Recovery of benthos after anoxic stress. II. Bivalve Mollucs

Mirjana HRS-BRENKO, Davor MEDAKOVIC, Elvis ZAHTILA and Zeljka LABURA

"Ruder Boskovic" Institute, Center for Marine Research, ROVINJ (**Croatia**)

After a mass mortality of benthic organisms in the autumn of 1989 (JAKLIN & ZAHTILA, 1990) the recovery of bivalve populations was studied at stations 005, 007 and 107 (Fig. 1). Samplings from a 0.4 m^2 bottom surface were done by a Van Veen 0.1 m^2 grab at almost one month intervals, from December 1989 to September (005 and 007), and November (107) 1990.

Samples collected at station 005 in December 1989 contained *Corbula gibba, Chione ovata, Myrtea spinifera, Mysia undata* and *Thracia papracea;* at station 007 *Corbula gibba, Mysia undata* and *Nucula nucleus;* and at station 107 *Corbula gibba, Nucula nitida, Thyasira flexuosa* and *Tellina* sp. Only adult specimens were noted.

After the autumn of 1989 anoxia the repopulation process started in the spring of 1990 either by juveniles of survived species, by species inhabiting in neighboring zones, or by species distributed southwards which larvae were drifted towards the northern Adriatic by the main currents. First juveniles of several species appeared in February, especially at station 107. From December 1989 the bivalve species numbers increased from 5 to 16 species at station 005, from 3 to 17 at station 007, and from 4 to 20 at station 107. An insignificant species decrease was noted in April 1990 (Fig. 2).

Some bivalve species showed a high recruitment rate until June. The most abundant species was *Corbula gibba* (390 specimens per sample), the next ones were *Chione ovata* (219) and *Musculus marmoratus* (77). Less abundant were *Acanthocardia echinata* (43) in March, *Mantellum hians* (42) in June, *Nucula nitida* (37) in September, *Laevicardium oblongum* (41) in November, and others (Fig. 3). In 1990 the recovery of *Pinna pectinata* populations was recorded from specimens 38 mm (Apr.) to 160 mm in length (Sept.) according to diver sampling collections.

At station 107 in December an adult *Corbula gibba* population consisted of specimens 10.0-12.2 mm in length. The settlement of juveniles about 2 mm in length started in February and continued until June, when the smallest specimen was about 4 mm in length. It seems that a natural mortality of adults had begun in February but until June the *Corbula* population structure, in general, did not altered (Fig. 4).

The recovery of bivalve species in the area affected by anoxia in the autumn of 1989 was successful and rapid, as their reproduction season began already in the spring of 1990.

Figure 1. Research stations in the area stressed by 1989 anoxia.

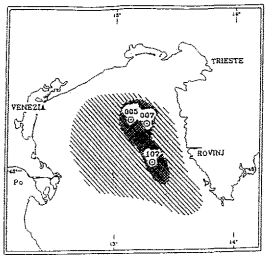


Figure 2. Bivalve species numbers in the early recovered period.

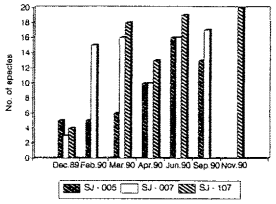


Figure 3. Population recovery of some common bivalves.

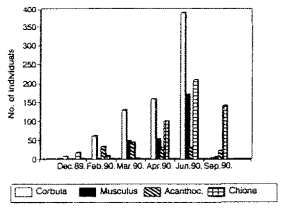
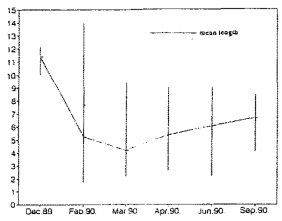


Figure 4. Population structure of *Corbula gibba.*



REFERENCES

JAKLIN A. & ZAHTILA E., 1990.- 1989 anoxia and mass mortality of macrobenthos in the Northern Adriatic Sea. 1st Int. Symp. "Ecological problems in the Adriatic Sea", Split, 7-9 November, 1990. *Abstracts*: 44-45.

Ulva Rigida (Chlorophyta) in the North-Eastern Adriatic fouling communities with regard to different environments and substrata

Ljubimka IGIC

"Ruder Boskovic" Institute, Center for Marine Research, ROVINJ (**Croatia**)

In the northern Adriatic seaweeds are not an important element in fouling communities. The most frequently noted species is *Ulva rigida* C. Agardh, 1822. It is a typical species for the fouling on floating objects throughout the world. Being a nitrophile species it inhabits before all slightly polluted environments (PERES, 1967) but also rather polluted harbors, where it is accompanied by some other algae (*Enteromorpha, Cladophora, Chaetomorpha*) representing the main nitrophile facies (RIGGIO, 1979). Therefore *Ulva* is considered the main eutrophication indicator in the sea and estuarine environments influenced by urban sewage effluents (HO, 1981). *Ulva* is as well common in cleaner environments richer in riverborne nutrients.

The data were collected from supralittoral to upper infralittoral, over a period of 20 years. All data are expressed as average values and are presented in a form consistent with standard ecological methods, so that frequency is according to ODUM (1971) and cover is after PERES & PICARD (1964).

Along the north-eastern Adriatic coast Ulva is the most frequent and the most abundant in slightly polluted harbors and in shellfish parks rich in nutrients, while in clean localities and shellfish parks poor in nutrients *Ulva* is of secondary importance in fouling communities (Table I). But in the Rijeka petrol-harbor, rich in nutrients. the settlement of *Ulva* was not intensive, probably due to a considerable oil pollution.

With regard to the substratum *Ulva* reacts differently. Its distribution over different parts of a ship is in correlation with light intensity, coating toxicity, relative water speed during sailing and similar. Because of this *Ulva* never settles on the keel of ships, axis of propellers, and on very toxic coating layers. However, the texture of the substratum could be of influence to the settlement of the *Ulva* species. For example, the rough surface of an oyster shell is more favorable for settling than the smooth shell of a mussel or glass plates (Table I).

The ecological importance of *Ulva* as a fouling species is unsubstantial, except on floating objects, because of its low abundance, growth, biomass, and low covering rate. Being a fouler *Ulva* very rarely reaches the adult stage, its thalli were in average only 3-8 mm high, extremely 71 mm on oyster shells. Only on the hulls of ships domiciled in harbors slightly polluted by urban sewage, in the upper part of the water line, *Ulva* thalli reached the length up to 20 cm but towards the ship-keel their dimensions decreased successively to only about 1-2 cm.

The seasonal distribution of *Ulva* is not strictly determined. At most it was found in the fouling from May to October with a peak in June.

The dynamics of *Ulva* in fouling communities is very accelerated alreadv after 15 days of exposure of the test substratum the thalli start to die out, and the mortality begins after 1-2 months, rarely after 4 months. The reason of such an accelerated development of *Ulva*, which thalli almost never reach the adult stage, is the fouling competition and kind of substratum.

Table I. Frequency of occurrence (F %) and average cover (C %) in relation to various substrata and environments (*rich in nutrients).

	Non-pollut. sites		Shell-fish parks		Petrol harbor		City harbor	
	F	C	F	C	F	C	F	C
Glass plates	4	8			*6	5		
Ostrea edulis			*50	12				
			1	5				
Mytilus gallo-provincialis			*4	7				
			2	7				
Fishing ships:								
Bow							25	7
Hull							25	3
Stern post							13	40
Stern							25	6
Rudder							25	60
Propeller - sides wing: external							50	66
internal							25	60

REFERENCES

HO Y.B., 1981.- Mineral element content in *Ulva lactuca* L.. with references to eutrophication in Hong Kong coastal waters. *Hydrobiologia*. 77: 43-47.

ODUM E.P., 1971.- Fundamentals of Ecology. W B Saunders Company. Philadelphia London Toronto : 674 pp.

PERES J.M., 1967.- The Mediterranean benthos. *Oceanogr. Mar. Biol. Ann. Rev.*, 5: 449-533.

PERES J.M. & PICARD. J., 1964.- Nouveau manuel de Bionomie Benthique de la mer Méditerranée. *Real. Trav. Stn. mar. Endoume.* 31 (47):1-137.

RIGGIO S., 1979. The fouling settlements on artificial substrata in the harbor of Palermo (Sicily) in the years 1973-1975. *Quad. Lab. Tecnol. Pesca.* 2: 207-253.

X