Defining Hydromorphological conditions for Rivers of Northern Spain

Pardo[1], I., Abrain[1], R. Miranda[2], A. & González-Piedra[2], J.
[1]Department of Ecology and Animal Biology, University of Vigo 36310 Vigo, Spain.
[2]Confederación Hidrográfica del Cantábrico, Ministerio de Medio Ambiente Medio Rural y Marino, Oviedo 33071, Spain.

1. Introduction

The Water Authorities of North Spain (Confederacion Hidrografica del Cantabrico y del Miño-Sil) are responsible for the management of the Northern Spanish Rivers (Figure 1). During the WFD implementation process and application of the technical annexes the CHC-MS have developed new ecological classification systems following WFD requirements for invertebrates and diatoms (Pardo et al., 2007). There have been also several projects and phases of data collection to fulfil WFD demands in relation with hydromorphological and physico-chemical quality conditions accompanying the high and good status classes, in order to integrate the final ecological classification of water bodies.

In this presentation we explain the approach used in the characterisation of the hydromorphological conditions accompanying the high status based on the invertebrate component. To do it, we have used hydromorphological variables gatherer at different scales, from basin to reach and to habitat, to predict the ecological class derived from the invertebrate component. In the future the aim is for integrating the evaluation coming from the fish ecological classification.

2. Study area

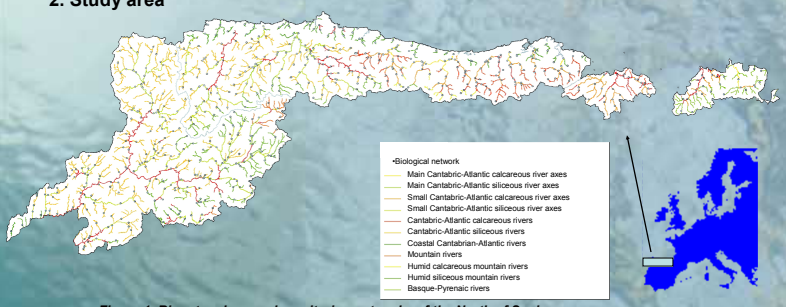

Figure 1. River typology and monitoring networks of the North of Spain.

3. Metodological approach

Proposed criteria for assessing hydromorphological risk

- WFD Identification of significant morphological alterations to water bodies
- WFD Morphological attributes of rivers
- CHN (Spain) Morphological attributes of Rivers
- Hydromorphological condition for High and good status
  - Combined risk threshold
  - Risk thresholds for individual variables
- Hydrological regime: Quantity and dynamics of water flow, connection to groundwater bodies → Hydrological models
- River continuity: Undisturbed migration of aquatic organisms and sediment transport → River continuity
  1. Number and cumulative height of dams upstream
  2. Number of dams downstream limiting fish migration
  3. Cumulative length of channelisation in the basin
  4. Estimates of land uses
- Morphological conditions: River depth and width variation, structure and substrate of the river bed, structure of the riparian zone
  1. Estructure and composition of substrate
  2. Variation in width/depth
  3. Riparian structure
  1. Stream habitat index (IHF)
  2. Photographs, field inspections for water level fluctuation
  3. Photographs and field data from riparian areas
- Multivariate logistic models provide class probability for High and good → Extraction of thresholds form individual variables in model

Table 1. Approximation used in the integration of the hydromorphological criteria to the high status.

4.Data bases

Scale	Variables in model	Explanation of variables
Basin	Channelisation rivers_basin	% of meters channelised per basin
	Dams_basin	% of dams higher than 3 m per basin
	Number of dams	Number of dams higher than 3 m upstream
	Weirs_basin	% of dams lower than 3 m per basin
	Industrial & commercial areas	CORINE land cover 1.2.1.
	Road, rail networks & associates land	CORINE land cover 1.2.2.
	Mining production areas	CORINE land cover 1.3.1.
	Rubbish dumps areas	CORINE land cover 1.3.2.
	Construction areas	CORINE land cover 1.3.3.
Habitat	IHF	River habitat index (Pardo et al, 2002)
Reach	Stream type	River typology following WFD system B based on invertebrates

Table 2. Variables used in the hydromorphological model

4. Hydromorphological model

Relationships between hydromorphological variables and ecological classes were established with logistic regressions, allowing for the extraction of variables that significantly contributed to explain the variation between samples from the ecological classes. The dependent variable is the ecological class and the independent variables are the hydromorphological variables. The model was performed with the programme SPSS v. 14.

The model used initially a database of 580 samples for whose no point pressures (organic) were present, being hydromorphological alteration the dominant pressure. In a second run, we also included other high status sites which were not considered previously (669 samples). The model performed with the 669 samples provided a significant R^2=0.68, and the global percentage of the model for the 5 ecological classes was of 63.5%. The prediction of classes from Moderate to bad was very low. Mainly due to the fact that sites in the worse classes were affected for more than one dominant pressure, and hydromorphological variables could not account for the total variation in the samples within these classes. The model predictions were very good for the high (89% of correct cross validation) and good classes (61% of correct cross validation) (Table 3).

	Classfication					
	Pronosticated					
Observed	High	Good	Moderate	Deficient	Bad	Correct percentage
High	201	24	1	0	0	88.9%
Good	72	140	13	4	0	61.1%
Moderate	12	55	38	16	0	31.4%
Deficient	3	12	12	44	2	60.3%
Bad	2	2	3	11	2	10.0%
Global percentage	43.3%	34.8%	10.0%	11.2%	.6%	63.5%

Table 3. Classification with the observed and predicted cases in each ecological class provided by the hydromorphological model, and the percentage of correct predictions for each class and for model.

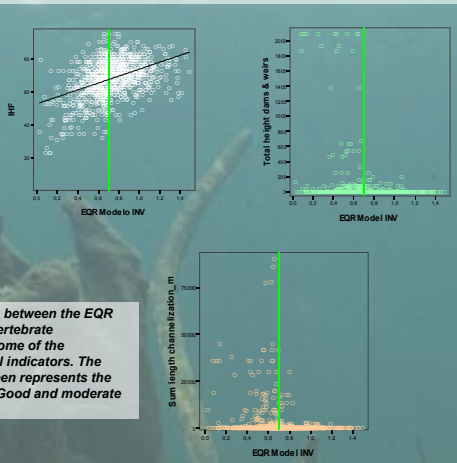

Fig 1. Relationships between the EQR provided by the invertebrate classification and some of the hydromorphological indicators. The reference line in green represents the boundary between Good and moderate status.

		Exclussion thresholds for High ES
Individual variables	Channelisation rivers_basin	5%
	Dams_basin	0,20%
	Weirs_basin	0%
	Industrial & commercial areas	0,10%
	Road, rail networks & associates land	0,25%
	Mining production areas	2%
	Rubbish dumps areas	0,00%
	Construction areas	0,50%
	IHF	59

Table 4. Provisional exclussion thresholds for the high status extracted for the individual variables from the Hydrological model

6. Conclusions

The Hydromorphological model allowed the inclusion of hydromorphological elements of importance for supporting the biological elements, and to check the High status provided by invertebrates, in the integration of the final ecological classification. The presented methodological approach is going to be improved when the fish classification will be finalised, and other variables of importance for the migratory fishes will be included (i.e. downstream river continuity).

The high ecological status can be confirmed by the variables of the model. A small number of sites in High status passed to be in good status according the model prediction. Other sites in good status were considered by the model to be in High status according the hydromorphological elements. This result highlights the potential for the model to identify sites in high HM conditions, indicating that the programme of measures and restoration at the reach-local scale can have a great potential to achieve high status. Also the model results will help in the improvement of the boundaries used up to now for the High/good classes.

7. Other projects

1.- DELINEATION OF PROTECTED RIPARIAN ZONES IN THE CANTABRIC & MIÑO-SIL WATER DISTRICS. The Cantabric & Miño-Sil water districts have signed a series of general protocols of cooperation with various councils within its territorial area to establish riparian protection zones with the objective of avoiding future human use of flooding areas linked with river dynamics. Up to know a total of 35 councils are participating.
2.- GEOMORPHOLOGIC EVOLUTION OF FLUVIAL REACHES. The rivers have been mapped, together with the existing roads and all lands influenced by the functioning of the rivers. The project studies the natural or artificial succession with historical aerial photograph and geomorphological.
3.- Regional projects generating obstacles inventories to assess the impacts of barriers to fish migration.
4.- Two phases of IMPRESS data collection to identify significant morphological alterations to water bodies.

References:
Pardo, I., Álvarez, M. & E., Roselló. 2007. Asistencia científica y técnica para la aplicación de los anejos II y V de la Directiva Marco del Agua en la Demarcación Hidrográfica del Norte. Technical report.
Pardo et al., 2002. El habitat de los ríos mediterráneos. Diseño de un índice de diversidad de hábitat. Limnetica, 21(3-4): 115-133