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**MORPHOLOGY OF *STENOTHOE* CF. *TERGESTINA* (NEBESKI, 1881)
(CRUSTACEA, AMPHIPODA, STENOTHOIDAE),
RECENT INVADER TO THE BLACK SEA**

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The relevance of research on species new to regions is governed by their interaction with species of local ecosystems, as it may be negative in some instances. The aim of this work is to clarify the morphology and variability of some parameters of body and appendages of adult males and females of *Stenothoe* cf. *tergestina* which is similar to *Stenothoe tergestina* (Nebeski, 1881) but has some morphological differences not allowing to classify them as different species. Methods of morphology investigations and analysis under both light and electron microscopes were used. A detailed description of adult *S. cf. tergestina* females and males, their appendages, and the sex structure of the population from fouling of constructions of a mussel-and-oyster farm near Sevastopol is provided. New data on the discovered taxon were comparatively analyzed with similar data from other habitats to clarify the species affiliation. The variability of several morphological traits was revealed. The length of females in the populations exceeded the length of males. The finding of individuals on various substrates evidences for high adaptability of the species to this habitat.

Keywords: Amphipoda, Black Sea, *Stenothoe* cf. *tergestina*, morphology

Since 1999, in the Black Sea, several Amphipoda species have been recorded previously unknown in this region [Grintsov, 2003a, b, 2009a, b, 2010, 2011, 2018, 2021].

The relevance of research on species new to regions is mediated by their interaction with species of local ecosystems, as it may be negative in some instances. To date, three species of the genus *Stenothoe* Dana, 1852 have been reported for the Black Sea: *Stenothoe monoculoides* (Montagu, 1813) [Greze, 1977, 1985], *Stenothoe marina* (Spence Bate, 1857) [Grintsov, Sezgin, 2011], and *Stenothoe* cf. *tergestina* [Grintsov, 2024]. *S. marina* is distributed along the coast of Turkey. *S. monoculoides* inhabits the entire Black Sea area. Since 2018, we register *S. cf. tergestina* in high abundance (males, females, and juveniles) on structures of a mussel-and-oyster farm (the outer roadstead of Sevastopol). These amphipods occur within a depth range of 0–10 m in all seasons.

The aim of this work is to clarify the morphology and variability of some body and appendage parameters of adult *Stenothoe* cf. *tergestina* males and females.

MATERIAL AND METHODS

Periphyton was sampled manually in 2018–2024 from constructions of the mussel-and-oyster farm located on the outer roadstead of Sevastopol, from a depth of 0–5 m.

Periphyton was kept in freshwater for 10 min and separated from the substrate. The resulting wash was filtered through a mill sieve with a mesh size of 0.5 mm and fixed with 96% ethanol. In a laboratory, amphipods were identified under a light binocular microscope MBS-9 (Russia) at a magnification of 8×2 and 8×4 and a microscope Mikmed-5 (Russia) at 10×4 and 10×10 . Species-specific features were analyzed [Greze, 1985; Grintsov, Sezgin, 2011; Krapp-Schickel, 1993]. Measurements were carried out with an eyepiece micrometer for MBS-9. Micrographs of the habitus and body details of adult Amphipoda males and females were taken under a scanning electron microscope (hereinafter SEM) Hitachi SU3500 (Japan) by the author of the work and the head of the IBSS microscopy laboratory V. Lishaev.

During late August–early September 2024, ratios of juveniles and adults of this amphipod, as well as males and females, were determined in 35 samples; 981 ind. were analyzed. In total, more than 10,000 ind. of *S. cf. tergestina* have been studied since 2018.

Morphological variability was assessed on 30 adult males and females. The following traits were analyzed: the body length (in mm), the ratio of antenna I length and antenna II length (LAI/LAII), the ratio of the length of the stalk of antenna II and the length of its flagellum (LAIISt/LAIIFl), the ratio of the maximum width of coxal plates II and III (CoxII/CoxIII), and the ratio of the telson length and the uropod III length (LT/LUIII). All ratios were calculated for the left side of the body. The arithmetic mean, standard deviation, minimum value, and maximum value were determined as well.

RESULTS AND DISCUSSION

Description of *Stenothoe cf. tergestina* morphology. Female (Fig. 1), length 4.50 mm, 6 eggs.

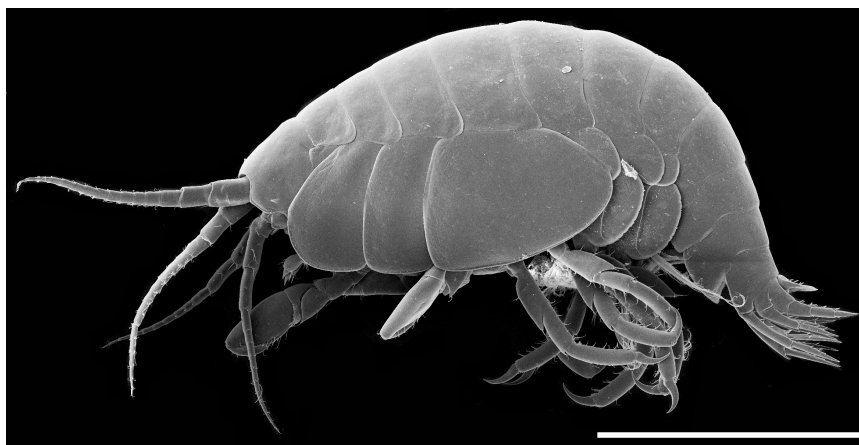


Fig. 1. Habitus of an adult *Stenothoe cf. tergestina* female (a scanning electron microscope). Scale line is 1 mm; from [Grintsov, 2024]

Head. Rostrum small. Eyes 0.15 mm, 3.33 times shorter than head length. Rounded, white in ethanol. Interantennal lobes trapezoidal.

Antenna I. Length 1.40 mm. Peduncle: ratio of lengths of 1 : 2 : 3 segments (articles) – 1.0 : 0.8 : 0.5; thickness of segments decreases successively from the 1st to the 3rd one; the 1st segment slightly narrows distally; a seta extero-laterally, a spine ventro-distally; the 2nd segment cylindrical, setae intero-laterally and distally, spines ventrally; the 3rd segment cylindrical, setae distally. Flagellum longer than peduncle, includes 14 segments; segments with setae and aesthetasc sensillae distally.

Antenna II. Length 1.40 mm. Peduncle: ratio of lengths of 3:4:5 segments – 0.5:1.0:1.0; the 3rd segment almost round, inflated, with curved spines intero-ventrally; the 4th segment cylindrical, slightly curved, spines extero-laterally, intero-laterally, and distally; the 5th segment slightly curved, spines and setae extero-laterally, intero-laterally, and distally. Flagellum longer than peduncle, includes 15 segments, segments with setae distally.

Mouthparts. Epistome and labrum. Labrum with a deep notch on ventral margin (Fig. 2A).

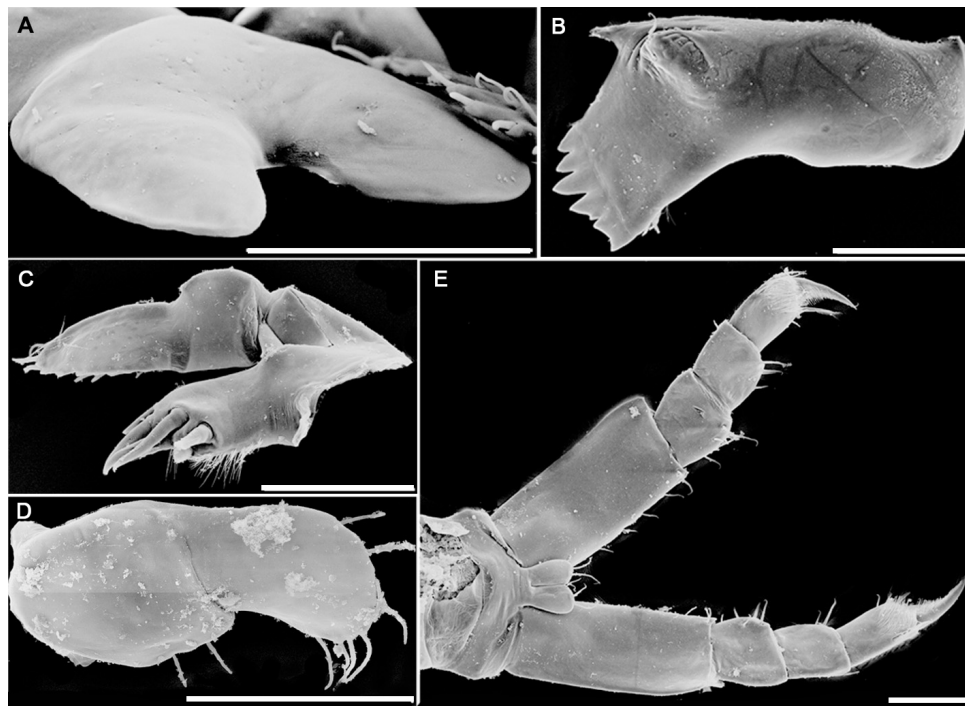


Fig. 2. Mouthparts of an adult *Stenothoe* cf. *tergestina* female (a scanning electron microscope). A, upper lip; B, right mandible; C, maxilla I; D, maxilla II; E, maxilliped. Scale lines are 0.1 mm; original photo

Right and left mandibles (Fig. 2B). Cutting edge with 6 denticles. Additional plate short, with 4 denticles. Row of denticles with 2 setae. Molar in the form of a small tubercle with setae. Labium. Inner and outer lobes fused and pubescent distally. Maxilla I (Fig. 2C). Inner lobe small, rounded, with 1 long seta; outer lobe several times larger than inner lobe, with strong spines distally. Palp 2-articulate, the 2nd segment twice longer than the 1st; the 2nd segment of palp with setae and spines along margin. Maxilla II (Fig. 2D). Inner lobe almost not expressed. Outer lobe convex along margin, with setae. Maxillipeds (Fig. 2E). Inner lobes small, much smaller than the 1st segment of palp, with 2 setae distally. No outer lobes. Palp 4-articulate, the 4th segment claw-like. Ratio of lengths of 1:2:3:4 segments – 1.0:1.0:1.2:1.0; the 1st, 2nd, and 3rd segments with setae along inner margin. Pereon. Width of segments increases from the 1st to the 7th one. Cuticular structures not expressed.

Gnathopod I (Fig. 3A). Coxal plate small, almost completely hidden by coxal plate II, rectangular in shape, with sparse small setae on ventral margin. Basipodite 1.1 times longer than ischium, propodus slightly narrowed in middle part, anterior margin proximally convex, subdistally with a notch, middle part of posterior margin straight; a tiny seta intero-distally. Ischium equal to merus in length, curved. A small seta in middle part of posterior margin. Merus 0.8 times as long as carpus; posterodistally forms a lobe with a brush of tiny setae at distal end and several larger setae and spines. Carpus 0.4 times as long as propodus, convex at anterior margin and with a small lobe posterodistally; setae and spines distally

on a lobe. Propodus twice as long as claw, subtly trapezoidal; anterior margin convex, with several setae, posterior margin straight, shorter than anterior margin, inner plane with several setae. Claw-side palmar margin slightly convex, with spines and setae, the largest spines are locking. Claw equal to claw-side palmar margin, with several setae.

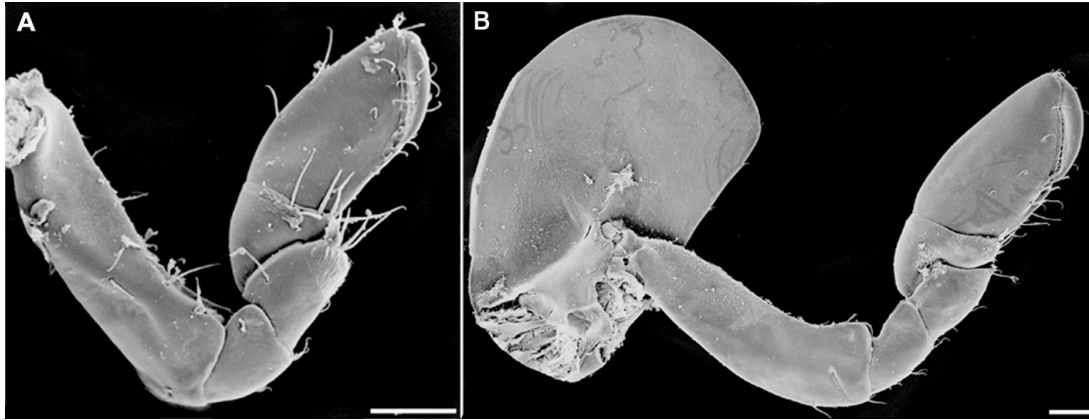


Fig. 3. Gnathopodes of an adult *Stenothoe* cf. *tergestina* female (a scanning electron microscope). A, gnathopod I; B, gnathopod II. Scale lines are 0.1 mm; original photo

Gnathopod II (Fig. 3B). Larger than gnathopod I. Coxal plate elongated dorsoventrally, widens ventrally, anterior and ventral margins convex, posterior concave, small spines posterodistally. Basipodite twice as long as ischium + carpus, widens distally, curved toward distal end, anterior margin weakly convex proximally, concave distally, posterior margin straight proximally, convex distally, setae posterodistally and distally. Ischium 0.9 times as long as merus, curved, anterior margin concave, posterior margin convex; one seta in middle part and one distally on posterior margin. Merus slightly larger than carpus, forms a triangular lobe along entire posterior margin, posterior margin convex; setae in posterodistal angle of posterior margin. Carpus 0.4 times as long as propodus, anterior margin convex, posterior margin with a narrow long lobe; 2 setae and 1 spine at distal end of lobe. Propodus 1.8 times the length of claw, oval, anterior margin convex proximally and straighter distally, posterior margin uniformly convex, with a small notch proximally; anterior margin with setae distally, posterior margin with setae and spines. Claw-side palmar margin about 0.5 times the length of inner margin, uniformly convex, with setae and spines, the largest spines are locking. Claw equal to claw-side palmar margin; setae on outer and inner margins, a denticle at distal end.

Pereopod III (Fig. 4A). Coxal plate III rectangular, elongated dorsoventrally, anterior and ventral margins convex, posterior margin concave; small spines along posterior margin. Basipodite 0.8 as long as ischium – propodus, curved, widening distally, anterior margin proximally convex, distally concave, posterior margin convex, setae in distal half of posterior margin, a seta entero-distally. Ischium 0.7 as long as merus, curved, anterior margin proximally concave, distally convex, posterior margin convex; setae in middle part of posterior margin. Merus equal to carpus in length, anterior margin forms a convex lobe, with its distal end not reaching middle part of carpus, a lobe ends in 3 different-sized spines, a seta in proximal part of a lobe; posterior margin convex proximally and concave distally, a seta in middle part of margin and distally. Carpus 0.7 as long as propodus, convex along anterior margin and straight along posterior one; spines along posterior margin and distally. Propodus 1.7 times the length of claw, slightly curved, convex along anterior margin and concave along posterior one; small setae along anterior margin and developed spines along posterior margin. Claw with no cuticular structures.

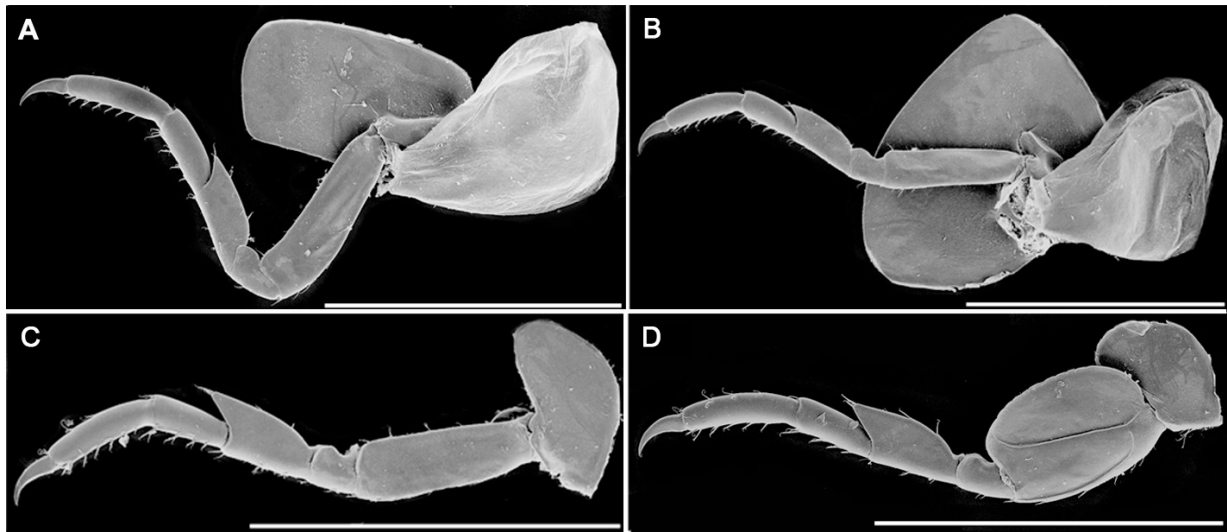


Fig. 4. Pereopodes of an adult *Stenothoe* cf. *tergestina* female (a scanning electron microscope). A, pereopod III; B, pereopod IV; C, pereopod V; D, pereopod VI. Scale lines are 1 mm; original photo

Pereopod IV (Fig. 4B). Similar in size to pereopod III. Coxal plate IV the largest, trapezoidal, width exceeds height; anterior, ventral, and posterior margins convex, with no cuticular structures. Basipodite equal to ischium + carpus in length, straight, not widen distally, spines distally and along posterior margin, especially in its distal half. Ischium + claw same as in pereopod III, but with more massive spines.

Pereopod V (Fig. 4C). Slightly longer than pereopod IV. Coxal plate V bilobed, posterior lobe longer and thinner, anterior lobe slightly convex, with setae. Basipodite + merus as in pereopod IV, but cuticular structures more developed. Carpus widens distally, armature similar to that of pereopod IV, but more massive; propodus + claw similar to those of pereopod IV, but cuticular structures more massive.

Pereopod VI (Fig. 4D). Slightly longer than pereopod V. Behind, coxal plate VI forms oval-elongated lobe with small spines along anterior margin. Basipodite equal to ischium + merus in length, convex along anterior margin; along posterior margin, forms a convex lobe, finely scalloped along margin and reaching a third of ischium; short, strong spines along anterior margin. Ischium 0.5 as long as merus, convex along anterior margin, with a proximal notch along posterior margin; spines along anterior margin. Merus equal to carpus in length, anterior margin straight, a convex lobe on posterior margin, with distal end of a lobe not reaching middle part of carpus; spines along anterior and posterior margins, the largest at distal end of a lobe. Carpus 0.9 times as long as propodus, widens distally, anterior margin straight, posterior margin convex; spines along anterior margin and distally. Propodus 1.5 times longer than claw, slightly curved; setae along posterior margin, strong spines along anterior margin. Claw with no cuticular structures.

Pereopod VII. Slightly larger than pereopod VI. Behind, coxal plate VII forms a small, irregularly rounded lobe. Basipodite 0.9 times as long as ischium + propodus, a lobe on posterior margin reaches half of the length of ischium. Rest of morphology and cuticular structures similar to those of pereopod VI.

Pleone (see Fig. 1). All segments of pleone equal in width. Epimeral plate I the smallest, ventrally convex. Epimeral plate II medium-sized, ventral margin convex, posterior margin almost straight. Epimeral plate III the largest, ventral margin convex, an outgrowth formed ventro-distally, posterior margin concave.

Urosome (see Fig. 1). The 1st segment significantly wider than other ones. Cuticular structures not expressed.

Uropod I (Fig. 5A, UI). Longer than uropod III. Peduncle longer than rami; spines extero-dorsally and distally, a small denticle formed distally below rami. Rami equal in length and pointed terminally, spines only dorsally, no terminal spines.

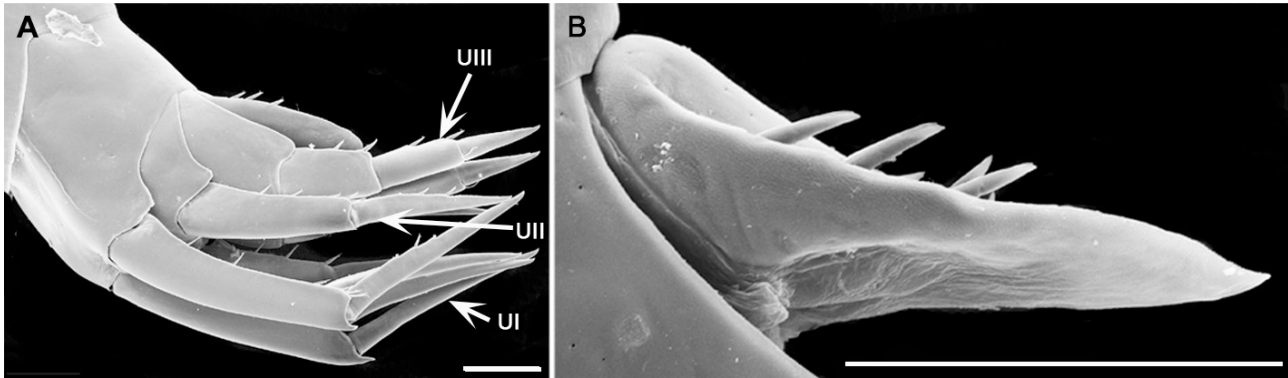


Fig. 5. Pereopodes of an adult *Stenothoe* cf. *tergestina* female (a scanning electron microscope). A, urosome with uropodes; B, telson (lateral view); UI–UIII, uropodes I–III. Scale lines are 0.1 mm; original photo

Uropod II (Fig. 5A, UII). Peduncle equal in length to inner ramus, spines extero-dorsally. Outer branch slightly shorter than inner one, both branches pointed terminally, with spines dorsally, no terminal spines.

Uropod III (Fig. 5A, UIII). Slightly shorter than uropod II. Peduncle shorter than single ramus, tapering distally, with strong spines dorsally. Ramus with 2 segments of equal length, the 1st segment with spines dorsally, the 2nd segment pointed at end and with no cuticular structures.

Telson (Fig. 5B). Entire, tapering distally, with convex margins and strong spines along margins.

Male (Fig. 6A), length 3.00 mm (distinctive sexual characteristics).

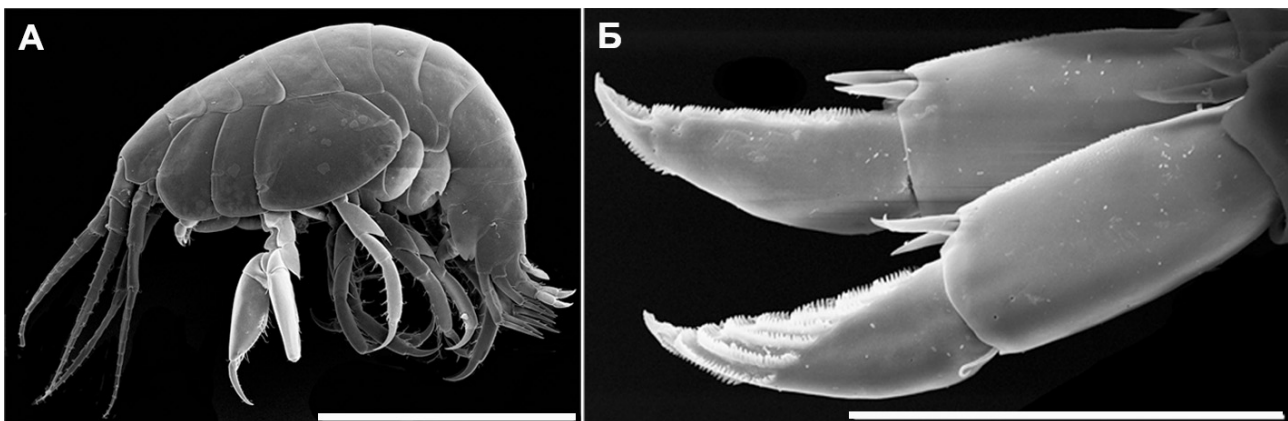


Fig. 6. Habitus (A) and rami of uropodes III (B) of a *Stenothoe* cf. *tergestina* male (a scanning electron microscope). Scale lines are 1 mm (A) and 0.1 mm (B); from [Grintsov, 2024]

Gnathopod II. Propodus equal to basipodite or slightly longer.

Uropod III (Fig. 6B). The second terminal segment of ramus with a different shape than in females: sharply swollen proximally and sharply tapering distally. Dorsally with a notch covered with rows of tiny hairs.

Analysis of individual variability of several traits showed as follows: the ratio of the length of the stalk of antenna II and the length of its flagellum (LAISt/LAIIFl) is subject to higher variability in both adult males and adult females (Table 1). Analysis of Pearson's paired correlation between the length of an individual and the studied ratios revealed no significant correlations in either females or males. Besides the above-mentioned ratio (LAISt/LAIIFl), the ratio of the lengths of antenna I and antenna II is noteworthy. In some females, antenna I predominates in length, in others, antenna II (see Table 1), although in general, antenna I prevails in length. In males, either antennae are equal or antenna I predominates (Table 1).

Table 1. Values of individual variability of morphological traits in adult *Stenothoe* cf. *tergestina* males and females

Morphological trait	Males	Females
Body length	2.15–3.25 2.72 ± 0.28	2.50–4.35 3.06 ± 0.47
LAI/LAII	1.00–1.41 1.16 ± 0.09	0.89–1.56 1.16 ± 0.15
LAISt/LAIIFl	0.44–1.05 0.72 ± 0.12	0.50–1.38 0.75 ± 0.17
CoxII/CoxIII	1.05–1.39 1.24 ± 0.07	1.02–1.50 1.15 ± 0.09
LTI/LUIII	0.52–0.77 0.64 ± 0.06	0.46–0.67 0.57 ± 0.06

Note: the range of values (min–max) is above the line; the mean \pm standard deviation is below the line. Abbreviations are explained in “Material and Methods” section.

Ecology. The species was found on various substrates of the marine farm structures: in oyster cages, on ropes, fastening elements, buoys, in Bivalvia druses, on Hydrozoa and Bryozoa colonies, and among several macrophytes. *S.* cf. *tergestina* settlements are female-dominated. The analysis of 35 samples (646 females and 335 males; 981 adult individuals in total) showed that females prevailed in 30 samples, the abundance of males and females was equal in 3 samples, and males predominated in 2 samples. In the overwhelming majority of the samples (30 out of 35), adult amphipods prevailed (981 adult individuals and 406 juveniles).

Conclusion. Clarifying the morphology of adult *Stenothoe* cf. *tergestina* females and males allows for comparing its representatives found on structures of a marine farm with individuals of various species of this genus from other habitats. For adults of both sexes, variability of several morphological traits was revealed reflecting the degree of their variability; this can be useful in comparative studies on the morphology of the genus *Stenothoe*. The analysis of the sex structure of adult individuals uncovered the predominance of females in settlements, and the investigation of the size composition of the population showed that the length of females exceeded that of males. The results of the study evidence for a high degree of adaptability of representatives of this taxon: those are capable of living in various communities and inhabiting different types of substrates.

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**МОРФОЛОГИЯ *STENOTHOE* CF. *TERGESTINA* (NEBESKI, 1881)
(CRUSTACEA, AMPHIPODA, STENOTHOIDAE),
НЕДАВНЕГО ВСЕЛЕНЦА В ЧЁРНОЕ МОРЕ**

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Актуальность исследований новых для регионов видов обусловлена их взаимодействием с видами местных экосистем, которое порой может иметь негативный характер. Цель настоящей работы — уточнить морфологию и вариабельность нескольких параметров тела и конечностей взрослых самцов и самок *Stenothoe* cf. *tergestina*, который сходен с *Stenothoe tergestina* (Nebeski, 1881), но имеет ряд морфологических различий, не позволяющих отнести их к разным видам. Для выполнения поставленных задач использованы методы анализа морфологии с применением световой и электронной микроскопии. Приведено детальное описание взрослых самок и самцов *S. cf. tergestina*, их конечностей, а также половой структуры популяции из обрастаний конструкций мидийно-устричной фермы вблизи Севастополя. Новые данные по обнаруженному таксону проанализированы в сравнении со сведениями из других местообитаний, что позволяет уточнить его видовую принадлежность. Выявлена вариабельность ряда морфологических признаков. В популяциях длина самок превышала длину самцов. Обнаружение особей на различных субстратах указывает на высокую приспособленность вида к данному местообитанию.

Ключевые слова: амфиподы, Чёрное море, *Stenothoe* cf. *tergestina*, морфология