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

In alphabetical order : Baran P¹, Boucard F³, Boyenval E³, Cassan L¹, Garmendia L², Hurel G¹ & Prel P¹

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 D¹
(dominique.courret@imft.fr)

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Lez river



Hydroelectric schemes

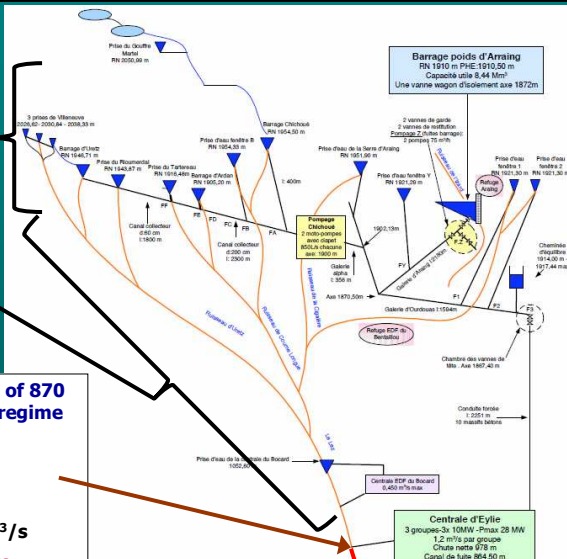
Series of 13 water intakes and 1 reservoir at high altitude (≈ 1900 m, diverted basin area : ≈ 12 km²)

Intermediate basin with flow reconstitution (≈ 16 km²)

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

- Basin area : ≈ 28 km²
- Mean discharge : ≈ 1 m³/s
- Width : 3-5 m
- Maximum turbine discharge : 3.6 m³/s

→ This causes high flows compared to stream size

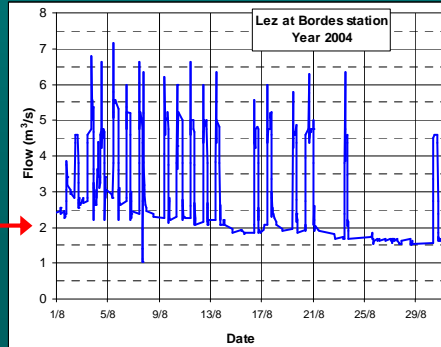
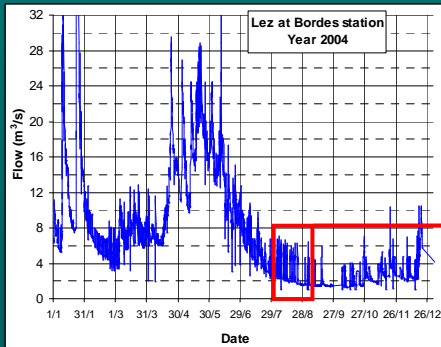


Affected reach
7 km long

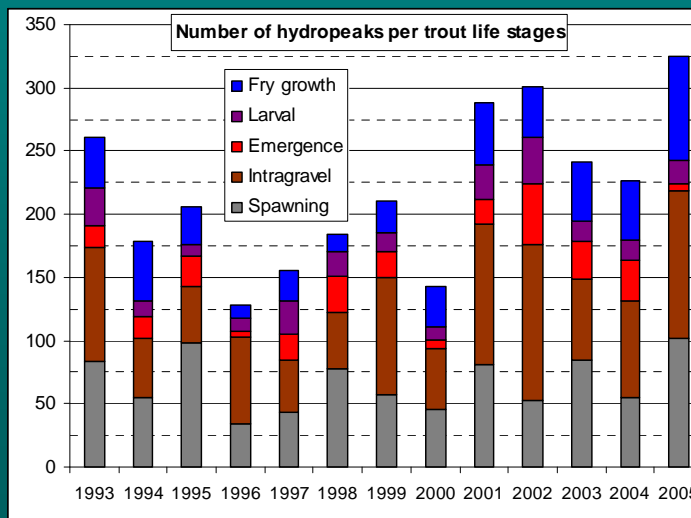
2

Hydropeaks characterization

- **Hydropeaks visualisation, at Bordes station** (around 15 km downstream hydropeaks restitution [212 km²], mean discharge 7.1 m³/s)
- **Most hydropeaks' amplitudes corresponds to maximum turbine flow**
- **Base flow estimates downstream Eylie power plant range down to 0.3-0.5 m³/s** (30-50% of mean discharge)



Hydropeaks characterization

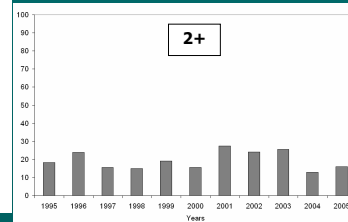
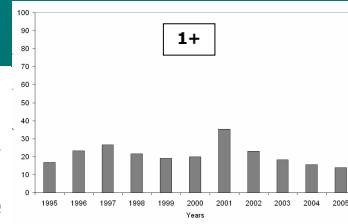
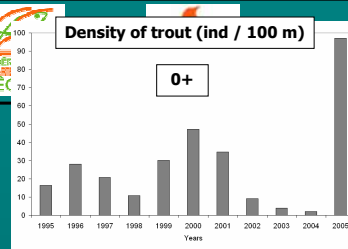
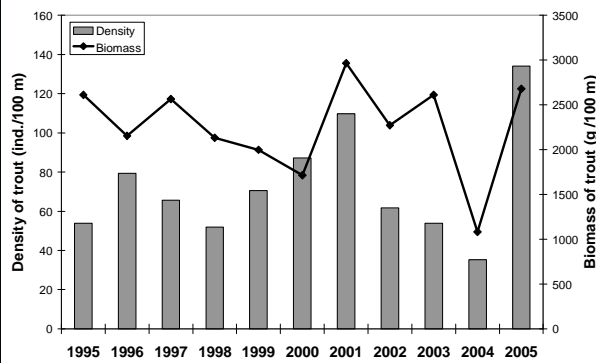


Lez river



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]

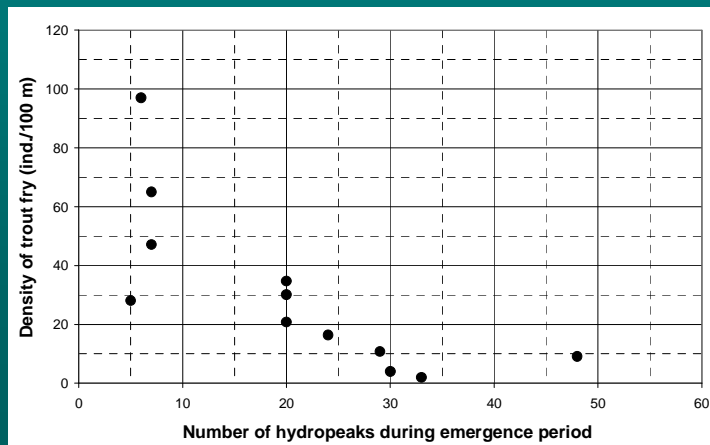


Lez river



Biological issues linked to hydropeaks

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

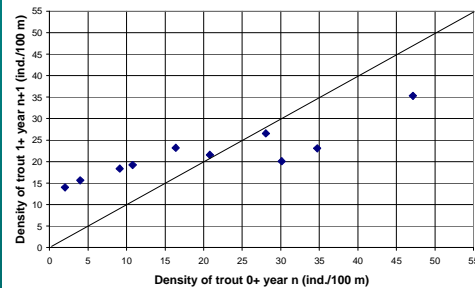


Lez river



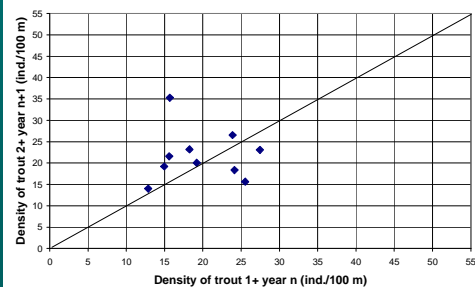
Biological issues linked to hydropeaks

- 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

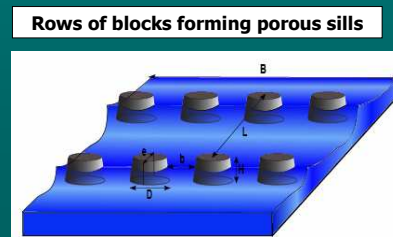
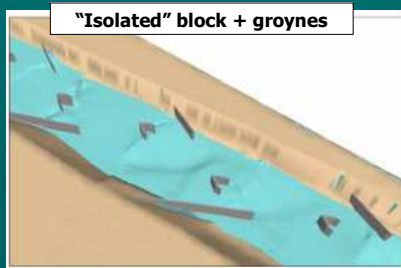
- Relicensing process includes blocks placement to mitigate hydropeaks impacts
- 2D hydraulic modelling of 4 stations to test several modalities for blocks placement
 - assessment of efficiency thank to microhabitat method

Topography of station 3



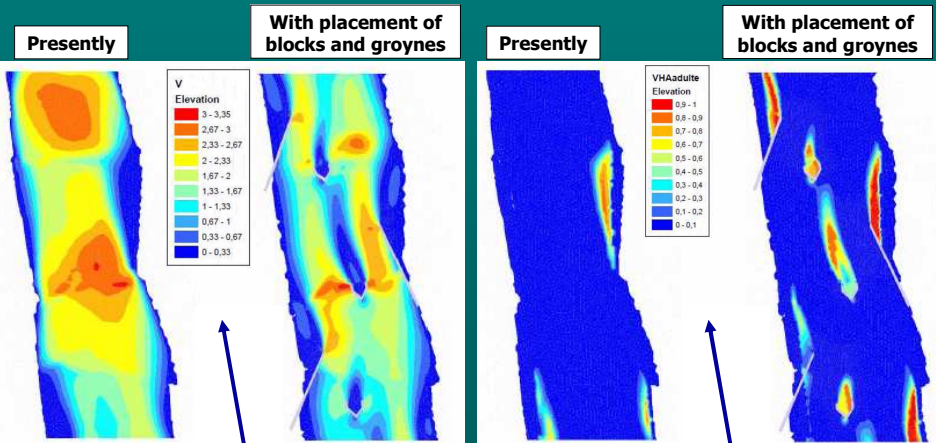
Studies to improve habitat conditions during hydropeaks

- 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 :



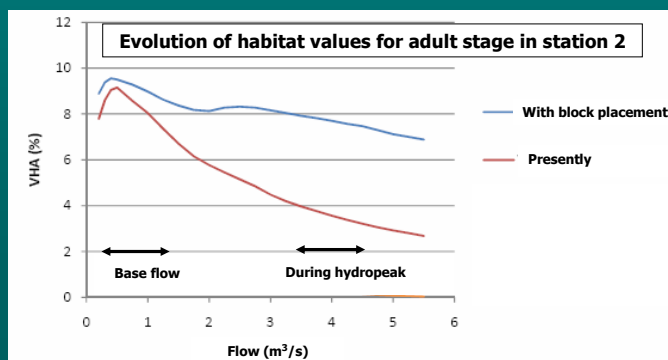
Studies to improve habitat conditions during hydropeaks

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