TROPHIC WEBS FROM DISCHARGES: NATURE ENHANCEMENT THROUGH THE WATERHARMONICA CONCEPT

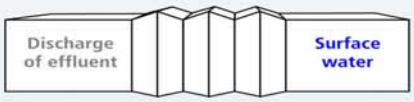
Sala L.[1], T. Claassen[2], R. Kampf[3], J. Sala[4], D. Boix[4] and H. Van der Geest[5]

[1] Consorci de la Costa Brava. E-mail: lsala@ccbgi.org [2] Wetterskip Fryslân, The Netherlands. E-mail: tclaassen@wetterskipfryslan.nl
[3] Vrije Universiteit Amsterdam and Waterboard Hollands Noorderkwartier, The Netherlands. E-mail: R.Kampf@hhnk.nl
[4] Aquatic Ecology Institute, University of Girona. E-mail: j.sala@menta.net and dani.boix@udg.es
[5] Universiteit van Amsterdam, The Netherlands. E-mail: hgeest@science.uva.nl

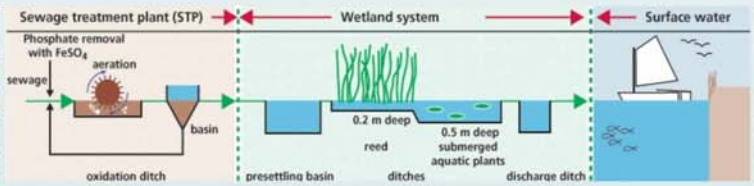
THE WATERHARMONICA CONCEPT - INITIAL APPROACH

- Treated wastewater: clean, but "dead" effluent, still with impacts on the receiving water bodies
- Need to return "live" effluents to the environment (European WFD) renaturalization of waters to be discharged for standard compliance (specially acute where dilution flows are low)
- Constructed wetland systems are effective transition zones between WWTPs and environment: the missing link between tap and source
- Designed and operated with a trophic web approach
  The Waterharmonica
  (Kampf & Claassen, 2005; http://www.waterharmonica.nl)

"Dead" effluent
(What we are discharging)
Sludge particles
High concentration of loose bacteria
High concentration of inorganic nutrients
Low concentration of dissolved oxygen
Odors



"Live" effluent
(What the environment needs)
Algae, crustaceans, insect larvae, etc.
Naturally disinfected water
Low concentration of inorganic nutrients
Oxygen dynamics as in natural water bodies
Absence of odors



Design approach: "Hard" treatments to be used for wastewater treatment (higher efficiency, smaller footprint), and "soft" treatment systems to be used for effluent polishing, where efficiency of the "hard" ones decreases and/or requires expensive investments (i.e., use of membranes)

NUTRIENT RECYCLING FOR ENVIRONMENTAL PROTECTION

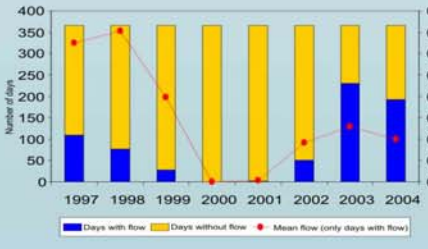
Nature enhancement through the development of trophic webs

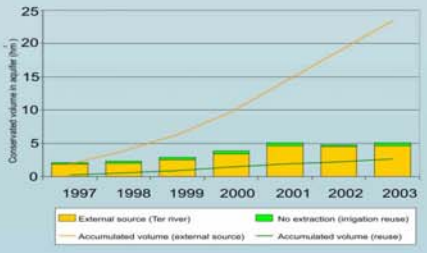
- **Everstekoog constructed wetland** (Island of Texel, The Netherlands) : Full scale constructed wetland for effluent polishing and research project on the growth of water fleas (*Daphnia magna*) feeding on effluent particles. Development of the "Grickleback process": use of Daphnia as food for sticklebacks (*Gasterosteus aculeatus*) , which in turn are also food for spoonbills (*Platalea leucorodia*).

- **Empuriabrava constructed wetland** (Costa Brava, Spain): Effluent polishing for environmental reuse at the Aiguamolls de l'Empordà Nature Reserve. Flora and fauna increasingly similar to the adjacent natural wetlands. Sustenance of dense and diverse populations of birds in spring due to food abundance. Improvement of the microbiological quality of the nearest beach at the mouth of the Muga river (see http://aca.gencat.net:8002/cat/platges/detallplatja.asp?xOrigen=3&xplatja=17047C)

Discharge reduction through reuse for irrigation (the crop as a "green filter")

- **Ridaura river basin** (Costa Brava, Spain): Water transfers from Ter river basin for municipal and domestic supply has allowed the recovery of the natural flows in the Ridaura river in average rainfall years. Wastewater reclamation and reuse for agricultural and golf course irrigation (600,000 m3/year not withdrawn from a coastal aquifer of 5 hm3/year of renewable resource production) has also decreased both groundwater and fertilizer demand (avg 16 tons N/year and 2 tons P/year recycled), and helped restore natural flows, reduce discharges and improve macroinvertebrate abundance in this temporary mediterranean stream.





Everstekoog constructed wetland

Empuriabrava constructed wetland

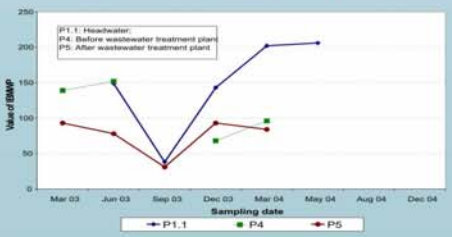
Ridaura river basin, summer early 90's - no restoration measures-: left, river bed upstream WWTP; right, downstream WWTP.

Ridaura river basin, 00's: -after flow restoration measures-: left, river bed upstream WWTP (march 03); right, downstream WWTP (august 05).

FUTURE RESEARCH AND MONITORING EFFORTS

- Removal of microbial indicators, pathogens and micropollutants in constructed wetland systems, and assessment of the improvement in receiving water bodies according to EU's WFD
- Assessment of improvement of ecological quality based on macroinvertebrate abundance on both streams (IBMWP, Alba-Tercedor & Sánchez Ortega, 1998) and wetlands (QAELS, Boix et al., 2005)

EVOLUTION OF MACROINVERTEBRATE ABUNDANCE ALONG THE RIDAURA RIVER (COSTA BRAVA, SPAIN)



Sampling started in spring 2003 and has been conducted quarterly since then (results after mid 2004 pending). Note that when the river was dry (almost all the time between 1998 and the 2002), index values were nil.

REFERENCES

- **Alba-Tercedor, J. & Sánchez-Ortega, A.** (1988). Un método rápido y simple para evaluar la calidad biológica de las aguas corrientes basado en el de Hellawell (1978). Limnetica, 4:51-56
- **Boix, D., Gascón, S., Sala, J., Martinoy, M., Gifre, J. & Quintana, X.D.** (2005). A new index of water quality assessment in Mediterranean wetlands based on crustacean and insect assemblages: the case of Catalunya (NE Iberian peninsula). Aquatic Conserv. Mar. Freshw. Ecosyst., 15:635-651
- **Kampf, R. & Claassen, T.** (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