

## Larvae of *Cylindera* (*Eugrapha*) *contorta* (Fleutiaux) (Coleoptera: Cicindelidae) and general review of larval features in the subgenus *Eugrapha*

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### Abstract

All larval instars of the tiger beetle species *Cylindera* (*Eugrapha*) *contorta* (Fleutiaux) are described for the first time based on material from Southern Ukraine (Kherson Region). New data on habitat preferences, ecology and bionomy for adults and larvae of *C. contorta* are listed. Larval characters are differentiated for all instars of species in the subgenus *Eugrapha* and some other Palearctic genera of the subtribe Cicindelina. The key for second and third instar of all known larvae of *Eugrapha* is given.

**Key words:** tiger beetles, *Eugrapha*, larval instars, description, ecology, comparative notes, key

### Introduction

The taxon *Eugrapha* Rivalier, 1950 was established as a subgenus of the polytypic genus *Cylindera* Westwood based on structures of inner armatures of aedeagi and shape of labrum (Rivalier 1950). To date, the subgenus includes about 35 species worldwide (Wiesner 1992). Twenty four species are known from the Palearctic region, but mostly from the Asian part (Putchkov & Matalin 2017). Only six species of *Eugrapha* are registered in Europe (Putchkov & Matalin 2017).

Adults of the subgenus *Eugrapha* are well studied, with information published on systematics, ecology and bionomy (Wiesner 1992). The data on larval instars are scant: larvae of only five species were described. All instars were studied for three species only: *C. arenaria* (Füessly), *C. trisignata* (Dejean) and *C. elisae* (Motschulsky) (Putchkov 1990, 2001, 2013; Serrano 1995); only third instar larvae of *C. sublacerata* (Solsky) and *C. litterifera* (Chaudoir) were studied (Putchkov & Cassola 1994). Moreover, the data on larval ecology and bionomy of the whole subtribe Cicindelina are extremely fragmentary (Serrano 1995; Putchkov 2005, 2013).

In the present work all larval instars of *Cylindera* (*Eugrapha*) *contorta* (Fleutiaux) are described for the first time. Additionally, many data on ecology of the species are provided, and larval characteristics for the subgenus *Eugrapha* are emended. Furthermore, we summarized data on the larval morphology of other species of the subgenus and propose a key for six species of *Eugrapha* (five species are recorded in Europe).

*Cylindera contorta* is recorded in southeastern Europe, Caucasus, Kazakhstan, Asia Minor and Central Asia, southwestern Siberia, western Mongolia and northern China (Putchkov & Matalin 2017). In Ukraine, the species inhabits sands in the southernmost part of Lower Dnieper geographic province, namely the territory of the Chernomorsky (Black Sea) Biosphere Reserve (Kherson Region) (Fig. 1).

### Material and methods

The descriptions are based on following larval material: 12 larvae of third instar, Southern Ukraine, Kherson Re-

gion, Skadovsk District, Dzharylgach island (spit), 14–15.08.2018, Nitochko and Moskalenko leg; 14 larvae of third instar, the same region, 5 km W Zalisnyi Port, Black Sea Biosphere Reserve, “Potievka” plot (locality), 20–21.08.2018, Nitochko leg; 8 larvae of second instar, the same place, 6–10.07.2016, Putchkov & Markina leg.; 6 larvae of first instar, the same place and dates.

We rank the tiger beetles as a separate family within Adephaga. This position is confirmed by morphological, ecological, biographical and phylogenetic evidences (Arndt & Putchkov, 1997; Cassola 2001; Putchkov & Cassola 2005). The taxonomic nomenclature of the generic level follows that of Putchkov & Matalin (2017). Terminology of larval morphology and chaetotaxy follows that of Knisley & Pearson (1984), Putchkov & Cassola (1994) and Putchkov (2001, 2013).



**FIGURE 1.** Occurrence of *C. contorta* in Lower Dnieper province, Kherson Region, Southern Ukraine.

The morphological terms are abbreviated as follows: HL—head length (from nasale apex to end of fronto-clypeal-labral area); HW—head width measured at its broadest part, usually at level of stemmata I-II; PNL—pronotum length measured along midline; PNW—pronotum width measured at its broadest part, usually at level of cephalolateral angles or slightly below; A1 and A2—first and second antennal segments; LP1—first labial palpus; PN—pronotum; PN1—half of pronotum with number of discal setae (but without marginal setae); PNa—cephalolateral (anterior) angles of pronotum; PNm—median line of pronotum; T3—third abdominal tergite; AT5—apical tergite; CT5—caudal tergite; LCT5—lateral tergite of 5th abdominal segment (hump); MH—medial hooks; IH—inner hooks on 5th abdominal segment; EU9—posterior part of 9th abdominal sternite; TE9—posterior part of 9th abdominal tergite; PY—pygopod.

The data on measurements in mm are given in table 1.

All larval material is deposited in the entomological collections of I. I. Schmalhausen Institute of Zoology, NAS of Ukraine.

**TABLE 1.** Measurements of head and pronotum, and pronotal width/length ratios of larvae\* in the subgenus *Eugrapha*

Species in the subgenus	Instars	Measurements (in mm) and ratios				
		HL	HW	PNL	PNW	PNW/ PNL
<i>Eugrapha</i>						
<i>C. contorta</i>	I	0.64 (0.55–0.68)	1.26 (1.02–1.40)	0.65 (0.60–0.72)	1.14 (1.08–1.20)	1.75 (1.68–1.80)
	II	1.03 (1.00–1.10)	1.73 (1.60–1.81)	1.06 (1.00–1.10)	1.67 (1.53–1.75)	1.58 (1.53–1.60)
	III	1.52 (1.42–1.63)	<b>2.57 (2.45–2.70)</b>	<b>1.58 (1.52–1.72)</b>	<b>2.45 (2.30–2.65)</b>	<b>1.55 (1.53–1.56)</b>
<i>C. arenaria</i>	I	0.58 (0.56–0.62)	1.07 (1.05–1.10)	0.55 (0.54–0.56)	0.97 (0.93–1.02)	1.76 (1.72–1.80)
	II	1.08 (1.05–1.10)	1.63 (1.55–1.70)	0.92 (0.88–0.95)	1.59 (1.52–1.65)	1.74 (1.73–1.75)
	III	<b>1.55 (1.52–1.63)</b>	<b>2.38 (2.25–2.40)</b>	<b>1.36 (1.32–1.43)</b>	<b>2.33 (2.25–2.42)</b>	<b>1.73 (1.71–1.74)</b>
<i>C. elisae</i>	I	0.57	1.18	0.58	1.05	1.81
	II	0.89 (0.82–0.93)	1.60 (1.58–1.72)	0.98 (0.95–1.02)	1.69 (1.63–1.75)	1.73 (1.72–1.75)
	III	<b>1.32 (1.24–1.36)</b>	<b>2.47 (2.42–2.55)</b>	<b>1.41 (1.35–1.45)</b>	<b>2.43 (2.38–2.48)</b>	<b>1.74 (1.71–1.76)</b>
<i>C. trisignata</i>	I	0.67 (0.62–0.72)	1.19 (1.09–1.25)	0.65 (0.58–0.72)	1.12 (1.02–1.20)	1.72 (1.67–1.74)
	II	0.95 (0.88–0.99)	1.67 (1.55–1.76)	0.97 (0.88–1.04)	1.58 (1.44–1.68)	1.63 (1.62–1.64)
	III	<b>1.44 (1.32–1.53)</b>	<b>2.53 (2.27–2.69)</b>	<b>1.50 (1.34–1.76)</b>	<b>2.41 (2.18–2.72)</b>	<b>1.60 (1.55–1.63)</b>
<i>C. litterifera</i>	III	<b>1.32 (1.22–1.41)</b>	<b>2.33 (2.30–2.52)</b>	<b>1.45 (1.40–1.52)</b>	<b>2.43 (2.33–2.54)</b>	<b>1.66 (1.63–1.67)</b>
<i>C. sublacerata</i>	III	<b>1.22 (1.14–1.32)</b>	<b>2.20 (1.32–1.34)</b>	<b>1.34 (1.25–1.37)</b>	<b>2.23 (2.14–2.34)</b>	<b>1.69 (1.64–1.72)</b>

\*data for third instar larvae are given with bold front

## Results

### *Cylindera (Eugrapha) contorta*

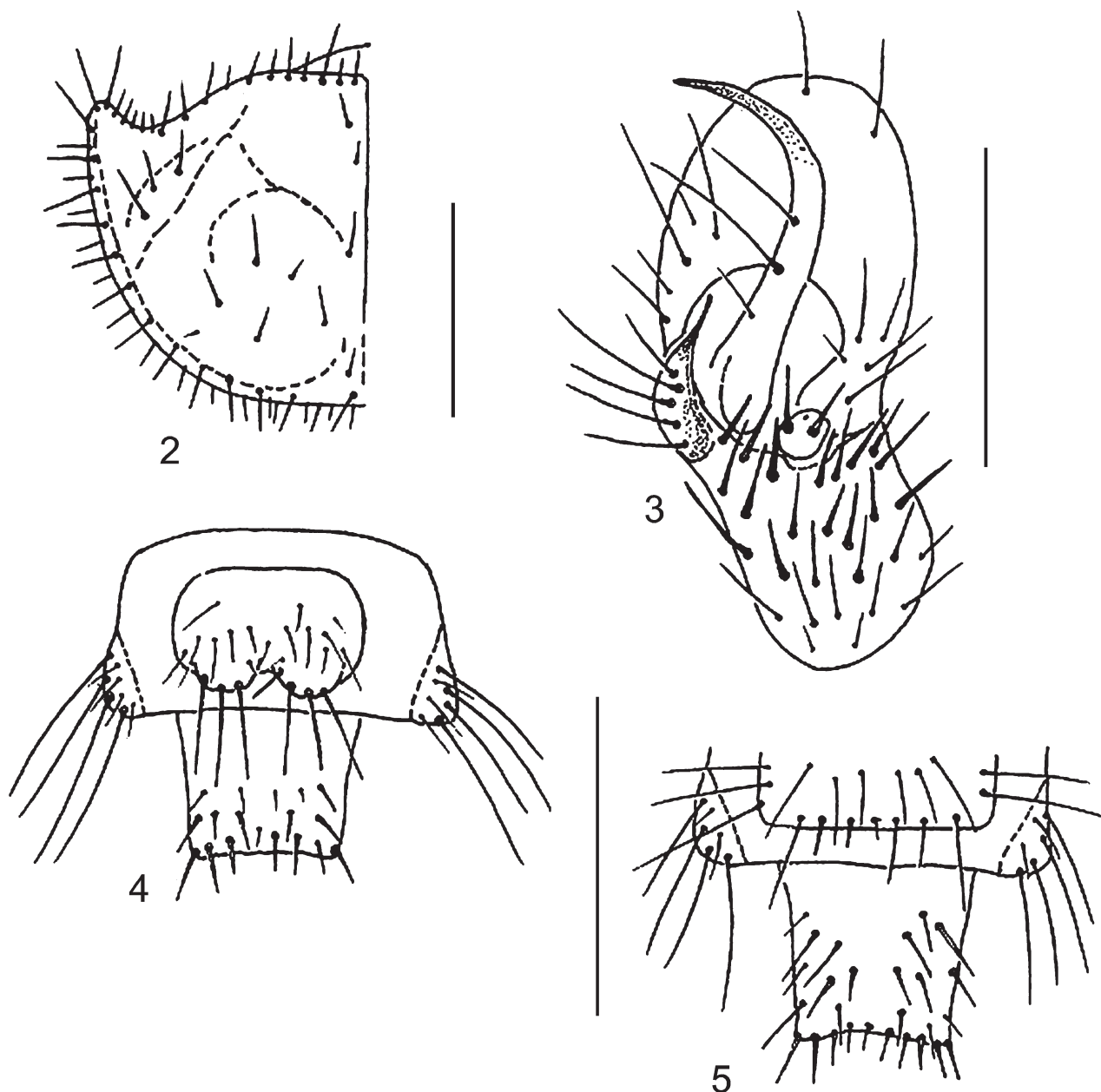
**Description of third instar larva.** Upper part of head brown or dark brown, with weak bronze luster (sometimes greenish hue), lower part of head light brown. Other appendages light brown, except for darkened apical part of mandibles. Maximum width of head at level of stemma I. Setae pale, thin, long and acute apically; some setae near stemmata I–II slightly obtuse. Epicranial suture distinct, but short.

Disk of PN dark brown with weak coppery luster. Apices of PNa and narrow marginal sides of PN lighter. Swellings of PNa and callous elevations on disk moderately distinct (Fig. 2). PNa widened with slightly rounded apices directed somewhat outwards and shorter than almost even anterior margin of PN. Setae pale with a reddish hue, most of them thin and long. PN1 with 12–16 setae, and 5–6 setae along PNm, ridge of PNa with 2–3 setae (Fig. 2).

Sclerotized areas of abdomen indistinct, gray with reddish hue. T3 almost square or oval with 6–9 reddish setae. Type II hypopleuron (two large sclerites). CT5 and AT5 light brown, almost semicircular, widely fused on inner margin and partly in contact on external margin (Fig. 3). Sclerotization of AT5 covers inner part of IH (Fig. 3). LCT5 with 4–5 long setae. CT5 with 20–25 stout setae (similar to those of IH) and some thin small setae on posterior margin. Most setae of AT5 located on its lower (external and inner) part (Fig. 3). MH with 3 (rarely 2) setae at the middle. MH slender, very long and strongly curved above the middle. Tips of MH traversing anterior margin of AT5 and distinctly directed outward. MH almost 5–6 times as long as wide at base. IH short, with two long stout setae and directed almost upwards. Central spine of IH absent or point-shaped (Fig. 3). IH 5.6–6.0 times shorter than MH. TE9 with 8 setae (4 of them at the middle shortened) (Fig. 5). EU9 with 2 groups of 3 long setae each (Fig. 4). PY (except apex) with 10–17 setae dorsally and 10–12 thinner setae ventrally. Tip of PY with 12–16 bristles, setae on dorsal side shorter.

**Description of second instar larva.** Upper part of head brown, with weak bronze-copper luster; lower part of head light brown. Setae pale or reddish transparent; most setae thin and acute, some obtuse apically. Epicranial suture distinct, but very short.

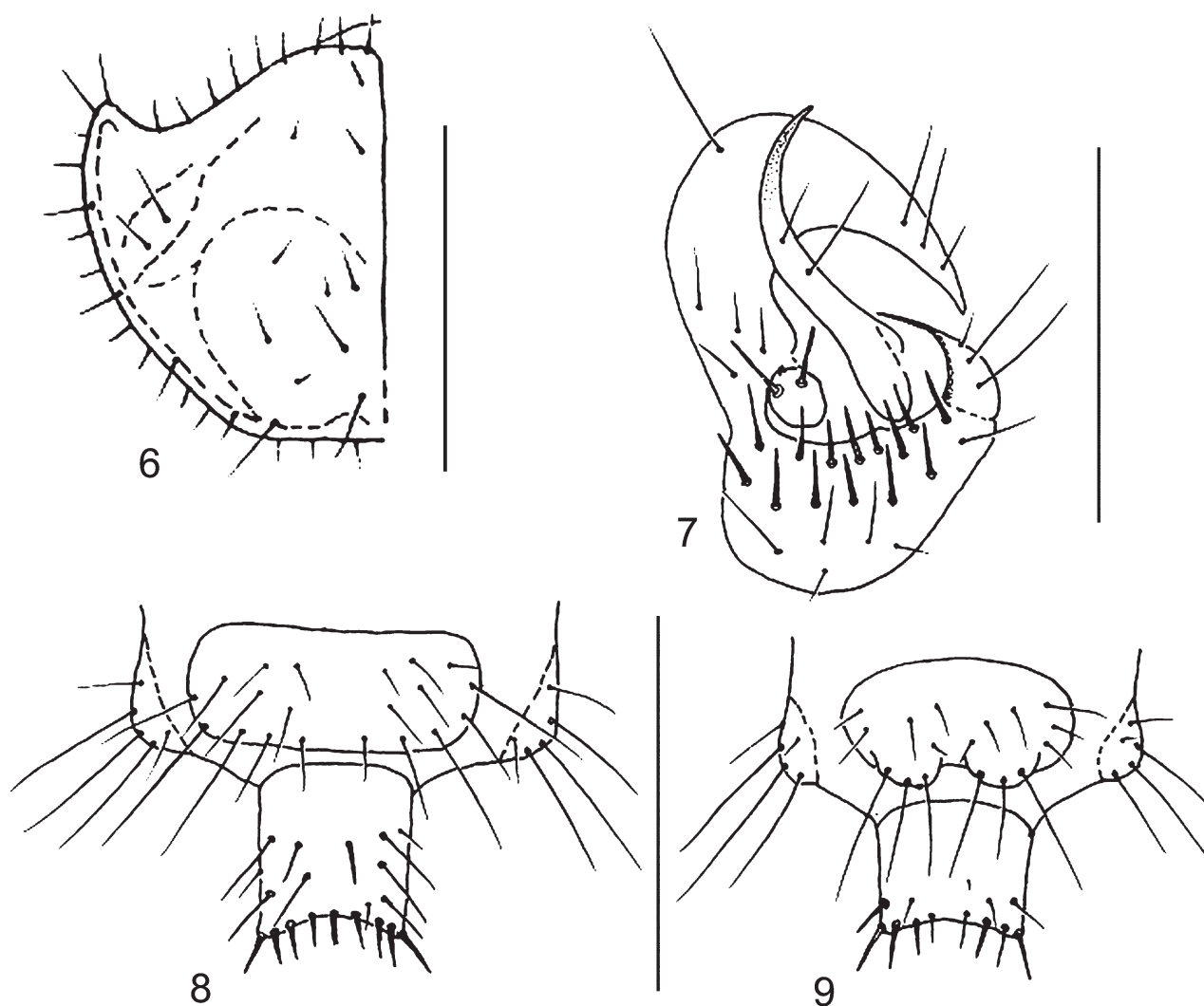
Disk of PN and head of same coloration. Apices of PNa widened and directed forwards. Anterior margin of PN greatly elongate, much longer than apices of PNa (Fig. 6). Setae of PN1 pale or light brown. Marginal setae reddish, transparent; most of them thin and long, acute, some setae obtuse. PN1 with 10–14 setae, and 4–5 setae along PNm, ridge of PNa with 2–3 setae (Fig. 6).



**FIGURES 2–5.** Features of third instar larvae of *Cylindera (Eugrapha) contorta*: 2. Pronotum, left half, dorsal view. 3. Hump, right half, dorso-lateral view. 4. Ninth segment and pygopod of abdomen, dorsal view. 5. Ninth segment and pygopod of abdomen, ventral view.

Sclerotized areas of abdomen slight distinct, gray. T3 almost square, with 5–7 reddish setae. CT5 and AT5 light brown, widely fused on inner margin and divided on external margin. Sclerotization AT5 covers inner part of IH too (Fig. 7). LCT5 with 2–3 long setae. CT5 with 12–16 stout setae and some thin small setae on posterior margin. Most setae of AT5 located on lower part (Fig. 7). MH with 2 (rarely 3) setae on middle. MH slender, long and distinctly curved above of upper third. Tips of MH reaching (slight traversing) anterior margin of AT5 and directed outward. Length of MH almost in 4.5–5.0 times more width at base. Central spine of IH present but very small (Fig. 7). IH length in 5 times less those MH. TE9 with 8 setae (4 of them on middle shortened) (Fig. 8). EU9 with 2 groups of 3 long setae each (Fig. 9). PY (except apex) with 10–12 setae dorsally and 5–7 ventrally. Tip of PY with 12–14 setae.

**Description of first instar larva.** Coloration of head and pronotum the same as in second and third instar larvae, but without luster. Setae pale; most setae thin and acute, some obtuse apically. Epicranial suture present, but indistinct.



**FIGURES 6–9.** Features of second instar larvae of *Cylindera (Eugrapha) contorta*: 6. Pronotum, left half, dorsal view. 7. Hump, dorso-lateral view. 8. Ninth segment and pygopod of abdomen, dorsal view. 9. Ninth segment and pygopod of abdomen, ventral view.

PNa more widened and directed outwards; its apices rounded. Anterior margin of PN much longer than apices of PNa and middle region very distinctly concave (Fig. 10). All setae of PN transparent pale. Most of them thin and long, acute; some marginal setae obtuse. PN1 with 5–6 setae, 3–4 setae located along PNm. PNa without setae (Fig. 10).

Sclerotized areas of abdomen indistinct, grayish. T3 almost square with 3 reddish setae. CT5 and AT5 light brown, indistinctly contacting at inner margin. Lower parts AT5 and CTL5 more sclerotized; AT5 with 2 setae (Fig. 11). CT5 without setae. LCT5 with one long seta. MH with one long seta above the middle. MH distinctly narrowed and curved above the middle. Tips of MH reaching anterior margin of AT5. MH almost 4.0 times as long as wide at base. Central spine of IH present, but very small (Fig. 11). IH no more than 3.5 times as long as MH. TE9 with 6 setae (Fig. 12). EU9 with 2 groups of 3 long setae each (Fig. 13). PY (except apex) with 6 setae dorsally and bare ventrally. Tip of PY with 10 setae.

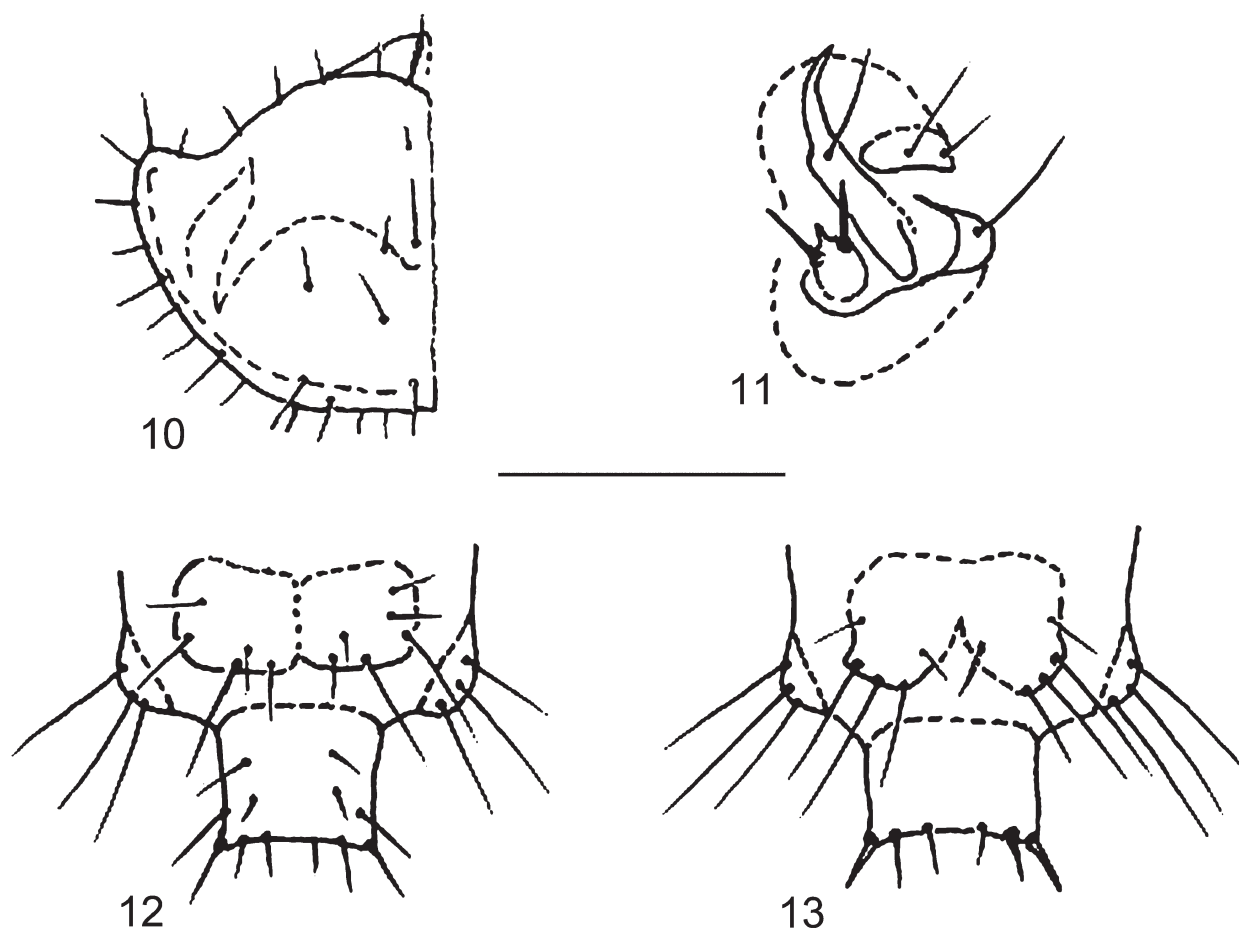
**Distribution and ecological peculiarities.** In Southern Ukraine the tiger beetle *Cylindera contorta* is found sporadically at open areas of the sea coastline: at the outer coasts of the Kinburn, Tendra and Dzhyrlygach sand spits of the Kherson Region, whose total coastal line is 142 km long (Fig. 1).

Adults and larvae of the species are moderately halophilous, thus concentrated at small narrow saline lagoons, 3–5 m wide and 5–30 m long, less at the zone of sea surf (Figs. 14–17).

The life cycle of *C. contorta* lasts from one to two years, but a two years cycle is more common (Putchkov & Nitochko, 2016). Oviposition is observed from late spring (May) to mid-summer (July). The overwintering phase



is usually third instar larvae, rarely the adults hibernate. Pupation takes place from end of May to June. Adults live from 3 months to 1–2 years, while larvae live up to 2 years. Copulation (Fig. 19) is usually observed from first days of June to middle of July. Adults are found at open sandy sea shore areas, occasionally adults are recorded at sandy-shellfish beaches, salt lakes and estuaries (Fig. 14–15). Adults are registered from early May to late August, in highest quantities from late May to mid-July. The species is locally distributed, though occasionally abundant. The larvae of first and second instars are recorded at first and second decades of July, and third instar larvae are found from the end of July to middle of August. Larvae prefer only the sandy areas at the littoral zone of quiet bays, estuaries and salt lakes (Fig. 16–17), as well as at the depressions with sufficient soil moisture; and larvae discard the sandy areas at zone of sea surf (Fig. 20).



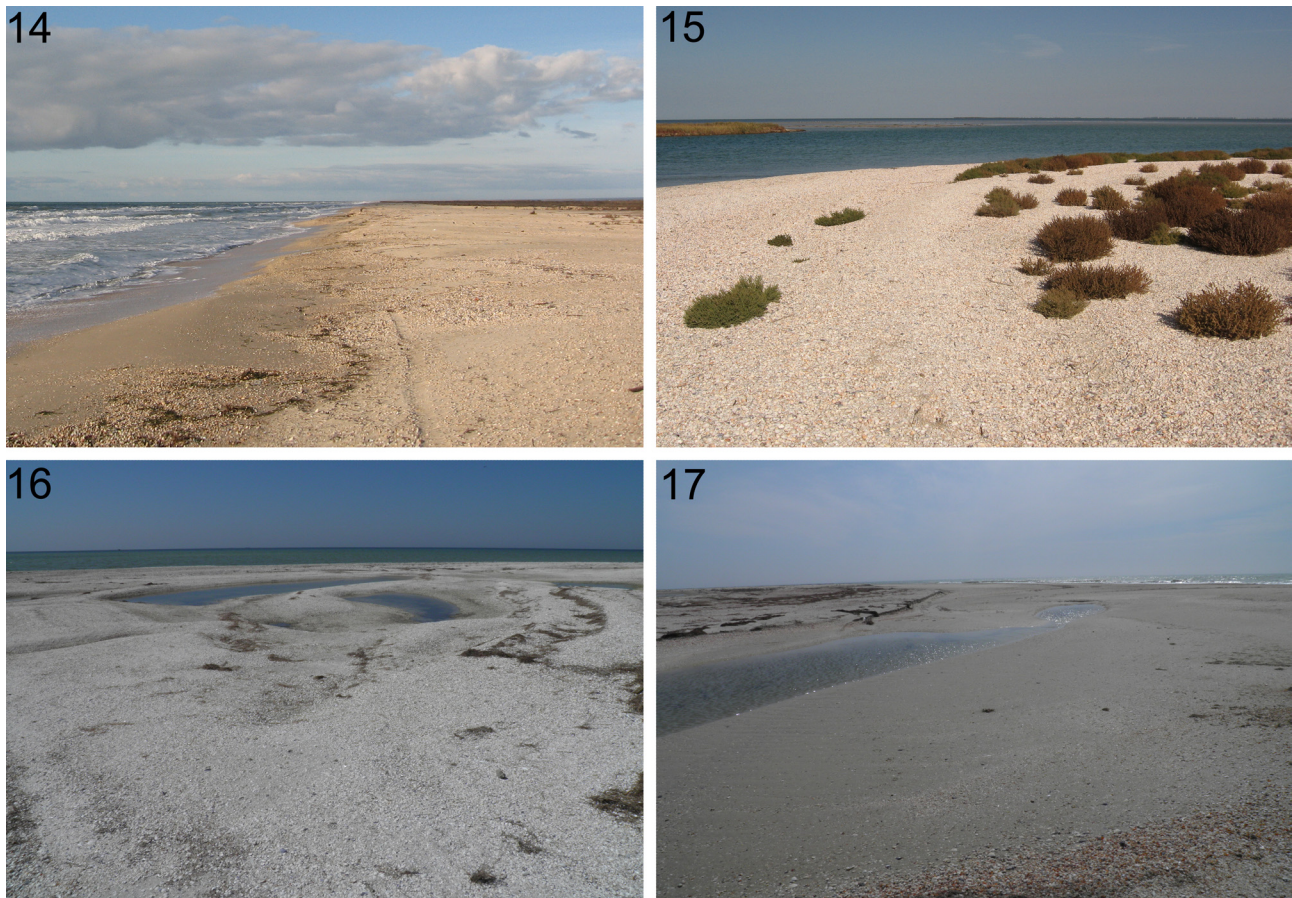
**FIGURES 10–13.** Features of first instar larvae of *Cylindera (Eugrapha) contorta*: 10. Pronotum, left part, dorsal view. 11. Hump, right part, dorso-lateral view. 12. Ninth segment and pygopod of abdomen, dorsal view. 13. Ninth segment and pygopod of abdomen, ventral view.

Larvae usually aggregated at certain elements of mesorelief (Fig. 16–17): small lagoons 3–5 m wide and of various lengths (usually 5–30 m long). Moreover, the burrows made by larvae are found at very limited section of lagoons, along their outer contour, but not in the very moist central part (Fig. 18, 20). Larvae cover the upper part of burrows with soil (sometimes to one third of the total length) when the cold weather, heavy rain or very hot (dry) periods come and remain inactive until conditions improve. Under excessive moisture or habitat destruction caused by storms, the larvae leave the burrows and migrate (usually at night) to more favorable areas, sometimes up to several tens of meters away. Usually larvae can be found only in limited periods of the year: from the end of July to August.

Adults and larvae of *Cylindera contorta* are often found simultaneously with the Eurasian species *Calomera littoralis* (Fabricius). However, these species differ in bionomy and habitat preferences.

Adults and larvae of *C. littoralis* are numerous throughout the littoral zone (beetles are often recorded far from water): at areas with dense clay soils to sands with varying degree of moisture. The species is common during all warm season, from April–May to September. They usually overwinter as both, adults and third instar larvae. The

oviposition is usually prolonged and lasts from the beginning of May to the end of August. Thus, specimens of *C. littoralis* are developing asynchronously. The depth of larval burrows vary from 15 cm (first and second instar larvae) to 25 cm (third instar larvae).



**FIGURES 14–17.** The habitats of adults and larvae of *C. contorta* in the Lower Dnieper province, Kherson Region, Southern Ukraine: 14. Sandy-shell sea shores, the main habitats of adults. 15. Sandy sea coast, the main habitats of adults. 16–17. Small lagoons on coast of sand spits, the main habitats of larvae (mostly) and adults (rarely).

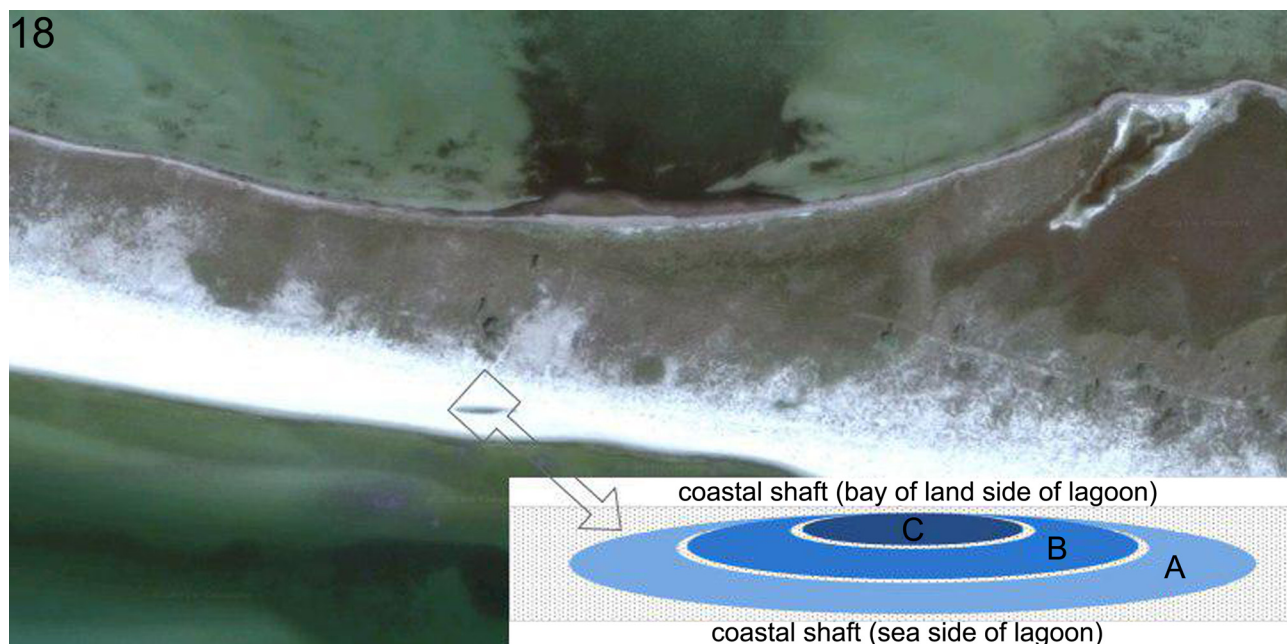
Adults and larvae of *C. contorta* occur mostly at sandy coastal areas. Beetles are found from the beginning of May to the end of second decade of August, with maximal abundance from the middle of July to mid-August. They usually overwinter as third instar larvae. Most of first and second instar larvae occur at July, but third instar larvae are recorded since first half of August. Thus, specimens in studied populations of *C. contorta* are developing synchronously. The depth of larval burrows varies from 8–15 cm (first and second instar larvae) to no more than 20 cm (third instar larvae).

**Protection and limiting factors.** In Ukraine, over 90% of habitats of *C. contorta* is covered by the Ramsar sites. These habitats are partially protected at the Black Sea Biosphere Reserve, “Dzharylgachsky” National Nature Park and “Beloberezhie of Svyatoslav” National Nature Park (all in Kherson Region).

A number of factors limit the abundance of *C. contorta* in Ukraine: small habitat areas, storms that destroy the main biotopes (lagoons and sea spits), flooding of areas with larval burrows. However, the anthropogenic pressure is especially dangerous, namely the urbanization of sea coasts: development of tourist infrastructure with recreation centers and resorts (especially in Dzharylgach island).

**Comparative notes.** In Cicindelidae the larvae of different instars (including *Eugrapha*) are well distinguishable by some qualitative and quantitative characteristics. The most important are the proportions of pronotum, especially its length/width ratio that varies from 1.41–1.53 (R1, R2) to 2.15–2.40 (R3) in different larvae of the subgenus (table 2 and abbreviations of the table). Moreover, the larval instars are well identified by the chaetotaxy of different segments. The most important and constant feature of chaetotaxy is the number of setae on the second segment of the galea: one seat for first instar larvae; two setae for second instar larvae; three or four setae for third instar larvae.





**FIGURES 18.** Scheme showing lagoons on coast of sand spits, the sites of aggregation of *C. contorta* larvae: A — outer contour of the lagoon where *C. contorta* larvae dug burrows; B-C — over-wetted central part of the lagoon where *C. contorta* larvae are rare or absent (most part of zone C is filled with water).

**TABLE 2.** Growth ratios of pronotal width for three instars of subgenus *Eugrapha* larvae

Species in the subgenus <i>Eugrapha</i>	Ratios*		
	R1	R2	R3
<i>C. contorta</i>	1.46	1.47	2.15
<i>C. arenaria</i>	1.64	1.47	2.40
<i>C. elisae</i>	1.61	1.44	2.31
<i>C. trisignata</i>	1.41	1.53	2.15

\*—R1 = second instar larvae/first instar larvae; R2 = third instar larvae/second instar larvae; R3 = third instar larvae/first instar larvae

In addition, other peculiarities can be used to identify different larval instars of *Eugrapha* and other Cicindelina:

- no setae on AN1, PNa, and CT5 in first instar larvae; 4–6, 1–3, and 13–25 setae on AN1, PNa, and CT5 in second and third instar larvae respectively;
- only 3–4 setae on T3 in first instar larvae; 5–9 setae on T3 in second instar larvae; 6–15 setae on T3 in second and third instar larvae;
- LCT5 with one bristle in first instar larvae; LCT5 usually with 3–5 bristles in second instar larvae; LCT5 with 5–10 bristles in third instar larvae;
- LP1 with only 3 setae in first instar; LP1 usually with 5 setae in second instar; LP1 with 7 setae in third instar larvae.

Our previous research revealed, that all *Eugrapha* larvae are characterized by some specific features and they are well distinguished from other larvae the genus *Cylindera* and other genera of the subtribe Cicindelina (Putchkov, 2001, 2013).

Thus, second and third instar larvae of the genus *Eugrapha* exhibit following combination of characters:

- central spine of IH absent or very small (short);
- IH very short, usually 4–5 times shorter than MH;

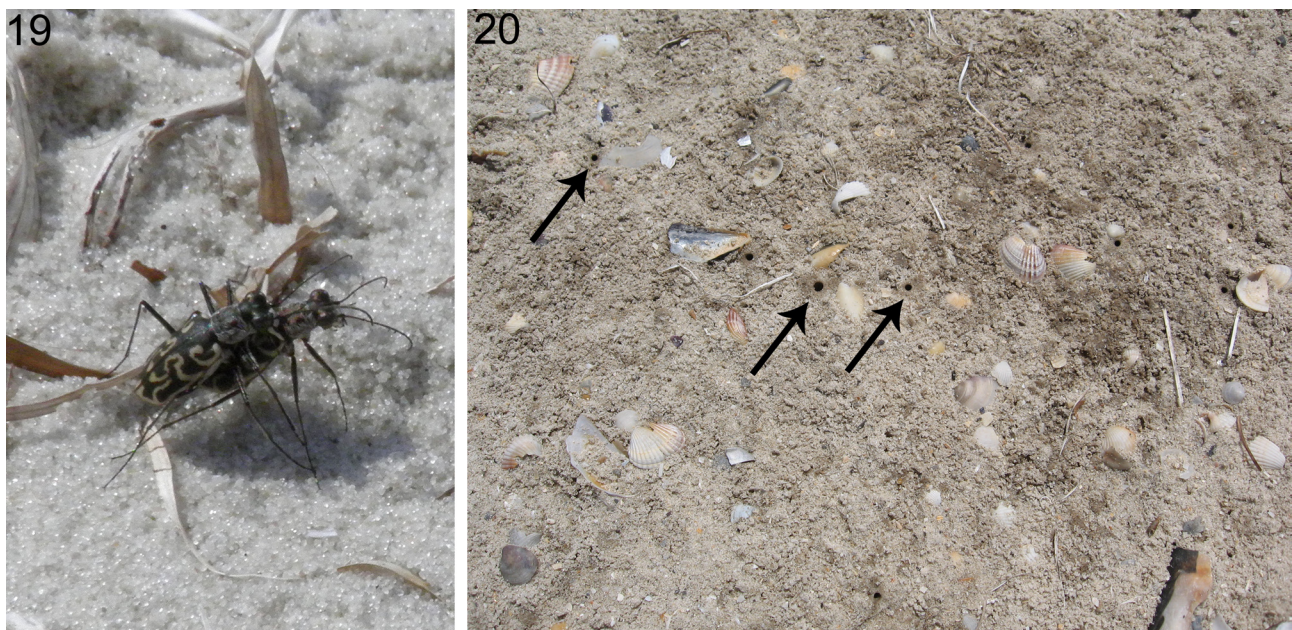


- MH slender and usually strongly curved in upper third, their tips usually reaching anterior margin of AT5 or longer;
- tergites of fifth abdominal segment always fused on inner margin;
- sclerotized areas of abdomen slightly distinct;
- EU9 always with 2 groups with 3 setae;
- anterior margin of PN longer than apices of PNa;
- head and PN no more than 1.8 mm wide in second instar larvae and no more than 2.8 mm wide in third instar larvae.

The first instar larvae of the genus *Eugrapha* differ in having following combination of characters (in contrast to larvae of other *Cicindela* s.l.):

- AT5 of the fifth abdominal segment is more sclerotized along posterior inner margin only (as separate areas);
- MH long, slightly curved, but distinctly narrowed in the upper third;
- central spine of IH distinct, but short;
- anterior margin of PN strongly convex, distinctly longer than cephalolateral angles;

However, many larval characters of *Eugrapha*, especially features of chaetotaxy, taken separately appear to be relatively similar or overlapping within the subgenus (table 3). Thus, determination of the species becomes reliable only based on a complex of features: these are given in an updated key for larvae of the subgenus *Eugrapha* (see below).



**FIGURES 19–20.** 19. Adults of *C. contorta* “in copula”. 20. Burrows of different larval instars of *C. contorta*.

**TABLE 3.** Number of setae at main segments and sclerites of third instar larvae of the subgenus *Eugrapha* (see text for abbreviations)

Species in the subgenus <i>Eugrapha</i>	Body structures							
	PN1	PNa	PNm	T3	CT5	CT15	MH	Tip of PY
<i>C. contorta</i>	12–16	2–3	5–6	6–9	20–25	4–5	2–3	12–16
<i>C. arenaria</i>	11–22	1–2	4–8	10–15	18–24	7–10	3–4	15–18
<i>C. elisae</i>	12–16	2–5	6–8	8–12	16–22	5–7	3	14–17
<i>C. trisignata</i>	13–20	2–3	5–6	8–12	16–18	5	2–3	12–15
<i>C. litterifera</i>	12–20	3–4	4–8	8–12	17–20	4–6	3–4	15–17
<i>C. sublacerata</i>	12–16	2–3	5–6	10–14	16–23	6–9	2–3	18–20

## Conclusion

Larvae of *Cylindera (Eugrapha) contorta* reveal all characters established above for the subgenus, but following morphological features are specific: shape, size and proportions of PN; chaetotaxy of T3, tergites and appendages of fifth abdominal segment and PY; size and ratio of head and PN (tables 1, 2). Thus, it is possible to distinguish reliably *C. contorta* from other species of the subgenus based on larval features given in the key below.

## Key to second and third instar larvae of the subgenus *Eugrapha*

- 1 Type I of HY; PNa directed forwards, and not longer than anterior margin of PN, which is slightly prominent; MH less curved in upper third and their tips not reach anterior margin of AT5; central spine of IH evident, but very small. Southeastern Europe, Caucasus and Central Asia. Usually on the sands and close to water basin. . . . . ***C. sublacerata***
- Type II of HY; PNa slightly directed laterally; anterior margin of PN distinctly prominent and longer than apices of PNa; MH strongly curved in upper third and their tips reach at least anterior margin of AT5; central spine of IH usually indistinct or absent . . . . . 2
- 2 CT5 and AT5 widely fused on inner margin and partly in contact on external margin; AT5 partly covers inner part of IH (Fig. 3); MH very long and strongly curved above the middle; tips of MH traversing anterior margin of AT5 (third instar larvae) or reaching its anterior margin (second instar larvae) (Figs. 3, 7); IH 5–6.0 times shorter than MH. PN of 1.53–1.60 (1.55) linear width/length ratio (table 1). Southeastern Europe, Transcaucasia, Minor and Central Asia, West Siberia (south), Mongolia. Sands plots near saline basins. . . . . ***C. contorta***
- CT5 and AT5 fused on inner margin, but not in contact on external margin; AT5 not reaching IH; MH less curved above the middle; apices of MH reaching its anterior margin only; IH 4.5–5.0 times shorter than MH; CT5 with 16–22 setae in third instar larvae; PN of 1.60–1.76 (1.55) linear width/length ratio (table 1). . . . . 3
- 3 PN of no more than 1.70 linear width/length ratio; pronotum more narrowed basally . . . . . 4
- PN of more than 1.68 linear width/length ratio; pronotum less narrowed basally. . . . . 5
- 4 Ridge of PNa with 1–2 setae in second-third instar larvae; CT5 with 15–22 stout setae in second instar and 18–24 stout setae in third instar larvae; LCT5 with 3–4 long setae in second instar and 7–10 long in third instar larvae. Europe. Mainly on the sands, near water reservoirs or far from water bodies. . . . . ***C. arenaria***
- Ridge of PNa with 1–2 seate in second instar and 2–5 setae in third instar larvae; CT5 with less than 13–17 stout setae in second instar and 17–22 stout setae in third instar larvae; LCT5 with 2–3 long setae in second instar and 5–7 long setae in third instar larvae. Far East. Mesohygrophytic meadows and near water bodies. . . . . ***C. elisae***
- 5 Linear width/length ratio of PN 1.55–1.63 (1.60); PNa with 2–3 setae; tip of PY with 12–15 setae; CT5 with 16–18 stout setae. South Europe. Near freshwater and saline bodies . . . . . ***C. trisignata***
- Linear width/length ratio of PN 1.64–1.67 (1.66); PNa with 2–4 setae; tip of PY with 15–18 setae; CT5 with 18–20 stout setae. Southeastern Europe and Central Asia. Usually near different freshwater reservoirs . . . . . ***C. litterifera***

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