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ORIGINAL ARTICLE

Amphipod assemblage found on sublittoral hydroids in the White Sea with the special remarks to symbiotic association of stenothoid *Metopa alderi* with hydroid *Tubularia larynx*

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Data on amphipod assemblage associated with sublittoral hydroids collected in the Kandalaksha Bay in the White Sea are presented in the paper. Eleven species of amphipods were found, among them only *M. alderi* (Stenothoidae) could be considered as specific symbionts for 3 species of sublittoral hydroid, namely *H. falcate*, *S. mirabilis* and *T. larynx*. Aquarium and in situ observation showed that adult females of *M. alderi* occupy hydrants and protect from other invading females, while males are moving between hydrants showing the absence of any strict territoriality. Probably, the species specifically associated with the habitat on the hydroids polyps allowing feed both on tissues of polyp/hydrant and catching floating particles. Females show no negative reaction to juveniles or males presenting on the same hydrants, and normally co-existed during all time of observations. The males during usually actively move inside the colony of hydroids T. larynx between hydrants and migrating to neighboring colonies showing no negative reaction to females or juvenile; they were numerously catch in plankton in September.
Key words: Hydrozoa; associations; symbiosis; Amphipoda; Stenothoidae; *Metopa*; hydroids; *Tubularia*; White Sea

Introduction

Presently, more and more attention of the world scientific community is devoted to the study of symbiotic relationships, and their role in the functioning of marine ecosystems. The most convenient objects for studying symbiotic interactions are colonial coelenterates, in particular coral polyps, with which a large number of different species of living organisms are associated. Rich communities of coral reefs attract researchers, which contributes to their active study. However, due to the peculiarities of metabolism, coral polyps could not live in cold waters, where their ecological niche is occupied by colonial hydroids. However, the number of scientific works devoted to the study of communities of organisms associated with colonial hydroids is extremely small. Nevertheless, being abundant species, hydroids and associated symbiotic communities play an important role in the ecosystems of the northern seas and in many ecosystems are species-edificators.

The amphipod family Stenothoidae Boeck, 1871 (Crustacea: Amphipoda) represent a cosmopolitan group of marine benthic amphipods found from tidal zone to continental shelf, with some species recorded at depths of up to 5000 m (Barnard & Karaman 1991; Krapp-Schickel & Koenemann, 2006). Some species are known to be symbiotic living on hydroids, where they seem to eat hosts' tentacles and eggs (Edgar 1983, Krapp-Schickel 1993). Stenothoids are also known to be commensals of hermit crabs (McGrath 1978; Marin & Sinelnikov 2012, 2016; Marin et al. 2013; Vader & Tandberg, 2015) and bivalve mollusks (Vader 1972; Vader & Tandberg, 2013; Krapp-Schickel & Vader, 2015). At the same time, the records of stenothoids among algae can be probably explained the presence of small hydroids (see Marin & Sinelnikov, in press). Nevertheless, according to the nature of the interaction of amphipods with the host and ecology, there is very little data.

In Russian literary sources, representatives of the family Stenothoidae and, especially, of the genera *Metopa* Boeck, 1871 and *Stenothoe* Dana, 1852 are mentioned as a component of various benthic samples. Different stenothoids were found in benthic bottom grab samples taken on hard substrates of the Black Sea (Korshunov, 2002) additionally being the main food resources for fish *Thyriscus anoplus* (Gilbert & Burke, 1912) (Tokranov, 2009). At the same time, there are no data on the ecology of most of stenothoids in the Russian waters.

The aim of this work is to analyze the amphipod species composition inhabiting various hydroids in the Kandalaksha Bay of the White Sea, as well as the study of host specificity and some features of ecology of symbiotic species inhabiting the most abundant and large White Sea hydroid *Tubularia larynx* (Ellis & Sollander, 1786) (Cnidaria: Hydrozoa: Tubulariidae). During the study we try to describe the fauna of amphipods associated with 5 most abundant species of colonial hydroids and identify species of symbiotic amphipods specific for these hosts.
An attempt to study the symbiontofauna of the hydroids of the sublittoral of the White Sea is presented for the first time. The work essentially complements the data on ecology of symbiotic animals, the problem of mutual relations in the symbiont-host system and contributes to the study of crustaceans and hydroids as the main components of symbiotic complexes of Arctic and Far Eastern seas.

Material and Methods

The collection of the material has been accomplished the area of the Kandalaksha Bay of the White Sea in the vicinity of the White Sea Biological Station of the M.V. Lomonosov Moscow State University (BBS MSU) from mid-July to mid-September 2009. The symbiotic fauna was collected from most abundant White Sea sublittoral hydroids *Gonothyrae loveni* (Allman, 1859), *Obelia longissima* (Alder, 1857), *Dynamena pumila* (Linnaeus, 1758), *Clava multicornis* (Forskal, 1775), *Hydralmania falcata* (Linnaeus, 1758), *Sertularia mirabilis* (Verrill, 1873) and *Tubularia (Ectopleura) larynx* (Ellis, Solander, 1786). To study the ecology and population structure of associated animals, 80 colonies of hydroids *T. larynx* of various sizes were collected. Collection was held with regularity 2 times a week; about 5-10 colonies were collected at each sampling. Hydroids were collected underwater with the help of SCUBA equipment. Underwater hydroid colonies were carefully separated from the substrate and placed in sealed plastic bags, eliminating the loss of symbionts. Flushing of symbionts from hydroids was carried out in the laboratory through a net with a diameter of a screen of 70 μm with a 5-10% solution of ethanol. Further, the collected animals and colonies were fixed in a 70% solution of ethanol.
Processing of material was carried out at the Laboratory of Ecology and Morphology of Marine Invertebrates of the A.N. Severtsov Institute of Ecology and Evolution of RAS, Moscow. The symbiotic assemblage from each colony was viewed under the binocular microscope; fixed animals were sorted into groups. The amphipod species identification was carried out according to Guryanova (1951). For statistical studies of population characteristics, individuals collected during one season at one point were taken. All specimens of amphipods were identified to the species level. The results of the analysis of symbiotic assemblage of individual colonies of *Tubullaria larynx* were recorded in tables showing the number of males, females, juveniles and their size. The size of the crustaceans was measured from the tip of the rostrum and to the last urosome segment. The sex was determined by the presence or absence of a marsupial bag (available in females only), as well as the structure of the gnathopod II and the length of antenna II. The number of eggs and the expected stage of their development were indicated in females with eggs in marsupium. Semi-permanent glycerol preparations of limbs were prepared for the species identification and then studied under Olympus Bx41 microscope. Worms, mollusks and other organisms found on hydroid colonies were also identified and weighed to determine their biomass. Data on the weight of the size and species composition were recorded in the tables.

Results

Various sublittoral hydroids were collected in order to reveal the specificity of the associated amphipods. Representatives of the family Stenothoidae were found in samples with the colonies of hydroids *G. loveni, H. falcata, S. mirabilis* and *T. larynx* (see Table 1). Also other amphipods, namely *Amphithoe rubricata* (Montagu, 1808), *Ischyrocerus* cf. *enigmatus* (Gurjanova, 1934), *Crassicorophium bonelli* (Milne-Edwards, 1830), *Sympleustes glaber* (Boeck, 1861), *Pleustes panoplus* ssp. *tuberculatus* (Bate, 1858), *Eurystheus melanops* (G. Sars, 1882), *Dulichia bispina* (Gurjanova, 1930), *Dulichia porrecta* (Bate, 1857), *Socarnes vahli* (Krøyer, 1838) and caprellids *Caprella septentrionalis* (Krøyer, 1838), were found in our samples. All these species were also found separately from hydroids on sublittoral algae and the fucales (fucoids) in the littoral zone.

Specificity of collected amphipods

Caprella septentrionalis (Krøyer, 1838) (Caprellidae) lead a sedentary lifestyle and live on various substrates to which they are attached by means of specially adapted pereiopods V–VI. These amphipods specialize in catching detritus particles from the water column with the help of antennas I-II and gnathopod I densely covered with bristles and setose setae (Geptner, 1963).
Crassicorophium bonelli (Milne-Edwards, 1830) (Corophiidae) and *Ischyrocerus cf. enigmaticus* (Gurjanova, 1934) are sedentary animals building muddy tubes on bottom. They create water currents through the tube with the help of pleopods and gnathopods armed with fan-shaped bristles catching detritus particles suspended in water (Gurjanova, E.F., 1951). Their records in the samples can be explained by the fact that when collecting material the colonies were placed in a package together with the surrounding substratum.
Ampithoe rubricata (Montagu, 1818) (Amphitoidae) is one of the most abundant sublittoral species of amphipods in the White Sea. The species is found in large numbers on the rhizoids of *Laminaria* algae. The diet of A. rubricata includes remains of plant and animal origin (Skutch, 1926).

Sympleustes glaber (Boek, 1861) (Pleustidae), similar to *A. rubricata*, is an abundant sublittoral species exclusively inhabiting the zone of algae (Gulliksen, 1978). The species was found in almost all samples with colonies *T. larynx* and other hydroids studied, except *D. pumila*. It should also be noted that only juvenile specimens were found in our samples.
Pleustes panoplus ssp. *tuberculatus* (Bate, 1858) (Pleustidae) is a sublittoral amphipod species found in crimson clusters and bottom fouling communities in the White Sea. Similar to above species, was found only once in the sample from the colony of *T. larynx*.
Eurystheus melanops (G. Sars, 1882) (Isaeidae) is the White Sea sublittoral species found at depths of 10 to 90 meters. There is no literary data about the lifestyle of the species.

Table 1. The fauna associated with the sublittoral hydroids of the White Sea (only hydroids where stenothoid amphipods were found)

Hydroid host	Number of collected colonies	Symbiotic species	Number of specimens of symbionts
Gonothyraea loveni	8	*Amphithoe rubricata*	91
		Caprella septentrionalis	24
		Eurystheus melanops	2
		Ischirocerus cf. enigmatus	5
		Metopa alderi	**12**
		Sympleustes glaber	9
		Chironomus f.l. solenarius	12
		Nymphon cf. longitarse	13
Obelia longissima	9	***Metopa alderi***	**25**
		Ischirocerus cf. enigmatus	19
		Sympleustes glaber	25
		Chironomus f.l. solenarius	40
		Nymphon cf. longitarse	7
Hydralmania falcata	7	*Caprella septentrionalis*	49
		Corophium bonelli	25
		Eurystheus melanops	10
		Ischirocerus cf. enigmatus	12
		Sympleustes glaber	97
		Metopa alderi	**49**
		Isopoda gen et sp.	6
		Dendronotus frondosus	12
Tubularia larinx	44	*Amphithoe rubricata*	1
		Caprella septentrionalis	4
		Corophium bonelli	358
		Dulichia bispina	60
		Dulichia porecta	29
		Eurystheus melanops	83
		Ishirocerus cf.enigmatus	130
		Metopa alderi	**1215**
		Pleustes panoplus	1
		Socarnes vahli	1
		Sympleustes glaber	846
		Mytilis edulis	1142
		Coryphella verrucosa	44
		Dendronotus frondosus	79
		Amphitrite figulus	37

		Lepidonotus squamatus	79
		Pista maculata	5
		Phillodoce maculata	29
		Pterosyllis finmarchica	71
		Nematoda gen et sp.	156
		Nymphon longitarse	8
		Phoxichilidium femoratum	47
Sertularia mirabilis	7	*Caprella septentrionalis*	15
		Corophium bonelli	25
		Eurystheus melanops	5
		Ischirocerus cf. enigmatus	12
		Metopa alderi	**34**
		Sympleustes glaber	57
		Coryphella verrucosa	5
		Mytilis edulis	19
		Lepidonotus squamatus	8
		Nymphon longitarse	4

Dulichia bispina (Gurjanova, 1930) and *Dulichia porrecta* (Bate, 1857) (Dulichiidae) are benthic amphipods that build sticks of silt particles glued together by a special substance secreted by these crustacean (e.g. Mattson & Cedhagen, 1989.). These species form quite large colonies in the sublittoral of the White Sea at depths of 10–25 meters. The species catch the detritus passing into plankton, using antennas I–II, which are armed with long and strong bristles and setose setae. Amphipods *D. bispina* and *D. porrecta* build their constructions on the terminal branches of colonial hydroids quite often explaining their finding in our samples.

Socarnes vahli (Krøyer, 1838) (Lysianassidae) is an arctic-boreal shallow water species found on silty substrates and in the area of the red algae in the White Sea (Guryanova, 1951). The species was found only once (one female) in the sample from the colony of *T. larynx*.

Metopa alderi (Spence Bate, 1857) (Stenothoidae) is a sublittoral species living at depths of 5–25 meters on various hydroids of the White Sea. It has previously been reported only as free living and never before as a symbiont (Lincoln, 1979; Dauvin, 1999; after Tandberg et al., 2010). At the same time, the species was found on almost all of the studied sublittoral hydroids in relatively large number of specimens, except hydroids *C. multicornis* and *D. pumilla*. However, the most numerous clusters of the species represented by adult males, females and juveniles of different ages were observed on *T. larynx, S. mirabilis* and *H. falcata*. In our samples from colonies of *G. loveni* and *O. longissima*, these amphipods were also found, but they were presented by young and immature females only. According to the data obtained after the analysis of samples, the population of the species from mid-June to mid-August is represented by juvenile specimens of different ages and sexually mature females with eggs at different stages of their development. Males appear in samples only at the end of August and are presented at September catching in plankton during the night. The species has been never observed on other substrates than hydroids.

Observations on the behavior of *Metopa alderi* (Bate, 1857) on hydroid hosts.

During the observations in aquarium and *in situ* it was indicated that each separate hydrant is occupied by adult female attaching to the stalk with the help of thoracic appendages IV–VII, while gnathopods I–II are directed forward and most likely participate in the food collection.

Most of observed time females were sitting on the top of the hydrant, crawling on hypostomal polyp periodically and moving up and down along the perisarc (stalk) of the hydrant. When any large object was flowing into the water near the colony, amphipods crawled to the base of the colony. Periodically the amphipods folded and cleaned something from their pleopods using gnatopods that, we suppose, should be considered as a forming of "food lump". The contents of the "lump" were examined under a microscope showed that it is usually consist of diatoms, plankton algae and transparent mucus, which can be the mucus of hydroids.

A sometimes females of *M. alderi* were observed to swim from one hydrant to another, sometimes, occupied by another individual. After meeting each individuals felt the opponent with antennas, and then tried to drive the invader from the hydrant pushing it with gnathopods. The winner of such competition returned to normal activity. Females show no negative reaction to juveniles or males presenting on the same hydrants, and normally co-existed during all time of observations. The males during the observations led a more active lifestyle moving inside the colony of hydroids *T. larynx* between hydrants and migrating to neighboring colonies. During the meeting with females, males swam away, not trying to compete for the hydrant in any way. Probably, growing bigger than 2 mm in size, juveniles probably move to an independent way of life, and occupy separate hydrants. Unfortunately, the age of transition to an independent (territorial) way of life was not determined during our observation.

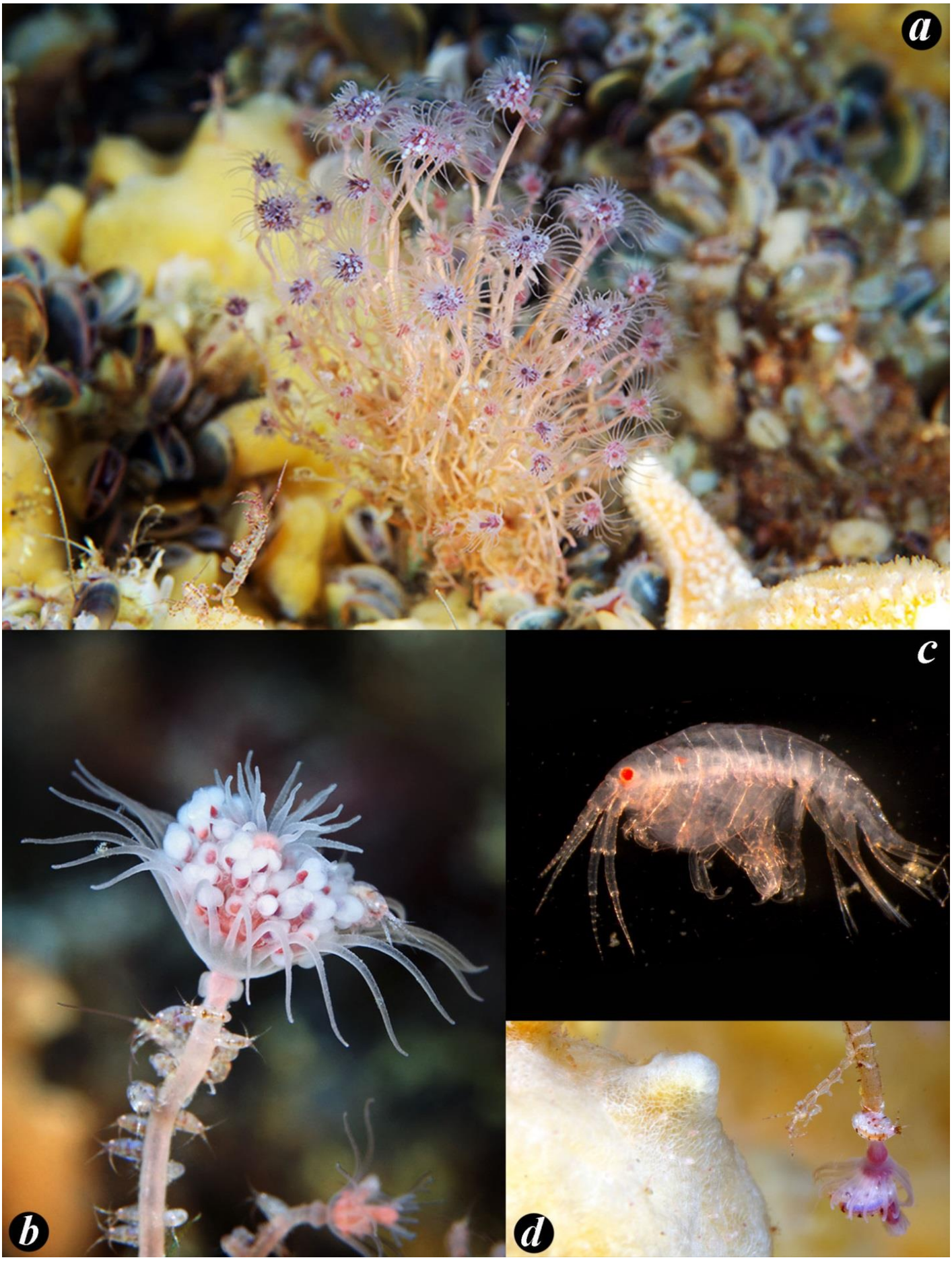

Fig. 1. *a* – colony of sublittoral hydroid *Tubularia larynx* in the Kandalaksha Bay of the White Sea; *b, d* – separate hydrant of T. larynx occupied by specimens of *M. alderi*; *c* – general view of *M. alderi*

Conclusions

1. Eleven species of amphipods were found on the sublittoral hydroids in the Kandalaksha Bay of the White Sea: *Metopa alderi* (Bate, 1857), *Sympleustes glaber* (Boeck, 1861), *Pleustes panoplus* ssp. *tuberculatus* (Bate, 1858), *Ishyrocerus* cf. *enigmatus* (Gurjanova, 1934), *Eurystheus melanops* (G. Sars, 1882), *Crassicorophium bonelli* (Milne-Edwards, 1830), *Dulichia bispina* (Gurjanova, 1930), *Dulichia porrecta* (Bate, 1857), *Socarnes vahli* (Krøyer, 1838), *Amphithoe rubricata* (Montagu, 1808), *Caprella septentrionalis* (Krøyer, 1838).
2. Among them only *M. alderi* (Bate, 1857) could be considered as a specific symbiont for 3 species of sublittoral hydroid, namely *H. falcate, S. mirabilis* and *T. larynx*. Representatives of the genus *Metopa* Boeck, 1871 are specialized on symbiosis with colonial coelenterates (e.g. Krapp-Schickel & Vader, 2015) and bivalve mollusks (Tandberg et al., 2010; Vader & Beehler, 1983). *Metopa alderi* is a subarctic species distributed along the coast of Europe, from the Southwest. Iceland and Boguslena to the Kara Gates and Ugra Ball, in the White Sea, the Barents Sea, near Spitsbergen and east to Greenland and the Kara Sea (Lincoln, 1979; Dauvin, 1999). In the White Sea, this species occurs on various sublittoral colonial hydroids, but mostly on hydroids *T. larynx* as it was observed in the Kandalaksha Bay. Our specimens were collected on hydroids, inhabiting biotopes characterized by strong currents. Based on the literature data, as well as on our own observations, we can conclude that *M. alderi* is a specialized symbiont of the White Sea sublittoral hydroids.
3. Adult individuals of *M. alderi* prefers to live on sublittoral *T. larynx* while juvenile specimens can be found on *L. flexuosa* and *G. loveni*, which probably indicates that adult individuals are able to expel juveniles from the main host.
4. On *T. larynx*, each individual hydrant of the colony is occupied by one mature female that protect the territory, while males are moving between hydrants showing the absence of any strict territoriality.
5. Stenothoid *M. alderi* specifically associated with the habitat on the hydroids polyps allowing feed both on tissues of polyp/hydrant and catching floating particles.

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References

Barnard, J.L., Karaman, G.S. (1991). The families and genera of marine gammaridean Amphipoda (except marine gammaroids). Records of the Australian Museum, Supplement, 13, 1–866.
Dauvin, J.–C. (1999). Mise a`jour de la liste des espe`ces d'Amphipodes (Crustace´s Pe´racarides) pre´sents en Manche. Cahiers de Biologie Marine, 40, 165–183.
Edgar, G.J. (1983). The ecology of south-eastern Tasmanian phytal animal communities. IV. Factors affecting the distribution of amphithoid amphipods among algae. Journal of Experimental Marine Biology and Ecology, 70, 205–225.
Geptner, M.V. (1963). Reproduction biology and life cycle of *Caprella septentrionalis* Krøyer (Amphipoda, Caprellidae) in the White Sea. Zoologicheskii Zhurnal, 42, 1619–1630 [in Russian].
Gulliksen, B. (1978). Rocky bottom fauna in a submarine gulley at Loppkalven, Finnmark, Northern Norway. Estuarine and Coastal Marine Science, 7(4), 361–372.
Gurjanova, E.F. (1951). Amphipods of the seas of the USSR and surrounding waters (Amphipoda-Gammaridea). Opredeliteli po Faune SSSR, 41, 1–1029 (in Russian).
Krapp-Schickel, T. (1993). Family Stenothoidae. In: Ruffo, S. (ed.): The Amphipoda of the Mediterranean. Part 3. Memoires de l'Institut oceanographique. Monaco, 13, 692–709.
Krapp-Schickel, T., Koenemann, S. (2006). Cladistic analysis of the family Stenothoidae (Amphipoda, Crustacea). Contributions to Zoology, 75(3/4), 169–188.
Krapp-Schickel, T., Vader, W. (2015). Stenothoids living with or on other animals (Crustacea, Amphipoda). Zoosystematics & Evolution, 91(2), 215–246.
Lincoln, R.J. (1979) British marine Amphipoda: Gammaridea. London: British Museum (Natural History)
Marin, I., Sinelnikov, S. (2012). *Metopelloides paguri* sp. nov., a new species of symbiotic stenothoid amphipod (Crustacea: Amphipoda: Stenothoidae) associated with sublittoral hermit crabs in the Sea of Japan. Zootaxa, 3244, 59–67.
Marin, I.N., Sinelnikov, S.Yu. (2016). Diversity and ecological features of symbiotic communities associated with large hermit crabs along the southern part of the Russian coast of the Sea of Japan. Arthropoda Selecta, 25(2), 171–182.
Marin, I., Sinelnikov, S. (in press) Two new species of amphipod genus Stenothoe Dana, 1852 (Stenothoidae) associated with fouling assemblages from Nhatrang Bay, Vietnam. Zootaxa.
Marin, I., Sinelnikov, S., Sokolova, A. (2013). Ecological remarks and re-description of the hermit crab-associated pleustid amphipod *Pleusymtes japonica* (Gurjanova, 1938) (Crustacea: Amphipoda: Pleustidae: Pleusymtinae) from the Sea of Japan. Zootaxa, 3640(4), 581–588.

Mattson, S., Cedhagen, T. (1989). Aspects of the behavior and ecology *of Dyopedos monacanthus* (Metzger) and *D. porrectus* Bate, with comparative notes on *Dulichia tuberculata* Boeck (Crustacea: Amphipoda: Podoceridae). Journal of Experimental Marine Biology and Ecology, 127, 253–272.

McGrath, D. (1978). *Stenula latipes* (Chevreux and Fage) (Crustacea: Amphipoda), associated with the hermit crab *Pagurus bernhardus* (L.), new to the Irish fauna. Irish Naturalists' Journal, 19, 196–197.

Skutch, A.F. (1926). On the Habits and Ecology of the Tube-Building Amphipod *Amphithoe rubricata* (Montagu). Ecology, 7(4), 481–502.

Tandberg, A.H.S., Schander, C., Pleijel, F. (2010). First record of the association between the amphipod *Metopa alderii* and the bivalve *Musculus*. Marine Biodiversity Records, (2010), 3, e5.

Vader, W. (1972). Associations between amphipods and mollusks. A review of published records, Sarsia, 48, 13–18.

Vader, W., Tandberg, A.H.S. (2013). A survey of amphipods associated with mollusks. Crustaceana, 86(7–8), 1038–1049.

Vader, W., Tandberg, A.H.S. (2015). Amphipods as associates of other Crustacea: a survey. Journal of Crustacean Biology, 35(4), 522–532.

Vader, W., Beehler, C.S. (1983) *Metopa glacialis* (Amphipoda, Stenothoidae) in the Barents and Beaufort Seas, and its association with the lamellibranchs *Musculus niger* and *M. discors*. l. Astarte, 12 (1979), 57–61.

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