International workshop – Dresden March 2019
Freshwater mussels: Search for resettlement habitats and evaluation of protection measures

What is a suitable microhabitat for *Unio crassus*?
A case study

Vaessen Quintia[1], Peeters Alexandre[1], Mayon Nicolas[2], Houbrechts Geoffrey[1]

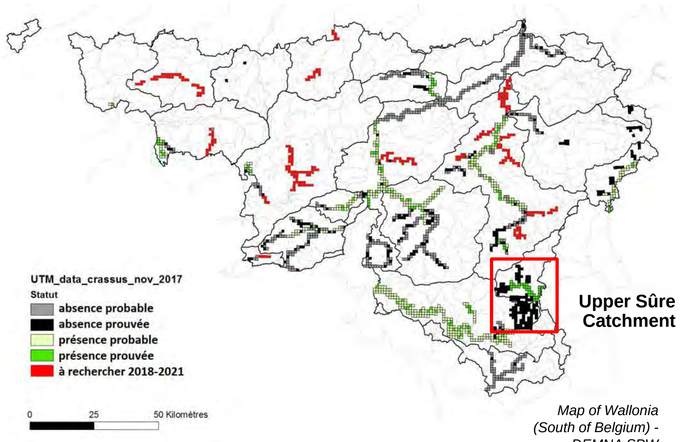
[1] University of Liege, Departement of Geography, Hydrology and Fluvial Geomorphology Research Center, Belgium

[2] Parc naturel Haute Sûre Forêt d'Anlier, Belgium

I. Context

Unio crassus populations are currently declining worldwide, including in Wallonia (Belgium). River habitat degradation is one of the major causes of its decline.

The *Parc naturel Haute Sûre Forêt d'Anlier* has undertaken several river rehabilitation projects (*e.g.* weir removal, remeandering channel, habitat rehabilitation) in the Upper Sûre River. These projects required to characterize the habitat of *Unio crassus.*

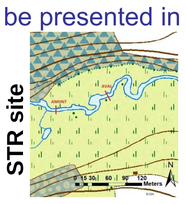


Map of Wallonia (South of Belgium) - DEMNA SPW

River characteristics (at Martelange gauging station):

- ***Drainage area: 209 km²***
- ***Mean annual discharge: 3.69 m³/s***
- ***Gravel bed river (D_{50}: 42 mm ; D_{90} 91 mm)***
- ***Width (at bankfull stage): 13.4 m***
- ***Average slope: 2.2 ‰***
- ***Unit stream power (at bankfull stage): 51 W/m²***

3 sites were studied : MEN, STR, BOD. Only one will be presented in details here, the STR site.



E: 691786.425 ; N: 5528856.244

River characteristics (STR site):

- ***Drainage area: 122 km²***
- ***Width (at bankfull stage): 10 m***
- ***Riffles particles size: D_{50}: 31 mm ; D_{90} 64 mm***

II. Microhabitats cartography & spatial distribution of the thick shelled river mussels

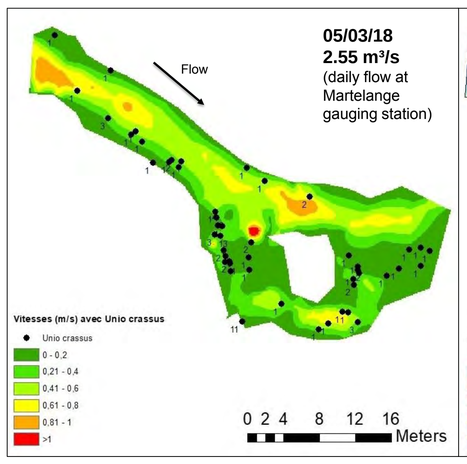
Through an adaptation of the microhabitat method used by Castelain *et al*. (2018), we provide a cartography of *Unio crassus* microhabitats, based on measures of flow velocity, water depths and dominant substrate classes. The aim was to identify suitable hydromorphological characteristics for this species in the Sûre River.

Flow velocity and water depths measurements were performed at a median flow (~2m³/s).

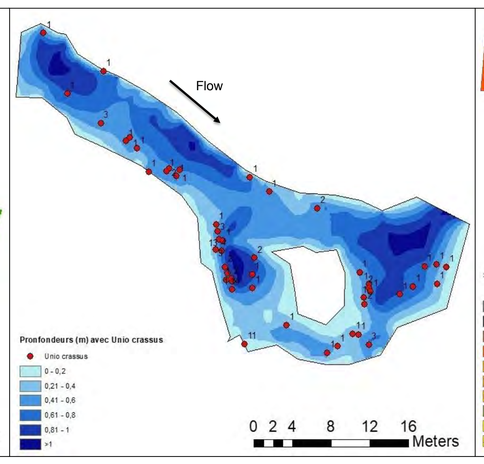
The population survey of *Unio crassus* in the 3 studied sites took place in Spring after the microhabitats survey (~0.9 m³/s).

We found 131 thick shelled river mussels in total (~ 1850m²). We measured the length and the width of each one of them.

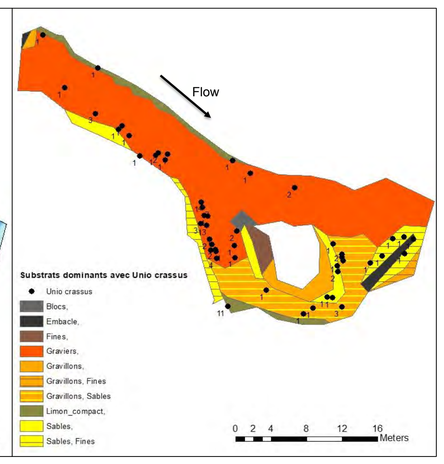
a) Flow velocity



b) Bathymetry

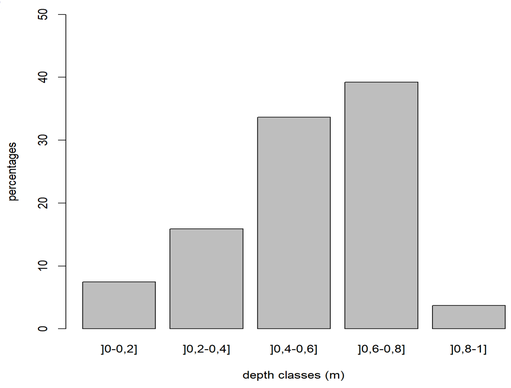


c) Dominant substrates

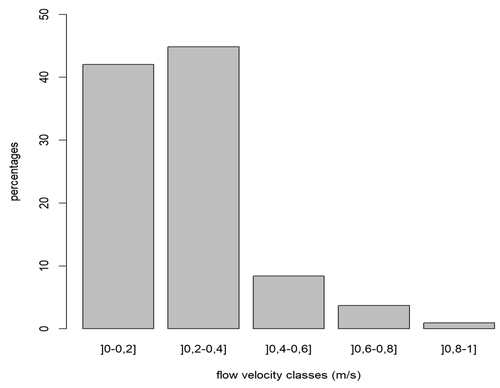


Percentages of individuals by depths classes (all sites)

Depth classes (m)	% individuals - MEN site (n=12)	% individuals - STR site (n=88)	% individuals - BOD site (n=7)
]0-0.2]	0	9.1	0
]0.2-0.4]	33.3	14.8	0
]0.4-0.6]	41.7	31.8	42.9
]0.6-0.8]	25	39.8	57.1
]0.8-1]	0	4.5	0



Proportions of thick shelled river mussels by classes (flow velocity & depths) is homogenous between sites (Fisher's exact test).

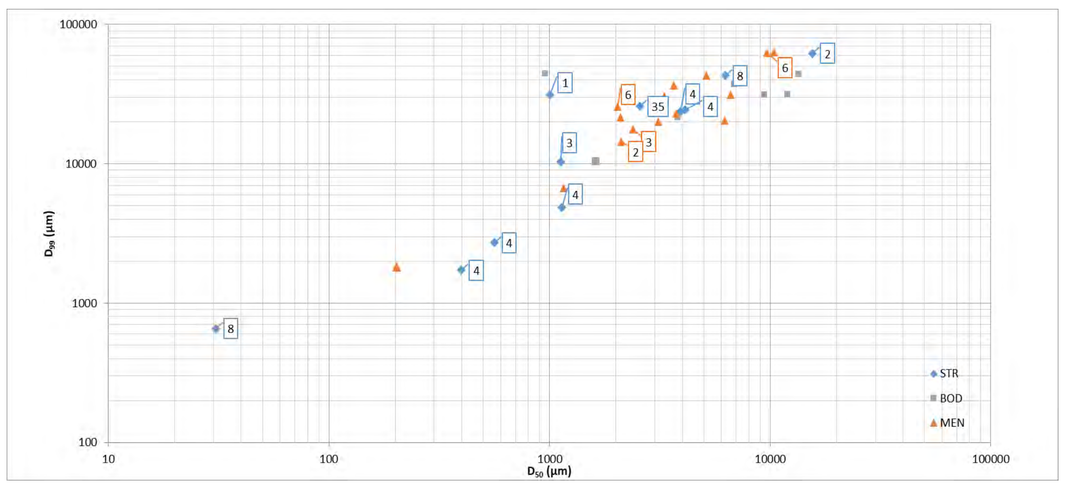


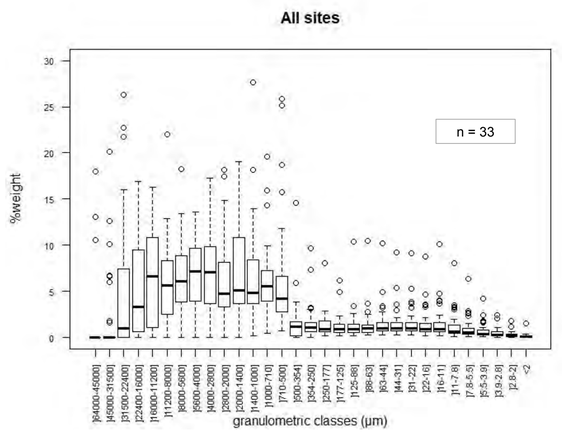
Percentages of individuals by flow velocity classes (all sites)

Flow velocity classes (m/s)	% individuals - MEN site (n=12)	% individuals - STR site (n=88)	% individuals - BOD site (n=7)
]0-0.2]	33.3	45.5	14.3
]0.2-0.4]	33.3	44.3	71.4
]0.4-0.6]	16.7	6.8	14.3
]0.6-0.8]	8.3	3.4	0
]0.8-1]	8.3	0	0

III. Substrate analysis

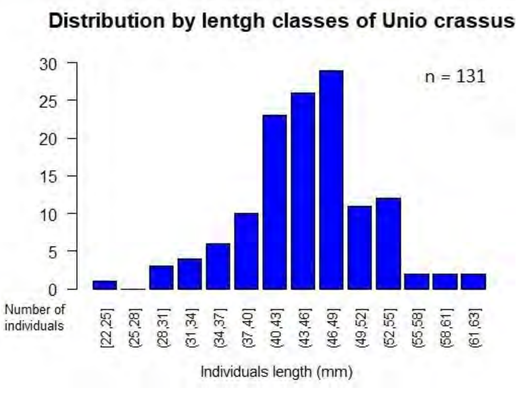
Substrate samples were taken at the exact location of each *Unio crassus* individual (or group). Grain size lab analysis was performed.
Results are shown following the Passega CM diagram (Passega, 1964), wherein the values of the D_{99} (percentile 1) are plotted against the median (D_{50}). The substrate inhabited by *Unio crassus* in the Sûre River is well sorted and mainly results of graded suspension transport and deposition.





Boxplot of the percentage-weight of each granulometric fraction for the 3 sites shows that the variability mainly occurs in the lower part of gravel fraction and in upper sands fraction. Circles are the outliners.

	Median (P25 - P75)
D50 (mm)	3.31 (1.16 – 6.24)
D99 (mm)	24.42 (14.44 – 36.48)



The non parametric Spearman's rank correlation test reveals no statistically significant correlation between the shell size of the thick shelled river mussels and the grain size (defined by D_{50} and D_{99}).

Correlation tests (Spearman) H0 : ρ = 0 *vs* H1 : ρ ≠ 0		
	rho	**p-value**
D50-width	0.07	0.4615
D50-length	0.04	0.6784
D99-width	0.08	0.3805
D99-length	0.05	0.5766

IV. Conclusion:

- *U. crassus* are mainly found in low velocity zones (from 0 to 0.4 m/s) & in depths higher than 0.3 m (at a median flow level);
- They are mostly located at the bank toe of point bars (inside of stream bend)
- *Unio crassus* seems to be able to inhabit within variable grain textures but shows preference for substrate characterized by median grain size around 3 mm (D_{50}) and with a D_{99} around 24 mm.
- No evidence of a relationship between *Unio crassus* shell size and substrate granularity was found.

So what is a suitable microhabitat for *Unio crassus*?

For now, we could describe it as a lentic zone, with an enough water depth, probably to prevent being emerged, in a meandrous river with a dominant gravel type substrate and a sandy matrix. A certain variability in granularity seems to be acceptable for *Unio crassus*. It also seems that they can inhabit unstable substrate (results to quantify – scour chains). These results are valid in the case of the Sûre River. We will extent to others Walloon rivers in a PhD project.





Liévin Castelain, Alexandre Peeters, Marie Halleux, Bernard de le Court, and Gisèle Verniers. 2018. "Walphy, Un Projet Expérimental de Réhabilitation de Cours d'eau : Suivis Hydromorphologiques et Écologiques." Hydroécologie Appliquée 20:29–55.
Passega, R. 1964. "Grain Size Representation by CM Patterns as a Geologic Tool." Journal of Sedimentary Research 34 (4):830–47.