Macrozoobenthic communities present state in Varna and Beloslav Lakes adjacent to Black Sea

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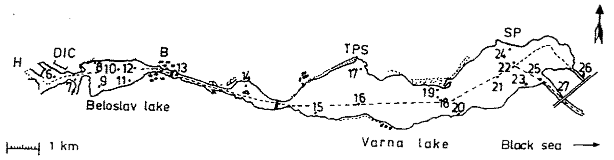
Beloslav and Varna lakes were fresh - water firths with a little flow into Black sea up to 1909 when after digging a channel between the sea and Varna lake its salinity rose considerably (8 - 13‰). Further there were a number of changes in this lakes as a result of human activity as follows: 1923 - the channel between the two lakes was dug; 1954 - the first plants in the Devnya chemical industrial complex were built: 1968 - "Varna" Thermo - electric power station and its harbour were put into operation; 1974 - "Varna - West" harbour was opened; 1976 the second Varna lake - sea channel was dug. In fact since 1970 the Beloslav lake - Varna lake - Varna bay zone has been an area exposed to the cascade - like west - east influence of anthropogenic factors and the lakes have become a buffer - zone holding pollution back. So they have completely lost their self - purification ability and their salinity is almost the same as that of the sea water (15 - 16‰ at present).

Numerous faunistic and biocoenological investigations in the lakes have been carried out in different periods (VALKANOV, 1935; CASPERS, 1951; KANEVA - ABADJIEVA, 1957; KANEVA - ABADJIEVA *et al.*, 1967). From the last 25-30 years there haven't been data about the benthic zoocoenoses therefore in 1990-91 the present investigations were carried out. From 7 sampling stations in the Beloslav lake and 15 stations in Varna lake were taken samples by Birdge - Ekman grab (0.44 m2)(Fig. 1). The data obtained were used for determining the communities structure, calculating Shannon - Weaver's information index H and kombined K-dominance curves for species abundance/biomass comparison too (ABC method) (WARWICK *et al.*, 1987).



Fig,1. Sampling stations location in Beloslav and Varna lakes
H - "Varna-West" harbour; DIC - Devnya industrial complex;
B - Beloslav town; TPS - "Varna" Termo-electric
power station; SP - Varna town sewage plant.

A total of 7 species and groups are registered in the Beloslav lake, out of which 3 Annelida (*Nereis diversicolor, Melinna palmata, Oligochaeta*), 3 Crustacea (*Gammarus subtypicus, Pontogammarus* sp., *Palaemon elegans*) and *Chironomidae larvae*. The greatest number of species are established in summer (5), while in the rest of the seasons they are 2. The mean density, formed preliminary of *Ch. larvae* (96.8%) is highest in summer (29321 ind.m-2); in spring and winter it is 7155 and 10697 respectively. The mean biomass composed mainly of *Ch. larvae* too (95.5%) is highest in winter (38.8 g.m-2) and lowest in summer (11.52) in accordance with the dominant organisms development cycle specificity. H index (calculable only in two stations - 8 and 12) is extremely low - average 0.05. According to the ABC graphplots the macrozoobenthic communities are "grossly polluted" in st.8 and "moderately polluted" in st.12 in summer. A typical phenomenon here is the presence of two types of strongly destructed zoocoenoses: 1/totally lacking living organisms - dead zones; 2/ monospecies zoocoenoses. The western part of the lake is a dead zone throughout the year (st.6). It is reduced gradually to east where monospecies coenoses are established in the southern coastal zone and fairway, while along the northern coast a weak trend of improvement of macrozoobenthic communities status is to be observed.

A total of 45 macrozoobenthic species and groups out of which 17 Vermes, 12 Crustacea and 12 Mollusca are registered in the Varna lake. Vermes prevail in density - from 94.0% in winter to 71.2% in summer. The mean density is highest in spring (8449 ind.m-2) composed mainly of *Nereis diversicolo, Nereis succinea, Polydora ciliata* and Oligochaeta and lowest in autumn (2194). Maximum annual density is registered in the almost singular monospecies zoocoenosis situated in the 1st lake sea channel zone (st. 26) - 15658 (*Capitomastus minimus*) and the minimum (88) - in the fairway zone west of the Varna town sewer discharge (st. 22) Vermes prevail in the biomass too (60.4%) excluding the zone in front of and in the second lake - sea channel where Mollusca dominate (67.3%) (*Cunearca cornea, Mytilus galloprovincialis, Rapana thomasiana*). In the last zone the maximum biomass is registered (2272.8 g.m-2) while the minimum biomass zone (0.145) coincides with that of the minimum density.

The information index H varies between 0.55 in autumn to 1.1 in summer. It is lowest (0.25) in the minimum density and biomass area and highest (1.72) - in the second lake - sea channel. There are two dead zones throughout the year in this lake - in front of "Varna" TPS (st. 17) and in front of the town sewage plant (st. 24). In almost all the other stations the H-index is extremely low - from 0.2 to 1.0; the ABC graphplots configuration characterizes some communities as "moderately polluted" and other as "grossly polluted" depending on the season. "Unpolluted" are only two zones - farest from the dead zones (st. 14 and st. 19) whose H - index is 1.6.

Conclusions

1/Most critical is the zoobenthic coenoses status in the Varna and Beloslav lakes in autumn when the dead zones are 8.

2/Totally lacking living macrozoobenthic organisms throughout the year are those areas exposed to industrial and sewage pollution.

3/The presence of "unpolluted" communities in separate limited zones allow us to consider that a certain stabilization and gradual restriction of the zoobenthos is possible after restriction or stopping the pollution.

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Patella caerulea (Gastropoda, Mollusca) as a key biomonitor for chemical and thermal pollution along the rocky intertidal of the Israeli Mediterranean

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Patella caerulea is the most common gastropod in the intertidal and splash zone of the rocky habitats of the Israeli Mediterranean, both natural and artificial. Being microalgal grazers, these organisms are constantly exposed to environmental variables, evolutionarily adapted to survive stress conditions of changing ambient parameters. This makes them suitable for studies of the occurrence of pollutants both in water as well as the atmosphere. This study was performed during 1989-1991 along various sites of the Mediterranean shore with special attention to locations occupied by electric power plants using coals, where the cooling heated-up water outflowed onto the rocky shore. Monthly samples were analyzed for heavy metals by flameless NAS for mercury, and by AAS and X-ray probe for other metals. The ecology of the population was studied on marked quadrants, and gonadial activity and GI were examined by serial histological sections.

Table 1 summarizes the results of metals in *Patella* at the sites from Rosh Hanikra on the Lebanese border to Ashdod in the south. Although raised levels of heavy metals were revealed at several sites, the detrimental synergism of pollution and higher water temperature, such as found at Hadera, (the site of the power plant), is evident, especially concerning mercury, zinc, iron and cadmium. This site also demonstrated very high levels of sulphur, chlorine and magnesium. Figure 1 shows the levels of cadmium, copper and lead in two consecutive years, 1989-1990. As evident, on most sites close to the industrial zones an increase in these metals was observed.

Table 1: Metal concentrations in *Patella caerulea* collected along the Mediterranean Sea of Israel: Maximal (µg/g/dry weight) from north to south of the country .

Site	Cd	Cu	Pb	Fe	Hg	Zn
Rosh Hanikra	3.67	7.19	5.53	1505.1	0.0	72.15
Akhziv	5.26	12.75	8.4447	1650.5	0.052	94.78
Akko	5.92	18.37	9.73	1345.8	0.013	94.72
Atlit	3.25	7.81	10.5	1388.3	0.0	75.58
Caesarea	2.10	10.18	9.22	1501.3	0.0	89.86
Hadera (EPP)	4.76	21.00	8.52	3468.0	0.225	219.40
Mikhmoret	2.80	12.82	6.02	1863.4	0.0	83.47
Sidni Ali	1.04	9.10	10.42	1468.2	0.0	53.89
Tel Aviv	2.07	25.12	13.68	2669.9	0.0	95.64
Bat Yam	2.32	11.97	8.80	1526.1	0.0	69.50
Palmahim	4.42	7.65	5.73	1351.8	0.056	65.10
Ashdod	4.18	17.52	10.31	1852.9	0.0	66.10

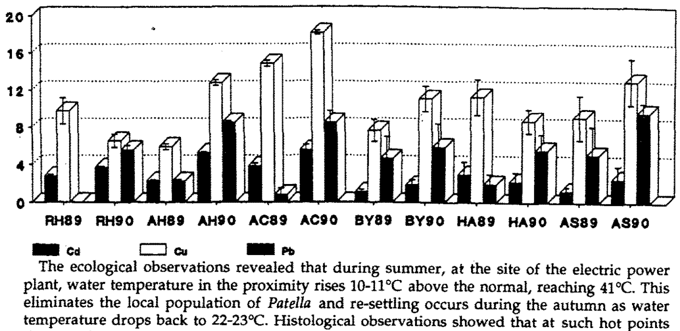
Table 2 compares the levels of three metals as reported from various sites of the Mediterranean. The Israeli material has almost the highest level of pollution.

In *P. caerulea* the levels of metal concentrations of anthropogenic origin demonstrated correlation with the proximity to power plants, both near Hadera (north of Tel Aviv) and near Ashdod (south of Tel Aviv) (Fig. 1). As these sites are in the centre of industrial areas, particularly metallurgic and chemical, we cannot isolate individual polluters, but should see the results as consequences of a possible synergism of all biological active agents.

Table 2: Metal concentration in *Patella* spp. (µg/g/dry weight) from various shores of the Mediterranean Sea (CASTAGNA *et al.*, 1985; RAMELOW, 1985)

Location	Cu	Cd	Pb
Turkey (1985)	3.5-13.7	2.1-40.3	0.3-3.2
Sicily (1985)	6.12-29.3	1.52-6.72	2.34-45.3
Spain (1978)	5.0-10.0	1.1-7.1	2.0-16.0
Lebanon (1978)	11.3-38.0	0.4-4.7	6.8-95.6
Israel (1990)	6.5-46.7	0.5-11.3	0.42-25.9

Figure 1 : Selected metals in *P. Caerulea* (µg/g/dry weight) from along the Israeli Mediterranean, in 1989-1990; RH - Rosh Hanikra; AH -Akhziv; AC - Akko; HA Hadera; BY - Bat Yam; AS - Ashdod.



The ecological observations revealed that during summer, at the site of the electric power plant, water temperature in the proximity rises 10-11°C above the normal, reaching 41°C. This eliminates the local population of *Patella* and re-settling occurs during the autumn as water temperature drops back to 22-23°C. Histological observations showed that at such hot points the gonads undergo degenerative processes, leading towards reabsorption of ripening eggs, multiplication of primary oogoni, and hermaphroditism, especially masculinization. Enzyme analysis revealed that at these sites the Cytochrome P-450 showed very low levels. It can be predicted that if such hotwater outflows multiply along the shoreline, the entire population of *Patella* and other intertidal organisms will undergo a process of dramatic change.

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