



Ecological and Environmental State of the North-western Algerian Coast

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Author's contribution

This whole work was carried out by the author BD.

Original Research Article

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ABSTRACT

The present study is an analysis of the evolution of the ecological environment natural habitats on a number of years framed in three decades. It is interested in the coastal ecosystem (ecosystem, habitat nature, and *Posidonia*) in Oran (Algeria). The research activity has exactly been guided in the Department of Biology, Faculty of Life Sciences and Nature, Oran University, the North-West of Algeria 2012-2013. The methods used in the study are largely based on several environmental and ecological data acquired during the last thirty years, supplemented by field research and personal observations (dives, offshore work, surveys along the coast). Then the data were collected to arrive at the proposal of a scalable representation of the band of the Oran coast state. During the last thirty years the western Algerian coast has experienced a loss of space and of species (Macta, Kristel, Ain El-Turk Village), and urban expansion has occurred mainly along the coast. The touristic, industrial, and residential development has not taken environmental quality into consideration and has largely contributed to its degradation and to the pollution of the marine and coastal local ecosystem (Targa and El Maleh zone). Today the local environmental and ecological factors are displayed and their variability is relatively identified. It is just as critical to generate studies and efforts to protect the coastal species and habitats, as well as oversight and ongoing discussions of the existing rich ecosystem. Also, laws in favor of marine and coastal resource protection must be applied.

Keywords: Evolution; coastal retreat; anthropogenic effects; Oran's coast.

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1. INTRODUCTION

The maritime frontage of Oran represents a largely open basin towards the Mediterranean, and offers a much diversified configuration and ecological environment, a coast low, sandy, rectilinear and monotonous, rock sectors and coasts with cliffs [1,2,3-8]. The geomorphology of this margin is under the complex dependence of the structural features, the ecosystem and the climatic control of the mechanisms of erosion since the configuration of the Mediterranean.

By virtue of its great biodiversity and richness, the Algerian coast is a gigantic natural reserve of significant resources and potential that must be safeguarded and protected from various natural and anthropogenic disturbing factors [9-12]. During the last decade, significant erosion accompanied by notable development, with limited regulation, has generated significant and remarkable topographic natural redesign.

The coastal risk factors can be ranked on the basis of several criteria in the following order of influence: Biological, geographic, geomorphologic, and hydrodynamic [1,13]. One of the greatest dangers threatening this coastal ecosystem is the erosion or retreat of shorelines and seafloor. Population concentration in the coastal communities of western Algeria has importantly evolved in the last decade [2,14,15].

The most important purpose is to analyse the Oran environment and ecological coastal state and its related to an alternation of stable and unstable periods during which its diagram becomes complicated by the intervention of several factors, among which the most significant is anthropogenic, and who have trophic and metabolic consequences.

2. MATERIALS AND METHODS

Firstly previous studies and maps (produced by The National Institute of Cartography, INCT) in the Oran area were documented and confirmed [16-20], then a series of monthly follow-up photographic missions and profile surveys were archived. In some cases, specific surveys from the top of the sea cliffs in order to measure the active retreat of these were realized. This is a raised profile of the base to the cliff summit, taking into account the nature of different parts of the cliff and the mode of its erosion (landslide, slide, collapse) in order to understand the various modes of degradation, erosion and cliffs evolution, and therefore better manage their protection and restoration [1] (Fig. 1).

2.1 Sea Recognition

During five years (2009- 2013), several dives was realized in the Oran coastal zone to confirm the location of sea grasses, especially *Posidonia oceanica* [18-20]. These locations were generally observed quarterly (after localization of the *Posidonia* areas by aerial photography). Added to this data the statistics provided by the environment office of Oran, Mostaganem and Ain Temouchent. The observation, localizations and the locations of the herbarium requires a comparison with the results of previous series of other plunging (by amateurs and professionals of the sea), throughout the year to measure and monitor the extent herbarium [21-23].

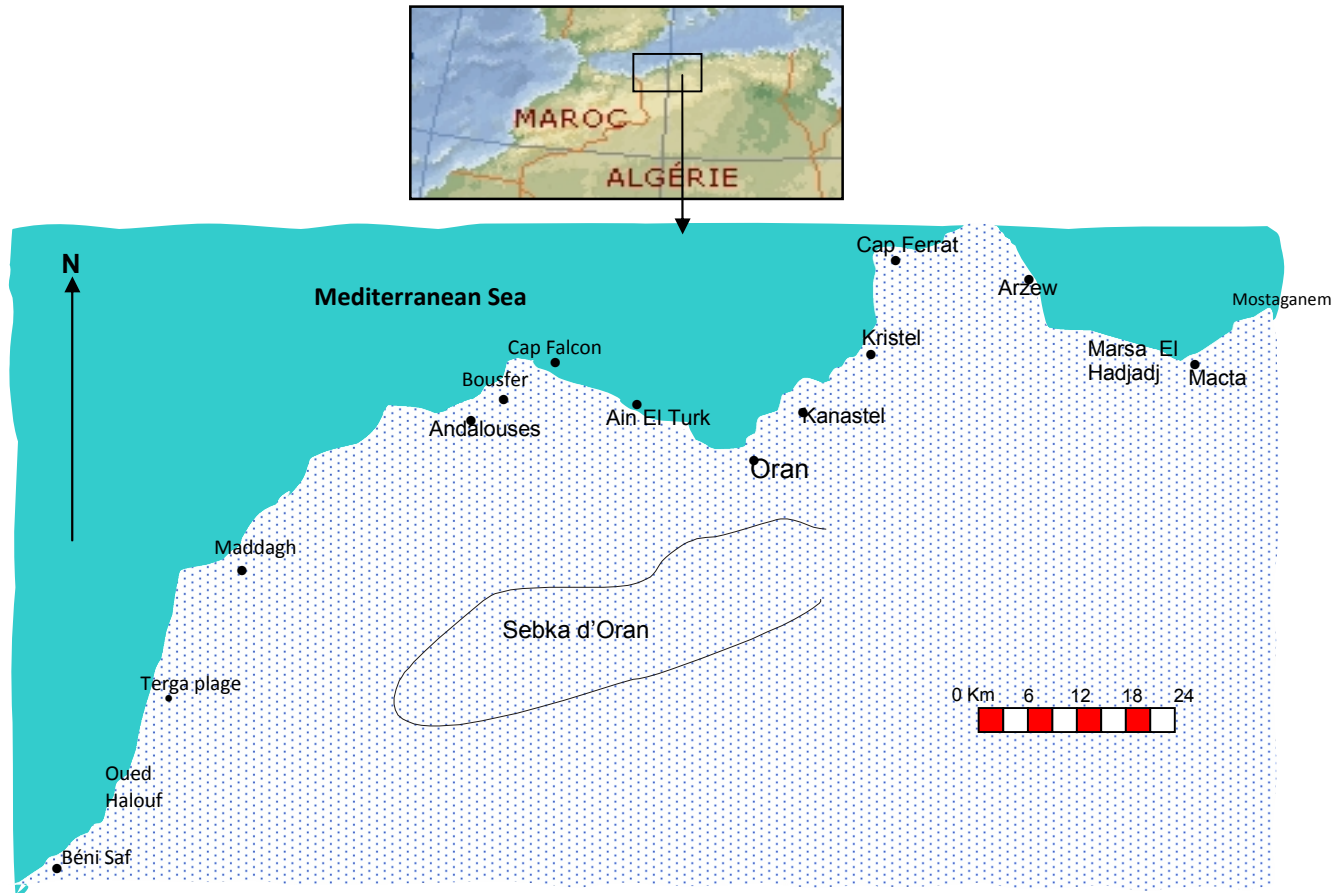


Fig. 1. Study areas

2.2 Coastal Investigations

Fishermen and browsers and guests in different ports in the area (Oran's ports, Kristel, Arzew, Mrasat el Hadjadj, Beni saf, Bouzedjar, Mostaganem) were surveyed. The important result of this process is a database with accessible knowledge having an ecological and economic aspect which enable us to produce a typology of coastal ecosystems at a local level, their economic importance and support forcing [6-8]. Then, integrated the data set conquered in investigations with another data from field work and analysis of ecological, economic and eco-environment characteristic.

3. RESULTS

3.1 Coastal Retreat

Comparison of old documents with more recent data (Different profiles of topographic maps, map showing the evolution of the coastline and the urban aspect, sets of data on the extent of the *Posidonia* herbarium, climate data) produces insight into one cycle of about 100 years (Fig. 2). This permits an estimation of the acceleration of coastal retreat, especially with regard to the cliffs. These retreat are slower than the lowland areas. Aerial photography is less accurate near the cliffs than in the low-relief areas.

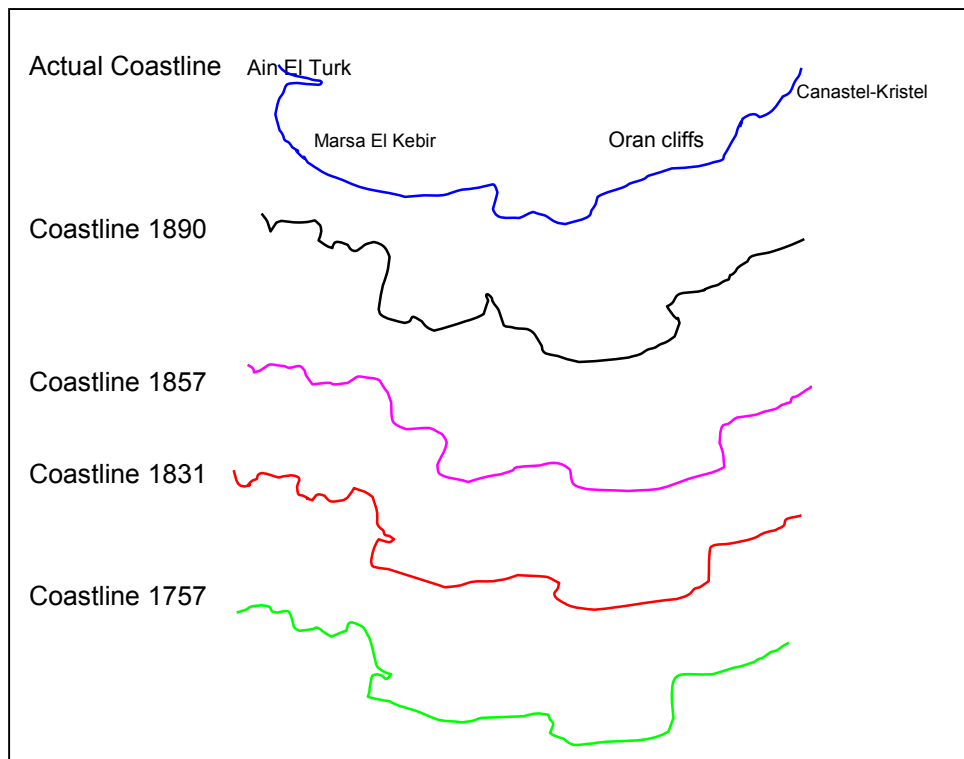


Fig. 2. Evolution schematic of the Oran's coastline

In the case of local slumps like Kristel, the analysis of the role of various geodynamic factors (content, dip, layering) is better, as well as the one of external factors (precipitation, runoff, land use, seism) and marine erosion. However, it is important to understand and consider this marine erosion as relative to other factors (human activity, climate, hydrology) (Fig. 3).



Fig. 3. Platform left after the regression of a cliff (Marsa El Hadjadj).

3.2 Littoralization and Urban Configuration

Oran's coastal zone is marked by pronounced stress caused by urban development where building regulations are quasi-absent. This unplanned development has led to the degradation of the inherited natural environment (Fig. 4).

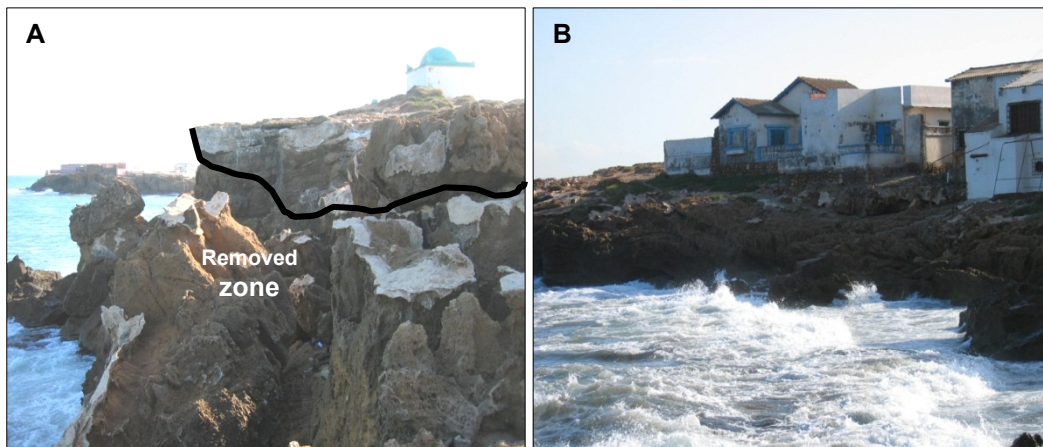


Fig. 4. Reduces cliffs (the coastline) and habitat destruction, El Marsa Hadjadj (Oran's coast).

*A: Posting an important area of cliff;
B: Housing abandoned after the fall of the line.*

The urban zones are organized as follows:

- A sector of one million inhabitants (Oran);
- A sector of 150,000 inhabitants (Mostaganem);
- Intermediate sectors with 20,000- 100,000 inhabitants (Beni Saf, Ain El Turk, Arzew) and some small villages (Terga, Sassel).

Practical organization of urbanization of the coastal is seen also in:

13,230 hectares for home construction;
2800 hectares for industrial zones;
370 hectares for harbor zones.

The littoralization and urbanization threatens the balance of the entire coastal system:

The building of many residential and industrial sites (at different spots on the coast of Oran, Ain El Turk, Cap Falcon, kiristel, Arzew) and touristic sites create a complication which smoothens numerous beaches and degrades the coastal and marine environments' states.

The last thirty years have witnessed unplanned urban development having caused very significant and grave exhaustion, degradation, and pollution of the marine environment. These unplanned developments have caused a destabilization of the topographic relief (in the case of the Canastel cliffs) and an imbalance of the coastal system (in the case of Cape Falcon) (Fig. 5).



Fig. 5. Destruction of caves (habitat of monk) by the dual action anthropogenic and natural marine

The different types of adjustments and deteriorations of the coastal and marine ecosystems, originating from human activity, are at the source of damage due to some major factors stabilizing the coastal system (Fig. 6).

Some distinction in the distribution of seagrass was reached. The more remarkable regression was observed in the area of Oran compared to Mostaganem and Ain Temouchent sectors. This can be explained by the relative stability of the coastline and urbanization dynamic along this areas (Fig. 7).

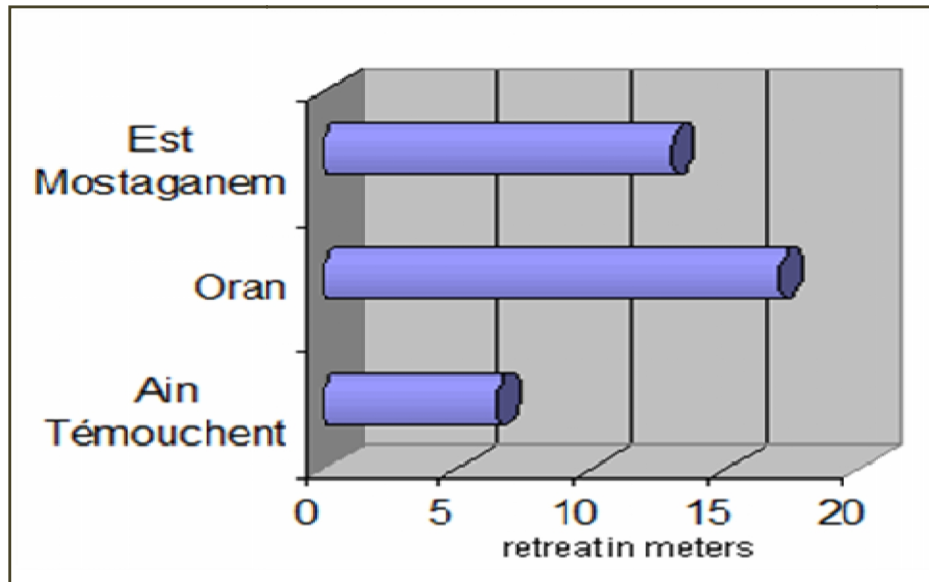


Fig. 6. Actual Oran's coastline retreat

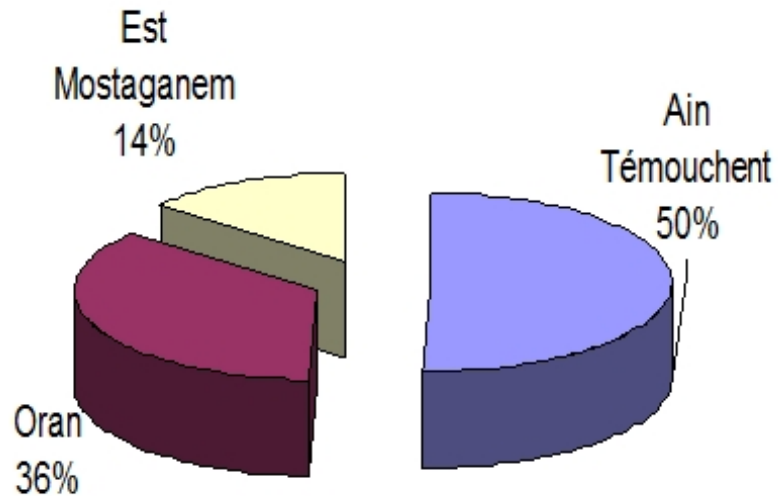


Fig. 7. The *Posidonia* herbarium regression in the Western Algerian coast

4. DISCUSSION

The western Algerian coast has retreated largely because of the random urban and industrial development (Macta, Kristel, Ain El Turk); these projects (Road construction, factories, residential sites) have reduced and even halted alluvial contributions from the various rivers, especially around Macta. The increased need for sand and gravel for these projects have overexploited the supply from the rivers and beaches (Terga). Furthermore, the overexploitation of coastal sands, as it is the case of the Terga pit upsets the coastal ecosystem and enhances the coastline degradation which is accompanied by major reconfigurations of natural landscapes, in addition, to the small industrial installation planted along the coast without any assessment. This is evidenced by the flood that caused much human and material damage in the region of Terga in 2000 following a rise in level base of the El Maleh oued and sea level [1,2,6].

Furthermore, numerous rivers were redirected from their original course (Macta, Arzew, Kristel, Oued El Halouf), causing different ecological perturbations. Indeed, a breakdown of the spatial whole ecosystem as was the case of separation by a road installed in 2005 at the Macta area, causing a real obstacle to the progress of water and natural flow of sediments and alluviums into the sea, it is in this part of the Oued suffered significant physical and biological disruption. The first are materialized by water projects, traffic and the alluvium extraction. The second are presented by the urban and industrial discharges, consequently thus disrupts all physicochemical parameters of the coastal zone (salinity, temperature) The density of new building (Road, factories, and residential sites.) in already crowded areas (Oran, Cape Falcon.) creates hazards to man as well as destabilization and deterioration of topography and ecosystems. In conclusion, the coastal development has disturbed the hydrodynamic conditions and has caused erosion to exceed sedimentation. The disappearance of many sands beaches which have been replaced with pebbles beaches (Bousfer, Ain Turk, Cap Falcon) confirms the creation of a erosive dynamic greater than sedimentation.

Similarly building and roadwork have worsened slumping, especially because a good part of the soil near Oran (Canastel, Kristel, Terga) consists of sandy clays and sands [1]. For instance, the cliff at Canastel may collapse at any time ((This is due to the nature of sand and clay cliffs and confirmed following the collapse of several of these cliffs in recent years, but following the latest trembling that struck the region in contrast to other coastal areas of Oran).

It is necessary to examine a typical cycle of coastal erosion dynamics. That need is at the effectiveness of defensive action plans for protected and safeguarding the coastline and coastal equilibrium. This might consist of varied layers (representing erosion, crumbling, and slump), of low frequency, of marine or continental origin. The reject of various human activities and constructions along the coast are clearly seen.

The *Posidonia* beds represent one of the most important Mediterranean ecosystems damaged by human activity. This ecosystem contributes largely to the stabilization of the sea floor, particularly near the sandy coasts.

Posidonia is considered as the veritable lungs of the sea because of the enormous quantity of oxygen generated each day. Many benefits can be discerned from this rich Mediterranean habitat:

Stabilization of unconsolidated sea floor (underwater dunes) driven either toward the coast or toward the deep sea. In this case the modification of the profile would lead to the disappearance of the beaches.

Reduction of wave and surge forces and protection of the beaches.

The retreat of the *Posidonia* meadows creates a general regression in the biological richness of its habitat. Man's harmful effect is clear. Indeed, near the cities, coastal villages and harbors, the decline of all marine ecosystems is striking. All along the coast, human pressure is felt (strong demography, the phenomenon of littoralization).

Moreover, in addition to man's occupation of most of the *Posidonia* habitats, man has invaded other areas previously frequented or inhabited by many marine organisms (caves, coastal plains, islets, and islands) and contributed greatly to their disappearance [11].

This situation has created a spatial rupture of the entire ecosystem, as in the case of a road newly laid out in 2006 that caused a division of the Oued of Macta and thus is an obstacle to natural routing of water and alluvium to the sea. Significantly, it is this part of the Oued that has undergone major physical and biologic disturbance, first as a product of hydraulic and road layouts and alluvial mining, and secondly as a result of urban and industrial wastes. However, the main urban planning, water treatment, health, and transport programs, all related to good environmental quality, stand as written laws (Law n° 83-03 of 5 February 1983 qualified to the environment protection) without being applied.

5. CONCLUSION AND RECOMMANDATIONS

It remains to analyze the response mechanisms in the evolution of ecological events observed, the role of the wind at the coast (intensity, orientation). Spatiotemporal variability of the ecological factors and the coastal ecosystem state is under the influence of the respective changes in sea level, continental inputs and anthropogenic pressure.

The intensification of industrialization and urbanization has caused strong significant harmfulness's incompatible with the requirements of the fishery. Thus, an overall management of coastal and offshore, from purely scientific arguments, could reconcile the needs of man and the preservation of space and natural capital used. However, scientific and technical achievements should enable both to avoid past mistakes and to consider a rehabilitation of degraded sites. Indeed, it is certain that if the anthropogenic pressure decrease on the coast, a restoration of *Posidonia* meadows is guaranteed.

Furthermore, the different locations, urban and industrial installations, port, and road lack of impact study. The basement in this case is an eco-environmental planning and management for the coastal environment in the future. Such an approach is to assess the overall ecological and environmental factors of the area in question, and then combine them to report their impact on the plans, with clear vision and overall environmental conditions before and after any installations.

It is just as critical to generate studies and efforts to protect the coastal species and habitats, as well as oversight and ongoing discussions of the existing rich ecosystem. Also, laws in favor of marine and coastal resource protection must be applied.

On the Oran coast and throughout the Mediterranean, *Posidonia* beds protect the coast by acting as sediment traps and by reducing surge energy. Moreover, even after their death, the plants pile up along the beaches, forming a baffle for the surge intensity and preventing beach erosion. The survival of the *Posidonia* beds requires a sedimentation rate of no more than 5 mm/year.

It is critical to note that long-term development requires protective management of existing resources (countryside, nature, and building) in order to allow their rejuvenation and passage to future generations.

Long-term development requires the input of specialists as much in the follow-up phase as in the building phase. Collaboration of scientists and policy-makers is in the interest of successful development.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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