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MEIOBENTHIC FAUNA (WITHOUT HARPACTICOIDA) IN THE SOUTHERN PART OF GULF OF TRIESTE, SLOVENIA: LIST OF TAXA

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ABSTRACT

The article presents an integral systematic review of meiobenthic fauna (without the already presented Copepoda Harpacticoida), arranged on the basis of extensive material gathered in the course of numerous investigations during the last 30 years in the southern part of the Gulf of Trieste. The emphasis is on a systematic survey, which includes a total of 30 higher taxa with nearly 180 species, although still a minor part of all expected but undiscovered species of the area.

Key words: meiofauna, list of taxa, Gulf of Trieste, Slovenia

FAUNA MEIOBENTONICA (ESCLUSI GLI ARPACTICOIDI) DELLA PARTE MERIDIONALE DEL GOLFO DI TRIESTE, SLOVENIA: LISTA DEI TAXA

SINTESI

L'articolo presenta una revisione sistematica integrale della fauna meio bentonica (esclusi i copepodi arpacticoidi già presentati), preparata in base al vasto materiale raccolto durante le numerose ricerche effettuate negli ultimi 30 anni nella parte meridionale del Golfo di Trieste. Posta in rilievo l'indagine sistematica che include 30 taxa superiori con quasi 180 specie, benché queste rappresentino solo una piccola parte di tutte le specie attese ma ancora sconosciute dell'area.

Parole chiave: meiofauna, lista dei taxa, Golfo di Trieste, Slovenia

INTRODUCTION

The paper presents meiofauna of the southern part of Gulf of Trieste, Copepoda excluded. The present work is a continuation of the survey of meiobenthos in the Slovene sea (initiated several years ago), with an emphasis on its species structure and spatial distribution. In the first two articles (Vrišer, 2000a, b), the systematics and ecology of harpacticoid copepods (Copepoda, Harpacticoida) as one of the most dominant groups were presented, while the aim of this paper is to outline the taxonomic structure of the remaining meiofauna.

Meiobenthos of the southern part of Gulf of Trieste has so far not been researched at such level as already mentioned harpacticoid copepods. The extent of more complete taxonomic determinations is here incomparably poorer. Amongst the causes for such state of affairs we must highlight, apart from a truly exceptional bulk of the material itself, mainly the following very specific and excusable reasons:

1. in many groups, particularly in those that are sparse or with more delicate body structure, taxonomic study would require some very special and to them adapted sampling techniques and substantially greater number of parallel samples, as well as often repeated seasonal sampling;

2. even today, many groups remain poorly researched, with insufficient, outdated or hardly accessible literature;

3. lack of suitable specialists or taxonomic consultants;

4. predominantly juvenile character of several groups (temporary meiofauna, i.e. juvenile stages of the future macrofauna), which greatly aggravates precise identification of species;

5. damaged body structures of the more delicate, especially "worm-like" groups owing to the use of routine methods of fauna extraction from the substrate, which are more or less unsuitable for these particular groups;

6. incompatibility of the necessary (stated) specific methodological approaches with simultaneous demands of general ecological studies of the great spatial or temporal frequency span.

In spite of it all, a fairly clear structural and ecological picture has crystallised from the research lasting for more than thirty years, which in many groups reached a notable degree of a systematic rounding up. The research into some methodologically exceptionally demanding taxa unfortunately remained at its initial stage (e.g. Nemertinea, Nematoda, Oligochaeta, if mentioning only the most abundant ones) and is still waiting to be continued.

We believe that in spite of the above-mentioned gaps, fauna other than copepod, too, would deserve its first presentation of a clearer although for the time being still unavoidably preliminary systematic survey.

MATERIAL AND METHODS

Most of our samplings were implemented with gravity core sampler (Meischner & Rumohr, 1974); only in lagoonar conditions they were also carried out manually, always with three parallel samples in the surface sediment of 10 cm², 5-10 cm deep. Meiofauna was extracted with the sieving-decantation technique according to Wieser (1960) on 1 mm, 0.125 mm, and 0.050 mm sieves, preserved (4% formalin with seawater), sorted out, counted and, if at all possible, identified to its species.

Only a minor part of the meiofauna groups was taxonomically analysed by specialists: Foraminifera (Franc Cimerman, Slovenian Museum of Natural History, Ljubljana), Polychaeta (Andrej Avčin, Marine Biology Station Piran, National Institute of Biology, Ljubljana), Tanaidacea (Dušan Zavodnik, Centre for Marine Research, Rudjer Bošković Institute, Rovinj), Insecta (Ignac Sivec, Slovenian Museum of Natural History, Ljubljana), Bryozoa (Brian M. Marcotte, Clark University, Worcester, USA).

For taxonomic determination, authentication and classification of all remaining groups stated in brackets below, the author used the following important references:

Bartsch & Iliffe, 1985 (Acarina); Bonaduce *et al.*, 1975 (Ostracoda); Bouillon & Grohmann, 1990 (Hydrozoa); Chevreux & Fage, 1925 (Amphipoda); De Min & Vio, 1997 (Gastropoda, Bivalvia); Gruner, 1965 (Isopoda); Higgins, 1977 (Kinorhyncha); Hulings, 1971 (Hydrozoa, Kinorhyncha); Karaman, 1972, 1973, (Amphipoda); Klie, 1938 (Ostracoda); Nordsieck, 1968, 1972 (Gastropoda), 1969 (Bivalvia); Platt & Warwick, 1983, 1988 (Nematoda); Riedl, 1956 (Turbellaria), 1983 (Anthozoa, Cirripedia, Decapoda, Cumacea, Lepidostrea, Sipunculida, Chaetognatha, Holothurioidea, Asteroidea, Ophiuroidea, Echinoidea, Ascidiacea, Nemertinea); Rieger, 1971 (Turbellaria); Salvini-Plawen, 1966 (Hydrozoa); Sars, 1896 (Isopoda).

ECOLOGICAL CHARACTERISTICS
OF THE RESEARCHED ENVIRONMENT

The so far carried out research into the meiofauna of southern Gulf of Trieste has dealt with the entire depth span of these waters: from 0.3-5 m in coastal studies, to the samplings in the Gulf's open waters (19-30 m depth). Meiofauna of the four coastal sampling profiles (1-15 m) in the Bays of Koper, Strunjan and Piran was comparatively researched in the summer and winter months, while the meiofauna of deeper areas was studied only in the summer.

Thermic conditions of the entire area range from 9-21 °C, with average salinity of 37.5 psu, oxygen content in the span of 55-96% saturation, except in the very rare

periods of hypoxia crisis, when the values can fall below 40%.

With the exception of some marginal coastal localities (Koper and Piran Bays), which were at the time of sampling still under a great impact of organic pollution of urban origin, all the remaining meiofauna dealt with in this paper belonged to a clean and unburdened environment.

The substrate of the investigated area consists of clayey silt (10-20% clay), which along the coast gradually turns into silty clays (up to 25% of clay) and, towards the open sea, into fine sands (Ogorelec *et al.*, 1991).

TAXONOMIC EXTENT OF RESEARCH INTO THE MEIOFAUNA OF SOUTHERN GULF OF TRIESTE

Taxonomic structure of meiofauna of the selected research area has in fact never been studied purposely (with the exception of harpacticoid copepods), at least not exclusively with this aim, for the emphasis was largely on the ecological complexities and typology of its associations. Although subordinate, it still was a component part of these investigations, whose selection, arranged according to the thematic criterion, is here presented only in a condensed form.

In Slovenia, the first ecological meiobenthic research was initiated by Marcotte & Coull (1974) on the coastal profile of Piran Bay. This research was followed by the author's investigations in the experimental basins of Strunjan (Vrišer, 1979, 1982), on the coastal profiles of the Bays of Koper, Strunjan and Piran (Vrišer, 1983-84, 1986), in the open waters of Gulf of Trieste (Vrišer, 1989, 1991, 1992), in the Bays of Strunjan and Izola (Vrišer, 1999, 2001), and in coastal lagoons (Vrišer, 2002).

At first, *i.e.* until the mid-1980s, the investigations were still directed at utterly ecological objectives, dealing primarily with the impacts of pollution on the meiofauna's associations. Nonetheless, these works contributed most of the taxonomic data presented herewith. To a smaller extent they were supplemented by the long-term studies of seasonal dynamics and meiofauna's long-term oscillations in the centre of Gulf of Trieste (Vrišer, 1996, 1997; Vrišer & Vukovič, 1999), as well as of its recolonisation characteristics (Vrišer, 1998; Vrišer & Vukovič, 2000).

There are unfortunately no other studies that would have contributed to a clearer picture of the systematic structure of the meiofauna in the southern part of Gulf of Trieste, but let us mention numerous investigations of separate groups of this fauna on at least three sites in the immediate vicinity of our waters, which are due to their closeness of a considerable significance for as well.

The first such site is situated close to Trieste (Italy): it is in fact the site of the former marine biology station,

where the first meiobenthic determinations were made in the early 20th century – *e.g.* Grünspan (1908) with the group Gastrotricha.

The second such site is the area around Rovinj (Croatia), where numerous investigations were made in the 1950s and 1960s by a number of taxonomists, such as Riedl (1956) (group Turbellaria), Sterrer (1965, 1967) (group Gnathostomulida), Schrom (1966a) (group Gastrotricha) and Salvini-Plawen (1966, 1968) (groups Cnidaria, Kamptozoa, Aculifera).

The third interesting site is the area around Venice, where much research was carried out by Schrom (1966b, c), Hummon *et al.* (1990) and Evans *et al.* (1993), all concentrating on the group Gastrotricha, and by Rieger (1971) (group Turbellaria).

Here follows a survey of all 31 registered higher taxa of the researched meiofauna, arranged in systematic succession (Riedl, 1983). Only some of the groups and species from the list are planktonic, all the rest being benthic.

For each group, an approximate estimate of their **occurrence** in our sea is stated, *i.e.* their quantitative representativeness (% relative abundance within total meiofauna, hereinafter referred to as *rel. ab.*) and an estimate of their systematic covering, *i.e.* of the suppositional and actually established **number of species** in the area researched. All estimates about the probable number of species stated in further text thus refer exclusively to meiofauna. For within the same groups the number of macrobenthic species can be here and there not only higher but also lower than in the meiofauna, *i.e.* by spatially variable share (number of species) of that particular meiofauna's component, which in contrast to the juvenile macrofauna does not surpass, not even in the adult stage, the size of 1mm (permanent meiofauna). However, the precise number of these species in the majority of dominant groups of our meiofauna is still not known.

FORAMINIFERA

Foraminifera, which are no doubt part of meiofauna, are by most meiofaunists omitted from their research for methodological reasons. Namely, with the standard methods of colouring, suitable for the remaining fauna, it is not possible to distinguish between live and dead foraminiferous individuals. Foraminifera can thus be subject of only specialised sampling techniques, extraction, colouring, separation and particularly identification.

Occurrence: massive. If taken into account, foraminifera would be one of the first three dominant groups of meiofauna. **Number of species:** no actual data at hand. All 13 determined species from our list are from the Strunjan lagoon.

HYDROZOA

Occurrence: rare, more common only here and there, generally below 0.1% rel. ab. **Number of species:** unknown, perhaps up to 10 species. 5 species determined partially.

ANTHOZOA

Occurrence: only a few fragments of juvenile individuals were registered, presumably from the group of Anthipatharia. **Number of species:** unknown.

TURBELLARIA

Occurrence: mass group in most samples, 1% rel. ab. **Number of species:** presumably up to 50, almost all of them permanently meiobenthic. 7 species determined partially.

NEMERTINEA

Occurrence: rare, below 0.2% rel. ab. **Number of species:** unknown, no determinations.

NEMATODA

Occurrence: most abundant, dominant group (70% rel. ab.) throughout in all samples! **Number of species:** unknown, possibly up to 100, almost exclusively permanent meiobenthic species. Only 4 less common species determined.

KINORHYNCHA

Occurrence: common group, 0.25% rel. ab. **Number of species:** about 10 species of permanent meiofauna, 8 partial determinations.

POLYCHAETA

Occurrence: third most abundant group (8% rel. ab.). **Number of species:** unknown, perhaps up to 100 species, to a great extent of temporary character (juvenile macrofauna), 38 species registered and in most cases determined.

OLIGOCHAETA

Occurrence: very abundant group (2% rel. ab.). **Number of species:** unknown, perhaps few dozen species. No species determined.

OSTRACODA

Occurrence: common group, mostly with low abun-

dances (0.25% rel. ab.). **Number of species:** unknown, perhaps over 50 species. 16 species registered and partially determined in our samples.

CIRRIPIEDIA

Only two coincidentally caught juvenile individuals.

DECAPODA

Occurrence: rare, generally below 0.1% rel. ab. **Number of species:** perhaps up to 20 species, 10 more common species partially identified.

AMPHIPODA

Occurrence: modest, in places somewhat more common, generally below 0.1% rel. ab. **Number of species:** perhaps up to 30 species, 14 more common species partially identified.

ISOPODA

Occurrence: rare individuals, generally below 0.1% rel. ab. **Number of species:** unknown, 13 species partially determined.

MYSIDACEA

Occurrence: rare, mostly occurring individually, altogether below 0.1% rel. ab. **Number of species:** unknown, 4 species partially identified.

CUMACEA

Occurrence: rare, mostly occurring individually, altogether below 0.1% rel. ab. **Number of species:** perhaps above 10 species, 4 only partially determined.

TANAIDACEA

Occurrence: rare, mostly occurring individually, generally below 0.1% rel. ab. **Number of species:** 4, with 3 of them identified.

LEPTOSTRACA

A single identified individual.

ACARINA

Occurrence: rare, mostly occurring individually, generally below 0.1% rel. ab. **Number of species:** perhaps up to 10 species, with 4 of them identified only partially.

INSECTA

Some rare and in only at two localities found dipteran larvae (family Chironomidae) of unknown number of species.

SIPUNCULIDA

A single and only partially determined individual.

GASTROPODA

Occurrence: common, although not massive, usually with a few individuals per sample. Altogether 0.30% rel. ab. **Number of species:** unknown, possibly over 100 species. Only 10 species partially identified.

BIVALVIA

Occurrence: massive, even with a few dozen individuals per sample. Altogether 0.25% rel. ab. **Number of species:** unknown, possibly over 100 species, with only 9 partially determined.

BRYOZOA

Some rare individuals, 1 partially identified species.

CHAETOGNATHA

Two coincidentally caught planktonic individuals of the same species.

HOLOTHURIOIDEA

Some rare juvenile individuals, 3 partially identified species.

ASTEROIDEA

Some rare juvenile individuals, 1 identified species.

OPHIUROIDEA

Occurrence: all over the research area. Individual juveniles, only 1 species determined.

ECHINOIDEA

Some rare individual larvae of unknown number of species.

ASCIDIACEA

Some rare larvae.

At the end of taxonomic survey of our meiofauna, a question might be raised, where to place, in view of its species diversity, the area researched, if looking at potentially similar parts of the near and far neighbourhood. No comparable surveys can unfortunately be traced, while any serious diversity evaluation of our data is rendered very difficult by at this moment still highly inadequate systematic extent of research into the dominant, abundant and species-rich groups, such as Nematoda, Oligochaeta, Nemertinea, Polychaeta, Gastropoda and Bivalvia. Much work is thus still waiting for the future taxonomists, for the species determinations carried so far have probably reached less than a third of their presumed total number.

In spite of the stated taxonomic gaps, we could venture a judgment – on the very basis of the existing facts – that along with harpacticoid copepods (130 species) the fauna presented in this paper (180 species) also significantly contributes to the high diversity of our coastal waters.

LIST OF SPECIES

With the exception of harpacticoid copepods, the list presents all till now registered taxonomic groups of meiofauna in the area researched. They are arranged according to the already mentioned system, i.e. in compliance with the available degree of their systematic analysis. This, however, can be only at the level of the higher taxa (e.g. ordo, classis, subclassis, familia), or it is determined down to the level of genus and species. The different species within the same taxon are either indicated as undetermined number of species (spp.) or are differentiated and numbered (genus sp. 1, sp. 2, etc.). Complete species determinations were given where at all possible.

FORAMINIFERA

Ammonia beccarii (L.) - smooth
Ammonia beccarii (L.) – ornamented
Ammonia sp. 1
Cibicides lobatulus sp. 1
Eggerella advena Cushman
Elphidium crispum (L.)
Elphidium sp. 1
Milammina sp. 1
Quinqueloculina sp. 1
Rosalina globularis d'Orbigny
Sigmoilina cf. costata Schlumberger
Trifarina angulosa d'Orbigny
Trochammina inflata (Montagu)

HYDROZOA

Siphonohydra sp. 1
Halammohydra sp. 1

Halammohydra sp. 2*Pinushydra* sp. 1*Psammohydra* sp. 1

ANTHOZOA

Anthipatharia gen. spp.

TURBELLARIA

Allostoma sp. 1*Convoluta convoluta* Abild*Nemertoderma* spp.*Diopisthoporus* spp.*Mecynostomum* spp.*Paraphanostoma* spp.*Plagiostomum* sp. 1

NEMERTINEA

Heteronemertini gen. spp.*Hoplonemertini* gen. spp.

NEMATODA

Cyatholaimus sp. 1*Desmoscolex* sp. 1*Enoplus* sp. 1*Euchromadora striata* (Eberth)

KINORHYNCHA

Echinoderes sp. 1*Echinoderes* sp. 2*Neocentrophyes* sp. 1*Pycnophyes* sp. 1*Pycnophyes* sp. 2*Pycnophyes* sp. 3*Trachydemus* sp. 1*Trachydemus* sp. 2

POLYCHAETA

Aonides oxycephala (Sars)*Aricidea* spp.*Brada villosa* (Rathke)*Capitella capitata* (Fabricius)*Capitellidae* gen. spp.*Cirratulus filiformis* (Keferstein)*Cossura soyeri* Laubier*Dorvillea* sp. 1*Euclymene palermitana* (Grube)*Eunice vittata* (delle Chiaje)*Hesionidae* gen. spp.*Hyalinoecia brementi* Fauvel*Lumbrineris gracilis* (Ehlers)*Lumbrineris* spp.*Magelona* sp. 1*Maldane glebifex* Grube*Micronephrys* sp. 1*Nereidae* gen. sp. 1*Nereidae* gen. sp. 2*Notomastus* sp. 1*Notomastus* sp. 2*Onuphis* sp. 1*Owenia fusiformis* delle Chiaje*Paraonis lyra* Southern*Proxillella* sp. 1*Proxillella* sp. 2*Proxillella* sp. 3*Prionospio cirrifera* Wiren*Prionospio malmgreni* Claparede*Sabellidae* gen. spp.*Scolecopsis fuliginosa* (Claparede)*Sphaerosyllis* sp. 1*Spionidae* gen. spp.*Spirorbinae* gen. spp.*Syllidae* gen. sp. 1*Syllidae* gen. sp. 2*Syllidae* gen. sp. 3*Terebellides stroemi* Sars

OLIGOCHAETA

Enhydraeidae gen. spp.

OSTRACODA

Callistocythere adriatica Masoli*Callistocythere* sp. 1*Callistocythere* sp. 2*Costa edwardsi* (Roemer)*Costa batei* (Brady)*Cythere antiquata* Baird*Cytheretta adriatica* Ruggeri*Cytheridea neapolitana* Kolmann*Hiltermannicythere turbida* (G.W.Müller)*Loxoconcha* sp. 1*Loxoconcha* sp. 2*Neocytherideis* sp. 1*Neocytherideis* sp. 2*Pterygocythereis jonesi* (Baird)*Semicytherura* sp. 1*Semicytherura* sp. 2

CIRRIPEDIA

Chthamalus sp. 1

DECAPODA

Callinassa stebbingi Borra

Carcinus sp. 1
Crangon sp. 1
Ethusa mascaroni Herbst
Galathea sp. 1
Hippolyte sp. 1
Macropodia longirostris (Fabricius)
Palaemon sp. 1
Processa canaliculata (Leach)
Sicyonia sp. 1

AMPHIPODA

Ampelisca typica (Bate)
Ampelisca spinnipes Boeck
Ampelisca sp. 1
Ampelisca sp. 2
Caprella sp. 1
Dexamine sp. 1
Gammarus locusta (L.)
Gammarus sp. 1
Gammarus sp. 2
Lepideopcreum sp. 1
Lysianassa sp. 1
Leucothoe sp. 1
Phisica marina Slabber
Pseudoprotella sp. 1

ISOPODA

Anilocra physodes (L.)
Arcturus sp. 1
Bopyrus squillarum Latr.
Cirolana borealis Lill.
Cyathura carinata (Kr.)
Cymodoce truncata (Mont.)
Dynamene sp. 1
Gnathia sp. 1
Idotea baltica (Pall.)
Ligia italica Fabr.
Limnoria sp. 1
Nerocilla sp. 1
Synisoma sp. 1

MYSIDACEA

Diamysis sp. 1
Mysis sp. 1
Siriella clausi G. Sars
Siriella sp. 1

CUMACEA

Cumella sp. 1
Diastylis sp. 1
Iphinoe sp. 1
Leucon mediterraneus Sars

TANAIDACEA

Apseudes latreillei (Milne Edw.)
Leptochelia savignyi (Kröyer)
Tanais cavolinii Milne Edw.

LEPTOSTRACA

Nebalia bipes Fabr.

ACARINA

Agauopsis brevipalpus Trousseart
Agauopsis sp. 1
Copidognathus sp. 1
Copidognathus sp. 2

INSECTA

Chironomidae gen. spp.

SIPUNCULIDA

Phascolosoma sp. 1

GASTROPODA

Bittium reticulatum Da Costa
Cerithium vulgatum Bruguiere
Conus sp. 1
Gibbula spp.
Haminea hydatis (L.)
Monodonta spp.
Nassa spp.
Opisthobranchia spp.
Polynices sp. 1
Rissoa spp.

BIVALVIA

Aloidis gibba (Olivi)
Cardioidea spp.
Chlamys sp. 1
Gastrana fragilis (L.)
Loripes lacteus (L.)
Macoma sp. 1
Nucula sulcata (Bronn)
Tellina pulchella Lamarck
Venerupis sp. 1

BRYOZOA

Aetidae gen. spp.
 Bicellardiidae gen. spp.
Monobryozoon gen. sp. 1