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Restoration and protection of ecosystem in the Seman delta / Strategies for the requalification of the Coast

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110 Abstract

This paper analyzes the impact of natural and human factors on the erosion of Albanian beaches and proposes several strategies for the restoration and recovery of coasts. The widespread phenomenon of erosion on beaches is a natural process caused by the action of wind, tides or storm surges, but also the increase of the sea level resulting from global warming. The coastal erosion can be accentuated or accelerated by human activities, such as land use for agriculture and industry, urbanization, tourism development processes, pollution. The result is the alteration of morphological characteristics of the shoreline and risk of biodiversity loss as well of landscape identity. The aim of the strategies adopted to restore the dune system is the reconstruction of dunes by planting native vegetation, the establishment of fences and barriers, the use of cages and, in extreme cases, the import of compatible graded sand from other areas. Finally, development of sustainable tourism in harmony with recovery strategies and restoration of ecosystems must be encouraged as well as awareness-raising campaigns about environmental issues, promoting the active involvement of the local population.

The principal causes of the transformations and alteration of coastal areas are to be allocated to natural phenomena which include the widespread phenomenon of coastal erosion and the world increase of the sea level, but also human activities like urbanization, wild building construction, waste and pollution, processes of tourism development (fig 1). The recovery and requalification of environmentally degraded areas provide planning and management strategies related to landscape resources (Calcagno, 2012). The Rio de Janeiro Conference (1992) and agreements arising therefrom have broadened the environmental protection concept, which until then were almost exclusively used to denote the conservation of habitats and species, including sustainable development. An eco-sustainable development is based on the equilibrium between environmental

quality, economic activity and the needs of society, able to preserve ecosystems for the future by encouraging actions that conserve what exists and restore what was damaged or lost (Diefenderfer and Thom, 2003).

Methods

This research required a preliminary study in order to know the area of interest and identify the different problems. The process of territorial knowledge started during the site survey, documented by photographs. This paper considers the Albanian coast overlooking the Adriatic sea, in particular the area that extends along the Seman Delta (fig 2), defined as a zones of transition which includes water marine and tidal freshwater marshes (fig 3). The lagoon system of the Karavasta-Divjaka National Park along with the Shkumbin and Seman rivers, their outlets,



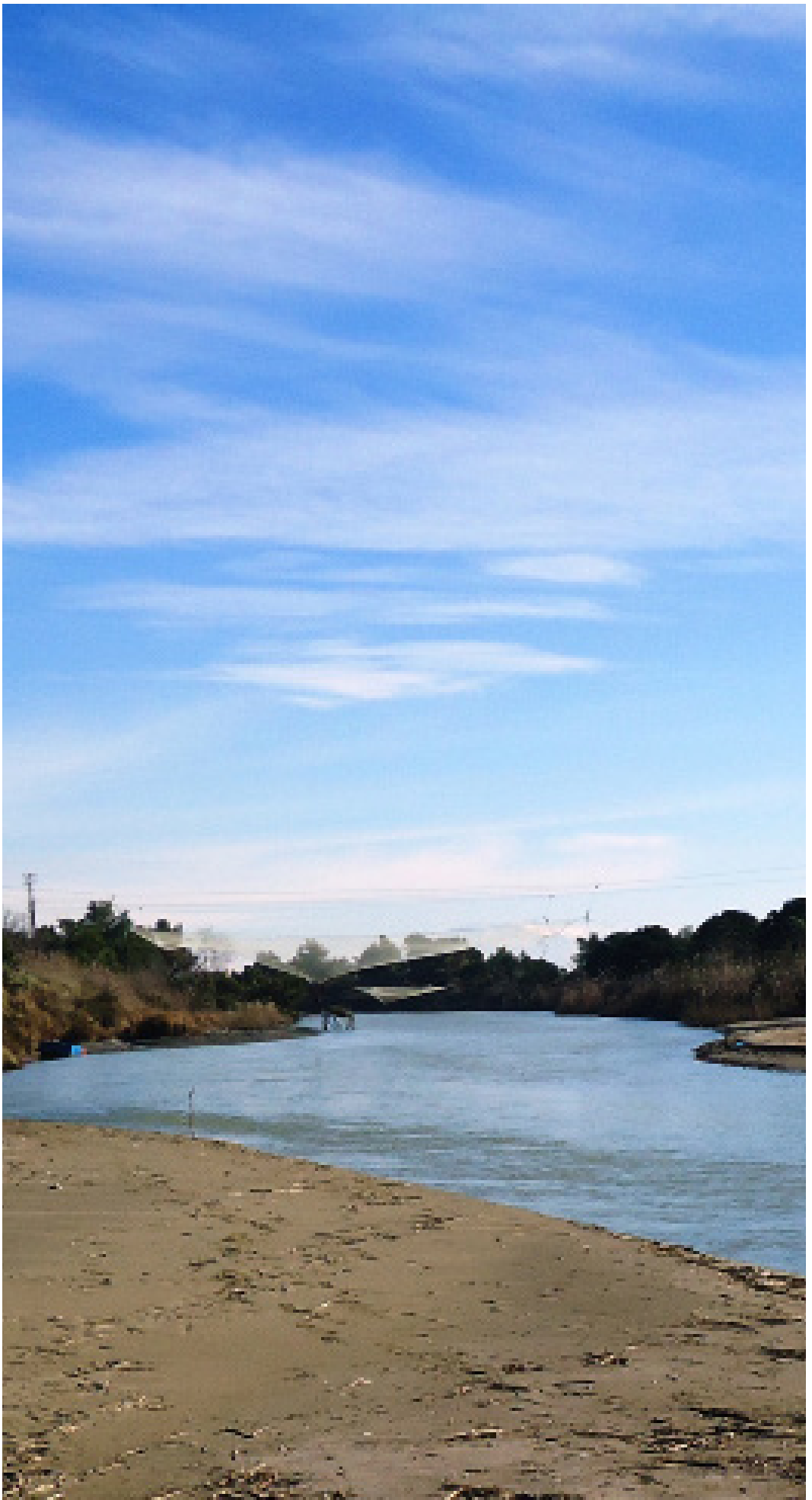
*Fig1 / State of neglect of the beaches during the winter period
source / Maria Teresa Camerada*

the Terbufi Myzeqe and drainage channels, have an ecological economic importance, constituting one of the most complicated and dynamic hydrological systems in Albania.

The area is near the archaeological site of Apollonia, which was founded in 588 BC by ancient civilization from Corfu and Corinth Island and which reached its maximum development during the Roman period. The ancient road called Via Egnatia remains as evidence of its existence. It was built by the Romans in the 2nd century BC to connect the Roman provinces of Illyricum, Macedonia and Thrace, the territory that is nowadays part of modern Albania, to Thrace (Turkey). The town of Apollonia bears other testimonies of the past, for example the Saint Mary church and monastery (13th century), where the remains found in the archaeological park are exhibited. The erosion of the Albanian coasts is attributed to natural phenomena such as an increase in the sea level due to global warming and the reduction of solid materials compared to the reservoir of sediment formed during the last glaciation of Würm (Balla and Bulliqi, 2014), as well as to human factors which intensify this process. In fact, the construction of hotels, holiday homes, car parks, beach facilities and faulty waste management produce negative impacts, while the erection of dams and harbors, as well as the deviation of the river in artificial canals, has reduced the sediment supply for beaches with a loss of an average of 50 metres for year. Following the flooding that occurred between 1962 and 1963, the mouth of

the Seman river was shifted by 13 Km South. This shift has caused an intense and continuous erosion of the delta because of the cessation of the intake of sediments, a phenomenon increased by human activities in the upper basin in the floodplains, as agricultural development, the chemical plants, oil and gas fields, oil refinery, etc.

The morphology of the Albanian territory is a result of tectonic activity that has included diverse set of soils of different ages and origins. In particular, the soil in this region is mainly composed of Quaternary sand and clay sediments, affecting the topography, the river network and therefore the erosive and depositional phases. The corrugation of the coastal region is accompanied by considerable vertical movements and consequent appearance of numerous failles, some of which are inclined and thrust modest. In this way cliffs are formed and in correspondence with tectonic depressions some deep bays, in which ancient marine deposits, beaches and dunes, in addition to being preserved and accumulated, are also modeled; all those formations are subject to possible erosion and landslides (Magnani, 1946). In some areas the sea has advanced inland swallowing beaches, forest and agricultural land, altering wetlands and lagoon ecosystems and creating damages for touristic investments, contributing to the elimination of dunes and vegetation. Generally the beach is formed when the quantity of sedimentary material available on a coast is larger than what the sea can take away (Balla and Bulliqi, 2014).



*Fig2 / Delta of Seman River
source / Vezir Muharremaj*



Fig3 / Tidal freshwater marshes near the coast source / Maria Teresa Camerada

The materials are redistributed by the alternation of storm with calm sea, swift erosion during storms and a gradual return to the beach of the eroded material during quiet periods. The beneficial functions of coastal dunes emerge in their ability to provide a reservoir that nourishes eroding beaches, acting as a barrier to storm surges and flooding, limiting storm wave effects on landward coastal deposits (O'Connell, 2008). In fact, the natural dunal areas are buffer zones able to reduce the impact of fluctuations and sea erosion. As it was observed during the Seman delta survey, the severe erosion has left the pine forest exposed to strong winds, salt spray and other adverse environmental conditions (fig 4).

The beach erosion is often associated with the subsequent demolition of the dunes behind. So there is an alteration of the sequence of coastal habitats, lacking the entire first portion of the chain of habitats. In this way, the vegetation stabilized on the dunes comes to be in direct contact with the sea, with no protection from wind, salt, etc. Generally the vegetation communities may be different in three zones: Pioneer, Woodland/Scrub and Forest/Heath zones. Pioneer plants, present from the debris line on the beach to the crest of the frontal dune, constitute the initial vegetation which colonizes newly developing sand accumulations and prepares the soil and other habitat conditions for the establishment of secondary stabilizers. The Woodland Zones usually covers the crest of the frontal dune and may extend further inland to include the

secondary dune. The function of this zone is to stabilize the accumulated sand and generally improve soil conditions to enable a wider range of plant species to establish later. Finally, the heath or forest areas are located usually landward of woodland areas and represent the mature state of the development of coastal vegetation. The main function of the forest areas is to stabilize hind dunes areas by holding the sand in place, providing a habitat for flora and fauna and an important transition zone between the sea and the inland areas. The vegetation significantly influences the size and stability of the dune areas, because the system's long and deep roots allow to minimize the loss of sand due to wave action. While, height and density of native dunal species provide an effective buffer, minimizing wind effects and managing to intercept wind-borne nutrients from the sea. Furthermore, native dunal vegetation provides a habitat and corridors for local and migratory fauna species. To restore an ecosystem means restoring its lost functions by natural engineering solutions, promotion of good landscape design and thus the policy should be educational and promotional. The natural dune rebuilding process can take several years. Also local experiences prove that this process can be facilitated by the installation of the sand fence and the planting of vegetation. In extreme cases otherwise it is necessary to import sand of compatible grain size to build the dune (O'Connell, 2008) At first the sand fencing should be installed landward, far from the sea, so as not to suffer the loss of sand during storms and floods. The sand fences are made of different materials,



Fig4 / Effects of wind and salt air on the pine forest
source / Maria Teresa Camerada

including wood, plastic, polyethylene, and metal. The rebuilding of the dunes is done by using sand fencing to capture wind-blown sand but also it is critical that the area be stabilized with pioneer plants to start the redevelopment process of the vegetation zones. Moreover, it should impose the ban on taking inert materials from river-beds and on the coastline (Balla and Bulliqi, 2014). The pioneer species used such as sea rocket maritime (*Cakile maritima*), prickly saltwort (*Salsola kali* L.), are gradually replaced by the typical dune vegetation (fig 5) dominated mostly by sand couch grass (*Agropyron junceum*), and rarely by beach grass (*Ammophila arenaria*).

The dunes *Elymus farctus* colonized are consolidated by *Ammophila arenaria*, The tufts over a meter long and extensive root system of this *Graminaceae* form a wind-blown sand barrier which is deposited between the drums increasing the height of the dune stems Leaves grow in turn and it is set in a dynamic balance between accumulation of sand, wind erosion and growth of *Ammophila arenaria*. The vegetation must be planted with care, covering up almost completely, so that the plant accesses moisture more easily and is protected from wind and trampling. The forest is composed of pine species *Pinus Halepensis* and *Pinus pinea*, which are mixed with deciduous trees, in particular common alder (*Alnus glutinosa*), common oak (*Quercus robur*), white poplar (*Populus alba*), in particular common elm (*Ulmus minor*). The shrubs are represented by typical Mediterranean species, which, occasionally, form very dense bushes.

The most common species of shrubs are: common myrtle (*Myrtus communis*), mastic tree (*Pistacia lentiscus*) and prickly juniper (*Juniperus oxycedrus*). Among the possible interventions put in place on Albanian beaches for erosion control and reduction of the loss rate of materials is the use of groins and seawalls. These structures, usually made of rocks or wood, are usually perpendicular to the shore and extend from a point landward of possible shoreline recession into the water at a sufficient distance to stabilize the shoreline. Seawalls are shore parallel structures, designed to protect upland property from coastal erosion and flooding caused by wave action and storm surges.

The seawalls are typically constructed of concrete or steel sheet piling. There are various types of windbreaks and different materials: wood or ramiglia, in jute mesh or coconut fiber, in single or double row. The use of checkerboard barriers made with reed mats on poles in chestnut, promotes the deposition of the wind sand and the consequent creation of a dune deposit. The vegetation and the favorable conditions for its development, help to increase and stabilize the deposit. With time, the fences are covered with sand, rot and disappear, leaving the dune with a natural appearance as early as the 6th-7th year. Another solution can be the use of gabions of natural materials, with a square section, filled with bundles of tied twigs and sand mixed chips, covered with sand from the excavation. The gabions have a high flexibility and adaptability to the morphological variations of the soil



Fig5 / Dune vegetation on degraded beach near the mouth of the river source / Maria Teresa Camerada

and are not visible. The erosion has a heavy economic impact; in fact the beaches are the basis of seaside tourism, just as the number of native and foreign visitors has been continuously growing, but also on the ecosystem and their equilibrium.

The two things are closely connected in that the growth of tourism has brought with it the construction of hotels, holiday homes, parking lots, roads, beach facilities and marinas, which have led to the elimination of dunes and Mediterranean vegetation (Balla and Bulliqi, 2014). In this case, it would be necessary to construct access ways for the use of vehicles and pedestrians, but also some fences to limit the trampling of bathers on the dunes. The establishment, maintenance and upgrading of access to the shoreline can be implemented through a walkway consisting of a wooden platform resting on the floor and arranged according to the morphological evolution of the existing path, adapting to the natural contours of the dune near the sandy shore, to avoid being walked (Bartoletti et al, 2010). In fact, a light footfall favors annual species that manage to germinate faster and complete their life cycle, at the expense of perennial ones that need time to develop the extensive root system that helps to stabilize the sandy substrate. Typically, in the vicinity of frequented paths by bathers, where the wind erosion potential increases the creation of preferential lines of erosion and the reduction of vegetation cover, one can form blowouts (deflation basins by removing products of sand particles by wind), with progressive

destruction of the dune ridges. The size of blowouts are proportional to those of the dune cordon in which they are formed (O'Connell, 2008). The dunes and plants that grow in them have limited capacity to recover from intensive use without assistance and care from the community and the deposit. To prevent the invasion of dune ecosystems by alien species the easiest and most effective action would be the prevention of introductions, encouraging the use of the native species psammophilous for ornamental purposes and their cultivation in the nursery. Weeds and exotic species are common in dunal areas that are impacted by human activity and can be introduced through their roots and seeds in plant pots, cuttings, poorly managed compost, animal manures, wind, tides, animals, and dumping of garden wastes. This requires the removal of these unwanted plants, introduced through actions planned and controlled in time. The weeds are not removed at once, the seeds and the sections of the root system are removed, while native species appropriate for the area are replanted. Weeds and / or invasive species are removed from areas public / private property adjacent to dunal areas to prevent infestation and spread. The weed plants are eradicated by hand, while only the use of low toxic and no residue chemicals is permitted according to the law. Another problem is the management of waste. Currents, tides, winds and wave action can carry on seashore durable solid materials products by humans, along with the natural organic debris, turning the beaches into a natural storage site (fig 6).



Fig6 / Waste taken ashore from the sea
source / Maria Teresa Camerada

It is necessary to be accurate in defining "waste" as, in fact, the natural organic debris that normally is along the beach and which constitutes a valuable element in the balance of these fragile systems, is perceived as waste and consequently removed altogether with normal trash. The structures built for retaining sand, as barriers, fences, reintroduced native plants, could constitute a further element of degradation if left in a state of neglect (fig 7).

As regards to the management of organic and inorganic wastes, the daily cleaning of the beaches should be performed preferably by hand, for the collection of beached material, or by mechanical small wheeled or tracked screeners, so as not to remove the sand. In fact, another very common threat is the mechanical execution of cleaning and scraping of the beach, aimed at the tourist exploitation of the beaches. In this way the morphology of the beach is altered, also causing the removal of pioneer plant communities.

Conclusions

The requalification of degraded coastal areas is possible by intervention plans and projects aimed at restoring ecosystems, using available resources in a sustainable manner. It must try to create an equilibrium between environmental quality, economic activities and society's needs, promoting the development of sustainable tourism, which considers

the landscape a collective good and inheritance for future generations. The first step is the protection and recovery of dune systems by implementing targeted strategies, but also through information and awareness campaigns, actively involving local populations, and through the implementation of laws and regulations. For the timely recovery and preservation of dune and dune environments, redevelopment must be associated with good behavioral practices of those using the area or public and private entities who manage it (tourism, cleaning).

The monitoring and maintenance in continuum represent an effective control tool over time. The monitoring of an ecosystem is a complex investigation process which involves the collection of data and subsequent analysis of the recorded information. In the case of investigations that involve a long period, one can use not only the data obtained from the field observations, but also they derived from other sources, such as satellite images or series of historical aerial photographs, in cases where the objective is the reconstruction of trends of change or the creation of simulation models for the prediction of future scenarios. The landscape is a living and dynamic organism, but also a shared resource that must be preserved, valued and managed properly, by integrating it with models of sustainable development that promote the conservation and protection of ecosystems.



Fig7 / Effects of erosion on the interventions put in place to restore the dune system source / Maria Teresa Camerada

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