

Portuguese coastal zones and the new coastal management plans

Veloso-Gomes, F.* & Taveira-Pinto, F.

*Faculdade de Engenharia da Universidade do Porto,
Rua Dr. Roberto Frias, 4200-465 Porto, Portugal; *Corresponding author; E-mail vgomes@fe.up.pt*

Abstract. Coastal zones in Portugal, as interface areas between land and sea, have problems related to the growing human pressure in terms of changes in land use associated with urban and industrial occupation, new accessibility (ports, motorways) and traffic flows, intensification of recreational use (beaches, water sports) and excessive fishing. Impacts include deterioration of water quality and sediments; alteration and degradation of natural habitats; new hydrodynamic situations; major landscape changes; and rapid changes in habits and way of life of the local populations and increased exposure of populations and assets to natural and induced risks (storms, accidents, spills, explosions).

Plans for the Management of the Coastal Zone (POOC) have been developed and seven of them have been approved, while two similar plans are at a final stage of preparation. Together they cover the entire coast of Portugal. Their implementation and assessment could be a first step towards an integrated management of the Portuguese coastal zones. River Basin Management Plans (PBH) have been concluded and recently approved for the whole country. However, these plans do not consider estuarine systems and some other issues related to coastal systems. The National Water Plan (PNA) is under public presentation and discussion. Several 'key messages' are presented in this paper as a contribution for assessment of the proposals of this plan on issues related with coastal waters.

Keywords: Human impact; Integrated Coastal Zone Management; Land use; River basin management plan.

Abbreviations: PBH = Planos de Bacia Hidrográfica (Plans for River Basin Management); POOC = Planos de Ordenamento da Orla Costeira (Coastal zone management plans).

Introduction

Portuguese coastal zones, as interface areas between land and sea, have problems typical of such zones. They are related to the growing pressure in terms of changes in land use associated with urban and industrial occupation, new accessibility (ports, motorways) and traffic flows, intensification of recreational use (beaches, water sports) and excessive fishing. The impacts are:

- deterioration of water quality and sediments;
- alteration and degradation of natural habitats;
- new hydrodynamic situations;
- major landscape changes;
- rapid changes in habits and way of life of the local populations and increased exposure of populations and assets to natural and induced risks (storms, accidents, spills, explosions).

The Northwest Atlantic tide, wave regime and associated littoral drift currents can be very severe and there is a global concern for coastal erosion. The beaches have high recreational and protection value. There are zones with well-preserved beaches and fields of sand dunes (Torreira - S. Jacinto, Mira - Cap Mondego, Leirosa - Nazaré, Tróia - Sines, Ria Formosa) but also narrow and degraded stretches (Silvalde, Esmoriz, Cortegaça, Costa Nova, Cova-Gala, Costa Caparica, Quarteira).

The present situation of general coastal erosion has been identified as a coastal response to the reduction of river sediment sources and river sediment transport, mean sea-level rise and the human occupation of water fronts (Veloso-Gomes 1994, 1997a).

Hydro-electric plants in Portuguese and Spanish rivers currently constitute an important component for supplying renewable energy. However, the use of water for the production of energy, water supply to humans, industry and agriculture is drastically reducing the sediment volume transported to the sea, which increases coastal erosion (Veloso-Gomes 1994, 1997a; Vasco Costa 1996).

This reduction is also associated with the extraction and dredging of sand for navigation and civil construction industries whose impacts on the coastal zones have

not been assessed. The sandy coast erodes because the potential transport capacity of oblique waves (between 1 and 2 million m³ per year) is greater than the annual sediment volume supplied by the rivers (at present between 0 and 0.2 million m³ per year).

Maritime transport is one of the most important vectors of international trade. 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.

The intense rate of the occupation, use and transformation of various Portuguese coastal zones has been reported as worrying. (Veloso-Gomes 1994, 1997b, 1999, 2001). There is a continuous pressure towards consolidation, growing density, and expansion of waterfront building.

The model adopted in various coastal municipalities, despite not being openly assumed in municipal land-use plans, is equivalent to effective consolidation and densification of coastal construction. Several built waterfronts, protected by groynes and seawalls have increased the vulnerability to erosion and direct wave action (Veloso-Gomes et al. 1999).

The population has both the aspiration and the right to use the climatic and scenic conditions associated with coastal zones. Leisure and tourist activities are undergoing a phase of marked growth. Tourism represents a very important, and even vital, component of many economies at a national, regional or local level (Veloso-Gomes 1997b).

Integrated Coastal Zone Management

Integrated management of coastal zones is aimed at promoting development models that favour:

- protection and improvement of their social and cultural resource value of the ecosystems and natural resources;
- coastal environments (natural, urban, rural, forested, seaside),
- quality of life of their population.

This is a dynamic process in which co-ordinated strategies, multi-sector and long-term viewpoints are developed and implemented. They have to be supported by:

- Adequate physiographic characterization and understanding of the natural processes;
- Registration and monitoring of ecosystems and resources;

- Classification and zone usage;
- Analysis of vulnerabilities and risks;
- Assessment of the cumulative effects;
- Analysis of the ecosystem's capacity to bear the strain;
- Legal and institutional frameworks;
- Assessment of the environmental, economic and social impacts caused by the interventions.

Integrated management requires:

- Fitting man's actions into wider objectives and spatial and time horizons;
- Assessment of the requirements;
- Recognition of the specificity of the places and the conflicts of interests;
- Reduction of some human activities;
- Support of the best available scientific and technical information;
- Integration and harmonization of sectorial policies;
- Assumption of planning strategies and coherent policies;
- Institutionalization of effective management systems that enable local action whilst thinking globally.

Portuguese Coastal Zone Management Plans

The management of coastal zones will have to involve aspects of economical, social, technical and political nature. It will have to consider potential conflicting uses and interests of diverse nature, typical of a heterogeneous system, open, dynamic and strongly polarizing.

The plans for the Management of the Coastal Zone (POOC = Planos de Ordenamento da Orla Costeira, Law 309 of 2 September 1993, Law 218 of 20 August 1994, Decree Law 151 of 24 June 1995, Law 5 of 29 February 1996) are a first step towards 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 will guide specific activities on the coast (between sea bottom level -30 m and a land protection zone with a maximum width not exceeding 500 m from the seashore limit line), with a view to safeguarding fundamental ecosystems, ecologically sensitive areas and the existing resources.

The following POOC have been completed: Caminha - Espinho, Ovar - Marinha Grande, Alcobaça - Mafra, Cascais - S. Juliao da Barra, Sado - Sines, Sines - Burgau and Burgau - Vilamoura (Fig. 1).

The POOC of Sintra - Sado and Vilamoura - Vila Real de Santo António have yet to be concluded.

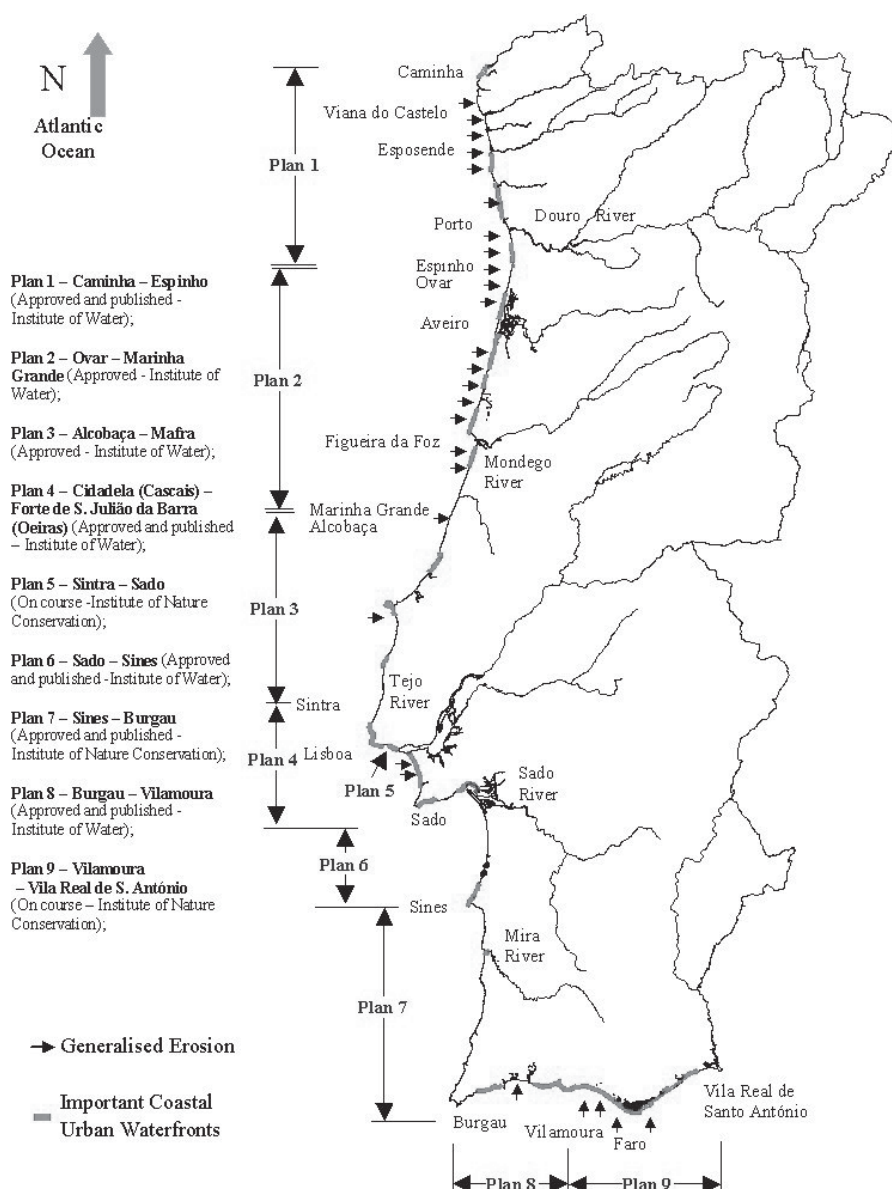


Fig. 1. Portuguese coastal zone management plans.

In the 'Coastal Zone Management Plans' (Anon. 1999), there is an extended summary of the content and relevant aspects contained within the POOC drawn up by the teams that elaborated the plans. It includes the characterizations carried out in the Basic Studies, the diagnosis contained within the Preliminary Study and the Planning Proposals.

The teams that drew up the POOC had somewhat different scientific and technical backgrounds and used different methodologies. The specificity of the seafronts being analysed and the set-up and attitudes of the accompanying technical commissions, led to final products of differing quality, technical and scientific detail,

that are reflected in the proposals that were drawn up. POOC can and should play an important role in correction of the existing dysfunctions and the prevention of new ones. Expectations created around their compilation were huge. However, difficulties and limitations have appeared that have to be borne in mind during their implementation and assessment:

- The planning teams had to carry out a job with a wide scope and a great responsibility within a relatively reduced time scale;
- There was no monitoring programme or even up-to-date topo-hydrographic studies of the POOC's intervention areas;

- In several domains and geographical areas there were no suitable basic scientific and technical studies (in terms of quality, time span, and spatial density) and research studies that could enable the establishment of a 'environmental state of reference' and to elaborate short and medium term projections;
- Part of the coastal information, dispersed between many institutions, was not made available to the POOC planning teams in time;
- 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 sediments, which are essential to supply the beaches and include urban fronts and bathing zones. Amongst others, the problems of water quality, 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. Will it be possible to overcome this situation with the creation of inter-ministry workgroups? Will it be possible to promote dialogue and mobilize the financial resources to proceed with nourishment of the beaches with sand dredged from the port areas?
- The final result of many of the proposals contained in the POOC was a reflection of the positions taken by the Municipal Authorities present in the Accompanying

Technical Commissions. The implementation of the POOC may, in several cases, constitute a difficult 'puzzle' 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.

- It is necessary to overcome the problems of an institutional nature and management insufficiency, inadequate mobilization of human, technical and financial resources to implement and accompany the proposals contained within the POOC.

The overall balance is certainly positive due to the geo-referenced information processed in many dozens of volumes, the reflections caused by the generality of the proposals presented and by the public debate created (Anon. 1999). The development of different planning figures with implications on coastal zones, if they are correctly integrated, co-ordinated and applied, may enable the taking of an important step forward in the management of the coastal zone and thus on the quality of its environment.

River basins and coastal zones

The morphological configuration of the coast and shoreline together with the quality of the coastal environment and coastal waters, are greatly influenced by different natural dynamic processes and by anthropogenic interventions and actions. Estuaries, gulfs, lagoons and



Fig. 2. The estuary of the Douro river.

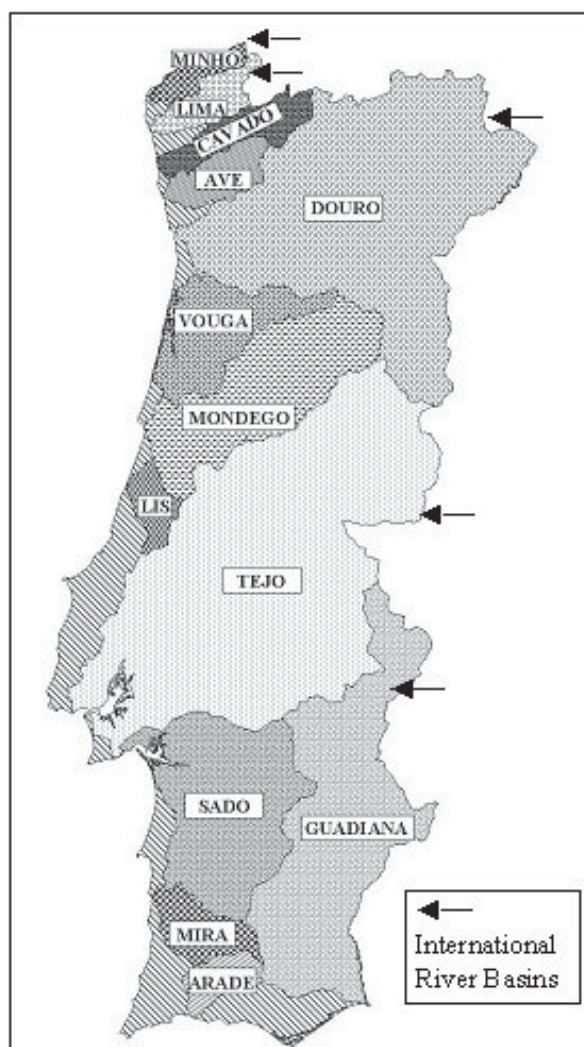


Fig. 3. Portuguese river basins.

lagoon systems are especially vulnerable to the uses and interventions carried out or underway at their river basins. The river basin areas of the main rivers extended to Portugal and Spain (river Minho, Lima, Douro, Tejo, and Guadiana) (Figs. 2 and 3).

Infiltration of contaminants into the groundwater, the discharge of untreated industrial and urban residual effluents, the deposition of waste, the extraction of sediments, the consumption of water for agricultural and human use, the alteration of the hydrological regime, the regularization of the water courses, agricultural activities and urban occupation are problems that have to be managed at the river basin level and which are directly or indirectly reflected in the coastal waters (European Union Water Policy Directive).

Portuguese coastal zones receive all flows and charges generated or introduced into the basins, so that the

objectives of preserving and rehabilitating the coastal waters largely exceed the ambit of the POOC.

Interventions undertaken or foreseen in the Portuguese and Spanish river basins related to the construction of dams and the diversion of the water flow, influence the coastal waters especially, on estuaries and lagoon systems.

The reduction in the flow of solids and nutrients, the progression of saline intrusions to higher and neighbouring areas and the waters' reduced capacity for self-renewal are impacts that cannot continue being ignored in the studies and decision processes.

Flood control will also have a negative effect on the coastal morphology, so that the problems of altered hydrological regimes, especially as far as international rivers are concerned, cannot be limited merely to discussing the smaller or average flows.

The River Basin Management Plans (PBH) that have been concluded for all the rivers, should have assessed all these problems and incorporated the outcome of the characterization and quality objectives included in the Coastal Zone Management plans and other studies.

As far as the problems of the coastal zones are concerned it is thought that the River Basin Management Plans should have included:

- Registration and analysis of the available hydro-geological, hydrodynamic, physiographic and ecological information relative to the estuarine and lagoon zones.
- Estimates for solid waste, organic and inorganic charges transported by the water system to the estuaries and the ocean.
- Potential conflict between the users of the water resources in the river basins and their systems in the estuaries, lagoons and coastal zones.
- The impact of extreme hydrological situations on estuaries, lagoons and coastal zones. Exposure risks and prevention and protection measures.
- The impacts and risks of the 'artificialization' of river and estuary bank on the coastal zones.
- Sedimentary balances for the various natural and intervention scenarios in the basin and in the estuaries and lagoons.
- Saline intrusion in the estuaries, lagoons and banks: diagnosis, progression and control scenarios.
- The establishment of criteria for quantifying the environmental flows in estuaries and lagoons.
- The specific problems of small estuarine and coastal rivers.
- Integration and articulation of water resource planning and POOC and other planning and land-use instrument (namely port and urban plans).
- Protection, improvement and valuation of estuarine and lagoon systems.
- Proposals for monitoring.

- Proposals for hierarchical measures, actions and infrastructure for the estuaries, lagoons and coastal zones associated to alternative scenarios considered at a basin level and for various time spans.

Lack of consideration or incomplete consideration of the above-mentioned aspects is an important drawback of the PBH plans.

In the approved municipal land-use plans the building construction potential was, consciously or not, viewed as a guiding vector. PBH plans should discuss urban development along the estuary banks but they missed it.

Small river basins

Small river basins are associated to rivulets and water lines. Due to the country's pronounced phenomenon of population concentration along the coast, such basins and even riverbeds have generally been made very artificial with serious water quality problems as, in the great majority of situations, they are improperly used as receptors of residual waters, contaminated rainwater and waste (Veloso-Gomes 1997a).

Channelling of small rivers in urban zones was a wrong attempt to camouflage their dire organoleptic aspect or to provide more areas for development.

There will have to be a complete inversion of the current situation, privileging projects that reduce pollution and natural regeneration. The large sewage systems and treatment plants being built or that have recently come on stream will definitely contribute to reducing pollution. However, many problems involving the absence of separating public collectors, numerous illegal discharges, the non-treatment of urban as well as industrial water and diffuse pollution still subsist.

Impact from shipping traffic

On the other hand, there are activities that affect the Coastal Zones that do not fit into the geographical management units (Districts) associated to river basins. This is applicable to effluent and solid waste that originates in international shipping traffic and accidents with ships (intense international traffic along the Portuguese coast). It is also applicable to the polluting charges released to the atmosphere that affect areas distant from their place of emission.

The problem with pollution originating in shipping traffic, despite initiatives undertaken under the Lisbon Agreement (1990), the Envireg Programme (1990 to 1993) and the Clean Seas Programme (1993), still requires measures for reducing the potential risks and consequences of the traffic and accidents that exceed the ambit of national territory and legal framework.

Erosion, risk zones and physiographic monitoring

Various sources have published data (EUROCOAST-Portugal 1997) that demonstrate a generalized retreat of the Portuguese coastline, which is of worrying proportions in certain areas. Erosion is progressing with great intensity on several known stretches of the coast and, despite the existence of seawalls and groynes, the situation continues to be critical. Several urban waterfronts (Mindelo, Esmoriz, Cortegaça, Furadouro, Costa Nova, Vagueira) currently appear as small 'capes' that enter the sea, surrounded by coastal defence structures of considerable dimension (Veloso-Gomes 1994, 1997b, 2001; Vasco Costa 1996). There are situations where it has become necessary, or will become so in the medium term, to proceed with the resettlement of the inhabitants living in risk areas. Some decades ago, these buildings might not have given rise to safety concerns.

Seafront safety in relation to erosion and overtopping has been delegated to defence works (if they exist) or ignored in a static vision of the situation (short-term horizon). However, defence works are vulnerable to extreme events, persistent events, and demand frequent operations of maintenance and repairs. It has to be highlighted that until recently repairs were hardly ever undertaken, leading to a rapid progression of the damage and risk situations, which are unacceptable in the adjacent built-up areas (Veloso-Gomes 1997b, 1999, 2001; Vasco Costa 1996). Up to the end of the 1980s 'coastal protection' was exclusively associated to the construction of defence works (seawalls and groynes) to reduce the risks of exposure of the building fronts to the action of waves and tides.

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). Defence works may permit a reduction of such risks, but they do not cancel or reduce them to predictable levels when the timespan adopted in new building projects is taken into account.

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 characterization were lost (namely, and at least, topographic studies) that are essential for the quantification, comprehension and forecasting of the phenomena.

A general monitoring plan of coastal physiography is under development. The definition of a monitoring strategy for the continental Portuguese coastline and will constitute another important milestone in the development of an integrated strategy for the coastal zone.

The use of coastal zones

Leisure and tourist development is in a phase of rapid growth. It is, however, necessary to reduce the seasonal fluxes and fixation of tourists on the coast so as to protect the natural values and avoid making regional imbalances worse. This should not be associated with degradation of the quality of life as noticed in various forms such as chaotic traffic, pollution, destruction of biotopes, the disturbance of local communities, loss of landscape characteristics, property speculation, excessive land occupation, overuse of urban infrastructure, etc. (Fig. 4).

While mass tourism includes bathing and beach recreation in an hectic atmosphere and a transformed landscape, we should recognize the right of many other

citizens to enjoy the season in a calm atmosphere in an unchanged landscape. Coastal zones classified as being of natural, scenic or historic interest should not suffer pressures that are incompatible with their status.

At present, tourism assumes a relevant importance at local, regional and national levels, but it has had an extremely negative impact with a cumulative nature on the coastal environment (Velo-Gomes 1997). Developers of tourist facilities are starting to understand that quality-demanding customers do not return to facilities sited in degraded areas.

The existence of unique and beautiful coastal, estuarine and lagoon landscapes can mean a big tourist attraction, but this attraction will disappear if the landscapes are not preserved.



Fig. 4. Land use conflicts: urban expansion and tourism on narrow sand spit exposed to severe wave action and erosion phenomena (Aveiro Lagoon).

It is not possible to merely restrict and prohibit. It is necessary to selectively improve the points of access to beaches. Better accesses should not mean an uncontrolled trampling of dunes and permission to construct houses in areas that are ecologically vulnerable or in areas at risk from the actions of the sea.

Improvement of tourist facilities does not necessarily imply a transformation into luxury tourism. Leisure areas, buildings and car parking lots should not continue to be located on beaches, dunes, cliffs, marshes, sandbanks, islets and other sensitive areas.

Nautical leisure activities, especially sailing, enable contact between man and the aquatic systems and can contribute to a physical and psychic well-being, which may strengthen civic attitudes and the defence of environmental values. Their development will have to be controlled, in terms of the localization and size of the infrastructures, pollution discharges, noise levels and safety. The establishment of leisure centres in existing ports with facilities which are no longer used, may offer an alternative to the proliferation of new leisure ports with their accompanying impacts.

The preservation of areas of natural interest, the recuperation of the landscape and cultural values, the implementation of efficient basic sanitation infrastructures and the improvement of the local population's living conditions should be considered as priorities whenever touristic development programmes are launched. Tourism can then provide an incentive to protect the environmental conditions instead of being an element of their degradation.

Dunes

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 coastal zone, constituting buffer zones in heavily used coastal regions. Their preservation is one of the main priorities. (Fig. 5).

The conservation, reconstruction and stabilization of coastal dunes, their protection from construction projects and pathways, as well as the revegetation of denuded areas, are actions that can and should be stimulated and undertaken by governmental agencies, mu-



Fig 5. Dune fields in the central region of Portugal

municipalities and environmental groups. They do not demand large technical or financial means. Such operations, however, should be carefully programmed and accompanied by experts and can be part of other environmental awareness and educational initiatives (Velo-Gomes 1997, 1999, 2001).

At present there are several interesting dune rehabilitation projects being undertaken on the Portuguese coast. The conservation of dunes and their revegetation should merit special attention due to the rapid degradation occurring in more easily accessible and even in more remote areas, that are increasingly being used by off-road vehicles and motorcycles. Revegetation should as far as possible make use of native plant species in their natural distribution areas (Anon. 1998).

The importance of dunes, especially the primary chain, is internationally recognized by the scientific community. One of the aspects to be considered is the reserve of alluvial sources and the adaptive barrier function to wave run-up and overtopping.

Unfortunately, in view of the size of the hydro-morphological imbalance that is occurring in Portuguese coastal areas and the high wave energy, dune conservation, reconstruction and stabilization measures, by themselves, will not lead to stabilization 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 (dunes act as a sand reservoir for beaches) but also in terms of protecting and recovering other natural values.

Key messages for a requalification of coastal zones

The National Water Plan (Plano Nacional da Água) promoted by the Ministry of the Environment has been presented for Public discussion. As a contribution for the assessment of the proposals of such a plan in relation to coastal waters, the following key messages have been provided:

- Development of the coastal zones should be assessed from an environmental perspective.
- Reinforcement of the acquisition of data and coastal zone and ocean research (actions, characteristics, behaviour, forecasting), based on a multi-subject and inter-subject approach and with a strengthening of the links between the technical / scientific community and the managing entities, is urgent. There is the necessity to prepare and implant coherent and co-ordinated observation/monitoring programmes, of a systematic nature. Monitoring should start before intervention.
- Interdependence between the quality of the water and sediments on the coast and in river basins should be

considered. This interdependence is also important in sediment transport.

- It is becoming necessary to prepare an ecological map of the coastal zone and proceed with a global and integrated definition of national ecological reserves in relation to the coast.
- A national network of specially protected marine areas should be created.
- Management models applied to coastal ecosystems should start integrating assessments of the medium and long-term direct and indirect benefits and costs. Alteration of the social fabric and relationships, the landscape, the ecological systems, environmental dynamics, production and elimination of residues are examples of indirect costs which are hardly ever taken into consideration;
- More sound medium and long-term delimitation of coastal risk areas (natural and induced risks);
- The requirement to inform and train the population, technicians and local authorities, and for a continuous policy of 'persuasion' has been highlighted. It is necessary to 'pass' the message on to various intervening public and private agents and to mobilize society;
- Research into new technical coastal defence solutions and/or the improvement of the current ones should be promoted;
- Technical and financial assistance to local authorities to mitigate the problems should be considered. Financial assistance to private individuals/entities whose legitimate rights are wronged because of protection and conservation measures should also be considered;
- A 'preventative' policy, and also a 'curative' one, should be implemented because of the severity of the present problems.
- It is necessary to start Environmental Impact Studies at the initial study phase of a project and to widen assessments of Environmental Impact to all plans and programmes.
- The articulation/harmonization/establishment of the hierarchy in the land use management plans that are underway or in preparation constitutes a difficult but necessary challenge;
- A Geographical Information System at a national level on the coastal zone would form a vital component in the support of the gathering, processing, updating and availability of information at various levels.
- It is necessary to significantly improve the capacity to implement the legislation and planning in force and to make the systems of accompaniment, assessment and inspection operational.
- The requirement for training technical staff and managers (public service, companies) in relation to the problems of coastal zones is recognized.
- The development of a strategic coastal management

plan as well as the creation or the reinforcement of an institutional agency prepared to handle the problems and management of the country's coastal zones is considered indispensable.

- Integrated management of coastal zones includes the identification of conflicts and platforms of agreement and the formulation of clear objectives and a strategy.
- An integrated strategy requires a co-ordination between institutions, sharing and assuming options, a capacity to decide and implement suitably funded multi-annual programmes.
- Intervention policies and strategies should be evaluated.

Conclusions

Seven of the Portuguese coastal zone management plans have been approved and two similar plans are at a final stage of preparation; they cover the entire coast. Their implementation and assessment could be a first step towards an integrated management of the Portuguese coastal zones but several limitations must be borne in mind:

- Lack of field data;
- Exclusion of the 'areas of harbour interest' within the POOC intervention areas;
- Many of the proposals contained in the POOC was a reflection of the positions taken by the municipal authorities present in the accompanying technical commissions,
- The existence of a marked conflict of interests between the users.

It is necessary to overcome the problems of an institutional nature and management insufficiency, inadequate mobilization of human resources, technical and financial resources to implement and accompany the proposals contained within the POOC.

River basin management plans (PBH) have been concluded and approved recently for the whole country. The larger river basins are international. PBH are very important management tools but these plans do not consider estuarine systems and some other issues related to coastal systems.

The general monitoring plan of coastal physiography, will allow the definition of a long-term monitoring strategy for the mainland Portuguese coastal zone and the inclusion of technical elements required for the planning and execution of short and long-term monitoring will constitute another important milestone in the development of an integrated strategy for the coastal zone.

A national water plan is being publicly presented and discussed. Several 'key messages' are presented in this

paper as a contribution for the assessment of the proposals of this Plan in issues related with coastal waters.

References

- Anon. 1997. *Colectânea de ideias sobre a zona costeira de Portugal*. Eurocoast-Portugal. Porto, PT.
- Anon. 1998. *Dunas da zona costeira de Portugal*. Eurocoast-Portugal. Porto, PT.
- Anon. 1999. *Os Planos de Ordenamento da Orla Costeira*. Associação EUROCOAST, Porto, PT.
- Vasco Costa, F., Veloso Gomes, F., Silveira Ramos & Claudino Vicente. 1996. History of coastal engineering in Portugal. In: *History and heritage of coastal engineering*, pp. 413-428. American Society of Civil Engineers, US.
- Veloso Gomes, F. 1998. *Coastal zones*. EXPO'98 Pavilhão do Futuro. Official Book, pp 122-131. In English, French, Spanish and Portuguese. EXPO'98. Lisbon, PT.
- Veloso Gomes, F. & Taveira Pinto, F. 1994. *Urban expansion in high risk north-west coastal areas in Portugal*. Littoral '94 Proceedings, pp. 981-996. Eurocoast-Portugal. Lisbon, PT.
- Veloso Gomes, F. & Taveira Pinto, F. 1997a. A opção protecção para a costa oeste portuguesa. In: *Colectânea de ideias sobre a zona costeira de Portugal*, pp 163-190. Eurocoast-Portugal. Porto, PT.
- Veloso Gomes, F. & Taveira Pinto, F. 1997b. *Portuguese urban waterfront expansion near coastal areas. Environmental challenges in an expanding urban world and the role of emerging information technologies*, pp. 189-198. National Centre for Geographical Information, Lisbon, PT.
- Veloso Gomes, F. & Taveira Pinto, F. 1999. *Reconstruction and repair of Portuguese coastal defence structures*. Losada, I. (ed.) Balkema, Rotterdam, NL.
- Veloso Gomes, F. & Taveira Pinto, F. 2001. Portuguese coastal zones and the new coastal management plans. In: Özhan, E. (ed.) *Proceedings MEDCOAST 01*. Tunes, TN.

Received 18 October 2002

Revision received 17 January 2003;

Accepted 4 April 2003.

Co-ordinating Editor: M. Cassar.