

The Waterharmonica seen from a Spanish and Dutch perspective

“Ecological engineered wetlands to convert well treated waste water into usable surface water: backgrounds and examples in The Netherlands and in Spain”

Contribution for the International symposium on Saemangum Ecological Site Construction

Seoul, Korea, 24-26 November 2011

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Summary

Waterharmonica is a conceptual idea developed by Theo Claassen & Ruud Kampf in The Netherlands in the late 90's and early 00's in order to use natural systems, mainly constructed wetlands, for polishing treated wastewater and provide a simultaneous nature enhancement. It is important to note that there is this double goal of achieving some degree of water treatment and of ecosystem recreation and restoration, or of biodiversity enhancement is seldom found in a single design. This additional water treatment can be a key step in the compliance of EU WFD mandate for a good ecological status of water bodies. More or less in parallel, in 1998, the Consorci Costa Brava set in operation a constructed wetland system to further improve the quality of the secondary effluent from the Empuriabrava wastewater treatment plant and also aimed at achieving some beneficial environmental effects. Since then, this wetland system has been producing a reclaimed water of very low nitrogen content, which has mostly been reused at the Aiguamolls de l'Empordà Nature Reserve. This presentation will explain the conceptual ideas of the so called Waterharmonica systems and will use the information obtained from 15 years of operation of the Waterharmonica's in Spain and The Netherlands as an example of what can be achieved with them.

Keywords: biodiversity; effluent polishing; natural technologies; trophic webs; water reclamation; waterharmonica

Introduction

The use of constructed wetlands as a technique for wastewater treatment or for effluent polishing has been going on for decades in many parts of the world. Despite the general black-box approach, they are well known and well-studied systems from the engineering point of view, but lesser consideration has been given to where they can be placed and which can be their role for the community. European Water Framework Directive calling for a good ecological status of all the water bodies is changing the paradigm on what has to be done in wastewater treatment. We can no longer rely on the fact that compliance would only be based on having a few parameters being below certain threshold levels. As described by Hynes in 1960 in his seminal book “The Biology of Polluted Waters”, when wastewater is introduced in a water body there are severe alterations on its physical,

chemical and biological properties. However, these alterations are decreasing with distance until the stream can be considered as pristine again, as if any upstream discharge was never made.

Nowadays, in EU countries most of the discharges are not of raw wastewater, but usually of biological secondary effluents, still causing some impairment effects downstream of the discharge point. Impairment on water bodies can be caused not only by the concentration of the remaining pollutants in the effluent but also on the dilution level that they will have on a given water body, which can be low in streams of small size and/or located in areas prone to dry conditions, like those under Mediterranean type of climate. In this sense, good ecological status in receiving water is not related to any specific threshold level of pollutants, but about a minimal or, ideally, nil impairment downstream the discharge point. The cleaner the discharge, the lesser the impact and the more likely this compliance with the good ecological status requirements.

Waterharmonica is a conceptual idea developed by Theo Claassen & Ruud Kampf in The Netherlands in the late 90's and early 00's in order to use natural systems, mainly constructed wetlands, for two different but simultaneous goals: a) for polishing treated wastewater before its discharge in the environment, in order to reduce the degree of impairment in a specific water body, as demanded by Water Framework Directive; and b) for producing a simultaneous nature improvement by making conscious decisions about biodiversity enhancement in the system and in the surrounding area. Due to the dissemination work of the developers of the idea, the Netherlands have seen a marked increase on this kind of systems in the recent years, mainly because of the above mentioned benefits and an easy integration into the surrounding landscape, giving them an increasingly natural appeal.

In the highly touristic Costa Brava area (Girona, NE Spain), a constructed wetland system was built in 1998 beside the Empuriabrava WWTP, funded at 80% by European Union Cohesion Funds, and at 20% by the Consorci de la Costa Brava, the local water utility. The project was devised after the manager of the nearby nature reserve of Aiguamolls de l'Empordà became interested in using the effluent from the local wastewater treatment plant to feed some artificial ponds created in the most visited parts of the reserve and that suffered from inadequate water supply, especially in summer. However, because of the still high levels of nutrients for that specific purpose, a buffer treatment was needed before it could be successfully reused for environmental uses. Under these circumstances, a constructed wetland system was proposed and was finally built.

This 7-hectare system was designed to have a little number of straight lines and included areas with different depths, mainly to attract different kinds of birds. Maintenance decisions were also taken together with the nature reserve staff, in order to make sure that the biological potential of the area was being maintained and, if possible, enhanced. Other biodiversity-enhancement measures applied were to plant bushes with berries around the facility in order to attract frugivorous birds or to control water levels in the system in order to attract certain kind of birds on migration, like wading birds, in certain times of the year. Because they can be managed more easily and with less restrictions than natural systems, these artificial ones could also be designed and used as specific areas for the protection and/or breeding of species threatened by habitat loss, like the Spanish toothcarp (*Lebias iberica*) or the European pond turtle (*Emys orbicularis*), for example.

In comparison with the first systems of this kind in The Netherlands, like the one in the island of Texel, the Empuriabrava system had a lesser degree of engineering, but an appearance much closer to a natural system. On Texel the improvement of biodiversity was originally aimed on improvement

of habitat of Stickleback (both *Gastrosteus acculeatus* and *Pungitius pungitius*), small fish important as food for Spoonbills (*Platalea leucorodia*), rare in western Europe of which The Netherlands host the majority of the breeding population.

Due to this interaction with the Dutch experiences, some aspects were improved in Empuriabrava, mainly to reduce short circuiting, whereas new designs in The Netherlands had a much more natural look, as in the Grou and Soerendonk projects. The latter have been designed to provide a “soft landing” of treated wastewater into nature, going through settlement basins (Daphnia ponds), a plug-flow constructed wetland thickly planted with reed, and a final pond connected with a natural water body. Summarizing, as water is further treated and quality further improved, a lower degree of engineering and maintenance in the facilities is needed, and at the same time its natural values are increased, which is essential to sustain an adequate biological richness. This is why wastewater, after a biological treatment including N/DN, phosphorus removal, settling in Daphnia ponds and going through a vegetated ditch can be finally let to mix with natural water with no impairment on the receiving water body.

The Waterharmonica approach considers constructed wetlands systems as valuable beyond their main role of water quality improvement. They can provide other parallel functions with just some slight changes in design or in practice, especially for the recreation of vanishing habitats. At the same time, the reclaimed water they produce can be reused to produce environmental benefits in certain areas, either because of the reduction of discharges (lower degree of impairment) or because its direct reuse in nature, as in the case of the Empuriabrava constructed wetland system and the Aiguamolls de l'Empordà Nature Reserve in Spain and the Waterharmonica's in The Netherlands. In the presentation during the workshop the cases will extensively be described.

References

Available through www.waterharmonica.nl

Kampf, R., Eenkhoorn, B., Foekema, E. & Henno van Dokkum (2002), Can Spoonbills play a role in Integral water management on Texel?, 68th Eurosite Workshop, Wetland management for Spoonbills and associated waterbirds, 19 – 22 April 2002, Texel, The Netherlands

Kampf, R. & Claassen T. H. L. (2005). The Use of Treated Wastewater for Nature: The Waterharmonica, a Sustainable Solution as an Alternative for Separate Drainage and Treatment. Proceedings of the 2nd IWA. Leading-Edge Conference on Water and Wastewater Treatment Technologies - Prague 2004 and Water Intelligence Online. IWA Publishing 2005

Sala, L., Claassen, T., Kampf, R., Sala, J., Boix, D. & van der Geest, H. (2006). Trophic webs from discharges: Nature enhancement through the Waterharmonica concept. 1st Annual Meeting of the Society of Wetland Scientists, Europe, Integrating our approaches to Wetland Science, Bangor, Wales, UK.