

Structuring conditions of benthic macroinfauna on sandy beaches in lagoonal environment

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INTRODUCTION

On exposed sandy beaches, the physical environmental properties act directly through the swash climate (breaker height, wave period and turbulence), beach slope and sand grain size (Bayed 2003, Defeo & McLachlan 2005) independently of tide regime (microtidal, mesotidal or macrotidal). Many beach classifications have been proposed and the most relevant ones were based on the morphodynamic features (e.g. Bayed 1991). Some morphodynamic indices were proposed (beach state index, beach deposit index, beach index, etc.) to classify beach types (cf. Defeo & McLachlan 2005).

Sandy beaches are not restricted to the coastal zone that is directly exposed to marine actions. These can also occupy transitional areas as downstream zones of estuaries and lagoons. In these cases, the morphodynamic features may significantly change. The exposure rate is smaller, the energy of wave breaking is lower and the slope is generally gentler (Yamanaka et al. 2010). Consequently, also other ecological characteristics may be involved as structuring factors for macrozoobenthos, e.g. salinity, current velocity and silt content. These intertidal sandy zones undergo a dual influence, a marine one during flood tides and a lagoonal one during ebb tides.

The aim of the present research is to compare the community structure and composition of the macroinfauna inhabiting in the inner zone of the Walidia lagoon (Morocco) with those from other Moroccan sandy beaches, directly exposed to the Atlantic Ocean.

MATERIAL AND METHODS

The lagoon of Walidia (32°45'N 9°3'W) located on the Atlantic coast has a stretched shape with 7.5-km length, 0.5-km mean width. The depth is ranging

from 6 m close to the lagoon entrance to 0.5 m at the lagoon inner part. The tide currents can reach 77 cm/s during spring tides (Hilmi et al. 2004-2005). The tidal range varies between 2 m during spring tides and 0.6 m during neap tides.

Three stations, S1, S2 and S3, were chosen located respectively at the lagoon entrance, 0.9 km and 1.5 km in the inner part of the lagoon. Quantitatively samplings were carried out in March, June, September and December 2007. The sampling area at each station was of 0.15 m². Water temperature and salinity were measured during each sampling campaign at low spring tide and at the same time of the day. Samples of sand were collected to estimate the median grain size, silt content and organic matter content.

RESULTS AND DISCUSSION

From the lagoon mouth towards its inner part, the intertidal sandy zones of Walidia showed decreasing gradients of hydrologic parameters (temperature: 19.0-17.0°C; salinity: 35.2-32.9) and median grain size (347-262 µm). From the biological point of view this was associated to increasing gradients of biotic parameters (species richness, abundance and diversity H'; Shannon-Weaver's index) (Table I). Farther away from the lagoon entrance the physical effect of waves was limited and the decreasing instability promoted the settlement of molluscs with higher dominance particularly at station 3. This beach is considered an ultra dissipative system (Defeo & McLachlan 2005), having with a gentler beach slope that promotes interstitial water's retention. As a matter of fact, the sand becomes less compacted especially for burrowing species like molluscs. The same observation was reported for the Moroccan sandy beaches where Donacidae mollusc abundances increased on dissipative beaches compared to intermediate beach types (Guillou & Bayed 1991). Species number of molluscs was clearly lower on

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those sandy beaches than on the intertidal sandy zone of Walidia lagoon.

Table I: Biotic parameters measured on the intertidal zone of the Walidia lagoon at three stations between March and December 2007 (Dom. = dominance).

Parameters	Station 1	Station 2	Station 3
Total species number	6	12	19
Mean species number	1.75	5.75	7.25
Mean abundance	3.75	34.25	41.25
Mean H' (bit)	0.63	1.69	2.24
Mean Dom. Crustacea (%)	35.0	16.9	31.0
Mean Dom. Mollusca (%)	25.0	46.5	57.7
Mean Dom. Polychaeta (%)	40.0	36.3	11.3
Mean Dom. Cnidaria (%)	0.0	0.3	0.0

Polychaetes exhibited an opposite trend than molluscs and seemed to prefer the areas close to the lagoon mouth, where the granulometry, slope and drainage were clearly higher. As matter of fact, the Spionidae *Scoloplos armiger* predominated under these environmental conditions.

MDS analysis applied on abundance data showed that the three stations contained a unique and the same community with marine affinity, whose dominant species were *Urothoe grimaldii* and *Scoloplos armiger*. On the Moroccan Atlantic sandy beaches, *Urothoe grimaldii* with *Donax trunculus* constituted a sub-community for the saturation zone, settled on fine sand with coarse sand content not exceeding 10% (Bayed 1991). This sub-community was recorded on many sandy beaches near of Walidia (e.g. Azemmour and Essaouira) or far from Walidia (e.g. Asilah, Agadir and Tarfaya). *Scoloplos armiger* was less frequent on these beaches and was only found at Agadir beach (Bayed 1991). The macrofauna community identified on the intertidal sandy zone of the Walidia lagoon is thus similar to that of sandy beaches open to the ocean but it can differ regarding

S. armiger abundance that indicates the marine influence.

The analysis of macrofauna composition did not reveal any eutrophication traces in this internal part of the lagoon. The tide currents were strong and consequently the silt and organic matter contents in the sediment were lower (0-0.17% and 1.49-3.9% respectively) because of the non-occurrence of fine particle sedimentation and related organic matter trapping.

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