

## A review of the Saharo-Sindian species of the genus *Zonitoschema* (Coleoptera: Meloidae), with description of new species from Tunisia, Yemen and Socotra Island

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**Abstract.** Representative material of the genus *Zonitoschema* Péringuey, 1909 (Coleoptera: Meloidae: Nemognathinae: Nemognathini) from North Africa, Arabian Peninsula and the Near East is revised. Three new species are described: *Z. arabica* sp. nov. from continental Yemen, *Z. chourriba* sp. nov. from southern Tunisia, and *Z. kaszabi* sp. nov. from Socotra Island. *Zonitoschema iranica* Kaszab, 1959, supposedly endemic to southern Iran, is recorded from Chad, Sudan, Israel, Saudi Arabia, United Arab Emirates and Oman for the first time, and we consider most of the citations of *Z. gibdoana* (Kaszab, 1956) from the Arabian Peninsula to refer to it. *Zonitoschema iranica* is strictly close to *Z. oculatissima* Peyerimhoff, 1929, endemic to central Sahara. *Zonitoschema gibdoana* from eastern Africa (here recorded from Mozambique for the first time) is also related to *Z. iranica* but it is probably a synonym of *Z. paolii* Pic, 1927, a species described from Somalia and almost unknown. The species recorded in recent literature as ‘*Z. griseohirta* Pic, 1914’ from several Afrotropical countries and the Arabian Peninsula, is instead an unnamed distinct species related to *Z. genicularis* (Wellman, 1910), being clearly distinct from the true *Z. griseohirta* from Somalia. *Zonitoschema rubricolor* Pic, 1924 is removed from the fauna of the United Arab Emirates and is reported from Oman and Kenya for the first time. Host association of *Z. iranica* with carpenter bee *Pseudoheriades grandiceps* Peters, 1988 (Megachilidae) is recorded from the United Arab Emirates. Distributions of all species from North Africa, Near East and the Arabian Peninsula are discussed. A key to the Saharo-Sindian species is proposed and all species are figured. The unbalanced Meloidae fauna of the Socotra Island is compared to that of other islands/archipelagos and of adjacent continental areas.

**Key words.** Coleoptera, Meloidae, *Zonitoschema*, new species, nocturnal activity, host association, Megachilidae, insularity, Afrotropical Region, Palearctic Region, North Africa, Arabian Peninsula, Near East, Tunisia, Yemen, Socotra

## Introduction

The Saharan and Arabian deserts are part of the transitional Saharo-Sindian Region, which represents a very interesting biogeographic zone characterized by a combination of Palaearctic and Afrotropical elements. In the family Meloidae, several genera characterize this area, such as *Lydomorphus* Fairmaire, 1882, *Cyaneolytta* Péringuey, 1909, *Cabalia* Mulsant & Rey, 1858, *Actenodia* Laporte de Castelnau, 1840, *Zonitoschema* Péringuey, 1909, *Horia* Fabricius, 1787, as examples of the Afrotropical component (e.g. BOLOGNA et al. 2008a), and *Croscherichia* Pardo Alcaide, 1950, *Diaphorocera* Heyden, 1863, *Lyttolydulus* Reitter, 1913, *Lyttonyx* Marseul, 1876, as examples of the Palaearctic component (for a synthetic discussion see BOLOGNA 1988, 1991). In this contribution we study the diversity of the genus *Zonitoschema* (Nemognathinae: Nemognathini) in this transitional area.

*Zonitoschema* is a Palaetropical genus (for redefinition see BOLOGNA et al. 2013), including 58 described and at least 20 undescribed species, inhabiting predominantly warm regions of the Old World, in particular in the Afrotropical and Oriental Regions, the transitional Saharo-Sindian Region, and part of the Australasian Region (New Guinea and close archipelagos; Queensland in Australia). Most species are spread in tropical Africa (BOLOGNA & PINTO 2002), while in the West Palaearctic Region the genus includes thus far six species, distributed in North Africa, Arabian Peninsula and marginally in the Sinai, Israel and south Iran (BOLOGNA 2008). The ecology of the genus is almost unknown, but for most species there is evidence of nocturnal habits (BOLOGNA & PINTO 2002; BOLOGNA et al. 2013, unpublished data), with which the enlarged eyes (notably in males) seem to be associated. Probably for this reason records of several species are scarce and specimens are usually collected at light (both traps and house lighting).

No phylogenetic relationships among the species can be defined, the systematic revision is missing and several unresolved taxonomic problems still exist. In fact, till now some species are distinguished by colour features and seem very similar to each other. Characters of the genitalia could be useful to better define species limits and resolve some possible synonymies. Moreover, several species need to be described.

Published records of *Zonitoschema* from North Africa, Israel and Iran [*Z. iranica* Kaszab, 1959; *Z. oculatissima* Peyerimhoff, 1929; *Z. pallidissima* (Reitter, 1908)] are singletons or scarce (the last species), and only brief comparisons (PEYERIMHOFF 1929, KASZAB 1959) are available for the distinction of species. The occurrence of *Zonitoschema* in the Arabian Peninsula was also only occasionally recorded. All three species recorded from Arabia (*Z. gibdoana* (Kaszab, 1956), *Z. griseohirta* Pic, 1914, *Z. rubricolor* Pic, 1924) were first reported by KASZAB (1983) and they are all supposedly Afrotropical elements spread also in this transitional zoogeographical zone. More recently, few additional records, were added by SCHNEIDER (1991), BOLOGNA & TURCO (2007) and BATELKA & GEISTHARDT (2009). Due to the continuously increasing collecting activities in the Arabian Peninsula, more specimens from the region became available for comparison.

Results of our study proved that some species are much more widespread in the Saharo-Sindian Region than previously recorded and at the same time that some isolated populations represent well distinguishable but still undescribed species. Revision of the available material, including types of *Z. griseohirta* Pic, 1914 and *Z. paolii* Pic, 1927 also revealed some misidentifications in previous records by KASZAB (1983), BOLOGNA & TURCO (2007) and BATELKA &

GEISTHARDT (2009). Consequently, we can hereby (a) describe one new species from southern Tunisia and two new species from Yemen (including one from Socotra Island), (b) postulate some morphology-based taxonomic conclusions, and (c) add new records concerning several species distributed in the transitional Saharo-Sindian Region.

## Material and methods

Acronyms of collections housing the *Zonitoschema* specimens studied for this contribution, with names of curators who supported our work, are as follows:

BMNH	The Natural History Museum, London, United Kingdom (Maxwell V. L. Barclay);
IRSN	Institut Royal des Sciences Naturelles de Belgique, Bruxelles, Belgium (Didier Drugmand, Pol Limbourg);
JBCP	Jan Batelka collection, Prague, Czech Republic;
MBCR	Marco A. Bologna collection, Department of Sciences, University Roma Tre, Roma, Italy;
MNHN	Muséum national d'Histoire naturelle, Paris, France (Antoine Mantilleri);
MRAC	Musée Royal de l'Afrique Centrale, Tervuren, Belgium (Marc De Meyer);
MSGNG	Museo civico di Storia naturale 'G. Doria', Genova, Italy (Roberto Poggi);
MZUF	Museo di Scienze Naturali dell'Università di Firenze, Sezione Zoologia 'La Specola', Florence, Italy (Luca Bartolozzi);
NHMB	Naturhistorisches Museum, Basel, Switzerland (Eva Sprecher and Isabelle Zürcher);
NMPC	Národní muzeum, Prague, Czech Republic (Jiří Hájek);
TAUC	University of Tel Aviv, Insect Collection, Tel Aviv, Israel (Amnon Freidberg and Laibale Friedman).

In the taxonomy section, only references to original descriptions and main taxonomic contributions are listed. For the distribution, only updated synthetic references and those concerning Saharo-Sindian localities are listed. Complementary notes to label data are presented in square brackets.

Images were taken using a Canon EOS 550D digital camera with an MP-E 65 mm macro lens and a Leica Z16APO stereomicroscope, equipped with a Leica DFC420 camera and Leica Application Suite 3.7. Partially focused images of some figures were completed using Zerene photo stacker software (Zerene Systems LLC, Richland, USA).

Body length of specimens is measured from apex of mandibles to elytral apex.

The zoogeographic term 'Saharo-Sindian Region' used throughout the paper is adopted from VIGNA TAGLIANTI et al. (1992), however it is herein extended to the whole Arabian Peninsula and Socotra Island.

Although *Zonitoschema* is proposed as a neuter grammatical gender by LÖBL & SMETANA (2010: 34), it has never been used as such in previous literature, and we therefore still consider the name a feminine.

## Taxonomy

### *Zonitoschema arabica* sp. nov.

(Figs 1, 33, 46, 56, 57)

**Type locality.** Yemen, 20 km NW of Dhawran, 14°40'N, 44°13'E, 1794 m a.s.l.

**Type material.** HOLOTYPE: ♂, W. Yemen, 20 km NW of Dhawran, 14°40'N, 44°13'E, 1794 m, 29.x.2005, S. Kadlec lgt. (NMPC). PARATYPE: 1 ♀ (BMNH), Arabia [Yemen], Dhala, x.1935, at light, R.C.M. Darling [see remarks below]. The paratype lacks totally both antennae, left foretarsi and right foreleg and is probably teneral because of the light colour of black parts.

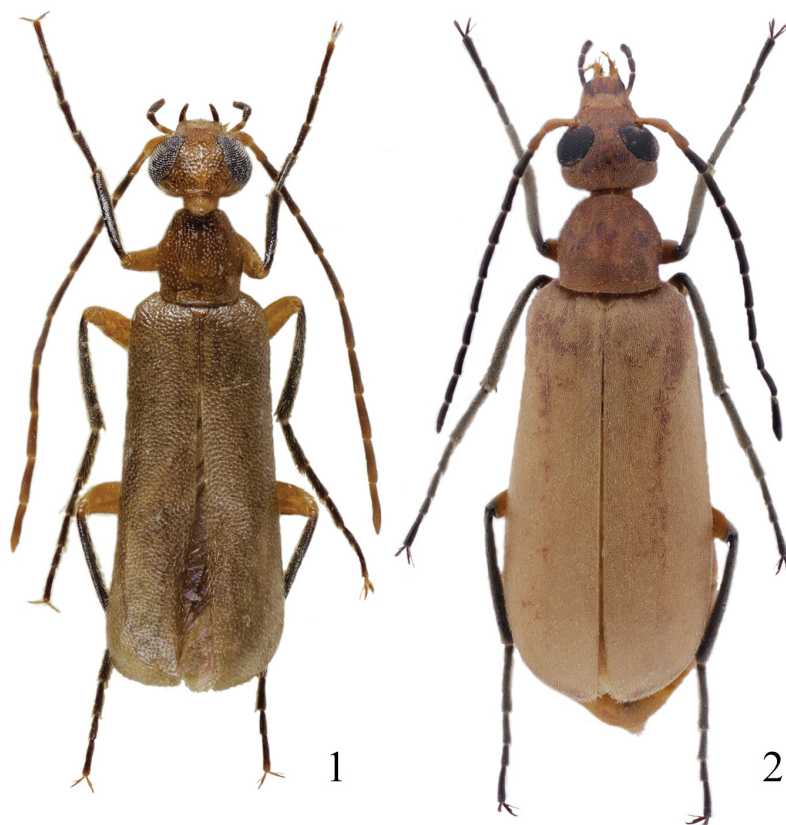
**Description. Male.** Body subopaque yellowish-brown, darker dorsally; eyes, apical third of mandibles, maxillary palpomeres III–IV, labial palpomere III, antennomeres III–XI, tibiae and tarsi black. Setation light golden-yellow, recumbent, not dense except on tibiae, longer on elytral sides, tibiae and tarsi. Body length: 8 mm (holotype).

Head (Fig. 33) slightly wider than pronotum, maximum width at eye level. Eyes very large, bulged, anterior portion distinctly emarginated near antennal socket, extended ventrally and reaching medial margin of maxillae on underside of head, almost contiguous; frontally 1.4 times as wide as frontal narrowest space between eyes. Frontal suture curved; frontal longitudinal middle line only weakly depressed, regularly punctuate. Head punctures wide, deep, intermediate surface very narrow and shiny; setae suberect. Temples very short and distinctly narrowed posteriad, ca. 0.25 times as long as longitudinal middle diameter of eye. Clypeus flat, subtrapezoidal; anterior half glabrous and impunctate, shagreened; posterior half with punctuation and setation as on head capsule. Labrum suboval, depressed anteriorly and medially; anterior margin scarcely arcuate, about as long as clypeus. Mandibles slightly longer than apex of labrum, straight but curved in apical third. Galeae penicillate, about as long as maxillary palpi; palpomeres II–III slender and subcylindrical, IV scarcely widened in anterior half and subtruncate at apex. Antennae elongate, ca. 5.3 times as long as pronotum disc; ratio between each antennomere and shortest one (II) as follows: I: 1.1; III: 1.1; IV: 1.5; V: 1.7; VI: 1.8; VII: 1.7; VIII: 1.7; IX: 1.7; X: 1.7; XI: 1.8.

Pronotum (Fig. 46), 1.06–1.16 times as wide as long, sides slightly widened from basis to middle and anteriorly evidently narrowed with straight sides; fore third progressively depressed, particularly on sides; base only slightly depressed and posterior margin slightly rebordered; sides scarcely depressed in basal half in lateral view; punctures and setae as on head, setae short; prosternum progressively and weakly narrowed posteriorly. Mesonotum slightly depressed in middle, largely rounded at posterior apex; mesoventrite transverse but laterally narrowed on sides and posteriorly greatly narrowed; metaventrite large, medial line impunctate and glabrous. Elytra densely and subrugosely punctuate, punctures as deep as on head and pronotum, and setae shorter than on pronotum, except at base and on sides; venations scarcely visible. Metathoracic wings present and completely developed. Legs slender, setae of tibiae very dense and silver-yellow, those of femora shorter and more robust, particularly on ventral side. External apex of fore tibiae slightly triangularly expanded; both foretibial spurs slender, inner one more pointed; both mesotibial spurs slender at apex; both metatibial spurs stick-like, parallel and subquadrate at apex; fore and middle tarsi 1.4 times as long as respective tibia, metatarsi as long as metatibia; tarsal claws denticulate, claw teeth thin and close to each other, ventral blade very thin.

Abdominal ventrites densely setated, surface almost shagreened; last ventrite deeply incised, posterior margin of ventrite IV strongly emarginated in middle. Gonoforceps short, apically narrow and strongly curved upwards, aedeagus short and robust (Figs 56, 57).

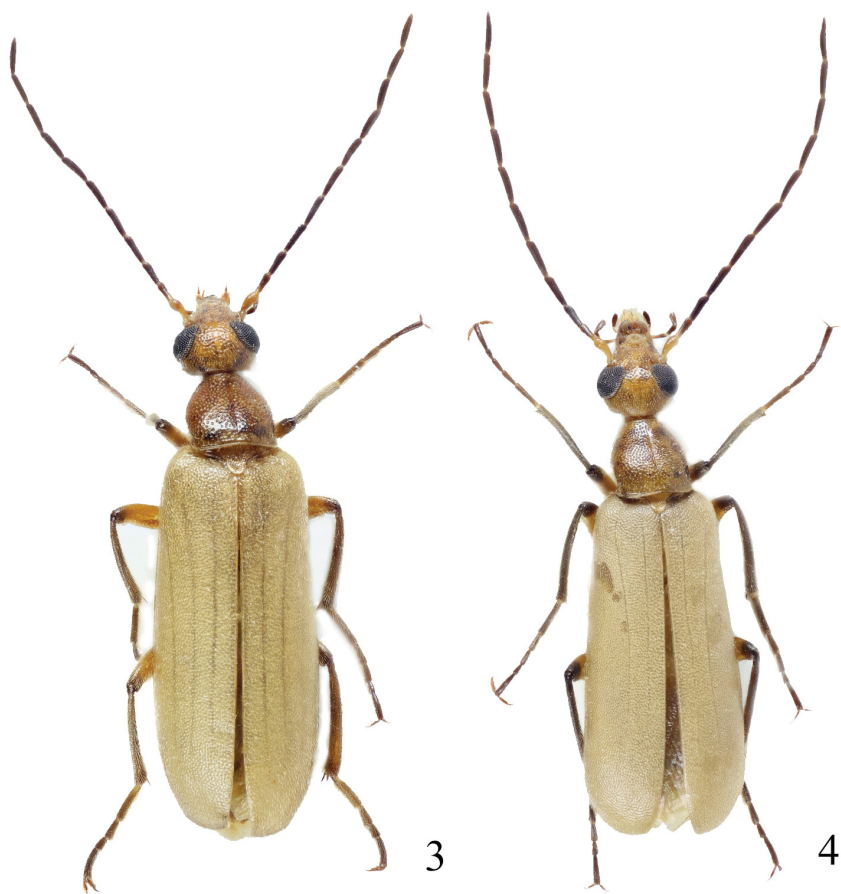
**Female.** Similar to male, except of body colouration lighter; of maxillary palpomeres only palpomere IV black; eyes only 0.9 times as wide as frontal narrowest space between eyes; frontal suture less curved; temples a little longer; pronotal setae longer; elytral venations well visible; claw teeth more robust and well separated, last ventrite V-shaped. Body length: 12 mm (paratype).



Figs 1–2. 1 – *Zonitoschema arabica* sp. nov., dorsal habitus of holotype (male); 2 – *Z. kaszabi* sp. nov., dorsal habitus of female paratype. Not on the same scale.

**Differential diagnosis.** Species characterized by the combination of the following features: elytra unicolour brown-yellow, femora completely orange-yellow, antennomeres I–II yellow, the remaining black, antennomere II ca. 3 times as long as wide. *Zonitoschema arabica* sp. nov. is similar to *Z. gibdoana*, but clearly distinct by legs colour and deeper and wider punctuation of head, pronotum and elytra.

Among the Afrotropical and Palaearctic species with unicolour orange-brown or yellowish elytra, *Z. arabica* sp. nov. represents an exception because of the completely yellow-brown femora. Only *Z. gigantea* (Fairmaire, 1894), distributed in western Africa and in the Congo basin has the same femur colouration; that species is easily distinguishable from *Z. arabica* sp. nov. because of its greater size (ca. 15–23 mm), body colour reddish, only the antennomere I yellow, and shallower dorsal punctures. However, more *Zonitoschema* species with yellow femora occur in Kenya (two species) and Namibia (one species) (M. A. Bologna & J. Batelka, unpublished data).



Figs 3–4. *Zonitoschema chourriba* sp. nov. 3 – dorsal habitus of female paratype; 4 – dorsal habitus of male paratype. Not on the same scale.

**Etymology.** The name of this new species refers to the Arabian Peninsula, in the south-western part of which it is distributed; adjective.

**Collecting circumstances.** The type locality is a hill with flowering *Euphorbia ammak* Schweinf. (Euphorbiaceae) (D. Král, pers. comm.). The expedition stayed at the locality overnight and used light to attract nocturnal insects. The holotype was probably collected at light because it is covered with small white scales of some nocturnal Lepidoptera. The specimen from Dhala was collected at light as it is indicated on the locality label. The Dhala locality and its vicinity (visited again in September 1937 by another British expedition) is described and pictured in SCOTT (1939).

**Remarks.** The paratype specimen was erroneously recorded by BOLOGNA & TURCO (2007) as '*Zonitoschema* sp. (*oculatissima*?)' from 'Saudi Arabia: Dhah'. After a more detailed analysis, the specimens proved to be different from *Z. oculatissima*, and the correct spelling of the locality label is Dhala, in SW Yemen (120 km SSE of Dhawran).



*Zonitoschema chourriba* sp. nov.

(Figs 3, 4, 26, 27, 44, 45, 58, 59)

**Type locality.** Southern Tunisia, south of Kebili, Blidette village, 33°35'N, 08°51'E.

**Type material.** HOLOTYPE: ♂, Tunisia, Blidette (south of Kebili), 14./15.ix.1996, J. Batelka & H. Podroužková lgt. (MBCR). PARATYPES: 1 ♂ 1 ♀ (JBCP), Tunisia, Douz [33°27'N, 09°01'E], 11./12.ix.1996, J. Batelka & H. Podroužková lgt.

**Description. Male.** Body shiny brown-orange, but elytra clearer and subopaque; eyes, apical third of mandibles, antennomeres II–XI, tibiae and tarsi black, maxillary palpomeres dark brown. Setation light gold-yellow, recumbent, not dense except on tibiae and tarsi, where longer. Body length: 9.5–11.0 mm (holotype 11.0 mm).

Head (Fig. 26, 27) slightly wider than pronotum, maximum width at eye level. Eyes very large, bulged, fore side evidently emarginated near antennal socket, extended ventrally and attaining medial margin of maxillae on underside of head, almost contiguous, frontally 1.1 times as wide as frontal narrowest space between eyes. Frontal suture curved in middle; frontal longitudinal middle line only weakly depressed, regularly punctuate. Head punctures regular, quite deep, medium sized, intermediate surface very narrow and shiny; setae sub-erected, posteriorly recumbent. Temples very short and obliquely distinctly narrowed posteriad, occiput slightly protruded. Clypeus flat, subtrapezoidal, anterior half glabrous and impunctate, shagreened, posterior half with punctuation and setation as on head capsule. Labrum suboval, depressed anteriorly and medially, anterior margin scarcely arcuate, slightly longer than clypeus. Mandibles slightly longer than apex of labrum, straight but curved in apical third. Galeae penicillate, shorter than maxillary palpi; palpomeres II–III slender and subcylindrical, IV scarcely widened in anterior half and subtruncate at apex. Antennae elongate, ca. 5.2 times as long as pronotal disc; ratio between each antennomere and shortest one (II) as follows: I: 1.1; III: 1.1; IV: 1.5; V: 1.7; VI: 1.7; VII: 1.6; VIII: 1.65; IX: 1.6; X: 1.6; XI: 1.9.

Pronotum (Fig. 44), 1.1 times as wide as long, sides subparallel, only slightly widened from basis to middle and anteriorly subobliquely narrowed with straight sides; fore third scarcely depressed, posterior margin slightly rebordered; dorsally only scarcely convex in lateral view; punctures and setae as on head, but slightly more scattered; prosternum progressively and weakly narrowed posteriorly. Mesonotum slightly depressed in middle, largely rounded at posterior apex; mesoventrite transverse but laterally narrowed on sides and posteriorly greatly narrowed; metaventrite large, middle longitudinal line impunctate and glabrous. Elytra ca. 2.9 times as long as wide at base, ca. 4.1 times as long as pronotum, with dense and distinct, quite deep punctures, deeper and denser than on head and pronotum, setae dense, ca. as long as on pronotum, three venations well visible, dark and shiny. Metathoracic wings present and completely developed. Legs slender, setae of tibiae very dense and silver-yellow, those of femora shorter and more robust, particularly on ventral side. External apex of fore tibiae scarcely triangularly expanded; both foretibial spurs slender, inner one more pointed; meso-tibial spurs both slender at apex; both metatibial spurs stick-like, parallel and subquadrate at apex; fore and middle tarsi 1.3 times as long as respective tibia, metatarsi as long as metatibia; tarsal claws denticulate, claw teeth thin and close to each other, ventral blade very thin.

Abdominal ventrites densely setated, surface almost shagreened; last ventrite deeply incised, posterior margin of IV ventrite strongly emarginated in middle. Gonoforceps slender, only slightly widened and rounded at apex and slightly curved posteriad (Figs 58, 59).

**Female.** Similar to male, except of eyes less close together, frontally  $0.9\times$  as wide as frontal narrowest space between eyes; temples a little longer; ratio between each antennomere and shortest one (II) as follows: I: 1.3; III: 1.2; IV: 1.4; V: 1.4; VI: 1.5; VII: 1.4; VIII: 1.4; IX: 1.4; X: 1.4; XI: 1.5; pronotum (Fig. 45), 1.0 times as wide as long; elytra ca. 4.6 times as long as pronotum, claw teeth more robust and well separated, last ventrite V-shaped. Body length: 9.5 mm (paratype).

**Sexual dimorphism.** Length of antennae in male longer than length of elytra, in female shorter than length of elytra. Elytra ca. 4.1 times as long as pronotum in male, and 4.6 times in female.

**Differential diagnosis.** *Zonitoschema chourriba* sp. nov. is very similar to *Z. pallidissima*, but distinct by the strong elytral nervature, only slightly visible in *Z. pallidissima*, and by the elytral punctures, deeper and well distinct, never confluent; other differences are the length of male antennomeres VIII–XI, which are ca. as long as VII–XI of *Z. pallidissima*, the shape of male temples, which are clearly inclined and more convergent posteriorly than in *Z. pallidissima*, and the apex of male gonoforceps less widened than in *Z. pallidissima*. Ratio between length of elytra and pronotum is different in both sexes of *Z. chourriba* sp. nov. (see Sexual dimorphism), but is identical in both sexes of *Z. pallidissima*.

**Etymology.** The name of this new species is dedicated to the Tunisian Chourriba family, from Blidette village, especially to brothers Mehdi and Laid for their outstanding friendship, support and for guiding us through South Tunisian nature. The name is a noun in nominative case in apposition.

**Collecting circumstances.** All three specimens came to UV light-traps in an area of sand dunes at the edges of date palm plantations ('palmeria'). Paratypes from Douz were collected together with a rich number of *Paussus thomsoni* Reiche, 1860 (Coleoptera: Carabidae) just before a thunderstorm. This unique event was in detail described by BATELKA (2000). In the locality of Blidette (Fig. 60), the situation was similar. Only several specimens of *P. thomsoni* and other insects were in flight with *Zonitoschema chourriba* sp. nov., however next night (i.e. 15/16.ix.1996) heavy storm with strong wind came and no more beetles were collected. Although the same localities were also explored in September 1995 and September 1997, no other *Zonitoschema* specimen was collected. It seems reasonable to assume that the main flight activity of *Zonitoschema chourriba* sp. nov. is connected with stormy weather as is the case with *Paussus thomsoni* and some other Saharan insects (BATELKA 2000).

**Remarks.** See below comments on *Z. pallidissima*.

### *Zonitoschema* sp. cf. *genicularis* (Wellman, 1910)

(Figs 20, 29, 38, 39, 50, 51)

*Zonitoschema griseohirta* nec PIC (1914: 107): KASZAB (1983: 187) (misidentification).

**Material examined.** SAUDI ARABIA: 1 ♀ (NHMB), Al Alayah [Asir, 19°55'N, 41°52'E (BÜTTIKER 1980: 26)], 1950 m, 9.x.1979, W. Büttiker lgt. [identified as *Z. griseohirta* by Z. Kaszab, 1983]. YEMEN: 1 ♀ (NMPC), Shawbah gov., S of An Nuqbah, Al Aram vill., 970 m, 14°13'48"N, 47°04'59"E, 22.x.2005, D. Král lgt.; 2 ♀♀ (NMPC), NEE Al Hudayah, Jabal Bura, 14°52'N, 43°24'E, 225–600 m, 30.x.–1.xi.2005, S. Kadlec lgt. CENTRAL AFRICAN REPUBLIC: 1 ♂ 1 ♀ (JBCP), 35 km E of Ndélé, 450 m, 08°29'N 20°57'E, 17.v.2009, J. Halada lgt.; 1 ♂ (JBCP), 40 km S of Kaga Bandoro, 530 m, 06°41'N 19°07'E, 14.iv.2010, J. Halada lgt.; 1 spec. (MBCR), Bamingui-Bangoran Rd., 45 km SSW Bamingui, 15–23.iv.2010 A. Kudrna lgt. CHAD: 1 spec. (MRAC), N'Gouri, distr de Kanem, ix.1958, P. Renaud lgt. DEMOCRATIC REPUBLIC OF THE CONGO: 1 spec. (MRAC), Kivu: Buseregenye



(Rutshuru) ix.1923, Ed. Luja lgt.; 1 spec. (MRAC), Bassin Lukuga, iv.–vii.1934, De Saeger lgt.; 1 spec. (MRAC), Kivu: Luvungi, xii.1932, L. Burgeon lgt.; 1 spec. (MRAC), Mayidi 1945, P. Van Eyen lgt.; 4 spec. (MRAC), Kivu, Kavimvira (Uvira) (à la lumière) 1.–15.v.1955, G. Marlier lgt.; 1 spec. (MRAC), idem x.1955; 2 spec. (MRAC), idem xii.1954; 1 spec. (MRAC), Elisabethville (à la lumière), 1957–1958, Ch. Seydel lgt.; 1 spec. (MRAC), Lulalaba, Ruwe (piège lumineuse), i.–ii.1960, V. Allard lgt.; 1 spec. (MBCR), P.N. Virunga, Tongo, 21.vii.1990, 1600 m, G. Carpaneto lgt. **ETHIOPIA**: 1 spec. (MBCR), Sidamo prov., 50 km NE Yabello, 22.–23.iv.2007, 1550 m, A. Kudrna lgt.; 1 spec. (MBCR), Gamo Gofa prov., 15 km SW Arba Minch, 12.–16.iv.2007, 1200 m, A. Kudrna lgt. **KENYA**: 1 spec. (MBCR), SE Voi, 12.xii.2009, M. Snížek lgt.; 1 spec. (MBCR), Meru distr., 5.xi.1980, D. Gianasso lgt.; 4 spec. (MBCR), Meru distr., Materi, Mitunguu, 5.–13.xi.1983, 800 m, R. Mourglia lgt.; 1 spec. (MBCR), Meru, Mkubu, 1.–10.i.1987, 1500 m, R. Mourglia lgt. **MOZAMBIQUE**: 1 ♂ 1 ♀ (JBCP), Mozambique centr. occ., 45 km NW of Chimoio, Manica env., 12.–15.xii.2003, J. Halada lgt.; 1 ♀ (JBCP), same data, but M. Snížek lgt.; 1 ♀ (JBCP), Mozambique NW, 65 km S of Vlongné, 15°13'S 34°19'E, 1250 m, 8.xii.2005, J. Halada lgt. **NIGERIA**: 1 ♂ (JBCP), 30 km SE of Serti env., Gashaka Gumfi NP, 380–560 m, 07°21'N 11°32'E, 24.iv.–8.v.2011, J. Halada lgt. **RWANDA**: 1 spec. (MRAC), contraf Est Muhavure 2100 m, 8.i.53, P. Basilewsky lgt. **SENEGAL**: 14 spec. (MBCR), Niokolo-Koba N.P., 13°01.1'N–13°18.5'W, 15.vii.2004, M. Halada lgt. **SIERRA LEONE**: 1 ♀ (MBCR), North prov., Kangai hills, nr. Baoma, 3.xi.1991, W. Rossi lgt. **SOMALIA**: 2 spec. (MBCR), Lower Shebelli, Abarey, Lake Joware, 13.–14.v.1988, M. Bologna lgt. **SOUTH AFRICA**: 1 ♂ 2 ♀♀ (JBCP), RSA E, KwaZulu Natal NE, Maputoland, Ndumo, W border Tembe Elephant Park, 80 m, 29.xii.2007–9.i.2008, M. Snížek lgt.; 3 ♀♀ (JBCP), Limpopo prov., 35 km W of Hoedspruit, 24°23'S 30°40'E, 470 m, 19.xii.2009, J. Halada lgt. **ZAMBIA**: 2 ♂♂ (JBCP), Zambia NW, E of Chisasa, W of Solwezi, 24.x.2008, M. Snížek lgt.; 1 ♂ (JBCP), Zambia NW, 15 E of Solwezi, 17.x.2008, M. Snížek lgt.; 1 ♀ (JBCP), Zambia N, 50 km W of Chingola, 1.–2.i.2003, J. Halada lgt.

**Remarks.** After the examination of the holotype of *Zonitoschema griseohirta* (MSNG) and one paratype (MNHN), we suspect that almost all citations of this species must refer to a different species, probably new; we believe this taxonomic decision has to be made in the context of a broader revision of the genus. The true *Z. griseohirta*, described from Somalia, and known so far only from this country, is well characterized by the following colouration: antennomeres completely black, femora red except at apex, tibiae and tarsomeres black. The specimens from other countries in Africa and from the Arabian Peninsula identified as *Z. griseohirta*, have antennomere I clearly yellow. No Palaearctic species has antennomeres completely black and, in the Afrotropical species with this feature, legs are completely black [*Z. atrimembris* (Fairmaire, 1894); *Z. nigrimembris* Pic, 1913; *Z. nitidicollis* Borchmann, 1942] or, in an undescribed species from Kenya, femora completely red.

The species erroneously named *Z. griseohirta*, widely distributed in Africa and in the western part of the Arabian Peninsula, seems related to *Z. genicularis* (Wellman, 1910) from the Congo basin, due to the shape of the apex of parameres, hooked posteriad (Figs 50, 51). *Zonitoschema genicularis* (replacement name for *Zonitis geniculata* Fairmaire, 1888, homonym of *Zonitis geniculata* Fairmaire, 1887, another *Zonitoschema* from Sulawesi) is known to us only after the description and only the revision of types could define its status. A very similar characteristic shape of parameres is common in other Afrotropical species, such as *Z. coccinea* (Fabricius, 1801) and *Z. cf. capensis* Kaszab, 1961 (sensu PARDO ALCAIDE 1966), both well distinctive by their body colouration, which probably form a natural group.

Moreover, there is another species with similar colouration, which differs from *Z. sp. cf. genicularis* (as herein defined) in spatulate metatibial spurs (narrow in *Z. genicularis*) and male genitalia (genitalia of specimen from eastern Kenya, Nguni, N of Ngomeni (JBCP) are figured in Fig. 55). We tentatively identify this species as *Z. eborina* (Fåhræus, 1870). Both species apparently overlap extensively in their distribution, but whether or not *Z. sp. cf.*

*genicularis* as herein defined represents more than one species (only females are available from the Arabian Peninsula), is yet to be investigated.

**Differential diagnosis.** This species is distinguishable from the remaining species distributed in the transitional Saharo-Sindian Region by the characters listed in the key (see below). Its body colouration is similar to that of *Z. eborina* from eastern, southern and central Africa which, according to the shape of gonoforceps, belongs to a different group of species.

**Distribution.** Chad, Democratic Republic of the Congo, Eritrea, Ethiopia, Gambia, Ghana, Kenya, Nigeria, Rwanda, Somalia and Saudi Arabia (KASZAB 1983). First records from Central African Republic, Mozambique, Senegal, Sierra Leone, South Africa, Yemen and Zambia.

### *Zonitoschema* spp. cf. *gibdoana* (Kaszab, 1956)

(Figs 17, 18, 25)

*Zonitopsis gibdoanus* Kaszab, 1956: 631.

*Zonitoschema gibdoana*: KASZAB (1983: 187, partim); BOLOGNA & TURCO (2007: 30, partim).

**Material examined.** (a) **OMAN:** 2 ♂♂ 3 ♀♀ (JBCEP), Dhofar prov. Wadi Al Mughsayl, 16°52'N, 53°43'E, 120 m, 10.iv.2014, J. Halada lgt.; 4 spec. (MBCR), Dhofar prov., Wadi Al Mughsayl, 8/23.ix.2010, 16°52'N–53°44'E, M. Snížek lgt. **SAUDI ARABIA:** 1 ♀ (NHMB), Wadi Dhiyan, 1050 m, 19°50'N, 41°28'E, [no date], W. Büttiker lgt. [identified as *Z. gibdoana* by Z. Kaszab].

(b) **SAUDI ARABIA:** 1 ♂ (NHMB), N. Hedjaz, 17 km S of Khaybar [= Wadi Sulaym, 25°36'N, 39°16'E (ABO-KHATWA et al. 1980: 9)], 680 m, 26.iv.1979 [identified and published as *Z. gibdoana* by KASZAB (1983: fig. 62)].

(c) **SAUDI ARABIA:** 1 ♀ (NHMB), Wadi Juwa [probably Asir Mts., 15 km east of Abu Arish, 17°03'N, 42°58'E], 8.ii.1986, J. Grainger lgt.

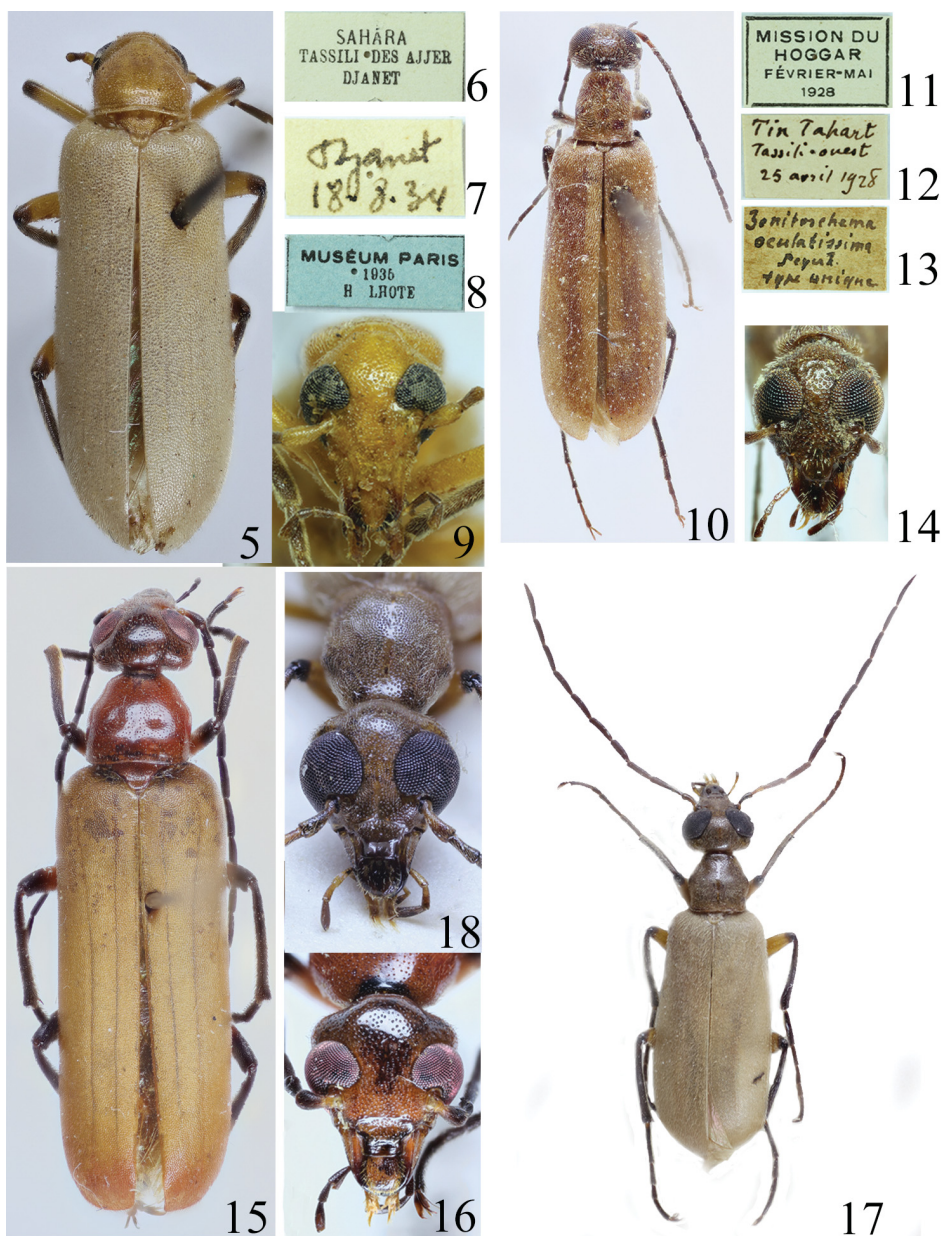
**Remarks.** Specimens previously recorded or explicitly identified as *Z. gibdoana* (Kaszab, 1956) or included in material identified like that, actually belong to a complex of species. After examination of the female holotype of *Z. paolii* Pic, 1927 (MZUF), we suspect that *Z. gibdoana*, described from Tanzania could be a synonym of *Z. paolii*. We maintain *Z. gibdoana* as a distinct species from eastern Africa, while specimens from other countries are assigned to other species (see below *Z. iranica*, *Z. kaszabi* sp. nov.), some of which are still undescribed. A comprehensive revision of the genus will clarify the taxonomy of this complex.

The female from Dhiyan (identified as *Z. gibdoana* by Z. Kaszab) and nine conspecific specimens from Oman differ from *Z. gibdoana* in wider temple, and in the pronotal disc very finely and very densely punctured (Fig. 25). Male genitalia were examined; they are almost identical to that of *Z. gibdoana*. All specimens show more robust and longer bodies than in *Z. iranica*.

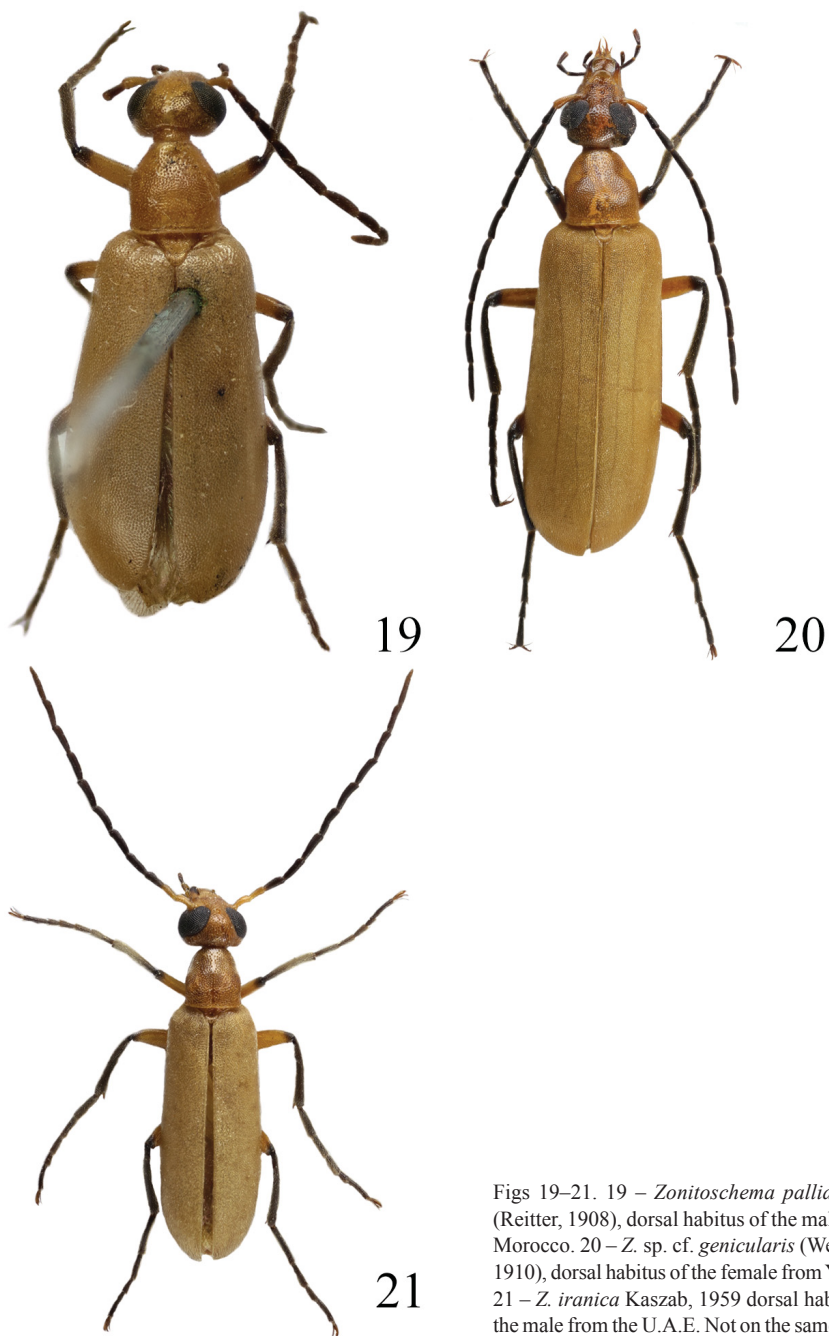
Although the male from Khaybar was identified as *Z. gibdoana* by Z. Kaszab, we doubt correctness of this identification, because of the different habitus, colouration and rugosity of elytra, wider pronotum, longer antennae and darkened basal antennomeres I and II (Figs 17, 18). Probably this specimen belongs to a distinct species.

The female from Juwa differs from *Z. gibdoana* in unique orange-yellow tibiae of all legs; no species of *Zonitoschema* have yellow tibiae except those whose femora are yellow too (see above *Z. arabica* sp. nov.).

All these three unidentified taxa differ from *Z. iranica* (see below) also in the more elongate mouthparts. Decision about their identity has to wait until more types of some African *Zonitoschema* become available.



Figs 5–18. 5–9 – *Zonitoschema* sp. cf. *pallidissima* (Reitter, 1908) – male from Algeria: 5 – dorsal habitus; 6–8 labels; 9 – head, dorsal view. 10–14 – *Z. oculatissima* Peyerimhoff, 1929, female holotype: 10 – dorsal habitus; 11–13 labels; 14 – head, dorsal view. 15–16 – *Z. rubricolor* Pic, 1924 female from Saudi Arabia: 15 – dorsal habitus; 16 – head, dorsal view. 17–18 – *Z. cf. gibdoana* (Kaszab, 1956), male from Khaybar (Saudi Arabia): 17 – dorsal habitus; 18 – head, dorsal view. Not on the same scale.

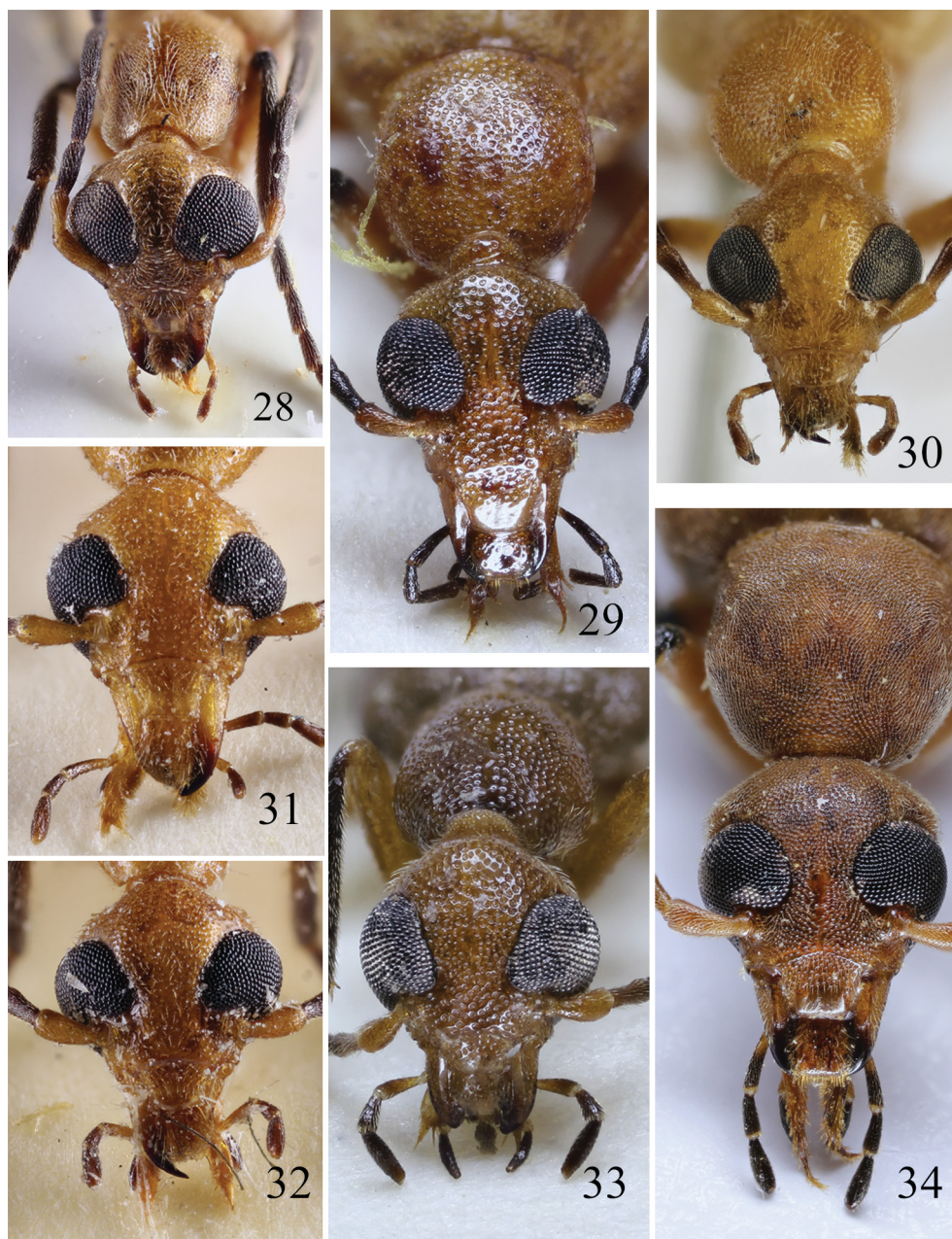


Figs 19–21. 19 – *Zonitoschema pallidissima* (Reitter, 1908), dorsal habitus of the male from Morocco. 20 – *Z. sp. cf. genicularis* (Wellman, 1910), dorsal habitus of the female from Yemen. 21 – *Z. iranica* Kaszab, 1959 dorsal habitus of the male from the U.A.E. Not on the same scale.



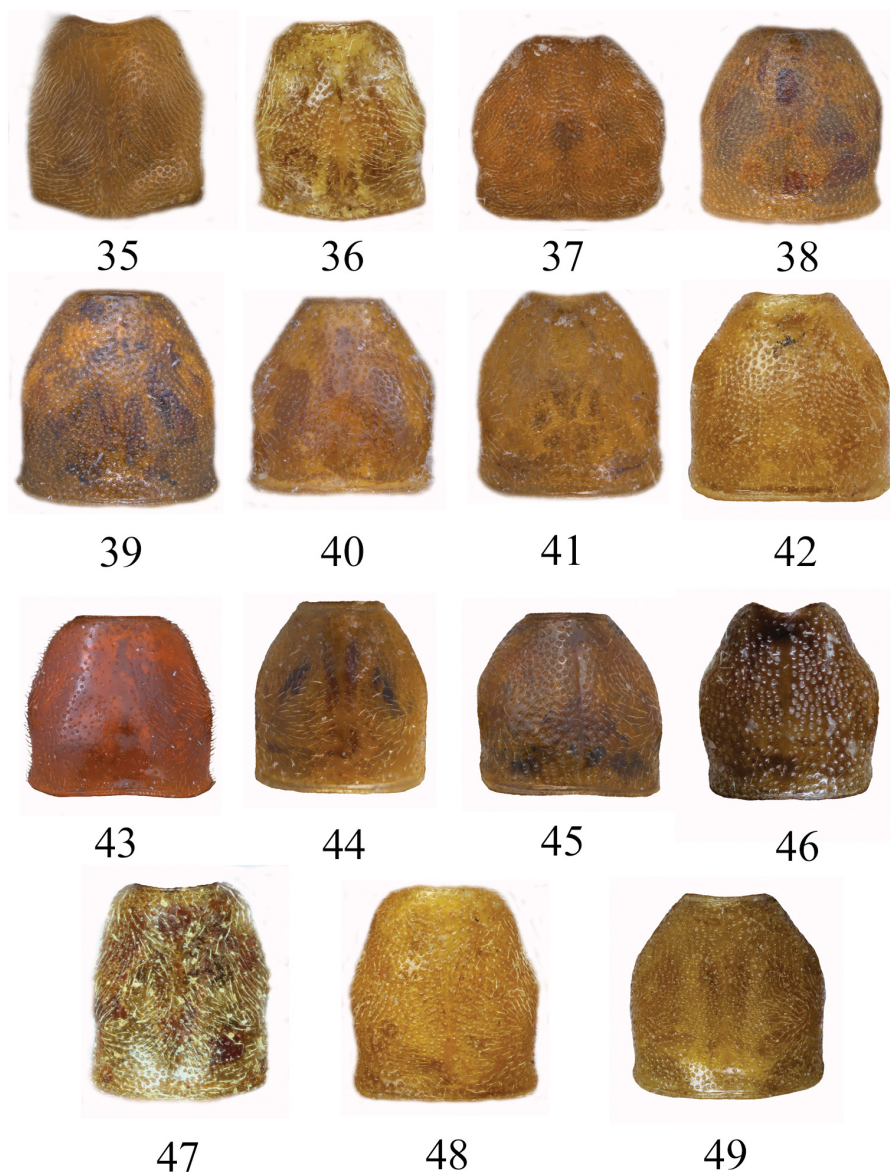


Figs 22–27. Heads. 22–23 – *Zonitoschema iranica* Kaszab, 1959 from Oman: 22 – male; 23 – female. 24 – *Z. oculatissima* Peyerimhoff, 1929 from Chad. 25 – *Z. cf. gibdoana* (Kaszab, 1956) from Dhiyan (Saudi Arabia). 26–27 – *Z. chourriba* sp. nov.: 26 – male paratype; 27 – female paratype. Not on the same scale.



Figs 28–34. Heads. 28 – *Zonitoschema iranica* Kaszab, 1959 from Iran. 29 – *Z. griseohirta* Pic, 1914 from Yemen. 30 – *Z. pallidissima* (Reitter, 1908) from Morocco. 31–32 – *Z. pallidissima* from Egypt: 31 – female; 32 – male. 33 – *Z. arabica* sp. nov., holotype (male). 34 – *Z. kaszabi* sp. nov., paratype (female). Not on the same scale.





Figs 35–49. Pronotal disc, dorsal view. 35–36 – *Zonitoschema iranica* Kaszab, 1959: 35 – male from the U.A.E.; 36 – female from Iran. 37 – *Z. kaszabi* sp. nov., paratype. 38–39 – *Z. sp. cf. genicularis* (Wellman, 1910): 38 – specimen from Somalia; 39 – specimen from Yemen. 40–41 – *Z. pallidissima* (Reitter, 1908) from Egypt: 40 – male; 41 – female. 42 – *Z. pallidissima* from Morocco. 43 – *Z. rubricolor* Pic, 1924 from Kenya. 44–45 – *Z. chourriba* sp. nov.: 44 – male paratype; 45 – female paratype. 46 – *Z. arabica* sp. nov., holotype. 47–48 – *Z. oculatissima* Peyerimhoff, 1929: 47 – holotype; 48 – specimen from Chad. 49 – *Z. cf. pallidissima* from Algeria. Not to the same scale.



Figs 50–59. Male genitalia, lateral view (57 and 59, dorsal view). 50–51 – *Z. genicularis* (Wellman, 1910): 50 – specimen from Zambia; 51 – specimen from Somalia (parameres only). 52 – *Z. iranica* Kaszab, 1959 from Israel. 53 – *Z. pallidissima* (Reitter, 1908). 54 – *Z. gibdoana* (Kaszab, 1956) from Kenya. 55 – *Z. sp.* from Kenya (a species similar in colouration to *Z. sp. cf. genicularis* (Wellman, 1910)). 56–57 – *Zonitoschema arabica* sp. nov., holotype. 58–59 – *Zonitoschema chourriba* sp. nov., paratype. Not to the same scale.

*Zonitoschema gibdoana* was described from Tanzania, and was subsequently recorded from Chad, Gambia, Kenya, Saudi Arabia, Sudan (KASZAB 1983, BOLOGNA & TURCO 2007). Records from Chad, Saudi Arabia and Sudan actually refer to *Z. iranica* (see below) or to the undetermined species discussed above. Those from Gambia need confirmation. We studied specimens, assignable to *Z. gibdoana* as herein defined, from Kenya (genitalia of male from eastern Kenya, N of Nguni, Ngomeni (JBCP) are figured in Fig. 54), Northern Mozambique, Tanzania (the type country) and Zambia (all MBCR).

### *Zonitoschema iranica* Kaszab, 1959

(Figs 21–23, 28, 35–36, 52)

*Zonitoschema iranica* Kaszab, 1959: 4.

*Zonitoschema gibdoana*: KASZAB (1983: 187, partim); BOLOGNA & TURCO (2007: 30, partim).

*Zonitoschema rubricolor* (misidentification): BATELKA & GEISTHARDT (2009: 201).

**Material examined. CHAD:** 1 spec. (MRAC), N'Gouri, distr. de Kanem, ix.1958, P. Renaud lgt., *Z. Kaszab* det. as *Z. gibdoana*; 1 ex. (MRAC), same data, but viii.1958. **IRAN:** 3 spec. (NMPC), Hormozgan prov., 10 km E of Tujak, 10 m, 26°04'N, 57°18'E, 14.–15.iv.2000, J. Hájek & M. Mikát lgt.; 1 spec. (MNHN), Hormozgan prov., Minab, 30.iii.1965, Mission Franco-Iranienne, *Z. Kaszab* det., 1967. **ISRAEL:** 4 spec. (TAUC), Nahal Shezaf, 30°43'N, 35°16'E, 29.v.1998, I. Yarom lgt., light trap; 4 spec. (TAUC), Shezaf N.R., 30°43'N, 35°16'E, 12.ix.1999, I. Yarom & V. Kravchenko lgt., light trap BL; 3 spec. (TAUC), same data, but 18.v.1999, 1 spec. (TAUC), same data, but 17.v.1999, 1 spec. (TAUC), same data, but 8.vi.1999, 3 spec. (TAUC), same data, but 2.vi.2000, I. Yarom lgt., light trap; 2 spec. (TAUC), Shezaf N.R., Nahal Shezaf, 2.vi.2000, E. & B. Orbach lgt., light trap; 4 spec. (TAUC), Hazeva, Field School, 30°46.70'N, 35°14.25'E, 21.v.1999, I. Yarom & V. Kravchenko lgt., light trap BL; 3 spec. (TAUC), Hazeva, 6.vi.2000, I. Yarom & V. Kravchenko lgt., light trap; 2 spec. (TAUC), Arava, Hazeva, 10.vi.2001, V. Kravchenko lgt.; 1 spec. (TAUC), Ne-ot Hakikkar, 15.v.1999, I. Yarom & V. Kravchenko lgt., light trap; 1 spec. (TAUC), 'Ein Zin, 5.vi.2000, I. Yarom & V. Kravchenko lgt., light trap; 3 spec. (TAUC), Nahal Peres, 1.vi.1998, A. Freidberg, light trap; 1 spec. (TAUC), Ein Gedi, 21.v.1966, Bytinsky-Salz; 1 spec. (TAUC), idem, 22.vi.19, Bytinsky-Salz. **OMAN:** 5 spec. (NHMB), Wahiba Sands, 21°38'N, 59°18'E [= possible Qarhat Mu'ammār?, identical coordinates as below], 23.–26.iii.1986, M. Gallagher lgt.; 2 spec. (NHMB), Qarhat Mu'ammār, camp 130 m, 21°38'N, 59°18'E, 28.iii.1986, M. Gallagher lgt.; 10 spec. (NHMB), N Sama il 400 m, Qaylah, 23°21'N, 58°03'E, 22.iv.1985, C. Holzschuh lgt.; 1 spec. (NHMB), same data, but 21.iv.1985; 1 spec. (NMPC), Al Dakhiliyah prov., Uwayfiyah oasis, 210 m, 22°15'N, 56°59'E, 3.iv.2012, A. Reiter lgt.; 1 spec. (JBCP), Dhofar prov., Jabal al Qamar, Wadi Al Mughsayl, 25.viii.2012, P. Kučera lgt.; 15 spec. (MBCR), Dhofar prov., Wadi Al Mughsayl, 8/23.ix.2010, 16°52'N–53°44'E, M. Snižek lgt. **SAUDI ARABIA:** 2 spec. (NHMB), Wadi Mizbil [Riyadh district, BÜTTIKER (1979: 19)], 13.iv.1977, W. Büttiker lgt. [1 spec. was misidentified as *Z. gibdoana* by *Z. Kaszab*, 1978]; 1 spec. (NHMB), Wadi Sheib Luha [Riyadh district, BÜTTIKER (1979: 19)], 27.v.1976, W. Büttiker lgt.; 1 spec. (NHMB), same data but 27.vi.1976; 1 spec. (NHMB), J. [mount] Lebaba, 24.iii.1985, M. Gallagher lgt.; 1 spec. (NHMB), Muhayel, 4.iii.1986, coll. RAWRC [collected syntopically with *Z. rubricolor*, see below]; 1 spec. (NHMB), Fifa, 23.x.1983 [misidentified as *Z. gibdoana* by *Z. Kaszab*, 1985]. **SUDAN:** 2 spec. (MBCR), Ed Damer Hudeiba, 1 and 25.iv.1962 R. Remane lgt. **UNITED ARAB EMIRATES:** 3 spec. (JBCP), Near Ras al-Khaymah Airport, Ghaf forest, 22.xi.2006, J. Batelka & H. Pinda lgt. [misidentified by BATELKA & GEISTHARDT (2009) as *Z. rubricolor* Pic, 1924]; 3 spec. (JBCP), 12749 [only the code number related to the locality is available], A. van Harten lgt.

**Host association.** All three specimens from Ras al-Khaymah (U.A.E.) were reared from nest of the carpenter bee *Pseudoheriades grandiceps* Peters, 1988 (Megachilidae) (J. Batelka det. 2010, identification confirmed by H. Dathe (Germany) in April 2013). For details on this record see BATELKA & GEISTHARDT (2009).

**Differential diagnosis.** *Zonitoschema iranica* is very close to *Z. oculatissima*, and distinguishable only by the pronotum less parallel. The real distinction of these two species needs

confirmation in a revision of the entire genus. Probably they form a group of species together with *Z. paolii*, *Z. gibdoana* (if distinct from *Z. paolii*), and *Z. spp. cf. gibdoana* from the Arabian Peninsula.

The populations of *Z. iranica* from eastern Sahel, Israel, and the Arabian Peninsula, have been confused in the literature and in the collections with *Z. gibdoana* (see above in the discussion concerning *Z. spp. cf. gibdoana*), described from Tanzania. *Zonitoschema iranica* is well distinct from *Z. gibdoana* and the unidentified taxa from the Arabian Peninsula (see above as *Z. spp. cf. gibdoana*), because of the shorter anterior part of the head, a character particularly evident in lateral view in both sexes and especially in male as concerns *Z. spp. cf. gibdoana*.

BATELKA & GEISTHARDT (2009) erroneously cited this species from the U.A.E. as *Z. rubricolor* Pic, 1924. Actually, *Z. rubricolor* is very different at least because of the body colour and punctures on head and pronotal disc (for details see key below).

Male genitalia (Fig. 52) are figured for the first time and differ from those of *Z. gibdoana* from Kenya (Fig. 54) because of the slender apex of both aedeagus and gonoforceps.

**Distribution.** Distributed along the coast of southern Iran (Sistan & Baluchestan (KASZAB 1959) and Hormozgan), Arabian Peninsula, Israel (Negev), and central and eastern Sahel (Chad, Sudan).

### *Zonitoschema kaszabi* sp. nov.

(Figs 2, 34, 37)

**Type locality.** Yemen, Socotra Island, Wadi Ayhaft, 12°36.5'N, 53°58.9'E, 200 m a.s.l.

**Type material.** HOLOTYPE: ♀ (NMPC), **YEMEN: SOCOTRA ISLAND:** Wadi Ayhaft, 12°36.5'N, 53°58.9'E, 200 m, 7./8.xi.2010, J. Batelka & L. Purchart lgt., at light. PARATYPES: **YEMEN: SOCOTRA ISLAND:** 1 ♀ (in ethanol 95%) (MBCR), the same data as the holotype; 1 ♀ (IRSN), Haghier Mts., [Wadi] Ayhaft, 500 m, 4.iii.2008, I. G. 31.496, A. Saldaitis lgt.

**Description. Female.** Body subopaque orange brown, but elytra mustard-brown, eyes, apical third of mandibles, maxillary palpomeres III–IV and apex of II, labial palpomere III, antennomeres III–XI (lightly yellow only in basal telescopic portion), knees, tibiae and tarsi black; one paratype with head and pronotum slightly darker, and metapleurites and metaventrite slightly infuscate. Setation light golden-yellow, recumbent, dense both dorsally and ventrally, thus cuticle below is almost invisible, setation longer on head, especially on temples, antennomeres I–II and pronotum. Body length: 14.0–15.0 mm.

Head (Fig. 34) scarcely narrower than pronotum, maximum width at eye level. Eyes very large, bulged, fore side evidently emarginated near antennal socket, extended ventrally and reaching medial margin of maxillae on underside of head, 1.6 times as wide as frontal space between eyes. Frontal suture curved, very curved in one paratype; frontal longitudinal middle line not depressed, but glabrous and shiner. Head punctures approached, medium in width and fairly deep, intermediate surface very narrow and shiny; setae suberected, directed towards front except on temples. Temples subparallel, ca. 0.5 times as long as longitudinal middle diameter of eye, slightly rounded posteriorly. Clypeus not convex, subtrapezoidal and sides progressively narrowed, one paratype with anterior half glabrous and impunctate, shagreened, posterior half with punctuation and setation as on head capsule; second paratype with clypeus almost completely unpunctate. Labrum suboval, darkened and slightly depressed on sides,



anterior margin scarcely arcuate, about as long as clypeus. Mandibles reaching apex of labrum, straight but curved in apical third. Galeae penicillate, about as long as maxillary palpi; palpomeres II–III slender and subcylindrical, IV progressively widened in anterior half and subtruncate at apex. Antennae elongate, ca. 3.5 times as long as pronotum disc; ratio between each antennomere and shortest one (II) as follows: I: 1.4; III: 1.4; IV: 1.6; V: 1.6; VI: 1.6; VII: 1.6; VIII: 1.4; IX: 1.4; X: 1.4; XI: 1.7.

Pronotum subcampaniform (Fig. 37), 1.1 times as wide as long, sides widened from basis to middle and anteriorly progressively narrowed with slightly curved sides; fore third not distinctly but progressively depressed; base only slightly depressed and posterior margin slightly rebordered; sides depressed in basal half in lateral view; punctures and setae as on head, setae recumbent along outline, mostly directed laterally; prosternum progressively and scarcely narrowed posteriorly. Mesonotum slightly depressed in middle, progressively narrowed and rounded at posterior apex; mesosternum transverse but laterally narrowed on sides and posteriorly greatly narrowed and at apex slightly rounded and recurved; metasternum large, middle longitudinal line impunctate and slightly depressed. Elytra densely punctate, but punctures less deep than on head and pronotum, and setae shorter than pronotum, except at base, venations scarcely visible in first paratype, both more visible in second paratype. Posterior wings present and completely developed. Legs slender, setae of tibiae very dense and silver-yellow, those of femora shorter and more robust, particularly on ventral side. External apex of fore tibiae slightly triangularly expanded; both foretibial spurs slender, inner one pointed, outer one slightly obtuse; mesotibial spurs both slender at apex; both metatibial spurs stick-like, parallel and subquadrate at apex; fore and middle tarsi 1.3 times as long as respective tibia, metatarsi 1.14 times as long as metatibia; tarsal claws denticulate, ventral blade thick.

Abdominal ventrites densely setated, surface almost shagreened; last ventrite scarcely incised on posterior margin, posterior margin of IV ventrite greatly emarginated in middle.

**Differential diagnosis.** Species characterized by the combination of the following features: elytra unicolour orange-brown, femora almost completely orange except at apex, antennomeres I–II yellow and the remaining ones black, antennomere II ca. 2.2 times as long as wide; similar to *Z. iranica* and *Z. gibdoana*, but distinct by the pronotum shape, widest in middle and not narrowed in the anterior third, forming a neck-like structure.

Only a few species with this combination of phenetic characters have the basal two antennomeres yellow-orange: *Z. capensis* endemic to southern Africa; *Z. gibdoana* probably widely spread through the Sahel and eastern Africa and possibly synonym of *Z. paolii* (see above); *Z. iranica* distributed from Chad and Sudan to the east to Negev, Arabian Peninsula and southern Iran; *Z. paolii* from Somalia; *Z. oculatissima* Peyerimhoff, 1929 from the western portion of Sahara (see below); and an undescribed species from Namibia close to *Z. capensis* (M. A. Bologna, unpublished data). The new species differs from all remaining species in the shape of its pronotum which is widened in the middle and not clearly “narrow-necked” in front. The setation on pronotum is slightly longer than in other species.

At least three other Afrotropical and Saharo-Sindian species are phenetically similar to *Z. kaszabi* sp. nov. in colour, but they are easily distinguishable because of the antennomere II black and most of them also by the shape of pronotum, not widened in the middle: *Z. palidissima* (Reitter, 1909) from Egypt and Israel (and possibly Morocco); *Z. cf. genicularis* (Wellman, 1910) widely spread through the Sahel, eastern and central Africa and west part

of the Arabian Peninsula (see above); and *Z. saga* (Péringuey, 1899) from South Africa. This last is the only species with the pronotum widened as in *Z. kaszabi* sp. nov., but differs from the new Socotran species because of the colour of antennomeres, the longer temples and body colouration deeper orange.

**Etymology.** The species is named after an outstanding specialist on Meloidae, the late Hungarian entomologist Zoltán Kaszab, who represented the first teacher during the studies of blister beetles for one of us (MAB).

**Collecting circumstances.** The holotype and one paratype collected by J. Batelka and L. Purchart were attracted by the UV light in a valley bed with disturbed primary vegetation (Fig. 61). The main components of the native flora at the locality were *Boswellia* Roxb. (Burseraceae), *Euphorbia* L. (Euphorbiaceae), *Sterculia* L. (Malvaceae) and probably some Mimosaceae trees, and bushes *Croton* L., *Jatropha* L. (Euphorbiaceae) and *Sarcostema* R.Br. (Apocynaceae). The sky was clear, however, a day later dark rainy clouds appeared above the Haghier massive above the valley, and soft rain fell around the nearby Hadibo on 9<sup>th</sup> November.

**Remarks.** With the taxonomy of the genus being unclear, we discuss only some morphological features useful to distinguish *Z. kaszabi* sp. nov. among the Afrotropical and Saharo-Sindian species with unicolour orange-brown or yellowish elytra and partially red femora and antennae. All types are females, and consequently relationships of the species remain uncertain.

### *Zonitoschema oculatissima* Peyerimhoff, 1929

(Figs 10–14, 24, 47, 48)

*Zonitoschema oculatissima* Peyerimhoff, 1929: 125.

**Type material examined.** HOLOTYPE: ♀ (MNHN, Peyerimhoff coll.), ALGERIA: Tassili ouest, Tin Tahart, 25.iv.1928, Mission du Hoggar Février–Mai 1928.

**Additional material examined.** CHAD: 1 ♂ (MNHN, general collection), Tibesti, E. du Kohoz, 700 m, 10.–12.xi.1949, Ph. de Miré lgt.

**Remarks.** The holotype is partly dark brown; it is possible that this is not its natural colouration, and it was possibly caused by some treatment of the specimen after collecting.

**Differential diagnosis.** This species is closely related to *Z. iranica* (see above) and differs from it only in its more parallel pronotum; it is distinguishable from other *Zonitoschema* distributed in the Saharo-Sindian Region by the characters listed in the key. For comparison of this and other species with unicolour elytra, partially red femur and antennomere I yellow, see also above the remarks on *Z. iranica* and *Z. kaszabi* sp. nov.

**Distribution.** Described only from the holotype from western Tassili Mts. in Algeria, and recorded here from the Tibesti (Chad) for the first time; this species is probably widely distributed in the Sahara.

### *Zonitoschema pallidissima* (Reitter, 1908)

(Figs 19, 30–32, 40–42, 53)

*Stenoderistella pallidissima* Reitter, 1908: 50.

*Zonitoschema pallidissima*: PEYERIMHOFF (1929: 126); KASZAB (1957: 229).

**Material examined.** EGYPT: 1 ♂ 1 ♀ (NMPC), Mariout – El Ayami, 11.x.1974, V. Zouhar lgt., M. Dvořák det. 1976; 2 ♂♂ (NMPC), Heluán, 2.x.1959, Veselý lgt., V. Günther det.; 1 spec. (TAUC), Alexandrie, Z. Kaszab det.; 2 ♂♂ (MNHN, Peyerimhoff coll.), Mamoura Abou Kir, 21.ix.1924, ex coll. Min. Agric. (Egypt), A. Alfieri [lgt.], P.



Peyerimhoff det. **ISRAEL:** 1 spec. (TAUC), Haifa checkpoint, 2.iii.1997, T. Pavlicek; 10 spec. (TAUC), Tel Aviv, 1.x.1969, Bytinsky-Salz lgt.; 6 spec. (TAUC), same data, but 2.ix.1971 + 6.–12.ix.1971; 2 spec. (TAUC), same data, but 1.x.1969; 2 spec. (TAUC), same data, but 23.ix.1980; 4 spec. (TAUC), same data, but 10.ix.1969; 6 spec. (TAUC), same data, but 25.ix.1969; 4 spec. (TAUC), same data, but 15.ix.1969; 5 spec. (TAUC), same data, but 20.ix.1969; 2 spec. (TAUC), same data, but 19.ix.1969; 1 spec. (TAUC), Ashdod, 14.ix.1996, R. Hoffman lgt.; 2 spec. (TAUC), Ramat Aviv, 10.vi.1995, V. Chikatunov lgt.; 1 spec. (TAUC), Gvulot, 1.ix.1983, E. Shney-Dor lgt.; 1 spec. (TAUC), idem 30.vi.1986, E. Shney-Dor lgt.; 1 spec. (TAUC), Nhal Tirza Res., zor Deir Shaman, Yordan Store, 15.iii.2005, V. Chikatunov lgt.; 2 spec. (TAUC), Rosh ha'Ayn, 15.x.1994, V. Chikatunov lgt.; 1 spec. (TAUC), Shalom, 19.vi.1997, R. Hoffman lgt.; 2 spec. (TAUC), Jordan Valley Udja 16.iii.2005, V. Chikatunov lgt.; 1 spec. (TAUC), Ein Hub, 12.x.1953, Fishelsohn lgt.; 1 spec. (TAUC), E. Gedi, 10.ix.1964, D. Furth, donated by En Gedi Field School; 3 spec. (TAUC), same data, but 10.vii.1969; 3 spec. (TAUC), same data, but 11.vii.1969; 2 spec. (TAUC), En-zin, 30°53.60'N, 35°09.17'E, 13.xii.1999, I. Yarom & V. Kravchenko lgt.; 2 spec. (TAUC), Nahal Peres, 1.vi.1998, A. Freidberg lgt., light trap; 1 spec. (UTA), Shizzafon, 7.viii.1995, V. Chikatunov lgt.; 1 spec. (UTA), Shezaf N.R., Nahal Shezaf, 30°44.96'N, 35°16.28'E, 6.xi.1999, I. Yarom & V. Kravchenko lgt., light trap. **MOROCCO:** 1 ♂ (MNHN, Peyerimhoff coll.), Maroc Saharien, Tissint [Anti Atlas, between Fom-Zguid and Tata], Ch. Rungs lgt.

**Differential diagnosis.** In this species, as in *Z. chourriba* sp. nov., sexual dimorphism is developed as follows: shortest distance between eyes dorsally in both species is equal to one third of total width of head in females, while it is almost one fourth in males. The male antennomere XI of *Z. pallidissima* is shorter than in female, while it is equal in both sexes of *Z. chourriba* sp. nov. Male genitalia (Fig. 53 for *Z. pallidissima*; Figs 58–59 for *Z. chourriba* sp. nov.). Elytra ca. 4.4 times as long as pronotum in both sexes, while in *Z. chourriba* sp. nov. the ratio is 4.1 in male, and 4.6 in female.

**Distribution.** Morocco (Kocher 1956), Algeria (Peyerimhoff 1929), Tunisia (Normand 1949), Libya (Bologna 2009), Egypt (Reitter 1908, Alfieri 1976), Israel (Kaszab 1957). In Israel it is distributed not only in the desert of Negev, as recorded by Kaszab (1957), where it is syntopic with *Z. iranica* and *Z. rubricolor*, but also along the sand coastal plain north to Haifa.

The distribution of this species in Maghreb countries should be re-evaluated. The only known specimen from Morocco, mentioned by Kocher (1956), was re-examined in the Peyerimhoff's collection. This specimen has slightly different rugosity of elytra than it appears in Egyptian specimens, but this character could represent a clinal variability. We failed to find any specimen from Algeria in the Peyerimhoff's collection; three specimens of uncertain identity from Djanet differing from Egyptian and Israeli populations of *Z. pallidissima*, are discussed below. Also the Tunisian specimen reported from Djerba by Normand (1949) should be re-examined, to evaluate whether or not it is conspecific with *Z. chourriba* sp. nov.

The citation from Saudi Arabia made by Bologna & Turco (2007) is uncertain and needs to be corroborated by voucher specimens.

### *Zonitoschema* cf. *pallidissima* (Reitter, 1908)

(Figs 5–9, 49)

**Material examined.** **ALGERIA:** 3 ♂♂ (MNHN, general collection), Sahara, Tassili des Ajjer, Djanet, 18.viii.1934, A. Lhote lgt.

**Remarks.** As discussed above, this species is similar to *Z. pallidissima* from Egypt and Israel in the general shape and having antennomere II black, but slightly differs because of the more rounded anterior angles of pronotal disc and by the pale-yellow elytra in contrast to

colouration of the head, pronotum and body. It probably represents a new species. However, in all three specimens antennae are almost completely missing (only two and six antennomeres are preserved in two of them) and more specimens from the same locality are needed for comparison with other *Zonitoschema* species. Both gonoforceps and aedeagus are similar to those of *Z. pallidissima* and *Z. chourriba* sp. nov.

### *Zonitoschema rubricolor* Pic, 1924

(Figs 15, 16, 43)

*Zonitoschema rubricolor* Pic, 1924: 454.

*Zonitoschema rubricolor*: KASZAB (1983: 187); SCHNEIDER (1991: 287).

**Material examined.** **ISRAEL:** 1 spec. (TAUC), N. Paran, 24.vi.1997, D. Simon lgt., M. A. Bologna det. 1997; 1 spec. (TAUC), Hazeva, 7.vi.1997, A. Maklakov lgt.; 2 spec. (TAUC), Nahal HaShifta, Hwy 90, km 82, 30°08.50'N, 35°08.40'E, 18.vi.1999, I. Yarom & V. Kravchenko lgt., light trap; 1 spec. (TAUC), Nahak Shezaf, 30°43'N, 39°16'E, 29.v.1998, I. Yarom lgt., light trap. **OMAN:** 2 ♂♂ 1 ♀ (JBCP), Al Batinah prov., Al Lajal, 170 m, 23°30'N, 57°56'E, 3.iv.2013, J. Halada lgt.; 1 ♀ (JBCP), the same data as preceding specimens, but 18.iv.2013; 1 ♂ (JBCP), Dhofar prov., Jabal Samhar Mt., 17°10'2N, 54°6'97E, 7.x.2013, J. Halada lgt. **SAUDI ARABIA:** 1 ♀ (NHMB), Muhayel, 4.iii.1986, coll. RAWRC [published as *Z. rubricolor* by SCHNEIDER (1991)]; 1 ♀ (NHMB), 81 km S of Buljurshi, 2000 m, viii.1979, G. Vogel lgt. [published as *Z. rubricolor* by KASZAB (1983)]; 1 ♀ (NHMB), Wadi Khumra [Riyadh district, BÜTTIKER (1979: 19)], 20.v.1977, W. Büttiker lgt. [published as *Z. rubricolor* by KASZAB (1983)]. **KENYA:** 1 spec. (MBCR), Hola, 2.–5.10.2000, Werner & Lizler lgt.

**Differential diagnosis.** This species is easily distinguishable from the remaining *Zonitoschema* distributed in the Saharo-Sindian Region by the reddish colouration, very fine punctures on pronotum and shiny surface of both head and pronotum (see key below).

**Distribution.** South Israel (CHIKATUNOV et al. 2006, as *Z. rubricolor* [sic!]; BOLOGNA 2008), Saudi Arabia and Democratic Republic of the Congo (KASZAB 1983, SCHNEIDER 1991, BOLOGNA 2008). First records from Oman and Kenya. Records from the United Arab Emirates (BATELKA & GEISTHARDT 2009) refer to *Z. iranica* (see above).

### Key to *Zonitoschema* species of the Saharo-Sindian Region

**Note.** Species in square brackets are distributed in Eastern Africa but have been erroneously recorded from the Saharo-Sindian Region).

- 1 Head and pronotum reddish, elytra mostly ochre, with apical fourth and setae reddish. Head and pronotum surface shiny, pronotum punctures shallow and sparse. .... *Z. rubricolor* Pic, 1924
- Head, pronotum and elytra completely yellow-brown, setae on whole elytra pale. Head and pronotum surface not so shiny, punctures deep and dense. .... 2
- 2 Femora completely yellow. .... *Z. arabica* sp. nov.
- Femora black in apical fourth. .... 3
- 3 Antennomere I black. .... [*Z. griseohirta* Pic, 1914]
- Antennomere I yellow. .... 4
- 4 Antennomere II yellow. .... 5
- Antennomere II black. .... 8
- 5 Pronotum widest in middle and not neck-like narrowed in fore third, almost or as long as wide. .... *Z. kaszabi* sp. nov.
- Pronotum longer than wider, not evidently widened in middle. .... 6

- 6 Mouthparts as long as head capsule in lateral view. .... *Z. sp. cf. gibdoana* partim [and *Z. gibdoana* (Kaszab, 1956), *Z. paolii* Pic, 1914]
- Mouthparts in lateral view distinctly shorter than head capsule. .... 7
- 7 Pronotum distinctly parallel-sided (Algerian Sahara). .... *Z. oculatissima* Peyerimhoff, 1929
- Pronotum slightly widened in middle (eastern Sahel, Negev, Arabian Peninsula, S Iran). .... *Z. iranica* Kaszab, 1959
- 8 Male and female temples subparallel; parameres hooked posteriad. .... *Z. sp. cf. genicularis* (Wellman, 1910)
- Male temples short and strongly converging on occiput; parameres slender and not hooked posteriad. .... 9
- 9 Elytral surface shiner, without obvious venation; temples in male less inclined and convergent posteriorly; elytra ca. 4.4 times as long as pronotum in both sexes; male genitalia as in Fig. 53. .... *Z. pallidissima* (Reitter, 1908)
- Elytral surface sub-opaque, with well visible venation; temples in male clearly inclined and convergent; elytra ca. 4.1 times as long as pronotum in male, 4.6 times in female; male genitalia as in Figs 58, 59. .... *Z. chourriba* sp. nov.

## Discussion

### Sexual dimorphism

Understanding sexual dimorphism in the genus *Zonitoschema* is crucial both for delimiting taxa and for the description of intraspecific variability. Males differ from females notably in the shape of the apical abdominal segments and differently modified claws. In male, the posterior margin of apical ventrite is deeply emarginated and the teeth on tarsal claws are very thin and close to each other, so there is little space among them and tarsal combs look very compact. In female, on the contrary, the posterior margin of apical ventrite is Y-shaped, as in most males of the Meloinae subfamily; claw teeth are robust, well separated and more widely spaced. These characters are valid in all species we examined so far, and allow easy sex identification of each specimen without dissection.

Although some species are similar to each other, they may be separated by differently pronounced sexual characters. For example, absolute length of female antenna in *Z. pallidissima* in comparison with that in male is shorter by the length of two apical male antennomeres, while in *Z. chourriba* sp. nov. it is shorter only by the length one apical male antennomere. Length of antennae in female is either shorter than the length of their elytra (e.g. in *Z. pallidissima* and *Z. chourriba* sp. nov.) or as long as the length of their elytra (e.g. in *Z. sp. cf. genicularis*), while in male they are substantially longer than the length of elytra.

Narrowest space between eyes in comparison with total width of eyes from frontal view is also different between sexes (see descriptions of new species), because eyes in males are larger and more convex. Male eyes are also more extended ventrally than in female and much closely approached along the mid line.

Ratio between length of elytra and pronotum might differ between sexes (e.g. in *Z. chourriba* sp. nov.) but might be similar in males and females of the closely related species (e.g. in *Z. pallidissima*).

### Biogeography

**Saharo-Sindian Region.** The distribution of the genus *Zonitoschema* in the transitional Saharo-Sindian Region represents a paradigmatic example of the fauna of this zone. As indicated, the genus is Palaeotropical, mostly diverse in tropical Africa and in the Indo-Malayan area, with restricted penetrations in the Palaearctic [both in the western (see below) and eastern parts (China, Taiwan and Japan)], and Australasian Regions (New Guinea and Queensland).

In the western Palaearctic Region, only deserts and mountains of the Sahara, Sinai and Negev, Arabian Peninsula and southern Iran were colonized by *Zonitoschema*. Excluding the taxa still not clear from a taxonomic point of view, three biogeographic components are recognizable in the area herein treated: (a) the Saharo-Sindian species, probably phylogenetically related to Sahelian elements; (b) the species endemic to southern Arabia and Socotra; (c) Afrotropical species. The first component includes at least four species, one endemic to Central Sahara (*Z. oculatissima*), inhabiting sand dunes habitats (PEYERIMHOFF 1929) but probably also other desert habitats; one endemic to oases of the Grand Erg Oriental (*Z. chourriba* sp. nov., related to *Z. pallidissima*); one widely distributed from eastern Sahel to southern Iran, through the Arabian Peninsula and Sinai (*Z. iranica*, closely related to *Z. oculatissima*); and one, possibly characterized by a higher ecological plasticity even if mostly related to dunes habitat, which is widely spread from Morocco to Egypt, Sinai and Israel (*Z. pallidissima*). The second component includes one species endemic to Socotra Island (*Z. kaszabi* sp. nov.) and one apparently endemic to the south-western tropical horn of the Arabian Peninsula (*Z. arabica* sp. nov.). Biogeographical affinities of these two endemics cannot be currently established. The third component includes one mostly tropical species which is spread from central Africa along the Arabian Peninsula to the savannah habitat of the South Israel (Wadi Araba) (*Z. rubricolor*), and one species widely distributed in the Sahel and eastern Africa, and marginally also in the tropical portion of the Arabian Peninsula (*Z. cf. genicularis*).

Among the Saharo-Sindian Region material there were also several unidentified individuals from the eastern part of Tassili Mts. in Algeria (see material under *Z. cf. pallidissima*), and singletons from Hejaz and Asir regions in Saudi Arabia (see *Z. spp. cf. gibdoana*), which may turn to be distinct undescribed species. Consequently, *Zonitoschema* diversity in some parts of this transitional region might be much higher than we expected. Ultimately, high diversity in some African countries is not unusual in this genus, as the region has been in focus of a more intense collecting activity. For example, in eastern Kenya at least eight well distinguishable species of *Zonitoschema* occur (J. Batelka & M. A. Bologna, unpublished data), i.e. 10 % of the currently described diversity of the genus (see BOLOGNA & PINTO 2002). In this area, in each of three well sampled localities, five different *Zonitoschema* species were collected together. Repeated syntopical occurrence of five species in the same habitat may indicate both high host specificity or, on the contrary, host plasticity as in other Nemognathinae (see BOLOGNA 1983b), or it may be the result of a change in microhabitat requirements, as a result of habitat shift. Those studying this genus must be mindful of any small differences among populations, because of possible high tendency to speciation (and endemism) or to intraspecific polymorphism.



**Socotra Island.** The presence of *Zonitoschema kaszabi* sp. nov. in Socotra Island is of special interest, because its fauna shows a combination of various biogeographic elements. Most Socotran elements are Afrotropical, shared with Somali or Ethiopian areas, or endemic, but still related to species from these countries; a few are endemic but related to Arabian elements or shared with the Arabian Peninsula. BOLOGNA (1990) and BOLOGNA & PINTO (1998) listed in Socotra only two *Meloe* Linnaeus, 1758 species, both belonging to the Afrotropical subgenus *Afromeloe* Schmidt, 1913: endemic *M. trapeziderus* Gahan, 1903, and *M. lefevrei*



Figs 60–61. 60 – Blidette (Tunisia), type locality of *Zonitoschema chourriba* sp. nov. 61 – Ayhaft (Yemen, Socotra Is.), type locality of *Z. kaszabi* sp. nov.

Guérin de Méneville, 1849, present also in Ethiopia. No strict affinities with the northern Somali Meloidae fauna were pointed out (BOLOGNA 1990).

All Socotran Meloidae have the first larvae phoretic on bees and this suggests a passive trans-marine dispersal with their hosts. A similar biogeographic origin of the meloid fauna of several oceanic islands was discussed by BOLOGNA & MARANGONI (1990), compared with the meloid fauna of islands originated by continental split. Detailed analyses were published on the Mediterranean and Macaronesian islands (BOLOGNA 1983a, 1986, 1994; BOLOGNA & MARANGONI 1990), but preliminary remarks were also available on other islands of the world (e.g. SELANDER & BOUSEMAN 1960, KASZAB 1965, MOHAMEDSAID 1979, BOLOGNA & MARANGONI 1990, BOLOGNA 1991, BOLOGNA et al. 2013). All these studies evidenced a predominance of genera (mostly Nemognathini and a few Meloini) with phoretic larvae in the insular faunas, with the presence of scarce Meloinae genera with non phoretic larvae only in some continental islands. For example, from seven genera and 13 species of Meloidae from Macaronesian volcanic islands, all genera have phoretic larvae (with the exception of a very uncertain record of *Hycleus* Latreille, 1817, Mylabrini). All species are parasites of bees, with the exception of *Cyaneolytta fryi* Wollaston, 1861 from Cape Verde Islands, which probably represents a particular case of phoresy on bees (SELANDER 1987) in a genus otherwise phoretic on Anthiini beetles (Carabidae) (BOLOGNA et al. 1990, DI GIULIO et al. 2003).

Long and uninterrupted isolation of Socotra Island allowed the evolution and survival of a remarkable richness of endemic forms of various organisms (BATELKA 2012). However, despite the habitat richness of Socotra, its blister beetle fauna is extremely poor in comparison with the mostly semi-arid Arabian Peninsula and East Africa. While more than one hundred species in 28 genera are reported from the continental Arabia (BOLOGNA & TURCO 2007, BATELKA & GEISTHARDT 2009), and 18 genera and 104 species from Somalia (BOLOGNA 1990). The Socotran Meloidae fauna is apparently poor in species also in comparison with many volcanic or continental islands around Africa (BOLOGNA & MARANGONI 1990). As some meloid genera repeatedly evolved phoretic first instar larva (BOLOGNA & PINTO 2001, BOLOGNA et al. 2008b), which supports their long distance dispersal abilities (BOLOGNA & MARANGONI 1990), the scarce presence of the family in Socotra is most likely the result of some establishing barriers (e.g. low density or absence of the host groups, notably solitary bees). Giving the genus *Zonitoschema* has also phoretic primary larva (BOLOGNA & PINTO 2001), good dispersal abilities of its species could be expected and possibly additional records of the genus, as well as other Nemognathini, in Socotra will be obtained.

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