

Habitat characterization of *Margaritifera margaritifera* populations from the Rabaçal and Tuela rivers (Northeast of Portugal)

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Introduction

Portuguese populations of the protected freshwater pearl mussel *M. margaritifera*, being in the southern distribution limit are exposed to different ecological conditions at least on the water temperature that is far higher than in the pearl mussel's rivers from central and northern Europe. However there were more than ten known Portuguese functional populations in the beginning of the 20th century. Nowadays only two of these populations remain healthy and viable with an estimated one million mussels in Rabaçal and fifty thousand in the Tuela river. However, these populations are still threatened by anthropogenic influences responsible for the loss of the available habitat (Reis 2003). As reported by Hastie et al. (2000) a more comprehensive knowledge on the habitat requirements of *M. margaritifera* is essential to identify the best river management policies. In this way, the main goal of these studies was to characterize water quality, sediments and the habitat and microhabitat used by pearl mussel populations in both rivers.

Methods

- Two river sections (500 m) were sampled in both rivers during summer season (September 2008) and River Habitat Survey (RHS) methodology applied (Karr et al. 1997) (Fig. 1).
- Additional transects were made for available and used microhabitat: a total of 80 transects (considering the 50 spot-checks defined for RHS) with one meter distance quadrats were surveyed and the microhabitat variables determined for each station/quadrat (0.25 m²) depth, cover, dominant and sub-dominant substrate, water current in the water column and in bottom of the river.
- At all stations, across each transect, visible mussels were detected and used microhabitat recorded by snorkelling and/or glass-bottomed viewing bucket (AquaScope®) (Fig. 2). A substrate layer of 50cm was sampled to investigate the presence of burrowed mussels, namely juvenile individuals;
- Water quality parameters were obtained in situ (temperature, pH, TSS, conductivity) and in laboratory (pH-Total, N-Total, Microbiology) as well as sediment analyses (POM and PIM);
- Data Analysis: Microhabitat preference curves were developed for the juvenile and adult populations. The preference was converted according to the habitat availability by calculating for each class of a variable the proportion use/availability followed by a standardization in order to obtain a range from 0.0 (unavailable) to 1.0 (optimal) (Reve 2008). These curves were fitted to the data using polynomial regressions (STATISTICA 7, Statsoft 2006).

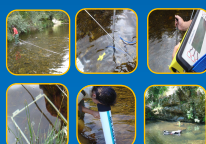


Figure 3. Sampling procedures used to determine the available and used microhabitat by juvenile and adult mussels.

Results

- The RHS showed that Rabaçal and Tuela river sections have excellent quality, considering both calculated indexes: Habitat Modification Score (HMS) and Habitat Quality Score (HQA);
- The preference curves (Fig. 4) for juveniles and adults of *M. margaritifera*, were shown to be similar to the water column velocity (0.10-0.20 m.s⁻¹) and bottom velocity (0-0.30 m.s⁻¹), dominant substrate (sand and gravel) and depth (30-40 cm), and different for the sub-dominant substrate (fine sediments for juveniles and cobbles and boulders for adults) and cover (boulders for juvenile and overhanging vegetation, roots and boulders for adults);
- The water quality parameters low levels of dissolved salts (conductivity < 50 µS/cm) and nutrients (N-Total < 0.2 mg/L; P-Total < 0.1 mg/L; Particulate Organic Matter (POM) < 0.5 mg/L and Particulate Inorganic Matter < 0.01 mg/L) and a high O₂ concentration (> 10 mg/L) (Table 1);
- Although the water quality was considered excellent, a low concentration of total coliform bacteria was found in the water of both rivers indicating some anthropogenic influences upstream. However, the presence of these microorganisms is still under debate if they are useful to some extent as food sources or harmful due to stress on the freshwater mussels immunological system.

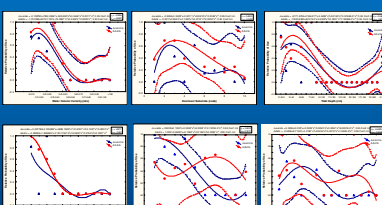


Figure 4. Preference curves, using polynomial regression, performed for juvenile (n=10) and adult (n=11) *Margaritifera margaritifera* in water in the reaches of river Rabaçal and sub-dominant substrate, total depth, water column velocity and bottom velocity in the River Rabaçal, August/September 2008. The preference curves were calculated according to the habitat availability by calculating for each class of a variable the proportion use/availability followed by a standardization in order to obtain a range from 0.0 (unavailable) to 1.0 (optimal) (Reve 2008). Juvenile mussels are represented by red and adult mussels by blue.

Table 1. Water quality analysis for Rabaçal and Tuela Rivers, during September 2008.

Table 1: Water quality analysis for Rabaçal and Tuela Rivers, during September 2019.										
River	NO ₃ ⁻ (mg/L)	pH	Conductivity (µS/cm)	HMS (mg/L)	HQA (mg/L)	Nitrate (mg/L)	Ca ²⁺ (mg/L)	Magnesium (mg/L)	Hardness (mg/L)	Water Hardness (mg/L)
Tuela	5.0	7.2	68.0	4.8	<0.01	18.0	0	0	0	0
Rabaçal	5.5	6.7	33.7	3	<0.01	18.0	<1	<1	<1	<1
River	NO ₃ ⁻ (mg/L)	NO ₂ ⁻ (mg/L)	NH ₄ ⁺ (mg/L)	N-Total (mg/L)	P-Total (mg/L)	PO ₄ ³⁻ (mg/L)	TSS (mg/L)	Chlorophyll a (µg/L)	Water Hardness (mg/L)	Water Hardness (mg/L)
Tuela	0.1	<0.01	0.05	0.16	<0.1	0.1	0.0	0.0	0.0	0.0
Rabaçal	<0.01	<0.01	0.1	<0.1	<0.1	0.1	0.0	0.0	0.0	0.0

Conclusions

- Microhabitat preferences are now being established for the southern *M. margaritifera* populations.
- These results are being now complemented with on going studies to establish more secure results and a more comprehensive knowledge on the Portuguese *M. margaritifera* populations with the intention of implementing action plans and more active conservation measures in Portugal.

Literature Cited

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Acknowledgments

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