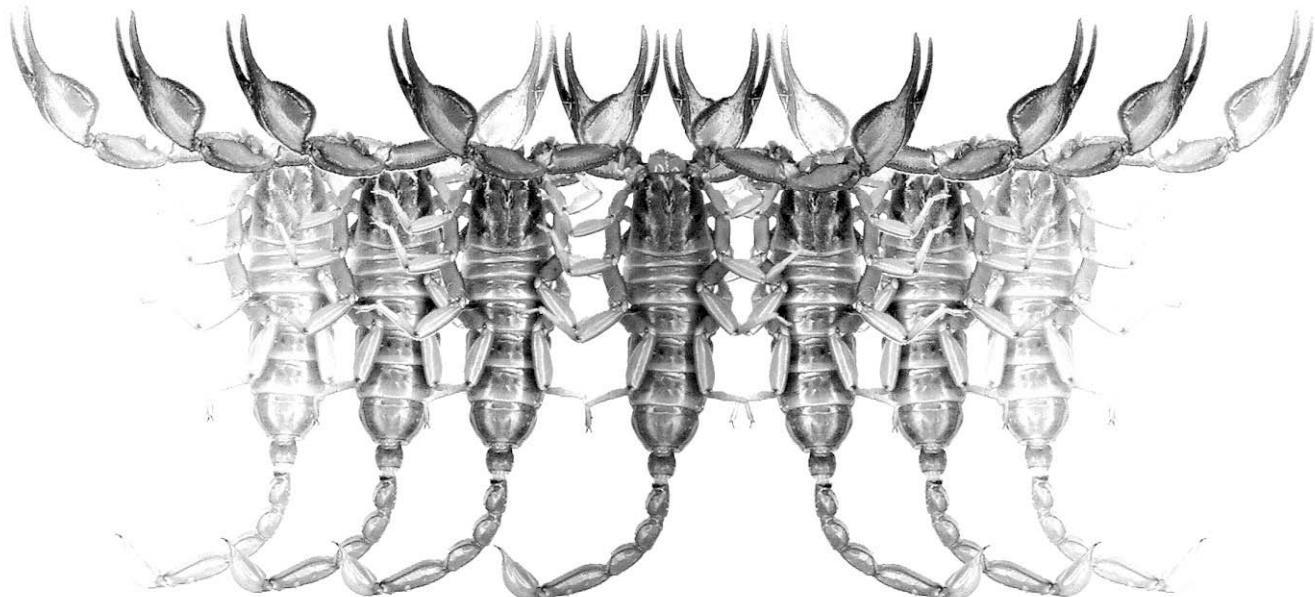


# *Euscorpius*

Occasional Publications in Scorpiology



**Etudes on Iurids, VI. Further Revision of *Calchas* Birula,  
1899 (Scorpiones: Iuridae), with a Description of a  
New Genus and Two New Species**

Ersen Aydin Yağmur, Michael E. Soleglad, Victor Fet & František Kovařík

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# *Euscorpius*

## Occasional Publications in Scorpiology

EDITOR: Victor Fet, Marshall University, ‘fet@marshall.edu’  
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# Etudes on iurids, VI. Further revision of *Calchas* Birula, 1899 (Scorpiones: Iuridae), with a description of a new genus and two new species

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<http://zoobank.org/urn:lsid:zoobank.org:pub:58F05E3F-13EA-4354-A067-466063E8B1D8>

## Summary

Several new *Calchas* populations are studied from Turkey, including specimens from Hakkari Province, which borders the northern edge of Iraq. A new genus, *Neocalchas*, gen. nov., and two new species, *Calchas anlasi*, sp. nov. and *C. kosswigi*, sp. nov., are described. The two genera, *Calchas* and *Neocalchas*, are diagnosed by their hemispermatophore structure, chelal finger dentition, telson morphometrics and setation, and trichobothrial topology of the pedipalp chela. Genus *Calchas* Birula, 1899 includes four species: *C. anlasi*, sp. nov., *C. birulai*, *C. kosswigi*, sp. nov., and *C. nordmanni*; genus *Neocalchas*, gen. nov., includes one species, *N. gruberi*, comb. nov. New diagnoses for genera *Calchas* and *Neocalchas* are provided as well as a key to the species of *Calchas*.

## Introduction

Fet et al. (2009) published the results of an extensive investigation of the somewhat rare scorpion genus *Calchas* (family Iuridae), which up to that point was considered monotypic. In their study, not only was a detailed analysis of the genus-level structures presented, but also the description of two new species. Their work was based on over 60 specimens obtained from several European museums. Following this work, Stathi et al. (2010) investigated the Greek Megisti Island population of *Calchas*. This present work, a continuation of the original Fet et al. (2009) and Stathi et al. (2010) effort, is based on the results of extensive collecting conducted by the first author (E.Y.). Many new populations from Turkey were investigated. Of special interest is the population collected in the extreme southeastern province of Hakkari, a province that borders the country of Iraq. Based on the analysis of these new populations, two new species, *Calchas anlasi*, sp. nov., and *C. kosswigi*, sp. nov., are described.

In addition to the two new species, new material representing all five species was studied. Of special importance was the availability and analysis of additional hemispermatophores of this genus providing key diagnostic characters for dividing the five species into two genera, *Calchas* and *Neocalchas*, gen. nov. The hemispermatophores of *Neocalchas gruberi* and *Calchas nordmanni*, which were instrumental in this analysis, had not been available in the earlier studies conducted by Fet et al. (2009) and Stathi et al. (2010).

New diagnoses for genera *Calchas* and *Neocalchas*, a key to the species of *Calchas*, and descriptions of the two new species are provided below. Biogeographical discussions, a detailed locality list of all known Calchinae reports (Appendix A), and a map are provided.

## List and distribution of species

*Calchas anlasi* Yağmur, Soleglad, Fet et Kovařík, sp. nov. (Turkey: Hakkari Province; Iraq: Arbil Province (not verified))

*Calchas birulai* Fet, Soleglad et Kovařík, 2009  
**(Turkey:** Adiyaman, Diyarbakır, Gaziantep, Kahramanmaraş, Kilis, Malatya, Mardin, Şanlıurfa Provinces)

*Calchas kosswigi* Yağmur, Soleglad, Fet et Kovařík, sp. nov. (**Turkey:** Siirt and Şırnak Provinces)

*Calchas nordmanni* Birula, 1899 (**Turkey:** Artvin and Erzurum Provinces)

*Neocalchas gruberi* (Fet, Soleglad et Kovařík, 2009), gen. nov., comb. nov. (**Turkey:** Antalya and Mersin Provinces; **Greece:** Megisti and Samos Islands)

## Methods and Material

### Abbreviations

The four-letter institutional abbreviations listed below and used throughout are mostly after Arnett et al. (1993), or introduced here to accommodate other collections: AZM: Alaşehir Zoological Museum, Celal Bayar University, Manisa, Turkey; FKCP, personal collection of František Kovařík, Prague, Czech Republic; FMNH, Field Museum of Natural History, Chicago, Illinois, USA; NHMC, Natural History Museum of Crete, Irakleio, Crete, Greece; NHMW, Naturhistorisches Museum Wien, Vienna, Austria; ZMUH, Zoologisches Institut und Zoologisches Museum, Universität Hamburg, Hamburg, Germany.

### Terminology and conventions

The systematics adhered to in this paper follows the classification as established in Fet & Soleglad (2005), as modified in Fet & Soleglad (2008), Fet et al. (2009), Kovařík et al. (2010), and Soleglad et al. (2012). 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). Hemispermatophore terminology follows that described in Fet et al. (2009) and Kovařík et al. (2010: 42). Trichobothrial nomenclature and hypothesized homologies are those described and illustrated in Vachon (1974). Techniques using maximized morphometric ratios follow those described in Fet & Soleglad (2002: 5), and further established in Soleglad & Fet (2008: 57–69) and Kovařík et al. (2010: appendix C). Statistical differences are stated in standard error ranges and the percentage of difference in the mean values (i.e., mean value difference (MVD)).

### Map generation software package

Maps were generated from Earth Explorer 6.1, with positional and altitude data compiled through Google Maps.

### Material Examined

We examined a total of 32 additional specimens of *Calchas* (28 specimens) and *Neocalchas* (4 specimens) to augment the 76 specimens studied in the original *Calchas* revisions of Fet et al. (2009) and Stathi et al. (2010), representing over 100 specimens in all. Of the seven localities listed below six are reported for the first time (see Appendix A). The type series (holotype and part of paratypes) of two new species are presented here, and repeated under the species descriptions.

#### *Calchas anlasi*, sp. nov. [8 specimens]

**Turkey:** Hakkari Province, Çukurca District, 1 km NE of Çukurca town, 37.255284°N, 43.612406°E, 1266 m, 18 May 2011, 1 ♂, 7 ♀ (♂ **holotype**, 7 ♀ **paratypes**), leg. E.A. Yağmur & M. Özkarük (AZM, FKCP, NHMW, NHMC).

#### *Calchas birulai* Fet, Soleglad et Kovařík, 2009 [4 specimens]

**Turkey:** Adiyaman Province, Central District, 8 km N of Adiyaman town, 37.834239°N, 38.315910°E, 959 m, 18 April 2008, 1 ♂, 3 ♀, leg. E.A. Yağmur & E. Tezcan (AZM).

#### *Calchas kosswigi*, sp. nov. [12 specimens]

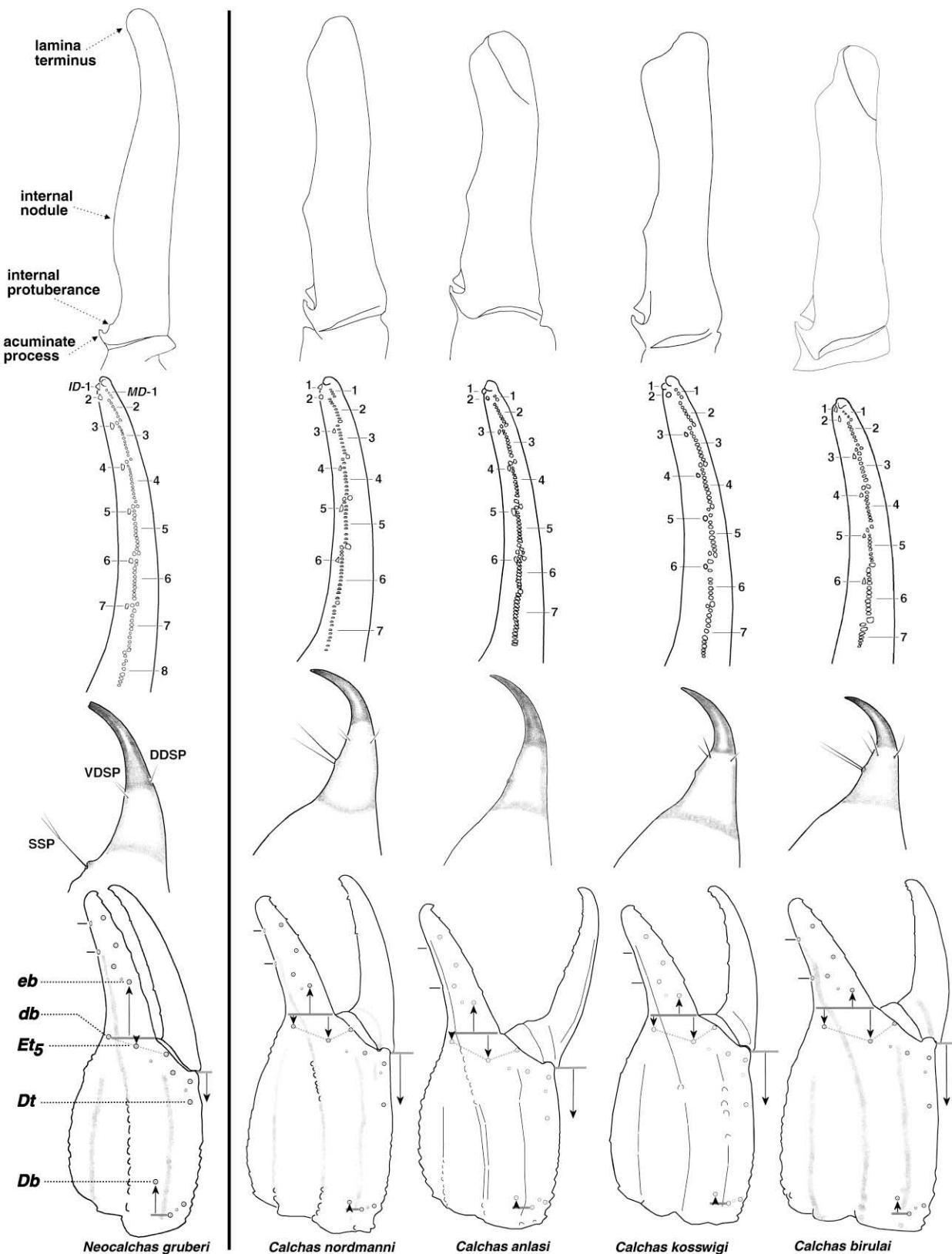
**Turkey:** Şırnak Province, İdil District, Devegeli Valley, Yörük village, 37.28856°N, 42.00729°E, 658 m, 12 May 2007, 1 ♂, 3 ♀ (♂ **holotype**, 3 ♀ **paratypes**), leg. E.A. Yağmur, H. Koç & E. Ulupınar (AZM); Siirt Province, Central District, 2 km W of Meydandere village, 37.921023°N, 42.075380°E, 853 m, 16 May 2011, 8 ♀ (8 ♀ **paratypes**), leg. E.A. Yağmur & M. Uslu (AZM, NHMC, FKCP).

#### *Calchas nordmanni* Birula, 1899 [4 specimens]

**Turkey:** Artvin Province, Hatila Valley National Park, around entrance gate, 41.216855°N, 41.782158°E, 506 m, 27 May 2012, 2 ♂, 2 ♀, leg. E.A. Yağmur (AZM).

#### *Neocalchas gruberi* (Fet, Soleglad et Kovařík, 2009), comb. nov. [4 specimens]

**Turkey:** Antalya Province, Central District, Küçük Çaltıçak area, 36.795095°N, 30.572573°E, 18 m, 5 May 2011, 1 ♂, 1 ♀, leg. E.A. Yağmur & E. Yağmur; Antalya Province, Akseki District, Murtiçi village, 36.864670°N, 31.750815°E, 495 m, 1 September 2012, 2 ♂, leg. E.A. Yağmur & F. Yeşilyurt (AZM).



**Figure 1:** Key diagnostic characters separating genera *Neocalchas* and *Calchas* are the overall shape, proportions, and orientation of substructures of the hemispermatophore, number of median denticle (*MD*) rows and inner denticles (*ID*) on the chelal fingers, position of the subaculeolar setal pair on the telson, and relative positions of external chelal trichobothria. *ID* = inner denticles, *MD* = median denticles, *SSP* = subaculeolar setal pair, *VDS* = ventral distal setal pair, *DDSP* = dorsal distal setal pair.

## Character Analysis

New genus *Neocalchas* is quite distinct from *Calchas*, demonstrating differences in several structures (see Figure 1): the hemispermatophore, chelal finger dentition, the telson and its setation, and relative trichobothrial positions of the pedipalp chela. Even differences in the relative pectinal tooth numbers as compared to the size of the adult specimen is of generic significance. Geographically, *Neocalchas* is separated completely from the four species of *Calchas*, occurring in the extreme southwestern area of Turkey, whereas *Calchas* is distributed in the eastern half. See the section on the biogeography of these interesting scorpions and the map in Figure 45.

### Hemispermatophore

In Figure 1 the hemispermatophore of the five species of Calchinae are shown diagrammatically, outlining important differences in its substructures. The lamina is quite different in *Neocalchas* when compared to *Calchas*. Its overall shape is more slender and elongated, terminating into a somewhat tapered point. In *Calchas*, the lamina is somewhat stocky, its internal and external edges essentially subparallel, not exhibiting a tapered terminus, which is distinctly truncated. The internal nodule of *Neocalchas* is very rounded to obsolete whereas in *Calchas* it is small and subtle, but distinctively pointed. The internal protuberance, a small and delicate substructure, is quite distinct in *Calchas*. In *Neocalchas* it is considerably reduced in size. The trunk in *Neocalchas* exhibits two sclerotized vertical bolsters (the primary and secondary bolsters which are also found in sister subfamily Iurinae) whereas in *Calchas* bolsters are not evident (see Fig. 2).

### Chelal finger dentition

*Neocalchas* can be distinguished from *Calchas* species by the number of inner denticles (*ID*) and median denticle (*MD*) groups found on the chelal fingers. In Fig. 1, we see that *N. gruberi* has one additional *ID* and *MD* group on the movable finger than the species of *Calchas*, seven and eight respectively. This difference of one *ID* and *MD* group is also seen in the fixed finger where *N. gruberi* exhibits six *ID* and seven *MD* groups, compared to five *ID* and six *MD* groups in *Calchas*.

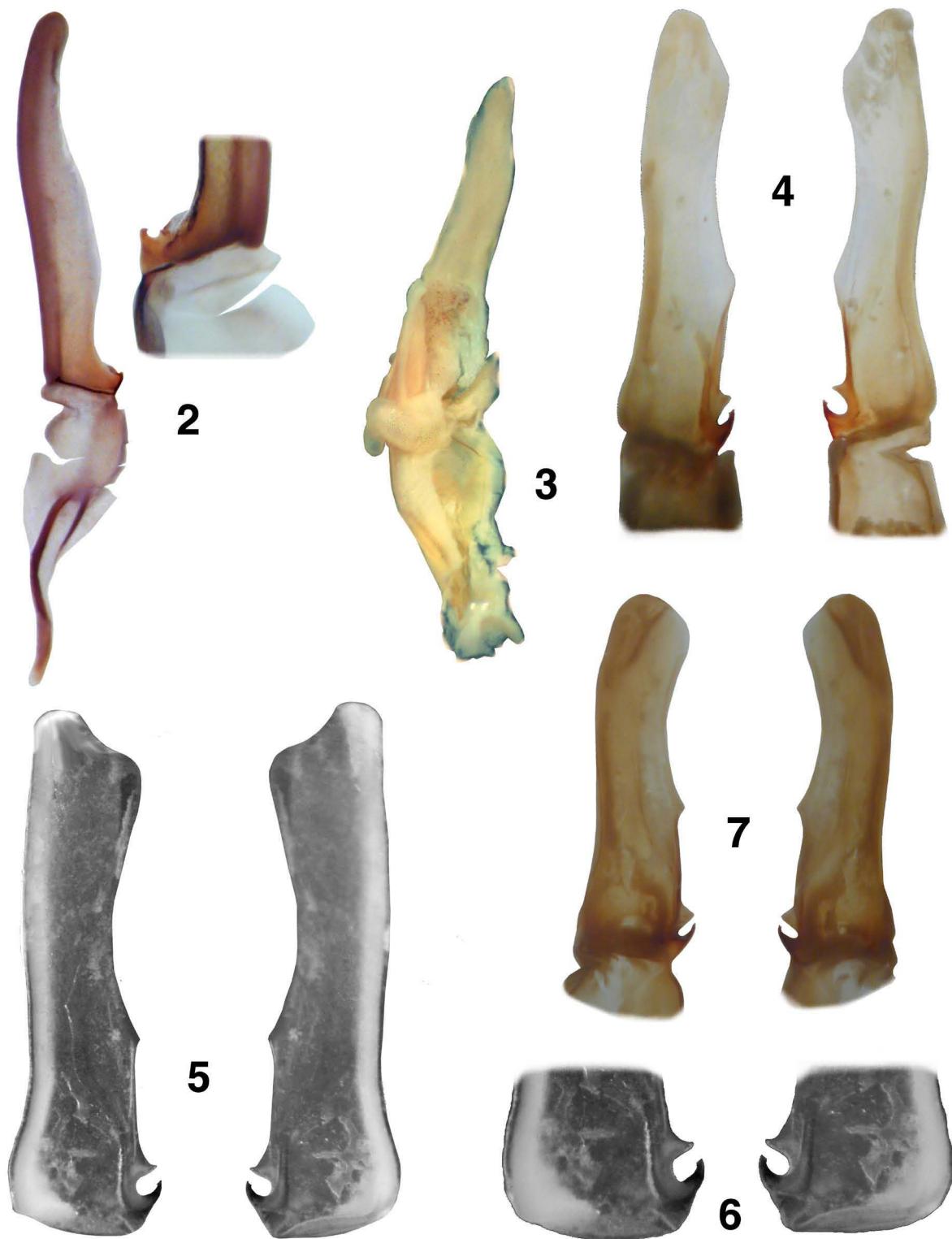
### Telson morphometrics and setation

The telson in *Neocalchas gruberi* is constructed differently than in the four *Calchas* species, involving both major setal placement and the overall proportions

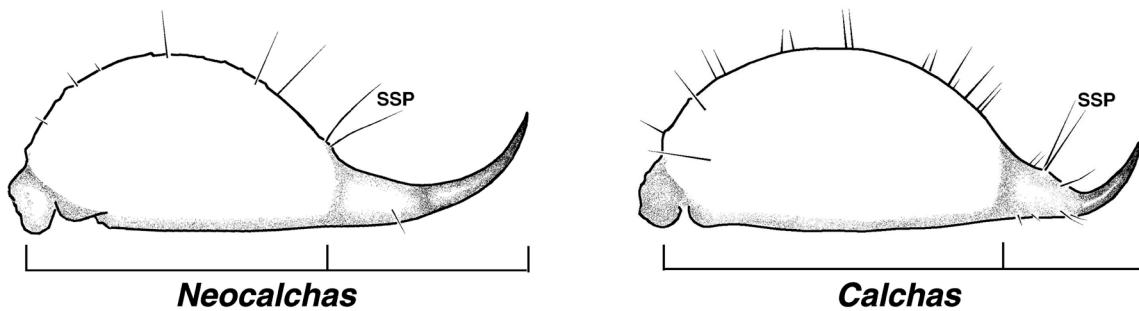
of the vesicle and aculeus. In *N. gruberi*, the subaculear setal pair (SSP) is positioned at the vesicle/aculeus juncture, a typical location in many scorpions. In the *Calchas* species, the SSP is located well on the aculeus, definitely distal of the vesicle/aculeus juncture. We might note here that this aculear location of the SSP is also found in two Iurinae genera, *Iurus* and *Protoiurus* (see Kovarik et al., 2010: figs. 33–34), implying that the vesicular position of the SSP as seen in *Neocalchas* is synapomorphic. The overall proportions of the two major telson components, the vesicle and aculeus, are different in the two genera. *Neocalchas* has a bulbous telson with a relatively long aculeus with a wide curve. In *Calchas* we see a more elongated vesicle, rapidly extending into the short aculeus, which curves abruptly distally. To demonstrate this difference, we constructed a ratio comparing the telson's length to the vesicle length where we see complete separation of the absolute ranges and mean value differences (MVD) ranging from 13 to 20 % (see Figure 8).

### Chelal trichobothria positions

Fet et al. (2009: 35–39; figs. 32–34) presented several trichobothria-based diagnostic characters separating the three species then placed in *Calchas*. Six of these characters are used in this presentation to separate genera *Neocalchas* from *Calchas*. Due to the relatively longer fingers and likewise smaller chelal palm found in *Neocalchas*, we see major positional differences in the trichobothria. For the fixed finger, trichobothrium *it* is placed more distal on the finger in *Neocalchas*, occurring on the distal half in a ratio of 0.57–0.74 (0.625) [17] (see Figure 8). In *Calchas* species, trichobothrium *it* is basal of the fixed finger mid-point in a ratio of 0.36–0.56 (0.457) [37], exhibiting a 37 % MVD from *Neocalchas*. Five external trichobothria found on the chelal palm exhibit positional differences between these two genera (see Fig. 1). In *Neocalchas*, the base of the fixed finger appears to be elongated, probably contributing to the fingers overall length. This is indicated by both the positions of trichobothria *it*, discussed above, and *eb*. Trichobothrium *eb* in *Neocalchas* is located just proximal of the fixed finger's midpoint whereas in *Calchas*, it is positioned much closer to the articular membrane of the movable finger (note, however, some variability exists in the longer fingered species *C. nordmanni* and *C. anlasi*). The alignment of trichobothria *Et<sub>3</sub>*–*Et<sub>5</sub>*–*db* essentially forms a straight line with *db* more distally placed in *Neocalchas*. In *Calchas*, trichobothrium *Et<sub>5</sub>* is positioned more proximally on the palm, thus the line formed by the three trichobothria is not straight but instead forms an obtuse angle at *Et<sub>5</sub>*. Trichobothria *Dt* and *Db* are situated more distally in *Neocalchas*, *Dt* clustered close to *Est* and *Et<sub>1</sub>* and *Db* separated from the



**Figures 2–7:** Hemispermophore examples of subfamily Calchinae. 2. Left hemispermophore (reversed) of *Neocalchas gruberi*, Auscuil, Antalya Province, Turkey. Dorsal view and closeup of median area, ventral view. 3–4. *Calchas nordmanni*, Hatila Valley National Park, Artvin Province, Turkey. 3. Partial paraxial organ, ventral view. 4. Left hemispermophore (reversed), dorsal and ventral views. 5–6. *Calchas kosswigi*, sp. nov., male holotype, Yörük Village, Şırnak Province, Turkey. 5. Right hemispermophore, dorsal and ventral views (grayscale, photos taken with dark background). 6. Closeup of median area, dorsal and ventral views. 7. *Calchas anlasi*, sp. nov., male holotype, Çukurca Town, Hakkari Province, Turkey. Left hemispermophore (reversed), dorsal and ventral views. All photographs are from structures submerged in alcohol.



Telson_Length / Vesicle_Length				
	Male	MVD	Female	MVD
<i>N. gruberi</i>	1.59–1.74 (1.671) ( $\pm 0.057$ ) [6] {1.61–1.73}	-	1.54–1.81 (1.665) ( $\pm 0.079$ ) [9] {1.59–1.74}	-
<i>C. anlasi</i>	1.483 (1.483) [1]	$\Delta$ 12.7	1.38–1.50 (1.449) ( $\pm 0.061$ ) [3] {1.39–1.51}	$\Delta$ 14.9
<i>C. kosswigi</i>	1.467 (1.467) [1]	$\Delta$ 13.9	1.42–1.48 (1.460) ( $\pm 0.031$ ) [3] {1.43–1.49}	$\Delta$ 14.0
<i>C. birulai</i>	1.41–1.50 (1.461) ( $\pm 0.035$ ) [5] {1.43–1.50}	$\Delta$ 14.4	1.38–1.51 (1.456) ( $\pm 0.053$ ) [8] {1.40–1.51}	$\Delta$ 14.4
<i>C. nordmanni</i>	1.37–1.49 (1.425) ( $\pm 0.057$ ) [4] {1.37–1.48}	$\Delta$ 17.3	1.36–1.42 (1.382) ( $\pm 0.023$ ) [6] {1.36–1.40}	$\Delta$ 20.5
<i>Calchas</i>	1.37–1.50 (1.450) ( $\pm 0.044$ ) [11] {1.41–1.49}	$\Delta$ 15.2	1.36–1.51 (1.433) ( $\pm 0.054$ ) [20] {1.38–1.49}	$\Delta$ 16.2

Trichobothrium_it_Position / Fixed_Finger_Length		
	Male/ Female	MVD
<i>N. gruberi</i>	0.57–0.74 (0.625) ( $\pm 0.040$ ) [17] {0.59–0.67}	-
<i>C. anlasi</i>	0.47–0.52 (0.502) ( $\pm 0.020$ ) [5] {0.48–0.52}	$\Delta$ 24.5
<i>C. nordmanni</i>	0.40–0.56 (0.474) ( $\pm 0.050$ ) [9] {0.42–0.52}	$\Delta$ 31.9
<i>C. kosswigi</i>	0.38–0.51 (0.459) ( $\pm 0.035$ ) [9] {0.42–0.49}	$\Delta$ 36.2
<i>C. birulai</i>	0.36–0.51 (0.429) ( $\pm 0.038$ ) [14] {0.39–0.47}	$\Delta$ 45.7
<i>Calchas</i>	0.36–0.56 (0.457) ( $\pm 0.045$ ) [37] {0.41–0.50}	$\Delta$ 36.8

**Figure 8:** Comparison of key morphometrics that exhibit significant statistical differences between genera *Neocalchas* and *Calchas*. In all examples *N. gruberi* shows separation of the absolute ranges from the four *Calchas* species as well as exhibiting significant mean value differences (MVD). Trichobothrium *it*\_position is the distance from *it* to the base of the fixed finger. Statistical data group = minimum–maximum (mean) ( $\pm$ SDEV) [N] {standard error range}. MVD = mean value difference (%).

*Eb* series. In *Calchas*, *Dt* is located more proximal of *Est* and *Et*, and *Db* is almost in alignment with the *Eb* series.

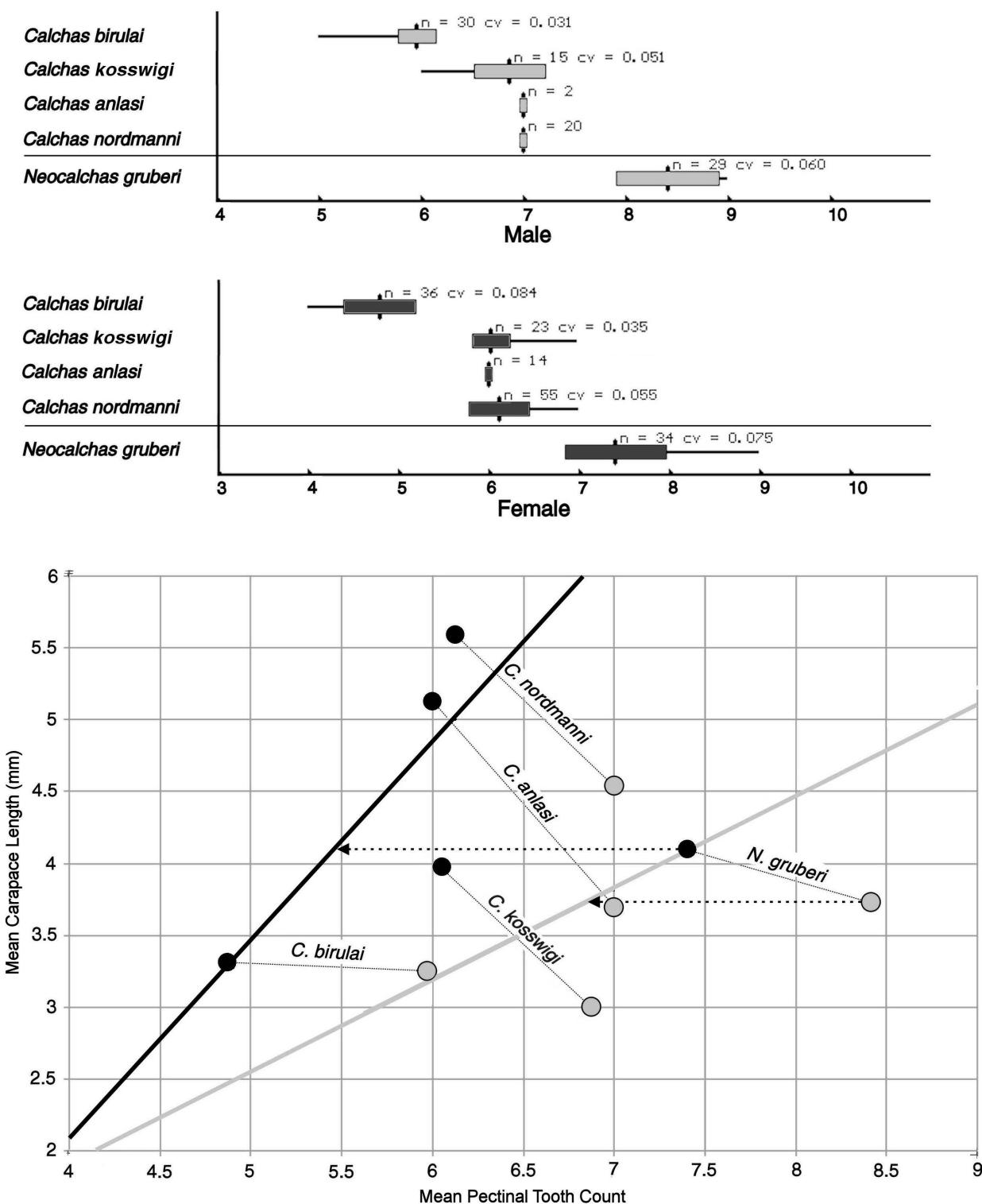
#### Pectinal tooth numbers

Analysis of the pectinal tooth counts is shown in Figure 9, based on over 250 samples. We see three groupings of pectinal tooth counts which are consistent across both genders: *Calchas birulai*, averaging five and six for female and male, respectively; *C. kosswigi* + *C. anlasi* + *C. nordmanni*, averaging six and seven; and *Neocalchas gruberi*, which has the largest counts, averaging 7.5 and 8.5, one and one-half teeth more than the largest count in *Calchas* for each gender. Important from a generic perspective is the comparison of the median pectinal tooth counts of the two genera to the average carapace length found in adults. In Figure 9 a scatter chart shows this comparison of all five species representing the two genera. Of special interest, the two regression lines represent the linear average of the male and female of the four species of *Calchas* showing a

distinct contrast with the corresponding gender plots of *Neocalchas*. The horizontal distance of *Calchas* females from its regression line ranges 0.036–1.360 (0.652) chart grid units whereas the *Neocalchas* female is 3.682 units from the same regression line, a 465 % mean value difference. For the males, *Calchas* ranges 0.243–2.219 (1.308) units as compared to 3.138 in *Neocalchas*, a 140 % difference. From this data we can infer that the pectinal tooth counts normalized by the adult size in *Neocalchas* are larger than those found in *Calchas* in both genders. Or, from the perspective of the adult carapace length, *Neocalchas* female and males would have to average 7.30 and 4.72 mm to comply with the regression lines, an increase of 78 % and 27 %, female and male respectively.

#### Systematics

Diagnoses of genera *Calchas* and *Neocalchas*, keys for species, and descriptions of two new species are provided in this section.



**Figure 9:** Distribution of pectinal tooth counts in genera *Calchas* and *Neocalchas* based on 258 samples (96 males and 162 females). Data are based on material examined and Birula (1900, 1905, 1911, and 1912). **Top.** Histogram shows minimum, maximum, mean (vertical bar), and standard error (rectangle) ranges. n = number of samples, cv = coefficient of variability. **Bottom.** Scatter chart showing relationship of carapace length of adults to pectinal tooth counts. The means are used for both data sets. Black icons = female, gray icons = male. Black and gray lines depict linear fit by least squares regression for *Calchas* females and males indicating a distinct contrast with *Neocalchas gruberi*. Dotted arrows depict the horizontal distance between *Neocalchas* genders and the corresponding gender regression lines of *Calchas*.

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

### Subfamily Calchinae Birula, 1917

For diagnosis see Soleglad et al. (2012: 12).

**Type Genus.** *Calchas* Birula, 1899.

**Composition.** This subfamily contains two genera *Calchas* and *Neocalchas*, gen. nov.

#### Key to genera of Calchinae

- 1 – Hemispermatophore lamina edges subparallel distally, forming a truncated terminus; internal nodule weak but decidedly pointed; pedipalp chelal movable finger with seven median denticle (*MD*) rows and six inner denticles (*ID*); telson subaculear setal pair located on the base of the aculeus ..... ***Calchas* Birula, 1899.**
- – Hemispermatophore lamina tapered distally, forming a rounded terminus; internal nodule widely rounded to obsolete; pedipalp chelal movable finger with eight median denticle (*MD*) rows and seven inner denticles (*ID*); telson subaculear setal pair located on the vesicle /aculeus juncture ..... ***Neocalchas*, gen. nov.**

### *Calchas* Birula, 1899

#### Synonyms:

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

**Type Species.** *Calchas nordmanni* Birula, 1899.

**Composition.** This genus contains four species:

- Calchas anlasi*, sp. nov.  
*C. birulai* Fet, Soleglad et Kovařík, 2009  
*C. kosswigi*, sp. nov.  
*C. nordmanni* Birula, 1899

**Diagnosis.** Hemispermatophore lamina edges subparallel distally, forming a truncated terminus; internal nodule weak but decidedly pointed; internal protuberance delicate but prominent; sclerotized trunk bolsters absent. Pedipalp chelal movable finger with seven median denticle (*MD*) rows and six inner denticles (*ID*). Telson subaculear setal pair located on the base of the aculeus; vesicle elongated and aculeus short, ratio of telson length to vesicle length 1.37–1.50 (1.450) in

males and 1.36–1.51 (1.433) in females. Pectinal tooth count means range 5.97–7.00 for males and 4.81–6.13 for females (based on four species).

#### Key to species of *Calchas*

- 1 – Pectinal tooth counts 6–7 (6.95) in males and 6–7 (6.09) in females; species medium to large, adult female carapace length 4.1–6.1 mm; overall color dark yellow-brown. .... 2
- – Pectinal tooth counts 5–6 (5.97) in males and 4–5 (4.81) in females; species small, adult female carapace length 3.2–3.4 mm; overall color light yellow-orange. Turkey: Adiyaman, Diyarbakır, Gaziantep, Kahramanmaraş, Kilis, Malatya, Mardin, and Şanlıurfa Provinces ..... ***Calchas birulai* Fet, Soleglad et Kovařík, 2009**
- 2 – Metasomal segments IV–V are medium in length and width, length compared to width 1.28 and 2.00–2.22 (2.110) in males, and 1.22–1.37 (1.276) and 2.00–2.25 (2.127) in females. .... 3
- – Metasomal segments IV–V are elongated and thin, length compared to width 1.38–1.56 (1.470) and 2.44–2.56 (2.518) in males, and 1.37–1.43 (1.392) and 2.41–2.70 (2.508) in females. Turkey: Artvin and Erzurum Provinces ..... ***Calchas nordmanni* Birula, 1899**
- 3 – Chelal fingers are somewhat elongated, fixed finger length compared to palm length 0.92 in males and 0.79–0.91 (0.870) in females; movable finger length compared to palm length 1.22 in males and 1.10–1.23 (1.184) in females; adult female carapace length 4.6–5.4 mm; sternite VII surface coarsely granulated with well developed lateral carinae. Turkey: Hakkari Province; Iraq: Arbil Province (not verified) ..... ***Calchas anlasi*, sp. nov.**
- – Chelal fingers are not elongated, fixed finger length compared to palm length 0.78 in males and 0.74–0.81 (0.766) in females; movable finger length compared to palm length 1.05 males and 0.92–1.10 (1.009) in females; adult female carapace length 4.1–4.3 mm; sternite VII surface essentially smooth with weakly developed lateral carinae. Turkey: Siirt and Şırnak Provinces ..... ***Calchas kosswigi*, sp. nov.**

**Discussion.** *Calchas* is distributed in the eastern half of Turkey (see map in Fig. 45). Structurally, the four species of *Calchas* are quite similar, only showing variability in adult size, subtle coloration differences, pectinal tooth counts, and morphometrics (see Table 1). Any significant differences in carinal development and/or overall granulation are not present. Geographically, only type species *C. nordmanni* exhibits significant disjunction from the other three species, occurring in the extreme northeastern area of Turkey, the Black Sea region. *C. nordmanni*, which is somewhat dark in co-

		<i>C. birulai</i>	<i>C. nordmanni</i>	<i>C. anlasi</i>	<i>C. kosswigi</i>
<b>Pectinal Tooth Counts</b>	♂	5–6 (5.97) [30]	7 [20]	7 [2]	6–7 (6.87) [15]
	♀	4–5 (4.81) [36]	6–7 (6.13) [55]	6 [14]	6–7 (6.04) [23]
<b>Adult Size (mm)</b>	♂	25–27	36–41	29	24
	♀	26–28	36–41	35–43	31–34
<b>Carapace Length (mm)</b>	♂	3.2–3.4	4.5–4.9	3.7	3.00
	♀	3.3–3.6	5.4–6.1	4.6–5.4	4.1–4.3
<b>Basic Coloration</b>	♂/♀	Light, yellow to yellow-orange	Dark, yellow-brown	Dark, yellow-brown	Dark, yellow-brown
<b>IVL / IVW</b>	♂	1.31–1.41 (1.36) [2]	1.38–1.56 (1.47) [4]	1.28 [1]	1.28 [1]
	♀	1.26–1.34 (1.31) [2]	1.37–1.43 (1.39) [3]	1.26–1.37 (1.31) [3]	1.22–1.28 (1.24) [3]
<b>VL / VW</b>	♂	1.91–2.17 (2.06) [5]	2.44–2.56 (2.52) [4]	2.22 [1]	2.00 [1]
	♀	1.88–2.15 (2.00) [8]	2.41–2.70 (2.51) [6]	2.09–2.19 (2.14) [3]	2.00–2.25 (2.12) [8]
<b>MFL / PalmL</b>	♂	0.97–1.00 (0.99) [2]	1.16–1.20 (1.18) [2]	1.22 [1]	1.05 [1]
	♀	1.00–1.03 (1.02) [2]	1.09 [1]	1.10–1.23 (1.18) [3]	0.92–1.10 (1.01) [3]
<b>FFL / PalmL</b>	♂	0.68–0.82 (0.74) [5]	0.85–0.91 (0.88) [2]	0.92 [1]	0.78 [1]
	♀	0.70–0.79 (0.74) [8]	0.82 [1]	0.79–0.91 (0.87) [3]	0.74–0.81 (0.77) [3]

**Table 1:** Major diagnostic characters for *Calchas* species. Data are presented as minimum–maximum (mean) [N]. IVL VL, IVW VW = metasomal segments IV–V length and width, MFL, FFL = chelal movable finger length and fixed finger length, PalmL = chelal palm length.

lation, is the largest member of the genus, adult males and females exceeding 35 and 40 mm, respectively (i.e., largest carapaces measured are 4.85 in male and 6.05 in female). Its most distinguishing character is its relatively slender metasoma, especially the distal segment V. The mean value difference percentages between *C. nordmanni* and the other three species when the segment V length is compared to its width ranges 13.6–25.9 (20.67) % for the male and 16.9–25.6 (20.27) % for the female.

The other three species are found in southeastern Turkey. *C. birulai* is the most widely distributed of these species, occurring in no less than eight provinces (see map in Fig. 45). *C. birulai* is the smallest and lightest colored species in *Calchas* (note, dark color phases do occur). Its color ranges from a light yellow to a yellow-orange, and it does not reach 30 mm in length in either gender (i.e., largest carapaces measured are 3.35 male and 3.55 female). *C. birulai* also has the smallest pectinal tooth count in the genus, averaging six and five for males and females, respectively, one pectinal tooth smaller than the other three species in *Calchas*.

The other two southeastern species, described as new in this paper, occur directly east of *C. birulai*, their ranges, so far identified, are limited. *C. kosswigi* is only found in two provinces abutting the Southeastern Taurus Mountains at its extreme eastern range, and *C. anlasi*, found in only one Turkey province, extends into Iraq, to what extent southward is unknown. These two species are darker in color, dark yellow-brown, and larger than *C. birulai*, females 34 to 43 mm. in length. And, as stated above, their pectinal tooth counts are larger than in *C. birulai*. *C. anlasi* is the larger of the two species,

females exceeding 40 mm in length whereas *C. kosswigi* reaches only 34 mm. Morphometrically, *C. anlasi* has relatively longer chelal fingers than *C. kosswigi*, which is readily apparent in Fig. 1 (also see above key and Table 1). Finally, *C. anlasi* is more granulose than *C. kosswigi*, as exhibited in the lateral aspects of the carapace and sternite VII.

#### *Neocalchas* Yağmur, Soleglad, Fet et Kovařík, gen. nov.

<http://zoobank.org/urn:lsid:zoobank.org:act:AE477CF1-0417-4CDC-B5BB-25A7C0EDC028>

**Type Species.** *Neocalchas gruberi* (Fet, Soleglad et Kovařík, 2009), **comb. nov.** [=*Calchas gruberi* Fet, Soleglad et Kovařík, 2009], designated here.

**Composition.** This genus contains one species, *N. gruberi*.

**Etymology.** The generic name is derived from the Ancient Greek prefix *νεο-* (neo-), from *νέος* (neos, “new, young”) and *Calchas*, indicating a new genus of Calchiinae based on its presumed derived position within the subfamily.

**Diagnosis.** Hemispermatophore lamina edges taper distally, forming a pointed terminus; internal nodule widely rounded to obsolete; internal protuberance weak and reduced in size; two sclerotized trunk bolsters present. Pedipalp chelal movable finger with eight median den-

ticle (*MD*) rows and seven inner denticles (*ID*). Telson subaculear setal pair located on the vesicle/aculeus juncture; vesicle rounded and aculeus elongated, ratio of telson length to vesicle length 1.59–1.74 (1.671) in males and 1.54–1.81 (1.665) in females. Pectinal tooth count mean 8.41 for males and 7.41 for females.

**Discussion.** The generic differences between *Neocalchas* and *Calchas* were discussed above; see Fet et al. (2009: 57–67) for a detailed description of *N. gruberi*. Note that, with this description, fauna of Turkey gains a new genus *Neocalchas*; however, fauna of Greece gains *Neocalchas* but loses *Calchas*.

## New Species Descriptions

### *Calchas anlaşı Yağmur, Soleglad, Fet et Kovařík, sp. nov.*

(Figs. 7, 10–27; Tables 1–2)

<http://zoobank.org/urn:lsid:zoobank.org:act:6ADF576A-EFC9-4F62-B9E4-901DB6094364>

#### REFERENCES:

?*Calchas birulai* (in part; Iraq, Arbil Province, not seen): Fet et al., 2009: 57.

**Holotype:** ♂ (AZM), **Turkey:** Hakkari Province, Çukurca District, 1 km NE Çukurca Town, 37.2558°N, 43.6128°E, 1269 m, 18 May 2011, leg. E.A. Yağmur & M. Özkarük. **Paratypes:** 1 ♀ (NHMW 21.951), 1 ♀ (FKCP), 1 ♀ (NHMC), 4 ♀, 1 ♂, 2 subad. ♀, 1 subad. ♂ (AZM), same label data as holotype; 5 subad. ♀, 2 subad. ♂, 1 juv. (AZM), same locality as holotype, 19 May 2011, leg. E.A. Yağmur & M. Özkarük; 2 subad. ♀, 1 subad. ♂ (AZM), Hakkari Province, Çukurca District, 1 km N Çukurca Town, 37.2210°N, 43.6044°E, 1283 m, 19 May 2010, leg. E.A. Yağmur & M. Özkarük.

**Additional material (not examined): Iraq:** 1 specimen, Arbil (Erbil, Hawler) Province, Geli Ali Beg waterfall, 36.6305°N, 44.4475°E, 21 April 1958, leg. C. Kosswig (ZMUH, no. 9/1958) (R. Kinzelbach, pers. comm., May 2009).

**Diagnosis.** Medium to large-sized scorpion for this genus, 29–43 mm in length, pectinal tooth counts 7 male and 6 female. Coloration dark yellow-brown with little pigmented patterns. Fixed and movable fingers of chela relatively elongated, movable finger length / palm length 1.22 for male and 1.18 for female, and fixed finger length / palm length 0.92 for male and 0.87 for female (based on the mean).

**Distribution.** TURKEY: southeast (Hakkari Province). IRAQ: north (Arbil Province (not verified) (see map in Fig. 45).

**Etymology.** Species name is a patronym honoring Dr. Sinan Anlaş, a Turkish entomologist and a friend of the first author.

**MALE.** Description based on holotype male from Çukurca, Turkey. Measurements of the holotype plus three female paratype specimens are presented in Table 2. See Figure 10 for dorsal and ventral views of the male holotype.

**COLORATION.** Basic color of carapace, mesosoma, metasoma, pedipalps a dark orange-brown; telson and legs yellow-brown; sternites brown; carinae of pedipalps and metasoma reddish to dark brown; chelal finger dentition and telson aculeus a dark brown. No variegated patterns present.

**CARAPACE (Fig. 11).** Anterior edge with a small median indentation; interocular area somewhat rough with scatter granulation, though smooth around the immediate area of the median eyes; posterior lateral aspects covered with medium to large granules. Anterior and lateral edges next to lateral eyes with small but conspicuous pointed granules. Mediolateral ocular carinae present and granular, extending to the lateral eyes; lateral eyes number two, the posterior eye slightly smaller. Median eyes and tubercle somewhat small, positioned considerably anterior of middle with the following length and width formulas: 0.276 (anterior edge to medium tubercle middle / carapace length) and 0.154 (width of median tubercle including eyes / width of carapace at that point).

**MESOSOMA (Figs. 20–22).** Tergites I–II smooth, III–VI with heavier granulation, primarily on posterior half; tergite VII covered with coarse granules with two pairs of crenulate carinae. Sternites III–VI rough under magnification, VII surface rough; on segment VII, one pair of irregularly granulated lateral carinae and one median pair essentially obsolete with some traces present posteriorly. Stigmata (Fig. 20) are short sub-oval in shape, angled 45 degrees in an anterointernal direction.

**METASOMA (Fig. 12).** Segments I–IV: dorsal and dorsolateral carinae crenulate to serrate; dorsal (I–IV) and dorsolateral (I–III) carinae terminate with spine; lateral carinae crenulate on I, present on 60 % of II, on 30 % of III, and absent on IV; ventrolateral carinae crenulate to serrulate and ventromedian crenulate. Dorsolateral carinae of segment IV terminates at articulation condyle. Segment V: dorsolateral carinae serrate; lateral carinae crenulate to serrulate for two-thirds of

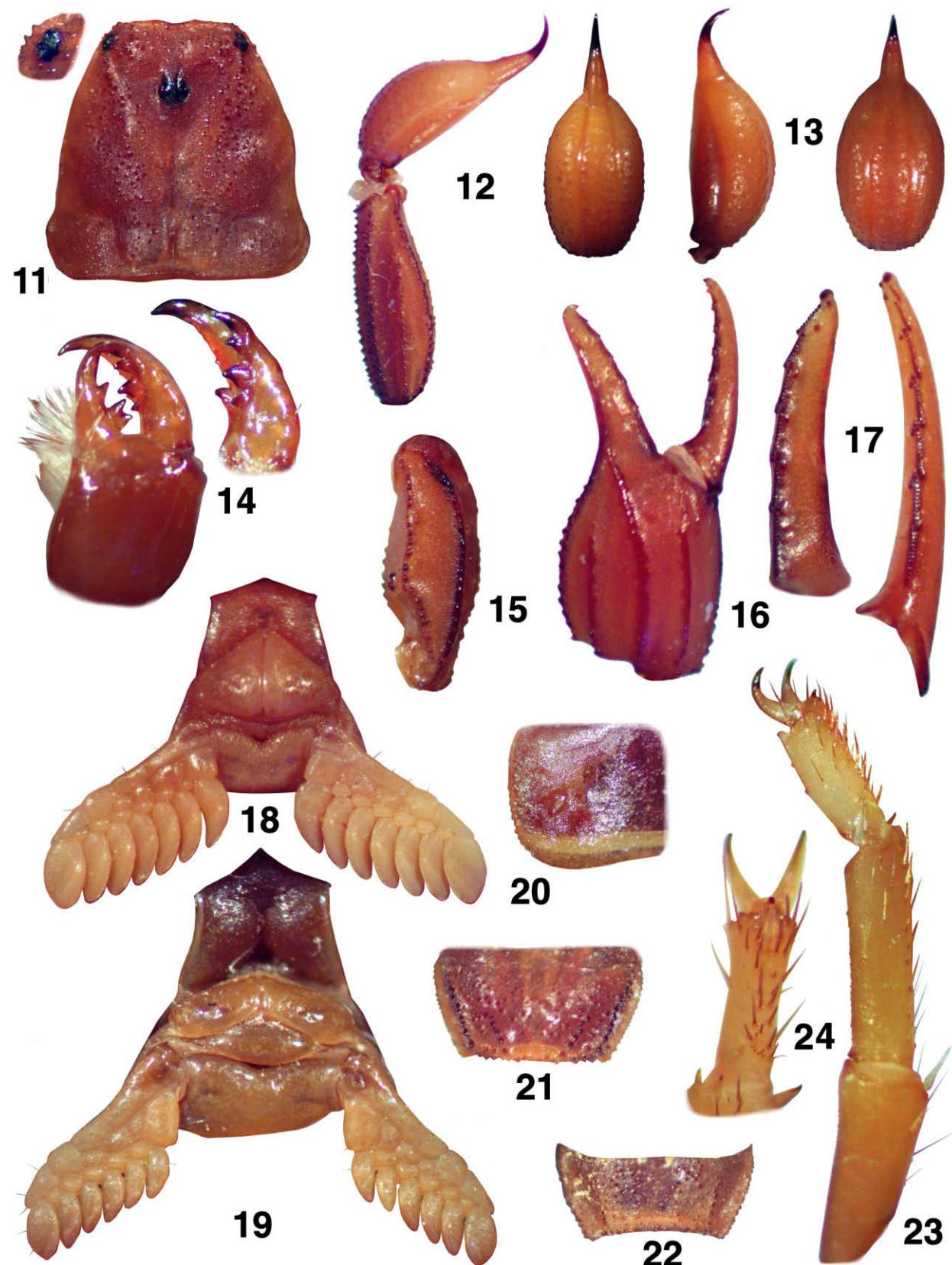


**Figure 10:** *Calchas anlasi*, sp. nov., dorsal and ventral views. Çukurca Town, Hakkari Province, Turkey. **Top.** Male holotype. **Bottom.** Female paratype.

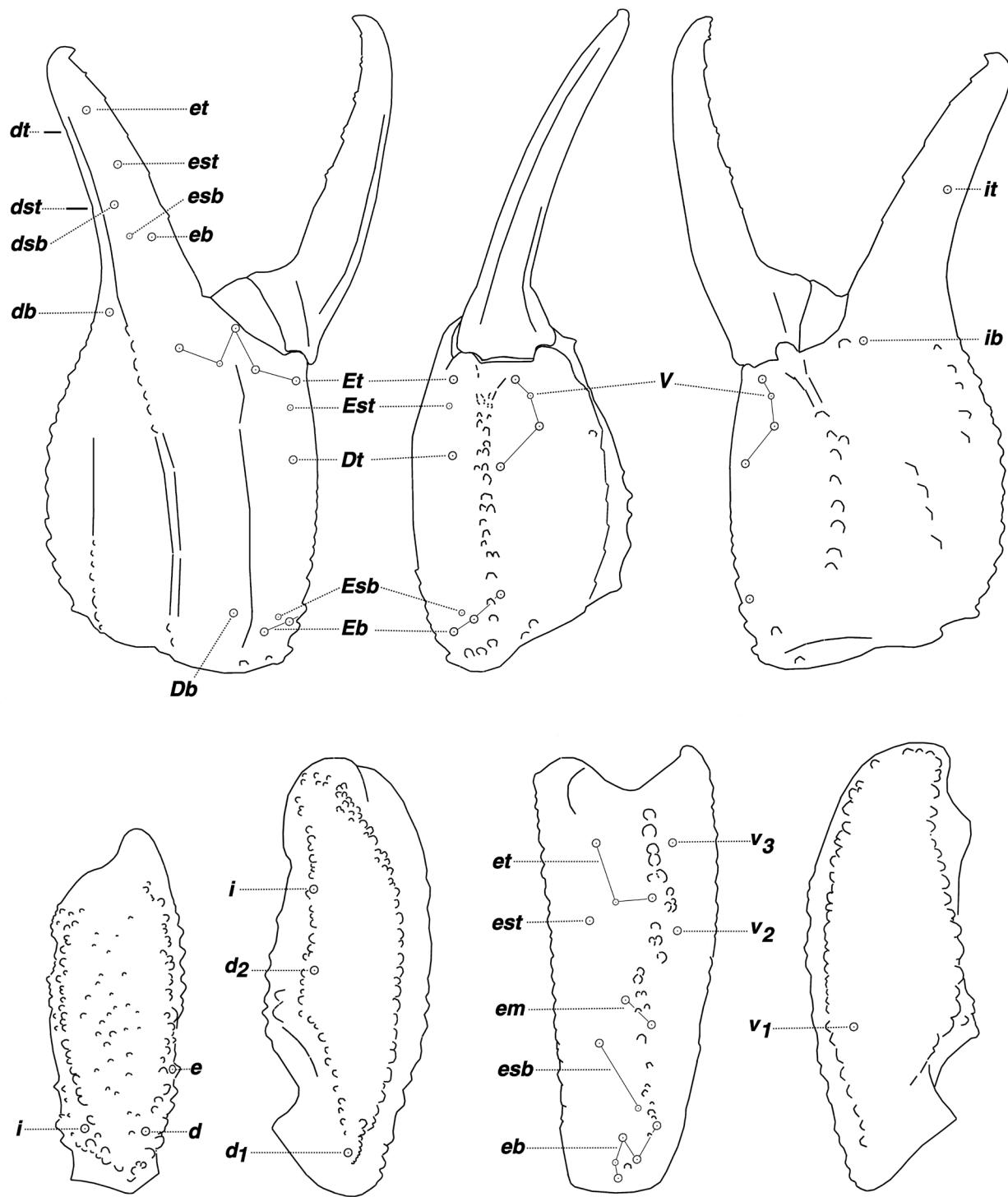
posterior aspect; ventrolateral and single ventromedian carinae crenulate to serrate. Intercarinal areas of segments I–IV essentially smooth. Metasoma essentially void of setation.

**TELSON (Figs. 12, 13, paratype female).** Elongated vesicle with short abruptly curved aculeus. Vesicle ventral surface covered with medium sized granules, heavier basally; subaculeolar setal pair (SSP) located on base of aculeus, distal of vesicle/aculeus juncture. Vesicular tabs smooth; anal arch with 17 small granules.

**PECTINES (Figs. 18, 19, female paratype).** Well developed segments exhibiting length/width formula 1.923 (length taken at anterior lamellae/width at widest point including teeth). Sclerite construction complex, three anterior lamellae and 4/4 middle lamellae; fulcra of medium development. Teeth number 7/7. Sensory areas developed along most of tooth inner length on all teeth, including basal tooth. Basal piece large, with deep indentation along anterior edge, length/width formula 0.586.



**Figures 11–24:** *Calchas anlasi*, sp. nov., Çukurca Town, Hakkari Province, Turkey. 11–12, 15–18, 20–23. Male holotype. 13–14, 19, 24. Female paratype. 11. Carapace and lateral eyes (enlarged). 12. Telson and metasomal segment V, lateral view; telson ventral view. 13. Telson, lateral and ventral views. 14. Chelicera, dorsal views. 15. Patella, dorsal view. 16. Chela, external view. 17. Dentition of movable and fixed fingers. 18. Sternopectinal area. 19. Sternopectinal area (note prepectinal plate). 20. Right stigma II. 21. Tergite VII. 22. Sternite VII. 23. Right leg III (note tibial spur). 24. Closeup of leg tarsus, ventral view.



**Figure 25:** Trichobothrial pattern of *Calchas anlasi*, sp. nov., male holotype, Çukurca Town, Hakkari Province, Turkey.

**PREPECTINAL PLATE (Fig. 13).** Not present in male (see discussion on female below).

**GENITAL OPERCULUM (Figs. 18, 19, female paratype).** Sclerites large, subtriangular, approximately as wide as long, separated for most of length. Conspicuous genital

papillae present behind the sclerites, but not extending beyond the posterior edge (see discussion on female below).

**STERNUM (Figs. 18, 19, female paratype).** Type 2, posterior emargination present, well-defined convex



**Figure 26:** *Calchas anlasi*, sp. nov., in its natural habitat (top) and general view of type locality (bottom), Çukurca Town, Çukurca District, Hakkari Province, Turkey.



**Figure 27:** *Calchas anlasi*, sp. nov., type locality, Çukurca Town, Çukurca District, Hakkari Province, Turkey.

lateral lobes present, apex visible but not conspicuous; wider than long, length|width formula 0.759; sclerite tapers anteriorly, posterior-width|anterior-width formula 1.272.

**CHELICERAE (Fig. 14, female paratype).** Movable finger dorsal edge with one large subdistal (*sd*) denticle; ventral edge with one small pigmented crenulation (*va*) on the distal half, and one large pigmented accessory denticle at finger base; ventral edge with heavy setal brush covering well-developed serrula, terminating just before distal tip. Ventral distal denticle (*vd*) considerably longer than dorsal (*dd*). Fixed finger with four denticles, median (*m*) and basal (*b*) denticles conjoined on common trunk; no ventral accessory denticles present.

**PEDIPALPS (Figs. 15–17).** Relatively elongate fingered, strong chelae, heavily carinated, no scalloping on chelal fingers, thus not exhibiting sexual dimorphism in this structure. **Femur:** Dorsointernal and ventrointernal carinae serrate, dorsoexternal carina crenulate, ventroexternal smooth. Dorsal surface scattered with large granules, ventral proximal area with granules, internal with scattered granules with one line of eight granules, and external surface with irregular line of 15 serrate granules. **Patella:** Dorsointernal and ventrointernal carinae serrate, dorsoexternal and ventroexternal rounded and granulate, and exteromedian carina irregularly granulate. Dorsal, ventral, and external surfaces smooth; external surface with granulate exteromedian carina; internal surface smooth except for weakly developed doubled DPS and single VPS. **Chelal carinae:** Complies with the “8-carinae configuration”. Digital (*D1*) carina strong, smooth to granulate; dorsosecondary (*D3*) present on basal 2/3 only, slightly granulate; dorsomarginal (*D4*) strong, continuous and irregularly granulate; dorsointernal (*D5*) weak, rounded, sparsely granulated; ventroexternal (*V1*) strong and granulated proximally, terminating at external condyle of movable finger; ventrointernal (*V3*) strong with large granules, continuous to internal condyle; external (*E*) strong, continuous, essentially smooth except proximally which is granulate; internal (*I*) weak, rounded, not continuous, with large granules. **Chelal finger dentition (Fig. 17):** median denticle (*MD*) row groups oblique and slighting imbricating, numbering 6/6 and 7/7 on fixed and movable fingers; 5/5 and 6/6 internal denticles (*ID*) and 5/5 and 6/6 outer denticles (*OD*) on fixed and movable fingers, respectively. No accessory denticles present. Number of *MD* denticles on movable finger is 60+. **Trichobothrial patterns (Fig. 25):** Type C, orthobothrioxic.

**LEGS (Figs. 23, 24, female paratype).** Both pedal spurs present on all legs; tibial spurs present on legs III and IV. Tarsus covered heavily with large socket setae on ventral surface. Small ventral spinules located at base of tarsus.

**HEMISPERMATOPHORE (Fig. 7).** The overall structure is simplistic with a straight, parallel, and somewhat wide lamina terminating in a blunt truncated distal tip. The distal tip is thickened on the external edge exhibiting a slight sclerotization. At the lamina base is a nonpigmented, slightly sclerotized thin pointed internal protuberance. Emanating from the internal aspect of the capsular area is a highly pigmented sclerotized acuminate process terminating in a delicately truncated point. Right hemispermatophore measures 5.51 mm, the lamina 2.91 mm and the trunk = 2.60 mm.

**Female Paratype (Figs. 13–14, 19, 24).** Adult females are somewhat larger than the holotype male, 29 [1] for male, compared to 35–43 [3] for females. The genders do not exhibit any significant morphometric differences. Pectinal tooth counts in the male exceed the female by one tooth, the male with 7 and the female with 6 (see histogram in Fig. 9). The genital operculum of the male is dramatically different from that in the female (Figs. 18–19). The sclerites, subtriangular in shape, are as long as or longer than wide in the male, whereas in the female the sclerites are short and wide, more than twice as wide as long. Whereas the sclerites are fused medially in the female, they are separated their entire length in the male, exposing significantly developed genital papillae. The prepectinal plate (Fig. 19), so conspicuous in the female, is absent in males. Figures 10, 26–27 show dorsal and ventral views of both male holotype and female paratype specimens, and a locality area (Çukurca Town, Hakkari Province, Turkey) for this species.

### *Calchas kosswigi Yağmur, Soleglad, Fet et Kovářík, sp. nov.*

(Figs. 5–6, 28–44; Tables 1–2)

<http://zoobank.org/urn:lsid:zoobank.org:act:DCC08CAF-07E0-4351-8B6D-8E18FB510FA7>

### REFERENCES:

- Calchas nordmanni* (in part; Siirt Province): Kinzelbach, 1980: 171.  
*Calchas birulai* (in part; Siirt Province): Fet et al., 2009: 55.

**Holotype:** ♂ (AZM), **Turkey:** Şırnak Province, İdil District, Devegeli Valley, 2 km N of Yörük village, 37.28856°N, 42.00729°E, 735 m, 12 May 2007, leg. E.A. Yağmur, H. Koç & E. Ulupınar. **Paratypes:** 1 subad. ♂, 3 ♀ (AZM), same label data as holotype; 1 juv. (AZM), Şırnak Province, İdil District, 20 km N of Cizre town, 37.3660°N, 41.9995°E, 654 m, 20.05.2010, leg. E.A. Yağmur & İ. Özgen; 1 juv. (AZM), Şırnak Province, Silopi District, Görümlü village, 37.3389°N, 42.5750°E, 1009 m, 20 May 2010, leg. E.A. Yağmur & M. Özkörtük; 1 ♀ (FKCP), 1 ♀ (NHMC), 6 ♀, 2 subad.

	<i>Calchas anlasi</i>				<i>Calchas kosswigi</i>			
	Hakkari, Turkey				Yörük, Turkey	Siirt, Turkey		
	Male Holotype	Female Paratype	Female Paratype	Female Paratype	Male Holotype	Female Paratype	Female Paratype	Female Paratype
<b>Total length</b>	28.55	42.90	38.70	35.40	24.00	31.30	34.25	33.20
<b>Carapace length</b>	3.70	5.40	5.35	4.60	3.00	4.05	4.30	4.30
<b>Mesosoma length</b>	8.85	14.65	11.10	11.55	8.95	11.65	13.40	13.05
<b>Metasoma length</b>	11.70	16.70	15.95	13.85	8.75	11.40	11.95	11.55
<b>Segment I length/width</b>	1.40/2.15	1.95/3.15	1.95/3.20	1.60/2.60	1.10/1.80	1.40/2.10	1.40/2.35	1.40/2.25
<b>Segment II length/width</b>	1.75/2.05	2.55/2.75	2.40/2.80	2.15/2.40	1.30/1.50	1.65/2.00	1.85/2.05	1.80/2.05
<b>Segment III length/width</b>	1.95/1.95	2.75/2.70	2.60/2.75	2.45/2.30	1.40/1.45	1.80/1.90	2.00/2.05	1.90/2.00
<b>Segment IV length/width</b>	2.50/1.95	3.55/2.60	3.35/2.65	2.80/2.15	1.85/1.45	2.25/1.85	2.50/1.95	2.45/2.00
<b>Segment V length/width</b>	4.10/1.85	5.90/2.70	5.65/2.70	4.85/2.25	3.10/1.55	4.30/1.95	4.20/1.95	4.00/1.95
<b>Telson length</b>	4.30	6.15	6.30	5.40	3.30	4.20	4.70	4.30
<b>Vesicle length width/depth</b>	2.90 1.85/1.45	4.45 2.70/2.20	4.30 2.90/2.25	3.60 2.35/1.85	2.25 1.60/1.25	2.85 1.85/1.45	3.30 2.05/1.75	2.90 2.00/1.55
<b>Aculeus length</b>	1.40	1.70	2.00	1.80	1.05	1.35	1.40	1.40
<b>Pedipalp length</b>	12.35	18.95	18.70	15.60	10.80	13.25	14.30	13.30
<b>Femur length/width</b>	3.20/1.25	4.65/1.90	4.55/1.85	3.85/1.55	2.70/1.10	3.25/1.20	3.50/1.35	3.25/1.35
<b>Patella length/width</b>	3.15/1.20	4.50/1.95	4.55/1.90	3.80/1.60	2.70/1.15	3.25/1.40	3.45/1.50	3.25/1.50
<b>Chela length</b>	6.00	9.80	9.60	7.95	5.40	6.75	7.35	6.80
<b>Palm length width/depth</b>	3.00 2.20/2.60	4.65 3.40/4.00	4.60 3.65/4.10	4.10 2.90/3.45	2.75 2.10/2.25	3.45 2.50/2.95	3.85 2.80/3.20	3.65 2.75/3.15
<b>Fixed finger length</b>	2.75	4.20	4.20	3.25	1.95	2.70	2.90	2.70
<b>Movable finger length</b>	3.65	5.70	5.65	4.50	2.90	3.70	3.55	3.65
<b>Sternum length/width</b>	1.10/1.45	1.55/1.70	1.50/1.85	1.40/1.75	1.10/1.30	1.20/1.65	1.20/1.70	1.15/1.50
<b>Pectines teeth middle lamellae</b>	7-7 4+-5	6-6 4-4	6-6 4-4	6-6 4-4	7-7 4-4	7-6 3-3	6-6 4-3	6-6 4-4

**Table 2:** Morphometrics (mm) of *Calchas anlasi*, sp. nov. and *Calchas kosswigi*, sp. nov.

♀, 5 subad. ♂ (AZM), Siirt Province, Central District, 2 km W of Meydandere village, 37.921023°N, 42.07538°E, 853 m, 16 May 2011, leg. E.A. Yağmur & M. Özkarük; 1 ♀, 1 subad. ♂ (AZM), same locality, 37.9217°N, 42.0914°E, 874 m, 19 May 2009, leg. E.A. Yağmur & M. Uslu; 1 ♀ (AZM), Siirt Province, Central District, 13 km SW of Siirt town, 37.2831°N, 42.0200°E, 676 m, 19 May 2009, leg. E.A. Yağmur & M. Uslu; 1 juv. (AZM), Siirt Province, Baykan District, 20 km SW of Baykan town, 38.0522°N, 41.7806°E, 596 m, 18 May 2009, leg. E.A. Yağmur & M. Uslu; 1 ♂ (NHMW 0842), Siirt Province, road Siirt–Kurtalan, 16 May 1966, leg. J. Eiselt et al.; 1 ♀ (NHMW 0846), Siirt Province, Baykan town, 38.165°N, 41.780°E, 15 May 1966, leg. J. Eiselt et al.; 1 ♀ (ZMUH A37/72), Siirt Province, Central District, Siirt town, 37.933°N, 41.95°E, 18 June 1972, leg. C. Kosswig.

NOTE: the latter three specimens (deposited in NHMW and ZMUH) were listed as part of paratype series of *Calchas birulai* by Fet et al. (2009: 55).

**Diagnosis.** Small to medium-sized scorpion for this genus, 24–34 mm in length, pectinal tooth counts 6–7 (6.87) male and 6–7 (6.04) female. Coloration dark yellow-brown with little pigmented patterns. Fixed and movable fingers of chela not elongated, movable finger length / palm length 1.06 for male and 1.01 for female, and fixed finger length / palm length 0.78 for male and 0.77 for female (based on the mean).

**Distribution.** TURKEY: southeast (Siirt and Şırnak Provinces) (see map in Fig. 45).

**Etymology.** Species name is a patronym honoring Dr. Curt Kosswig (1903–1982), the founder of academic zoological research in Turkey, and a Professor of Zoology at the University of Istanbul in 1937–1955.

**MALE.** Description based on holotype male from İdil, Turkey. Measurements of the holotype plus three female paratype specimens are presented in Table 2. See Figure 28 for dorsal and ventral views of the male holotype.

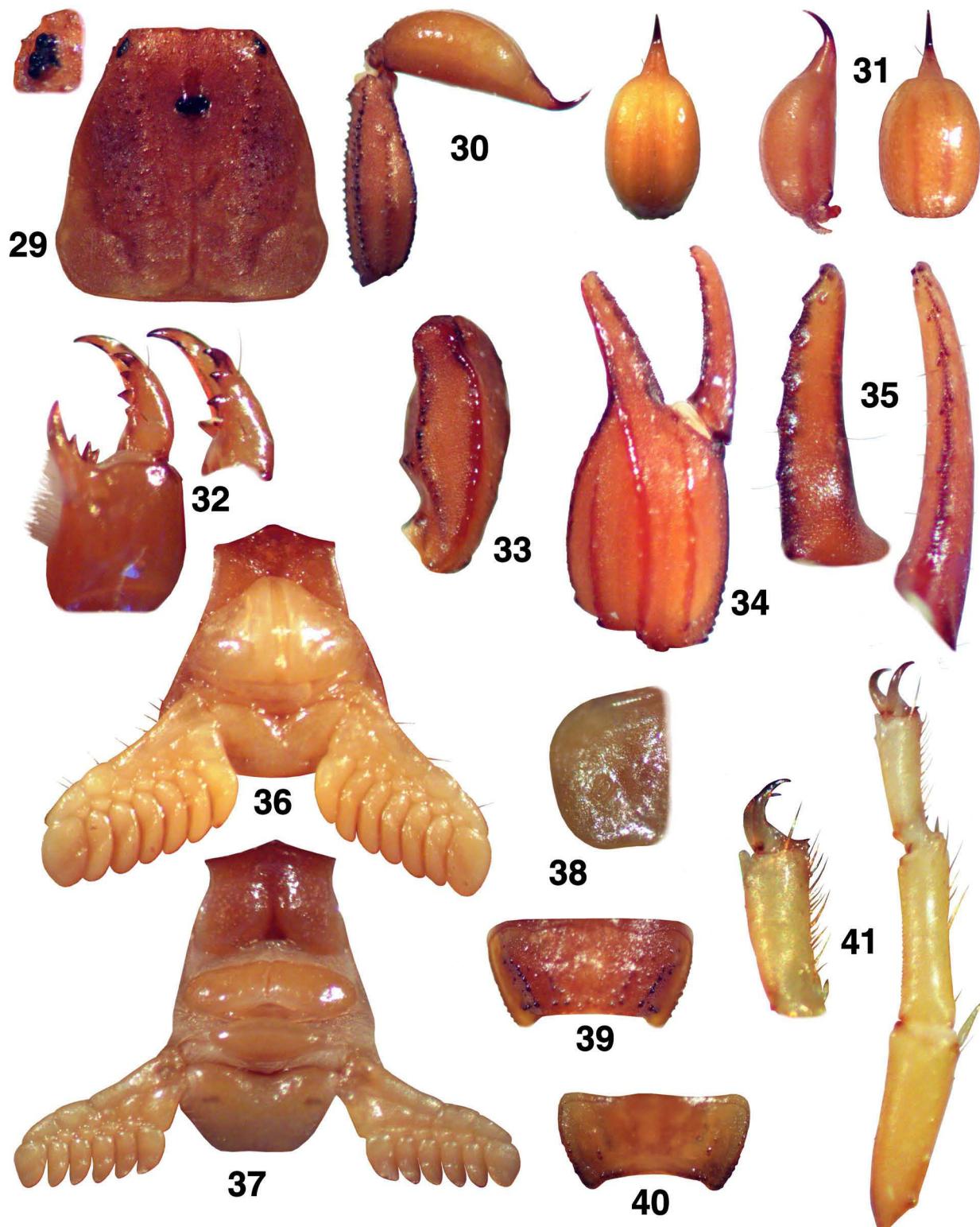


**Figure 28:** *Calchas kosswigi*, sp. nov., dorsal and ventral views. **Top.** Male holotype, Yörük Village, Şırnak Province, Turkey. **Bottom.** Female paratype, Meydandere Village, Siirt Province, Turkey.

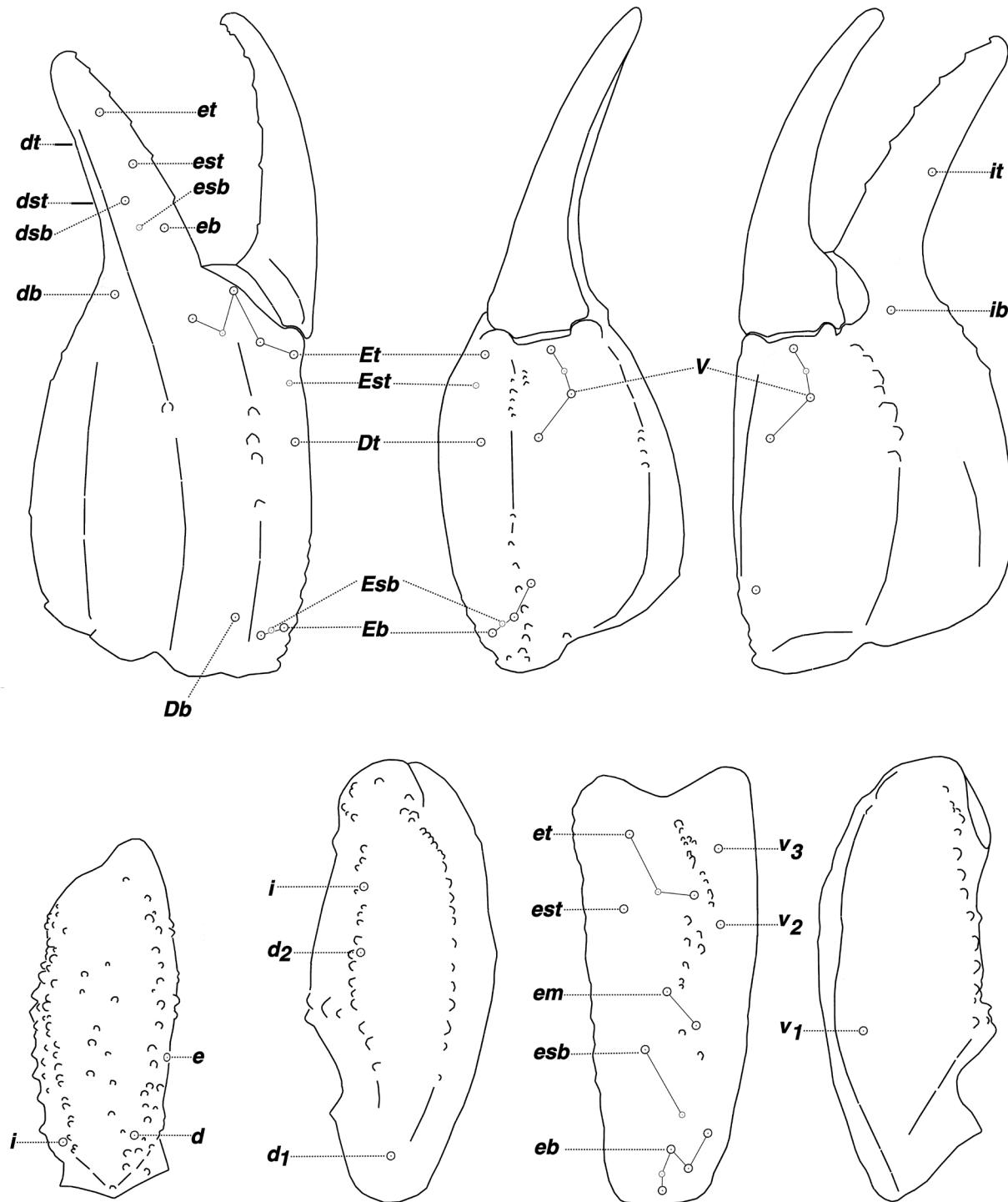
**COLORATION.** Basic color of carapace, mesosoma, metasoma, and pedipalps a dark orange-brown; telson and legs yellow-brown; sternites brown; carinae of pedipalps and metasoma reddish to dark brown; chelal finger dentition and telson aculeus a dark brown. No variegated patterns present.

**CARAPACE (Fig. 29).** Anterior edge with a small median indentation; interocular area somewhat rough with scat-

tered granulation, though smooth around the immediate area of the median eyes; posterior lateral aspects covered with medium to large granules except for extreme anterolateral lobes which are smooth. Anterior and lateral edges next to lateral eyes with small but conspicuous pointed granules. Mediolateral ocular carinae present and granular, extending to the lateral eyes; lateral eyes number two, the posterior eye slightly smaller. Median eyes and tubercle somewhat small, po-



**Figures 29–41:** *Calchas kosswigi*, sp. nov. 29–30, 33–36, 38–40. Male holotype, Yörük Village, Şırnak Province, Turkey. 31–32, 37, 41. Female paratypes, Meydandere Village, Siirt Province, Turkey. 29. Carapace and lateral eyes (enlarged). 30. Telson and metasomal segment V, lateral view; telson ventral view. 31. Telson, lateral and ventral views. 32. Chelicera, dorsal views. 33. Patella, dorsal view. 34. Chela, external view. 35. Dentition of movable and fixed fingers. 36. Sternopectinal area. 37. Sternite VII. 38. Right stigma II. 39. Tergite VII. 40. Sternite VII. 41. Right leg III (note tibial spur); closeup of leg tarsus, lateral view (second female paratype).



**Figure 42:** Trichobothrial pattern of *Calchas kosswigi*, sp. nov., male holotype, Yörük Village, Şırnak Province, Turkey.

sitioned considerably anterior of middle with the following length and width formulas: 0.281 (anterior edge to medium tubercle middle / carapace length) and 0.167 (width of median tubercle including eyes / width of carapace at that point).

**MESOSOMA (Figs. 38–40).** Tergites I–VI smooth; tergite VII covered with granules with two pairs of crenulate carinae. Sternites III–VII smooth; on segment VII, one pair of weak irregularly granulated lateral carinae, median pair obsolete. Stigmata (Fig. 38) are short sub-oval

in shape, angled 45 degrees in an anterointernal direction.

**METASOMA (Fig. 30).** Segments I–IV: dorsal and dorsolateral carinae crenulate to serrate; dorsal (I–IV) and dorsolateral (I–III) carinae terminate with spine; lateral carinae crenulate on 90 % of I, on 50 % of II, on 30 % of III, and absent on IV; ventrolateral carinae crenulate to serrulate and ventromedian crenulate. Dorsolateral carinae of segment IV terminates at articulation condyle. Segment V: dorsolateral carinae granulate to crenulate; lateral carinae crenulate for two-thirds of posterior aspect; ventrolateral and single ventromedian carinae serrate. Intercarinal areas of segments I–IV essentially smooth except for ventral surface of segment V which is scattered with large granules. Metasoma essentially void of setation.

**TELSON (Figs. 30, 31, paratype female).** Elongated vesicle with short abruptly curved aculeus. Vesicle ventral surface essentially smooth with slight granulation basally; subaculear setal pair (SSP) located on base of aculeus, distal of vesicle/aculeus juncture. Vesicular tabs smooth; anal arch with 10 small granules.

**PECTINES (Figs. 36, 37, paratype female).** Well-developed segments exhibiting length/width formula 1.744 (length taken at anterior lamellae/width at widest point including teeth). Sclerite construction complex, three anterior lamellae and 4/4 middle lamellae; fulcra of medium development. Teeth number 7/7. Sensory areas developed along most of tooth inner length on all teeth, including basal tooth. Basal piece large, with deep indentation along anterior edge, length/width formula 0.524.

**PREPECTINAL PLATE (Fig. 37).** Not present in male (see discussion on female below).

**GENITAL OPERCULUM (Figs. 36, 37, paratype female).** Sclerites large, subtriangular, approximately as wide as long, separated for most of length. Conspicuous genital papillae present and visible between the sclerites, but not extending beyond the posterior edge (see discussion on female below).

**STERNUM (Figs. 36, 37, paratype female).** Type 2, posterior emargination present, well-defined convex lateral lobes, apex visible but not conspicuous; wider than long, length/width formula 0.846; sclerite tapers anteriorly, posterior-width/anterior-width formula 1.182.

**CHELICERAE (Fig. 32, female paratype).** Movable finger dorsal edge with one large subdistal (*sd*) denticle; ventral edge with one large pigmented accessory dent-

icle at finger base; ventral edge with heavy setal brush covering well-developed serrula, terminating just before distal tip. Ventral distal denticle (*vd*) considerably longer than dorsal (*dd*). Fixed finger with four denticles, median (*m*) and basal (*b*) denticles conjoined on common trunk; no ventral accessory denticles present.

**PEDIPALPS (Figs. 33–35).** Short fingered, strong chelae, heavily carinated, no scalloping on chelal fingers, thus not exhibiting sexual dimorphism in this structure. **Femur:** Dorsointernal and ventrointernal carinae serrate, dorsoexternal carina crenulate, ventroexternal smooth. Dorsal surface smooth with sparingly scattered with large granules, ventral smooth, internal smooth with one line of five granules, and external surface smooth with slight trace of granulation. **Patella:** Dorsointernal and ventrointernal carinae crenulate, dorsoexternal rounded and granulate, ventroexternal smooth, and exteromedian carina irregularly granulate distally with weak rounded granules. Dorsal, ventral, and external surfaces smooth; external surface smooth except for exteromedian carina; internal surface smooth except for weakly developed doubled DPS and single VPS. **Chelal carinae:** Complies with the “8-carinae configuration”. Digital (*D1*) carina strong and smooth; dorsosecondary (*D3*) present on basal 3/4 only, smooth; dorsomarginal (*D4*) strong, rounded and irregularly granulate; dorsointernal (*D5*) weak, rounded, sparsely granulated; ventroexternal (*V1*) strong and granulated proximally, terminating at external condyle of movable finger; ventrointernal (*V3*) strong and smooth, continuous to internal condyle; external (*E*) medium, continuous, essentially smooth except proximally which is granulate; internal (*I*) weak, rounded, not continuous, with large granules. **Chelal finger dentition (Fig. 35):** median denticle (*MD*) row groups oblique and slightly imbricating, numbering 6/6 and 7/7 on fixed and movable fingers; 5/5 and 6/6 internal denticles (*ID*) and 5/5 and 6/6 outer denticles (*OD*) on fixed and movable fingers, respectively. No accessory denticles present. Number of *MD* denticles on movable finger is 53+. **Trichobothrial patterns (Fig. 42):** Type C, orthobothrioxic.

**LEGS (Fig. 41, female paratype).** Both pedal spurs present on all legs; tibial spurs present on legs III and IV. Tarsus covered heavily with large socket setae on ventral surface. Small ventral spinules located at base of tarsus.

**HEMISPERMATOPHORE (FIG. 5–6).** The overall structure is simplistic with a straight, parallel, and somewhat wide lamina terminating in a blunt truncated distal tip. The distal tip is thickened on the external edge exhibiting a slight sclerotization. At the lamina base is a nonpigmented, slightly sclerotized thin pointed internal



**Figure 43:** *Calchas kosswigi*, sp. nov., in its natural habitat (top) and typical habitat (bottom), Meyandere village, Siirt, Province, Turkey.



**Figure 44:** *Calchas kosswigi*, sp. nov., type locality, Yörük Village, Devegeli Valley, İdil District, Şırnak Province, Turkey.

protuberance. Emanating from the internal aspect of the capsular area is a highly pigmented sclerotized acuminate process terminating in a delicately truncated point.

**Female Paratype (Figs. 31–32, 37, 41).** Adult females are somewhat larger than the holotype male, 24 [1] for male, compared to 31–34 [3] for females. The genders do not exhibit any significant morphometric differences. Pectinal tooth counts in the male exceed the female by one tooth, the male with 7 and the female with 6 (see histogram in Fig. 9). The genital operculum of the male is dramatically different from that in the female (Figs. 36–37). The sclerites, subtriangular in shape, are as long as or longer than wide in the male, whereas in the female the sclerites are short and wide, more than twice as wide as long. Whereas the sclerites are fused medially in the female, they are separated their entire length in the male, exposing significantly developed genital papillae. The prepectinal plate (Figs. 37), so conspicuous in the female, is absent in males. Figures 28, 43–44 show dorsal and ventral views of both male holotype and female paratype specimens, and type locality area (Yörük village, Şırnak Province, Turkey) for this species.

## Calchinae Biogeography

Kaltsas et al. (2008: 238) mentioned that “the biogeography of the monotypic genus *Calchas* still remains a mystery to scientists.” Soon after, Fet et al. (2009) described two new species in this genus and discussed the *Calchas* species known at that time in a biogeographic context. They noted that the distributions of *C. gruberi* (now *Neocalchas gruberi*), *C. birulai* and *C. nordmanni* are consistent with patterns of allopatric speciation postulated for co-distributed Anatolian taxa. All three are separated by high mountain ranges. The nominotypical *Calchas nordmanni* in the extreme northeast of Turkey is an endemic species confined to Çoruh River valley (Black Sea watershed) with its mild climate. The Çoruh valley, which houses a high number of endemic animal and plant species, lies within the Caucasus ecological zone. *C. nordmanni* is found up to 2108 m a.s.l. In the south, the range of *C. nordmanni* appears to be separated from its congeneric species by the high mountain ranges from Munzur to Aras, and further south by Southeastern Taurus Mountains (Güneydoğu Toroslar).

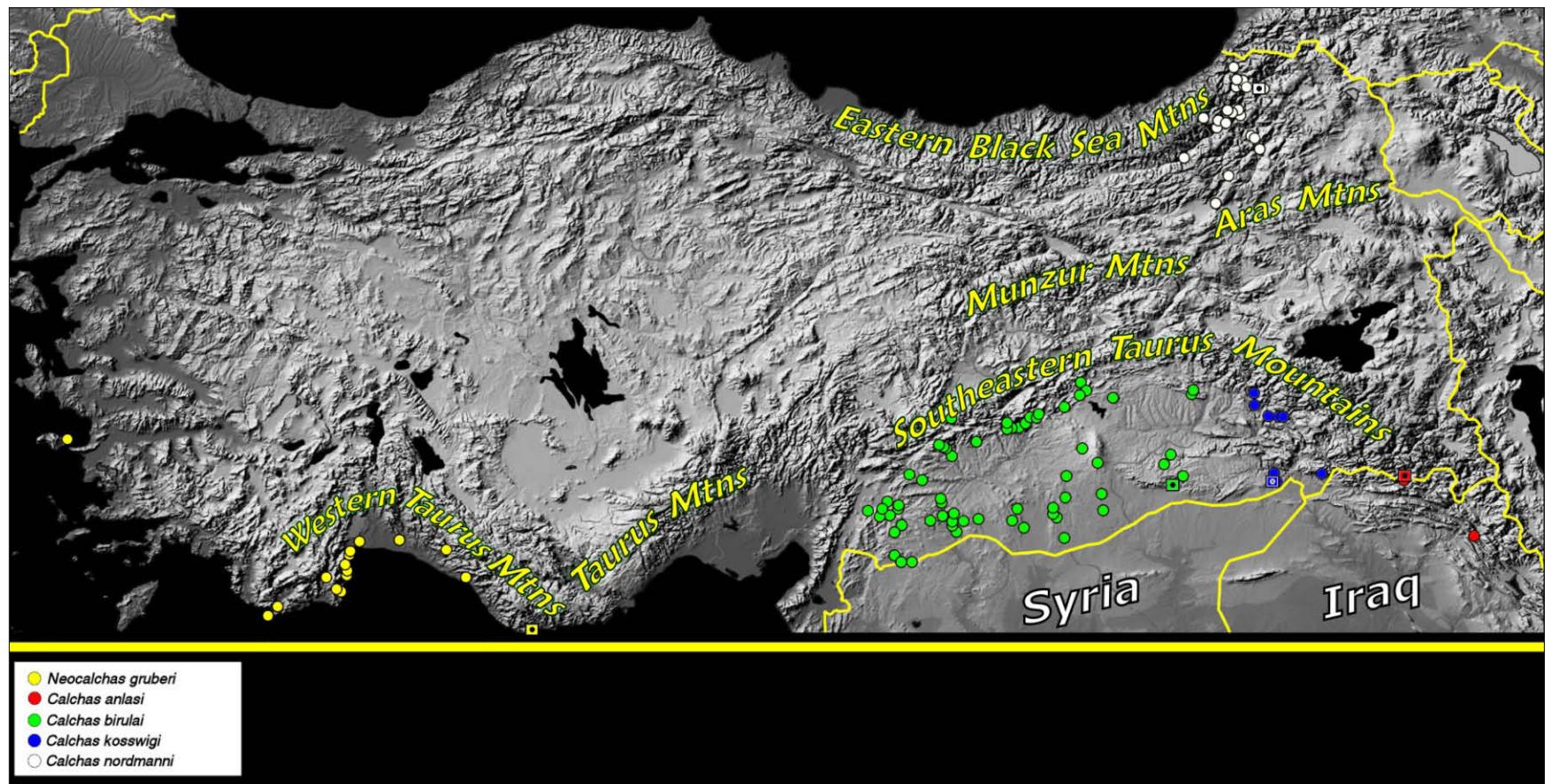
*Calchas birulai* appears to be the most common and widespread of three congeneric species found in southeastern Turkey, from Gaziantep Province in the east to Mardin Province in the west (between 37 and 41°E). It inhabits arid mountains and foothills between 350 and 1415 m a.s.l., on the southern slopes of Southeastern Taurus.

Two new species from southeastern Turkey described in this paper, *C. kosswigi* sp. nov. and *C. anlasi* sp. nov., are closely allopatric to *C. birulai*. Populations from Siirt Province listed as *C. birulai* in Fet et al. (2009) are described here as *C. kosswigi*, along with newly discovered populations from Şırnak Province. Allopatric distribution of *C. birulai* and *C. kosswigi*, with a small gap currently identified between their range boundaries in Mardin and Siirt Provinces, respectively, could be due to local isolation. Siirt Province mountains house a number of endemic animal species in other low-dispersal groups such as land snails (Şesen & Schütt, 2000).

The second new species described here, *C. anlasi*, is known only from its type locality, Çukurca, which could be its northernmost distribution limit. Çukurca is isolated by mountains from the rest of Hakkari Province, and lies at a relatively low altitude (1269 to 1283 m) for this high mountainous region. It is possible that *C. anlasi* is found further south, along lower slopes of Southeastern Taurus toward northern Iraq. The single reported record of *Calchas* from Iraq (Geli Ali Beq, Arbil Province), which Fet et al. (2009) tentatively identified as *C. birulai*, most likely belongs to *C. anlasi*.

Our description of *Neocalchas* makes it the only currently monotypic genus of Iuridae, and the second genus of Calchinae. Its only species *N. gruberi* is limited to southwestern Anatolia (Mediterranean biogeographic region), mainly to Antalya Province, and separated by the high massifs of Western Taurus and central Taurus Mountains from four species of the sister genus *Calchas*. *Neocalchas gruberi* is a rather low-altitude species, found from sea level to 865 m a.s.l., from Samos Island in the west to Anamur (Mersin Province) in the east (Fet et al., 2009).

*N. gruberi* is also the only species of Calchinae found within the Greek territory, on two coastal islands located very close to Anatolia (Samos and Megisti), which have been connected to the Asian mainland in Pleistocene. Stathi et al. (2010), based on ample material, determined that the island population from Megisti is consistent with the populations from Turkey described by Fet et al. (2009). From Samos, however, only one specimen is known, collected on 23 April 1979 by the Polish malacologist Adolf Riedel. We examined this specimen (FMNH), which was first reported by Sissom (1988; as *Paraiurus nordmanni*). However, Dimitris Kaltsas did not find *Calchas* in the specified locality during his regular visits to Samos between 2006 and 2008, including the exact label locality of Riedel (southern slope of Mt Spiliani) (Kaltsas et al., 2008: 227). We do not know if Riedel's specimen represents a natural disjunct population or could have been introduced. Clearly, additional specimens of both genders need to be studied from this island. Based on its significant disjunction from the primary *N. gruberi* pop-



**Figure 45:** Distribution of *Neocalchas* and *Calchas* in Turkey and Greece (i.e., Samos and Megisti Islands). Type localities are indicated by a square icon with a dot. Locations are based on material collected and/or examined, and reported in literature (see Fet et al., 2009 for a complete list of literature references). Note *Calchas* has been reported for Iraq which presumably is *C. anlasi* but the species identity has not been verified.

ulation, it will not be surprising if the Samos population turns out to be a separate and therefore new species. Note that another localized iurid endemic, *Iurus kinzelbachi*, has been found on Samos and adjacent western Anatolia (Kovařík et al., 2010; Soleglad et al., 2012).

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## Appendix A

### *Calchas* and *Neocalchas* Locality Data

This appendix includes a complete list of all locality-based references to scorpions comprising subfamily Calchinae, including all new references established during the research for this present paper.

<b>LOCALITY DATA (with altitude a.s.l.)</b>		<b>Reference</b>	<b>Coordinates, °N °E</b>
<b><i>Calchas nordmanni</i> Birula, 1899: Turkey (northeast)</b>			
1	<i>Artvin Province</i> : Ardanuç District, Ardanuç town ( <b>type locality</b> )	Birula, 1899, 1900, 1912, 1917a, 1917b; Kamenz & Prendini, 2008; Fet et al., 2009	41.128 42.059
2	<i>Artvin Province</i> : Ardanuç District, 2 km W of Ardanuç town, Cehennemderesi Valley, 538 m	new	41.1331 42.0148
3	<i>Artvin Province</i> : Central District, Artvin town	Crucitti & Vignoli, 2002; Fet et al., 2009	41.182 41.819
4	<i>Artvin Province</i> : Central District, Lomashen (Lomasheni) (now Seyitler Köyü), near Artvin	Birula, 1911, 1912, 1917a, 1917b; Vachon, 1971; Fet et al., 2009	41.1813 41.8406
5	<i>Artvin Province</i> : Central District, Svetibar (Svetibari) (now between Seyitler and Deriner), near Artvin town	Birula, 1912, 1917a, 1917b; Fet et al., 2009	41.1872 41.8453
6	<i>Artvin Province</i> : Çoruh River, near Borçka town	Birula, 1917a, 1917b; Fet et al., 2009	41.3625 41.68
7	<i>Artvin Province</i> : “Khakhauch”, “Keniya Mts.” (now Genya Mts.), left bank of Çoruh River, 5 km S of Artvin town	Birula, 1912, 1917a, 1917b; Fet et al., 2009	41.14921 41.83157
8	<i>Artvin Province</i> : Central District, Hatila Valley National Park, 563 m	Yağmur et al., 2012	41.1615 41.7070
9	<i>Artvin Province</i> : Central District, Hatila Valley National Park, around entrance gate, 485 m	new	41.2171 41.7827
10	<i>Artvin Province</i> : Central District, Hatila Valley National Park, Taşlıca village, 912 m	Yağmur et al., 2012	41.2280 41.7581
11	<i>Artvin Province</i> : Central District, Hatila Valley National Park, after entrance gate, 485 m	new	41.2171 41.7827
12	<i>Artvin Province</i> : Central District, Hatila Valley National Park, trail to Mt. Otluca, 553 m	new	41.18844 41.73255
13	<i>Artvin Province</i> : Yusufeli District, Yusufeli	Kinzelbach, 1980; Fet et al., 2009	40.817 41.55
14	<i>Artvin Province</i> : Yusufeli District, Çevreli village, 1264 m	new	40.7667 41.4324
15	<i>Artvin Province</i> : Yusufeli District, Havuzlu village, 1327 m	new	40.9166 41.7086
16	<i>Artvin Province</i> : Yusufeli District, Kömürlü village, 1381 m	new	40.9010 41.6666
17	<i>Artvin Province</i> : Yusufeli District, Öğdem village, 1238 m	new	40.9137 41.6126
18	<i>Artvin Province</i> : Yusufeli District, Özgüven village, 1498 m	new	40.8419 41.4484
19	<i>Artvin Province</i> : Yusufeli District, Tekkale village, 2075 m	new	40.0329 41.3739
20	<i>Artvin Province</i> : Yusufeli District, Yaylalar village, 2108 m	new	40.8646 41.2643



**Figure A-1:** *Calchas nordmanni* in its natural habitat (top) and typical habitat (bottom), inside of valley, Hatila Valley National Park, Central District, Artvin Province, Turkey.

21	<i>Artvin/Erzurum Provinces</i> : “Demirkent, Tortum”, i.e., between Demirkent (Artvin Province, Yusufeli District) and Tortum (Erzurum Province, Tortum District)	Fet et al., 2009	40.298–40.885   41.548–41.738
22	<i>Erzurum Province</i> : Ispir District, Ispir town, left bank of Çoruh Nehri	Fet et al., 2009	40.483 40.995
23	<i>Erzurum Province</i> : Oltu District, near Oltu	Birula, 1917a, 1917b; Fet et al., 2009	40.55 41.983
24	<i>Erzurum Province</i> : Oltu District, Anzov (now Anzav, or Kayaaltı village)	Birula, 1912, 1917a, 1917b; Fet et al., 2009	40.68216 41.87098
25	<i>Erzurum Province</i> : Oltu District, N of Oltu, border post Erük (now Örük, or Derebaşı village)	Birula, 1905, 1917a, 1917b; Fet et al., 2009	40.64998 41.90284
26	<i>Erzurum Province</i> : Tortum District, Tortum	Kinzelbach, 1980, 1982; Fet et al., 2009	40.298 41.548
<b><i>Calchas birulai</i> Fet, Soleglad et Kovařík, 2009: Turkey (southeast)</b>			
1	<i>Adiyaman Province</i> : Central District, 8 km N of Adiyaman town	new	37.8342 38.3156
2	<i>Adiyaman Province</i> : Central District, 1 km W of Aydinoluk village fork in the road, 730 m	new	37.7078 38.0017
3	<i>Adiyaman Province</i> : Gerger District, 2 km NE of Açma village, 595 m	new	37.9931 38.9642
4	<i>Adiyaman Province</i> : Gerger District, 5 km NE of Aydınlar village, 1388 m	new	38.0614 39.1122
5	<i>Adiyaman Province</i> : Gerger District, 5 km NE of Çiftemiş village, 672 m	new	37.9514 38.8733
6	<i>Adiyaman Province</i> : Gerger District, 2 km W of Gerger town, 963 m	new	38.0447 39.0222
7	<i>Adiyaman Province</i> : Gerger District, 2 km NE of Kaşyazı village	new	38.0403 39.0906
8	<i>Adiyaman Province</i> : Kahta District, Mt. Nemrut National Park, 1415 m	new	37.9500 38.7600
9	<i>Adiyaman Province</i> : Kahta District, Mt. Nemrut (Nemrut Dağı) between summit and Horik	Fet et al., 2009	37.93–37.97   38.70–38.73
10	<i>Adiyaman Province</i> : Kahta District, Mt. Nemrut (Nemrut Dağı) 40 km N of Kahta	Fet & Braunwalder, 2000 (as <i>C. nordmanni</i> ); Fet et al., 2009	37.982 38.741
11	<i>Adiyaman Province</i> : Tut District, 5 km W of Tut town	new	37.7833 37.9408
12	<i>Adiyaman Province</i> : Tut District, 2 km NW of Meryemuşağı village fork in the road, 1143 m	new	37.8086 37.8636
13	<i>Adiyaman Province</i> : Tut District, Tut town, 1052 m	new	37.7964 37.9142
14	<i>Diyarbakır Province</i> : Ergani District, Değirmendere village, 874 m	new	38.3392 39.6992
15	<i>Diyarbakır Province</i> : Ergani District, Kavurma village, 10 km NE of Ergani, 1400 m	Kovařík, 1997 (as <i>C. nordmanni</i> ); Fet et al., 2009	38°19'N, 39°41'E
16	<i>Diyarbakır Province</i> : Eğil District, 3 km N of Kalkan village, 832 m	new	38.1775 40.0889
17	<i>Diyarbakır Province</i> : Ergani District, 1 km NE of Salihli village fork in the road, 902 m	new	38.2272 39.6686
18	<i>Diyarbakır Province</i> : Silvan District, Boyunlu village, 1240 m	new	38.2071 41.0157



**Figure A-2:** *Calchas birulai* in its natural habitat (top) and typical habitat (bottom), Birecik town, Kelaynak Valley, Şanlıurfa Province, Turkey.

19	<i>Diyarbakır Province</i> : Silvan District, Mt. Köçek, 1126 m	new	38.1819 41.0050
20	<i>Gaziantep Province</i> : Araban District, Köklüce village, 673 m	new	37.4767 37.6142
21	<i>Gaziantep Province</i> : Yavuzeli District, Rumkale ruins	Fet et al., 2009 (erroneously listed in <i>Şanlıurfa Province</i> : Halfeti District)	37.265 37.874
22	<i>Gaziantep Province</i> : Nizip District, Altındağ Village, 667 m	new	37.0872 37.7019
23	<i>Gaziantep Province</i> : Nizip District, 2 km S of Aşağı Kışla village, 511 m	new	37.1214 37.8565
24	<i>Gaziantep Province</i> : Nurdağı District, Sakçagözü village	Fet et al., 2009	37.198 36.927
25	<i>Gaziantep Province</i> : Şahinbey District, Yukarıbayır quarter, 924 m	new	37.0489 37.3582
26	<i>Gaziantep Province</i> : Şahinbey District, Güllüce village	Karataş & Çolak, 2005 (as <i>C. nordmanni</i> ); Fet et al., 2009	36.983 37.267
27	<i>Gaziantep Province</i> : Şehitkamil District, 2 km SW of Akçaburç village, 834 m	new	37.2358 37.3131
28	<i>Gaziantep Province</i> : Şehitkamil District, 1 km S of Eski Şarkaya village, 1000 m	new	37.2123 37.1293
29	<i>Gaziantep Province</i> : Şehitkamil District, 1 km NE of İncesu village (İncesu Köyü), 942 m	Kamenz & Prendini, 2008 (as <i>C. nordmanni</i> ); Fet et al., 2009	37.2211 37.3014
30	<i>Gaziantep Province</i> : Şehitkamil District, 2 km E of Yamaçoba village, 1099 m	new	37.1742 37.0925
31	<i>Gaziantep Province</i> : Şehitkamil District, 2 km S of Yeşilce village, 1088 m	new	37.1533 37.2125
32	<i>Kahramanmaraş Province</i> : Pazarcık District, Akçalar village, 966 m	new	37.5417 37.4547
33	<i>Kahramanmaraş Province</i> : Pazarcık District, 1 km S of Karabiyıklı village, 907 m		37.2983 37.1889
34	<i>Kilis Province</i> : Central District, 2 km E of Küplüce village, 624 m	Yağmur et al., 2007 (as <i>C. nordmanni</i> )	36.7589 37.2553
35	<i>Kilis Province</i> : Elbeyli District, 1 km W of Canak Village, 542 m	Yağmur et al., 2007 (as <i>C. nordmanni</i> )	36.6883 37.3314
36	<i>Kilis Province</i> : Elbeyli District, 1.5 km NE of Uzunali village, 564 m	Yağmur et al., 2007 (as <i>C. nordmanni</i> )	36.6878 37.4556
37	<i>Malatya Province</i> : Malatya	Fet et al., 2009	38.067 38.0167
38	<i>Mardin Province</i> : Mardin ( <b>type locality</b> )	Fet et al., 2009	37.30 40.733
39	<i>Mardin Province</i> : Mazıdağı District, 20 km W of Sürgücü village, 948 m	new	37.5006 40.6203
40	<i>Mardin Province</i> : Savur District, 2 km N of Sürgücü village, 802 m	new	37.5956 40.7189
41	<i>Mardin Province</i> : Yeşilli District, Hop Pass, 1161 m	new	37.3722 40.8642
42	<i>Şanlıurfa Province</i> : Birecik District, Birecik town ("Bilejdik", "Biledjik")	Francke & Soleglad, 1981 (as <i>C. nordmanni</i> ); Fet & Braunwalder, 2000 (as <i>C. nordmanni</i> ); Kamenz & Prendini, 2008 (as <i>C. nordmanni</i> ); Fet et al., 2009	
43	<i>Şanlıurfa Province</i> : Birecik District, 10 km E of Birecik town, Mt. Arat, 678 m	new	37.0522 38.1180
44	<i>Şanlıurfa Province</i> : Birecik District, 2 km N of Birecik town, Kelaynak Valley, 388 m	new	37.0497 37.9853
45	<i>Şanlıurfa Province</i> : Birecik District, Çicekalan village, 350 m	new	36.9539 38.0269
46	<i>Şanlıurfa Province</i> : Birecik District, 2 km N	new	37.1458 38.0017

	of Yukarı Habip village, 633 m		
47	<i>Şanlıurfa Province</i> : Central District, 2 km SE of Asri village, 561 m	new	37.0767 39.2250
48	<i>Şanlıurfa Province</i> : Central District, Çanakçı village, 2 km E of Pirpir hamlet, Tektek Mts., 532 m	new	37.1287 39.2422
49	<i>Şanlıurfa Province</i> : Central District, 5 km E of Dağyanı village, 653 m	new	37.2242 39.4017
50	<i>Şanlıurfa Province</i> : Central District, 1.5 km W of Duruca village, Tofaş Memorial Forest, 423 m	new	36.9578 38.8733
51	<i>Şanlıurfa Province</i> : Central District, Karahisar village, Karaca hamlet, 622 m	new	37.0397 39.2786
52	<i>Şanlıurfa Province</i> : Central District, Kızılıkuyu village, 543 m	new	37.0413 38.7238
53	<i>Şanlıurfa Province</i> : Ceylanpınar District, 5 km N of Ceylanpınar town, 484 m	new	37.0800 39.8667
54	<i>Şanlıurfa Province</i> : Halfeti District, Halfeti town	Kovařík, 1997 (as <i>C. nordmanni</i> ); Fet & Braunwalder, 2000 (as <i>C. nordmanni</i> ); Fet et al., 2009	37.25 37.867
55	<i>Şanlıurfa Province</i> : Halfeti District, 2 km S of Halfeti town, 622 m	new	37.2333 39.8764
56	<i>Şanlıurfa Province</i> : Halfeti District, 1.5 km N of Savaşan village, 527 m	new	37.2861 37.8586
57	<i>Şanlıurfa Province</i> : Harran District, Tektek Mts., 426 m	new	36.8314 39.3694
58	<i>Şanlıurfa Province</i> : Siverek District, Karacadağ Mts., near Siverek, 1200 m	Kinzelbach, 1982 (as <i>C. nordmanni</i> ); Fet et al., 2009	37.15 38.80
59	<i>Şanlıurfa Province</i> : Siverek District, Karacadağ Mts., 1303 m	new	37.5406 39.8319
60	<i>Şanlıurfa Province</i> : Siverek District, Karakeçi village, 760 m	new	37.4333 39.4361
61	<i>Şanlıurfa Province</i> : Suruç District, Ezgil village, 605 m	new	37.0658 38.2983

*Calchas kosswigi Yağmur, Kovarik, Fet et Soleglad, sp. n.: Turkey (southeast)*

1	<i>Siirt Province</i> : Baykan District, 20 km SW of Baykan town, 596 m	new	38.0522 41.7806
2	<i>Siirt Province</i> : Central Distict, 13 km SW of Siirt town, 676 m	new	37.2831 42.0200
3	<i>Siirt Province</i> : Central District, 2 km W of Meydandere village, 874 m	new	37.9217 42.0914
4	<i>Siirt Province</i> : Central District, Siirt town	Kinzelbach, 1980 (as <i>C. nordmanni</i> ); Fet et al., 2009 (as <i>C. birulai</i> )	37.933 41.95
5	<i>Siirt Province</i> : road Siirt–Kurtalan, Baykan (between Siirt and Bitlis)	Fet et al., 2009 (as <i>C. birulai</i> )	38.165 41.780
6	<i>Şırnak Province</i> : İdil District, 20 km N of Cizre town, 654 m	new	37.3660 41.9995
7	<i>Şırnak Province</i> : İdil District, Devegeli Valley, 2 km N of Yörük village, 658 m ( <b>type locality</b> )	new	37.28856 42.00729
8	<i>Şırnak Province</i> : Silopi District, Görümlü village, 1009 m	new	37.3389 42.5750



**Figure A-3:** *Neocalchas gruberi* in its natural habitat (top) and typical habitat (bottom), Küçük Çaltıçak area, Antalya Province, Turkey.

<i>Calchas anlasi Yağmur, Kovarik, Fet et Soleglad, sp. n.: Turkey (southeast); ?Iraq (north)</i>			
<b>TURKEY</b>			
1	<i>Hakkari Province</i> : Çukurca District, 1 km NE of Çukurca town, 1269 m ( <b>type locality</b> )	new	37.2558 43.6128
2	<i>Hakkari Province</i> : Çukurca District, 1 km N of Çukurca town, 1283 m	new	37.2210 43.6044
<b>IRAQ</b>			
3	<i>Arbil (Erbil, Hawler) Province</i> : Geli Ali Beg waterfall (tentative identification)	Fet et al., 2009 (not seen; as <i>C. birulai</i> )	36.6305 44.4475
<i>Neocalchas gruberi</i> (Fet, Soleglad et Kovařík, 2009): Turkey (southwest); Greece (Samos and Megisti islands)			
<b>TURKEY</b>			
1	<i>Antalya Province</i> : mountains N of Antalya	Fet et al., 2009 (as <i>C. gruberi</i> )	36.913 30.69
2	<i>Antalya Province</i> : 46 km by road N of Antalya, 865 m	Fet et al., 2009 (as <i>C. gruberi</i> )	37.327 30.69
3	<i>Antalya Province</i> : Akseki District, 12 km S of Akseki	Fet et al., 2009 (as <i>C. gruberi</i> )	37.0486 31.79
4	<i>Antalya Province</i> : Akseki District, 2 km N of Murtiçi village, 495 m	new	36.8647 31.7508
5	<i>Antalya Province</i> : 15 km NE of Kumluca	Kinzelbach, 1980, 1982 (as <i>C. nordmanni</i> ); Fet et al., 2009 (as <i>C. gruberi</i> )	36.546 30.283
6	<i>Antalya Province</i> : Alanya District, Taşatan Plateau, 2 km N of fork in the road, 727 m	new	36.5919 31.9924
7	<i>Antalya Province</i> : Kaş District, between Kasaba and Kaş towns, 444 m	new	36.2466 29.7031
8	<i>Antalya Province</i> : Kemer District, Kemer town	Fet et al., 2009 (as <i>C. gruberi</i> )	36.60 30.55
9	<i>Antalya Province</i> : Kemer District, 5 km N Kemer town, 30 m	new	36.6441 30.5466
10	<i>Antalya Province</i> : Kemer District, Çıralı area, 31 m	new	36.4174 30.4702
11	<i>Antalya Province</i> : Kemer District, Göynük Canyon, 82 m	new	36.6833 30.5297
12	<i>Antalya Province</i> : Kemer District, Kiriş Village, 29 m	new	36.5880 30.5622
13	<i>Antalya Province</i> : Kemer District, Mt. Olympos	Fet et al., 2009 (as <i>C. gruberi</i> )	36.403 30.474
14	<i>Antalya Province</i> : Kemer District, Mt. Olympos, fork in the road, 382 m	new	36.4354 30.4284
15	<i>Antalya Province</i> : Kemer District, Mt. Olympos, Alasını area, 225 m	new	36.4324 30.4335
16	<i>Antalya Province</i> : Kemer District, Mt. Olympos, Çıralı area, 331 m	new	36.4174 30.4702
17	<i>Antalya Province</i> : Konyaaltı District, Büyük Çaltıçak, 17 m	new	36.7847 30.5692
18	<i>Antalya Province</i> : Konyaaltı District, Küçük Çaltıçak area, 13 m	new	36.7952 30.5730
19	<i>Antalya Province</i> : Serik District, Belkis (Aspendos)	Fet et al., 2009 (as <i>C. gruberi</i> )	36.939 31.172
20	<i>Mersin Province</i> : Anamur District, 15 km by road W of Anamur	Fet et al., 2009 (as <i>C. gruberi</i> )	36.078  32.817
21	<i>Mersin Province</i> : Anamur District, Mamure Castle (Mamure Kalesi) ( <b>type locality</b> )	Fet et al., 2009 (as <i>C. gruberi</i> )	36.078  32.834
<b>GREECE</b>			
22	Samos Island: south slope of Mt. Spilianni, 2	Sissom, 1988 (as <i>Paraiurus</i> )	37.757 26.977

	km N of Pithagorion	<i>nordmanni</i> ); Kaltsas et al, 2008 (as <i>C. nordmanni</i> ); Fet et al., 2009 (as <i>C. gruberi</i> )	
23	Megisti (=Kastelorizo) Island, Mandraki, Paleokastro	Fet & Braunwalder, 2000 (as <i>C. nordmanni</i> ); Stathi & Mylonas, 2001 (as <i>C. nordmanni</i> ); Kaltsas et al, 2008 (as <i>C. nordmanni</i> ); Fet et al., 2009 (as <i>C. gruberi</i> )	36.149 29.594