

# Lakes: the mirrors of the earth

BALANCING ECOSYSTEM INTEGRITY AND HUMAN WELLBEING

Proceedings of 15<sup>th</sup> world lake conference

WILC15  
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**15<sup>TH</sup> WORLD LAKE CONFERENCE**



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Lakes: The Mirrors of the Earth  
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## Lagoons and lakes in Western Greece: Human-made impact on the natural ecosystems and geomorphological changes.

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### Introduction

Freshwater wetlands around the Mediterranean Sea have decreased considerably in number and quality. Greece has lost two thirds of its wetlands during the last seventy five years; however, many wetlands with considerable conservation value remained (Gerakis, 1993; Kagalou et al., 2010; Mertzanis et al., 2011). Since then, extensive losses have occurred, many of the original wetlands have been drained and converted to farmland, industrial sitings, urban and touristic development. A wide range of human activities at the catchment's areas (intensification and development of agriculture projects, infrastructure works, hydroelectric power dams, irrigation dams and water supply dams), may lead to environmental deterioration of river waters or hydro-geomorphological changes and constitute the cause of environmental destabilization (Vavizos & Mertzanis, 2003).

The intensification of human interventions, especially after the decade of 1950, in the delta area and in the drainage basin of some rivers in Western Greece (Epirus and Aitolokarnania), such as those in the delta area of some rivers (r. Arachthos, r. Acheloos), Kalodiki fen and Ziros lake, have affected the natural ecosystems and the protected wetlands.

### Materials and methods

This study focuses in two coastal zones (delta area of river Arachthos and river Acheloos), a fen (Kalodiki fen) and a natural lake (Ziros lake), which have undergone alterations due to human activities. These areas are found in Greece: Acheloos Delta complex-Aitolokarnania-West Greece, Arachthos Delta complex-Epirus-West Greece, Kalodiki fen-Epirus-West Greece, Ziros lake-Epirus-West Greece.

For the depiction of the condition of the natural ecosystems and especially the geomorphology of the under study areas, there were used data collection involved review of existing reports, contemporary and older topographical maps (H.A.G.S. scale 1:50.000 & 1:100.000), geological (I.G.M.E., scale: 1:50.000) and oceanographic maps and hydrological data. Also for the assessment and the evaluation of the changes/impact and the alterations to the natural environment and the geomorphology of the areas under study, have been used aerial photos various years and scale (H.A.G.S.) as well as satellite images (Landsat).

### **Results and Discussion**

The most common man-made changes/impacts on the natural environment of some areas under study, are listed below: a. Alterations to the fauna, the flora and the local natural ecosystems, b. Landscape changes, c. Alterations to the surface and underground waters and c. Alterations of geomorphological processes.

Comparing the aerial photos, dated in 1945 and 1960, as well the satellite images of 2010 and 2012, many changes of the coastline, the littoral zone, the river mouth, the landscape, the riparian vegetation (deforestation) and the land use, have been observed. Prominent changes concerning the fluvial and deltaic environment, such as abandonment of the old drainage system (old small lakes, old delta mouth, etc) are identified. Also an expansion of the agriculture land and a decrease of the wet ground are observed (Vassilopoulos et al., 2010; Mertzanis et al., 2011).

The shape of the deposition tongue in Acheloos river mouth at the west part of the area has been eroded; consequently it appears to be more elongated nowadays. Moreover, the shape of the coastline has been altered during those years due to wave and the current action. The delta front has also been extensively modified in the past decades (Vassilopoulos et al., 2010). In the case of the Arachthos river, historical charts of Amvrakikos gulf confirm that the Arachthos river was discharging at Paleobouka at least from the 17<sup>th</sup> Century A.D. to the end of the 19<sup>th</sup> Century. Since the beginning of the 20<sup>th</sup> Century, the mouth shifted to its present position. During the last 50 years, human intervention on the deltaic plain, has affected to a great extent the sediment supply, the lagoons and the small lakes, and therefore, the present day sedimentation patterns (Kapsimalis et al., 2005). This tendency, for at least as far as the part of the sand barrier which connects Koronisia with Fidokastro (Logarou and Tsoukalio lagoons) is concerned, has been set back in the last 20 years when its largest part was converted to a road with the necessary coastal protection works along the shoreline (rock armour, riprap, etc.) (Mertzanis, 1992; Mertzanis et al., 2011). More specifically, after studying the temporal evolution of the coastal area and of the Arachthos river delta, one can see the overall tendency of the sand barriers to shrink, and a tendency of regression of the coast line to the west part of its estuaries until Koronisia, with the exception of the occurrence of some local phenomena of advance at the mouth of the river (Kapsimalis et al., 2005)

According to Vassilopoulos et al. (2010) and Mertzanis et al. (2011), the human interventions have modified the physical environment and the local deltaic ecosystems of the rivers Acheloos and Arachthos, to a great extend. The hydroelectric power dams, irrigation dams and water supply dams construction, on the main river channel, has resulted in a progressive reduction of the fluvial sediments. Diverse eco-environmental , geomorphologic and land use

changes concerning the coastal plains and the coastal area are also detected. The degradation of these coastal areas is accelerated by the salt water's intrusion, the over-exploitation of the groundwater, the intensification and development of agriculture projects and the expansion of the touristic structures and the urban development.

In Kalodiki wetland anthropogenic inputs which show distinct, but variable, concentration peaks, mixing with agricultural runoff and water level fluctuation are primarily responsible for wetland's productivity, in terms of nutrients and chlorophyll-a, leading in a progressive cultural eutrophication. Noted that agricultural run-off transferred by the neighbor cultivations was identified as the main source of the nutrients (Kagalou et al., 2006, 2010). According to the previous studies Kalodiki wetland has displayed a progressive cultural eutrophication as a result of both water abstraction for domestic and agricultural purposes and landscape alterations. Degradation of water quality as well as issues concerning water quantity and availability have been highlighted by Kagalou et al., (2006). Grazing and arable farming largely influence the area and cause detrimental effects to many animal habitats (due to deforestation, uncontrolled water extraction, alterations in vegetation composition, pollution by the overuse of fertilizers and pesticides, riverbank erosion, etc.) (Mertzanis et al., 2011).

The anthropogenic interventions in the Lake Ziros are very limited and are, therefore, not detected significant changes in the natural environment and the lake ecosystem. These interventions identified at certain points in the littoral zone and concern to the presence of a boarding school, now abandoned, forest roads and small touristic structures.

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Lakes, both natural and artificial are vital and strategic resources for life on our planet. At the same time, they are also highly vulnerable to human activities, especially if they are not properly preserved and used in a sustainable manner. These natural resources and their ecosystems have defined borders, while at the same time also strongly influenced by where they are located. Although there is a geographic limit between a lake ecosystem and neighboring ecosystems, lakes are heavily influenced by the substances entering them in their incoming waters. Moreover, lakes are very complex systems influenced by many different factors, major ones being the materials dissolved in their waters, the climate of the region, energy exchanges with the atmosphere, the soil and the variety of organisms inhabit them, all of which are influenced by, and also influence, the lake system itself. This complexity means that when a lake is studied on the basis of a single discipline, it can often lead to misleading conclusions, or even incorrect results. Multidisciplinary is a keyword in regard to this conference, different approaches and point of views also must be taken into account to address complex lake issues. Therefore, we are inviting not only scientists, but also resource managers, politicians, and lake basin stakeholders and users to the conference. The interactions among this diverse audience will result in a wider discussion, with the goal of connect a top-down approach to a bottom-up perspective to solving complex lake basin issues.

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