

WORKS FOR THE DIVERSION OF BED OF RIVERS AND TORRENTS AND THEIR IMPACT TO THE ENVIRONMENT OF THE LAGOONS OF GREECE AND ITALY

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Abstract

This work deals with the comparative account and evaluation of the impact to the environment and especially with the alterations to the geomorphological structure and the hydro-geomorphological processes caused by the works for the diversion of the beds and the flow of rivers and torrents in the greater area of the “Katafourko lagoon” in Greece and of the “Venice lagoon” in Italy. Human intervention in the study areas, was of different aims in each location, but it all resulted in the alteration of the dynamic evolution of the hydro-geomorphological processes which has led to the creation of an “artificial” environment, controlled to a great extent by human power and which in turn, in the long term re-strengthens and re-enforces the possibility of environmental destabilization.

1. INTRODUCTION

The projects for the diversion of the beds and the flow of rivers and torrents constitute a significant intervention to the natural and human - made environment of an area, especially when these projects are in a position to destabilize the environmental balance of the area and to alter the natural evolution of the parameters that are directly correlated with the creation, preservation and development of vulnerable ecosystems such as those of the “Katafourko lagoon” and the “Venice lagoon”. It is noted that for the preservation and the development of the lagoon ecosystems, an important parameter is the rate of supply of water and sediments of the lagoon site and the coastal area, as well as their qualitative characteristics.

2. MATERIALS AND METHODS

2.1 Geographical location of the study areas

This study focuses in to two lagoons, which have been subjected to major alterations of their form and their environmental characteristics due to human intervention. The first study area is located in Greece and the second in Italy (Figure 1). More specifically these areas are: a. ^{1st}Area - “Katafourko lagoon” Western Greece and specifically at the eastern coast of the Amvrakikos gulf, b. ^{2nd}Area - “Venice lagoon” in Northeastern Italy.

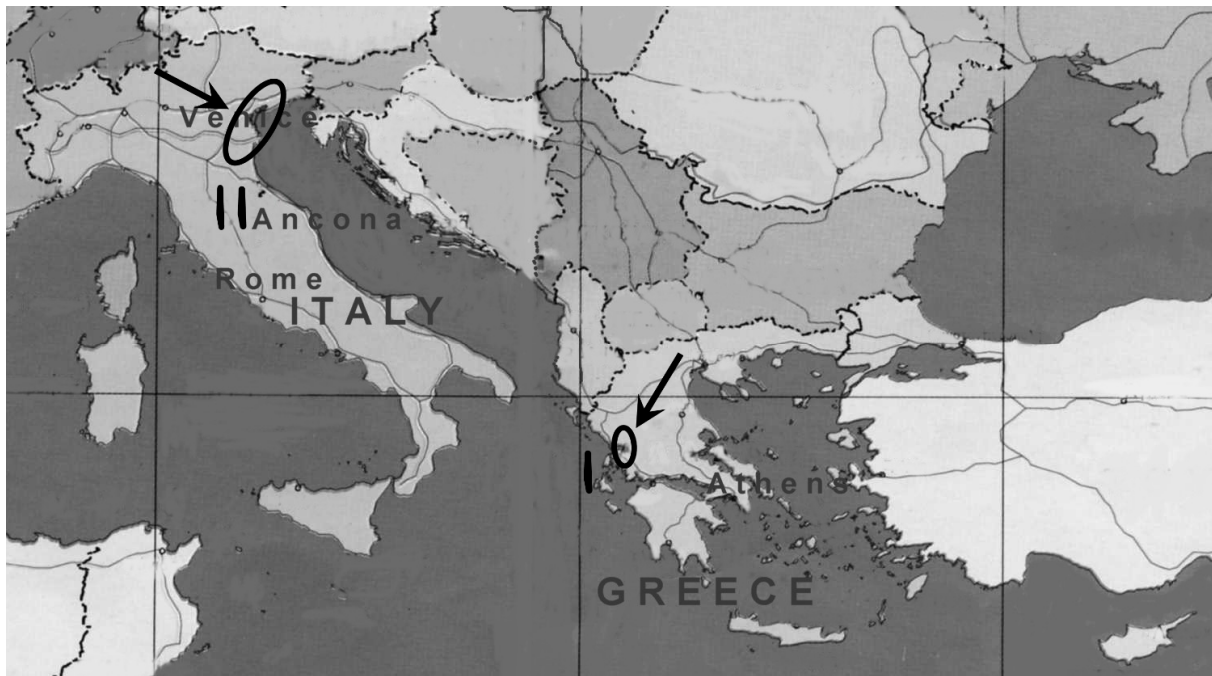


Fig. 1 - Geographical location of the study areas. “Katafourko lagoon” Western Greece (I) and “Venice lagoon” Northeastern Italy (II).

2.2 Geomorphology – Water resources of the study areas

The lagoons under study constitute dynamic geomorphological systems where the hydro-geomorphological processes evolve at a relatively high speed. a. The Katafourko lagoon, in 1945, was of longitudinal, arch shape and with a size of approximately 2.500.000 sq. meters. It is a shallow lagoon with a mean depth of 0.2 meters and a maximum depth of 0.6 meters and it is separated from the sea by a sand strip of about 1.000 meters long and a mean width of about 25 meters.

Geologically speaking the bottom and the surrounding area of the lagoon have been formed by the deposition of earth - alluvial depositions. (Anastasakis and Mertzanis 1987). The “Krikeliotis” torrent which constitutes the main supplier of “fresh” water and sediments of the low plain area of the Katafurko lagoon, during the past discharged into the eastern Amvrakikos gulf while ever since 1959 due to human intervention it has been diverted and discharges inside the Katafurko lagoon. (Figure 2). b. The lagoon of Venice has a longitudinal arch shape and occupies an area of 550 km², out of which approximately 11% constitutes the main water body, while 80% consists of swamp-marsh areas. Its length is 50 km and its width is 8-14 km. Nowadays the lagoon communicates with the Adriatic Sea is through three natural openings - channels of communication. The bottom and the surrounding area of the lagoon have been formed by alluvial formations-sediments and especially by successions of sand, sand sludge and sludge which vary in composition, depending on their location (Enzi and Marabini, 1992). The river bodies “Adige”, “Bacchiglione”, “Brenta”, “Sile” και “Piave”, which during the past have been discharged inside the lagoon of Venice have already been diverted by human intervention and are now discharged into the Adriatic Sea (Figure 3). The underground water table in the greater area of the lagoon is differentiated: α . at the *shallow well table*, and β . at the *deep water table under pressure* (Carbognin et. al., 1984).

3. RESULTS - DISCUSSION

3.1 Works for the diversion of the beds of rivers and torrents and evolution trends of the lagoons and the coastal area – Environmental Impact

This study focuses into two lagoons (one in Greece and one in Italy), which have suffered intense alterations, that is, deformations and adverse changes in their environmental characteristics, due to human intervention which altered the dynamic of the evolution of the hydro-geomorphological processes as well as their qualitative characteristics (Figures 2 & 3).

These human intervention has mainly to do with: a. projects for the diversion of the beds of rivers and torrents which during the past were supplying the lagoons or the greater area of them with water and sediments, b. portal works inside the lagoons or at the coastal zone (ports, fishing stations etc.) as well as

industrial and touristic installations and c. exploitation-pumping of underground waters.

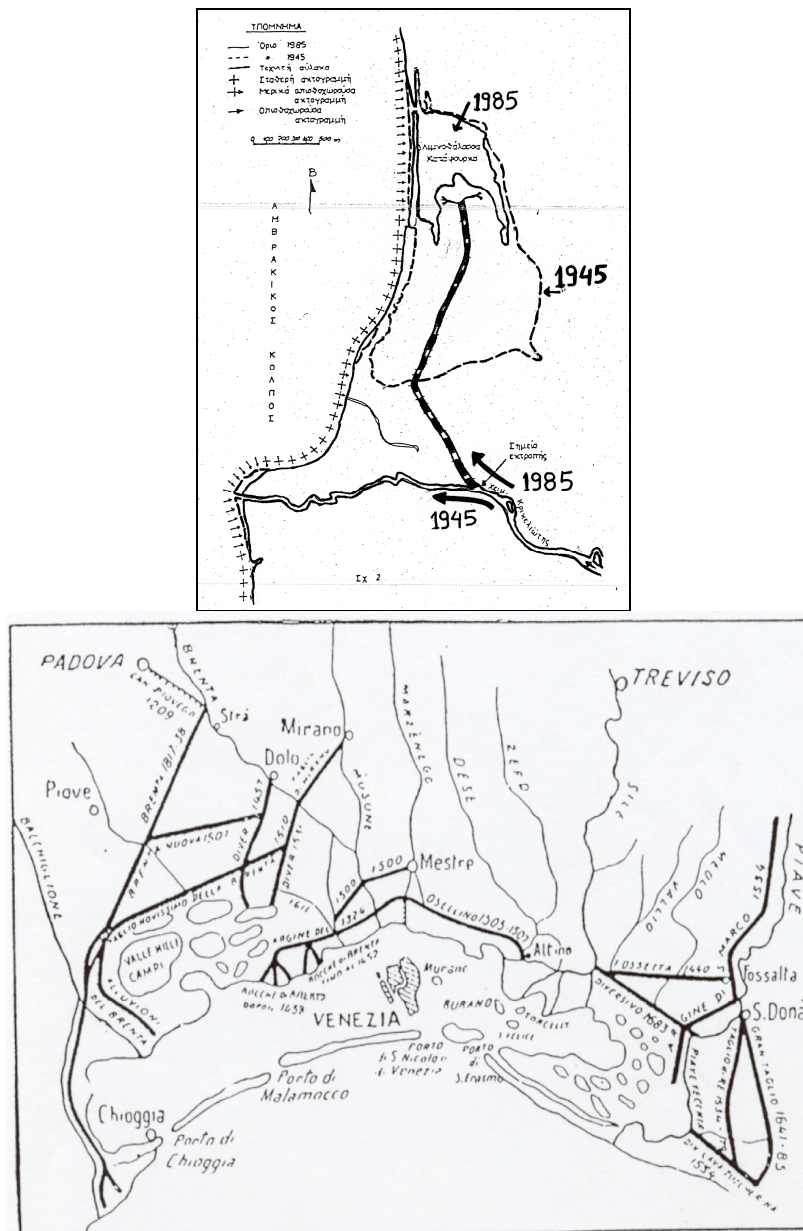


Fig. 2 & 3 - Katafourko lagoon: The evolution of the Katafourko lagoon and its coastal area (Eastern Amvrakikos gulf), between 1945 until 1985. The new bed of the diverted Krikeliotis torrent and the new position of its outfall in the lagoon instead of its old discharge position (before August 1959) in the eastern Amvrakikos gulf (source: Anastasakis and Mertzanis 1987) (Fig. 2). Venice lagoon: Schematic map of the diversion of the rivers into the sea and the digging of canals for inland navigation, (Pavanello 1931) (Fig. 3).

3.1.1. 1st Area – “Katafourko lagoon”

The extremely vulnerable and “protected” ecosystem of the lagoon of Katafourko, ever since August 1959 and until nowadays is flooded by the water of the Krikeliotis torrent and at the same time is filled from the dragged materials from this torrent. The generation of new “artificial” hydro-geomorphological processes due to the artificial diversion of the bed of the Krikeliotis torrent, has altered the geomorphological structure and the hydro-geomorphological processes of the study area, and this has resulted in the shrinkage of the area of the lagoon and especially of its “water pane” which has assumed an area of less than 500.000 sq. meters as opposed to the 2.500.000 sq. meters that it occupied in the year 1945 (Anastasakis and Mertzanis 1987, Mertzanis 1992). At the same time in the coastal zone, have been generated conditions of erosion and regression of the coast line, due to the drawing away of the outfall of the Krikeliotis torrent from the eastern Amvrakikos gulf and as a consequence the deprivation of the coast from dragged material (Figure 2). The phenomena of erosion and regression of the coast line, at least in the northern part of the sand strip which separates and “protects” the lagoon of Katafourko from sea action, appear to be enforced due to the inhibition of the natural movement of sediments in the coastal - sea area due to the construction of the port -fishing station in the last 15 years.

3.1.2 2nd Area – “Venice lagoon”

The “Venice lagoon” nowadays is more and more submerged by sea flooding "acque alte", as a result of the combination of the natural processes and especially of the climatic changes and the human intervention (river diversion, deepening of navigation channels, over pumping of underground waters in industrial locations etc.). More specifically the natural evolution of the “Venice lagoon” has been altered as a result of human intervention, where for defense purposes but also for commercial reasons were constructed already ever since old times, (1300-1800 a.C) projects for the diversion of the Adige, Bacchiglione, Brenta, Sile, Piave and Po aiming at their discharge outside the lagoon so that its filling with dragged material could be avoided (Teodoro Viero 1799) (Figure 3). Similar interventions were seen until the XIX century which hindered the filling of

the lagoon with sediments and the union of the island-town of Venice with the mainland and created such a situation that would allow the predominance of the sea processes as opposed to the river-terrestrial ones, and this resulted in the intensification of the erosion phenomena of the coastal area and especially of the thin sand strip which edges in and separates the lagoon from the Adriatic sea and which constitutes an important geomorphological characteristic for its protection. There were also interventions for the purpose of the enforcement and the protection of the sand strip which separates the lagoon from the Adriatic Sea and this resulted to the creation of an artificial lagoon environment which is as far as possible controlled by man. The above interventions were followed by intense over pumping of underground waters which resulted in the subsidence "subsidenza" and the lowering of the soil surface of the lagoon area and the sand strip (Pavanello 1931, Gatto & Carbognin 1981, Carbognin et al. 1985, Carbognin and Marabini 1989, Marabini and Veggiani 1991).

4. CONCLUSIONS

In the study areas the projects for the diversion of the rivers and torrents constitute human intervention of totally different aims which were: a. In the case of the Katafourko lagoon, banking up, and the consequent shrinkage of the lagoon area, by the dragged material from the Krikeliotis torrent. For this purpose, the artificial diversion of the bed of the Krikelioti torrent was constructed, which resulted in its discharge (outfall of the torrent) in the Katafourko lagoon instead of into the Amvrakikos gulf and b. The avoidance of the filling of the Venice lagoon with the dragged material brought by the rivers which discharge into it, for defensive but also for commercial reasons. Works for the diversion of the rivers Adige, Bacchiglione, Brenta, Sile, Piave and Po have been constructed so that the rivers will discharge outside the lagoon. Also there were digging works for the deepening of the navigation channels.

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