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BIODIVERSITY OF "COCKETRICE" SANDY BANK (BLACK SEA) - A PREREQUISITE FOR ITS CONSERVATION AS A PROTECTED AREA

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Considering the growing in the last years interest shown by various economic organizations to take sand from the Black sea natural deposits for construction purposes, as well as the negative effect registered after such activity along the coast of Ukraine (Odessa), detailed oceanological investigations -including direct observation of the "Cocketrice" sandy bank- have been carried out during 1986-89 period (DIMITROV *et al.*, 1990). This bank, discovered by the English oceanographic vessel "Cocketrice" in 1887, is located in the North-Eastern part of the Bourgas Bay - the greatest and most polluted bay along the Bulgarian Black sea coast (Fig. 1). Accor-

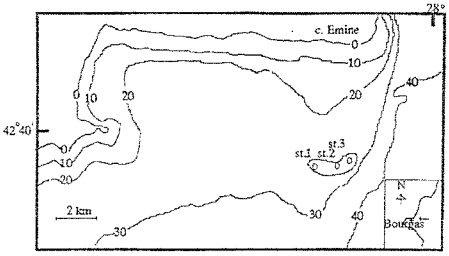

Figure 1 : sampling stations

ding to the main results obtained, the highest part of the bank is 16.2 m deep, the sand is of a mean grain size composition and the potential sand stock amounts to about 126 mln.t. The unusual location of the cresting bank with hardened sections in some high disposed zones and relatively strong streams in its eastern part predispose favourable conditions for the development of the typical for the rocky sublittoral *Mytilus galloprovincialis* population. These data gave grounds for conclusions that the specifying of the biota status in this reef-like structure is of a special interest having in mind that it is located in the most ecologically threatened zone along the Bulgarian Black sea coast and the need to estimate the ecological effect after a possible sand exploitation is obligated. Moreover, the results obtained would be a definite contribution at present when there is a pronounced tendency to use artificial reefs along the Bulgarian sector of the Black sea for restoration of the destructed coastal ecosystems.

Sampling from three stations (at 18, 21 and 22 m depth) by Van-Veen grab, covering 0.1m^2 has been carried out seasonally during 1991-92. The samples were washed through a set of sieves (the last one with 0.6 mm mesh size) and fixed in 4% formaldehyde. All macrozoobenthic specimens were defined to species level (excluding *Nemertini, Turbellaria* and *Oligochaeta*), counted and weighed. The Sorensen's coefficient of similarity and Shannon Weaver H-index were calculated; the species abundance/biomass comparison method was used for detecting pollution effect (WARWICK, 1986). A total of 92 macrozoobenthic species and groups are registered in all stations (st.1-18 m; st.2-21 m; st.3-22 m depth), the most numerous of which are *Polychaeta* (34), followed by *Crustacea* (29) and *Mollusca* (22). According to Sorensen's coefficient (48.2) the most shallow zoocoenosis (st.1) strongly dominated by *Mytilus galloprovincialis* is differentiated as a specific one, that necessitates a separate discussion of the results. The species composition in this station consists of a total of 65 species and groups (including *Pisces* larvae) among which prevails *Polychaeta* (25), while *Crustacea* and *Mollusca* are presented by 20 and 16 species respectively. The number of species varies slightly seasonally from 35 during the summer to 39 during the winter. In the total abundance (14492 ind/m^2) *Mollusca* predominates (60.6%) presented mainly by *M. galloprovincialis* (48.4%) together with sparsely distributed *Chamelea gallina* (8.3%). The seasonal maximum in abundance is in summer (20925 ind/m^2), *Crustacea* showing the most intensive (3.2 times) increase. The total biomass (4045.0 g/m^2) is structured mainly by *Mollusca* (99.4%) the two basic species M. *galloprovincialis* and *Ch. gallina* presented by 57.7% and 38.0% respectively. The average H-index value (2.93) varies slightly seasonally : from 2.7 during the summer to 3.3 during the spring. The results show that a specific zoocoenosis has been formed in this highest zone of the sandy bank : it combines the characteristic features of the two richest zoocoenosis - the *Mytilus* rocky and sandy ones. The registered *Pisces* larvae (20 ind/m^2) testify to the existence of favourable conditions for ichthyofauna reproduction and development.

The high degree of similarity between macrozoobenthic communities in st.2 and 3 (75.2) gave ground to analyze their data unified. The species composition in this part of the sandy bank is more various; from the total of 80 species and groups, 30 are *Polychaeta*, 25 *Crustacea* and 19 *Mollusca*. The species diversity increases from 42 species registered in spring to 60 in the summer, from which *Polychaeta* and *Crustacea* are almost equally presented (20 and 19 species respectively). In the total abundance (13149 ind/m^2), *Polychaeta* prevails throughout the year (63.5%) while the rest of the quantity consists of *Crustacea* (16.6%) and *Mollusca* (17.2%), a structure typical for sandy zoocoenosis. The maximum abundance is registered during the summer (24537 ind/m^2) which is due to a certain degree to the *Pisces* larvae high quantity (7090 ind/m^2). The summer is the season with the highest H-index value also : 3.74 (average H = 3.48). In the total biomass (1730.0 g/m^2) prevails *Mollusca* (88.96%) with the typical sandy species *Ch. gallina* predomination (61.36%). A comparative analysis with the Bourgas Bay zoobenthic communities status shows that : 1/ the species diversity is considerably lower (54 species); 2/ a tendency for maximum abundance drop is registered during the crucial summer period (39 times *Crustacea* density reduction); 3/ the average density and biomass are almost 10 times lower; 4/ the communities are characterized as "grossly" and "moderately polluted"; 5/ *M. galloprovincialis* population dies during the summer as a result of the deteriorated environmental conditions (hypoxia), that prevent the population from reproduction in the Bay (STOYKOV *et al.*, 1994).

Consequently, the "Cocketrice" sandy bank is a nature reserve inhabited by unique zoobenthic coenoses differentiated from the adjacent region by the following peculiarities : 1/ high biodiversity and sustainable abundance and biomass structure, that determine their ecological status as "unpolluted" throughout the year; 2/ the presence of a normally functioning *M. galloprovincialis* population which as the most powerful biofilter among the Black sea *Mollusca* contributes to the de-eutrophication of the area; 3/ the presence of some threatened by extinction *Crustacea (Upogebia pusilla)*; 4/ *Pisces* larvae great quantity presence defines this bank as a spawning area. All these prerequisites determine the imperative need for preventing the "Cocketrice" sandy bank as a protected area.

REFERENCES

DIMITROV, P., E. DEMIREV, J. CHERNEVA, D. SOLAKOV. 1990. Rep. Int. Symp. Geolog. monit. geoecol. probl. Baltick and Black sea, Pitersburg, Russia.
STOYKOV, S. *et al.*, 1994. *Proc. Inst. Fish.*, Varna, 22 : 5-57.
WARWICK, K.M. 1986. *Mar. Biol.*, 92 : 557 - 562.

LIGHT LIMITATION OF *POSIDONIA OCEANICA* (L.) DELILE GROWTH AT DIFFERENT DEPTHS

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Although several factors could be responsible for seagrass distribution and production patterns, light plays a major role in both growth rates and depth distribution (BUIA *et al.*, 1992; DUARTE, 1990). Reduction of light resources, due to environmental quality deterioration, contributes to the regression phenomena which make *Posidonia oceanica*, endemic of the Mediterranean Sea, an endangered species. The wide depth distribution shown by *Posidonia* translates into a variety of irradiance environment. The relationships between the light regime, production features and allocation of carbon has been approached in the case of other seagrass species such as *Zostera marina* (ZIMMERMANN *et al.*, 1991), *Thalassia testudinum* (FOURQUREAN and ZIEMAN, 1991) and others (POLLARD & GREENWAY, 1993). The objectives of the present research were to highlight :

- the role of photoperiod and available irradiance levels in explaining leaf growth patterns at different depths and light regimes,
- the role of belowground metabolic demand in the whole-plant carbon balance.

Two stands located at 5 m and 22 m respectively along a depth gradient at Lacco Ameno (Ischia, Gulf of Naples) were chosen. They are characterized by different structure (e.g. shoot density, Leaf Area Index) and growth patterns (BUIA *et al.*, 1992). Photosynthetic features were estimated measuring oxygen evolution through Clark-type electrodes of leaf tissues of different ages. Respiration by leaves and belowground tissues (roots and rhizomes) were estimated by the same methods. By knowing the leaf standing stock, these parameters were referred for each stand to the unit area (square meter). *In situ* PAR irradiance was periodically measured by a quanta meter and the average attenuation coefficient of local water column was calculated. By knowing the irradiance at which saturation of photosynthesis is achieved (Ik), the *in situ* maximum noon irradiance (Im) and the photoperiod, the daily period of saturating irradiance (Hsat) was assessed (DENNISON & ALBERTE, 1985). Hcomp, i.e. the daily period of irradiance above compensation light (Ic), was also estimated.

Stands at 5 m and 22 m showed variations in Pmax (maximum photosynthesis) mainly related to different leaf ages found in the different seasons (ranges are between 0.72 and 1.5 mgC/gdw/h at 5 m, and between 0.72 and 1.04 mgC/gdw/h at 22 m). However, in both stands low Ik ranging from 40 to 65 uE/m^2/sec were found, ensuring an optimal exploitation of light energy available. Belowground respiration is generally one order of magnitude lower than shoot respiration (0.05 vs 0.3 mgC/gdw/h, on the average). Hsat ranged from 14.4 hours (May) to 9.6 (November) at 5 m, and from 7.4 (May) to 4.9 hours (November) at 22 m (Fig.1). By combining production rates and respiration rates with the Hsat periods in the four seasons, a carbon balance was obtained for the unit area of the two stands. At 5 m, the maximum was achieved in May with 4.3 gC/m^2/day whereas the minimum occurred in January (0.6). At 22 m, a maximum was also achieved in May (0.2 gC/m^2/day) while in winter negative values were found (- 0.03 in Jan. and - 0.27 in Nov.). When Hcomp was taken into consideration, balance values at 22 m in winter were substantially raised (0.04 gC/m^2/h in Jan., - 0.14 gC/m^2/h in Nov.) (Fig.1).

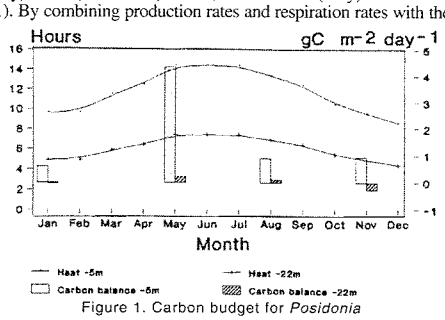

Figure 1. Carbon budget for *Posidonia*

The Hsat required to balance carbon demand, estimated by respiratory demand of the whole plant, as referred to the entire biomass, was largely reached and exceeded at 5 m in all four seasons, whereas at 22 m a deficit occurred in winter (Fig. 2). Light limitation seems to largely account for differences in growth patterns and production levels between the two stands; however plant is adapted to overcome this limitation and to grow along depth gradients :

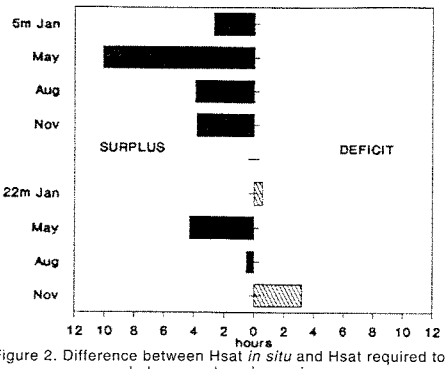

Figure 2. Difference between Hsat *in situ* and Hsat required to balance carbon demand.

- belowground tissues, despite the high biomass, have a low metabolic demand in comparison to the shoots;
- surplus production with respect to shoot growth, occurring in spring-summer, can be stored in the belowground tissues (PIRC, 1985) and can compensate for the depression of production due to biotic and abiotic factors.

As a result, although the plant has acquired adaptation to life at low irradiance, light limitation could be a factor for the rising of depth limit of *P. oceanica* contributing to the regression of its beds and consequently to the reduction of the high biodiversity which characterizes such systems. The role of *Posidonia oceanica* as a "biomass storer" through accumulation of belowground tissue is crucial in the coastal systems of the Mediterranean Sea making the species one of the most important structural component of complex ecosystems.

REFERENCES

BUIA M.C., ZUPO V., MAZZELLA L., 1992. *P.S.Z.N.I. Marine Ecology*, 13 : 2-16.
DENNISON W.C. and ALBERTE R.S., 1985. *Mar. Ecol. Prog. Ser.*, 25 : 51-61.
DUARTE C., 1991. *Aquat. Bot.*, 40 : 363-377.
FOURQUREAN J.W. and ZIEMAN J.C., 1991. *Mar. Ecol. Prog. Ser.*, 69 : 161-170.
PIRC H., 1985. *P.S.Z.N.I. Marine Ecology*, 6 : 141-165.
POLLARD P.C. and GREENWAY M., 1993. *Aust. J. Mar. Freshwater Res.*, 44 : 127-139.
ZIMMERMAN R.C., REGUZZONI J.L., WYLLIE-ECHEVERRIA S., JOSSELYN M. and ALBERTE R.S., 1991. *Aquat. Bot.*, 39 : 353-366.