Habitat simulation and spatial analysis for the assessment of environmental flows in Catalonian rivers (NE Spain)

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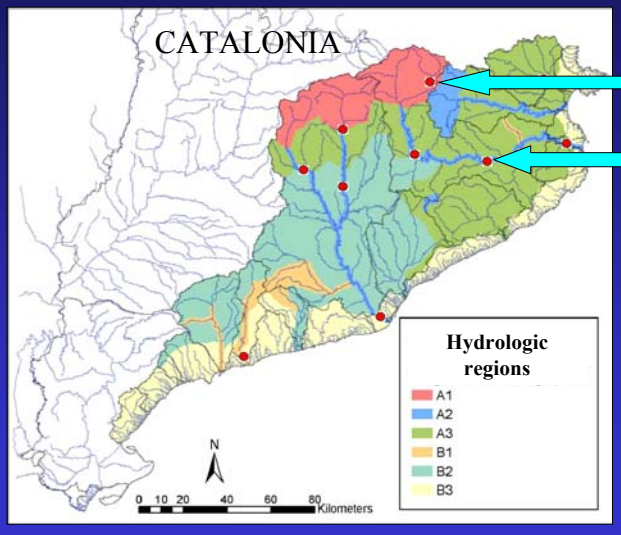
BACKGROUND & STUDY AREA

- **November-2005: Regional Government in Catalonia approved a Regional Plan for Environmental Flows (PSCM), in Catalonia (first regional plan for E. Flows in Spain)**
- **The Plan (PSCM) defines Env. Flow Regimes (EFR) in 320 river segments.**
- **Based on hydrologic methods: Basic Flow Method (QBM, Palau 2006) calculated with natural flow series**
- **This study evaluated the EFR by the use of physical habitat simulation:**
  - **10 river segments in 4 basins of Catalonia (Ter, Llobregat, Muga, Gaia)**
  - **Physical habitat simulation in 1dim (3 segments) & 2 dim (7 segments)**
- **Mediterranean rivers: minimum natural flow occurs in the summer, when pools are isolated → the study starts with the assessment of minimum flows for the summer. In the Pyrenees, the minimum occurs in winter.**

STUDY SITES

Site code	River	Hidro-region	Site name
LI1	Llobregat	A1	Colonia Rosal
LI2	Llobregat	A2	Navás
LI4	Cardener	A2	Clariana de Cardener
LI7	Llobregat	A2	Derivación de potabilizadora St. Joan Despí
T1	Ter	A1	Camprodon
T4	Ter	A2	Manlleu
T5	Ter	A2	Anglès
T6	Ter	A2	Torrella de Montgrí
M1	Muga	A3	Aguas abajo de Pont de Molins
G1	Gaiá	B1	Aguas abajo del pantano de Gaiá

STUDY SITES



River Ter at Camprodon (min flow: february)

River Ter at Anglés (min flow: august)

METHODS

1. Representative species (by reaches) & Biological Meaningful Periods
2. Microhabitat Suitability Curves
3. Physical Habitat Simulation, to evaluate and improve EFR in the PSCM
   - 1-dim – RHYHAB (Jowett, NIWA, NZ)
   - 2-dim – RIVER 2D (Steffler, Univ. of Alberta, CA)
4. Spatial analysis with the patches of suitable areas (ArcGIS 9)
5. Flow Series and Habitat Time Series analysis (MS Excel)

SPECIES, BMP & MICROHABITAT SUITABILITY CURVES

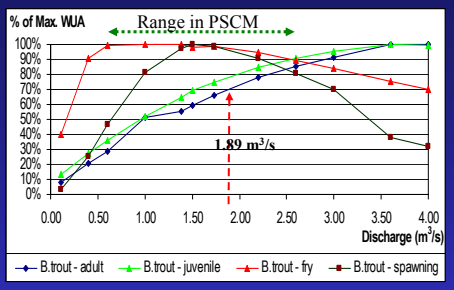
- **Cyprinids**: Dominant in Iberian rivers. Microhabitat studies were available in the Tagus River Basin for Iberian Barbel, Iberian nase & Iberian chub
  - To date there are HSC for cyprinids in the Júcar and Ebro River basins.
- **Brown trout**:
  - BT adult - Stanislaus R. (TRPA, Ca), S. Platte R. (Bovee, USGS, unpublished)
  - BT fry - Raleigh *et al.* (1986)
  - BT spawning - Bovee (1986)

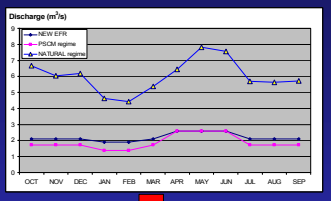
	Autumn			Winter			Spring			Summer		
Month	SE	OC	NO	DE	JA	FE	MA	AP	MA	JU	JL	AU
species & size class												
B.trout fry						X	X	X	X			
B.trout juvenile												
B.trout adult	X	X	X	X	X	X						
B.trout spawning			X	X	X	X						

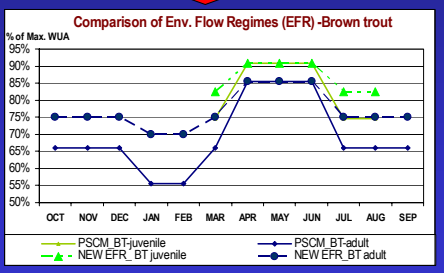
	Autumn			Winter			Spring			Summer		
Month	SE	OC	NO	DE	JA	FE	MA	AP	MA	JU	JL	AU
species & size class												
Cyprinids fry	X							X	X	X	X	X
Cyprinids juvenile	X	X	X	X	X	X	X					
Cyprinids adults	X	X	X	X	X	X	X	X	X	X	X	X

PHYSICAL HABITAT SIMULATION

R. Ter at Camprodón – Sp: B. trout



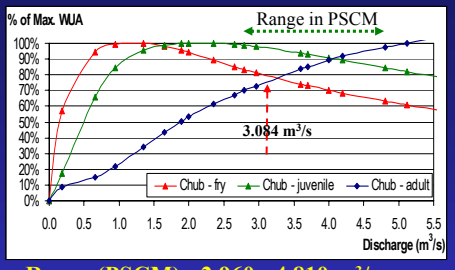


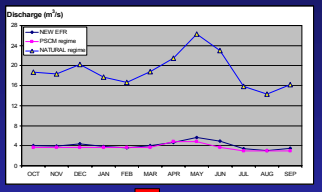


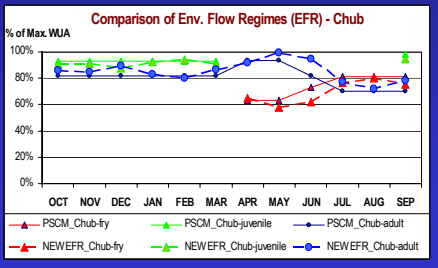
- **Range (PSCM) : 0.602 – 2.595 m³/s**
- **New proposal: Increase mean flow for 9 months to increase habitat for juvenile & adult B.Trout. Minimum 1.89 m³/s**
- **For cyprinids (*Barbus*) percentages of max. WUA were good (all over 75%)**

PHYSICAL HABITAT SIMULATION

R. Ter at Anglés – Sp: Iberian Chub

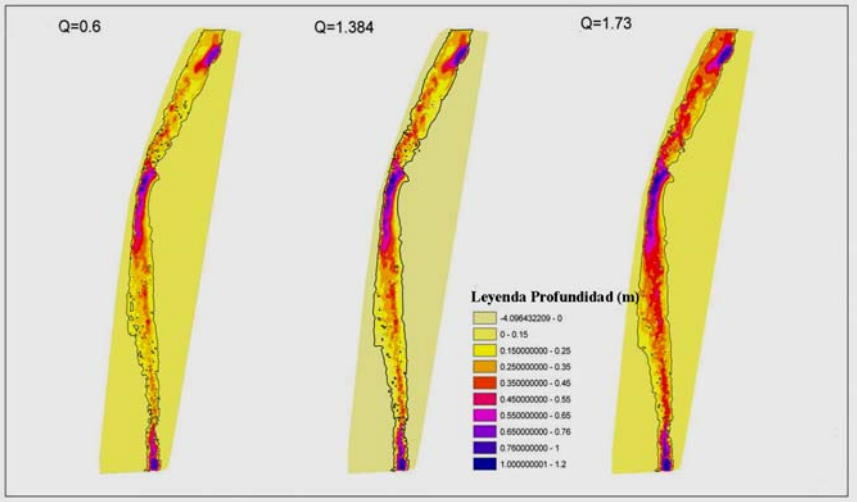






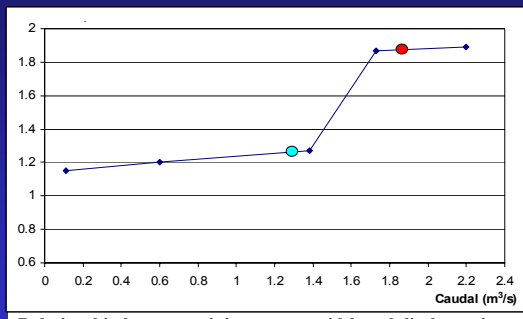
- **Range (PSCM) : 2.960 - 4.810 m³/s**
- **New proposal: 3.084 - 5.654 m³/s**
- **Other 2 spp. of cyprinids were less demanding in flow.**

SPATIAL ANALYSIS
LONGITUDINAL CONNECTIVITY



Ter at Camprodón

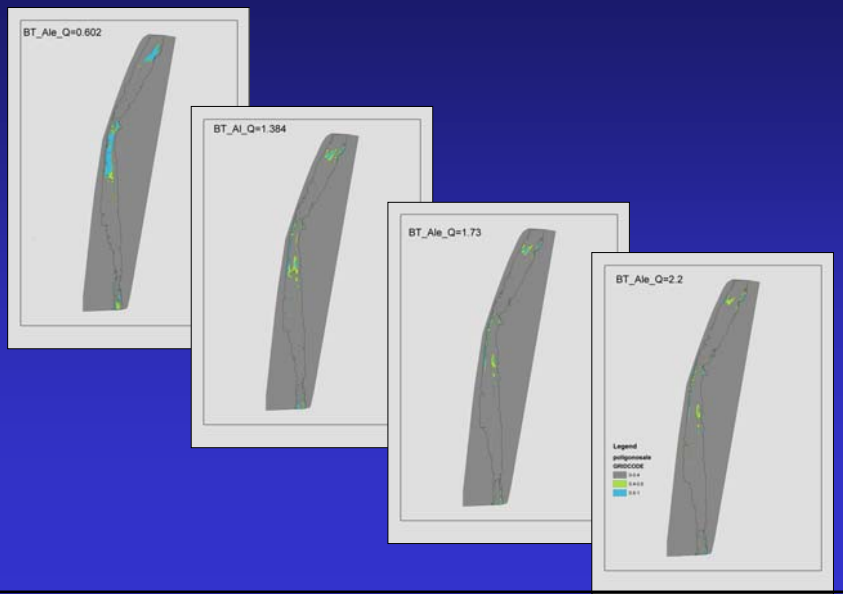
SPATIAL ANALYSIS
LONGITUDINAL CONNECTIVITY



Relationship between minimum pass width and discharge in the R. Ter (Camprodón) in February (minimum)

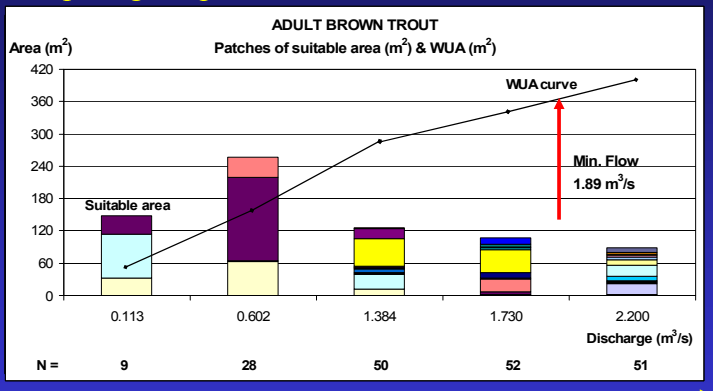
Ter at Camprodón

SPATIAL ANALYSIS OF SUITABLE AREAS
Qualitative results



SPATIAL ANALYSIS OF SUITABLE AREAS
Quantitative results

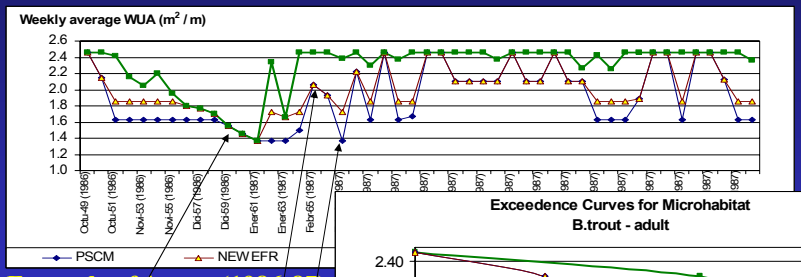
Comparing the profiles: WUA curve *vs.* Suitable Area curve



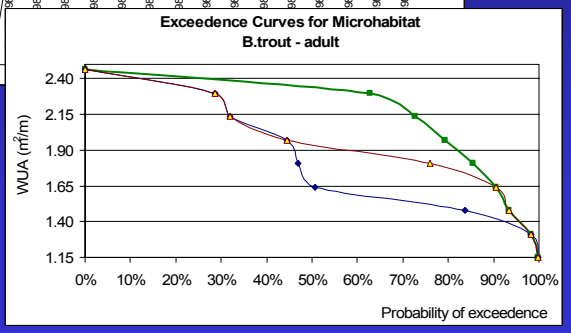
- Stable nº patches above 1.38 m^3/s
- Relevant unsuitable areas contribute to WUA

HABITAT & FLOW SERIES ANALYSIS

- **Qualitative results: limiting events for microhabitat**
- **Quantitative results: summarized in exceedence curves**



Example of 1 year (1986-87)



CONCLUSIONS

- **Comparison Basic Flow Method – Physical Habitat Simulation:**
  - **No clear correlation between results by the 2 methods for 9 sites**
  - **We usually raised minimum flow and monthly average flow throughout the year (different proportions)**
- **A relevant proportion of unsuitable areas can contribute to WUA, in this case WUA curve indicated higher minimum flow, more reasonable regarding the natural flow (to examine each case)**
- **Habitat time series analysis were essential to observe the events that are limiting habitat along the years and simulate the long-term effect of the new EFR proposed**
- **It is affordable to develop studies at a large scale, in two steps:**
  1. **Hydrological methods (economic) applied in a high number of sites**
  2. **Habitat simulation in representative reaches of the hydrological types**

THANK YOU FOR YOUR ATTENTION

THANKS TO THE GROUP THAT MADE IT POSSIBLE

THANKS TO TERRY WADDLE (USGS) FOR HIS GREAT HELP