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Sustainable aquaculture and coastal wetland conservation in the GFCM area: the case of Doñana (SW Spain)

by J. Miguel MEDIALDEA

RAC/SPA Consultant

Meeting on

Mediterranean coastal lagoons management: interaction between aquaculture and capture fisheries

Cagliari, Italy, 28-30 June 2011

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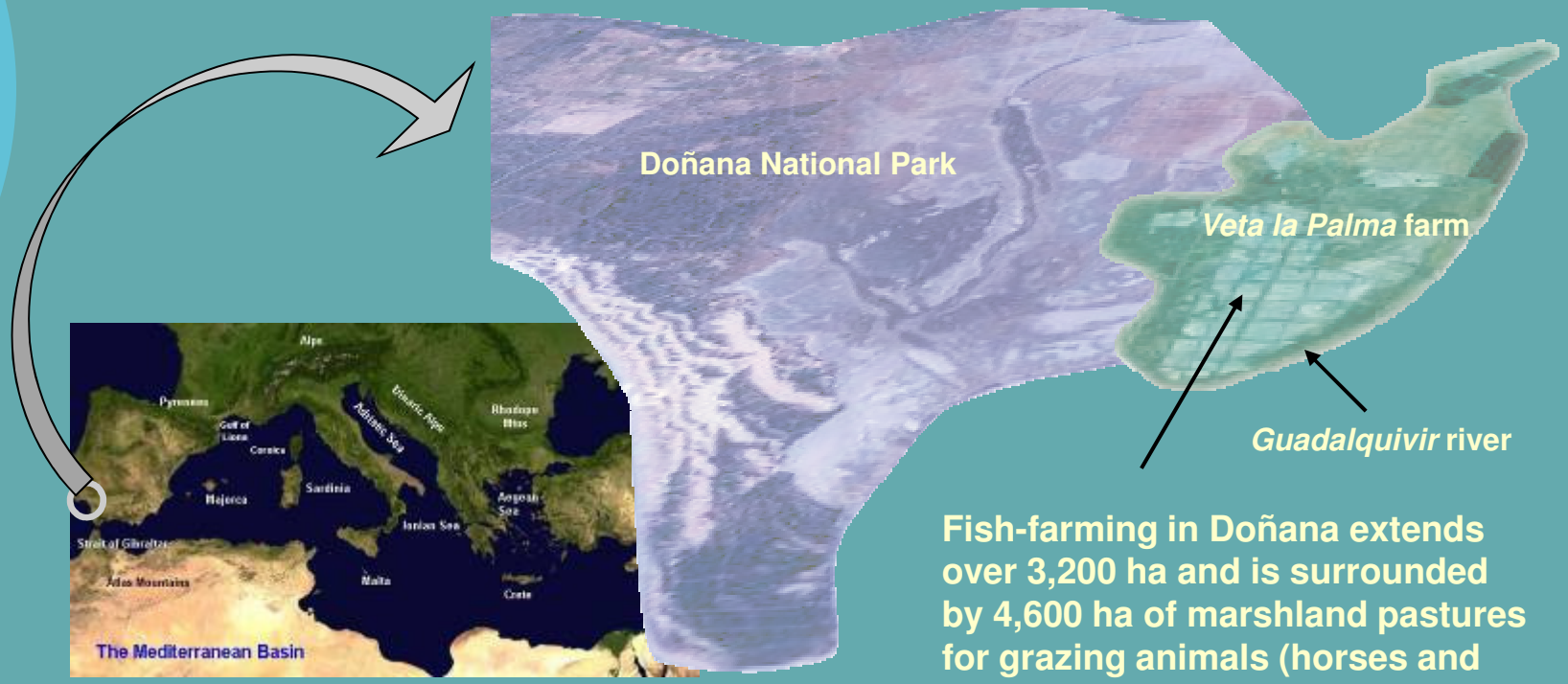
Doñana Nature Reserve is situated in SW Spain and is notable for its wide variety of landforms, fauna and vegetation types representative of the Mediterranean biome. It is a RAMSAR Wetland site of International Importance and a Biosphere Reserve under the UNESCO Man & Biosphere Programme.

Due to its vast size (108,000 hectares) and strategic location, Doñana is one of the most important coastal wetlands on the Mediterranean area.



Fish-farming in Doñana extends over 3,200 ha and is surrounded by 4,600 ha of marshland pastures for grazing animals (horses and livestock), and 2,500 ha for the growing of dry cereals and rice.

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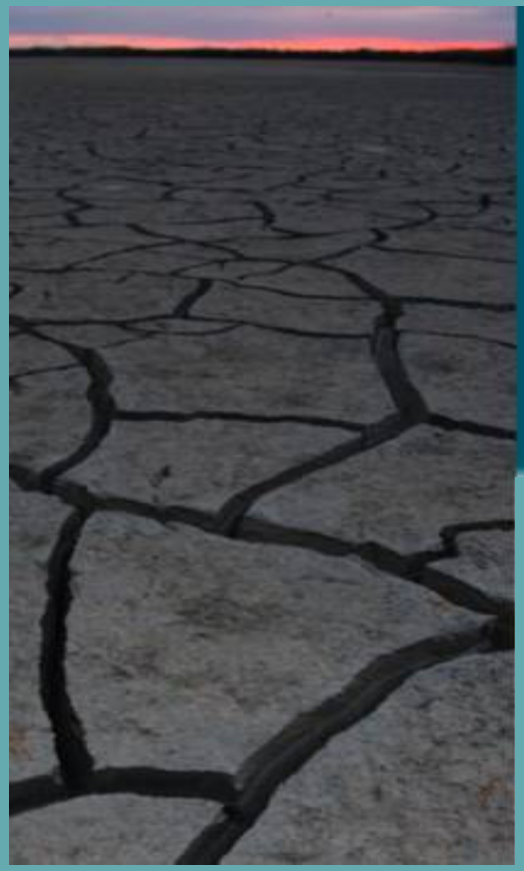
During the course of the 20th century, and after a long history of man-made transformations and natural evolution by silting-up, the original ecology of this formerly seasonal wetland area was effectively disturbed.



In early 1990s, a polyculture fish-farming operation was permitted in the area, in order to recover the original ecology while creating economic value from land use.

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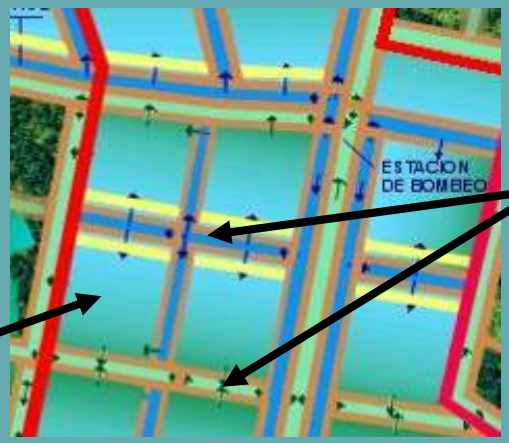
At present, fish-farming activity in Doñana is organized in 45 rectangular 70-ha ponds connected to each other and with the river *Guadalquivir* by means of a 300-km irrigation and drainage channel network.

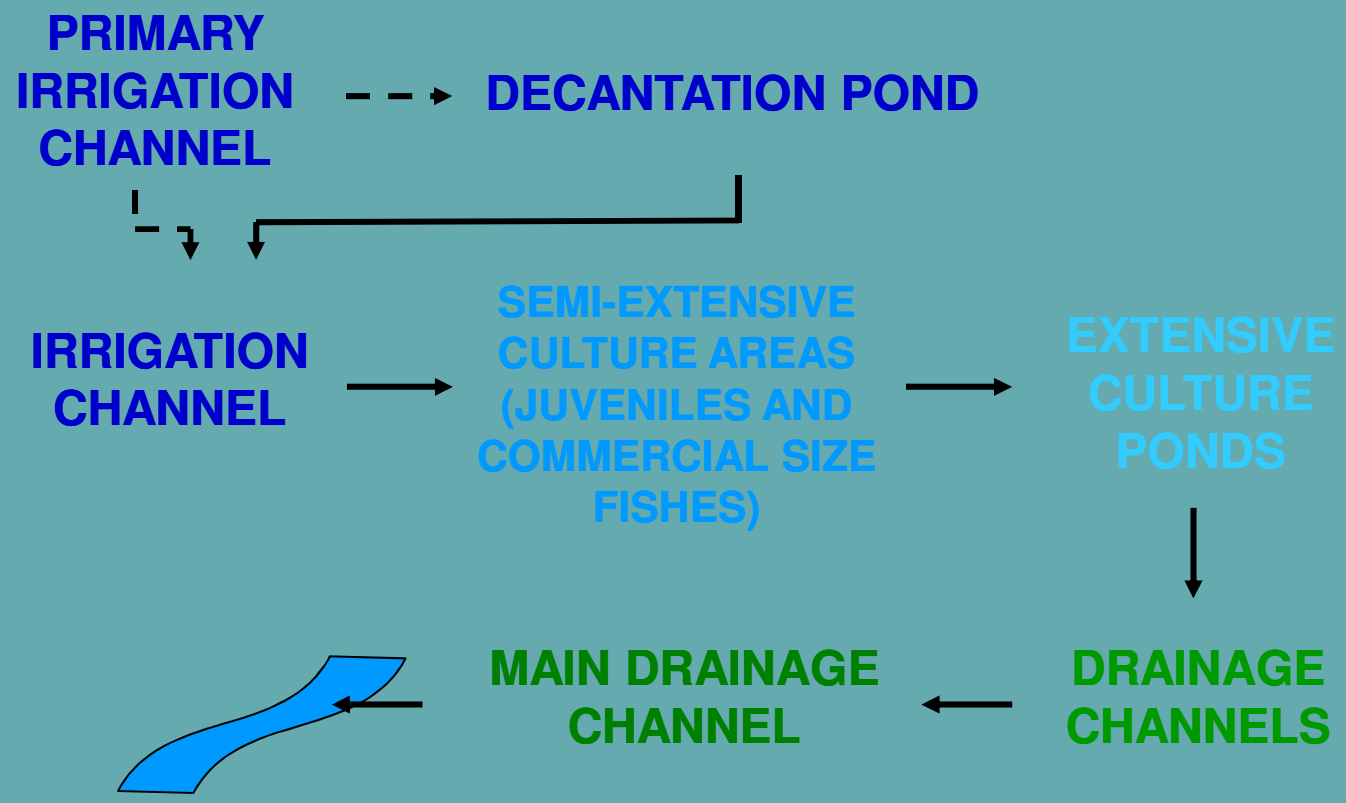
Culture ponds



Irrigation and drainage channel network

To maintain oxygenation and water quality, a flow rate of 12 m^3/s (about 1 hm^3/day) of tidal water is pumped from the river estuary through the whole system, which is designed to work both in open and close circuit.

Restablishing the formerly interrupted waterflow: water control scheme at the farm



A highly stable and productive close-to-nature aquaculture system

The combination of water, light and nutrients, through the effects of water flow management, generates a highly stable, multitrophic and productive aquatic ecosystem of artificial origin.

This stability, in terms of :

- flooded surface (3,200 ha)
- average depth (40-50 cm)
- water flow rate (up to 1 hm^3/day in summer)
- salinity, although salt content may fluctuate according to the season and the amount of rain (6-15 g/l in wet periods and 15-25 g/l during driest episodes)

promotes a massive development of phytoplankton (i.e. microalgae). Microalgae, as well as sediment-linked algae and bacteria taking part in decomposition, are predated by a varied aquatic microfauna composed of worms, insects, crustaceans and small fishes that ultimately constitutes the natural diet of cultivated fishes.

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The dense communities of microalgae and invertebrate are the foundation of a extensive range of top-quality aquaculture products.

Cultivated species are typical of the *Guadalquivir* estuary:

- ✓ sea-bass (*Dicentrarchus labrax*)
- ✓ sea-bream (*Sparus aurata*)
- ✓ meagre (*Argyrosomus regius*)
- ✓ sole fish (*Solea solea, S. senegalensis*)
- ✓ shrimp (*Palaemonetes varians*)
- ✓ eel (*Anguilla anguilla*)
- ✓ Mullets (*Mugil cephalus*, *Liza ramada*)

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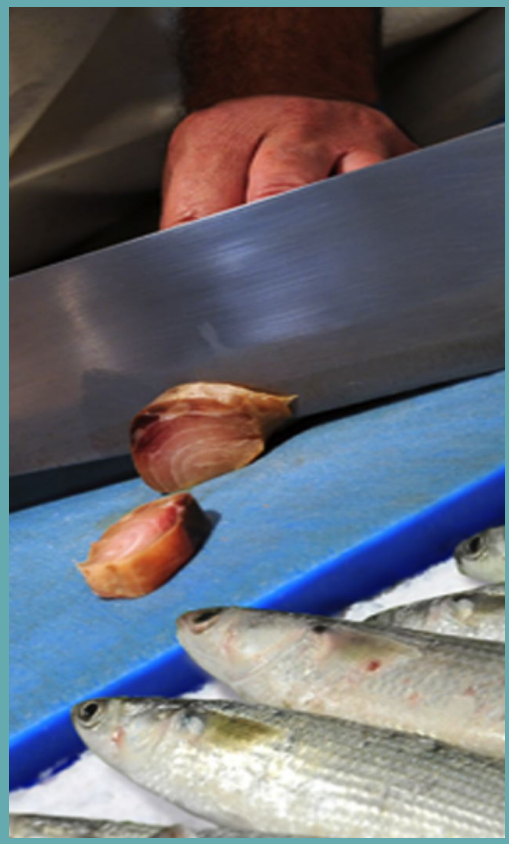
Economic profitability

Annual fish production is about 1,500 tonnes, marketed primarily to gourmet food shops and high quality food distributors in European countries and the United States.

Business profitability is essential to generate an environmental outcome and social welfare.



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Increased profitability by increasing food safety, quality and environmental sustainability

AENOR ER Empresa Registrada UNE-EN ISO 9001
ES-0441/2008

All standards and guidelines of production operations at the farm are based on the International Standards UNE-EN ISO 9001:2008, UNE-ENE ISO 14001:2004, and UE Reglament Nº 761:2001 (EMAS), and are yearly overseen by Quality Management Audits.

EMAS

AENOR Gestión Ambiental UNE-EN ISO 14001
GA-2004/0429

UNEP MAP RAC/SPA

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Social welfare

Extensive and semi-intensive aquaculture in Doñana provides direct income to 100 people from surrounding villages, also generating many other non-direct employees.

Along with the application of innovative farming practices, this activity is committed to the task of preserving traditional fishing methods that have been employed during centuries by the people living around the *Guadalquivir* estuary area.

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Restoration of the original coastal wetland landscape

Sustainable aquaculture has become an integral part of Doñana, where important material and human resources have been invested from public and private sectors to further improve restoration of wetland ecology, through different initiatives

A 300-hectare Bird Sanctuary and a 500-hectare Biological Research Area have been established in two areas of the farm, that includes natural shallow lagoons and high marsh vegetation.

More than a 100 islands and walls have been built within fish farming ponds to serve as bird refuges and nesting sites for waterfowls.

Total 150 km of pond shores and embankments have undergone extensive revegetation.

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Effects on regional biodiversity

Sustainable aquaculture plays a fundamental role for the conservation of the rich and diverse Doñana avifauna, which includes several species listed as endangered or threatened in Annex II of the ASP/BD Protocol of the Barcelona Convention or in the Red List of the International Union for Conservation of Nature (IUCN).

Shortly after aquaculture began in the area, the bird population utilizing the 500 ha initially flooded reached more than 60,000.

Presently, at any time during the year, more than 250,000 birds congregate in the 3,200 ha of extensive fish ponds.

Total bird population size reaches its maximum between August and November, sometimes stretching 600,000 and representing 80% of all birds of Doñana by that time

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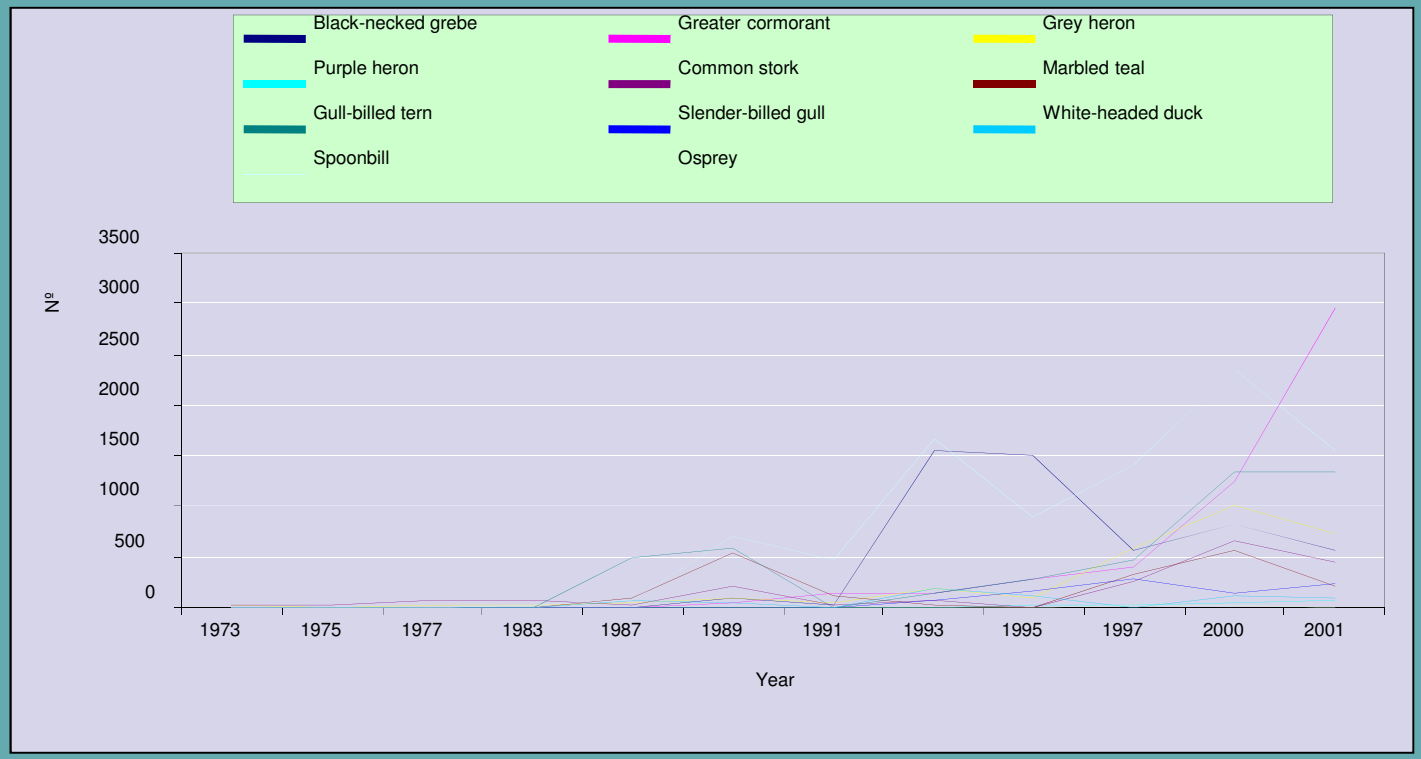
Evolution of the population of some relevant bird species in the extensive aquaculture area of Doñana, for the period 1973 (before fish farming operations and, subsequently, with original wetland still degraded) – 2001.

Gull-billed tern (*Sterna nilotica*), Slender-billed gull (*Larus genei*) and Osprey (*Pandion haliaetus*) are included in the Annex II of the ASP/BD Protocol of the Barcelona Convention.



The 3,200 ha of extremely productive extensive ponds also play an important role in the protection of the *Guadalquivir* estuary fish species as *Aphanius iberus*, *Pomatoschistus* microps (both included in Annex II), *Atherina boyeri*, and catadromous species as *Alosa alosa* or *Anguilla anguilla*, whose exploitation is currently regulated (Annex III of the ASP/BD Protocol of the Barcelona Convention).

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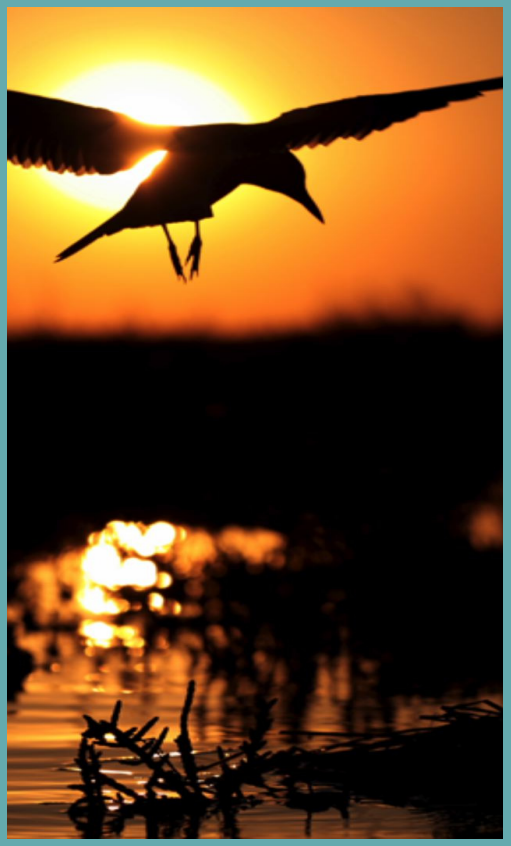
Current fish-farming in Doñana is a highly successful model of integrated management for aquaculture and conservation. The areas of extensive aquaculture ponds and remaining natural marshland constitute an ecosystem of great wealth, where balanced human management has recovered a former wetland that had been largely destroyed, and has increased natural gradients of heterogeneity (hydrologic, topographic, etc.).



… and the same principles could be applied to other coastal wetlands in the GFCM area.

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Thank you very much for your attention