

## **Minimising Conflicts among Stakeholders within a Littoral Cell**

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### **Abstract**

The 20-kilometer-long Apuo-versilian beach comprises coastal segments falling under many different administrations: two Regions (Liguria and Tuscany), two Provinces (La Spezia and Massa-Carrara), six Municipalities (Ameglia, Sarzana, Carrara, Massa, Montignoso and Forte dei Marmi), one Interregional River Basin Authority (Magra River) and one Port Authority (Marina di Carrara Port).

This stretch of coast is fed by Magra River, emptying onto the Ligurian Sea at the northern end of the littoral cell. Due to the reduction of the sediment input from its watershed, the entire coast has been experiencing severe coastal erosion, with shoreline retreat of approximately 800 meters at the river mouth from 1880 until now. Since its construction, which begun in 1920, the Marina di Carrara harbour has been intercepting southwards littoral transport, thus converting the Marina di Carrara historical shoreline retreat in beach accretion, and therefore increasing erosion down the coast.

Several coastal defences have been built south of the harbour since the 1930s and from the river mouth to the south (in Ligurian territory) since the 1960s. These defences were built without a wide scale strategy, and each new structure became a

cause for conflicts among different stakeholders as the coast started to be intensively used for tourist and leisure activities.

Recently, the different administrations responsible for coastal management started to implement new projects in a more integrated manner, planning at cell scale and considering the management of river sediments to be a fundamental part of Integrated Coastal Zone Management, in light of EUROSION view and recommendations.

Information sharing and stakeholder participation was part of this strategy. Beach evolution monitoring was performed and discussed in open meetings and people expectancies and suggestions were carefully considered.

This work of reducing conflicts among stakeholders allowed adopting more sustainable coastal defence strategies, aimed at balancing the benefits and reducing the negative fallouts to the neighbouring communities.

This paper traces the history of this stretch of coast and analyses the evolution of coastal defence strategies during the last century.

### Introduction

Beaches, which are the most important component of coastal resources supporting recreational tourism, are eroding all over the world (Bird, 1996) and communities have been demanding new and more efficient shore protection projects to contrast this process.

Most hard solutions are based on the reduction of sand loss from the selected site or on trapping sediment flowing alongshore; both can induce severe downdrift erosion affecting the tourist activity of neighbouring communities.

Within any given littoral cell, impacts of shore protection projects on neighbouring beaches and careful planning must be performed in the optic of Integrated Coastal Zone Management (ICZM), calling for active participation of different administrations governing the area and understanding among stakeholders (Williams & Micallef, 2009).

The area under study, the 20-kilometer-long Apuo-versilian strand (Fig. 1), comprises coastal segments falling under many different administrations: two Regions (Liguria and Tuscany), two Provinces (La Spezia and Massa-Carrara), six Municipalities (Ameglia, Sarzana, Carrara, Massa, Montignoso and Forte dei Marmi), one Interregional River Basin Authority (Magra river) and one Port Authority (Marina di Carrara Port) (Fig. 2).

In addition, in a narrow strip of this coastal plain one of the most ancient and valuable tourist districts in Italy (Versilia) coexists with a worldwide famous marble quarry (Carrara) and a general stone transformation area, where an industrial harbour imports raw rocks and exports local and foreign processed stones.

Fig. 1

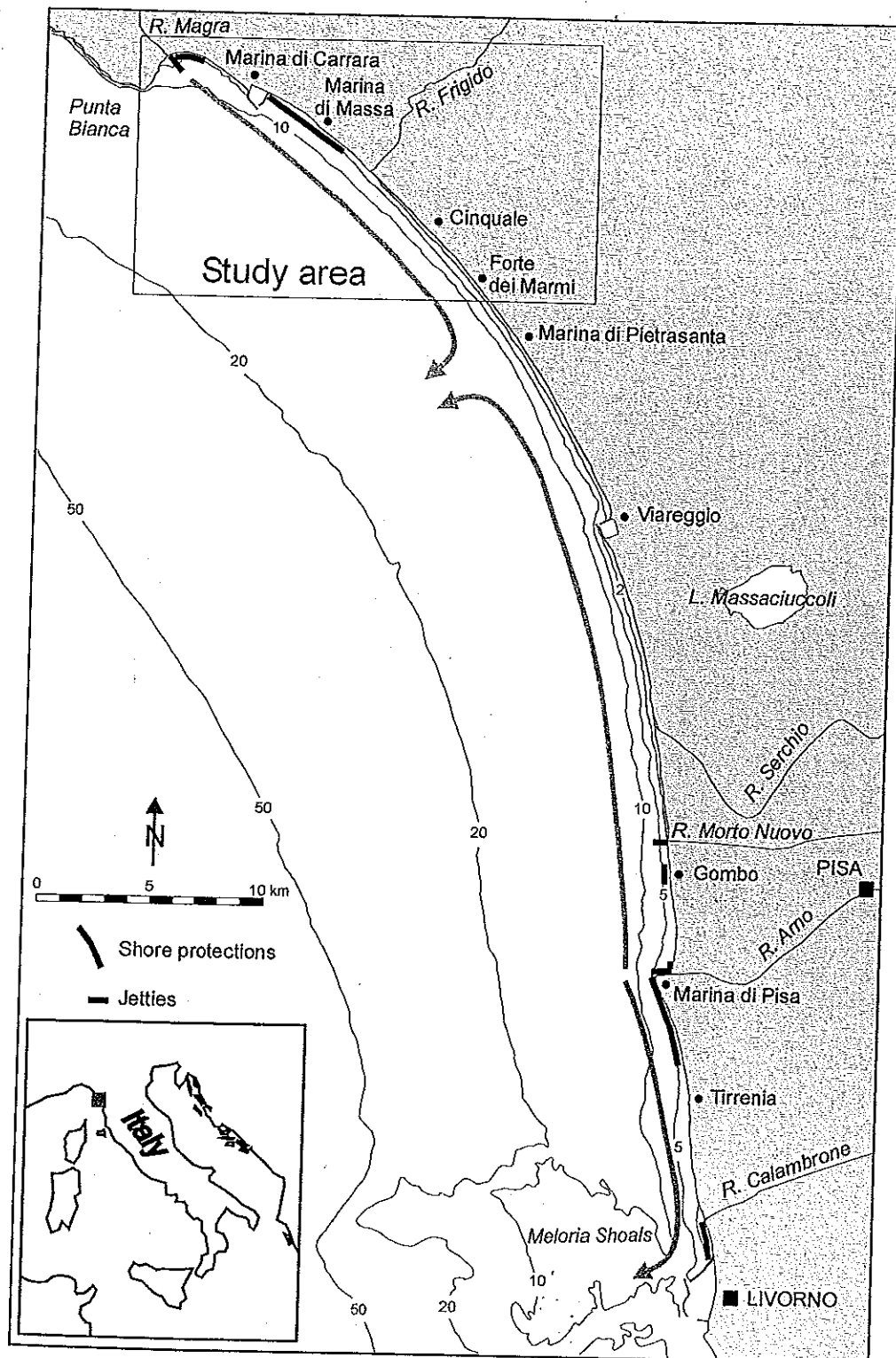


Fig. 1: Location map

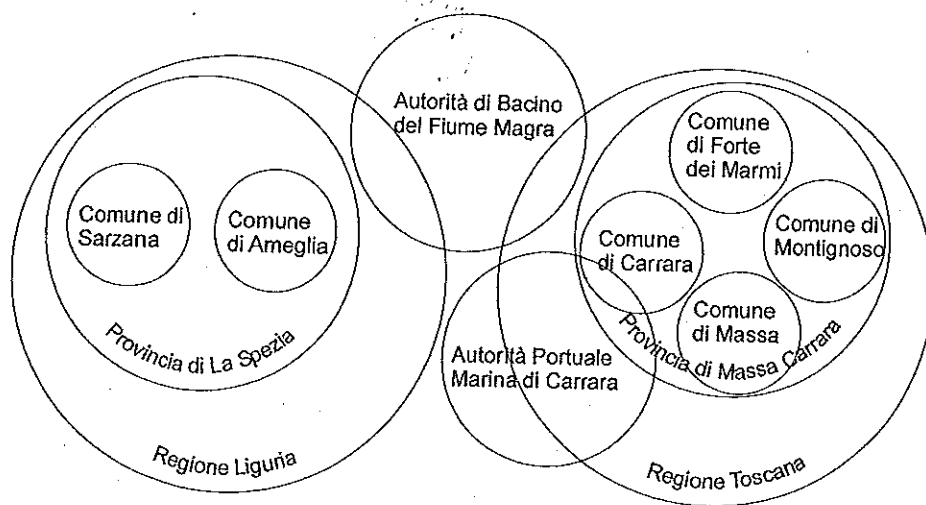


Fig. 2: Connections among administrations in charge of coastal management in the study area

### Study Area

The coastal segment under study is part of the Northern Tuscany Physiographic Unit and is fed by River Magra, which empties onto the Ligurian Sea at the northern end of the littoral cell, closing at the Punta Bianca promontory (Fig. 1).

The abandonment of cultivated hill areas (with the consequent expansion of bush and forests), the construction of dams, and river bed quarrying during the 20th Century, all resulted in a large reduction in river sediment input (Pranzini, 1994); this was the main cause for the severe erosion experienced by this stretch of coast since the beginning of the last century. Beach erosion started at the river mouth, where actual shoreline retreat is of approximately 800 meters, and gradually expanded to the southern beaches. (Ferri *et al.*, 2008) (Fig. 3)

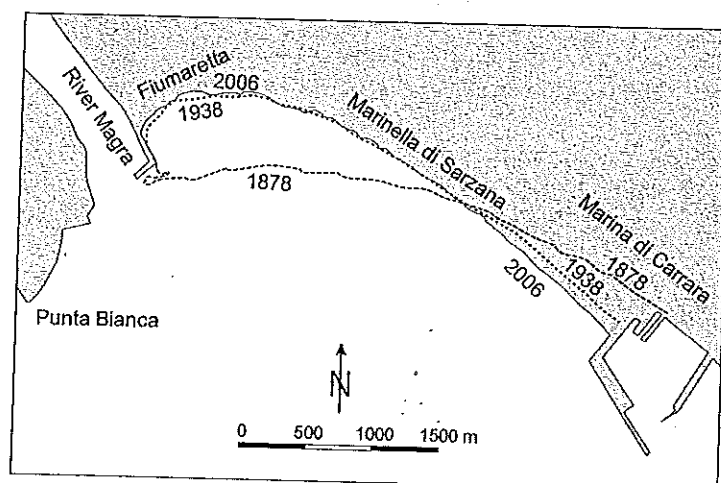


Fig. 3: Shoreline rotation in the northern part of the study area

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For many decades, conflicts among stakeholders prevented the adoption of due solutions for improving both the stability and quality of the beach, and the efficiency of the harbour. Recently, most of the problems have been overcome due to an agreement among the various competent administrations, as well as studies performed by independent research institutions.

The history of this stretch of coast and a summary of past conflicts are herein reported, together with the new scenario that is now emerging from the present relationships and possibilities.

Marina di Carrara beach began to experience erosion in the 1920s, when the piers for loading the marble were changed to a harbour. The new harbour jetties started to intercept the longshore sediment transport southwards, halting erosion on the northern beach, but increasing it to the south (Cipriani *et al.*, 2001) (Fig.4).

Several coastal defences were built downcoast the harbour since the 1930s (Albani *et al.*, 1940), and from the river mouth to the south (in Ligurian territory) since the 1960s.

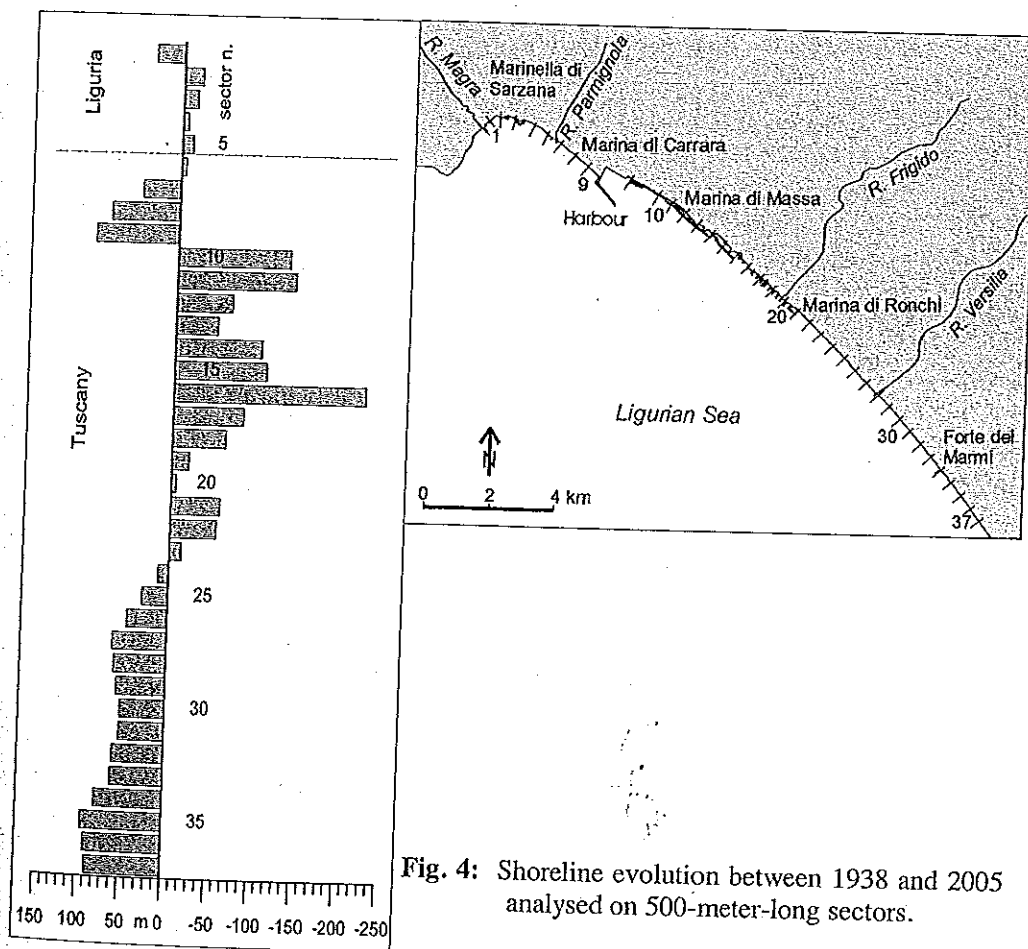
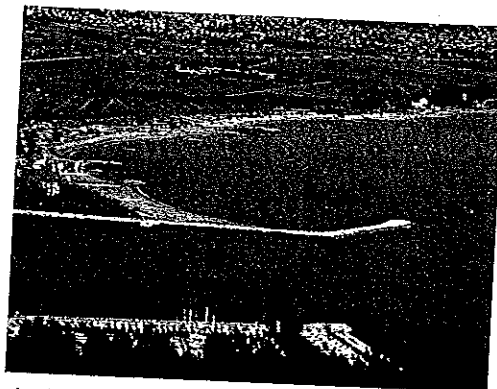


Fig. 4: Shoreline evolution between 1938 and 2005 analysed on 500-meter-long sectors.

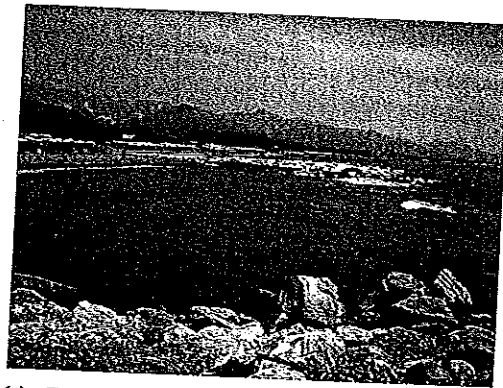
Near the river outlet round-platforms were constructed (Fig. 5a), later connected to the shore with groins; to the south, but still in Liguria, some emerged and submerged groins were built in the 1980s and 1990s (Fig. 5b).

On the lee side of the harbour, rip-raps were constructed, in front of which detached breakwaters were later added (Fig. 5c). In this area most of the beaches were lost, together with related structured tourist activities (Cipriani *et al.*, 2001).

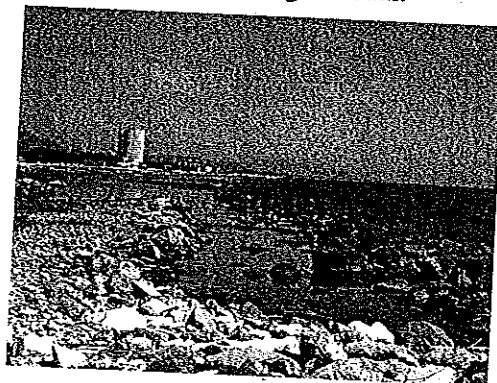
In the most appealing beach of Marina di Massa, after an attempt to stabilise the shore with permeable groins (Pranzini, 2004a), a set of rocky groins were built in the 1980s. Their inefficiency led to the construction of submerged shore-parallel breakwaters to connect their tips, which needed to be elevated to mean sea-level to become effective in protecting the coast (Fig. 5d), thus reducing significantly the quality of bathing water. After the last improvements, an average beach expansion of 16 m was obtained, however beach erosion increased on the southern coastal segments down-drift. Each kilometre of central Marina di Massa beach is now protected by 1.8 km of hard structures and the holders of concessions for bathing establishments started to demand that the same type of hard shore protection be extended southwards - even if there had been proof that these would have induced erosion at the neighbouring beach of Forte dei Marmi, one of the most popular and trendy beach resorts in Italy.



a) Artificial islands later connected with groins, at the River Magra mouth.



b) Groins at Marinella di Sarzana, in the Ligurian part of the coast.



c) Rip-raps and detached breakwaters south of the Marina di Carrara harbour.



d) Groins connected at their tips with submerged breakwater at Marina di Massa.

Fig. 5: Shore protection structures in the coastal sector under study.



At the same time, on the Ligurian side, more hard defences were being requested and designed, since the beach was too narrow to support a profitable tourist activity; in addition, during severe storms the coastal road had to be closed because of water floods.

A third party entered in action at that time: the Marina di Carrara Port Authority presented a project for harbour expansion to the Ministry of the Environment and Regione Toscana, since the present structure was not competitive in times of increase in ship size and expansion of maritime traffic. As the harbour was seen as the main cause for beach erosion at Marina di Massa, this project was resolutely opposed by the stakeholders, even if numerical models had demonstrated that the new shape of the harbour would favour sediment bypass, if longshore sediments were arriving from the north southwards.

### The New Role of the Administration

This was the scenario at the beginning of the new millennium, when most of the administrations in charge of managing this stretch of coast became actors of a new policy, favoured by several factors at regional and national level.

First, a national law passed most of the competencies on shore protection matters from the National level to the Regions. Before that, the Ministry of Public Works, through the "Ufficio del Genio Civile per le Opere Marittime", had been financing, designing and executing all the works for coastal defence, although Municipalities, Provinces and Regions would sometimes offer and discuss some inputs.

Some EU projects, like EUROSION ([www.euroSION.org](http://www.euroSION.org)), had the participation of Regions and their products were disseminated within administrations and stakeholders. In particular within the EUROSION Work Package 3.1, Regione Toscana and the University of Florence were selected to choose a pilot site along the Tuscan coast to monitor stakeholder participation in the ICZM decision making process. Marina di Massa beach was selected due to its characteristics and conflicts, and here public participation, involvement of social and economic stakeholders, and analysis of communication processes were tested through a series of questionnaires (Cipriani *et al.*, 2003). The final results of this study were presented by Regione Toscana at the final event of presentation of EUROSION outputs and policy recommendation which took place in Brussels on May 18, 2004.

In this manner public administrations entered the international network and were informed that new shore protection strategies were available, from beach nourishment to innovative and experimental works based on submerged structures, new materials (e.g. geotextiles), beach draining systems, etc.

In Italy, some Regions, like Lazio, anticipated this path issuing specific laws to acquire competencies on shore protection topics and were allowed to test new techniques and perform beach nourishment, difficult to be carried out through national administration and legislation due to problems related to authorisations and inspections. Other Regions, because of their status as "Regioni a statuto speciale" were able to carry

out projects that would be impossible to perform elsewhere, like Region Sardinia and its project at Cala Gonone (Pranzini, 2009).

Research performed by public institutions, like Universities, addressed the identification of causes of beach erosion and of the failure of "archaeostructures"; in addition, the need for studies and projects at a sedimentary cell scale was promoted by Regione Toscana.

The first example is the "General study of the Northern Tuscany Physiographic Unit - Definition of general guidelines for coastal defence between Bocca di Magra and Viareggio - Preliminary and Experimental projects for the restoration of Marina di Massa beach". The study was financed by Regione Toscana for approximately 1 Million Euro during the summer of 1997 and lasted for 2.5 years. It was coordinated by Regione Toscana and the Regional Agency for the Protection of the Environment in Tuscany, and was implemented by 3 research Institutes (Consorzio Pisa Ricerche, Dipartimento di Scienze della Terra dell'Università di Firenze and Centro Studi Prato Ingegneria) (Pranzini, 2004b).

Within this project, an experimental geotextile submerged groin was constructed and monitored for two years (Cammelli *et al.*, 2006) and three similar structures were later added and monitored thanks to resources financed by the Municipality of Massa. As a result a 4 m/year shoreline retreat was halted in the test area located downdrift Marina di Massa hard shore protection structures (Pranzini & Farrell, 2006).

In view of these results, a preliminary project for the restoration of the stretch of coast comprised between Marina di Carrara harbour and the Versilia river outlet was designed. The term "restoration" of Marina di Massa beach was used to mean the progressive abandonment and transformation of hard defences (sea-wall, detached breakwaters and groins) and a gradual reconstruction of mixed gravel and sand beaches. The project has been later completed by a team of researchers and technicians belonging to Regione Toscana, Massa Carrara Province, Massa and Montignoso Municipalities and the University of Florence. Finally, funding for approximately 30 Million Euro was granted by Regione Toscana in 2003 within its ICZM Plan (Sargentini *et al.*, 2004).

### Shared Coastal Management

Although stakeholder participation is included in the concept of ICZM, a conflict reduction strategy is seldom applied. In addition, conflicts frequently arise among different uses of the territory, e.g. industry vs. tourism, harbours vs. beaches, tourism profit makers vs. non profit makers *etc.*

In the present case most of conflicts occur between the same categories of users living upcoast or downcoast from a project area. For example, in the case of harbour expansion, which induces conflict between tourism and industry, updrift beach users would prefer a harbour that would limit sediment bypass, whereas the most extremist downdrift stakeholders would call for harbour demolition.

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A first step of inter-regional coordination was undertaken when shore protection works planned on the Ligurian coast, and firstly opposed by Tuscan stakeholders, were executed under the supervision of the Magra River Basin Authority (inter-regional basin co-managed by Toscana and Liguria). This Basin Authority entrusted the University of Florence to carry out a beach monitoring program that could evaluate the efficiency and effectiveness of the works and identify possible impacts on the downdrift coast. Works resulted to be effective in reducing erosion rates, but were unable to provide the local community with a beach that was sufficiently wide in order to support an increase in tourism activities, as expected by stakeholders. Impacts downdrift resulted to be irrelevant.

In 2001, Regione Toscana and Regione Liguria signed an agreement for a concerted action in order to find a solution for the sediment deficit and consequent problem of coastal erosion in the stretch of coast between Bocca di Magra and Marina di Carrara. Regione Liguria financed a preliminary project of the entire sub-cell and Regione Toscana financed the study of the effectiveness of the project through numerical model simulation.

This new project is now under execution. It was financed with approximately 3 Million Euro by Regione Liguria and implemented by the Municipalities of Sarzana and Ameglia. This is mostly based on beach nourishment with sand and gravel coming from the Magra River outlet, a strategy that is well accepted by Tuscany stakeholders downcoast, aware of the advantages related to a sediment input updrift. The costs related to sand and gravel extraction from the river and relocation along the beach were sustained by the Province of La Spezia, which obtained the double goal of reducing both the risks of river flooding and shoreline retreat. A total volume of approximately 300.000 m<sup>3</sup> of river aggregates is planned to be relocated (Aminti pers. comm.).

On the Tuscan sector, north of the Marina di Carrara harbour, another coastal restoration project is in progress. Financed by Regione Toscana with approximately 10 Million Euro within its ICZM Plan (Sargentini *et al.*, 2004), the project is divided in two phases. The first phase comprises the modification of the Parmignola and Fossa Maestra river jetties, and a beach fill with approximately 150.000 m<sup>3</sup> of sand, which was executed between 2006 and 2008. The second phase, presently under design, comprises the construction of a submerged breakwater made of geotextile tubes and a beach fill using approximately 100.000 m<sup>3</sup> of sand.

During the first phase, beach fill sediments coming from land quarries in the Po river alluvial plain were utilised. Recently, however, the Environmental Impact Assessment (EIA) procedure carried out by Regione Toscana for the authorisation of the coastal restoration works strongly recommended the use of sediments coming from the local drainage basin (Magra River), instead of acquiring sand coming from different Regions. Thus, an agreement (Memorandum of Understanding) among several local administrations in Liguria and Tuscany is in progress to be signed in order to fulfil the EIA recommendation and to use sediments stored upstream the dam at Santa Margherita Vara in the upper course of the Magra River.

The following administrations are willing to sign this protocol (Memorandum of Understanding): Regione Toscana, Regione Liguria, Magra River Interregional Basin

Authority, Province of la Spezia, Province of Massa-Carrara, Municipality of Carrara, Mountain Community of Val di Vara, Regional Environmental Agencies for Liguria and Toscana, together with the private company "Tirreno Power S.p.A.", in charge of the management of the dam and distribution of electric energy.

This agreement was strongly encouraged by the Magra River Interregional Basin Authority, who is willing to apply the strategy in order to prevent any unauthorised river bed quarrying (gravel mining) and therefore increase the sediment input to the connected coast. If sediment extraction is necessary to favour river discharge and to reduce the risk of flooding, gravel and sand will be carried to the connected coast. This is a bold goal opposing the traditional procedure to pay for river maintenance works (flood control by restoration of river channel sections) with the sediment extracted, one of the main causes of sediment loss after the official closure of quarries in the rivers.

The agreement is based on the fact that both Regione Toscana and Regione Liguria acknowledge that practical actions aimed at restoring the river sediment bed-load are crucial and strategic for the hydro-geological equilibrium of the Magra river basin and for its environmental sustainability.

The natural and dynamic evolution of the River basin together with the need for safeguarding and protecting the natural environment imply the need for wise management of the sediments stored behind river dams, following EUROSION recommendation n. 1, in order to improve coastal erosion management: "Restoring the sediment balance and providing space for coastal processes" (European Communities, 2004). In addition, both Regione Toscana and Regione Liguria have proposed the definition of regulatory tools for the correct use of river bed sediments, including sediment stocks upstream river dams, to be used primarily for artificial nourishment of connected beaches of the Magra River Basin in the CAMP Italia Project ([www.pap-thecoastcentre.org](http://www.pap-thecoastcentre.org)). This is coordinated by the Italian Ministry for the Environment and UNEP PAP-RAC and implemented by the following Italian Regions: Tuscany, Liguria, Latium, Emilia-Romagna and Sardinia. CAMP is oriented at the implementation of practical coastal management projects in selected Mediterranean coastal areas, applying ICZM as a major tool in the light of the recently signed Protocol for ICZM in the Mediterranean ([www.pap-thecoastcentre.org](http://www.pap-thecoastcentre.org)).

INTERREG IIICsud BEACHMED-e project ([www.beachmed.eu](http://www.beachmed.eu)) and in particular GESA Measure "Management of sand deposits collected by coastal and river infrastructures: Recovery of sediment transport" have anticipated the study of the availability of sediments along the Magra River Basin. As part of the goal towards achieving integrated management of coastal zones, Gesa subproject has focused on sand deposits which have been intercepted by coastal and river infrastructures as well as the recovery of river sediments.

The Port Authority of Marina di Carrara has only been in charge of maintenance and dredging since 1999. At the Port of Carrara, and many other Italian coastal infrastructures, reuse of dredged aggregates has never been adopted and off-shore dumping was the main solution in the past. However, the 2007 authorisation decree of the Italian Ministry of the Environment for dredging includes an important obligation: it states that the 25,000 m<sup>3</sup> dredging intervention at a harbour entrance channel has to be

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"compensated" by downdrift nearshore nourishment of the same (or higher) volume (Cappucci *et al.*, 2009).

Unfortunately, the unavailability of suitable sediments in the area forced to use Po River alluvial deposits, with an environmental impact (CO<sub>2</sub> emissions, noise, traffic, etc.) probably higher than using sediment by-pass in an area where slightly polluted sediments are widespread. However, the principle that sediments subtracted from the littoral sedimentary budget must be replaced is an important, although expensive, goal.

### Conclusions

The Northern Tuscany Physiographic Unit hosts many conflicting economic activities and is managed by different Administrations at several levels. When beach erosion started to hit this area, conflicts made it difficult to adopt due solutions for shore protection strategies and for harbour expansion.

The new role acquired by Regional administrations in shore protection matters, after the transfer of competencies to them from the National government, together with the collaboration with research institutes and the experience favoured by the participation in some EU-financed projects, resulted in a "New Deal" in Integrated Coastal Zone Management.

Part of this is a policy of reducing conflicts among stakeholders within the Northern Tuscany littoral cell, which had in the past prevented the implementation of an integrated project suitable to face and adapt to beach erosion. Dissemination of knowledge, participation of stakeholders in all steps of shore protection design, and supervision of independent research institutes, allowed minimising and overcoming this phase of conflicts.

New shore protection projects are now well known by the communities affected; their pros and cons are discussed and accepted so that each of the different administrations involved can play its role in a participated and shared manner.

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