Evaluation of the sea water quality of Mostaganem bay through the sea urchin *Paracentrotus lividus* (Lmk) bioindicator

Oulhiz A.[1, 2], Soualili D. L.[1] ; Mezali K.[1]

[1]Department of Marine Science and Aquaculture, [2]Department of Biology, Faculty of Natural Science and life, Abdelhamid Ibn Badis University of Mostaganem (UMAB), 27000,PO Box 300, Algeria. Email: haoua11@yahoo.fr

SUMMARY

Since the last decade, the use of biological indicators in assessing the quality of the environment has become one of the latest methods in the history of environmental science. Indeed, any human activity (industrial, agricultural or tourism development) cause a very important environmental pressure on coastal marine species assemblage. For this, we chose to test the quality of sea waters off the coast of Mostaganem, using the test of larval development of the purple sea urchin Paracentrotus lividus (Lamarck, 1816), species widely used for this type of analysis. In fact, the sensitive phase of embryonic and larval development of the sea urchin is used as a bioindicator of the health of the marine environment. Two sites situated in the Mostaganem coastline (Stidia and Kharouba) were selected. This choice is based on their exposure to different sources of pollution. The use of the echinoid P. lividus revealed a higher degree of disturbance at the site of Kharouba marked by a relatively low rate of normal larvae (71.2%) against the highest rate (84.1 %) obtained at Stidia station. The analysis was thorough two years later, by studying the ability of the sea urchins to normal and viable larvae (tests of fertilization and larval development), at the site of Kharouba. Also, the temporal comparison of the obtained results during the two years (2011-2013) confirmed that the site of Kharouba is in state of continuous disturbance; caused by the pressure originating from various anthropogenic activities.

Key words: Biological indicators, Paracentrotus lividus, larval development, pollution, Mostaganem.

INTRODUCTION

The Mediterranean coastal area has long been known to serious environmental problems caused by human activities such as fishing, industrialization and urban development [1] (KEBIR, 1996). Mostaganem is one of the major Algerian coastal cities affected by the anthropogenic pressure that causes varying degrees of environmental disturbances. In this regard, the evaluation of the quality of the coastal marine environment requires a provision of tools for biomonitoring such as a testing protocol using the marine invertebrates' embryo-larval development. This is the case for the purple sea urchin *Paracentrotus lividus*, a species used as biological indicators to determine the health status of the shallow water area [2] (Chapman *et al.*, 1991; 1992).

MATERIALS AND METHODS

Study sites

Two sites were selected: Stidia and Kharouba (Fig. 1). The sites were chosen according to their exposure to different sources of pollution.

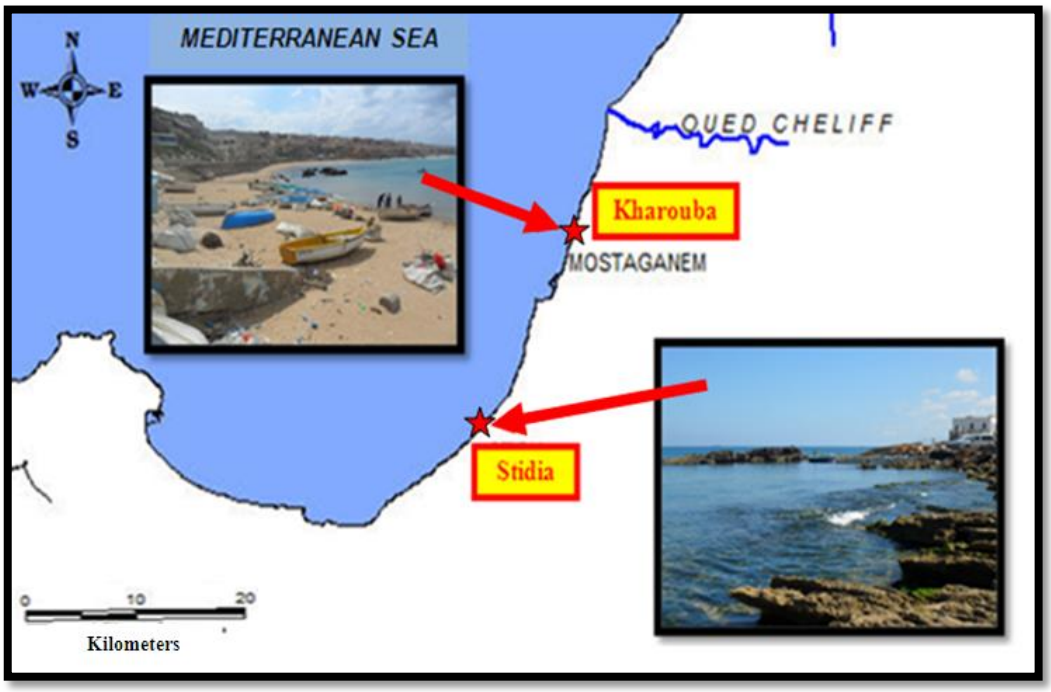

Figure 1. Map of the coast of Mostaganem showing the situation of both studied sites (Stidia and Kharouba).

Sampling

The biological material

Ten (10) individuals of *P. lividus* (ranging from 4cm to 6cm in size) were collected from the site of Stidia at a depth ranging from -1 to -3 meters during two months (June and October 2011). In June 2013, another sampling (10 individuals of *P. lividus*) was carried out at Kharouba station (Fig. 1). In the laboratory, we use the color of the gonadal liquid for sex identification (orange in the female, white in male) (Fig. 2).

Figure 2. Distinction between female (A) and male (B) of the purple sea urchin *P. lividus* using the color of the *gonadal liquid*

Sediment and seawater

The surface sediment of each studied site (where *P. lividus* individuals were collected) is removed, stored in plastic bag, transported using a cooler (4 °C) and processed immediately

upon arrival at the laboratory. The seawater used for this type of analysis is sampled from each site, filtered and stored at 4 °C.

Methods of analysis

To test the quality of larval development of *P. lividus*, we used the protocol of Quiniou *et al.* (1999) adapted by Soualili (2008). The analysis was performed for 5 fertilizing eggs by females individually pooled from 3 male sperm. Once fertilized eggs are obtained, they are able to develop in contact with the sediment originating from the different studied sites. Fertilized eggs are then incubated for 72h at loboratory temperature, then some drops of formalin (35%) are added. Stages of development are performed on the basis of the four categories defined by Pagano *et al.* (1988) (NL: normal larvae; ANL: abnormal larvae; DL: delayed larvae; BL: blastula larvae). The percentages of each stage are then calculated and tested by ANOVA single factor (Site, $P < 0.05$), followed by Dunnett's test.

RESULTS AND DISCUSSION

Biological evaluation of the quality of the marine environment of the different studied sites

Given the high percentage of normal larvae obtained in the test of larval development of *P. lividus* to assess the quality of coastal waters (Tab.1), the site of Stidia, could be considered the least disturbed site compared to Kharouba site (Fig.3).

Table 1. Frequencies of different types of larvae obtained after exposure of *Paracentrotus lividus* embryos to sediment originating from the studied sites. NL: normal larvae; ANL: abnormal larvae; DL: delayed larvae; BL: blastula larvae.

	NL	ANL	BL	DL
Control	94.9	0	0	5.1
Stidia	84.1	8.3	1.5	6.1
Kharouba	71.2	17.1	2.4	9.3

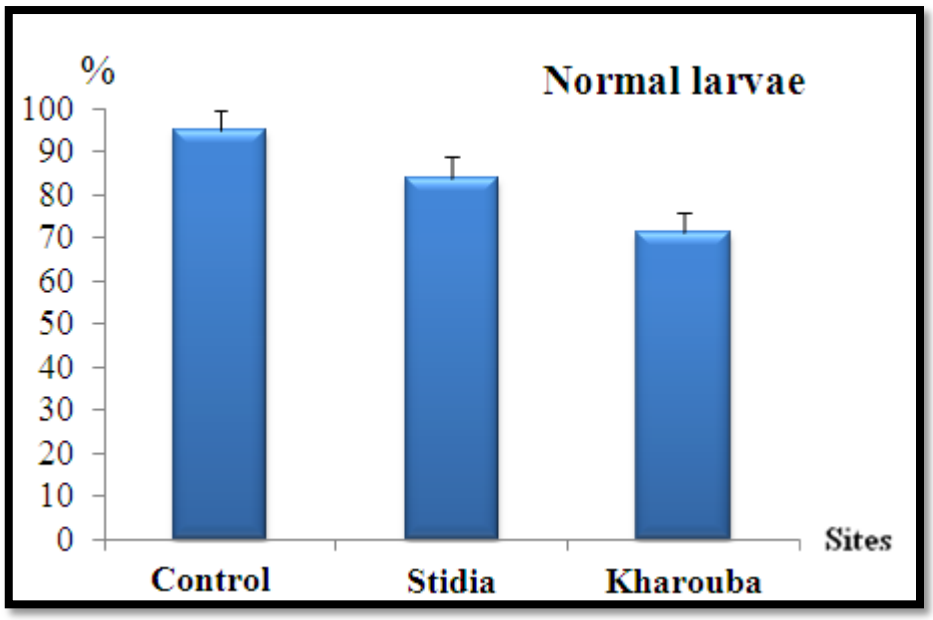

Figure 3. Percentages of normal larvae of *P. lividus* exposed to the sediments originating from the different studied sites.

The analysis shows that the lowest percentage of normal larvae is obtained in the site of Kharouba (71.2%). In contrast, the highest value is obtained in the control (94.9%). We also note at the site of Stidia that the value of the normal rate of larvae is near to the control. There isa significant difference between the sites and the control ($P = 0.024 < 0.05$).
The statistical tests (Dunnett and Tukey HSD) applied to normal larvae showed a difference with those obtained with the control at the site of Kharouba ($P = 0.01 < 0.05$), while for the site of Stidia, no significant difference of the different categories of larvae with the control, was detected ($P \approx 0.05$). Therefore, we could classify the degree of disturbance of the studied sites according to the following gradient:

Sites Stidia Kharouba
(-) ⟶ (+)
Degree of disturbance of the sediment quality of the studied sites.

Biological assessment of marine environmental quality of Kharouba site in 2013.
The results obtained in 2011, discriminate the site of Kharouba as the most disturbed site compared to Stidia environment. In 2013, a long-term monitoring was performed on the site of Kharouba to assess the ecological status of its marine environment. We studied the water quality of this site in the same manner as the tests (larval development of *P.lividus)* carried out in 2011, subjecting the fertilized eggs of Kharouba water of their own station. Monitoring of embryonic development revealed a normal rate of pluteus larvae (51.16%, Tab.2).
It is noticed that *P. lividus* poulation of Kharouba site, have the capacity to produce viable pluteus larvaes at fairly significant values. However, these values are lower than those observed in 2011 when *P. lividus* has a high percentage of normal larvae (71.2%, Tab.2). The latter was considered as a disturbed site.

Table 2. Mean requencies of the obtained larvaes categories (2011-2013) NL: normal larvae; ANL: abnormal larvae; BL: blastula larvae; DL: Delayed larvae.

	NL	ANL	BL	DL
Kharouba (2011)	71.2	16.1	5.4	7.3
Kharouba (2013)	51.16	48.9	0.3	0

We can conclude that the current environmental status of the Kharouba site has a strong effect on the inhibition of larval development of *P. lividus*.

CONCLUSION

This study assessed the quality of the marine environment of the coast of Mostaganem through the purple sea urchin *Paracentrotus lividus*, a species widely used as bioindicator. The results showed that the larval development quality of *P. lividus*, revealed and confirmed a general satisfactory condition at Stidia site. However, the Kharouba site, shows a signs of environmental degradation caused by human activities (tourism, coastal management…).

REFERENCES

[1] Kebir L., 1996. Mediterranean Institutions: the Action Plan for the Mediterranean (PAM). http://base.dph.info/en/fiches/premierdph/fiche-premierdph-2229.html.
[2] Chapman P. M., Power E. A., Dexter R. N., Andersen H. B., 1991. Evaluation of effects Associated with year oil platform using the sediment quality triad. Environ. Toxicol. Chem., 10: 407-424.

[2] Chapman P. M., Swartz R. C., Roddie B., Phelps H. L., Van den Hurk P., Butler R., 1992. An international comparison of sediment toxicity tests in the North Sea. *Mar. Ecol. Prog. Se.*, 91: 253-264.

[3] Quiniou F., Guillou M., A. Judas, 1999. Arrest and delay in embryonic development in sea urchin populations of the Bay of Brest (Brittany, France); link with environmental factoring. *Mar. Pollut. Bull*., 38 (5): 401-406.

[4] Soualili D. L., 2008. Natural populations of sea urchins: an evaluator tool of the state of health of the Bay of Algiers. *PhD thesis*. University of Algiers, 130p.

[5] Pagano G., Cipollaro M., Corsale G., Esposito A., Giordano G. G., Ragucci E., Trieff N. M., 1988. Comparative toxicities of Benzene, Chlorobenzene Dichlorobenzene and Sea Urchin Embryos and to Sperm. *Bull. Environ. Contam. Toxicol*., 40: 481-488.