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Zoobenthos of Kaštela Bay - state and problems

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The data obtained by trawling (1972-1988) showed the zoobenthic biomass in the bay to be still high, no changes with respect to the biomass, having been recorded for the last two decades. As to the structure of biocoenosis of the coastal terrigeneous muds no serious changes have been observed, at least within about eighty macroforms which make up the bulk of the biomass.

The floor of the bay has been soiled from one year to another by the discard of man-fabricated materials released into the bay in the form of wastes, preventing a growing problem.

Individual bay parts are strongly affected by bottom currents, so that it may be assumed that those parts are well aerated.

Settlements of shellfishes Lithophaga lithophaga *and* Arca noae *are well developed in the area of Resnik (Kaštel Stari).*

Ecological balance in benthic settlements in the eastern part of the bay, near Grmovac point, Šilo rock and Kaštel Gomilica, has been disturbed by different types of pollution that have caused considerable changes and degradation of these settlements. However, the structure of surface biocoenoses of the Bene cove has been only sligthly changed, manifested as the presence of some nitrophilous species.

INTRODUCTION

The data published by GAMULIN-BRIDA *et al.* (1971); GAMULIN-BRIDA (1974); BASIOLI (1976); ZORE-ARMANDA *et al.* (1976) were used in this paper. We also made use of the data on trawling in the Kaštela Bay in 1972, 1974, 1976, 1987 and 1988; dredge and grab data from 1974 and 1988 along with the data on the state of shellfish *Lithophaga lithophaga* and *Arca noae* in the bay in 1986 and 1988. List of species collected by trawl is also enclosed.

MATERIALS AND METHODS

Material was collected from the Kaštela Bay.

Two methods were used for studies of benthic animal settlements: 1. Diving method, that is direct method of sampling and observation of qualitative-quantitative samples of benthic settlements: 2. Method of indirect sampling by Petersen grab, dredge and trawl.

Trawl was operated between 15 and 40 m at ship speed of 3.0 Nm/h. Trawling was performed in the directions from the line in the Bene cove towards Arbanasi or Slatine (Fig. 1). Transects were laid out in the eastern part of the Kaštela Bay. Dredge and grab were operated in the area around a submarine reef between Slatine and Arbanija (Fig. 1). *Lithophaga lithophaga* samplings were carried out at several locations in the bay, from square metre surfaces.

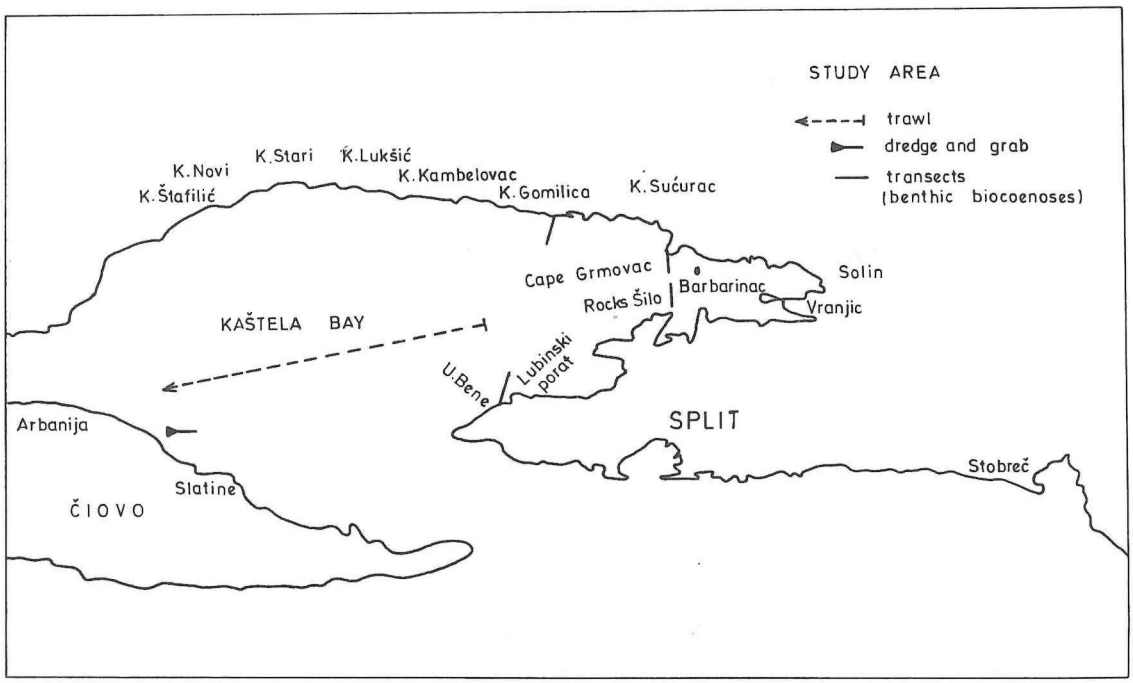

Fig. 1. Kaštela Bay

RESULTS AND DISCUSSION

a) Trawl (Fig. 1)

The paper by GAMULIN-BRIDA *et al.* (1971) covering the three year period (1968, 1969, 1970) deals, among the other benthic settlements and biocoenoses of coastal terrigeneous muds, with the facies of sedentary forms in the Kaštela Bay. According to these authors it occurs in typical association with characteristic and accompanying species. It was reported that larger quantities of poorly vagile and sedentary forms of zoobenthos are particularly well represented. These forms are characteristic and, at the same time, dominant of the recorded species: *Stichopus regalis* CUV. and *Alcyonium palmatum* PALL. along with the species of wider distribution *Holothuria tubulosa* GMEL. and *Holothuria forskali* DELE CHIAJE. The analysis of three year structure of biocoenosis showed the biomass of dominant avertebrata group, that is Porifera and Echinodermata, to be constant and the ratio between edible catch part in 1948/49 and that in 1970 to be lower than one, as distinct from that in 1968 and 1969. This points to the fact that the zoobenthos biomass in the bay is high.

The data obtained by trawling in 1972, 1974, 1976, 1987 and 1988 gave no reliable information of the state in the bay since they were not collected seasonally but from time to time. However, irrespective of the scarcity of data, it may be stated that the zoobenthos biomass is high and that no serious changes in biomass have occurred for the last two decades. As to the structure of biocoenosis of coastal terrigeneous muds in the Kaštela Bay, no significant changes have been recorded, at least not within about eighty macro forms (observed regularly) which make up the bulk of the biomass.

For the last decade the bay has been increasingly loaded with a large quantities of wastes. Much of this rubbish has its origin in packaging - beer and wine bottles, barrels, tins and boxes of different juices, plastic bags, as well as a number of large objects which impede normal operation of trawls.

b) Dredge and grab (Fig. 1)

The biocoenosis of coarse sands and tiny gravel developed at 15 m depth is affected by

bottom currents. Mollusca are represented by the largest number of species: *Piter rude* (POLI), *Venus verrucosa* L., *Cardium* sp., *Clausinella fasciata* (DACOSTA), *Modiolus barbatus* (L.), *Arca noae* L., *Pecten jacobaeus* L., *Laevicardium oblongum* (CHEMNITZ), *Archimediella triplicata* (BROCCHI), *Gourmya vulgata* (BRUG.), *Trophonopsis* sp., *Ocinebrina* sp., *Antalis* sp., Grab samples contained *Branchiostoma lenceolatum* (PALLAS), a species characteristic of this biocoenosis. Proceeding towards the area of muddy sands the presence of a large number of individuals of the species *Nucula nucleus* (L.) and *Corbula gibba* (OLIVI) was recorded. Of other groups the following species occurred: *Cladocora cespitosa* (L.), *Parthenope angulifrons* LATR., *Parthenope massena* ROUX, *Porella cervicornis* (PALL.) on the reff, *Holothuria tubulosa* GMELIN, *Cucumaria planci* (BRANDT), *Sphaerechinus granularis* LAM., *Astropecten aurantiacus* (L.), *Astropecten irregularis* (LINCK), *Psammechinus micro-tuberculatus* (BLAIN.), *Phallusia mammilata* (CUV.), *Microcosmus sulcatus* COQUEBERT. Polychaeta (Eranthia) occurred also in great numbers.

After GAMULIN-BRIDA (1974) the biocoenosis of coarse sands and tiny gravels is affected by bottom currents. It is developed in the area of rather strong bottom currents and known as the habitat of "Amphioxus". This author also reported its occurrence most frequently in the vicinity of marine phanerogams at clearings of non-overgrown sands, like for example in the Kaštela Bay. This points to the fact that individual smaller parts of the bay are affected by stronger bottom currents. So it may be assumed that these parts are also well aerated.

c) Settlements of shellfishes Lithophaga lithophaga *L. and* Arca noae *in the bay (Fig. 1)*

BASIOLI (1976) reported that a nursery of juvenile oysters was erected in the Vranjic cove in 1930 and that the western part of the bay was the site of wild growing *Arca noae*. This author also wrote about the yield of 20 to 30 tons of *Arca noae* per year in this part of the bay between the two wars. After a general kill of this species throughout the Adriatic, this area became desolate in 1984, new settlements having been slowly regenerated.

The observations of the state of the settlements of *Arca noae* in 1986 and 1988 showed that wild growing specimens of this shellfish might be found all over the bay, form its eastern-most part (Vranjic cove), being best developed in the shallow part of the bay in the area between the small town Kaštel Stari (Resnik) and Arbanija and - Slatine (Čiovo Island). It should also be pointed out that this species has suffered serious kills on several occasions. The last one, of catastrophic extent, was recorded in 1979. However, the kill did not occur at several sites only: the area of the Bay of Mali Ston, near Skradin and in the Kaštela Bay.

Samples of *Lithophaga lithophaga* were collected from a square metre surfaces (the number of individuals) in the areas: near the cove Lubinski porat (83 ind.), Barbarinac (65 ind.), Kaštel Kambelovac - Kaštel Lukšić (30 ind.), Kaštel Stari, near "Palace" hotel (52 ind.), Arbanija (136 ind.), Slatine (100 ind.). This species is best represented in the area near Resnik (400 m off the tower, 7 m depth, sea bed relief: rocky with some patches of fine sands), where 224 individuals per square metre were recorded of the total weight 4.30 kg (mean weight: 0.019 kg, mean lenght of the sample: 7.0 cm).

d) Transects (Fig. 1)

Two transects were sampled in August 1976 (ZORE-ARMANDA, 1976). The first transect runs from the Grmovac point (near the cement factory "Partizan") to the rock Šilo (near the shipyard "Split") and the second from Kaštel Gomilica to the Bene cove. The inventory of species could not be completed since samplings were carried out only in summer taking into account only macrobenthic forms. The analysis of samplings, nothwithstanding the scarcity of data, showed the great variations in the number of species on both transects, as well as at their individual portions. Qualitative composition of benthic settlements showed far bet-

ter conditions with respect to pollution in the Bene cove than in the area near Grmovac (rocks being covered by cement dust), Šilo and Kaštel Gomilica where the ecological balance has been seriously disturbed in benthic settlements by different pollution, causing considerable changes and degradation. The situation in the Bene cove appears far more favourable since benthic biocoenoses, both surface ones and those from deeper waters, have been still well preserved (including all the characteristic species and most of the accompanying species, as well as high numbers of individuals). It could be stated only that the structure of surface biocoenoses have been slightly changed. This is manifested by the presence, even though not yet the dominance, of some nitrophilous species (*Balanus amphitrite* DARWIN, *Mytilus galloprovincialis* LAM.) prefering eutrophicated waters.

Table 1. List of species collected by trawling in the Kaštela Bay (1972, 1974, 1976, 1987, 1988)

PORIFERA

Geodia cydonium (Jameson)
Tethya aurantium (Pall.)
Suberites domuncula (Olivi)
Chondrosia reniformis Nardo
Spongia officinalis L.
Hippospongia communis (Lam.)
Verongia aerophoba (Schmidt)

CNIDARIA

Nemertesia sp.
Calliactis parasitica (Couch)
Cladocora cespitosa (L.)
Alcyonium palmatum Pall.

ANNELIDA

Aphrodita aculeata L.
Laetmonice hystrix (Sav.)
Sternaspis scutata (Renier)
Pomatoceros triqueter (L.)
Protula tubularia (Mont.)
Serpula vermicularis (L.)
Spirographis spallanzani Viviani

ARTHROPODA

Squilla mantis Fabr.
Penaeus kerathurus (Forsk.)
Paguristes oculatus (Fabr.)
Porcellana platychelles (Penn.)
Porcellana longicornis (Penn.)
Dorippe lanata (L.)
Macropodia longirostis (Fabr.)
Macropodia rostrata (L.)
Inachus dorsettensis (Penn.)
Pisa nodipes Leach
Maia verrucosa Milne Edw.
Macropipus depurator (L.)
Pilumnus hirtellus (L.)
Gonoplax angulata (Penn.)

MOLLUSCA

Turritella communis Risso
Lemintina arenaria (L.)
Gourmya vulgata Brug.
Calyptraea chinensis (L.)
Aporrhais pespelecani (L.)
Capulus hungaricus (L.)
Galeodea echinophora (L.)
Murex brandaris L.
Fusinus rostratus (Olivi)
Aplysia fasciata Poiret
Doris sp.
Antalis dentalis (L.)
Arca noae (L.)
Chlamys varia (L.)
Pecten jacobaeus L.
Anomia ephippium (L.)
Ostrea edulis L.
Isocardia humana (L.)
Laevicardium oblongum (Chemnitz)
Corbula gibba (Olivi)
Hiatella arctica (L.)

TENTACULATA

Porella cervicornis (Pall.)

ECHINODERMATA

Antedon mediterranea (Lam.)
Holothuria tubulosa Gmelin
Holothuria forskali Delle Chiaje
Stichopus regalis Cuv.

Table 1. conitunued

Cucumaria planci (Brandt)
Trachythyone elongata (Düb.-Kor.)
Trachythyone tergestina (M. Sars)
Sphaerechinus granularis Lam.
Echinus acutus Lam.
Psammechinus microtuberculatus (Blain.)
Marthasterias glacialis (L.)
Astropecten aurantiacus (L.)
Astropecten irregularis (Linck)
Anseropoda placenta (Linck)
Echinaster sepositus Gray
Ophiothrix quinquemaculata (Della Chiaje)
Ophiothrix fragilis (Abild.)
Ophioderma longicauda (Retzius)
Ophiura texturata Lam.

TUNICATA

Ascidia mentula (Müller)
Ascidia virginea (Müller)
Phallusia mammilata (Cuvier)
Halocynthia papillosa L.
Microcosmus sulcatus Coquebert

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Zoobentos Kaštelanskog zaljeva - stanje i problemi

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KRATKI SADRŽAJ

Podaci dobiveni povlačnom mrežom (1972-1988) ukazuju da je biomasa zoobentosa u zaljevu velika i da nisu uočene neke promjene u pogledu biomase, u razdoblju posljednjih dvadesetak godina. Ni u pogledu strukture biocenoze obalnih terigenih muljeva nisu uočene neke promjene, makar ne unutar osamdesetak makro oblika, koji čine glavninu biomase.

Uočeno je također, da se kruti otpad iz godine u godinu sve više i više gomila na samom dnu zaljeva, i da iz dana u dan stvara sve veći problem.

Istraživanja su pokazala da su pojedina manja područja zaljeva pod utjecajem jačih pridnenih struja, pa je za pretpostaviti da su ti dijelovi zaljeva dobro i prozračeni.

U predjelu Resnika (Kaštel Stari), naselja školjkaša *Lithophaga lithophaga* i *Arca noae* su lijepo razvijena.

U istočnom dijelu zaljeva, u predjelima oko rta Grmovac, hridi Šilo i Kaštel Gomilice, ekološka ravnoteža u bentoskim naseljima je narušena raznovrsnim oblicima zagađenja, što je izazvalo znatne promjene i degradaciju u tim naseljima. U predjelu u. Bene površinske biocenoze pretrpjele su samo manje promjene, koje se očituju u prisustvu nekih nitrofilnih vrsta.