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

In alphabetical order: Baran P1, Boucard F2, Boyenval E3, Cassan L1, Garmandia L2, Hurel G1 & Prel P1

The Lez River downstream Eylie Power plant

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

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 an 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

Presented by Courret D¹
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Lez river

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)

![Graph of hydropeaks at Bordes station](image)

Lez river

Hydropeaks characterization

![Graph showing number of hydropeaks per trout life stages](image)
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)

- 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

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**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
**Lez river**

Studies to improve habitat conditions during hydropéaks

- **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 hydropéaks
  - Provide shelter

- **2 modalities tested for blocks placement**:

  - "Isolated" block + groynes
  - Rows of blocks forming porous sills

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**Lez river**

Studies to improve habitat conditions during hydropéaks

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

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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.

![Evolution of habitat values for adult stage in station 2](image)

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