

# *Marano and Grado lagoon: synoptic framework and problems related to the implementation of WFD 2000/60*

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## **Introduction**

*The Marano and Grado lagoon is the most complex transitional water system of the Region Friuli Venezia Giulia. The denomination "Laguna di Marano e Grado" is the only one to be officially accepted at present. From a scientific point of view, however, the name should be changed in order to highlight the geomorphological, hydrodynamical and chemical-physical characteristics of the different areas.*

*Indeed, Grado lagoon has higher salinity than Marano lagoon (28,5 against 22,2), its sediments are mainly sandy and it is characterised by a higher presence of islands and saltmarshes. It would therefore be more indicated to use two separate denominations for the two lagoonal compartments.*

## **Geo-morphological and socio-economic framework**

*The Marano and Grado lagoon characterises a good portion of FVG coastal areas. The lagoon was originated around V-VI century due to the evolution of Tagliamento and Isonzo river mouths. The current morphology has been affected by the reclamations carried out at the beginning of the XX century. The lagoonal area covers a surface of 160 km<sup>2</sup>, and it is developed for about 32 km, with a width of about 5 km. The inner hydrology is affected by the sea, and it is subject to continuous human pressures.*

*In the last thirty years, a lot of structures have been built, such as Porto Buso and Grado dykes, Porto Nogaro commercial harbour and channel, Porto Lignano inner dyke, Isola di S. Andrea stabilization, touristic harbours for about 6000 boats and channels to connect them to the Litoranea Veneta. In addition, lagoonal channels have not been excavated since 1998, and this has led to a progressive increase in sedimentation levels throughout the lagoon. The ingress of the sea into the lagoon is allowed by 6 mouths (Lignano, S. Andrea, Porto Buso, Morgo, La Fosa di Grado, Primero), with a water exchange of about 8750 mc/sec. Consequently, the following basins can be recognized: Marano (5.056 ha), S. Andrea (2.150 ha), Buso (3.556 ha), Morgo (297ha), Grado (3.314 ha), Primero (1.368 ha). The ingress of freshwater carried by the rivers is difficult to measure. However, it can be assessed in 100 mc/sec, of which 50 mc/sec come from Stella, 7-8 mc/sec from Cormor, 1- 2 mc/sec from Zelvina, 5-6 mc/sec from Corno, 7-8 mc/sec from Aussa, 4-5 mc/sec from Natissa. The freshwater ingress affects for about 70-80% Marano lagoon, whereas Grado lagoon has more marine characteristics.*

*The input of the 22 water pumps is also significant, reaching a volume of 200 millions mc/year, that is comparable to the volume of the entire lagoon with a 1m tide. Two sites included in the lagoon are protected by the Ram-*

sar convention on wetlands of international interest (Valle Cavanata and Foci del Fiume Stella).

Also, according to dir. Habitat (92/43/EC) and D.P.R. 8 settembre 1997 n. 357 on biodiversity conservation, the whole lagoon is included in Natura 2000 network (SAC – IT3320037).

Traditional fishing is carried out throughout the lagoon. Since the Eighties, Marano lagoon is also interested by seashell fish farming. In particular, *Tapes philippinarum* farming has caused a variation of the benthic community, and native clams (*Tapes decussatus* and *semidecussatus*) have almost disappeared. Seashell farming is an important socio-economic activity, and it is at present well controlled in order to avoid strong impacts on the environment and microbiological contamination of waters and organisms. A portion of the lagoon close to Aussa and Corno rivers has been declared Polluted Site of National Interest according to D.M. 471/99. The synoptic framework of the lagoon is summarized in figure 1.

### **Application of WFD 2000/60 to Marano and Grado lagoon**

The objective of WFD is to reach in all European States a good conservation status of waters within 2015. A further aim is to classify waters according to their characteristics, so that they can be more effectively managed. Water bodies should be described according to all the components (abiotic, hydrological, biological, ecological, toxicological, environmental), the quality state assessed through chemical-physical and toxicological tests on sediments and bioindicators, all different uses considered (eg seashell farming, bathing), all pressures identified and specific actions to mitigate impacts defined.

Currently, it is difficult to find standardized methods to carry out such tasks, that can be shared by all Member States, due to the high diversity of transitional environments throughout the community territory.

### **Environmental quality of the lagoons**

The GIS results of the monitoring activities carried out from 2000 to 2005 in 20 stations are shown.

Considering the chemical-physical parameters (Fig. 2), lagoonal waters result well oxygenated during the day, so the quality status is good. Marano lagoon is characterised by high concentrations of nutrients that can lead to algal blooms and nocturnal oxygen deficit (Fig. 3). The river mouth areas have high concentrations of nitrogen (over the limits given by the nitrate directive).

### **Mercury**

Another important problem is given by the contamination of lagoonal waters by Hg, coming from the mines of Idrija (Slovenia) and from the Torviscosa industries. Fig. 4 and 5 show Hg concentrations in sediments and in organisms used as bioindicators (*Mytilus galloprovincialis*, *Tapes philippinarum*).

Due to the high concentrations of Hg (11-14 mg/kg s.s. against a limit of 0.3 mg/kg s.s.), Grado and Marano lagoon quality state must be classified as "low" (Grado is more contaminated than Marano – 14 mg/kg s.s. against 1-2 mg/kg s.s.). As the contamination is spread throughout the 16.000 ha of lagoon, it is not possible to remove all polluted sediments. Sanitary studies however show that the contamination of humans, especially through fish consumption, is significantly lower than that indicated by the threshold of risk. Updated protocols of investigation should however be carried out in order to determine the sanitary and environmental hazard.

### **The Polluted Site of National Interest framework**

The problems related to the presence of a polluted site of national interest (Fig. 6) can be referred to the diversity of approach and uses of the lagoonal areas. With regard to the approach, the sediment characterization was carried out in a standardized way (every 450 m and 150 m, 20 cm of sediment every meter for 2 m of depth)

*without consulting the local scientific community. About 6,5 millions of euros were paid to carry out sampling and analyses. Such characterization was carried out considering the sediment as waste material to be dumped. However, the option of reclaiming 16.000 ha of lagoon sediments is not realistic at all. Furthermore, Isonzo river continues to introduce Hg in the lagoon (up to 40mg/kg s.s. were found at Isonzo river mouth). On the other hand, it is urgent to remove Hg present in Banduzzi channel, as in such area the concentrations are extremely high and the risk conditions more significant.*

## **Conclusions**

*The application of WFD 2000/60 in Marano and Grado transitional waters implies a more indepth knowledge of the lagoonal system, from the geomorphological, hydrodynamical, biological, toxicological and environmental point of view. Such a knowledge implies an updating of methods and an improvement of monitoring systems, that are often not able to describe the complexity of the site.*

*The presence of human activities of high economic value (seashell farming and navigation) and the presence of a polluted site of national interest, make the management planning of the SAC even more difficult.*

*Considering that the lagoonal environment is highly variable both in space and time, and that specific restrictions to the use are often applied, it would be the case to use innovative methods for the environmental analysis, such as multifactorial techniques typical of landscape ecology .*

*The objective is to identify a system of subareas and subbasins that can be managed in different ways, always keeping in mind the principles of compatible and sustainable development.*

*To achieve this task, proper indicators should be chosen in order to determine the quality state of lagoons. Possibly, different indicators should be applied to the different ecosystems, in order to define environmental and sanitary state and accumulation of hazardous substances in sediments, as these affect all conservation and socio-economic activities.*

*Hence, the planning of naturalistic management of the lagoonal SAC and SPA must be considered as a component of the lagoonal system considered by WFD 2000/60, aimed at reaching a good environmental quality status within 2015.*