

# Lake Karla: restoration and environmental education

Maria Chamoglou

*Management Body of Ecodevelopment Area of Karla - Mavrovouni – Kefalovriso –  
Velestino, Greece*

Ecological restoration is an intentional activity that initiates or accelerates the recovery of an ecosystem with respect to its health, integrity and sustainability. Frequently, the ecosystem that requires restoration has been degraded, damaged, transformed or entirely destroyed as the direct or indirect result of human activities. Such an example is Lake Karla, a lake ecosystem which was completely drained in 1962 and has experienced a number of anthropogenic impacts including wetland loss, significant drawdown of the aquifer's water table leading to soil salinization, loss of ecological and aesthetic value. Restoration efforts started in the 80's, addressing to the re-establishment of a new functional reservoir and wetland. At the present time, the reservoir has been constructed and is filling with water while the restoration project of the wetland is still ongoing. The necessity for protection and sustainable management of Karlas Wetland has been recognized as it is an element of natural and cultural heritage, but also a foundation for economic and social development. Moving towards the goal of sustainability requires fundamental changes in human attitudes and behavior. Progress in this direction is thus critically dependent on environmental education and public awareness. One of the main projects of Management Body of the Ecodevelopment area of Karla Mavrovouni Kefalovriso Velestino is the planning of public awareness campaigns.

## **1. Lake Karla – general information about drainage of the wetland and the reconstruction project.**

The former Lake Karla (the ancient Lake Voiviis) was one of the largest and most important lakes in Greece. It was formed in a tectonic depression at the beginning of the Quaternary period, when the first sediments were deposited, followed by eroded debris from the neighboring River Pinios and other local sources of water (Rouskas, 2001). Wetland occupied most of the eastern part of the Thessaly region. Surface runoff from the watershed and floodwaters of the Pinios River supplied the lake with large quantities of fresh water (Zalidis et. al., 2005). Its surface area fluctuated between 40 km<sup>2</sup> and 180 km<sup>2</sup>, depending on the inflow-outflow balance. Much of the surrounding farmland was inundated when floodwaters were held in the lake, causing problems to soil salinization of the surrounding area. The need for flood protection of the surrounding plain area and for the revelation of agricultural fields was the reason to various technical studies after the release of Thessaly, 1881. Technical studies recommended draining the lake via the Karla tunnel and building a smaller reservoir instead of the natural lake. With the completion (1949-1950) of the first flood protection projects, involving the mountain collectors and Pinios dykes, Karlas watershed restricted by one-third with consequence for reduction of river inflows and the degradation of wetland. The final drainage of the lake was completed in 1962, with the

construction of the tunnel drainage and part of the drainage network. But, the suggested reservoir was never built and only a small marsh was left with an area of 4 km<sup>2</sup>, in order to satisfy the irrigation needs of the surround cultivations. This delay has created a series of environmental problems with anthropogenic impacts (Zalidis et. al., 2005). The remaining small, temporary marsh was unable to support the aquatic food web, and numerous species were extirpated or emigrated. Furthermore, the remnant wetland still received discharge from a large part of the watershed, but it was too small for effective nutrient removal/transformation and sediment/toxicant trapping. These environmental problems affected directly the local economy through lower family income and higher social instability associated with reduced crop production and elimination of fisheries (Sidiropoulos et al 2012).

Lake Karla's restoration project was launched in 2000. The rehabilitation of the former lake Karla has been funded by the Operational Program 'Environment' which was approved by the European Commission for the period of 2000-2006. According to the objectives of the project, the re-costrusted Lake Karla will satisfy a various targets: a) Flood protection of the surrounding plain area, b) Environmental restoration and wetland conservation, c) Meeting of irrigation needs for the surrounding cultivations in an area of 92 km<sup>2</sup> , d) Meeting of water supply needs for city of Volos and e) Tourism emergence.

The re-constructed Lake Karla is now located on the lower depression of the Thessaly plain in the Region of Central Greece. Its area is now 38 km<sup>2</sup> and its refilling started in 2009 and still refilling while its re-establishment being almost complete. At the present time, artificial Lake Karla it is characterized by its shallow depth with a maximum water depth of 4.5 m, while today the maximum depth is 1.5 m. After four years of re-filling it is already undergone drastic eutrophication attributed upon a matrix of geological, hydrogeochemical, climatologically natural characteristics and of the human activities (Chamoglou *et al.* 2013).

## 2. Importance of artificial wetland of Karla- Overview

Artificial lake Karla is one of the most important environmental projects in Europe and perhaps the only wetland restoration project in the wider Mediterranean. As part of Ecodevelopment area Karla-Mavrovouni-Kefalovriso-Velestino, according to the National and European legislation, artificial lake Karla is under the umbrella of the following protective status: a) as a Site of Community Importance of the «NATURA 2000» Network with code GR 1420004 « Karla - Maurovouni - Kefalovriso Velestino - Neohori " for the conservation of natural habitats and of wild fauna and flora, b) as Special Protection Area (SPA) for the conservation of wild bird species, with code GR 1430007 «Reservoir area of former lake Karla " and c) as Permanent Wildlife Refuge which established in 2010 to protect and conserve habitats essential breeding, feeding areas, wintering species of wild fauna and spawning and nursery areas of fish of commercial and conservation importance. According to the proposal of Water Framework Directive 2000/60/EC, the wetland is characterized as Heavily Modified Water body, a water body which was constructed by human activity at a place where existed a lake.

In terms of biodiversity, the former Lake Karla endowed with a variety of habitats (pelagic, floating vegetation, shallow marshes with *Juncus sp.* and *Typha sp.*, emergent vegetation and rocks), had the ability to support a rich fish and bird fauna (Jerrentrup, 1990). More than 143 bird species were registered, 55 of which are protected by EC directive 79/409 (Zalidis et. al., 2005).

Nowadays, the area is still of paramount importance for migratory, wintering and breeding waterfowl, waders and raptors bird species. Birds are by the far the best studied group of animals in the region. Grey Heron (*Ardea cinerea*), Egret (*Egretta garzetta*) and Cormorant (*Phalacrocorax carbo*) are a small sample of big waterfowl while Buzzard (*Buteo buteo*) and Marsh-harrier (*Circus aeruginosus*) are some of various kinds of raptors. Worth noting that wetland is used by a large number of pelicans (Globally threatened species) as a place to rest and feed and is now home to the most recently established breeding colony of Dalmatian pelicans (*Pelecanus crispus*) in Greece (Management Body of Ecodevelopment Area of Karla - Mavrovouni – Kefalovriso – Velestino, 2013). Once again and in the case of Karla is proving that one of the main threats to birds is the destruction of natural habitat and the restoration their salvation.

In the past lake Karla with its abundant fish has always been a place of cultural evolution and development of an impressively unique lifestyle of the people who – for centuries – have been living off fishing. Today in the artificial wetland of Karla have been record 13 fish species, with predominant family the Cyprinidae, such as Carp (*Cyprinus carpio*). Six species of them are considered as endemic of Pinios River such as Velonitsa (*Cobitis vardarensis*) noting the significance of the ecosystem (Management Body of Ecodevelopment Area of Karla - Mavrovouni – Kefalovriso – Velestino, 2013).

In the area there are a serious number of rare and endangered mammals such as badgers (*Meles meles*) and rodents of the species *Microtus guentheri*. Meaningful is the appearance of otter (*Lutra lutra*) in the shoreline of the artificial wetland of Karla, which is considered as Endangered in Greece and as Near Threatened globally and is protected in most European countries.

At a social level, the drying of Lake Karla turned the economic activities of residents mainly in agriculture without much success as the land granted could not be exploited due to brackish water, of unsuitable soils and frequent flooding. At the present, the local community is mainly engaged in agriculture, animal husbandry and in recent years, some of them, with tourism.

The area of Voividas Karla, has inhabited from ancient times, so the mythology and the ancient sources often refer to this lake. After all, two major cycles of Mythology, the Argonautic Expedition and the Trojan War refer directly to its area. God Apollo spends nine years in the area, bewildered by the incredible natural scenery (Rouskas, 2001).

History of the Lake is connected with the ancient and modern history of Greece. In the area was coming Alamanes and Alexander the Great. The Slavs are setting around the lake on the 6<sup>th</sup> century, while the Vlachs and the Normans settled there in 1078. On the western shores of the Lake, in 1910 took place the farmers struggle (Rouskas, 2001).

### **3. Environmental Awareness**

Environmental awareness relates to the recognition by the public of environmental issues and values, and the implications they have in relation to economic issues and social standards of living (Chaineux et. al., 1999). Public environmental awareness and participation is vital to the goal of achieving a sustainable future. Social involvement in this course of action can only happen when the communities are aware of the importance of maintaining healthy and productive ecosystems (De Lorme et. al., 2003).

Management Body of the Ecodevelopment area of Karla Mavrovouni Kefalovriso Velestino has realized the importance and the necessity of this management tool so that residents and visitors of the protected area, become familiar with the idea of protected areas

with the regulations and conditions which govern and the objectives set a) for the protection and preservation of the natural environment and cultural heritage and b) for sustainable social and economic development of the region, and to obtain information and education to benefit the protection and prevention. For that reason designs, organizes and implements environmental programs which includes:

- Environmental education in schools within and outside the protected area through audiovisual media and tours
- Participation in local events, informing about the value of the area
- Organizes events celebrating World Days, such as art exhibitions with a World Environmental Day theme, eco-theme painting competitions for World Wetlands Day, birdwatching, clean-up campaigns etc
- Information leaflets and posters, in terms of species and ecosystem diversity, (electronic and printed) which distributed free
- Creation of the map "The paths of Karla" prominence points of ecotourism (e.g. information center, Museum of Natural History and Culture of Lake Karla, site views, cultural monuments etc)
- 16 environmental interpretation signs, a key on-site form of communication between natural area managers and visitors
- Organization meeting with title "Creation of a protected wetland or reservoir?" in 2011
- Promoting business, compatible with the environment, to strengthen the local economy
- Participation at conferences
- Website of Management Body of Karla Mavrovouni Kefalovriso Velestino
- Environmental information through newspapers, magazines, radio and television

In the context of implementation of the program information and awareness raising, Management Body maintains files of visitors and tours in the protected area. According to these files some tangible results for local society have already begun to appear. In 2012 the number of visitors was 751 and in 2013 there was 1254, among them "specialized" visitors who reveal the protected area as tourist destination. Furthermore, observed increase in visits from organized groups (schools, universities etc) visiting the region under educational activities.

On the activities of alternative forms of tourism such as horse-riding, mountain climbing, cycling etc the Management Body supports their development in the protected area where their approved.

At present it is a matter of gaining people's support and participation, based first of all on knowledge and understanding of the problem and consequently awareness for permitting a generalized change of attitude which can be positively channeled for the benefit of nature and man.

#### **4. Conclusions**

The re-established Lake Karla is a challenge regarding community preservation, biodiversity, watershed management and protecting water quality, and other resource management issues. Forces us to make choices ... demand management measures ... acquire knowledge, skills and attitudes that are necessary for the sustainability of the system.

## 5. References

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