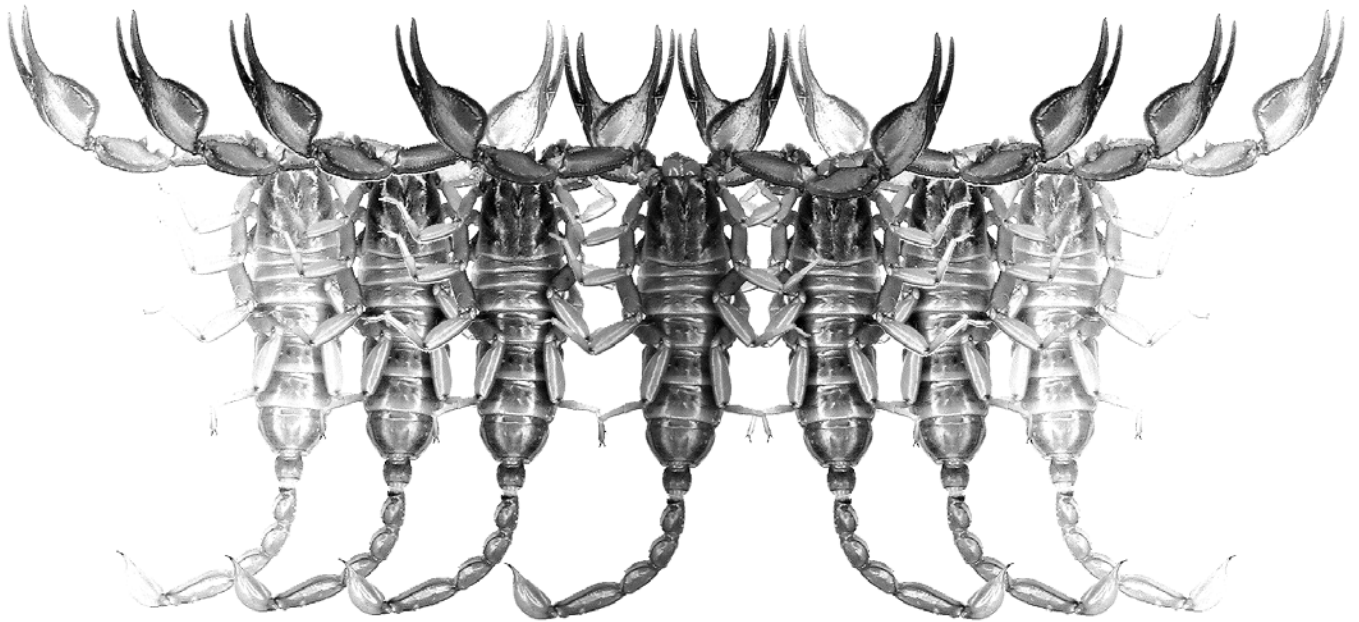


Euscorpius

Occasional Publications in Scorpiology



**Etudes on Iurids, II. Revision of Genus *Calchas* Birula, 1899,
with the Description of Two New Species (Scorpiones: Iuridae)**

Victor Fet, Michael E. Sologlad & František Kovařík

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- **MZUC**, Museo Zoologico "La Specola" dell'Universita de Firenze, Florence, Italy
- **ZISP**, Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia
- **WAM**, Western Australian Museum, Perth, Australia
- **NTNU**, Norwegian University of Science and Technology, Trondheim, Norway
- **OUMNH**, Oxford University Museum of Natural History, Oxford, UK

Etudes on iurids, II. Revision of genus *Calchas* Birula, 1899, with the description of two new species (Scorpiones: Iuridae)

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Summary

The relict, phylogenetically important scorpion genus *Calchas* Birula, 1899 (Iuridae) remained monotypic since its description. Its sole species, *Calchas nordmanni* Birula, 1899, was known only from northeastern Turkey until Kinzelbach (1980) published first records from southern and southeastern Turkey. A few more localities have been reported from Turkey; the species was also found on two Greek islands, Samos and Megisti. We analyzed significant material (63 specimens, including a previously unpublished large series from Naturhistorisches Museum Wien), and concluded that *three* distinct, disjunct species exist rather than one widespread species as previously thought. Two new species are described: *Calchas birulai* sp. nov. (southeastern Turkey, northern Iraq; 30 specimens studied) and *Calchas gruberi* sp. nov. (southern Turkey; Megisti Island and Samos Island, Greece; 23 specimens studied). The type species *Calchas nordmanni* Birula, 1899 (10 specimens studied) is restricted to northeastern Turkey.

Introduction

The scorpion genus *Calchas* Birula, 1899 has attracted considerable attention due to its phylogenetic position. Along with its sister genus *Iurus*, it comprises family Iuridae Thorell, 1876, one of the most basal families of parvorder Iurida (Soleglad & Fet, 2003b; Fet & Soleglad, 2008), and possesses a unique combination of ancestral and derived features. *Calchas* has been often discussed in systematic, biogeographic, and phylogenetic contexts for over 100 years (Birula, 1899, 1900, 1905, 1912, 1917a, 1917b; Werner, 1934; Vachon, 1971, 1974; Kinzelbach, 1975, 1980; Francke & Soleglad, 1981; Fet & Braunwalder, 2000; Stathi & Mylonas, 2001; Soleglad & Fet, 2003b; Fet et al., 2004; Fet & Soleglad, 2008; Kaltsas et al., 2008).

Birula's original brief description of genus *Calchas* and species *C. nordmanni* (Birula, 1899) is reproduced and translated here (Fig. 1). It included a diagnosis in Latin and comments in Russian, justifying original placement in Chactidae (from which it, however, differed so much that a separate monotypic subfamily Calchinae was created for this genus later by Birula, 1917a). This publication, and the subsequent detailed description (Birula, 1900) were based only on two syntype females collected by Konstantin Deryugin in Ardanuç (now Artvin Province, Turkey) in July 1898 (see Deryugin, 1899, for the details of this collection trip). This area (Çoruh River watershed) yielded not less than 15 additional specimens, collected by Russian

naturalists (E. König, B. Lindholm, P. Nesterov, and Yu. Voronin) between 1904 and 1911 (Table 1, Fig. 2). All of these specimens were collected within the erstwhile Russian Empire, some along the border with the Ottoman Empire.

At least 11 or 12 of these specimens were kept by Alexei A. Birula in St. Petersburg, Russia (ZISP). Nothing was known about the fate of Birula's collection for a long time. Although Vachon (1971) loaned and redescribed a single male from ZISP, Kinzelbach (1980) suggested that most of Birula's specimens were lost. However, Fet (1989a, 1989b) confirmed existence of syntypes (two subadult females from Ardanuç, coll. K. Deryugin, ZISP 942). Our Fig. 2 presents a copy from Birula's original handwritten log book still kept in ZISP along with the Birula's surviving collection (courtesy Viktor Krivochatsky). The first two entries in this list (ZISP 942, 943) are in A. A. Birula's own hand. At least five of Birula's specimens, including two syntypes, are still deposited in ZISP. Specimens ZISP 1393, 1394 and 1395 (the adult male studied by Vachon, 1971) are in alcohol, and two syntypes ZISP 942 are dry. A large lot ZISP 943 (B. Lindholm leg.) could not be found (Viktor Krivochatsky, pers. comm., 2008).

In addition, some specimens of *C. nordmanni* studied by Birula belonged to the Caucasian Museum in Tiflis, now Georgian National Museum, Tbilisi, Georgia (GNM). The Georgian researchers (Vera Pkhakadze, pers. comm., 2009) report that this museum still has, in alcohol, at least 12 specimens of *C. nordmanni* from the

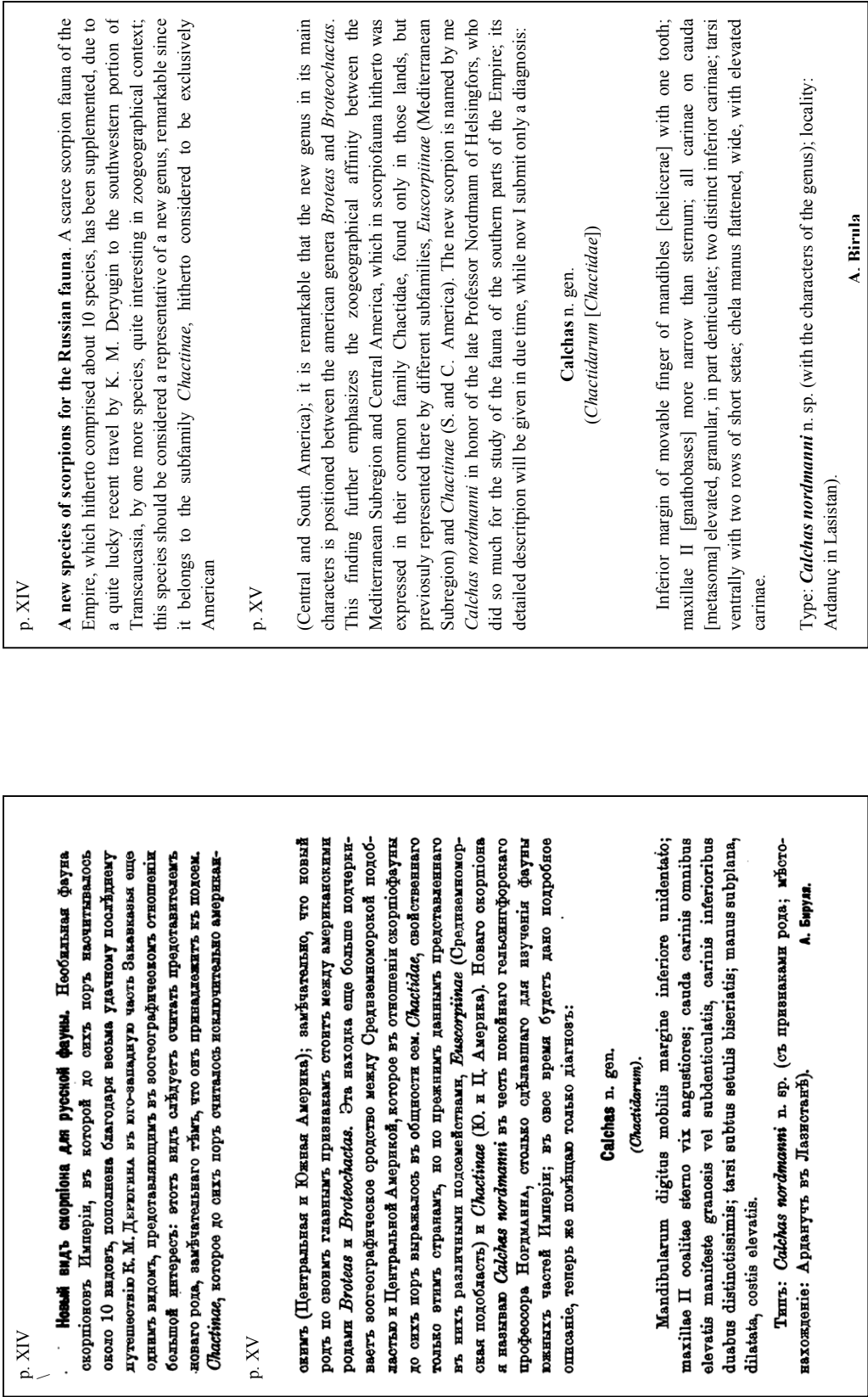


Figure 1: Original description of *Calchas* (Birula, 1899). Left. Text in Russian, diagnosis in Latin. Right. English translation.

material studied and published by Birula (1905, 1912, 1917a, 1917b) (Table 1).

Two wonderful books by Birula (1917a, 1917b), available in English translations since the 1960s, are still an important source for an extended description and scarce details on locality and life history of *Calchas nordmanni* in northeastern Turkey.

The genus has remained monotypic since its description. Its sole species, *Calchas nordmanni* Birula, 1899, has been for a long time known only from a limited area, which until 1917 belonged to the Russian Empire. This area (now within Artvin and Erzurum Provinces, northeastern Turkey) was among the territories ceded by Russia to Turkey by the Treaty of Brest-Litovsk in 1918, later confirmed by the Treaty of Kars in 1921. *Calchas nordmanni* has never been found in the adjacent Georgia (before 1991, the USSR) (Fet, 1989a, 1989b; Sissom & Fet, 2000), although a number of sources claimed so (e.g. Rikhter, 1945; Vachon & Kinzelbach, 1987).

It seems that until 1971 no European author realized that this genus inhabits Turkey; it was never included in the reviews of Turkish fauna published by Vachon (1947a, 1947b, 1951, 1966) and Tolunay (1959). Meanwhile, the entire known range of *Calchas* was within Turkey since 1918; however, both Werner (1934) and Millot & Vachon (1949) loosely referred to *Calchas* without a country reference, as inhabiting “Transcaucasia”. The term was usually used to designate the combined area of Armenia, Azerbaijan, and Georgia (now independent countries; “republics” of the USSR before 1991).

Vachon (1971) for the first time listed *Calchas* as present in Turkey; he also was the first European researcher to see a specimen. Using modern systematic criteria, especially trichobothrial patterns, Vachon provided a detailed redescription of one of the Birula’s specimens, loaned from Russia (an adult male from Artvin, ZISP 1395, see Fig. 2). This important paper, with beautiful artwork by Maurice Gaillard that always accompanied Vachon’s works, was published in Russian (with French summary) in a central Russian journal, *Entomologicheskoe Obozrenie* (translated from French, which explains a few typos and some unusual deviant terminology). It was also almost simultaneously published in English as *Entomological Review*, with the text translated again from the Russian (the original French text was never published!). Vachon (1971) observed for the first time that *Calchas* (then placed in Chactidae) is very close to *Iurus* (then placed in Vaejovidae). This study also allowed for the incorporation of *Calchas* into Vachon’s monumental study of trichobothrial patterns in scorpions (Vachon, 1974).

Birula (1917b: 156) was correct when he predicted: “The scorpion fauna of Asia Minor is still too little known to allow the determination of the western and

southern boundaries of the range of *Calchas nordmanni*.” However, no new additional records of *Calchas* were published between 1917 and 1980. Kinzelbach (1975: 28) first indicated that new specimens of *Calchas nordmanni* from Turkey existed in European collections (ZMUH). Later, he (Kinzelbach, 1980) published not only additional records from the northeast (Tortum and Yusufeli) but also was the first to report widely disjunct records of *C. nordmanni* from both southern Turkey (Kumluca in Antalya Province) and southeastern Turkey (Siirt). Another new record from Urfa (now Şanlıurfa, southeastern Turkey) was added by Kinzelbach (1982).

Francke & Soleglad (1981) reestablished family Iuridae, and demonstrated that *Calchas* and *Iurus* are sister genera, therefore removing *Calchas* from Chactidae. They examined, however, only a single, previously unpublished female of *Calchas* (MNH RS 6452, loaned to O. Francke, reexamined here), collected by Jean Garzoni in 1971 in “Bilejdik”. This locality is not entirely clear. A map of Kinzelbach (1985), reproduced by Vachon & Kinzelbach (1987, fig. 6) and Fet & Braunwalder (2000), shows it as a very disjunct population in Bilecik (or Biledjik), a provincial center in northwestern Turkey (west from Bursa). This MHN specimen was also seen and its locality listed as “Biledjik” by Kamenz & Prendini (2008). At the same time, Vachon & Kinzelbach (1987: 99) use a different spelling when they report finding *Calchas* “in the region of Birecik as well as in region of Antalya”. Now, Birecik (but not Bilecik!) is in southeastern Turkey (an ancient Birtha on Euphrates) and falls well within the range of *Calchas* discussed in the present paper. Crucitti & Vignoli (2002: 459) first commented on this confusion. Wilson Lourenço (pers. comm., 2008) informed us that Garzoni indeed collected along the Syrian border in the southeastern Turkey. We therefore consider the provenance of MNHN RS 6452 female as Birecik (Şanlıurfa Province), and include this specimen among the paratypes of *C. birulai* **sp. nov.** (see below). Prof. Ragnar Kinzelbach (pers. comm., May 2009) confirms that the published locality of *Calchas* in Bilecik (northwestern Turkey) was an error, and should indeed read Birecik. An additional specimen from the environs of Birecik (across Euphrates in Gaziantep Province) has been studied here (see below and Fig. 58).

Sissom (1988) reported a single specimen of *Calchas nordmanni* (as *Paraiurus nordmanni*), collected on 23 April 1979 on the Greek island of Samos by the Polish malacologist Adolf Riedel. We examined the Samos specimen (FMNH) and verified Sissom’s placement in *Calchas* (see below). This disjunct locality was, however, doubted by Kaltsas et al. (2008: 227) since D. Kaltsas did not find *Calchas* in the specified locality during his regular visits to Samos between 2006 and 2008, including the exact label locality (south slope of Mt Spiliani). At the same time, other Riedel material

REFERENCE	SPECIMENS & RECORDS	SPECIES as established in this paper
Birula, 1899: XIV–XV (in Russian, diagnosis in Latin, without figures)	Genus and species diagnosis (see Fig. 1); type locality: Russian Empire, “Southwestern Transcaucasia”, “Ardanuç in Lasistan”; no information on type specimens.	<i>Calchas nordmanni</i> Birula, 1899
Birula, 1900: 252–256 (in German, without figures). <i>Note</i> : in all Birula’s specimen labels, a date in parentheses refers to European (new, Gregorian) calendar; date outside parentheses refers to the old (Julian) calendar used in Russia before 1918. The difference between two calendars was 12 days in the 19th century, and 13 days in the 20th).	The first detailed description of <i>female</i> syntypes: Russian Empire, Batum Province, Lasistan [now Turkey, <i>Artvin Province</i>], Çoruh River, Ardanuç, in houses, 5(17) July 1898, 2 ♀ subad. (ZISP 942), K. M. Deryugin leg. See Deryugin (1899) for the first-hand report of his Çoruh expedition. Existence of these specimens has been first confirmed in print by Fet (1989a, 1989b); see also Fig. 2.	<i>Calchas nordmanni</i> Birula, 1899
Birula, 1905: 130–131 (in German, without figures)	The first description of a single <i>male</i> (which does not belong to the type series), 1 ♂ ad. (GNM 212), Kars Province [now Turkey, <i>Erzurum Province</i>], Oltu District, N of Oltu, border post Erük [now Örik], 30 May (12 June) 1904, E. König leg. This specimen still exists in GNM (Vera Pkhakadze, pers. comm., 2009).	<i>Calchas nordmanni</i> Birula, 1899
Birula, 1911: 175–177, figs. 2–3 (in German)	A new series of 10 specimens from Batum Province [now Turkey, <i>Artvin Province</i>]: 2 ♀ ad., 1 ♂ ad., 2 ♂ juv., 5 ♀ juv., Lomashen (Lomasheni) near Artvin, 10 (23) June 1909, P. V. Nesterov leg. The first illustration of genital area emphasizing prepectal plate of female (fig. 3) and its absence in male (fig. 2). Of all these specimens, only one is preserved (ZISP 1342, see Fig. 2).	<i>Calchas nordmanni</i> Birula, 1899
Birula, 1912: 124 (in German, without figures)	Another new series of 10 specimens from the Caucasian Museum in Tiflis (now GNM, Tbilisi, Georgia) from the environs of Artvin (Khakhauch, Lomashen, Svetibar), and Oltu (Anzov). The important adult male from Lomashen ([Lomasheni, 5 km E of Artvin], July 1911, Yu. N. Voronov leg.) exists as ZISP 1395 (see Fig. 2; redescribed by Vachon, 1971). At least 8 other specimens (from Khakhauch, Svetibar, and Anzov) still exist in GNM (label data by Vera Pkhakadze, pers. comm., 2009, and reconstructed from Birula, 1912, 1917b, and other sources): Russian Empire, Batum Province [now Turkey, <i>Artvin Province</i>]: 1 ♀ ad., 1 ♀ subad., 1 ♀ juv. (GNM 243, two specimens exist), Khakhauch, Keniya Mts., left bank of Çoruh River, SE Artvin, July 1911, Yu. N. Voronov leg.; 3 ♀ juv., 1 ♂ juv., 1 ♀ pull. (GNM 211) Svetibar [Svetibari] near Artvin, July 1911, Yu. N. Voronov leg.; Kars Province [now Turkey, <i>Erzurum Province</i>], 1 ♀ juv. (GNM 519), Oltu District, Anzov [now Anzav], 24 August (6 September) 1905, E. König leg. (Birula, 1912: 124; 1917a: 149; 1917b: 154).	<i>Calchas nordmanni</i> Birula, 1899
Birula, 1917a: 138–153, figs. 11–15; Birula, 1917b: 143–159, pl. II, figs. 1–9, pl. IV, figs. 1–2 (original books in Russian, both available also in English translation).	Two 1917 books summarized all information on <i>Calchas nordmanni</i> studied by Birula since 1899; all this material originated from Batum or Kars Provinces of the Russian Empire (now Artvin and Erzurum Provinces of Turkey). Birula (1917b: 144) published a list of ZISP collection which then included 17 specimens: 2 ♀ syntypes from Ardanuç; a series of 9 (not 10 as in Birula, 1911) specimens from a Lomashen collection by P. V. Nesterov in 1909 (see above), plus the following new material collected in 1910–1911: Batum Province [now Turkey, <i>Artvin Province</i>]: 1 ♀ ad., Çoruh River, near Borçka Village, 15 (28) May 1910, P. V. Nesterov leg.; 1 ♂ juv., 2 ♀ juv., ear Artvin, 29 May (11 June) 1912, 1 ♀ ad., B. Lindholm leg.; Kars Province [now Turkey, <i>Erzurum Province</i>]: 1 ♂ juv., Oltu District, near Oltu, 12 (25) July 1910, P. Nesterov leg. Of these 17 specimens, only four still exist in ZISP collection (ZISP 942, 1393, 1394). It also includes 1 ♂ (ZISP 1395) from Artvin (1911, Voronov leg., originally listed by Birula, 1912: 124 for the Caucasian Museum), redescribed by Vachon (1971). See Fig. 2 for further details.	<i>Calchas nordmanni</i> Birula, 1899

Vachon, 1971: 406–408, figs. 1–12	1 ♂ (ZISP 1395), from Artvin, redescribed (collector's name misspelled as "N. Voronin"); see Fig. 2 and also Birula (1912, 1917a, 1917b).	<i>C. nordmanni</i> Birula, 1899
Kinzelbach, 1980: 169–174, figs. 1–5	Turkey, <i>Artvin Province</i> , Yusufeli, 30 April 1971 (ZMUH), C. Kosswig leg.; <i>Erzurum Province</i> : 1 ♀ (ZMUH), Tortum, 1970, C. Kosswig leg. (Kinzelbach, 1980, figs. 3–4); <i>Siirt Province</i> : Siirt, 18 and 20 June 1972 (ZMUH), C. Kosswig leg.; <i>Antalya Province</i> [listed incorrectly as "Antakya" on pp. 169 and 174!]: 1 ♀ subad. (NMM), "20 km N of Kumluca", 12 August 1972, R. Kinzelbach leg. (Kinzelbach, 1980, figs. 1–2).	<i>C. nordmanni</i> Birula, 1899 (Tortum, Yusufeli). <i>C. birulai</i> , sp. nov. (Siirt). <i>C. gruberi</i> , sp. nov. (Antalya).
Francke & Soleglad, 1981: 245	Turkey, 1 specimen [♀] (MNHN RS 6452), 23 April 1971, "Bilejik" [<i>Şanlıurfa Province</i> , Birecik, see Introduction], [J. Garzoni leg.], det. M. Vachon.	<i>C. birulai</i> , sp. nov.
Kinzelbach, 1982: 58	Turkey, <i>Erzurum Province</i> : Tortum, April 1970 (NMM 0203), C. Kosswig leg.; <i>Şanlıurfa Province</i> : Urfa [now Şanlıurfa], Karacadağ Mts., 1200 m a.s.l., 18 April 1981 (NMM 0500), W. Heinz leg.; <i>Antalya Province</i> , "15 km NE of Kumluca", 12 August 1972 (NMM 0250), R. Kinzelbach leg. (same specimen as reported in Kinzelbach, 1980).	<i>C. nordmanni</i> Birula, 1899 (Tortum) <i>C. birulai</i> , sp. nov. (Şanlıurfa) <i>C. gruberi</i> , sp. nov. (Antalya)
Kinzelbach, 1985, Map IV	Turkey, general (estimated?) range map. The range is projected far toward Black Sea coast (Rize and Trabzon Provinces) and into the southeast Turkey (Hakkari Province) and northern Iraq, which was not confirmed by published specimens.	<i>C. nordmanni</i> Birula, 1899 (northeast) <i>C. gruberi</i> , sp. nov. (Antalya). <i>C. birulai</i> , sp. nov. (Birecik)
Vachon & Kinzelbach, 1987: 99	Turkey, general range map, repeats Kinzelbach's (1985) map IV but adds Bilecik in the northwest [Birecik! - see Introduction; in the text, "region of Birecik" (different spelling!) is mentioned; depository and specimen data unspecified; refers to MNHN RS 6452].	<i>C. nordmanni</i> Birula, 1899 (northeast) <i>C. gruberi</i> , sp. nov. (Antalya) <i>C. birulai</i> , sp. nov. (Birecik)
Sissom, 1988: 272	Greece, Samos Island: 1 ♂ subad. (FMNH), south slope of Mt. Spiliani, 2 km N of Pithagorion, 23 April 1979, A. Riedel leg.	<i>C. gruberi</i> , sp. nov. (tentative assignment)
Kovařík, 1997: 184	Turkey, <i>Dişarbakır Province</i> : Kavurma Köyü, 10 km NE Ergani, 1400 m a.s.l., 39°41'E, 38°19'N, 27 April 1989, "2 juvs." (HNHM), G. Fabian, G. Ronkay, & L. Ronkay leg.; <i>Şanlıurfa Province</i> : Halfeti, 1990, "5 juvs." (HNHM), G. Ronkay leg.; Halfeti, valley of Euphrates, 500 m a.s.l., 15–22 April 1990, "3 juvs." (HNHM), B. Herzog & G. Ronkay leg. See text for details on the specimens.	<i>C. birulai</i> , sp. nov.
Fet & Braunwalder, 2000: 18	Turkey and Greece, general range (fig. 6). New localities listed (F. Kovarik, pers. comm., specimen data unspecified): Turkey, <i>Adıyaman Province</i> : Nemrut Dağı (fig. 6, locality 7, incorrectly placed on map; <i>Malatya Province</i> : Malatya (fig. 6, locality 6); <i>Şanlıurfa Province</i> : Halfeti (fig. 6, locality 5); <i>Antalya Province</i> : "Antakya" (fig. 6, 4) [incorrect, should be Antalya – F.K.]; Greece, Megisti (=Kastelorizo) Island (I. Stathi/NHMC, pers. comm.) (fig. 6, locality 3). The map includes Bilecik in the northwest (fig. 6, locality 1) [should be Birecik! - see above.]. The range, following Kinzelbach (1985), is projected toward Black Sea coast and into northern Iraq, which was not confirmed by published specimens (N Iraq is first confirmed in the present paper; R. Kinzelbach, pers. comm.)	<i>C. nordmanni</i> Birula, 1899 (northeast) <i>C. birulai</i> , sp. nov. (Halfeti, Malatya, Nemrut Dağı) <i>C. gruberi</i> , sp. nov. (Antalya, Megisti)
Stathi & Mylonas, 2001: 290, 293	Greece, Megisti (=Kastelorizo) Island (Crete), southeastern part of the island, Mandraki, Paleokastro (NHMC), "big populations", specimen data unspecified.	<i>C. gruberi</i> , sp. nov. (tentative assignment)
Crucitti & Vignoli, 2002: 458–459	Turkey, <i>Artvin Province</i> , Çoruh River, near Artvin, and between Artvin and Yusufeli, July–August 1999 [P. Crucitti & V. Vignoli leg.], depository and specimen data unspecified. Also mentioned (as unpublished data) by Crucitti, 1999: 87.	<i>C. nordmanni</i> Birula, 1899
Karataş & Çolak, 2005: 4	Turkey, <i>Gaziantep Province</i> : Şahinbey, Güllüce Village, lower slopes of Mt. Ellezi, 13 September 2003, 1 ♂, 1 ♀ (ZDNU 2003/524/1-2); Şahinbey, Güllüce Village, 21 September 2003, 1 ♂ (ZDNU 2003/573/1), 1 ♀ (ZDNU 2003/573/2) [A. Karataş & M. Çolak leg.]	<i>C. birulai</i> , sp. nov.
Kamenz & Prendini, 2008: 43, pl. 62	Turkey, <i>Artvin Province</i> : 1 ♀ (AMNH [LP 2246]), Ardanuç [misspelled "Ardanuç"], 26 August 2001, A. Karataş leg.; <i>Gaziantep Province</i> : 1 ♂ (AMNH [LP 4333]), Şehitkamil District, İncesu Köyü, 7 May 2005, E. Aydın [Yağmur] leg. (listed as "Antep-Şehitkamil: İncesu Köyü"). Also 1 ♀ (MNHN RS 6452, see above) from Birecik is listed, as "Bilejik".	<i>C. nordmanni</i> Birula, 1899 (Ardanuç) <i>C. birulai</i> , sp. nov. (İncesu Köyü, Birecik)

Table 1: Specimens and records listed in the literature as *Calchas nordmanni*.

with the identical label data exists (e.g. an opilionid *Zachaeus anatolicus*, see Snegovaya & Starega, 2008: 73). A large reproducing population of *C. nordmanni* was discovered by the NMHC staff on the Greek island of Megisti (=Kastelorizo, the easternmost point of Greece) (Fet & Braunwalder, 2000; Stathi & Mylonas, 2001). Both Samos and Megisti are located very closely to the Anatolian coast.

Kovářík (1997), based on new collections by Hungarian zoologists, listed three new localities in southeastern Turkey (Diyarbakır, Malatya, and Şanlıurfa Provinces; HNHN). Fet & Braunwalder (2000) referring to a personal communication of F. Kovářík, reiterated two of those localities, and added (based on FKCP collection) two more localities: Nemrut Dağı (Adıyaman Province) and Antakya; the latter, however, was reported in error (corrected here; should be Antalya).

Crucitti & Vignoli (2002: 459) collected *Calchas nordmanni* in northeastern Turkey, close to type localities in Çoruh valley. Karataş & Çolak (2005) and Kamenz & Prendini (2008) added two new localities from southeastern Turkey (Gaziantep Province).

Our research group (Soleglad & Fet, 2003a, 2003b; Fet et al., 2004, 2006a, 2006c; Graham & Fet, 2006) further investigated the phylogenetic position of *Calchas* and published important new morphological data on this genus.

Ragnar Kinzelbach (pers. comm., May 2009) kindly shared with us unpublished materials and data on *Calchas* from Turkey, and also pointed at an unpublished specimen from northern Iraq (famous Geli Ali Beg waterfalls in Kurdistan), a new country record for *Calchas* (see below and map on Fig. 38). He also reports a sighting of a scorpion (not collected) that very likely could be *Calchas*, in northern Syria, Latakia Governorate, Slinfah (Slennfê), 35.583°N, 36.183°E, oak forest. This scorpion was seen by the late Prof. Dr. Adel Hamwi, who started a scorpion collection at the Department of Zoology, University of Damascus. We include this unconfirmed locality, under question, in our map (Fig. 38).

Our new morphological analysis, presented below, demonstrates that the taxon currently called "*Calchas nordmanni*" in fact includes *three* well-defined, allopatric species. We describe two new species, and restrict *Calchas nordmanni* Birula, 1899 to the populations from northeastern Turkey, approximately to the original area characterized by Birula. In Table 1, we list all *published* data on specimens and localities identified as *Calchas nordmanni*. Part of this material is assigned to two new species established in this paper, and the majority of these specimens have been studied by us.

This paper continues a series of publications on Iuridae that we launched recently with an important discovery of neobothriotaxy in *Iurus* (Soleglad et al., 2009).

Material and Methods

Abbreviations

The institutional abbreviations listed below and used throughout are mostly after Arnett et al. (1993).

AMNH, American Museum of Natural History, New York, New York, USA

FKCP, collection of František Kovářík, Praha, Czech Republic

FMNH, Field Museum of Natural History, Chicago, Illinois, USA

GNM, Georgian National Museum, Tbilisi, Georgia

HNHN, Hungarian Museum of Natural History, Budapest, Hungary

MNHN, Muséum national d'Histoire naturelle, Paris, France

NMHC, Natural History Museum of Crete, Irakleio, Crete, Greece

NMM, Naturhistorisches Museum, Mainz, Germany

NMW, Naturhistorisches Museum Wien, Vienna, Austria

VF, collection of Victor Fet, Marshall University, Huntington, West Virginia, USA

ZDNU, Zoology Department, Niğde University, Niğde, Turkey

ZISP, Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia

ZMUH, Zoologisches Institut und Zoologisches Museum, Universität Hamburg, Hamburg, Germany

ZSRO, Zoologische Sammlung der Universität, Rostock, Germany

Terminology and conventions

The systematics adhered to in this paper is current and therefore follows the classification as established in Fet & Soleglad (2005) and as modified Fet & Soleglad (2008). Terminology describing pedipalp chelal finger dentition follows that described and illustrated in Soleglad & Sissom (2001), that of the sternum follows that in Soleglad & Fet (2003a), and the metasomal and pedipalp carination, and leg tarsus armature follows that described in Soleglad & Fet (2003b). Techniques using maximized morphometric ratios follow those described in Fet & Soleglad (2002: 5) and further amplified in Soleglad & Fet (2008: 57–69).

SEM microscopy

To investigate scorpion morphology, various structures were dehydrated in an ethanol series (50, 75, 95, and two changes of 100%) before being dried and coated with gold/palladium (ca. 10 nm thickness) in a Hummer sputter coater. Digital SEM images were acquired with a JEOL JSM-5310LV at Marshall University, West Virginia. Acceleration voltage (10–20 kV), spot size, and working distance were adjusted as necessary to

№ входящего журн.	Число экз.		Полъ.	МѢСТО СБОРА.	Время сбора.	КОЛЛЕКТОРЪ.	Кто определятъ.	ОТМѢТКА.
	Слупт.	Мнр. прр.						
942. 2			♀	ср. Ардакуча (в д. Саласъ)	5 VII 1898	Катерининъ Ф. Ф.		
943. 3			♂	Батумская обл., окр. Гургуль (в д. Артабукта)	29 V 99	Велингольскъ А. И.		
1593. 1			♂	Карская обл. Вер. м. д. Гургуль	12 VII 1910	Н. Нестеръ		№ 17-1911.
1594. 1				Батумская обл. Артабукта	10 VII 1909	"		Васило " Виле
1595. 1			♂	Батумская обл., Мама-мем у подножья г. Арабикъ	VII 1911	Ю. Боронъ		Поланъ В. П. д. Кр. Чаръ Vachon 14. 69. Возвр. 3 VII 72

Registration number	Number of specimens			Gender	Locality	Date [“old calendar”]	Collector	Who identified	Notes
	in alcohol	dry	microscope slides						
942	2			♀	Transcaucasia, Lasistan, Ardanaç town (in houses)	5 July 1898	K. Deryugin	Sp. typ.	
943	4 (corrected from 5)			1 ♀ ad. + 2 ♀ + 1 ♂ + juv.	Batum Province, near Artvin town	29 May [1]1912	V. Lindholm	A. Birula	
1393	1			♂ juv.	Kars Province, near Olty village	12 August 1910	P. Nesterov	“	No. 17 - 1911
1394		1			Batum Province, Artvin District, Lomashen village	10 July 1910 ¹	P. Nesterov	“	in dry condition
1395	1			♂	Batum Region, Lomashen “at the foot of g. Artvin” ²	July 1911	Yu. Voronov	“	sent to Prof. Vachon in Paris July [19]69, returned 3 July [19]72

optimize resolution, adjust depth of field, and to minimize charging.

Specimens examined

We examined a total of 61 specimens (FKCP, HNHM, MNHN, NMM, NMW, VF, ZMUH) from northeastern, southern and southeastern Turkey, as well as one specimen from Samos Island, Greece (FMNH), and one juvenile specimen from Megisti Island, Greece (VF). In our opinion, the majority of the examined specimens belong not to *Calchas nordmanni* Birula, 1899, but to two new, geographically disjunct species. These two species are described below and compared to *C. nordmanni*. A detailed list of specimens and label data are provided under each species.

❖ **Notes:** ¹ should be 10 June 1909 (see Birula, 191: 175; 1917b: 144, 158); ² the label is confusing; in Russian, the first-letter abbreviation “g” could stand for both “town” (“g[orod]”) and “mountain” (“g[ora]”). Artvin is a spectacular city on a mountaintop above the Çoruh River. A popular Turkish song says: *Ölmeden önce Parisi değil Artvini Gör arkadaşım...* (“Not Paris, my friend, see Artvin before you die”).

Figure 2: *Calchas nordmanni* Birula in ZISP. **Top**, the original handwritten collection list in the museum journal from ZISP (courtesy V. A. Krivochatsky, ZISP). **Bottom**, Translation from Russian. Two first entries (ZISP 942 and 943) are in A. A. Birula’s hand, in “old” (pre-1918) Russian orthography. Note that ZISP 1395 male was loaned to M. Vachon in 1969, and returned in 1972 (see Vachon, 1971, for its redescription). Birula (1917b: 144) listed as in ZISP possession (without registration numbers) 17 specimens corresponding to lots 942 (two ♀ syntypes), 943 (1 ♀ ad., 1 ♂ juv., 2 ♀ juv.), 1393 (♂ juv.), and 1394 (Birula listed a large series, but only a single specimen still exists in ZISP), as well as 1 ♀ ad from Borçka (see Table 1). Of the 11 specimens listed in this museum journal, currently ZISP collection has only five, including two female syntypes. Lot ZISP 943 lot could not be found (V. A. Krivochatsky, pers. comm.) Lot ZISP 1395 (1 ♂ from Lomashen, Yu. Voronov leg.) was not listed by Birula (1917b) as in ZISP possession but this material was mentioned in the text (Birula, 1917b: 154). Additional Voronov material (Birula, 1912: 24 listed 8 specimens) and some other specimens studied by Birula, which belonged to the Caucasian Museum in Tiflis, are still deposited there (GNM, Tbilisi, Georgia, see Table 1).

Systematics

The systematics of superfamily Iuroidea has been discussed in detail in three recent papers: (1) Soleglad & Fet (2003b), a high-level cladistic analysis of extant scorpions, where Iuroidea was originally declared; (2) Fet et al. (2004), an analysis of the leg tarsal spination of Iuroidea, where a key to all six genera was provided and genus *Hoffmanniadrurus* was erected; and (3) Fet & Soleglad (2008), a cladistic analysis of Iuroidea with an emphasis on subfamily Hadrurinae, where *Hoffmanniadrurus* was resurrected.

Order **SCORPIONES** C. L. Koch, 1850
Suborder Neoscorpiones Thorell et Lindström, 1885
Infraorder Orthosterni Pocock, 1911
Parvorder Iurida Soleglad et Fet, 2003
Superfamily Iuroidea Thorell, 1876
Family Iuridae Thorell, 1876

Genus *Calchas* Birula, 1899

Type species *Calchas nordmanni* Birula, 1899, by original designation.

Synonyms:

Paraiurus Francke, 1985. See Fet & Madge (1987) and Sissom & Fet (2000) for details on synonymy.

Taxonomic History

The taxonomic position of *Calchas* remained vague for decades. Birula (1899, 1905) placed it in Chactidae but remarked in detail on its difference from other chactids (specifically comparing *Calchas* to New World Brotheinae and Chactinae). Eventually, Birula (1917a: 138, 164) created for this genus a separate monotypic subfamily, Calchinae. Much “missing link” talk has been made (Birula, 1917a, 1917b) of its *tibial spur*, unique for non-buthids, which indeed could be a plesiomorphic feature. Other features appeared to place *Calchas* closer to *Chaerilus*, and for a while it was listed under Chaerilinae (within Chactidae) (Werner, 1934; Millot & Vachon, 1949). The precarious family status of *Calchas* has not been challenged until Vachon (1971) redescribed it and cautiously indicated “affinities between Chactidae and Vaejovidae” – i.e. between *Calchas* and *Iurus*! In the mid-1970s, Vachon (1974) and Stahnke (1974) simultaneously launched a major reassessment of scorpion family-group taxa, especially so-called “chactoids” (trichobothrial Type C scorpions). In an important paper that followed in the same revisionary vein, Francke & Soleglad (1981) reestablished family Iuridae, and demonstrated that *Calchas* and *Iurus* are sister genera, therefore moving *Calchas* from Chactidae to Iuridae (subfamily Iurinae). Calchinae Birula, 1917 became a synonym of Iurinae Thorell, 1876; see Soleglad & Fet (2003b: 110) for details. This relationship was further emphasized when Soleglad & Fet (2003b) limited Iuridae to these two Mediterranean genera, separating New World family Caraboctonidae.

Diagnosis

General appearance. Small to medium sized scorpion (22–52 mm); chelae robust and carinate, metasoma with well developed carinae. Pectinal tooth counts small, 5–9 male, 5–8 female. Carapace granular,

highly tapered anteriorly with small narrow indentation; median eyes and tubercle small, located on anterior one-quarter; two lateral eyes; mediolateral ocular carinae of medium development.

Important taxonomic characters. Legs III–IV with tibial spur; ventral surface of tarsus covered with large socketed setae and populated with irregular spinule clusters medially on at least its base. Femoral trichobothrium *d* located on dorsal surface; *e* located considerably distal of *d*; chelal trichobothrium *db* positioned at base of fixed finger; *Db* located dorsally of digital (*DI*) carina, not in line with *Eb* series; patellar trichobothrium *i* located on dorsal surface, adjacent to *DI* carina. Well developed prepectinal plate present in female; stigma short and sub-oval in shape. Large ventral accessory (*va*) denticle of cheliceral movable finger located at finger base; highly developed serrula present. Hemispermatophore lamina lightly sclerotized, spatulate in shape; lamellar internal base with triangular-shaped protuberance; capsular area with moderately developed acuminate process with subtle truncated tip. Chelal finger median denticle (*MD*) groups number 6–8; inner denticles (*ID*) 5–7. Patellar dorsal (DPS) and ventral (VPS) spurs weakly developed and generally doubled.

Detailed Analysis of Morphology at Genus Level

Here, we describe basic morphology specific to genus *Calchas*. Where appropriate, we also highlight three major sources that deal with *Calchas*: Birula (1917a, 1917b), where a detailed low-level description is provided of the type species *C. nordmanni*; Vachon (1971), where excellent illustrations of the trichobothrial pattern, chelicerae, leg, and chelal finger dentition are provided for a male of *C. nordmanni* from Birula's original collection; and Kinzelbach (1980), providing a detailed survey of all *Calchas* reports plus additional data on some morphology.

Carapace

The carapace of *Calchas* has essentially the same structure across all three species, exhibiting medium to heavy granulation, a highly tapered anterior edge with a small narrow indentation, and small median eyes positioned well ahead of the middle (Fig. 3). The ratio of median eye position (measured from carapace anterior edge to center of median eyes) to the carapace length is less than one-third, ranging 0.241–0.310 (0.289) [7]. The median eyes and tubercle are relatively quite small, the width of eye tubercle as compared to the carapace width at that position ranges 0.138–0.178 (0.157) [6]. [Incidentally, the median eye position and width mor-

phometrics in *Calchas* match or exceed that reported by Soleglad & Fet (2008: fig. 126) for the genera *Pseudo-uroctonus* and *Uroctonites* in their revision of Vaejovidae. As with *Calchas*, scorpions of these genera have very small median eyes and tubercles which are situated well in advance of the middle.] *Calchas* has two lateral eyes per side, the posterior eye as large or slightly larger than the anterior eye (also see species level illustrations, Fig. 44 and Fig. 61). Diagnostic of family Iuridae are the well-developed mediolateral ocular carinae found on the anterior third of the carapace. In *Calchas* these carinae are of medium development, not as defined as in genus *Iurus*.

The anterior indentation and mediolateral ocular carinae of the carapace were first defined as diagnostic of Iuridae by Fet et al. (2004: 23, figs. 53, 54) and presented as characters in their cladistic analysis of Iuroidea (Fet & Soleglad, 2008: character 23 (state=1), character 24 (state=1)) where both were synapomorphies for Iuridae.

Birula (1917a) provides a very detailed description of the carapace of *C. nordmanni*, from which we provide relevant excerpts:

“...The carapace ... elongated; ... its anterior margin with a shallow notch opposite the ocular tubercle; the whole surface of the carapace covered with very fine but distinctly marked dense granulation ... Ocular tubercle clearly shifted anteriorly, set at a distance from the anterior margin of approximately 1/4 of the length of the carapace; it is comparatively small, flat ... eyes are small, the distance between them being not more than the diameter of an eye. The lateral eyes are very small, not greater than the surrounding tubercles, black, shining, separated from the margin of the carapace by a marginal crest ...”.

Kinzelbach (1980: fig. 4) illustrates the lateral eyes of *C. nordmanni* showing two lateral eyes within the low profile tubercle, the anterior eye slightly larger than the posterior eye. However, shown posterior to the tubercle is another possible smaller eye as suggested by Kinzelbach. Francke & Soleglad (1981: 245) state that the specimen they examined had three lateral eyes on the left side. We have examined many specimens of all three species and could only detect two lateral eyes, as illustrated in Figs. 3, 44, and 61. However, the latero-anterior edge of the carapace is granulate, granules sometimes occurring within the lateral eye tubercle, thus darkly pigmented as the eyes. We suspect these darkened granules could be easily mistaken for additional eyes.

Mesosoma

The *Calchas* **sternum** (Fig. 4) conforms to the type 2 sternum as defined by Soleglad & Fet (2003a). This

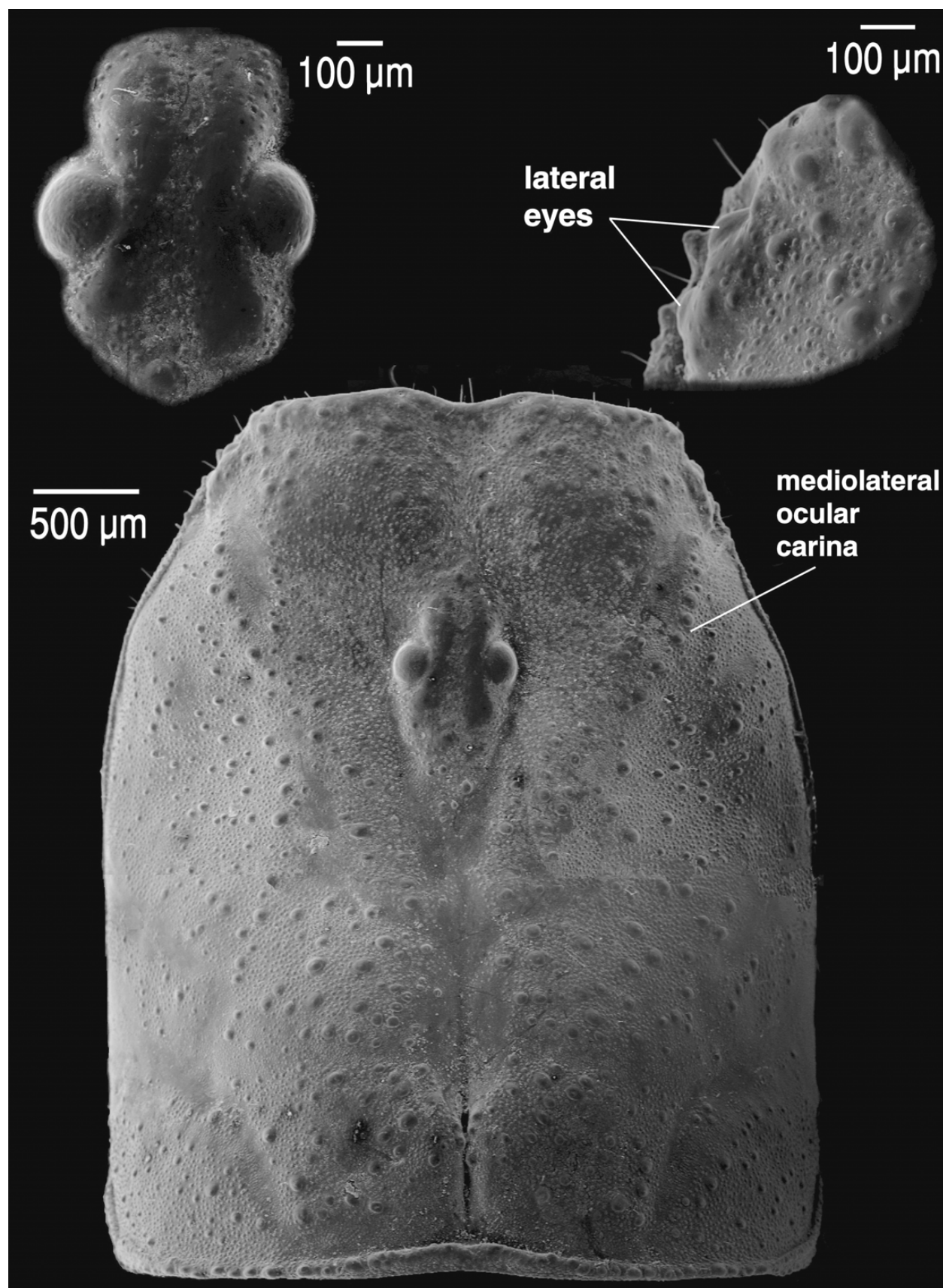


Figure 3: Carapace and close-up of median and left lateral eyes in *Calchas gruberi*, **sp. nov.**, female, Antalya, Turkey. Lateral eyes and mediolateral ocular carina indicated.

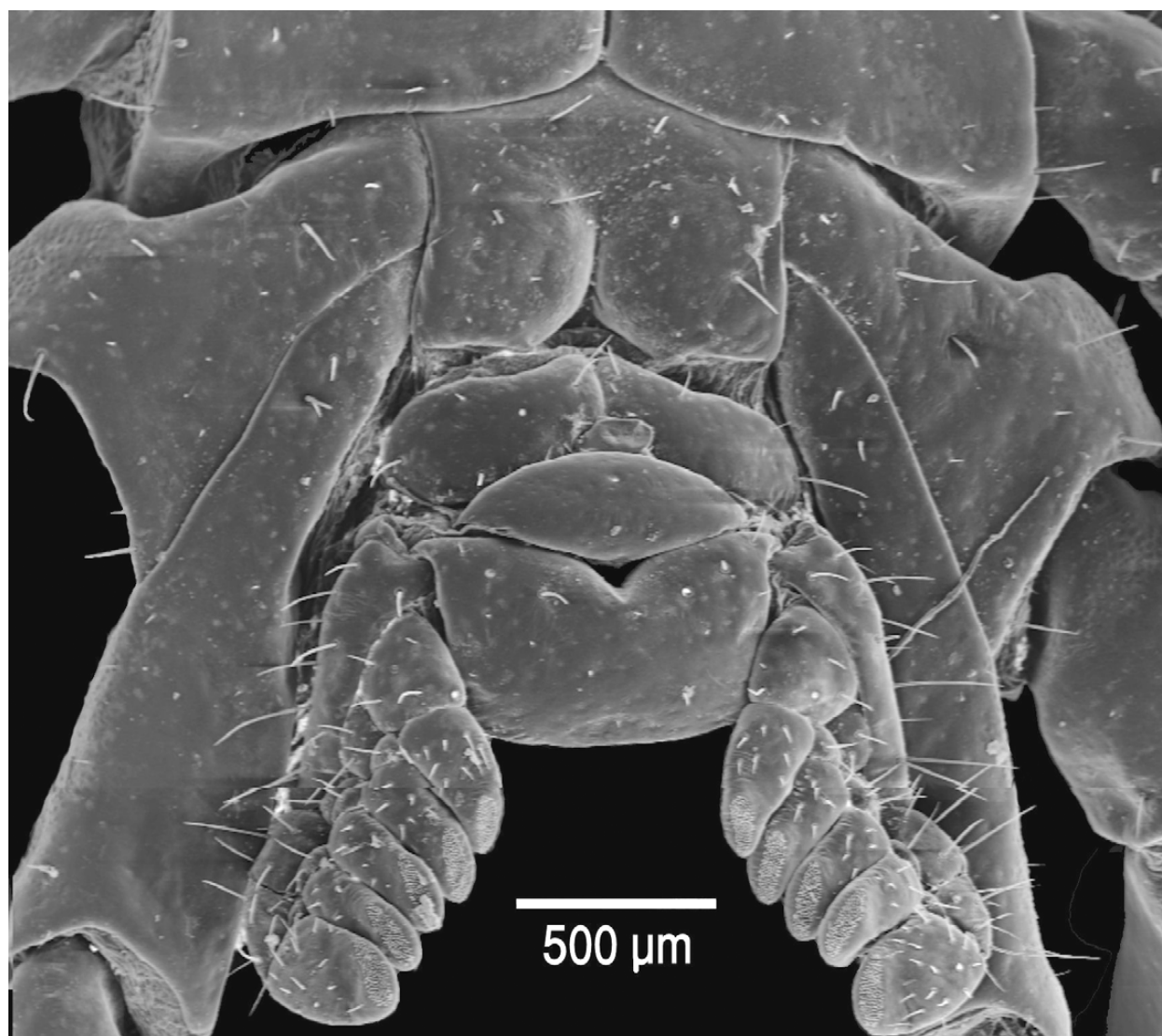


Figure 4: Sternopectinal area of *Calchas birulai*, **sp. nov.**, female, Nemrut Dağı, Turkey, showing sternum, genital operculum, prepectinal plate, basal piece, and pectines.

structure is wider than long with a well defined posterior emargination forming two convexed lateral lobes. The apex is not particularly deep or offset from the lobes. The sternum tapers anteriorly. The entire sternocoxal area of *C. gruberi*, **sp. nov.**, is illustrated in Soleglad & Fet (2003a: fig. 8; referred to as *C. nordmanni*).

The **genital operculum** exhibits considerable sexual dimorphism in *Calchas*. In the female (all three species are illustrated in Fig. 35), the individual sclerites are much wider than long and are fused medially most of their length. In the male, each sclerite is subtriangular in shape, roughly as long or longer than wide, separated most of their length. In addition, in the male, well-developed **genital papillae** are visible between the two plates, but not extending posterior of the operculum. Fet & Soleglad (2008: character 10 (state=0)) hypothesized this genital papillae configuration symplesiomorphic for family Iuridae (i.e., same configuration found in *Iurus*)

where it also existed for outgroup *Chaerilus* (parvorder Chaerilida).

Unique to genus *Calchas* is a considerably well-developed **prepectinal plate** always found only in the females of all ages (Figs. 5, 35). This plate, situated between the genital operculum and the pectinal basal piece, is fully sclerotized and is as wide as or wider than an individual operculum sclerite. In species *C. nordmanni* and *C. birulai*, **sp. nov.**, the prepectinal plate is somewhat swollen medially, making its length almost equal to that of the genital operculum. In species *C. gruberi*, **sp. nov.**, this plate is a little less swollen medially, thus having a more slender appearance though still quite well developed. The prepectinal plate is not found in the male.

This structure was first identified by Birula (1911: 176) and can be clearly seen on the illustrations of *C. nordmanni* by Birula (1911, fig. 3; 1917a, fig. 12B;

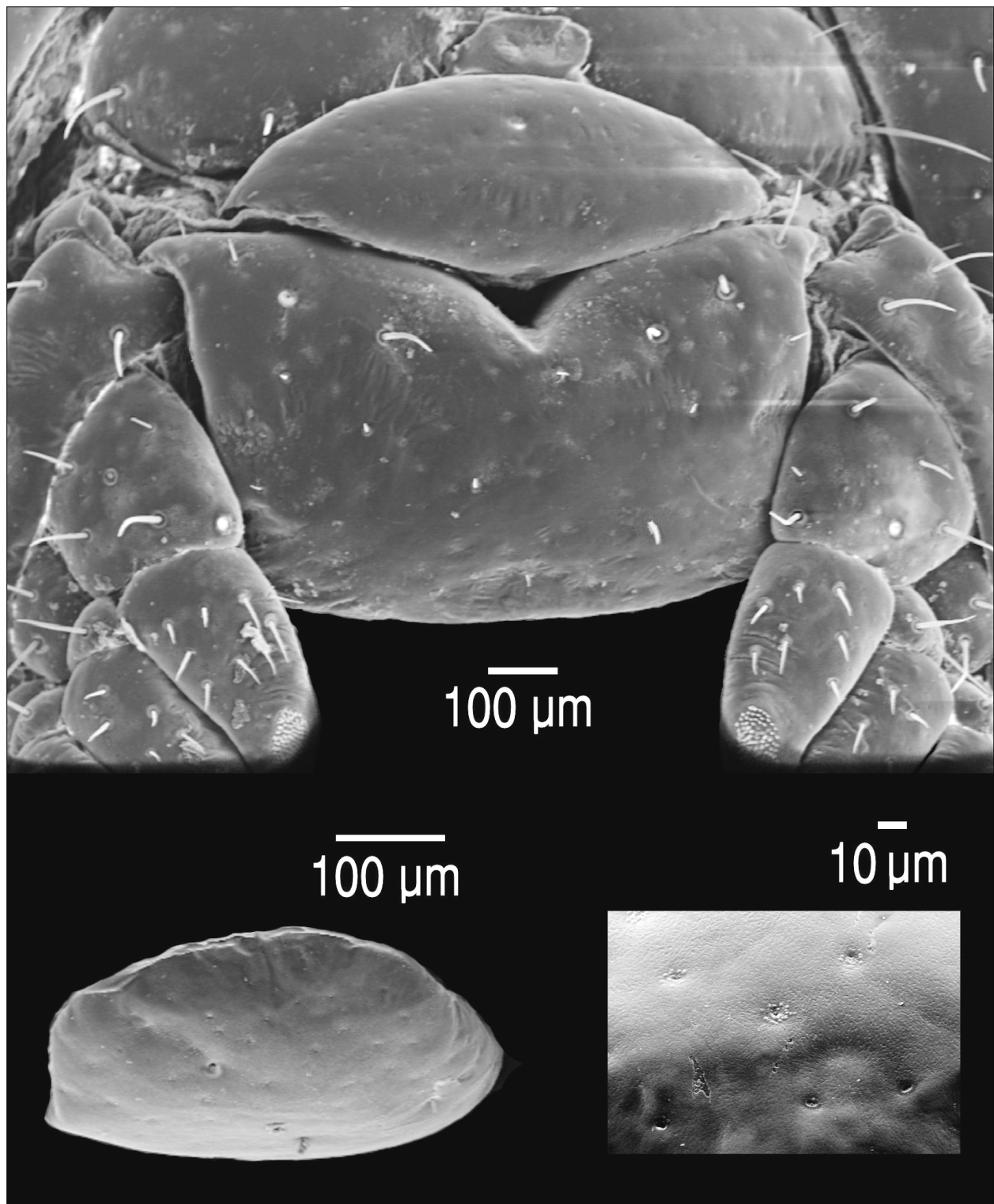


Figure 5: Prepectal plate in *Calchas*. **Top.** Close-up of prepectal plate of *Calchas birulai*, **sp. nov.**, female, Nemrut Dağı, Turkey. **Bottom.** Detached prepectal plate of *C. gruberi*, **sp. nov.**, female, Antalya, Turkey, and close-up showing surface of the plate.

1917b, Pl. II, fig. 2). It seems that after Birula, the prepectal plate in *Calchas* has *never* been mentioned—although at least the Birula (1911) paper published in

German was immediately accessible to the European scientists, and it clearly described this “...am Hinterrande der Genitalöffnung liegenden Querwulste; ein

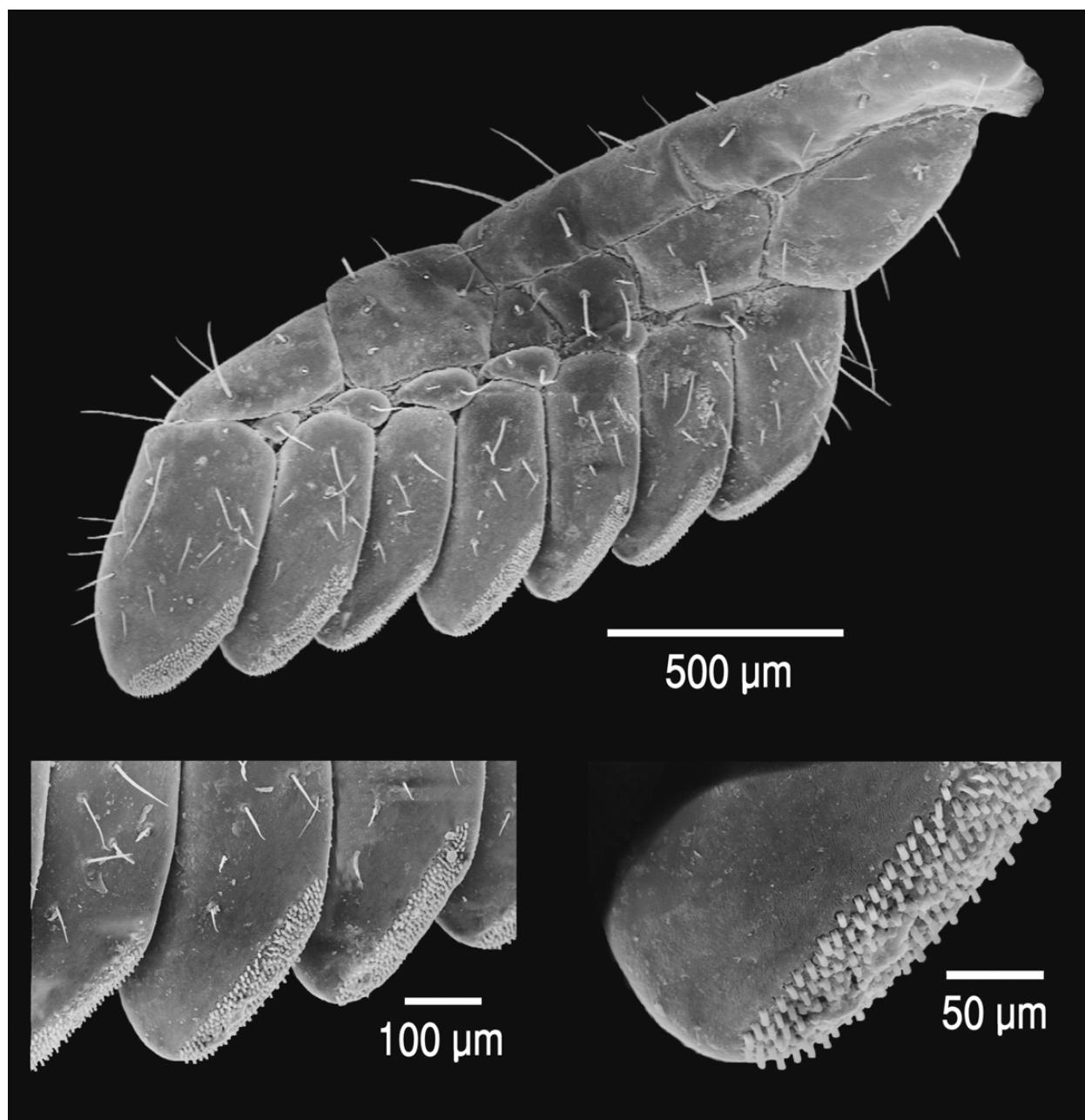


Figure 6: Pecten of *Calchas gruberi*, **sp. nov.**, female, Antalya, Turkey, showing close-up of peg sensilla.

solcher Querwulst fehlt bei den anderen mir bekannten Skorpionen. [a transverse thickening at the posterior end of the genital opening; such a transverse thickening is absent in all scorpions known to me].” The English translations (Birula, 1917a, 1917b), which appeared in the 1960s, describe this structure clearly: “an elliptical transverse thickening which is wanting in males...the transverse crest at the posterior end of the genital aperture is very well developed in females of any age” (Birula, 1917b: 152–153, transl. B. Munitz, 1965) and “elliptic transverse thickening present in female i.e. immediately behind genital aperture; same thickening

absent in male. ...Transverse ridge behind genital aperture clearly developed in female... the above-mentioned difference in structure of the genital area helps in distinguishing the sex of very small specimens of *Calchas*” (Birula, 1917a: 147–178, transl. J. Salkind, 1964). In the original Russian text, Birula also used non-specific terms “utolshchenie [thickening]” or “valik” [ridge], clearly having no established terminology for this unique structure.

The modern term “prepectinal plate” originates from Kjellesvig-Waering (1986) who claimed its existence in some fossil and extant scorpions between the

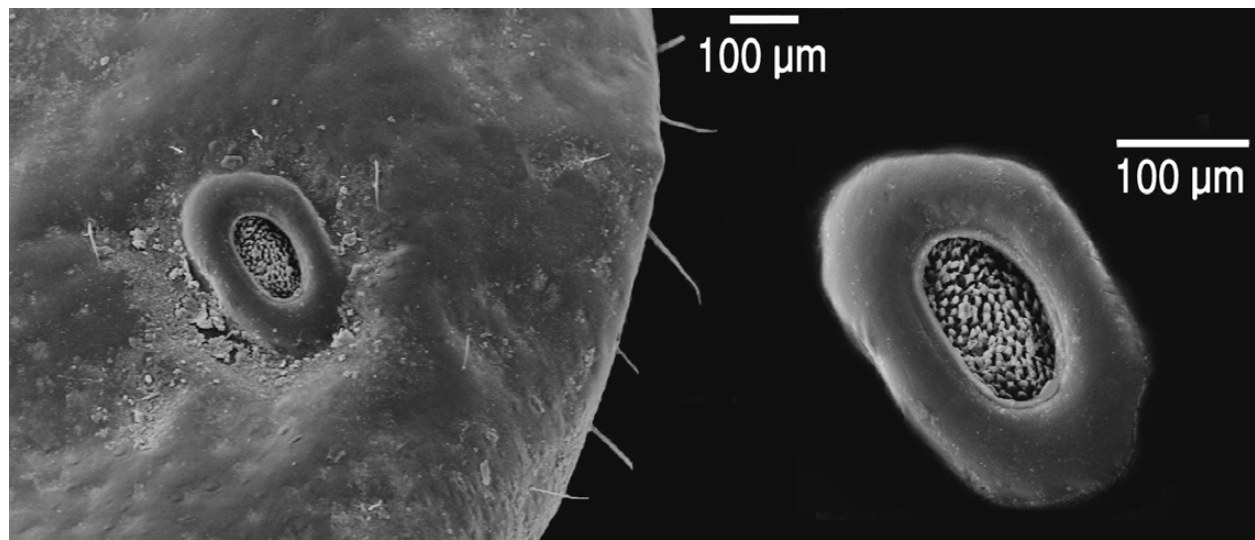


Figure 7: Fourth left lung stigma in *Calchas gruberi*, **sp. nov.**, female, Antalya, Turkey.

operculum (segment X) and the pectinal plate (segment XI). Existence of such a structure in fossil scorpions still has to be confirmed (J. Dunlop, pers. comm., 2008). This issue is important for general scorpion morphology since only seven mesosomal segments are currently accepted in scorpions, but Kjellesvig-Waering (1986) suggested that the prepectinal plate could indicate that the fundamental scorpion mesosoma should be considered as having eight segments; he also indicated existence of prepectinal plate in some *males*, but not *females* (*Calchas* has a reverse situation) of the extant New World Buthidae. Sissom (1990: 148) and Farley (1999: 125; 2001: 20, 25) reviewed this structure based on Kjellesvig-Waering (1986) but did not mention *Calchas*. We use this term, keeping in mind that it is unclear whether the structure discussed by Kjellesvig-Waering (1986) is homologous to the prepectinal plate found in *Calchas*. The function of the prepectinal plate is not known.

The **pectines** in *Calchas* are fully developed, exhibiting all major substructures common to most scorpions (Figs. 4, 6). Three anterior lamellae are present, the most basal significantly longer than the middle and distal lamellae. Middle lamellae are present but only extend below the basal anterior lamellae, the area below the middle and distal lamellae is occupied by these lamellae. The number of middle lamellae ranges from two to six (the largest number of six found in a male *C. gruberi*, **sp. nov.**, from the Greek island of Samos). Well-developed fulcra are present between the inner bases of pectinal teeth. The pectinal teeth are well-developed in *Calchas*, exhibiting well-defined sensorial areas on their inner distal edges. The sensorial areas are densely populated with peg sensilla, which are shaped as uniform elongated cylinders (see close-up in Fig. 6). The pectinal **basal piece** is well-developed in *Calchas*,

longer than the genital operculum in the female. Anterior edge exhibits a somewhat wide deep indentation.

Birula (1917a) says the following for the sterno-pectinal area in *C. nordmanni*:

“...sternum with a deep groove, running from the posterior margin to its middle and divided into three parts by shallower grooves ... the sternum is pentagonal, anteriorly noticeably narrowed ... the genital opercula of the male have the shape of a triangle with unequal sides ... the genital opercula of the female are very narrow and have the shape of transverse, elongate-oval ... in addition, there is a convex elliptical crest behind the genital pore of the female ...”.

In the species-level descriptions of *C. birulai*, **sp. nov.**, and *C. gruberi*, **sp. nov.**, we illustrate the sterno-pectinal area of both genders (Figs. 47, 52 and Figs. 64, 70).

The lung **stigmata** (spiracles) in *Calchas* are somewhat small, suboval in shape (Fig. 7). They are angled roughly 45° toward anterointernal direction. The fine structure of the posterior spiracle margin (Kamenz et al., 2005) can be seen in Fig. 7.

Chelicerae

In Figures 8–9, the dorsal and ventral surfaces of the *Calchas* chelicera are illustrated. This chelicera conforms to the definitive form as described for superfamily Iuroidea: ventral edge equipped with a large basal denticle (*va*), hypothesized as synapomorphic by Soleglad & Fet, 2003b (character 42, state=2) and Fet & Soleglad, 2008 (character 9, state=1). The dorsal edge has a single large subdistal (*sd*) denticle, classified as symplesiomorphic (Soleglad & Fet, 2001; Fet & Soleglad, 2008). In addition, we see, as characteristic of