

# Trace element bioaccumulation in rope-grown *Mytilus galloprovincialis*: Knowledge update

J. Richir\* and S. Gobert (\*jonathan.richir@ulg.ac.be)

Laboratory of Oceanology, University of Liège, Sart-Tilman, B6c, 4000 Liège, Belgium

Since the mid-70<sup>es</sup> when Goldberg proposed the mussel-watch concept to record the quality of marine waters, mussels from the genus *Mytilus* of which *M. galloprovincialis* (Lamarck, 1819; Fig. 1) have been widely used as bioindicators. But mussel watch programs have historically focussed on a limited number of trace elements (TEs). Thus, the 1<sup>st</sup> objective of this study was to investigate the bioindicator potential of *M. galloprovincialis* for the monitoring of several TEs little surveyed and of environmental emerging concern. Since the influence of the mussel morphology on flesh TE levels is still ambiguous, the 2<sup>nd</sup> objective was to model the effect of the mussel size and weight on TE levels. As the accumulation of reserves during sexual dormancy and their subsequent mobilization during gametogenesis influence TE levels and compartmentalization in *Mytilus* spp., the last objective was to study the importance of these physiological processes in *M. galloprovincialis*.

## Introduction and objectives

Rope-grown *M. galloprovincialis* were purchased from the good water quality Diane salty pond (east Corsica, France):

- 74 mussels sampled before spawning (February 2011) were used: i) to study the accumulation of Be, Al, Fe, Mn, Co, Se, Mo, Sn, Sb and Bi (TEs little monitored and of environmental concern) in mussel flesh, in addition to Cr, Ni, Cu, Zn, Cd, Pb, As, Ag and V (TEs broadly monitored); ii) to model - linear regression or power function - relationships between the mussel flesh weight or shell length and TE levels; iii) to compare TE accumulation between males and females before spawning.
- 40 mussels sampled before (February 2011) or after spawning (March 2010) were analysed for compartmentalization at both reproductive statuses with a year of interval.
- TE analyses were performed by DR-CICP-MS.

## Material and methods

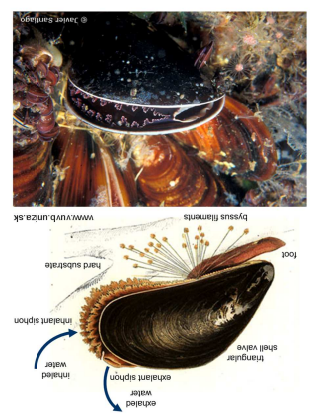


Fig. 1. Drawing and picture of *Mytilus galloprovincialis*.

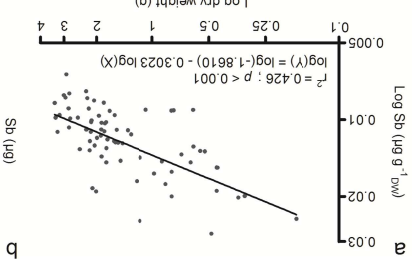


Fig. 3. Above - (a) Double log transformed power function and (b) linear regression modelling relationships between *M. galloprovincialis* flesh dry weight or shell length and Sb concentrations ( $\mu\text{g g}^{-1}\text{DW}$ ) or total contents ( $\mu\text{g}$ ), respectively. Linear equations and their fitting parameters ( $r^2$ ;  $p$ -values) are given.



Fig. 4. Left - Linear regressions modelling relationships between *M. galloprovincialis* shell length and Cr or Se concentrations ( $\mu\text{g DW}$ ). Right - Linear regressions modelling relationships between *M. galloprovincialis* shell length and Cr or Se concentrations in  $\mu\text{g g}^{-1}\text{DW}$ . Symbolsize females and males. The significance ( $p$ -values) of regressions either common (co.) or specific (fe.; ma.; graph d) to  $\sigma$  and  $\phi$  are given, as well as probabilities of linear slopes to deviate (dev.) from 0 ( $\sigma$ .; significant, n.s.: non-significant).

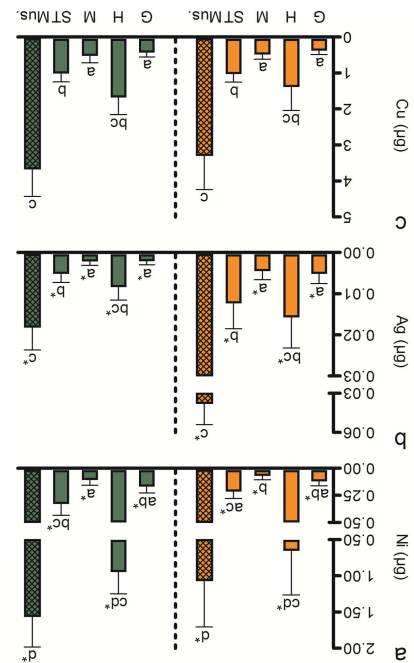


Fig. 6. (a) Ni, Pb and (c) Cu contents (mean  $\pm$  SD, in  $\mu\text{g}$ ) in gills 'G', hepatopancreas 'H', mantle 'M', remaining soft tissues 'ST' and whole *M. galloprovincialis* 'Mus.' sampled before (orange; February 2011) or after (green; March 2010) spawning with a year of interval. Significant differences ( $p < 0.05$ ) between compartments and whole mussels of a same gametogenic status (letters) at both reproductive statuses ( $\sigma$ ) are given.

## Results and discussion

- Rope grown *M. galloprovincialis* efficiently accumulated little biomonitoring TEs (Be, Al, Fe, Mn, Co, Se, Mo, Sn, Sb, Bi) in addition to TEs classically investigated (Cr, Ni, Cu, Zn, Cd, Pb, As, Ag, V) in that species (Fig. 2). Concentrations in the Diane pond were globally low to very low and could serve as baseline levels for comparison with ulterior surveys.
- TE body concentrations decreased when the mussel flesh weight increased; these relationships were better modelled by power functions. TE body contents increased when the mussel shell length increased; these relationships were better modelled by linear regressions (Fig. 3).
- Significant ( $p < 0.05$ ) linear correlations observed between the shell length of mussels sampled before spawning and concentrations of most TEs were attributable to small-size individuals ( $< 55$  mm; higher mean TE levels and important inter-individual variability). For mid- to large-size mussels, the size did not influence TE body concentrations. Significant linear correlations still observed between some TEs and the mussel shell length, small-size individuals excluded, did result from the unequal accumulation of TEs between females and males during gametogenesis (Fig. 4).
- TEs were preferentially accumulated in the hepatopancreas. Neither the reproductive status (before or after spawning) nor the sampling year (2010 or 2011) did influence the compartmentalization. Conservative graphic profiles of contents of some essential micronutrients (Cu, Zn, Co) further required strong internal regulatory mechanisms (Figs. 5, 6).

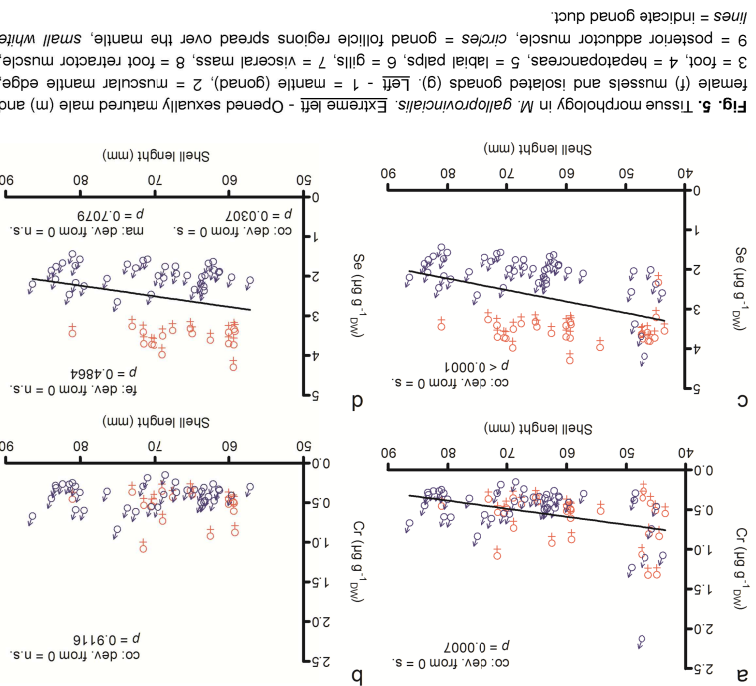


Fig. 5. Tissue morphology in *M. galloprovincialis*. Extreme left - Opened sexually matured male (m) and female (f) mussels and isolated gonads (g). Left - 1 = mantle (gonad), 2 = muscular mantle edge, 3 = foot retracter muscle, 4 = visceral mass, 5 = gills, 6 = labial palps, 7 = foot, 8 = posterior adductor muscle, 9 = gonad follicle regions spread over the mantle, small white lines = indicate gonad duct.

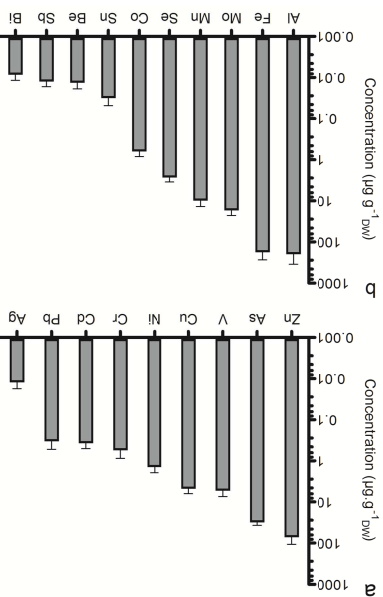


Fig. 2. Range of concentrations (mean  $\pm$  SD, in  $\mu\text{g g}^{-1}\text{DW}$ ; log scale) of TEs either (a) broadly or (b) little/not biomonitoring with *M. galloprovincialis*.

## Conclusion

Results from the present study underlined the potential use of *M. galloprovincialis* in the biomonitoring of numerous little studied TEs of environmental concern and gave some insights into the decisive role played by some relevant biological parameters in bioaccumulation processes of the 19 investigated TEs in rope-grown mussels.