Use and environmental impact of antifouling paints in the Baltic Sea

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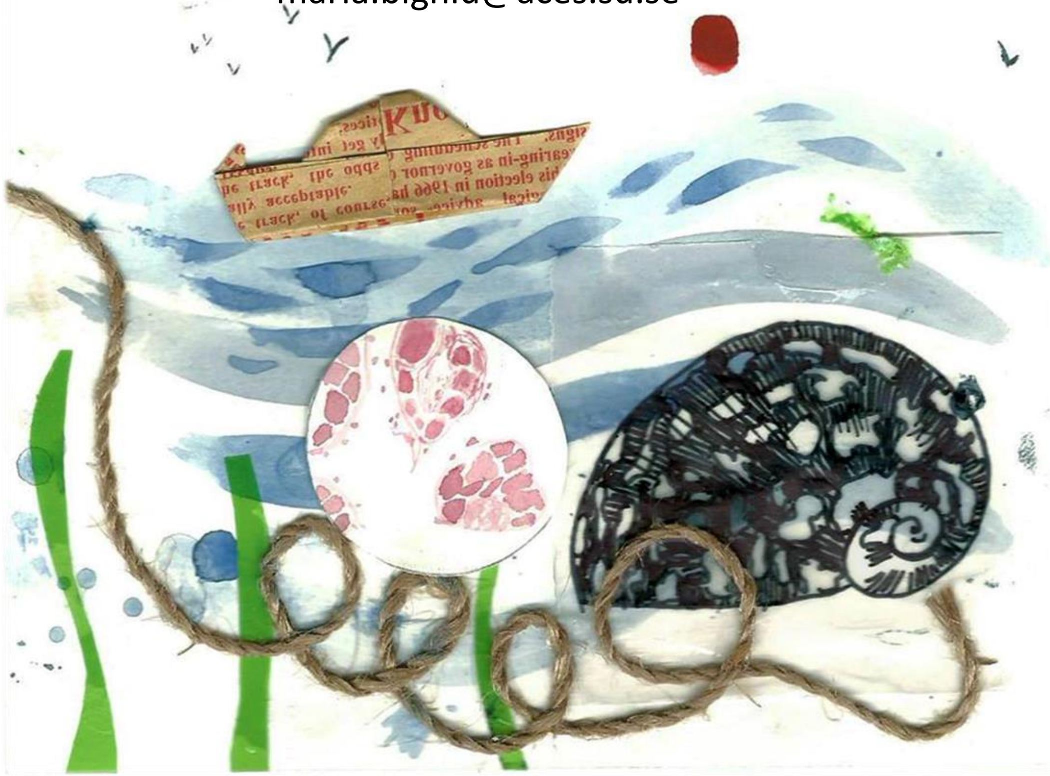


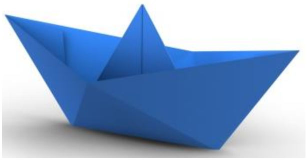
Båtmiljöseminarium, Göteborg 20.04.2017

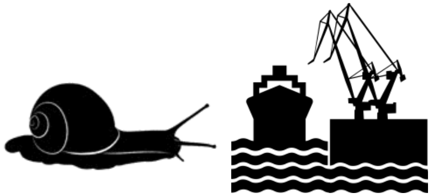
Thesis overview and aims

Measuring metal levels in AF paints directly on boats (XRF)

Metal accumulation in biofouling *(påväxt)*

In situ ecotoxicity studies





Paper 1

XRF measurements of tin, copper and zinc in antifouling paints coated on leisure boats

Ytreberg E., Lundgren L., Bighiu M. Eklund B.

Environmental Pollution (2016)

Paper 2

Biofouling of leisure boats as a source of metal pollution

Bighiu M., Eriksson-Wiklund A.K., Eklund B.

Environmental Science and Pollution Research (2016)

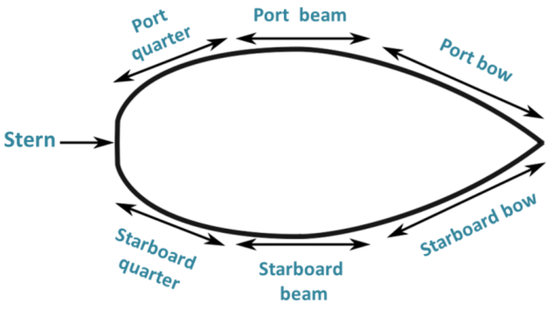
Aims:

1. To quantify metal concentrations in biofouling;

2. To evaluate the importance of several factors for biofouling (i.e. type of paint, mechanical cleaning, hull colour, etc).

Methods:

- collection of biofouling from boats
- Survey for boat owners
- Substratum colour experiment



Very high concentrations of metals in the biofouling

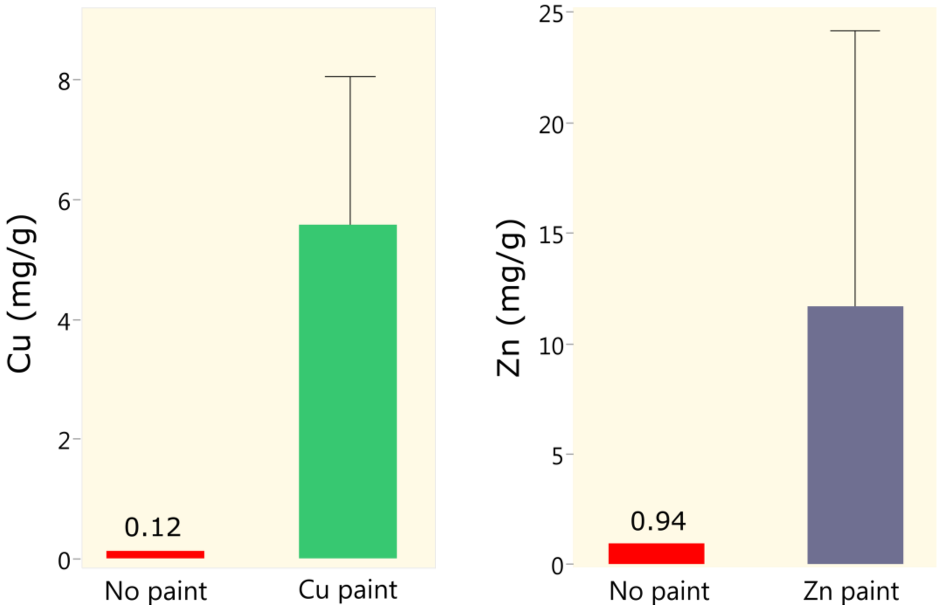
→ Correlated to the metal concentrations on boat hulls (XRF)

Metals in biofouling (mg/g)

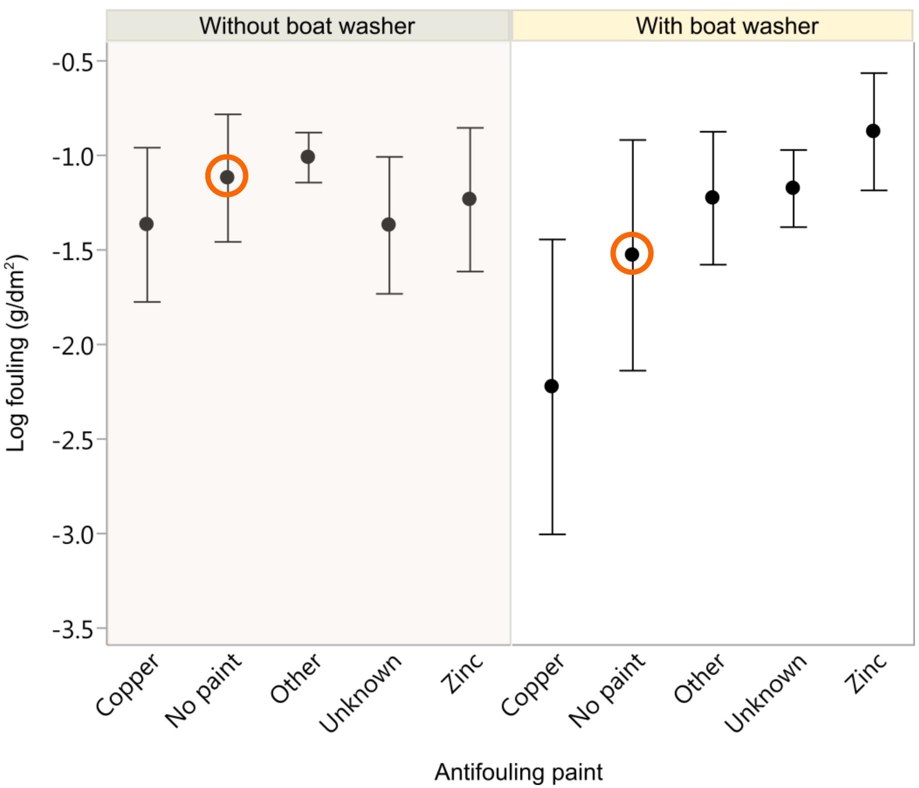
	Cu	**Zn**	**Sn**
Median	3.5	6.3	0.01
LSL	0.2	0.5	NA

↓

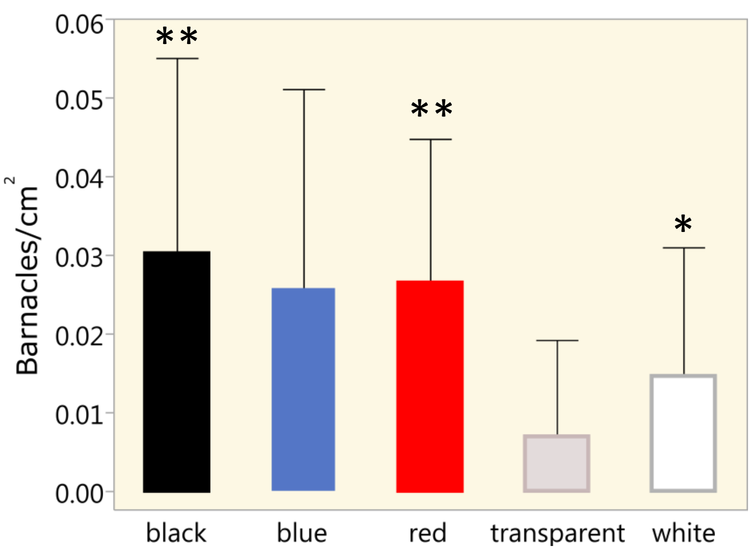
Exceed LSL by a factor of 18 for Cu and 13 for Zn



No effect of AF paint



Effect of hull colour



Paper 3

Metal contamination in harbours impacts life-history traits and metallothionein levels in snails

Bighiu M., Gorokhova E., Carney Almroth B., Eriksson-Wiklund A.K.

(under review)

Aims:

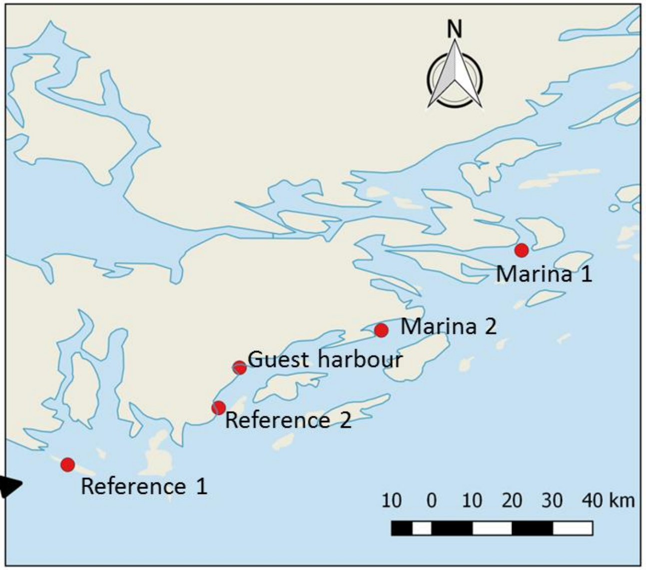
1. To investigate the effect of long-term exposure in harbours on snail growth, reproduction, survival and metallothionein (MT).

2. To evaluate the importance of abiotic factors (Cu, Zn, nutrients, pH, salinity) for the observed effects.

Experimental setup

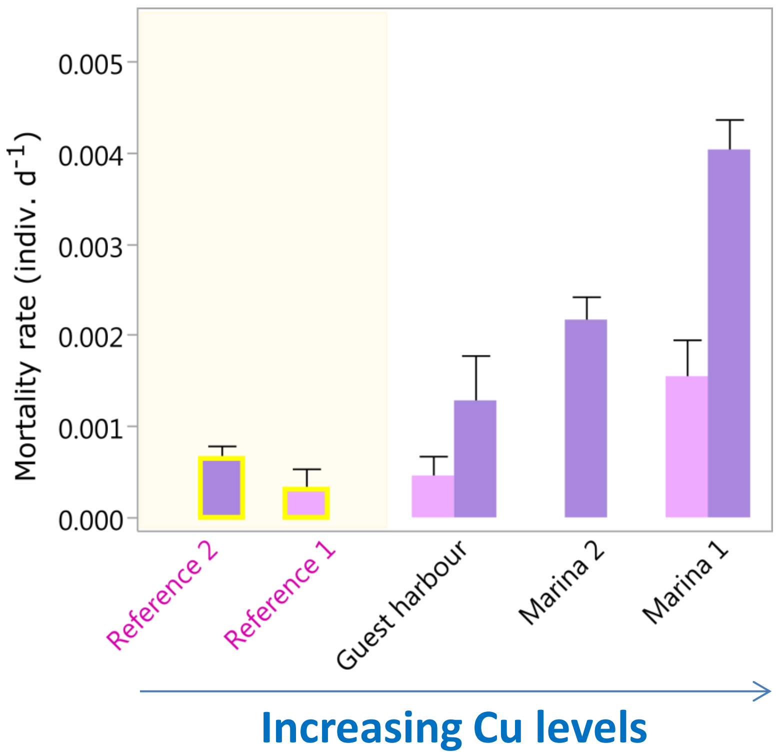
Cages at 1 m depth
2014 (8 weeks)
2015 (16 weeks)

~ 7 mm
Theodoxus fluviatilis

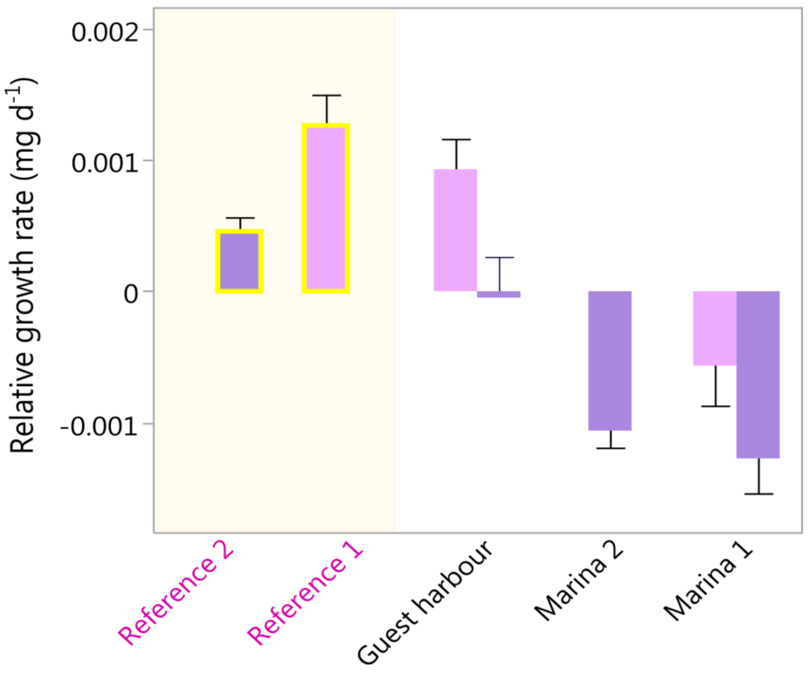


Reduced fitness in harbours

Mortality



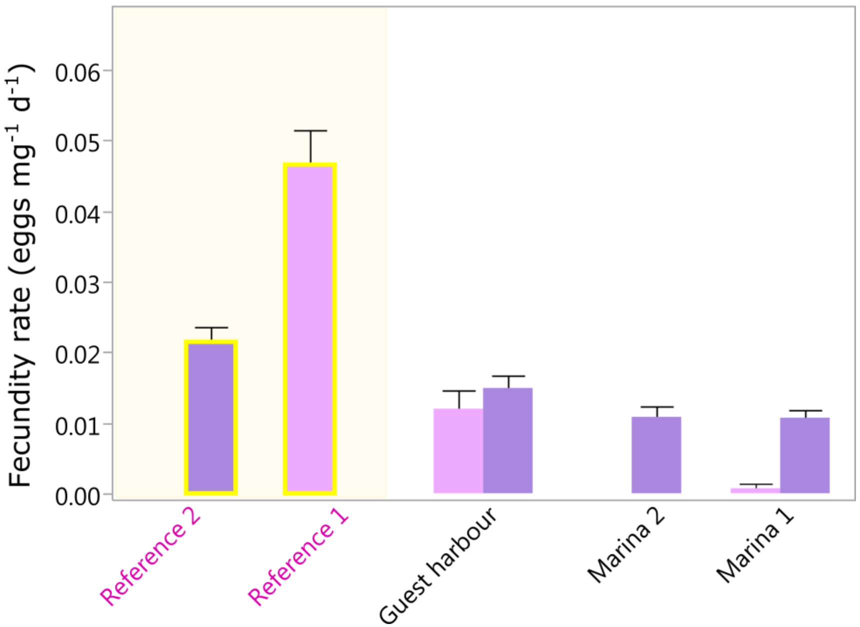
Growth



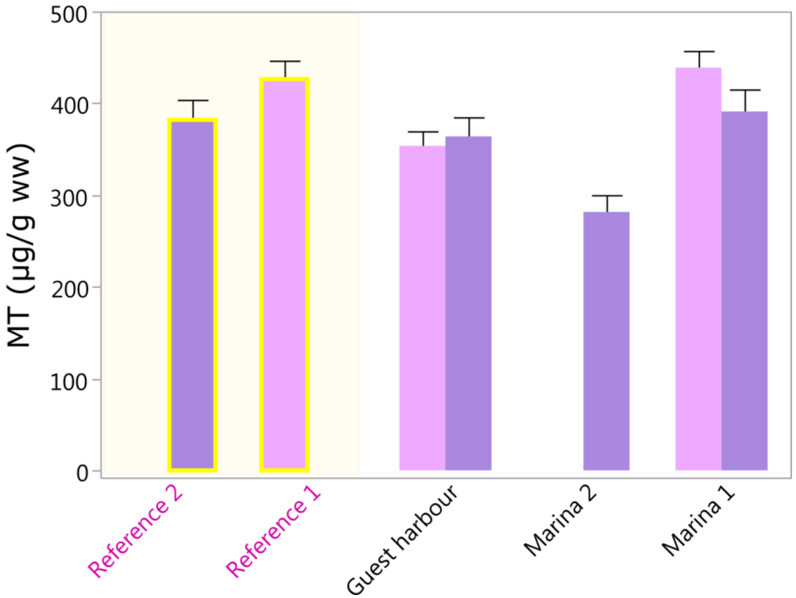
Year
2014
2015

Reduced fecundity in harbours

Fecundity



Metallothionein



Year
2014
2015

Metals are key explanatory factors

		Fecundity rate	Growth rate	MT	Mortality rate
water	Cu	-			+
water	Zn		-	-	
water	Cu:Zn				
sediment	Cu_{sed}				+
sediment	Zn_{sed}				
sediment	Cu_{sed}:Zn_{sed}	+	+	+	
	Total Phosphorous				
	Total Nitrogen				
	Salinity			-	
	pH				
	Body size		-		

Paper 4

Mortality and histopathological effects in harbour-transplanted snails with different exposure histories

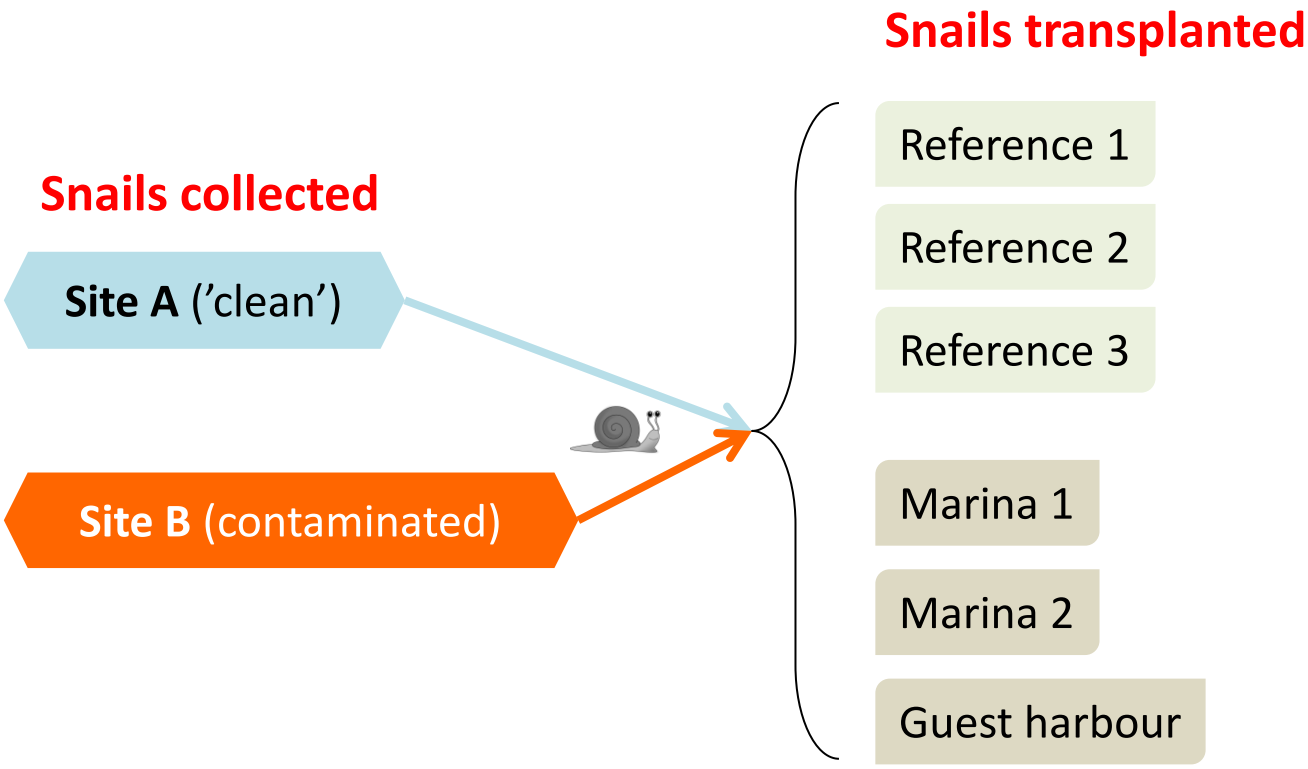
Bighiu M., Watermann B., Guo X., Carney Almroth B., Eriksson-Wiklund A.K.

(under review)

Aims:

1. To assess histopathological effects in snails and evaluate the contribution of abiotic factors to these effects.
2. To assess the difference in tolerance to contaminants between snails with different exposure histories.
3. To evaluate the role of genetic diversity for the (potential) difference in tolerance.

Experimental setup

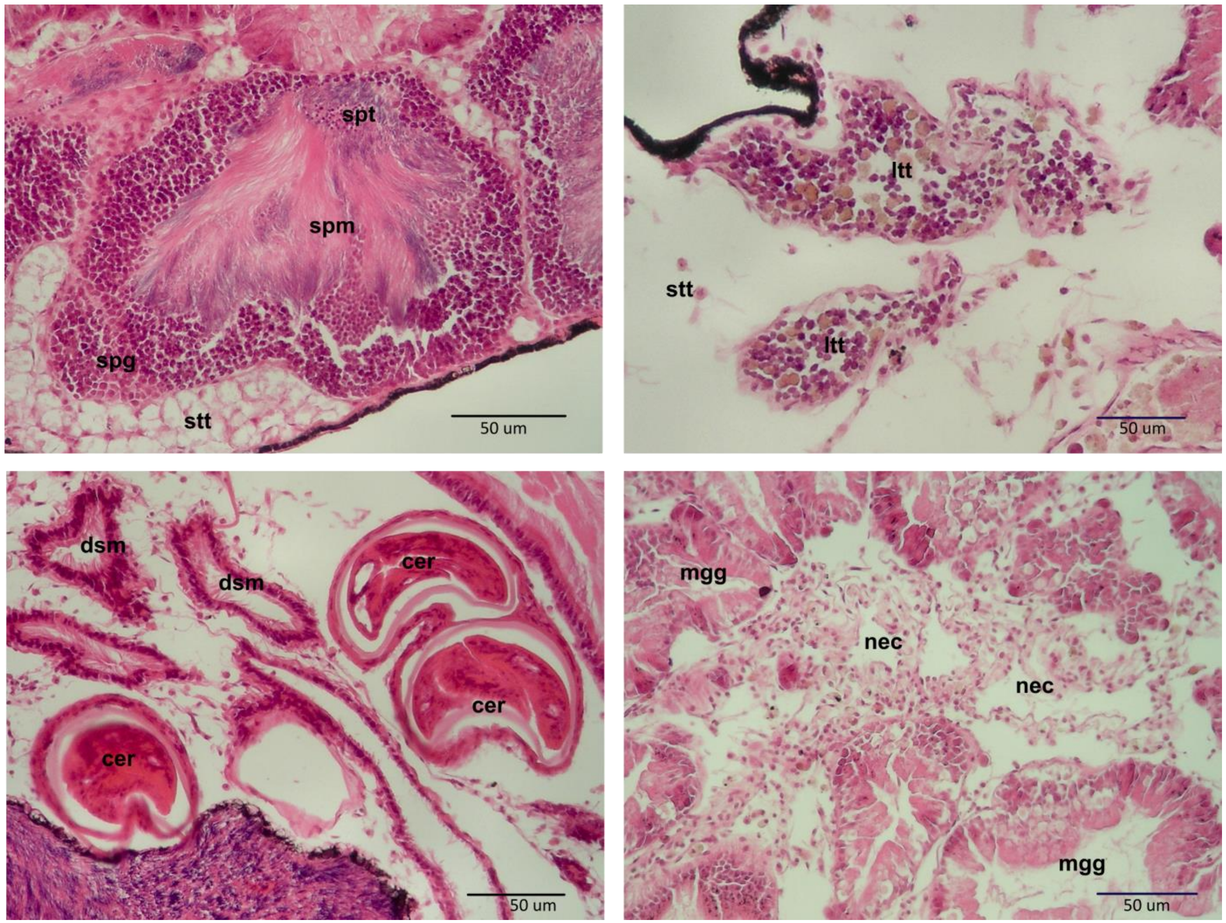


- 1 m depth, 2 months

Histopathological effects

Healthy gonads

Lysis of gonads

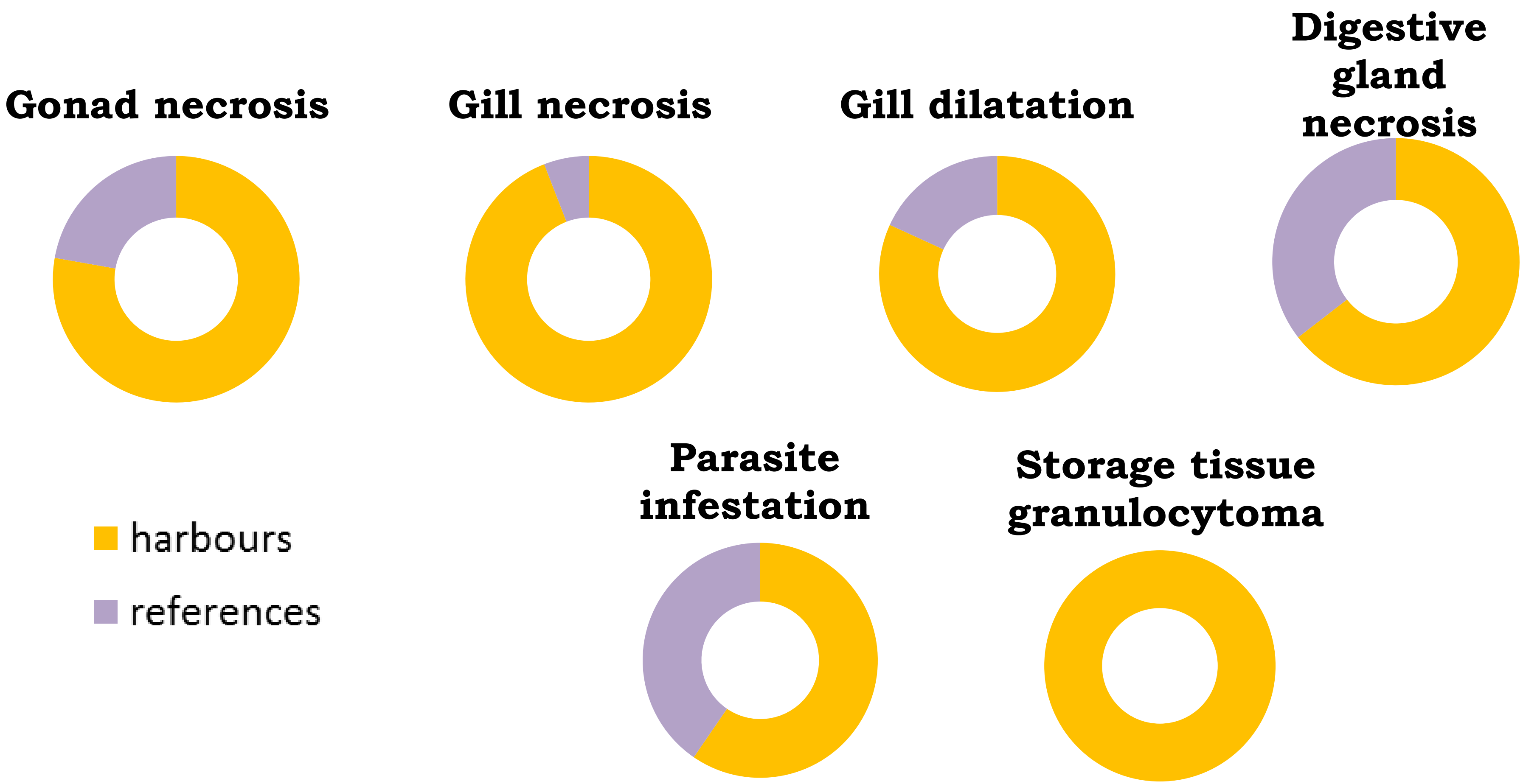


Parasites

Necrosis of digestive gland

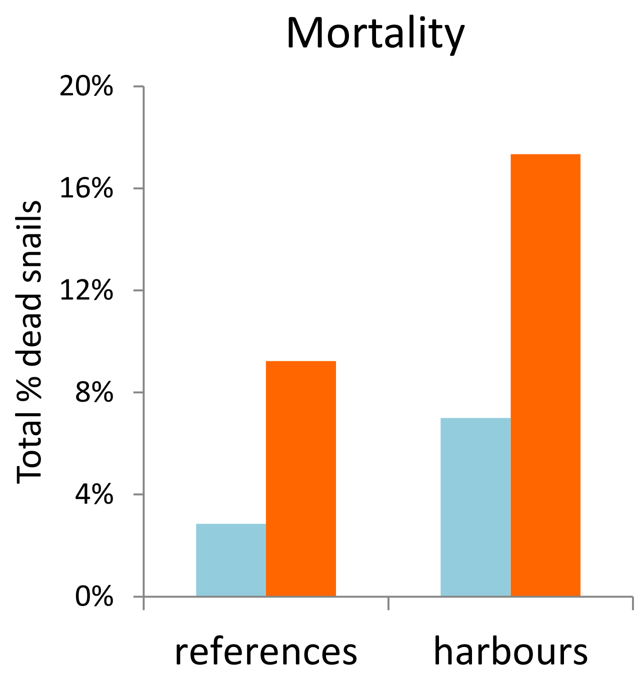
Photos: B. Watermann

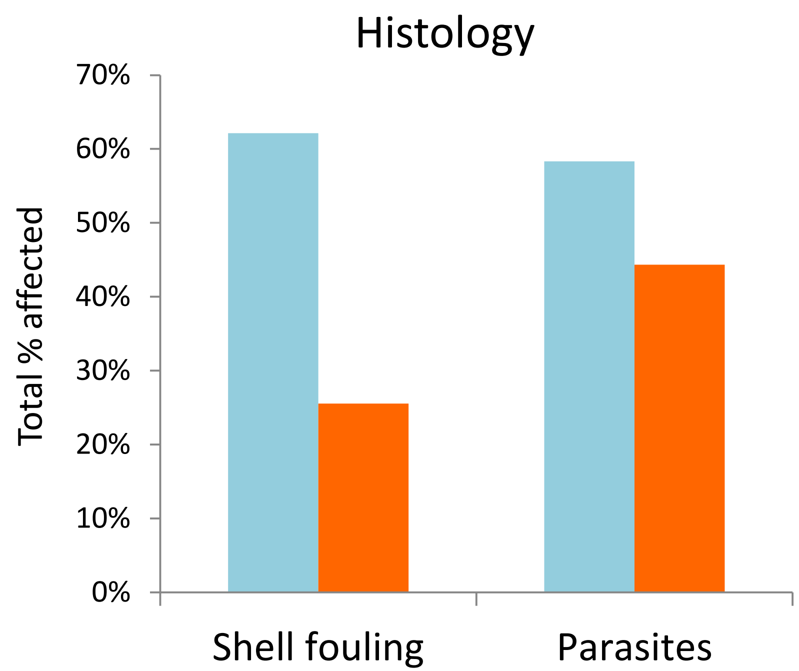
Histopathological effects



Cu and Zn were key explanatory variables.

Differences in tolerance





snails A (no exposure history)

snails B (pre-exposed)

No significant genetic differentiation

Based on sequencing of mtDNA, cytochrome c oxidase subunit I (COI).

Result: low genetic diversity *within* each group and no difference *between* groups.

→ other mechanisms might be involved in the increased tolerance of snails A to contaminant stress (phenotypic plasticity?)

Conclusions

- Metals accumulate in biofouling, which ends up on the soil in boat yards at the end of season;
- No evidence for the superior efficiency of Cu AF paints in the Baltic Sea;
- The use of AF paints is associated with chronic toxic effects on the non–target snail *T. fluviatilis:* increased mortality, reduced growth and fecundity and increased tissue pathologies.

Thank you for listening!

Stockholm University

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