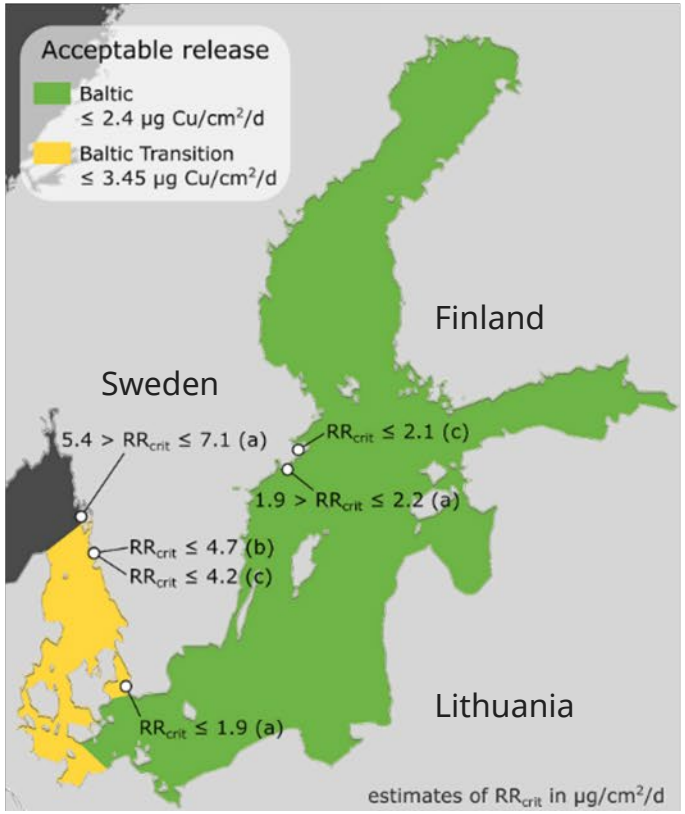
Field study of copper release rates and the risk assessment of antifoulings for pleasure crafts

IAC 2025 Gothenburg, Petter Andreassen

Jotun Protects Property

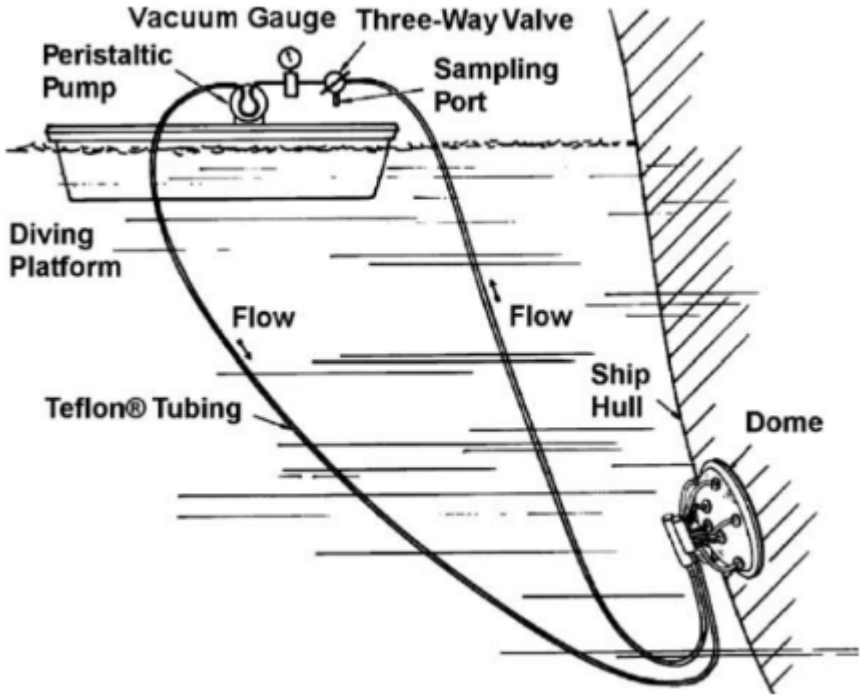
Environmental risk assessment of using antifouling paints on pleasure crafts in European Union waters

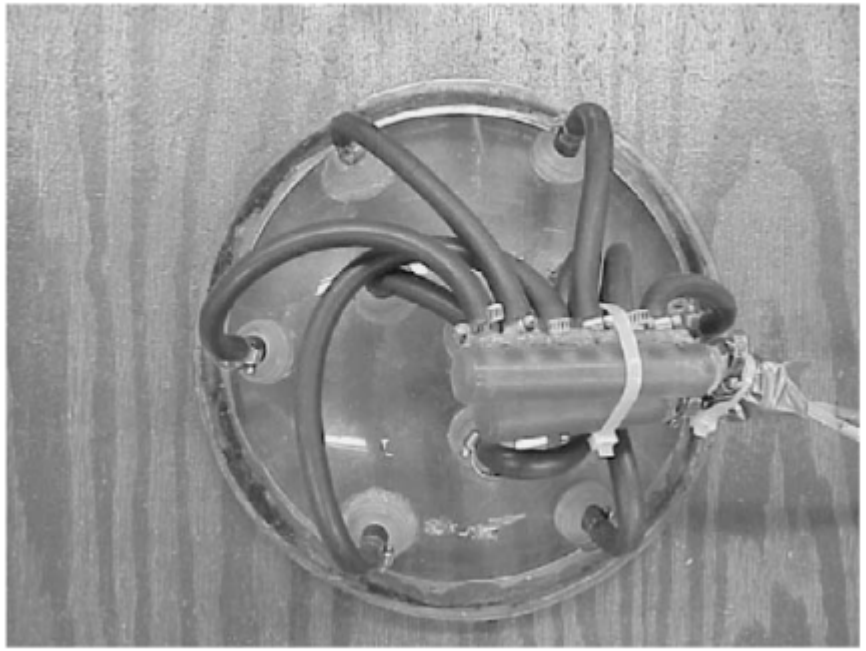
Erik Ytreberg [a,*], Maria Lagerström [a], Sofia Nöu [a], Ann-Kristin E. Wiklund [b]



Journal of Environmental Management
Volume 281, 1 March 2021, 111846

The Dome method

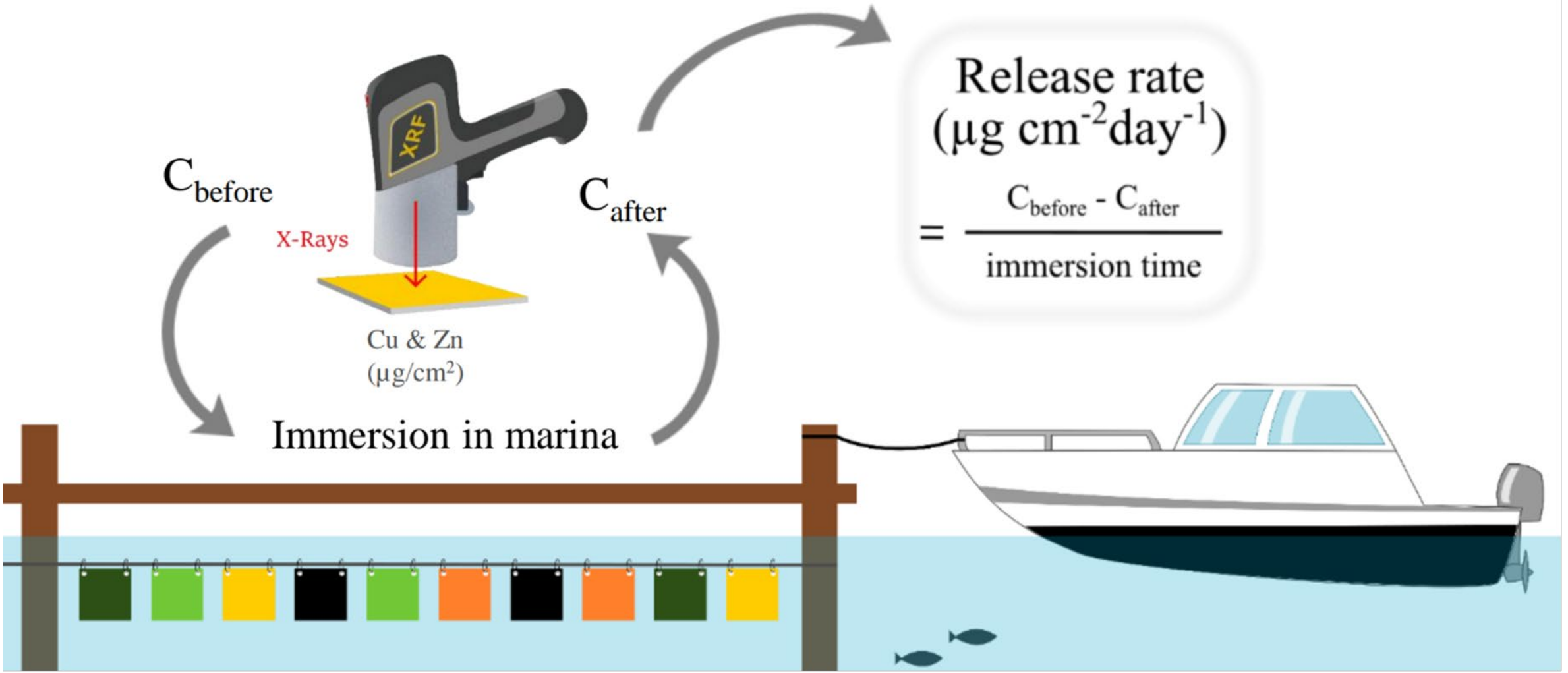




ISO 10890:2010

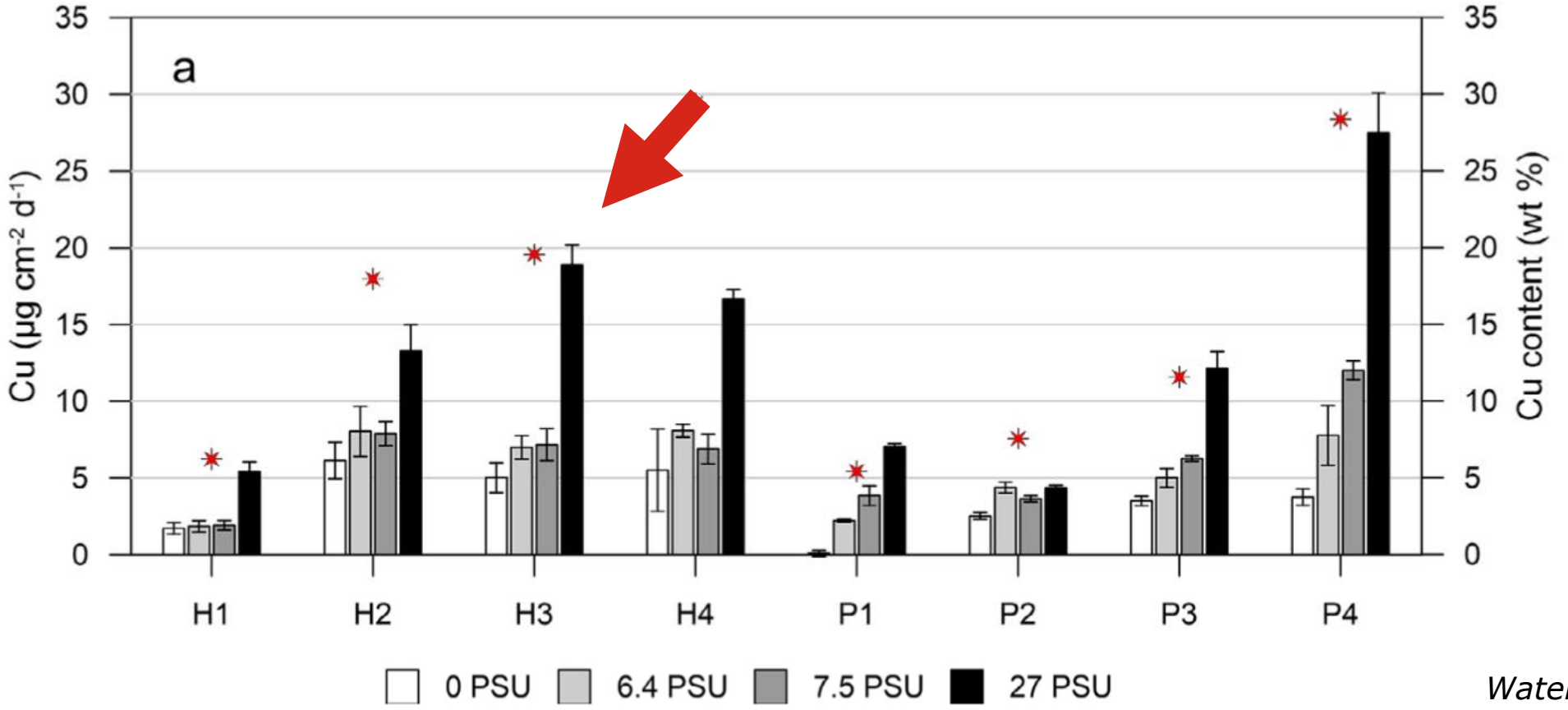
Paints and varnishes — Modelling of biocide release rate from antifouling paints by mass-balance calculation

- Gives a conservative estimate for the total release over the lifetime of the product
- The underlying principle is that a paint cannot release more biocide than was present in the paint when applied
- However, when a boat is moored, the ISO method will strongly overestimate the release rate, typically by approximately 3x versus the Dome method
- Finnie (2006) developed correction factors to improve the estimates of environmental copper release under mooring conditions



Source: Chalmers 2022

Antifouling paints leach copper in excess – study of metal release rates and efficacy along a salinity gradient



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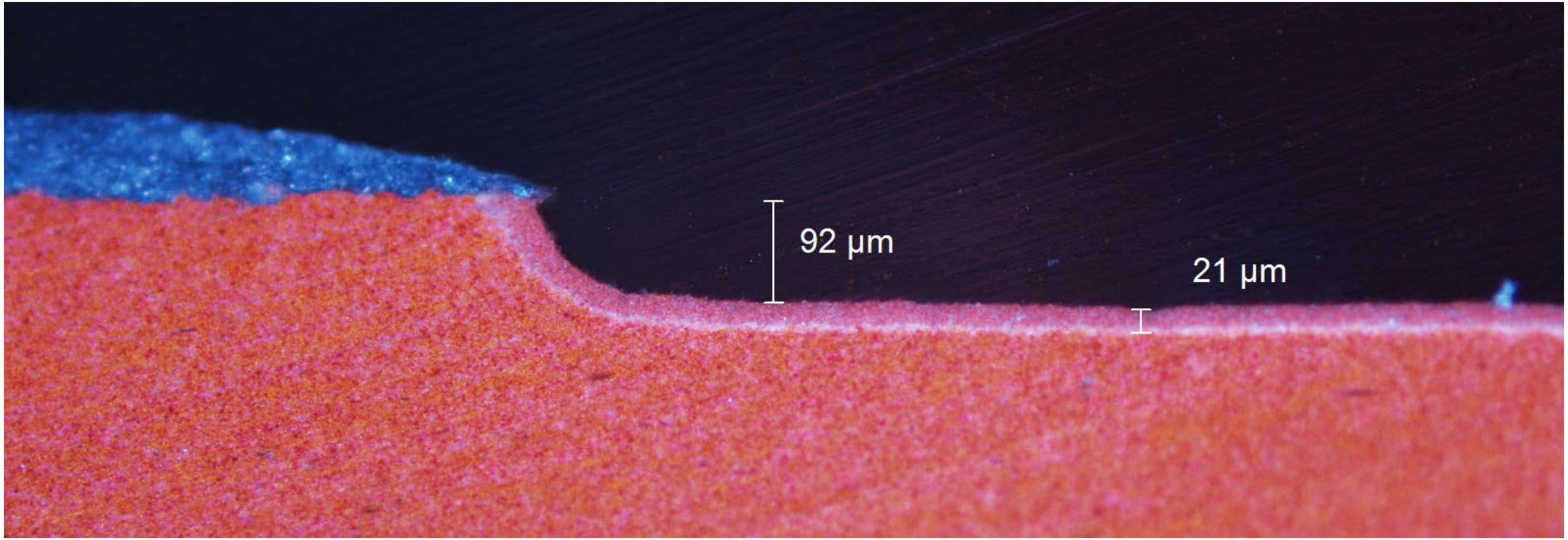
Conclusions from the XRF study

1. Antifouling paints are leaching copper in excess

2. The leaching rate is strongly influenced by the seawater salinity

3. The correction factor of 2.9 should not be used

Using Microscopy to measure the copper release rate



Conclusions from the Microscopy study

1. Antifouling paints are not leaching copper in excess

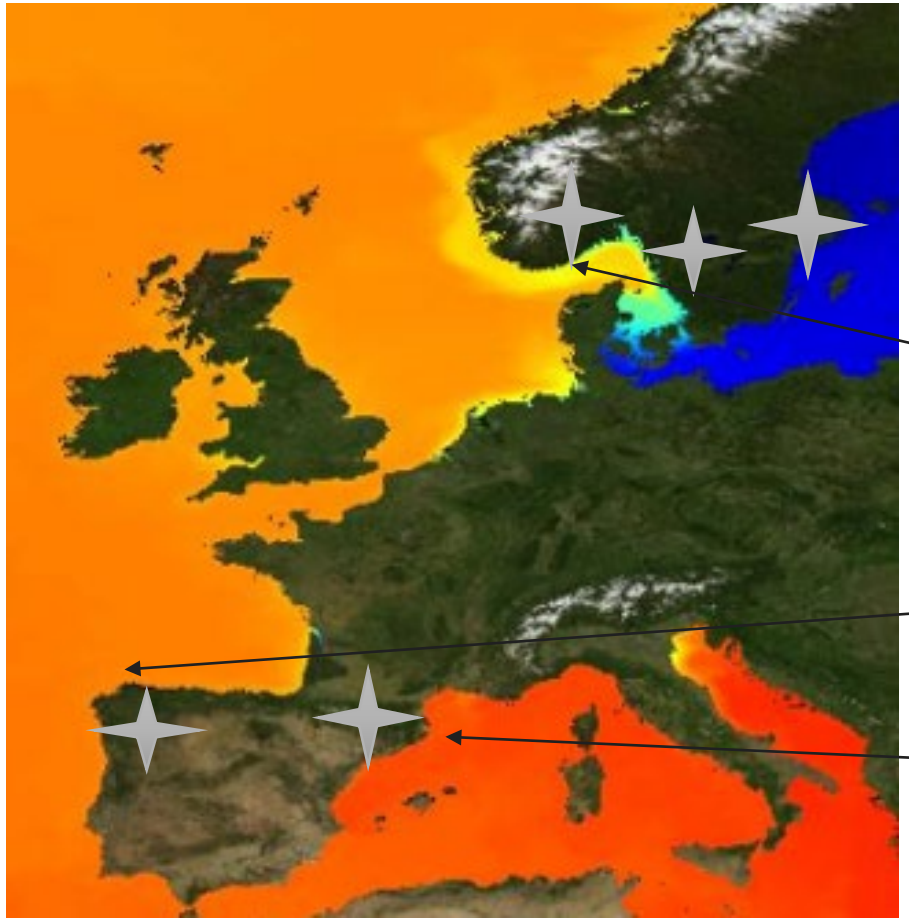
2. The leaching rate is not strongly influenced by the seawater salinity

3. The correction factor of 2.9 should ~~not~~ be used

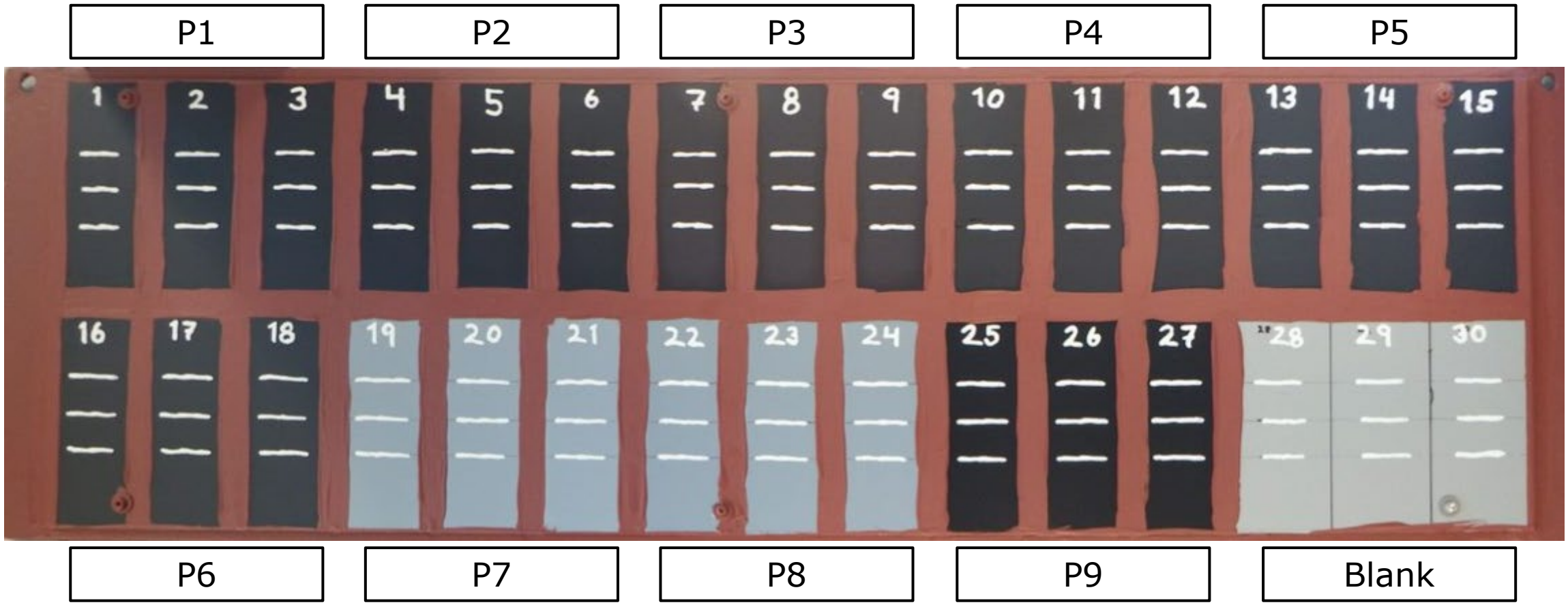
   The field test demonstrated that the leaching rate was approx. 1/3 when the boat was laying idle!

New field study – using both Microscopy and XRF

- 6 months study
- From April to October
- 9 products
- 5 marinas (4 to 38 ‰)

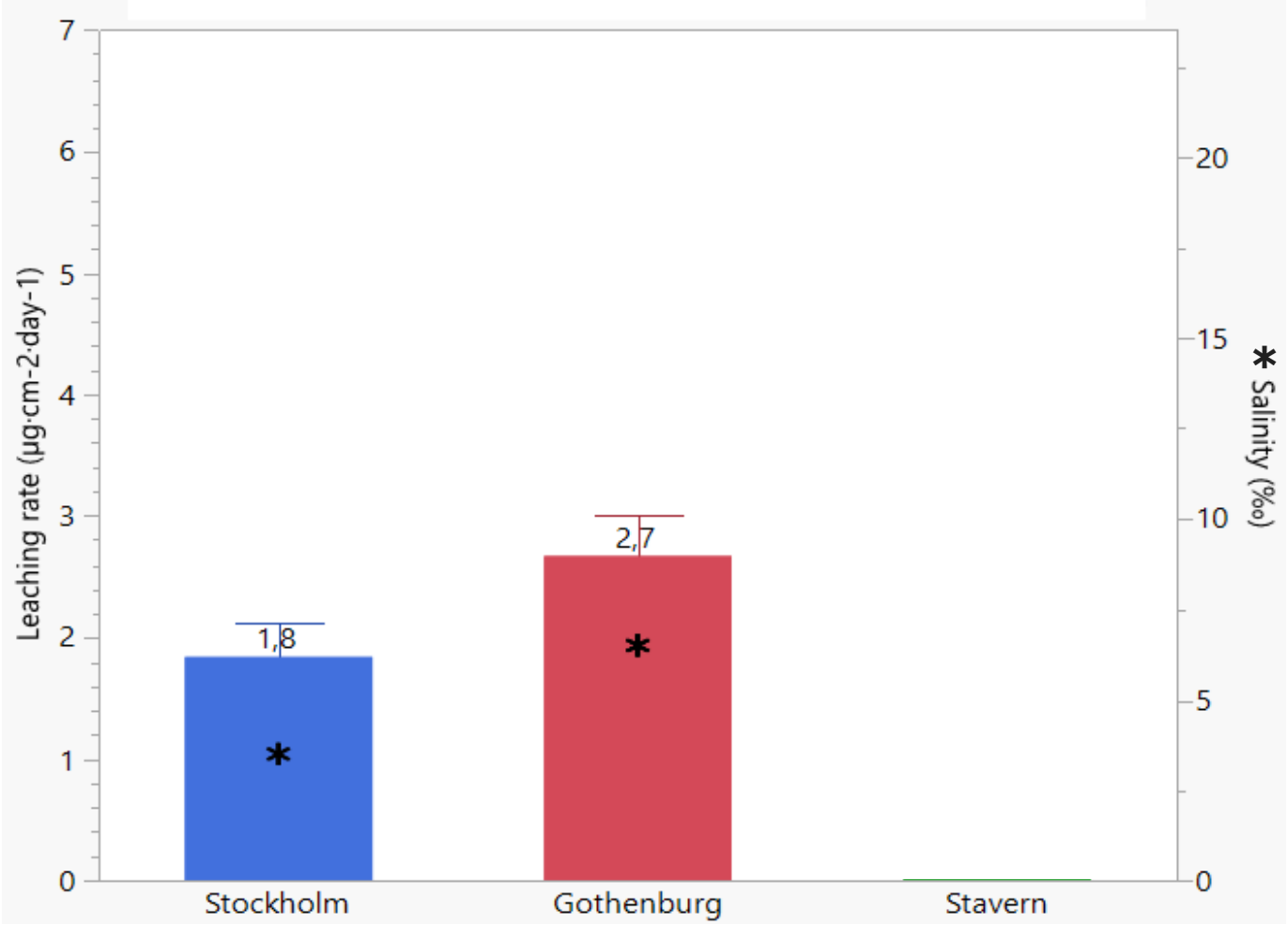


Test panel

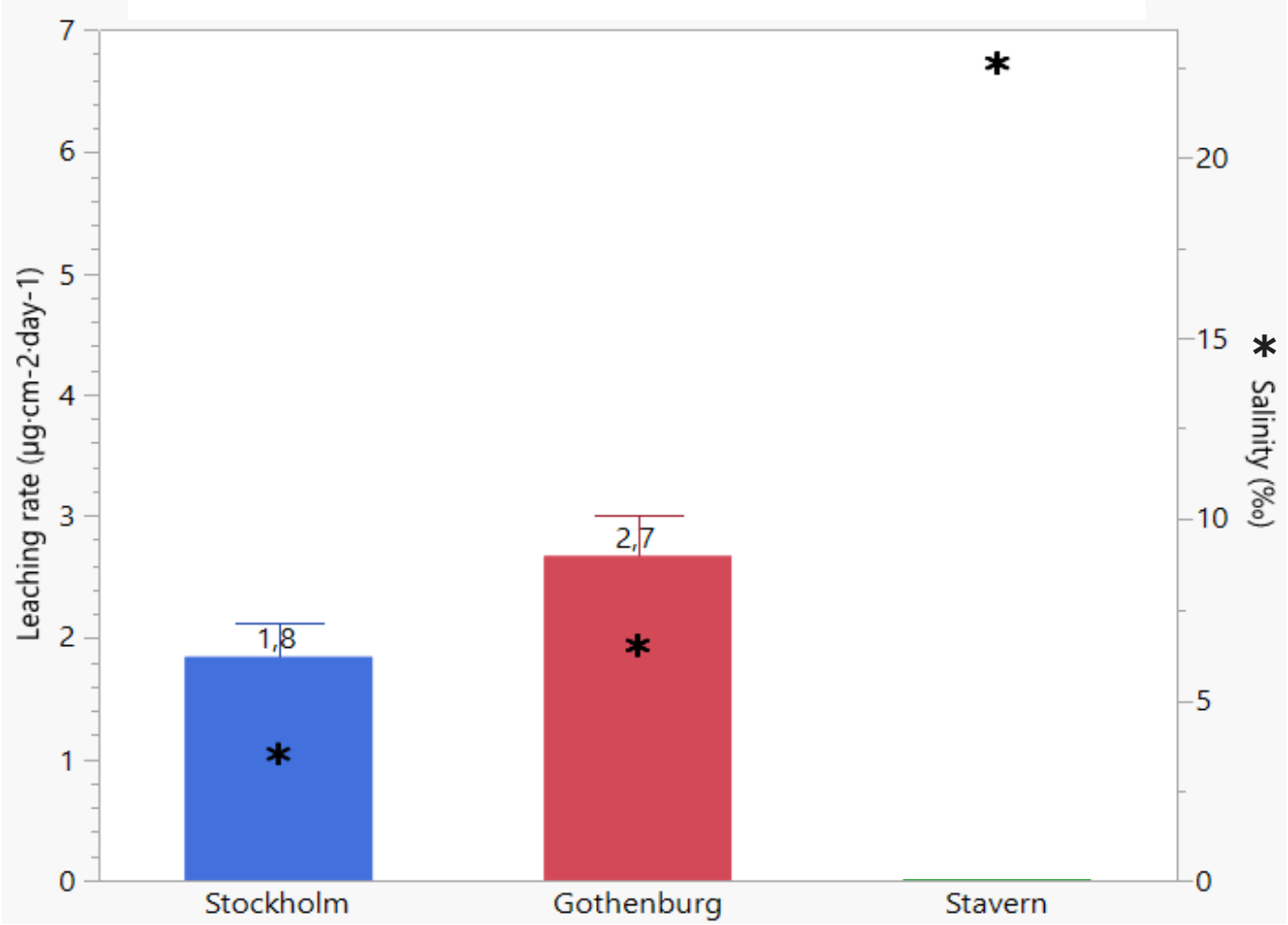

P1
P2
P3
P4
P5
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
P6
P7
P8
P9
Blank

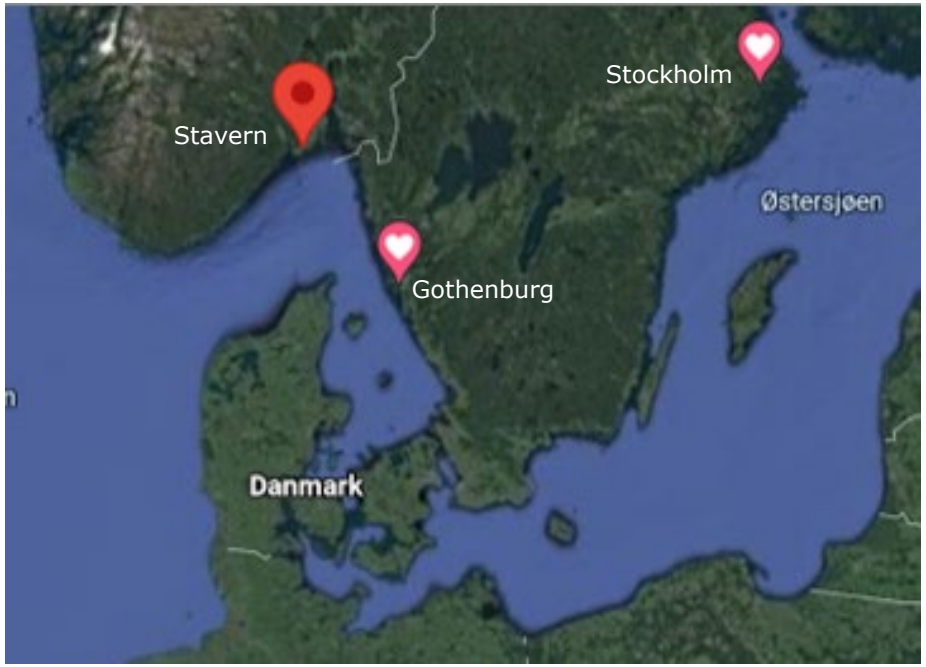
Copper release rate vs. salinity

Copper release rate vs. salinity

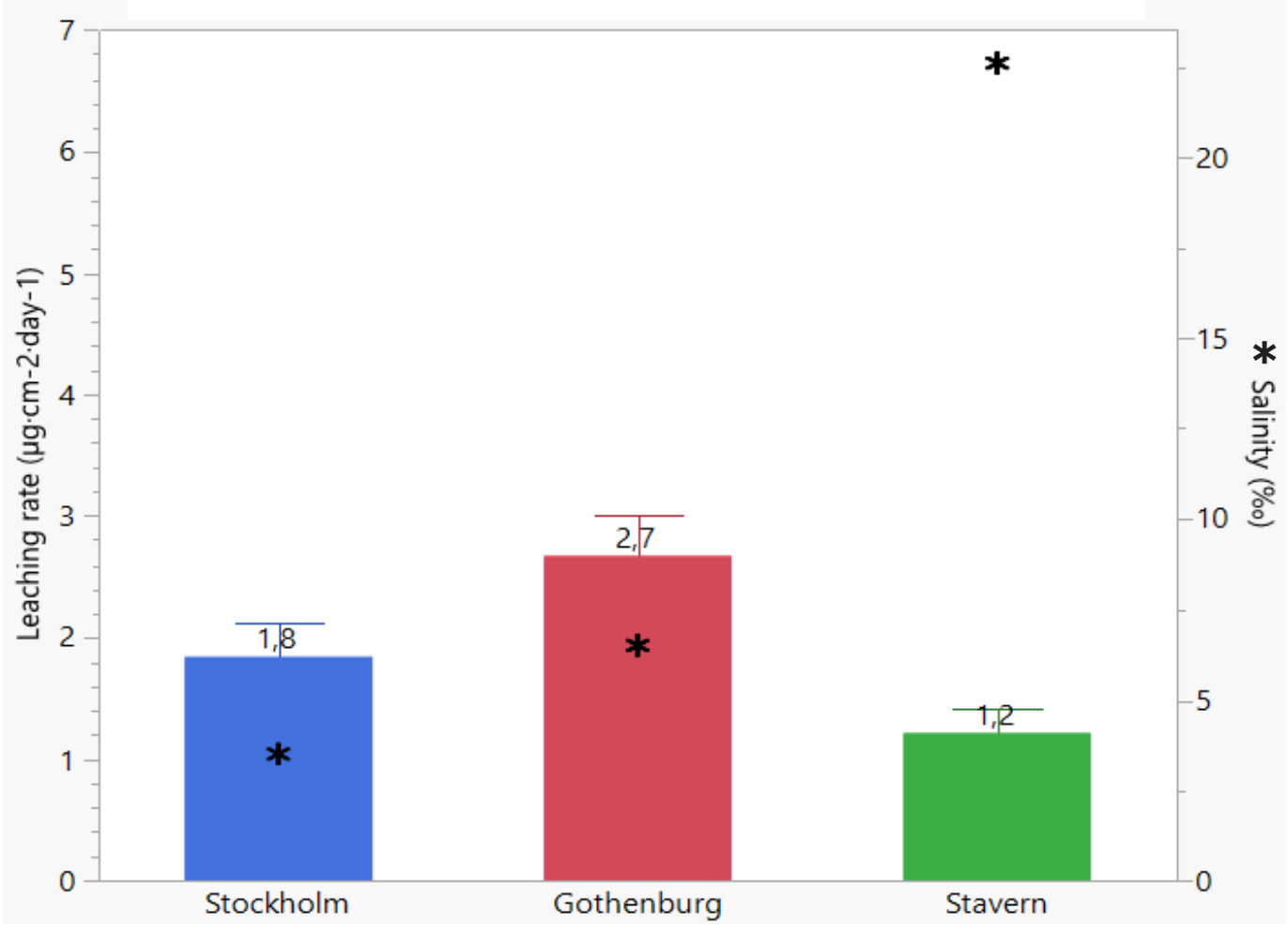


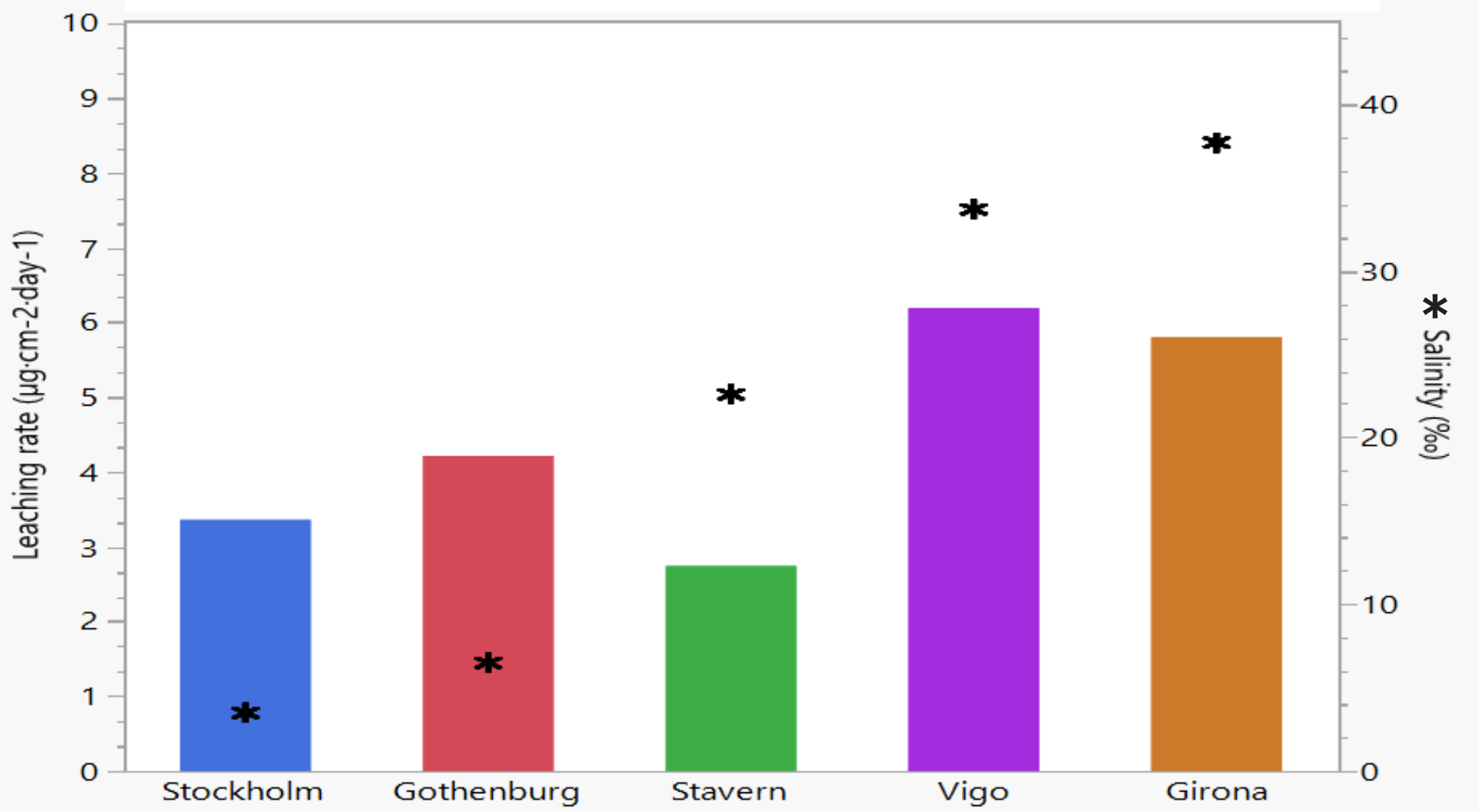
Copper release rate vs. salinity





Copper release rate vs. salinity



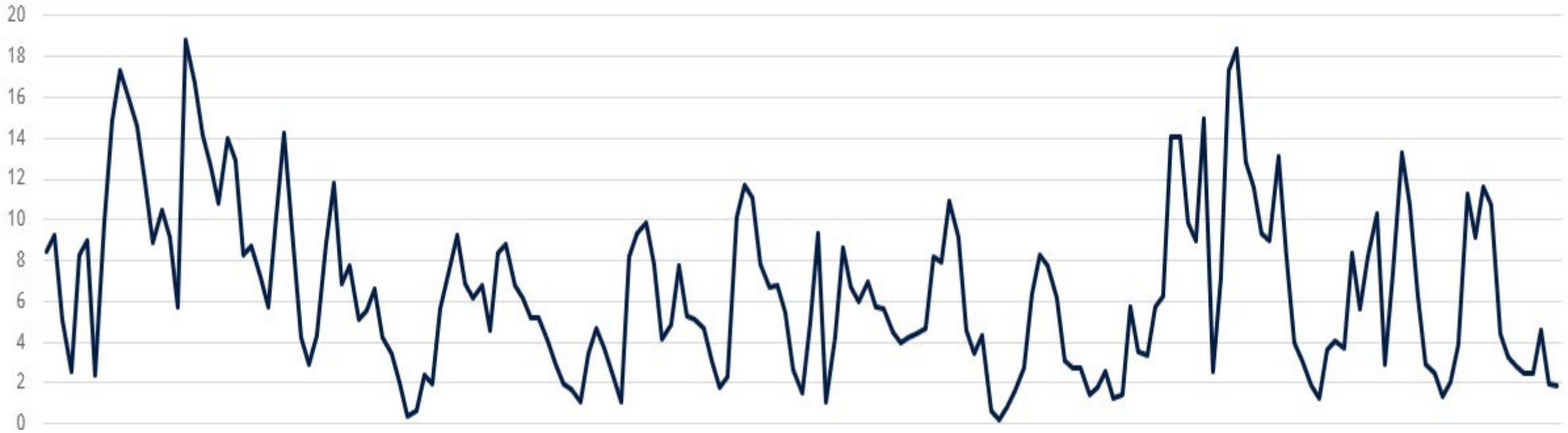

Leaching rate (µg·cm-2·day-1)
10
9
8
7
6
5
4
3
2
1
0
40
30
20
10
0
* Salinity (‰)
Stockholm
Gothenburg
Stavern
Vigo
Girona

Sjöstadens Varv, Gothenburg


Älvsborgsbron
Quality Hotel
Waterfront Göteborg
Nya Älvsborgs Fästning
River
outlet
Nya Varvet
Västra kyrkogårde
SE - Fredrikshamn, DK
Stora Billingen
Västerleden
Oscar II Fort
Midlertidig stengt
Käringberget
Torgny Segerstedtsgatan
Älvsborg
Hagen
Fågelvägen
Grimmereds
Långedrag
Sjöstadens Varv
AB - Volvo Penta
Svensk
JOTUN

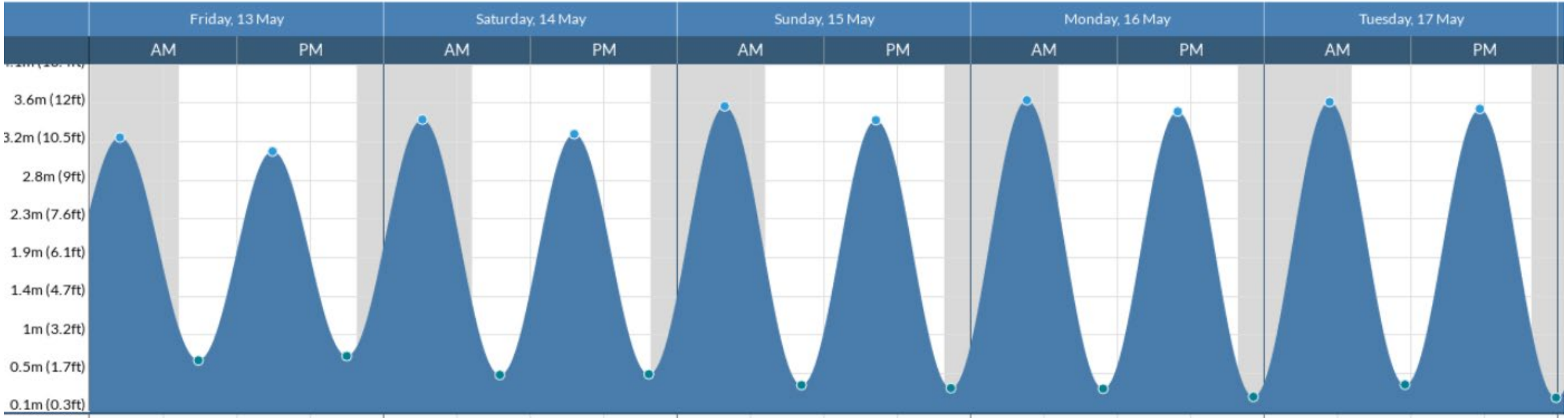
Salinity Gothenburg

Average	6.5
Max	18.8
Min	0.2



Yatesport Marina, Vigo

Vigo, Spain, Tide Times.



	Friday, 13 May				Saturday, 14 May				Sunday, 15 May				Monday, 16 May				Tuesday, 17 May			
	AM		PM		AM		PM		AM		PM		AM		PM		AM		PM	
HIGH (CEST)	2:26AM 3.25m (10.66ft)		2:55PM 3.09m (10.14ft)		3:10AM 3.46m (11.34ft)		3:35PM 3.29m (10.79ft)		3:53AM 3.61m (11.84ft)		4:15PM 3.45m (11.32ft)		4:36AM 3.68m (12.07ft)		4:56PM 3.55m (11.65ft)		5:21AM 3.66m (12.01ft)		5:38PM 3.58m (11.75ft)	
LOW (CEST)		8:51AM 0.68m (2.23ft)		8:59PM 0.73m (2.4ft)		9:30AM 0.51m (1.68ft)		9:41PM 0.52m (1.71ft)		10:10AM 0.40m (1.3ft)		10:23PM 0.36m (1.18ft)		10:50AM 0.35m (1.16ft)		11:07PM 0.26m (0.85ft)		11:31AM 0.40m (1.31ft)		11:52PM 0.25m (0.82ft)

The Stavern marina was the only sheltered marina

Stavern marina. A model marina under EU-BPR.

UNIVERSITY OF GOTHENBURG

DEPARTMENT OF MARINE SCIENCES

JOTUN

RELEASE OF COPPER FROM ANTIFOULING PAINTS EXPOSED IN EUROPEAN WATERS

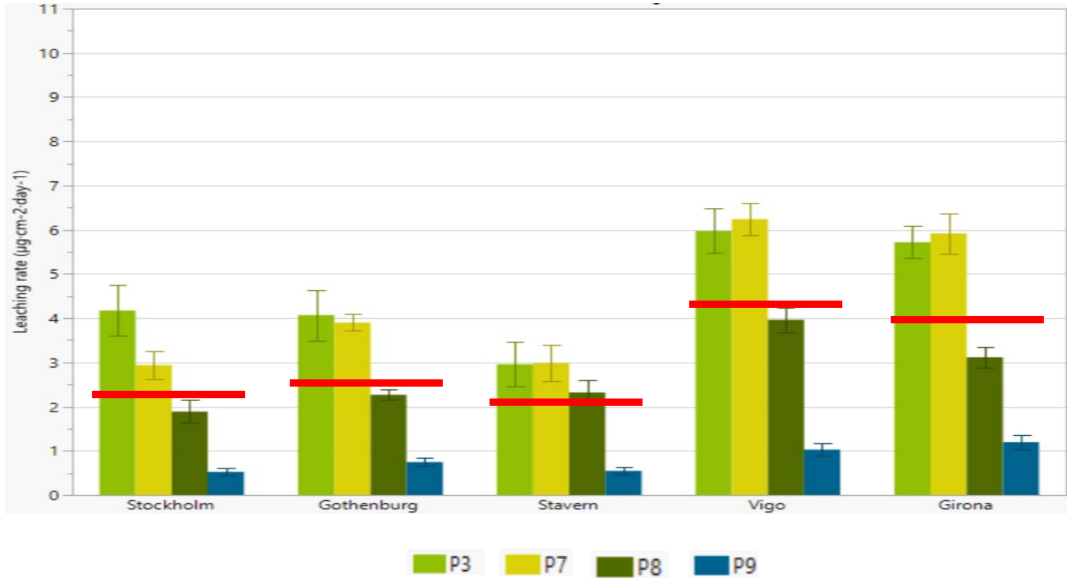
Author: Emma Rova

Only 4 of the 9 products were possible to measure with XRF

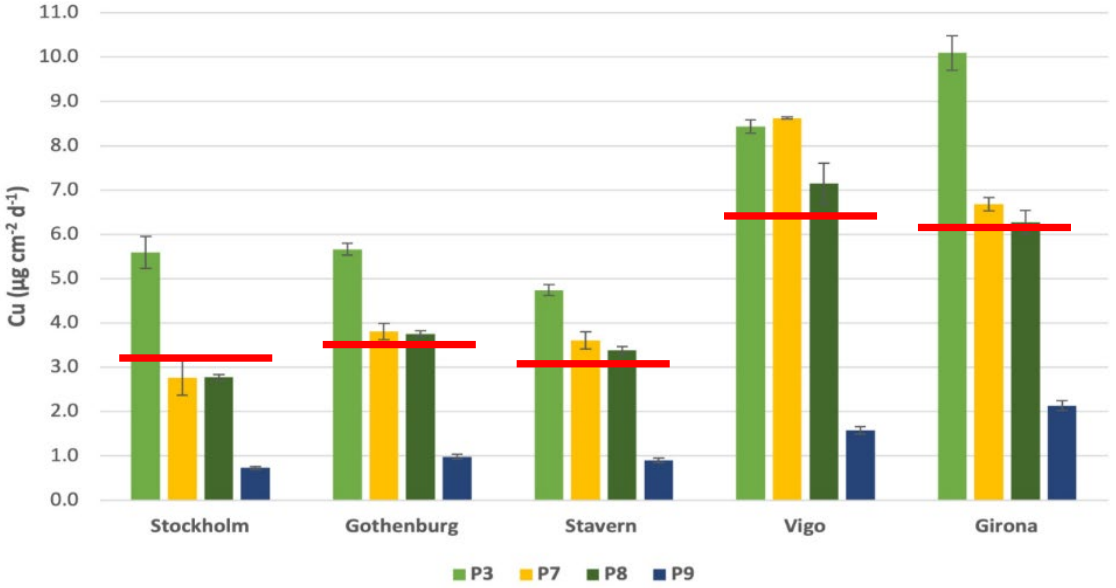
Figure 12: Full picture of panel retrieved from Stockholm site. Red boxes indicate the analysed paints in this study.

Similar results and conclusions

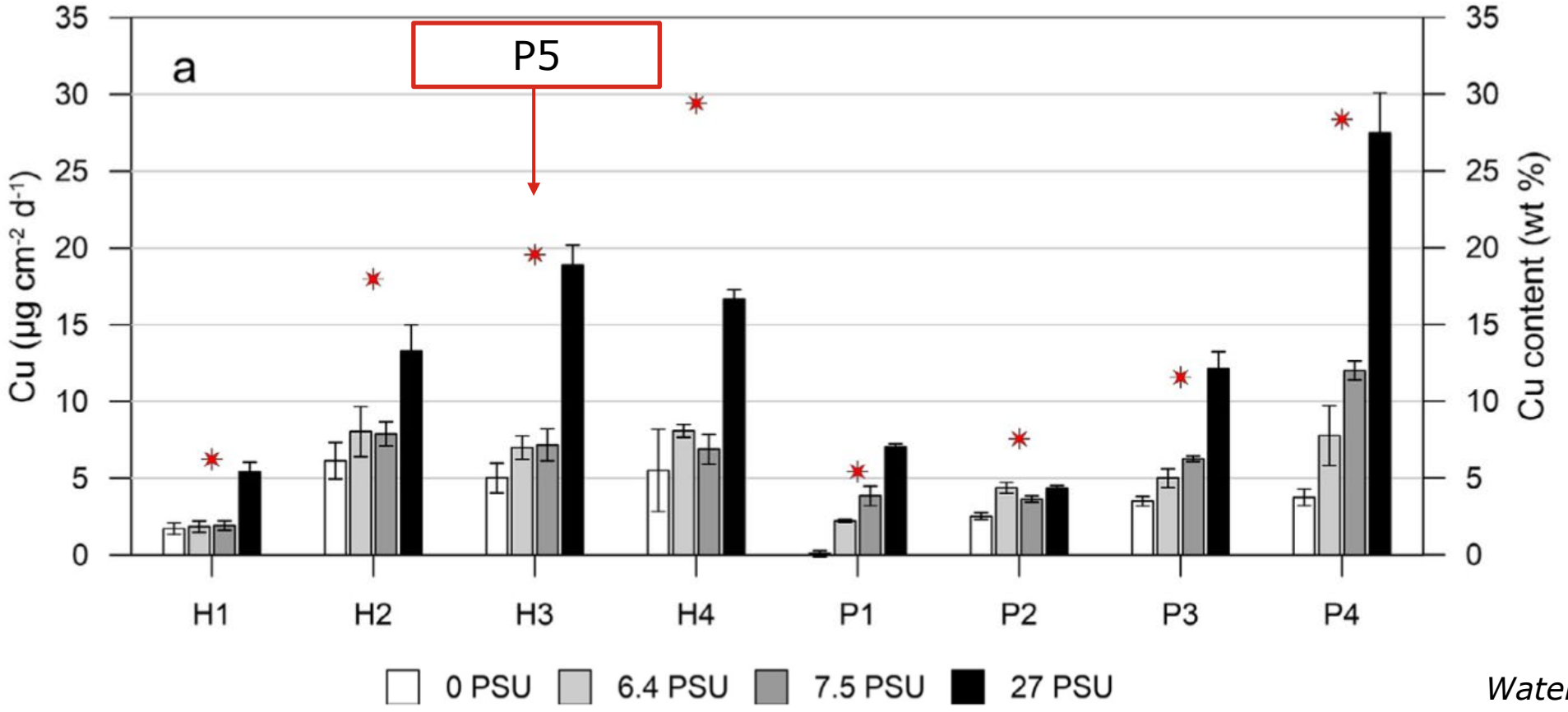
Microscopy



XRF



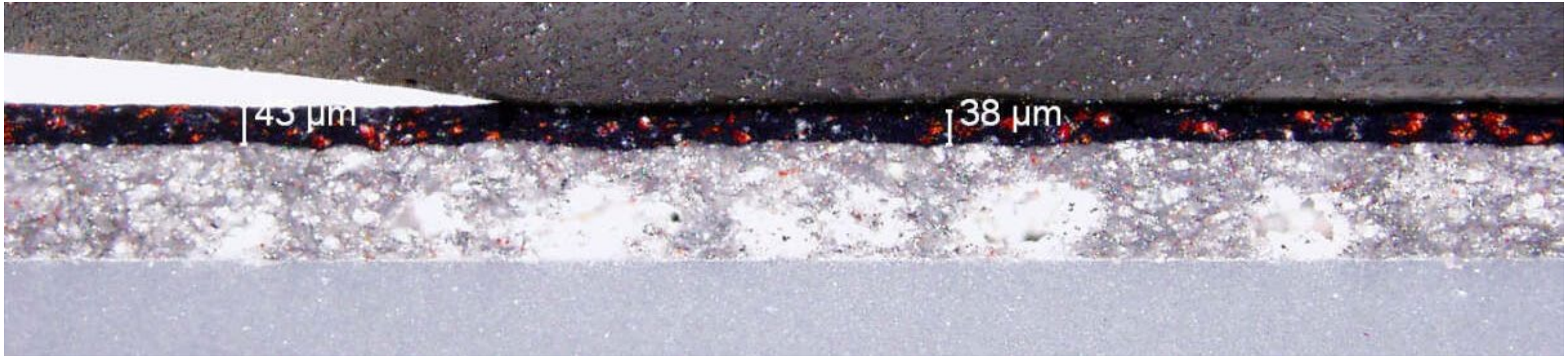
Antifouling paints leach copper in excess – study of metal release rates and efficacy along a salinity gradient



P5 would be exhausted with copper in 3 months with this leaching rate!

Water Research, 186, 2020

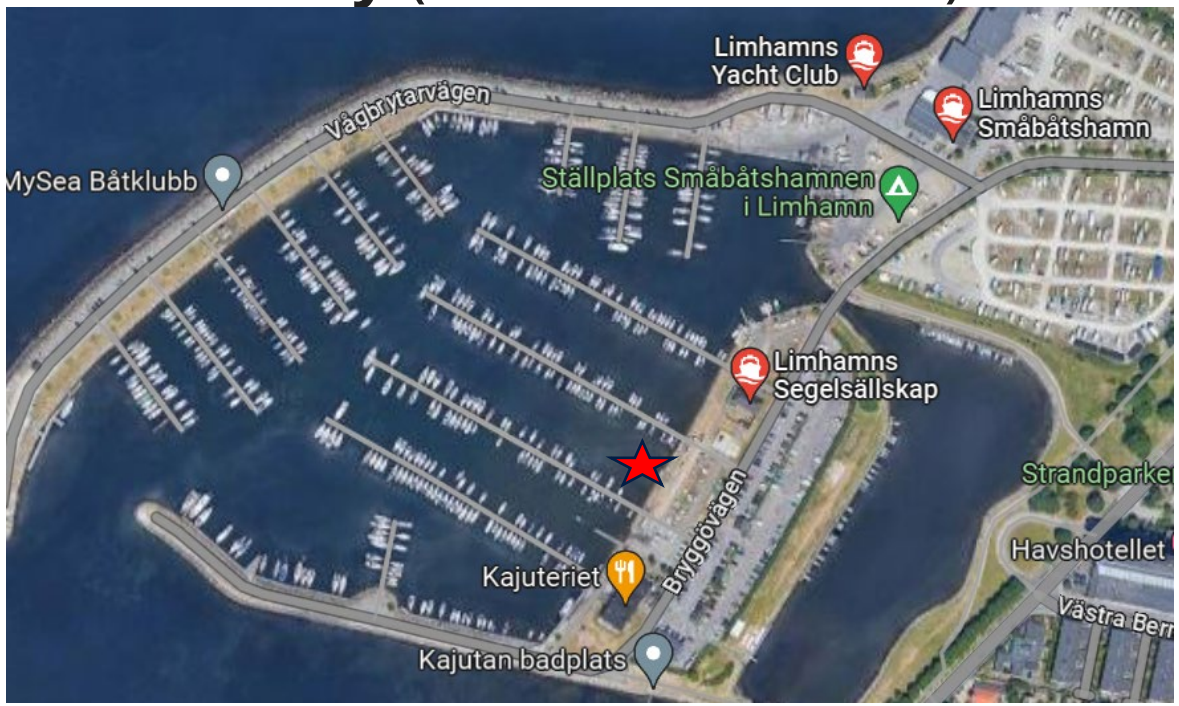
P5 after 6 months immersion in Gothenburg



The paint film is <u>not</u> exhausted with copper!

Not only the salinity that differed between the test sites

Low salinity (sheltered marina)



High salinity (raft in a sound)

The high salinity test site in the XRF study had much higher seawater flow!

Environmental risk assessment

Tier 1

Mass balance calculation based on ISO 10890

Tier 2

Site specific and product specific copper release rate measurements inside sheltered marinas

Baltic Transition scenario

Product P5	PEC:PNEC Seawater Inside marina	PEC:PNEC Sediments Inside marina	
Tier 1 - ISO 10890	1.00	1.52	X
Tier 2 - Field test in Gothenburg	0.61	0.61	√

Baltic scenario

Product P9	PEC:PNEC SW Inside marina	PEC:PNEC SUSP Inside marina	
Tier 1 - ISO 10890	1.00	1.52	X
Tier 2 - Field test in Stockholm	0.61	0.61	√

Conclusions

1. The copper release is slower when the boat is laying idle inside a sheltered marina

2. The salinity does not have a great impact on the release rate

3. The Environmental risk assessment should take product and site specific field tests into account

Acknowledgements

Tonje Nordby
Co-author

Dag Størkersen
Measurements

Kjartan Boman
Statistics

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