye sizes and interdistances: AME 0.11, PME 0.07, AME–AME 0.1, AME–ALE 0.04, PME–PME 0.2, PME–PML 0.11, ALE–PME 0.12. AME size index: 0.076 (0.067-0.087). PME interdistance index: 1.81 (1.65-1.97). Clypeus height index: 0.16 (0.15-0.18). LegII length index: 1.47 (1.39-1.56).

Colour. Dorsal shield of prosoma (Fig. 15) brown with bright orange-brown median band that extends to posterior margin, allatal stripes discontinuous, metadiscus a whitish V-sign, mesodiscus with characteristic pattern. Clypeus with a rectangular beige area (Fig. 9), chelicerae brown with black spots. Sternum whitish with dots and brown patches at the margin. Legs orange-brown, intensely mottled and with double annula-



Figures 29-32. *Halodromus patellaris* from Monastir. **29-30** Left male palp (**29** ventral, **30** retrolateral); **31** Epigyne, ventral; **32** Vulva, dorsal. Scale line = 0.1 mm.

tions at femora, threefold annulations at tibiae and single, weak annulations at metatarsi. Opisthosoma densely covered with whitish pubescence, interspersed with dark setulae. Dorsum grey with conspicuous black cardiac mark, flanks darkish, in posterior half with four to five chevrons and two lateral dark patches. Venter greyish marbled.

Pedipalp (Figs 1, 29-30). Patellar apophysis relatively short, less than two thirds the length of tibia, in ventral view narrow, in lateral view triangular, with small but distinct bulge at basis of ventral margin. Tibia with broad, rounded RTA. Cymbial tip short, less than one fifth of CyL, broadly rounded. Cymbium length (CyL) 0.68-0.74, width (CyW) 0.38-0.44, ratio CyL/cephalothorax width 0.44-0.46. Subtegulum visible in ventral view. PTA a small narrow hook, directed retrolaterally, its tip pointing in ventral direction. Sperm duct forming an elongate, asymmetric loop in retrolateral half of tegulum, opening in 8:30 o'clock position. Conductor partly hidden behind embolus, in ventral view visible at retrolateral side of embolus. Embolus clearly divided in basal and distal embolus. Basal embolus with prolateral-distal bulge and curved keel at ventral side. Distal embolus stout, curved to retrolateral side.

Epigyne-vulva (Figs 31-32). Epigyne wider than long. Median septum almost quadrangular, epigynal sutures short. Epigynal grooves covered by lateral plates. Posterior guide pockets small, anterior guide pockets prominent, heavily sclerotized, with almost parallel slits, extending anteriorly far beyond receptacula. Receptacula at epigastric furrow, separated from each other by their diameter. Glandular heads in innerdistal position, with short ducts pointing in lateral-distal direction.

Remarks. Due to the serious illness of Dr Gershom Levy I failed to receive the type series of *Ebo eremus* Levy from the Hebrew University of Jerusalem for examination. However, the species was sufficiently characterized by Levy (1999, 2007) to propose synonymy with *Halodromus patellaris* (Wunderlich).

Distribution and habitat. The species is known from the eastern Canary Islands Fuerteventura (Wunderlich 1987, 1992) and Lanzarote, from the Negev desert in southern Israel (Levy 1999, 2007), and from Tunisia (Fig. 37). All specimens from Israel were taken using pitfall traps. The specimens from Tunisia were beaten from prostrate halophytic shrubs in saline habitats at both coastal and inland sites. They were perfectly camouflaged in the dense vegetation.

Halodromus patellidens (Levy, 1977)

Figs 13, 33-36

Ebo patellidens Levy, 1977: 210-212, figs 36-39 (description male, female; holotype not examined). – Wunderlich 1992: 504, figs 808f-g.

Material examined. ALGERIA: Biskra: 1endown defined in the formula of the start of the star

1 juv., Kubbar Island, 29° 04'N, 48° 29'E, 17 March 1988, leg. W. Büttiker (NHMB); 1 \bigcirc , same data, leg. W. Al-Bouty (NHMB). SAUDI ARABIA: Eastern Province: 1 \bigcirc , Al-Khobar, 26° 17'N, 50° 12'E, 12 January 1983, leg. E. Heiss (CTh). TUNISIA: Tataouine: 1 \bigcirc , Bir Thelethine S Tataouine, in *Salicornia* and tamarisk bushes, 32° 55'N, 10° 27'E, 18 December 2000, leg. R. Bosmans (CB). YEMEN: 'Adan: 6 \circlearrowleft , 8 \bigcirc , Aden, 12° 48'N, 45° 02'E, 1889, leg. E. Simon (1 \circlearrowright , 1 \bigcirc MNHN ES 10779; 5 \circlearrowright , 7 \bigcirc MNHN ES 19099). Hadramowt: 2 \circlearrowright , 4 juv., Island Perim, 12° 65'N, 43° 41'E, leg. F. Jousseaumme (MNHN ES 10818).

Diagnosis. Males are characterized by the exceptionally large patellar apophysis and by the large PTA that projects beyond the retrolateral margin of the cymbium (Figs 33-34). Females are recognizable by the coiled anterior guide pockets and the shape of the receptacula (Figs 35-36).

Description. Measurements. Male (n=5): total length 2.89 (2.65-3.2), CL 1.37 (1.25-1.45), CW 1.47 (1.35-1.55), ClyH 0.24 (0.22-0.27), OL 1.65 (1.5-1.8), OW 1.33 (1.2-1.6). Leg I 6.11 (5.9-6.3) [1.78, 0.63, 1.63, 1.28, 0.81], FemII 2.53. Eye sizes and interdistances: AME 0.12, PME 0.07, AME–AME 0.1, AME–ALE 0.04, PME–PME 0.22, PME–PLE 0.11, ALE–PME 0.14. Pedipalp: PFem 0.58 (0.5-0.6), PPat 0.23 (0.2-0.25), PatApo 0.32 (0.26-0.36), PTib 0.3 (0.28-0.32), CyL 0.65 (0.6-0.68), CyW 0.36 (0.35-0.36). AME size index: 0.08 (0.077-0.083). PME interdistance index: 1.83 (1.75-2.0). Clypeus height index: 0.17 (0.15-0.18). LegII length index: 1.46 (1.41-1.53).

Female (n = 5): total length 3.16 (2.9-3.5), CL 1.27 (1.05-1.45), CW 1.4 (1.15-1.6), ClyH 0.23 (0.18-0.27), OL 2.09 (1.8-2.3), OW 1.87 (1.6-2.1). Leg I 5.16 (4.2-5.9) [1.56, 0.55, 1.35, 1.05, 0.65], FemII 2.29 (1.95-2.6). Eye sizes and interdistances: AME 0.11, PME 0.07, AME–AME 0.1, AME–ALE 0.04, PME–PME 0.2, PME–PML 0.11, ALE–PME 0.12. AME size index: 0.076 (0.067-0.087). PME interdistance index: 1.81 (1.65-1.97). Clypeus height index: 0.16 (0.15-0.18). LegII length index: 1.47 (1.39-1.56).

Colour. Dorsal shield of prosoma (Fig. 13) brown with bright orange-brown median band that extends to posterior margin, allatum with dark radiating stripes and whitish patches along longitudinal allatal stripes, metadiscus a whitish V-sign, mesodiscus with characteristic pattern. Clypeus with a beige area, chelicerae orange brown with dark spots. Sternum whitish with numerous small spots. Legs orange-brown, intensely mottled and with double annulations at femora and threefold annulations at tibiae. Opisthosoma densely covered with whitish pubescence, interspersed with dark setulae. Dorsum grey with conspicuous black cardiac mark that broadens in posterior third, followed by two dark spots and some partially fused chevrons, flanks darkish, in posterior half with four to five chevrons and two lateral dark patches. Venter greyish marbled with three faint longitudinal stripes.

Pedipalp (Figs 33-34). Patella exceptionally long and voluminous, longer than tibia. Tibia with almost rectangular processing RTA with rounded tip. Cymbial tip relatively short, less than one fourth of CyL. Cymbium length (CyL) 0.6-0.68, width (CyW) 0.35-0.36, ratio CyL/cephalothorax width 0.4-0.47. Subtegulum visible in ventral view. Anterior border of tegulum indistinct, PTA large, laminar, projecting be-

yond retrolateral margin of cymbium, its tip pointing in ventral direction. Sperm duct forming an elongate, asymmetric loop in retrolateral half of tegulum, opening in 8 o'clock position. Conductor a narrow membrane at retrolateral side of embolus, mostly visible in ventral view. Embolus broadly merged with tegulum, near distal embolus with prolateral bulge, distal embolus stout, pointing in a retrolateral-distal direction.

Epigyne-vulva (Figs 35-36). Epigyne slightly wider than long. Median septum triangular, but margins covered by lateral plates, thus epigynal sutures and epigynal grooves invisible in ventral view, margins of lateral plates sigmoid. Posterior guide pockets small, indistinct, anterior guide pockets conspicuously coiled structures, in dorsal view covered by receptacula. Receptacula widely separated from epigastric furrow, with median insection, distal parts in close contact. Glandular heads in inner -distal position, pointing inwards.

Remarks. Due to the serious illness of Dr Gershom Levy I failed to receive the type series of *Ebo patellidens* Levy from the Hebrew University of Jerusalem for examination. However, the detailed figures provided by Levy (1977) allow the unequivocal identification of the examined material with this species.

Distribution and habitat. The available evidence suggests that *H. patellidens* is rather widespread in the Middle East, but also along the north-African coast (Fig. 37).



Figures 33-36. *Halodromus patellidens* from Aden. **33-34** Left male palp (**33** ventral, **34** retrolateral); **35** Epigyne, ventral; **36** Vulva, dorsal. Scale line = 0.1 mm.



Figure 37. Distribution of Halodromus species.

The occurrence of *H. patellidens* on the Cape Verde Islands (Schmidt 1990, Schmidt and Krause 1995) was doubted by Wunderlich (1992: 504-505), yet it could be confirmed through examination of material from the SMF. On the other hand, the species has not been recorded from the Canary Islands. The record from Fuerteventura (Schmidt 1990) results from the erroneous synonymization with *H. patellaris* (already rejected by Wunderlich 1992: 504). Habitat information is scarce, but Schmidt and Krause (1995) collected the species from halophytes.

Incertae sedis

The following species, originally described in *Ebo*, show striking differences in genitalic and/or somatic characters to *Ebo latithorax* and its congeners from North America. However, these species are difficult to place in the system, and at the current state of knowledge I refrain from suggesting new generic assignments.

Ebo bharatae Tikader, 1965

Ebo bharatae Tikader, 1965: 278-279, figs 2a-c. – Tikader 1971: 67, figs 18a-c; Tikader 1980: 179, figs 249-251.

Remarks. No information on leg spination and morphometric indices is given in Tikader (1965, 1971, 1980). Without re-examination of the type series the relationship of this species cannot be inferred.

Ebo carmineus Mello-Leitão, 1944

Ebo carmineus Mello-Leitão, 1944: 362-363, fig. 55.

Remarks. Mello-Leitão (1942, 1943, 1944) described three *Ebo* species from South America. From the information given in the original descriptions I feel unable to deduce their correct generic placement. With five pairs of ventral spines on tibia I and four pairs on the metatarsus the leg spination in *Ebo carmineus* it is strikingly different from North American *Ebo*, suggesting generic misplacement.

Ebo distinctivus Lyakhov, 1992

Ebo distinctivus Lyakhov, 1992: 148-149, figs 1-4.

Material examined. RUSSIA: Altai Republic: 1♂, vicinity of Kosh-Agatch, Kurai Mt. range, approx. 50° 10'N, 88° 40'E, June 1970, leg. Berman (holotype, ZMUM); 1♂, same data (paratype, SZMN); 1♀, same locality, 26 May 1970, leg. A. P. Kononenko (allotype, epigynum missing, ZMUM).

Remarks. The leg spination pattern and other features preclude the retention of this species in *Ebo*. Several morphological characters (configuration of embolus, lack of PTA, leg spination pattern) suggest a sister-group relationship with *Titanebo*. On the other hand, it differs from *Titanbeo* in the reduced tibial apophyses, and the presence of an apical pair of ventral spines on the tibiae is a unique character.

Ebo fuscus Mello-Leitão, 1943

Ebo fuscus Mello-Leitão, 1943: 118-119, fig. 21.

Remarks. See E. carmineus.

Ebo meridionalis Mello-Leitão 1942

Ebo meridionalis Mello-Leitão 1942: 405-407, figs 29-30.

Remarks. See E. carmineus.

Discussion

A close examination of morphometrics, leg spination as well as male and female genitalia has clearly demonstrated the polyphyletic character of *Ebo* as hitherto delineated. The Nearctic subgenera *Ebo* and *Titanebo* are distinct enough to deserve genus rank. Their occurrence in the Old World remains uncertain, as the placement of *Ebo bharatae* from India and *Ebo distinctivus* from the Altai Mountains requires further studies. The remaining species from the Old World are either transferred to the Philodromus histrio group or to the new genus Halodromus, which is characterized by at least one putative autapomorphy, the long apophysis at the patella of the male palp. The presence of a patellar apovphsis is very unusual within Philodromidae, only males of the Philodromus subgenus Locupletes Schick, 1965 also bear a short retrolateral projection at the palpal patella (Schick 1965). The proposed transfers are a contribution to the effort of making more genera of Philodromidae monophyletic. However, phylogenetic relationships among the Ebo-like philodromid spider genera remain largely unresolved, as different character sets provide conflicting evidence. Concerning male genitalic traits, Ebo and Titanebo appear closely related. Leg spination is similar in Titanebo, Halodromus and Rhysodromus, but strikingly different in Ebo. Female genitalia are unique in Titanebo, but almost indistinguishable between Halodromus and Rhysodromus. Morphological and biogeographic considerations suggest a rather close relationship of Halodromus and Rhysodromus, but it is not clear whether Halodromus is sister to Rhysodromus or rather a distal clade within *Rhysodromus*. Reconstructions are further hampered by the problematic delineation of *Rhysodromus*/the *Philodromus histrio* group. In the limits of Szita and Logunov (2008) it is most probably a paraphyletic assemblage.

The *Ebo*-like philodromid genera recognized in this study have the following biogeographic origins. Schick (1965) identified *Ebo* as an "Austral element", with a distribution centre south of the Nearctic coniferous forests. *Ebo* s. str. is widely distributed in temperate North America, while *Titanebo* is an eremial element with primary centre of distribution in the deserts of the southwestern Nearctic ("Sonoran element"). *Halodromus* is also allocated to the eremial fauna, with a distribution centre in the Afro-Syro-Eremial regions south of the Mediterranean. A remarkable result of this study is the uncovering of the vast Afroeremial distribution of several species that have been considered narrow endemics of Israel or the Canary Islands respectively. *Rhysodromus* species are widely distributed from boreal to eremial regions in the Holarctic. The highest diversity is recorded from the eastern Palaearctic (Szita and Logunov 2008), but a better knowledge of the African and South-Asian philodromid fauna may result in deeper insights.

Acknowledgements

This research received support from the SYNTHESYS Project http://www.synthesys. info/ which is financed by European Community Research Infrastructure Action under the FP6 'Structuring the European Research Area' Programme. The hospitality of the host Christine Rollard (MNHN) contributed to the success of this project. I would like to thank Peter Michalik (University of Greifswald) for access to technical resources in his department and for taking the SEM photographs. This study would not have been possible without the generous loan of specimens from the following persons and institutions: Robert Bosmans (CB), Efrat Gavish-Regev (TAU), Ambros Hänggi (NHMB), Peter Jäger and Julia Altmann (SMF), Barbara Thaler-Knoflach (CTh), Norman Platnick (AMNH), Christine Rollard and Elise-Anne Leguin (MNHN), and Jörg Wunderlich (CJW). Access to copies of rare and old literature was given by courtesy of Peter Jäger (SMF). Thanks are due to Christophe Herve (MNHN) for his help with identifying labels and localities from the Simon collection. I am deeply indebted to Dmitri Logunov (the Manchester Museum) for the loan of comparative material, fruitful discussion and comments on an earlier draft. The comments of two anonymous referees helped to improve a former version of the manuscript.

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RESEARCH ARTICLE



A survey of East Palaearctic Hersiliola Thorell, 1870 (Araneae, Hersiliidae), with a description of three new genera

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Academic editor: Jason Dunlop	Received 1 March 2009 Accepted 24 April 2009 Published @@ August 2009
	urn:lsid:zoobank.org:pub:

Citation: Marusik YM, Fet V (2009) A survey of East Palaearctic *Hersiliola* Thorell, 1870 (Araneae, Hersiliidae), with a description of three new genera. In: Stoev P, Dunlop J, Lazarov S (Eds) A life caught in a spider's web. Papers in arachnology in honour of Christo Deltshev. ZooKeys %%: 1-14. doi: 10.3897/zookeys.%%.\$\$\$

Abstract

Three new genera and eight new species of Hersiliidae are described from the East Palaearctic (Afganistan, Iran, Kazakhstan, Kyrgyzstan, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan). The genus Hersiliola Thorell, 1870 (Araneae: Hersiliidae) is revised, and four new species are described. The genus includes nine species: *H. afghanica* Roewer, 1960 (Afghanistan); *H. esyunini* **sp. n.** (Uzbekistan); *H. foordi* **sp. n.** (Iran); *H. lindbergi* **sp. n.** (Afghanistan); *H. macullulata* (Dufour, 1831) (type species; from Spain and Algeria to Israel and Yemen); *H. simoni* (O.P.-Cambridge, 1872) (from Spain and Morocco to Israel); *H. sternbergsi* **sp. n.** (Turkmenistan, Uzbekistan); *H. versicolor* (Blackwall, 1865) (Cape Verde); and *H. xinjiangenis* (Liang & Wang, 1989) (Xinjiang, China). A new genus *Duninia* **gen. n.** is described, with two new species, *Duninia baehrae* **sp. n.** (type species; Turkmenistan) and *D. rheimsae* **sp. n.** (Iran). A new genus *Deltshevia* **gen. n.** is described, with two new species, *Deltshevia* **gen. n.** is described, with two new species, *Daninia baehrae* **sp. n.** (Uzbekistan, Kazakhstan). The widely ranging Central Asian *Hersiliola pallida* Kroneberg, 1875 (Kazakhstan, Kyrgyzstan, Pakistan, Tajikistan, Turkmenistan, Uzbekistan) is transferred to a new monotypic genus, *Ovtsharenkoia* **gen. n.**

Keywords

Spider, Central Asia, China, new genus, new species, new combination, *Hersiliola, Deltshevia* gen. n., *Duninia* gen. n., *Ovtsharenkoia* gen. n.

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Introduction

Hersiliidae is a globally distributed entelegyne spider family that currently includes 159 species belonging to 12 genera (Platnick 2009, Marusik 2009). Most hersiliid species are found in tropical and subtropical regions. Ranges of only a few species extend north of 40°N. Hersiliids are easily recognizable due to their very long posterior lateral spinnerets. All species of the family are ecribellate. Hersiliidae, together with Oecobiidae, traditionally formed the superfamily Oecobioidea (Lehtinen 1967). Some araneologists also considered Eresidae as a family related to Oecobiidae and Hersiliidae, and placed these three families in Eresoidea (Coddington and Levi 1991).

During the last two decades, this family was subject to extensive studies, which resulted in exhaustive revisions of its Australian, Oriental, Neotropical, and Afrotropical faunas (Baehr and Baehr 1987, 1993, 1998; Rheims and Brescovit 2004; Rheims et al. 2004; Foord and Dippenaar-Schoeman 2005, 2006; Foord 2008), as well as a revision of fossil taxa (Penney 2006). Less attention has been devoted to the small Palaearctic genus *Hersiliola* Thorell, 1870.

Some important changes affecting *Hersiliola* composition have been introduced recently. South African species, formerly included in *Hersiliola*, have been transferred to a new genus *Tyrotama* by Foord and Dippenaar-Schoeman (2005). Fet (2008) transferred the dubious taxa *Hersiliola brachyplura* Strand, 1913 and *H. b. demaculata* Strand, 1914 (both from Israel) to *Oecobius* (Oecobiidae). As a result, Platnick (2009) listed only five valid species of *Hersiliola* with the following geographic ranges: *H. afghanica* Roewer, 1960 (Afghanistan, Turkmenistan); *H. macullulata* (Dufour, 1831) (type species, Mediterranean to Turkmenistan, Burkina Faso); *H. pallida* Kroneberg, 1875 (Central Asia); *H. simoni* (O. P.-Cambridge, 1872) (Mediterranean, Nigeria, Cape Verde Islands), and *H. versicolor* (Blackwall, 1865) (Cape Verde Islands). In addition, Marusik (2009) transferred one species to *Hersiliola* described from China (Xingiang) as *Hersilia xinjiangenis* Liang & Wang, 1989.

Both Mediterranean species, *Hersiliola macullulata* and *H. simoni*, have been recently redescribed (Ribera et al. 1988, Levy 2003, Rheims et al. 2004, Foord and Dippenaar-Schoeman 2005). However, there was no study of *H. macullulata* across its presumed wide range in Central Asia. Also, no revision addressed two other Asian species, *H. afghanica* and *H. pallida*.

The published range of the genus in Asia is quite large, and extends southwards to the Karakoram Mts (northeastern Pakistan; Caporiacco 1935; *H. pallida*) and eastwards to Xingiang (northwestern China; Marusik 2009; *H. xinjiangenis*). *Hersiliola afghanica* was reported as occurring widely across Afghanistan (Denis 1958, Roewer 1960). From Turkey, *H. macullulata* was reported (Hatay Province; Yağmur et al. 2008), but the family was not included in the recent checklist (Bayram et al. 2008).

Published records of *Hersiliola* from five Central Asian republics of the former USSR (now the independent countries of Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan) have been also sporadic, although spiders of this genus are very common in deserts and dry mountains, found under stones, in rodent burrows (Krivokhatsky and Fet 1982, Krivokhatsky 1987), and in pitfall traps (Kuznetsov and Fet 1984). Taxonomic placement of Central Asian species so far has been unclear; they were usually identified tentatively as either *H. macullulata* (often misspelled as *maculata*; see below for discussion of correct spelling), *H. pallida*, or *H. afghanica*. No illustrations of male palps from Central Asian *Hersiliola* have been published.

Here, based on extensive new material, we reappraise all hersiliids found in Afghanistan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan, with a description of six new species and three new genera (*Duninia* gen. n., *Deltshevia* gen. n., and *Ovtsharenkoia* gen. n.). In addition, we describe two new species from Iran (the first record of Hersiliidae for this country).

Material and methods

This paper is based on 238 specimens including 35 collected by the authors (28 specimens collected by VF during his resident work in Turkmenistan in 1975-1984, and 7 specimens collected by YM in Iran in 2000), as well as all available museum material (203 specimens, among them 31 collected by A.V. Gromov during a joint expedition with VF to Uzbekistan and Turkmenistan in 2002). Numerous new specimens from Central Asia reached us, due to the efforts of Alexander Gromov and Dmitri Logunov, when this paper was already finalized; therefore a few descriptions are based on older material (*Ovtsharenkoia* gen. n.) or on a subadult male with a well developed palp (*Deltshevia gromovi* sp. n.).

Specimens were photographed using an Olympus SZX12 stereomicroscope and Olympus Camedia C-5050 camera in the Zoological Museum, University of Turku, Finland. The images were montaged using CombineZM image stacking software.

Whole specimens, palps and unmacerated epigynes were photographed in deep cups with a wax bottom. Depressions of different shape and size were made in wax for fixing specimens in the correct position. Epigynes were macerated using either KOH or lactic acid. In some cases, to make weakly sclerotized structures within epigynes more visible, we used Amido Black 10B (Amidoschwartz, naphthol blue black) amido acid. All measurements are in mm.

Terminology. There are some contradictions in applying terminology for epigynal structures in Hersiliidae. Describing a hersiliid epigyne, Rheims and Brescovit (2004) and Foord and Dippenaar-Schoeman (2005) indicated both S (=spermatheca) and SR (=seminal receptacle). The same two terms were used in their character matrix. In fact, these two terms, derived from either Greek ("spermatheca") or Latin/English ("seminal receptacle"), refer to the same function: depository of sperm into the female epigyne. Ubick et al. (2005) treated these terms as synonyms. In our opinion, such confusion is caused by a specific structure of epigyne, which in most hersiliids contains accessory globular or digitiform structures near the terminal part of fertilization duct. We call these structures "accessory glands" (*Ag*), although their function is unknown.

Abbreviations: Morphological terms used in figures: *Ag*, accessory gland; *As*, accessory sclerite; *Bd*, digitiform part of basal apophysis; *Bl*, lamellate part of basal apo-

physis; *Bm*, mesal part of basal apophysis; *Dp*, deep pocket; *Eb*, base of embolus; *Em*, embolus; *Et*, tip of embolus; *Fd*, fertilization duct; *Fp*, flattened part; *Ha*, horizontal arm of *Te*; *Id*, insemination duct; *Lp*, lateral pocket; *Mp*, median plate; *Pp*, pale (colourless) part of epigyne; *Sd*, seminal duct; *Se*, septum; *Sp*, spermatheca (=receptaculum); *Te*, tegular (median) apophysis; *Ul*, upper loop of *Id*; *Va*, vertical arm of *Te*; *Wi*, window. **Nomenclatural acts** (in reference lists): D, described; T, transferred.

Depositories: CAS, California Academy of Sciences, San Francisco, California, USA; GNM, Göteborgs Naturhistoriska Museum, Göteborg, Sweden; HDO, Hope Department, Oxford University, Oxford, UK; MIZST, Museo ed Istituto di Zoologia Sistematica, Università di Torino, Turin, Italy; MNHN, Muséum national d'Histoire naturelle, Paris, France; MZUF, Museo zoologico "La Specola", Università di Firenze, Florence, Italy; SMF, Senckenberg Museum, Frankfurt, Germany; ZMMU, Zoological Museum of Moscow State University, Moscow, Russia.

Taxonomy

Hersiliola Thorell, 1870

Type species. Aranea macullulata Dufour, 1831, from Spain.

Diagnosis. *Hersiliola* can be easily distinguished from other Palaearctic hersiliid genera by short spinnerets (shorter than abdomen length) and the shape of copulatory organs: discoid tegulum; long, whip-like coiled embolus; a small tegular apophysis perpendicular to the axis of the palp; insemination ducts coiled around fertilization ducts and uncoiled upper loop. The other three Central Asian genera of Hersiliidae (described here) have either a globular tegulum or have more than one tegular apophysis and uncoiled insemination ducts. From habitually similar African genera (*Tama* Simon, 1882 and *Tyrotama* Foord & Dippenaar-Schoeman 2005), *Hersiliola* can be distinguished by a digitate cymbium; presence of a hook-like median tegular apophysis; flattened bulbus of the male palp [=discoid tegulum]; a filiform, elongate, spirally coiled embolus; elongate, coiled copulatory ducts; small [relatively smaller] seminal receptacles (Foord and Dippenaar-Schoeman 2005); and some somatic characters. See Foord and Dippenaar-Schoeman (2005) for a detailed redescription of the genus and the type species. See also below for the studied material of the type species and comments on its distribution.

Comments. For a long time this genus, as well as the Afrotropical *Tama*, was diagnosed as a hersiliid with short spinnerets (shorter than abdomen length). All species with short spinnerets were placed in these two genera until Foord and Dippenaar-Schoeman (2005) recognized that species from southern Africa have copulatory organs and some somatic characters very different from *Hersiliola* and *Tama*, and described a new genus *Tyrotama*.

Composition. Here, we assign nine species to *Hersiliola*, including four new species: *H. afghanica* Roewer, 1960 (\mathcal{Q} , Afghanistan); *H. esyunini* sp. n. ($\mathcal{J}\mathcal{Q}$, Uzbekistan); *H. foordi* sp. n. (\mathcal{Q} , southern Iran); *H. lindbergi* sp. n. (\mathcal{Q} , Afghanistan); *H. macullulata*



Figure 1.1-4 Habitus of females of *Hersiliola sternbergsi* sp. n. (1), *H. esyunini* sp. n. (2), *H. lindbergi* sp. n. (3), and *H. afghanica* (4).



Figures 2. 1-8 *Hersiliola sternbergsi* sp. n. (1), *H. esyunini* sp. n. (2), *Outsharenkoia pallida* (3-8). 1 male carapace, frontal; 2 carapace, dorsal; 3-4 male carapace, dorsal and lateral; 5 abdomen of juvenile, dorsal; 6-7 habitus of female and male, respectively; 8 female abdomen, ventral.

(Dufour, 1831) ($\mathcal{J} \hfill \hfill$

Distinguishing characters. Species of *Hersiliola* can be distinguished by the shape of the copulatory organs. The most important diagnostic characters in the male palp are as follows: (1) position of the embolic base; (2) number of embolic coils; (3) shape and position of tegular apophysis; and (4) size of cymbial terminal part. In females, the most important characters are: (1) shape of median plate; (2) number of coils of insemination duct; (3) shape and size of spermathecae; and (4) position of insemination duct attachment to the spermathecae.

Distribution. The genus is found in Europe (Iberian Peninsula), Africa (Algeria, Burkina Faso, Cape Verde, Chad, Libya, Mali, Morocco, Niger), and Asia (from Middle East to Xinjiang). The northern limit of its distribution lies in Xinjiang (44°N). Two Mediterranean species have wide ranges within North Africa and the Middle East. Only one Central Asian species, *H. sternbergsi* sp. n., has a fairly large range. All other species are known either from a single locality or from a few closely located points.

Hersiliola macullulata (Dufour, 1831)

Figs 4.1, 5.1, 6.1

Aranea m. Dufour, 1831: 360, pl. 10, f. 2 (D^Q₊).

- *Hersilia oraniensis* Lucas, 1846: 129, pl. 4, f. 8 (D $\bigcirc \uparrow \updownarrow$).
- *H. maculata*: Ribera et al. 1988: 98, f. 1, 4, 7-8 ($\stackrel{\wedge}{\bigcirc} \stackrel{\circ}{\downarrow}$) (misspelling).
- *H. m.*: Levy 2003: 28, f. 57-60 (♂♀).
- *H. simoni*: Rheims and Brescovit 2004: 208, f. 12, 27, 39-42 ($\mathcal{F}_{\mathcal{P}}$). Misidentification, at least of \mathcal{F} . Geographical origin of illustrated specimens unknown, maybe Yemen.
- *H. simoni*: Rheims et al. 2004: 344, f. 4-6, 24-32 (3°). Misidentification.
- H. m.: Foord and Dippenaar-Schoeman 2005: 259, f. 2A-G (♂♀). ♂ appears to be misidentified.

For a full list of references, see Platnick (2009).

Material examined (9 specimens): 1, "Algerie, Espagne" (MNHN, No 410); SPAIN: "*Hersiliola maculata* (Dufour) 2, Spanien, Franz leg., Wiehle det. SMF". ALGE-RIA: 1, Air, Fezzan, E. Simon det., Dj. Harrasa 26.09.1909 B.S., Ras Four' Lal, 29.09.1909, B.S. (MNHN, B-693); 1, El Oued, 100 m, 5.05.1981, E. S. Ross coll. (CAS). LIBYA: 3, Uadi Kuf, E. Festa coll., L. di Caporiacco det. (MIZST). MALI: 1, 10 km E of Sevare, 14°30'N, 04°W, 15.07-1.09.1977, W. H. Settle coll. (CAS). **Diagnosis.** Can be easily recognized by its long embolus, starting at position about 5 h and making 1.5 coils (Figs 4.1, 5.1, 6.1); and by the shape of tegular apophysis and epigyne.

Description. Redescribed in detail by Levy (2003) and Rheims et al. (2004, as *H. simoni*).

Comments. This species was described from Spain, and later reported from Algeria, Israel and Burkina Faso. Its types appear to be lost (Levy 2003). It is very likely that that specimens from Burkina Faso (males) illustrated by Foord and Dippenaar-Schoeman (2005) are not conspecific with specimens from Algeria (females). Males from Burkina Faso have their embolus base in another position (at 04 hrs) compared to specimens from Spain or Israel (at 05 hrs). African males may belong to *H. versicolor* Blackwall, 1865, a species known from Cape Verde from females only. Another possibility is that specimen from Burkina Faso had a partially expanded bulbus, and its tegulum was slightly displaced (turned).

Figures of "*H. simoni*" in Rheims and Brescovit (2004) and Rheims et al. (2004) undoubtedly correspond to *H. macullulata*.

Distribution. *H. macullulata* is confirmed here from Spain, Algeria, Israel (Levy 2003, Foord and Dippenaar-Schoeman 2005), Yemen (as *H. simoni*, Rheims et al. 2004), Libya (first record), and Mali (first record). Its records from Burkina Faso (Foord and Dippenaar-Schoeman 2005) and Turkey (Yağmur et al. 2008) could refer to another species. All reported Central Asian populations refer to *H. sternbergsi* sp. n. (Turkmenistan) or *Deltshevia gromovi* gen. n. sp. n. (Kazakhstan).

Note. This name has been commonly listed as "*H. maculata*" although Dufour's original name is *Aranea macullulata*. The name was misspelled as "*H. macululata*" by Simon (1885: 28). Karsch (1881: 7) 'corrected' the name to "*maculata*" which was widely used. Bonnet (1957: 2180; footnote) suggested that *macullulata* is poor Latin, being derived from a non-existent word "macullula" ("a small spot"). The consistent usage for over 100 years still does not validate Karsch's emendation (ICZN Article 32b-c). In fact, Dufour's original description (1831: 360) shows that his intention was to document a pattern of very small spots; and "macullula" is acceptable as an invented Latin word, parallel to the existing terms "medullula" or "ampullula" (H.D. Cameron, pers. comm. 1995).

Hersiliola simoni (O.P.-Cambridge, 1872)

Figs 4.2, 5.2, 6.2-3

Hersiliada simonii O. P.-Cambridge, 1872: 275, pl. 14, f. 9 (D $\bigcirc^{\uparrow} \bigcirc$).

- *Hersilidia lucasii* O. P.-Cambridge, 1876: 562, pl. 58, f. 5 (D♂♀) (Egypt: Alexandria); synonymized by Levy (2003).
- *H. lucasi*: Wiehle 1960: 470, f. 15 (\bigcirc) (specimen from Egypt).
- *H. s.*: Ribera et al. 1988: 99, f. 2, 5, 9-10 ($\bigcirc^{\circ} \bigcirc$).
- *H. s.*: Levy 2003: 25, f. 47-56 (♂♀, subad.).
- H. s.: Rheims and Brescovit 2004: 208, f. 12, 27, 39-42 (♂♀). Misidentification; refers to H. macullulata.

H. s.: Rheims et al. 2004: 344, f. 4-6, 24-32 (2°). Misidentification; refers to *H. macullulata*.

H. s.: Foord and Dippenaar-Schoeman 2005: 261, f. 3A-G ($\stackrel{?}{\bigcirc} \stackrel{?}{\ominus}$). For a full list of references, see Platnick (2009).

Material examined (28 specimens). Types of *H. simoni*: ISRAEL: Jerusalem, Jericho, holotype 3° , paratypes: 8° , 6° , 1° subad. 3° , 9° subad. 9° (HDO, Bottle 400). Additional material: LEBANON: 13° , 1893, E. Festa coll., P. Pavesi det. (MIZST Ar. 336); 13° , 19° "H. Simonii, Palästina, leg. 13.09.1931, Wiehle det." (SMF 19407/2)".

Diagnosis. *Hersiliola simoni* can be recognized by the position of the embolic base (ca. 10:30 hrs), a relatively short embolus forming only one coil, and the shape of epigyne. From *H. sternbergsi* sp. n., it differs by a flatter palp with a smaller number of loops, a different position of the embolic base, and a different tegular apophysis.

Description. Redescribed in detail by Levy (2003).

Comments. Figures of *H. simoni* in Rheims and Brescovit (2004) and Rheims et al. (2004) undoubtedly correspond to *H. macullulata*.

Distribution. Hersiliola simoni was reported widely from Spain, Morocco, Niger, Cape Verde, Tunisia, Egypt, Libya, Lebanon, Syria, and Israel, although some records are doubtful or incorrect. Records of this species from Cape Verde should, in our opinion, refer to *H. versicolor*, the only species described and properly recorded from these islands (cf. Rheims et al. 2004). The record and illustrations of *H. simoni* from Yemen (Rheims et al. 2004) refer, in our opinion, to *H. macullulata*.

Hersiliola versicolor (Blackwall, 1865)

Fig. 7.1

Hersilia v. Blackwall, 1865: 81 (D♀). *H. v.*: Simon 1893: 445. *H. v.*: Foord and Dippenaar-Schoeman 2005: 261, f. 4A-D (♀).

Material examined: A slide of an epigyne (SMF, from the H. Wiehle collection) from "Kapeverde, Maio" [=Cape Verde Islands, Maio Island]. Identified as *H. simoni*.

Diagnosis. *H. versicolor* is similar to *H. simoni*, but differs from it by the shape of the median plate of the epigyne, which is much higher and has a wider septum.

Description. Redescribed by Foord and Dippenaar-Schoeman (2005).

Comments. This species is known from females only. The shape of the median plate illustrated by Foord and Dippenaar-Schoeman (2005: fig. 4A) appears to be misinterpreted, judging from the figure of the vulva, and from the specimen (a slide of the epigyne) examined by us. Black dots on their fig. 4A and on our Fig. 7.1 seem to correspond to accessory glands. On the slide, glands seem to be displaced due to pressure from the cover glass.

Distribution. Known only from the Cape Verde Islands.

Hersiliola sp.

Fig. 7.2

H. simoni: Benoit 1974: 997, f. 3, 6 ($\stackrel{\bigcirc}{\downarrow}$) (?)

Material examined. A slide of the epigyne (SMF, from the H. Wiehle collection) labeled as "*H. macullulata* from Palestine.

Comments. Unlike other species from the Middle East (Israel), this specimen has only one coil of the insemination duct, and it can be expected that its male should have a correspondingly shorter embolus. It could belong to *H. lucasi* (O.P.-Cambridge, 1876), which was described from Egypt and is currently synonymous with *H. simoni*. Conformation of the epigyne is similar to those illustrated by Benoit (1974) from Tunisia and identified as *H. simoni*. Benoit (1974) compared his specimen with those from Egypt.

Hersiliola afghanica Roewer, 1960

Figs 1.4, 7.3-4, 8.1

H. a. Roewer, 1960: 48, f. 16a-d (D^Q).

Type material (examined). Holotype \mathcal{Q} , with label "*Hersiliola afghanica* n.sp. $1\mathcal{Q}$ Typus, $1(\mathcal{O}$ inad.) A409" (GNM); inadult male is absent from the vial. According to the original publication (Roewer 1960), the holotype was collected in "AFGHANISTAN, Kabul, Mont Sher Dervazeh, under stones (K. Lindberg coll.)".

Note. Roewer (1960) also listed 19 additional specimens ("paratypes") across a wide range in Afghanistan (Mazari-Sharif, Kabul, Jalalabad, etc.), but all of them were indicated as juveniles. However, in the SMF we found a single adult female, clearly designated as a paratype (allegedly of *H. afghanica*), with the following label: "1^Q Paratype, SMF 12996, No. 15, Afghanistan". Holotype (GNM) and paratype (SMF) labels are written by the same hand, presumably by Roewer. Study of this SMF female demonstrated that it belongs to another species, which is described below as *H. lindbergi* sp. n.

Diagnosis. *Hersiliola afghanica* is most similar to *H. sternbergsi* sp. n., from which it can be distinguished by larger spermathecae, shape of the upper loop, and insemination duct terminating on dorsal wall of the spermatheca.

Description. Male unknown. Female: Total length 5.5. Carapace 2.0 long, 2.15 wide, femur I 3.25 long, femur I/carapace length ratio 1.63. General colouration light brown. Carapace in poor condition, pattern is not visible. Abdomen with well developed pattern composed by a heart spot with dark margins; posterior part of abdomen with three transverse stripes. Legs with distinct annulations, light and dark rings equal in width. Coxae IV separated by less than one diameter. Chelicerae and maxillae with strong erect hairs. Epigyne as in Figs. 7.3-4, 8.1. Septum as wide as lateral arms of median plate; windows distinct. Insemination duct relatively short; upper loop of coil located over the spermatheca; accessory gland digitiform.

Distribution. Afghanistan (Kabul Province).

Comments. Although this species was reported from a number of localities in Afghanistan, all records except for the holotype \mathcal{Q} from Kabul are based on juveniles that could be misidentified since other hersiliids (*H. lindbergi* sp. n. or *Ovtsharenkoia pallida*) could occur in this area. Any of these species could also have been reported by Denis (1958) from Pirzada (Afghanistan) as *H. simoni*.

All records of *H. afghanica* from Turkmenistan are misidentifications and refer either to *Duninia baehrae* gen. n. sp. n. or to *Deltshevia danovi* gen. n. sp. n.

Hersiliola lindbergi, sp. n.

urn:lsid:zoobank.org:pub: Figs 1.3, 7.5-6, 8.3

Type material. Holotype \bigcirc with label "1 \bigcirc Paratyp, SMF 12996, No. 15, Afghanistan", in SMF.

Etymology. The species name is a patronym honoring its collector, Dr. Knut Lindberg (1892-1962) of Lund, Sweden, who conducted an important expedition to Afghanistan between 1957 and 1960.

Note. Roewer (1960) in his description of *H. afghanica* indicated only one adult specimen, the holotype female. All paratypes were juveniles. Labels of the holotype of *H. afghanica* (GNM) and the SMF 12996 "paratype" were written by the same hand, probably by Roewer.

Description. Male unknown. Female: Total length 3.6. Carapace 1.5 long, 1.7 wide, femur I 2.5 long, femur I/carapace length ratio 1.66. General colouration light yellowbrown. Carapace without pattern but with dark margins. Abdomen with a wide heart spot and one transverse stripe; sides with brown bands. Legs without distinct annulations. Chelicerae and maxillae without strong setae. Coxae IV separated by less than one diameter.

Epigyne as in Figs 7.5-6, 8.3, with septum as wide as epigyne openings; median plate not separated from the epigynal plate; translucent spermathecae small and round, close to each other, their diameter approximately equals width of epigyne openings, windows absent; spermathecae separated from the opening by three diameters; insemination ducts long, making six coils around fertilization duct; the upper loop well-developed; accessory glands small, digitiform.

Diagnosis. *H. lindbergi* sp. n. clearly differs from other species by the very long insemination ducts making six coils and an apical loop. It can be also distinguished by small round spermathecae, the shape of the septum and the epigyne openings.

Comments. There is a certain possibility that *H. lindbergi* sp. n. belongs to another genus. Unlike in *H. maculullata*, *H. afganica*, *H. simoni*, *H. sternbergsi* sp. n., *H. versicolor*, and *Duninia baehrae* sp. n., the median plate in this species is not separated from the epigynal plates and has no accessory sclerites or windows. The position of *H. lindbergi* sp. n. cannot be confirmed until a male is found.

Distribution. Afghanistan, without a precise locality.

Hersiliola foordi, sp. n. *urn:lsid:zoobank.org:pub:* Figs 7.13-14, 8.5

Type material (3 specimens): Holotype 1° , IRAN [01] Fars Province, 50 km NNE of Shiraz, Bamoo Reserve, 52°45'E 29°45'N, 18-28.05.2000, Yu.M. Marusik coll. (ZMMU). Paratypes: 1° , 1 juv. $^{\circ}$, IRAN [09] Fars Province, Shiraz, 52.533°E 29.607°N, 18-26.05.2000, Yu.M. Marusik coll. (ZMMU).

Etymology. The species name is a patronym honouring our colleague Stefan H. Foord (Thohoyandou, South Africa), for his contributions to in-depth modern studies of Hersiliidae.

Description. Male unknown. Female: Total length 5.01-5.75. Carapace 2.1-2.25 long, 2.2-2.45 wide, femur 3.1-3.75 long, femur I/carapace length ratio 1.47-1.67. Coxae IV separated only slightly. Abdominal pattern such as in holotype of *H. afghanica* formed by short flat hairs of orange-light brown, dark brown, and white colour.

Epigyne as in Figs 13-14, 8.5, with septum as wide as lateral arms of median plate; median plate not well separated from epigynal plate; translucent spermathecae oval, separated by their length (height) from the epigynal opening; insemination duct short, with only one loop; fertilization duct with a long appendix-like accessory gland extending along the duct.

Diagnosis. *Hersiliola foordi* sp. n. can be easily distinguished from all other congeners by its very short and wide insemination ducts, unseparated median plate, and lack of windows.

Comments. This species, like *H. lindbergi* sp. n., could belong to a separate genus. Its median plate is not separated from the rest of the epigynal plate. It also has no accessory sclerites and no windows.

Distribution. The species is known only from two nearby localities near Shiraz, southern Iran.

Hersiliola sternbergsi, sp. n.

urn:lsid:zoobank.org:pub: Figs 1.1, 2.1, 3.2, 4.3, 5.3, 6.4-5, 7.7-9, 8.2

- H. maculata: Vlassov and Sytchevskaya 1937: 248 (Turkmenistan: Ashgabat); Kaplin 1978: 35 (Turkmenistan: Repetek); Krivokhatsky and Fet 1982: 69-70 (Repetek); Fet 1983: 837; Fet 1984: 259; Krivokhatsky 1987: 96 (Repetek). Misidentification and misspelling.
- *H. pallida*: Spassky 1952: 196, 200 (in part); Sabirova 1975: 79 (Repetek); Ovtsharenko and Fet 1980: 443 (Turkmenistan: Badghyz). Misidentification.
- *H.* sp. 2: Mikhailov and Fet 1994: 504 (in part).



Figures 3. 1-6 Retrolateral view of the male palp of *Hersiliola esyunini* sp. n. (1), *H. sternbergsi* sp. n. (2), *Duninia baehrae* sp. n. (3), *Deltshevia danovi* sp. n. (4), *D. gromovi* sp. n. (5), and *Ovtsharenkoia pallida* (6). Scale = 0.5 mm.

Type material (49 specimens). Holotype: ∂ and paratypes 3Q, 4 juv. (ZMMU) with a label "TURKMENISTAN, Lebap Area, Karakum Desert, Repetek Reserve, NW environs of Repetek, 200 m, sands, 38°33'57-59"N 63°09'46"–10'13"E, 14.04.2002, A.V. Gromov coll."

Paratypes. TURKMENISTAN: 1° , 1° , 2 subad. $^{\circ}$, 5 juv., Balkan Velayati (=Province), Turkmenbashi (=Krasnovodsk), 21.01.1978, K.G. Mikhailov coll. (ZMMU, Ta-3091); 3 juv., Balkan Province, Tuarkyr Mts., Kafigshem Plateau, 7.11.1982, V. Fet coll.; 1^Q (ZMMU), Lebap Province, East Karakum, Repetek Reserve, 170 m a.s.l., 05-06.1914, N.N. Plavilshchikov coll. (ZMMU); 1 subad.², attracted by light, 6.05.1972, V.I. Kuznetsov coll. (ZMMU); 2[♀], 13.05.1981 (SMF); 1[♂], 7.03.1982 (SMF); 1♂, 8.06.1982 (ZMMU), V.A. Krivokhatsky coll.; 1♂, 2♀ ZMMU), 18.04.1993, S.V.Ovtchinnikov coll.; 2⁽²⁾, 2⁽²⁾, Lebap Province, Karakum Desert, Repetek Reserve, Repetek, 170 m, 38°33'55"N 63°10'46"E, 17.04.2002, A.V. Gromov coll. (ZMMU); 13, Lebap Province, Amudarya Reserve, Kabakly, 4-14.05.1987, F. Zeleev coll. (ZMMU); 2^Q (ZMMU), Mary Province, Sultanbent, 05.1929, V.I. Sytchevskaya coll. (ZMMU); 1°_{2} , 1juv., Mary Province, NE vicinities of Serhetabad (=Kushka), Kushka River left bank, 645 m a.s.l., 35°17'24"N 62°20'58"E, 12.04.2002, A.V. Gromov coll. (ZMMU). UZBEKISTAN: 13, 19, Navoiy (=Navoi) Viloyati (Province), Kyzylkum Desert, near Gazli, 21.05.1994 (S.V. Ovtchinnikov coll.) (ZMMU); 1⁽²⁾, Buxoro (=Bukhara) Province, Kyzylkum Desert, near Gazli, 3.05.1998, S.V. Ovtchinnikov coll. (ZMMU); 6° , 2 juv., Buxoro Province, Yagzakkum Sands, ca 7 km S of Nayumetan, 39°37'30"N 64°23'30"E, 20.04.2002, A.V. Gromov coll. (ZMMU).

Etymology. The species name is a patronym honoring our late colleague and friend Maris Šternbergs (1940-1996), of Riga, Latvia, the only Latvian araneologist of his generation, who also instructed VF in spider studies during his visit to Badghyz (Turkmenistan) in April 1977.

Diagnosis. Hersiliola sternbergsi sp. n. is most similar to *H. simoni*, from which it can be distinguished by a longer terminal portion of the cymbium, thicker seminal ducts, lower position of the tegular ridge, and position of the base of the embolus (at almost 12 hrs). Females of *H. sternbergsi* sp. n. differ by a wider septum, thicker lateral arms, and only one coil of the insemination duct around the fertilization duct. The epigyne of *H. sternbergsi* sp. n. is also similar to that of *H. afghanica*. These two species have an almost identical septum shape, but in *H. sternbergsi* sp. n. the epigyne is smaller in size, has smaller spermathecae, and fertilization ducts terminating on the ventral wall of the spermatheca (on the dorsal wall in *H. afghanica*).

Description. Male. Total length 4.6-5.4. Carapace 1.85 long, 2.0 wide, femur I 3.5, femur I/carapace length ratio 1.89. Colouration as in female. Palp as in Figs 3.2, 4.3, 5.3, 6.4-5, tip of cymbium as long as height of tegulum; seminal duct thick; embolus filiform, makes one coil (360°); embolus base located at 11-11:30 hrs; tegular apophysis located almost at the center of the tegulum.

Female. Total length 5.0-5.2. Carapace 1.6-1.95 long, 1.8-2.05 (wider than long), femur I 2.5-2.85, femur I/carapace length ratio 1.46-1.56. Pattern distinct, composed by wide dark marginal bands, radial spots, transverse spot on median grove and V-


Figures 4. I-8 Retrolateral view of the male palp of *Hersiliola macullulata* (**I**), *H. simoni* (**2**), *H. sternbergsi* sp. n. (**3**), *H. esyunini* sp. n. (**4**), *Duninia baehrae* sp. n. (**5**), *Deltshevia danovi* sp. n. (**6**), *D. gromovi* sp. n. (**7**), and *Ovtsharenkoia pallida* (**8**). Scale = 0.5 mm.

shaped mark behind eyes. Abdomen with a heart spot and four pairs of transverse bands. The upper transverse band originates from the heart spot. Sides of abdomen with dark spots. Epigyne as in Figs 7.7-9, 8.2, with a distinct median plate and windows, proportions of median plate and windows variable; insemination duct makes one coil around fertilization duct; insemination duct terminates on ventral side of the spermatheca.

Comments. This species has been collected widely in the lowland deserts of Central Asia (Turkmenistan and Uzbekistan), but constantly misidentified (and misspelled) as *"H. maculata"* or *H. pallida.* Spassky (1952), who did not list *"H. maculata"*, men-



Figures 5. 1-8 Prolateral view of the male palp of *Hersiliola macullulata* (1), *H. simoni* (2), *H. sternbergsi* sp. n. (3), *H. esyunini* sp. n. (4), *Duninia baehrae* sp. n. (5), *Deltshevia danovi* sp. n. (6), *D. gromovi* sp. n. (7), and *Ovtsharenkoia pallida* (8). Scale = 0.5 mm.

tioned a wide distribution of "*H. pallida*" in the Turanian Zoogeographical Province, thus obviously assuming this name for the population from Ashgabat identified by Vlassov and Sytchevskaya (1937) as "*H. maculata*". Our study shows that this lowland desert Central Asian taxon is a new species, different from *H. macullulata* (see above on *H. macullulata*).

Hersiliola sternbergsi sp. n. is widespread in lowland Turkmenistan on various types of desert substrates from clay and gypsum to sand. Krivokhatsky and Fet (1982) provide details on its phenology and ecology as a bothrophile in rodent burrows in the sand desert of East Karakum (Repetek Reserve), where it was most numerous in the entrances of burrows of the gerbil, *Rhombomys opimus* Licht. In Repetek, adult females of *H.*



Figures 6. 1-9 Male palp of *Hersiliola macullulata* (1), *H. simoni* (2-3), *H. sternbergsi* sp. n. (4-5), *H. esyunini* sp. n. (6-7), *Duninia baehrae* sp. n. (8), and *Ovtsharenkoia pallida* (9). 1-2 ventral; 3-4, 6 from below; 5, 7, 9 from above; 8 retrolateral. Scale = 0.5 mm.



Figures 7. 1-14 Epigynes of *Hersiliola versicolor* (1), *Hersiliola* sp. (2), *H. lindbergi* sp. n. (3, 6), *H. afghanica* (4-5), *H. sternbergsi* sp. n. (7-9), *H. esyunini* sp. n. (10-12), and *H. foordi* sp. n. (13-14). 1-8, 10-11, 13-14 ventral; 9, 12 dorsal. Scale = 0.5 mm.

sternbergsi sp. n. were recorded from November to May, and adult males, from December to April, indicating a winter-spring mating period. Spiders were active in daytime.

Distribution. Turkmenistan (lowland deserts from the Caspian Sea to Amudarya Valley), Uzbekistan (west, Kizylkum Desert).

urn:lsid:zoobank.org:pub: Figs 1.2, 2.2, 3.1, 4.4, 5.4, 6.6-7, 7.10-12, 8.4

H. xinjiangensis (in part): Marusik 2009: 153-156, f. 1-2, 4-13 (♂♀). Misidentification.

Type material. Holotype: ♂ together with paratypes 1♂ and 2♀ (ZMMU) from UZ-BEKISTAN: Namangan Province, Pap District, SE foothills of Kurama Mountains, ca. 5-5.5 km NW of Khanabad, ca. 850 m a.s.l., 40°54'05"N 70°45'44"E, 16.05.2002, A.V. Gromov coll.; paratype 1♂, Namangan Province, Pap District, SE foothills of Kurama Mountains, ca. 5.5 km NW of Khanabad, ca. 380 m a.s.l., under stones, 40°54'15"N 70°45'29"E, 15.05.2002, A.V. Gromov coll. (SMF).

Etymology. The species name is a patronym honoring our friend and colleague Sergei Esyunin of Perm, Russia.

Diagnosis. *H. esyunini* sp. n. is closely related to *H. xinjiangenis*, from which it can be distinguished by its smaller size, different shaped tegular apophysis and the median plate of the epigyne. From all congeners *H. esyunini* sp. n. can be easily distinguished



Figures 8. 1-7 Epigynes, ventral view, of *Hersiliola afghanica* (1), *H. sternbergsi* sp. n. (2), *H. lindbergi* sp. n. (3), *H. esyunini* sp. n. (4), *H. foordi* sp. n (5), *Duninia baehrae* sp. n. (6), and *D. rheimsae* sp. n. (7).

by a relatively shorter tip of the cymbium, undivided tegular apophysis and a median plate of the epigyne with turned up lateral edges of the median plate.

Description. Male. Total length 3.4-3.65. Carapace 1.4-1.5 long, 1.5-1.6 wide, femur I 3.0-3.1 long, femur/carapace length ratio 2.1-2.14. Body yellow-light brown with pattern formed by brown hairs and spots. Carapace with brownish eye area and posterior cephalic part, and brown vertical stripe on clypeus (Figs 1.2, 2.2). Margins of carapace brown. Abdomen with indistinct pattern. Legs with broad, dark annulations, dark rings wider than light ones. Femur I almost entirely dark. Coxae IV separated by one diameter. Palp as in Figs 3.1, 4.4, 5.4, 6.6-7, with femur, patella+tibia and cymbium subequal in length, tibia in terminal part slightly wider than femur. Tegulum discoid, with long filiform embolus and tegular apophysis. Embolus starts at about 01 hrs, makes a loop of more than 270° and terminates around 10 hrs. Tegular apophysis perpendicular to tegulum. Apical part of the bulb slightly flattened (embolus straight, not rounded).

Female. Total length 3.75-4.0. Carapace 1.4-1.5 long, 1.5-1.6 wide, femur I 2.25-2.5 long, femur/carapace length ratio 1.6. Colouration as in female. Epigyne as in Figs. 7.10-12, 8.4. Median plate anchor-like, with a pair of small accessory sclerites on the side that visually makes the basal part wider; spermathecae and seminal duct translucent through the integument. Accessory gland digitiform.

Comments. Earlier, Marusik (2009) confused this species with the related *H. xin-jiangensis* due to the similarity of their male palps, i.e. same shape of the apical part of the tegulum (character unknown in other *Hersiliola* species), same position of the embolic tip, and same shape of the tegular apophysis. Misidentification was made before we started this revision of East Palaearctic *Hersiliola*.

Distribution. The species is known only from two nearby localities in eastern Uzbekistan.

Hersiliola xinjiangensis (Liang & Wang, 1989)

Figs 13.1-4

Hersilia Xinjiangensis Liang and Wang 1989: 56, f. 1-4 (D^{\uparrow}_{\bigcirc}).

Hersilia x.: Hu and Wu 1989: 78, f. 55.5-8 (♂♀, same figs. as in Liang and Wang 1989). *Hersilia x.*: Song et al. 1999: 80, f. 32O-P, 33F-G (♂♀, same figs. as in Liang and Wang 1989).

H. x. (in part): Marusik 2009: f. 3a-d ($T^{\uparrow \bigcirc}_{\downarrow}$, same figs as in Liang and Wang 1989).

Type material: 23, 22, CHINA: Xinjiang, Urumchi, not seen, apparently lost (see below).

Diagnosis. This species can be easily distinguished from all congeners, except for *H. esyunini* sp. n., by a relatively shorter tip of the cymbium, flattened apical part of the tegulum, and undivided tegular apophysis. From the sibling species *H. esyunini* sp. n., *H. xinjiangensis* can be distinguished by its larger size, different shape of the tegular apophysis and median plate of the epigyne.

Description (translated from original description). "Female. Total length 5.8, body flat. Cephalic part of carapace swollen, the position of PME highest. Cervical groove deep. Thorax low and flat. Eye area brown, 8 eyes in 2 rows. Both AER, PER curved, AER curved stronger than PER. ALE white, others 6 eyes black, AME largest, located in the front of head; ALE small, located below in front of PLE. 4 eyes of PER near same size. Chelicera small, yellowish brown, with one promarginal tooth and no retromarginal. Pedipalps and legs yellowish brown, each segments of pedipalps and legs with blackish brown annuli in the median and the distal. Tarsus with 3 claws. Upper claw with a single tooth. Leg formula 2143. Opisthosoma dorsally with yellowish brown scales and grayish brown spots. Heart spot black, with three pairs of muscular depressions. The venter yellow, without marking. Anterior spinnerets robust, their distal segment small. Median spinnerets thin, nearly the same length as anterior ones. Rear spinnerets located on the sides of median ones. The distal segment same length as opisthosoma, smaller than the basal one. Colulus present. Epigyne brown, septum inverse T-shaped.

Male. Total length 5.00. Habitus, colour and markings style as in female.

This species inhabits crevices and holes of walls. It is a common species. Its colouration is cryptic and therefore it is not easy to find specimens."

Comments. Type specimens $(2\sqrt[3]{}, 2\mathbb{Q})$ were supposedly deposited in the Department of Plant Protection, Xinjiang August 1st Agricultural College, Urumqi, Xinjiang, China (Liang and Wang 1989). At our request, Shuqiang Li tried to find these types but failed. It seems that after the retirement of Tie Liang these specimens were lost or transferred. The embolus base was not depicted by Liang and Wang (1989). Judging from the conformation of the epigyne in its sibling, *H. esyunini* sp. n., it is likely that median plate of the epigyne and vulva (endogyne) have been somewhat misinterpreted.

Distribution. *H. xinjiangensis* is known only from central Xinjiang (China). It is the northernmost species of the genus and of the entire family Hersiliidae. In Europe (Iberian Peninsula), the northernmost locality of *Tama edwardsi* (Lucas, 1846) (Ribera et al. 1988) is in northeastern Portugal ca. 41°N, while the type locality of *H. xinjiangensis* lies north of 44°N.

Duninia, gen. n.

Type species. *Duninia baehrae* sp. n.

Etymology. The genus name is a patronym honoring our late colleague, friend, and a prominent araneologist Pyotr Dunin (1952-1998) who lived and worked in Baku (Azerbaijan) and Togliatti (Russia). Gender: feminine.

Diagnosis. Duninia gen. n. can be easily distinguished from other genera of Hersiliidae by its globular tegulum, thick seminal duct, non-screw-shaped embolus that is thicker than the tegular apophysis, round spermathecae, and a heavily sclerotized copulatory opening below the epigynal plate. A globular tegulum is also present in the Central Asian genus *Deltshevia* gen. n., but this genus has a screw-shaped embolus and a thinner tegular apophysis. Females of *Ovtsharenkoia pallida* also seem to have copulatory openings below the epigynal plate, but they are not heavily sclerotized as in *Duninia* gen. n.; also, *O. pallida* does not have round spermathecae.

Description. Body length ca. 5 mm, carapace as long as wide from 1.75 to 2.25. Pattern as in *Hersiliola*. Palp cymbium with a long tip, tegulum globular, seminal duct wide, embolus wide and not screw-shaped, tegular apophysis claw-like, with its claw part thinner than embolus. Epigynal plate with a septum-like structure, but without windows and openings, median plate without distinct margins. Copulatory opening is located below the epigynal plate in an epigastral fold; spermathecae round, coiled ducts absent.

Comments. Conformation of the epigyne in this genus is, in some respects, unique among entelegyne spiders. The epigynal plate has no openings (furrows or fovea) but possesses two pairs of fovea on the vertical posterior wall located inside the epigastral fold. The lateral pair of fovea is shallow and elongate. Another pair of fovea is closer to the median part and located deeper; they have a more heavily sclerotized wall and are very deep. It seems that these deep pockets have copulatory openings inside the anterior part. Lateral pockets seem to match the tegular apophysis of the male.

There are few taxa among entelegyne spiders that have a copulatory opening on the posterior vertical wall of the epigyne located in the epigastral fold. Besides some Erigoninae, we know of only one such genus, *Paratus* (Liocranidae) (cf. Marusik et al. 2008). *Paratus* has epigynal plate without furrows and fovea, and a small fovea hidden in the epigastral wall that leads to two closely separated copulatory openings.

The male palp of *Duninia* gen. n. is unique among Hersiliidae because of its short, broad embolus and tegular apophysis extended along the cymbial axis.

Distinguishing characters. Two species of *Duninia* gen. n. can be easily distinguished by the shape of the copulatory organs.

Composition and distribution. *Duninia* gen. n. includes two species: *D. baehrae* sp. n. (type species; Turkmenistan) and *D. rheimsae* sp. n. (northern Iran, Tehran Province).

Duninia baehrae, sp. n.

urn:lsid:zoobank.org:pub: Figs 3.3, 4.5, 5.5, 6.8, 8.6, 11.1-4

- *Hersiliola pallida*: Ovtsharenko and Fet 1980: 443 (Turkmenistan: Badghyz). Misidentification.
- *Hersiliola afghanica*: Fet 1983: 837 (in part; Turkmenistan: Kopetdagh; see also *Delt-shevia danovi* sp. n.); Kuznetsov and Fet 1984: 52 (Turkmenistan: Central Kopetdagh); Mikhailov and Fet 1994: 504. Misidentification.
- Hersiliola afghana: Fet 1984: 259 (misspelling). Misidentification.

Type material (6 specimens): Holotype: ♂ (ZMMU), TURKMENISTAN: Ahal Province, Central Kopetdagh, Kopetdagh State Reserve, Kurkulab, 7-24.05.1978, G.T. Kuznetsov coll. Paratypes: TURKMENISTAN: 1♀, Ahal Province, Central Kopetdagh, Gaudan, 26-27.07.1895, O. von Rosen coll. (ZMMU, Ta-4009); 1♂, Ahal Province, Central Kopetdagh, Kopetdagh State Reserve, Bolshie Katranki, 9-16.09.1978, G.T. Kuznetsov coll. (SMF); 1^Q, Mary Province, Serhetabad (=Kushka) District, Morgunovka, 29.06.1975, V. Fet coll. (SMF); 2^Q, Balkan Province, Bolshoi Balkhan Mts., 6 km from Nebit-Dagh (now Balkanabat), 4.04.1993, S.V.Ovtchinnikov coll. (ZMMU).

Etymology. The species name is a patronym honoring our colleague Barbara Baehr (Brisbane, Australia), for her contributions to in-depth modern studies of Hersiliidae.

Diagnosis. From its sibling *D. rheimsae* sp. n., females can be easily distinguished by a larger body and epigyne, diverging spermathecae, and deep pockets longer than the lateral ones.

Description. Male (holotype from Kurkulab, abdomen and most of legs are missing): Carapace 2.12 long, 2.25 wide, femur I 5.0 long, leg I/carapace length ratio 2.36. Palp as in Figs. 3.3, 4.5, 5.5, 6.8, bulbus globular, basal portion of seminal duct thick; embolus very massive, flat and short, twice shorter than the apical portion of the cymbium, opening large and clearly visible, tegular apophysis claw-like, large, located on the apical part of tegulum, extends parallel to cymbial axis, its terminal part much thinner than embolus.

Female: epigyne as in Figs. 8.6, 11.1-4, lacks windows and distinct openings; median plate twice as wide as high; translucent spermathecae round, separated from median plate by more than one diameter; lateral sides of epigynal plates with "arches" clearly visible on dissected epigyne; vulva with two round spermathecae separated by one diameter and large lateral wings. Lateral arches lead to small pockets, and large wings correspond to large and deep pocket that seems to correspond to copulatory opening. It is not clear which structures of the vulva correspond to fertilization ducts, and also not clear whether the fertilization duct has accessory glands.

Comments. Kuznetsov and Fet (1984: 52) recorded this species (as Hersiliola afghanica) for several localities in Central Kopetdagh (Turkmenistan, bordering with Iran) within the territory of Kopetdagh State Reserve as well as its office in Berzengi, suburb of Ashgabat. These records were based on six specimens, all captured in pitfall traps by Gennady Kuznetsov. In addition to Kurkulab, and B[olshie] Katranki localities (see labels above), Kuznetsov and Fet (1984) listed two specimens from Berzengi (05-06.1980, 1°) and M[alyi] Dashtoi (22-29.07.1981, 1³). Three reported localities within the Kopetdagh State Reserve lie at 900-2000 m a s.l (Kurkulab, 900-1000 m; Bolshie Katranki and Malyi Dashtoi, 1500-2000 m) (G. T. Kuznetsov. pers. comm. 2008). An additional, previously unpublished, specimen from Gaudan (ZMMU) was collected by an early local naturalist, Baron O. von Rosen, in 1895. The species undoubtedly will be found in neighboring northeastern Iran (Khorassan Province) and northern Afghanistan. It is an element of the not yet fully explored mountainous fauna of the Turkmeno-Khorassan region, a transitional zoogeographic area between the western mountains of the Mediterranean/Iran and eastern mountains of Central Asia/Himalayas (Fet 1994). This area consistently yields interesting new spider taxa such as e.g. Paracedicus gennadii (Fet, 1993), P. ephthalitus (Fet, 1993) (Desidae), Synaphris orientalis Marusik & Lehtinen, 2003 (Synaphridae), or a hersiliid *Deltshevia danovi* gen. n. sp. n. (see below).

Distribution. Turkmenistan (Bolshoi Balkhan, Central Kopetdagh, Badghyz).

Duninia rheimsae, sp. n. *urn:lsid:zoobank.org:pub:* Figs 8.7, 11.5-7

Type material: Holotype subadult \bigcirc with a well-developed epigyne and paratypes 3 juvenile specimens: IRAN [25], Tehran Province, ca. 80 km E of Tehran, Damavand District, Aroo Village, 52°27'E 35°40'N, 15.06.2000, Yu.M. Marusik coll. (ZMMU).

Etymology. The species name is a patronym honoring our colleague Cristina A. Rheims (São Paulo, Brazil), for her contributions to in-depth modern studies of Hersiliidae.

Description. Male unknown. Female: Total length 5.0. Carapace 1.75 long, 1.85 wide, femur 2.15 long, femur I/carapace length ratio 1.23. Epigyne as in Figs. 8.7, 11.5-7, with a sort of septum on the median plate, spermathecae converging and almost touching each other, epigynal pockets subparallel, with hemispherical terminal part. Lateral pockets long, appear longer than their depth.

Diagnosis. *D. rheimsae* sp. n. can be distinguished from the sibling species *D. baehrae* sp. n. by its smaller body and epigyne size, converging spermathecae, and less slanting epigynal pockets bearing large, clearly visible hemispheres.

Comments. Judging from the conformation of the male palp and epigyne in its sibling *D. baehrae* sp. n. and conformation of the epigyne in *D. rheimsae* sp. n., it is reasonable to suggest that male of this species should have a smaller embolus (matching a small, deep pocket of *D. rheimsae* sp. n.) and a larger tegular apophysis.

Distribution. Known only from type locality in northern Iran.

Deltshevia, gen. n.

Type species. Deltshevia danovi sp. n.

Etymology. The genus name is a patronym honoring our colleague, friend, and a prominent araneologist, Christo Deltshev of Sofia, Bulgaria. We are especially glad to dedicate this genus to Christo on the occasion of his 70th birthday. Gender: feminine.

Diagnosis. *Deltshevia* gen. n. differs from other genera of Hersiliidae by a globular tegulum; thick and screw-shaped embolus with a tapering, sharp tip; large two-armed tegular apophysis extended upward; large epigyne openings; and thick copulatory ducts.

Comments. A globular tegulum and tegular apophysis extended upward are also found in *Duninia* gen. n. In the latter genus, however, the tegular apophysis has one claw-like arm; this arm is thinner than the embolus and is extended upward (along the cymbial axis). In *Deltshevia* gen. n., the tegular apophysis has two arms: an upper arm directed upward, and a claw-like arm perpendicular to the cymbial axis. Females of this genus can be easily recognized by the presence of a (real) septum, large copulatory openings, and a wide (wider than spermathecae) and uncoiled insemination duct. Septum and small copulatory openings are present also in *Hersiliola*, but insemination ducts in this genus are always coiled and thinner than the spermathecae, or subequal in width to the spermathecae.

Description. Small hersiliids 5-7 mm long, with carapace 2.1-2.7 long and wide. Palp globular; embolus thick and screw-shaped; tegular apophysis large, with two arms: a massive vertical arm and a small horizontal arm. Epigyne with large copulatory openings; wide insemination ducts; septum and median plate distinct; spermathecae oval; fertilization duct short; accessory gland globular.

Distinguishing characters. The two species of *Deltshevia* gen. n. can be easily distinguished by the shape of copulatory organs.

Composition and distribution. *Deltshevia* gen. n. includes two species: *D. danovi* sp. n. (type species; Turkmenistan and Kazakhstan) and *D. gromovi* sp. n. (eastern Uzbekistan).

Deltshevia danovi, sp. n.

urn:lsid:zoobank.org:pub: Figs 3.4, 4.6, 5.6, 9.1-5, 10.1-3

Hersiliola afghanica: Fet 1983: 837 (Turkmenistan: SW Kopetdagh). Misidentification.

Hersiliola danovi: Fet 1985: 72 (nomen nudum; no description published).

Hersiliola sp. 1: Mikhailov and Fet 1994: 504.

Type material (31 specimens): Holotype: \mathcal{J} (ZMMU) and paratypes $3\mathcal{Q}$, 1 juv. \mathcal{Q} (ZMMU), $3\mathcal{Q}$ (SMF), TURKMENISTAN: Balkan Province, Southwest Kopetdagh, Syunt-Khasardagh Reserve, N of Mt. Syunt, Damdam, 1000 m a.s.l., 8.07.1984, V. Fet coll.

Paratypes. TURKMENISTAN: Balkan Province, Southwest Kopetdagh, Garrygala (=Kara-Kala), Parkhai, 400 m a.s.l., 2 juv. \bigcirc , 08.1983; 1 \bigcirc , 7.06.1984, V. Fet coll. (ZMMU); Balkan Province, Southwest Kopetdagh, Hodzhagala, 400 m a.s.l., under stones, 1 subad. \bigcirc , 05.1981, N. Yermakov coll. (ZMMU), 1 \bigcirc , 11.05.1984, V. Fet coll. (SMF), 4 subad. \bigcirc , 11.05.1984, 2 subad. \bigcirc , 3 subad. \bigcirc , 4.06.1984, V. Fet coll. (ZMMU); Balkan Province, Gyzylarbat (=Kyzyl-Arvat), 12.05.1984, 2 \bigcirc , 1 juv. \bigcirc , V. Fet coll. (ZMMU). KAZAKHSTAN: $3\bigcirc$, 3 \bigcirc , Atyrau (=Guryev) Province, Ustyurt Reserve, W of Baskorgan, 27.05.1989, Raikhanov & Ibrayev coll. (ZMMU).

Etymology. The species name is a patronym honoring the late Rostislav Danov (1941-1993) of St. Petersburg, Russia, a naturalist, snake hunter, and artist, a friend of VF and his family, who spent many years working in Southwest Kopetdagh.

Diagnosis. *Deltshevia danovi* sp. n. is similar to *D. gromovi* sp. n., from which it can be easily distinguished by the shape of the embolus, tegular apophysis and epigyne. *Deltshevia gromovi* sp. n has a shorter and screw-shaped embolus, while *D. danovi* sp. n. has a longer, non-screw-shaped embolus. The apical portion of the tegular apophysis in *D. gromovi* sp. n. has subparallel margins, while the apical portion of the tegular apophysis in *D. danovi* sp. n. is triangular, with slanting margins. The epigyne of *D.*



Figures 9. 1-7 Somatic characters of *Deltshevia danovi* sp. n. (1-5) and *D. gromovi* sp. n. (6-7). 1, 7 female carapace, dorsal; 2-3 abdomen of female, ventral and dorsal respectively; 4-5 male carapace, frontal and lateral, respectively; 6 female habitus.



Figures 10. 1-5 Epigynes of *Deltshevia danovi* sp. n. (1-3) and *D. gromovi* sp. n. (4-5). 1, 3-4 ventral; 2 and 5 dorsal. Scale = 0.5 mm.

danovi sp. n. has round openings (bell-shaped in *D. gromovi* sp. n.), a wider septum than in *D. gromovi* sp. n., a higher median plate, and larger spermathecae.

Description. Male. Total length 5.0. Carapace 2.4 long, 2.7 wide. Eyes, AME 0.11, ALE 0.17, PME 0.08, PLE 0.14, AME–AME 0.11, AME–ALE 0.07, ALE–PLE 0.03, PME–PLE 0.17, PME–PME 0.11. Carapace pattern and eye arrangement as in Fig. 9.1. Palp as in Figs. 3.4, 4.6, 5.6, femur as long as cymbium, patella+tibia length about 2/3 of cymbium or femur length; bulbus globular, seminal duct thin; embolus thick, long and screw-shaped, terminal portion tapering, tip sharply pointed; tegular apophysis massive, with two arms: a large membranous apical arm, and a bill-shaped retrolateral arm.

Female. Total length 6.0-7.0. Carapace 2.1-2.3 long, 2.4-2.5 wide (wider than long). Carapace pattern and eye arrangement as in Figs 9.4-5. Abdominal pattern as in Fig. 9.3, dorsal side with a dark heart band and four transverse stripes, sides of abdomen with dark spots, venter without pattern. Epigynal plate 1.00-1.14 wide, fovea 0.47-0.57 wide, plate/fovea ratio 2-2.1. Epigyne as in Figs 10.1-3, with distinct windows, well-separated septum, median plate anchor-like, epigynal opening distinct (with well-expressed borders), opening diameter larger than septum width and equal to median plate height; translucent spermathecae elongate and located aside of openings. Vulva simple, with large pockets (continuation of epigynal opening), with oval spermathecae separated by more than three times their widths; insemination duct short, accessory gland globular, poorly visible.

Distribution. Turkmenistan (southwest), Kazakhstan (southwest).

Deltshevia gromovi, sp. n.

urn:lsid:zoobank.org:pub: Figs 3.5, 4.7, 5.7, 9.6-7, 10.4-5

Hersiliola macullulata: Zyuzin et al. 1994: 6 (Kazakhstan). Misidentification.

Note: Much new material from Central Asia reached us, due to the efforts of Alexander Gromov and Dmitri Logunov, when this paper was already finalized; therefore the following description and figures of a male are based on a subadult with welldeveloped palp.

Type material (49 specimens): Holotype: \bigcirc and paratype subadult \eth (with well-developed palp) (ZMMU), UZBEKISTAN: Surkhandarya Province, Kattakum Sands, ca. 4 km NE of Uchkyzyl, ca. 330 m a.s.l., 37°22'33"N 67°16'38"E, 27.04.2002, A.V. Gromov coll.

Paratypes. UZBEKISTAN: 1 Uzbekistan, Surkhardarya Province, Uzun District, Babatagh Mt. Range, environs of Akmechet' 12-20.04.1994, O. Lyakhov coll. (ZMMU); 4 3, 4 \bigcirc (SMF), 4 3, 3 \bigcirc , 3 juv (ZMMU), Uzbekistan, Surkhardarya Province, Babatagh Mt. Range, 25.04.1994, S.V. Ovtchinnikov coll.; 3 \bigcirc , 3 \bigcirc , Surkhardarya Province, Uzun District, E slope of Babatagh Mt. Range, ca 5.5 km WSW of Akmechet', 38°01'34"N 68°15'22"E, 696 m, 3.05.2002, A.V. Gromov coll. (ZMMU); 1 \bigcirc , Surkhardarya Province, Uzun District, E slope of Babatagh Mt. Range, ca 5.5 km WSW of Akmechet', 38°01'42"N 68°14'48"E, 766 m, 4.05.2002, A.V. Gromov coll. (ZMMU); 1 \bigcirc , Surkhardarya Province, Uzun District, E slope of Babatagh Mt. Range, ca 4.5 km WSW of Akmechet', 38°01'34"N 68°15'22"E, 500 Akmechet', 38°01'34"N 68°15'22"E, 706 m, 21.05. 2003, A.V. Gromov coll. (ZMMU); 1 \bigcirc ?, Surkhardarya Province, UZUN District, E slope of Babatagh Mt. Range, ca 4.5 km WSW of Akmechet', 38°01'34"N 68°15'22"E, 706 m, 21.05. 2003, A.V. Gromov coll. (ZMMU); 1 \bigcirc ?, Surkhardarya Province, UZUN District, E slope of Babatagh Mt. Range, ca 5 km WSW of Akmechet', 38°01'20"N 68°15'08"E, 769 m, 23.05.2003, A.V. Gromov coll. (ZMMU); 1 \bigcirc , Surkhardarya Province, UZUN District, E slope of Babatagh Mt. Range, ca 4.5 km WSW of Akmechet', 38°01'20"N 68°15'08"E, 769 m, 23.05.2003, A.V. Gromov coll. (ZMMU); 1 \bigcirc , 1 \bigcirc , Surkhardarya Province, UZUN District, E slope of Babatagh Mt. Range, ca 4.5 km WSW of Akmechet', 38°01'20"N 68°15'08"E, 769 m, 23.05.2003, A.V. Gromov coll. (ZMMU); 1 \bigcirc , 1 \bigcirc , Surkhardarya Province, UZUN District, E slope of Babatagh Mt. Range, ca 4.5 km WSW of Akmechet', 38°01'28"N 68°15'17"E, 700 m, 23.05.2003, A.V. Gromov coll. (ZMMU); 2 \bigcirc ,

2, Buxoro (=Bukhara) Province, Gizhduvan District, SW foothills of Karaktau Mt. Range, ca 14.5 km N of Kanimekh, 40°24'51"N 65°08'57"E, 392 m, 5.06.2003, A.V. Gromov coll. (ZMMU); 1Å, 1 \bigcirc , Navoi Province, Kanimekh District, Kyzylkum Desert, ca 65 km W of Chengel'dy, near Darvazatepa Mt., clay hills, 211 m, 40°57'26"N 64°07'51"E, 4.06.2003, A.V. Gromov coll. (ZMMU); 1 \bigcirc , Kyzylkum Desert, Kuldzyktau Mt., Dzhengeldy, 22.05.1994, S.V. Ovtchinnikov coll. (ZMMU). KAZAKHSTAN: 2Å, 3 \bigcirc , South Kazakhstan Province, Chimkent (now Shimkent) District, Kyzylkum Desert, Karaktau Mt. Range, Karamola Mt., 8.06.1989, A.A. Zyuzin coll. (ZMMU); 4 \bigcirc , Kazakhstan, South Kazakhstan Province, Kyzylkum Desert, Karaktau Mt. Range, Karamola Mt., 29.05.1993, A.A.Zyuzin coll. (ZMMU); 1 \bigcirc , Kyzylkum Desert, Karamola Mt., 42°14'57.2"N 67°48'21.1"E, 228 m, 3.07.2006, A.V. Gromov coll. (ZMMU).

Etymology. The species name is a patronym honoring its collector, our friend and colleague Alexander V. Gromov of Almaty, Kazakhstan.

Diagnosis. Deltshevia gromovi sp. n. is similar to *D. danovi* sp. n., from which it can be easily distinguished by the shape of the embolus, tegular apophysis and epigyne. Deltshevia gromovi sp. n has a shorter and screw-shaped embolus, while *D. danovi* sp. n. has a longer, non-screw-shaped embolus. The apical portion of the tegular apophysis in *D. gromovi* sp. n. has subparallel margins, while the apical portion of the tegular apophysis in *D. danovi* sp. n. is triangular, with slanting margins. Openings of the epigyne in *D. gromovi* sp. n. are bell-shaped but not round, copulatory ducts are much longer than in the sibling species, and accessory glands are much larger in comparison to the spermathecae.

Description. Male (subadult, but with well-developed palp). Total length 5.6. Carapace 2.0 long, 2.2 wide, femur I 2.75 long. Carapace with 4 pairs of dark marginal spots, 2 pairs of lateral spots in anterior half and unpaired median spot in thoracic part. Legs with distinct annulations. Palp as in Figs. 3.5, 4.7, 5.7, with a long, non-screw-shaped embolus, which almost reaches the cymbium tip; tegular apophysis large, its apical part has almost parallel sides.

Female. Total length 5.0. Carapace 2.1 long, 2.35 wide, femur I 3.25 long, epigynal plate 0.71 wide, fovea 0.36 wide, ratio 0.5. Colouration as in male. Epigyne as in Figs. 9.6-7, 10.4-5, with distinct large bell-shaped copulatory openings, thin tapering septum, and thin edge of median plate; openings leads to voluminous copulatory ducts, their height is about three times longer than their diameter and two times longer than height of copulatory openings; spermathecae small, oval; accessory glands globular, large (about half the size of a spermatheca)

Comments. It is possible that in mature males the embolus is screw-shaped, as in *D. danovi* sp. n. The single male that we studied was subadult, and its embolus was straightened being pressed between the cymbium and cuticle. It is possible that after the final molt the embolus would become partially screw-shaped.¹

Distribution. Uzbekistan, Kazakhstan (south).

¹ shape of embolus in adult males studied when manuscript was in review is the same as in subadult male.



Figures 11.1-7 Epigynes of *Duninia baehrae* sp. n. (1-4) and *D. rheimsae* sp. n. (5-7). 1-2, 5 ventral; 3 dorsal; 4, 6-7 caudal. Scale = 0.5 mm.

Ovtsharenkoia, gen. n.

Type species. Hersiliola pallida Kroneberg, 1875.

Etymology. The genus name is a patronym honoring our friend and colleague, and a prominent araneologist, Vladimir Ovtsharenko of New York, USA. Gender: feminine.

Diagnosis. *Ovtsharenkoia* gen. n. can be easily distinguished from other genera of Hersiliidae by its short spinnerets and the shape of the copulatory organs. The male palp has a unique conformation for the family due to the presence of a complex outgrowth in the basal part of the tegulum. All other genera similar to *Hersiliola* have only one apophysis (tegular). Females of *Ovtsharenkoia* gen. n. can be recognized by a small median plate of the epigyne, a transverse translucent fertilization duct, large pale areas next to the median plate, and absence of distinct spermathecae.

Description. Same as for the type species.

Comments. A discoidal tegulum and whip-like embolus in *O. pallida* indicate that *Ovtsharenkoia* gen. n. is more closely related to *Hersiliola* than to two other Central Asian genera, *Deltshevia* gen. n. and *Duninia* gen. n., both of which have a globular tegulum and a thick, short embolus. A discoidal tegulum and whip-like embolus are also found in *Hersilia*. Embolus base modified, and differs from that in all other hersilid genera. The epigyne of *O. pallida* has some similarity with those in *Duninia* gen. n. due to its pockets, but has an entirely different vulva. The type of embolus in *O. pallida* is similar to those in some *Neotama* species (cf. figs 45c, 46c in Baehr and Baehr 1993).

Composition and distribution. Type species only, *Ovtsharenkoia pallida* (Kroneberg, 1875), found widely across the mountains and foothills from southern Turkmenistan to Uzbekistan, Kazakhstan, Kyrgyzstan, and Tajikistan; south to northern Pakistan.

Ovtsharenkoia pallida (Kroneberg, 1875)

Figs 2.3-8, 3.6, 4.8, 5.8, 6.9, 12.1-5

Hersiliola p. Kroneberg, 1875: 13-14, pl. 5, f. 41 (D^Q).

Hersiliola p.: Kroneberg 1885: 545-547; Kroneberg 1888: 189-190; Simon 1893: 445; Reimoser 1919: 188; Charitonov 1932: 23; Caporiacco 1935: 142 (Pakistan); Spassky 1952: 196-200 (in part); Bonnet 1957: 2180; Andreeva and Tyshchenko 1969: 382; Andreeva 1976: 30-31 (Tajikistan).

Type material. Lectotype: \bigcirc (designated here): UZBEKISTAN: Samarkand, A.P. Fedchenko coll. (ZMMU, Ta-1323); paralectotype \bigcirc (designated here): KYRGYZSTAN: Osh, A.P. Fedchenko coll. (ZMMU, Ta-1324). Vial with paralectotype female contains also adult female of *Oecobius nadiae* (Spassky, 1936). This species and specimen were not mentioned in Kroneberg's text. It seems that he considered this specimen a juvenile *Hersiliola*.

Additional material examined (48 specimens). KAZAKHSTAN (first country record): 13, Zhambyl Province, environs of Djambul (=Zhambyl, = Taraz), 11.04.1994, S.V. Ovtchinnikov coll. (ZMMU). KYRGYZSTAN: 13, Bishkek (=Frunze), in a house, 17.07.1979, S.L. Zonstein coll. (ZMMU); 1∂, 6♀, 2 subad.∂, 1984, same locality, in buildings, S.V. Ovtchinnikov coll. (ZMMU); 13, 19, 1984, same locality, S.V. Ovtchinnikov coll. (SMF); 1Å, Bishkek, 8.06.1994, S.V. Ovtchinnikov coll. (ZMMU); 2Å, 1° , Bishkek, in house, 1.07.1994, S.V. Ovtchinnikov coll. (ZMMU); 4° , 3° , Bishkek, 2.06.1994, S.V. Ovtchinnikov coll. (ZMMU); 5♂, 4♀, Bishkek, waste ground, 17.06.2005, S.V. Ovtchinnikov coll. (ZMMU); 33, 19, Bishkek, waste ground, 23.06.2005, S.V. Ovtchinnikov coll. (ZMMU). PAKISTAN: "Karakoram", no exact locality, 1 subad. ♀, L. di Caporiacco coll. (MZUF) [locality published by Caporiacco (1935) as "Chongo, Hot Sulpur Spring, 3000 m", located in Braldu Valley of Karakoram Mts., Baltistan, Pakistan; collected 07.1929]. TURKMENISTAN (first country record): 1⁽²⁾, Badkhyz, Zyulfagar Mt. Range, 13.04.1993, S.L. Zonstein coll. (ZMMU). UZBEKISTAN: Samarkand Province, Amankutan, 14.07.1967 and Bokhara Province, Ayakagitma, 7.06.1970 (a combined label from two localities), 1^{\uparrow}_{\circ} , 3^{\bigcirc}_{\circ} , 5 juv. $^{\bigcirc}_{\circ}$, A. Murtazaev coll. (ZMMU).



Figures 12. 1-5 Epigyne of Ovtsharenkoia pallida (1-5). 1-3 ventral; 4 caudal; 5 dorsal. Scale = 0.5 mm.



Figures 13. 1-4 *Hersiliola xinjiangenis*, after Liang and Wang (1989). 1-2 epigyne, ventral and dorsal, respectively; 3-4 male palp, retrolateral and ventral, respectively.

Diagnosis. Same as for the genus.

Description. Male (described here for the first time). Total length 4.8. Carapace 2.0 long, 2.25 wide, femur I 4.25 long, femur/carapace length ratio 2.13. Carapace light brown with dark margins, radial dark stripes and median dark band; cephalic part separated from the thoracic part by a dark V-shaped spot. Abdomen light brown with a brown heart spot, transverse stripes and dark sides. Dorsal pattern variable. Venter of abdomen without pattern. Palp as in Figs. 3.6, 4.8, 5.8, 6.9, femur and cymbium equal in length, patella+tibia almost as long as cymbium or femur; tegulum round, basal part extended; embolus whip-like, arched; embolus makes a half loop, base of embolus located on retrolateral side; tegulum with two apophyses: apical (?tegular) and basal. Basal apophysis (outgrowth) complicated, subdivided into three parts: lamellate, digitiform retrolateral, and mesal. Embolus passes below mesal part of basal apophysis. Apical apophysis perpendicular to the cymbial axis.

Female. Total length 4.2-6.0. Carapace 2.0-2.5 long, 2.25-2.75 wide, femur I 3.5, femur/carapace length ratio 1.75. Colouration as in male. Epigyne as in Figs 12.1-5, with strongly chitinized small median plate, septum well-developed, its length subequal to length of lateral arms; width of septum variable; windows absent, lateral sides of epigynal plate with small extensions, indicating pockets; aside of median plate epigyne is pale, size of pale part variable; upper part of epigynal plate with a pair of transverse stripes formed by translucent insemination (?) ducts. Distinct spermathecae absent, insemination ducts relatively thin, coils absent; fertilization ducts with globular accessory glands. Insemination ducts have small globular extensions that possibly correspond to spermathecae proper.

Size of epigyne variable, although size of median plate is not variable, as well as position of translucent fertilization ducts. Distance between epigastral fold and ducts is the same in large and small epigynes.

Comments. Details of epigynal structure remain uncertain. It is not clear whether openings on the median plates are real copulatory openings or just fovea, origins of copulatory (insemination) ducts as well as the position of the terminal part of the fertilization ducts. Most probably the insemination duct is weakly sclerotized and originates in pockets lying below the epigynal plate.

This species has been described from the important collections of the famous 1868–1871 expedition of Alexei P. Fedchenko (1844–1873) and his wife Olga A. Fedchenko to Russian Turkestan. The original type series includes two female syntypes; the lectotype from Samarkand and paralectotype from Osh are designated here. Andreeva and Tyshchenko (1969) and Andreeva (1976) reported juveniles of this species from Tajikistan (Bishkent Valley, Chiluchor-chashma, 4 juv., 8.05.1965, E. Martynova coll.; Khozratisho Range, 13 km from Muminabad along Obisurkh River valley, 1 juv., 9.06.1966, E. Andreeva coll.). Adults from Tajikistan are unknown.

We also examined a juvenile female reported as *Hersiliola pallida* by Caporiacco (1935) from Karakoram Mts. (Pakistan) which tentatively belongs to this species. This specimen originates from a single high mountain locality, Chongo in Braldu Valley, Baltistan (in the vicinity of the Baltoro Glacier); see Spoleto (1930) for the 1929 Italian expedition route. Although Caporiacco (1935) reported three adult males, these specimens could not be located in MZUF (L. Bartolozii, pers. comm.).



Earlier records from lowland Turkmenistan were misidentifications and refer to *Hersiliola sternbergsi* sp. n. (Repetek, Badghyz) or *Duninia baehrae* sp. n. (Badghyz). However, new material collected by S. L. Zonstein in 1993 shows that this species is indeed found in Turkmenistan. It was collected in the very southwest of Badghyz, in the mountainous area bordering Iran (Zyulfagar Range in the watershed of Tejen, which forms an important zoogeographic boundary between the Turkmeno-Khurassan mountains to the west and all Central Asian/Himalayan mountains to the east; see Fet 1994).

Distribution. Kazakhstan, Kyrgyzstan, Pakistan (Baltistan: Karakoram Mts.), Tajikistan, Turkmenistan (south), Uzbekistan. Unlike most species of *Hersililola* and other habitually similar genera, this species is restricted exclusively to mountainous areas and seems to be the only species of hersiliids in the Palaearctic that penetrates human settlements and buildings (Bishkek). It could be a petrophilous species that inhabits cliffs and walls.

Discussion

According to several authors (Baehr and Baehr 1987, Dippenaar-Schoeman and Jocqué 1997, Jocqué and Dippenaar-Schoeman 2006, etc.), Lehtinen (1967) was the first who indicated a close relationship between Hersiliidae and Oecobiidae. However, Lehtinen (1967: 305) clearly indicated that the priority of such a statement belonged to Bristowe (1938), who placed together Hersiliidae and Urocteidae in a special section among Clubionoidea. At the same time, Caporiacco (1938) suggested a separate superfamily Hersiliiformia that included Hersiliidae and Oecobiidae (but without the cribellate Urocteidae). Later, Mello-Leitão (1941) and Petrunkevitch (1958) proposed a superfamily Oecobioidea that included Oecobiidae, Urocteidae (now a subfamily of Oecobiidae), and Hersiliidae. These three families were united under this superfamily according to the structure of copulatory organs, spination, modification of carapace, eye pattern, and setation. In addition, Crome (1957) found some behavioral similarities between Hersiliidae and Oecobiidae (op. cit. after Lehtinen 1967: 305).

We have no doubt that Oecobiidae are related to Hersiliidae. In addition to clear somatic characters indicated by earlier authors such as eye pattern, an almost round carapace (width equals length), etc., both families have elongated posterior lateral spinnerets and the same way of holding the palps (converging femora, and diverging tibia and terminal joint) in both sexes (Fig. 1.2, 2.1; fig. 71a in Jocqué and Dippenaar-Schoeman 2006). Similarities between Oecobiidae and Hersiliidae even led Strand (1913) to confusion when he described *Oecobius (s.l.) brachyplura* (Strand, 1913) in *Hersiliola* (see Fet 2008).

Coddington and Levi (1991) placed Oecobiidae and Hersiliidae in Eresoidea. Although Eresidae, like Oecobiidae and Hersiliidae, are very different from the rest of the entelegyne spiders, we doubt that they should be placed in the same superfamily due to entirely different somatic morphology, morphology of copulatory organs, ecology, and behavior.

One of the additional diagnostic features of Hersiliidae, not indicated by earlier authors, is the presence of "accessory glands" in the epigyne. These structures appear to be present in the majority of hersiliid genera such as *Hersilia, Hersiliola, Deltshevia* gen. n., *Duninia* gen. n., *Yabisi* Rheims & Brescovit, 2004, most of *Tyrotama* Foord & Dippenaar-Schoeman, 2005, *Murricia* Simon, 1882, *Neotama* Baehr & Baehr, 1993, and *Tamopsis* Baehr & Baehr, 1987. Some *Tamopsis* species appear to have two pairs of sack-like structures in addition to spermathecae (cf. figs 25e, 28e in Baehr and Baehr 1987). Neotropical *Iviraiva* Rheims & Brescovit 2004 has acinoform spermathecae (not known in other entelegynes), and it is not clear whether they have accessory glands. Interestingly, structures that appear to be homologous to "accessory glands" have been observed in the related family, namely *Uroctea limbata* (C.L. Koch, 1843) and two unidentified species of *Uroctea* (Oecobiidae) (cf. figs 10-16 in Baum 1972). Baum (1972) called these structures a "blind endender Anhang". They were found in only half the studied species. Unlike in Hersiliidae, "acessory glands" in *Uroctea* are placed close to the spermathecae, but not close to the terminal part of the fertilization duct.

Structures similar to the "accessory glands" of Hersiliidae are common among entelegyne spiders. Most Hadrotarsinae (Theridiidae) have one or even two additional pairs of "spermathecae" (function unknown). Some Hahniidae have a second pair of globular structures called secondary receptacula (spermathecae) (cf. Harm 1966). Primary and secondary receptacula (spermathecae) in most of hahniid species are of the same size. The agelenid genus *Azerithonica* Guseinov, Marusik & Koponen, 2006 has a globular accessory gland at the midpoint of the fertilization duct (Guseinov et al. 2006, fig. 33). Structures similar to accessory glands are present in other agelenid genera too, such as *Ageles-cape* and *Malthonica*. In all above mentioned cases in other families, accessory glands are associated with insemination ducts, while in Hersiliidae and some Oecobiidae they are connected (if present) with fertilization ducts. In Hersiliidae, accessory glands are much smaller than spermathecae (receptacula), with the exception of *Deltshevia gromovi* sp. n. where accessory glands are only 2 to 2.5 times smaller than the spermathecae.

It is also worth mentioning that, unlike in all other entelegynes, fertilization ducts in Hersiliidae are long and heavily sclerotized (often more heavily than insemination ducts). Relatively long fertilization ducts are known in Oecobiidae, but they are weakly sclerotized.

Judging from the description provided by Baehr and Baehr (1993) for the Oriental genus *Hersilia*, this genus could be split into several genera. For example, the male of *H. kinabaluensis* Baehr & Baehr, 1993 has a bulbous tegulum, a screw-shaped embolus (filiform or stick-like in other species) directed parallel to the cymbium, and lacks a tegular apophysis (which is present in all other species of the genus). Some females of *Hersilia* have one and some, two pairs of "accessory glands". At the same time, some species of *Hersilia* lack distinct spermatheca (like *Ovtcharenkoia pallida*).

Acknowledgements

We thank Rostislav Danov, Orsetta Elter, Galina Fet, Yuri Gorelov, Manfred Grasshoff, Charles Griswold, Alexander Gromov, Paul Hillyard, Peter Jäger, Viktor Krivokhatsky, Gennady Kuznetsov, Natalia Kuznetsova, Dmitri Logunov, Oleg Lyakhov, Kirill Mikhailov, Vladimir Ovtsharenko, Sarah Whitman, Ersen Yağmur, Nikolai Yermakov, Farid Zeleev, and Sergei Zonstein, as well as late Jaqueline Hertault, Gershom Levy, Andrei Nenilin and Sergei Ovtchinnikov, for their kind gifts or loans of specimens over many years, as well as help with field logistics. We thank Shuqiang Li and Tang Guo for help with literature, translation of the description of *H. xinjiangensis* from Chinese, and searching for its types. We are grateful to Barbara Baehr, Antonio D. Brescovit, Stefan H. Foord, and Carles Ribera for providing valuable literature, and to Seppo Koponen for his help during YM's stay in Turku, and providing necessary equipment. VF's sincere thanks go to all the people whose kindness helped him and his family to survive in 1975-1987 in Turkmenistan, and whose names are too numerous to list, first of all the native people of Aidere and Tutlykala villages (the Bakhar clan of Nokhurli Turkmens). Travel of VF and A.V. Gromov to Turkmenistan and Uzbekistan in 2002 was supported by the National Geographic Society (USA) Research and Exploration Fund (grant 7001-0001), and was greatly facilitated by Viktor Lukarevsky, Alexander Tarabrin, Gochmurad Kutlyev, Shukhrat Shakhnazarov, Dzhamshid Dzhuraev, Aliya Gromova, Sergei Kuznetsov, and especially Alex and Elena Kreuzberg. H.D. Cameron kindly discussed with us Dufour's Latin. We are especially thankful to Alexander V. Gromov for his efforts in preserving the spider collection of the late Sergei Ovtchinnikov; and to Dmitri V. Logunov who made these specimens available to us, and provided important comments on the manuscript. This work was supported in part by the Russian Foundation for Basic Research (#-09-04-01365-a).

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RESEARCH ARTICLE



On the huntsman spider genera Sparianthina Banks, 1929 and Anaptomecus Simon, 1903 from South and Central America (Araneae, Sparassidae)

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Academic editor: Jason Dunlop Received	3 April 2009	Accepted 16 June 2009	Published @@ August 2009
urn:lsid:zoobank.org:pub:			

Citation: Jäger P, Rheims CA, Labarque FM (2009) On the huntsman spider genera *Sparianthina* Banks, 1929 and *Anaptomecus* Simon, 1903 from South and Central America (Araneae, Sparassidae). In: Stoev P, Dunlop J, Lazarov S (Eds) A life caught in a spider's web. Papers in arachnology in honour of Christo Deltshev. ZooKeys %%: 1-14. doi: 10.3897/ zookeys.%%.@@@

Abstract

The huntsman spider genera *Sparianthina* Banks, 1929 and *Anaptomecus* Simon, 1903 are reviewed. The type species of *Sparianthina, Sparianthina selenopoides* Banks, 1929, is redescribed, illustrated, and recorded from Costa Rica for the first time; a lectotype and paralectotype are designated. Three species are transferred to the genus: *Sparianthina pumilla* (Keyserling, 1880) **comb. n.** from *Heteropoda* Latreille, 1804 (lectotype and paralectotype are designated), *Sparianthina rufescens* (Mello-Leitão, 1940) **comb. n.** from *Anaptomecus* and *Sparianthina milleri* (Caporiacco, 1955) **comb. n.** from *Macrinus* Simon, 1887. The \bigcirc of *S. rufescens* (Mello-Leitão, 1940) **comb. n.** and the \bigcirc of *S. milleri* **comb. n.** are described for the first time. Three new species are described: *Sparianthina adisi* **sp. n.**, *S. deltshevi* **sp. n.**, and *S. saaristoi* **sp. n.** The male and female of *Anaptomecus longiventris* Simon, 1903 are described for the first time and the species is recorded from Panama for the first time. Two new species are described: *Anaptomecus temii* **sp. n.** and *A. levyi* **sp. n.**

Keywords

Taxonomy, re-description, transfer, review

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Introduction

American representatives of the spider family Sparassidae have been neglected in modern scientific publications. The last revision was by Gerschman and Schiapelli (1965) on the genus *Polybetes* Simon, 1897. Many genera were never recorded after their original publication.

The genus *Sparianthina* Banks, 1929 with its type species *Sparianthina selenopides* Banks, 1929 was described by Banks (1929) within a survey of the spider fauna of Panama. Since then no systematic work listed this genus or species. In recent times, a few South American species were recognised as species *incertae sedis*, among those *Macrinus milleri* Capporiacco, 1955 (Rheims 2007). This latter and two additional species are transferred here to the genus *Sparianthina*. Three new species are described. A re-diagnosis of the genus is given by means of the copulatory organs.

A similar case is the genus *Anaptomecus* Simon, 1903 which was known for a long time exclusively from its type species *Anaptomecus longiventris* Simon, 1903 before Mello-Leitão (1940) described a second species: *A. rufescens.* No records were published since then except for one juvenile of *A. longiventris* from Costa Rica (Lapinski et al. 2002).

The present paper is one in a series of papers treating Sparassidae from the Americas (Jäger and Rheims 2008, Rheims 2007, 2008, Rheims and Jäger 2008, Rheims et al. 2008) and aims to revise the two genera *Sparianthina* and *Anaptomecus*.

Material and methods

Types and non-type material were examined from the following collections: AMNH – American Museum of Natural History, New York, United States of America; IBSP – Instituto Butantan, São Paulo, Brazil; MACN – Museo Argentino de Ciencias Naturales "Bernardino Rivadavia", Buenos Aires, Argentina; MBUC – Museo de Biología, Universidad Central de Venezuela, Caracas, Venezuela; MCNB – Museu de Ciències Naturals de Barcelona; MCZ – Museum of Comparative Zoology at Harvard University, Cambridge, United States of America; MNHN – Muséum National d'Histoire Naturelle, Paris, France; MZPW – Museum of the Institute of Zoology, Polish Academy of Science, Warsaw, Poland; NHM – Natural History Museum, London, United Kingdom; NHMW – Naturhistorisches Museum, Vienna, Austria; NHRS – Naturhistoriska Riksmuseet, Stockholm, Sweden; SMF – Senckenberg Museum, Frankfurt, Germany.

It was not possible to take all measurements due to the fragile condition of some of the types. Material was examined and is preserved in 70% denatured ethanol. Female copulatory organs were cleared in lactic acid or clove oil. GPS data in square brackets were taken from Google Earth. Measurements are in millimetres. Styles of description are according to Jäger (2008) and Rheims (2008). Positions of tegular structures, e.g., embolus and conductor, are given as clock positions on the left palp in ventral view. Abbreviations used in the text: ALE – anterior lateral eyes; AME – anterior median eyes; DTA – distal tegular apophysis; PJ – consecutive number for specimens of Sparassidae examined by Peter Jäger; PLE – posterior lateral eyes; PME – posterior median eyes; RTA – retrolateral tibal apophysis; SD – number for Sparassidae with DNA/tissue-sample, Coll. Jäger, SMF; I-IV – legs I-IV. Illustrations were made using a Leica MZ 12.5 / MZ 16 and a Leitz Wetzlar 751739 stereomicroscope with camera lucida attachments. Pictures were taken with Leica DFC 500 and Nikon DXM1200 digital cameras mounted on a MZ 16A and Nikon SMZ1500 stereomicroscope respectively. Extended focal range images were composed with Leica Application Suite version 2.5.0 R₁ and Helicon Focus 3.10.3 or 4.01.

Taxonomy

Family Sparassidae Bertkau, 1872 Genus *Sparianthina* Banks, 1929

Sparianthina Banks, 1929: (description of genus). Roewer 1954: 684. Bonnet 1958: 4110. Platnick 2009.

Type species by monotypy: Sparianthina selenopoides Banks, 1929.

Extended diagnosis. Small sized Sparassidae with total length: 5.2-9.8. Cheliceral teeth with 3 (in exceptional cases with 4) promarginal and 4 to 8 retromarginal teeth; cheliceral furrow with denticles, mostly arranged in a long row (Figs 10, 26, 33, 38, 43, 52, 63). Eye arrangement similar to Heteropodinae (Jäger 1998) with lateral eyes larger than median eyes and anterior eye row recurved, posterior eye row slightly recurved to straight. Posterior lateral eyes close to transition between narrow head part and thoracic part of prosoma (Figs 25, 32, 39, 44, 53, 62). Lateral projections of trilobate membrane extending beyond median hook (Fig. 11). Female palpal claw with moderately elongated teeth (Figs 13, 64; Jäger 2004: fig. 15 sub Anaptomecus sp.). Males with tegulum shifted basally, leaving space in the distal alveolus for a strongly developed subtegulum (e.g., Figs 2, 6). Embolus in some species with embolic apophysis, membranous conductor situated on a membranous base, thus being movable (Fig. 9). Heavy dorsal tegular apophysis (DTA) present, situated dorsally from embolus and being in tight contact with subtegulum by a hook or other appendages (Figs 1-2, 4). RTA arising medially to distally from tibia with complex shape and more than one apex. Females hardly diagnosable by their copulatory organs; in most species known so far epigynal furrows ("epigyneale Falte/Furche" sensu Järvi 1912, 1914) only present in anterior epigyne (Fig. 46: EF), not connecting to epigastric furrow (exception: S. pumilla comb. n.), posterior epigyne slightly extending beyond epigastric furrow as a rounded median extension. Internal duct system with one pair of glandular appendages in functionally initial part, i.e. in anterior part.

Redescription. Total length ($\bigcirc \bigcirc \bigcirc$ and $\bigcirc \bigcirc \bigcirc$) 5.2-9.8. Prosoma as long as wide. Cephalic region slightly higher than thoracic region. Fovea long and conspicuous on posterior third of prosoma. Eyes arranged in two rows, the anterior recurved and posterior straight or very slightly recurved. AME slightly smaller than ALE and further apart from each other than from laterals. PME smaller than PLE, equidistant. Clypeus low, as high as or slightly lower than AME diameter. Chelicerae longer than wide, the two retrolateral basal teeth smaller than others. Intermarginal denticles present, mostly scattered at the base of the cheliceral groove. Gnathocoxae parallel, longer than wide with dense scopula on internal margin (Fig. 45). Leg formula 2143. Tarsi I-IV with pair of pectinate claws bearing 15-20 short and slightly curved teeth. Female pedipalp with single pectinate claw with 5-6 long and curved teeth. Opisthosoma slightly triangular, longer than wide. Tracheal spiracle contiguous to spinnerets. Anal tubercule small and triangular, covered by a few long hairs. Six spinnerets: anterior lateral spinnerets contiguous, conical and bi-segmented. Basal segment slightly elongate and cylindrical. Distal segment short and truncated. Posterior median spinnerets conical and short. Posterior lateral spinnerets conical and bi-segmented. Basal segment elongate and cylindrical. Distal segment short and truncated.

Male palp: Tibia slightly longer than cymbium, with one retrolateral, one dorsal and three prolateral spines. Distal margin with small ventro-retrolateral, triangular projection and retrolateral RTA. Cymbium with large median alveolus and elongate dorsal scopula. Subtegulum oval, smooth. Tegulum with retrolateral swelling and subembolic projection, the latter notched onto the subtegulum. Embolus with wide base and distally narrowed, with one or two small projections at its base. Conductor long and hyaline.

Female epigynum: epigynum divided longitudinally into a median septum and lateral borders. Lateral borders smooth, lacking projections. Anterior atrium bearing pair of copulatory openings. Vulva with long and convoluted internal duct system with small, anterior glandular projection close to copulatory openings. Fertilisation ducts very long and hook shaped.

Distribution. Costa Rica, Panama, Colombia, Venezuela, Guyana (undescribed species are known from Ecuador, Trinidad and Tobago, French Guyana).

Composition. Sparianthina selenopoides Banks, 1929, Sparianthina pumilla (Keyserling, 1880) comb. n., Sparianthina rufescens (Mello-Leitão, 1940) comb. n., Sparianthina milleri (Caporiacco, 1955) comb. n., Sparianthina deltshevi sp. n., Sparianthina adisi sp. n., Sparianthina saaristoi sp. n.

Relationships. Sparianthina resembles in several characters Heteropodinae from Asia and Africa: Eye arrangement with lateral eyes larger than median eyes and at least the anterior eye row distinctly recurved, denticles in cheliceral furrow present in combination with 3 promarginal teeth, long teeth on the Q palpal claw and trilobate membrane with all three elements, i.e., median hook and lateral projections well developed and of about the same size (Jäger 1998). Cheliceral denticles occur in various genera of Sparassidae, e.g., in the Asian genera *Gnathopalystes* Rainbow, 1899, *Prychia* L. Koch, 1875 and *Tychicus* Simon, 1880, in some African, European and Asian species of *Eusparassus* Simon, 1903, and in the South American genus *Adcatomus* Karsch, 1880 [only females of *A. flavovittatus* (Simon, 1897)] (Jäger 1998, 2001, Rheims 2008). All these species have less than three promarginal teeth on the chelicerae and are not considered closely related to either Heteropodinae or *Sparianthina*. The character combination of denticles with three promarginal teeth is known from Asian, Australian, and African Heteropodinae. Moreover, it occurs in some representatives in East Africa and Madagascar (Jäger 2004). However, as Sparassidae exist with denticles and three retromarginal teeth in combination with different character states in eye arrangement and female palpal claw, *Sparianthina* is not included in Heteropodinae. An extended systematic grouping ("Heteropodinae s. l.") may include Heteropodinae s. str. (sensu Jäger 1998, 2002), East African, Madagascan (key in Jäger and Kunz 2005: 166; *Berlandia* Lessert, 1921, species group near "*Rhitymna*" *saccata* Järvi, 1914) and South American (*Sparianthina, Sadala* Simon, 1880, *Anaptomecus* Simon, 1903) genera.

Sparianthina selenopoides Banks, 1929

Figs 1-21, 74-75

- *Sparianthina selenopoides* Banks 1929: 80, pl. 2, fig. 28 (description ♂ and ♀; Syntypes: 1 ♂ (PJ 797), 1 ♀ (PJ 798), Panama, Barro Colorado [9°9'53.36"N, 79°50'21.21"W], Canal Zone, 17 July, Banks, MCZ 23023, examined). Roewer 1954: 684. Bonnet 1958: 4110. Platnick 2009.
- **Note.** For reasons of stability and considering that it concerns a genus type, the 3 syntype is herewith designated the lectotype, the 2 syntype the paralectotype.

Further material examined. COSTA RICA. *Limón*: Rio Parismina [10°17'13.46"N, 83°21'21.11"W], 0 m altitude, on shrubs, 2 \checkmark (PJ 885-886), 2 \bigcirc (PJ 887-888), 1 subadult \diamondsuit , 1 juv. (NHMW). *Heredia*: Puerto Viejo, La Selva, 1 \circlearrowright , 1 \bigcirc , 1980-1983, W. Eberhard leg. (MCZ 69110, 69111). PANAMA. *Bocas del Toro*: Punta de Peña, 1 \bigcirc , 1907, R.E.B. McKenny leg. (USNM); *Canal Zone*: Barro Colorado Island, 9 \circlearrowright (16), 169, 24 juv., 1934-1954, A.M. Chickering leg. (MCZ 69055, 69056, 69057, 69058, 69059, 69060, 69061, 69062, 69063, 69064, 69065, 69066, 69067, 69069, 69068, 69070, 69071, 69072, 69112); 2 \circlearrowright (17.VII.1924, N. Banks leg. (MCZ 23023); 1 \bigcirc , 20.III.1946, T.C. Schneirla (AMNH); Fort Davis, 1 \circlearrowright , 1 \bigcirc , 2 juv., 14.VIII.1936, A.M. Chickering leg. (MCZ 69074, 69076); Madden Dam Forest, 1 \circlearrowright , 18.VIII.1936, A.M. Chickering leg. (MCZ 69075); French Field, 2 \circlearrowright 1 \bigcirc , 2 juv., 17.VIII.1939, A.M. Chickering leg. (MCZ 69077); Fort Sherman, 1 \bigcirc , 15.VIII.1939, A.M. Chickering leg. (MCZ 69078).

Diagnosis. Opisthosoma triangular to pentagonal (Figs 74-75). Males: Cymbium tip narrow and elongated (Figs 2, 6); embolus with a distinct subapical widening (Fig. 9); additional, pointed apophysis between embolus and conductor (Fig. 9: EA); DTA



Figures 1-13. *Sparianthina selenopoides* Banks, 1929 from Panama (**1-4** $\stackrel{<}{\circ}$ MCZ 69063, **5-10** $\stackrel{<}{\circ}$ lectotype, **11-13** $\stackrel{<}{\circ}$ paralectotype). **1-9** Left $\stackrel{<}{\circ}$ palp (**1**, **5** prolateral; **2**, **6** ventral; **3**, **7** retrolateral; **4** cymbium with bulbus expanded; **8** RTA, dorsal; **9** embolus, embolic apophysis, conductor, ventral). **10** Left chelicerae, ventral. **11** Trilobate membrane, distal metatarsus IV, dorsal. **12** Leg claw, lateral. **13** Palpal claw, retrolateral. BH – basal haematodocha; C – conductor; DTA – distal tegular apophysis; E – embolus; EA – embolic apophysis; MH – median haematodocha; ST – subtegulum; T – tegulum.



Figures 14-21. *Sparianthina selenopoides* Banks, 1929 from Panama (**14-15** MCZ 69063, **16-18** \bigcirc paralectotype) and Costa Rica (**19-21** PJ 887, NHMW). **14**, **16**, **19** Epigyne, ventral. **15**, **17**, **20** Internal duct system, dorsal. **18**, **21** Schematic course of internal duct system, dorsal. A – atrium; FD – fertilisation duct; GP – glandular pores; MS – median septum; PL – posterior lobe of epigyne.

slender in lateral views (Fig. 4), pointing prolatero-distally in ventral view (Figs 2, 6); RTA with foliate hook-shaped distal part directed dorsally in retrolateral view (Figs 3, 7). Females: Epigynal furrows present on anterior half of epigyne, roundly bent, pointing to median body axis (Figs 14, 16, 19); fertilisation ducts running posteriorad to epigastric furrow, then turning at 180°, forming two hook-like structures; glandular appendages laterally at anterior part of internal duct system, inconspicuous (Figs 15, 17-18, 20-21).

Description. Male (MCZ 69063). Total length 6.0. Prosoma: 3.0 long, 3.0 wide. Opisthosoma: 2.9 long, 2.5 wide. Eye diameters and interdistances: AME 0.18, ALE 0.22, PME 0.14, PLE 0.2, AME-AME 0.14, AME-ALE 0.04, PME-PME 0.24, PME-PLE 0.24, AME-PME 0.20, ALE-PLE 0.22. Legs: I: femur 6.4, patella 1.9, tibia 7.3, metatarsus 6.2, tarsus 2.2, total 24.0; II: 6.9, 2.0, 8.1, 7.1, 2.4, 26.5; III: 5.1, 1.5, 5.0, 4.7, 1.5, 17.8; IV: 5.4, 1.4, 5.5, 5.8, 2.0, 20.1. Spination: femur I-III: p1-1-1; d0-1-1; r1-1; femur IV: p1-1-1; d0-1-1; r0-1-1; tibia I-II: d1-1-1; v2-2-2-0; tibia III-IV: p1-0-1; d1-0-1; r1-0-1; v2-2-0; metatarsus I-III: p1-1-0; r1-1-0; v2-0-0; metatarsus IV: p1-1-2; r1-1-2; v2-0-0. Chelicerae with 3-4 anterior and 7 posterior teeth, and with ca. 17 denticles in one row (Fig. 10).

Palp as in diagnosis. Embolus arising from tegulum at a 9- to 10-o'clock-position, conductor at a 10- to 11-o'clock-position. Tegulum extending strongly beyond cymbium. Sperm duct running marginally (Figs 2, 6).

Colouration. Prosoma orange with small lateral light brown markings. Chelicerae orange with light brown markings. Gnathocoxae pale yellow, distally cream coloured. Labium orange, slightly darker at base. Legs and pedipalps pale orange with small light brown markings and dark brown spots at the base of the spines. Opisthosoma cream coloured with scattered small white markings (Fig. 74).

Female (MCZ 69063). Total length 7.4. Prosoma: 3.3 long, 3.2 wide. Opisthosoma: 4.0 long, 4.0 wide. Eye diameters and interdistances: AME 0.14, ALE 0.20, PME 0.16, PLE 0.22, AME-AME 0.12, AME-ALE 0.08, PME-PME 0.26, PME-PLE 0.28, AME-PME 0.20, ALE-PLE 0.26. Legs: I: femur 5.2, patella 1.8, tibia 5.4, metatarsus 4.3, tarsus 1.5, total 18.2; II: 5.7, 1.9, 6.1, 4.6, 1.6, 19.9; III: 4.3, 1.5, 3.9, 3.6, 1.2, 14.5; IV: 4.5, 1.3, 4.0, 4.3, 1.5, 15.6. Spination: femur I-II: p1-1-1; d0-1-1; r0-1-1; femur III: p1-1-1; r0-1-1; r0-0-1 femur IV: p1-1-1; d0-1-1; r0-0-1; tibia I–II: d0-0-1; v2-2-20; tibia III-IV: p0-0-1; d0-0-1; r0-0-1; v2-2-0; metatarsus I-III: p1-1-0; r1-1-0; v2-0-0; metatarsus IV: p1-1-2; r1-1-2; v2-0-0. Palpal claw with 8 teeth (Fig. 13), leg claws with 14 teeth, proximal teeth blunt and inconspicuous (Fig. 12). Trilobate membrane with broadly pointed median hook and long lateral projections (Fig. 11).

Copulatory organ as in diagnosis. Epigynal field round to rectangular, longer than wide. Posterior margin of epigyne with distinct lobe. Copulatory openings situated at anterolateral end of epigynal furrows (Figs 14, 16, 19). Internal duct system complex with strongly wound ducts (Figs 15, 17-18, 20-21).

Colouration as in male, slightly darker (Fig. 75).

Variation. Males (n=10): total length 5.2-6.9; prosoma 2.7-3.2; femur I 4.9-6.4. Females (n=10): total length 6.4-7.5; prosoma 3.1-3.4; femur I 4.0-5.8.

Distribution. Costa Rica and Panama.

Sparianthina pumilla (Keyserling, 1880) comb. n.

Figs 22-33

- *Heteropoda pumilla* Keyserling 1880: 237, pl. 6, fig. 129 (description ♂ and ♀; Syntypes, 1 ♂, 3 ♀♀, 1 juv., Colombia, Bogota [4°35'56.33"N, 74°3'56.96"W], NHM 3099-3102, examined). Petrunkevitch 1911: 488. Roewer 1954: 721. Bonnet 1957: 2194. Platnick 2009.
- **Note.** The juvenile is considered as belonging to the type series, although it was not mentioned in the original description. As it was together with the adult specimens in one vial, Keyserling had seen and identified it as belonging to the same species by writing the label to all specimens and not excluding the juvenile from the type series (International Commission on Zoological Nomenclature 1999: 72.4.1). For reasons of stability and considering the potential sympatric diversity, the male syntype is herewith designated the lectotype, the female syntypes and the juvenile syntype as paralectotypes.

Diagnosis. Males: embolus filiform, distinctly bent (roughly at a right angle); additional apophysis between embolus and conductor, blunt to rounded, widened distally; DTA massive in lateral views, bluntly rounded, pointing retrolatero-distally in ventral view; RTA with two appendages, one smaller pointing ventrally, the other larger, stout and slightly pointed and pointing distally (Figs 22-24). Females: epigynal furrows present over the entire length of epigyne, forming two rounded fields, a larger anterior and a smaller posterior one (Figs 27-28); fertilisation ducts very slender running posteriorad, turning at epigastric furrow; glandular appendages dorsally at anterior part of internal duct system, inconspicuous (Figs 29-30).

Redescription. Male (Lectotype). Total length 6.8. Prosoma: 3.1 long, 3.0 wide. Opisthosoma: 3.5 long, 2.1 wide. Eye diameters and interdistances: AME 0.16, ALE 0.22, PME 0.18, PLE 0.20, AME–AME 0.12, AME–ALE 0.08, PME–PME 0.24, PME–PLE 0.24, AME–PME 0.22, ALE–PLE 0.22. Legs: I: femur 4.4, patella 1.6, tibia 4.7, metatarsus 4.3, tarsus 1.6, total 16.6; II: 5.0, 1.6, 5.1, 4.8, 1.5, 18.0; III: 4.0, 1.3, 3.6, 3.7, 1.3, 13.9; IV: 4.3, 1.3, 4.0, 4.4, 1.8, 15.8.

Palp as in diagnosis. Embolus arising from tegulum at a 9:30-o'clock-position, conductor at a 10-o'clock-position. Tegulum extending strongly beyond cymbium. Sperm duct running submarginally (Fig. 23).

Female (Paralectotype). Total length 9.8. Prosoma: 3.8 long, 3.5 wide. Opisthosoma: 5.6 long, 3.8 wide. Eye diameters and interdistances: AME 0.20, ALE 0.26, PME 0.20, PLE 0.28, AME–AME 0.14, AME–ALE 0.08, PME–PME 0.32, PME–PLE 0.28, AME–PME 0.22, ALE–PLE 0.22. Legs: I: femur 4.2, patella 1.6, tibia 3.9, metatarsus 3.4, tarsus 1.3; II: 4.5, 1.7, 4.2, 3.6, 1.4, 15.4; III: 3.7, 1.4, 3.1, 3.0, 1.1, 12.3; IV: 4.2, 1.4, 3.5, 3.6, 1.2.

Copulatory organ as in diagnosis. Epigynal field rounded, as long as wide. Posterior margin of epigyne with distinct lobe. Copulatory openings situated anteromedially of anterior median field (Figs 27-28). Internal duct system less complex than that of *S. selenopoides*, with wound part of internal duct system transversely arranged. Fertilisation ducts long, bent and narrow (Figs 29-30).



Figures 22-33. Sparianthina pumilla (Keyserling, 1880) comb. n. from Colombia (22-26 ♂ lectotype, 27-33 ♀ paralectotypes). 22-24 Left ♂ palp (22 prolateral, 23 ventral, 24 retrolateral). 25, 32 Eyes, dorsal. 26, 33 Chelicerae, ventral. 27-28 Epigyne, ventral. 29 Internal duct system, dorsal. 30 Schematic course of internal duct system, dorsal. 31 Habitus, dorsal.
For further details see Keyserling (1880). **Distribution.** Colombia (known only from the type locality).

Sparianthina rufescens (Mello-Leitão, 1940) comb. n.

Figs 34-49

- Anaptomecus rufescens Mello-Leitão 1940: 180, fig. 8-9 (description ♀; holotype ♀ [PJ 1662], Guyana, Essequibo River [6°21'53.25"N, 58°37'52.36"W], 1930.1164, No. 3491, A.W. Richards (c.), Oxford University Expedition K.B.G., NHM, examined). Roewer 1954: 712. Platnick 2009.
- **Notes.** Mello-Leitão (1940: 181) listed "type no. 2491". Although the label shows "3941" it is considered the holotype female according to the match of other data. A juvenile (PJ 1663) apparently of the same species was in the same vial, as well as one male Salticidae. The juvenile is not considered to be a syntype, as Mello-Leitão wrote "type" in singular.

Further material examined. GUYANA. 1 \mathcal{S} (PJ 1665), Guest, Maraballi River, Essequibo River, 15 miles above Bartica, Bottle I, No. 68, 1.II.[19]29, R.W.G. Hingston, Mello-Leitão det. (NHM 1930.4.15.48); 1 \mathcal{Q} (PJ 1664), Guest, Maraballi River, Essequibo River, 15 miles above Bartica, Bottle I, No. 65, 29.X.[19]29, R.W.G. Hingston, Mello-Leitão det. (NHM 1930.4.15.45); 2 $\mathcal{Q}\mathcal{Q}$, Essequibo River, opposite Twasinki Mts. 25.IX.1937, W.G. Hassler (AMNH); 1 \mathcal{Q} , Parish, 1913 (AMNH); 1 \mathcal{Q} , Kangarooma, 13.VI.1911, F.E. Lutz (AMNH). 1 \mathcal{Q} (PJ 1878), Bovallius leg. (NHRS).

Diagnosis. Males: embolus widened; DTA pointing retrolaterally in ventral view; RTA with three appendages, dorsal one stiletto-like and slightly bent, median one finger-shaped and ventral one roughly triangular (Figs 34-37). Females: epigynal furrows present in the posterior part of epigyne, running diagonally from median to antero-laterally, bent at their anterior end (Figs 40-41, 46). Fertilisation ducts situated in the centre of the internal duct system; glandular appendages long and conspicuous, pointing in an anterior direction, diverging (Figs 42, 48-49).

Description. Male (NHM). Total length 5.9. Prosoma: 3.2 long. Opisthosoma: 2.7 long. Chelicerae with 3 anterior and 4 posterior teeth, and with ca. 20 denticles in a row (Fig. 38).

Palp as in diagnosis. Embolus and conductor arising from tegulum at 9- to 9:30-o'clock-position (Fig. 35).

Redescription. Female (AMNH). Total length 8.5. Prosoma: 3.5 long, 3.3 wide. Opisthosoma: 4.8 long, 3.0 wide. Eye diameters and interdistances: AME 0.18, ALE 0.24, PME 0.18, PLE 0.24, AME–AME 0.12, AME–ALE 0.06, PME–PME 0.24, PME–PLE 0.26, AME–PME 0.26, ALE–PLE 0.22. Legs: I: femur 4.0, patella 1.6, tibia 3.7, metatarsus 3.6, tarsus 1.4, total 14.3; II: 4.5, 1.7, 4.3, 4.0, 1.6, 16.1; III: 3.9, 1.5, 3.2, 3.4, 1.0, 13.0; IV: 3.8, 1.3, 3.2, 3.8, 1.5, 13.6. Spination: femur I–III: p1-1-1; d0-1-1; r1-1-1; femur IV: p1-1-1; d0-1-1; r0-0-1; tibia I–II: p1-0-0; r1-0-0;



Figures 34-45. *Sparianthina rufescens* (Mello-Leitão, 1940) comb. n. from Guyana (34-39 $\stackrel{\circ}{\circ}$ NHM 1930.4.15.48, 40 $\stackrel{\circ}{\circ}$ holotype, 41-45 $\stackrel{\circ}{\circ}$ NHM 1930.4.15.45). 34-37 Left $\stackrel{\circ}{\circ}$ palp (34 prolateral, 35 ventral, 36-37 retrolateral). 38, 43 Chelicerae, ventral. 39, 44 Eyes, dorsal. 40-41 Epigyne, ventral. 42 Internal duct system, dorsal. 45 Labium and left gnathocoxa, ventral.



Figures 46-49. *Sparianthina rufescens* (Mello-Leitão, 1940) comb. n. from Guyana (\bigcirc NHRS, PJ 1878). 46-47 Epigyne (46 ventral, 47 posterior). 48-49 Internal duct system (48 dorsal, 49 detail of right half). EF – epigynal furrow (explanation see diagnosis for *Sparianthina*).

v2-2-2-0; tibia III–IV: p1-0-1; r1-0-1; v2-2-0; metatarsus I–II: p1-0-0; r1-0-0; v2-2-0; metatarsus III: p1-1-0; r1-1-0; v2-2-0; metatarsus IV: p1-1-2; r1-1-2; v2-2-0. Chelicerae with 3 anterior and 4 posterior teeth, and with ca. 20 denticles in a row (Fig. 43).

Copulatory organ as in diagnosis. Epigynal field rounded, without anterior bands; slit sense organs separated by about one of their lengths from epigynal field. Internal duct system with reticulate pattern in large oval parts (Fig. 49), apparently representing narrow ducts.

Colouration. Prosoma, chelicerae, legs and pedipalps brownish-orange. Sternum pale orange with darker margins. Gnathocoxae pale orange, labium pale orange with brown base. Opisthosoma cream coloured with faint brown pattern of transverse chevrons.

Variation. Total length: 6.3-6.7. Prosoma length: 3.1-3.3.

Distribution. Guyana.

Sparianthina sp. Figs 50-54

Material examined. 1 \bigcirc (PJ 1667), French Guyana, Cayenne, R. Yelski leg, U. Taczanovski det. sub *Sparassus* sp. (MZPW).



Figures 50-54. *Sparianthina* sp. from French Guyana (Q MZPW, PJ 1667). 50 Epigyne, ventral. 51 Internal duct system, dorsal. 52 Chelicerae, ventral. 53 Eyes, dorsal. 54 Right leg III, retrolateral.

Note. The copulatory organ of this female is very similar to that of *S. rufescens* comb. n., but differs in the orientation of the epigynal furrows (almost parallel and only slightly bent), in the shape of the glandular appendages (narrow and almost parallel, tip only slightly widened), and in having two short dorsal tibial spines on all legs. It is not described here as a new species, as intraspecific variation in this genus is not known. Conspecific males should help to characterise this form.

Sparianthina milleri (Caporiacco, 1955) comb. n.

Figs 55-64, 76

Macrinus milleri Caporiacco 1955: 404, figs 57a–b (description ♂; holotype ♂, Venezuela, Aragua, Rancho Grande, 1.VIII.1949, Racenis leg., MUCV 810, in MBUC, examined). Brignoli 1983: 594. Platnick 2009.

Further material examined. VENEZUELA. 1 ♂, Rancho Grande, 24.VI.–1.VII.1945, W. Beebee (AMNH); 1 ♂, Aragua, Maracay, Rancho Grande, 1.–10.VIII.1987, Bordan & Peck (AMNH); 2 ♂♂, 1.–10.VIII.1987, Bordan & Peck (AMNH). 1 ♀ (PJ 2855), Aragua, Henri Pittier National Park, nr Rancho Grande, 1100-1800 m, 12.–30.XI.1997, T. Pape leg. (NHRS).

Diagnosis. Males: embolus massively widened, conductor directed prolaterally; DTA with well differentiated tip in ventral view pointing retrolatero-distally; sperm duct with retrolateral S-shaped bend; RTA massive with various small appendages, palpal tibia appearing triangular (Figs 55-57). Females: epigynal furrows present over entire length of epigyne (but inconspicuous in posterior part), anterior epigynal furrow situated laterally close to margin of epigynal field, posterior furrows S-shaped, running from lateral to median body axis (Fig. 58); fertilisation ducts situated at epigastric furrow; glandular appendages long and massive, pointing in an anterior direction, converging (Figs 59-61).



Figures 55-64. *Sparianthina milleri* (Caporiacco, 1955) comb. n. from Venezuela (55-57 ³/₂) holotype, 58-64 NHRS, PJ 2855). 55-57 Left ³/₂ palp (55 prolateral, 56 ventral, 57 retrolateral). 58 Epigyne, ventral (arrows point to lateral outgrowths of epigynal field). 59 Internal duct system, dorsal. 60 Schematic course of internal duct system, dorsal. 61 Detail of right glandular appendage, dorsal. 62 Eyes, dorsal. 63 Chelicerae, ventral. 64 Palpal claw, retrolateral.

Redescription. Male (Holotype, MUCV 810). Total length 5.7. Prosoma: 2.7 long, 2.7 wide. Opisthosoma: 2.6 long, 2.0 wide. Eye diameters and interdistances: AME 0.24, ALE 0.16, PME 0.22, PLE 0.22, AME–AME 0.10, AME–ALE 0.06, PME–PME 0.24, PME–PLE 0.20, AME–PME 0.18, ALE–PLE 0.24. Legs: I: femur 4.0, patella 1.3, tibia 4.4, metatarsus 3.7, tarsus 1.6, total 15.0; II: 4.6, 1.4, 4.8, 4.1, 1.6, 16.5; III: 3.6, 1.1, 3.3, 3.3, 1.2, 12.5; IV: 4.2, 1.0, 3.8, 4.2, 1.6, 14.8.

Palp as in diagnosis. RTA massive, with wide dorsal branch bearing a small distalmedian projection. Ventral branch bifid. Embolus and conductor arising from tegulum at a 9-o'clock-position (Figs 55-57).

Colouration generally brown (Fig. 76). Specimen very badly preserved.

Description. Female. Total length 6.6. Prosoma: 3.0 long, 2.9 wide, anterior width 1.5. Opisthosoma: 3.6 long, 2.5 wide. Eye diameters and interdistances: AME 0.17, ALE 0.25, PME 0.22, PLE 0.27, AME–AME 0.11, AME–ALE 0.05, PME–PME 0.25, PME–PLE 0.24, AME–PME 0.25, ALE–PLE 0.22, clypeus AME 0.33, clypeus ALE 0.29. Palp: femur 1.2, patella 0.7, tibia 1.2, metatarsus -, tarsus 1.7, total 4.8; legs: I 3.5, 1.4, 3.7, 2.8, 1.3, 12.7; II: 4.0, 1.5, 3.9, 3.1, 1.4, 13.9; III: 3.2, 1.2, 2.9, 2.6, 1.1, 11.0; IV: 3.5, 1.0, 3.2, 3.2, 1.4, 12.3. Leg formula 2143. Spination: palp 131, 101, 2121, 1014; femur I–III 323, IV 321; patella 000; tibia 2024; metatarsus I–II 0014, III 2014, IV 3036. Ventral tarsus III and IV with bristles in two rows, tarsus IV with more and stronger bristles. Chelicerae with ca. 15 denticles in a row, basally with two denticles beside this row, 3 (+ 1 small) anterior and 6 posterior teeth (Fig. 63). Palpal claw with 9-10 teeth (Fig. 64). Spinnerets cylindrical.

Copulatory organ as in diagnosis. Epigynal field roughly rectangular, with lateral outgrowths (Fig. 58: arrows) and without anterior bands, longer than wide. Posterior lobe of epigyne almost rectangular with rounded edges, distinctly extending beyond the epigastric furrow (Fig. 58). Internal duct system with wide ducts throughout and with reticulate structure close to glandular pores (Figs 59-61).

Colouration. Body and appendages yellowish-brown. Dorsal prosoma with darker striae and posterior-marginal band, fovea marked. Legs with indistinct spine patches. Sternum, labium, ventral gnathocoxae and coxae bright pale yellow. Opisthosoma without pattern.

Distribution. Known only from the type locality.

Relationship. As diagnostic characters for *Sparianthina* are congruent with those found in *S. milleri* comb. n. (shifted tegulum, complex RTA, membranous conductor flexible, epigynal furrows only in anterior part, internal duct system of females with glandular appendages, etc.) the species is transferred to this genus. Relationships within the genus cannot be recognised.

Sparianthina adisi sp. n.

Figs 65-67, 77

Types. ∂ holotype, Venezuela, Merida, ULA Biological Reserve, 20 km SE Azulita [08°17'N, 72°05'W], 28.VI.–3.VIII.1989, S. & J. Peck (AMNH). Paratypes: 1



Figures 65-67. *Sparianthina adisi* sp. n. from Venezuela (Å holotype). 65-67 Left Å palp (65 prolateral, 66 ventral, 67 retrolateral).

♂, same data as for holotype (AMNH); 2 ♂♂, Venezuela, Merida, Mucuy, Tabay [08°38'N, 71°04'W], 19.VI.–24.VII.1989, FIT, S. & J. Peck (IBSP 99860; SMF: PJ 1721); 1 ♂, Venezuela, Merida, El Valle, 15km NE Merida, 24.VI.–2.VIII.1989, S. & J. Peck (AMNH).

Further material examined. VENEZUELA. Merida: 3 ♂♂, Mucuy, Send. Lag. Suero, Tabay [08°38'N, 71°04'W], 19.VI.–24.VII.1989, S. & J. Peck (2 ♂♂ AMNH; 1 ♂ IBSP 99861).

Etymology. The species is dedicated to Joachim Adis (1950-2007) for his important contributions about the Amazonian forest and its ecology and for his longstanding contribution to the study of arachnids in South America; name in genitive case.

Diagnosis. The males of *Sparianthina adisi* sp. n. are distinguished from those of the remaining species of the genus by the bifid RTA with similar sized branches (Figs 66-67). It resembles *Sparianthina deltshevi* sp. n. by the long and slender projection at the retrolateral base of the embolus (Figs 66, 69), but is distinguished from this species by exhibiting a much narrower projection.

Description. Male (AMNH, holotype). Total length 6.6. Prosoma: 3.0 long, 3.0 wide. Opisthosoma: 3.5 long, 2.3 wide. Eye diameters and interdistances: AME 0.16, ALE 0.22, PME 0.20, PLE 0.26, AME–AME 0.08, AME–ALE 0.04, PME–PME 0.22, PME–PLE 0.22, AME–PME 0.16, ALE–PLE 0.18. Legs: I: femur 4.3, patella

1.5, tibia 4.5, metatarsus 3.9, tarsus 1.4, total 15.6; II: 4.9, 1.6, 4.9, 4.2, 1.6, 17.2; III: 3.9, 1.3, 3.4, 3.3, 1.2, 13.1; IV: 4.5, 1.2, 4.1, 4.2, 1.5, 15.5. Spination: femur I–III: p1-1-1; d0-1-1; r1-1-1; femur IV: p1-1-1; d0-1-1; r0-0-1; tibia I–II: v2-2-2-2-0; tibia III–IV: p1-0-1; d0-0-1; r1-0-1; v2-2-0; metatarsus I–II: v2-2-0; metatarsus III: p1-1-0; r1-10; v2-2-0; metatarsus IV: p1-1-2; r1-1-2; v2-2-0.

Palp as in diagnosis. Embolus and conductor arising from tegulum at a 9-o'clockposition (Fig. 66). Ventral tibial lobe small and slightly shifted retrolateral. Tegular subembolic projection notched prolaterally to the subtegulum. Conductor hyaline and laminar. Sperm duct running submarginally (Figs 65-67).

Colouration. Prosoma orange-brown, slightly darker at eye area and brown along fovea and thoracic striae. Chelicerae orange. Pedipalps dark orange. Legs orange with light brown markings at spine bases. Sternum yellow with orange margins. Gnathocoxae pale yellow. Labium pale yellow, light brown at base. Opisthosoma pale yellow (Fig. 77). Female unknown.

Variation. Males (n=8): total length 6.2-7.4; prosoma 3.0-3.6; femur I 3.6-4.5. **Distribution**. North-western Venezuela, state of Merida.

Sparianthina deltshevi sp. n.

Figs 68-70, 78

Types. ♂ holotype from Venezuela, Merida, ULA Biological Reserve, 20 km SE Azulita [08°17'N, 72°05'W], 28.VI.–3.VIII.1989, S. & J. Peck (AMNH). Paratypes: 2 ♂♂, same data as for holotype (AMNH; IBSP 99859).

Etymology. The species is dedicated to Christo Deltshev on occasion of his 70th birthday for his various contributions to the field of arachnology especially of the Balkan Peninsula; name in genitive case.

Diagnosis. The males of *Sparianthina deltshevi* sp. n. are distinguished from those of the remaining species of the genus by the RTA with a slightly cylindrical dorsal branch and a smaller and distally bent ventral branch (Figs 69-70). It resembles *Sparianthina adisi* sp. n. by the presence of a long and slender projection at the retrolateral base of the embolus but is distinguished from this species by exhibiting a much thicker projection.

Description. Male (AMNH, holotype). Total length 8.0. Prosoma: 3.4 long, 3.1 wide. Opisthosoma: 4.4 long, 2.4 wide. Eye diameters and interdistances: AME 0.18, ALE 0.26, PME 0.22, PLE 0.28, AME–AME 0.12, AME–ALE 0.04, PME–PME 0.24, PME–PLE 0.24, AME–PME 0.28, ALE–PLE 0.24. Legs: I: femur 4.7, patella 1.7, tibia 5.0, metatarsus 4.4, tarsus 1.7, total 17.5; II: 5.2, 1.7, 5.3, 4.8, 1.8, 18.8; III: 4.3, 1.5, 4.0, 3.8, 1.4, 15.0; IV: 4.8, 1.4, 4.6, 4.9, 1.7, 17.4. Spination femur I–III: p1-1-1; d0-1-1; r1-1-1; femur IV: p1-1-1; d0-1-1; r0-0-1; tibia I: v2-2-2-0; tibia III: p1-0-1; d0-0-1; r1-0-1; v2-2-0; tibia IV: p1-0-1; d1-0-1; r1-0-1; v2-2-0; metatarsus I–II: v2-2-0; metatarsus IV: p1-1-2; r1-1-2; v2-2-0.



Figures 68-70. *Sparianthina deltshevi* sp. n. from Venezuela (*A* holotype). 68-70 Left *A* palp (68 prolateral, 69 ventral, 70 retrolateral).

Palp as in diagnosis. Embolus and conductor arising from tegulum at a 9-o'clockposition. Sperm duct running marginally with a small bend retrolaterally (Fig. 69).

Colouration. Prosoma brownish-orange, slightly darker along fovea and thoracic striae. Clypeus slightly lighter than prosoma. Chelicerae orange. Legs and pedipalps orange with light brown markings at spine bases. Labium and gnathocoxae orange, distally lighter. Sternum pale yellow with orange margins. Opisthosoma brownish-grey (Fig. 78).

Female unknown.

Variation. Males (n=3): Total length 7.5-8.2; prosoma 3.4-3.7; femur I 4.7-5.5. **Distribution**. North-western Venezuela, state of Merida.

Sparianthina saaristoi sp. n.

Figs 71-73, 79

Types. \bigcirc holotype from Venezuela, Merida, Mucuy, Tabay [08°38'N, 71°04'W], 17.VI.–2.VIII.1989, S. & J. Peck, AMNH. Paratypes: 4 $\bigcirc \bigcirc$, Venezuela, Merida, El Valle, 15 km NE Merida [08°35'N, 71°08'W], 24.VI.–2.VIII.1989, S. & J. Peck (2 $\bigcirc \bigcirc$ AMNH; 1 \bigcirc IBSP 99864; 1 \bigcirc SMF: PJ 1722); 2 $\bigcirc \bigcirc$, Venezuela, Merida, Telef.

Esta. La Montana [08°35' N; 71°08' W], 27.VI.–26.VII.1989, S. & J. Peck (IBSP 99862; SMF: PJ 3116).

Further material examined. VENEZUELA. *Merida*: 10 ♂♂, Tabay [08°38'N, 71°04'W], Mucuy, Send. Lag. Suero, 17.VI.–2.VIII.1989, S. & J. Peck (AMNH); 1 ♂, 19.VI.–24.VII.1989, S. & J. Peck (AMNH); 12 ♂♂, Merida [08°35'N, 71°08'W], Hechicera, Monte Zerpa, 22.VII.–2.VIII.1989, S. & J. Peck (8 ♂♂ AMNH, 2 ♂♂ IBSP 99863, 2 ♂♂ SMF: PJ 3114-3115); 4 ♂♂, Telef. Esta. La Montana, 27.VI.–26. VII.1989, S. & J. Peck (AMNH); 2 ♂♂, El Valle, 15 km NE Merida, 24.VI.–2. VIII.1989, S. & J. Peck (AMNH); 71°45'W], Presa Las Cuevas, 9.–31.VII.1989, S. & J. Peck (AMNH).

Etymology. The species is dedicated to Michael Saaristo (1938-2008) for his many contributions to the taxonomy of spiders; name in genitive case.

Diagnosis. The males of *Sparianthina saaristoi* sp. n. are distinguished from those of the remaining species of the genus by the slender embolus without projections and by the RTA having only one dorsal branch (Figs 71-73).

Description. Male (AMNH, holotype). Total length 7.6. Prosoma: 3.8 long, 3.0 wide. Opisthosoma: 3.8 long, 2.8 wide. Eye diameters and interdistances: AME 0.22, ALE 0.28, PME 0.22, PLE 0.30, AME–AME 0.08, AME–ALE 0.04, PME–PME



Figures 71-73. *Sparianthina saaristoi* sp. n. from Venezuela (*A* holotype). 71-73 Left *A* palp (71 prolateral, 72 ventral, 73 retrolateral).



Figures 74-79. Sparianthina spp., habitus, dorsal. 74-75 S. selenopoides (74 , 75 9). 76 S. milleri comb. n., 3. 77 S. adisi sp. n., 3. 78 S. deltshevi sp. n., 3. 79 S. saaristoi sp. n., 3.

0.24, PME–PLE 0.26, AME–PME 0.20, ALE–PLE 0.18. Legs: I: femur 4.3, patella 1.5, tibia 4.3, metatarsus 3.9, tarsus 1.5, total 15.5; II: 4.8, 1.5, 5.0, 4.4, 1.7, 17.4; III: 3.9, 1.3, 3.5, 3.4, 1.3, 13.4; IV: 4.6, 1.3, 4.1, 4.6, 1.6, 16.2. Spination: femur I–III: p1-1-1; d0-1-1; r1-1-1; femur IV: p1-1-1; d0-1-1; r0-0-1; tibia I–II: d1-0-1; v2-2-2-0; tibia III–IV: p1-0-1; d1-0-1; r1-0-1; v2-2-0; metatarsus I–II: v2-2-0; metatarsus III: p1-1-0; r1-1-0; v2-2-0; metatarsus IV: p1-1-2; r1-1-2; v2-2-0.

Palp as in diagnosis. Embolus and conductor arising from tegulum at a 9-o'clockposition. Sperm duct running marginally at the distal and proximal tegulum and submarginally at the retrolateral tegulum (Fig. 72).

Colouration. Prosoma brownish orange, brown along fovea and thoracic striae. Eye borders black. Chelicerae orange-brown. Legs and pedipalps orange with brown markings at spine bases. Labium and gnathocoxae brownish-orange, distally lighter. Sternum pale orange with slightly darker margins. Opisthosoma yellowish-grey (Fig. 79).

Female unknown.

Variation. Males (n=10). Total length 6.0-7.6; prosoma 2.9-3.8; femur I 3.9-4.8. **Distribution**. North-western Venezuela, states of Merida and Tachira.

Genus Anaptomecus Simon, 1903

- Anaptomecus Simon 1903b: 28 (description of genus). Simon 1903a: 1027. Petrunkevitch 1911: 444. Roewer 1954: 712. Bonnet 1955: 313. Lapinski et al. 2002: 4. Platnick 2009.
- **Note.** Simon (1903a) listed genus name and species name with a cross reference to his publication (Simon 1903b) in which he described the new genus and the new species. First of all there is a mistake in this reference, as Simon wrote "1893" instead of "1903"; all other data (journal name, volume number, page number) are correct. Secondly, it might be that he assumed that the genus description would be published first, and added the reference in advance. As the name of the type species (*A. longiventris*) proposed by Simon (1903a) was not available at the time of publication of the genus description (identification key for genera of Heteropodeae) (International Commission on Zoological Nomenclature 1999: Article 68.2), and as the name of the type species was not nominal, i.e. available, it is not valid. Therefore the genus and species names were made available only in Simon (1903b).

Type species by original designation: Anaptomecus longiventris Simon, 1903.

Diagnosis. Medium-sized Sparassidae with total length 8.6-14.1. Prosoma flat (Figs 87, 97). Opisthosoma elongated (Figs 98-99). Cheliceral teeth with 3 promarginal (median enlarged) and 6-7 retromarginal teeth and denticles in a patch. Eye arrangement similar to Heteropodinae (Jäger 1998) with lateral eyes larger than median eyes, and eye rows recurved. Posterior eye row narrower than that in *Sparian-thina*, i.e. more space left between PLE and prosomal margin. Head part of prosoma

extended with almost parallel margins, i.e. PLE distinctly anterior to the transition between head and thoracic part. Median hook of trilobate membrane extending beyond lateral projections. \bigcirc palpal claw with 5 barely elongated teeth (Figs 92, 112). Tibiae with 4 ventral spines, lacking two additional distal spines present in Heteropodinae. Males: Tegulum pear shaped, sperm duct with U-shaped bend in ventral view; embolus and hyaline conductor situated on a membranous base, thus being movable; massive embolus retrolaterally bent with small teeth at base and a soft lamina at the end, hyaline conductor, RTA simple. Females hardly diagnosable by their copulatory organs; median extension of posterior epigyne forming two indistinct lobes.

Redescription. Dorsal shield of prosoma slightly longer than wide (Figs 98, 107). Eye region slightly elevated (Figs 87, 97). Fovea conspicuous and short on posterior third of prosoma. Eyes arranged in two recurved rows (Figs 88, 108). Clypeus as high as diameter of anterior eyes. Chelicerae longer than wide, with middle anterior tooth larger than others and size of posterior teeth gradually decreasing from proximal to basal. Denticles in distinct patch (Figs 89, 109-110). Gnathocoxae almost parallel, slightly converging distally, longer than wide with dense scopula on internal margin (Fig. 90). Leg formula 1243 or 2143. Tarsi I–IV with pair of pectinate claws bearing 12-20 teeth. Female pedipalp with single pectinate claw with 5 larger teeth and 1-2 tiny teeth. Opisthosoma distinctly longer than wide. Tracheal spiracle contiguous to spinnerets. Anal tubercule small and triangular, covered by few long hairs. Six spinnerets.

Male palp. Tibia shorter than cymbium. Tibia with RTA arising subdistally. RTA simple, slightly twisted and not extending beyond distal tibia. Cymbium narrow, with dense prolatero-dorsal scopula along its entire length. Tegulum in basal half of alveolus, not extending beyond cymbial margin. Embolus and conductor arising at an 11 to 12:30-o'clock-position from tegulum. Embolus curved and slightly twisted. Sperm duct running centrally in tegulum as a U-turn. Conductor hyaline, may be reduced.

Female palpal spination with reduced number of dorsal spines on femur (usually 131 in Sparassidae): femur 121 (111), patella 101, tibia 2121, tarsus 1014. Internal duct system twisted, fertilisation ducts situated medially.

Distribution. Costa Rica, Panama, Ecuador, Colombia.

Composition. Anaptomecus longiventris Simon, 1903, A. temii sp. n., A. levyi sp. n. **Species transferred.** Anaptomecus rufescens Mello-Leitão, 1940 (see Sparianthina, this paper)

Relationships. See discussion under *Sparianthina*. Characters of *Anaptomecus* such as presence of denticles at cheliceral furrow in combination with three anterior teeth, eye arrangement, female palpal claw with long teeth, and basally shifted tegulum may represent evidence of a closer relationship to *Sparianthina*. Differentiating characters between the genera are the conformation of denticles (patch vs. row), female palpal claw with primary tooth sensu Jäger (2004) shorter vs. longer than following secondary teeth, shape of opisthosoma (triangular to oval vs. elongated), and trilobate membrane with median hook longer vs. shorter than lateral projections.

Anaptomecus longiventris Simon, 1903

Figs 80-99

Anaptomecus longiventris Simon 1903: 28 (description immature; holotype juvenile, Ecuador, Cayambe, MNHN, examined). Petrunkevitch 1911: 444. Roewer 1954: 712. Bonnet 1955: 313. Lapinski et al. 2002: 4. Platnick 2009.

Further material examined. PANAMA. 1 3, Chiriquí, Reserva Forestal Fortuna, Quebrada Honda, 1 hectare Pancoding inventory, 8°45'00.3"N, 82°14'20.7"W, 1135 m, 7.–12.VI.2007, M. Arnedo, D. Dimitrov, G. Hormiga, F. Labarque & M. Ramírez legs. (MACN 16833); 2 2 2, same locality, 20.VI.2008, L. Piacentini, L. Benavides & F. Labarque legs. (MACN 16835); 1 2, 6 immatures, Coclé, P. Nac. G.D. Omar Torrijos Herrera, El Cope, 1 hectare Pancoding inventory, 8°40'5.1" N, 80°35'33.3" W, 760 m, 4.–9. VI. 2008, M. Arnedo, L. Benavides, G. Hormiga, F. Labarque, M. Ramírez legs. (MCNB 2008-0986; MACN); 1 👌, 1 immature, P. Nac. Altos de Campana, 1 hectare Pancoding inventory, 8°41'00.4" N, 79°55'47.4" W, 895 m, 14.–19.VI.2007, M. Arnedo, D. Dimitrov, G. Hormiga, F. Labarque, M. Ramírez legs. (MCNB 2008-0985; MACN). Voucher codes SFU2NBD019, preparation codes FML-00593-596, LNP-00236-237. COSTA RICA. 1 Q (PJ 2852), Talamanca, 01.09.1882, Bovallius leg. (NHRS). 1 juv. \bigcirc (PJ 1644), Alajuela Province, Cordillera de Tilarán, ca. 45 km NW of San Ramón, road to Reserva Biológica Alberto Manuel Brenes, primary, submontane rainforest, vegetation along the road, 900 m alt., 10.3.2001, W. Lapinski leg. (SMF). 1 subadult 🍳 (PJ 3122), Costa Rica, Heredia Province, La Virgen de Sarapiqní, Reserva Biológica Tirimbina, ca. 160 m ü. NN, under palm leaf (42 x 6 cm) hanging over forest stream, 08.06.2008, 2.00 a.m., W. Lapinski leg. (SMF) [epigyne and vulva were developed under cuticle]. 1 \bigcirc (PJ 3117), Costa Rica, Heredia Province, La Virgen de Sarapiqní [Sarapiquí?], Reserva Biológica Tirimbina, ca. 180 m ü. NN, under leaf of Melastomataceae sp., ca. 1.8 m distance from ground, in forest, 07.05.2008, 9:50 p.m., W. Lapinski leg. (SMF).

Diagnosis. Males: embolus arising prolaterally on tegulum with smooth teeth at base and a lamina widest medially at the end; conductor well developed, hammer-shaped; RTA relatively distant from cymbium (Figs 80-81, 94-96). Females: Copulatory openings situated laterally, appearing as large circles (in some cases filled with [mating] plug); epigynal furrows absent; posterior epigynal margin with inconspicuous lobe(s) (Fig. 82). Fertilisation ducts short, situated in the centre of internal duct system, the latter with two blind ending appendages, one long, pointing in a posterior direction, the other short, pointing in an anterior direction, with glandular pores at its tip (Figs 83-86).

Description. Male (MACN 16833). Total length 8.61. Prosoma: 3.12 long, 2.72 wide. Opisthosoma: 5.49 long, 0.28 wide. Eye diameters and interdistances: AME 0.18, ALE 0.18, PME 0.14, PLE 0.16, AME–AME 0.1, AME–ALE 0.06, PME–PME 0.18, PME–PLE 0.24, AME–PME 0.18, ALE–PLE 0.20. Legs: I: femur 9.05, patella 1.62, tibia 9.45, metatarsus 10.76, tarsus 3, total 33.88; II: 8.89, 1.72, 9.62, 11.08, 3.04, 34.35; III: 5.74, 1.38, 6.14, 6.63, 1.92, 21.81; IV: 7.11, 1.38, 6.71, 8.73, 2.28,



Figures 80-93. Anaptomecus longiventris Simon, 1903, (80-81 $\stackrel{>}{\circ}$ from Panama, 82-93 $\stackrel{\bigcirc}{\circ}$ from Costa Rica, NHRS PJ 2852). 80-81 Left $\stackrel{>}{\circ}$ palp (80 ventral, 81 retrolateral). 82 Epigyne, ventral. 83, 85 Internal duct system, dorsal (85 detail, left half). 84, 86 Schematic course of internal duct system, dorsal. 87 Prosoma, lateral. 88 Eyes, dorsal. 89 Chelicerae, ventral. 90 Labium and gnathocoxae, ventral. 91 Trilobate membrane, distal metatarsus, dorsal. 92 Left palpal claw, prolateral. 93 Prolateral claw of left leg I, prolateral. C – conductor; CD – copulatory duct; E – embolus; FD – fertilisation duct; GP – glandular pores; T – tegulum.



Figures 94-99. Anaptomecus longiventris Simon, 1903, $\stackrel{>}{\circ}$ from Panama. 94-96 Left $\stackrel{>}{\circ}$ palp (94 prolateral, 95 ventral, 96 retrolateral). 97-99 Habitus (97 lateral, 98 dorsal, 99 ventral).

26.21. Leg formula 2143. Spination: femur I–II: p1-1-1; d0-1-0; r1-1-1; femur III: p1-1-1; r0-1-1; femur IV: p0-1-0; r0-0-1; tibia I–II: p1-1-0; d1-1-0; r1-1-0; v2-2-0; tibia III–IV: p1-1-0; d0-1-0; r1-1-0; v2-2-0; metatarsus I–II: p1-0-0; r1-0-0; v2-2-0; metatarsus III: p1-1-0; r1-0-0; v2-2-0; metatarsus IV: p1-1-0; r1-1-0; v2-2-2.

Colouration (Figs 97-99). In live specimens, prosoma pale green with olive green margins and fovea. Chelicerae pale yellow, anterior base pale green. Pedipalps and legs pale yellow with light brown markings at the base of the spines. Sternum, gnathocoxae and labium pale yellow. Opisthosoma pale orange, with two large, yellow dots dorsally and two yellow and white stripes laterally. Colour fading in ethanol, leaving a whitish pale appearance; dorsal prosoma with dark marginal band (Fig. 98).

Female (MACN 16835). Total length 10.11. Prosoma: 3.48 long, 3.04 wide. Opisthosoma: 6.63 long, 1.76 wide. Eye diameters and interdistances: AME 0.12, ALE 0.18, PME 0.14, PLE 0.14, AME–AME 0.14, AME–ALE 0.08, PME–PME 0.20, PME–PLE 0.26, AME–PME 0.24, ALE–PLE 0.24. Legs: I: femur 5.98, patella 1.6, tibia 6.71, metatarsus 6.63, tarsus 1.92, total 22.84; II: 5.82, 1.56, 6.46, 6.3, 1.92, 22.06; III: 4.04, 1.3, 4.2, 4.28, 1.38, 15.20; IV: 4.64, 1.2, 4.36, 4.36, 1.62, 16.18. Leg formula 1243. Spination: femur I–II: p1-1-1; d0-1-0; r1-1-1; femur III: p0-1-0; r0-1-1; femur IV: p0-1-0; tibia I–II, IV: p1-1-0; r1-1-0; v2-2-0; tibia III: p1-1-0; d0-1-0; r1-1-0; v2-2-0; metatarsus III–IV: p1-1-0; r1-0; v2-2-0; Metatarsus III-IV: p1-1-0; r1-1-0; v2-2-0; Metatarsus III-IV: p1-1-0; r1-0; v2-0; v2-0.0. Chelicerae with 3 anterior and 7 posterior teeth, with ca. 20 denticles in a patch (Fig. 89). Palpal claw with 5-6 teeth (Fig. 92), leg claw with 19-20 teeth (Fig. 93). Median hook of trilobate membrane acuminate and extend

Copulatory organ as in diagnosis. Epigynal field not recognisable. Posterior margin of epigyne with two indistinct lobes.

Colouration as in male, slightly darker.

Variation. Males (n=2): total length 8.61-10.59; prosoma 3.52-3.12; femur I 9.7-9.05. Females (n=3): total length 10.11-11.74; prosoma 3.48-3.96; femur I 5.98-6.78. Median sac-like parts of the internal duct system may be considerably smaller and not touching each other.

Natural history. One female collected with a spherical egg sac, containing 76 spiderlings. In Costa Rica all specimens were observed on leaves of shrubs and lower tree branches.

Distribution. Ecuador, Eastern Panama and Costa Rica.

Anaptomecus temii sp. n.

Figs 100-101

Type material. ♂ holotype from Panama, Panama Province, P. Nac. Altos de Campana, 1 hectare Pancoding inventory, [8°41'00.4" N, 79°55'47.4" W], 895 m, 14.–19. VI.2007, M. Arnedo, D. Dimitrov, G. Hormiga, F. Labarque, M. Ramírez leg., voucher codes SCU2NDH005, preparation codes FML-00605 (MACN 16834). Paratype: 1 ♂, same data as for holotype; voucher codes SCB1DGR001, preparation codes LNP-00397-398 (MCNB 2008-0987).

Etymology. The specific name honours Temistocles "Temi" Tejedor, who provided logistic support to the PANCODING team during the fieldwork in Panama in June 2007 and 2008 that led to the discovery of this species. His hospitality and friendship were essential for the successful bioinventoring of the spiders and water beetles of the Panamanian cloud forests; name in genitive case.

Diagnosis. Males: embolus emerging mesally with well developed teeth at base and a smooth lamina at the end, conductor reduced, RTA relatively close to cymbium (Figs 100-101).



Figures 100-101. Anaptomecus temii sp. n., δ holotype from Panama, left δ palp (100 ventral, 101 retrolateral).

Description. Male (MACN 16834, holotype). Total length 10.87. Prosoma: 4.08 long, 2.92 wide. Opisthosoma: 6.79 long, 1.72 wide. Eye diameters and interdistances: AME 0.20, ALE 0.18, PME 0.16, PLE 0.18, AME–AME 0.12, AME–ALE 0.08, PME–PME 0.18, PME–PLE 0.22, AME–PME 0.26, ALE–PLE 0.24. Legs: I: femur 10.76, patella 1.80, tibia 12.22, metatarsus 12.71, tarsus 3.08, total 40.57; II: 10.11, 1.94, 11.57, 12.71, 2.96, 39.29; III: 6.79, 1.50, 7.35, 6.95, 1.96, 24.55; IV: 8.81, 1.60, 8.65, 9.70, 2.44, 31.2. Leg formula 1243. Spination: femur I–II: p1-1-1; d1-0-1; r1-1; femur III: p1-1-1; r1-1; femur IV: p1-1-0; r1-0; v2-2-0; metatarsus I–II: p1-0; r1-0; v2-2-0; metatarsus III: p1-1-0; v2-2-0; metatarsus III: p1-1-1; v2-2-2.

Colouration. Prosoma pale yellow with brown margins, anterior dots and fovea. Chelicerae pale yellow. Pedipalps and legs pale yellow with olive green markings at the base of the spines. Sternum, gnathocoxae and labium pale yellow. Opisthosoma pale orange, with three yellow and white large dots laterally.

Variation. Males (n=2): total length 10.87-10.59; prosoma 4.08-3.76; femur I 11.25-10.76.

Distribution. Eastern Panama.

Anaptomecus levyi sp. n.

Figs 102-113

Type material. ♀ holotype (PJ 2856), Colombia, ?Gosomoco, 800 m, Fassl, NHMW. Note. In a letter from Jürgen Gruber to Herbert Levi fom 1986 the questionable locality "Gosomoco" is discussed. According to information of JG reported in this letter, there is a report of the lepidopterologist A.H. Fassl from Teplitz (Bohemia) who collected with his brother and another colleague 1888-1912 in Colombia. Fassl mentioned in one of his travel reports a "Sosomuco" where he collected one year in a mountain forest in altitudes of 800-1200 meters. This "Sosomuco" is located approximately a two day march east of Bogota.

Etymology. The specific name honours Gershom Levy (1937-2009) for his important contributions to the knowledge about spiders and scorpions from Israel and the Middle East; name in genitive case.

Diagnosis. Opisthosoma elongated, without conspicuous bright patches on its dorsal side (Fig. 107). Male unknown. Female: epigynal furrows present in centre of epigyne as moderately bent rims (Fig. 102); fertilisation ducts situated in the centre of internal duct system; glandular appendages of internal duct system directed dorsally, conspicuous; posterior epigynal margin with trapezoidal lobe (Figs 103-106).

Description. Female (holotype). Total length 14.1. Prosoma: 5.0 long, 4.1 wide, anterior width 2.3. Opisthosoma: 9.1 long, 3.0 wide. Eye diameters and interdistances: AME 0.26, ALE 0.31, PME 0.21, PLE 0.27, AME–AME 0.16, AME–ALE 0.04, PME–PME 0.27, PME–PLE 0.27, AME–PME 0.29, ALE–PLE 0.30, clypeus AME 0.23, clypeus ALE 0.30. Palp: femur 2.5, patella 1.1, tibia 2.1, metatarsus -, tarsus 2.5,

total 8.2; legs: I 7.8, 2.3, 8.5, 7.8, 2.2, 28.6; II: 7.7., 2.4, 8.4, 7.8, 2.2, 28.5; III: 5.6, 1.8, 5.9, 5.1, 1.6, 20.0; IV: 6.9, 2.0, 6.1, 6.4, 2.0, 23.4. Leg formula 1243. Spination: palp 121, 101, 2121, 1014; femur I–III 323, IV 321; patella 000; tibia 2024; metatarsus I–II 1014, III 2014, IV 3035. Ventral tarsus IV with few thin bristles. Chelicerae with ca. 20 denticles in a distinct field, 3 anterior and 6-7 posterior teeth (Figs 109-110). Palpal claw with 5 larger teeth and 1 tiny tooth (Fig. 112), leg claw IV with 17 teeth (Fig. 113). Trilobate membrane with pointed median hook and blunt lateral projections (Fig. 111).



Figures 102-113. *Anaptomecus levyi* sp. n., ♀ holotype from Colombia. 102 Epigyne, ventral. 103, 105 Internal duct system (103 anterior, 105 dorsal). 104, 106 Schematic course of internal duct system (104 anterior, 106 dorsal). 107 Habitus, dorsal. 108 Eyes, dorsal. 109-110 Chelicerae, ventral. 111 Trilobate membrane, distal metatarsus, dorsal. 112 Right palpal claw, retrolateral. 113 Retrolateral claw of left leg IV, retrolateral. AB – anterior bands of epigynal field.

Copulatory organ as in diagnosis. Epigynal field rounded, as long as wide, with distinct anterior bands, the latter indistinctly separated from epigynal field. One slit sense organ included marginally in epigynal field. Copulatory openings situated anteriorly at medial rims (Fig. 102). Internal duct system stout. Fertilisation ducts long, bent and narrow (Figs 103-106).

Colouration. The colouration of the holotype female is strongly faded. Body and appendages show in ethanol a yellow-brown colour. Dorsal prosoma exhibiting a darker marginal band. Legs dorsally having small indistinct spots. Dorsal opisthosoma with bright guanine crystals, which extend laterally, and four pairs of small muscle sigilla (Fig. 107).

Distribution. Colombia (known only from the type locality).

Acknowledgements

Thanks for hospitality to Christine Rollard (MNHN), Torbjorn Kronestedt (NHRS), Jürgen Gruber (NHMW) and Paul Hillyard (NHM) during PJ's visits in the particular collections and for theirs and Laura Leibensperger's and Herbert Levi's (MCZ) efforts for loaning specimens as well as financial support by the European Union (Access to Research Infrastructure Action of the Improving Human Potential Programme: Paris - PARSYST, Stockholm - HIGHLAT, London - SYS-RESOURCE). PJ also thanks Witold Lapinski (University Ulm) for providing specimens of Anaptomecus longiventris from his collecting in Costa Rica. CAR likes to acknowledge an Ernst Mayr grant from the Museum of Comparative Zoology at Harvard University, a Theodore Roosevelt Memorial fund from the American Museum of Natural History, and Fundação de Amparo á Pesquisa do Estado de São Paulo (FAPESP grants # 02/11277-9; 06/61167-6). FML wishes to acknowledge the PANCODING project, a Fundación BBVA (3ª Convocatoria de Ayudas a la Investigación en Biología de la Conservación) grant to this project and a doctoral fellowship from CONICET. Also he is grateful to STRI of Panama, which provided the authorisation permission and logistic support during PANCODING bioinventoring to work on the Panama's National Parks, he would also like to thank the people from National Parks for assistance. Very special thanks to Carlos Espinoza and Alberto Gonzalez who provided invaluable logistic support at RF Fortuna. Lic. Amarilis Mendoza, director of ANAM in La Chorrera, facilitated fieldwork in Altos de Campana National Park. FML also wishes to thank Gustavo Hormiga, Dimitar Dimitrov and Ligia Benavides (GW), Miquel Arnedo (UB), Martín Ramírez and Luis Piacentini (MACN) for their help and orientation in the field work that provided the specimens of Anaptomecus from Panama; also to Luis Piacentini for providing stereomicroscope digital images.

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RESEARCH ARTICLE



A revision of the African wolf spider genus Amblyothele Simon (Araneae, Lycosidae, Piratinae)

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Academic editor: Pavel Stoev	Received 19 February 2009 \mid Accepted 15 May 2009 \mid	Published @@ August 2009
	urn:lsid:zoobank.org:pub:	

Citation: Russell-Smith A, Jocqué R, Alderweireldt M (2009) A revision of the African wolf spider genus *Amblyothele* Simon (Araneae, Lycosidae, Piratinae). In: Stoev P, Dunlop J, Lazarov S (Eds) A life caught in a spider's web. Papers in arachnology in honour of Christo Deltshev. ZooKeys %%: 1-14. doi: 10.3897/zooKeys.%%.\$\$\$

Abstract

The African lycosid genus *Amblyothele* Simon is revised and its subfamily placement clarified. A diagnosis is provided for the genus in relation to other genera in the subfamily Piratinae. The type species, *Amblyothele albocincta* Simon, 1910, is redescribed as is *A. togona* Roewer, 1960. Six new species, *Amblyothele atlantica* **sp. n.** (\mathcal{G}), *A. ecologica* **sp. n.** (\mathcal{G}), *A. hamatula* **sp. n.** (\mathcal{J}), *A. kivumba* **sp. n.** (\mathcal{J}), *A. latedissipata* **sp. n.** (\mathcal{J}) and *A. longipes* **sp. n.** (\mathcal{J}) are described. *Amblyothele jaundea* Roewer, 1960 is removed from the genus and transferred to *Pardosa*. An illustrated key to the species is provided.

Keywords

Afrotropical Region, new species, Piratinae, systematics, illustrated identification key

Introduction

The genus *Amblyothele* Simon, 1910 was created by Eugène Simon for a single male lycosid collected in Botswana during the Schultze expedition between 1903 and 1905 (Simon 1910). Unfortunately, no further specimens unequivocally assign-

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able to this species have been collected. Following this, Roewer (1960) described two more species in the genus, *Amblyothele togona* Roewer, 1960 from Togo and *A. jaundea* Roewer, 1960 from Cameroon, both from females. Apart from the listing in the Venoniinae by Dippenaar-Schoeman and Jocqué (1997), there has been no further mention of the genus in the literature and its status and relationships have thus remained obscure.

While conducting surveys using pitfall traps in both East and West Africa, we collected both sexes of a number of small lycosid species whose relationships were obscure but which were clearly unrelated to the Pardosinae and Lycosinae which dominate African savannas (Jocqué and Alderweireldt 2005). Comparison of males with the type specimen of *Amblyothele albocincta* convinced the authors that these specimens were congeneric. In this paper we redescribe the genus and its type species *Amblyothele albocincta*, and describe six new species, of which two are represented by both sexes. The relationships of this genus within the family Lycosidae are discussed.

Methods

Specimens were examined in 70% ethanol. Epigynes were cleared in methyl salicylate and temporarily mounted in a mixture of methyl salicylate and cedukol (Merck, Darmstadt). Scanning electron micrographs were obtained with a JEOL LV6450, after drying the specimens or parts in hexamethyl disilazane. Measurements were made with an eyepiece micrometer and are in mm. In the spination formulae, numbers between brackets indicate spines that may be lacking in some specimens.

Abbreviations:

Acronyms of institutions and collections:

ARS	Private collection A. Russell-Smith
MRAC	Musée Royal de l'Afrique Centrale, Tervuren (R. Jocqué)
NCA	National Collection of Arachnids, Pretoria (A. Dippenaar-Schoeman)
SMF	Senckenberg Museum, Frankfurt (P. Jäger)
ZMB	Zoologisches Museum, Berlin (J. Dunlop)

Abbreviations in descriptions: ac – aciniform gland spigot; ALE – anterior lateral eyes; ALS – anterior lateral spinnerets; AME – anterior median eyes; CL – carapace length; CW – carapace width; pi – piriform gland spigot; e – embolus; MA – median apophysis; mAmp – major ampullate gland spigot; PLE – posterior lateral eyes; PME – posterior median eyes; PLS – posterior lateral spinnerets; TA – tegular apophysis; TL – total length.

Systematics

Amblyothele Simon, 1910

Amblyothele Simon, 1910. **Type species**, *Amblyothele albocincta* Simon, 1910, by original designation.

Small wolf spiders (males 3.08-4.17, females 3.33-5.17) without pronounced carapace pattern, sometimes with pale median band and darker striae radiating from fovea (Fig. 1). Anterior eye row (Fig. 2) usually either straight or, more often, recurved, with AME ranging in size from equal to twice diameter of ALE. PME 1.40-2.25 times diameter apart; PLE 0.66-0.86 times diameter of ALE. Eye region normally suffused with black. Chelicerae pale, mottled or streaked with grey, clothed in long dark setae; posterior margin with two teeth, proximal one normally larger, anterior margin normally with three minute teeth with middle one largest although in some species anterior margin lacks teeth altogether. Labia and maxillae coloured as chelicerae with maxillae 1.75 to 2.0 times longer than labium. Sternum pale, scutiform, moderately to strongly produced between hind coxae, with scattering of dark setae. Legs pale yellow to pale brown, clothed in short adpressed setae, noticeably longer and thinner than those of all other well-characterised piratine genera, with length/width ratio of femur I ranging from 5.60 to 10.50. Leg IV 1.25-1.35 times length of leg I. Ventral spines of leg I normally with three pairs on tibia and three on metatarsus, distal pairs normally reduced in size. All leg spines long, thin and pale. Tarsi with three claws (Fig. 9); paired claws with two to five long thin teeth and few tiny ones at base; unpaired claw small on raised pad, with four or five small teeth, having two long serrated bristles adjacent. Tarsal organ with keyhole shaped aperture (Fig. 8). Abdomen pale yellow to brown, sometimes suffused with grey and usually with paler dorsal folium (Fig. 1). Type species, A. albocincta, with row of four paired pale white spots on dorsal surface. Abdomen of males without dorsal scutum. Dorsal surface sometimes clothed in dark hairs. Ventrally pale yellow to white. Spinnerets long, ALS twice length of AMS, clearly 3 segmented (Figs 1, 4, 5). Dorsally pale to dark brown or grey, ventrally pale white or cream. ALS in female with two major ampullate gland spigots near median margin, surrounded by numerous piriform gland spigots. PLS with numerous aciniform gland spigots.

Male palp longer and narrower than that of most piratine genera and cymbium without terminal claws. MA located distally on bulb, very large U or C-shaped sclerite with two branches (Figs 6, 7, 10, 14); larger, anterior branch directed antero-mesally, blade-shaped. Smaller posterior branch directed anteriorly, variable in shape: blunt lobe with rounded tip in *A. albocincta*, abruptly truncate in *A. togona* and *A. longipes*, pointed barb in *A. hamatula*. Course of E almost totally obscured by MA in unexpanded palp (Figs 6, 7) with only very tip visible near base of MA in *A. albocincta*, *A. latedissipata* and *A. togona*. Sub-tegulum relatively large in most species, occupying from quarter to third of surface of bulb, but reduced in size in *A. hamatula*.



Figure 1. Amblyothele togona Roewer, female, habitus (MRAC 223302). Scale = 1 mm.



Figures 2-9. *Amblyothele togona* Roewer (specimens from Masako, Congo DR) Scanning electron micrographs 2 female carapace, frontal view; 3 epigyne, ventral view; 4 anterior lateral spinneret; retro-caudal view;
5 posterior lateral spinneret, last segment, ventral view; 6 male palp, ventral view; 7 male palp, detail, ventral view; 8 tarsal organ on leg 2; 9 tarsal claws, leg 2. (E: embolus; MA: median apophysis; TA: tegular apophysis).

Female epigyne resembling that of other piratine genera in being simple plate (Fig. 3), often obscured by densely packed, long, barbed setae. Epigynal plate suboval in shape, shallowly (*A. latedissipata*) to deeply (*A. togona*) notched on posterior border. Spermathecae and their ducts visible to greater or lesser extent through lateral margins of epigynal plate. Viewed internally, genital openings visible to either side of central notch on posterior margin of epigyne with spermathecal ducts extending anteriorly, either straight or curving mesally. Spermathecae relatively small, either spherical or pyriform. With two small laterally-oriented glands at base of spermathecal ducts, near the posterior margin of the epigynal plate; gland ducts connect to spermathecal ducts.

Diagnosis of Amblyothele Simon, 1910

Pirata, the nominate genus of the subfamily, is distributed throughout the world with the exception of SE Asia(?), Australia and the Pacific region. The tegular apophysis in Pirata varies widely in form (see, for example Almquist (2005) for European species, Tanaka (1988) for those of Japan and Wallace (1978) for Nearctic species). The tegular apophysis in Amblyothele resembles that of some species of Pirata (e.g., P. latitans (Blackwall, 1841), P. insularis Emerton, 1885, Pirata uliginosus (Thorell, 1856) and among European species (see Almquist 2005, figs. 236 a-h, 237 a-e) but not that of the type species, *P. piraticus* (Clerck, 1757). The epigynes of *Amblyothele* species also resemble those of *Pirata* species but in several species have a conspicuous notch on the posterior margin. Despite the similarity of the male palp in at least some *Pirata* species and Amblyothele, the two genera differ significantly in somatic characters. The legs of Amblyothele are much longer and thinner than those of Pirata species with the length/width ratio of Femur I of three *Pirata* species ranging from 3.21 to 3.33 and that for three Amblyothele species from 5.67 to 10.45. Furthermore, the legs of Pirata species are more or less densely clothed in semi-erect setae while those of Amblyothele species have only a sparse clothing of short, adpressed setae. Overall, most Amblyothele species are smaller than Pirata species although the smallest Pirata (e.g. P. latitans) overlap in size with the largest Amblyothele.

In the palp of the genera *Proevippa*, *Trabea* and *Pterartoria*, the basal part of the tegulum bears one or more, more or less translucent, poorly sclerotised membranous extensions (see Fig. 10b in Russell-Smith 1981 and Fig. 1a in Russell-Smith 1982) which are lacking in *Amblyothele*. Furthermore, the terminal apophysis in *Proevippa* Purcell, 1903 and *Trabea* Simon, 1876 is much larger than that in *Amblyothele* and has a characteristic tongue-shaped form with a sharply reflexed distal portion (Russell-Smith 1981, 1982).

Synapomorphies

In the absence of a thorough phylogenetic analysis polarizing characters in function of an outgroup, we can only suggest a number of apomorphies for the definition of the genus. They are: very long thin legs with sparse cover of setae, lack of membranous extensions on the tegulum and large, distal MA and small embolus in the male palp.

Notes. The most conspicuous structure of the male palp of *Amblyothele albocincta* and all other members of the genus described here is the greatly enlarged, more or less sickle shaped, median apophysis which is orientated longitudinally on the palpal bulb (Figs 6, 10, 16, 20, 22, 28, 33). By contrast, the embolus is very small (only the tip is visible in the unexpanded palp) and is situated distally on the bulb (Figs 6-7). Both of these characters are given as synapomorphies for the subfamily Venoniinae by Dondale (1986). As Dondale pointed out, this concept of the subfamily to a group of web-building lycosid genera with a centre of distribution in S.E. Asia. More recently, Yoo and Framenau (2006) revised the genus *Venonia* Thorell, 1894 and revalidated Venoniinae in the restricted sense of Lehtinen and Hippa (1979), on the basis of the distinctive palpal morphology including the distal position of a well sclerotised conductor. However, this does not correspond with the definition of the subfamily provided by Dondale (1986).

The correct subfamily name for the remaining genera previously included in the Venoniinae by Dondale (including at least *Pirata* Sundevall, 1833, *Proevippa*, *Trabea* and *Pterartoria* Purcell, 1903) appears to be Piratinae sensu Zyuzin (1993) as they possess a functional conductor which is combined with a short, thin embolus in a common sickle-shaped complex, resting in a deep and narrow ascending tegular groove. Although it is clear that more detailed research is necessary on the subfamily level (Murphy et al. 2006), the characteristics of the male palp of *Amblyothele* as described above, place it in the Piratinae.

Misplaced species. We have seen the type specimen of *Amblyothele jaundea* Roewer, 1960 (ZMB), a single female. Examination of the epigyne shows that this specimen certainly cannot be placed in *Amblyothele* and is most probably a member of the subfamily Pardosinae. It is therefore suggested to list it temporarily in the right subfamily as *Pardosa jaundea*.

Key to the species of Amblyothele

1	Males	.2
_	Females	.7
2	Palpal tibia with dense ventral cluster of short setae in basal half (2a, b)	.3
_	Palpal tibia without dense cluster of short setae (2c)	.4







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Descriptions

Amblyothele albocincta Simon, 1910

Figs 10-13, Map 1

Amblyothele albocincta Simon, 1910: 207, description ♂; Roewer 1960: 955, description ♂.

Diagnosis. The posteriorly widened palpal tibia with ventral brush of short setae and the shape of the median apophysis of the male palp, with a tiny nipple-shaped projection on the basal lobe are distinctive.

Type material. Holotype. Male. BOTSWANA: Kalahari, between Lehututu and Kokong, 23°58'S 021°52'E (ZMB).

Other material examined. BOTSWANA: 1 \bigcirc : Maxwee, Okavango Delta, 19°28'S 023°39'E, 28.IV.1976, Mopane woodland, in pitfall, A. Russell-Smith leg. (MRAC 223296).

Notes. The type specimen is in poor condition, lacking one palp, three legs and one jaw. The colours have been largely lost due to long immersion in alcohol. It is with some hesitation we assign the female here described to this species, given the wide separation (530 km) of the locality from that of the type locality. However, the distinctive line of light spots on the abdomen corresponds well with Simon's original description of the appearance of the male (before decolouration in alcohol) and no other species in the genus has a similar appearance.

Description. Holotype. Male. Total length. 4.00 mm. *Carapace*. Length 2.08 mm, width 1.67 mm. Colour chestnut brown with faint darker lines radiating from fovea. Fovea only moderately long. Head region not at all raised but sharply narrowed and clearly distinct from thoracic region. *Eyes*. Anterior row very slightly procurved. AME separated from each other by 0.6 x their own diameter and by 0.4 x their own diameter from the very small ALE. Eyes of middle row 1.4 x diameter of AME's and separated from each other by 0.7 x their own diameter. PLE 0.7 x diameter of PME, separated by



Figures 10-13. *Amblyothele albocincta* Simon (holotype). **10** right male palp, ventral view; **11** right male palp, retrolateral view; **12** epigyne, ventral view; **13** epigyne, dorsal view, cleared. Scales: **10-11** 0.5 mm; **12-13** 0.1 mm.

4 x their own diameter. Immediate region of eyes with dark pigmentation. *Chelicerae*. Coloured as the carapace, long and relatively thin. Dentition not seen. Maxillae and labium. Maxillae ca 2 x length of labium, strongly truncate at distal end. Coloured as the carapace. Labium sub-quadrate, as long as broad, coloured as the maxillae. Sternum. Shield-shaped but longer than in other species of the genus and strongly produced between the hind coxae. Coloured as the carapace. Legs. Relatively shorter and more robust than in many other species of the genus. Ratio of length to breadth of tibia IV 12:1. Leg IV 1.45 x length of leg I. Ventral spines of leg I; metatarsus 2-2-(2), tibia 2-2-(2). Pale yellow brown, without annulations. Paired claws of tarsi relatively short, teeth not seen, the central claw minute, on a raised pad and having two long serrated bristles adjacent. Abdomen. Dark brown, paler spots mentioned in original description no longer visible. Ventrally pale yellowish brown. Spinnerets. Long and thin. PLS ca 2 x length of AMS. Second segment of PLS 0.5 x length of basal segment. Coloured as the abdomen. *Male palp* (Figs 10-11). Tibia widened at base, with retroventral brush of short setae in basal half. Median apophysis situated terminally. Anterior lobe of median apophysis broadly sickle-shaped, posterior lobe with a minute nipple-shaped apical projection. Tip of embolus thin and partly obscured by median apophysis.



Map 1. Localities of A. albocincta.
Female. Total length 3.84 mm. *Carapace*. Length 1.84 mm, width 1.33 mm. Colour as in male. *Eyes*. Anterior row straight. AME eyes larger than those of male, separated by 0.2 x their diameter and touching the ALE's. Chelicerae. Smaller than those of male, with two minute teeth on posterior margin and no visible teeth on anterior margin. *Maxillae and labium*. As in male. *Sternum*. 1.12 long, 0.89 wide. *Legs*. Only one fourth leg survives. Similar in colouration and spination to that of male. *Abdomen*. Dorsally dark greyish brown with four pairs of pale spots along its length. Otherwise as in male. *Spinnerets*. PLS ca 2.5 x length of AMS. Second segment of PLS as long as first. Dorsally dark greyish brown. *Epigyne* (Figs 12-13). Ventral view with vague pattern consisting of two oblique asymmetrical v-shaped stripes in front and a rounded inversed v in centre of posterior part; entrance to duct openings visible in transparency as darker spots on either side of inverted v. Dorsal view of cleared epigyne with largely separated entrance openings near posterior margin; short S-shaped entrance ducts directed forward to small oval spermathecae.

Distribution. Botswana (map 1).

Amblyothele atlantica sp. n. urn:lsid:zoobank.org:pub: Fig. 14, Map 2

Diagnosis. The appearance of the epigyne is characteristic and unique within the genus with looped ducts extending anteriorly and a triangular posterior projection. The very dark charcoal grey colouration is also distinctive.

Etymology. Named after the type locality.

Type material. Holotype. Female. CAMEROON: Atlantic Mountains, 08°31'N 012°36'E, 30.IV.2007, litter at the base of rocks, sieving. R. Jocqué, K. Loosveldt, L. Baert, M. Alderweireldt leg. (MRAC 221300).

Description. Female. Total length 4.17 mm. *Carapace*: Length 1.75 mm, width 1.08 mm. Dark charcoal grey with a paler yellowish median stripe extending from behind eyes, wide anteriorly and abruptly narrowing posteriorly. With black striae ra-



Figures 14-15. 14 *Amblyothele atlantica* sp. n. epigyne of holotype, ventral view; **15** *A. ecologica* sp. n. epigyne of holotype, ventral view. Scale: 0.1 mm.

diating from the relatively long fovea. Eyes. Anterior row straight. AME 2x diameter of ALE and separated by 0.75 x their own diameter and by 0.2 x their diameter from the ALEs. Middle eyes 1.4 x diameter of AMEs and separated by 0.7 x their own diameter. PLE 0.7 x diameter of PME, separated by 2.8 x their own diameter. All eyes with black surrounds and eye region with sparse scattering of shining white spatulate setae. Cheli*cerae*. Pale greyish cream with darker black longitudinal bands, With a sparse clothing of long black setae. Cheliceral dentition not seen. Maxillae and labium. Maxillae 1.87 x length of labium, broadened and truncate at distal end. Pale cream suffused with grey. Labium trapezoidal, 1.86 x wider than long, coloured as maxillae. Legs: Long and slender. Ratio of length to breadth of tibia IV 11.7 Leg IV 1.32 x length of leg I. Dark charcoal grey dorsally, paler ventrally. Ventral spines of leg I; metatarsus 2+2+(2), tibia 2+2+2. Tarsal claws short, with 5 teeth. Abdomen. Dorsally dark charcoal grey with a median pale band extending one third its length. Ventrally pale grey with a pair of narrow white longitudinal stripes extending back from the epigastric fold. With sparse tuft of curved black setae anteriorly. Spinnerets. Long and thin. Posterior lateral spinnerets 1.5 x length of others. Dark charcoal grey. Epigyne. Fig. 14. Very distinctive in ventral view with a pair of looped ducts extending anteriorly from the epigynal plate and curving towards each other. Epigynal plate with a triangular posterior projection.

Male unknown.

Distribution. Known only from the type locality (map 2).



Map 2. Locality of A. atlantica.

Amblyothele ecologica sp. n. urn:lsid:zoobank.org:pub: Fig. 15, Map 3

Diagnosis. The appearance of the epigyne is characteristic with a large rectangular notch on the posterior margin of the epigynal plate and the short converging ducts seen through the cuticle.

Etymology. The specific name is a Latinised form of the Greek for "household" and "knowledge" and is used in its modern sense of "environmentally friendly", referring to its occurrence in an intercrop.

Type material. Holotype. Female. SOUTH AFRICA: Mpumalanga, Roodeplaat Research Station, 25°45'S 28°10'E, 1.III.1995, in tomato and basil intercrop, E. von Maltitz leg. (NCA).

Description. Female. Total length 5.17 mm. Carapace. Length 2.17 mm, width 1.67 mm. Pale chestnut brown with dark grey striae radiating from fovea. Fovea long, 0.2 x length of carapace. Eyes. Anterior row slightly recurved. AME 0.9 x diameter of ALE, separated by 0.2 x their own diameter and almost touching ALE. Middle eyes 1.83 x diameter of AME, separated by 0.87 x their diameter. PLE 1.12 x diameter of PME, separated by 1.67 x their own diameter. Eye region dark black with a few dark setae. Chelicerae. Coloured as carapace and clothed in long pale setae. Retro-margin with two teeth, proximal largest. Pro-margin with three teeth, middle largest. Maxillae and labium. Maxillae 0.75 x length of labium, truncate at tip. Labium as wide as long at base, tapering to a rounded tip. Coloured as chelicerae. Sternum. Shield shaped and somewhat produced between hind coxae. Pale yellow with a scattering of dark setae. Legs: Pale brown. Relatively stout for genus. Ratio length/breadth of tibia IV 13.2. Leg IV 1.33 x length of leg I. Ventral spines of leg I; tibia 2+2, metatarsus 2+2+(2). Tarsal claws moderately long, with 5 long teeth. Abdomen. Dorsally chestnut brown suffused with grey and with 5 pairs of lighter spots along length, consisting of pale setae. Ventrally pale cream. Spinnerets. Long, PLS 2 x length of other spinnerets. Dorsally dark greyish brown, ventrally pale cream. *Epigyne* (Fig. 15). In ventral view, large, with a conspicuous rectangular notch on the posterior margin of the epigynal plate. Ducts (as seen through cuticle), short narrow, curved and converging at the anterior end.

Male unknown.

Distribution. Known only from the type locality (map 3).

Amblyothele hamatula sp. n. urn:lsid:zoobank.org:pub: Figs 16-17, Map 4

Diagnosis. The male differs from other species of the genus by the shape of the broad median apophysis, with the apical lobe narrowing abruptly at the tip and the basal lobe with a barbed, forward pointing projection.



Map 3. Locality of A. ecologica.

Etymology. The specific name is derived from the Latin for a small hook or barb and refers to the shape of the projection on the posterior lobe of the median apophysis.

Type material Holotype. Male. COTE D'IVOIRE: Mbé, near Bouaké, WARDA site, 7°52'N 5°06'W, 15.VIII.1994, pitfall traps in upland rice, A. Russell-Smith leg. (MRAC 223299).

Description. Holotype. Male. Total length 3.17 mm. *Carapace.* Length 1.56 mm, width 1.08 mm. Orange-brown with darker streaks radiating from fovea. Head region slightly lower than thoracic region. Fovea moderately long. Whole eye region suffused with black and covered with flattened white setae. *Eyes.* Anterior row straight. AME ca. 2 x diameter of ALE, separated from them by ca. 0.20 x their own diameter. AME separated from each other by 0.5 x their own diameter. Middle eyes 2.0 x diameter of AME and separated by 0.5 x their own diameter. PLE 0.75 x diameter of PME and separated by 2.33 x their own diameter. *Chelicerae.* Moderately long, pale orange-yellow with black mottling. Posterior margin with two teeth, that nearest the fang the largest, anterior margin with three teeth, the middle the largest. *Maxillae and labium.* Coloured as chelicerae. Maxillae ca. twice as long as labium and somewhat convex at distal end. Labium markedly longer than wide. Both with a scattering of dark bristles. *Sternum.* Yellowish orange heavily suffused with grey. Shield-shaped, not produced between hind coxae. *Legs.* Orange-yellow with all femora and tibiae IV suf-



Figures 16-17. *Amblyothele hamatula* sp. n. (holotype) **16** right male palp, ventral view; **17** right male palp, retrolateral view. Scale: 0.5 mm.



Map 4. Locality of *A. hamatula*.

fused with grey. Moderately long, ratio of length/breadth of tibiae IV 14.8:1. Leg IV 1.36 x length of leg I. Ventral spines of leg I; metatarsus 2-2-(2), tibia 2-2-(2). Lateral tarsal claws with 4 teeth, central claw minute, bent at right angles. *Abdomen*. Dorsally, base colour orange-yellow heavily suffused with black except on short central folium. Ventrally pale whitish-yellow. *Spinnerets*. Both dorsally and ventrally black. PLS long, second segment ca 0.75 x length of basal segment. *Male palp* (Figs 16-17). Median apophysis placed distally on tegulum. Apical lobe of median apophysis broad at base, tapering abruptly to a narrow tip. Posterior lobe with a small, forward pointing, barbed projection. Embolus invisible in unexpanded palp, long and thin, lying parallel to the projection and the same length as it.

Female unknown.

Distribution. Only recorded from the type locality in Côte d'Ivoire (map 4).

Amblyothele kivumba sp. n.

urn:lsid:zoobank.org:pub: Figs 18-19, Map 5

Diagnosis. The broad, deeply cupped apical lobe of the median apophysis of the male palp is distinctive as is the very long embolar tip which is clearly visible in ventral view.

Etymology. Named after the type locality.

Type material. Holotype. Male. RWANDA: Akagera N.P., lac Kivumba, 1.5 km from principal road, 01°43'S 030°45'E, 15.XI-4.XII.1985, pitfalls in wooded savannah, Jocqué, Nsengimana, Michiels leg. (MRAC 165654).

Paratype. 1 ♂: RWANDA: Akagera N.P., 10 km N of fisheries, 01° 40'S 030°35'E, 17.XI-4.XII.1985, pitfalls in savannah, Jocqué, Nsengimana, Michiels leg. (MRAC 165773).

Description. Total length: 3.08 mm. Carapace. Length 1.56 mm, width 1.10 mm. Dark greyish brown. Head region lower than thoracic region. Fovea long, with dark streaks radiating from it to the margin. Head region with a coating of adpressed iridescent white setae and many forward-pointing strong black bristles. Eyes. Anterior row markedly recurved. AME 2 x diameter of ALE, all eyes touching one another. Middle eyes 1.75 x diameter of AME and separated by 0.43 x their own diameter. PLE 0.86 x diameter of PME and separated by 2.83 x their own diameter. Chelicerae. Yellowish brown mottled with dark grey. Relatively short and stout for the genus and clothed in dark bristles. Posterior margin with two teeth, that nearest the fang the largest, anterior margin with three teeth, the middle the largest. Maxillae and Labium. Maxillae 2 x length of labium, truncate distally, coloured as the chelicerae. Labium wider than long, sub-quadrate, coloured as chelicerae. Sternum. Shield-shaped and strongly produced between the hind coxae. Coloured as chelicerae. Legs. Coloured as the carapace, without any darker banding. Long, ratio of length/breadth of tibia IV 10.5:1. Leg IV 1.35 x length of leg I. Ventral spines of leg I long and thin; metatarsus 2-2-(2), tibia 2-2-(2). Tarsal claws with 3 long fine teeth, central claw on pad and bent at right angles. Abdomen. Dorsally, dark grey with a feint paler central folium on the anterior third.



Figures 18-19. *Amblyothele kivumba* sp. n. (holotype) **18** right male palp, ventral view; **19** right male palp, retrolateral view. Scale: 0.5 mm.



Map 5. Localities of *A. kivumba*.

Clothed in dark bristles. Ventrally, pale yellowish. *Spinnerets*. Coloured as the abdomen. Long and thin with distal segment of PLS as long as basal segment. *Palp* (Figs 18-19). Median apophysis short, deeply cupped, with relatively narrow apical lobe, and with projection pointing forward. Embolus long and thin, as long as apophysis of basal lobe of MA and lying alongside it.

Female uknown.

Distribution. Known only from the type locality in Rwanda (map 5).

Amblyothele latedissipata sp. n. *urn:lsid:zoobank.org:pub:* Figs 20-27, 41, Map 6

Diagnosis. The male may be recognised by the shape of the median apophysis, the proximal end of which tapers to a point and lacks any forward pointing lobe. The female differs from other members of the genus in possessing a broadly cordate central plate in the epigyne and by the shape and position of the spermathecae as seen through the cuticle.

Etymology. The specific name is derived from the Latin for "widely distributed" and refers to the wide separation of the three known localities for the species.

Type material. Holotype. Male. TANZANIA: Mkomazi Game Reserve, 4°00'S, 38°00'E, 26.XI.1994, pitfall traps in open *Acacia/Commiphor*a bushland, A. Russell-Smith leg. (MRAC 225507).

Paratypes. TANZANIA: 8 \bigcirc 3 \bigcirc : together with Holotype (MRAC 225508); MOZAMBIQUE: 2 \bigcirc : near Marracuene, Blue Anchor Inn, 50 m a.s.l. 25°35.124'S 32°39.568'E, 28.XI.2007, sifting leaf litter, savannah, C. Haddad & R. Fourie leg. (NCA); SOUTH AFRICA: 2 \bigcirc : Tembe Elephant Park, Muzi Swamps, 27°01'S 32°24'E, pitfall traps, 22.I.2002, C. Haddad leg. (NCA).

Other material examined. TANZANIA: 7 $\stackrel{?}{\circ}$ 8 $\stackrel{?}{\circ}$: Mkomazi game Reserve, near Ibaya camp, 4°00'S, 38°00'E, IV.1995, A. Russell-Smith leg.; 4 ♂ 2 ♀: same site, IV. 1995; 2 ♂: same site, IV.1995; 2 ♂: same site, VI.1995; 2 ♂ 2 ♀: same site, XI.1995; 3 ♂ 1 ♀: same site, XII.1995; 2 ♂ 1 ♀: same site, III.1996; 10 ♂ 4 ♀: Mkomazi Game Reserve, Ibaya camp, IV.1995, from pitfall traps, in mixed grassland on footslope, A. Russell-Smith leg.; 13 ♂ 7 ♀: same site, V.1995; 1 ♂: same site, VI.1995; $6 \stackrel{?}{\circ} 2 \stackrel{?}{\circ}$: same site, VI.1995; $2 \stackrel{?}{\circ} 1 \stackrel{?}{\circ}$: same site, XI.1995; $1 \stackrel{?}{\circ}$: same site, III.1996; 3 Q: Kyela, 09°35'S 033°48'E, 18.XI.1991, cashew nut litter, sieved, R. Jocqué leg. (MRAC 173507). SOUTH AFRICA: 1 ♂: Kwazulu-Natal Province. Sani Pass, 29°39'S 029°27'E, 1200 m, 20.I.2008, pitfall trap, D. Prentice leg. (NCA); 2 🖧 same data as previous (NCA); 12: 15 km N of Richard's Bay, 10.XII.1966, rehabilitated coastal forest, T. Wassenaar leg. (NCA 97/946); 12: Kwazulu-Natal, Ndumo Game Reserve, Eastern shore of Shokwe Pan, 26°52.516'S 32°12.407'E, wandering around in leaf litter, C. Haddad leg. (MRAC 226176); 1∂: Kwazulu-Natal, Ndumo Game Reserve, 26°52.464'S 32°16.050'E, subtropical bush, Acacia nigrescens woodland, C. Haddad leg. (MRAC 226177).



Figures 20-27. *Amblyothele latedissipata* sp. n. 20-21, 25 specimen from Ndumo, South Africa; 22-24, 26-27 from Tanzania. 20, 22 left male palp, ventral view; 21, 23 left male palp, prolateral view; 24 male palp, retrolateral view; 25, 26 epigyne, ventral view; 27 epigyne, dorsal view, cleared. Scales: 20-24 0.5mm; 25-27 0.1 mm.

Description. Male. Total length, 3.75 mm. *Carapace.* Length 1.64 mm, width 1.24 mm. Colour pale yellow-brown with a feint paler longitudinal median band extending from behind the head region to hind margin. With some darker striae radiating from the fovea. Fovea relatively long (ca. 20% of carapace length). Head region not noticeably elevated. *Eyes.* Anterior row straight or very slightly procurved. AME 2.7 x diameter of



Map 6. Localities of A. latedissipata.

very small ALE and touching them. Middle eyes 2.25 x diameter of AME and about 0.33 x their own diameter apart. PLE 0.66 x diameter of PME and widely spaced, by ca. 2.0 x their own diameter. Immediate region of eyes densely black pigmented. Chelicerae. Long and narrow with a small fang. Coloured as carapace. Posterior margin with two very small teeth, anterior margin toothless. Maxillae and labium. Maxillae ca. 2 x length of labium, slightly broadened and strongly truncate distally. Colour very pale yellow. Labium slightly longer than broad, sub-quadrate, coloured as the maxillae and with a scattering of dark setae. Sternum. Shield shaped, slightly longer than broad, coloured as maxillae and with a scattering of dark setae. Legs. Typical of genus, long and thin, especially in male. Leg IV 1.27 x length of leg I. All segments pale yellow without any darker pigmentation. Ventral spines of leg I; metatarsus 2-2-(2), tibia 2-2-(2). Spines long, thin and pale. With three tarsal claws, the outer pair with five long thin teeth, the central claw small, on a raised pad and having two long serrated bristles adjacent. Abdomen. Dark grey-brown with a pale orange folium dorsally and, posterior to this, a pattern of chevrons with adjacent pale spots. The dorsal part densely clothed in dark setae. Ventrally pale whitishyellow. Spinnerets. The PLS long, almost 2 x length of AMS. Basal segment of PLS ca. 2 x length of terminal segment. Coloured as abdomen. Palp. Figs 20-24. Median apophysis situated distally, anterior lobe sickle-shaped, posterior lobe without a forward pointing projection on the proximal end, which tapers to a point. Embolus also situated distally, relatively narrow, the tip obscured by a narrow functional conductor.

Female. Total length 4.58 mm. Carapace. Length 1.75 mm, width 1.24 mm. Colour as in male but somewhat darker. Pattern more diffuse than in male. Head region not at all elevated. Eyes. Anterior row slightly recurved, all eyes touching. AME 1.66 x diameter of ALE. Middle eyes 1.8 x diameter of AME, separated by 0.33 x their own diameter. PLE 0.55 x diameter of PME and widely separated by 2.73 x their own diameter. Immediate region of eves suffused with black. Chelicerae. Similar to those of male in coloration and shape but slightly broader. Posterior margin with two small teeth, anterior margin with one very minute tooth. Maxillae and labium. Maxillae similar to those of male in colour and shape but rather broader in relation to length. Labium broader than in male but otherwise similar. Sternum. Identical in shape and colour to that of male. Legs. Similar of those of male but relatively shorter. Spination as in male but spines shorter, darker and more robust. Tarsal claws as in male but teeth longer and more robust. *Abdomen*. Dorsally, similar in colour to that of male but pattern much more indistinct. Ventrally, pale whitish yellow. Spinnerets. Long, proportions and coloration as in male. *Epigyne*. Figs 31, 32, 41. Central plate broadly cordate in shape with posterior margin slightly indented. Outline of spermathecae relatively small and positioned near the anterior end of central plate. Dorsal view Fig. 32.

Variation. Total length, males 3.50 - 4.17 mm (10 specimens), females 3.83 - 5.00 mm (9 specimens). There is some variation in the depth of pigmentation between individuals and in the distinctness of the dorsal pattern of the abdomen, with females generally having a less well defined pattern. The appearance of the female epigyne varies somewhat with the internal structures more visible through the cuticle in some specimens than others.

Distribution. Known from Mkomazi Game Reserve, Tanzania, Marracuene, Mozambique and Tembe Elephant Park, South Africa (map 6).

Biology. Over one hundred specimens of this species were taken in pitfall traps in Mkomazi Game Reserve between April 1995 and March 1996. Traps were operated for four days in each month in both *Acacia/Commiphora* bushland on a hillside and tall grassland on a footslope below. *Amblyothele latedissipata* was found in both habitats but was most abundant in bushland that had not been recently burnt. It also occurred commonly in a grassland area that had been burnt a few months previously but was almost absent from recently burnt bushland. It showed a peak of activity in all habitats in the wet months of April and May with a second minor peak in October.

Amblyothele longipes sp. n. urn:lsid:zoobank.org:pub: Figs 28-32, 40, Map 7

Diagnosis. The male may be recognised by the shape of the small median apophysis, with the anterior lobe sickle shaped and the posterior lobe truncate and pointing forward. The female differs from other members of the genus by the rounded posterior lobes of the posterior margin of the epigyne and the fairly long, slightly curved entrance ducts.

Etymology. The specific name refers to the exceptionally long, thin legs in this species.

Type material. Holotype. Male. COTE D'IVOIRE: Mbé, near Bouaké, WARDA site, 7°52'N 005°06'W, 12.IX.1994, quadrat in upland rice, A. Russell-Smith leg. (MRAC 223299).

Paratypes. COTE D'IVOIRE: 3 ♂: Mbé, near Bouaké, WARDA site, 2.IX.1994, quadrat in upland rice, A. Russell-Smith leg.; 9 ♂ 3 ♀: Bouaké, Mbé, WARDA site, 07° 52N' 005° 06'W, 12.IX.1994, trash management experiment, A. Russell-Smith leg. (MRAC 225505).

Other material examined. COTE D'IVOIRE: 2 \Im : Mbé, near Bouaké, WARDA site, 7°52'N 5°06'W, 1.X.1993, in tall *Andropogon* fallow; 1 O 2 \bigcirc : same site, 27.VII.1994. A. Russell-Smith leg.; 1 O: Mbé, near Bouaké, WARDA site, 7°52'N 5°06'W, 15.VIII.1994, pitfall traps in upland rice, A. Russell-Smith leg.; 3 O 2 \bigcirc : same site, 16.IX.1994; 1 O: same site, 14.XI.1994; 9 O: same site, 7.X.1994; 1 \bigcirc : same site, 23.VII.1995; 3 O 1 \bigcirc : same site, 17.VIII.1995; 4 O: same site, 7.IX.1995; 13 O 1 \bigcirc : same site, 26.IX.1995; 15 O 2 \bigcirc : same site, 14.X.1995; 1 O: same site, 26.XI.1995, A. Russell-Smith leg.; 1 O: Ganhoué, near Touba, 9°43'N 7°24'W, 27.VIII.1993, pitfall trap in upland rice field, A. Russell-Smith leg.; 3 O: Touba, VIII-X.1994, quadrats in upland rice, A. Russell-Smith leg.; 2 O 2O: Touba, 18.VI.1995, upland rice field, A. Russell-Smith leg.; 1 O: N of Korhogo, Bandama River, 09°27'N 005°38'W, IV.1980, edge riverine forest, J. Everts leg. (MRAC 171852). TOGO: 1 O 2 O: Bassari, 9°15'N 0°47'E, in pitfall trap, P. Douben leg. (MRAC 174086).

Description. Male. Total length. 3.50 mm. Carapace. Length 1.40 mm, width 0.94 mm. Pale yellow-brown with grey-black wedges radiating from fovea. Fovea long. Thoracic region slightly elevated relative to head region and posterior margin steeply sloping. Eyes. Anterior row slightly recurved. AME 2 x diameter of very small ALE and almost touching them. AME separated by 0.2 x their own diameter. Middle eyes 1.4 x diameter of AME and separated by 0.33 x their own diameter. PLE 0.86 x diameter of PME and separated by 2.17 x their own diameter. Eye region heavily suffused with black. Chelicerae. Long and relatively thin, yellow brown suffused with grey and with two darker longitudinal stripes. Posterior margin with three small teeth, the middle the largest; anterior margin with 3 small teeth, placed further from base of fang than those of posterior margin. Maxillae and labium. Maxillae 2 x length of labium, distally truncate. Pale yellow suffused with grey. Labium sub-quadrate, as long as broad, coloured as maxillae. Sternum. Shield shaped, broader than long, produced between hind coxae. Coloured as maxillae but paler. Legs. Exceptionally long and slender. Ratio of length/breadth of tibia IV 22:1. Leg IV 1.36 x length of leg I. Yellow with tibiae and metatarsi suffused with grey. Paired tarsal claws with 5 long curved teeth, central claw small, bent at right angles. With paired serrated bristles opposite claws. *Abdomen*. With a pale yellow folium anteriorly and three dark chevrons posterior to the folium. Yellowgrey with darker markings. Ventrally pale whitish yellow. Spinnerets. Long and thin, typical of genus. PLS ca 2 x length of AMS, their second segments equal in length to basal segments. Coloured as abdomen. Palp. Figs 28-30. Cymbium pale yellow-brown.



Figures 28-32. *Amblyothele longipes* sp. n. (male holotype; female paratype) **28** right male palp, ventral view; **29** right male palp, retrolateral view; **30** right male palp, prolateral view; **31** epigyne, ventral view; **32** epigyne, dorsal view, cleared. Scales: **28-30** 0.5 mm; **31-32** 0.1 mm.



Map 7. Localities of A. longipes.

Median apophysis relatively small, situated distally, with an apical sickle-shaped arm and a truncate basal lobe oriented anteriad. The two arms of the apophysis appearing to almost touch when viewed ventrally. Tip of embolus almost entirely concealed by the relatively broad functional conductor.

Female. Total length 3.75 mm. Carapace. Length 1.54 mm, width 1.04 mm. Colour as in male but somewhat darker. Fovea long. Head region not at all raised. Eyes. Anterior row slightly recurved. AME 2 x diameter of ALE and almost touching them. AME separated by 0.5 x their own width, Middle eyes 1.25 x diameter of AME and separated by 0.60 x their own diameter. PLE 0.84 x diameter of PME and separated by 1.44 x their own diameter. Eye region suffused with black and with a covering of white decumbent setae. Chelicerae. Similar to those of male but broader and shorter and with a stouter fang. Coloured as in the male but with many stout black bristles. Teeth as in male but shorter and stouter. Maxillae and labium. Broader than in male and with more dark pigmentation. Labium as in male but with darker pigmentation. Sternum. As in male but more darkly pigmented. Produced into a lobe between the hind coxae. Legs. Long and thin but much less so than in male. Ratio of length to breadth of tibia IV 17:1. Coloration darker than in male but otherwise similar. Paired tarsal claws as in male but larger and stouter. Abdomen. Coloration and dorsal pattern as in male but darker. Beset with dark bristles and white (plumose ?) setae. Underside as in male. Spinnerets. As in male but larger and more darkly pigmented. Epigyne. Figs 31-32, 40. In ventral view, posterior margin of epigyne rounded and deeply notched. Spermathecae small, situated near anterior margin. Slightly curved ducts just discernible through cuticle directed forward from spermathecae. Dorsal view, Fig. 40.

Variation. Total length, males 3.33-3.75 mm (6 specimens), females 3.33-3.92 mm (5 specimens). There is some variation in depth of pigmentation between individuals and in the distinctness of the dorsal pattern of the abdomen varies. The appearance of the female epigyne varies somewhat with the internal structures more visible through the cuticle in some specimens than others.

Distribution. This species has been recorded in Côte d'Ivoire and Togo (map 7).

Biology. This species has been taken in both tall savannah with *Andropogon gayanus* and in upland rice fields in Côte d'Ivoire. It occurred in the derived savannah zone at Bouaké and Touba but was apparently absent from the forest zone at Gagnoa. In upland rice at Bouaké it appear to have a peak of activity in the second half of September and first half of October, approximately coincident with the flowering and seed setting phase of rice growth.

Amblyothele togona Roewer, 1960

Figs 1-9, 33-39, Map 8

Diagnosis. The median apophysis of the male palp most resembles that of *A. longipes* but the apical lobe is considerably broader in relation to its length and the basal lobe is shorter and not forked at its tip. The embolus is broader in relation to length than that

of *A. longipes* and is more apparent in ventral view. The female epigyne has a very deeply notched posterior margin that is distinctive. The stout banded legs are characteristic.

Type material. Holotype. Female: TOGO. Without further data (SMF).

Other material examined. CÔTE D'IVOIRE: $1 \stackrel{\bigcirc}{\downarrow}$ (with egg-sac): Ganhoué, near Touba, 8°11'N 7°51'W, 27.VIII.1993, pitfall trap in upland rice field, A. Russell-Smith leg.; 12: Bouaflé, 6°59'N 5°45'W, 28.I.1981, pitfalls, J. Everts leg. (MRAC 174006). CAMEROON: 5 ♂ 3 ♀: Ebolowa, 02°54'N 011°09'E, IV.1980, pitfall traps, A. Russell-Smith leg. (MRAC 223302); ^Q: Chabal Mbabo, 7°25'N 12°47'E, 8.IV.1983, from litter in gallery forest, Bosmans & Van Stalle leg. (MRAC 162625). KENYA: 1 2: Kakamega Forest, 00°13'N 034° 54'E, 17-24.III.2002, Malaise trap, D. Shilabira Smith leg. (MRAC 212619); 1 2: Kakamega Forest, 00°13'N 034°54'E, 6.IV.2002, malaise trap, D. Shilabira Smith leg. (MRAC 220463). CONGO DR: 1 🖧 3 🖓: Kisangani, Forêt de Masako, N 00°35' E 025°11', 20.VII.2001, young fallow, J.-L. Juakaly leg. (MRAC 211829); 1 \bigcirc 1 \bigcirc : same locality, 27.VII.2001, young fallow, J.-L. Juakaly leg. (MRAC 211842); 2 Q: same locality, 18.VII.2001, young fallow, J.-L. Juakaly leg. (MRAC 211854); 2 ♀: same locality, 20.VII.2001, young fallow, J.-L. Juakaly leg. (MRAC 211866); 1 ♀: same locality, 13.VII.2001, young fallow, J.-L. Juakaly leg. (MRAC 211926); 2 \Im : same locality, 12.VII.2001, young fallow, J.-L. Juakaly leg. (MRAC 211978); 1 🖒 4 \mathbb{Q} : same locality, 13.VII.2001, young fallow, J.-L. Juakaly leg. (MRAC 212019); 1 \mathbb{Q} : same locality, 12.VII.2001, young fallow, J.-L. Juakaly leg. (MRAC 212033); 2 2: same locality, 5.VII.2001, young fallow, J.-L. Juakaly leg. (MRAC 212063); 1 2: same locality, 11.VII.2001, young fallow, J.-L. Juakaly leg. (MRAC 212070); 2 2: same locality, 11.VII.2001, young fallow, J.-L. Juakaly leg. (MRAC 212111); 1 2: same locality, 5.VII.2001, young fallow, pitfall, J.-L. Juakaly leg. (MRAC 212115); 2 🖧: same locality, 17.XII.2002, young fallow, pitfall, J.-L. Juakaly leg. (MRAC 214364); 1 🖧 same locality, 24.IX.2002, young fallow, pitfall, J.-L. Juakaly leg. (MRAC 214572).

Description. Female (holotype): Total length, 3.33 mm. Carapace. Length 1.42 mm, width 1.20 mm. Orange brown suffused with greyish black except for central longitudinal band. Head region not noticeably raised. Fovea relatively short. Immediate surroundings of eyes suffused with black. Eyes. Anterior row very slightly recurved. AME 2 x diameter of ALE and touching them, separated by ca 0.2 x their own diameter. Middle eyes 1.75 x diameter of AME, separated by 0.43 x their own diameter. PLE 0.57 x diameter of PME separated by 3.75 x their own diameter. Chelicerae. Greyish orange. Relatively short and stout for genus, with a few dark bristles. Posterior margin with two teeth, that nearest fang the larger, anterior margin with three small teeth, the central largest. Maxillae and labium. Maxillae ca 2 x length of labium and with relatively rounded distal margins. Labium as long as wide, sub-quadrate. All pale yellow except for darker triangle at base of labium. Sternum. Pale yellow. Shield-shaped and produced between hind coxae. Legs. Only three legs surviving on specimen. Pale yellow with two dark grey rings on femora and tibiae. Relatively stout, ratio of length/breadth of tibia IV 9.1:1. Ventral spines of leg I; metatarsus 2-2-(2), tibia 2-2-(2). Spines long, thin and pale. With three tarsal claws, the outer pair with three long thin teeth, the central claw small, on a raised pad and bent at right angles. Abdomen. Dorsally very



Figures 33-38. *Amblyothele togona* Roewer (male from Ebolowa, Cameroon) **33** right male palp, ventral view; **34** right male palp, prolateral view; **35** epigyne (specimen from Ebolowa, Cameroon); **36** epigyne, specimen from Masako, DR Congo; **37** epigyne, holotype; **38** epigyne, dorsal view, cleared, specimen from Masako, DR Congo. Scales: **33-34** 0.5 mm; **35-38** 0.1 mm.

dark greyish brown with a feint paler central folium. Ventrally pale whitish yellow. *Spinnerets*. Coloured as abdomen. PLS long, the distal segment 0.8 x length of basal segment. *Epigyne*. Figs 3, 35-39. Very similar in general appearance to that of *A. lon-gipes*. Epigynal plate almost twice width of that of *A. longipes*. Outline of spermathecae through cuticle larger and sperm ducts shorter and broader. Notch on hind margin of epigynal plate broader than that of *A. longipes* and lobes pointed.

Male. Total length 3.50 mm. *Carapace*. Length 1.75 mm, width 1.17 mm. Head region not at all raised. Fovea long, 0.25 x length of carapace. With a broad pale yellow-brown dorsal stripe along carapace and with grey-black wedges radiating from fovea to carapace margin. A series of long dark bristles along the central stripe of the carapace. *Eyes.* Anterior row recurved. AME 1.67 x diameter of ALE and almost touching them. Middle eyes 1.80 x diameter of AME and separated by 0.33 x their own diameter. PLE 0.78 x diameter of PME and separated by 2.1 x their own diameter. Immediate eye region suffused with black. *Chelicerae.* Relatively long and narrow. Chestnut brown with a narrow darker stripe extending along half the length of the anterior face. Hind margin with two teeth, that nearest to fang the larger, posterior margin with one large tooth. *Maxillae and labium.* Maxillae ca 2 x length of labium and strongly truncate at distal end. Pale yellow-brown. Labium subquadrate, as long as broad, coloured as maxillae. *Sternum.* Shield shaped and somewhat produced between hind coxae. Pale yellow. *Legs.* Relatively long and thin, ratio of length/breadth of tibia IV 15:1. Leg IV 1.33 x length



Figures 39-42. Epigynes, cleared, dorsal view; **39** *Amblyothele togona* sp. n. (Masako, Congo DR); **40** *Amblyothele longipes* sp. n. (Mbé, Ivory Coast); **41** *Amblyothele latedissipata* sp. n. (Mkomazi, Tanzania); **42** *Amblyothele albocincta* (Okavango). Scales = 0.1 mm.

of leg I. Ventral spines of leg I; metatarsus 2-2-(2), tibia 2-2-(2). Spines relatively short for genus. All segments pale orange-yellow, clothed in short dark setae. Tarsal claws (fig. 9) with 2-3 fine teeth, typical of genus. Inferior claw with five small teeth. Tarsal organ with keyhole shaped opening (Fig. 8). *Abdomen*. With greyish-brown markings on a paler yellow background. With a dark dorsal folium anteriorly and behind this 3 faint chevrons. Ventrally pale whitish. *Spinnerets* (Figs 4-5). PLS ca 2 x length of AMS. Terminal segment of PLS 0.7 x length of basal segment. Coloured as the abdomen.

Male Palp. Figs 6, 7, 33, 34. Median apophysis rather similar to that in *A. longipes*. Apical lobe sickle-shaped but not tapering to a narrow tip as in *A. longipes*. Basal lobe with short forward pointing projection which is truncate at tip. Anterior and posterior lobes of MA do not approach close to one another. Embolus very broad, clearly visible alongside MA.

Variation. Total length, males 3.50 - 3.83 mm (5 specimens). There is some variation in depth of pigmentation between individuals and in the distinctness of the dorsal pattern of the abdomen varies. The shape of the epigyne may vary considerably depending on the inclination. In the holotype the V-shaped notch is not conspicuous because the posterior part of the epigyne is slightly invaginated.

Distribution. Known from Côte d'Ivoire, Cameroon, D.R. Congo and Kenya (map 8).

Biology. Unlike other species of the genus, *A. togona* has been recorded in the litter of a riverine forest.



Map 8. Localities of A. togona.

Discussion

There is a superficial similarity between *Amblyothele* species and representatives of the genus *Trebacosa* Dondale & Redner, 1981 of which a species has recently been discovered in Europe (Szinetár and Kancsal 2007, Villepoux 2007) and which clearly belongs in the Piratinae. However there are clear differences between *Trebacosa* and *Amblyothele*. In the former, the cephalothorax is densely covered in short setae, the position of the eyes is clearly different, and the legs are much shorter. Among the differences in the structure of the genitalia, mainly the large and prominent MA and TA on the male palp and the very short copulatory ducts in the epigyne of *Trebacosa*, discern it from *Amblyothele*.

In Africa, lycosid spiders of the subfamily Piratinae [sensu Zyuzin (1993)] are represented by at least six genera. The nominate genus Pirata includes 10 described species from throughout the continent. The African representatives of the genus have never been fully revised and since seven of these are known only from females it is likely that a number of synonyms exist. As in Europe and N. America, nearly all African Pirata species are associated with wetland habitats. The monotypic genus Auloniella (holotype male of A. maculisterna Roewer, 1960 in ZMB seen) is very close to Pirata and may yet be considered to belong to that genus once revised. *Proevippa* is currently represented by 11 species, almost entirely confined to southern Africa and characteristic of savannah grasslands and open woodland. Trabea, which is closely related to Proevippa (Russell-Smith 1982) is also largely southern African although T. bipunctata and T. heteroculata extend northwards as far as Rwanda (Alderweireldt 1999) and Ethiopia. Most of the 11 species are recorded either from grasslands or fynbos. The recently described and enigmatic monotypic genus Minicosa from S. Africa is probably also best placed in the Piratinae, showing some similarities to Trabea (Alderweireldt and Jocqué 2007). The genera Pterartoria Purcell and Pterartoriola Roewer have never been fully revised and although both have a palpal structure that shares features with Proevippa and Trabea, their relationships remain obscure. The four species in each of these genera are confined to South Africa.

The genus *Amblyothele* can now be added to these. The genus is closest to *Pirata* in terms of genitalic morphology but differs significantly in its generally smaller size, longer legs and different leg chaetotaxy. It also differs from *Pirata* in its habitat preference, the former ocurring in wetlands while *Amblyothele* species are found in a range of different savanna grassland and open woodland habitats. Like *Pirata*, the geographical range of *Amblyothele* in Africa is wide, the species being found from Côte d'Ivoire in W. Africa to Rwanda in E. Africa and southwards to Botswana, Mozambique and South Africa.

Acknowledgments

We are indebted to A. Dippenaar-Schoeman (NCA), J. Dunlop (ZMB), P. Jäger (SMF) for loan of material. Charles Haddad made a special effort to make recently collected specimens available for study. Many thanks are due to Alain Reygel for preparation of the drawings.

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RESEARCH ARTICLE



On two sibling *Lathys* species (Araneae, Dictynidae) from northern Europe

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Academic editor: Jason Dunlop | Received 2 March 2009 | Accepted 29 April 2009 | Published @@ August 2009

Citation: Marusik YM, Koponen S, Fritzén NR (2009) On two sibling *Lathys* species (Araneae, Dictynidae) from northern Europe. In: Stoev P, Dunlop J, Lazarov S (Eds) A life caught in a spider's web. Papers in arachnology in honour of Christo Deltshev. ZooKeys %%: 1-14. doi: 10.3897/zookeys.%%.\$\$\$

Abstract

New diagnoses for the morphologically closely related species *Lathys humilis* (Blackwall, 1855) and *L. nielseni* (Schenkel, 1932) are provided. These species are most easily distinguished from one another by their abdominal patterns. Detailed illustrations are provided, and the distribution limits and habitat preferences of both species are discussed. Previous records of *L. humilis* from Finland refer to *L. nielseni*. The taxonomy of the genus *Lathys* is also briefly discussed.

Keywords

Lathys humilis, Lathys nielseni, spiders, taxonomy, distribution, habitats

Introduction

Lathys is a relatively large genus of dictynid spiders with 38 species known exclusively from the Holarctic (Platnick 2009). This genus has not been revised on a large scale. Our recent studies on the morphology of the male palp (Marusik et al. 2006) revealed that members of *Lathys* have a highly complex palpal structure with several features unique for the family and even for the order. Three species of *Lathys* are known to occur in northern Europe: *L. humilis* (Blackwall, 1855), *L. nielseni* (Schenkel, 1932)

and *L. stigmatisata* (Menge, 1869) (Roberts 1995, Almquist 2006). Only the first two species are known from Fennoscandia (Norway, Sweden and Finland). For more than a decade following Lehtinen's (1967) revision, *L. nielseni* was considered a synonym of *L. humilis*. The former species, which was described from Öland Island, Sweden, was removed from synonymy by Thaler (1981) who could show distinct differences in the morphology of the male palp and more prominent differences in the shape of the female epigyne.

A recent survey of the Swedish fauna revealed that two closely related species, *L. humilis* and *L. nielseni*, occur in the southeastern region of the country (Almquist 2006). Finnish check-lists of spiders (Palmgren 1977, Koponen 2008) mention only *L. humilis*. During our studies of Palaearctic *Lathys* we realized that specimens of *L. humilis* from Finland differ greatly in their abdominal patterns from specimens of the same species from Crimea, Azerbaijan and Iran. The Finnish specimens of *L. humilis* that we studied, stored in the collections of the Zoological Museums of the University of Turku and the University of Helsinki, actually belong to *L. nielseni*. Although the male palps in these two species are very similar, the epigynes are quite different, and both species can be easily distinguished by their abdominal patterns. The specific abdominal coloration is distinct even in juveniles. The differences in patterns were illustrated by Almquist (2006), but the importance of such differences was not commented on or even mentioned.

The goal of this study is to provide detailed diagnoses for both species and to trace the distribution range of these two sibling *Lathys* species.

Materials and methods

Specimens were photographed using an Olympus Camedia C-5050 camera attached to an Olympus SZX12 stereomicroscope. The images were processed using "CombineZM" image stacking software. SEM-microphotographs were taken with a JEOL JSM-5200 in the Zoological Museum, University of Turku. Scales in some figures are missing because of the lack of special equipment and/or computer programs. All measurements are given in millimetres.

Acronyms:

- **ZMH** Zoological Museum, Finnish Museum of Natural History, University of Helsinki
- ZMMU Zoological Museum, Moscow Lomonosov State University
- **ZMT** Zoological Museum, University of Turku.

Abbreviation used for the copulatory organs: Ca – apical portion of conductor; Ct – tip of conductor; Co – copulatory opening; Da – dorsal tibial apophysis; Fm – margin of the epigynal fovea; Ia – intermediate tibial apophysis; Pa – patellar apophysis; Se – septum; Va – ventral tibial apophysis.

Lathys Simon, 1884

Lethia Menge, 1869: 249.

Lathys Simon, 1884: 321, nomen novum pro Lethia Menge, 1869 preoccupied by Lethia Hübner, 1816 in Lepidoptera.

Type species: *Lethia varia* Menge, 1869 from Prussia. It is considered a junior synonym of *Ciniflo humilis* Blackwall, 1855 (= *Lathys h.*, from England). The type specimens of *L. varia* seem to be lost. It is unclear as to whether *L. varia* and *L. humilis* are synonyms. *L. varia* may also be a senior synonym of *L. nielseni* (Schenkel, 1932), the coloration and habitat data of Menge (1869) may refer to both species.

Lathys humilis is considered by several arachnologists, for example Lehtinen (1967), Thaler (1981) and Platnick (2009), to be the type species of the genus. However, Gertsch (1946) and Chamberlin and Gertsch (1958) clearly indicated that *Lethia varia* was the generotype, even though it is a junior synonym of *L. humilis*.

Lehtinen (1967) seems to have been the first to split *Lathys* into eight species groups. The third group was named *humilis*. Lehtinen (1967) included three species in this group: *L. alticola* (Denis, 1954); *L. brevitibialis* Denis, 1956 (still known from males only) and *L. sexpustulata* (Simon, 1878) and seems to have forgotten to include *L. humilis* in the list. It is not clear whether all three species belong to this group. One subspecies, *L. humilis meridionalis* (Simon, 1874), known from Spain, France, Corsica and North Africa (Platnick 2009) is not mentioned by Lehtinen (1967). Its status remains unclear, because it has not been studied by taxonomists in recent years. All three taxonomic entries for this species belong to Simon (Platnick 2009). Following the removal of *L. nielseni* and *L. annulata* Bösenberg & Strand, 1906 from synonymy with *L. humilis* (Thaler 1981, Ono 2003), and the recent synonymisation of *L. alticola* with *L. sexpustulata* (Ledoux et al. 2008) the *L. humilis*, *L. annulata* and *L. nielseni*) have been properly studied and undoubtedly belong to the *humilis* group.

The detailed morphology of the male palp in *Lathys* in general, and in its type species in particular, was unknown for a long time. There was no detailed written or illustrated description of the palpal tibia and bulbus. Thaler (1981) was the first to indicate and illustrate three tibial apophyses in *Lathys humilis* and *L. nielseni*. The structure of the bulbus in the *Lathys stigmatisata*-group was first studied by Marusik et al. (2006). They found that members of this group had a unique modification of the conductor, consisting of a very long upper part forming several coils over one another, a very long embolus, and a totally fixed terminal part of the conductor by the tibial apophyses and cymbium [cf. Marusik et al. (2006)]. The present study revealed that *L. humilis* and *L. nielseni* have the same conformation of the bulbus in general and the conductor in particular. As a result of this and previous studies it became possible to provide a new, revised diagnosis for the genus.

Lathys can be easily distinguished from other dictynids by the presence of three tibial apophyses, the long and coiled upper arm of the conductor, which totally covers the tegulum, and a screw-like terminal part of the conductor arrested by the tibial apophyses and the cymbium (Figs 13, 15-17, 19).

Females of *Lathys* cannot be diagnosed so easily. In all *Lathys* species studied by us (*L. stigmatisata-* and *L. humilis-*groups) the insemination ducts make a kind of loop or coil around the copulatory opening (cf. Figs 27, 30 and fig. 229b in Wiehle 1953). In addition, the epigynal fovea or the pair of copulatory openings are larger than or equal to the spermatheca or in some cases about two times smaller. The related genus *Scotolathys* Simon, 1884 has no loops (or coils) around the copulatory duct, and its spermatheca is much larger than its fovea (cf. Marusik et al. 2009).

Lathys humilis (Blackwall, 1855)

Figs 1-3, 7-9, 13-16, 20-22, 26-27

- *L. h.*: Wiehle 1953: 102, f. 222-227 (♂♀).
- *L. h.*: Thaler 1981: 127, f. 77-79, 85-86 (♂♀).
- *L. h.*: Almquist 2006: 319, f. 280a-h (♂♀).
- For other references, see Platnick (2009). Some of them may refer to *L. nielseni* or other species.

Misidentifications:

L. h.: Schenkel 1936: 14, f. 1a-b (\bigcirc). May refer to undescribed species.

- L. h.: Lehtinen 1967: 242, f. 264 (3). Refers to L. nielseni.
- L. h.: Palmgren 1977: 22, f. 4.20-24 (22). Refers to L. nielseni.
- *L. h.*: Paik 1978: 185, f. 75.1-5 (^Q). Seems to refer to *L. maculosa* (Karsch, 1879).
- L. h.: Hu 1984: 60, f. 55. 1-2 (Q). Refers to L. nielseni.
- L. h.: Zhu 1985: 58, f. 48a-c (3). May refer to L. nielseni or to L. annulata.
- L. h.: Song et al. 1999: 364, f. 215N (3). May refer to L. nielseni or to L. annulata.
- L. h.: Song et al. 2001: 287, f. 181A-B (d). May refer to L. nielseni or to L. annulata.

Material examined. DENMARK: 1 \bigcirc (ZMT: AA 11.130), Bornholm Isl., Ibsker, Paradisbakkerne Grydedal, in small sphagnum beds around a small pond, 30.06.1967 (P.T. Lehtinen). BULGARIA: 1 \bigcirc (ZMMU), Blagoevgrad Distr., Rila Mt. range, ESE slope of Karpatnik Mt., Bodovitsa River Valley, right riverside, ca 3.8 km WNW of Bachevo, *Pinus & Fagus* forest, 41°56'12"N, 23°24'09"E, 1230 m, 10.08.2005 (A. Gromov). UKRAINE: 35 \checkmark \bigcirc (ZMUT, ZMMU) **Crimea**, Simferopol Distr., Chatyr-Dagh Mt., 23.04.2000 (D.S. Letova); Feodosya Distr., Karadag Nature Reserve, Kara-Agach Mt., *Juniperus excelsa*, sweeping, 14-16.05.2008 (A.A. Nadolny); Yalta Distr., Martyan Cape Reserve, 30.04.-13.05.2007 (M.M. Kovblyuk); 1 \checkmark (ZMMU), **Ternopil'** Area, environs of Dzvynyach Village, old nest of *Sylvia atricapilla*, on bush 0.9 m above the ground, 5.05.2006 (M. Fedoryak). AZERBAIJAN: $2\sqrt[3]{31}$ (ZMMU), SE Azerbaijan, Lenkoran Dist., environs of Aurora Village, 38°40'N 48°52'E, 23-28.04.2001 (Yu.M. Marusik); $1\sqrt[3]{}$ (ZMMU) same locality and collector, 21-29.05.2003; $2\circupee$ (ZMMU), SE Azerbaijan, Lenkoran Distr., Hyrcan Reserve, environs of Apo Village, 38°38'N 48°47'E, 28.05.2003 (Yu.M. Marusik); $1\sqrt[3]{}$ (ZMMU), SE Azerbaijan, ca 10 km W of Astara Village, Isti-Su, 38°27'N 48°47'E, 25.04.2001 (Yu.M. Marusik). IRAN: $2\circupee$ (ZMMU), Mazandaran Prov., Nashtarood-Khoshkadaran, 51.033°E 36.750°N, 9-10.06.2000 (Yu.M. Marusik).

Description. Measurements (Crimean specimens). **Male**. Total length 1.7; carapace 0.9 long, 0.7 wide, 0.4 high; chelicerae 0.5 long. Variation (n=2): total length 1.6-1.7; carapace 0.8-0.9 long, 0.6-0.7 wide; 0.4 high.

0	0 0					
	femur	patella	tibia	metatarsus	tarsus	total
Ι	0.8	0.3	0.7	0.6	0.4	2.8
II	0.6	0.3	0.5	0.5	0.3	2.2
III	0.5	0.2	0.4	0.4	0.2	1.7
IV	0.6	0.2	0.5	0.5	0.2	2.0

Length of leg segments:

Female. Total length 1.9; carapace 0.8 long, 0.6 wide, 0.4 high; chelicerae 0.4 long. Variation (n=3): total length 1.9; carapace 0.8-0.9 long; 0.6 wide, 0.4 high.

	femur	patella	tibia	metatarsus	tarsus	total
Ι	0.7	0.2	0.6	0.5	0.3	2.3
II	0.6	0.2	0.4	0.4	0.2	1.8
III	0.5	0.2	0.3	0.4	0.2	1.6
IV	0.6	0.2	0.4	0.5	0.2	1.9

Length of leg segments:

Colouration. Carapace in both sexes without distinct pattern. Males slightly darker than females. Abdomen with distinct pattern consisting of white guanine dots, black pigment (cardiac mark, sides, and wide posterior band). Legs with distinct annulations.

Copulatory organs. Male palp (Figs 7-9, 13-16) with patellar apophysis, tibia with three apophyses (retrolateral dorsal, retroventral and retrolateral (or intermediate) that fix (lock) terminal part of conductor. Conductor very long with two arms. Upper arm coiled, and terminal part spine-like and slightly twisted. Epigyne as in Figs 20, 26-27 with one shallow fovea, and copulatory openings placed in apical-lateral part of fovea. Receptacula droplet-shaped. Insemination ducts short and forming one turn.

Diagnosis. *Lathys humilis* can be easily distinguished from the closely related *L. nielseni* by the abdominal pattern consisting of dark stripes and white spots formed from guanine deposits (Figs 1-3). White guanine deposits are totally absent in *L. nielseni* (Figs 4-6). The two species can also be separated on the basis of the copulatory organs. The epigyne of *L. humilis* has shorter insemination ducts turned upwards in



Figures 1-6. Habitus and pattern of *Lathys humilis* (1-3) and *L. nielseni* (4-6). 1, 4 male, dorsal; 2-3, 5-6 female, dorsal. 1-2 from Crimea; 3 from Azerbaijan; 4-5 from Finland; 6 from Ural.

the place where they are attached to the spermathecae. The females also differ in the shape of the fovea (cf. Figs 20, 30). In *L. humilis* the epigynal fovea is subdivided by the septum, fovea deep with distinct margins (there is no septum and there are no distinct margins of the fovea in *L. nielseni*). The male palps of the two species are more similar than the epigynes. The two species can be separated by the thicker and broader patellar apophysis in *L. humilis*, the shape of the dorsal tibial apophysis, and the thicker and longer tip of the conductor in *L. humilis*.

L. humilis can be distinguished from the Japanese *L. annulata*, treated for a long time as a junior synonym, by its droplet-shaped spermathecae and its shorter insemination duct forming one loop only (vs. round spermathecae and insemination ducts forming several coils, cf. figs 10-12 in Ono 2003).



Figures 7-12. Male palp of *Lathys humilis* (7-9, from Crimea) and *L. nielseni* (10-12, from Finland). 7, 10 ventral; 8, 11 retrolateral; 9 bulbus, retrolateral; 12 bulbus, dorsal. 12 after Marusik et al. (2009).

Distribution. According to the Platnick's (2009) catalogue, this species has a Palaearctic (=trans-Palaearctic) distribution with several records from China (Shandong, Anhui, Shanxi and Gansu), Taiwan and Korea. Judging from the figures of the Chinese specimens, all records of *L. humilis* refer to *L. nielseni* or another species (males of *L. annulata* are unknown). Judging from the figures (cf. Fig. 32) the record of this species from Shandong (Hu 1984) refers to *L. nielseni*. Other records of *L. humilis* from eastern China based on males may also refer to *L. nielseni* or *L. annulata*. The actual species belonging of "*L. humilis*" from Gansu (Schenkel 1936) remains unclear. Figures of the epigyne made by Schenkel are dissimilar to those of *L. humilis* or *L. nielseni*. The specimen stored in the Swedish Museum of Natural History, Stockholm lacks an epigyne and the abdominal pattern is indistinct. The record of this species from Korea (Paik 1978) refers to *L. maculosa* (Karsch, 1879), which belongs to the *Lathys stigmatisata*-group. According to our studies of the Palaearctic *Lathys*, *L. humilis* seems to be distributed from western Europe to Caucasus and Mazandaran, northern Iran (see "material examined"). The overlapping ranges of *L. humilis* and *L. nielseni* in SW Sweden may be caused partly by misidentifications. Both species were found, however, in samples from Öland in the Swedish Museum of Natural History.



Figures 13-19. Male palp of *Lathys humilis* (**13-16** from Crimea) and *L. nielseni* (**17-19** from Finland). **13, 17** retrolateral; **14, 18** ventral; **15-16, 19** patella, tibia and base of cymbium, retrolateral-dorsal, different turns. **13, 15** after Marusik et al. (2009). Scale = 0.1 mm if not otherwise indicated.

Habitats. According to Hänggi et al. (1995), *L. humilis* is found in Europe especially in coniferous forests (both spruce and pine), on the forests' edges, in field shrubs and hedges, and less frequently in deciduous forests. It has been collected mostly on trees, both in canopies and on stems (Hänggi et al. 1995). According to Roberts (1995), in Great Britain it occurs on bushes and trees with small, hard leaves (heather, gorse, box, yew). Harvey et al. (2002) reported this species from bushes and trees in woodland and scrub, on oak, yew, pines, gorse, etc. It may also be fairly common on ornamental evergreen and privet hedges in parks and gardens; juveniles overwinter in leaf litter, brushwood, under bark and in other similar places (Harvey et al. 2002). In Sweden the species was reported from litter in dry pine forests, from *Calluna*-stands and from litter in woods with oaks and on limestone (Almquist 2006).

Note. Lehtinen (1967) synonymised three species with *L. humilis: L. annulata* (Japan), *Altella nielseni* Schenkel, 1932 (Sweden) and *Altella lathysoides* Denis, 1937 (Algeria). The first two names were removed from synonymy by Ono (2003) and Thaler (1981) respectively.

Lathys nielseni (Schenkel, 1932)

Figs 4-6, 10-12, 17-19, 23-25, 28-32

Altella n. Schenkel, 1932: 206, f. 1 (D♀).

- L. humilis: Lehtinen 1967: 242, f. 264 (3). Misidentification
- *L. bifoveolatus* Miller, 1971: 71, pl. IV, f. 3 (D $\stackrel{\bigcirc}{\rightarrow}$).
- L. humilis: Palmgren 1977: 22, f. 4.20-24 (♂♀). Misidentification.
- *L. n.*: Thaler 1981: 126, f. 74-76, 80-84 (♂♀).
- L. humilis: Hu 1984: 60, f. 55.1-2 (Q). Misidentification, seems to refer to L. nielseni.
- *L. n.*: Roberts 1987: 170, f. 88a (♂♀).
- *L. n.*: Heimer and Nentwig 1991: 380, f. 985 ($\bigcirc \bigcirc$).
- *L. n.*: Roberts 1995: 88, f. (♂♀).
- *L. n.*: Roberts 1998: 90, f. (♂♀).
- *L. n.*: Almquist 2006: 320, f. 281a-f (♂♀).
- L. humilis: Zhu 1985: 58, f. 48a-c (3). Misidentification, seems to refer to L. nielseni or L. annulata.
- L. humilis: Song et al. 1999: 364, f. 215N (3). Misidentification, seems to refer to L. nielseni or L. annulata.
- L. humilis: Song et al. 2001: 287, f. 181A-B (3). Misidentification, seems to refer to L. nielseni or L. annulata.

Note: some of the references to L. humilis may refer to this species.

Material examined. FINLAND: Åland Isl., Geta, Getaberget: 6° , 27° , 33 juv. (ZMT/ARA28251), lichenous rocks, 24.05.1975 (P.T. Lehtinen); Humppila, Rantakallio: 1° (ZMT), 28.06.1962 (P.T. Lehtinen); Parainen, Mustfinnö: 1°_{\circ} (MZT), forest, 4.06.1968 (S. Koponen); same locality: 1°_{\circ} , 15°_{\circ} (ZMT), *Vaccinium*-type forest



Figures 20-25. Epigyne and male chelicera of *Lathys humilis* (20-22 from Crimea) and *L. nielseni* (23-25 from Finland). 20, 23 epigyne, ventral; 21, 24 frontal; 22, 25 inner. 20 from Azerbaijan, 21-22 – from Crimea. Scale = 0.1 mm.

(P.T. Lehtinen); same locality: 13, 25 (ZMT), among moss in forest, 14.06.1966 (M. Saaristo); Turku, Kärsämäki, Pomponrahka: 5^o/₊ (ZMT), among *Cladonia*, 29.03.1967 (M. Saaristo); Dragsfjärd, Purunpää: 1Å (ZMT), 6.06-20.07.1971 (P.T. Lehtinen); Rymättylä, Ruotsalainen: 1^Q (ZMT), 10.07.1971 (P.T. Lehtinen); Nauvo, Seili: 1♀ (ZMT), lichenous rock, 1-30.10.1967 (P. Häkkilä); Somero, Ruunala: 1♂ (ZMT), 1974-1975 (H. Hippa & R. Mannila); Virrat, Patalankylä, Yli-Havankajärvi: 1 juv. (ZMT), 11.07.1972 (P.T. Lehtinen); Turku, Ruissalo: 1^Q (ZMT), 1968 (P.T. Lehtinen); Pori, Yyteri: 1⁽²⁾ (ZMT), *Elymus* dyne, 14.10. 1961 (P.T. Lehtinen); Tuusula, Ruotsinkylä: 6Å, 15^Q, 5 juv. (ZMH), Calluna-type forest, 1962-1965 (V. Huhta); Mäntyharju, Hietaniemi, Mäkelä: 23, 29 (ZMH), Vaccinium-type pine forest among *Pleurozium*, 29.05.1966 (P. Palmgren); Hanko, Tvärminne by: 9∂, 4♀, 5 juv. (ZMH), Calluna-type pine forest among Cladonia and Hylocomium schreberi, 1.06.1962 (P. Palmgren); same locality and habitat: 5° , 16 juv. (ZMH), 8.08.1964 (P. Palmgren); 1⁽²⁾ (ZMH), Dragsfjärd, Högholmen: among litter in *Myrtillus*-type forest, 5.06.2006 (I. Österblad); 1^o (ZMH), Hanko, Lappohja, Högsand: 1^o, pitfall-trap, sandy shore, edge of dry pine forest, 19.07-9.08.2004 (N.R. Fritzén); Kuusamo, Rukajärvi, Rukatunturi: 4♀, 15 juv. (ZMT), 10.07.1961 (P.T. Lehtinen). RUSSIA: 2♂, 3♀



Figures 26-32. Epigyne of *Lathys humilis* (**26-27**) and *L. nielseni* (**28-32**). **26**, **28-29** digital photograph of epigyne, ventral; **27**, **30** epigyne after maceration, ventral; **31-32** epigyne, dorsal. **26-27** from Crimea; **28**, **30-31** from Finland; **29** from Ural; **26** after Marusik et al. (2009); **32** after Hu (1984). Scale = 0.1 mm.

(ZMMU), **Bashkortostan**, Ilmenski Reserve, 29.05.1959 & 8.06.1959, (Stebaev). 2∂7♀ [ARAN.SIB 117, MZT] **Novosibirsk** Area, Borovoye, 16.6.1983 (H. Hippa).

Description. Measurements (Finnish specimens). **Male**. Total length 1.8; carapace 0.89 long, 0.69 wide, 0.42 high; chelicerae 0.53 long. Variation (n=3): total length 1.7-1.9; carapace 0.88-0.90 long, 0.68-0.71 wide, 0.39-0.45 high; chelicerae 0.49-0.63 long.

	0 0					
	femur	patella	tibia	metatarsus	tarsus	total
Ι	0.81	0.29	0.72	0.63	0.40	2.85
II	0.70	0.27	0.52	0.50	0.35	2.32
III	0.57	0.23	0.37	0.40	0.29	1.87
IV	0.65	0.25	0.50	0.52	0.28	2.20

Length of leg segments:

Female. Total length 1.8; carapace 0.78 long, 0.62 wide, 0.39 high; chelicerae 0.33 long. Variation (n=3): total length 1.6-2.3; carapace 0.75-0.86 long, 0.58-0.65 wide, 0.37-0.40 high; chelicerae 0.26-0.36 long.

	femur	patella	tibia	metatarsus	tarsus	total
Ι	0.61	0.26	0.47	0.40	0.28	2.01
II	0.53	0.25	0.34	0.34	0.26	1.71
III	0.42	0.24	0.28	0.29	0.21	1.44
IV	0.55	0.23	0.40	0.41	0.23	1.82

Length of leg segments:

Colouration. Carapace in both sexes without distinct pattern, although dark stripes distinguish the cephalic area from the thoracic region. Abdomen with distinct pattern consisting of brownish pigment: long median stripe with transverse arms. Legs without annulations.

Copulatory organs. Male palp (Figs 10-12, 17-19) with patellar apophysis, tibia with three apophyses (retrolateral dorsal, retroventral and retrolateral (or intermediate) that fix (lock) terminal part of conductor. Conductor very long with two arms. Upper arm coiled, lower part spine-like and slightly twisted. Epigyne as in Figs 23, 28-32, with indistinct epigynal fovea and distinct round copulatory openings. Spermathecae egg-shaped. Insemination ducts long with each duct having a vertical and a horizontal loop. First duct turned downwards and then upwards.

Diagnosis. *L. nielseni* can be easily distinguished from *L. humilis* and *L. annulata* by lacking white guanine spots on the abdomen (Figs 4-6). The epigyne of *L. nielseni* resembles that of *L. annulata*. The two species can be separated by the shape of the receptacula (egg-shaped in *L. nielseni* and rounded in *L. annulata*) and the longer insemination ducts in the Japanese species. In addition to colour pattern, males of this species can be separated from the European *L. humilis* by the different shapes of the patellar and tibial apophyses (cf. Figs 13-16 and 17-19), the thinner tip of the conductor and the absence of leg annulations (cf. Figs 1, 4). The females of the two species can be separated by the shape of the fovea (distinct margins and septum in *L. humilis*, no distinct margins and septum in *L. nielseni*), the shape of the spermathecae and the length and the course of the insemination ducts (cf. Figs 20, 23, 26-30).

Distribution. It seems that this species has a trans-Palaearctic range and is distributed from the UK to Shandong (China) and possibly to Taiwan. Within Europe, this species has been reported from Austria, Belorus, the Czech Republic, Great Britain, Germany, Slovakia, Sweden and Switzerland (Helsdingen 2007). In addition, *L. nielseni* is also known from the St. Petersburg Area and the southern Urals in Russia. The easternmost proven record of this species lies in the Novosibirsk Area (ca 85°E). The northernmost records are from Finland (where the species is often found up to 63°N) and Kuusamo, 66°10'N (Map 1). A comparison of figures of the epigyne (Figs 31-32) made from Finnish and Shandong specimens (identified by Hu 1984 as *L. humilis*) leaves no doubt that the Chinese specimens belong to *L. nielseni*. Other records from eastern China based on males may also refer either to *L. nielseni* or *L. annulata* (known exclusively from females). The identity of *L. humilis* from Gansu (Schenkel 1936) remains unclear. Figures of the epigyne made by Schenkel are dissimilar to those of both *L. humilis* and *L. nielseni*. The specimen stored in the Swedish Museum of

Natural History, Stockholm, lacks the epigyne and the abdominal pattern is indistinct due to bleaching.

Habitats. Thaler (1981) reported *L. nielseni* from warm pine wood steppe (as high as 1500 m a.s.l.), and Buchar and Růžička (2002) mentioned that it occurs within moss and lichens in pine forests (at 400 m). In England this species occurs in moist places at ground level on heathland, under stones or among damp, dead *Molinia caerulea* litter between the tussocks (Harvey et al. 2002). Almquist (2006) reported the species from dune heaths. In Finland it has been collected mainly from dry habitats, among litter, moss and lichens, also on sand dunes with *Elymus*. It seems that this species occurs only in litter, while the sibling *L. humilis* inhabits bushes and trees, and is found in litter occasionally.

Discussion.The taxonomy of *Lathys* remains poorly and improperly studied in several respects. The limits of this genus are unclear (*Lathys insulana* Ono, 2003 seems to belong to *Argenna* or an undescribed genus; several Nearctic species appear to be distantly related to *L. humilis*). *Scotolathys*, which has long been considered a synonym of *Lathys*, was recently revalidated (Marusik et al. 2009). Many *Lathys* species remain unstudied since their original description, with many species known only from one sex. Many species appear to have been incorrectly synonymised with *L. stigmatisata*. Only a few species have been illustrated adequately.

One of the reasons why the genus has been studied unsatisfactorily is a lack of developed species criteria. For example, in his revision, Lehtinen (1967) paid attention to the tip of the conductor, which is very similar in many species, or the structure of the epigynal fovea (also similar in many distantly related species) (P.T. Lehtinen pers. comm.). The species criteria were poorly defined because the conformation of the male



Map 1. Distribution of *Lathys humilis* (dot) and *L. nielseni* (square). A square and a circle refer to areas where both species have been found. Some dots and two squares (Germany, Switzerland) refer to state records. An open dot and square refer to a questionable record. Diamonds refer to doubtful records of *L. humilis* that may relate either to *L. nielseni* or *L. annulata*. Specimens from localities east of the broken line have been studied by us (except for questionable records).

palp was unknown until recently. The first detailed and correct figures of the *Lathys* male palpal tibia were published by Thaler (1981) and the structure of the bulbus was shown for the first time in 2006 (Marusik et al. 2006).

Acknowledgements

We wish to thank S.L. Esyunin (Perm), Maria Fedoryak (Chernovtsy, Ukraine), M.M. Kovblyuk (Simferopol), T. Kronestedt (Stockholm) and T. Pajunen (Helsinki) for *Lathys* specimens and Terecia Fritzén for proof-reading the English of the earlier draft. The English of the final draft was kindly checked by David Penney, Manchester. This work was supported in part by the RFFI grant # 09-04-01365-a.

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RESEARCH ARTICLE



The first lowland species of the Holarctic alpine ground spider genus Parasyrisca (Araneae, Gnaphosidae) from Hungary

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Academic editor: Jason Dunlop | Received 20 February 2009 | Accepted 17 April 2009 | Published @@ August 2009 urn:lsid:zoobank.org:pub:

Citation: Szinetár Cs, Eichardt J, Szűts T (2009) The first lowland species of the Holarctic alpine ground spider genus *Parasyrisca* (Araneae, Gnaphosidae) from Hungary. In: Stoev P, Dunlop J, Lazarov S (Eds) A life caught in a spider's web. Papers in arachnology in honour of Christo Deltshev. ZooKeys %%: 1-14. doi: 10.3897/zooKeys.%%.\$\$\$

Abstract

The first lowland species of the alpine genus *Parasyrisca, Parasyrisca arrabonica* Szinetár & Eichardt, **sp. n.**, is described from the sandy grasslands of Hungary. The genus was hitherto known only from Western Europe (Pyrenees and Western Alps) and Eastern Europe (Crimea), and although records from Slovenia and Romania were known, these are listed in check-lists in both cases as doubtful since no voucher specimens are available. Thus this species is not only the first representative of *Parasyrisca* in the Hungarian fauna and in the Pannonian region, but is the first verified record of the genus in Central Europe too. *Parasyrisca arrabonica* seems to belong to the speciose *potanini* group (of which this is the first European record and the westernmost occurrence to date), and is especially similar to *P. turkenica* Ovtsharenko, Platnick & Marusik, 1995 and *P. songi* Marusik & Fritzén, 2009. Detailed descriptions of the species' ecological characteristics (habitat, co-occurring species) are provided, as its habitat preference is unusual and unique within the genus. This species is quite rare: only eight specimens have been found among 20700 captured spiders. Adult specimens have been collected exclusively in late autumn and early spring (so practically outside the major collecting period), which might explain why this species was not discovered earlier.

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Keywords

New species, Pannonian lowland, sandy grassland, steppe, Parasyrisca arrabonica sp. n.

Introduction

The alpine ground spider genus *Parasyrisca* Schenkel, 1963 is among the "well-known" gnaphosid genera of the Holarctic (Ovtsharenko et al. 1995, Marusik and Fritzén 2009). So far 47 species have been described (Platnick 2009, Marusik and Fritzén 2009), but there are probably still more awaiting discovery. While Ovtsharenko et al. (1995) covers pretty much the Eurasian highlands (Fig. 18) and European mountains (Alps, Pyrenees), exploration of the Chinese and Iranian highlands has only now started (Marusik et al. 2006), and there are discoveries to be made in the highlands of Afghanistan, Pakistan and India too. Thus discovering a new *Parasyrisca* species is not that surprising, as the majority of suitable Eurasian alpine habitats have *Parasyrisca* species which are probably endemic to that very mountain (Mikhailov and Mikhailova 2000, Marusik 2003). However, *Parasyrisca arrabonica* was found not in high or even low mountains, but at three localities in two separate lowland areas, ca. 100 m above sea level, in the fairly isolated Pannonian sandy grasslands (Figs 15-17, 19).

Natural sandy grasslands are one of the remaining typical habitat types of the Hungarian grasslands, once found in large numbers in Hungary and the Carpathian Basin. The most comprehensive habitat assessment of the Pannonian sandy grasslands to date was started within the framework of the project "Monitoring dry grasslands" NBmR, in 2000 (Szinetár et al. 2005, Vörösházi 2006). In this project, collections were carried out in three main regions of Hungary: in Kiskunság, in Nyírség and in the Kisalföld sandy grasslands, the three major sandy areas of the Carpathian Basin. During this monitoring program about 155 species have been found, represented by 20700 specimens, among which eight belong to a new gnaphosid taxon found at three separate localities (Bugac, Orgovány and Győrszentiván). These relatively large spiders (Figs 13-14) belong to the genus Parasyrisca, hitherto not known from Hungary, and only doubtfully recorded from the Carpathian Basin (Fig. 19) and thus without any verified records in Central Europe. From the Alföld (Hungarian Plain) only males (6), while in the Kisalföld (Small Hungarian Plain) one male and one female specimens were found. Adults were all captured in autumn and early spring, which are the least collected periods of the year and probably explains why this species remained undiscovered for such a long time. This was the case for Alopecosa psammophila Buchar, 2001, a large wolf spider also recently found, but as collecting periods have been modified to its phenology it has been found in larger quantities in many localities (Szinetár et al. 2005, Esyunin et al. 2007). Modified collecting methods also resulted in discoveries even from habitats very close to human settlement, like Pelecopsis loksai Szinetár & Samu, 2003 (applying D-Vac 500 m from city border of Budapest see Szinetár and Samu 2003) or Trebacosa europaea Szinetár & Kancsal, 2007 (applying swimming pitfall traps within the small town of Agárd next to the Velence lake, see Szinetár and Kancsal 2007).

Besides the unusual habitat choice, this species belongs to a different group, the *potanini* group, compared to the remaining European species *Parasyrisca vinosa* (Simon, 1878) and *P. marusiki* Kovblyuk, 2003 (which belongs to the *vinosa* group sensu Kovblyuk 2003).

Methods

All specimens were collected via pitfall traps. Identification, study and drawings were carried out at the Berzsenyi College's Department of Zoology, Arachnological Laboratory, using a Leica MZ6 stereo microscope. Drawings were made by János Eichardt. Digital images were taken in the Danish Natural History Museum, using a Nikon DXM1200F attached to the Leica MZ16A microscope and edited using the software packages Auto-Montage and Adobe Photoshop. All morphological measurements are given in millimeters. The format of the descriptions and standard abbreviations of morphological terms follow Ovtsharenko et al. (1995) and Marusik and Fritzén (2009). Specimens are deposited in the Hungarian Natural History Museum, Budapest (HNHM – holotype, paratype female), the University of West Hungary, Szombathely (UWH – five paratype males) and the Danish Natural History Museum, Copenhagen (ZMUC – one paratype male).

Maps have been downloaded from the NOAA Satellite and Information Service's National Geophysical Data Center (http://www.ngdc.noaa.gov/mgg/topo) and edited in Adobe Photoshop.

Taxonomy

Parasyrisca arrabonica Szinetár & Eichardt, sp. n.

urn:lsid:zoobank.org:pub: Figs 1-17

Material examined. Type material. Holotype. Male (NHMH) from Hungary, Győrszentiván, Gazdák erdeje, N 47°42'56", E 17°47'33", 125 m, Barber traps, 01.10-02.12.2004, leg. Cs. Szinetár.

Paratypes. 1 female (NHMH) from the same locality, Barber traps, 15.01-02.04.2005, leg. Cs. Szinetár; 1 male from Bugac N 46°39'36", E 19°35'14", 110 m, Barber traps, 02.09.2003, leg. Cs. Szinetár; 3 males (2-UWM, 1-ZMUC) from the same locality, Barber traps, 04.10-18.10.2003, leg. R. Gallé; 2 males from Orgovány N 46°42'25", E 19°30'57", 100 m, Barber traps, 02.10.2007, leg. Cs. Szinetár.

Etymology. The species' name refers to the type-locality. Arrabonicum is the Latin name of the Kisalföld.

Remarks. *P. arrabonica* Szinetár & Eichardt, sp. n. belongs to the *potanini* speciesgroup. It is quite similar to *P. turkenica* Ovtsharenko, Platnick & Marusik, 1995 and *P.*



Figures 1-6. *Parasyrisca arrabonica* Szinetár & Eichardt, sp. n.: Male holotype: 1 pedipalp, prolateral view; 2 same, ventral view; 3 same, retrolateral view. Female: 4 epigyne, ventral view; 5 vulva, dorsal view; 6 posterior ridge (PRE) of the female epigyne, rear view. Scale bars: 1-3 0.3; 4-6 0.2.

songi Marusik & Fritzén, 2009, in having a long RTA (Figs 2, 3, 7-9), and a blunt terminal apophysis (Figs 2, 7, 10); these three species might even deserve a separate species-group. However, without detailed comparative study of the two taxa mentioned above or a cladistic analysis to judge the shared characters we are reluctant to propose a formal new group, but feel the similarity is worth mentioning.

Diagnosis. Males resemble those of *P. turkenica*, but can be easily recognized by the shorter and thicker retrolateral tibial apophysis (Figs 2, 3, 7-9) and the thinner and straight, erect conductor (Figs 2, 7, 8, 10). The shape of the tibial apophysis is similar to that of *P. songi* in lateral view but significantly smaller (Figs 3, 8, 9) and the conductor and terminal apophysis are somewhat different (Figs 2, 7, 10). The epigyne of *P. arrabonica* Szinetár & Eichardt, sp. n. (Fig. 4) is similar to that of *P. turkenica* but the shape of the anterior hood differs, being twice as wide as high, with the epigynal plate depressed at the posterior end as a posterior ridge of a flat U shape, with two pointing tips on the sides (Fig. 4).

Description. Male. Habitus as seen in Figs 13-14. Total length 7.1. Carapace 2.6 long, 2.1 wide. Femur II 2.2 long. Eye sizes and interdistance: AME 0.16, ALE 0.14, PME 0.14, PLE 0.12; AME - AME 0.08, AME - ALE 0.04, PME - PME 0.1, PME - PLE 0.14, ALE - PLE 0.16; MOQ lenght 0.46, front width 0.36, back width 0.4.



Figures 7-9. *Parasyrisca arrabonica* Szinetár & Eichardt, **sp. n. 7** male pedipalp, ventral view; **8** same, semi-retrolateral view, showing the pointed tip of the conductor (c – arrowed); **9** same, retrolateral view. Scale bar = 0.3.

Leg spination: femora ; I,II d 1-1-0, p 0-0-1; III d 1-1-0, p 0-1-1, r 0-0-1; IV d 1-1-0, (without prolateral spine), r 0-0-1; tibiae I v 2-2-0; II v 1-1-0; III v 1-1-2, p 1-1-0, r 1-1-0; IV v 1-2-2, p 0-1-1, r 1-0-1; metatarsi I-II v 2-0-0; III v 2-0-2, p 2-0-2, r 2-0-2; IV v 1-0-2, p 2-0-2, r 2-0-2.

Palps (Figs 1-3, 7-11) with strong, well developed, long RTA (Figs 2-3), reach ¹/₄ of cymbium length (Figs 2-3, 7-9). RTA tip seems abrupt in lateral view. Conductor (Fig. 10) twisted, directed upward (Fig. 2), gradually tapered at end, twisted in shape (Figs 2, 10), with thin tip (Fig. 8) clearly visible in frontal and lateral views. Embolus unusually long, largely covered by conductor, visible only after conductor is removed (Fig. 11). Terminal apophysis thick, curved toward sides (Figs 2-3, 10).

Colouration. (Fig. 12) Legs yellowish-brown, tibia, metatarsus and tarsus slightly darker than proximal segments. Carapace also yellowish-brown, but head somewhat darker. Chelicerae, cymbia, gnathocoxae and labium also darker brown. Abdomen grayish-brown with a few narrow, light brown stripes at the posterior end, just before the spinnerets.

Female. Total length 9.2. Carapace 3.3 long, 2.3 wide. Femur II 2.2 long. Eye sizes and interdistance: AME 0.16, ALE 0.14, PME 0.16, PLE 0.12; AME - AME 0.1,



Figures 10-11. *Parasyrisca arrabonica* Szinetár & Eichardt, sp. n. male bulb, close-ups: **10** male pedipalp, ventral view, close-up; **11** bulbus, prolateral view, conductor removed (c – conductor, e – embolus, ta – terminal apophysis), showing the long embolus and base of the terminal apophysis.



Figures 12-14. *Parasyrisca arrabonica* Szinetár & Eichardt, sp. n., male habitus: **12** paratype from Orgovány, prosoma, dorsolateral view, showing the strong setae on the paturon; **13** same specimen, dorsal view; **14** same specimen, ventral view. Scale bar = 2.0.

AME - ALE 0.04, PME - PME 0.12, PME - PLE 0.16, ALE - PLE 0.18; MOQ length 0.52, front width 0.36, back width 0.4. Leg spination: femora; I,II d 1-1-0, p 0-0-1; III d 1-1-0, p 0-0-1; r 0-0-1; IV d 1-1-0, (without prolateral spine), r 0-0-1; tibiae I v 2-2-0; II v 1-1-0; III v 1-1-2, p 1-1-0, r 1-1-0; IV v 1-2-2, p 0-1-1, r 0-1-1; metatarsi I-II v 2-0-0; III v 2-0-2, p 2-0-2, r 1-0-1; IV v 1-1-2, p 2-0-2, r 2-0-2.

Female genitalia (Figs 4-6) Epigyne elongate, with length/width ratio 1.7. Anterior hood twice as long as wide (Fig. 4), atrium elongated as in *P. songi*. Epigynal plate depressed at the posterior end, posterior ridge (PRE) invaginated from the posterior end having a two-pointed tip at the sides (Fig. 4). As seen in rear view (Fig. 6), PRE U-shaped (as the epigynal plate depressed), which is in an inverted position compared to other *Parasyrisca* species. Spermathecal ducts directed upwards and curved inwards (Fig. 5). Ducts significantly stronger than that of *P. turkenica*.

Colouration. Similar to that of male, but carapace with more distinct pattern: three radially directed dark stripes present on both sides of fovea.

Biology. The well-developed chelicerae equipped with strong spines (Fig. 12) suggest that this is a sand-dwelling species. All the adults (as immatures were not considered in the NBmR) were captured between late September and early April. Thus it seems likely that this species overwinters as adults.

Habitat preference. (Figs 15-17) We collected the specimens in the calciferous open sand steppes (coenologic name *Festucetum vaginatae danubiale*) in the area between the rivers Danube and Tisza and on the Kisalföld.

Distribution. (Figs 18-19) Known from Hungary only. From the type locality (Győrszentiván) and from two collecting sites of the Kiskunság area: Bugac and Orgovány.



Figures 15-17. Seasonal vegetation changes on the habitat of *Parasyrisca arrabonica*: **15** summer vegetation dominated by the late-coming pink (*Dianthus serotinus*); **16** winter vegetation of the habitat; **17** spring vegetation characterized by different feather grasses (*Stipa capillata, S. borysthenica*).

Discussion

In their monographic work, Ovtsharenko et al. (1995) sorted the species into four groups: the *guzeripli* (1 species), the *breviceps* (10 species), the *vinosa* group (3 species, see also Kovblyuk 2003, Marusik and Fritzén 2009) and the *potanini* group (32 species). While the *guzeripli* and the *breviceps* groups are restricted to a smaller geographical range (Fig. 18), i.e. the Caucasus and Kyrgyzstan-Tajikistan respectively, the *vinosa*



Figures 18-19. Distribution maps of the genus *Parasyrisca*: **18** Eurasian distribution of the species groups of *Parasyrisca* (red, pink – *potanini* group, pink – *P. arrabonica*, *P. turkenica*, *P. songi*, yellow – *vino-sus* group, light blue – *guzeripli* group, dark blue – *breviceps* group). **19** European distribution of *Parasyrisca* (red – *potanini* group, yellow – *vinosus* group). Yellow question marks represent doubtful records.

and the *potanini* group are distributed across a much wider (Fig. 18) area (this might be an artifact of insufficient biogeographical data). Thus *Parasyrisca* species occur in most mountain systems across the Palearctic with 46 species, and in the Nearctic with 1 species (southern British Columbia in Canada and western Washington State in the United States; see Ubick 2005).

Parasyrisca species were previously thought to occur at high elevations only, mostly in the alpine zones of mountains on the montane tundra, mainly between 600 and 2200 m (Ovtsharenko et al. 1995), although Marusik (2003) reported finding *P. holmi* also close to the seashore and thus at sea level. Based on the available data, *P. arrabonica* sp. n. is a typical member of sandy plain habitats with the sandy steppe vegetation. These habitats are located at elevations only 100-125 m above sea level, although it is possible that representatives of this genus can be found in the high mountains of the Carpathian regions (Fig. 19) bordering the Pannon region as two tentative records of *P. vinosa* are present in the literature (Nikolić and Polenec 1981 in Grimm 1985, and Weiss and Urák 2000), in the Eastern Alps or in the Carpathian mountains.

Based on available data we conclude that *Parasyrisca arrabonica* is a rare, but probably generally occurring species of the ground-dwelling spider communities in the sandy grasslands (Figs 15-17) of the Hungarian plains in the Carpathian Basin. On the basis of the other spiders co-occurring with *P. arrabonica* we suspect that this species may occur in the similar dry sandy habitats of southern Moravia, in southern Slovakia and in the sandy steppe habitats of northern Serbia (as was the case of the *Alopecosa psammophila*).

These sand steppes (Festucetum vaginatae danubiale) are dominanted by the following plant species: Festuca vaginata, F. pseudovina, Stipa borysthenica, S. capillata, Koeleria glauca and Dianthus serotinus. The vegetation changes significantly during different seasons: during summer (Fig. 15) the late-coming pink (Dianthus serotinus) is typical, while during springtime the vegetation (Fig. 17) is characterized by different feather grass species (Stipa spp.). During winter vegetation coverage is mainly by dead or dry vegetative parts of plants (Fig. 16). The above described sandy steppe has a rather distinct spider fauna (Szinetár et al. 2005, Esyunin et al. 2007). These habitats accommodate specialist spiders and although it is premature to draw ecological conclusions on the basis of slightly more than a half-a-dozen specimens, it is worth mentioning that Parasyrisca arrabonica co-occurs with Alopecosa psammophila Buchar, 2001, A. mariae (Dahl, 1908), A. sulzeri (Pavesi, 1873), Berlandina cinerea (Menge, 1872), Sintula spiniger (Balogh, 1935), Improphantes geniculatus (Kulczyński, 1898), Aelurillus v-insignitus (Clerck, 1757), Pardosa bifasciata (Hahn, 1826), Callilepis nocturna (Linnaeus, 1758) and Dictyna szaboi Chyzer, 1891. The sandy steppe vegetation reaches its westernmost occurrence in Hungary, and such habitats exist in Eastern Europe to a large extent. The spider fauna is rather distinct and characterized by almost the same species (compare Szinetár et al. 2005 vs. Esyunin et al. 2007), even several thousand kilometers away, as has been discussed by Esyunin et al. (2007). Their list overlaps with the Hungarian spider list from the same type of vegetation significantly, suggesting that the spider fauna of the sandy grasslands consists of species which are characteristic for

dry, open, sandy and rocky habitats regardless of the soil type. However, a relatively small number of species (8% Szinetár unpubl. data) appears almost exclusively connected to sandy habitats, and are therefore considered "*psammophilous*". *Parasyrisca arrabonica* probably belongs among these taxa too, although our data are insufficient to make an unequivocal statement. Other – well proven – psammophilic species are *Alopecosa psammophila* and *Berlandina cinerea*, which have been found in great abundance, whereas others, like *Dictyna szaboi*, are represented only by a few specimens.

Parasyrisca arrabonica is apparently a typical, but very rare gnaphosid spider of sandy open grassland (or steppe) habitats, and overwinters as adults, which makes them hard to collect. However, suitable vegetation/habitat types are found in numerous other places outside of Hungary, and we encourage our colleagues to extend or modify their collecting periods, which might improve their chances of capturing this species.

Acknowledgements

The authors are grateful to Yuri M. Marusik and Vladimir I. Ovtsharenko for help in connection with the generic placement of the species. The authors thank Dr. Viktor Markó (Hungarian organiser of NBmR), the Directorates of the Kiskunság, the Hortobágy, and the Fertő-Hanság National Parks for kind assistance with collecting permits. We are grateful to Gábor Takács (Fertő-Hanság National Park) and Tibor Vörösházi for their valuable help during fieldwork in the Kisalföld. Special thanks to Dr. Péter Molnár for linguistic revision of the manuscript. Thanks are due to the UWH University Scientific Boards for providing support for fieldwork carried out in the Small Hungarian Plain. Tamás Szűts is a postdoctoral fellow of the Carlsberg Foundation, Denmark and expresses his gratitude to Nikolaj Scharff for his supervision and endless help during his postdoc years. We thank Róbert Gallé for providing the three specimens from Bugac, and Tamás Török for providing Fig. 11.

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RESEARCH ARTICLE



A new species of the basal araneomorph spider genus *Ectatosticta* (Araneae, Hypochilidae) from China

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Academic editor: Pavel Stoev	Received 17 February 2009 Accepted 16 April 2009 Published @@ August 2009			
urn:lsid:zoobank.org:pub:				

Citation: Platnick NI, Jäger P (2009) A new species of the basal araneomorph spider genus *Ectatosticta* (Araneae, Hypochilidae) from China. In: Stoev P, Dunlop J, Lazarov S (Eds) A life caught in a spider's web. Papers in arachnology in honour of Christo Deltshev. ZooKeys %%: 1-14. doi: 10.3897/zookeys.%%.\$\$\$

Abstract

The hypochilid spider *Ectatosticta davidi* (Simon) is redescribed on the basis of adults from Mt. Taibaishan in Shaanxi Province, China; the specimens from Qinghai Province previously identified as *E. davidi* by most modern authors belong to a new species described as *E. deltshevi*.

Keywords

Araneae, Araneomorphae, Hypochilidae, Ectatosticta, China

Introduction

The spiders of the family Hypochilidae have long been recognized as the most primitive of all araneomorph, or true, spiders. In modern cladistic analyses, they appear as the sister group to all other araneomorphs (Platnick 1977, Forster et al. 1987, Griswold et al. 2005).

Only two genera of hypochilids are known, *Hypochilus* Marx from the United States, and *Ectatosticta* Simon from China. Although 10 species of *Hypochilus* are now

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recognized, for *Ectatosticta* only the type species, *E. davidi* (Simon, 1888), has been described, and that species has been known from only a few specimens.

Even the type locality of *E. davidi* is problematic. In the original description, Simon (1888) indicated that the male and female syntypes were collected by A. David from "Montagnes au nord de Péking". Those specimens are now labeled only "Sina", but Simon (1892) later listed the species as being from "China merid." (southern China), which hardly describes areas north of Beijing. Many decades ago, one of Simon's female specimens from "Inkiaphou" in Shaanxi Provice, China, was donated to Dr Willis Gertsch; the label with that specimen reads "Inkiaphou, Chine méridionale, Mus. Nat. d'Hist. Nat. coll. E. Simon". According to Schenkel (1963: 8), A. David collected at "Inkia-fu, Süd Schensi" in 1873. Repeated attempts by Chinese colleagues to recollect the species in the mountains north of Beijing have all been unsuccessful; Forster et al. (1987: 24) therefore concluded that the syntypes were probably collected at Inkiaphou. The exact location of Inkiaphou (in French) or Inkia-fu (in German) is also uncertain, but those names might refer to Inkiapo, now known as Yinjiapo (on Mt. Qinling) in Shaanxi (near 34°00'N, 108°00'E).

The redescription and illustrations of *E. davidi* provided by Forster et al. (1987) and other modern authors were based primarily on specimens taken in Qinghai Province, to the west of Inkiaphou. The collection of a good series of specimens, by the second author and colleagues, at Mt. Taibaishan in Shaanxi Province, has led us to reexamine the available material. We conclude that there are at least two species of *Ectatosticta*, that the specimens from Mt. Taibaishan and Inkiaphou in Shaanxi Province belong to *E. davidi*, and that the specimens from Qinghai Province described and illustrated by Forster et al. (1987) and other modern authors belong instead to a different species, here described as *E. deltshevi*.

The format of the descriptions follows that of Forster et al. (1987). It is with great pleasure that we dedicate this paper, and the new species, to our Bulgarian colleague, Dr Christo Deltshev, in honor of his many contributions to arachnology. The material examined is housed in the following collections:

AMNH	American Museum of Natural History, New York
IZCAS	Institute of Zoology, Chinese Academy of Sciences, Beijing
MNHN	Muséum National d'Histoire Naturelle, Paris
SMF	Forschungsinstitut Senckenberg, Frankfurt am Main

Ectatosticta davidi (Simon)

Figs 1-4

Hypochilus davidi Simon, 1888: ccviii (one male and one female syntypes, supposedly from mountains north of Beijing but probably from Inkiaphou, Shaanxi Province, China, in MNHN, examined).

Ectatosticta davidi: Simon 1892: 204, figs. 143-146, 148-149. Gertsch 1958: 13, figs. 10, 19, 22-31. Lehtinen 1967: 298, fig. 15.



Figures 1-4. *Ectatosticta davidi* (Simon): **I** left male palp, prolateral view; **2** same, ventral view; **3** same, retrolateral view; **4** female spermathecae, dorsal view.

Diagnosis. Males of *E. davidi* can be distinguished from those of *E. deltshevi* by the details of the distal modifications on the retrolateral side of the palpal tibia. In *E. davidi*, there is a small triangular lobe followed apically by a large ledge bearing 5-7 thickened setae, all closely appressed (Fig. 3); in *E. deltshevi*, there are only four thickened setae, and the most dorsal of those is smaller and well separated from the main group of three (Forster et al. 1987: fig. 81). Females of *E. davidi* (Fig. 4) have the inner pair of spermathecae relatively larger and more robust than is the case in *E. deltshevi* (Forster et al. 1987: fig. 82).

Male. Total length 9.57. Carapace 4.61 long, 3.78 wide, yellow, with margins of pars cephalica and pair of broad marginal bands mottled with purplish brown, similar mottling along midline, with additional pair of purple lines originating anterior of thoracic groove, extending to posterior median eyes; clypeus at middle about twice AME diameter in height. Eye sizes and interdistances: AME 0.09, ALE 0.18, PME 0.21, PLE 0.15; AME-AME 0.15, AME-ALE 0.26, PME-PME 0.22, PME-PLE 0.15, ALE-PLE 0.06; MOQ length 0.37, front width 0.33, back width 0.63. Chelicerae yellow, unmarked; endites light brown, darkened distally; labium light brown, darkened distally; sternum light brown, with three broad, transverse bands of purple pigment covering most of surface. Legs light brown, with femora,

patellae, and tibiae darkened distally. Femur I more than twice as long as carapace. Leg spination (only surfaces bearing spines listed): femora: I d3-0-0, p0-4-1, r1-3-1; II d3-0-0, p0-3-2, r3-3-1; III d3-0-0, p1-2-1, r3-2-1; IV d4-0-0, p1-3-1, r0-2-2; tibiae: I d1-0-1, p2-2-1, v4-4-3, r2-3-1; II d1-0-1, p2-2-1, v4-4-3, r2-2-1; II d1-0-1, p1-2-1, v2-2-2, r1-2-1; IV d1-0-1, p1-2-1, v2-2-1, r1-2-1; metatarsi: I d1-0-0, p1-2-2, v2-4-4, r1-1-0; II, III d1-0-0, p1-1-0, v4-4-2, r1-1-0; IV p1-0-1, v2-2-0, r1-0-1. Dorsum of abdomen white with about six purple chevrons, posterior ones stronger than anterior ones, covering most of posterior one-third, sides and venter mottled except on lung covers. Retrolateral side of palpal tibia distally with small triangular lobe followed distally by large lobe bearing 5-7 modified setae, all closely appressed (Fig. 3); embolus rounded, more smoothly curved than in *E. deltshevi* (Figs 1-3).

Female. As in male, except as noted. Total length 10.98. Carapace 4.20 long, 2.97 wide. Eye sizes and interdistances: AME 0.11, ALE 0.20, PME 0.20, PLE 0.18, AME-AME 0.14, AME-ALE 0.25, PME-PME 0.30, PME-PLE 0.15, ALE-PLE 0.09; MOQ length 0.37, front width 0.36, back width 0.70. Chelicerae light brown; sternum with only one anterior transverse light band interrupting purple mottling. Femora darkened medially and distally, tibiae and metatarsi with basal, median, and distal darkenings. Leg spination (only surfaces bearing spines listed): femora: I d2-0-0, p1-2-3, r2-4-2; II d2-1-0, p1-1-2, r2-3-1; III d2-3-0, p1-1-1, r3-3-2; IV d3-1-0, p0-2-1, r0-1-2; tibiae: I d1-0-1, p2-1-1, v2-5-2, r1-2-1; III d1-0-1, p1-2-1, v4-5-2, r1-2-1; III d1-0-1, p1-2-1, v2-2-2, r1-1-1; IV d1-0-1, p1-1-0, v2-3-2, r1-1-0; metatarsi: I d1-0-0, p1-1-0, v2-4-4, r1-1-0; II d1-0-0, p1-1-0, v4-4-4, r1-1-0; III d1-0-0, p1-1-0, v4-2-2, r1-1-0; IV p0-1-0, v1p-1p-1p, r0-1-0. Inner pair of spermathecae relatively long, robust throughout their length (Fig. 4).

Material Examined. CHINA: **Shaanxi:** Inkiaphou (AMNH), 1 \bigcirc ; presumably Inkiaphou, label reads only "Sina" (MNHN 7285), 1 \bigcirc , 1 \bigcirc (syntypes); Mt. Taibaishan, S flanks, above Houshenzi, 33°54'43.98"N, 107°46'44.06"E, June 12-15, 1997, tree line, scattered mixed coniferous/*Rhododendron* forest, elev. 3050 m (P. Jäger, C. Fischer, AMNH), 1 \bigcirc , 2 \bigcirc , same (IZCAS), 1 \bigcirc , 1 \bigcirc , same (SMF), 1 \bigcirc , 8 \bigcirc (not all dissected, some may be juvenile), June 25, 1997, primary broad-leaved forest, elev. 2500-2600 m (J. Martens, P. Jäger, SMF), 1 \bigcirc .

Natural History. According to observations by the second author at Mt. Taibaishan, *E. davidi* occurs in stony debris in open, semi-open, and forest-covered habitats. One part of the elongate sheet-web (Fig. 5) is situated at the surface and connected to a stone or rock and surrounding vegetation. The apparently larger part of the web leads, as a narrow band, deep into the debris. Spiders cannot be seen or lured out of their retreat during the day. When it gets dark, the spiders sit close to the surface part of the web, ready to escape to their retreat. One male was found walking around, apparently searching for a female. Another male was observed during courtship, at the margin of a female's surface web; that male touched the web only with its first pair of legs. The third male was taken in its own web.

Distribution. Known with certainty only from Shaanxi Province, China (Fig. 6).



Figure 5. Web of Ectatosticta davidi (Simon) from Mt. Taibaishan, Shaanxi, China.



Figure 6. Map of China, showing records of *Ectatosticta*.

Ectatosticta deltshevi, sp. n.

urn:lsid:zoobank.org:pub:

Ectatosticta davidi (misidentification): Li and Zhu 1984: 510, figs. a-g. Forster et al. 1987: 23, figs. 6-16, 18-20, 23-24, 31-36, 78-82. Song et al. 1999: 41, figs. 11D, 17Q-T. Hu 2001: 69, figs. 1.1-6. Song et al. 2001: 64, figs. 24A-E.

Type. Male holotype from Huangyuan County, Qinghai Province, China, 15.IX.1984, Z.S. Li leg., deposited in IZCAS.

Etymology. The specific name is a patronym in honor of Dr Christo Deltshev.

Diagnosis. Males of *E. deltshevi* can be distinguished by the form of the specialized setae situated distally on the retrolateral ledge of the palpal tibia, as detailed above, and by the distally more sharply angled embolus (Forster et al. 1987: fig. 79). Females have the inner pair of spermathecae shorter, less robust, and distally less sclerotized than in *E. davidi*.

Male. Described by Forster et al. (1987: 23), as E. davidi.

Female. Described by Forster et al. (1987: 23), as E. davidi.

Other material examined. CHINA: **Qinghai:** Huangyuan County, Sept. 10, 1983 (Z.S. Li, AMNH), 1°_{\circ} , 1°_{\circ} , Sept. 15, 1984 (Z.S. Li, IZCAS), 2°_{\circ} , 3°_{\circ} .

Distribution. Known with certainty only from Huangyuan County, Qinghai Province, China. A juvenile taken at an elevation of 2300-2700 m in Beishan National Park, 120 km NE Xining City, Qinghai Province, China, 36°56'N, 102°29'E, 23.V – 8.VI.1996, J. Martens leg. (SMF) may also belong to this species (Fig. 6).

Acknowledgements

We thank Dr Christine Rollard (MNHN) for loaning the syntypes, the late Prof. Song Daxiang and Dr Li Shuqiang (IZCAS) for specimens and information, Dr Mohammad Shadab (AMNH) for providing the illustrations, and Liu Jie (IZCAS) for constructing the map. The expedition of Jochen Martens and Peter Jäger to China in 1997 was partly supported by the Stifterverband für die Deutsche Wissenschaft.

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RESEARCH ARTICLE



A new species of Loxosceles (Araneae, Sicariidae) from Tunisia

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Academic editor: Jason	Dunlop Received	13 March 2009	Accepted 11 May 2009	Publish	ed @@ August 2009
		urn:lsid:zooban	k.org:pub:		

Citation: Ribera C, Planas E (2009) A new species of *Loxosceles* (Araneae, Sicariidae) from Tunisia. In: Stoev P, Dunlop J, Lazarov S (Eds) A life caught in a spider's web. Papers in arachnology in honour of Christo Deltshev. ZooKeys %%: 1-14. doi: 10.3897/zookeys.%%.\$\$

Abstract

A new species of the spider genus *Loxosceles, L. mrazig* **sp. n.**, found in Tunisia is described and illustrated. The male bulb shows a high degree of morphological similarity to that of *L. gaucho* from Brazil, but the proportions of the palpal segments and the general colouration of the body reveal significant differences between the two species. A distance analysis of the sequences of the mitochondrial gene *cox1* reveals that the specimen from Tunisia shows high genetic distance from *L. gaucho* (more than 20%). The American species *L. gaucho* and *L. laeta* form a sister group to the Mediterranean representatives (*L. rufescens* and the Tunisian specimen).

Keywords

taxonomy, Araneae, Loxosceles, new species, Tunisia

Introduction

The genus *Loxosceles* Heineken et Lowe, 1832 is currently known to comprise 97 species (Platnick 2009), 82 of which occur in America, 12 in Africa and two in China. Following Brignoli's (1969, 1976) contributions with respect to the Mediterranean basin, only a single species is currently accepted as valid, *L. rufescens* (Dufour, 1820),

whose type locality is near Sagunt, Valencia (Spain). The other two (sub-) species are considered *nomina dubia*: *L. decemnotata* Franganillo, 1925 from Spain and *L. rufescens lucifuga* Simon, 1910 from Algeria. In the same paper Brignoli (1976) reported the South American species *L. gaucho* Gertsch, 1967 from Tunisia.

In 2007 colleagues from the Ecology Department at the University of Barcelona collected in Douz (Tunisia) a male of *Loxosceles* in a dune located several kilometres from the city. The morphology of the copulatory bulb is remarkably similar to that of *L. gaucho* from Brazil, although the differences of the proportions of the male palpal segments plus the general colouration of the body suggested that it could be a different species. In order to test this curious distribution, we used the cytochrome oxidase I gene (*cox1*) to compare this new record with *L. gaucho* (Sao Paulo, Brazil).

Material and methods

Taxonomy. Specimens were examined under a Zeiss Stereo Discovery V12 stereomicroscope equipped with an Infinity X DeltaPix digital camera. Digital microscopic images were edited using DeltaPix DpxWiew Pro AZ V. 13.6 software, using an enhanced focus function. Ink drawn digital illustrations were generated with the assistance of Photoshop CS3 software.

Measurements were taken using the enhanced focus function incorporated into the DeltaPix DpxWiew Pro AZ software. All morphological measurements are given in millimetres. Prosoma and opisthosoma measurements were taken in dorsal view. Total body length represents the sum of the lengths of the prosoma and opisthosoma, omitting the pedicel. Eye largest diameters were taken from the spans of the lens. The largest leg article lengths were measured in lateral view without detaching the legs from the specimen, by placing the article being measured in a perpendicular position. Holotype, and all other specimens are deposited in the Arachnid Collection of the CRBA (Centre de Recursos de Biodiversitat Animal) at the University of Barcelona; catalogue numbers are given in brackets.

Abbreviations used in the text. Repositories. CRBA: Centre de Recursos de Biodiversitat Animal, Universitat de Barcelona, Spain. Eyes: **ME** = median eyes; **LE** = lateral eyes.

Molecular data. Taxonomic sampling. Taxa analyzed in the present study are listed in Table 2. *L. mrazig* sp. n. from Douz (Tunisia), *L. gaucho* from Sao Paulo (Brazil) and nine specimens of *L. rufescens* from different localities in the Iberian Peninsula and Tunisia were analyzed. In addition we included a representative of *Loxosceles laeta* (Nicolet, 1849) (Montevideo, Uruguay) in order to test the phylogenetic affinities of *L. gaucho* with other South American species, since *L. laeta* belongs to a different species group (Gertsch 1967, Binford et al. 2008). A sequence from *Dysdera crocata* C. L. Koch, 1838 from GenBank was also included to root the tree.

Sample Storage and DNA Extraction. Specimens were preserved in 95% or absolute ethanol and stored at 4°C. Total genomic DNA was extracted from legs of a single specimen using the QIamp[®] DNA Mini Kit (QIAGEN) following the manufacturer's

protocols. The approximate concentration and purity of the DNA obtained were verified using 1.5% agarose/TBE gel electrophoresis.

PCR Amplification and Sequencing. A total of 899 bp of the cytochrome oxidase I gene (*cox1*) was amplified from each individual using PCR with the following primer pairs: C1-J-1718 (Simon et al. 1994) with C1-N-2776 (Hedin and Maddison 2001). The PCR reaction mixture contained a final concentration of 0.2 μ M of each primer, 0.2 mM of each dNTPs, 0.5 U Taq polymerase (Promega), with the supplied buffer, and 1.5-2.5 mM Mg Cl2 in a final volume of 25 μ L.

A Perking-ElmerCetus Moldel 480 thermocycler was used to perform 35 iterations of the following cycle: 30s at 94°C, 45s at 44°C, and 1 min at 72°C, beginning with an additional step of 3 min at 94°C, and ending with another step of 5 min at 72°C. The PCR results were visualized by means of a 1.5% agarose/TBE gel. Amplified products were purified using MultiScreen 96 – well filter plates from Millipore. The purified products were directly cycle-sequenced from both strands using ABI BigDye (Applied Biosystems) chemistry and run out on ABI Prism 377 (Applied Biosystems) automated sequencers. Sequencing reactions were performed in our lab with the forward and reverse PCR primers and one additional pair of internal *cox1* primers, CI-J-2183 and C1-N-2191 (Simon et al. 1994). The resulting products were run and analyzed at the Serveis Científico-Tècnics of the Universitat de Barcelona.

Alignment. Raw sequences were compared against chromatograms and complementary contigs built and edited using the Geneious Pro 3.6.2 software (http://www. genious.com). Sequences were manipulated and preliminary manual alignments constructed using BioEdit V.7.0.5.3 (Hall 1999). Alignment of *cox1* was trivial, given that no evidence of insertions/deletions was observed.

Genetic distances and distance analyses. Uncorrected genetic distances between and within taxa were estimated with MEGA v.3.0 (Kumar et al. 2004). The Neighbour-joining algorithm was applied to the estimated genetic distances to build a phenogram (Saitou and Nei 1987) conducted with the same program. Clade support was assessed via Bootstrap (Felsenstein 1985) as implemented in MEGA, based on 1000 bootstrap replicates.

Results. Molecular data. The distance tree is shown in Fig. 1. The specimens identified as *L. rufescens* form a monophyletic clade with a high support value (100%). *L. mrazig* sp. n. is supported as more closely related to *L. rufescens* (75% bootstrap value) than to the two South American representatives included in this analysis: *L. gaucho* and *L. laeta*. The latter two species cluster together with moderate support (68%).

Averages between group genetic distances are presented in Table 1. The cluster formed by the nine specimens of *L. rufescens* from Spain and Tunisia shows scarce

	L. rufescens	L. mrazig	L. gaucho
L. mrazig	0.1991		
L. gaucho	0.1927	0.2063	
L. laeta	0.1973	0.2086	0.1635

Table 1. Average between group genetic distances of gene cox1 from the four species analyzed.

within-group average genetic distances (0.26%) and suggests that this species shows a high genetic coherence. The deep genetic divergence between *L. mrazig* and *L. gaucho* (20.63%) together with the observation that both species belong to different clusters provide clear evidence that *L. mrazig* is an independent evolutionary lineage and should, therefore, be considered a different species.

Species	Locality	GenBank Accession
		number
Loxosceles laeta	Montevideo, Uruguay	FJ986177
Loxosceles gaucho	Sao Paulo, Brazil	FJ986178
Loxosceles mrazig sp. n.	Douz, Tunisia	FJ986179
Loxosceles rufescens	Torrejon de Ardoz, Madrid, Spain	FJ986183
Loxosceles rufescens	Ciudad Real, Spain	FJ986185
Loxosceles rufescens	Denia, Alacant, Spain	FJ986187
Loxosceles rufescens	Chumilla, Murcia, Spain	FJ986181
Loxosceles rufescens	Barcelona, Spain	FJ986182
Loxosceles rufescens	Siles, Jaen, Spain	FJ986188
Loxosceles rufescens	Sierra Gorda, Cartagena, Murcia, Spain	FJ986180
Loxosceles rufescens	Alacant, Spain	FJ986184
Loxosceles rufescens	Testour, Tunisia	FJ986186
Dysdera crocata	Hoz de Pergrina, Guadalajara, Spain	EF458137

Table 2. Species included in the phylogenetic analysis and GenBank accession numbers for cox1.



Figure 1. Neighbour-joining distance tree. Different representatives of *L. rufescens* from the western Mediterranean basin (Spain and Tunisia), *L. mrazig* sp. n., *L. gaucho* and *L. laeta* are included. Numbers on nodes represent bootstrap support values.

Taxonomy

Family Sicariidae Genus *Loxosceles* Heineken et Lowe, 1832

Loxosceles mrazig, sp. n. urn:lsid:zoobank.org:pub: Figs 2-7

Material examined. 1 male (Holotype) from Douz, Tunisia, 33° 24' 26.77" N, 09°02'41.92"E, 27 January 2007, Cesc Múrria leg. (CRBA-LX1054).

Material for comparison. 2 males, 2 females of *L. gaucho* (CRBA-LX1024) from Sao Paulo, Brazil, November 2007, A. Brescovit leg.; 2 males, 2 females of *L. laeta* (CRBA-LX1028) from Montevideo, Uruguay, L. Acosta leg.; 1 male, of *L. rufescens* (CRBA-LX1012) from Gavà, Barcelona, López-Pancorbo leg.

Etymology. The species' name honours the people called Mrazig, formerly nomadic, living in and around the city of Douz (Tunisia). The Mrazig are the descendants of the Banu Saleim tribe that fled the Arabian Peninsula in the seventh century and came to Tunisia in the thirteenth century. It is known that they practiced transhumance in the Great Sahara. Noun in apposition.

Diagnosis. Differs from *L. gaucho*, *L. rufescens* and its similar relatives in the proportion of male palp segments, mainly the tibia. In *L. mrazig* the tibia is markedly oval, slightly longer than wide (0.63 - 0.54) (Figs 2, 3, 5); in *L. gaucho* it is ³/₄ as wide as long (Gertsch 1967, plates 3-4), whereas, in *L. rufescens*, it is slightly oval, although dorsally almost straight (Gertsch 1967, plate 10). Also differs from *L. rufescens* by the size of the tegulum and the size and shape of the embolus (Figs 2-5). Body pigmentation yellowish-brown in *L. gaucho* and pale yellow in *L. mrazig*. In general, the morphological differences compared to *L. rufescens* are more conspicuous. The size of the tegulum and, especially, the shape and length of the embolus are clearly different.

Description. Colouration: Carapace pale yellowish with a fine, pale brown lateral stripe. Median groove and adjacent integuments darkened. Pars cephalica slightly darkened, brown coloured, and clearly demarcated by a lateral reddish brown line. Less conspicuous, but still important, diagnostic traits are the four thin longitudinal lines (lightly impressed when seen under higher magnification) located in the centre of the pars cephalica (Fig. 6). Eye tubercles black. Sternum pale yellowish, paler than carapace. Labium and gnathocoxae with slightly more pigmentation. Legs light yellow or somewhat shaded, with the apical segments slightly darkened. Opisthosoma yellowish-white.

Prosoma. Carapace (Fig. 6) slightly longer (2.39) than wide (2.15). Median groove deep, occupying the posterior third of carapace. Clypeal width slightly more than 2.5 diameters of ME. Eyes close together (Fig. 7); LE separated from ME by the diameter of ME. LE larger than ME (0.18 - 0.1 respectively). Sternum about ²/₃ as wide as long, extended between the IV pair of coxae. Labium as long as wide at its base, apically narrowed and rounded. Gnathocoxae distally convergent, enclosing the labium.



Figures 2-5. Male palp of *Loxosceles mrazig* sp. n. 2 prolateral view; 3 retrolateral view; 4 apical view; 5 dorsal view.

Opisthosoma elongate oval in dorsal view.

Male palp (Figs 2-5). Femur cylindrical, more than five times longer than wide. Tibia short, oval, slightly longer than wide. Tarsus flattened below, slightly shorter than tibia, rounded apically. Tegulum large, 4/5 as wide as tarsal length. Embolus enlarged at base, forming a sinuous curve, about 1.5 times longer than tegulum.

Measurements. Male (holotype): Prosoma 2.15 wide, 2.39 long: opisthosoma 3.22 long. Total body length 5.61. Legs: I: coxa 0.81, trochanter 0.23, femur 5.42, patella 0.84, tibia 5.70, metatarsus 5.76, tarsus 1.38, total length 20.14; II: coxa 0.58, rest of segments missing. III: coxa 0.81, trochanter 0.23, femur 4.94, patella 0.82, tibia 4.69, metatarsus 5.37, tarsus 1.12, total length 17.98; IV: coxa 0.81, trochanter 0.23, femur 5.26, patella 0.84, tibia 5.40, metatarsus 6.42, tarsus 1.33, total length 20.29; Palp: femur 1.19, patella 0.36, tibia 0.63, tarsus 0.56, total length 2.74.

Female unknown.

Distribution. So far, *L. mrazig* is known only from the type locality. The unique specimen was collected in a dune of sand near the city of Douz.



Figures 6-7. Prosoma of *Loxosceles mrazig* sp. n. **6** dorsal view, arrow indicates the four longitudinal lines located in the centre of the pars cephalica. **7** frontal view.

Discussion

The possibility that this species should be assigned to *L. gaucho* can be ruled out due to the high genetic distance observed between both species (more than 20%) and especially because they do not form a sister group relationship, but belonging to different clades. The morphological similarity can be explained as a convergence phenomenon due to the simple morphological structures of the copulatory organs found in haplogyne spiders.

Determining the closest relatives is difficult for this species due the lack of current knowledge on African *Loxosceles* species. Taking into account the shape of the male bulb, this species could be related to *L. foutadjalloni* Millot, 1941 from Guinea, in which the proportional palpal segments differs notably (mainly the tibia) and by the shape and size of the embolus. *L. mrazig* sp. n. – which could possibly be a member of a different group, or form a subgroup with the above mentioned *L. foutadjalloni*. *L. mrazig* sp. n. – is the second *Loxosceles* species known from the Mediterranean basin.

Acknowledgements

We would like to thank Luís Acosta from Uruguay and Antonio Brescovit from Brazil for their inestimable help and collaboration in providing us with the specimens of *L. gaucho* and *L. laeta* for this work. We also thank Cesc Múrria for collecting the new species and Miquel A. Arnedo for providing the sequence of *D. crocata*. This research was supported by the Spanish Ministry of Education and Science grants CGL2008-03385/BOS and CGL2006-13374/BOS.

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RESEARCH ARTICLE



Notes on Mediterranean Theridiidae (Araneae) - II

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Academic editor: Pavel Stoev	Received 4 March 2009	Accepted 16 June 2009	Published @@ August 2009		
urn:lsid:zoobank.org:pub:					

Citation: Knoflach B, Rollard C, Thaler K (2009) Notes on Mediterranean Theridiidae (Araneae) – II. In: Stoev P, Dunlop J, Lazarov S (Eds) A life caught in a spider's web. Papers in arachnology in honour of Christo Deltshev. ZooKeys %%: 1-14. doi: 10.3897/zookeys.%%.\$\$\$

Abstract

Taxonomic and faunistic amendments are provided for 15 species and one subspecies of comb-footed spiders (Theridiidae) of the Mediterranean region, in the genera *Anatolidion, Episinus, Heterotheridion, Theridion* and *Theridula*. The following taxonomic changes are proposed: *Anatolidion osmani* Wunderlich, 2008 and *Theridion crinigerum* Simon, 1881 are synonymised with *T. gentile* Simon, 1881, making it the type species of the monotypic genus *Anatolidion Wunderlich*, 2008. *Episinus albescens* Denis, 1965 is synonymised with *E. algiricus* Lucas, 1846, *Theridion xinjiangense* (Hu & Wu, 1989) with *Heterotheridion nigrovariegatum* (Simon, 1873). *Theridion aelleni* Hubert, 1970 is removed from synonymy of *Theridion spinitarse* O. P. Cambridge, 1876 and transferred to *Theridula*. The recent transfer of *Theridion pinicola* Simon, 1873 and *T. genistae* Simon, 1873 into *Paidiscura* has to be rejected. *Theridion genistae turanicum* Charitonov, 1946 from Uzbekistan is raised to species level. New faunistic records are presented for *Theridion pinicola* from North Africa, *Anatolidion gentile, Theridion genistae* and *T. hemerobium* from Greece. Several poorly known (sub-)species are redescribed: *Anatolidion gentile, Episinus maculipes numidicus* Kulczyński, 1905, *Theridion genistae*, *T. glaucinum* Simon, 1881, *T. musivum* Simon, 1873, *T. pinicola, T. pyrenaeum* Denis, 1944, *T. semitinctum* Simon, 1914 and *T. spinitarse* O. P.-Cambridge, 1876.

Keywords

Theridiidae, taxonomy, synonymy, faunistics, Mediterranean region, *Anatolidion, Episinus, Heterotherid*ion, Theridion, Theridula

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Introduction*

In the Mediterranean region spider taxonomy has been far less thoroughly considered and revised than in central and northern European countries, mainly owing to a lack of continuous research (Thaler 2000). Similar deficiencies in the current knowledge of spider diversity are also still substantial among the Theridiidae (Knoflach and Thaler 2000). About half of the roughly 280 comb-footed spider species described from Europe and the Mediterranean, including North Africa and Macaronesia, are known from one sex only and many of them have not been found again since their first discovery (Knoflach and Thaler 2000). Further problems arise in the long list of "species inquirendae", which are difficult to interpret. As many theridiids show large areas of distribution, numerous synonyms may be expected. This contribution is the continuation of a stepwise approach and concept to improve taxonomic and faunistic insights on comb-footed spiders in this region. We re-examined miscellaneous representatives of the genera Anatolidion, Episinus, Heterotheridion, Theridion and Theridula, with most species having been described by the French arachnologists Eugène Simon, Jacques Denis and Hippolyte Lucas, and we present new records and comparative remarks. As major taxonomic changes, four new synonymies are here proposed and a previous synonym is revalidated.

Material and methods

Specimens were examined using a Leica Wild M8 stereoscopic microscope with a micrometer eyepiece. Male and female genitalia were dissected and studied as temporary mounts by submerging them in glycerine and Hoyer's compound solution (Kraus 1984) on half-covered slides under a Wild M20 microscope with a drawing tube. Living spiders were photographed with a Nikon F3, Medical-Nikkor 120 mm lens, ring flash and a teleconverter. All measurements are in mm.

Abbreviations: C – conductor, Cy – cymbium, E – embolus, ETA – extra tegular apophysis, S – subtegulum, T – tegulum, MA – median apophysis, TTA – theridiid tegular apophysis (nomenclature of male palp sensu Agnarsson 2004 and Agnarsson et al. 2007). Species are listed in alphabetical order.

Depository and museum abbreviations: CM – Collection C. Muster [private collection], CTh – Collection Thaler and Knoflach [private collection], MHNG – Muséum d'Histoire naturelle Genève, MHNP – Muséum d'Histoire naturelle Paris, NHMB – Naturhistorisches Museum Basel, NMW – Naturhistorisches Museum Wien, SMF – Senckenberg Museum, Frankfurt am Main.

^{*} We cordially dedicate this study to Dr. Christo Deltshev on the occasion of his 70th birthday

Taxonomic part

Anatolidion gentile (Simon, 1881)

Figs 1-9

Theridion gentile Simon, 1881: 106, male, type locality: Corsica. *Theridion crinigerum* Simon, 1881: 72, female, type locality: Corsica. **New synonymy.** *Theridion crinigerum*: – Dalmas 1922: 86, male, Isola del Giglio. *Anatolidion osmani* Wunderlich, 2008: 385, figs 491-495, photo 352, male, type loca-

lity: Anatolia. New synonymy.

Detailed description. Wunderlich (2008, sub *Anatolidion osmani* Wunderlich, 2008, male).

Synonymy. Recent syntopically collected males and females of this striking theridiid from Chios allow matching of the sexes on the one hand, but also synonymy of Simon's *Theridion crinigerum*, as well as the recently described species *Anatolidion osmani* Wunderlich, 2008. According to Simon's material, *Theridion crinigerum* and *T. gentile*, which since their description have been known from one sex only, can clearly be assigned as conspecific with the Greek specimens, and thus are considered here as synonyms. As both species were described in the same year and the same work it is in compliance with the principle of the first reviser (ICZN 24.2, International Commission on Zoological Nomenclature, http://www.iczn.org/iczn/index.jsp) for our decision to determine precedence, which is in favour of *gentile*. The genus created by Wunderlich (2008) cannot be appropriately discussed here. *A. gentile*, which now becomes the type species of the monotypic genus *Anatolidion* Wunderlich, 2008, appears to share some features with the genus *Neottiura*, such as voluminous palps, a non-bulging epigaster, as well as an elevated clypeus, so that the cheliceral apodeme is far distant from the anterior eyes.

Material examined. Morocco: $1 \ (MHNP \ AR \ 2253 \ sub$ *Theridion crinigerum*).**Algeria:** $"Provence; Biskra; Tlemcen; Alger", <math>1 \ 3$, subadult $\ 3$ (shortly before maturation) 5 subadult $\ 3$, 22 juveniles (MHNP AR 2250 sub *Theridion gentile*). **Greece:** Chios, Volissos oaks, under oak logs in wood, $1 \ 9$ (CTh), 12.5.2006, leg. R. Snazell, swept flowers and grass between oaks, $2 \ 3$ (CTh), 12.5.2006, leg. A. Russell-Smith.

Measurements. Male (n=3, min-max): Total length 1.6-1.9, carapace length 0.7-0.8, width 0.7-0.8, length femur I 0.9-1.0, tibia I 0.6-0.8 mm. Femur of male palp 0.4-0.5 mm long. Female (n=2, min-max): Total length 2.2-2.5, carapace length 0.8-0.9, width 0.8, length femur I 0.8-0.9, tibia I 0.6 mm.

Somatic features, colouration (Figs 6-9). Carapace as long as wide, rather high. Eye region of male raised, clypeus projecting. Cheliceral apodeme quite distant from anterior eyes. Male epigaster not protruding. Carapace dark brown, with cephalic and lateral diffused dark areas. Sternum dark brown. Legs uniformly brown or with tibiae apically darkened, in males rather faint. Abdomen with blackish areas of various extent on brownish background, males considerably darker. Abdominal hairs long and

strong, as indicated by the naming of Simon's female as *T. crinigerum*. For further details see Simon (1881) and Wunderlich (2008).

Surprisingly, Dalmas (1922: 87, sub *T. crinigerum*) mentions an apical spur on femur IV in the male "L'éperon apical du femur IV du mâle est une particularité très remarquable de cette espèce.". This particular spur was not visible in the males examined and was not mentioned by Simon (1881: 107).

Male palp (Figs 1-3). Palp rather large (Fig. 7), femur long (see measurements) and slender. Tibia likewise well developed, with two retrolateral trichobothria, distinctly tapering at its base. Base about 0.3 width of distal rim in ventral view (Fig. 2). Cymbium voluminous and rounded. Embolus forms a conspicuous, heavily scle-



Figures 1-5. *Theridion gentile* Simon from Algeria (MHNP AR 2250; **1-3**) and Morocco (**4-5**). Male palp, retrolateral (**1**), ventral (**2**), prolateral view (**3**). Epigynum/vulva, ventral (**4**), dorsal view (**5**). **1-3** and **4-5** drawn at same scale. Scale lines: 0.20 mm (**1-3**), 0.10 mm (**4-5**).

rotised spiral (Figs 1-3), as described by Simon (1881: 107) "bulbe volumineux, ... pourvu d'un très fin stylum circulaire, ..." and by Dalmas (1922: 86) "...un fort style roulé en deux spires dans un plan perpendiculaire au tarse". The conductor is a membranous, lobed outgrowth, only its distal part enclosing the embolus. Median apophysis furcate, Y-shaped. Apparently, a second tegular apophysis is missing (see fig. 495 in Wunderlich 2008).

Epigynum/vulva (Figs 4-5). Epigynal cavity small and round, with anterior margin sclerotised (Fig. 4). Copulatory ducts rather wide, ca. 0.8-0.9 mm long, running in several loops, winding in several directions and around each other, proximal coil overlapping receptacles posteriorly (Figs 4-5). Lumen narrows with last coil towards entrance into receptacula seminis (Fig. 5).

Distribution. This little-known species is apparently widespread in the Mediterranean, but records are scattered: Algeria, Morocco, Corsica (Simon 1881, 1914), Italy (Toscana, Isola del Giglio, see Dalmas 1922, sub *T. crinigerum*; Firenze, Villa Mercatale, see Caporiacco 1923, sub *T. gentile*), Greece and Turkey (Wunderlich 2008). Interestingly, the report of Caporiacco (1923) concerns a single female of *T. gentile*, which at that time and until now was known from the male only.



Figures 6-9. *Theridion gentile* Simon from Algeria (MHNP AR 2250). Habitus of specimens preserved in alcohol. Juvenile female (**6**), adult male (**7**), subadult male (**8**, **9**). Photos: B. Knoflach.

Episinus algiricus Lucas, 1846

Figs 10-13, 15-17, 22, 25-26

- *Episinus algiricus* Lucas, 1846: 269, fig. 11, pl. 17, subadult male, type region: Algeria, not examined.
- *Episinus albescens* Denis, 1965: 611, figs 1-3, female, holotype from Landes, France, in MHNP, examined, **New synonymy.**

Description, identification. Kulczyński (1905), Denis (1965; sub *E. albescens*, female), Knoflach and Thaler (2000, female). Species name *algiricus* as in original description (see Lucas 1846: 269).

Synonymy. The type specimen (female) of *Episinus albescens*, which is in rather poor condition, allows a clear synonymisation according to the epigynal/vulval characters (Figs 15-16). Shape and size of epigynal cavity and receptacula agree well with *E. algiricus*. Also colour pattern and the abdominal shape figured by Denis (1965) support this interpretation. *E. albescens* has not been recorded since its description. The type locality in Landes lies within the distribution area of *E. algiricus*.

Material examined. France: Var, Cavalaire, 1 \Diamond (MHNP AR 2198, sub *Episinus truncatus*). Menton, 1 \Diamond (MHNP AR 2184), 22.5.1915, E. Simon. "Gallia" without exact locality, 2 \Diamond , 6 \bigcirc 1 juvenile (MHNP AR 2196). Landes, surroundings of Dax, 1 \bigcirc ,



Figures 10-12. *Episinus algiricus* Lucas from France, Menton. Male palp, retrolateral (**10**), ventral (**11**), prolateral view (**12**). All figures drawn at same scale. Scale line: 0.30 mm.
August 1962, leg. Schilt (Denis 1965; type of *E. albescens*; faded and shrivelled; MHNP). Corse, Evisa, 1 \bigcirc (MHNP AR 2206 sub *E. angulatus*). **Italy:** Sardinia, Ogliastra, W Baunei, 718 m, 40°06.319' N, 09°34.867' E, 1 \bigcirc (CTh), 2.6.2003, beating from *Quercus*, leg. B. Knoflach & K. Thaler [Th-443 Sa03/2]. Baunei/Dorgali, close to branch-off to Codula di Luna, 635 m, 40°05.791' N, 09°33.158' E, 1 \bigcirc (CTh), 5.6.2003, pasture plateau, beating from *Cistus*, leg. B. Knoflach & K. Thaler [Th-455 Sa03/14]. E Dorgali, above Cala Gonone, 220 m, 40°16.290' N, 09°36.641' E, 1 \bigcirc (CTh), 5.6.2003, beating in oak forest with rocky, bare ground, leg. B. Knoflach & K. Thaler [Th-458 Sa03/17]. **Tunisia:** Monastir, salt marsh near airport, 35°45'N 10°47'E, 1 \bigcirc (CM), 27.4.2007, from scrub, leg. C. Muster. **Algeria:** "Forêt de Zonagha", 1 \bigcirc , 1 juvenile (MHNP).

Measurements. Males (n=5, min-max): Total length 2.9-4.2, carapace length 1.2-1.6, width 1.0-1.4, length femur I 3.4-4.2, tibia I 2.8-3.9 mm. Females (n=5, minmax): Total length 4.2-5.0, carapace length 1.5-1.6, width 1.2-1.4, length femur I 2.5-2.8, tibia I 2.1-2.4 mm. Prosoma smaller than in *E. maculipes* (see also Kulczyński 1905), but male legs comparatively longer (Fig. 22).

Somatic features, colouration (Figs 22, 25-26). Habitus, colour and pattern similar to *E. maculipes*. Sternum dark, its light median stripe narrower than in *E. maculipes*, sometimes even missing. Carapace with brown median band and reticulate pattern at margins. These and leg markings more diffuse than in *E. maculipes*. Venter and epigaster usually dark or greyish.

Male palp (Figs 10-12). Theridiid tegular apophysis (= TA 2 in Knoflach and Thaler 2000) of characteristic shape, markedly projecting beyond conductor and cymbium (TTA in Figs 10-12). Conductor forming two small tips, retrolateral one tooth-like (Fig. 11). Palp morphology as in other congeners: embolus well developed, containing numerous loops of sperm duct, partially guided by a large conductor, three apophyses present (nomenclature of median apophysis, theridiid tegular apophysis and extra tegular apophysis according to Agnarsson et al. 2007), tibia with one dorsal and two retrolateral trichobothria, cymbium with two distal groups of setae. Palp altogether smaller than in *E. maculipes* (Figs 22 vs. 21; see also Kulczyński 1905), in ventral view 0.4-0.5 mm broad, 0.7-0.8 mm long (distance between distal rim of tibia and tip of cymbium). Tibia as wide as long (Fig. 11), see also Simon (1914).

Epigynum/vulva (Figs 13, 15-17). Epigynal cavity longer than wide, covering proximal part of receptacula (Figs 13, 17), without median septum. Cavity 0.19-0.21 mm wide, its posterior margin distinct. Receptacula seminis small as compared with *E. maculipes*, and less spherical. The uncertain assignment of *E. algiricus* females in Knoflach and Thaler (2000) can be confirmed here.

Distribution. *Episinus algiricus* is apparently confined to the western Mediterranean. Several records come from North Africa, Algeria (Lucas 1846, Simon 1914, Denis 1937), Tunisia (Simon 1914) and Morocco (Simon 1873a), and from south-west Europe, Portugal (Bacelar 1927, Cardoso 2009), Spain (Simon 1873a, 1914), France (Simon 1914; Denis 1934, 1964, 1965, 1966; Soyer 1973) including Corsica (Simon 1873a; sub *E. truncatus* Walckenaer, 1809), and Italy (Sardinia), see also Knoflach and Thaler (2000). Sympatric occurrence with *E. maculipes* seems to be evident from a few localities only, e.g. Vendée, Longeville (Denis 1964, 1966). Among the present records from Sardinia both species were found at least not far apart.

Episinus maculipes Cavanna, 1876

Figs 14, 18, 21, 23, 24

Description, identification. Kulczyński (1905), Brignoli (1967), Locket et al. (1974), Hillyard (1983), Roberts (1995), Knoflach and Thaler (2000), Agnarsson (2004).

Material examined. France: "Gallia" without exact locality, $1 \Leftrightarrow (MHNP \ AR 2196, sub$ *Episinus algiricus*, together with specimens of*E. algiricus* $). Idem, 8 <math>\stackrel{<}{\supset}$ 17 $\stackrel{<}{\ominus}$



Figures 13-18. *Episinus algiricus* Lucas (13, 15, 16, 17) from Gallia (MHNP AR 2196) (13, 17) and France: Landes (15, 16; type of *E. albescens* Denis). *E. maculipes* Cavanna (14, 18) from Gallia (MHNP AR 2196, sub *E. algiricus*). Epigynum ventral (13-14), epigynum/vulva, ventral (15, 17-18), dorsal view (16). All figures drawn at same scale. Scale lines: 0.20 mm.

1 subadult \Diamond (MHNP AR 2207). **Italy:** Sardinia, Bosco Selene, above Lanusei, 930 m, N 39°52.810 N, 09°31.213' E, beating from scrub and oak, 6 \Diamond 5 \heartsuit , 6.6.2003, leg. B. Knoflach & K. Thaler [Th-461, Sa03/20+19]. Sardinia, above Baunei, Golgo-Plateau, 580 m, 40°02.715' N, 09°40.003' E, beating, 1 \heartsuit 4 juveniles, 7.6.2003, leg. B. Knoflach & K. Thaler [Th-466 Sa03/25]. Liguria, Levanto surroundings, beating scrub and pine, 2 \heartsuit , 19.9.2004, leg. B. Knoflach & K. Thaler [Th-468 OI04/2]. Ibidem, Monterosso vs. St. Antonia, Colle di Grippa, 200-400 m, beating *Erica arborea*, 1 \Diamond 1 \heartsuit , 23.9.2004 [Th-471 OI04/5].



Figures 21-27. *Episinus maculipes* Cavanna from Sardinia (21, 23, 24), *E. algiricus* Lucas from Sardinia (22, 25, 26) and *E. theridioides* Simon from Corsica (27). Male (21-23, 25), female (24, 26, 27).

South Tyrol/Alto Adige, Klausen, Säben, 1 \bigcirc , 19.6.2004, leg. B. Knoflach & K. Thaler. **Greece:** Chalkidiki, Sithonia east coast, above Koutloumousi beach, near rill, 1 \bigcirc , 3.5.2000, leg. B. Knoflach & K. Thaler [Th-388 Gr 00/9]. W-Crete, Georgioupolis, 1 \bigcirc , 29.3.1999, swept from scrub, see Knoflach & Thaler (2000) [TH-353 K99-3b]. Voucher specimens deposited in CTh, MHNG, NMW if not specifically indicated.

Measurements. Males (n=5, min-max): Total length 3.9-4.2, carapace length 1.4-1.7, width 1.4-1.6, length femur I 3.4-3.8, tibia I 2.7-3.3 mm. Females (n=5, minmax): Total length 4.8-6.1, carapace length 1.6-1.9, width 1.5-1.7, length femur I 2.7-3.0, tibia I 2.2-2.4 mm.

Selected comparative remarks, diagnosis. *E. maculipes* is well characterised by numerous authors, for details of morphology and distribution see Knoflach and Thaler (2000). Some features are given here for identification and differentiation compared to *E. algiricus*: Prosoma larger than that of *E. algiricus*. Sternum dark, with marked light median stripe, which widens anteriorly. Carapace with clear brown median band and reticulate pattern at margins (Figs 23-24). Legs conspicuously speckled. Venter pale. Male palp larger than that of *E. algiricus* (Figs 21 vs. 22; see also Kulczyński 1905), in ventral view 0.6-0.7 mm broad, 0.9-1.0 mm long (distance between distal rim of tibia and tip of cymbium). Palpal tibia 1.5 times wider than long (Simon 1914). Theridiid tegular apophysis (= TA 2 in Knoflach and Thaler 2000) less prominent than in *E. algiricus*. Epigynal cavity wider than long, not overlapping receptacula (Figs 14, 18), with narrow median septum. Cavity 0.25-0.31 mm wide. Posterior margin of cavity less distinct than in *E. algiricus*. Receptacula seminis comparatively large and spherical.

Distribution. This widespread expansive Mediterranean species (for details see Knoflach and Thaler 2000) has recently been reported from Crimea, which is the east-ernmost record (Kovblyuk et al. 2008).

Episinus maculipes numidicus Kulczyński, 1905

Figs 19-20

E. m. numidica Kulczyński, 1905: 437, pl. 11, figs 4, 17, male, female, type region North Africa.

Description, identification. Kulczyński (1905).

Taxonomic status. Considerations on the subspecific rank have to be postponed owing to lack of material, especially males.

Material examined. Tunisia: Jendouba, Kroumirie near Aïn Draham, 196 m, 1 \bigcirc , (SMF), 16.4.2007, beating and sweeping in macchia, leg. C. Muster.

Measurements. Female (n=1): Total length 3.8, carapace length 1.3, width 1.2, length femur I 1.9, tibia I 1.5 mm.

Somatic features, colouration. The single female shows a similar colour pattern to *E. maculipes*, except for the sternum, which lacks a light median stripe.



Figures 19-20. *Episinus maculipes numidicus* Kulczyński from Tunisia. Epigynum (19), epigynum/vulva, ventral (20). Scale line: 0.20 mm.

Epigynum/vulva (Figs 19-20). Epigynal cavity considerably wider than long, 1.8 times in the examined female. Cavity 0.24 mm wide, about as long as receptacula seminis. Median septum broad and rather short.

Differentiation from *E. maculipes.* As indicated by Kulczyński (1905) *Episinus m. numidicus* is smaller than *E. maculipes.* The following features agree well with the description of Kulczyński (1905): Sternum almost completely dark, without light median stripe. Median septum of female epigynum considerably broader and shorter than in *E. maculipes* (Fig. 19 vs. 14; see also Kulczyński 1905, figs 17 vs. 18). Ratio width to length of epigynal cavity larger in *E. m. numidicus.* Cavity about as long as receptacula, while in *E. maculipes* it is 1.2-1.3 times longer than receptacula.

Distribution. North Africa (Kulczyński 1905).

Episinus theridioides Simon, 1873

Figs 27-31

Plocamis pyrenaea Simon, 1914: 246, 291, female, type locality: Pyrénées-Atlantiques (Bosmans and de Castro 2002).

Material examined. France: Pyrénées-Atlantiques, La Rhune, near St-Jean-de-Luz, 2 \bigcirc 1 juvenile (MHNP AR 2182; type material of *P. pyrenaea*, Simon 1914: 291). Corsica, Haute Asco, 1400-1440 m, 42°23,589' N, 08°55,349' E, under stones from scree at forest line, 2 \bigcirc (CTh), 12.9.2001, leg. K. Thaler & B. Knoflach [Th-417 Co01/15].

Description, identification. Knoflach (1993), Agnarsson et al. (2007), for further citations see Platnick (2008).

Synonymy. The synonymisation of *E. pyrenaeus* (Simon, 1914) with *E. theridioides* by Bosmans and de Castro (2002) is supported by the present material from the Pyr-



Figures 28-31. *Episinus theridioides* Simon from France, La Rhune (28-29; *E. pyrenaeus* AR 2182) and Corsica (30-31). Epigynum/vulva, ventral (28, 30), dorsal view (29, 31). All figures drawn at same scale. Scale line: 0.20 mm.

enees and from Corsica, though only females have been compared. General appearance (Fig. 27), shape of epigynum and overall course of copulatory ducts (Figs 28-29) are not or barely different from *E. theridioides* (Figs 30-31).

Distribution. *Episinus theridioides* occurs discontinuously in the Mediterranean (Knoflach and Thaler 2000) and is known only from a few localities in the French and Spanish Pyrenees, Cantabria, Corsica and Sardinia; for a distribution map see Bosmans and de Castro (2002). Unlike members of the *E. truncatus*-group it appears to be an exclusively epigeic species.

Heterotheridion nigrovariegatum (Simon, 1873)

Figs 32-33, 44, 59

Achaearanea xinjiangensis Hu & Wu, 1989: 119, male, female, figs 92.1-5, type region: China, Xinjiang. **New synonymy.**

Theridion xinjiangensis: - Zhu 1998: 187, figs 121A-F, male, female.

Theridion xinjiangensis: - Song et al. 1999: 148, figs 82E-F, I-J, male, female.

Heterotheridion nigrovariegatum: – Wunderlich 2008: 388, 460, figs 510-516, male, female, transfer from *Theridion*.

For additional synonyms see Platnick (2008).

Material examined. Uzbekistan: Vil. Tashkent, T. Bostanlyk, Tschatkal mountains, Mt. Surenatra, 1550-1700 m, SSE Karamosov, 2 👌, 15.6.-17.6.1997, leg. H. &. R. Rausch [97-23]. Vil. Kashka Darja, Hissar mountains W, Kukbulok surroundings, 1500 m, 1 3, 6.6.1997, leg. H. & R. Rausch [97-15]. Ibidem, 2000-2100 m, 1 3, 6.6.1997, leg. H. & R. Rausch [97-16]. Vil. Surchan Darja, 4km SW Shurob, 14-1500 m, 2 3, 26.5.-27.5.1997, leg. H. & R. Rausch [97-8]. Vil. Dzhizak, T. Farish, Nuratau mountains, Hayat-Saj, S Hayat, 950-1100 m, 1 ♂ 1 subadult ♂, leg. H. & R. Rausch [97-4]. Iran: Prov. Golestan, Tangegol, E Gonbad-e Qabus, 37°22'N/55°56'E, 800 m, 1 🖧, 22.5.-24.5.2001, leg. E. Heiss. **Turkey:** Adapazari 12km SSW, branch-off to Sapanca, ca. 100 m, beating at edge of oak forest, 1 male (NMW), 14.6.1967, leg. J. Gruber, Greece: Corfu, W of Spartilas, above Pirgi, in olive grove and scrub, beat catches, 1 👌 29.5.1996, leg. B. Knoflach & K. Thaler [TH260 Ko96-5]. Corfu, Pantokrator, above Spartilas-Taxiarkhis, 650 m, beat catches around chapel, $1 \stackrel{\bigcirc}{\downarrow}$, 31.5.1996, leg. B. Knoflach & K. Thaler [TH-263 Ko96-8]. Italy: Calabria, Catanzaro, Bosco di Stilo, S Paso d. Pietra Spada, 38°29'40"N, 16°21'06"E, 1300 m, 4 👌, 16.6.2003, leg. H. & R. Rausch [2003-19]. Toscana, Le Regine, Popiglio 800 m, 1 9, 15.10.1975, leg. K. Thaler. Molise, Matese, Campitello, 1500-1900 m, 1 3, 10.8.1989, leg. G. Osella. Friuli, Trieste, Aurisina, beating from Juniperus, 1 ♀, 13.7.1993, leg. F. Ber-



Figures 32-35. *Heterotheridion nigrovariegatum* Simon (**32-33**), male and female from South Tyrol, courtship (**32**), copulation (**33**). *Theridion genistae* Simon (**34-35**), female from Kephallonia (**34**), male from Corsica (**35**).

trandi. Ibidem, 1 3, 4.5.1994, 1 2, 2.6.1994, 1 3 7 2, 17.6.1994, leg. F. Bertrandi. Lombardia, Lago di Garda, Rocca die Manerba, 1 3 1 2, 16.6.1964, leg. K. Thaler. Lago di Garda, Riva, Monte Brione, 7 3 1 2, 13.6.1964, leg. K. Thaler. South Tyrol/ Alto Adige, Klausen, Säben, beat catches, 2 3 4 2, 19.6.2004, leg. B. Knoflach & K. Thaler. **Austria:** Northern Tyrol, Oetz, 850-900 m, 2 3 6 2, 9.6.2007, leg. Knoflach. Innsbruck surroundings, 700 m, from rolled leaf of *Corylus avellana*, 1 2, 27.7.2008, leg. B. Knoflach.

Voucher specimens deposited in CTh, MHNG, MHNP, NHMB, NMW if not specifically indicated.

Description, identification. Wiehle (1937), Miller (1971), Zhu (1998; sub *Theridion xinjiangensis*), Jäger et al. (2000), Deltshev (2003), Nentwig et al. (2003), Wunderlich (2008), for additional citations see Platnick (2008).

Generic placement. Wunderlich (2008) established a new monotypic genus *Heterotheridion* for this strikingly coloured species (Figs 32-33) owing to its genital characters, such as the palpal tibia being elongated into a slender outgrowth, the cymbium with an apical, scaly bulge and a distal embolus directed clockwise (Fig. 59). Furthermore, the anterior median eyes are smaller than the posterior medians, the posterior eye row is procurved and the legs are rather long (Wunderlich 2008). According to its mating behaviour, *H. nigrovariegatum* does not correspond to representatives of the genus *Theridion* (Knoflach 2004). Time and duration of sperm induction and number of insertions are clearly different. Sperm induction takes place independently of copulation and lasts correspondingly longer. Copulation usually consists of two insertions only (Knoflach 2004).

Synonymy. Theridion xinjiangensis (Hu & Wu, 1989) is synonymised with H. nigrovariegatum from the literature (figs 121 in Zhu 1998) because of the following distinct characters: Conformation of male palp and epigynum very similar (Figs 44, 59). Tibial and cymbial outgrowth typical, bulbus genitalis fully corresponding; conductor characteristically pointed, embolus clockwise, sperm duct highly convoluted within voluminous subtegulum and tegulum, median apophysis inconspicuous and hidden by cymbium (Fig. 59). Epigynum and vulva of *Theridion xinjiangensis* largely resemble those of H. nigrovariegatum in shape of copulatory orifices, coiled course of copulatory ducts and relatively large receptacula (Fig. 44). The only apparent morphological difference concerns the opisthosoma, which ends in a small tubercle in T. xinjiangensis (see fig. 121B in Zhu 1998). Specimens examined from Uzbekistan strengthen this synonymy. Also the type province Xinjiang is not so far distant from the hitherto known eastern records in Kyrgyzstan and Tajikistan.

Distribution. *Heterotheridion nigrovariegatum* shows a wide distribution range within the Palaearctic, reaching its easternmost limits in Kyrgyzstan, Tajikistan (Mikhailov 1997), W-China (Zhu 1998, Song et al. 1999, sub *T. xinjiangensis*) and Siberia (Simon 1914: 294, without exact locality), and northernmost in the Russian plain (Mikhailov 1997). This distinctive species has also been reported from a few localities in North Africa, Algeria (Denis 1937) and Libya (Bonnet 1959: 4495, Caporiacco 1936a, Ghat). In Europe it has been assigned as Mediterranean-expansive

(Thaler 1981, Knoflach and Thaler 1998). Further records come from several districts in Turkey (Türkeş and Mergen 2007). In Central Europe a preference for xerothermic habitats is evident (Buchar 1975, Thaler 1981, Jäger et al. 2000). *H. nigrovariegatum* lives on vegetation. Females hide in rolled leaves where they guard their egg sacs (Kubcová and Buchar 2005).

Theridion genistae Simon, 1873

Figs 34-40

Theridion genistae Simon, 1873a: 95, male female, type locality: Corsica. *Paidiscura genistae*: – Wunderlich 2008: 392, transfer from *Theridion*.

Material examined. France: Corsica, Calvi, Capo di a Veta, 180 m, 42°32'16.5"N, 08°45'11.6"E, beating garigue, Cistus, 2 3, 29.4.2001, leg. B. Knoflach & K. Thaler [Th-402 Co-01/1]. Corsica, Ostriconi estuary, E Ile Rousse, 42°09'40.4"N 09°03'39.9"E, at sea shore, 5 m, beating shrubs, *Genista*, 17 $\stackrel{?}{\triangleleft}$ 38 $\stackrel{\circ}{\downarrow}$, 3.5.2001, leg B. Knoflach & K. Thaler [Th-410 Co-01/9]. Italy: Calabria, Sibari, beat catches, 1 \mathcal{Q} , 3.6.1977, leg. S. Meyer. Sardinia, Ogliastra, W Baunei, 718 m, 40°06.319' N, 09°34.867' E, 2 ♂ 1 ♀, 2.6.2003, beating from *Quercus*, leg. B. Knoflach & K. Thaler [Th-443 Sa03/2]. Sardinia, E Dorgali, above Cala Gonone, 40°16.290'N, 09°36.641'E, 220 m, 1 2, 2.6.2003, beating in oak forest, leg. B. Knoflach & K. Thaler [Th-447 Sa03/6]. Greece: Corfu, Dasia, Sgombou/Gavrolimni, 100 m, beating phrygana and macchia, Quercus, 8 2, 28.5.1996, leg. B. Knoflach & K. Thaler [TH-259 Ko 96-4]. Corfu, Spartilas surroundings, 500-600 m, beating scrub, $2 \triangleleft 2$, 29, 5.1996, leg. B. Knoflach & K. Thaler [TH-260 Ko 96-5]. Corfu, Spartilas, 600 m, 1 ♀, 3.-4.6.1997, leg. E. Heiss. Kephallonia, Atheras beach, Atheras, 36 m, 38°19.997' N, 20°24.195'E, 30 m, 1 ♂ 19 ♀, 15.5.2002, beating from scrub, leg. B. Knoflach & K. Thaler [Th-427 Ke02/4]. E Crete, Stalida, garden, 1 3, 4.-10.4.1998, leg. B. Knoflach & K. Thaler [TH-321 K98/0]. W Crete, Georgioupolis, 1 ♀, 29.3.1999, leg. B. Knoflach & K. Thaler [TH-352 K99-2-3].

Voucher specimens deposited in CTh, MHNG, NHMB, NMW if not specifically indicated.

Description, identification. Wiehle (1960, female), Brignoli (1967, male, female), Vanuytven et al. (1994, male).

Measurements. Males (n=6, min-max): Total length 1.3-1.6, carapace length 0.6-0.8, width 0.5-0.7, length femur I 0.9-1.2, tibia I 0.6-0.9 mm. Females (n=6, min-max): Total length 1.4-1.6, carapace length 0.6, width 0.5-0.6, length femur I 0.6-0.8, tibia I 0.4-0.5 mm.

Somatic features, colouration (Figs 34-35). Small *Theridion* species, carapace and sternum dark brown, legs annulated and abdomen with numerous dark dots and characteristic whitish folium, which widens at midline and fades within whitish area (Fig. 34). Female epigastric region bulging. For details see Simon (1873a).

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Figures 36-40. *Theridion genistae* Simon from Corfu. Male palp, retrolateral (**36**), ventral (**37**), prolateral view (**38**). Epigynum/vulva, ventral (**39**), dorsal view (**40**). **36-38** and **39-40** drawn at same scale. Scale lines: 0.10 mm.

Male palp (Figs 36-38). Tibia rather small and short, with one retrolateral trichobothrium. Bulbus largely developed (see also Fig. 35). Embolus forms a long, thread-like spiral. Embolar base with knob-like locking device. Conductor a large, membranous, folded structure with furrow guiding embolus. Median apophysis inconspicuous, with a few scales, hidden within cymbium.

Epigynum/vulva (Figs 39-40). Epigynal atrium tiny and rounded. Copulatory ducts long and highly convoluted, narrowing towards receptacula.

Generic placement: The generic placement of *Theridion genistae* in *Paidiscura* as proposed by Wunderlich (2008) cannot be supported. Neither its general appearance nor structure of the male palpal organ favour such a combination. *T. genistae* shows a cymbial hood typical for *Theridion*, whereas in *Paidiscura* a hook is present. Also leg characters agree with *Theridion*: number of setae on tibiae I-IV 2/2/1/2 and metatarsus III with trichobothrium (see Knoflach and Thaler 2000).

Distribution. Western Mediterranean; known from southern France (Simon 1914, Denis 1935, Soyer 1973, Vanuytven et al. 1994) including Corsica (Simon 1873a, 1914), Algeria (Simon 1914), Tunisia (Simon 1885, 1914), Morocco (Simon 1873a), Italy (Latium, Isola di Zannone; Brignoli 1967). Easternmost records from Greece (present material from Ionian Islands and Crete), where it was hitherto not known (Bosmans and Chatzaki 2005). The species inhabits the vegetation in phrygana/garigue and macchia, which is reflected by the specific epithet referring to *Genista*.

Theridion genistae turanicum Charitonov, 1946. Judging from the illustration of the female genital organs by Charitonov (1946, fig. 29) *Theridion genistae turanicum* Charitonov, 1946 from Uzbekistan appears to belong to the *T. melanurum*-group and is not related to *T. genistae*. This justifies its elevation to species rank, *Theridion turanicum* stat. n.

Theridion glaucinum Simon, 1881

Figs 41-42

T. glaucinum Simon, 1881: 76, female, type locality Isères, Le Bourg-d'Oisans.

Material examined. France: "Alpes" [Rhone-Alpes, Isères, Grenoble, Le Bourgd'Oisans, see Simon 1881: 77], 1 Q (MHNP AR2834, type), det. E. Simon.

Description. Simon (1881: 76, female). Male unknown.

Measurements. Total length 3.0, carapace length 1.0, width 0.9, length femur I 1.8, tibia I 1.6 mm.

Somatic features, colouration. Carapace light, with narrow dark margins and dark central patch. Sternum dark. Legs light yellow with dark annulations. Abdomen in this faded specimen beige, a few faint dots on dorsum and a small dark longitudinal patch on venter. Spinnerets light, surrounded by dark pigmentation. For details see Simon (1881).

Epigynum/vulva (Figs 41-42). Epigynal cavity wider than long, its width 0.09 mm at midline; its overall shape trapezoidal, as anterior and posterior borders unevenly wide. Copulatory ducts rather short, ca. 0.2 mm long. They diverge sideways and form a short inwards coil towards the receptacula thereby gradually narrowing. Receptacula seminis rather elongated.

Affinities. Theridion glaucinum appears to be closely related to *T. petraeum* L. Koch, 1872. General appearance and epigynal characters are rather similar. Females of *T. petraeum* are comparatively larger, show an evenly transverse-oval epigynal cavity, copulatory ducts of 0.5 mm length and globular receptacula. As in other representatives of this species group, the epigynum of *T. glaucinum* is filled with mating plug secretions (see Knoflach 1998).

Distribution. Known only from the type locality. No further reference noted since its description.



Figures 41-44. *Theridion glaucinum* Simon from France (**41-42**), *Theridion musivum* Simon from Sardinia, Isola San Pietro (**43**) and *Heterotheridion nigrovariegatum* Simon from Northern Italy, Trieste (**44**). Epigynum/vulva, ventral (**41**, **43**, **44**), dorsal view (**42**). **41-42** drawn at same scale. Scale lines: 0.10 mm.

Theridion hannoniae Denis, 1944

Figs 45-47, 50-52, 56

Material examined. Tunisia: Hammamet, coast, $1 \ coast$, $1 \ coas$

3 \bigcirc 1 juvenile 20.9.1987. 2 \bigcirc 1 subadult \oslash 7 juveniles 10.10.1987. 1 \oslash 1 subadult \oslash 1 juvenile 30.10.1987. 10 \oslash 5 \bigcirc 9 subadult \oslash 12 juveniles 11.12.1987. 4 \oslash 8 \bigcirc 1 subadult \oslash 1 juvenile 1.4.1988. 2 \oslash 5 \bigcirc 4 juveniles 1.5.1988. 2 subadult \oslash 38 juveniles 2.6.1988. 3 \oslash 1 \bigcirc 6 juveniles 2.7.1988. Toscana, Grosseto, Alberese, Le Tofane, pitfall trap, leg. P. Cenzi: 1 \oslash 7 juveniles 2.7.1987. 1 \oslash 1 \bigcirc 1 subadult \oslash 2 juveniles



Figures 45-49. *Theridion hannoniae* Denis from Corsica; Forêt de Bonifatu (**45-46**) and Italy, Venezia (**47**). *Theridion pyrenaeum* Denis from Spain, Sierra Nevada (**48-49**). Male palp, ventral (**45, 48**), prolateral (**46, 49**), retrolateral-ventral view (**47**). All figures drawn at same scale. Scale lines: 0.20 (**45-46**, **48-49**), 0.10 mm (**47**).



Figures 50-55. *Theridion hannoniae* Denis from Mallorca (**50**, **52**) and Italy, Toscana (**51**). *Theridion pyrenaeum* Denis from Spain, Sierra Nevada (**53**, **54**) and France, Pyrenees (**55**). Epigynum/vulva, ventral (**50-51**, **54-55**), dorsal view (**52-53**). Scale lines: 0.10 mm.

23.7.1987. 2 juveniles 8.8.1987. 5 \bigcirc 1 subadult \bigcirc 2 juveniles 1.9.1987. 3 juveniles 20.9.1987. 2 \bigcirc 3 subadult \bigcirc 7 juveniles 10.10.1987. 1 \bigcirc 1 juvenile 30.10.1987. 6 \bigcirc 1 \bigcirc 3 subadult \bigcirc 3 juveniles 11.12.1987. 1 \bigcirc 2 \bigcirc 1.4.1988. 2 \bigcirc 2 \bigcirc 1 juvenile 1.5.1988. 3 \bigcirc 6 juveniles 2.6.1988. 4 \bigcirc 2 \bigcirc 1 juvenile 2.7.1988. Emilia-Romagna, Forli, 4 \bigcirc , 1992, pitfall trap, leg. M. Paoletti & V. Celano.

Voucher specimens deposited in CTh, MHNG, MHNP, NHMB, NMW if not specifically indicated.

Description, identification. Denis (1944), Wunderlich (1987; sub *T. denisi* Wunderlich, 1987), Thaler and Noflatscher (1990), Bosmans et al. (1994), Kloid (1994), Roberts (1998), Nentwig et al. (2003), Warmingham and Merrett (2009, in press).

Measurements. Fig. 56, smaller sibling species of *Theridion pyrenaeum*. Males (n=5, min-max): Total length 1.6-1.9, carapace length 0.7-0.8, width 0.6-0.7, length femur I 1.2-1.3, tibia I 1.0-1.1 mm. Females (n=5, min-max): Total length 2.0-2.9, carapace length 0.7-0.8, width 0.7-0.8, length femur I 0.9-1.3, tibia I 0.7-1.0 mm.

Somatic features, colouration. Carapace and sternum brown to dark brown. Legs yellowish with dark annulations. Abdomen greyish brown with dorsal whitish folium. Venter dark, with two distinct white patches. Male epigaster protruding. Colour pattern as in *Theridion pyrenaeum*.

Male palp (Figs 45-47). Conformation of male palp as in other representatives of the *Theridion varians* group (see Knoflach 1998). Conductor, median apophysis and theridiid tegular apophysis of specific shape, albeit highly concordant with the sibling species *T. pyrenaeum*. Median apophysis sickle-shaped, with abruptly narrowing, pointed, light prolateral tip. Theridiid tegular apophysis bifid. Differentiation from *T. pyrenaeum* by smaller dimension: Cymbium 0.32-0.38 mm long (mean 0.35, n=13). Distal part of embolus 0.18, 0.20, 0.25 mm long (n=3).

Epigynum/vulva (Figs 50-52). Epigynal cavity marked by two longitudinal, sclerotised ridges encircling roughly a square, with copulatory orifices situated at the anterior edges. Copulatory ducts diverge sideways, form a wider inwards coil and another small turn before entering receptacula. Overall genital morphology as in *T. pyrenaeum*, distinguished by size and proportion of following parts: Epigynal cavity smaller than in *T. pyrenaeum*, 0.06-0.08 mm wide (mean 0.07, n=10), less than or as wide as the distance to outside of ducts (x, Fig. 50). Receptacula seminis distinctly longer than epigynal cavity.

Phenology. In Belgium Bosmans et al. (1994) found males from June to October only, while juveniles and females were abundant throughout the year. Present data from Tuscany reveal considerable male activity also during the winter season (Table 1).

Distribution. Western Mediterranean, apparently expanding northwards. *Theridion hannoniae* is known from North Africa (Algeria, Tunisia), Macaronesia, South-West-Europe and by scattered records from Central-Europe (Bosmans et al. 1994). Numerous European records come from Portugal, Spain, France (type locality Douchy, NE-France) and Belgium. Recently, the species has also been found in Germany (Kloid 1994, Staudt 2003) and Wales (Warmingham 2008). The easternmost border of its distribution currently appears to lie in Italy (South Tyrol, Thaler and Noflatscher 1990; and present data from Tuscany and Emilia-Romagna). In northern Italy it may almost meet its eastern vicariant *Theridion refugum*, another representative of this still insufficiently known, ground-living, lapidicolous species complex. The allopatric occurrence of these closely allied species indicates different glacial refugia and respective reinvading processes. In contrast to its sibling *T. pyrenaeum*, *T. hannoniae* appears to be

Table 1. Phenological activity of *Theridion hannoniae* in Tuscany, Grosseto, Alberese (Sei Busi and Le Tofane) in 1987 and 1988, pitfall trapping by P. Cenzi. Abbreviations/explanations: sad M - subadult male, juv. M - juvenile male, juv. F - juvenile or subadult female, inad – inadult specimen, early instar.

	Male	Female	sad M	juv M	juv F	inad
02.07.1987	6	3	2	3	1	6
23.07.1987	5	2	2	4	1	1
08.08.1987	1	-	1	1	1	-
01.09.1987	10	-	2	-	-	2
20.09.1987	2	-	-	-	-	4
10.10.1987	4	-	4	4	5	7
30.10.1987	2	-	1	-	-	2
11.12.1987	17	6	12	2	9	4
01.04.1988	6	10	1	1	1	-
01.05.1988	3	6	-	-	-	7
02.06.1988	-	3	2	3	3	38
02.07.1988	7	3	-	-	-	7



Figure 56. Relationship of prosoma width and length of tibia I in *Theridion hannoniae* Denis and *T. pyrenaeum* Denis. Open symbols represent females, closed males.

restricted to lower altitudes; highest localities being about 800-1100 m. *T. hannoniae* occurs under stones in natural boulder fields and scree, but also in human debris, such as quarries, dikes and railway constructions (Bosmans et al. 1994, Staudt 2003).

Theridion hemerobium Simon, 1914

Figs 57-58

Material examined. Greece: Peloponnesos, Nafplio, Argos, brookside, 1 $\stackrel{?}{\circ}$ (CTh), 22.6.2000, leg. J. Buchar.

Description, identification. Differentiation from the closely related, larger *T. pictum* see Levi (1957a, sub *T. berkeleyi*), Blick et al. (1993), Bosmans et al. (1994), Roberts (1995), Nentwig et al. (2003), Almquist (2005). For additional citations and synonyms see Platnick (2008).

Male palp (Figs 57-58). Palp less elongated and considerably smaller than in *T. pictum*, length of tibia and tarsus ca. 0.4 mm (versus ca. 0.7 in *T. pictum*). Tibia rather broad at base as compared with distal rim, about 0.7 of distal width in ventral view, thus little constricted. Shape of conductor and median apophysis diagnostic. Prolateral tip of median apophysis closer to tip of conductor than in *T. pictum*. Embolus short, distal part 0.12 mm long (*T. pictum* 0.3 mm, see Knoflach 1998).

Distribution. *Theridion hemerobium* is widespread in North America (Levi 1957a) and Europe (Bosmans et al. 1994, Anthes 2000). From Greece it was hitherto not known (Bosmans et al. 1994, Anthes 2000, Bosmans and Chatzaki 2005). The present finding bridges a distribution gap in southeast Europe, though its occurrence is not surprising. A further record comes from Bulgaria (Deltshev 1992); the easternmost one from Israel (Levy 1998). Interestingly, the species has so far not been mentioned from Russia (Mikhailov 1997, 1998). *T. hemerobium* occurs stenotopically on the vegetation in wetlands and on banks of lakes, ponds and running water (Anthes 2000) and also colonises human-made structures in these habitats, e.g. bridges and fences (Jones 1994, Daws 2003).

Theridion musivum Simon, 1873

Figs 43, 60-64

T. musivum Simon, 1873a: 94, pl. 2, f. 26, male female, type region: Corsica.

Material examined. Croatia: Istria, Rovinj surroundings, agricultural site, $1 \ (CTh)$, 4.8.1965, leg. K. Thaler [Yu 65-15]. **Italy:** Sardinia, Isola Serpentara, $2 \ 1$ juvenile, 9.5.1988 Vaglio, leg. G. Osella & Gregori. Sardinia, Isola di San Pietro, Stagno di Cala Vinagra, $1 \ 2$, 13.5.1988, leg. Gregori, ded. G. Osella. Sardinia, Isola di San Pietro, Pendici, Mte Guardia dei Mori, $1 \ 2$, 10.6.1989, leg. G. Osella. Sardinia, Oristano, Su Pallosu, $1 \ 2$, 24.-28.4.1992 leg. E. Heiss. Sardinia, Baunei/Dorgali, close to branch-

off to Codula di Luna, 635 m, 40°05.791' N, 09°33.158' E, 2 \bigcirc (CTh), 5.6.2003, pasture plateau, beating *Cistus*, leg. B. Knoflach & K. Thaler [Th-454 Sa03/13]. **France:** Corsica, Calvi, Capo di a Veta, 180 m, 42°32'16.5"N 08°45'11.6"E, beating garigue, *Cistus*, 1 \bigcirc , 29.4.2001, leg. B. Knoflach & K. Thaler [Th-402, Co-01/1]. Corsica, Ostriconi-estuary, E Ile Rousse, 42°09'40.4"N 09°03'39.9"E, at sea shore, 5 m, beating shrubs, *Juniperus*, 2 \bigcirc , 3.5.2001, leg. B. Knoflach & K. Thaler [Th-410 Co-01/9]. Gabas (Br.), 18 \bigcirc 4 subadult \bigcirc 40 \bigcirc 16 juveniles (MHNP AR 2244 sub *T. varians*). Vaucluse, Vaison, 1 \bigcirc (MHNG), 18.5.1953, leg. A. Comellini. **Spain:** Mallorca, Pal-



Figures 57-62. *Theridion hemerobium* Simon from Peloponnese (**57-58**). *Heterotheridion nigrovariegatum* (Simon) from Uzbekistan, Surchan Darja (**59**). *Theridion musivum* Simon from France, Vaucluse (60) and Gabas (**61-62**). Male palp, ventral (**57, 59, 60, 61**), prolateral view (**58, 62**). **57-58** and **61-62** drawn at same scale. Scale lines: 0.2 (**57-59**) and 0.1 (**60-62**) mm.

ma, Camp de Mar, Castillo de Bellver, 1 \bigcirc (CTh), April 1974. **Tunisia:** Kairouan – Ouesslatia, 35°49'5.7"N 9°45'8.9"E, 288 m, beating *Juniperus* and *Pinus*, 1 \bigcirc (CTh), 26.4.2007, leg. C. Muster. Kebili, Zaafrane, 15 km W Douz, palm grove, tamarisk, 33°26'44.2"N 8°54'7.6"E, 50 m, 3 \bigcirc 1 subadult \bigcirc (CM), 21.4.2007, leg. C. Muster. Hammamet, coastal garden, beating scrub, 1 \bigcirc , 27.2.1997, leg. B. Knoflach & K. Thaler [TH-293 Tun97-2]. Voucher specimens deposited in CTh, MHNG, MHNP, NHMB, NMW if not specifically indicated.

Description, identification. Wiehle (1960), Levy and Amitai (1982), Levy (1998), see also Platnick (2008).

Measurements. Males (n=5, min-max): Total length 1.5-1.7, carapace length 0.6-0.7, width 0.6-0.7, length femur I 1.0-1.1, tibia I 0.6-0.7 mm. Females (n=5, min-max): Total length 1.8-2.3, carapace length 0.7-0-8, width 0.7-0.8, length femur I 0.9-1.0, tibia I 0.5-0.6 mm.

Somatic features, colouration (Figs 63-64). Overall colouration of carapace, sternum, gnathocoxae and chelicerae bright red in living specimens. This striking colour fades in specimens preserved in alcohol. Legs and palps lighter, with distal femora, patellae and distal tibiae reddish, but no dark annulations. Abdomen uniformly dark brown to ruby coloured. Male epigaster sclerotised, seminal vesicle (part of male genital system) conspicuously dark, translucent.

Male palp (Figs 60-62). Tibia very short, wider than long, with one retrolateral trichobothrium. Embolar base with anchoring process for tegular notch, as in other *Theridion* species. Distal part of embolus rather short (0.2 mm long) and stout. Conductor covered with minute scales. Theridiid tegular apophysis straight and pointed, closely adjoining conductor. Median apophysis sickle-shaped.

Epigynum/vulva (Fig. 43). Entrance of copulatory ducts distinctly sclerotised, visible through integument. Ducts 0.46 mm long, forming several overlapping, short coils. Receptacula seminis globular.

Distribution. Mediterranean region, most records coming from Southwest Europe and North Africa: France (Simon 1914, Denis 1934; type locality Corsica "commun en Corse sur les buissons" Simon 1873a), Spain (Simon 1914), Portugal (Cardoso 2009), Italy (Caporiacco 1922, 1936b), Croatia (present paper), Morocco (Simon 1909, 1914), Algeria (Simon 1914) and Tunisia (Pavesi 1884). More recently, *Theridion musivum* has also been shown to occur in Sinai, Egypt, (Levy 1998).

Theridion pinicola Simon, 1873

Figs 65-67, 69-75

Theridion pinicola Simon, 1873b: 364, 371, male female. Type locality: Corsica. *Paidiscura pinicola*: – Wunderlich 2008: 392, transfer from *Theridion*.

Material examined. France: Corsica, $3 \stackrel{?}{\circ} 35 \stackrel{?}{\circ} 4$ juveniles (MHNP AR 2257). N Corsica, Calvi, Forêt de Bonifatu, Bocca di Erbaghiolu, 1200 m, 42°25'15.0"N

08°50'15.5"E, beating from *Pinus nigra laricio*, 5 $3 \Leftrightarrow 1$ subadult 3 1 subadult 9, 2.5.2001, leg. B. Knoflach & K. Thaler [Th-409 Co-01/8]. Ibidem, 1200 m, 3 $3 \uparrow 1 \Leftrightarrow 3$ subadult 3, 30.4.2001. Corsica, Haute Asco, 42°23'32.2"N 08°55'08.9"E, 1400-1440 m, 2 \Leftrightarrow , 12.9.2001, beating pine at timber line, leg. B. Knoflach & K. Thaler [Th-417 Co01/15]. **Tunisia:** Kasserine, W Thélepte, Dernaya (close to Algerian border), 35°7'24.3"N 8°28'57.0"E, 1120 m, sparse pine wood, 2 3 (1 3 CM, 1 3 SMF), 19.4.2007, leg. C. Muster.



Figures 63-68. *Theridion musivum* Simon (**63-64**), female from Corsica (**63**), female guarding egg-sac from Sardinia (**64**). *T. pinicola* Simon from Corsica (**65-67**), male (**65-66**), copulating pair (**67**). *T. semitinctum* Simon from Northern Italy, female vulva, dorsal view (**68**).

Voucher specimens deposited in CTh, MHNG, NMW if not specifically indicated. **Description, identification.** The species has not been reported since the original description of Simon (1873b: 364, 371; 1881: 105).

Measurements. Males (n=5, min-max): Total length 1.5-1.9, carapace length 0.7-0.9, width 0.7-0.8, length femur I 0.9-1.1, tibia I 0.6-0.8 mm. Females (n=5, min-



Figures 69-75. *Theridion pinicola* Simon from Corse, Forêt de Bonifatu. Male palp, retrolateral (69), ventral (**70**), prolateral view (**71**). Epigynum/vulva, ventral (**72**, **74**), dorsal view (**73**, **75**). **69-71** and **72-75** drawn at same scale. Scale lines: 0.20 (**69-71**) and 0.10 mm (**72-75**).

max): Total length 1.5-2.4, carapace length 0.7-0-8, width 0.6-0.7, length femur I 0.7-0.9, tibia I 0.5-0.6 mm.

Somatic features (Figs 65-67). Carapace yellowish with thin dark margins and dark median band from eye region to midline. Sternum light, its margins may be diffuse dark. Legs yellowish with dark annulations from distal femora onwards. Abdomen dark brown, dorsum usually with whitish median folium. Male epigaster protruding.

Male palp (Figs 69-71). Conformation of male palp as in other representatives of the *Theridion varians* group (see Knoflach 1998). Tibia short, with one retrolateral trichobothrium. Conductor pointed and curved. Prolateral part of median apophysis triangular and strongly protruding. Theridiid tegular apophysis pointed. Embolus slender. Distal part of embolus 0.25 mm long.

Epigynum/vulva (Figs 72-75). Epigynal cavity rounded, its posterior border strongly sclerotised; with central copulatory orifices fused to common, rounded opening. Copulatory ducts ca. 0.4 mm long. They diverge laterally, forming a few coils, turn inwards and enter the receptacula by a final wide coil. In mated females the epigynal cavity is filled by plug secretions. All parts of vulva clearly translucent through integument.

Copulatory behaviour. Copulation follows the pattern of the *Theridion varians* group, with 6-8 sperm inductions, a presumed initial pseudocopulation and a final mating plug sequence (Knoflach 2004).

Generic placement: The generic placement of *Theridion pinicola* in *Paidiscura* by Wunderlich (2008) has to be rejected, since there is no convincing argument for such a combination. *T. pinicola* is clearly a member of the *T. varians* group, see above and Knoflach (2004), for *Paidiscura* see Knoflach and Thaler (2000).

Distribution. *Theridion pinicola* was hitherto known only from Corsica (Simon 1873b, 1881, 1914). The present new record from Tunisia suggests a wider distribution. As indicated by the naming of Simon the species occurs on pines, and appears to be a specialised inhabitant of pine forest, "en été sur les pins" (Simon 1881).

Theridion pyrenaeum Denis, 1944

Figs 48-49, 53-55, 56

Material examined. Spain: Sierra Nevada, Veleta route, 2600 m, boulder fields, 3 \bigcirc 9 \bigcirc 1 subadult \bigcirc 1 subadult \bigcirc (CTh), 18.7.1982 and 19.7.1982, leg. K. Thaler [Sp82-2, 82-7]. Sierra Nevada, Corral de Veleta, 3000 m, 1 \bigcirc (MHNG), leg. K. Thaler [Sp82-5]. **France:** Pyrenees, Larruns, Arrens, E Col d'Aubisque, 1600 m, scree, 1 \bigcirc 4 \bigcirc 1 subadult \bigcirc 1 juvenile (CTh), 14.7.1982, leg. K. Thaler [Py 82-11]. Pyrenees Orientales, Massif du Canigou, between Chalet de Cortalets and Cirque, 2200-2400 m, 1 \bigcirc (NMW), 26.9.1983, leg. K. Thaler [F83-8].

Description, identification. Denis (1944), Bosmans et al. (1994).

Taxonomic status. The statement of Bosmans et al. (1994: 238) ".. further material of *T. pyrenaeum* is needed to allow a biometric study of some parts of the palp and epigyne to decide about the status of this species" indicates its close similarity to

T. hannoniae and the arising problem of interspecific/intraspecific classification. This requirement remains. Judging from the present specimens, *T. pyrenaeum* is larger in body and leg size, although in the females this was not always clearly reliable (Fig. 56). However, the dimensions of the male and female genitalia (cymbium length and width of epigynal cavity) from various locations show consistent differences.

Measurements. This is a similar, but larger, species compared to *Theridion hannoniae* (Fig. 56). Males (n=4, min-max): Total length 2.2-2.5, carapace length 1.0, width 0.9-1.0, length femur I 1.8-2.2, tibia I 1.6-2.0 mm. Females (n=5, min-max): Total length 2.0-3.0, carapace length 0.8-1.0, width 0.8-1.0, length femur I 1.4-1.8, tibia I 1.1-1.5 mm.

Somatic features, colouration. Not distinguishable from *Theridion hannoniae*, see above.

Male palp (Figs 48-49). Conformation of male palp: see *T. hannoniae*, as palpal elements do not differ in shape. Differentiation from *T. hannoniae* by larger dimensions: Cymbium 0.50-0.52 mm long (n=4). Distal embolus 0.38-0.40 mm long (n=2).

Epigynum/vulva (Figs 53-55). Overall genital morphology as in *T. hannoniae*, distinguished by size and proportion of following parts: Epigynal cavity larger than in *T. pyrenaeum*, 0.12-0.15 mm wide (n=11), its width exceeding the distance to outside of ducts (x, Fig. 53). Receptacula seminis as long as or shorter than width of epigynal cavity.

Distribution. According to the current state of knowledge *Theridion pyrenaeum* appears to be endemic to western European mountain systems, in allopatry with the widespread *T. hannoniae*. Up to the present, *T. pyrenaeum* has been found only in the French and Spanish Pyrenees and Sierra Nevada (Spain). There it is confined to the higher zones, between 2500 and 3130 m altitude in Sierrra Nevada, about 2000 m in the type region Andorra (Denis 1957) and between 1600 and 2400 in the French Pyrenees (present paper). Ecological preference and altitudinal zoning resemble that of *Theridion petraeum* in the Alps.

Theridion semitinctum Simon, 1914

Figs 68, 76-77

Material examined. Spain: El Pardal (CM), $3 \ \bigcirc$ (MHNP AR 2298). **Italy:** Lombardia, Lake Lugano, Porlezza, $1 \ \bigcirc$ (CTh), 30.6.1962 (Thaler 1966, Abb. 2d, sub *Theridion* sp.).

Description, identification. This species has not been reported since the description of Simon (1914: 270, 297). A more detailed redescription including that of the unknown male is planned in comparison with the other members of the *Theridion melanurum* group (Knoflach, in preparation). For comparative analysis and illustration of females see Thaler (1966).

Measurements. One female from El Pardal: Total length 3.2, carapace length 1.2, width 1.1, length femur I 1.8, tibia I 1.5 mm.

Somatic features, colouration. The species is clearly a representative of the *Theridion melanurum*-group (Thaler 1966) and shares its general appearance, colour pat-



Figures 76-77. *Theridion semitinctum* Simon from Spain, El Pardal (MHNP AR 2298). Epigynum/ vulva, ventral (76), dorsal view (77), drawn at same scale. Scale line: 0.20 mm.

tern and overall conformation of genital organs with *Theridion betteni*, *T. melanurum*, *T. mystaceum*, etc. Abdomen with clear folium.

Epigynum/vulva (Figs 68, 76-77). Epigynal cavity a little longer than wide, scarcely sclerotised. Copulatory orifices about 0.1 mm apart, situated at posterior inner side of cavity. Copulatory ducts extensively coiled with large overlap of coils. Receptacula seminis globular.

Distribution. Simon (1914) reported *Theridion semitinctum* from France (Provence), Spain, and the Balearic islands (Simon 1914). A further record came from northern Italy (Thaler 1966 sub *Theridion* sp.). The species has probably been confused with *T. mystaceum*.

Theridion spinitarse O.P.-Cambridge, 1876

Figs 78-79

Theridion spinitarsis O. P.-Cambridge, 1876: 570, female, type locality: Cairo.

- *Theridion bifoveolatum* Denis, 1945: 48, fig. 17, female, type locality: Luxor, Egypt, March 1923 (Levy and Amitai 1982: 84).
- Non: *Theridion aelleni* Hubert, 1970: 190, figs 1-4, male, female; contra Brignoli (1984: 301), see *Theridula aelleni* below.

Material examined. Egypt: Assuan, $4 \, \bigcirc \, (CTh)$, 22.6.1975, on wall, leg. G. Kübelböck. **Saudi Arabia:** Wadi Karrar, $3 \, \bigcirc \, (NHMB)$, 10.2.1980, leg. W. Büttiker. **Yemen:** Wadi Warazan, $1 \, \bigcirc \, 28.10.1999$, on guava, leg. M. Mahyoub & A. van Harten [794]. Al Hudaydah - Az Zaydiyah, $2 \, \bigcirc \, 06.12.1998$, leg. van Harten [533].

Description, identification. Identification based on the description and figure given by Denis (1945 sub *T. bifoveolatum*). Male unknown.

Measurements. Females (n=5, min-max): Total length 3.4-4.2, carapace length 1.3-1.5, width 1.1-1.3, length femur I 1.7-2.0, tibia I 1.3-1.5 mm.



Figures 78-79. *Theridion spinitarse* O. P.-Cambridge. Epigynum/vulva, ventral (78), dorsal view (79), drawn at same scale. Scale line: 0.10 mm.

Somatic features, colouration. Carapace light brown, with dark margins and dark band at midline, which does not extend to eye region. Sternum of same light ground colour, sometimes with a few indistinct greyish patches or margins. Legs light brown, with dark annulations. Abdomen on dorsum with white, evenly undulated folium outlined by dark pigmentation. Epigaster light brown, venter whitish.

Epigynum/vulva (Figs 78-79). Copulatory orifices laterally oval, ca. 0.07 mm wide, 0.05 long. Orifices widely separate, about 0.2 mm apart and thus about twice their width. Their distance to epigastric furrow equals about their overall width. In mated females the orifices are filled with plug secretions. Copulatory ducts ca. 0.45 mm long, coiled dorsally and anteriorly, and form a long transverse turn laterally before bending to receptacula. Receptacula seminis large as compared with copulatory orifices, ca. 0.15 mm long, clearly visible through integument.

Affinities. The species appears to be rather close to the North American *Theridion murarium* Emerton, 1882.

Distribution. North Africa and Arabian Peninsula. *Theridion spinitarse* is so far known from several localities in Egypt (O.P.-Cambridge 1876, Denis 1945) and from Ethiopia (Pavesi 1883; Shewa, mountains around Let Marefia). It also occurs in Saudi Arabia and Yemen (present paper). It has been collected at least partially from vegetation "A single example was found on a low plant near Cairo" (O.P.-Cambridge 1876).

Theridula aelleni (Hubert, 1970) stat. n., comb. n.

Figs 80-84

Theridion aelleni Hubert, 1970: 190, figs 1-4, male female, type locality: Tunisia, Gr. des Chauves-Souris, El-Haouaria, 3.10.1967. Resurrected from synonymy with *Theridion spinitarse* O. P.-Cambridge, 1876 (contra Brignoli 1984). **New combination**.

Type material examined. Female holotype, male allotype, MHNG, Tunisia, Gr. des Chauves-Souris, El Haouaria, 3.10.1967, leg. P. Strinati, M. Frainier & V. Aellen, det. M. Hubert 1969.

Further material examined. Spain: Cadiz, Embalse de Palmones, $1 \ \bigcirc$ (in collection J. van Keer), 16.3.1994, leg. J. van Keer.

Description, identification. Hubert (1970).

Measurements. n=3, holotype female/allotype male/female from Spain: Total length 2.4/2.0/3.2, carapace length 1.0/0.9/1.1, width 0.9/0.8/1.0, length femur I 1.3/1.4/1.5, tibia I 1.2/1.3/1.2 mm.

Somatic features, colouration. Specimens from Tunisia uniformly pale yellow, probably faded (but see Hubert 1970). The female from Cadiz shows an indistinct pattern: Carapace light brown with faint dusky margins and median band. Sternum dusky grey. Legs uniformly pale yellowish. Abdomen grey, with three pairs of pale transverse, oval patches, arranged in diagonal paramedian rows. Venter uniformly grey. Spinnerets contrastingly light. Male chelicerae longer than in female. Abdomen globular, a little longer than wide, without protuberances. For further details see Hubert (1970).

Male palp (Figs 80-82). Tibia rather asymmetrical, retrolaterally fairly extended (Fig. 80), but prolaterally excavated (Fig. 82), its distal rim in ventral-prolateral view oblique and almost reaching patella (Fig. 81). Two trichobothria present on retrolateral side of tibia. Cymbium elongate and slender, its base occupying prolateral side of palp, where it is markedly incised. Cymbial hood in dorsal-median position. Subtegulum and tegulum constitute the main part of genital bulb and are densely crossed by wide loops of sperm duct. The embolus forms a straight element inserted deeply within the tegulum. Subtegulum with strongly protruding sclerotised basal shaft, which is embedded within a cavity and surrounded by a noticeably developed basal haematodocha. Distal part of embolus conspicuously screwed. Embolar base encircled by a membranous apophysis, which interlocks with cymbial hood and thus is interpreted as the median apophysis.

Epigynum/vulva (Figs 83-84). Copulatory orifices roughly circular, ca. 0.6 mm wide, with marked, sclerotised outlines. They are clearly separate, but less than their diameter apart. Their distance to epigastric furrow equals about their diameter. Copulatory ducts rather short, forming a small coil, at entrance rather wide, narrowing towards receptacula. Receptacula seminis barely larger than copulatory orifices.

Taxonomic remarks, generic placement. The former synonymy of *Theridion aelleni* with *T. spinitarse* by Brignoli (1984: 301) was concluded from illustrations only and cannot be supported here. Along with the present analysis of type material the resurrection of *T. aelleni* has to be confirmed (for comparison see *Theridion spinitarse* above). However, the generic placement among *Theridion* evidently implies some difficulty. The new allocation offered here may be surprising and not fully satisfactory when considering the general appearance of hitherto known *Theridula* species, which is known to be striking, mainly through a tuberculate and wide abdominal shape, often combined with bright colour. Especially the unmodified abdomen of *T. aelleni* at first glance argues against placement within *Theridula*, but would suggest resemblance with the only hitherto known species of *Paratheridula* (see Levi 1957b). However, a transfer

of the species into *Theridula* is suggested, mainly owing to characters of the male palp: 1. Membranous median apophysis adjoining embolus and arresting towards cymbial hood (= distal haematodocha according to Levi 1954, 1966 and Levi and Levi 1962, Heimer 1982; median apophysis according to Agnarsson 2004: 596). 2. Distal part of embolus screw-shaped. 3. Asymmetry of tibia. 4. Prolateral incision of cymbium. 5. Female genitalia of concordant structure. In *Paratheridula* a median apophysis (distal



Figures 80-84. *Theridula aelleni* (Hubert) from Tunisia. Male palp, retrolateral (**80**), ventral (**81**), prolateral view (**82**). Epigynum/vulva, ventral (**83**), dorsal view (**84**). **80-82** and **83-84** drawn at same scale. Scale lines: 0.20 (**80-82**) and 0.10 mm (**83-84**).

membrane) is reported to be completely missing, which appears to be the main criterion for its separation from *Theridula* (Levi and Levi 1962).

Distribution. *Theridula aelleni* is so far known only from the type locality in Tunisia and from Spain.

Acknowledgements

For material and for various help we are grateful to Dr. Fulvia Bertrandi (Trieste), Prof. Dr. Jan Buchar (Praha), Dr. Paola Cenzi (Padova), Dr. Vincenzo Celano (Padova), Dr. Sieglinde Meyer (Innsbruck), Dr. Jürgen Gruber (Vienna), Dr. Ambros Hänggi (Basel), Dr. Bernd Hauser (Genève), Dr. Ernst Heiss (Innsbruck), Dr. Erich Kreissl (†), Dr. Volker Mahnert (Genève), Dr. Christoph Muster (Putbus), Prof. Dr. Giuseppe Osella (L'Aquila), Prof. Dr. Maurizio Paoletti (Padova), Hubert and Renate Rausch (Scheibbs), Dr. Anthony Russell-Smith (Sittingbourne), Dr. Peter Schwendinger (Genève), Dr. Rowley Snazell (Swanage), Antonius van Harten (United Arab Emirates) and Johan van Keer (Kapelle-op-den-Bos). Sincere thanks go to Dr. Peter Merrett (Swanage) for linguistic check of the manuscript. Figure 68 was kindly provided by Dr. Hans Jörg Kraus (Jenbach).

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RESEARCH ARTICLE



Further notes on the Harmochireae of Africa (Araneae, Salticidae, Pelleninae)

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Academic editor: Pavel Stoev	Received 7 March 2009	Accepted 16 April 2009	Published @@ August 2009				
urn:lsid:zoobank.org;pub:							

Citation: Logunov DV (2009) Further notes on the Harmochireae of Africa (Araneae, Salticidae, Pelleninae). In: Stoev P, Dunlop J, Lazarov S (Eds) A life caught in a spider's web. Papers in arachnology in honour of Christo Deltshev. ZooKeys %%: 1-14. doi: 10.3897/zookeys.%%.\$\$

Abstract

Four new spiders, *Bianor paulyi* **sp. n.** (\mathcal{J}^{\diamond} ; from Madagascar and the Comoros), *Microbianor deltshevi* **sp. n.** (\mathcal{J}^{\diamond} ; from Madagascar), *M. madagascarensis* **sp. n.** (\mathcal{J}^{\diamond} ; from Madagascar), and *Sibianor anansii* **sp. n.** (\mathcal{J}^{\diamond} ; from Botswana), are diagnosed, illustrated and described. A new combination is suggested: *Sibianor proszynskii* (Zhu et Song, 2001) **comb. n.** (ex *Harmochirus*). New faunistic records from Africa are given for *Bianor albobimaculatus*, *B. kovaczi*, *Harmochirus luculentus*, *Modunda staintoni*, *Neaetha oculata*, and *Sibianor kenyaensis*. A brief discussion of the current state of knowledge of the Harmochireae is also provided.

Keywords

New species, jumping spiders, Harmochireae, Araneae, Africa, Madagascar

Introduction

Originally (Simon 1903), the group Harmochireae consisted of a single genus *Harmochirus*. Referring to the atlases of diagnostic illustrations by Prószyński (1984, 1987), Żabka (1991: p. 12, table 1) commented that the Harmochireae was a group of randomly selected genera, of which four genera (*Bianor, Harmochirus, Neaetha* and *Modunda*) were similar; yet, he discussed neither its diagnostic characters, nor

its taxonomic status. Later, Logunov (1996, 2001) provided a diagnosis of the Harmochireae and included seven genera in it (see Table 1). Based both on somatic morphology and on the structure of the copulatory organs, all the salticid genera currently included in this group were diagnosed, (re)described and discussed in detail by Logunov (2000, 2001).

The group Harmochireae is a member of the subfamily Pelleninae (sensu Maddison and Hedin 2003, Maddison et al. 2008). Its congeners can be readily distinguished from the rest of the Pelleninae genera by the absence of the compound terminal apophysis and cymbial dorso-lateral projections in males and of the epigynal flaps in females (for further details see Logunov 2001). The group Harmochireae most probably deserves tribal status within the Pelleninae, but this matter is outside the scope of the present work. It is worth mentioning though that *Bianor* and *Sibianor*, the two genera of Harmochireae sampled by Maddison et al. (2008) for their phylogenetic analysis, formed a separate clade within the Pelleninae (Op.cit.: fig. 9). The taxonomic status and composition of the group Harmochireae require further attention in the future, when more genera (particularly, *Harmochirus, Microbianor* and *Neaetha*) have been sampled for DNA sequence data.

Since the latest review of Harmochireae (Logunov 2001) only a few new species have been described (e.g., Jastrzębski 2007), with one of them, *Bianor biguttatus*, described from north Africa (Arabian Peninsula) (see Wesołowska and van Harten 2002). In the present work, I have considered new African material of various Harmochireae genera (10 species altogether) which became available to me in 2008. Four new species are described, and new faunistic records are reported for six other species.

Material and methods

This work is based on specimens borrowed from the following museums: BMNH= Department of Entomology, the British Natural History Museum, London, UK (Ms J. Beccaloni); and MRAC= Musée Royal de l'Afrique Centrale, Tervuren, Belgium (Dr. R. Jocqué). Abbreviations used in the text: *Eyes*: AME = anterior median eye, PLE = posterior lateral eye(s). *Leg segments*: Fm = femur, Mt = metatarsus, Pt = patella, Tr = tarsus, Tb = tibia. *Position of spines on legs*: ap = apical, d = dorsal, pr = prolateral, rt = retrolateral, v = ventral. For the leg spination the system adopted is that used by Ono (1988). The sequence of leg segments in measurement data is as follows: femur + patella + tibia + metatarsus + tarsus. The names of two collectors are abbreviated as follows: AP = A Pauly; ARS = A Russell-Smith. For previously described species only references to reliable sources of identification are provided. For a complete set of taxonomic references for each known species see Platnick (2009). All measurements are in mm.

Genera and species	Distribution			
Bianor Peckham et Peckham, 1885				
<i>B. albobimaculatus</i> (Lucas, 1846)	S Africa, Mediterranean to Central Asia			
B. angulosus (Karsch, 1879)	S China, S and SE Asia			
<i>B. biguttatus</i> Wesołowska et van Harten, 2002	Socotra			
B. biocellosus Simon, 1902	Brazil (TL)			
B. compactus (Urquhart, 1885)	New Zealand (TL)			
B. concolor (Keyserling, 1882)	New South Wales (TL)			
B. diversipes Simon, 1901	Malaysia (TL)			
B. eximius Wesołowska et Haddad, 2009	South Africa (TL)			
B. incitatus Thorell, 1890	S China, S and SE Asia, Caroline Islands			
B. kovaczi Logunov, 2001	Ivory Coast, Ethiopia, Botswana			
B. maculatus (Keyserling, 1883)	Australia, New Zealand			
B. murphyi Logunov, 2001	Kenya			
B. nexilis Jastrzębski, 2007	Bhutan (TL)			
<i>B. paulyi</i> sp. n.	Madagascar, the Comoros			
B. pseudomaculatus Logunov, 2001	N and E India, Vietnam			
B. punjabicus Logunov, 2001	N India, Afghanistan			
B. quadrimaculatus (Lawrence, 1927)	Namibia (TL)			
B. senegalensis Logunov, 2001	Senegal			
B. tortus Jastrzębski, 2007	Nepal, E India*			
B. vitiensis Berry, Beatty et Prószyński, 1996	Fiji			
B. wunderlichi Logunov, 2001	Canary Is., Azores			
Harmochirus S	imon, 1885			
H. brachiatus (Thorell, 1877)	Bhutan to Taiwan and Indonesia			
H. insulanus (Kishida, 1914)	S China, Korea, Japan			
<i>H. lloydi</i> Narayan, 1915	India (TL)			
H. luculentus Simon, 1886	S Africa to Yemen			
H. pineus (Xiao et Wang, 2005)**	SE China (TL)			
<i>H. zabkai</i> Logunov, 2001	Nepal, N India, Vietnam			
Microbianor Logunov, 2000				
<i>M. deltshevi</i> sp. n.	Madagascar (TL)			
<i>M. golovatchi</i> Logunov, 2000	The Seychelles (TL)			
<i>M. madagascarensis</i> sp. n.	Madagascar			
M. nigritarsis Logunov, 2000	The Seychelles			
M. saaristoi Logunov, 2000	The Seychelles, Réunion			
Modunda Simon, 1901				
M. aeneiceps Simon, 1901	Sri Lanka (TL)			
M. staintoni (O. Pickard-Cambridge, 1872)	S Africa, the Middle East to NW India			

Table 1. Valid species of the Harmochireae and their distribution.

Genera and species	Distribution			
Napoca Simon, 1901				
N. insignis (O. Pickard-Cambridge, 1872)	Israel (TL)			
Neaetha Simon, 1884				
N. absheronica Logunov et Guseinov, 2002	E Mediterranean, the Caucasus			
N. catulina Berland et Millot, 1941	Mali (TL)			
N. cerussata (Simon, 1868)	Mediterranean			
N. irreperta Wesołowska et Russell-Smith, 2000	Tanzania (TL)			
N. membrosa (Simon, 1868)	W Mediterranean and Central Europe			
N. murphyorum Prószyński, 2000	Israel (TL)			
N. oculata (O. Pickard-Cambridge, 1876)	E Mediterranean, Botswana			
Sibianor Logunov, 2001				
S. aemulus (Gertsch, 1934)	Canada, USA			
S. anansii sp. n.	Botswana (TL)			
S. annae Logunov, 2001	SE China (TL)			
S. aurocinctus (Ohlert, 1865)	Europe to C Siberia			
S. japonicus (Logunov, Ikeda et Ono, 1997)	The Russian Far East, Japan			
S. kenyaensis Logunov, 2001	Kenya, Botswana			
S. kochiensis (Bohdanowicz et Prószyński, 1987)	Japan			
S. larae Logunov, 2001	Fennoscandia to the Russian Far East			
S. latens (Logunov, 1991)	S Siberia to the Russian Far East			
S. nigriculus (Logunov et Wesołowska, 1992)	The Russian Far East, N Korea, Japan			
S. pullus (Bösenberg et Strand, 1906)	The Russian Far East, China, Korea, Japan			
S. proszynskii (Zhu et Song, 2001), comb. n.***	NE China (TL)			
S. tantulus (Simon, 1868)	Europe to E Siberia			
S. turkestanicus Logunov, 2001	The Caucasus, Central Asia			
S. victoriae Logunov, 2001	Kenya (TL)			

Mainly based on the works by Logunov (1996, 2000, 2001), with subsequent contributions by Jastrzębski (2007), Ledoux (2007), Logunov and Guseinov (2002), Prószyński (2003), Song et al. (2001), Wesołowska and van Harten (2002, 2007), Wesołowska and Russell-Smith (2000), Wesołowska and Tomasiewicz (2008), Xiao and Wang (2005), Wesołowska and Haddad (2009), and present data. Abbreviation (TL) means that the species is known only from the type locality.

* The male mentioned by Jastrzębski (2007: p. 27) from E India (Assam) most probably belongs to *B. incitatus.*

** This species is likely to be a junior synonym of *H. insulanus* (cf. Logunov 2001: figs 194-203), which has also been reported from SE China. This problem requires special attention in the future.

*** A new combination has been suggested for *Sibianor proszynskii* (Zhu et Song, 2001) comb. n. (ex *Harmochirus*). On the basis of the original figures by Song et al. (2001: figs 284a-d), it is clear that the species possess all the male diagnostic characters of *Sibianor* (see Logunov 2001: pp. 223, 262), viz. the fringes on leg I and the tegular knob present, the PLE are not elevated, and the *3* chelicerae are not modified. Thus, it is safe to conclude that this species is better considered a member of *Sibianor*. Furthermore, *S. proszynskii* is most likely a junior synonym of *S. nigriculus* (cf. Logunov 2001: figs 272-273) known to date from the Russian Far East, Japan and N Korea. This problem requires special attention in the future.
Genera and species	Distribution, comments and references
Bianor Peckh	nam et Peckham, 1885
<i>B. fasciatus</i> Mello-Leitão, 1922	Brazil; not a member of <i>Bianor</i> (Logunov 2001).
<i>B. fimbriatus</i> Mello-Leitão, 1917	Brazil; nomen dubium (Logunov 2001).
B. hongkong Song, Xie, Zhu et Wu, 1997	Hong Kong; not a member of <i>Bianor</i> (Logunov 2001)
<i>B. monster</i> Żabka, 1985	Vietnam. Likely to be a junior synonym of <i>B. an-</i> gulosus (see Logunov 2001).
<i>B. simplex</i> (Blackwall, 1865)	Cape Verde Is. Logunov (2001) treated this name as a <i>nomen oblitum</i> , but he did not mention the record by Berland (1936: p. 80, fig. 24-25), who illustrated the \Im of this species from Santo Antão. Reasoning from the \Im body colour pattern illus- trated by Berland, one can conclude that there seems to be a separate species of <i>Bianor</i> occurring on the Cape Verde Is. (different from <i>B. albobi- maculatus</i>). Yet its status and name require further study in the future.
Harmoch	birus Simon, 1885
H. bianoriformis (Strand, 1907)	C and E Africa, Madagascar. The taxonomic status and validity of this species are uncertain (Logunov 2001).
H. duboscqi (Berland et Millot, 1941)	Ivory Coast, Senegal. Likely to be a junior syn- onym of <i>H. luculentus</i> (Logunov, 2001).
H. rufescens Caporiacco, 1940	Somalia; <i>nomen dubium</i> (Wesołowska 1994, Logunov 2001).
Modun	ada Simon, 1901
<i>M. ghigii</i> Caporiacco, 1949	Kenya. This species, listed by Platnick (2009) under the genus <i>Bianor</i> , is of uncertain taxonomic status, as the \bigcirc holotype (see Caporiacco 1949: fig. 96) is not a member of the Harmochireae (no central blind-ending pocket!) and belongs elsewhere.
<i>M. orientalis</i> Dönitz et Strand, 1906	Japan. This species, listed by Platnick (2009) under the genus <i>Bianor</i> , was described from a single \bigcirc (Bösenberg and Strand 1906: table 8, fig. 123); as the original illustration is insufficient to assign the species to any of the currently known Harmochire- ae genera, it is safer to treat the species as being of uncertain taxonomic status.
Neaeth	<i>ba</i> Simon, 1884
N. aegyptiaca Denis, 1947	Egypt. On the basis of the $\stackrel{\circ}{\circ}$ palp illustrated nicely by Denis (1947: plate V, figs 14, 15), it is easy to conclude that <i>N. aegyptiaca</i> is not a member of <i>Neaetha</i> but belongs in <i>Evarcha</i> Simon, 1902.

Table 2. A list of existing species names of the Harmochireae excluded from discussion.

Genera and species	Distribution, comments and references
N. alborufula Caporiacco, 1949	Kenya. The original illustration by Caporiacco (1949: fig. 91) leaves no doubt that this taxon is not a member of <i>Neaetha</i> , as the figured ♂ palp is more similar to that of <i>Hispo</i> Simon, 1885 rather than to any <i>Bianor</i> -type taxa.
<i>N. catula</i> Simon, 1886	E and S Africa. This species is of uncertain taxonom- ic status: the \bigcirc illustrated by Caporiacco (1949: fig. 90) does not belong to the Harmochireae, as it does not have the central pocket.
N. fulvopilosa (Lucas, 1846)	Algeria, Tunisia. This species is of uncertain taxo- nomic status, known only from the original de- scription.
N. ravoisiei (Lucas, 1846)	Algeria, E Africa. This species is of uncertain taxo- nomic status. The record by Strand (1907: p. 720) was based on an immature specimen.
Stichi	us Thorell, 1890
S. albomaculatus Thorell, 1890	Sumatra; nomen dubium (Logunov 2001).
Velloa Peckt	nam et Peckham, 1903
V. modesta Peckham et Peckham, 1903	S Africa; <i>nomen dubium</i> (Wesołowska 1994, Logunov 2001).

Taxonomic part

Bianor Peckham et Peckham, 1885

Bianor is the largest genus of the Harmochireae, consisting of 21 valid species (Table 1), with the majority of them occurring in the Ethiopian or Oriental Regions. Six additional species have uncertain taxonomic status or are invalid (Table 2). In the light of findings of a new *Bianor* species from Madagascar and of new records of *B. kovaczi* from Botswana (see below), of which females are practically identical to those of *B. albobimaculatus* (cf. Figs 13-14 and figs 19-27, 36-46 in Logunov 2001), it is worth reconsidering the taxonomic status of *B. rusticulus* Peckham et Peckham, 1903 (known from the Q holotype), which was synonymized with *B. albobimaculatus* by Logunov (2001). Yet, such reconsideration will only be possible pending collection of a series of both sexes from the type locality of *B. rusticulus*, given on the original label as 'Clanwilliam, Cape Colony'.

With a few exceptions (e.g., *B. biocellosus* Simon, 1902), species of *Bianor* cannot be reliably diagnosed from the female copulatory organs alone because of a wide range of intraspecific variation (for details, see Logunov 2001: p. 222). Therefore, descriptions based on single females are hardly sufficient for proper diagnoses of *Bianor* species. Yet, such descriptions continue to appear (Jastrzębski 2007, Wesołowska and van Harten 2002).

Bianor albobimaculatus (Lucas, 1846)

Identification. Logunov (2001: figs 4-8, 13-27, 36-46).

Material examined. IVORY COAST: 13 (BMNH), nr. Gagnoa, Zoukroboua, in rice swamp (hand collecting), 20.08.1992, ARS. – NIGERIA: 134 (BMNH), Ibadan, International Institute of Tropical Agriculture, forest stream, swept grassland, 6.07.-17.08.1974, ARS; 23 (BMNH), same locality, swept tall grasses by lake, 21.09.1974, ARS.

Comments. *B. albobimaculatus* is the most common and widespread species of the genus *Bianor*, reported from South Africa, northward throughout the entire continent to the Mediterranean, the Arabian Peninsula and the Near East, and then northeastward to Central Asia (Logunov 2001). However, in the light of new records of *B. kovaczi* from Botswana (see below), whose females are practically identical to those of *B. albobimaculatus*, some of the records of the latter species from South Africa should be revised.

Bianor kovaczi Logunov, 2001

Figs 1-6

Identification. Wesołowska and Tomasiewicz (2008: figs 13-20).

Material examined. IVORY COAST: $2\sqrt[3]{7}$ (BMNH), Bouaké, West African Rice Development Association, in irrigated rice plots, 08.1994, ARS; $1\sqrt[3]{8}$ (BMNH), same locality, trash management experiment, 12.09.1994, ARS. – BOTSWANA: $1\sqrt[3]{8}$ (BMNH), Maun, R. Thamalakane, grazed *Setaria* grassland, 24.07.1977, ARS; $1\sqrt[2]{8}$ (BMNH), same locality, swept *Miscanthidium* grassland, 28.06.1975, ARS; $1\sqrt[3]{8}$ (BMNH), same locality, in floodplain grassland, 1.02.1976, ARS; $1\sqrt[2]{8}$ (BMNH), nr. Maun, Maphaneng Pan, riverine woodland, 1.04.1976, ARS; $2\sqrt[3]{8}$ (BMNH), c. 10 km S of Maun, Botetle, swept in riverine woodland, 5.03.1976, ARS; $1\sqrt[3]{8}$ (BMNH), Kwai North gate, Margin of muddy lagoon, 15.07.1978, ARS; $1\sqrt[3]{8}$ (BMNH), Okavango, R. Boro (KB B63), in *Hyparrhenia* grassland, 2.07.1977, ARS; $1\sqrt[3]{8}$ (BMNH), Okavango, island in R. Moanachira, in *Hyparrhenia* grassland, 14.07.1977, ARS; $1\sqrt[2]{8}$ (BMNH), same locality, Moremi G.R., Mroma lagoon, in *Hyparrhenia* grassland, 13.08.1977, ARS; $1\sqrt[2]{8}$ (BMNH), same locality, R. Shashe, in floodplain grassland (hand collecting), 31.08.1975, ARS.

Comments. To date, this species has been recorded from Ethiopia only (Logunov 2001, Wesołowska and Tomasiewicz 2008). New records here from Ivory Coast and Botswana significantly extend our knowledge on the distribution of *B. kovaczi*, which seems to be a common Afrotropical species. Males of *B. kovaczi* can easily be distinguished from the remaining *Bianor* species by the proportions of the tegulum and especially by the relatively large promarginal teeth of the chelicerae (see Wesołowska and Tomasiewicz 2008: fig. 14). The latter character varies to some extent, which is



Figures 1-6. *Bianor kovaczi* Logunov 2001, specimens from Ivory Coast (1-3) and Botswana (4-5) 1, 4 male general appearance, dorsal view; 2, 5 ditto, lateral view; 3, 6 female general appearance, dorsal view. (scale bars: 1 mm).

quite common in the Harmochireae (e.g., in *B. angulosus* or *Modunda staintoni*, etc; see Logunov 2001), but remains more or less constant in all the males I have examined. Unfortunately, females of all African *Bianor* species cannot be reliably diagnosed by their copulatory organs; males are always required to identify a species.

Bianor paulyi, sp. n. urn:lsid:zoobank.org:pub: Figs 7-14

Type material. Holotype. ♂ (MRAC, 225.263; Figs 7, 10-12) from Madagascar, Tamatave, Foulpointe, grassy vegetation near sea water, 10.1994, AP.

Paratypes. MADAGASCAR: $2\sqrt[3]{5}$ (MRAC, 225.263; Figs 8-9, 13-14), together with the holotype; $1\sqrt[3]{2}$ (MRAC, 201.744, 206.734), same locality, Tamatave prison, on sand and masonry walls, 09-11.1994, AP; $1\sqrt[3]{}$ (MRAC, 174.492), Ambatondrazaka, Riviere, yellow trap, 21.04.1992, AP. – FEDERAL ISLAMIC REPUBLIC OF THE COMOROS: $1\sqrt[3]{}$ (MRAC, 213.140), Mohéli, lac Boundouni, sweeping, 22.05.2003, R. Jocqué & D. den Spiegel.

Other material examined. MADAGASCAR: 1° (MRAC, 174.507), Alaotra, reed marsh, yellow trap, 23.04.1992, AP; 1° (MRAC, 205.996), same locality, in swamp, yellow trap, 23.04.1992, AP; 2° (MRAC, 177.975), Madagascar, Lagune Onibe, boggy vegetation, 9.05.1993, AP; 1° (MRAC, 174.554), same locality, Cyperaceae marsh, yellow trap, 22.04.1992, AP.

Diagnosis. This species is most similar to *B. kovaczi* (see figs 13-20 in Wesołowska and Tomasiewicz 2008; Figs 1-6), reported from several African countries (see above), but can be reliably distinguished from it by the cheliceral dentition in males: i.e., the promarginal tooth being rather large and bicuspid (Fig. 12). The conformation of the epigyne and spermathecae in both species (cf. Figs 13-14 and figs 17-20 in Wesołowska and Tomasiewicz 2008), as well in many others (e.g. *B. albobimaculatus*, *B. maculatus*; see Logunov 2001), is almost indistinguishable.

Etymology. The species is named after Dr A Pauly, the collector of the type series and of many other salticid species from Madagascar.

Distribution. NE region of Madagascar (several localities) and the Comoros.

Description. Male (the holotype). Measurements. Carapace 2.10 long, 1.88 wide, 1.15 high at PLE. Ocular area 1.33 long, 1.35 wide anteriorly and 1.75 wide posteriorly. Diameter of AME 0.50. Abdomen 2.15 long, 1.63 wide. Cheliceral length 1.13. Clypeal height 0.15. Length of leg segments: leg I- 1.85+1.20+1.40+0.98+0.65; leg II- 1.00+0.70+0.63+0.58+0.41; leg III- 1.15+0.53+0.60+0.70+0.39; leg IV-1.15+0.60+0.73+0.80+0.43. Leg spination. Leg I: Fm d 0-0-1-2ap; Tb v 2-2-2; Mt v 2-2ap. Leg II: Fm d 0-0-1-2ap; Tb pr 0-1, v 1-1; Mt v 2-2ap. Leg III: Fm d 3ap; Tb pr and rt 1-1, v 1-1ap; Mt pr and rt 2ap, v 1ap. Leg IV: Fm d 0-0-1-2ap; Tb rt 0-1; Mt pr 1ap, rt 2ap. Colouration. Carapace russet, punctured-reticulate, sparsely covered with white scales (Fig. 7); clypeus and 'cheeks' russet, 'naked' (with sparse black hairs). Sternum yellowish brown, covered with white protruding hairs. Labium, maxillae and chelicerae russet. Abdomen (Fig. 7): dorsum brown, with pairs of white spots and without scutum; sides and venter yellowish grey. Book-lung covers and spinnerets yellow, tinged with grey. Legs I stronger and longer than others, russet, Tb, Mt and Tr covered with protruding light hairs. Legs II-IV yellowish brownish, with all tarsi contrastingly yellow. Palps yellowish-brownish; palpal structure as in Figs 10-11.



Figures 7-9. *Bianor paulyi* sp. n., male holotype (**7**) and female paratype (**8-9**). **7** male general appearance, dorsal view; **9** ditto, lateral view. (scale bars: 1 mm).



Figures 10-14. *Bianor paulyi* sp. n., male holotype (**10-12**) and female paratype (**13-14**). **10** left male palp, ventral view; **11** ditto, retro-lateral view; **12** left male chelicera, ventral view; **13** epigyne, ventral view; **14** spermathecae, dorsal view. (scale bars: 0.1 mm).

Female (the paratype, sample 225.263). Measurements. Carapace 1.83 long, 1.60 wide, 0.90 high at PLE. Ocular area 1.05 long, 1.23 wide anteriorly and 1.53 wide posteriorly. Diameter of AME 0.43. Abdomen 3.03 long, 2.13 wide. Cheliceral length 0.63. Clypeal height 0.10. Length of leg segments: leg I- 1.08+0.68+0.71+0.58+0.41; leg II- 0.83+0.53+0.48+0.50+0.38; leg III- 1.05+0.48+0.50+0.58+0.35; leg IV- 1.10+0.53+0.65+0.73+0.40. Leg spination. Leg I: Fm d 0-0-1-1ap; Tb v 2-2-2; Mt v 2-2ap. Leg II: Tb pr 0-1, v 1-1; Mt v 2-2ap. Leg III: Fm d 1ap; Tb pr and rt 0-1, v 1ap; Mt pr and rt 2ap, v 1ap. Leg IV: Mt pr and rt 1ap. Colouration as in the male (Figs 8-9), but differs as follows: carapace much more densely covered with white adpressed scales; clypeus and chelicerae anteriorly covered with white hairs and scales; dorsum with poorly marked or no pattern of white spots; palps entirely yellow. Epigyne and spermathecae as in Figs 13-14.

Harmochirus Simon, 1885

The genus *Harmochirus* accommodates six valid species (Table 1) plus three species names of uncertain taxonomic status (Table 2). The genus is largely restricted to the Oriental Region, with a few species (e.g. *H. insulanus* and *H. zabkai*) also known from southern areas of the Palaearctic Region and one (*H. luculentus*) from the Ethiopian Region.

Harmochirus luculentus Simon, 1886

Identification. Logunov (2001: figs 206-246); Wesołowska and van Harten (2007: figs 68-75, pl. 11-12).

Material. IVORY COAST: 2012 (BMNH), Bouaké, West African Rice Development Association, upland rice field (pitfall traps), 6.09.1994, ARS. - NIGE-RIA: $1 \swarrow 3 \Im$ (BMNH), Ibadan, International Institute of Tropical Agriculture, forest stream, swept grassland, 6.07-17.08.1974, ARS. – BOTSWANA: $1\bigcirc 1 \bigcirc 1 \bigcirc$ (BMNH), nr. Maun, Maphaneng Pan, tall grass in riverine woodland, 5.12.1976, ARS; 1 (BMNH), same locality, grazed Setaria grassland, 22.08.1978, ARS; 1♀ (BMNH), nr. Maun, Island Safari Lodge, riverine woodland, 21.09.1975, ARS; 1∂ (BMNH), Maun, R. Thamalakane, grassland, 1.02.1977, ARS; 19 (BMNH), same locality and habitat, 3.03.1976, ARS; 4^Q (BMNH), same locality, grazed Setaria grassland, 24.07.1977, ARS; 1º (BMNH), same locality, on fig tree, riverine woodland, 03.1976, ARS; 13 (BMNH), nr. Maun, Maphaneng Pan, in short grassland (hand collecting), 24.02.1976, ARS; 1º (BMNH), same locality, grass tufts in riverine woodland, 26.03.1976, ARS; 1º (BMNH), nr. Maun, Okavango, Mankunyane lagoon, grassland (sweeping), 8.01.1977, ARS; 2∂ (BMNH), Okavango, Shaile Camp, in riverine woodland, 28.03.1976, ARS; 19 (BMNH), Okavango, Moremi G.R., Mboma lagoon, in *Hyparrhenia* grassland, 13.08.1977, ARS; 1° (BMNH), same locality, swept floodplain grassland, 14.01.1976, ARS; $1\overset{\circ}{,}3^{\circ}$ (BMNH), Okavango, R. Shashe, in floodplain grassland (hand collecting), 31.08.1975, ARS; $1\overset{\circ}{,}1^{\circ}$ (BMNH), Maun, Okavango, in garden (house 36), 5.06.1976, ARS; 1° (BMNH), Okavango, Moremi Reserve, swept tall grassland by lagoon, 19.05.1976, ARS. – SOUTH AF-RICA: 2° (BMNH), Cape Peninsula, Buffels Bay, in sand dunes (hand collecting), 12.08.1978, ARS.

Comments. This is a common African species, distributed from South Africa (Logunov 2001, present data) to the Arabian Peninsula (Wesołowska and van Harten 2007).

Microbianor Logunov, 2000

This is a small, recently described genus with five valid species (Table 1). Originally, the genus was considered endemic to the Seychelles (Logunov 2000), but after the discovery of *M. saaristoi* in Réunion (Ledoux 2007) it became clear that the genus was more widespread. The findings of two new *Microbianor* species from Madagascar support this conclusion. It is interesting to note that after the original description of *Microbianor* (Logunov 2000) all new discoveries of its species have been made in the islands of the Indian Ocean rather than continental Africa. Furthermore, both new Malagasy species came from the NE shore of Madagascar. Thus, it is reasonable to assume that the distribution of *Microbianor* may reflect the Asian faunal affinities of Madagascar, which have been reported for a number of animal groups including scorpions and spiders (e.g., Legendre 1972, Lourenço 2003, Griswold 2003). If so, more new species of *Microbianor* might also be found in Sri Lanka and India.

Microbianor deltshevi, sp. n. urn:lsid:zoobank.org:pub: Figs 15-23

Type material. Holotype. ♂ (MRAC, 200.164; Figs 15-17) from Madagascar, Foulpointe, lagoon forest, yellow trap, 10.1993, AP.

Paratypes. MADAGASCAR: $12\sqrt[3]{4}$ 1juv (MRAC, 200.164; Figs 18-23), together with the holotype; $2\sqrt[3]{1}$ (MRAC, 177.809), same locality, 11.1993, AP; $1\circ$ (MRAC, 177.904), same locality, *Asplenium*-forest, 12.1993, AP; $1\sqrt[3]{}$ (MRAC, 201.769), Madagascar, Tamatave, Foulpointe, forest on clay, 07.1994, AP; $1\circ$ (MRAC, 200.225), same locality and habitat, 12.1993, AP; $1\sqrt[3]{}$ (MRAC, 205.810), same locality, yellow trap on upper beach margin, under *Scaevola taccata*, 11.1995, AP; $1\sqrt[3]{}$ (MRAC, 200.064), Madagascar, Foulpointe, sea shore forest, sieving litter, 11.1993, AP.

Diagnosis. Compared to all the described species of *Microbianor* (see Logunov 2000), *M. deltshevi* sp. n. differs in having a straight embolus (Fig. 20) and dark brown femora and tarsi I (Fig. 17) in males and the complete absence of fossae in females (Fig. 22).



Figures 15-19. *Microbianor deltshevi* sp. n., male holotype (**15-17**) and female paratype (**18-19**). **15** male general appearance, dorsal view; **16** ditto, lateral view; **17** male left leg I, lateral view; **18** female general appearance, dorsal view; **19** ditto, lateral view. (scale bars: 0.5 mm).

Etymology. The new species is dedicated to Prof Christo Deltshev (Bulgaria), for his life-long dedication to, and effective work on, spiders, and on the occasion of his 70th anniversary.

Distribution. NE part of Madagascar (Tamatave).

Description. Male (the holotype). Measurements. Carapace 1.08 long, 1.08 wide, 0.63 high at PLE. Ocular area 0.80 long, 0.90 wide anteriorly and 1.08 wide posteriorly. Diameter of AME 0.29. Abdomen 1.05 long, 0.95 wide. Cheliceral length 0.43. Clypeal height 0.07. Length of leg segments: leg I- 0.85+0.55+0.58+0.33+0.30; leg II- 0.50+0.33+0.29+0.28+0.26; leg III- 0.65+0.28+0.25+0.30+0.26; leg IV- 0.63+0.26+0.29+0.35+0.28. Leg spination. Leg I: Tb v 2-2; Mt v 2-2ap. Leg II: Fm d 1ap; Tb pr 0-1-0, v 1-1; Mt v 2-2ap. Leg III: Fm d 1ap; Tb pr and rt 0-1-0, v 1ap; Mt pr and rt 1ap, v 1-2ap. Leg IV: Fm d 1ap; remaining segments with no spines. Colouration. Carapace russet, shining with sparse white elongated scales (Figs 15-16). Eye field darker (brown), with black around eyes. Clypeus russet, with



Figures 20-23. *Microbianor deltshevi* sp. n., paratypes 20 left male palp, ventral view; 21 ditto, retrolateral view; 22 epigyne, ventral view; 23 spermathecae, dorsal view. (scale bars: 0.1 mm).

sparse black hairs. Sternum, labium, maxillae and chelicerae yellowish, tinged with red. Abdomen yellow-grey; dorsum completely covered with brownish scutum (Fig. 15), without marked colour pattern or with a poorly marked narrow transverse white stripe. Book-lung covers yellowish, spinnerets grey brownish (sometimes dark brown). Leg I (Fig. 17): Fm and Tr dark brown (almost black), Pt, Tb and Mt yellow; Fm dorsally and Pt & Tb ventrally with a row of black bristles. Legs II-IV yellow, with brown rings at segment joints (Fig. 16). Palps yellowish brownish; palpal structure as in Figs 20-21.

Female (the paratype, sample 200.164). Measurements. Carapace 1.25 long, 1.10 wide, 0.63 high at PLE. Ocular area 0.85 long, 0.90 wide anteriorly and 1.13 wide posteriorly. Diameter of AME 0.29. Abdomen 1.48 long, 1.13 wide. Cheliceral length 0.68. Clypeal height 0.06. Length of leg segments: leg I- 0.73+0.35+0.40+0.33+0.25; leg II- 0.55+0.35+0.28+0.28+0.25; leg III- 0.65+0.33+0.25+0.30+0.25; leg IV- 0.65+0.31+0.35+0.38+0.28. Leg spination. Leg I: Tb v 2-2; Mt v 2-2ap. Leg II: Tb pr 0-1-0, v 1-1ap; Mt v 2-2ap. Leg III: Tb v 1ap; Mt 3ap. Leg IV: no spines. Colouration as in the male (Figs 18-19), but paler and differs as follows: no scutum on dorsum; the colouration of legs I is similar to the other legs: all femora slightly darker (brown) than remaining segments, which are yellow with brown rings at segment joints; palps brownish yellowish, with brown tarsi. Epigyne and spermathecae as in Figs 22-23.

Microbianor madagascarensis, sp. n. urn:lsid:zoobank.org:pub: Figs 24-32

Type material. Holotype. ♂ (MRAC, 200.164; Figs 24-26, 29-30), Madagascar, Foulpointe, lagoon forest, yellow trap, 10.1993, AP.

Paratypes. MADAGASCAR: $2 \eth 3 \heartsuit$ (MRAC, 200.164; Figs 27-28, 31-32), together with the holotype; $1 \image 1 \heartsuit$ (MRAC, 177.809, 206.057), same locality, 10-11.1993, AP; $1 \circlearrowright$ (MRAC, 200.355), same locality, forest on sand, sieving litter, 2.12.1993, AP; $1 \circlearrowright$ (MRAC, 206.921), same locality, forest of red soil, in litter, 11.1994, AP; $1 \clubsuit$ (MRAC, 201.407), Madagascar, Tamatave, Foulpointe, grassy vegetation near sea water, 10.1994, AP; $1 \circlearrowright$ (MRAC, 200.390), Foulpointe, Filao-plantation on sea shore, sieving litter, 11.1993, AP; $1 \heartsuit$ (MRAC, 200.390), Madagascar, Ranomafana, 15.03.1994, AP.



Figures 24-28. *Microbianor madagascarensis* sp. n., male holotype (**24-26**) and female paratype (**27-28**) **24** male general appearance, dorsal view; **25** ditto, lateral view; **26** male right leg I, lateral view; **27** female general appearance, dorsal view; **28** ditto, lateral view. (scale bars: 0.5 mm).



Figures 29-32. *Microbianor madagascarensis* sp. n., male holotype (**29-30**) and female paratype (**31-32**) **29** left male palp, ventral view; **30** ditto, retro-lateral view; **31** epigyne, ventral view; **32** spermathecae, dorsal view. (scale bars: 0.1 mm).

Diagnosis. Compared to all the described species of *Microbianor* (see Logunov 2000), *M. madagascarensis* sp. n. differs in having the best-developed and most clearly observable fossae in females (Fig. 31; in the rest of *Microbianor* species the fossae are undeveloped or poorly marked). By conformation of their palp, males of *M. madagascarensis* sp. n. are similar to those of *M. nigritarsis* (cf. Logunov 2000: figs 11-12), from which they can be distinguished by yellow tarsi tinged with brown in their basal halves (Fig. 26; black in *M. nigritarsis*). Females of both species are quite distinct in the conformation of their epigyne and spermathecae (cf. Figs 31-32 and figs 18-20 in Logunov 2000).

Etymology. The new species is named after the area of its occurrence, Madagascar. **Distribution.** NE region of Madagascar (Tamatave and Ranomafana).

Description. Male (the holotype). Measurements. Carapace 1.33 long, 1.15 wide, 0.70 high at PLE. Ocular area 0.98 long, 1.03 wide anteriorly and 1.18 wide posteriorly. Diameter of AME 0.35. Abdomen 1.28 long, 0.95 wide. Cheliceral length 0.45. Clypeal height 0.05. Length of leg segments: leg I- 0.93+0.50+0.65+0.48+0.50; leg II- 0.60+0.36+0.33+0.33+0.26; leg III- 0.68+0.35+0.31+0.38+0.30; leg IV-0.70+0.35+0.38+0.45+0.33. Leg spination. Leg I: Tb v 1-2-2ap; Mt v 2-2ap. Leg II: Fm d 1ap; Tb pr 0-1, v 1-1; Mt v 2-2ap. Leg III: Fm d 2ap; Tb pr and rt 0-1-0, v 1ap; Mt pr, rt and v 1ap. Leg IV: Fm d 1ap; Tb rt 0-1-0; Mt rt 1ap. Colouration. Carapace russet, shining, with black around eyes; eye field of the same colour as the

rest of carapace (Figs 24-25). Clypeus russet, with sparse long white hairs forming a triangle and overhanging the chelicerae. Sternum yellowish-brownish. Maxillae, labium and chelicerae russet. Abdomen greyish-yellowish; dorsum, entirely covered with brownish shining scutum and with a pair of transverse white spots (sometimes poorly marked; Fig. 24). Book-lung covers and spinnerets yellow, slightly tinged with brown. All legs yellow, with no brown rings, but tibiae I and the basal half of tarsi I brownish (Fig. 26). Palps yellow to brownish, but cymbium always yellow; palpal structure as in Figs 29-30.

Female. (the paratype, sample 200.164). Measurements. Carapace 1.38 long, 1.15 wide, 0.65 high at PLE. Ocular area 0.93 long, 1.00 wide anteriorly and 1.16 wide posteriorly. Diameter of AME 0.34. Abdomen 1.55 long, 1.10 wide. Cheliceral length 0.43. Clypeal height 0.05. Length of leg segments: leg I- 0.78+0.40+0.48+0.35+0.30; leg II- 0.58+0.36+0.31+0.33+0.29; leg III- 0.65+0.29+0.33+0.38+0.28; leg IV-0.75+0.30+0.40+0.48+0.33. Leg spination. Leg I: Tb v 1-2-2; Mt v 2-2ap. Leg III: Tb pr 0-1-0, v 1-1ap; Mt v 2-2ap. Leg III: Tb pr and rt 0-1-0, v 1ap; Mt pr, rt and v 1ap. Leg IV: no spines. Colouration as in the male (Figs 27-28), but differs as follows: no scutum on dorsum; book-lung covers and spinnerets yellow; palps yellow; tibiae I brownish. Epigyne and spermathecae as in Figs 31-32.

Modunda Simon, 1901

This is a very small genus consisting of two valid species, of which one (*M. aeneiceps*) remains known only from the type locality (Sri Lanka: Colombo). The second species mentioned below is a widespread Afrotropical species.

Modunda staintoni (O. Pickard-Cambridge, 1872)

Identification. Logunov (2001: figs 347-366); Wesołowska and van Harten (2007: figs 118-123, pl. 20-21); Wesołowska and Tomasiewicz (2008: figs 102-106).

Material examined. BOTSWANA: $2 \eth 2 \clubsuit$ (BMNH), Maun, R. Thamalakane, grassland (on ground layer), 3.03.1976, ARS; $1 \oiint$ (BMNH), same locality, swept *Setaria* grassland, 2.01.1977, ARS; $1 \clubsuit$ (BMNH), same locality and habitat, 24.07.1977, ARS; $3 \clubsuit$ (BMNH), same locality, in grass tufts, 2-17.03.1976, ARS; $2 \oiint$ (BMNH), same locality, in *Vossia* swamp, 26.02.1976, F. Wanless & ARS; $2 \clubsuit$ (BMNH), Okavango, Moremi South Gate, grassland, 14.03.1977, ARS; $1 \clubsuit$ (BMNH), Okavango, Moremi Game Reserve, Mboma lagoon, in *Hyparrhenia* grassland, 30.06.1977, ARS.

Comments. This is a rather common species distributed from Botswana (present data), north-eastward throughout Ethiopia, the Arabian Peninsula (Wesołowska and van Harten 2007, Wesołowska and Tomasiewicz 2008) and the Near East (Prószyński 2003), to Afghanistan and Punjab in NW India (Logunov 2001).

Neaetha Simon, 1884

This is a relatively small genus consisting of 7 valid species that are known exclusively from the Mediterranean and Africa (Table 1). Five additional species names are of uncertain taxonomic status (Table 2). A new record of a *Neaetha* species given below has extended the distribution of the genus as far south as Botswana.

Neaetha oculata (O. Pickard-Cambridge, 1876)

Identification. Logunov (1996: figs 18-23).

Material examined. BOTSWANA: 1435° (BMNH), Okavango, Shorobe lagoon, grassland (pitfall traps), 24.06.1975, ARS.

Comments. This is the first record of *N. oculata* from southern Africa. To date the species was known from the Eastern Mediterranean, Egypt and the Arabian Peninsula (Wesołowska and van Harten 1994, Logunov 1996). The species *N. irreperta* Wesołowska et Russell-Smith, 2000, described recently from Tanzania, displays a strong similarity to *N. oculata*. On the basis of published accounts of both species, it is impossible to decide whether they are conspecific or not. The matter requires further attention in the future.

Sibianor Logunov, 2001

This genus, with its 15 described species, is almost entirely confined to the Palaearctic and Afrotropical Regions (Table 1). The only exception is *S. aemulus* (Gertsch, 1934), known from the Nearctic Region (Canada and USA; Ubick et al. 2005). A new species described below is one of the three species known to date from tropical Africa. It is safe to assume that the real diversity of the Afrotropical species remains largely undescribed.

Sibianor anansii, sp. n.

urn:lsid:zoobank.org:pub: Figs 33-41

Type material. Holotype. (BMNH; Figs 33-35, 38-39) from Botswana, Okavango, Moremi G.R., Mboma lagoon, in *Hyparrhenia* grassland, 13.08.1977, ARS.

Paratypes. BOTSWANA: 1^{\bigcirc} (BMNH; Figs 36-37, 40-41), together with the holotype.

Diagnosis. Of the African species of *Sibianor*, the new species is most similar to *S. victoriae* (cf. Logunov 2001: figs 292, 293), described from a single male from Kenya. *S. anansii* sp. n. differs in having a wider tibial apophysis, which is also of a different shape (Fig. 39). The female of *S. anansii* sp. n. differs from all the known *Sibianor*



Figures 33-37. *Sibianor anansii* sp. n., male holotype (**33-35**) and female paratype (**36-37**). **33** male general appearance, dorsal view; **34** ditto, lateral view; **35** male left leg I, lateral view; **36** female general appearance, lateral view; **37** female abdomen, dorsal view. (scale bars: 1 mm).

species in having longer insemination ducts (Fig. 41). Besides, the entire body of both sexes of *S. anansii* sp. n. is covered with white scales (Figs 33-17), which is not the case of *S. victoriae* (see Logunov 2001: p. 276).

Etymology. The new species is dedicated to the spider Anansi, a popular figure in the folklore of West Africa (the Ashanti of Ghana), appearing as a cunning trickster and the King of all Stories.

Distribution. The type locality only.

Description. Male (the holotype). Measurements. Carapace 1.25 long, 1.00 wide, 0.58 high at PLE. Ocular area 0.78 long, 0.85 wide anteriorly and 1.04 wide posteriorly. Diameter of AME 0.29. Abdomen 1.25 long, 1.08 wide. Cheliceral length 0.38. Clypeal height 0.10. Length of leg segments: leg I- 0.70+0.40+0.55+0.35+0.28; leg II- 0.50+0.31+0.28+0.28+0.25; leg III- 0.59+0.33+0.28+0.30+0.30; leg IV-



Figures 38-41. *Sibianor anansii* sp. n., male holotype (**38-39**) and female paratype (**40-41**). **38** left male palp, ventral view; **39** ditto, retro-lateral view; **40** epigyne, ventral view; **41** spermathecae, dorsal view. (scale bars: 0.1 mm).

0.73+0.33+0.33+0.38+0.33. Leg spination. Leg I: Tb v 1-2; Mt v 2-2ap. Leg II: Fm d 1ap; Tb v 1-1; Mt v 2-2ap. Leg III: Fm d 1ap; Tb pr 0-1-0, v 1ap; Mt pr and rt 2ap, v 1ap. Leg IV: Fm d 1ap; Mt pr and rt 1ap. Colouration. Carapace light brown, evenly covered with adpressed white scales (Fig. 33); black around eyes. Clypeus light brown, covered with white scales and hairs, overhanging the chelicerae. Sternum, labium and chelicerae light brown. Abdomen grey-brownish, dorsum completely covered with scutum; entire abdomen evenly covered with white adpressed scales (Figs 33-34). Booklung covers and spinnerets light brown. Legs I stronger than others, brown with yellow Mt and Tr, and with fringes of black bristles on Pt, Tb and ventral sides of Fm (Fig. 35). Legs II-IV yellow, with brownish Fm and brown rings at segment joints (Fig. 34). Palps yellow; palpal structure as in Figs 38-39.

Female (the paratype). Measurements. Carapace 1.27 long, 1.05 wide, 0.60 high at PLE. Ocular area 0.83 long, 0.85 wide anteriorly and 1.10 wide posteriorly. Diameter of AME 0.26. Abdomen 1.75 long, 1.25 wide. Cheliceral length 0.50. Clypeal height 0.08. Length of leg segments: leg I- 0.63+0.35+0.38+0.33+0.25; leg II- 0.48+0.33+0.25+0.28+0.24; leg III- 0.63+0.33+0.30+0.33+0.29; leg IV- 0.68+0.30+0.38+0.43+0.30. Leg spination. Leg I: Tb v 1-2; Mt v 2-2ap. Leg III: Tb v 1-1; Mt v 2-2ap. Leg III: Tb v 1ap; Mt pr 1ap. Leg IV: no spines. Colouration as in the male (Figs 36-37), but differs as follows: all legs yellow, with brown Fm and brownish rings at segment joints; no scutum on dorsum; palps: Fm brown, remaining segments yellow. Epigyne and spermathecae as in Figs 40-41.

Sibianor kenyaensis Logunov, 2001

Figs 42-44

Identification. Logunov (2001: figs 292, 293).

Material examined. BOTSWANA: 1♂ (BMNH), Okavango, Maxwee, Mopane woodland (pitfall traps), 21.11.1975, ARS.

Comments. This is the first record of *S. kenyaensis* following its original description and a new record outside the type locality (Kenya: Kilifi).



Figures 42-44. *Sibianor kenyaensis* Logunov, 2001, male from Botswana. **42** general appearance, dorsal view; **43** ditto, lateral view; **44** clypeus and chelicerae, front view. (scale bars: 1 mm).

Discussion

At present, 57 recognized species from seven genera are included in the group Harmochireae (Table 1). Of these, 20 species are known only from their respective type localities, and a few remain unrevised and/or of uncertain taxonomic status. An additional 17 species names are excluded from the list of valid names for various reasons (see Table 2).

Of the Neotropical genera of the Pelleninae, *Havaika* Prószyński, 1992, an endemic genus to the Hawaiian Archipelago, is rather similar to members of Harmochireae in the conformation of its copulatory organs, especially in the thin, whip-shaped embolus (see Prószyński 2008: figs 21-36). Yet, according to the available molecular phylogeny of Salticidae (Maddison and Hedin 2003: fig. 5; Maddison et al. 2008: fig. 9), within the Pelleninae, *Havaika* is closer to *Pellenes* Simon, 1876 and *Habronattus* F. O. Pickard-Cambridge, 1901 than to *Bianor* and *Sibianor*, i.e. it does not belong with the group Harmochireae as it is currently diagnosed (see Introduction, and Logunov 2001).

Harmochireae is predominantly an Old-World group, as over 90% of its described species are restricted to the Palaearctic, Ethiopian or Oriental Regions (Table 3). In the Neotropics, the only described species is *Bianor biocellosus*, known from the type locality in Brazil ('le Para'; Logunov 2001: p. 234). A single species, *Sibianor aemulus*, has been described and recorded from the Nearctic Region (Logunov 2001, Ubick et al. 2005). Yet, there are three *Bianor* species described from the Australian Region, including New Zealand, but two of them (*B. compactus* and *B. concolor*) remain unrevised and known from the original descriptions and only from their type localities. The taxonomic status of both of them is uncertain, as these names might be junior synonyms of *B. maculatus*. With the above four exceptions, the remaining Harmochireae species have only been recorded from the Old World.

Genera	Zoogeographical regions						
	Palaearctic	Ethiopian**	Oriental	Australian**	Nearctic	Neotropic	
Bianor	4	8	6	3		1	
Harmochirus	2	1	5				
Microbianor		5					
Modunda	1	1	1				
Napoca	1						
Neaetha	5	2					
Sibianor	10	3	1		1		
Total	23	20	13	3	1	1	

Table 3. Number of described species of the Harmochireae in main zoogeographical regions*.

* Some species are distributed in several zoogeographical regions, therefore their presence has been counted separately for each region.

** For simplicity, Madagascar was considered together with the Ethiopian (=Afrotropical) Region, and New Zealand with the Australian Region. Traditionally, both areas are treated as separate zoogeographic regions (e.g., Kryzhanovski 2002: map 1).

Within the Old World, the Palaearctic and Ethiopian regions contain a similar number of recorded species and genera: 23 vs. 20 species and five vs. six genera, respectively. Four genera (Bianor, Harmochirus, Modunda and Sibianor) have their representatives in all three zoogeographic regions of the Old World. Of these genera, Modunda is represented by a single widespread species M. staintoni, distributed throughout Africa from Botswana, north-eastward to Afghanistan and Punjab. Five of the six described species of *Harmochirus* are confined to the Oriental Region. The only widespread Afrotropical species is *H. luculentus*. The genus *Sibianor* is most diverse in the Palaearctic Region, with 10 of its 15 species recorded there. All Sibianor species have recently either been revised or been described (Logunov 2001, Zhu et Song 2001, etc.), therefore to date the species composition of Sibianor seems to be the most reliable in terms of taxonomy. The genus displays a clear modern centre of diversity in the Manchurian area, to which at least six species are confined. *Bianor* is the most common genus of Harmochireae in the Ethiopian and Oriental Regions. In the Palaearctics, the only known, widespread species is B. albobimaculatus, confined to southern regions below the 40-45° latitude.

Two genera display a rather limited distribution. *Napoca* is a monotypic genus known to date only from Israel. All the species of *Microbianor* have been described from islands in the Indian Ocean, but new findings from Sri Lanka and India are possible as has been discussed above (p. XXXX).

Acknowledgements

I wish to express my warmest thanks to Ms J Beccaloni (of the BMNH), Dr R Jocqué (of the MRAC), and Dr A Russell-Smith (Kent, UK) for giving access to the collections of their museums or their personal collections. I also want to thank Mr AV Gromov (Almaty, Kazakhstan) for giving me a chance to use his personal photographic equipment during my trip to Almaty in January 2009. Two anonymous referees are obliged from their critical comments which helped to improve the ms. Dr D Penney (Manchester, UK) is much obliged for editing the English of the final draft.

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Addendum

While the present work was in press, I received a copy of the large faunal-taxonomic paper by Wesołowska and Haddad (2009) on the Salticidae of the Ndumo Game Reserve in South Africa. Their list contains 72 species in 38 genera and includes three species of the group Harmochireae: *Bianor eximius* Wesołowska et Haddad, 2009 (new; after a single \mathcal{Q}), *Harmochirus luculentus* and *Modunda staintoni*.

Reasoning from the small size (2.9 mm long) and the slightly swollen femora I, *Bianor eximius* is more likely to belong in *Sibianor* rather than *Bianor*. Re-examination of the \bigcirc holotype will be required to confirm this. The records of *Harmochirus luculentus* are well in agreement with our records of this species from Botswana and South Africa.

Wesołowska and Haddad (2009: p. 58) suspected that their record of *Modunda staintoni* might have resulted from a human introduction or that it may belong to a new species. However, our records of this species from Botswana (based on both sexes) support the idea that this is a widespread Afrotropical – South Palaearctic species rather than an introduced one.

RESEARCH ARTICLE



A review of the West African genus Saraina (Araneae, Salticidae)

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Academic editor: Jason A. Dunlop	Received 17 April 2009	Accepted 16 June 2009	Published @@ August 2009		
urn:lsid:zoobank.org:pub:					

Citation: Azarkina G (2009) A review of the West African genus *Saraina* (Araneae, Salticidae). In: Stoev P, Dunlop J, Lazarov S (Eds) A life caught in a spider's web. Papers in arachnology in honour of Christo Deltshev. ZooKeys %%: 1-14. doi: 10.3897/zookeys.%%.\$\$\$

Abstract

The West-African genus *Saraina* is revised. The type species *Saraina rubrofasciata* Wanless & Clark, 1975 is redescribed based on its type material. Earlier records of *S. rubrofasciata* from Congo turned out to belong to two new species: viz., *S. deltshevi* **sp. n.** (\mathcal{J}) and *S. kindamba* **sp. n.** (\mathcal{J}). A key to the males of the known species is provided.

Keywords

Salticidae, Saraina, new species, Ivory Coast, Congo

Introduction

The monotypic genus *Saraina* from Ivory Coast was established by Wanless and Clark (1975) for *Saraina rubrofasciata* Wanless & Clark, 1975 known from females only. Later, Szűts and Scharff (2005) described the male of *S. rubrofasciata* from the Republic of Congo, and this has remained the only record of the genus since its original description. Recently, I was privileged to re-examine both the type specimens and those of Szűts and Scharff (with the exception of one male and female supposedly kept in the Wrocław University, but seemingly lost), together with new collections of *Saraina* from Ivory Coast and the Democratic Republic of Congo kept in the Musée Royal de l'Afrique Centrale Tervuren. Among these I have found additional male and female specimens of *S. rubrofasciata* collected from Ivory Coast. The specimens examined by Szűts and Scharff (2005) from the Republic of Congo and the Democratic Republic of Congo turned out to belong to two new species: namely, *S. deltshevi* sp. n. (\mathcal{J}) and *S. kindamba* sp. n. (\mathcal{J}). Thus, the genus *Saraina* currently comprises three species.

Material and methods

This work is based on the salticid collections held at the Musée Royal de l'Afrique Centrale, Tervuren (indicated as MRAC in the text, Dr R. Jocqué) and the Hungarian Natural History Museum, Budapest (HNHM, Dr. L. Dányi). The specimens were examined in ethanol and descriptions of colours refer to specimens in this medium. The drawings were made with the aid of a reticular eyepiece attached to a MBS-10 ster-eomicroscope. The male pedipalps and the epigynes were detached for study. Epigynes were macerated in 20% KOH solution for one night. After being drawn, the copulatory organs were placed in microvials or small pieces of paper with ethanol together with the specimens from which they had been removed.

All drawings were edited with Adobe Photoshop. Figures 2-4 and 7-8 for the right palp of the holotype were mirrored because for other species left palps have been illustrated. Abbreviations used in the text: AME – anterior median eyes, PME – posterior median eyes, PLE – posterior lateral eyes, Fm – femur, Pt – patella, Ti – tibia, Mt – metatarsus. The sequence of leg segments in the measurement data is as follows: femur + patella + tibia + metatarsus + tarsus. All measurements are in mm. Leg spination follows the system used by Ono (1988).

Taxonomy

Genus Saraina Wanless & Clark, 1975

Type species: Saraina rubrofasciata Wanless & Clark, 1975

Diagnosis. This genus can be recognized by the shape of the copulatory organs: a counterclockwise tegulum and embolus originating on the prolateral side of tegulum (Figs 2, 9, 19, and fig. 5 G in Szűts and Scharff 2005) in males, and an epigyne with two lateral narrow openings, two bent sclerotized structures (Figs 16, 24, 25) and a long, coiled insemination duct (Figs 17, 26) in females.

Saraina is a fissidentate genus. The structure of the male copulatory organs is unique: the tibia has three apophyses – ventral, medial and retrolateral (Fig. 1). The



Figure 1. Palpal tibia, retrolateral view: 1 ventral apophysis, 2 medial apophysis; 3 dorsal apophysis.

whip-liked embolus is long and thin, originating from the prolateral side, and directed inwards of the cymbium (Szűts and Scharff 2005). The relationships of this genus to other salticid genera are unclear (see Wanless and Clark 1975, Dippenaar-Schoeman and Jocqué 1997). The cheliceral base in both sexes and the female copulatory organs in *Saraina* resemble those of some Euophryinae (see also Wanless and Clark 1975, pp. 288-289), while the male copulatory organs are more similar to those of some Thiodininae.

Key to species (males only)

1	Cymbium with wide and flat apical part (Figs 2-4), medial tibial apophysis
	without dorsal bump (Fig. 7, arrowed) S. deltshevi
_	Apical part of cymbium otherwise (Figs 9-11, 19-21), medial tibial apophysis
	with dorsal bump (Figs 12, 23, arrowed)2
2	Ventral tibial apophysis short (Fig 9, arrow 1), medial tibial apophysis long
	and narrow in ventral view (Fig. 9, arrow 2), retrolateral bump of tegulum
	convex in dorsal view (Fig. 11, arrow)S. kindamba
_	Ventral tibial apophysis long (Fig. 19, arrow 1), medial tibial apophysis short
	and broad in ventral view (Fig. 19, arrow 2), retrolateral bump of tegulum
	concave in dorsal view (Fig. 21, arrow)S. rubrofasciata

Saraina deltshevi, sp. n. urn:lsid:zoobank.org:author: Figs 2-8

S. rubrofasciata: Szűts and Scharff 2005 [pro parte]: p. 368 (D³; misidentified).

Type material. Holotype ♂, DEMOCRATIC REPUBLIC OF CONGO, Luki Biosphere Reserve, primary forest, end of dry season, fogging (fog 18), 5°37'S, 13°05'E,

1.X.2007, D. De Bakker & J.-P. Michiels (MRAC 227854). Paratypes: 1Å, REPUB-LIC OF CONGO, Kindamba, Méya, Loulo river, 3°53'S, 14°31'E, HSZE Nr. 160, netted and singled material from low vegetation, 11.XI.1963, J. Balogh & A. Zicsi (HNHM Araneae-685).

Diagnosis. Males can be easily separated from *S. rubrofasciata* and *S. kindamba* by the stronger dorsal tibial apophiysis bending dorsad (Fig. 8, arrow) and by the medial tibial apophysis without a dorsal bump (Fig. 7, arrow).

Etymology. The species is named after Prof. Christo Deltshev, the well-known Bulgarian arachnologist, on the occasion of his 70th anniversary.

Description. Male: Measurements: Cephalothorax: length 2.60, width 2.00, height at PLE 1.40. Ocular area: length 1.40, width anteriorly 1.90, width posteriorly 1.80. Abdomen: length 2.40, width 1.55. Clypeal height: 0.15. Cheliceral length: 0.80. Diameter of AME: 0.55. Length of leg segments: I: 1.40+0.70+1.00+1.05+0.55. II: 1.60+0.70+1.05+1.05+ 0.65. III: 1.75+0.70+1.20+1.50+0.60. IV: 1.90+0.80+1.40+1.50+0.70. Leg spination: I: Fm d 1-2-5; Pt pr & rt 1; Ti pr & rt 1-1-1, v 2-2-0-2 ap; Mt pr 1-1, rt 2-1 ap; v 2-0-2 ap. II: Fm d 1-2-5; Pt pr & rt 1; Ti d 1-0-0, pr & rt 1-1-1, v 2-2-0-2 ap; Mt pr 1-1-1, rt 1-1 ap; v 2-0-2 ap. III: Fm d 1-3-5; Pt pr & rt 1; Ti d 1-0-0, pr & rt 1; Ti d 1-0-0, pr & rt 1-1-1, v 2-0-2 ap; Mt pr 1-0-2 ap, rt 1-1-2 ap; v 2-0-2 ap. IV: Fm d 1-2-5; Pt pr & rt 1; Ti d 1-0-0, pr & rt 1, Ti d 1-0-0, pr & rt 1, Ti d 1-0-0, pr & rt 1-1-1, v 2-0-2 ap; Mt pr 1-0-2 ap; Mt pr 1-0-2 ap, rt 1-1-2 ap or pr& rt 1-1-2 ap, v 1-1-2 ap. Colouration: Similar



Figures 2-8. Saraina deltshevi, sp. n.: 2 right palp, ventral view; 3 ditto, retrolateral view; 4 ditto, ventroapical view; 5 left chelicera, holotype; 6 left chelicera, paratype; 7 palpal tibia, retrolateroapical view; 8 ditto, dorsal view. Scale = 0.1 mm.

to that of *Saraina rubrofasciata* but body is darker. Chelicerae with 5 (holotype Fig. 5) or 4 (paratype Fig. 6) promarginal teeth. Palpal structure as in Figs 2-4, 7-8.

Distribution. Known from the Democratic Republic of Congo and Republic of Congo.

Saraina kindamba, sp.n.

urn:lsid:zoobank.org:author: Figs 9-18

Saraina rubrofasciata: Szüts and Scharff 2005: 368, f. 5A-G, 6A-C (f, Dm - misidentified).

Type material. Holotype: ∂, REPUBLIC OF CONGO, Kindamba, Méya 46, 3°53'S, 14°31'E, 30.X.1963, J. Balogh (HNHM Araneae-683). Paratypes: REPUBLIC OF CONGO: 1∂, Lefini Reserve, Nambouli River, HSZE Nr. 660, beaten from vegetation, 2°55'S, 15°39'E, 12.I.1964, J. Balogh & A. Zicsi (HNHM Araneae-682); 2∂, Brazzeville, ORSTOM Park, beaten from trees and shrubs of park, mostly from border of woods, 4°16'S, 15°17'E, J. Balogh & A. Zicsi (HNHM Araneae-686); 1♀, Kindamba, Méya, 3°53'S, 14°31'E, 129 méyai barlang pitfall traps, J. Balogh (HNHM Araneae-684).



Figures 9-15. *Saraina kindamba*, sp. n.: **9** left palp, ventral view; **10** ditto, retrolateral view; **11** ditto, ventroapical view; **12** palpal tibia, retrolateroapical view; **13** left female chelicera; **14** left male chelicera; **15** palpal tibia, dorsal view. Scale = 0.1 mm.

Diagnosis. Males can be easily separated from those of *S. rubrofasciata* by the shorter ventral and the longer medial tibial apophyses (Fig. 9, arrows 1 and 2), and also by the shape of the retrolateral bump of the tegulum, especially in its dorsal part (Fig. 11, arrow). From *S. deltshevi* sp. n., it can be separated by the presence of a dorsal bump on the medial tibial apophysis (Fig. 12, arrow). Females can easily be distinguished from *S. rubrofasciata* by the longer insemination ducts (Fig. 17).

Etymology. The species is named after the type locality of the holotype, Kindamba, Republic of Congo. Noun in apposition.

Description. Male: Measurements: Cephalothorax: length 2.30, width 1.80, height at PLE 1.35. Ocular area: length 1.30, width anteriorly 1.80, width posteriorly 1.65. Abdomen: length 2.50, width 1.70. Clypeal height: 0.10. Cheliceral length: 0.60. Diameter of AME: 0.55. Length of leg segments: I: 1.45+0.70+1.00+0.90+0.60. III: 1.65+0.70+0.80+1.00+0.60. III: 1.60+0.80+1.00+1.20+0.65. IV: 1.70+0.60+1.15+1.35+0.65. Leg spination: I: Fm d 1-2-5; Pt pr & rt 1; Ti pr & rt 1-2, v 2-2-0-2 ap; Mt pr 1-1, rt 2-1 ap; v 2-0-2 ap. III: Fm d 1-2-5; Pt pr & rt 1; Ti d 1-0-0, pr & rt 1-1, v 2-2-0-2 ap; Mt pr 4: 1-1, v 2-0-2 ap; Mt pr 1-0-2 ap, rt 1-1-2 ap; v 2-0-2 ap. IV: Fm d 1-2-5; Pt pr & rt 1; Ti d 1-0-0, pr & rt 1-1, v 2-0-2 ap; Mt pr 4: 1-1, v 2-0-2; Nt pr 4: 1, v 2-0-2; Nt pr 4: 1,

Female: Measurements: Cephalothorax: length 3.00, width 2.30, height at PLE 1.50. Ocular area: length 1.40, width anteriorly 2.00, width posteriorly 1.80. Abdomen: length 4.50, width 3.10. Clypeal height: 0.10. Cheliceral length: 0.90. Diameter of AME: 0.65. Length of leg segments: I: 1.55+0.90+1.10+1.05+0.60. II: 1.65+0.80+1.00+1.00+0.55. III: 1.70+0.90+1.20+1.30+0.70. IV: 2.00+1.00+1.40+1.60+0.70. Leg spination: I: Fm d 1-2-5; Pt pr & rt 1; Ti pr & rt 1-2, v 2-2-0-2 ap; Mt pr 1-1, rt 2-1 ap; v 2-0-2 ap. II: Fm d 1-3-5; Pt pr & rt 1; Ti pr & rt 1-2, v 2-2-0-2 ap; Mt pr & rt 1-1 ap; v 2-0-2 ap. III: Fm d 1-3-5; Pt pr & rt 1; Ti pr & rt 1-1-1, v 1-0-2 ap; Mt pr 1-0-2 ap, rt 1-1-2 ap; v 2-0-2 ap. IV: Fm d 1-2-5; Pt pr & rt 1; Ti pr & rt 1; Ti pr & rt 1-1-1, v 2-0-2 ap; Mt pr & rt 1-1-2 ap, v 1-1-2 ap. Colouration: as in the male. Chelicerae with 4 promarginal teeth (Fig. 13). Structure of epigyne and spermathecae as in Figs 16-18 (compare with Figs 6, A-C in Szüts & Scharff 2005 which looks quite different).

Distribution. Known only from the Republic of Congo.

Remarks. The material from the Kindamba locality (Republic of Congo) contains three samples – two males from different species and a single female. It has been difficult to decide which species the female belong to, as the body colouration of all three species is very similar. I have provisionally assigned it to *S. kindamba* sp. n. More material of both sexes is needed to resolve this problem in the future.

Saraina rubrofasciata Wanless & Clark, 1975

Figs 19-29

S. rubrofasciata Wanless and Clark, 1975: 289, f. 23-26 (Df).

Type material. Holotype: ♀, IVORY COAST, Bingerville, 5°21'N, 3°53'W, I.1964, J. Decelle (MRAC 126105).

Other material examined. IVORY COAST: 1∂, Bingerville, 5°21'N, 3°53'W, I.1964, J. Decelle (MRAC 126108), 1♀, Appouesso, FC Bossematié, 4°16'S, 15°17'E, forest, pitfall, station 1D, 29.I.1995, R. Jocqué & Tanoh (MRAC 203686).

Diagnosis. Males can be easily separated from those of *S. deltshevi* by the presence of a dorsal bump on the medial tibial apophysis (Fig. 23, arrowed). From *S. kindamba*, they can be distinguished by the longer ventral and shorter medial tibial apophysis (Fig. 19, arrows 1 and 2), also by the shape of the retrolateral bump of the tegulum, especially on its dorsal part (Fig. 21, arrow). The females differ from those of *S. kindamba* in having shorter insemination ducts (Fig. 26).

Description. Male: Measurements: Cephalothorax: length 2.40, width 1.90, height at PLE 1.45. Ocular area: length 1.30, width anteriorly 1.90, width posteriorly 1.75. Abdomen: length 2.30, width 1.45. Clypeal height: 0.15. Cheliceral length: 0.60. Diameter of AME: 0.60. Length of leg segments: I: 1.40+0.60+0.85+0.80+0.55. II: 1.50+0.70+0.90+0.90+0.55. III: 1.55+0.60+1.10+1.05+0.65. IV: 1.75+0.75+1.10+1.25+0.75. Leg spination: I: Fm d 1-2-5; Pt pr & rt 1; Ti pr & rt 1-1-1, v 2-2-0-2 ap; Mt pr & rt 1-1 ap; v 2-0-2 ap. II: Fm d 1-3-5; Pt pr & rt 1; Ti d 1-0-0, pr & rt 1; Ti d 1-0-0, pr & rt 1-1-1, v 2-0-2 ap; Mt pr 1-0-2 ap, rt 1-1-2 ap; v 2-0-2 ap. IV: Fm d 1-2-5; Pt pr & rt 1; Ti d 1-0-0, pr & rt 0, pr & rt 1; Ti d 1-0-0, pr & rt 1; Ti d 1-0-0, pr & rt 0, pr & rt 1; Ti d 1-0-0, pr & rt 0; Ti d 1-0-0, pr & r

Colouration: Carapace dark brown with brownish yellow medial stripe and black patches around the eyes covered with white hairs. Sternum brownish yellow. Clypeus



Figures 16-18. *Saraina kindamba*, sp. n.: 16 epigyne, ventral view; 17 spermathecae, dorsal view; 18 scheme of insemination ducts. Scale = 0.1 mm.

and cheeks yellow, chelicerae brown. Chelicerae with 5 promarginal teeth (Fig. 27). Abdomen grey-yellow. Ventral part grey-brown. Dorsum brownish yellow or yellow covered with white hairs, with medial and two lateral brown stripes. Book lungs covers grey-yellow, spinnerets brownish yellow. All legs yellow with brown bands. Palps yellow covered with white hairs. Palpal structure as in Figs 19-23.

Female: Measurements: Cephalothorax: length 2.80, width 2.20, height at PLE 1.65. Ocular area: length 1.35, width anteriorly 2.05, width posteriorly 2.00. Abdomen: length 2.90, width 2.00. Clypeal height: 0.15. Cheliceral length: 1.15. Diameter of AME: 0.60. Length of leg segments: I: 1.50+0.95+0.95+0.90+0.55. II: 1.55+0.90+1.00+0.95+0.55. III: 1.70+0.80+1.00+1.00+0.65. IV: 1.90+0.90+1.35+ 1.50+0.75. Leg spination: I: Fm d 1-2-5; Pt pr & rt 1; Ti pr 1-2, rt 1-0-1, v 2-2-0-2 ap; Mt pr 1-1, rt 2-1 ap; v 2-0-2 ap. II: Fm d 1-2-5; Pt pr & rt 1; Ti pr & rt 1-1-1, v 2-2-0-2 ap; Mt pr 1-1 ap, rt 1-1-1 ap; v 2-0-2 ap. III: Fm d 1-3-5; Pt pr & rt 1; Ti pr & rt 1-1-1, v 1-0-2 ap; Mt pr 1-0-2 ap, rt 1-1-2 ap; v 2-0-2 ap. IV: Fm d 1-2-5; Pt pr & rt 1; Ti pr & rt 1-1-1, v 1-0-2 ap; Mt pr & rt 1-1-2 ap, v 2-0-2 ap. Colouration: Carapace dark brown with brownish yellow medial stripe and black patches around eyes covered with white hairs. Sternum yellow or brown. Clypeus and cheeks yellow or brown. Chelicerae brown or dark brown. Chelicerae with 5 promarginal teeth (Fig. 28). Abdomen yellow-grey. Ventral part grey-brown. Dorsum brown covered with dense white hairs, with three orange stripes same position with male (holotype in poor condition, without orange hairs on stripes because of this). Posterior part with five pairs of orange points located between medial and lateral stripes. Book lungs covers yellow-grey. Spinnerets brownish yellow. All legs yellow or brownish yellow with indistinct brown bands. Palps yellow or brownish yellow covered with white hairs. Structure of epigyne and spermathecae as in Figs 24-26, 29.

Distribution. Known from Ivory Coast, Cameroon and Nigeria (Wanless and Clark 1975; present data).



Figures 19-23. *Saraina rubrofasciata*: **19** left palpus, ventral view; **20** ditto, retrolateral view; **21** ditto, ventroapical view; **22** palpal tibia, dorsal view; **23** ditto, retrolateroapical view. Scale = 0.1 mm.



Figures 24-29. *Saraina rubrofasciata*: **24** epigyne, ventral view, holotype; **25** epigyne, ventral view; **26** spermathecae, dorsal view; **27** left male chelicera; **28** left female chelicera; **29** scheme of insemination ducts. Scale = 0.1 mm.

Acknowledgements

I wish to thank Dr Rudy Jocqué (Musée Royal de l'Afrique Centrale, Tervuren, Belgium) and Dr László Dányi (Hungarian Natural Nistory Museum, Budapest, Hungary) for providing specimens of *Saraina* for this study. Special thanks to Dr Anthony Russell-Smith (Sittingbourne, UK) who provided linguistic help, to Domir De Bakker and Myriam Vandenbosch (both from the Musée Royal de l'Afrique Centrale Tervuren, Belgium) who helped me during preparation of this paper. Finally, many thanks to the two anonymous referees, with whose help the manuscript was significantly improved.

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RESEARCH ARTICLE



Lepthyphantes christodeltshev, a new species from Greece (Araneae, Linyphiidae)

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Academic editor: Jason Dunlop	Received 16 February 2009	Accepted 13 May 2009	Published @@ August 2009		
urn:lsid:zoobank.org:pub:					

Citation: Helsdingen P van (2009) *Lepthyphantes christodeltshev*, a new species from Greece (Araneae, Linyphiidae). In: Stoev P, Dunlop J, Lazarov S (Eds) A life caught in a spider's web. Papers in arachnology in honour of Christo Deltshev. ZooKeys %%: 1-14. doi: 10.3897/zookeys.%%.\$\$

Abstract

The male and female of *Lepthyphantes christodeltshev* **sp. n.** are described from mainland Greece. The presently accepted subdivision of *Lepthyphantes* s.l. into separate genera is commented upon and criticized as user-unfriendly. Possible functional aspects of the epigyne and male palp are discussed.

Keywords

Lepthyphantes christodeltshev, lepthyphantine genera, Linyphiidae, Greece

Introduction

Again a new species of *Lepthyphantes* s.l. There seems to be no end to the discovery of new species of this large taxon. Even though *Lepthyphantes* s.l. has been split up in many separate genera through the efforts of Michael Saaristo and Andrej Tanasevitch over the last twelve years it remains a delimited taxon, a group of genera which closely resemble each other and are most likely closely related. The present general procedure for identification of a stray specimen of an unfamiliar species of *Lepthyphantes* s.l. is to try and identify it by leafing through all available papers on all the *Lepthyphantes* sensu lato taxa to try and find a matching illustration of the epigyne or male palp of the specimen at hand. When the specimen has thus been identified the present allocation

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to one of the recently split-off taxa is noted and the species is named accordingly. If one cannot find a matching illustration one has to find a closely resembling species and describe the new species in the same genus. For the species described here no matching illustration could be found and none of the split-off genera were found suitable to accommodate this species. Therefore it is described in the "mother-genus" *Lepthyphantes* (see under Discussion).

Abbreviations (in the text and illustrations):

AME, anterior median eyes; as, arched part of scape; c, cymbium; e, embolus; h, haematodocha; l, lamella; pc, paracymbium; PME, posterior median eyes; r, radix; sta, supra-tegular apophysis; s, stretcher; rs, receptaculum seminis; ss, straight part of scape; t, tegulum; ta, terminal apophysis; ti, tibia. Chaetotaxy: l', pro-lateral; l", retro-lateral.

Lepthyphantes christodeltshev sp. n. urn:lsid:zoobank.org;pub:

Derivation of name: after Christo Deltshev, the well-known Bulgarian arachologist. Name treated as a noun in apposition.

Material. 1 \mathcal{J} (holotype), Greece, Attiki, Mt. Parnis N of Athens, in litter and grass under pine tree, 500 m, 6.I.1985, C.L. Deeleman leg.; 1 \mathcal{Q} (paratype), same sample. The general appearance of the two specimens convinced me that they are the male and female of one and the same species [The locality is Mt. Parnos or Parnis (Parnos Oros) directly north of Athens and not the famous Mountain Parnassus near Delphi]. Both specimens deposited in the collection of the National Museum of Natural History, Leiden, Netherlands.

Description. Since there are only two specimens available (the male holotype and female paratype) I have left both specimens intact as much as possible, so as to keep them fit for further examination. More detailed examination of the genitalia has to wait until additional material becomes available. The illustrations provided here consequently have to remain more schematic and are meant to enable identification and give insight into their anatomy as much as possible.

Male. Species of small size. Colour: Generally light brown, with light grey suffusion on the chelicerae. Sternum and abdomen dark grey. Legs yellow to brown. Abdomen on the dorsal posterior half with three faint chevron markings which are light brown because the grey pigment is lacking there on the otherwise grey abdomen; no white pigment present.

Measurements (in mm): total L 1.9, cephalothorax L 0.85, W 0.65, abdomen L 1.05, W 0.60, H 0.60; chelicerae L 0.28, W 0.15, height of clypeus 0.12.

All eyes of about same size (\emptyset 0.075), only AME much smaller (\emptyset 0.037); PME separated by 0.4 times \emptyset of PME, AME by 0.67 times \emptyset of AME.

Chelicerae. With coarse stridulating files, ridges 0.009 mm apart. Three relatively large pro-marginal teeth of equal size, five small retro-marginal teeth of equal size.

	Ι	II	III	IV	palp	
Fe	1.06	0.95	0.82	1.06	0.27	
Pa	0.25	0.25	0.21	0.22	0.11	
Ti	1.06	0.98	0.75	-	0.15	
Mt	0.99	0.89	0.72	-	-	
Ta	0.66	0.59	0.44	-	0.30	

Legs:

I eas

Fe I with one pro-lateral spine, other femora spineless; all tibiae with two dorsal spines, Ti I with pro-lateral (l') and retro-lateral (l') spine, Ti II with l''-spine only. TmI 0.19. Position of basal d-spine on tibia I 0.33, length of spine 0.20, \emptyset 0.087. Metatarsi spineless.

Male palp. Tibia without apophysis; only scar of dorsal spine visible, spine itself broken off. Cymbium simple, without basal dorsal protrusion. Paracymbium (Figs 1, 2) with a sharply pointed tooth at the postero-ventral corner and an equally slender tooth more forward, below inside the tub-shaped element, hidden behind a lobe-like retro-lateral extension of the ventral margin of the element. Suprategular apophysis straight and pointed. Lamella (Figs 1, 3, 4) broad where it emerges from the radix, then narrowing to a slender, curved central section and with a forked end, the two branches at a perpendicular angle. Radix (Fig. 4) with clear Fickert's Gland. Embolus slender, modestly sickle-shaped; no denticles at base visible (as present in some *Tenuiphantes* species). Other details were difficult to distinguish without damaging the palp of the holotype, which was left intact as much as possible.

Female. Coloration as in male. Abdomen with the faint chevron markings over the whole dorsal surface.

Measurements (in mm): total L 2.2, cephalothorax L 0.80, W 0.65, abdomen L 1.45, W 0.95, H 0.90; chelicerae L 0.37, W 0.17, height of clypeus 0.1.

Eyes. All eyes of about the same size (\emptyset 0.062), only AME slightly smaller (\emptyset 0.050); PME separated by 0.6 times \emptyset of PME, AME by 0.38 times \emptyset of AME.

Chelicerae. Stridulating files coarse. Three relatively large pro-marginal teeth of equal size, five small retro-marginal teeth of equal size.

1050					
	Ι	II	III	IV	
Fe	0.96	0.90	0.76	1.00	
Pa	0.25	0.25	0.21	0.21	
Ti	1.00	0.90	0.69	1.00	
Mt	0.84	0.75	0.61	0.83	
Ta	0.59	0.56	0.52	0.51	

Fe I with one pro-lateral spine, other femora spineless; all tibiae with two dorsal spines, Ti I with pro-lateral (l') and retro-lateral (l") spine, Ti II with l"-spine only. TmI 0.16. Position of basal d-spine on tibia I 0.36, length of spine 0.26, \emptyset 0.087. Metatarsi spineless.

Epigyne and vulval structures (Figs 5-6): The organ is not protruding, but is flush with the ventral surface. The basal part of the scape (ventral view, Fig. 5) is more or less oval, widest in the middle, and projects slightly over the epigastric furrow. A small parmula is visible, but mostly hidden below the scape. A narrow, slit-like space



Figures 1-6. *Lepthyphantes christodeltshev* sp. n. **I** male palp, retro-lateral view; **2** paracymbium from slightly more ventrally; **3** tip of lamella; **4** radical complex, with radix (r), base of lamella (l), and embolus (e); **5** epigyne, ventral aspect; **6** epigyne, dorsal aspect.
separates the scape from the lateral parts of the epigyne. At either side of the scape, between the widest part of the basal part of the scape and the posterior-most tips of the lateral ventral surface, a rounded structure ("lateral lobe") is visible, the function of which is unknown. The dorsal view (Fig. 6) reveals the knob-shaped parmula with a socket on top of the broad, squarish distal part of the scape; the entrances of the sperm ducts are discernible through the structure (situated at the ventral surface) laterally at the tip just mesally of a socket. I have not flattened the scape to investigate its precise anatomy because I have only this single specimen, but it looks as if the scape is not very flexible; the middle and terminal sections of the scape seem to arise from the dorsal side of the basal section of the scape, not at the tip but slightly more to the front (anterior direction) of that part of the scape. This would agree with the only slightly sickle-shaped embolus of the male (which has to fit into the curved section of the scape). In dorsal view it is clear that the rounded structures at either side if the scape are the extensions of the thin but well-chitinized "posterior median plate", which in this species is a dorsal median plate with concave distal margin; the "lateral lobes" appear to be separated from the bordering lateral ventral surface by a fissure; the lateral lobes and median plate should together be homologous with the posterior median plate in other *Lepthyphantes* species.

Discussion

Classification. Like *Linyphia*, *Neriene*, and *Erigone*, the genus *Lepthyphantes* served as an acceptable place for new species in the earlier days of spider taxonomy. In this way such genera became very large. Subsequent taxonomists transferred species from *Lepthyphantes* to other genera which had been created in the course of time, but even so many new contemporary species were described and thus the genus *Lepthyphantes* remained very rich in species.

Simon (1929) already subdivided the genus into species groups to accommodate the European species. It is mostly through the efforts of Michael Saaristo and Andrej Tanasevitch, separately or as collaborators and occasionally with another collaborator, that the Palaearctic *Lepthyphantes* s.l. species were further divided into many new genera. A few others also worked along this line. Altogether Saaristo and Tanasevitch created 27 new genera, between 1992 and 2006, while several genera were also established by others. Of these 27 genera 15 concern Europe (i.e. contain one or more European species), while the other genera contain non-European (Asian, North-American, and some African) species. The relevant publications are listed in the references (Tanasevitch 1992; Saaristo and Tanasevitch 1996, 1999, 2000, 2001). The genus *Ipa* was even placed in a separate (new) subfamily Ipainae (Saaristo 2007). For an overview of all the new genera, see the list of species transferred to other genera under the genus *Lepthyphantes* is probably not monophyletic but contains the left-overs or species which have not been assigned to species groups; as well as recently described new species with lepthyphantine features.

The subdivision of the genus by the two authors noted above is mainly based on the, often minute, details of the male palp and female epigyne. Other somatic characters were hardly used, with the exception of the presence or absence of an abdominal pattern, or at least they were not mentioned in their publications if the authors had found them. This makes their new classification user-unfriendly. None of the authors



Figures 7-11. *Lepthyphantes leprosus* (Ohlert). **7-8** epigyne, lateral view, in normal resting position (**7**) and after stimulation through courtship (**8**); **9-11** male and female genitalia in functional contact, in caudal view (**9**) from the female's right side (**10**) and the female's left side (**11**); male elements black (haematodocha excepted), female elements white; haematodocha, with stippled outline, much more swollen during copulation, here depicted as shrunken during fixation of the copulatory complex (after van Helsdingen 1965, adapted).

has provided a key or any other tool to distinguish between the many genera they created. In some cases one can recognize a certain pattern of apparent synapomorphies, e.g. in the shape of the epigyneal scape or of the lamella in the male palp, which seem to justify a separate taxon (genus, subgenus or species group). Therefore I prefer to describe this new species in *Lepthyphantes*. It might be close to *Tenuiphantes*, where it keys out using the subdivision of Simon (1929), but this key has become useless since the new taxonomic revisions.

Functional aspects of the genitalia. If we use *Lepthyphantes leprosus* (Ohlert) as an example of the way the genitalia function in the Lepthyphantini in general, and in the genus *Lepthyphantes* s.l. in particular (see van Helsdingen 1965), we can reflect and speculate on possible conformities and differences.

We may presume that the epigyne in *L. christodeltshev* will also be stimulated by male courtship and rise out of its resting position and become ready for copulation, ending up more or less perpendicular to the ventral surface of the female abdomen (compare Figs 7 and 8). During copulation the median suprategular apophysis will pick up the stretcher (parmula) at the tip of the epigyneal scape, finding a foothold there in the small socket, and pull the arched part of the scape around the male embolus. The rather tub-shaped paracymbium will be cupped over the end of the basal section of the scape and the two teeth on the paracymbium probably help to strengthen their grip on each other, preventing the paracymbium from slipping or twisting over the tip of the basal section of the scape. As indicated in the description of the epigyne, the structure of the scape makes it unlikely that the more distal parts of the scape can be distorted as easily as in *Lepthyphantes leprosus* (Ohlert), where the arched apical part is twisted to a position perpendicular to the basal stem and pulled around the disc-shaped male embolus (Figs 9-11). Here we must assume that the distal parts will be pulled around the male embolus too, but not twisted sideways as far as in *L. leprosus* (see Figs 9-11). The pair of sockets at either side at the inside (ventral side) of the distal part of the scape will be picked up by the embolic tooth and thus establish contact between the sperm ducts in the male palp and the sperm duct in the scapus of the epigyne; the entrance of the latter being situated just mesally of the socket. There is no terminal apophysis of any substance to disappear into the epigyneal cavity, which appears to be small.

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Tanasevitch A.V. (1992) New genera and species of the tribe Lepthyphantini (Aranei Linyphiidae Micronetinae) from Asia (with some nomenclatorial notes on linyphiids). Arthropoda Selecta 1: 39-50. RESEARCH ARTICLE



A new species of Incestophantes Tanasevitch, 1992 (Araneae, Linyphiidae) from Ukraine

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Academic editor: Pavel Stoev Received 23 January 2009 Accepted 12 April 2009 Published @@ August 20)09
urn:lsid:zoobank.org:pub:	

Citation: Gnelitsa V (2009) A new species of *Incestophantes* Tanasevitch, 1992 (Araneae, Linyphiidae) from Ukraine. In: Stoev P, Dunlop J, Lazarov S (Eds) A life caught in a spider's web. Papers in arachnology in honour of Christo Deltshev. ZooKeys %%: 1-14. doi: 10.3897/zookeys.%%.\$\$

Abstract

A new spider species, *Incestophantes australis* **sp. n.** (Linyphiidae), found on the Crimean Peninsula, Ukraine is described and illustrated. It is morphologically closely related to *Incestophantes crucifer* (Menge, 1866), but is easily distinguished by its palpal conformation.

Keywords

Araneae, Linyphiidae, Incestophantes australis sp. n., I. crucifer, Ukraine

Introduction

The genus *Incestophantes* Tanasevitch, 1992 includes 23 species so far (Platnick 2008). Only *Incestophantes crucifer* (Menge, 1866) has been recorded from the forest zone and in the Carpathian region of the Ukraine (Gnelitsa 2000, 2002; Evtushenko 1993). It has also been mentioned from the Crimean Peninsula (Gnelitsa 2004). Comparison of the Crimean specimens of *Incestophantes crucifer* with those from the Ukraine revealed some morphological differences. It is now thought that the Crimean *Incestophantes* represents an undescribed species, closely related to *Incestophantes crucifer* (Menge, 1866). Therefore, this species is described here as *Incestophantes australis* sp. n. and comparative drawings and a brief re-description of *Incestophantes crucifer* are provided as well.

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Material and methods

Specimens were collected using a hand-held suction sampler. Identification was made with a binocular microscope MBS-10; drawings were made using a camera lucida. The holotype male is deposited in the collection of the Zoological Department of Sumy State Teacher's Training University (SSTTU). All other specimens are deposited in author's private collection (VGC). Abbreviations of the names of palp and epigyne structures follow Hormiga (2000), Saaristo and Tanasevitch (1996), and Thaler et al. (1994): APc – apical part of paracymbium; E – embolus; i – keel of the lamella characteristica; Lch – lamella characteristica; LPc – lateral process of paracymbium; m – membrane; MPc – middle part of paracymbium; T – tegulum; TA – terminal apophysis; TA1 – first terminal apophysis; TA2 – second terminal apophysis; Ps – proscapus; DPs – distal part of scape. Other abbreviations in text: Fe – femur; Pt – patella; Mt – metatarsus; Ti – tibia; d – dorsal, p – prolateral, r – retrolateral position of leg spines. All measurements are in millimeters.

Taxonomic part

Incestophantes australis sp. n. urn:lsid:zoobank.org:pub: Figs 1, 2a-c, 3a-d, 4a-d

Material. Holotype. Male, Ukraine, Crimea, Yalta Distr., Cape Martjan reserve, 44°30'N 34°15'E: Quercus pubescens, Juniperus excelsa, Arbutus andrachne, Ruscus ponticus, Hedera taurica, leaf litter, 23.IV.2002, V. Gnelitsa leg. (SSTTU). - Paratypes [all found in Crimea, Ukraine]: Yalta Distr., Shaitan Merdven rise, 44°25'N 33°51'E: Quercus pubescens, Carpinus betulus, C. orientalis, Acer, Tilia, Euonimus verrucosa, Juniperus excelsa, Cotinus coggygria, Ruscus, Brachipodium, Hedera, in grass, male, 12.X.2001; foot of Kilse-Burun Mt., 44°24'N 33°50'E, terraced slope, Pinus pallasiana, Juniperus excelsa, Quercus pubescens, Carpinus orientalis, Hedera, Ruscus, Clematis, with Cotinus coggygria, in needle litter and in grass, 8 females 4 males, 14.X.2001. Alushta Distr., Demerdji Mountain massif, 44°46'N 34°26'E, Fagus forest, in leaf litter, male, 17.IV.2002; SSE slope cereals and motley grass meadow, with sparse Pyrus eleagnifolia, Fraxinus and Rosa, in grass, male, 11.X.2002; meadow, in the grass along the stream, male, 10.X.2002. Yalta, Botkin path, E slope, 44°29'N 34°08'E, Pinus, Quercus pubescens, Carpinus betulus, Swida, Ruscus, Crataegus, needle litter, 2 females 1 male, 17.X.2002. Pheodosia Distr., Karadag reserve, 44°55'N 35°14'E, NNW slope of Tumanov ravine, Quercus pubescens, Pinus pallasiana, sparse Fraxinus with Cornus mas, in litter, 16 females 3 males, 25.IV.2003, 13.X.2003; Svyataya Mt. slope between North pass and Gyaur-Cheshme spring, Quercus petraea, Acer, Paliurus spina-christi, sparse Fraxinus with Cornus mas, in litter and in grass, male, 20.IV.2003; Syuryu-Kaya



Figure 1. Distribution of Incestophantes species in Ukraine: filled star – I. australis; filled circle – I. crucifer.

Mt. slope, sparse *Quercus pubescens*, *Fraxinus* with *Cornus mas*, in grass, 3 females 3 males, 11.X.2003, all leg. V. Gnelitsa (all preserved in the VGC).

Diagnosis. Male palp: Lamella characteristica 'Lch' beneath the distal spire with a wide, rounded keel 'i' (Fig. 2a,b). Shortened and widened apical part of paracymbium 'Apc' (Fig. 2a) distally truncate, cf. 'Apc' of *I. crucifer* which is elongate and gradually narrows towards the rounded end (Fig. 2d). Paracymbium with elongate lateral process

Legs	Femur	Patella	Tibia	Metatarsus	Tarsus
Ι	1.48	0.32	1.55	1.57	0.92
II	1.34	0.31	1.27	1.34	0.77
III	1.05	0.27	0.84	1.01	0.55
IV	1.41	0.29	1.23	1.40	0.71

Table 1. Length of leg segments in male Incestophantes australis.

Table 2. Length of leg segments in female Incestophantes australis.

Legs	Femur	Patella	Tibia	Metatarsus	Tarsus
Ι	1.43	0.33	1.44	1.41	0.90
II	1.27	0.32	1.16	1.18	0.76
III	1.02	0.28	0.80	0.90	0.55
IV	1.37	0.28	1.18	1.26	0.71

'LPc' (Fig. 2a); first terminal apophysis 'TA1' of the new species (Fig. 2b,c) narrowing towards the end, without parallel sides as in *I. crucifer* (Fig. 2e,f). Thick, long spine on palpal patella gradually tapers to a sharp tip, while this spine in *I. crucifer* distally widens and then tapers to a point.

Female distinguished by the narrower and elongated distal part of the scape 'DPS' (Fig. 3c). Because of considerable variation in the shape of the proscapus 'Ps' (Figs 3a, 4a-d) females are difficult to distinguish.

Description. Male. Total length 2.20; carapace: 1.12 long, 0.91 wide; yellow with thin dark border and median longitudinal stripe; sternum: 0.63 long, 0.62 wide, caudally extended between coxae IV, yellow-gray with slightly darker margin; posterior median eyes 0.6 diameter apart, anterior margin of chelicerae with two medium sized teeth, posterior margin with two tiny teeth at the base of the fang; stridulating files distinct. Abdomen yellow with dorsal pattern of two longitudinal rows of gradually diminishing grey blotches which are drawn together caudally. Legs yellow, femur, tibia and metatarsus all with dark ring, tibia darkened distally; spination: FeI – 1p, TiI – 2d:1p:1r, MtI – 1d; TiII – 2d:1r, MtII – 1d; TiIII – 2d and 2 spines (1p 1r) at the distal end, MtIII – 1d; TiIV – 2d, MtIV – 1d; position of metatarsal trichobothrium: I – 0.19, II – 0.19, III – 0.18.

Palp: see Fig. 2a-c.

Female. General appearance as in the male. Total length 2.75; carapace 1.06 long, 0.81 wide, yellow with dark gray border and median longitudinal stripe; sternum 0.63 long, 0.59 wide, caudally extended between coxae IV, yellow with slightly darker border; posterior median eyes 0.6 diameter apart; anterior margin of chelicerae with three medium sized teeth, posterior margin with four tiny teeth close together; stridulating files indistinct.

Epigyne: see Fig. 3a-c; vulva: see Fig. 3d.



Figure 2. Male palp. *Incestophantes australis* sp. n.: **a** lateral aspect, **b** ventral aspect, **c** mesal aspect; *I. crucifer*: **d** lateral aspect, **e** ventral aspect, **f** mesal aspect.



Figure 3. *Incestophantes australis* sp. n., epigyne: **a** ventral aspect, **b** caudal aspect, **c** dorsal aspect, **d** vulva; *I. crucifer*, epigyne: **e** ventral aspect, **f** caudal aspect, **g** aspect, **h** vulva.



Figure 4. *Incestophantes australis* sp. n., variation of the epigyne (ventral and caudal views) of specimens from a single locality.

Incestophantes crucifer (Menge, 1866)

Bathyphantes c. Menge, 1866: fig. 41.
Bolyphantes c.: Wiehle 1956: fig. 268-272; Miller 1971: plate XLIII, figs 7-8; Palmgren 1975: fig. 9.23-24; Pichka 1983: fig. 2.
Lepthyphantes c.: Simon 1884: figs 18-19; Thaler et al. 1994: fig. 30-39.
Incestophantes c.: Saaristo and Tanasevitch 2000: p. 257.
Figs 1, 2d-f, 3e-h

Material. Ukraine: Volyn region, **Shatsk** Distr., Shatsky Nature Park, 51°30'N 23°55'E, *Quercus – Pinus* forest, male, female, IV-X.1990, K. V. Evtushenko leg. (Evtushenko's private collection); Chernovtsy region, **Vyzhnitsa** Distr., Dolishny Shepot environs, 48°01'N 25°16'E, Chiuchelka Mt. slope, *Picea*, in needle litter and in moss on the ground, 3 females, 2.VII.2001; Sumy region, **Konotop** Distr., 2 km to the North of Kuzky village, 51°18'N 33°17'E, *Pinus*, sparse *Quercus*, *Betula*, *Sorbus* with *Frangula*, *Vaccinium myrtillus* and *Calluna vulgaris*, at the base of *Pine* trunk and in litter, 3 females 2 males, 22.V.2003, **Yampol** Distr., Prudishche environs, 51°57'N 33°43'E, *Pinus*, sparse *Sorbus*, at the base of *Pine* trunk, 6 females 1 male, 7.V.2000; **Seredinobuda** Distr., Staraya Guta environs, Desnyansko-Starogutsky Nature Park, 52°19'N 33°46'E, *Pinus*, sparse *Quercus, Sorbus* with *Frangula*, at the base of *Pine*

Legs	Femur	Patella	Tibia	Metatarsus	Tarsus
Ι	1.19	0.28	1.25	1.26	0.82
II	1.05	0.27	1.02	1.07	0.68
III	0.80	0.22	0.65	0.76	0.48
IV	1.04	0.24	0.98	1.09	0.63

Table 3. Length of leg segments in male Incestophantes crucifer.

Table 4. Length of leg segments in female Incestophantes crucifer.

Legs	Femur	Patella	Tibia	Metatarsus	Tarsus
Ι	1.05	0.26	0.99	0.97	0.67
II	0.91	0.24	0.81	0.81	0.57
III	0.70	0.22	0.53	0.60	0.39
IV	0.95	0.22	0.78	0.83	0.55

trunk, female, 22.VI.2000; moss, 6 females, 13.V.2001, 5 females, 15.V.2001; *Pinus*, *Betula*, sparse *Quercus*, *Sorbus* with *Frangula* and *Vaccinium myrtillus*, in litter, female, 16.V.2001; *Sphagnum-Eriophorum* bog, on the rising ground in the grass near the base of *Betula* trees, female, 8.V.1990, 2 females, 22.VI.2000, 2 females, 17.IX.2000, 5 females 1 male, 18.IX.2000, all collected by V. Gnelitsa (all preserved in the VGC).

Description. Male. Total length 1.69, carapace: 0.94 long, 0.74 wide, yellow with dark border and median longitudinal stripe; sternum: 0.56 long, 0.55 wide, caudally extended between coxae IV, yellow with slightly darker margin; posterior median eyes 0.6 diameter apart. Anterior margin of chelicerae at the base of the fang with five medium sized teeth and a small one remotely positioned, posterior margin with tiny tooth at the base of fang; stridulating files distinct. Abdomen with dorsal pattern of two longitudinal rows of dark patches on a light background. Legs yellow, femur, tibia and metatarsus all with dark ring, tibia darkened distally; spination: FeI – 1p, TiI – 2d:1p:1r, MtI – 1d; TiII – 2d:1r, MtII – 1d; TiIII – 2d and 2 spines (1p, 1r) at the distal end, MtIII – 1d; TiIV – 2d and 2 spines (1p, 1r) at the distal end, MtIV – 1d; position of metatarsal trichobothrium: I – 0.20, II – 0.19, III – 0.18.

Palp: see Fig. 2d-f.

Female. General appearance as in the male. Total length 2.23; carapace 0.78 long, 0.62 wide, yellow with dark gray border and median longitudinal stripe; sternum 0.49 long, 0.45 wide, caudally extended between coxae IV, yellow-gray with slightly darker border. Posterior median eyes 0.6 diameter apart. Anterior margin of chelicerae with three (two medium sized, one small) teeth, posterior margin with five tiny teeth close together; stridulating files as in male. Position of metatarsal trichobothrium: I – 0.25, II – 0.23, III – 0.20.

Epigyne: see Fig. 3e-g; vulva: see Fig. 3h.

Remarks. *Incestophantes crucifer* is known from Austria, Belarus, Belgium, Bulgaria, the Czech Republic, Estonia, Finland, France, Germany, Hungary, Italy, Liechtenstein, Norway, Poland, Romania, Russia, Slovakia, Sweden, Switzerland, Ukraine and the former Yugoslavia (Van Helsdingen 2007). The spiders usually inhabit dry coniferous forests as well as bogs. Their webs are spanned in a slanting direction from tree trunks towards the litter.

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RESEARCH ARTICLE



Systematics and phylogeography of the Dysdera erythrina species complex (Araneae, Dysderidae) in Sardinia

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Academic editor: Jason Dunlop Received 12 March 2009 Accepted 19 June 2009 Published @@ August 200	09
urn:lsid:zoobank.org:pub:	

Citation: Arnedo MA, Gasparo F, Opatova V (2009) Systematics and phylogeography of the *Dysdena erythrina* species complex (Araneae, Dysderidae) in Sardinia. In: Stoev P, Dunlop J, Lazarov S (Eds) A life caught in a spider's web. Papers in arachnology in honour of Christo Deltshev. ZooKeys %%: 1-14. doi: 10.3897/zookeys.%%.\$\$\$

Abstract

Sardinia is the second largest island in the Mediterranean and, together with Corsica and nearby mainland areas, one of the top biodiversity hotspots in the region. The origin of Sardinia goes back to the opening of the western Mediterranean in the late Oligocene. This geological event and the subsequent Messinian Salinity Crisis and Pleistocene glacial cycles have had a major impact on local biodiversity. The *Dysdera* woodlouse hunter spiders are one of the most diverse ground-dweller groups in the Mediterranean. Here we describe the first two species of this genus endemic to Sardinia: *Dysdera jana* **sp. n.** and *Dysdera shardana* **sp. n.** The two species show contrasting allopatric distribution: *D. jana* **sp. n.** is a narrow endemic while *D. shardana* **sp. n.** is distributed throughout most of the island. A multi-gene DNA sequence phylogenetic analysis based on mitochondrial and nuclear genes supports the close relationships of the new *Dysdera* species and identify the Messinian Salinity Crises as the most plausible period for the split between Sardinian endemics and their closest relatives. Phylogeographic analysis reveals deep genetic divergences and population structure in *Dysdera shardana* **sp. n.**, suggesting that restriction to gene flow, probably due to environmental factors, could explain local speciation events.

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Keywords

taxonomy, phylogeny, DNA sequencing, Mediterranean biogeography, phylogeography

Introduction

The Mediterranean basin is one of the Earth's biodiversity hotspots for conservation priority (Myers et al. 2000). A dynamic and tumultuous geological history ranks high among the main factors responsible for the outstanding diversity of the region. The island of Sardinia constitutes a good example of this ever-changing geological landscape. At the beginning of the Oligocene (~30 million years ago, m.a.), several continental microplates, including present-day Sardinia, Corsica, the Balearic Islands, Calabria, the Kabylies and the Betic-Rift Cordillera, broke off from the north-eastern Iberian Peninsula as a result of geological back-arc extension processes, and started drifting to their present-day location. During the first stage of the back-arc extension, the northern microplate assemblage (i.e., Sardinia, Corsica and Calabria) started drifting counterclockwise with respect to the Eurasian plate and finally collided with the Apulian plate about 20-18 m.a. (Rosenbaum et al. 2002). There is no general consensus on the time of separation of Corsica and Sardinia. Some authors suggest that Sardinia broke off from Corsica 20 to 16 m.a. (Rosenbaum, Lister and Duboz 2002); while others consider that the process would not have been fully completed until about 9 m.a. (Alvarez 1972, 1974). The closing of the Miocene marine gateways between the Mediterranean Sea and the Atlantic Ocean, 5.96 m.a., caused a large drop in the Mediterranean water level (Blondel and Aronson 1999, Krijgsman et al. 1999) and the emergence of land connections between Sardinia and northern Italy and southern France. The opening of the Strait of Gibraltar about 5.3 m.a. restored the water exchange between the Atlantic and Mediterranean basins, re-establishing effective isolation of the island ecosystems (Loget and Van Den Driessche 2006, Loget et al. 2005). Eustatic sea level changes as a result of Pleistocene glacial cycles could have connected Sardinia with Corsica, and with the mainland, via Elba. Sea level oscillations creating land bridges between Sardinia and Corsica from the Miocene until well into the Pleistocene (5.7 - 0.23 m.a.)have been additionally suggested (Arias et al. 1980).

Sardinia is the second largest island in the Mediterranean (Fig. 1), generally mountainous with a few coastal plains. The island's mountains are divided into three ranges that largely coincide with areas of high endemism, namely Mount Limbara on the north, the Gennargentu-Supramonte Massif on the central-eastern side, and the Sette Fratelli on the south-east (Grill et al. 2007). Additionally, a separate biogeographic region has been proposed for the Sulcis-Iglesiente territory in the south-western part of Sardinia, based on exclusive plant endemism and a unique blend of geolithologic, geomorphologic, paleogeographic, bioclimatic and vegetation features (Bacchetta et al. 2007). It is worth noting that the Tyrrhenian islands, Sardinia and Corsica, and the Maritime-Ligurian Alps, are among the regions with the highest level of narrow endemism in the Mediterranean basin (Medail and Quezel 1999).



Figure 1. Maps showing the location of Sardinia and known localities of the new species. *Dysdera jana* sp. n.: Nuoro: (1) Dorgali, 450 m, (2) km 2 S of Dorgali, 500 m, (3) Supramonte di Oliena, 900 m, (4) Sa Oche, km 7 ESE of Oliena, 150 m. *D. shardana* sp. n.: Cagliari: (5) Fluminimaggiore, Is Arenas, (6) Fluminimaggiore, Tempio di Antas, Nuoro: (7) Aritzo, Castagneto Geratzia, 867 m, (8) Desulo, rd. to Fonni, 1146 m, (9) Macomer, Mt. S. Antonio. Oristano: (10) Cuglieri, rd. to San Leonardo 7 Fuentes, 587 m, (11) S. Leonardo 7 Fuentes, 699 m, (12) Morgongiori, Is Benas recreation area, 566 m, (13) Sassari: NW Torralba.

The woodlouse-hunter spiders of the genus *Dysdera* Latreille, 1804 include about 250 described species (Platnick 2009) of mostly nocturnal, wandering, ground-dwelling spiders. Although the geographic distribution of the genus includes most of the Western Palaearctic, it is especially diverse in the Mediterranean region, where it constitutes one of the most conspicuous components of the local ground arthropod fauna. The *erythrina* group was originally proposed by Deeleman-Reinhold and Deeleman (1988) to include the type species of the genus, *Dysdera erythrina* (Walckenaer, 1802), as well as some other species described from the Iberian peninsula, which included *D. fuscipes* Simon, 1882, *D. anonyma* Ferrández, 1984 and *D. veigai* Ferrández, 1984. This group was proposed to be related to the *crocata* group, from which it would differ by the shape and size of the carapace and the chelicera, the spination pattern and the shape of the male bulb (male secondary copulatory structure, located on palpal tarsi). The great French arachnologist E. Simon described three subspecies of *D. erythrina*, namely *D. erythrina lantosquensis* Simon, 1882 from France, *D. erythrina fervida* Simon, 1882 from Corsica and the Balearic Islands and *D. erythrina provincialis* Simon, 1882 from France (Platnick 2009). Subsequently, Řezáč and collaborators (2007) have granted species status to *D. lantosquensis*, and suggested that the rest of the subspecies should also be considered different species.

Sardinia harbours a rich endemic Dysderidae fauna, which includes four *Harpactea* Bristowe, 1939 species, one *Parachtes* Alicata, 1964 and the monotypic cave-dwelling endemic genus *Sardostalita* Gasparo, 1999 (Platnick 2009, Stoch 2003). Endemic *Dysdera* species have not been reported from Sardinia so far. The *crocata* group is represented by the synanthropic *D. crocata* C.L. Koch, 1839, *D. ancora* Grasshoff, 1959 and *D. ventricosa* Grasshoff, 1959, the latter two species also present in Sicily (Stoch 2003). Grasshoff (1959) reported the presence in Sardinia of *D. kollari* Doblika, 1853, a species previously reported from the eastern Adriatic coast (Chyzer and Kulczyński 1897) and northern Greece, and described the formerly unknown male (Grasshoff 1959) (it turned out to be a misidentification, see below; a drawing of the actual *D. kollari* male palp can be found in Gasparo 2004). However, the former citation has been suggested to refer to another species (Deeleman-Reinhold and Deeleman 1988). Finally, there is an early record of the presence of *D. erythrina* from Sardina (Costa 1885), which has not been subsequently confirmed to date.

In the present paper we confirm the presence of the *erythrina* group in Sardinia based on museum collections and newly collected material, and describe two new species, one of them including specimens previously misidentified as *D. kollari*. Phylogenetic position, time of origin and phylogeographic patterns of the new species are further investigated by means of molecular evidence

Methods

Taxonomy

Morphological methods are described in detail in Arnedo and Ribera (1999) and Arnedo et al. (2000). Taxonomic descriptions follow the format of Arnedo and Ribera (1999). Specimens were examined using a Leica MZ16A stereoscopic microscope equipped with a Nikon DXM1200 digital camera and an ocular measuring graticule. Digital microscope images were edited using the Auto-Montage software package v.4 (Syncroscopy, Frederick, MD, USA)]. Male right palps were removed, cleaned by means of ultrasound

and examined using either a HITACHI S-2300 Scanning Electron Microscope (SEM) (SCT, Universitat de Barcelona, Barcelona, Spain) operated at 15 kV. Left male palps were used for optic images and right palps were used for SEM images. All morphological measurements are given in millimetres. Eye diameters were taken from the spans of the lens. Carapace and abdomen measurements were taken in dorsal view, abdomen hairs were measured in lateral view, and cheliceral basal segment length was measured in lateral view. The prolateral groove of the chelicera was measured in dorsal view, by positioning the chelicera parallel to the background and measuring from the distal end of the margin to the beginning of the cheliceral lamina. The fang was measured in ventral view, from the basal segment condyl to the fang distal tip. The largest leg article lengths were measured in lateral view without detaching the legs from the specimen, by placing the article being measured in a perpendicular position. The female vulva was removed and muscle tissues were digested using a KOH (35%) solution before observation. Leg spination was recorded using the codification method fully described in Arnedo and Ribera (1997).

Eyes AME anterior medial eyes; **PME** posterior medial eyes PLE posterior lateral eyes Male copulatory bulb Т tegulum DD distal division IS internal sclerite ES external sclerite С crest AC additional crest AR arch-like ridge LF lateral fold over lateral sheet between internal and external sclerites L lateral sheet LA lateral sheet anterior apophysis additional lateral sheet at the internal border AL. Р posterior apophysis Female genitalia DA dorsal arch DF dorsal arch fold S spermatheca TB transversal bar Repositories **CRBA** Centre de Recursos de Biologia Animal, University of Barcelona CG F. Gasparo personal collection. **MSNVR** Museo Civico di Storia Naturale di Verona (P. Brignoli's collection)

Abbreviations used in the text and figures are as follows:

Molecular phylogeny

Taxa analysed in the present study, along with locality information and the GenBank accession numbers of the sequenced genes are listed in Table 1. Fresh specimens of D. jana sp. n. were not available for DNA analysis. Phylogenetic relationships of D. shardana sp. n. were inferred from a taxonomic sample that included all subspecies of Dysdera erythrina, representatives of the erythrina group (D. cf. inermis), putative related species based on genitalia characteristics (D. lusitanica Kulczyński, 1915, D. valentina Ribera, 2004), as well as two members of the crocata group. D. adriatica Kulczyński, in Chyzer and Kulczyński, 1897 was used as an outgroup based on the results of Macías-Hernández et al. (2008). The inclusion of D. cf. inermis specimens from both sides of the Strait of Gibraltar provided a vicariant biogeographic point (opening of the strait 5.3 million years ago) to estimate lineage age, by assuming that the separation of Iberian and Moroccan populations of D. cf. inermis was the result of this geological event. The same assumption has been used to calibrate molecular phylogenies in Canarian Dysdera (Macías-Hernández et al. 2008), scorpions (Gantenbein 2004), beetles (Gómez-Zurita 2004) and newts (Carranza and Arnold 2003). A second data matrix was built to investigate phylogeographic patterns in *D. shardana* sp. n. by sampling all freshly collected specimens amenable to DNA analyses, namely 14 specimens from localities in central Sardinia (Mt. Ferru, Mt. Arci, and Gennargentu).

Protocols for specimen handling, DNA extraction, amplification, and sequencing of the gene fragments followed those of Macías-Hernández et al. (2008). The following gene fragments were analyzed: mitochondrial genes cytocrome c oxidase subunit I (cox1, 676 bp), 16S rRNA (16S), the complete tRNA leu UAG (L1) (16S+L1, 387-546 bp), NADH dehydrogenase subunit I (nad1, 362 bp), and the nuclear genes 28S rRNA (28S, 620-768 bp) and histone H3 (H3, 328 bp). Sequences were edited and handled using the computer program GENEIOUS v. 4.5 (Drummond et al. 2009). Alignment of the protein coding genes was trivial, since no length differences were observed and no indel events needed to be postulated. Sequences of 16S-L1 and 28S were automatically aligned using the online version of the program MAFFT v. 5.8 (Katoh et al. 2005, Katoh et al. 2002) (manual strategy set to G-INS-i). Gaps were subsequently recoded as separate presence/absence characters with the aid of the program GapCoder (Young and Healy 2003) following Simmons and Ochoterena (2000), to minimise the effect of increasing the weight of overlapping multiple non-homologous gaps (Pons and Vogler 2006). Gene partitions were combined in a single data matrix using WINCLADA v.1.00.08 (Nixon 2002), with non-sequenced fragments scored as missing data.

Parsimony analyses of the data matrices were conducted with the program TNT v. 1.1 (Goloboff et al. 2003), using the following search strategy: 1,000 iterations of Wagner trees constructed with random addition of taxa and subsequent TBR branch swapping, holding five trees per iteration up to a total maximum of 10,000. Clade support was assessed via jackknife resampling using 1,000 replicates with individual heuristic searches consisting of 15 iterations of Wagner tree construction using random

Species	Vouchers	Locality	coxI	16S-L1-nad1	28SrRNA	H3
4	(DNA code)					
Dysdera adriatica	CRBA1167	Slovenia, Kozina, Materija	EU068026	EU068064	GQ285610	GQ285620
Dysdera cf. inermis	NHM75	Spain, Tarifa, Mirador del	EU068039	EU068073	EU139794	EU139725
		Estrecho				
Dysdera cf. inermis	NHM255	Morocco, Tanger	EF458142	EF458092	EU139795	EU139726
Dysdera crocata	CRBA851	Spain, Guadalajara, Hoz de	EF458137	EF458095	GQ285611	GQ285621
		Peregrina				
Dysdera erythrina	CRBAVO70	Spain, Barcelona, Cardedeu,	GQ285643	GQ285603	GQ285619	١
Dysdera erythrina fervida	CRBA677	France, Iles d'Hyères	GQ285630	GQ285606/-	GQ285615	GQ285625
Dysdera erythrina	CRBAVO101	Spain, Barcelona, Montseny,	GQ285642	GQ285602	GQ285618	1
provicialis		Les Illes				
Dysdera erythrina	K105	Spain, Barcelona, Sant Llorenç	AF244252	AF244162 /-	EU139790	EU139720
provicialis						
Dysdera lancerotensis	NMH441	Canary Is, Alegranza, la Caldera	EF458127	EF458080	EU139757	EU139686
Dysdera lantosquensis	CRBA653	Slovakia, Hrusov	GQ285628	GQ285604/-	GQ285612	GQ285622
Dysdera lantosquensis	CRBA678	Italia, Monte Argentario	GQ285631	GQ285607/-	GQ285616	GQ285626
Dysdera lusitanica	CRBA1002	Spain, Burgos, Puentedey	GQ285629	GQ285609	GQ285614	GQ285624
Dysdera shardana sp. n.	CRBA1238 (LB295)	Italy, Sardinia, Oristano,	GQ285635			
		Cuglieri				
Dysdera shardana sp. n.	CRBA1240 (LB296),	Italy, Sardinia, Oristano, S.	GQ285636			
	CRBA1708 (LB300)	Leonardo 7 Fuentes				
Dysdera shardana sp. n.	CRBA1707 (LB299)	Italy, Sardinia, Oristano, S.	GQ285637			
		Leonardo 7 Fuentes				
Dysdera shardana sp. n.	CRBA1247 (K477),	Italy, Sardinia, Orsitano,	GQ285633	GQ285605	GQ285613	GQ285623
	CRBA1714 (LB297)	Morgongiori, Is Benas				

Table 1. Species included in the phylogenetic analysis and GenBank accession numbers for the gene sequences

Species	Vouchers	Locality	coxI	16S-L1-nad1	28SrRNA	H3
	(DNA code)					
Dysdera shardana sp. n.	CRBA1256 (LB301)	Italy, Sardinia, Oristano,	GQ285638			
		Morgongiori, Bruncu Mutzuis				
Dysdera shardana sp. n.	CRBA1262 (LB303),	Italy, Sardinia, Nuoro, Aritzo,	GQ285639			
	CRBA1711 (LB306)	Castagneto Geratzia				
Dysdera shardana sp. n.	CRBA1710 (LB304)	Italy, Sardinia, Nuoro, Aritzo,	GQ285640			
		Castagneto Geratzia				
Dysdera shardana sp. n.	CRBA1263 (LB305),	Italy, Sardinia, Nuoro, Aritzo,	GQ285641			
	CRBA1712* (LB308)	Castagneto Geratzia				
Dysdera shardana sp. n.	CRBA1268 (LB294),	Italy, Sardinia, *Nuoro, Desulo,	GQ285634			
	CRBA1270 (LB307)	rd. to Fonni				
Dysdera valentina	CRBA777	Spain, Alacant, Cocentaina	GQ285632	GQ285608	GQ285617	GQ285627

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addition of taxa, holding five trees per iteration and an overall maximum of 10,000. The program jMODELTEST v. 0.1.1 (Posada 2008) was used to select the substitution model that best fits the data with the fewest parameters (including branch lengths as parameters), as indicated by the Akaike information criterion (AIC) (Akaike 1973).

Bayesian inference analyses were conducted with MRBAYES v.3.1.2 (Ronquist and Huelsenbeck 2003) and run remotely at the University of Oslo's Bioportal computer resources (http://www.bioportal.uio.no). The substitution models suggested by jMODELTEST were specified for each gene fragment and a standard discrete model was implemented for the gaps scored as absence/presence data (Nylander et al. 2004). The substitution estimates were allowed to vary independently between each partition. Two independent runs with four simultaneous MCMC (Markov Chain Monte Carlo) chains (one cold and three heated), each starting with random starting trees, were carried out simultaneously, sampling 1,000 generations until the standard deviation of the split frequencies of these two runs dropped below 0.01 (10 million generations). The program TRACER v. 1.4 (Rambaut and Drummond 2003) was used to ensure that the Markov chains had reached stationary by examining the effective sample size (ESS) values and also to determine the correct number of generations to discard as a *burn-in* for the analysis.

Maximum likelihood searches were conducted with the stand-alone version of the computer program RAxML v. 7.0.3 (Stamatakis 2006). Individual models of nucleotide substitution (GTR+ Γ +I, with default number of Γ -categories) were specified for each gene partition. The best trees were selected from 100 multiple inferences, and clade support was assessed by means of 100 non-parametric bootstrap resampled replicates of the original matrix.

Uncorrected genetic distances were estimated with MEGA v.4.0 (Tamura et al. 2007). A haplotype network was estimated from the *cox1* sequences using statistical parsimony, with probability connection limit set to 95%, as implemented in the program TCS v. 1.21 (Clement et al. 2000).

Lineage age estimates were obtained with the aid of the computer program R8S v. 1.71 (Sanderson 2003). Branch lengths were re-estimated with the computer program RAxML forcing the topology obtained in the Bayesian analysis and specifying independent GTR+I+G substitution models for each gene fragment. The same program was used to generate 100 trees with the same topology by bootstrapped branch lengths, to generate confidence intervals of the times of divergence. Trees were rooted and very short or zero branch length branches were pruned with the help of the software TreeEdit v. 1.0 (Rambaut and Charleston 2001). A preliminary cross-validation analysis (Sanderson 2002) conducted with r8s selected the penalized likelihood method with a smoothing parameter value of 3200 and additive penalty function as the best options for reconstructing divergence times in our data set. Subsequent analyses with the preferred method were conducted to obtain optimal ages and corresponding confidence intervals. The resulting chronograms were visualised and manipulated with the assistance of the computer program FigTree v. 1.1.2 (http://tree.bio.ed.ac. uk/software/figtree/).

Results

Results of the phylogenetic analyses conducted on all gene fragments concatenated in a single matrix are summarised in Fig. 2. Heuristic searches in TNT under equal weights yielded 3 trees of 2,015 steps. The best fit-models selected by the AIC for each data set were: TrN+I+G, TIM2+G, TIM2+G, GTR+G and TrNef+G for the cox1, 16S-L1, nad1, 28S and H3, respectively. All analyses support the sister group relationship of D. shardana sp. n. with the present and former subspecies of D. erythrina. All analyses support the hypothesis that *D. erythrina* sensu stricto and *D. erythrina provincialis* are sister species, while the sister-species relationship of *D. erythrina fervida* and *D. lantosquensis* is only contradicted by the maximum likelihood analysis, although with low support. D. valentina is resolved as the sister group to the clade formed by D. shardana sp. n. and D. erythrina sensu lato, although only the Bayesian analysis provides high support for this relationship. The phylogenetic analyses do not support a close relationship between either D. cf. inermis or D. lusitanica with the erythrina group. Parsimony partial analyses were run to assess the contribution of each data partition. The levels of support across the partial analyses were higher in the mitochondrial partition, followed by the 28S gene fragment, and the histone 3 was the less resolved. Instances of incongruence among the partial analyses were, in general, poorly supported. The mitochondrial genes



Figure 2. Chronogram of the species sampled in the present study, based on the preferred Bayesian tree obtained by simultaneous analyses of the *cox1*, *16S*, *nad1*, 28S and H3 partitions. Bars on branches denote support as follows: anterior bar refers to posterior probability, middle bar to maximum likelihood bootstrap support, posterior bar to parsimony jackknife support. Black bar: posterior probability >0.95 or ML bootstrap, Parismony jackknife > 70, grey bar: posterior probability <0.95 or ML bootstrap, Parismony jackknife > 70, grey bar: posterior probability <0.95 or ML bootstrap, Parismony jackknife < 70, white bar: this particular clade was not recovered in the analyses. Numbers on branches are the age of the clade in millions of years before the present, estimated using penalized likelihood (set penalty=add, smoothing=3200), number in brackets refer to bootstrap confidence intervals.



Figure 3. Haplotype network constructed using statistical parsimony (95%). Dots on branches refer to missing haplotypes. Node size proportional to number of haplotypes (1 or 2), nodes colour code and numbers inside refer to localities in Fig. 1.

yielded a single tree of 1800 steps, which mirrored results of the combined data set except for the position of *D. valentina*, which was sister to the *D. lancerotensis+D. crocata* clade (JS=60). The analysis of the 28S gene fragment yielded 5 trees of 136 steps, the strict consensus of which supports the sister group relationship of *D. valentina* and the erythrina group, but does not resolve the position of D. shardana sp. n. In addition, D. lantosquensis formed a clade with D. erythrina and D. erythrina provincialis, although with low support (JS=62). The histone 3 fragment yielded a single tree of 63 steps. The erythrina group, D. shardana sp. n. excluded, was recovered as a clade (JS=60), but the haplotype k105 of *D. erythrina provincialis* grouped with *D. fervida* (JS=61). Lineage age estimates are also summarized in Fig. 2. The split of the ancestor of *D. shardana* sp. n. from the remaining species of the *erythrina* group is estimated at 6.4 m.a. although confidence intervals recovered are very wide (from 1.9 to 10 m.a.). The fourteen D. shardana sp. n. individuals sequenced for the cox1 fragment resulted in 9 unique haplotypes. Statistical parsimony analysis of these resulted in two separate networks (Fig. 3) with strong geographic structure. The first network included the haplotypes sampled from Mt. Arci and the second network connected the haplotypes from Mt. Ferru, on the one hand, and those from Gennargentu, on the other. One specimen from Mt. Ferru remains isolated from any of the networks. Uncorrected genetic distances for the cox1 gene between *D. shardana* haplotypes and between and within haplotypes of the species related to *D. shardana* sp. n. are summarized in Table 2. Mean genetic distance between D. shardana sp. n. haplotypes (3.8%) was very similar to those observed in closely related species (4.6% and 3.4%. for *D. lantosquensis* and *D. erythrina provincialis*, respectively).

	LB303	LB305	LB294	LB304	LB299	LB296	LB295	K477	D. shar-	D. lanto-	D. e. fer-	D. e. pro-	D. eryth-
									dana sp.	squensis	vida	vincialis	rina
									n.				
LB305	0.003												
LB294	0.019	0.016											
LB304	0.019	0.016	0.012										
LB299	0.021	0.018	0.014	0.014									
LB296	0.02	0.017	0.012	0.012	0.002								
LB295	0.028	0.031	0.023	0.02	0.031	0.03							
K477	0.065	0.064	0.065	0.061	0.07	0.07	0.069						
LB301	0.071	0.07	0.071	0.067	0.076	0.076	0.075	0.009					
D. shardana sp. n									0.038				
D. lantosquensis									0.167	0.046			
D. e. fervida									0.157	0.15			
D. e. provincialis									0.161	0.147	0.146	0.034	
D. erythrina									0.168	0.164	0.172	0.13	
D. valentina									0.174	0.187	0.176	0.173	0.169

Taxonomy

Dysdera Latreille, 1804

Dysdera Latreille, 1804, type species *Aranea erythrina* Walckenaer, 1802: 224 (unspecified sex) by original designation, unspecified number of syntype specimens from France, surroundings of Paris (C. A. Walckenaer), repository unknown, supposedly lost.

Diagnosis. See Deeleman-Reinhold and Deeleman (1988).Species included. The genus presently includes 248 species (Platnick 2009).

Dysdera jana sp. n., Gasparo and Arnedo

urn:lsid:zoobank.org:author: Figs 4, 6, 8, 10-11, 14-18

Type material. Holotype: male: Italy, Sardinia, Nuoro, Dorgali, along Viale J.F.Kennedy (=SS 125), 450 m, under *Pinus*, 17 October 1989; F. Gasparo (MSNVR AR 0010).

Paratypes: 1 male (CRBA001736) and 4 females (CRBA001736-1737, MSNVR AR 0011-12) same data and collector.

Additional material examined. Nuoro: 2 km S of Dorgali, 500 m, under *Quercus ilex*, F. Gasparo leg. 20.X.1989, 2 $\Im \Im$ (CG); Supramonte di Oliena, 900 m, under *Quercus ilex*, F. Gasparo leg. 13.X.1989, 2 $\Im \Im$ (CG); Sa Oche (km 7 ESE of Oliena), 150 m, under *Quercus ilex*, F. Gasparo leg. 16.X.1989, 4 $\Im \Im$ (CG).

Diagnosis. *Dysdera jana* sp. n. can be distinguished from continental species of the *erythrina* group by the shape of the posterior-distal part of the tegulum, which is expanded in the continental species. It can also be distinguished from *D. erythrina* and *D. erythrina provincialis* by the lateral concave shape of the chelicera and a heavily wrinkled (foveate) carapace (Figs 4, 6). In addition, continental females of the *erythrina* group exhibit a characteristic hourglass-shaped spermatheca, which is very attenuated in *D. jana* sp. n. (Fig. 11). It differs from the other Sardinian species of the *erythrina* group by the spineless dorsal tibia 4, the position and length of the finger-like process on the tip of the male bulb (compare Figs 15 and 21), and by the fusion of the anterior sclerotised stripes of the vulva VA (compare Figs 11 and 13).

Etymology. The name in apposition refers to the "Domus de janas", characteristic Sardinian tombs dug in the rock often according to a labyrinth architecture. Domus de Jana translates in Sardinian as "House of the fairies or of the witches". It also happens to be the name of the first author's goddaughter.

Description. *Holotype male* num. CRBA 1736. Figs 4, 6, 8, 14-18. Carapace (Fig. 4) 2.6 mm long; maximum width 2.09 mm; minimum width 1.3 mm. Orange, darkened at borders; foveate at borders, slightly wrinkled at middle, covered with small black grains. Frontal border roughly round, from 1/2 to 3/5 carapace length; anterior lateral borders parallel; rounded at maximum dorsal width, back lateral borders straight; back margin wide, straight. AME diameter 0.17 mm; PLE 0.14 mm; PME 0.12 mm; AME slightly back from frontal border, separated from one another by about 1/2 diameter, close to PLE; PME very close to each other, about 1/3 PME diameter from PLE. Labium trapezoid-shaped, base wider than distal part; longer than wide at base; semicircular groove at tip. Sternum orange, darkened on borders; wrinkled; uniformly covered in slender black hairs.

Chelicerae 1.17 mm long, about 2/5 of carapace length in dorsal view; fang medium-sized, 0.97 mm; basal segment proximal dorsal, ventral side scantly covered with piligerous granulations; concave-shaped in lateral view (Fig. 6). Chelicera inner groove medium-sized, about 2/5 cheliceral length; armed with three teeth and lamina at base; B=M>D; D triangular, slightly below groove midpoint; B close to basal lamina; M close to B. Legs yellow. Lengths of male described above: fe1 2.01 mm (all measurements in mm); pa1 1.12; ti1 1.71; me1 1.43; ta1 0.46; total 6.73; fe2 1.94; pa2 1.07; ti2 1.63; me2 1.43; ta2 0.43; total 6.5; fe3 1.5; pa3 0.82; ti3 1.07; me3 1.17; ta3 0.41; total 4.97; fe4 1.89; pa4 1.02; ti4 1.58; me4 1.63; ta4 0.48; total 6.6; fe Pdp 1.12; pa Pdp 0.56; ti Pdp 0.61; ta Pdp 0.66; total 2.96; relative length: 1>4>2>3. Spination: leg1, leg2 spineless. Fe3d spineless; pa3 spineless; tb3d spines arranged in one band; distal 1.0.0; tb3v with one terminal spine on prolateral margin. Fe4d spineless; pa4 spineless; tb4d spines spineless; tb4v spines arranged in one band; proximal 0.1.0; with one terminal spine at one leg and two on other one. Dorsal side of frontal legs, ventral side of palp covered with hairs. Claws with eight teeth or less; hardly larger than claw width.

Abdomen 4.13 mm long; cream-coloured; cylindrical. Abdominal dorsal hairs 0.05 mm long; thin, curved, not compressed, pointed; uniformly, thickly distributed.

Male copulatory bulb (Fig. 8) T slightly shorter than DD; external, internal distal borders sloped backwards. DD slightly bent in lateral view, clearly less than 45°; internal distal border not expanded. ES wider, more sclerotised than IS; IS continuous to



Figures 4-7. Carapace, dorsal view: 4 *D. jana* sp. n. holotype; 5 *D. shardana* sp. n. holotype. Carapace, lateral view: 6 *D. jana* sp. n. holotype; 7 *D. shardana* sp. n. holotype.

tip. DD tip (12-15) straight in lateral view; AR present, parallel to DD; finger-like projection at distal end of the AR ridge base, as long as AR length. C absent. AC absent. LF absent. L reduced to distal part. LA absent. F absent. AL absent. P (Fig. 18) fused to T; perpendicular to T in lateral view; lateral length about 1/4 of T width; ridge present, perpendicular to T; not expanded, upper margin smooth; distally slightly projected.

Paratype female num. CRBA 1736. Figs 10-11. All characters as in male except: Carapace 3.26 mm long; maximum width 2.7 mm; minimum width 1.76 mm. Brownish orange, darkened at borders; slightly foveate at borders, wrinkled at middle, covered with tiny granulations. AME diameter 0.19 mm; PLE 0.18 mm; PME 0.16 mm; AME slightly back from frontal border, separated from one another by about 2/3 diameter, close to PLE; PME very close to each other, about 2/5 PME diameter from PLE. Sternum orange, darkened on borders; very slightly wrinkled, mainly between legs and frontal border.

Chelicerae 1.5 mm long, fang long, 1.33 mm; basal segment proximal dorsal, ventral side scantly covered with piligerous granulations. Legs orange. Lengths of female described above: fe1 2.5 mm (all measurements in mm); pa1 1.56; ti1 2.04; me1 1.84; ta1 0.48; total 8.42; fe2 2.35; pa2 1.48; ti2 1.94; me2 1.79; ta2 0.51; total 8.06; fe3 1.84; pa3 1.07; ti3 1.33; me3 1.58; ta3 0.51; total 6.32; fe4 2.35; pa4 1.33; ti4 1.89; me4 2.24; ta4 0.56; total 8.36; fe Pdp 1.43; pa Pdp 0.66; ti Pdp 0.77; ta Pdp 0.79; total 3.65; relative length 1>4>2>3. Spination: tb3d spines arranged in two bands; proximal 0-1.0.0; distal 1.0.0; tb3v spines arranged in one band; proximal 0.1.0; with two terminal spines. Tb4d spines spineless; tb4v spines arranged in one band; proximal 0.1.0; with two terminal spines.

Abdomen 3.73 mm long. Abdominal dorsal hairs 0.07 mm long; thin, curved, not compressed, pointed; uniformly, thickly distributed. Vulva DA (Fig. 10) clearly distinguishable from VA; DA slightly wider than long; DF wide in dorsal view. MF margins not fused, poorly developed, membranous. VA rectangle-like; frontal region completely sclerotized (Fig. 11); posterior region internal margin sclerotized, forming two stripes fused at the anterior part, diverging backwards; AVD absent. S attachment not projected under VA; arms as long as DA, slightly curved; tips not projected; neck as wide as arms. TB usual shape.

Variation. Carapace ranges in length from 2.37 mm to 3.77 mm, males (n=2) 2.42-2.60, female (n=10) average 3.14 (2.37-3.77). Females from Supramonte di Oliena are significantly smaller (2.37-2.72) than those from Dorgali and Sa Oche. Male (n=2) leg spination reduced compared to females. Spination variability summarised in Table 3.

Distribution. Known from several localities around the Supramonte region, a mountain and highland range in Sardinia, lying in the north-western part of the Gulf of Orosei.

	Proximal	Medio-proximal	Medio-distal	Distal
Tibia 3 dorsal	0-1.0.0	0	0	1.0.0
Tibia 4 dorsal	0	0	0	0
Tibia 3 ventral	0	0	0	1.0.0
Tibia 4 ventral	0.1.0	0	0	1.0.1

Table 3. Intraspecific spination variability in *D. jana* sp. n.



Figures 8-9. Left male palp, retrolateral view: 8 D. jana sp. n. holotype; 9 D. shardana sp. n. holotype.

Dysdera shardana sp. n., Opatova and Arnedo

urn:lsid:zoobank.org:author:

Figs 5, 7, 9, 12-13, 19-22

Dysdera kollari Grasshoff, 1959: 219, figs 6 [♂] (NO Torralba, SO Cuglieri, S Cuglieri). Schult, 1983: 69-84, fig. 8 [♂] (same specimens as Grasshoff, 1959). Misidentification.

Type material. Holotype: male: Italy, Sardinia, Oristano, Morgongiori, Is Benas recreation area, Mt. Arci, 39.7606N, 8.76062E, 566 m, mixed *Pinus* and *Quercus* forest, 15 October 2005, M. Arnedo & M. Mejía-Chang leg. (CRBA001246).

Paratypes: 1 female (CRBA001246), 1 female (CRBA001247, DNA extraction K477), 2 juvs (CRBA001713, CRBA001714, DNA extraction LB297) same data and collectors.

Additional material examined. Italy: Sardinia: Cagliari: Fluminimaggiore, Is Arenas, under *Quercus ilex*; 800 m; G. Gardini leg. 29.III.1991, 1 $\stackrel{\frown}{\rightarrow}$ (CG); Fluminimaggiore, Tempio di Antas, under *Quercus ilex*; 360 m; G. Gardini leg. 29.III.1991, 1 \bigcirc (CG). **Nuoro**, Aritzo, Castagneto Geratzia, Mt. Gennargentu; 39.96846N 9.19782E; 867 m; *Castaneus* and *Quercus suber* forest; 17.X.2005; M. Arnedo, M. Mejía-Chang & G. Giribet leg. (1 \bigcirc CRBA001262 cryo-collection, DNA extraction LB303, 1 \bigcirc CRBA001710 cryo-collection, DNA extraction LB304, 1 \bigcirc CRBA0001263 cryo-collection, DNA extraction LB305, 1 \bigcirc CRBA0001711 cryo-collection, DNA extraction LB306); Desulo, rd. to Fonni, Mt. Gennargentu; 40.05645N 9.22955E; 1146 m; *Quercus pubens* forest; 17.X.2005; M. Arnedo, M. Mejía-Chang & G. Giribet leg. (1 \bigcirc CRBA0001268, DNA extraction LB294, 1 \bigcirc CRBA001270 cryo-collection. DNA extraction LB307, 1 \bigcirc CRBA001712 cryo-collection. DNA extraction LB308); Maco-



Figures 10-13. *D. jana* sp. n. paratype female **10** vulva, dorsal view; **11** vulva, ventral view. *D. shardana* sp. n. paratype female **12** vulva, dorsal view; **13** vulva, ventral view.

mer, Mt. S. Antonio, A. Vigna leg. 2.V.1967, 1 & (MCVR). **Oristano**, Cuglieri, rd. to San Leonardo 7 Fuentes, Mt. Ferru; 40.17931N 8.58544E; 587 m; dry, open *Quercus* forest; 14.X.2005; M. Arnedo & M. Mejía-Chang leg. (1 & CRBA001238, cryo-collection, DNA extraction LB295); nearby S. Leonardo 7 Fuentes, Mt. Ferru, 40.20362N 8.68969E; 699 m; old crops and open forest *Quercus* and *Rubus*; 14.X.2005; M. Arnedo & M. Mejía-Chang leg. (1 & CRBA001240 cryo-collection, DNA extraction LB296,



Figures 14-18. *D. jana* sp. n. holotype, right male bulb **14** prolateral view, general; **15** anterior view; **16** posterior view; **17** retrolateral view; **18** P, prolateral view

1^Q CRBA001707 cryo-collection, DNA extraction LB299, 1juv. CRBA001708 cryocollection, DNA extraction LB300,); Morgongiori, Bruncu Mutzuis, 39.77145N 8.74666E; 761 m; open *Quercus* forest w/ mosses; 15.X.2005; M. Arnedo & M. Mejía-Chang leg. (1sub³ CRBA001256, cryo-collection, DNA extraction LB301)

Diagnosis. *Dysdera shardana* sp. n. differs from continental species of the *erythrina* group in the shape of the posterior-distal part of the tegulum, which is expanded in



Figures 19-22. *D. shardana* holotype, right male bulb **19** prolateral view, general; **20** prolateral view, tip detail; **21** anterior view; **22** P, prolateral view

the continental species. In addition, continental females of the *erythrina* group exhibit a characteristic hourglass-shaped spermatheca, which is very attenuated in *D. shardana* sp. n. It can also be distinguished from *D. erythrina* and *D. erythrina provincialis* by the lateral concave shape of the chelicera and a heavily wrinkled (foveate) carapace (Figs 5, 7). It differs from *D. jana* sp. n., also from Sardinia, in the presence of dorsal spines on tibia 4, the position and length of the finger-like process on the tip of the male bulb (compare Figs 15 and 21), and by the fusion of the anterior sclerotised stripes of the vulva VA (compare Figs 9 and 11).

Etymology. The name in apposition refers to the Shardana people, one of several groups of "Sea Peoples" that appear in fragmentary historical records (Egyptian inscriptions) for the Mediterranean region in the second millennium B.C. According to some scholars they settled in Sardinia after the period of Ramses III (around 1180 B.C.).

Description. *Holotype male* num. CRBA 1246. Figs 5, 7, 9, 19-22. Carapace (Fig. 5) 3.01 mm long; maximum width 2.35 mm; minimum width 1.68 mm. Dark red, darkened at borders; foveate at borders, slightly wrinkled in the middle, covered with small black grains. Frontal border roughly round, from 1/2 to 3/5 carapace length; anterior lateral borders parallel; rounded at maximum dorsal width, back lateral borders straight; back margin wide, straight. AME diameter 0.18 mm; PLE 0.18 mm; PME 0.16 mm; AME slightly backwards from frontal border, separated from one another by about 2/3 diameter, close to PLE; PME close to each other, less than 1/4 PME diameter from PLE. Labium trapezoid-shaped, base wider than distal part; longer than wide at base; semicircular groove at tip. Sternum brownish orange, darkened on borders; wrinkled; uniformly covered in slender black hairs.

Chelicerae 1.2 mm long, about 2/5 of carapace length in dorsal view; fang long, 1.22 mm; basal segment proximal dorsal, ventral side scantly covered with piligerous granulations; concave-shaped in lateral view (Fig. 7). Chelicera inner groove long, about 1/2 cheliceral length; armed with three teeth and lamina at base; B=M>D; D triangular, slightly below groove midpoint; B close to basal lamina; M close to B. Legs yellow. Lengths of male described above: fe1 2.3 mm (all measurements in mm); pa1 1.3; ti1 1.84; me1 1.66; ta1 0.48; total 7.57; fe2 2.09; pa2 1.22; ti2 1.71; me2 1.58; ta2 0.51; total 7.11; fe3 1.58; pa3 0.87; ti3 1.07; me3 1.43; ta3 0.41; total 5.31; fe4 2.09; pa4 1.17; ti4 1.68; me4 1.89; ta4 0.51; total 7.34; fe Pdp 1.22; pa Pdp 0.66; ti Pdp 0.66; ta Pdp 0.71; total 3.26; relative length: 1>4>2>3. Spination: leg1, leg2 spineless; fe3d spineless; pa3 spineless; tb3d spines arranged in two bands; proximal 1.0.0; distal 1.0.0; tb3v spines arranged in one band; proximal 0.1.0; with one prolateral spine on left leg, and two terminal on right leg. Fe4d spineless; pa4 spineless; tb4d spines arranged in two bands; proximal 1.0-1.1; distal 0.0.0-1; tb4v spines arranged in one band; proximal 0.1.0; with two terminal spines. Dorsal side of frontal legs, ventral side of palp covered with hairs. Claws with eight teeth or less; hardly larger than claw width.

Abdomen 3.26 mm long; cream-coloured; cylindrical. Abdominal dorsal hairs 0.13 mm long; thin, curved, not compressed, pointed; uniformly thickly distributed.

Male copulatory bulb (Fig. 9) T slightly shorter than DD; external, internal distal border sloped backwards. DD bent about 45° in lateral view; internal distal border not

expanded. IS, ES equally developed; IS truncated at DD middle part. DD tip (Fig. 19-21) straight in lateral view; AR present, parallel to DD; finger-like distal projection at AR retrolateral side, shorter than AR length. C absent. AC absent. LF absent. L reduced to distal part. LA absent. F absent. AL absent. P (Fig. 22) fused to T; sloped forming an angle of about 135 ° to T in lateral view; lateral length about 1/4 of T width; ridge present, parallel to T; not expanded, upper margin smooth; not distally projected; back margin slightly folded towards internal side.

Paratype female num. CRBA 1246. Figs 12-13. All characters as in male except: Carapace 3.19 mm long; maximum width 2.55 mm; minimum width 1.68 mm. AME diameter 0.18 mm; PLE 0.19 mm; PME 0.16 mm; AME slightly back from frontal border, separated from one another by about 2/3 diameter, touching PLE; PME very close to each other, less than 1/4 PME diameter from PLE. Sternum very slightly wrinkled, mainly between legs and frontal border.

Chelicerae 1.38 mm long; fang 1.48 mm; basal segment proximal dorsal side scantly covered with piligerous granulations. Chelicera armed with three teeth and lamina at base; M>B=D. Legs orange. Lengths of female described above: fe1 2.22 mm (all measurements in mm); pa1 1.35; ti1 1.73; me1 1.58; ta1 0.46; total 7.34; fe2 2.04; pa2 1.28; ti2 1.68; me2 1.53; ta2 0.48; total 7.01; fe3 1.66; pa3 0.92; ti3 1.15; me3 1.38; ta3 0.41; total 5.51; fe4 2.27; pa4 1.22; ti4 1.79; me4 1.89; ta4 0.48; total 7.65; fe Pdp 1.17; pa Pdp 0.61; ti Pdp 0.61; ta Pdp 0.71; total 3.11; relative length 4>1>2>3. Spination: tb3d spines arranged in two bands; proximal 1.0.0; distal 1.0.0; tb3v with two terminal spines. Tb4d spines arranged in one band; proximal 1.0.1; tb4v spines arranged in one band; proximal 0.1.0; with two terminal spines.

Abdomen 4.56 mm long. Abdominal dorsal hairs 0.14 mm long; medium-sized, curved, compressed, pointed; uniformly, thickly distributed. Vulva (Fig 12-13) DA clearly distinguishable from VA; DA slightly wider than long; DF wide in dorsal view. MF margins not fused, poorly developed, membranous (Fig 12). VA rectangle-like, pointed expansion at middle frontal part (Fig 13); frontal region completely sclero-tized; posterior region internal margin sclerotized, forming two divergent stripes; AVD absent. S attachment not projected under VA; arms as long as DA, slightly curved; tips not projected; neck hardly visible. TB usual shape.

Variation. Carapace ranges in length from 2.50 mm to 3.42 mm, males (n=7) average 2.79 (2.50-3.06), female (n=8) average 3.07 (2.68-3.42). In general male legs bear fewer spines that female legs, one male form Mt. S. Antonio representing an extreme case of reduced spination. Spination variability summarised in Table 4.

	Proximal	Medio-proximal	Medio-distal	Distal
Tibia 3 dorsal	1.0.0	0	0	1.0.0
Tibia 4 dorsal	0-1.0-1.1	0	0	0.0.0-1
Tibia 3 ventral	0. 0-1.0	0	0	1.0.0-1
Tibia 4 ventral	0. 0-1.0	0	0	1.0. 0-1

Table 4. Intraspecific spination variability in *D. shardana* sp. n.

Distribution. Known from several localities around the western half of Sardinia, and also in the Gennargentu region on the central-eastern side of the island, spanning from 360 to above 1100 m elevation.

Discussion

Molecular phylogenetic analyses unambiguously support the close relationship of Dy_{s-1} dera shardana sp. n. with the species of the erythrina group. Morphological synapomorphies for this clade include a large, semicircular expansion (AR) at the DD tip, running parallel to the bulb proximal-distal axis and a bilobular, granulated posterior diverticulum in the female vulva. Both D. shardana sp. n. and D. jana sp. n. exhibit a regular-shaped tegulum. This suggests that the particular shape of the tegulum with a mid-part constraint and an expansion around the P region is most likely a synapomorphy of the clade formed by D. lantosquensis and D. erythrina. The erythrina group was not defined in cladistic terms and hence it is not possible to assess its limits. The taxonomic sampling of the phylogenetic analysis conducted in this study included two species closely resembling those originally proposed to be part of the *erythrina* group, namely D. cf. inermis (closely similar to D. fuscipes) and D. lusitanica (resembling D. veigai). The phylogenetic analyses revealed that they are not closely related to D. erythrina. Deeleman-Reinhold and Deeleman (1988) did not justify the inclusion of D. fuscipes and D. veigai species into the erythrina group and thus it is difficult to evaluate convergence in morphological traits. All these species, however, share a particular shape of the P, which is in most cases short and with the proximal margin parallel, instead of perpendicular, to the proximal-distal axis of the bulb. Close examination of this structure, however reveals, obvious differences among the species (e.g., the particular shape observed in the *D. lantosquensis* / *D. erythrina* clade is probably synapomorphic for this group). The eastern Iberian species D. valentina was included in the analyses based on the similarities in the distal part of the male bulb DD to D. erythrina. All analyses support (although only marginally under parsimony and maximum likelihood) the sister group relationship of D. valentina with the D. shardana sp. n. / D. erythrina clade, suggesting that the presence of a long, arch-like expansion on the anterior-distal side of the DD, running parallel to a short L (see Ribera 2004, Figs 1A-B) could constitute a synapomorphy of a more inclusive clade that would also embrace the *erythrina* group. More morphological comparative data and new phylogenetic analyses based on more exhaustive taxonomic sampling would be required to confirm the latter suggestion.

Based on morphological evidence, there is little doubt that the two new Sardinian *Dysdera* species are closely related. They are extremely similar in somatic morphology (some minor differences in leg spination) and share at least one exclusive character: the presence of a finger-like projection at the tip of the male bulb (although it is not completely clear whether the process actually grows from the same position, see diagnosis). Unfortunately, the lack of genetic data for *D. jana* sp. n. precludes discerning whether the two endemics are sister species or whether one of them is actually more closely
related to the D. erythrina ID. lantosquensis clade. Examples of local diversification in Sardinia have been reported in other ground-dwelling animals. The cave beetle genera Ovobathysciola and Patriziella form a monophyletic group that includes six endemic species in Sardinia. Molecular clock analysis suggests that separation among the Ovobathysciola / Patriziella species started about 16 to 10 m.a., assuming that the clade originated as a result of the split of the Corsico-Sardinian plate from the Iberian peninsula (~30 m.a.) (Caccone and Sbordoni 2001). The Hydromantes cave salamanders, on the other hand, include five endemic lineages in Sardinia, which have been recently shown to form a paraphyletic group with regard to closest relatives in south-eastern France and northern-central Italy (Carranza et al. 2008). In this case, molecular time estimates suggest that the Messinian Salinity Crisis facilitated the two independent colonisation events that gave rise to present day Sardinian endemics (although a single colonisation of the island followed by a back colonisation of the mainland is an equally parsimonious explanation). The unresolved phylogenetic position of D. jana sp. n. hinders distinguishing between a scenario of a single colonisation of Sardinia followed by in situ speciation of the two new *Dysdera* species from a scenario with a colonisation of Sardinia by the common ancestor of the D. shardana sp. n. / D. erythrina clade followed by back colonisation of the mainland. Regardless of the scenario, time estimates clearly suggest that the split of D. shardana sp. n. from mainland relatives post-dates the opening of the western Mediterranean basin. Time estimates of the split of D. shardana sp. n. and of the diversification of the D. erythrina | D. lantosquensis clade are close enough to the Messinian Salinity Crisis time period to suggest that this geological event may have played a role in the origin of these lineages, as has also been proposed for the harvestmen genus Trogulus (Schönhofer and Martens 2008). Confidence intervals of the time estimates, however, are too large to rule out other alternative scenarios. Moreover, it has been shown based on mitochondrial substitution rates that trans-Gibraltar lineage divergences in the scorpion Buthus occitanus predate the opening of the strait of Gibraltar (Gantenbein and Largiader 2003), which opens the door to the possibility that our calibration point is too young and hence the time of colonization of Sardinia is an underestimation.

At this stage, it is not clear what factors may have prompted the speciation of the two new Sardinian endemics. The two species show allopatric distribution, generally associated to middle (500 m) and high elevations (1000 m). *D. jana* sp. n. seems to have a narrow distribution, restricted to the Supramonte region, while *D. shardana* sp. n. is widespread across most of the islands, except for the northern and southern-most areas (Mt. Limbara and Sette Fratelli, respectively). Interestingly, species of the cave-dwelling beetle lineage *Ovobathysciola / Patriziella* show a very similar geographic distribution pattern to *D. jana* sp. n. (*O. graffiti* is endemic to the Supramonte region) and *D. shardana* sp. n. (the rest of the *Ovobathysciola/Patriziella* species are found in Mt. Arci, Mt. Ferru and Gennargentu), although with contrasting levels of species diversity and phylogenetic relationships (compare Fig. 2 in Caccone and Sbordoni 2001 with our Fig. 3). Genetic analysis of several *D. shardana* sp. n. populations, however, revealed strong phylogeographic patterns in this species. Populations from Mt. Arci

form an independent network (i.e., highly divergent haplotypes) from those sampled from Mt. Ferru and Gennargentu, which are also separated (the southernmost known populations on Sulcis-Iglesiente could not be analysed genetically). This observation does not necessarily imply that the former haplotype groups should be considered independent evolutionary lineages, but it does suggest that there are environmental factors (e.g., unsuitable lowland habitat due to warmer climatic conditions) restricting gene flow across geographic areas separated by just 50 km. Environmental restrictions to gene flow could eventually lead to speciation and hence explain the presence of two sibling species of the *erythrina* group on Sardinia.

Conclusion

Two new species of the woodlouse-hunter spider genus *Dysdera* are described from Sardinia. Phylogenetic evidence and morphological features suggest that they are closely related to the type species of the genus *D. erythrina*. Time estimates reject an Oligocene origin of the new *Dysdera* species and instead suggest that the Messinian Salinity Crisis shaped the diversification of Sardinian endemics and their closest relatives. Deep genetic divergences and population structure in *Dysdera shardana* sp. n. identifies restriction to gene flow due to environmental factors as the most plausible explanation for local speciation events.

Acknowledgements

We would like to thank Mónica Mejía-Chang and Gonzalo Giribet for their invaluable assistance in the field. We are very grateful to Leticia Bidegaray-Batista for conducting part of the labwork. Gonzalo Giribet and an anonymous reviewer provided valuable comments that improved the final version of the paper. Funding was provided by grants from the Spanish *Ministerio de Educación y Ciencia* (CGL2006-08617/BOS to MA) and the European Union-funded ERASMUS programme (VO). Further funding support was provided by an *ICREA Academia* award for excellence in research from the *Generalitat de Catalunya* to MA.

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RESEARCH ARTICLE



Fossil harvestmen (Arachnida, Opiliones) from Bitterfeld amber

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Academic	editor: Pavel Sto	ev	Received 4 March 2009)	Accepted 4 May 2009		Published @@ August 2009
urn:lsid:zoobank.org:pub:							

Citation: Dunlop JA, Mitov PG (2009) Fossil harvestmen (Arachnida, Opiliones) from Bitterfeld amber. In: Stoev P, Dunlop J, Lazarov S (Eds) A life caught in a spider's web. Festschrift in Honour of Christo Deltshev. ZooKeys %%: 1-14. doi: 10.3897/zookeys.%%.\$\$

Abstract

Fossil harvestmen (Arachnida: Opiliones: Dyspnoi and Eupnoi) are described from Bitterfeld amber, Sachsen-Anhalt, Germany deposited in the Museum für Naturkunde, Berlin. The exact age of this amber has been in dispute, but recent work suggests it is youngest Palaeogene (Oligocene: Chattian). *Histricostoma tuberculatum* (Koch & Berendt, 1854), *Caddo dentipalpus* (Koch & Berendt, 1854), *Dicranopalpus ramiger* (Koch & Berendt, 1854) and *Leiobunum longipes* Menge, 1854 – all of which are also known from Eocene Baltic amber – are reported from Bitterfeld amber for the first time. They support the idea that both ambers sampled a similar terrestrial arthropod fauna: irrespective of any difference in age. *Mitostoma gruberi* **n. sp.** and *Amilenus deltshevi* **n. sp.** are described as new. One fossil is, in our opinion, morphologically indistinguishable from the extant species *Lacinius erinaceus* Staręga, 1966 from the Caucuses, and is tentatively assigned to this taxon. The Bitterfeld material thus includes the first fossil record of the extant genera *Amilenus* Martens, 1969 and *Lacinius* Thorell, 1876 respectively.

Keywords

Eupnoi, Dyspnoi, Oligocene, Sachsen-Anhalt, biogeography

Introduction

Most of the known fossil harvestmen (Arachnida: Opiliones) comprise inclusions in Baltic amber which are usually assigned to an Eocene (ca. 44-49 Ma) age. These Baltic amber species were described by Koch and Berendt (1854), Menge (1854) and Roewer (1939). Their affinities were reviewed by Bishop and Crosby (1924) and Starega (1976a, 2002) with formal redescriptions and synonymy lists in Ubick and Dunlop (2005) and Dunlop (2006). Excluding synonyms and nomina dubia, nine valid harvestman species in Baltic amber can currently be recognised: four eupnoids, four dyspnoids and one laniatorid. A less familiar source of amber is the Bitterfeld deposit from the Sachsen-Anhalt region of eastern Germany, sometimes referred to in the literature as 'Sächsischer Bernstein'. Barthel and Hetzer (1982) illustrated some Bitterfeld inclusions, including a juvenile harvestmen held in what is now the Deutsches Bernsteinmuseum, Ribnitz-Damgarten, Germany. The first fossil cyphophthalmid harvestman (a basal clade) was described as Siro platypedibus Dunlop & Giribet, 2003 from Bitterfeld material in the Museum für Naturkunde Berlin (MfN). Here, we complement this initial study by describing further wellpreserved Bitterfeld inclusions assignable to Eupnoi and Dyspnoi. Four of the taxa recorded here appear to be conspecific with species already known from Baltic amber (Dunlop 2006). Two species from Bitterfeld are interpreted as new, and another one can even be tentatively assigned to an extant harvestman species. The material includes the first fossil record of the extant genera Lacinius Thorell, 1876 and Amilenus Martens, 1969.

Material and methods

Bitterfeld amber originates from the site of the Goitsche [or Goitzsche] opencast 'Braunkohle' mine, near the town of Bitterfeld, Sachsen-Anhalt, Germany. Actively collected from the mid 1970s to the late 1990s, the mine is now flooded and no longer accessible (see e.g. Hoffeins and Hoffeins 2003). Bitterfeld inclusions held in the MfN arrived largely under the supervision of the palaeobotanist Prof. Manfred Barthel; see e.g. Barthel and Hetzer (1982) for an initial overview. The material came to Berlin as part of an agreement with the 'Volkseigener Betrieb Ostseeschmuck' (i.e. the GDR's state-owned Baltic Sea jewellery company), now the Deutsches Bernsteinmuseum in Ribnitz-Damgarten. In the 1980s the animal inclusions in Berlin were distributed to the relevant zoological curators of the MfN for sorting and provisional identification; the results of which were summarised by Schumann and Wendt (1989). The harvestmen (and other arachnids) were examined by Manfred Moritz, who assigned taxa where possible, but did not formally publish these identifications. In fact Schumann and Wendt (1989: 38) only listed "Phalangidae (subfamily Gyanthinae)" as present, without further details, and some of the provisional identifications by Moritz on the associated labels appear to

post-date this publication; see also Dunlop and Giribet's (2003) discussion of the cyphophthalmid.

All specimens described here are held in the palaeontological collections of the MfN, where they have been assigned MB.A. numbers (for Museum Berlin, Arthropoda). Sequential series of 10-30 images at different focal planes through the specimen were taken with a Leica stereomicroscope using the Leica Application Suite[®] software. Stacks of images were assembled into a single final picture using Auto Montage[®]. Specimens were drawn with a *camera lucida* attachment on a Leica MZ12 stereomicroscope. Fossils were compared to the literature – especially Šilhavý (1956) and Martens (1978, 2006) – and to extant material in the arachnological collections of the following institutions: MfN, Muséum d'Histoire naturelle, Genèva, Switzerland (MHNG), Museum and Institute of Zoology in Warszawa, Poland (MIZW), National Museum of Natural History, Sofia, Bulgaria (NMNHS) and the collection of Plamen Mitov (PMC). For comparative purposes photographs of the following Recent harvestmen species are also included here:

Mitostoma chrysomelas (Hermann, 1804). Material: Bulgaria, Sofia, Loven Park, housing complex "Dianabad", 10 m from Dragalevska River, under *Pinus*-bark, 10.IV.2004, leg. & det. P. Mitov (PMC). – 2 juv. (body length: 1.37 mm) (Fig. 4).

Mitostoma patrizii Roewer, 1953. Material: Italy, Sardinia, Village Domusnovas, Grotta di San Giovanni, 12.X.1980, leg. P. Beron, det. P. Mitov (NMNHS: museum inventory No. 84). – 1 male (body length: 2.1 mm) (Fig. 5).

Amilenus aurantiacus (Simon, 1881). Material: FYR of Macedonia: Šar planina (Šar Mountains), North of Tetovo, 800-1000 m altitude, *Fagus*-forest, on slopes, 11.IX.1986, leg. C. L. Deeleman & P. R. Deeleman, det. P. Mitov (MHNG). – 2 juv. (body length: 3.1 mm) (Fig. 22).

Lacinius erinaceus Staręga, 1966. Material: Caucasus: Abkhazia, region of Sukhumi, by the second bridge on Gumista River, on brushy limestone hillock, 21.XI.1963, leg. B. Pisarski (MIZW: museum inventory number 108/63). – 1 male (Holotype) (Figs 28-29).

Age of the inclusions

Considerable literature has been generated arguing both for and against a Miocene age for the Bitterfeld inclusions. Earlier studies generally supported a younger date and the uniqueness of the amber (Barthel and Hetzer 1982; Führman and Barsdorf 1986; Weitschat 1997). However, subsequent work (e.g. Röschmann 1997) recognised that both ambers appear to contain common arthropod species. Expanding this theme, Hoffeins and Hoffeins (2003) concluded that Baltic and Bitterfeld amber yield very similar faunal compositions and were thus probably of the same age – but perhaps with some regional differences. For spiders, Wunderlich (2004: 246-251) listed at least 17 species common to both ambers; with the comment that many other species are known only from single specimens and may be recovered from both localities in future. Wunderlich thus regarded these amber deposits as probably being similar in age, but perhaps (as per Hoffeins and Hoffeins) involving an independent Bitterfeld amber forest.

A general problem with these arguments is that it is not at all clear how long a 'typical' species of terrestrial arthropod can survive essentially unchanged (see also Schmidt and Dörfeld 2007). For example, Sellnick (1919, 1931) effectively assigned a number of oribatid mites from Baltic amber to living species, albeit distinguished by the subspecies name '*fossilis*'. From the ca. 16 Ma Dominican Republic amber there is at least one fossil pseudoscorpion which is indistinguishable from – and indeed assigned to – an extant species (Judson 1998). In a similar vein, Armas (1988) synonymised a Dominican amber scorpion species described by Schawaller (1979) with an extant scorpion from the Caribbean region. Schawaller (1982) himself noted that a Dominican amber whip scorpion (Amblypygi) was morphologically almost identical to a modern Caribbean form; maintaining a distinct species name for the fossil based on little more than the difference in age.

We identify a comparable situation among Opiliones from Bitterfeld amber here (see *Lacinius* below). Indeed another Baltic (and now also Bitterfeld) amber harvestman, *Caddo dentipalpus* (Koch & Berendt, 1854), has been closely compared to the extant species *C. agilis* Banks, 1892, found disjunctly in North America and Japan. Transferred by Crosby and Bishop (1924: 83), they explicitly noted "It is very closely related to *C. agilis.*", while to quote Shear (1975: 73) on these same fossil and Recent taxa: "There is a strong possibility that they really are the same species, and this indicates a much wider previous distribution for *Caddo*." Further discussion of this fossil harvestman's affinities can be found below.

Thus it is unclear to what extent terrestrial arthropods in amber (individually or generally) are stratigraphically relevant as 'index fossils' and how, in the absence of absolute radiometric dates, this can be tested independently without circular reasoning. Baltic and Bitterfeld amber clearly do yield morphologically very similar harvestmen (see below), as well as other arachnid species. This could be interpreted either as evidence for a similar age for the ambers, or as evidence for a continuum of long-lived (morpho-) taxa throughout the Palaeogene of north–central Europe. The strong similarity of many of these fossils to extant taxa would tend to favour the latter interpretation, and it is interesting to observe that the closest living matches to some northern European amber arachnids are distributed in warmer latitudes today.

Recent studies on the age and provenance of Bitterfeld amber have concluded that it should indeed be treated as independent of the better known Baltic amber (Knuth et al. 2002; Führman 2004; Schmidt and Dörfeld 2007). These papers suggest a youngest Palaeogene (Oligocene: Chattian) age, whereby the amber-bearing sediment has a suggested absolute age of 25.3-23.8 Ma; i.e. about 20 million years younger than Baltic amber. Further details of the geological setting and debates about the age of the Bitterfeld deposit can be found in these publications, and references therein. An Oligocene age is adopted in the present paper.

Descriptions

Suborder Dyspnoi Hansen & Sørensen, 1904 Family Nemastomatidae Simon, 1879

Genus ?Histricostoma Kratochvíl, 1958

Histricostoma tuberculatum (Koch & Berendt, 1854) Figs 1-2, 6-8

Synonymy. See Dunlop (2006, p. 179).

Holotype. MfN, Berendt collection, repository nr. 7248, redescribed by Dunlop (2006), from Baltic amber (Palaeogene, Eocene); precise locality unclear.

Additional material. MfN, MB.A. 1652 (also bears a label "Ser. 8/11") and MB.A. 1653. Bitterfeld amber, probably from the site of the Goitsche open-cast Mine near Bitterfeld, Sachsen-Anhalt, Germany; Palaeogene (Oligocene: Chattian).

Description. MB.A. 1652 (Figs 1, 6) is a fairly complete specimen in dorsal view. Body compact, smoothly oval, length 1.48 mm; maximum width ca. 1.0 mm. Prosoma and opisthosoma completely fused together with little or no evidence of tagmosis between these body regions, of divisions of the prosomal dorsal shield and/ or of opisthosomal segmentation. Ocular tubercle flattened, diameter of each lens c. 0.1 mm. Slight bilobation to the anterior margin of the prosomal dorsal shield. Basal article of chelicera projects forwards, maximum length 0.26 mm, more distal articles largely tucked under body obscuring details, but quite setose on their anterior margin. Basal article distally with a globular and setose apophysis (Fig. 7). Pedipalps elongate and slender. Palpal coxae project forwards up to 0.19 mm. Subsequent articles with lengths (in mm) of trochanter, 0.28; femur, 0.85; patella, 0.70; tibia, 0.78; tarsus, 0.33; giving a total post-coxal length of 2.94. Palpal trochanter oval, bearing numerous very short setae. Femur longer, curving mesally slightly and widening distally, and with longer inward-pointing setae; especially on the mesal surface. Patella and tibia also with some longer setae. Tarsus slightly swollen and quite densely setose. Leg 1 almost complete, other legs attached to body as femora only; with leg 4 quite poorly preserved. Leg 1 article lengths (in mm): trochanter, 0.22; femur, 1.59; patella, 0.26; tibia, 0.69; metatarsus, 1.50; tarsus at least 0.56. Tarsus with at least one long and one short distal article but distal end and any claw equivocal. Femora 2 and 3 with lengths of 1.87 and 1.44 mm respectively. Most leg articles elongate, slender and widening slightly distally, but patella short and globular. Femora typically with three pseudo-articulations, revealed as concavities in the limb outline and/or as paler bands about a third to a half of the way along the article. Trochanters often with short hairs (as in the pedipalps) and femora with a mixture of short hairs and robust, but very short spines along the length of the article. Setation seemingly weak or absent on more distal leg articles, but reappearing as a few longer setae towards the distal end. At least two disarticulated distal limb regions also cross the body, presumably deriving



Figures 1-5. Nemastomatids. 1 *Histricostoma tuberculatum* (Koch & Berendt, 1854), MB.A. 1652;
2 *H. tuberculatum*, MB.A. 1653;
3 *Mitostoma gruberi* sp. n. MB.A. 1654 (holotype) [all from Bitterfeld amber (Palaeogene: Oligocene)];
4 Juvenile *Mitostoma chrysomelas* (Recent harvestman for comparison);
5 Male *Mitostoma patrizii* (Recent harvestman for comparison). Scale bars equal 1.0 mm (1-2, 5), 0.5 mm (3) and 0.35 mm (4).



Figures 6-9. *Camera lucida* drawings of the specimens shown in 1-3. 6 ?*Histricostoma tuberculatum* (Koch & Berendt, 1854), MB.A. 1652; 7 the same – detail of the apophysis at the tip of the first cheliceral segment (right chelicerae, dorso-lateral view); 8 ?*H. tuberculatum*, MB.A. 1653; 9 *Mitostoma gruberi* sp. n. MB.A. 1654 (holotype). All from Bitterfeld amber (Palaeogene: Oligocene). Scale bars equal 1.0 mm (6, 8) and 0.5 mm (9).

from the same animal. Both end in a single curved claw and one is clearly an annulate tarsus with at least 15 individual elements. Opisthosoma smooth, without ornament save for four pairs of prominent spines standing perpendicular to the body surface. Spines c. 0.2 mm high, ending in slightly swollen and rounded tips. Anterior three pairs more or less parallel, c. 0.2 mm apart, posterior (fourth) pair a little larger and more widely separated, c. 0.3 mm apart. Ventral surface of body unknown.

MB.A. 1653 (Figs 2, 8) is an almost complete specimen, but one which is largely covered with a white emulsion, which makes features of the body and especially the proximal regions of the legs appear much thicker than they would have been in life. Body oval, length 1.52 mm. Eye tubercle distinct, but lacking details, while differentiation into a prosoma and opisthosoma unusually clearly expressed for a nemastomatid harvestman. Opisthosoma bears four pairs of erect spines arranged in two sub-parallel rows. Chelicerae and pedipalps largely equivocal. Legs relatively complete. Leg 1 with article lengths (in mm) of: femur, ca. 1.2; patella, 0.37; tibia, 0.77; metatarsus and tarsus, ca. 1.8. Total length ca. 4.1 mm. Metatarsus-tarsus boundary indistinct, but tarsus with some degree of distal division into tarsomeres. Leg 2 incomplete, lengths of trochanter 0.28 and femur 2.62 mm. Femur noticeably slender. Leg with article lengths (in mm) of: trochanter, 0.23; femur, 1.23; patella preserved at an angle which prevents measurement; tibia, 0.63; metatarsus and tarsus, ca. 2.77. Metatarsus-tarsus boundary indistinct. Leg 4 especially well preserved with article lengths (in mm) of: trochanter, 0.33; femur, 1.90; patella, 0.35; tibia, 0.80; metatarsus, 1.4; tarsus, ca. 2.3. Total length ca. 7 mm. Tarsus subdivided into four long and ten short tarsomeres; tarsus ends in a single claw.

Remarks. *?Histricostoma tuberculatum* (Koch & Berendt, 1854) has now been recorded from both Baltic and Bitterfeld amber. All these fossils are tentatively assignable to *Histricostoma* Kratochvíl, 1958 based on the pillar-like opisthosomal spines. However, other nematostomid genera can show similar armature, thus the slight uncertainty about this referral. Unfortunately without penis morphology, which has so far not been recorded in amber fossils, an unequivocal referral to *Histricostoma*, or any other genus remains difficult. An alternative could be *Mediostoma* Kratochvíl, 1958, although for us *?H. tuberculatum* is more *'Histricostoma'* like than *'Mediostoma'* like in term of the form and position of the thorns; the absence of specific microsculpture elements on the leg femora and scutum, and the position of the ocular tubercle. We concede that the shape of the apohysis matches the *Mediostoma* type, but this in isolation is insufficient – some other nemastomatid gerera express a similar shape (e.g. *Vestiferum* Martens, 2006, *Nemastomella* Mello-Leitão, 1936) – and variation in apophysis shape within *Mediostoma* species can be high (Martens 2006: 186).

Interestingly the opisthosomal spines are less pronounced in the holotype from Baltic amber (Dunlop 2006: fig. 6C) – which also has a slightly broader, somewhat pear-shaped, opisthosoma – when compared to the new Bitterfeld material. However, as Martens (1978) noted, in Recent species spination is less pronounced in females compared to males. Minor differences in the degree of spination would thus be a poor species character to adopt and it is conceivable that the differences observed here are principally sexually dimorphic. The unusually clear dividing line between the pro- and opisthosoma in MB.A. 1653 may result from the emulsion layer highlighting a furrow between the prosoma and opisthosoma, which is normally present in many adult nemastomatids. In juveniles such tagmosis is also clearly present since the scutum magnum remains divided into two parts (e.g. Rambla 1968: fig. 4), although here they are clearly separate sclerites. This cannot be resolved in the emulsion-covered MB.A. 1653.

Also of note is the fact that in this fossil species the legs and pedipalps are elongate and slender. This is untypical for males of Recent species, where the female pedipalp is usually the more slender (cf. Martens 2006: fig. 26). However, the presence of an apophysis on the chelicera of MB.A. 1652 (Fig. 7) is characteristic for males. It is conceivable that we could be dealing with an andromorphic female; see e.g. Chemini (1984) for an example of this phenomenon in Recent nemastomatids. Further support for this hypothesis comes from the absence of any thorns on the distal end of the pedipalp patella (Fig. 6) which are normally present in *Histricostoma* males (Staręga 1976b; Martens 1978, 2006; P. Mitov pers. obs.). In any case, the distal end of the pedipalp femur bears concavities – something typical for Recent *Histricostoma* species and provides further grounds for referring these fossils to this genus. Other potentially useful characters, such as the form and concavity of the secretion area of the cheliceral gland, are equivocal in these fossils.

Mitostoma gruberi, sp. n.

urn:lsid:zoobank.org:pub: Figs 3, 9

Material. MfN, MB.A. 1654. Bitterfeld amber. Probably from the site of the Goitsche Open Cast Mine near Bitterfeld, Sachsen-Anhalt, Germany; Palaeogene (Oligocene: Chattian).

Diagnosis. Fossil *Mitostoma* with a specific form of the apophysis on the first cheliceral segment and specific form of the palpal tarsal segment.

Etymology. In honour of Dr Jürgen Gruber (Vienna) in recognition of his extensive studies on harvestmen, and nemastomatids in particular.

Description. MB.A. 1654 comprises a well-preserved body and pedipalps in lateral view, with a number of slightly disarticulated leg femora. Body length, 1.5 mm. Ocular tubercle distinct, eye diameter 0.20 mm. Opisthosoma with hints of segmentation and slight tuberculation on the dorsal surface towards the posterior half of the body. Chelicerae largely obscured, but dorsal part of first segment appears inflated forming an apophysis whose form is close to that of the Italian endemic *Mitostoma orobicum* (Caporiacco, 1949) (see Tedeschi and Sciaky 1997: fig. 11). Pedipalps long and slender, article lengths in mm: trochanter, 0.27; femur, 1.42; patella, 1.63; tibia, 0.80; tarsus, 0.48. Tarsus slightly swollen at its distal end. Pedipalps setose, many palpal setae, particularly towards the distal end, with rounded tips (i.e. clavate setae). Trochanters of legs oval, femora long and slender, but more distal parts of the legs equivocal. Femora with scattering of short, thorn-like spines and one femur (femur 4?) with at least three short pseudoannulations, beginning about 0.8 mm along its length. **Remarks.** This fossil can be assigned to *Mitostoma*, as opposed to *Nemastoma* C. L. Koch, 1836, on the basis of the proportions of the pedipalp articles, while the cheliceral apophysis indicates a male specimen. Whether it is juvenile or adult is less clear, but strong parallels can be drawn with the widespread European species *M. chrysomelas* (Hermann, 1804) if the fossil is juvenile, or with the Sardinian troglobitic endemic *M. patrizii* Roewer, 1953 if adult (cf. Fig. 5). Juveniles of the former and adults of the latter have small tubercles on the scutum – see especially Roewer (1953: fig. 1) and Tedeschi and Sciaky (1997: fig. 1) for *M. patrizii* – although the scutum of the fossil specimen is better developed than in comparable juveniles of *M. chrysomelas* (cf. Fig. 4).

Note that an existing fossil from Baltic amber has already been assigned to *Mitostoma – M. denticulatum* (Koch & Berendt, 1854) – transferred here from *Nemastoma* by Staręga (1976a); an interpretation followed by Dunlop (2006). On reflection, this assignment to *Mitostoma* may be incorrect and the situation is not helped by the dorsal surface of the holotype being partially broken and the apparent loss of the type material of its putative junior synonym *N. succineum* Roewer, 1939. In our revised opinion, the legs of *M. denticulatum* express lengths more consistent with modern *Carinostoma* Kratochvíl, 1958 or *Mediostoma* Kratochvíl, 1958 species. These (and other) nemastomatid genera with comparable dorsal ornament may be closer to the Baltic amber fossils. The status of *M. denticulatum* will be reassessed in a future study of Baltic amber harvestmen. Thus for the reasons outlined above we are confident that our new Bitterfeld species can be assigned to *Mitostoma* and is probably not conspecific with Koch and Berendt's Baltic amber taxon.

Suborder Eupnoi Hansen & Sørensen, 1904 Family Caddidae Banks, 1893 Subfamily Caddinae Banks, 1893

Genus Caddo Banks, 1892

Caddo dentipalpus (Koch & Berendt, 1854) Figs 10-14

Synonymy. See Dunlop (2006, p. 169).

Holotype. MfN, Berendt collection nr. 7340, redescribed by Dunlop (2006), from Baltic amber (Palaeogene, Eocene); precise locality unclear.

Additional material. MfN, MB.A. 1655 (also bears the label "Ser. 12/13") and MB.A. 1656 (also bears the label "Ser. 8"), from Bitterfeld amber, probably from the site of the Goitsche open-cast Mine near Bitterfeld, Sachsen-Anhalt, Germany; Palaeogene (Oligocene: Chattian).

Description. MB.A. 1655 (Figs 10, 12) is a relatively complete specimen in lateral view. Body compact, length ca. 1.5 mm. Prosoma dominated dorsally by massive, oval eyes, maximum width 0.58 mm, in the form of a bilobed ocular tubercle. Further details of carapace morphology concealed beneath eyes. Chelicerae and sternal region cannot be

seen. Pedipalps stout, femur particularly robust with at least eleven stout setae on the inferior lateral surface opposing the more distal articles. Femoral dentition equivocal in this specimen. Palpal article lengths (in mm): femur, 0.46; patella, 0.40; tibia, 0.23; tarsus 0.42. Some setal positions on femur revealed as sockets only. More distal palpal articles also setose; tarsus ends in a single, gently curving claw. All legs elongate and slender, femora and patellae sometimes with a short, stout seta near the distal end; patella noticeably shorter than adjacent articles. Right legs 1, 2 and probably 4 relatively complete. Articles of leg 2 noticeably longer than corresponding articles of leg 1, e.g. patellae 0.26. and 0.29 mm, tibiae 1.02 and 1.29 mm and metatarsi 1.36 and 1.91 mm respectively. Right leg 1 ends in a distally annulate tarsus with at least 11 annulations; distal annulus bears a single, hook-shaped claw. Left leg 3 relatively complete, other legs on left side truncated. A disarticulated leg fragment, probably a distal region bearing an annulate tarsus, crosses the distal part of left leg 3. Opisthosoma covered dorsally with a shield-like sclerite, length 0.67 mm, lacking obvious segmental divisions. Ventral region equivocal, but some hints of up to four sternites towards the posterior end of opisthosoma preserved.

MB.A. 1656 (Figs 13-14) is another excellent specimen, also in lateral view, and preserving the mouthparts in some detail. Body compact, length c. 1.5 mm. Prosoma with large eyes, maximum diameter 0.56 mm, remainder of carapace obscured. Chelicerae robust, composed of three articles. First cheliceral article tubular, total length not preserved, ornamented with sparse setae. Second cheliceral article somewhat swollen and globose proximally, tapering distally and becoming recurved at the very end to form the fixed finger of the claw (= chela). Total length 0.57 mm. Movable finger short, length 0.16, forming the free finger of the claw. Pedipalps robust. Right trochanter bears one thorn medially. One femur preserves a prominent, dentate thorn on the inferior surface (hence the name *dentipalpus*) and both femora exhibit a blunt, mesal protuberance at the distal end of the article, bearing setae. Patella, tibia and tarsus of pedipalp strongly setose. Leg 1 complete, folded across the body, with podomere lengths (in mm) of femur, 0.60; patella, 0.32; tibia, 0.79; metatarsus, 1.79; and tarsus, 0.59. Total length 4.09. Tarsus multi-articulate, composed of ten elements with the longest located proximally, and ending in a single tarsal claw. Remaining legs incomplete, but longer than leg 1. Dorsal opisthosoma with evidence for at least five tergites. Ventral surface equivocal.

Remarks. *Caddo dentipalpus* (Koch & Berendt, 1854) is present in both Baltic and Bitterfeld amber. It is of particular interest given that there are no Recent records of caddids in Europe, or much of Asia for that matter. According to Shear (1975), Caddidae is currently restricted to North America, Mexico, Chile, Japan, Australia, New Zealand and South Africa. Like these amber inclusions, the genus *Caddo* is restricted today to the northern hemisphere. The amber shows that it used to occur more widely, being present in north-central Europe during the Palaeogene, but subsequently became extinct in this region. The Bitterfeld specimens described here are probably juveniles. Their body lengths of 1.5 mm are shorter than the 2.3 mm of the holotype in Baltic amber and are slightly outside the published minimum ranges for adults of the very similar extant species *Caddo agilis*: 1.64 mm for females, 1.9 mm for males (cf. Suzuki et al. 1977; Suzuki 1986). Minor differences in morphology can be observed in the Bitterfeld fossils, but compared to



Figures 10-11. *Caddo dentipalpus* (Koch & Berendt, 1854) from Bitterfeld amber (Palaeogene: Oligocene). 10 MB.A. 1655; 11 MB.A. 1656. Scale bars equal 1.0 mm.



Figures 12-14. *Caddo dentipalpus* (Koch & Berendt, 1854). *Camera lucida* drawings of the specimens shown in **10-11**. **12** MB.A. 1655; **13** MB.A 1656; **14** the same, detail of the mouthparts showing the distal median apophysis of the pedipalp femur (ap). All from Bitterfeld amber (Palaeogene: Oligocene). Scale bars equal 1.0 mm (**12-13**) and 0.2 mm (**14**).

extant taxa these are probably sexually dimorphic. For example, MB.A. 1655 (Fig. 12), without obvious spines or thorns on the pedipalp femur, is probably male, whereas MB.A. 1656 (Fig. 14), which has such spination, is probably female. The holotype of *C. den-tipalpus* clearly has three femoral thorns (Bishop and Crosby 1924: fig. 1). By comparison there are three such thorns in *Caddo agilis* females, whereas males have only one strong, finger-like protuberance (e.g. Gruber 1974: figs 18-22; Suzuki and Tsurusaki, 1983).

A distal mesal protuberance of the femur – as in MB.A. 1656 (Fig 14: ap) – is of some significance. Visible in both Bishop and Crosby's (1924: fig. 1) and Dunlop's (2006: fig 2A) drawings of the *C. dentipalpus* holotype too, this apophysis has also been reported in *C. agilis*. In detail, Bishop (1949) reported this structure at the distal mesal angle of the pedipalp femur in juveniles from North America. Suzuki (1958) reported it from his (Japanese) females and Gruber (1974) figured it in adult females from North America. It appears to be generally absent from males (Gruber 1974; Suzuki and Tsurusaki 1983). This femoral protuberance again emphasises the similarities – if not the conspecificity *sensu* Shear (1975) – between fossil and living *Caddo* harvestmen. The question of whether the amber examples merit a separate species is difficult to answer and further fossils would be welcome to test the stability of characters both between genders and instars. Bishop and Crosby's (1924: fig. 1) illustrations also hint at a protuberance on the mesal side of the patella and a rather poorly defined feature in this area – or at least a group of setae – was observed here in MB.A. 1655 (Fig. 12). If this character could be confirmed in other specimens it would offer a possible diagnostic character compared to Recent species.

Conceivably, Eocene–Oligocene populations of European *Caddo* occupied specialized habitats and expressed subtle differences from modern Asian and North American forms which are difficult to assess in the available fossils. To complicate matters further, some modern *Caddo* species are thought to have arisen through neotony of isolated populations (Shear 1975; Rambla 1980) and there are also frequent reports of parthenogenesis among the Recent fauna (e.g. Gruber 1974; Shear 1975; Suzuki 1976; Suzuki and Tsurusaki 1983) all of which may hinder the resolution of unequivocal apomorphies for the amber species. Shultz and Regier (2009) recently argued that *C. agilis* and its potential neonate *C. peperella* Shear, 1975 – both of which occur disjunctly in North America and Japan – evolved as distinct species, prior to their separation into American and Asian populations. Questioning the neotony hypothesis, they further discussed the potential role of paedo- and peramorphosis in understanding *Caddo* evolution and noted the need for further data from ancestral *Caddo* populations. With these provisions in mind, we prefer to retain *C. dentipalpus* as a separate taxon for the time being.

Family Phalangiidae Latreille, 1802 *Dicranopalpus* genus group

Remarks. The following two genera are clearly related, but their position has been debated. For example Martens (1978) referred them to Gyantinae [= Gyinae]. Crawford (1992, p. 4) disputed this and recognised an informal '*Dicranopalpus* genus group' comprising *Dicranopalpus*, *Amelinus* and *Lanthanopilio* Cokendolpher & Cokendolpher, 1984; which he suggested could eventually merit family status. In the absence of further revision, Crawford's term is adopted here.

Genus Dicranopalpus Doleschall, 1852

Dicranopalpus ramiger (Koch & Berendt, 1854)

Figs 15-19

Synonymy. See Dunlop (2006: 170).

Holotype. MfN, Berendt collection, repository number 7250, from Baltic amber (Palaeogene, Eocene); precise locality unclear.

Additional material. MfN, MB.A. 1657 (also bears label "Ser. 12/14) and MB.A. 1658 (also bears label "Ser. 8"), from Bitterfeld amber, probably from the site of the Goitsche open-cast Mine near Bitterfeld, Sachsen-Anhalt, Germany; Palaeogene (Oligocene: Chattian).

Description. MB.A. 1657 (Figs 15, 17) is a fairly complete specimen in dorsal view. Body oval to quadrate, length 1.22 mm, maximum width 0.90 mm. Prosoma with semicircular propeltidium bearing ocularium; length 0.125 mm, width 0.325 mm, distance from ocular tubercle to the front of prosoma 0.1 mm. Opisthosoma with hints of weak segmentation, largely obscured by an imperfection in the matrix. Chelicerae indistinct, as are proximal articles of pedipalp. Patella of pedipalp, length 0.18 mm, with characteristic *Dicranopalpus* setose apophysis on mesal side, length 0.25 mm, extending about three-quarters of the way down the adjacent tibia. Tibia of pedipalp with length 0.27 mm, terminating in a further blunt, short setose apophysis. Pedipalpal tarsus widens slightly distally and ends in a single claw. Legs long and slender, but full lengths not preserved. Leg 2 longest, at least 8.6 mm. Measurable articles preserved in their entirety are (in mm) as follows. Leg 1: femur, 1.05; patella, 0.29; tibia, 1.02. Leg 2: femur, 2.24; patella, 0.33; tibia, 2.37. Leg 3: femur, 1.04; patella, 0.25; tibia 0.92. Ventral surface of the body not visible.

MB.A 1658 (Figs 16, 18-19) is a fairly complete specimen in dorsal view. Body oval and compact, length 1.32 mm. Prosoma with semicircular propeltidium, length 0.44 mm, dominated by prominent, heart-shaped ocularium, length 0.20, width 0.225, distance from ocular tubercle to front of prosoma 0.1 mm. Ocular tubercle bears multiple short, forward-pointing setae in a band across the dorsal region between the eyes. Dorsal surface behind propeltidium, including all opisthosomal tergites, missing. Lateral regions of body only preserved in outline. Chelicerae fairly robust, but folded under the body with few details. Pedipalpal trochanter short, length 0.12 mm, and quadrate. Palpal femur long, length 0.72 mm, with slight curvature and distal widening. Palpal femur setose, especially on its inferior surface. Palpal patella short, length 0.19 mm, but with prominent and characteristic *Dicranopalpus* mesal apophysis. Length of apophysis 0.33 mm, bearing multiple setae towards the distal end in particular and



Figures 15-16. *Dicranopalpus ramiger* (Koch & Berendt, 1854) from Bitterfeld amber (Eocene: Oligocene). 15 MB.A. 1657; 16 MB.A. 1658. Scale bars equal 0.5 mm (15) and 1.0 mm (16).



Figures 17-19. *Dicranopalpus ramiger* (Koch & Berendt, 1854) from Bitterfeld amber (Eocene: Oligocene). *Camera lucida* drawings of the specimens shown in 15-16. 17 MB.A. 1657; 18 MB.A 1658; 19 the same, detail of the long patella and short tibial apophyses (arrowed) characteristic for the genus. Scale bars equal 0.5 mm (17), 1.0 mm (18) and 0.2 mm (19).

extending almost two-thirds of the way down the length of the adjacent tibia. Palpal tibia itself elongate, length 0.51 mm, and widening distally. Palpal tarsus incomplete, but elongate, length at least 1.0, with hints of distal curvature; although terminal end is obscured. Tibia and tarsus also setose. Leg trochanters globose. Femora elongate, but incomplete in legs 2-4. Femora bear a few short setae. Femora of legs 2 and 3 preserve a proximal pseudoarticulation close to the trochanter. Leg 1 fairly complete, elongate and slender; total length at least 8.0 mm. Femur length ca. 2.0 mm. Patella not clearly preserved. Tibia length 2.60 mm. Setation on more distal podomeres indistinct, as is expected metatarsus–tarsus boundary. Ventral surface of body unknown.

Remarks. *Dicranopalpus ramiger* (Koch & Berendt, 1854) is present in both Baltic and Bitterfeld amber. Both the Bitterfeld specimens described here are quite small with relatively large eye tubercles (e.g. Fig. 17) compared to other described fossil and Recent material in this genus. For this reason we suspect they might be juveniles. Dunlop (2006) discussed the second apophysis on the tibia – clearly preserved in MB.A 1658 (Fig. 19) – which was used by Menge (1854) to define a new species. Given the poor state of preservation in the holotype of Koch and Berendt's (1854) species, this character is regarded as unreliable and all Baltic (and now Bitterfeld) examples can probably be referred to a single taxon: *D. ramiger*. Note that the Bitterfeld specimen figured by Barthel and Hetzer (1982, fig. 9) from the Deutsches Bernsteinmuseum (repository number 5/2) was provisionally referred by these authors to *Dicranolasma* Sørensen, 1873. This is almost certainly a *lapsus* since this Recent genus belongs to the dyspnoid family Dicranolasmatidae. Their figured specimen clearly bears the long patellar apophysis typical for *Dicranopalpus* Doleschall, 1852 (Phalangiidae).

Genus Amilenus Martens, 1969

Amilenus deltshevi sp. n. urn:lsid:zoobank.org:pub: Figs 20-21, 23-26

Holotype. MB.A 1659. Bitterfeld amber, probably from the site of the Goitsche opencast Mine near Bitterfeld, Sachsen-Anhalt, Germany; Palaeogene (Oligocene: Chattian).

Additional material. MB.A. 1660 (paratype). From the same locality as the holotype.

Diagnosis. Fossil *Amilenus* species with a distinct form of the apophysis on the pedipalpal patella.

Etymology. In honour of Prof. Christo Deltshev (Sofia) in recognition of his extensive contributions to arachnology and on the occasion of his 70th birthday.

Description. The holotype (MB.A. 1659, Figs 20, 23-24) is an almost complete specimen in lateral view. Body ovoid, length ca. 0.8 mm; details of body, ocular tubercle and mouthparts equivocal. Pedipalps well-preserved, with article lengths (in mm) of: femur, 0.21; patella, 0.14; tibia, 0.16; tarsus, 0.4. Patella with a distinct, bluntly-

pointed, mesal apophysis bearing a number of stout spines. Tibia slightly inflated distally and also bearing stout mesal spines in this distal region. Tarsus slightly expanded distally; apotele present as a short, curving, distal claw. Legs relatively complete; all elongate and slender, and when preserved at their full length ending in a single, claw like apotele. Leg 1 with article lengths in (mm) of: femur, 0.56; patella, 0.19, tibia, 0.47; metatarsus and tarsus (boundary indistinct) 1.75. Leg 2 with article lengths in (mm) of: femur, 1.19; patella, 0.22; tibia 1.72, metatarsus and tarsus (boundary indistinct) at least 1.47, but full length not preserved. Leg 3 less completely known, patella 1.1 mm; tibia 0.58 mm. Leg 4 with article length in mm of: femur c. 0.8; patella, 0.19; tibia, 0.75, metatarsus and tarsus (boundary indistinct), 3.0.

The paratype MB.A. 1660 (Figs 21, 25-26) is an almost complete specimen best seen in dorsal view, but missing the second pair of legs and the dorsal surface of the opisthosoma. Body oval to rectangular, length c. 1 mm; width of prosoma 0.7; width of opisthosoma 0.75. Ocularium present on the propertidium, fairly large in proportion to the rest of the body; possibly hinting at a juvenile. Length 0.174 mm, width 0.215 mm, distance from ocular tubercle to the front of prosoma 0.110 mm. Mesoand metapeltidium, together with the tergal region of the opisthosoma equivocal. Pedipalps quite well-preserved. Both patella and to a lesser extent tibia express mesal apophyses, with fairly dense setation along the entire mesal surface of these articles. Leg 1 with article lengths (in mm) of: femur, 0.95; patella, 0.23; tibia, 1.02; metatarsus, 0.79; tarsus, 1.44. Some annulation of the tarsus preserved, but details lacking. Leg 2 only known from an incomplete femur on the left side. Leg 3 with article lengths (in mm) of: femur, 0.78; patella, 0.20; tibia, 1.02; metatarsal-tarsal division, indistinct but length together 2.8. Annulation of the tarsus into at least 12 elements and the distal apotele in the form of a single curving claw also visible in this limb. Leg 4 with article lengths (in mm) of: femur, 0.1.42; patella, 0.21; tibia, 1.28; metatarsal-tarsal division, indistinct but length together at least 1.8.

Remarks. The key character in both these specimens is the mesal apophysis on the patella of the pedipalp (Figs 24, 26, arrowed). Not as long as the apophysis of *Dicranopalpus* (see above), it closely matches the gross morphology of extant species such as *Amilenus aurantiacus* (Simon, 1881) (Fig. 22, arrowed) where even juveniles – the fossils could also be subadult – express such an apophysis. Based on this we recognise these Bitterfeld fossils as a new species, and the first fossil example of *Amilenus*. However, some expected details compared to extant members of this genus, like pseudoannulation of tibiae 2 and 4 or teeth on the pedipalp claw, could not be resolved; although the latter may not be present in modern juveniles of this size (i.e. body length). In the holotype the ocular tubercle is probably hidden behind the legs and is rather small in extant species. Also of note is the fact that the tibia of leg 2 in modern juveniles is longer than femur; a situation paralleled by the holotype.

One of our initial suspicions was that this new material could be conspecific with the Baltic amber species *Opilio ovalis* Koch & Berendt, 1854. Its holotype could not be traced in its expected repository in Berlin (cf. Dunlop 2006), but the original illustration implies the presence of a somewhat distally thickened and mesally rather setose



Figure 20-22. Fossil and Recent *Amilenus*. 20 *Amilenus deltshevi* sp. n., M.BA 1659 (holotype), from Bitterfeld amber (Palaeogene: Oligocene); 21 *A. deltshevi* sp. n. M.BA 1660 (paratype), also from Bitterfeld amber; 22 Juvenile *Amilenus aurantiacus* (Simon, 1881) (Recent harvestman for comparison), note the medial apophysis on the patella (arrowed). Scale bars equal 1.0 mm.

pedipalp patella. However, the Bitterfeld material differs from the *O. ovalis* illustration in having a distinct, projecting apophysis on the patella and strong setae on the tibia too. We are fairly certain that *O. ovalis* is misplaced at the genus level, but since the focus of the present paper is the Bitterfeld deposit, we will address this question fully in future work on Baltic amber harvestmen.



Figures 23-26. *Amilenus deltshevi* sp. n. *Camera lucida* drawings of the specimens shown in 20-21. 23 MB.A 1659 (holotype), from Bitterfeld amber (Eocene: Oligocene); 24 the same, detail of the pedipalp showing the patellar apophysis (arrowed); 25 MB.A 1660 (paratype); 26 the same, detail of the anterior prosoma and pedipalps showing the patella apophysis (arrowed). Scale bars equal 1.0 mm (23, 25), 0.2 mm (24, 26).

Genus Lacinius Thorell, 1876

¿Lacinius erinaceus Staręga, 1966

Figs 27, 31-32

Material. MB.A. 1661 (also bears the label "Ser. 12/12"), from Bitterfeld amber, probably from the site of the Goitsche open-cast Mine near Bitterfeld, Sachsen-Anhalt, Germany; Palaeogene (Oligocene: Chattian).

Description. An almost complete, juvenile specimen (Figs 27, 31-32) in anterolateral view, obscured in places by bubbles within the matrix. Body compact, length c. 1.75 mm, maximum width of prosoma 1.20, of opisthosoma 1.25. Division into pro- and opisthosoma, and any sclerites making up the prosomal dorsal shield, poorly resolved. Ocular tubercle pronounced, width 0.33 mm, bearing seven spines; immediately in front of it three fairly prominent spines present. Further, generally smaller, spines located behind the ocular tubercle. Anterior margin of prosomal dorsal shield slightly recurved to accommodate the chelicerae. Proximal article only of chelicerae preserved, lacking details. Pedipalps short and robust, again proximal articles only preserved. Right (?)patella of pedipalp with at least three denticle-like spines. Legs relatively short. Femur, patella and tibia quite robust, compared to the more slender distal articles, and heavily ornamented with rows of thorns. Each row can be up to ten thorns on the tibiae. Thorns take the form of conical, sometimes slightly curving, tubercles, length c. 0.1 mm; typically ending in a short bristle or seta. Metatarsus with one to three thorns proximally, but distal region generally bearing setae only. Legs most complete on right side, but leg 2 here missing, apart from a proximal stub (?trochanter). Metatarsal-tarsal division in leg 3 unclear; tarsus distally subdivided. Leg 4 well preserved with podomere lengths (in mm): patella, 0.41; tibia, 0.76; metatarsus, 1.12; tarsus, 1.21. Tarsus divided into one long and nine shorter elements, ending distally in a single, curved claw. Opisthosoma lacks clear segmentation, but is ornamented, like the legs, with conical spines, longest towards the posterior margin of the opisthosoma. The microsculture is granulated. The spines on the body do not appear to form any sort of regular pattern. Ventral surface largely covered by emulsion, but ventrally directed spines also observed here on the leg coxae and opisthosoma.

Remarks. This remarkable, spiny fossil is clearly something new for the European amber fauna. Two features (cf. Martens 1978) – the stout thorns ending in setae on the legs (and to a lesser extent the body) and the presence of three prominent spines in front of the eyes (Fig. 32) – indicate the extant genus *Lacinius* Thorell, 1876. The original hand-written note from Manfred Moritz provisionally assigned it to this genus. The probably closely-related *Odiellus* Roewer, 1923 lacks such well-developed thorns on the legs. Three Recent species of *Lacinius* occur in Germany today. All are distributed throughout much of the country, although somewhat rarer in the north (Blick and Komposch 2004). Interestingly, the extant central European species are notably less spiny than this Bitterfeld fossil. In gross morphology the new find is rather more like some extant species from the Mediterranean region (e.g. *Lacinius insularis*)

Roewer, 1923), and especially *Lacinius erinaceus* Staręga, 1966 from the Caucasus. Indeed we were unable to recognise any reliable or non-trivial characters – other than age – which could distinguish MB.A. 166 from *L. erinaceus* (Figs 28-29). We concede that assigning older fossils to living species is controversial, but note again the precedent from the slightly younger Dominican Republic amber (see Age of the inclusions) and tentatively refer this new Bitterfeld harvestman to *L. erinaceus*. The highly spinose *Lacinius* morphs were clearly more widely distributed during the Oligocene and occurred further north than their distribution today.

Family Sclerosomatidae Simon, 1879

Genus Leiobunum C.L. Koch, 1839

Leiobunum longipes Menge, 1854

Figs 30, 33

Synonymy. See Dunlop (2006, pp. 172-173).

Holotype. Probably originally in Danzig (=Gdańsk, Poland), current whereabouts unknown (see also Dunlop 2006), from Baltic amber (Palaeogene, Eocene); precise locality unclear.

Additional material. MB.A. 1662 (series 15/10, provisionally labelled "Gyantinae cf. *Amilenus*" but not in fact referable to this genus; see above), probably from the site of the Goitsche open-cast Mine near Bitterfeld, Sachsen-Anhalt, Germany; Palaeogene (Oligocene: Chattian).

Description. MB.A. 1656 (Figs 30, 33) is an almost complete specimen of a fairly large harvestman in dorsal view. Body length: 2.1 mm; width of prosoma and opisthosoma 1.3 mm. Carapace procurved anteriorly, with clear division into promeso- and metapeltidium, and centrally located ocular tubercle. Length of ocularium 0.225 mm, width 0.275 mm, distance from ocular tubercle to front of prosoma 0.25 mm. Opisthosoma covered by scutum parvum bearing in places slightly granular ornament; posterior region and any segmentation here obscure. Body covered with small black dots and a subcuticular, silvery pigment. Chelicerae equivocal. Pedipalps short and pediform, but details lacking. Legs relatively complete, at least proximally, elongate and slender. Leg 1 femur length 1.83 mm, patella, 0.24. Leg 2 only known from incomplete femora. Leg 3 complete with podomere lengths (in mm) of femur, 1.79; patella, 0.45; tibia, 1.52; metatarsus, 1.86, tarsus, 3.20. Tarsus divided into 24 individual elements, becoming shorter distally, and ending in a single claw (apotele). Leg 4 only known from incomplete femora.

Remarks. *Leiobunum longipes* Menge, 1854 is present in both Baltic and Bitterfeld amber. Apparently quite common in Baltic amber (Staręga 2002), this fossil is fairly large compared to the other Bitterfeld finds. Nevertheless, it is probably still only a juvenile, although we see nothing which differentiates it from the species known from Baltic amber.



Figures 27-30. 27 Fossil *?Lacinius erinaceus* Staręga, 1966, MB.A. 1661, from Bitterfeld amber (Palaeogene: Oligocene); **28-29** Recent male *Lacinius erinaceus* Staręga, 1966 (Holotype) in dorsal and lateral view for comparison, revealing an almost identical morphology to the amber fossil; **30** *Leiobunum longipes* Menge, 1854 from Bitterfeld amber, MB.A. 1662. Scale bars equal 1.0 mm.



Figures 31-33. *Camera lucida* drawings of the specimens shown in 27 and 30. 31 ?*Lacinius erinaceus* Starega, 1966, MB.A. 1661; 32 the same detail of ocularium and its spination; 33 *Leiobunum longipes* Menge, 1854, MB.A. 1662. Both from Bitterfeld amber (Palaeogene: Oligocene). Scale bars equal 1.0 mm (31, 33).

Acknowledgements

We thank Christian Neumann (MfN) for access to material in his care, Axel Schönhofer for some general initial comments on the fossils, Christel and Hans Werner Hoffeins and Alexander Schmidt for helpful discussions on the age of Bitterfeld amber and Robert Richter for assistance in assembling the figures. The reviewers are also thanked for valuable comments on the typescript. Plamen Mitov's visit to Berlin (DE-TAF-2708) and Warszawa (PL-TAF-4111) was supported by Synthesys project: http://www.synthesys. info, which is financed by European Community Research Infrastructure Action under the FP6 "Structuring the European Research Area" Programme.

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