Smallwat11
3rd INTERNATIONAL CONGRESS
WASTEWATER IN SMALL COMMUNITIES
TOWARDS THE WATER FRAMEWORK DIRECTIVE (WFD) AND THE MILLENNIUM DEVELOPMENT GOALS (MDG)

IIAMA
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Reduction of suspended solids in a free water surface constructed wetland treating eutrophicated waters

- Introduction. Eutrophication in the Natural Park of L'Albufera de Valencia (Spain).

WFD(2000). Art. 4. 1-a-iii "Member States shall protect and enhance all artificial and heavily modified bodies of water, with the aim of achieving good ecological potential and good surface water chemical status at the latest 15 years from the date of entry into force of this Directive…"

- Description FWSCW "Tancat de la Pipa".

- Results. First year April 2009 - March 2010. Start-up phase. Concentrations. Removal efficiency.
  - Total Suspended Solids.
  - Total Phosphorus.

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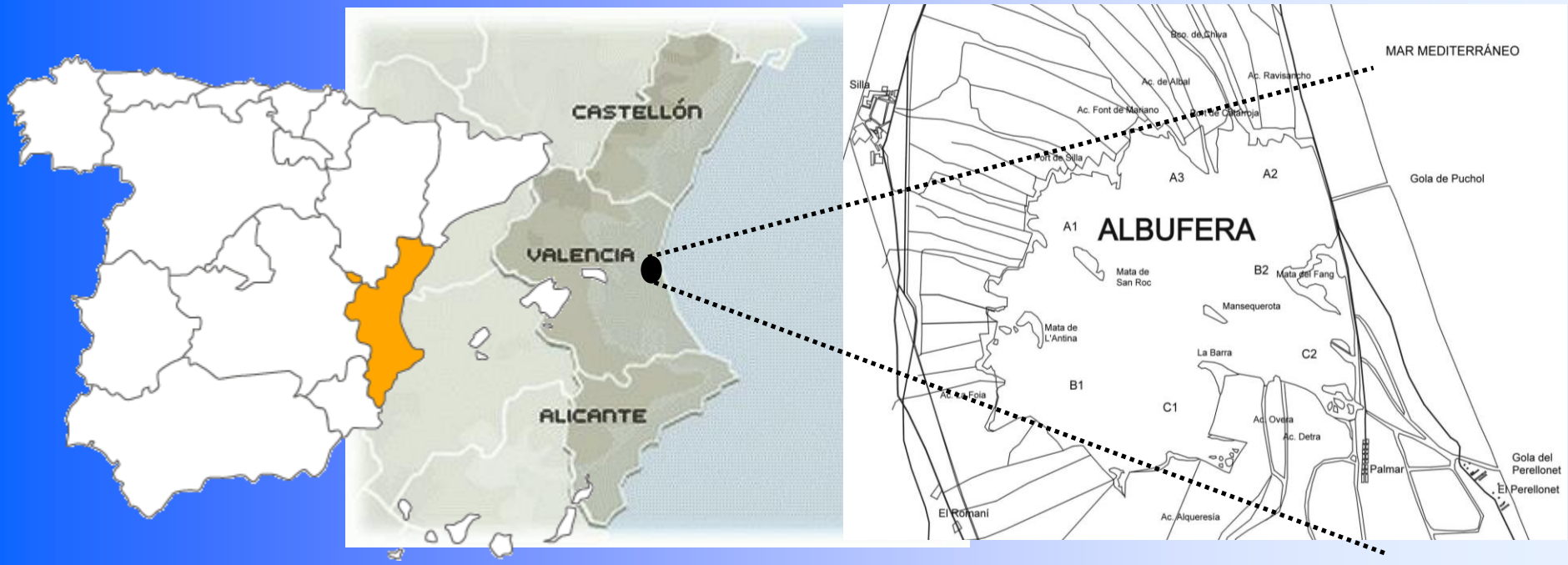

- L'Albufera de Valencia Natural Park (Ramsar,1990).
- Shallow coastal lake: 0.9 m water column + 0.9 m sediment layer.
- Valencia metropolitan area. 240000 inh.
- Surface: 24 km^2.
- Flows in-out: 3 – 6 m^3/s (annual mean)
- Mean hydraulic retention time: 1 – 2 months.

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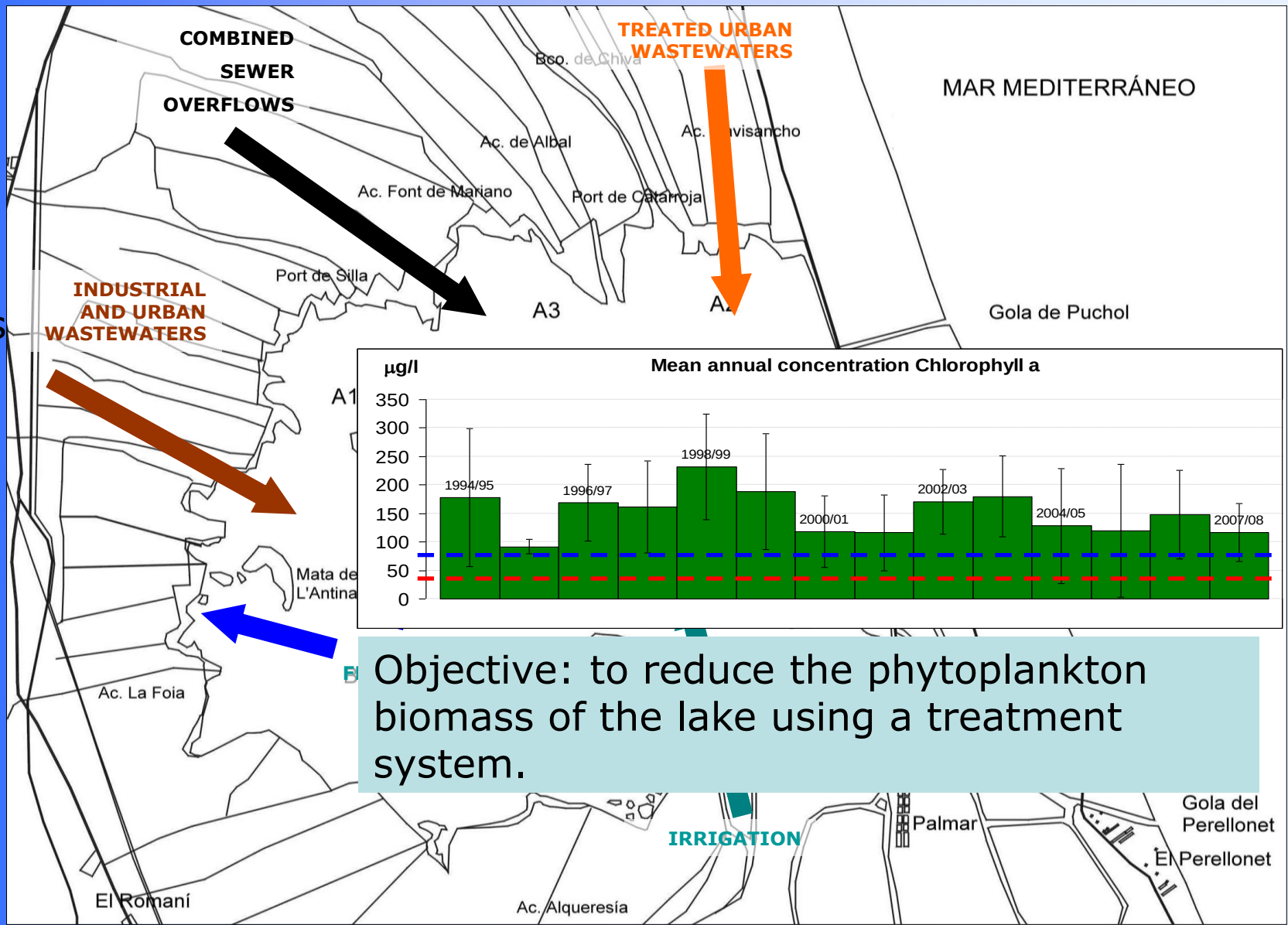
Pressures & Impacts



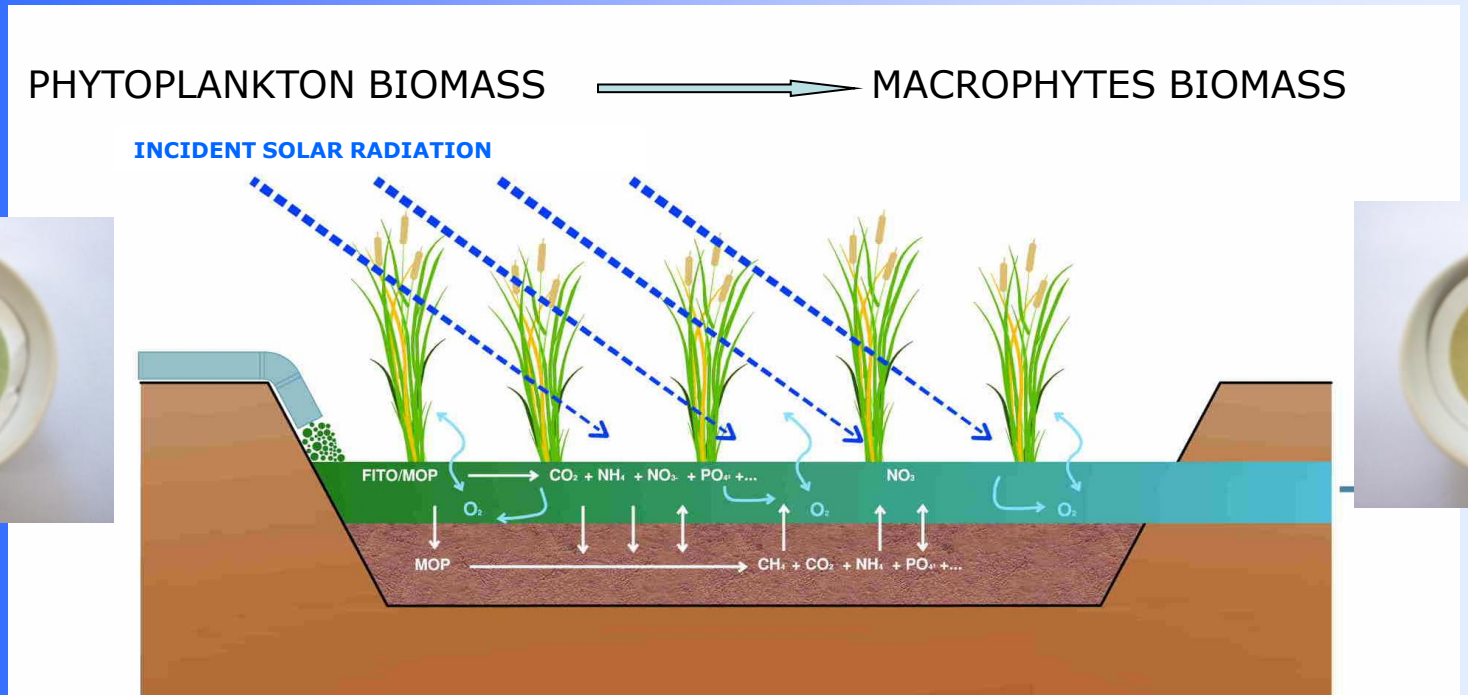
Objective: to reduce the phytoplankton biomass of the lake using a treatment system.

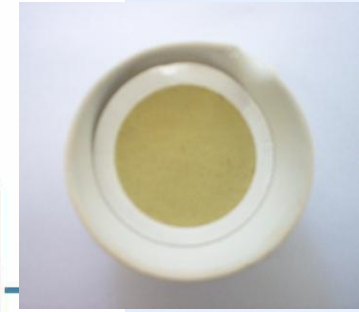
How?

Treatment System

Free Water Surface Constructed Wetland

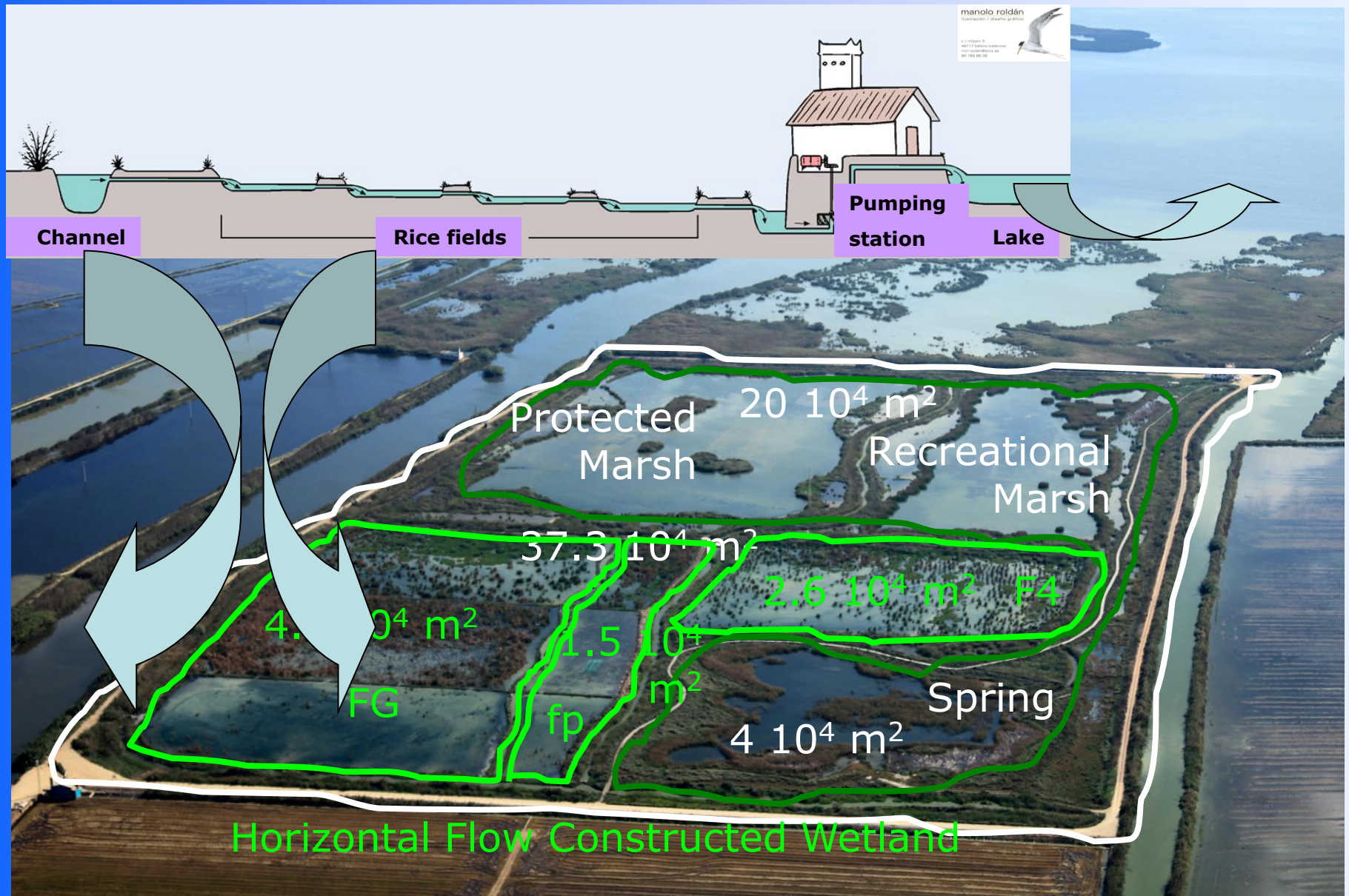
1. Reduce the phytoplankton growth by light attenuation (leaves, stems).
2. Increase the death of phytoplankton.
3. Settling and biodegradation of organic matter (aerobic/anoxic/anaerobic)
4. Release of nutrients.
5. Assimilation of nutrients by plants.
6. Harvest of plants.





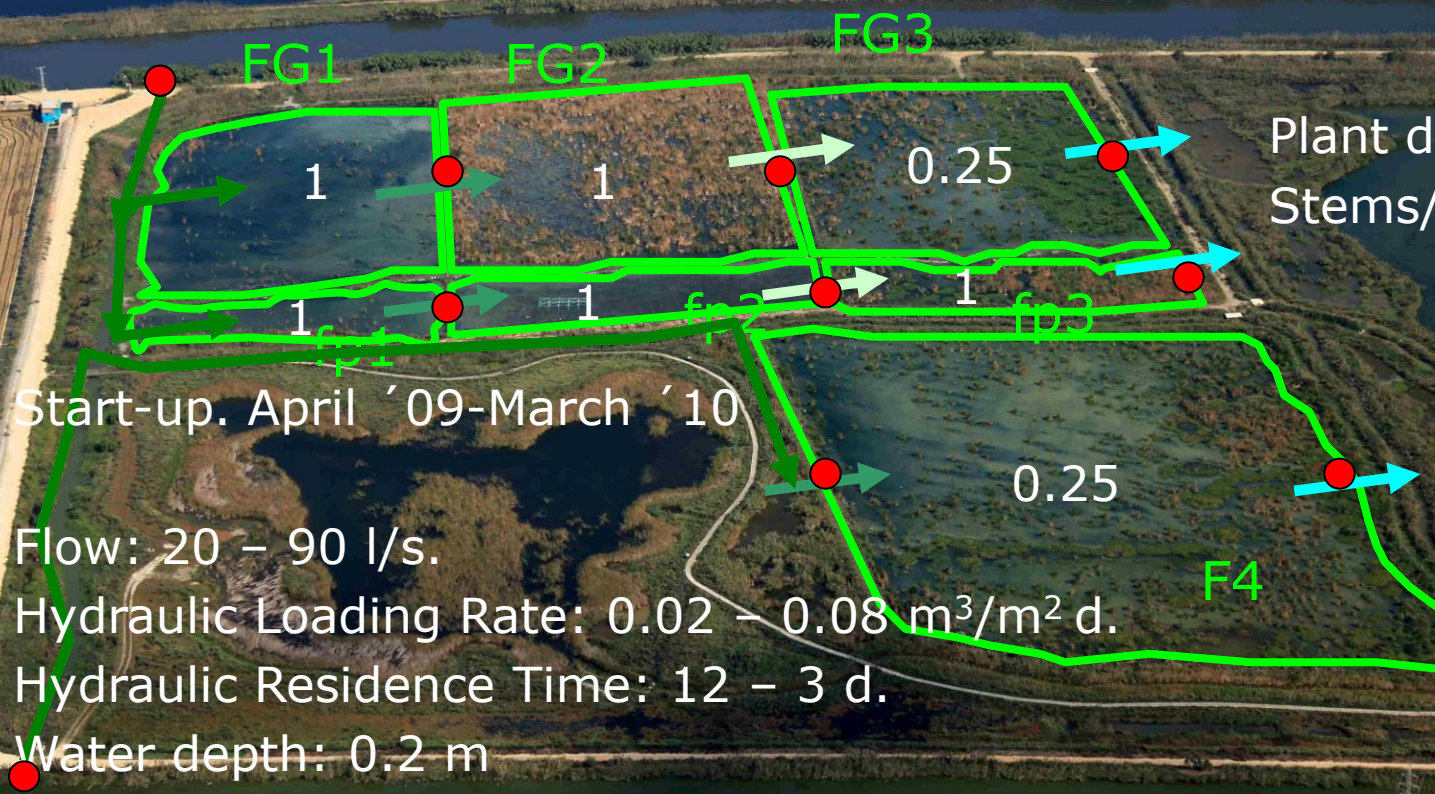
Where?

What is a "Tancat"?



Treatment System

Free Water Surface Constructed Wetland



Plant density
Stems/m²

Start-up. April ´09-March ´10

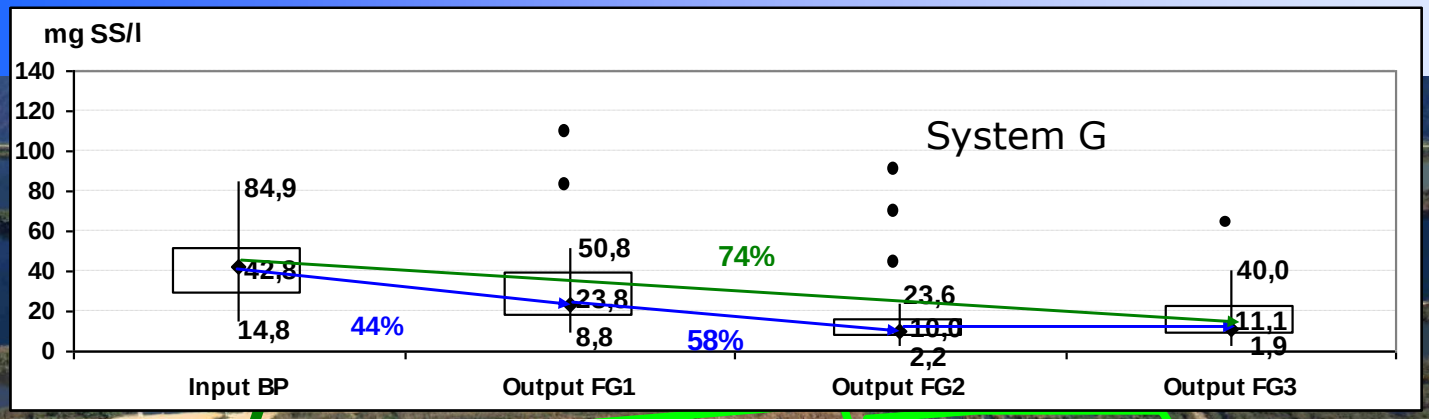
Flow: 20 – 90 l/s.

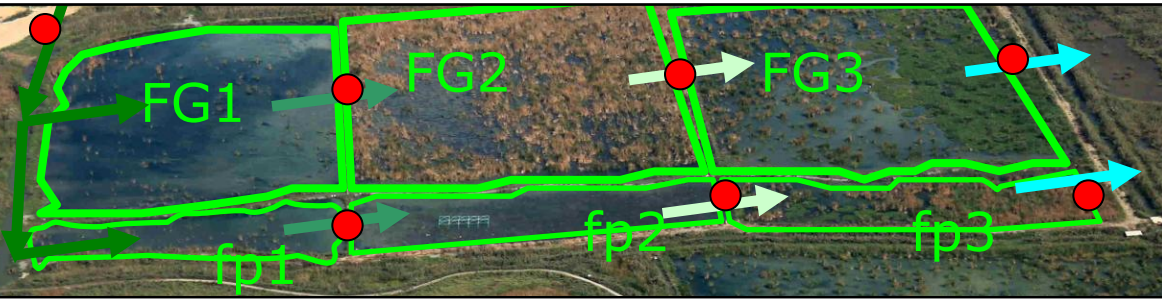
Hydraulic Loading Rate: 0.02 – 0.08 m^3/m^2 d.

Hydraulic Residence Time: 12 – 3 d.

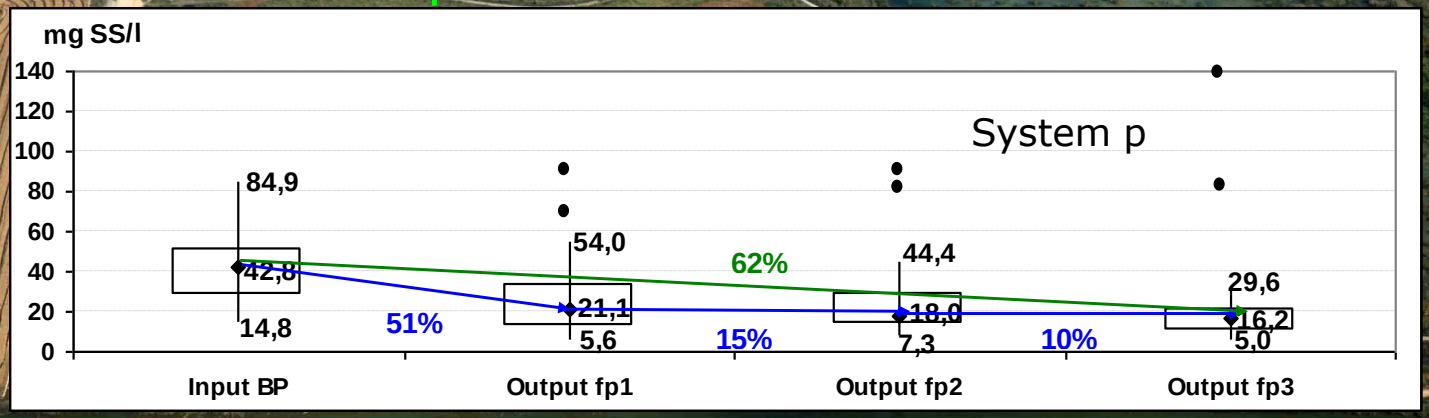
Water depth: 0.2 m

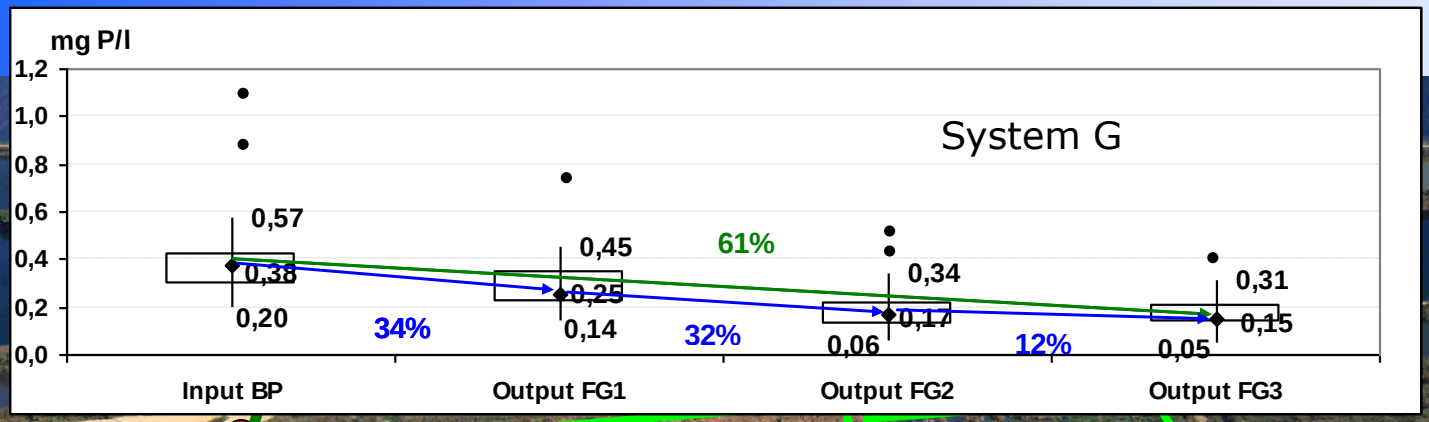
Ten sampling points: COD, TSS, VSS, PT, $P\text{-}PO_4^{3-}$, NT, $N\text{-}NH_4^+$, $N\text{-}NO_2$, $N\text{-}NO_3^-$, SiO_2^-, Conductivity, pH, Temperature, DO, Turbidity.

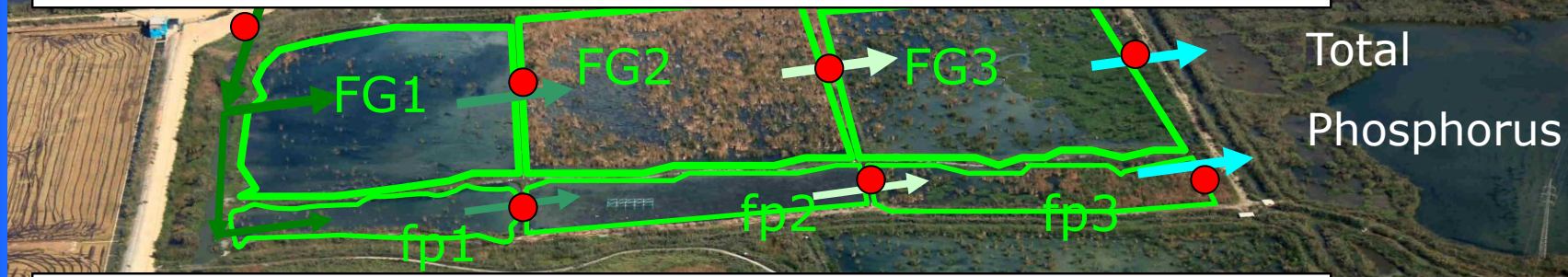




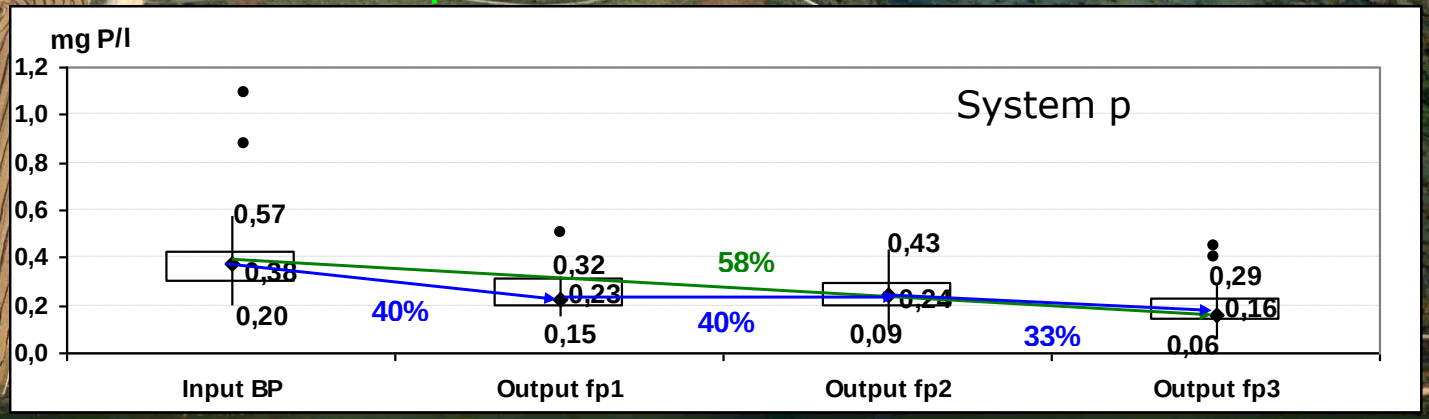
Total Suspended Solids





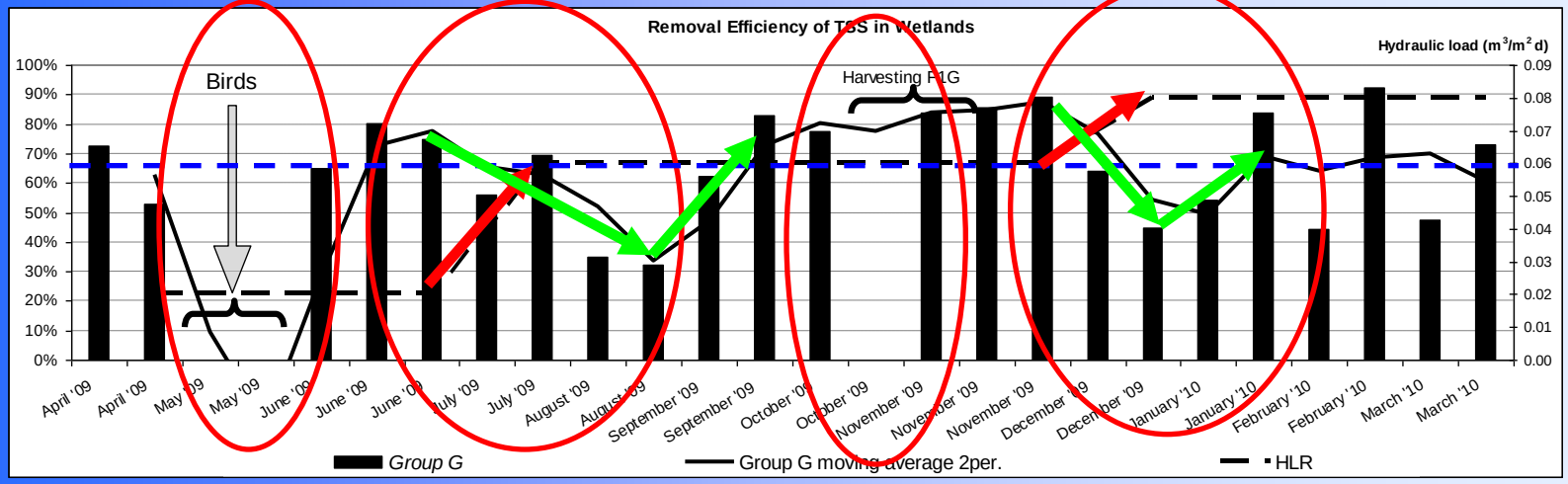


Total Phosphorus



Analysis of Removal Efficiency (kg/d). TSS.

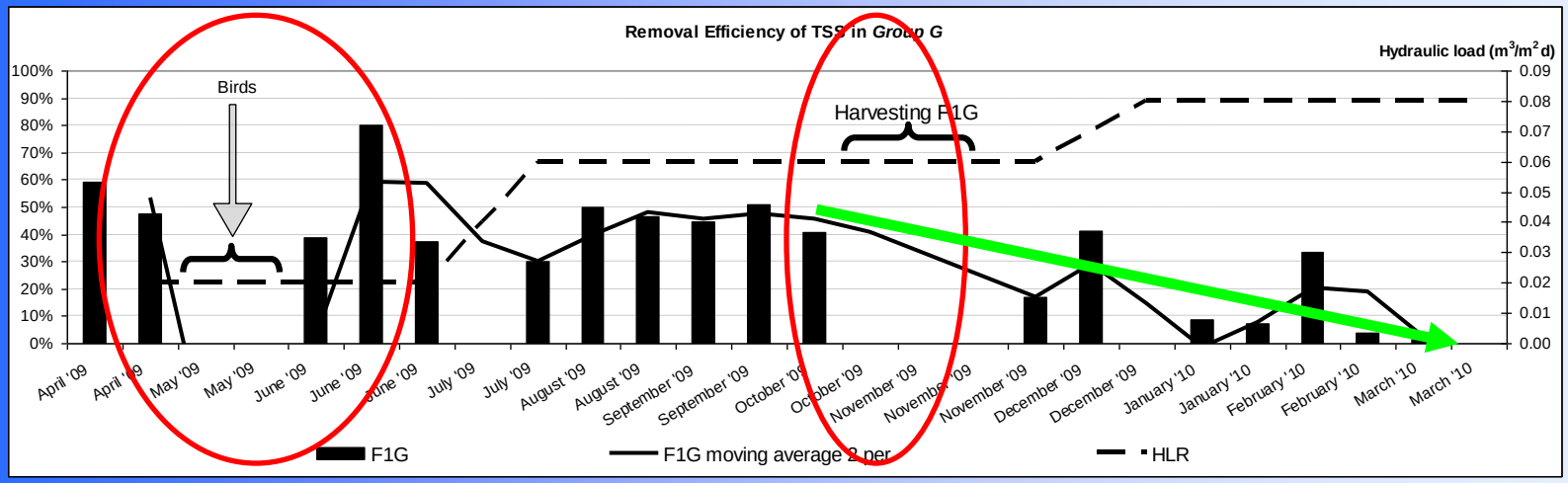
System G



- Mean input 103.8 kg/d; mean output 37.6 kg/d: 64%.
- Removal efficiency of TSS range from negative values to 90%. The birds activity produces resuspension.
- The increase of HLR produces an initial decrease of efficiency but it is recovered after two months.
- The partial harvest (FG1) has no consequences in System G.

Analysis of Removal Efficiency (kg/d)

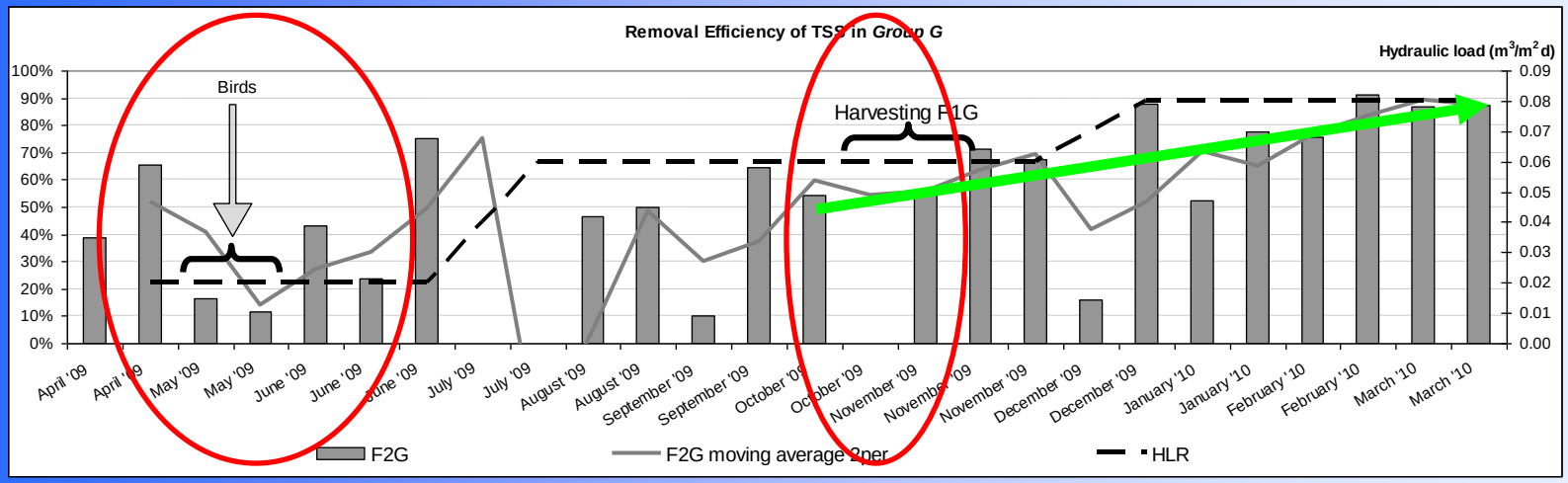
Cell FG1



- Removal efficiency of TSS is about 20%.
- Source of TSS by resuspension of sediments in May.
- The harvest reduces the efficiency to zero.

Analysis of Removal Efficiency (kg/d)

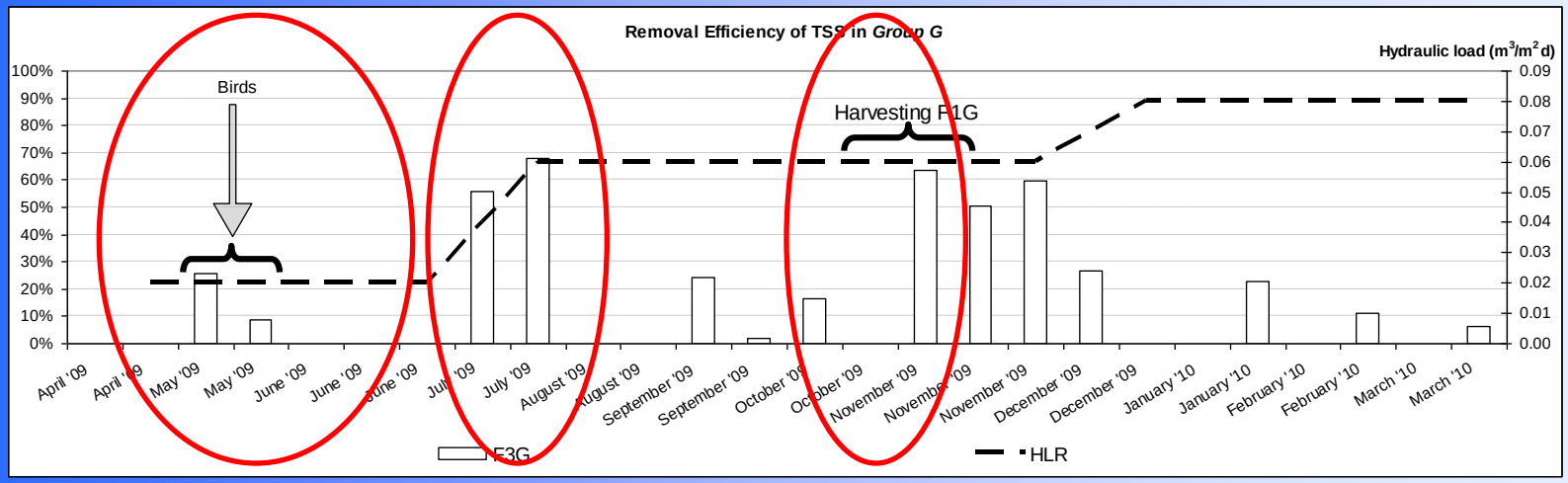
Cell FG2



- Removal efficiency is 55%
- The presence of birds reduces the efficiency of the second cell.
- Before the harvest of FG1 the efficiency increases to 90%.
- The cell FG2 balance the lost of efficiency of FG1.

Analysis of Removal Efficiency (kg/d)

Cell FG3



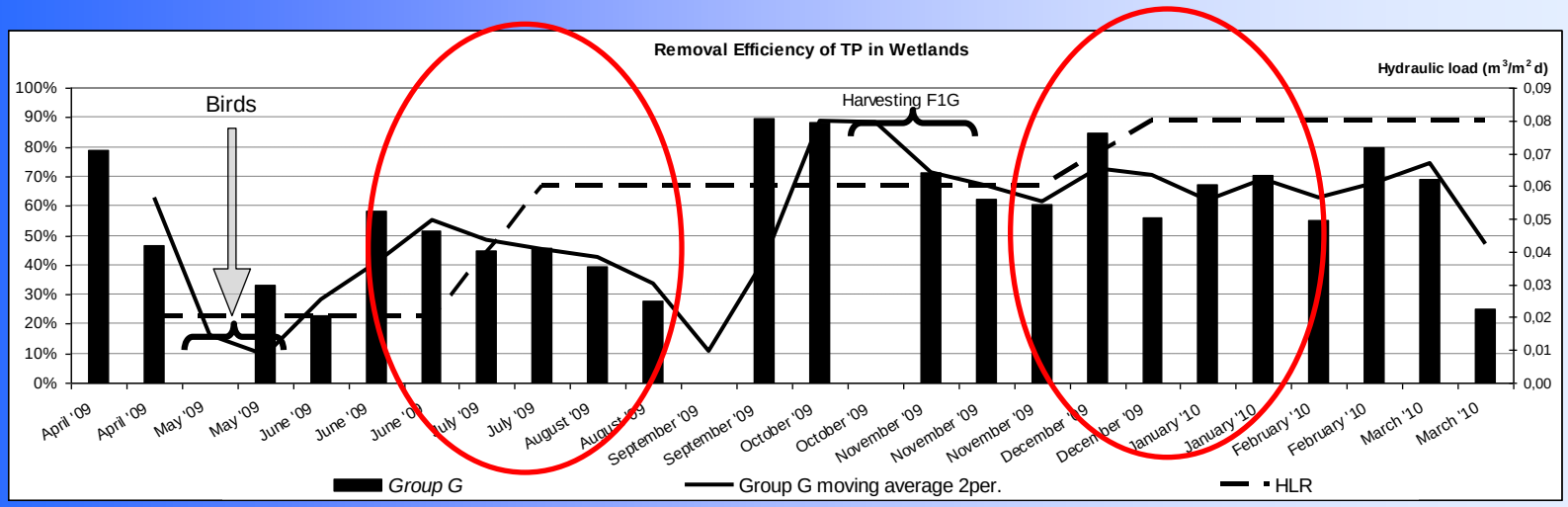
- The efficiency is the worst: 15%.
- Only when FG1 and FG2 reduces their efficiency the FG3 plays a role.

CONCLUSIONS

- The start-up of the system was with HLR 0.02 m^3/m^2 d.HRT 12 days. 20 l/s.
- The best results were obtained with HLR 0.08 m^3/m^2 d.HRT 3 days. 80 l/s.
- The Free Water Surface Constructed Wetland "Tancat de la Pipa" has been very effective to remove the main contaminants in eutroficated waters:
  - TSS from 42.8 mg/l to 11.1 mg/l.
  - PT: from 0.38 mg P/l to 0.15 mg P/l.
  - TSS removed: 0.87 g/m^2 d(Wetland) – 2.23 g/m^2 d (FG2)
  - PT: 0.013 g/m^2 d(Wetland) – 0.015 g/m^2 d (FG2)
- Reduction efficiency in harvested cells is balanced by the vegetated cells.
- Results about phytoplankton direct indicators (chlorophyll *a*) are also successful.

Analysis of Removal Efficiency (kg/d)

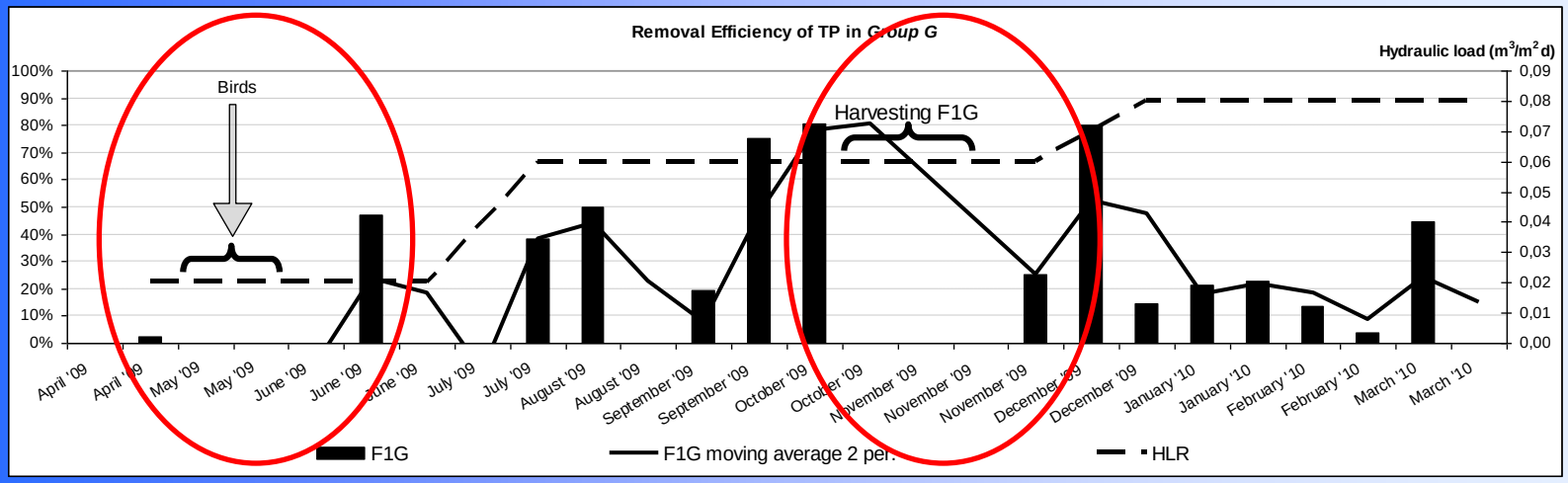
System G



- Removal efficiency of TP range from negative values (Birds) to 90%.
- The mean annual value is 64%
- The increase of HL produces an initial decrease of efficiency but it is recovered after two months.
- The animal activity (birds) reduces the efficiency.
- The partial harvest has no consequences.

Analysis of Removal Efficiency (kg/d)

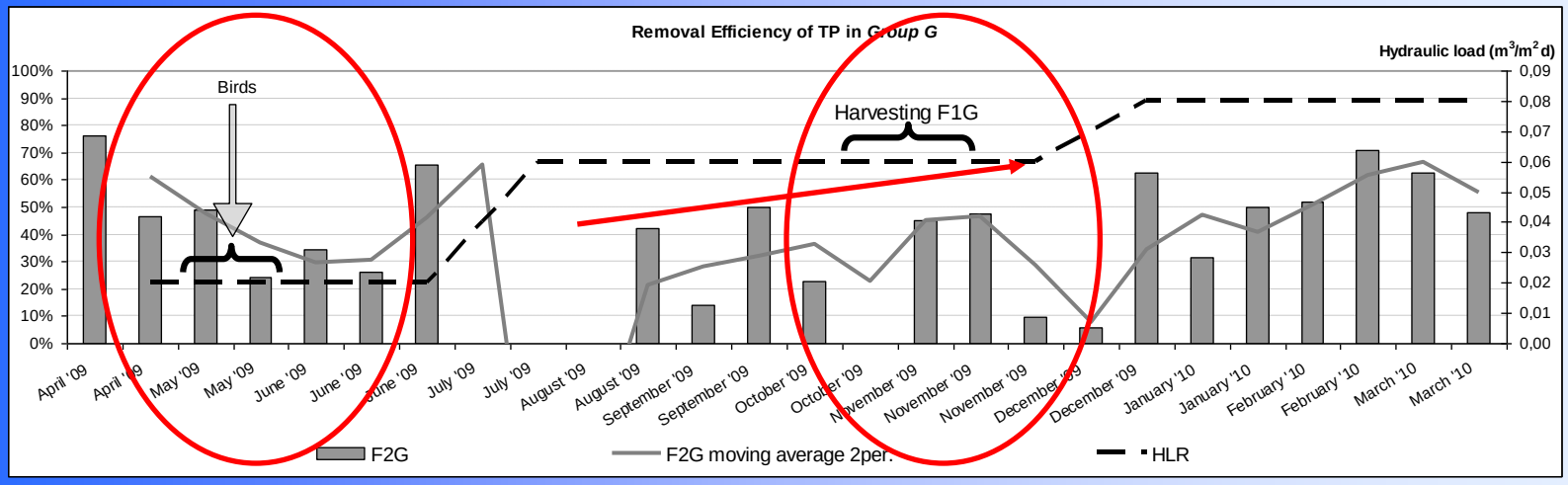
Cell FG1



- Removal efficiency of TP is about 38%.
- The efficiency drops dramatically when F1G is harvested.

Analysis of Removal Efficiency (kg/d)

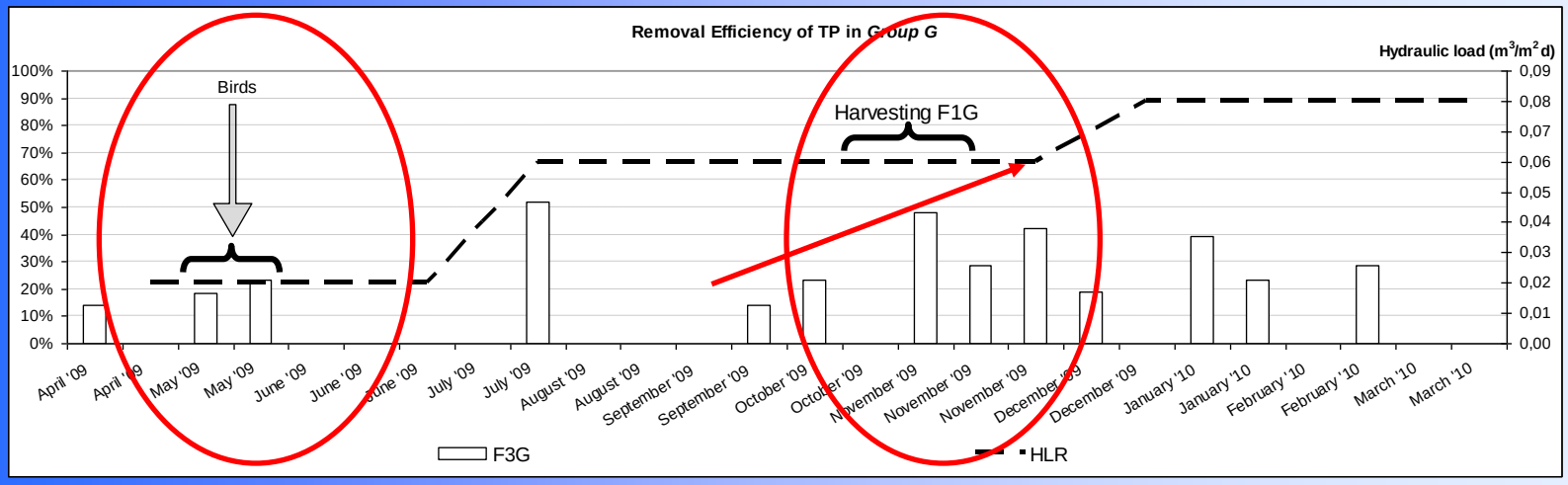
Cell FG2



- The efficiency of the second cell is about 30% when it works with cell FG1.
- When cell FG1 is harvested efficiency increases to 50%.

Analysis of Removal Efficiency (kg/d)

Cell FG3



- The efficiency of the third cell is the worst.
- Only when efficiencies of cells FG1 and FG2 are low, the values are significant (50%).