LIFE12 ENV/ES/000685 ALBUFERA

RENDIMIENTOS DE LOS HUMEDALES ARTIFICIALES

EFFICIENCIES OF CONSTRUCTED WETLANDS

Action B1. Hydraulics management.

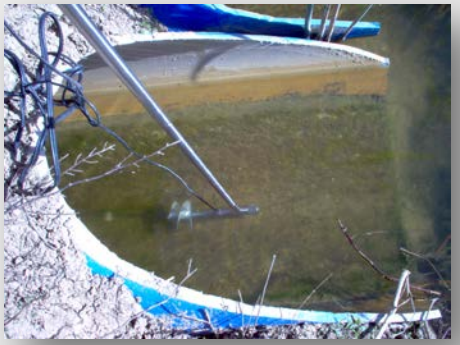
Action C1. Monitoring the impact of management on water quality and sediments.

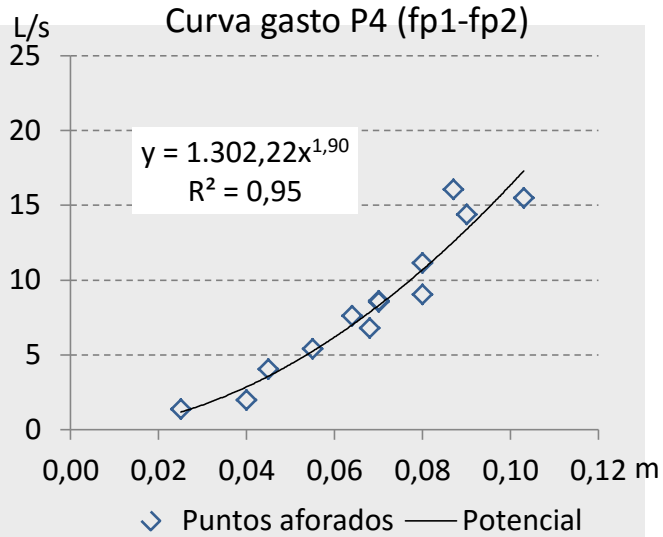
UNIVERSITAT POLITÈCNICA DE VALÈNCIA
Instituto de Ingeniería del Agua y Medio Ambiente
ACCIÓ ECOLOGISTA AGRÓ
FUNDACIÓN GLOBAL NATURE
SEO BirdLife
GOBIERNO DE ESPAÑA
MINISTERIO DE AGRICULTURA, ALIMENTACIÓN Y MEDIO AMBIENTE
CONFEDERACIÓN HIDROGRÁFICA DEL JÚCAR
acuaMed
Con el apoyo de:
GOBIERNO DE ESPAÑA
MINISTERIO DE AGRICULTURA, ALIMENTACIÓN Y MEDIO AMBIENTE
Fundación Biodiversidad

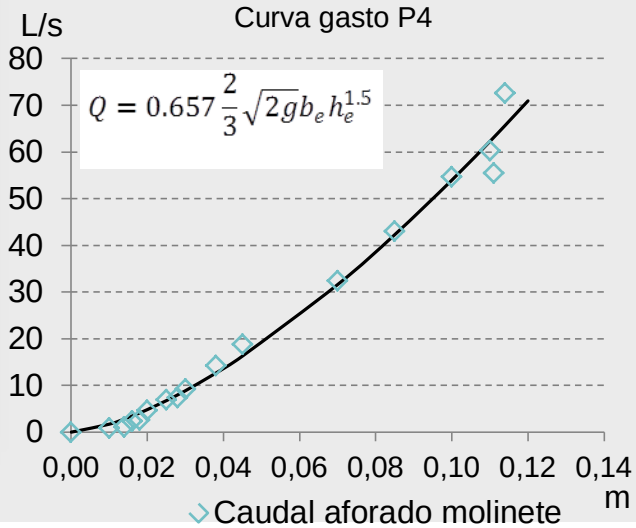
Objetives

ACCION B1. Hydraulics management.

- Monitoring and controlling circulating flows.
- To develop measurement tools for managers of CW.
- To assess preferential paths.
- Establish measures for energy optimization.



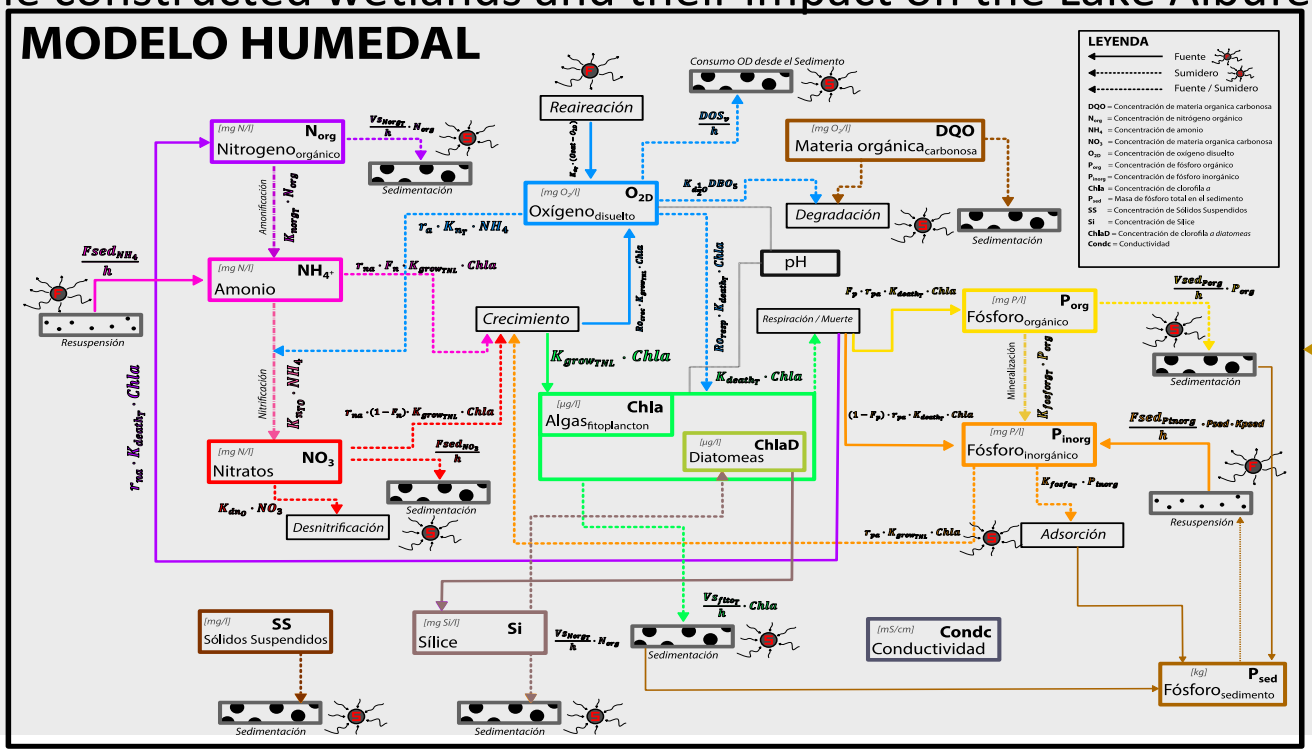




Objetives

ACCIÓN C1. Monitoring water quality (WQ).

- To calculate efficiencies and removal rates for water quality variables (physico-chemical and biological).
- To collect data for calibration and validation of a WQ mathematical model for the constructed wetlands and their impact on the Lake Albufera (ACTION B3).



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Humedales artificiales: tecnologías blandas para tratamiento de aguas.

- Aguas residuales pequeñas poblaciones (< 2000 he) (y deshidratación de fangos).
- Efluentes industriales, actividades agrícolas (contaminación difusa).
- Escorrentías urbanas (autopistas, descargas de sistemas unitarios…).
- Aplicaciones ambientales.

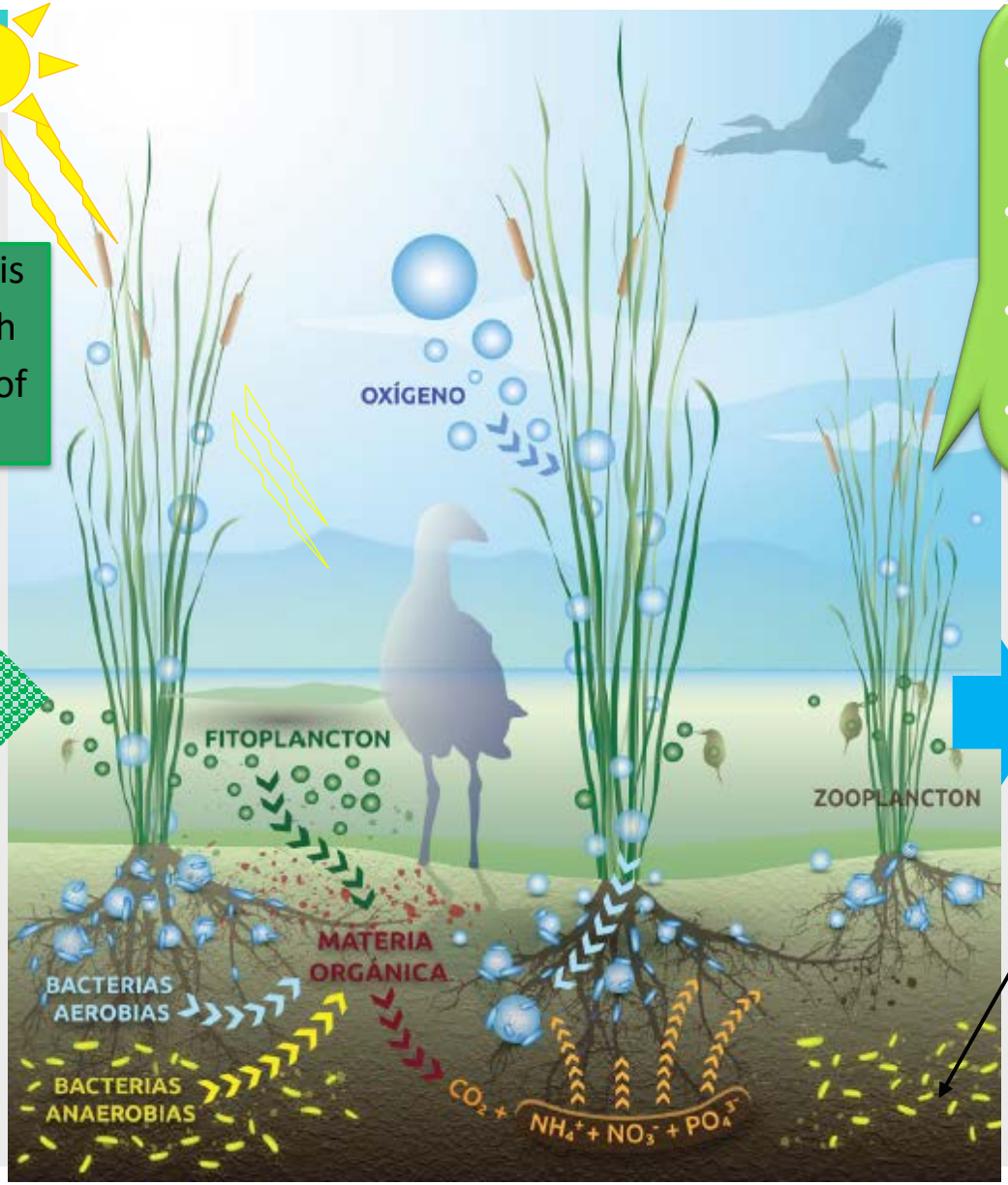
Tipologías:

Flujo superficial

Flujo subsuperficial

Objetives

The inlet water is green, with high concentrations of nutrients.



The helophyte vegetation:

- Reduces solar radiation, limiting the growth of phytoplankton.
- Promotes sedimentation and reduces resuspension.
- Absorb nutrients and produce oxygen.
- It is habitat for food, shelter and nesting areas.

The outlet water is transparent, with fewer nutrients and zooplankton charged.

Bacteria degrade organic matter, producing nutrients assimilable by vegetation.

Monitoring

Monitoring flow rates and water quality

Flows

Water levels

HRTs

HLRs

(18 per year)

Cond, pH, T, DO
COD total, soluble
TSS, VSS, turbidity
Nutrients (N, P, Si)
Alcalinity
Chlorophyll *a*
(18 per year)
SEDIMENTS (2 per year)

Phytoplankton

(6 per year)

Zooplankton

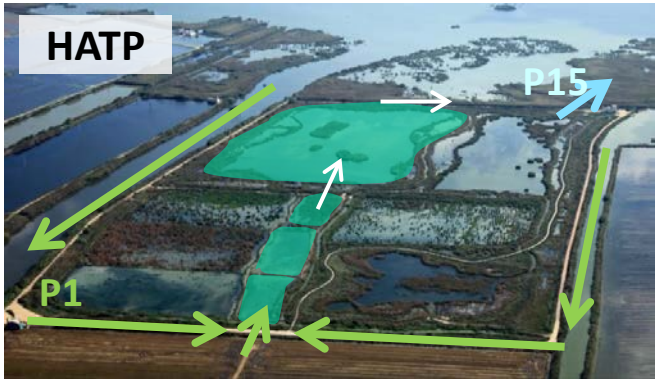
(6 per year)

Benthic macroinvertebrates

(4 per year)

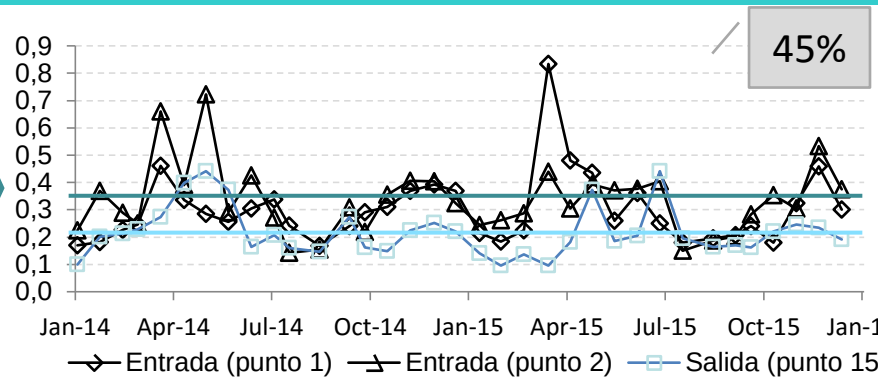
Results

Inlet and outlet concentrations from *tancats* (2014-15). **Total phosphorus (mg P/L)**



Entrada (Inlet)

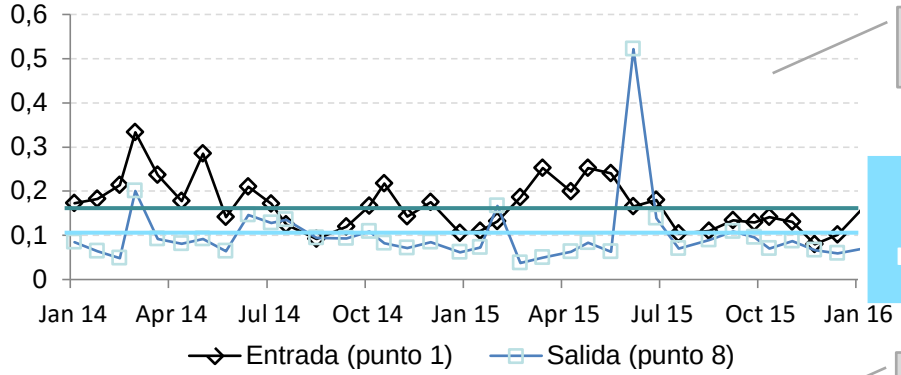
0.337 mg P/L



Salida (Outlet)

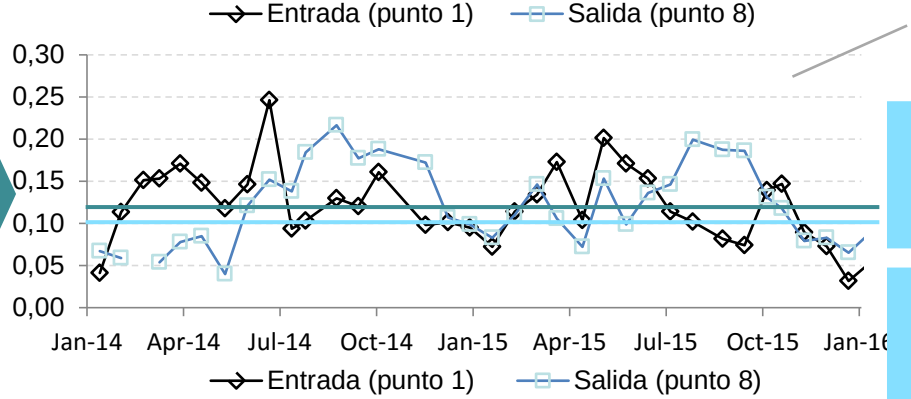
0.218 mg P/L

0.169 mg P/L



0.101 mg P/L

0.122 mg P/L



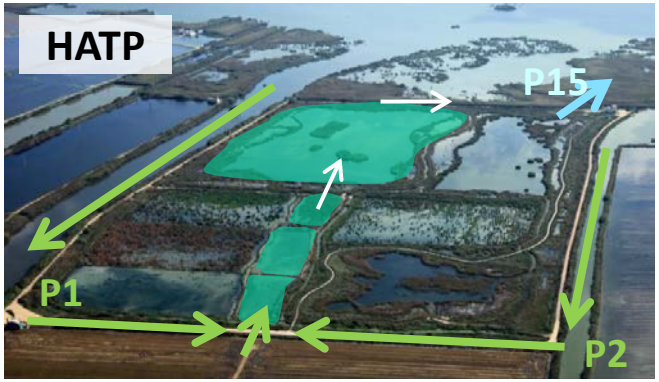
0.122 mg P/L

49%

0.076 mg P/L

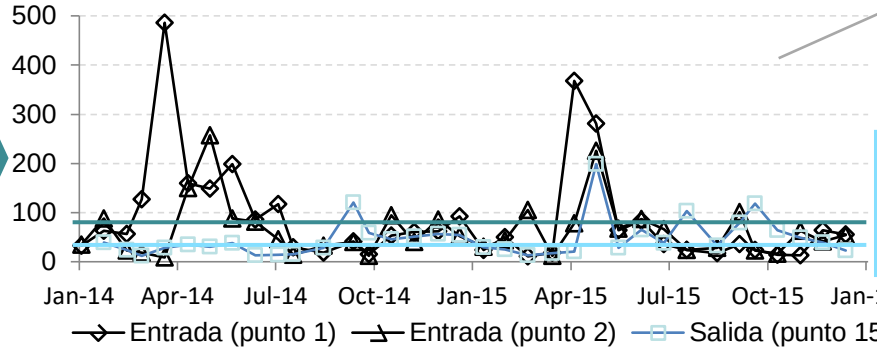
Results

Inlet and outlet concentrations from *tancats* (2014-15). **Chlorophyll *a* (µg/L)**



Entrada

87 (1), 64 (2) µg/L

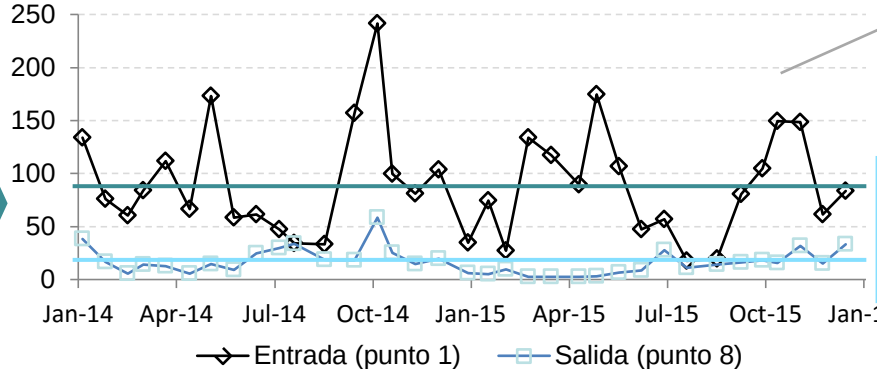


37%

Salida

47 µg/L

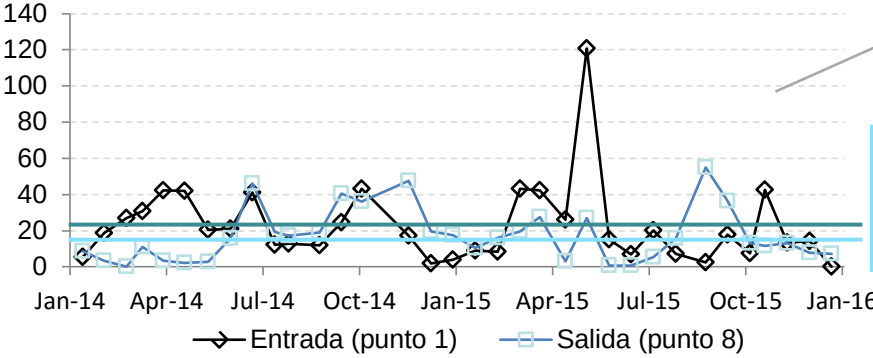
90 µg/L



83%

17 µg/L

23 µg/L

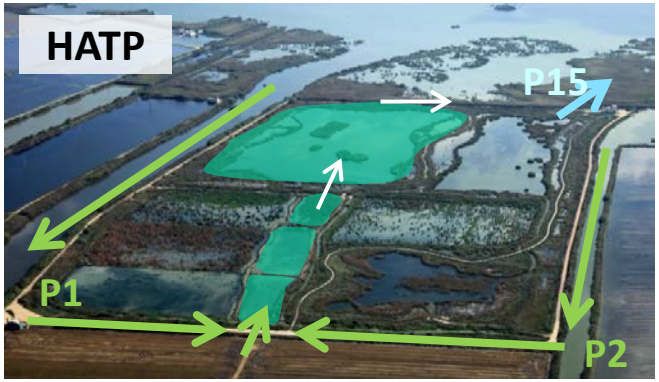


17%

18 µg/L

Results

Inlet and outlet concentrations from *tancats* (2014-15). **Chlorophyll *a* (µg/L)**



Inlet

87 (1), 64 (2) µg/L

90 µg/L

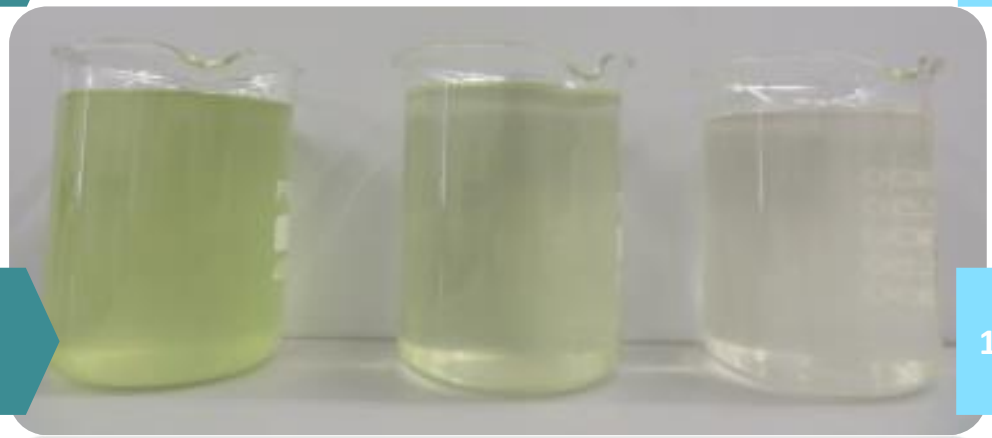
23 µg/L

Outlet

47 µg/L

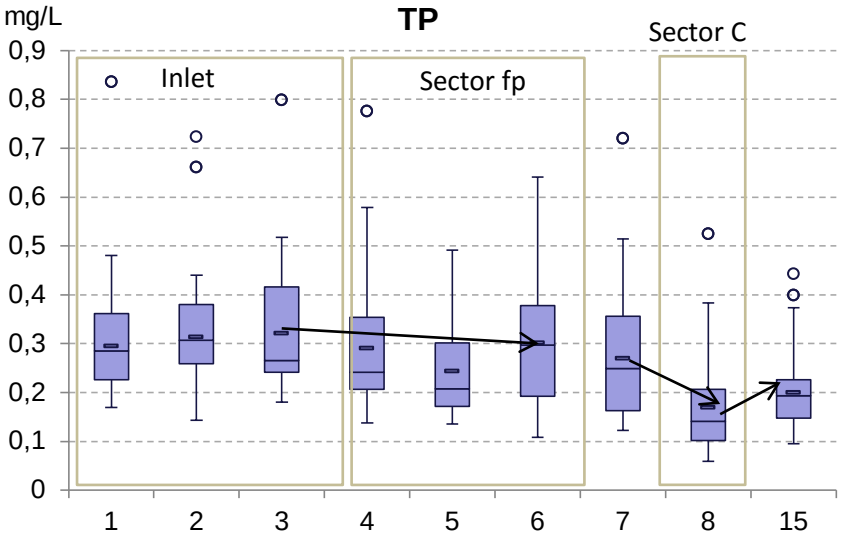
17 µg/L

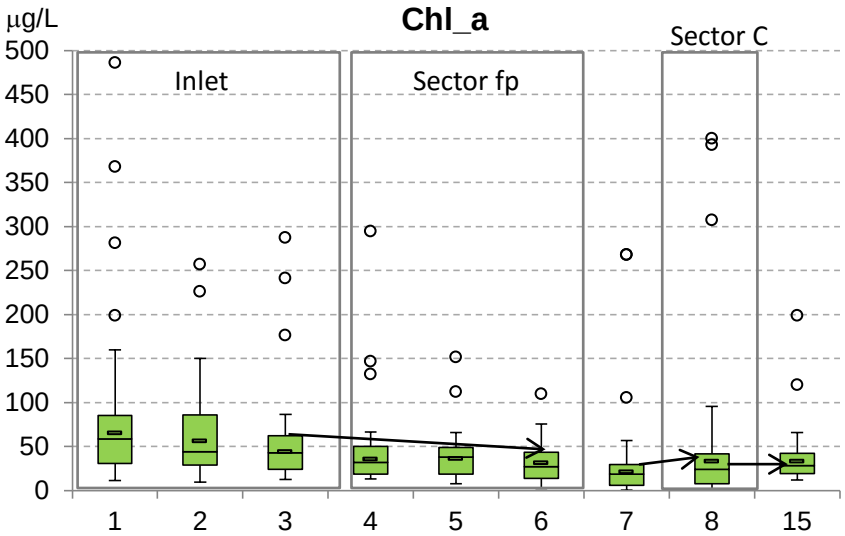
18 µg/L



Results

HA TANCAT DE LA PIPA. Total Phosphorus & Chlorophyll *a* (2014-15)



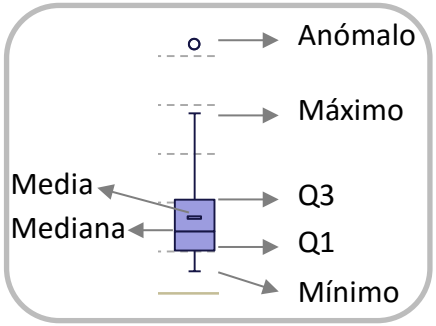


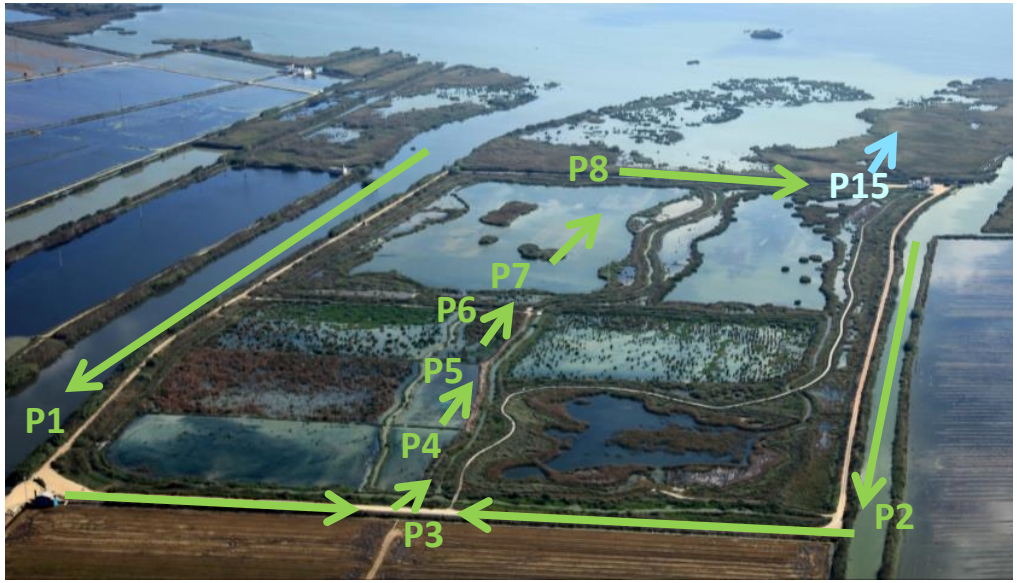
Volume treated 2014-15:

3.1 Hm^3 → 4247 m^3/d — 28000 hab

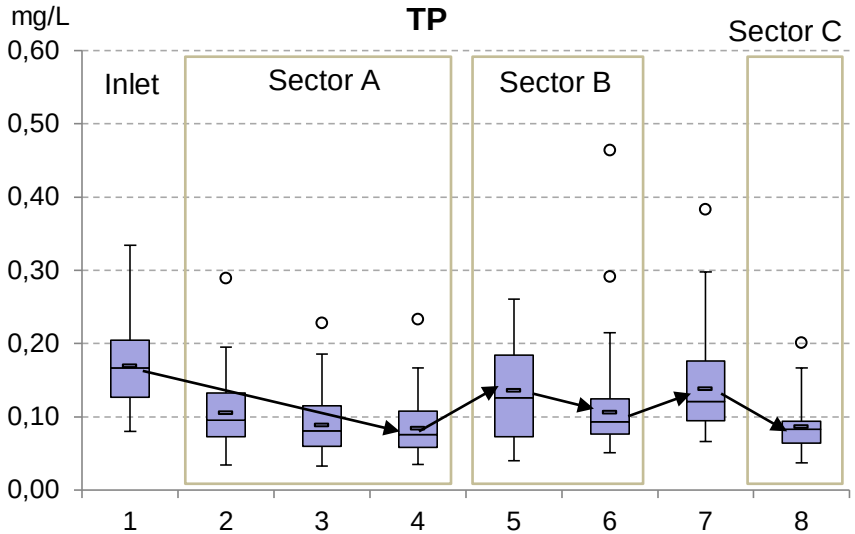
Mean efficiencies:

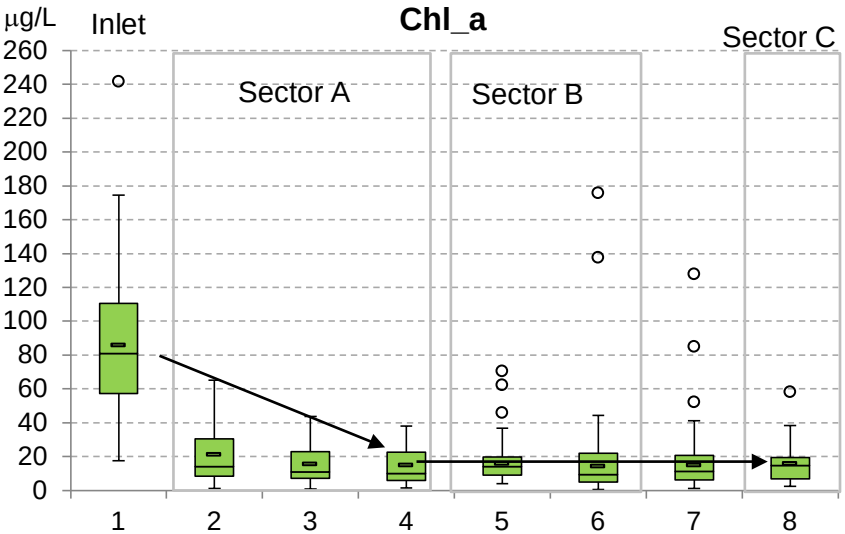
PT = 45% Cl_a = 37%

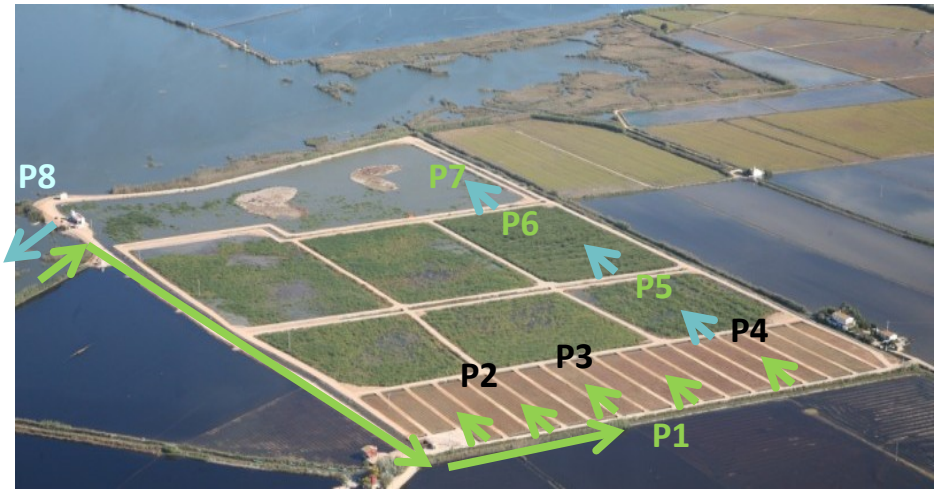




HA TANCAT DE MILIA. Total Phosphorus & Chlorophyll *a* (2014-15)

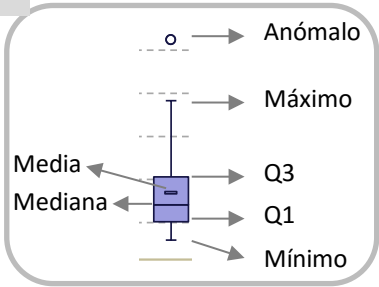






Volume treated 2014-15:
2.25 Hm^3 → 3082 m^3/d
Mean efficiencies:
PT = 55% Cl_a = 83%

20500 hab



Results

	Hydromorphologic & hydraulic variables			Water quality variables						
				Physico-chemical variables			Biologic variables			
Cells HA	Depth (m)	Hydraulic load ($m^3/m^2/d$)	TRH (d)	Inlet load NT ($mg/m^2/d$)	Mass remov rate NT ($mg/m^2/d$)	Efficiency NT (%)	Fito plancton	Zoo plancton	Macro-invertr	…
fp	0.15	0.077	2.5	328	158	48%				
…										
FG	0.20	0.033	7.3	92	46	50%				
…										
A	0.41	0.075	2.6	330	183	55%				
BE	0.32	0.047	7.2	101	29	29%				
…										
B3	0.49	0.037	16.9	102	61	60%				
…										
B4	0.52	0.018	42.2	52	34	64%				
…										
C-TP	0.27	0.015	25.9	33	9	27%				
C-TM	0.35	0.034	11.3	60	-1	-2%				
C-TI	0.57	0.067	11.4	79	-0.1	-0.1%				

Phytoplakcton:
Biovolume, composition, diversity.

Zooplankton:
Biomass, composition, diversity.

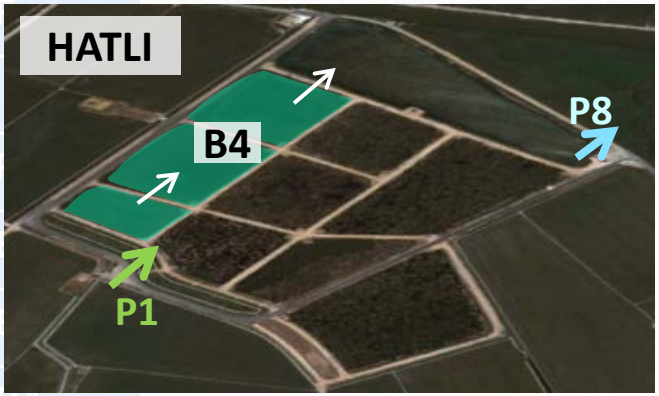
Macroinvertebrate:
Abundancr, especific diversity, equitativity, richness, trophic complexity (IMN, nutrition)

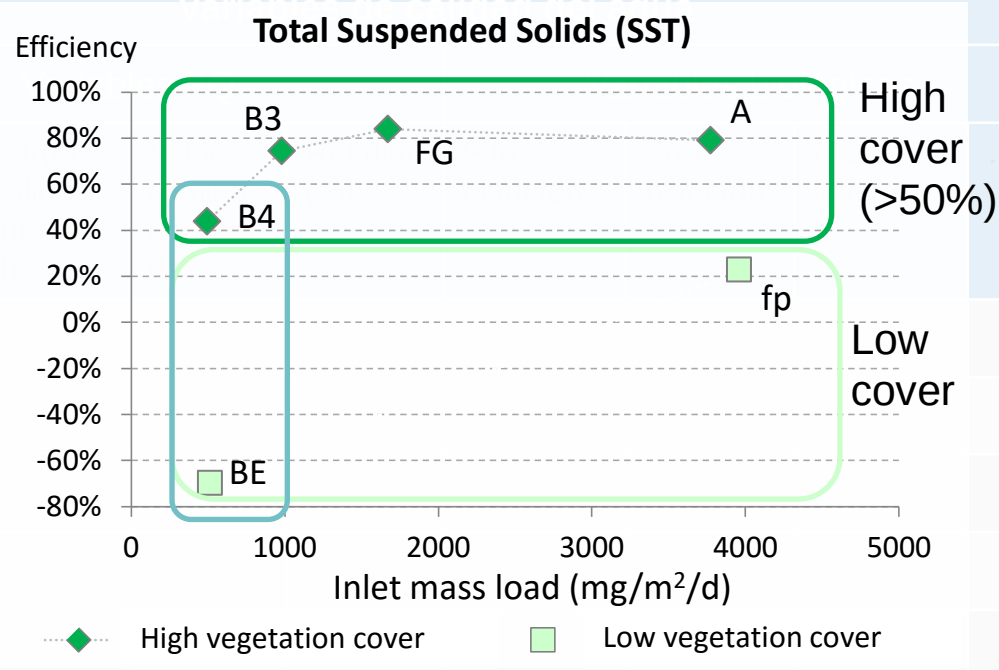
Vegetation: cover, sp, maturity

Ictiofauna: biomass, sp.

Birds: abundance, density breeding pairs, survival-productivity.

Results





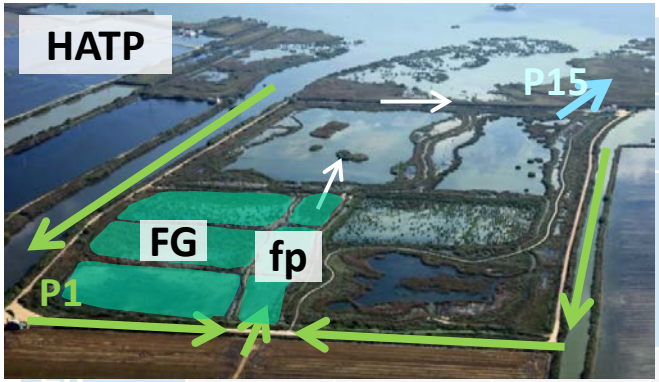
TSS Inlet load ≈ 500 mg/m²/d

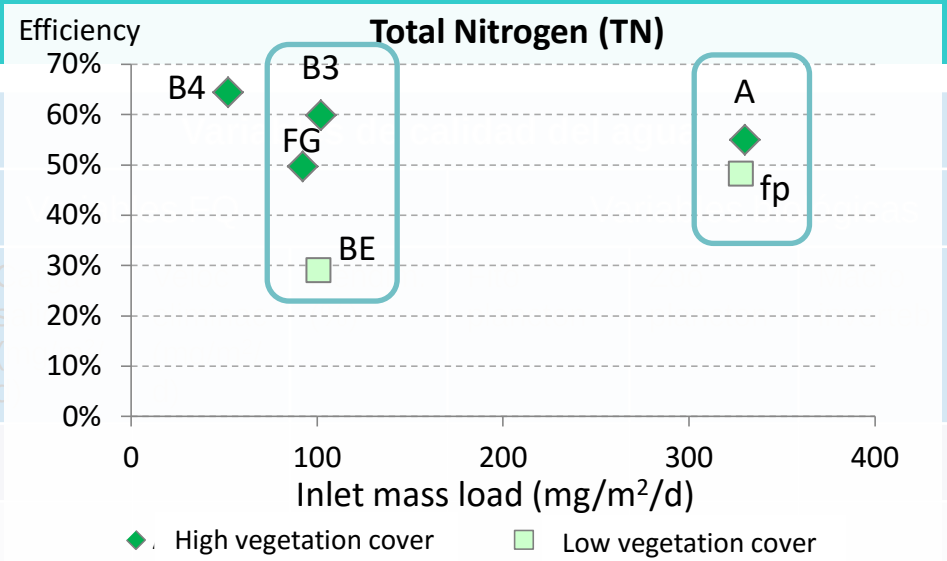
- Efficiency sector BE < 0 (-70%)
- Efficiency sector B4 = 44%

Importance of vegetation cover and bird presence

Alternance of cells with low and high vegetation cover

Results





Inlet load of TN ≈ 320 mg/m²/d

- Rendimiento sector fp = 48%
- Rendimiento sector A = 57%

Importance of support medium for bacteria growth (gravel)

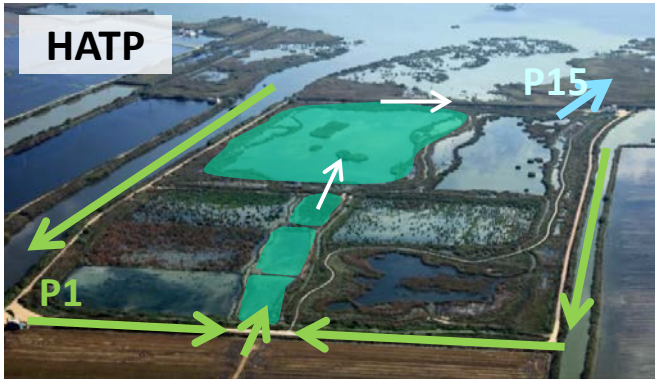
Inlet load of TN ≈ 100 mg/m²/d

- Rendimiento sector FG = 50%
- Rendimiento sector BE = 29%
- Rendimiento sector B3 = 60%

Importance of vegetation cover (support for bacteria growth)

Results

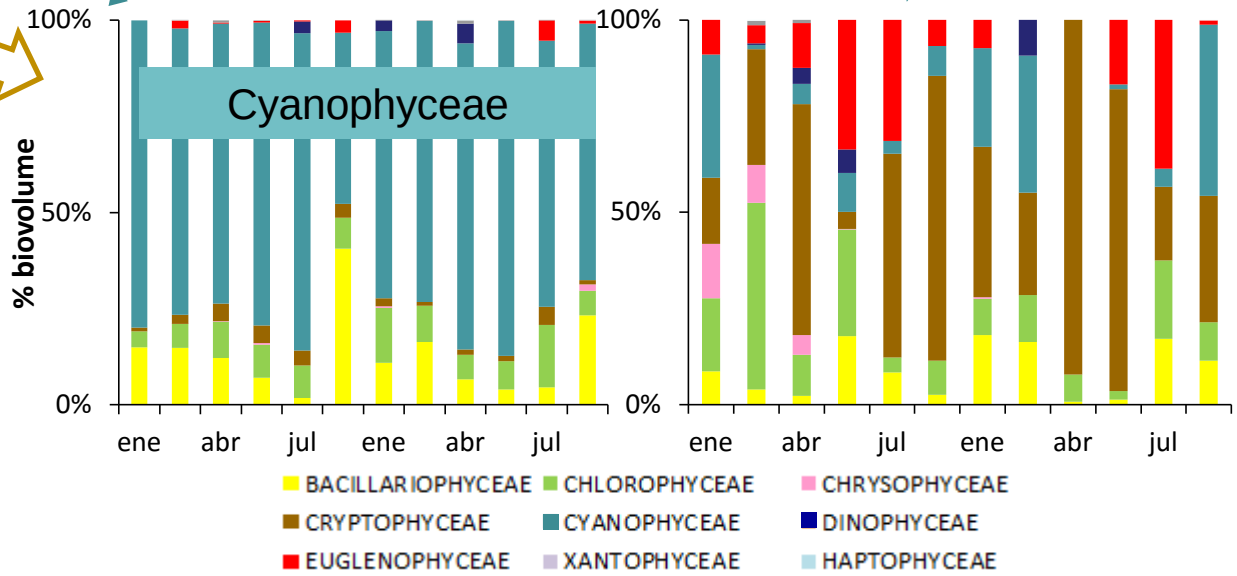
What reveal biological indicators?



INLET: dominance of **cyanophyceae.**

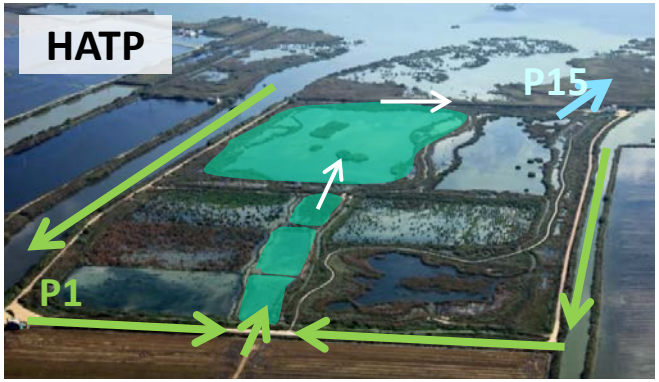
OUTLET: increased biodiversity and substitution by cryptophyceae → a composition of the algal community more desirable.

Phytoplankton



Results

What reveal biological indicators?



x 2.5

x 2.8

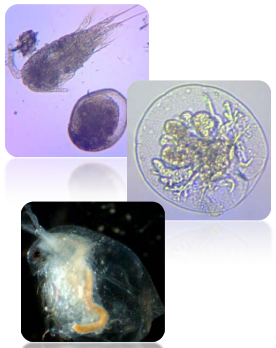
x 8.0

Increase of **zooplankton biomass**

Exporting herbivores (cladocerans and ostracods) to the lake.

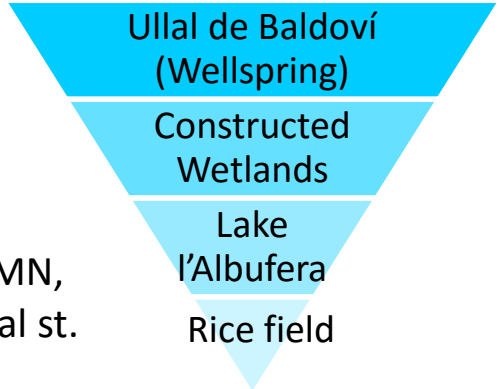
Filtering organisms that improve water **transparency**.

Zooplankton



Macroinvertebrate

- Abundance
- Especific diversity
- Equitativity
- Richness
- Trophic complexity (IMN, nutrition) → Ecological st.

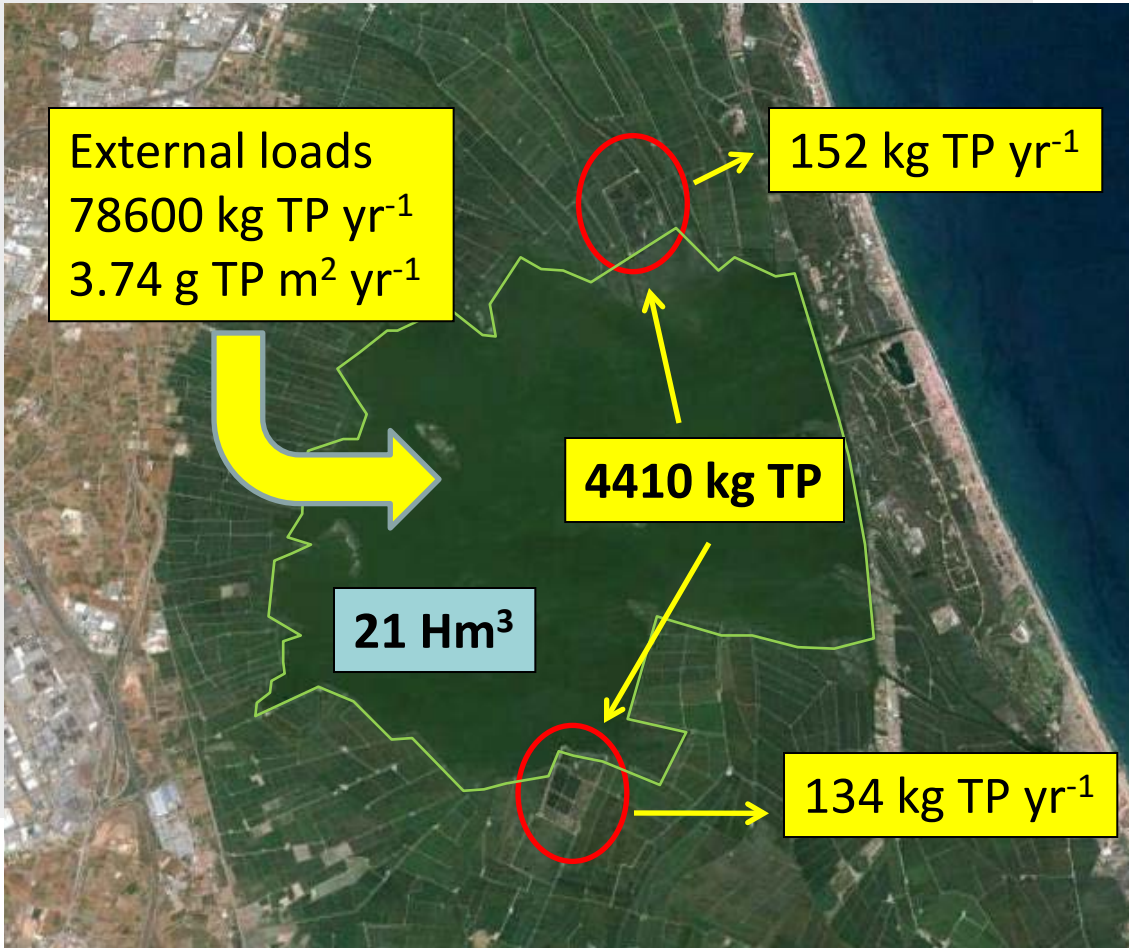


The impact

- Do the CWs solve the eutrophication of l'Albufera?
- **There are not single solutions for complex problems.**
- Putting the CWs in context:
  - CWTP: 1.55 $Hm^3\ yr^{-1}$
  - CWTM: 1.12 $Hm^3\ yr^{-1}$

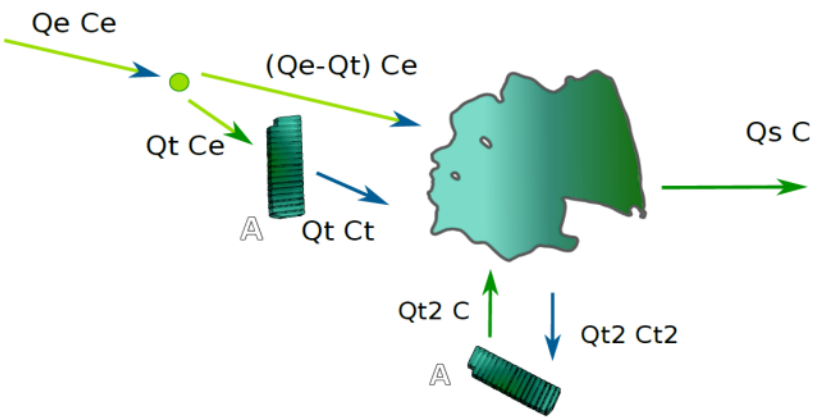
    12.7% Lake Volume

Social and Environmental Benefits



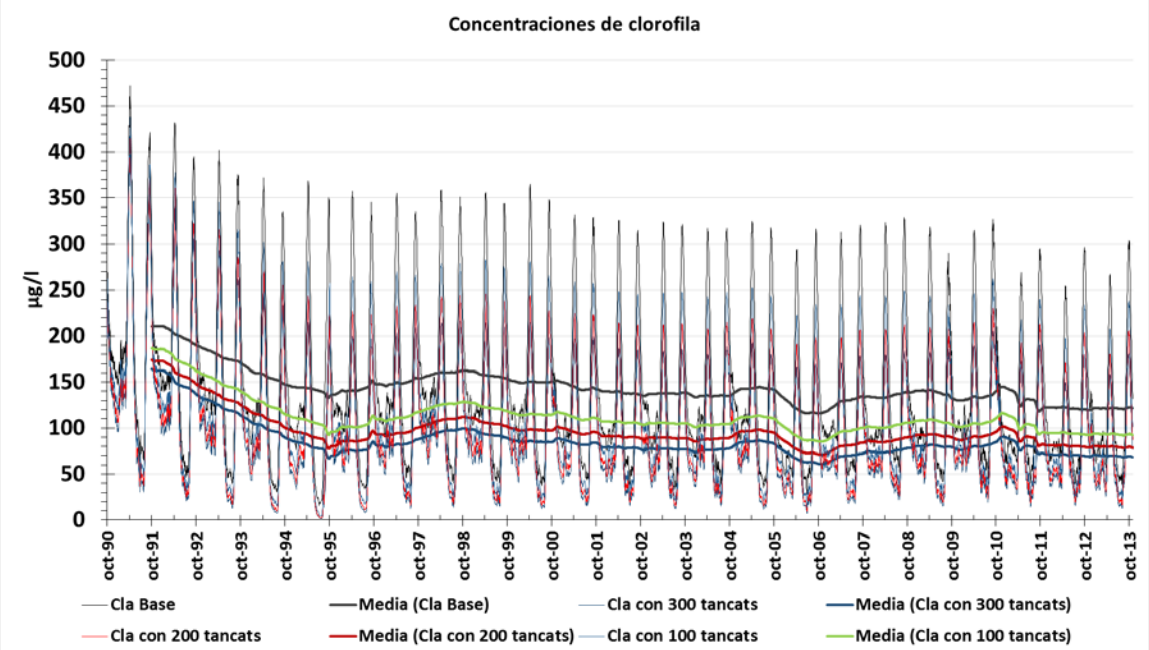
Simulaciones con el modelo matemático

Depurando agua del Lago y Acequias



Pruebas con sectores de tipo A (subsuperficiales):

Nº sectores	Q tratado (Hm^3/año)	Reducción promedio (%)
100	≈ 100	22
200	≈ 200	32
300	≈ 300	40



Conclusions

- Similar efficiencies of subsurface flow CW and highly vegetated surface flow CW.
  - Alternance of cells/areas with low and high vegetation cover.
  - Final zone highly vegetated.
- Subsurface CW provide high removal efficiencies, even for organic matter.
  - Easy maintenance tasks.
  - Water quality is preserved in subsequent cells.
- Decrease of phytoplankton biomass and it is more biodiverse.
- Enrichment of zooplankton biomass and enhancement of its biodiversity.
- Improvement of macorinvertebrate biodiversity respect to the lake and rice fields.
- Importance of avoiding the decomposition of vegetation biomass: equilibrium between biomass removal and habitat maintenance (constructed wetland vs natural wetland).
- Potential for increasing the flow rates and mass removal rates (operation at 50%).

Thanks for your attention!

Acknowledgement



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Miguel A. Eguibar (UPV)
Francisco Vallés (UPV)
Beatriz Nácher (UPV)
Edgar Belda (UPV)
Javier Paredes (UPV)

Con el apoyo de:

Reports

Reports available in website:

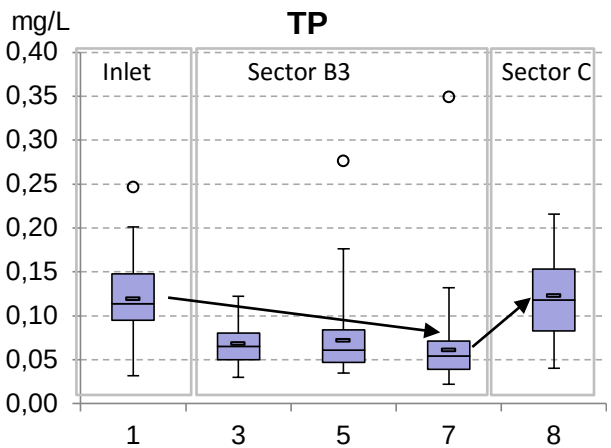
- Report of hydraulics management and monitoring (2014, 2015).
- Report of water quality monitoring (2014 y 2015).

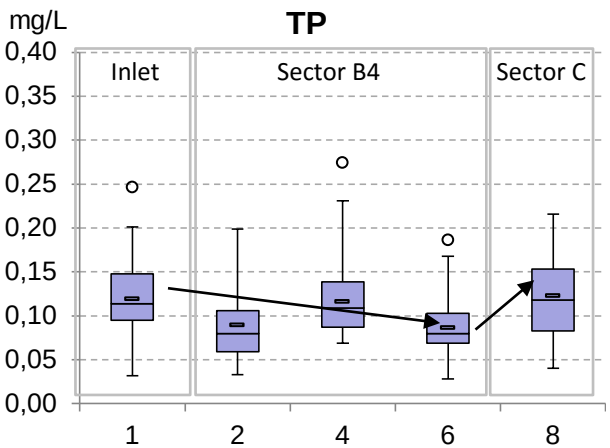
http://lifealbufera.org/index.php/es/documentos

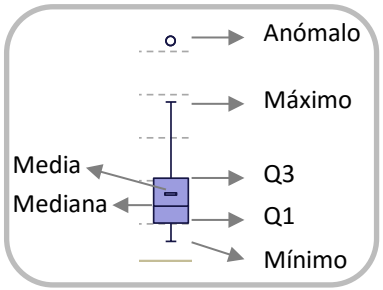
Coming soon:

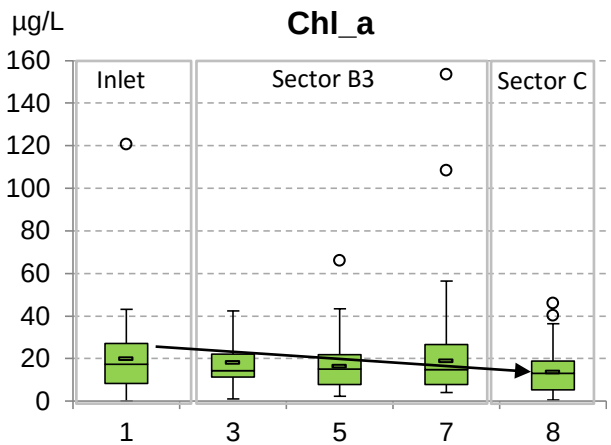
- Global reports 2014-15 (B1 y C1) (jun. 2016).
- Manual of hydraulics management (sep. 2016).

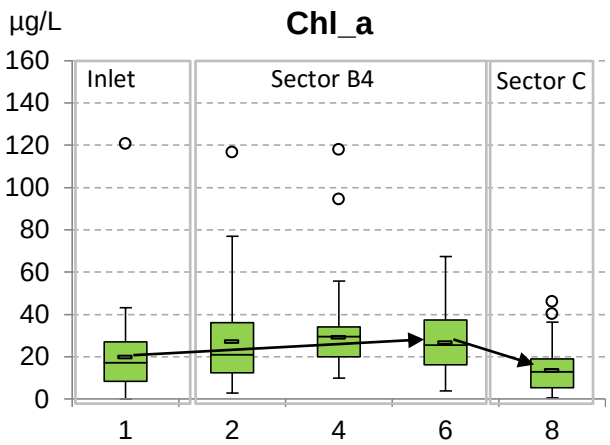
TANCAT DE L'ILLA. Total Phosphorus & Chlorophyll *a* (2014-15)











Volume treated 2014-15: 1.30 Hm^3 → 1780 m^3/d

Mean efficiencies:

PT = 20% Cl_a = 17%

11800 hab