COASTAL ZONE MANAGEMENT IN PORTUGAL

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INTRODUCTION

The intense rate of the occupation, use and transformation of various Portuguese coastal zones has been reported as worrying. There was a continuous pressure towards consolidation, growing density, and expansion of building on waterfronts. The model adopted in various Municipalities along the coast, despite not being openly assumed in the Municipal Land-use Plans, is equivalent to an effective consolidation and densification of the construction along the coast.

The Northwest Atlantic tide (up to for spring tides), the wave regime (storms above significant wave heights almost every year) and the associated littoral drift currents (up to m^3 of annual potential sediment transport) are very severe and there is a global process of coastal erosion (fig. 1). There are several problems of cliff instability also (fig. 1).

The beaches have high recreational and high protection value. There are zones with well-preserved beaches and fields of sand dunes but also narrow and degraded stretches with urban settlements at risk. The causes of the present situation of generalized coastal erosion have been identified as a coastal response to the weakening of the river sediment sources and river sediment transport, the mean sea-level rise, the human occupation of waterfronts, harbour breakwaters and dredging activities.

Several built waterfronts have increased the vulnerability to erosion and direct wave action and have been protected by groins and seawalls. There are 35 five groins, with lengths between 100m and 300m and several km of seawalls and other adherent works. Only two of groins have been built after 2000 but all of them need a major maintenance every 10 years (average) and small interventions every 2 years.

Up to the end of the 1980s "Coastal Protection" was exclusively associated to the construction of protection structures (seawalls and groins) to reduce the risks of exposure of the edified building fronts to erosion and storms (Vasco Costa *et al.,* 1996). There was no effort at land-use planning - which has objectives that are much greater than just reducing such risks (although these also have to be studied and reduced). The

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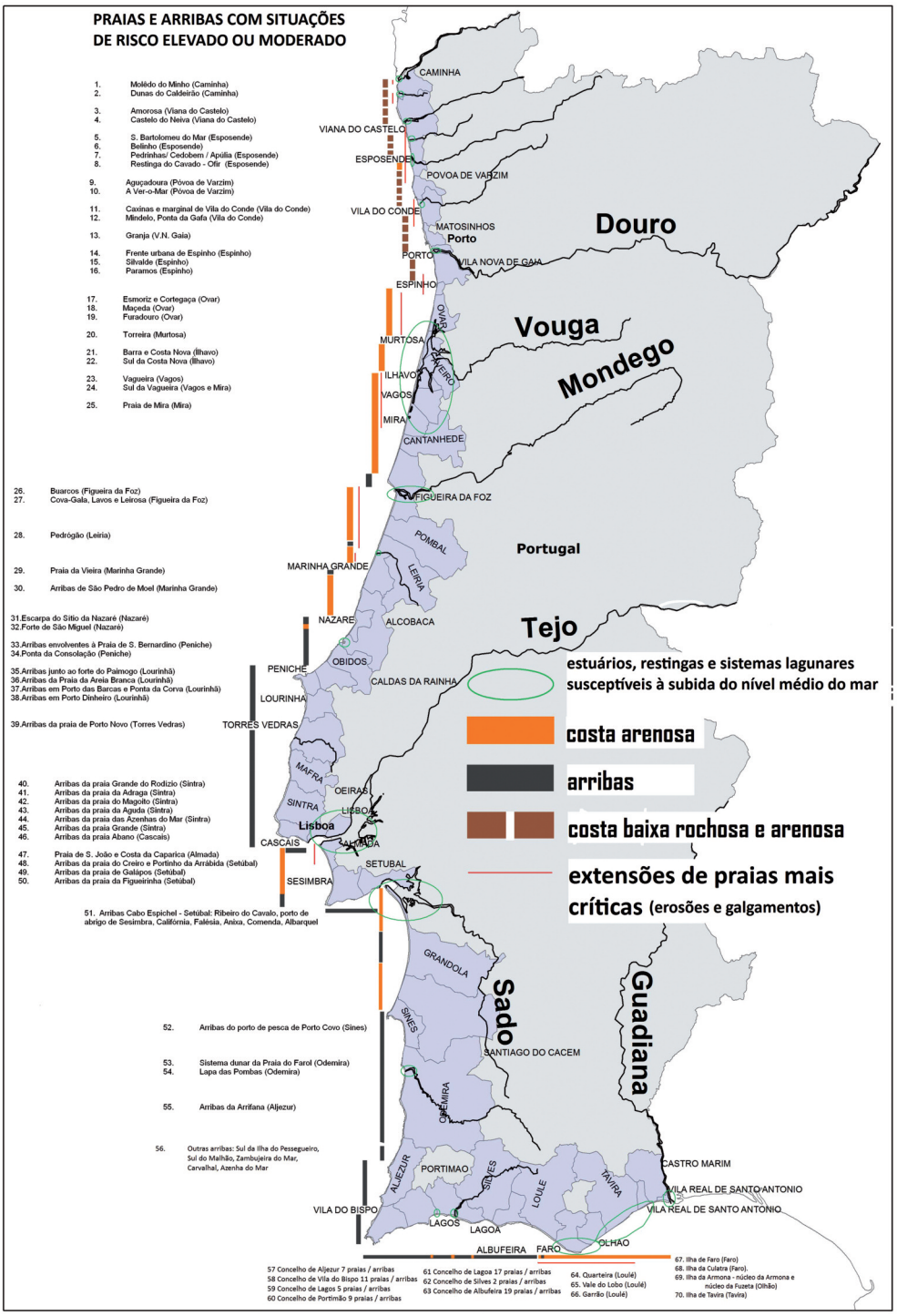

Figure 1. Characteristics of Portuguese continental coast (sandy coast, cliffs, low sandy and rocky coast). Beaches and cliffs with a severe or moderate risk situation.

coastal protection structures may permit a reduction of such risks, but they do not cancel or reduce them to predictable levels when the time span adopted in new building projects is taken into account.

In 1992-1993, jurisdiction of coastal zones was turned from the Direcção Geral de Portos (Directorate-General of Ports) to the Ministry of Environment with exception of harbour areas. But other ministries and agencies are involved in the coastal management resulting in an undesirable fragmentation of responsibilities.

COASTAL MANAGEMENT PLANS (POOC)

The Coastal Management Plans (POOC: Law 309 of 2 Sept. 1993, Law 218 of 20 August 1994, Decree Law 151 of 24 June 1995, Law 5 of 29 February 1996) were a first step towards an integrated management of the Portuguese coastal zones. They are sector-based plans that define the conditions, endowments and dominant uses, the localization of their support infrastructure (namely for beach support) and that will guide the specific activities on the coast (between sea bottom level and a land protection zone with a maximum width not exceeding from the seashore limit line), with a view to safeguarding fundamental ecosystems, ecologically sensitive areas and the existing resources.

An Action Plan for the period 2007-2013 has been implemented by the Ministério do Ambiente, do Ordenamento do Território e do Desenvolvimento Regional, 2007.

The preservation and valorisation of areas of natural interest, the recuperation of the landscape and cultural values, the implementation of efficient basic sanitation infrastructures, the improvement of the local population's living conditions and the reduction of risk exposure are important achievements.

From an assessment of the nine POOC implemented in the continental Portuguese coast during the last twelve years, one can conclude that the overall balance is certainly positive.

Some key points and contributions are presented in order to overcome some of the constraints and threats:

- The exclusion of the "areas of harbour interest" within the POOC intervention areas constituted an important limiting factor in the integrated approach to the coastal problems, especially as these areas and the corresponding harbour infrastructure are frequently located in estuary zones, that drastically reduce the transport of the sediments, which are essential to supply the beaches and include urban fronts and bathing zones. Amongst others, the problems of impact of the breakwaters and navigation channels, removal of marine and estuarine sediments, road accesses and industrial localization are not susceptible to a geographically and institutionally compartmentalized approach. This legal aspect should be revised but it was not.

- Outside the harbour areas there was no monitoring adequate programme or even up-to-date topo-hydrographical studies of the POOCs' intervention areas. This very important drawback should be overcome before revision of POOCs.

- The implementation of the POOCs is, in several cases, very difficult in relation to the acuity of the present problems, to the expectations created by the proposals in the previous Municipal Plans, and to the existence of a marked conflict of interests and of the users.

- As it happened twelve years ago, the teams of the consultant companies that will prepare the POOCs revision have somewhat different scientific and technical backgrounds and can use different methodologies, which together with the specificity of the seafronts being analyzed and the set-up and attitudes of the accompanying commissions and coordination institutions, can led to final products of differing quality, technical and scientific detail, that are reflected in the proposals.

- The interventions undertaken in the Portuguese and basins related to the construction of dams and the diversion of the water flow influence the coastal waters and, especially, on estuaries and lagoon systems. The reduction in the flow of solids, the progression of saline intrusions to higher and neighbouring areas and the waters' reduced capacity for self-renovation are impacts that must be assessed.

- The capacity to forecast the medium and long-term evolution of beaches, dunes and barrier-islands continues to be very limited due to scientific reasons. Apart from this limitation, many years of hydro-morphological characterisation were lost (namely, and at least, topo-hydrograhical studies) that are essential for the quantification, comprehension and forecasting of the phenomena. Coastal risks evaluation related with anthropogenic actions, climate variability and climate change and adaptation measures will be a great challenge.

The Portuguese Coastal Zone Management Plans (POOC) should be under revision (in fact just one of them is being revised) as well as the National Water Plan (PNA) with a special focus on the prevention and management of coastal risks. River Basin Management Plans (PGBH) have been prepared and are at public discussion. Estuary Management Plans (POE) related with four rivers should be elaborated by Law but there is a delay.

The Maritime Management Plan is being developed. So a difficult "puzzle" must be solved during the next years but the development of the different planning figures with implications on the coastal zones, if they are correctly integrated, co-coordinated and implemented is an important step forward the ICZM and thus on the quality of its environment.

Several "key messages" were presented as a contribution for the revision of the Coastal Zone Management Plans.

Veloso-Gomes *et al* (2011) present a comprehensive report about the Coastal Management Plans approved for the nine Islands of the Autonomous Region Azores. The report identifies best practices and problematic issues related with territorial management, land use and urban areas, water resources, natural, landscape and cultural heritage, vulnerabilities, risks and coastal protection, commercial and small fishing harbours, coastal tourism. The archipelagos of Azores and Madeira are of volcanic nature with rocky high cliffs (Fig. 2).

Figure 2. Azores. Santa Maria Island. Old wale harbour.

In the Autonomous Region of Madeira Islands there are no Costal Management Plans. This is a very sensitive problem. Despite the mild or moderate wave climate several coastal floods related with fluvial and debris streams and wave damages have been reported.

DUNE MANAGEMENT

The coastal forested areas and dune fields have played and should continue to play a very important role in the defence of the natural values of the seashore, constituting buffer zones in relation to the indiscriminate occupation of the land. Their preservation and valorisation are one of the main priorities.

The conservation, reconstruction and stabilisation of the coastal dunes, their protection from construction projects and pathways, as well their replanting with vegetation, are actions that were undertaken mainly during the last ten years by the Governmental Agencies and Municipalities. At present there are several interesting dune rehabilitation being undertaken on the Portuguese coast. The conservation of dunes and their replanting with vegetation should merit special attention due the rapid degradation that is occurring in areas of easier access and even in remoter ones that at present are increasingly being used by off-road vehicles and motorcycles. The importance of the dunes, especially the primary chain, is internationally recognised and one of aspects to be considered is the reserve of alluvial sources and of the adaptive barrier to run-ups and overtopping they supply.

Unfortunately, in view of the size of hydro-morphological imbalance that is occurring on the Portuguese coastal areas and the high wave energy present, the dune conservation, reconstruction and stabilisation measures, by themselves, will not lead to a stabilisation or even an inversion of the erosion situation. But they will be an important contribution, not only in terms of slowing down the ocean's advance but also in terms of protecting and recovering other natural values.

During the last decade an extensive dune rehabilitation programme has been carried along the Portuguese coast. Several other projects are being developed under three Polis programme in coastal municipalities (Litoral Norte, Aveiro and Algarve).

ARTIFICIAL SAND BEACH NOURISHMENT

On the Portuguese northern West coast the potential littoral drift transport by oblique waves can reach up to two million cubic meters per year. Coastline retreat and erosion

are critical issues and several coastal protection structures exist. Artificial sand nourishment can be an unfeasible solution if there are no transverse structures. This is what happened in West coast, Porto (Castelo do Queijo), where 1.9 Mm^3 nourishment project (1993 /1999) from harbour dredging activities had a small positive impact on the beach width.

Artificial sand nourishment has been performed in Algarve (South coast): Praia da Rocha (1970, 0.9 Mm^3; 1983, 0.1 Mm^3), Praia do Vau / Três Castelos (1983, 0.4 Mm^3; 1996, 0.64 Mm^3; 1998, 0.51 Mm^3), Vale do Lobo (1998, 0.7 Mm^3; 2006, 0.28 Mm^3), Quarteira / Vale do Lobo / Vale do Garrão (2010, 1.25 Mm^3), Vilamoura, Albufeira (2011, 0.6 Mm^3). Other small nourishment works have been carried out.

The approved option for protection of the coastal stretch between Costa da Caparica - Cova do Vapor, located on southern bank opposite to Lisbon of the Tagus river inlet, is being implemented and was divided into several phases (Veloso-Gomes, 2003; Veloso-Gomes et al, 2004, 2009):

- First phase – October 2004 / May 2005 and October 2005 / May 2006: Reshaping the existing groins: increasing the length and reconstruction of those that will have a "structural" role and reducing the length of those that could be dismantled in the medium-term; Reshaping the existing seawall in the urban waterfront.

- Second phase: Dune rehabilitation and protection where there are no seawalls due to reasons of safety and natural protection; Urban seafront rehabilitation (POLIS Program concluded); Seafront urban development control in the coastal zone South of the groin field (Coastal Master Plan approved in 2003 by the Government after public discussion) due to reasons of safety and natural protection; Cova do Vapor settlement retreat (Coastal Master Plan approved in 2003 by the Government after public discussion) due to reasons of safety and landscape; Artificial sand nourishment of the beaches and dunes (Fig. 3), with 3.5 million m^3 of sand dredged from the navigation channel as the source of sediments (0.5 million m^3 were nourished in July-September 2007; 1 million m^3 in August-November 2008; 1 million m^3 in 2009 and another). Due to economic restraints the artificial nourishment operation has not been completed yet.

The artificial sand nourishment programme on the Costa da Caparica beach is the most important in the Portuguese West coast. The sand nourishment operations were performed without major conflicts with stakeholders (beach users, surfers, fishermen, camping users, restaurants, anglers) and without personal accidents (Veloso-Gomes et al, 2004).

There is no past experience on the Portuguese West coast concerning nourishment life-spans in highly energetic environments. The life-span of the first nourishment program will be very important to improving the cost-benefit analysis. So a comprehensive monitoring program has been implemented: Coastal structures surveys, hydrographical surveys and complementary hydrographical surveys immediately before and after artificial nourishment operations, aerial image surveys and sediment size surveys.

The project considers that after nourishment the final beach profile will be "shaped" by the local wave conditions. The sand budget within several control "windows" of

Figure 3. Groin field, seawall and artificial beach nourishment at Costa da Caparica.

the system, for different time scales, has been evaluated through the comparison of several surveys. The results are very important in order to quantify the technical interventions, to adjust technical procedures and for evaluation and understanding and improving knowledge of the dynamic process in the area, as well as to improve design and maintenance of future coastal protection interventions.

New numerical modelling simulations benefit from new field data that was inexistent in the past. Simulations include a potential construction of submerged breakwaters structures using sand-filled geo-textile tubes as a complementary solution to the groin field and sand nourishment to sustain the nourished sand on the beach.

BREAKWATERS AND DREDGING CHANNELS

Maritime transport is one of the most important vectors of international trade. It makes more than 80% of this trade possible. The breakwaters and dredged navigation channels to commercial, fishing and leisure ports are essential to the safety and operability of maritime and riverine-maritime navigation. However, they introduce a "barrier" effect to the transport of solids to the coast, an effect that is persistent and which can be aggravated by increases in the number and size of such structures. It is essential to mitigate these consequences.

There are strong erosion problem in the Portuguese coastal stretches namely down drift the main harbours provided with large breakwaters: Viana do Castelo, Póvoa de Varzim, Leixões, Douro, Aveiro (Figure 4), Figueira da Foz, Vila Moura / Quarteira. The same problem happens downdrift the main dredged navigation channels in river estuaries (Tagus).

The main groin fields and seawalls for coastal protection are located in:

- Esposende (South river Cávado estuary and harbour).

Figure 4. Southern part of Aveiro South breakwater. Beach with evolution (between July 2004 and August 2011). Dredging works were done at the navigation channel.

- Espinho/ Esmoriz / Cortegaça (South river Douro estuary and Leixões harbour).
- Costa Nova / Vagueira / Mira (South Aveiro lagoon and Aveiro harbour).
- Cova / Gala / Leirosa (South river Mondego estuary and Figueira da Foz harbour).
- Costa da Caparica / Cova do Vapor (South river Tagus estuary and Lisbon harbour).
- Vilamoura / Quarteira (East Vilamoura marina and Quarteira fishing harbour).

The groins are made of rocky stones up to 120 kN. The exceptions are two groins (Espinho) where 300 kN tetrapod blocks were used.

INTEGRATED COASTAL ZONE MANAGEMENT STRATEGY (IZCM)

European Coastal Member States were encouraged in May 2002 through a Recommendation of the European Parliament and of the Council (2002/413/CE) to elaborate and implement, by February 2006, a national Integrated Coastal Zone Management Strategy.

A Technical Report "Basis for a National Strategy for Coastal Zone Management" was prepared (June 2006) by a Working Group for the Portuguese Ministry of Environment and Territorial Planning (Veloso-Gomes et al. 2007).

A SWOT analysis was presented considering several coastal key subjects within the following domains: Biophysical systems; Uses, Activities and Vulnerabilities; Management.

The last version of the Strategy for IZCM was prepared by the national Water Authority (Instituto da Água INAG) and it was approved in 2009 by the Portuguese Government as a Law entitled "National Strategy for Coastal Zone Management" (ENGIZC, Government Resolution 82, Diário da República, 8th Sept. 2009).

Veloso Gomes (2011) presents a critical comparison between the proposals of the technical Report "Basis for a National Strategy for Coastal Zone Management" prepared for the Portuguese Ministry of Environment and Territorial Planning (June 2006) and the approved Law entitled "National Strategy for Coastal Zone Management" (ENGIZC).

Between 2007 and 2009 several changes occur in the legal and institutional framework related water and water resources. The new Water Law, the definition of a national

Water Authority and the creation of new regional Water Authorities have strong implications on Coastal Zone Management with very important positive aspects but also negative consequences. The regional bodies are closer to the problems and this is very positive but the aim of reducing fragmentation of responsibilities and competences on the CZM has not been achieved. The regional bodies have lack of human and financial resources and the articulation of different competences within should be clarified.

So far the areas under port jurisdiction have not been integrated in the coastal management plans and this has been considered by the Working Group as a key issue.

The adopted model of Governance seems to be a mixture of strengthening the role of the State and public policies with Public-private cooperation.

The approved Strategy for Integrated Coastal Zone Management in Portugal is a good initiative and should be implemented taking in consideration a very dynamic physical, economic and social system. It is based on eight "Principal Thematic and Transversal Objectives".

"Thematic Objectives":

- Conservation and Valuation of Resources and of Natural and Landscape Heritage.
- Management of Risks and Social, Economic and Environmental Impacts.
- Sustainable Development of Coastal Economic Activities and Valuation of Specific Coastal Resources.
- Enhancement of the Scientific Knowledge on coastal ecosystems and landscapes.

"Transversal Objectives":

- Enhancement of the International Co-operation.
- Enhancement and Reinforcement of Institutional Communication and Integrated Policies and Management Instruments.
- Monitoring and observation mechanisms and networks.
- Promotion of Public Participation and Social Awareness.

The approved Strategy for Integrated Coastal Zone Management has included twenty "Strategic Measures" grouped as:

- Governance and management (3);
- Thematic (14);
- Monitoring (2);
- Public participation (1).

The opportunity to implement a Strategy for the Integrated Coastal Zone Management in Portugal is clearly beyond the scope of one ministry. As proposed by the Working Group and included in the model of Governance a platform has been approved, through the establishment of a national platform targeting the integration of national policies and the implementation, participation and dissemination of ICZM.

This platform considers three levels of articulation: Political and institutional, society and knowledge.

NEW INSTITUTIONAL FRAMEWORK

The new Portuguese Government (from 2011) has announced a new institutional framework for environment and water issues, including coastal waters. A "super" ministry and a "super" environment and water authority have been considered and the governance and management structure have been published in 2012.

The new national water authority is the "Agência Portuguesa do Ambiente, APA" (Portuguese Environment Agency). It is an institution that belongs to the "Ministério da Agricultura, do Mar, do Ambiente e do Ordenamento do Território" (Ministry of Agriculture, Sea, Environment and Territorial management). The Decree Law 56/2012 (12th March 2012) refers that APA should promote the preparation and implementation of the national Integrated Coastal Zone Management strategy and its implementation at regional level in order to assure the coastal protection and requalification.

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