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Hydropeaking impacts on the Dordogne river Definition of mitigation measures and assessment of their efficiency

In alphabetical order : Chanseau M⁵, Clave D¹ Courret D⁶,
Guéri O³, Lascaux JM², & Wibaux B⁴



Presented by Courret D (dominique.courret@imft.fr)

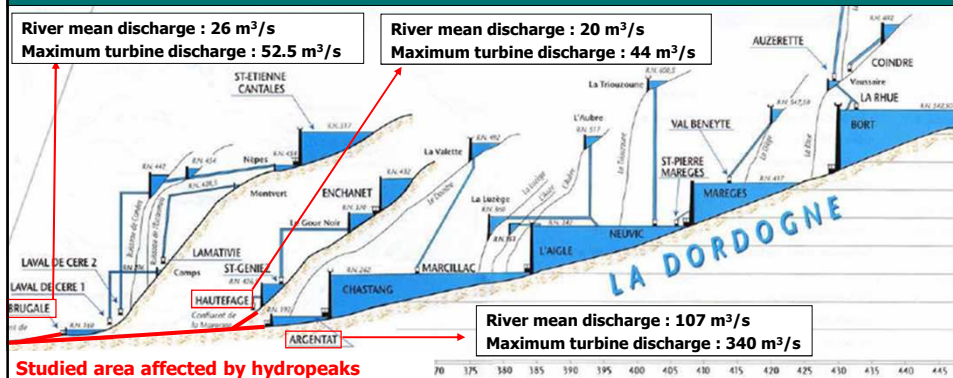
Dordogne river



Context : Hydroelectric schemes

- Dordogne river equipped with 5 principal dams in the upper part, organized in line (storage capacity of 970 Mm³) → 200 km and 20 species affected

+ 2 tributaries also equipped : Maronne and Cère river

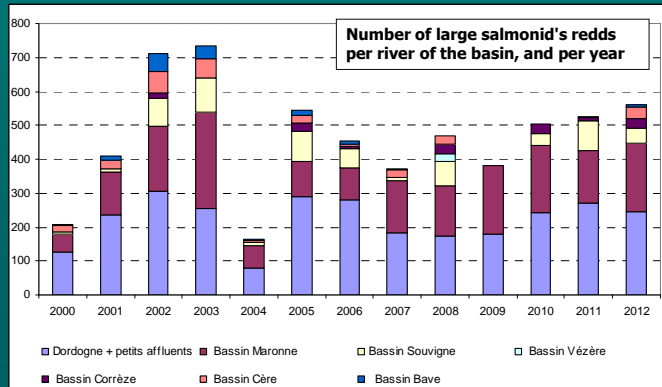


Dordogne river



Context : Biological stakes on the Dordogne river

- **Reintroduction plan under progress for Atlantic Salmon : 40% to 60% of the reproduction activity of the basin.**
- **Several fish species with high patrimonial and/or fisheries values : brown trout, grayling, dace, sculpin, planer lamprey, pike, perch, ...**



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Dordogne river



Organisms involved in partnership :

• Studies leaders :



• Technical operators :



• Hydroelectric operator :



• Funding agencies :



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Dordogne river



Studies and biological surveys :

• Biological surveys :

- Survey of large salmonid's reproduction since 1999/2000 (MIGADO – ECOGEA)
- Survey of stranding-trapping of salmonid's alevins since 2005 (MIGADO / EPIDOR – ECOGEA)
- Survey of spawning and stranding-trapping of others fish species since 2006 (EPIDOR – ECOGEA)
- Survey of salmonid's juveniles abundances in riffles since 2003 (MIGADO – ONEMA)
- Survey of other species' recruitment since 2010 (OMB, BAF, VAN, GOU, BRO, PER, ...) (EPIDOR – ECOGEA).

- **Hydrology and hydropeaks characterization updated each year** (ECOGEA – ONEMA R&D team).

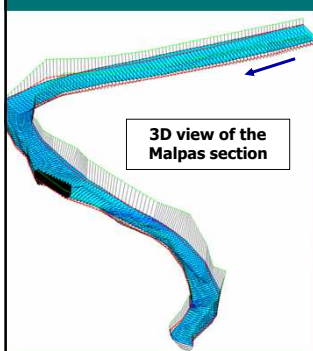
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Dordogne river

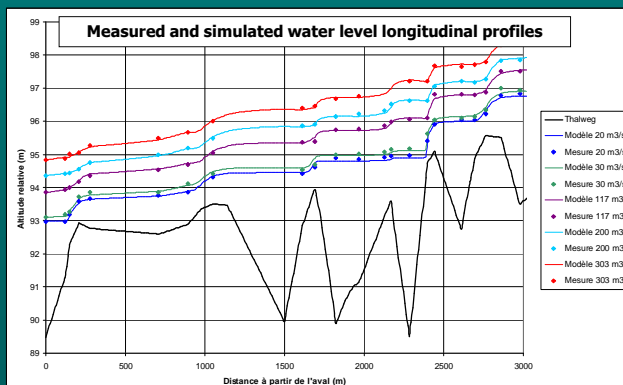


Studies and biological surveys :

- **Hydraulic modelling of several sections, ≈ 10 km in total**, keyed on the whole range of turbine flow (MIGADO – SIEE - ONEMA R&D team)



3D view of the Malpas section

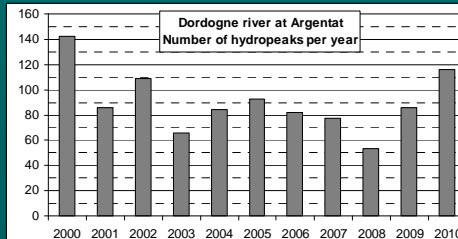
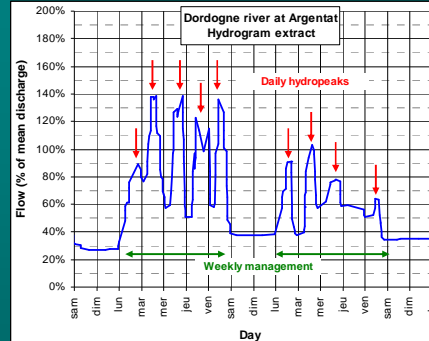
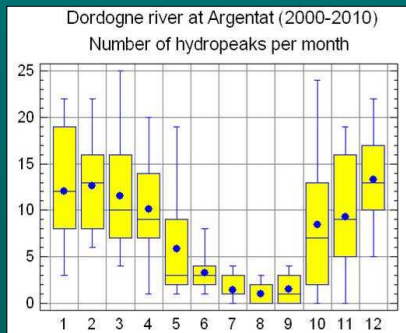


Dordogne river



Hydropeaks characterization

- Weekly and daily hydropeaks
- Between 50 and 150 hydropeaks per year (2000-2010 period)
- Mainly from October to May

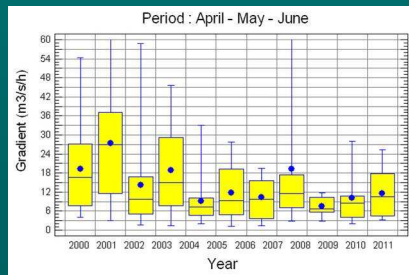
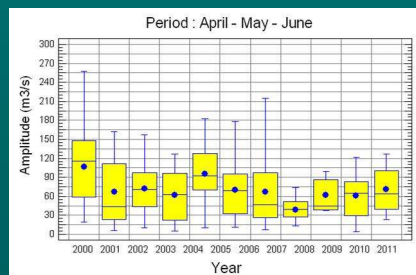
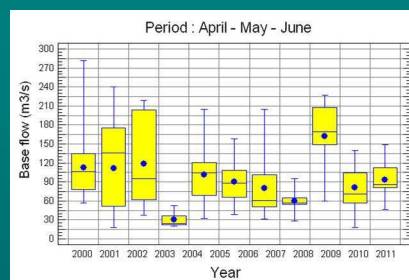


Dordogne river



Hydropeaks characterization

- High variability of hydropeaks
- Characterization useful :
 - To understand the impacts on fish populations
 - To reflect on mitigation measures

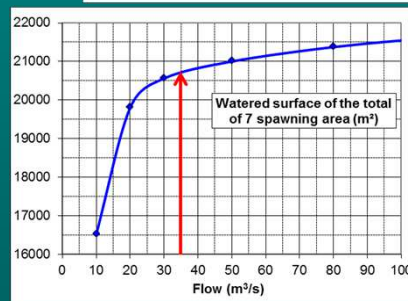
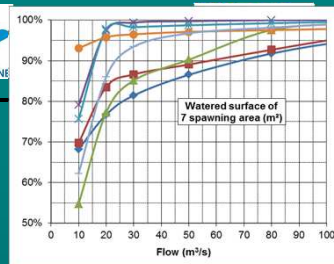


Biological issues linked to hydropeaks

- **Salmonid's redds dewatering during returns at low flow.**
- **Trapping of salmonid's alevins occurring :**
 - In channels margins during flow decreases, especially after long high flow periods
 - At the disconnection of secondary channels
- **Spawning dewatering and stranding-trapping of alevins of other fish species**
 - On dewatered gravel bars
 - At the disconnection of secondary channels and backwaters

Salmonid's redds dewatering issue :

- 84 redds of large salmonid dewatered on the Dordogne river during the 2000 – 2006 period.
- Redds generally located at less than 5 m from the shore, due to the rarefaction of adequate gravels, related to blockage of sediment transport by dams .



→ Maintaining a base flow of 35 m³/s (33% of mean discharge) in winter and spring (15/11-15/06)

Dordogne river

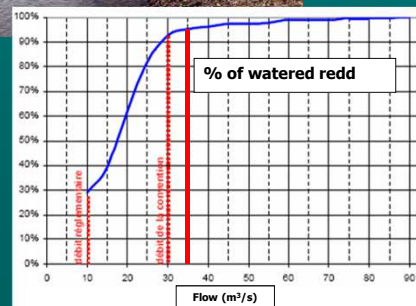


Salmonid's redds dewatering issue :

+ downgrading work on morphology of particularly sensitive sites :



→ **≈ 95% of redds safeguarded with a base flow of 35 m³/s, instead of only 30% at the regulatory minimum flow (10 m³/s).**

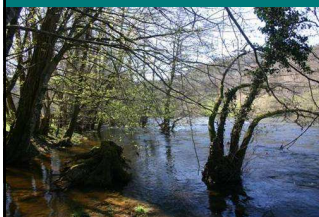


Dordogne river



Trapping of salmonid's alevins :

- Principally in potholes on channel margins during flow decreases, and especially after long high flow periods



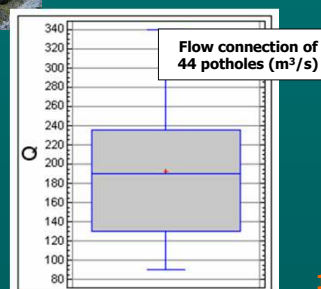
During a hydropeak at 300 m³/s



Back to 50 m³/s



→ **Limiting maximum turbine discharge to 190 m³/s (180% of mean discharge) during spring (15/03-15/06), to the extent permitted by natural hydrology.**



Dordogne river



Trapping of salmonid's alevins :

+ work on morphology :

Deleting particularly tricky sites



Before work



After work

Work on secondary channels' intakes to ensure their permanent connection



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Spawning dewatering and stranding-trapping of alevins of other species :

At 110 m³/s



At 80 m³/s



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Dordogne river



Spawning dewatering and stranding-trapping of alevins of others species :

Sculpin spawning



Grayling redds



Perch spawning



Dace eggs



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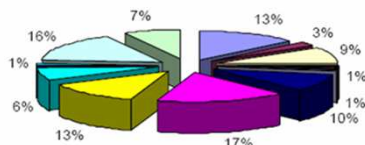
Dordogne river



Spawning dewatering and stranding-trapping of alevins of others species :

- At least 20 fish species are impacted, up to 200 km downstream the Argentat dam
- Mortalities are quantitatively unmeasurable !

Distribution of collected fishes by species



- ABL
- amnocète
- BAF
- Cypr. Ind.
- BOU
- BRE
- BRO
- CHA
- CHE
- GAR
- GOU
- LOF
- OMB
- PER
- PES
- TAN
- TRF/SAT
- VAI
- VAN

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Dordogne river



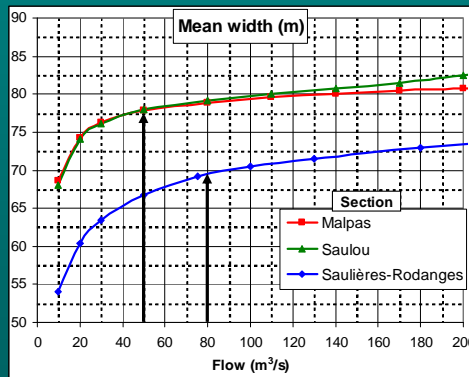
Spawning dewatering and stranding-trapping of alevins of others species :

→ Maintaining during spring (01/03-15/06) a base flow of :

- 50 m³/s at Argentat (47% of mean discharge)
- 80 m³/s downstream Maronne confluence (63% of mean discharge)

to the extent permitted by natural hydrology

→ Gradient of flow decrease limited to 33 m³/s/h (instead of 100 m³/s/h)



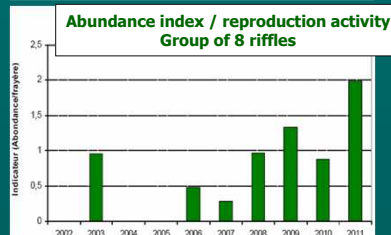
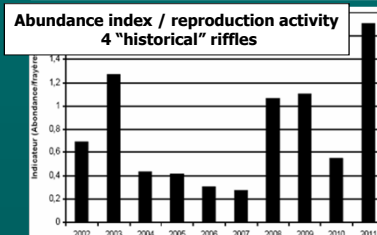
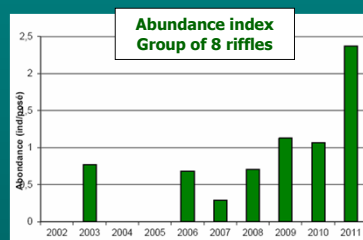
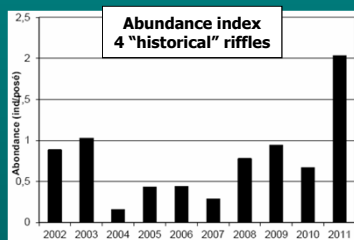
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Dordogne river



Survey of salmonid's juveniles abundances :

It's considered we have achieved significant improvements in abundance, notably since 2008



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Conclusions

However, several impacts remain to be addressed :

- **The reproduction of phytophil species, pike and perch especially,** which are severely affected if a significant drop of water level occurs during phases of egg and fixed larvae
- **Seasonal stocking which can lead to early flow reductions in spring and summer and can affect :**
 - the dynamics of upstream and downstream fish migration
 - the ascent of estuarine silt plug
- **Consequences on river morphology and habitat, due to the flood reduction and to the blockage of sediment transport :**
 - Riverbed paving and depletion of fine grain sizes (gravels)
 - Increased revegetation of channel margins
 - Single channelization of the stream bed