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## Hydropeaking impacts on the Lez river and studies to define mitigation measures

In alphabetical order : Baran P<sup>1</sup>, Boucard F<sup>3</sup>, Boyenval E<sup>3</sup>, Cassan L<sup>1</sup>, Garmendia L<sup>2</sup>, Hurel G<sup>1</sup> & Prel P<sup>1</sup>

### The Lez River downstream Eylie Power plant

- Mountain stream in Pyrenees
- Slope :  $\approx 0.3\%$
- Width : 3-5 m
- Brown trout population



Presented by Courret D<sup>1</sup>  
(dominique.courret@imft.fr)

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## Lez river



### Hydroelectric schemes

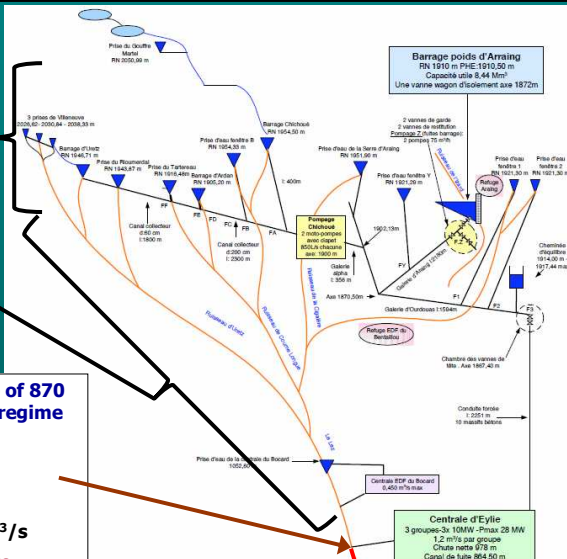
Series of 13 water intakes and 1 reservoir at high altitude ( $\approx 1900$  m, diverted basin area :  $\approx 12$  km<sup>2</sup>)

Intermediate basin with flow reconstitution ( $\approx 16$  km<sup>2</sup>)

Hydropeaks restitution at an altitude of 870 m, on a nearly natural hydrological regime

- Basin area :  $\approx 28$  km<sup>2</sup>
- Mean discharge :  $\approx 1$  m<sup>3</sup>/s
- Width : 3-5 m
- Maximum turbine discharge : 3.6 m<sup>3</sup>/s

→ This causes high flows compared to stream size

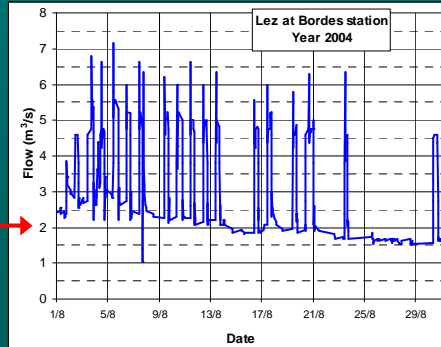
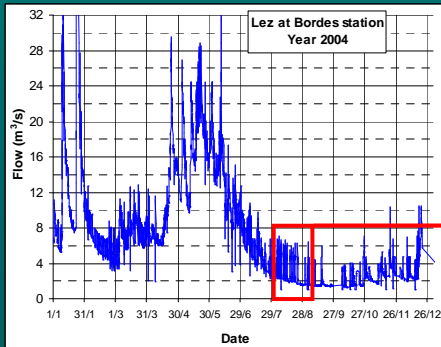


Affected reach  
7 km long

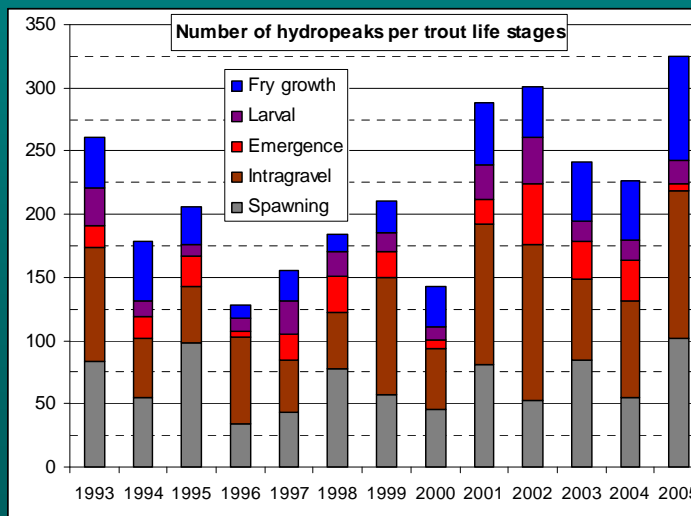
2

### Hydropeaks characterization

- **Hydropeaks visualisation, at Bordes station** (around 15 km downstream hydropeaks restitution [212 km<sup>2</sup>], mean discharge 7.1 m<sup>3</sup>/s)
- **Most hydropeaks' amplitudes corresponds to maximum turbine flow**
- **Base flow estimates downstream Eylie power plant range down to 0.3-0.5 m<sup>3</sup>/s** (30-50% of mean discharge)



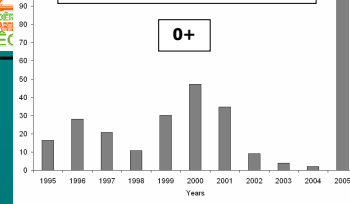
### Hydropeaks characterization



## Lez river

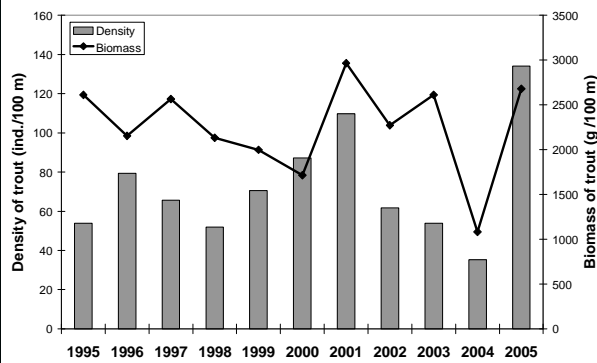


Density of trout (ind / 100 m)

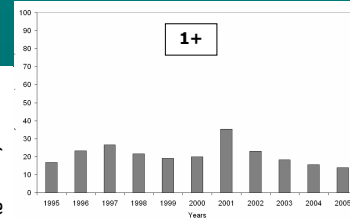


### Biological issues linked to hydropeaks

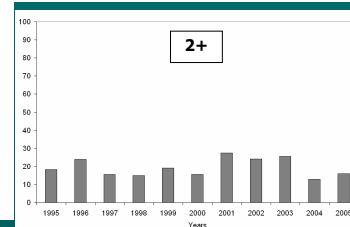
- Low trout densities and biomass compared to non-affected streams (183 and 312 ind./100 m, in Isard and Riberot tributaries with comparable size]



1+



2+

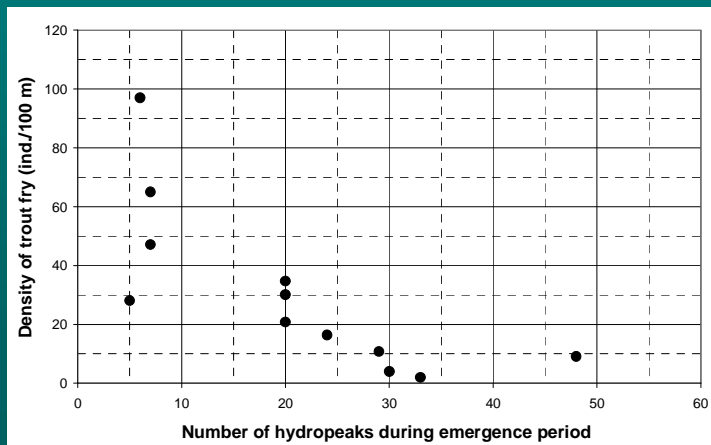


## Lez river



### Biological issues linked to hydropeaks

- Fry recruitment negatively related to the number of hydropeaks during emergence period

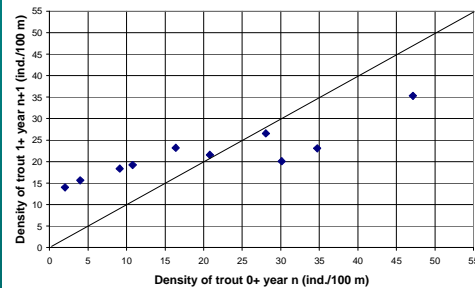


## Lez river



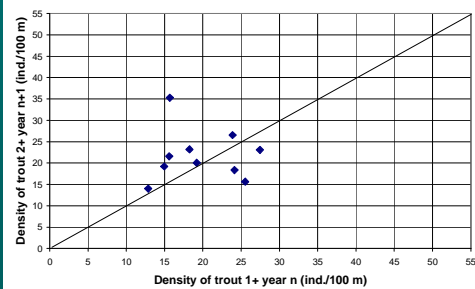
### Biological issues linked to hydropeaks

- Low influence of fry (0+) recruitment level on juvenile (1+) densities the next year



- No influence of juvenile densities on 2+ trout densities the next year

→ It's suspected that habitat conditions during hydropeaks are limiting for juveniles and adults



## Lez river



### Studies to improve habitat conditions during hydropeaks

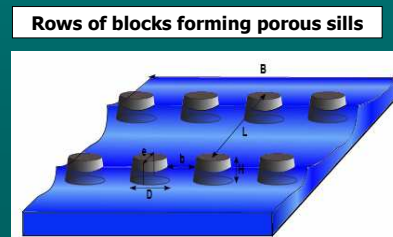
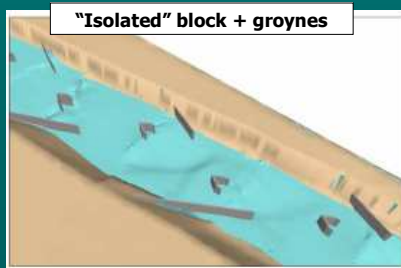
- Relicensing process includes blocks placement to mitigate hydropeaks impacts
- 2D hydraulic modelling of 4 stations to test several modalities for blocks placement
  - assessment of efficiency thank to microhabitat method

Topography of station 3



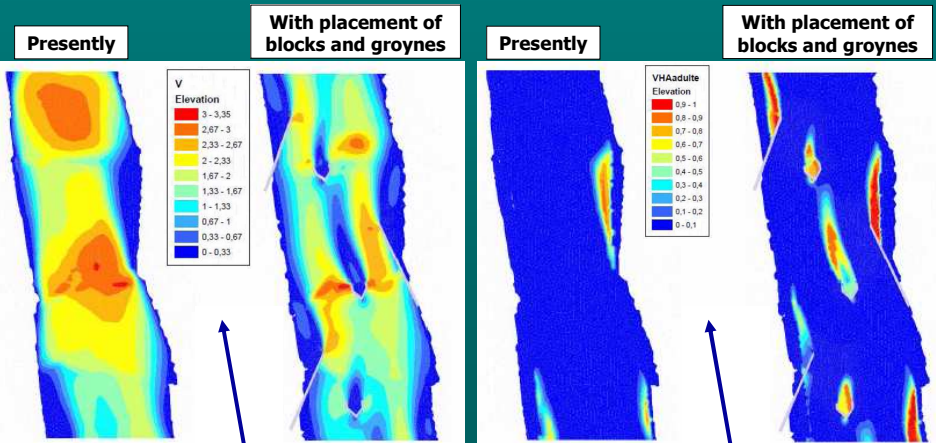
Studies to improve habitat conditions during hydropeaks

- Hydraulic conditions searched in block wakes :
  - Minimum water depth of 20-30 cm at low flow
  - Maximum water velocity of 20 cm/s in wake during hydropeaks
  - Provide shelter
- 2 modalities tested for blocks placement :



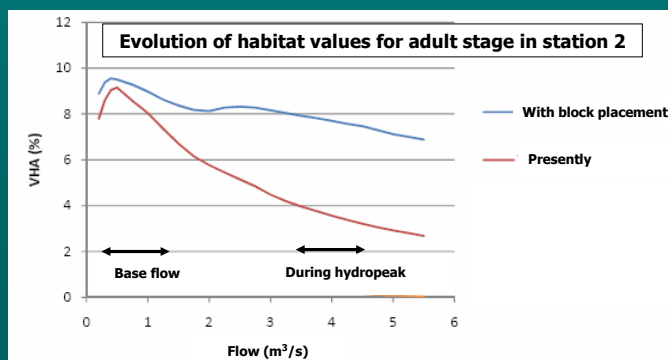
Studies to improve habitat conditions during hydropeaks

Flows velocities (left) and habitat values for adult (right) during an hydropeak on station 2



### Studies to improve habitat conditions during hydropeaks

- Hydraulic modelling results confirm that habitat conditions during hydropeaks can be limiting for trout population, more than low flow periods
- Block placement can be a solution to improve habitat conditions during hydropeaks



### Conclusions

- High flows conditions during hydropeaks** (maximum flow over 4 times the mean discharge) **appear to be limiting for the trout population.**
- Block placement can be a solution to improve habitat conditions during hydropeaks, but this need to be dimensioned** (size and position of blocks) → 2D hydraulic modelling can be a useful tool.
- Solution not yet implemented on the Lez river.**
- Work on morphology implies owning river banks, or owners' agreement, and raise several questions :**
  - Structure stability and consequences on water level during floods
- This solution leads to important works to produce a significant effect at the reach scale**
- Other ways of improvement, notably during emergence phase :**
  - Limiting number of hydropeaks and/or the maximum turbine discharge