Environmental assessment of several experiences of reclaimed water intakes in coastal Mediterranean creeks of Catalonia, NE of the Iberian Peninsula

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Centre d’Estudis dels Rius Mediterranis – Museu Industrial del Ter

Environmental area from the Industrial Museum of the Ter River, a foundation, a non lucrative organization, driven by the Municipality of Manlleu (Osona)

Created: 2001

Its objectives: study, diffusion and preservation of the cultural and natural heritage of the Ter River and other Mediterranean Rivers
Works on:

- Custòdia (river stewardship) –conservation and restoration- of continental water systems
- Environmental Education and community awareness
- Research in Mediterranean river ecosystems
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STUDY AREA: COSTA BRAVA AND MEDITERRANEAN CREEKS

Climate
- Mediterranean
- ~450 mm/y

Catchments
- Siliceous (gneiss)
- Forested (oaks and bushes)
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GENERAL OBJECTIVES

Assessment of the reclaimed water application at the Costa Brava area to:

- replace/reduce water intakes from other river basins (CCB)
- reduce overexploitation of coastal aquifers and seawater intrusion (CCB)
- analyze chemical organic micropollutans (UdG) and microbiology (UB)
- **To understand the impact of reclaimed water application on the creeks and their biota (CERM).**

Research group:
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METHOD

1. **Physicochemical parameters:**
   - Flow, conductivity, pH, DO
   - Nutrients (NO$_3^-$-N, NO$_2^-$-N, NH$_4^+$-N and SRP)

2. **Hydromorphological parameters:**
   - In-stream habitat (IHF index; Pardo *et al*., 2002)
     - Inclusion, runs, substrate, v – d, sun expos., heterog., aq. vegetation
   - Riparian vegetation (QBR index; Munné *et al*., 1998)
     - Veget. cover, cover structure, cover quality, channel alterations

3. **Biological parameters:**
   - Macr-invertebrates
     - Multihabitat qualitative sampling (identified up to families level)
     - IBMWP (Alba-Tercedor *et al*., 2002), EPT and OCH indexes (Lenat, 1983; Barbour *et al*., 1999)
   - Fish
     - Electrofishing and fish trapping
     - IBICAT index (ACA, 2006)
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**Tossa de Mar creek (Tossa de Mar, la Selva)**
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**Tossa de Mar creek (Tossa de Mar, la Selva)**

**WWTP**
- ~10,000 eq. inhabitants
- Physicochemical tertiary treatment
- 60% → sea
- 40% → pond + gardening

**Artificial pond**
- Infiltration or reclaimed water towards the creek since 2001
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Tossa de Mar creek: hydromorphological quality

- IHF
- GOOD QUALITY
- QBR
- GOOD QUALITY
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**Tossa de Mar creek: biological quality (IBMWP)**

(*) Dry reach

UPSTREAM

DOWNSTREAM

2003 2004 2005 2006 2007 2008
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**Tossa de Mar creek: biological quality (IBICAT)**

**IBICAT index:** Good

**UPSTREAM (To1):**

No captures (dry reach)

**DOWNSTREAM (To2):**

European eel

*(Anguilla anguilla)*

**Density:** 62 ind./100m

(1.409,09 ind./ha)

**Biomass:** 18,82 kg/ha

3 passes of a depletion sampling done in 16/12/2004
Tossa de Mar creek: conclusions

The intake of reclaimed water into the Tossa de Mar creek:

- Contributes to recovery of the original hydrologic regime of this creek, at least downstream, attenuating groundwater overexploitation effects

- Allows the maintenance/development of the native riparian tree species, some of which with high dependence on water (alders)

- In dry periods, water availability significantly affects macroinvertebrates taxonomic composition upstream. No differences are observed downstream and upstream in wet periods

- Allows the maintenance/development of macroinvertebrates families and native fish species
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**Rubiés creek (el Port de la Selva, l’Alt Empordà)**

**WWTP**

- ~ 993 inhabitants (in winter)
- Physicochemical tertiary treatment
- 98% → creek
- 2% → cleaning + gardening
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Rubíes creek (el Port de la Selva, l’Alt Empordà)

Peracetic acid (disinfectant agent)

Temporal variability
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Rubiés creek: hydromorphological quality

IHF

Mediocre quality

QBR

Bad quality
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Rubiés creek: biological quality (IBMWP, EPT and OCH)

EPT:
- Baetidae
- Caenidae

OCH:
- Ditiscidae
- Notonectidae
- Corixidae
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**Rubiés creek: biological quality (IBICAT)**

**FISH POPULATION (2010)**

IBICAT index: **Moderate**

- **Mosquito fish** *(Gambusia holbrooki)*
  - N: 786

- **Golden mullet** *(Liza aurata)*
  - N: 2

- **European eel** *(Anguilla anguilla)*
  - N: 41

**Biomass**

- N: 4,95 %
- N: 94,81 %
- N: 0,24 %
- N: 6,64 %
- N: 1,18 %
- N: 92,18 %

Graph showing biomass distribution with size classes from 250 to 650 mm.
Rubiés creek: conclusions

The intake of reclaimed water into the Rubiés creek:

- Based on macroinvertebrates indexes, water quality does not improve downstream the reclaimed water intake of the Wastewater Treatment Plant.

- However, some new macroinvertebrates families (such as Ditiscidae and Baetidae) appeared when the Wastewater Treatment Plant used a new disinfectant (peracetic acid), in 2008 and 2009.

- Bad habitat quality (IHF) seams to be one of the causes of the moderate improvement of some hydromorphological indexes (QBR) and biological water quality indexes at low Rubiés creek.

- So, it is recommended to retrofit or restore the low Rubiés creek to improve its ecological quality.
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**Llançà creek (Llançà, l’Alt Empordà)**

**WWTP**
- ~ 4,388 inhabitants (in winter)
- Physicochemical tertiary treatment
- 100% → creek
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Llançà creek (Llançà, l’Alt Empordà)
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**Llançà creek: hydromorphological quality**

- **IHF**
  - Mediocre quality
  - Aquatic vegetation
  - Heterogeneity
  - Sun exposition
  - Substrate
  - Runs
  - Inclusion

- **QBR**
  - Naturality
  - Quality
  - Estructure
  - Cober

- **BAD QUALITY**
  - LLA2
  - 2009
  - LLA2
  - 2010
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Llançà creek: biological quality (IBMWP, EPT and OCH)
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**Llançà creek: biological quality (IBICAT)**

**FISH POPULATION (2010)**

IBICAT index: **Good**

- **Golden mullet**
  - (Liza aurata)
  - N: 6

- **European eel**
  - (Anguilla anguilla)
  - N: 101
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Llançà creek: conclusions

The intake of reclaimed water into the Llançà creek:

- Contributes to recover part of the original hydrologic regime at low Llançà creek, attenuating groundwater overexploitation effects

- Allows the development of the native aquatic vegetation species, mostly macrophytes (reeds and cattails).

- Allows the development of the macroinvertebrates families and native fish species

- It is recommended to move the reclaimed water intake upstream. This action would increase the creek flow period of the whole low Llançà creek, and help restore its ecological quality (creek connectivity), specially in dry periods.
GENERAL CONCLUSIONS

- Reclaimed water inputs guarantee water availability in the Costa Brava creeks all over the studied years

- Vegetation tends to recover in the riparian areas

- Water availability affects significantly macroinvertebrates taxonomic composition, specially in dry periods

- Population of estuarine fish species, like European eels and mullets, could be recovered in the lower parts of these creeks
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MANY THANKS!
MOLTES GRÀCIES!

Consorci Costa Brava

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