



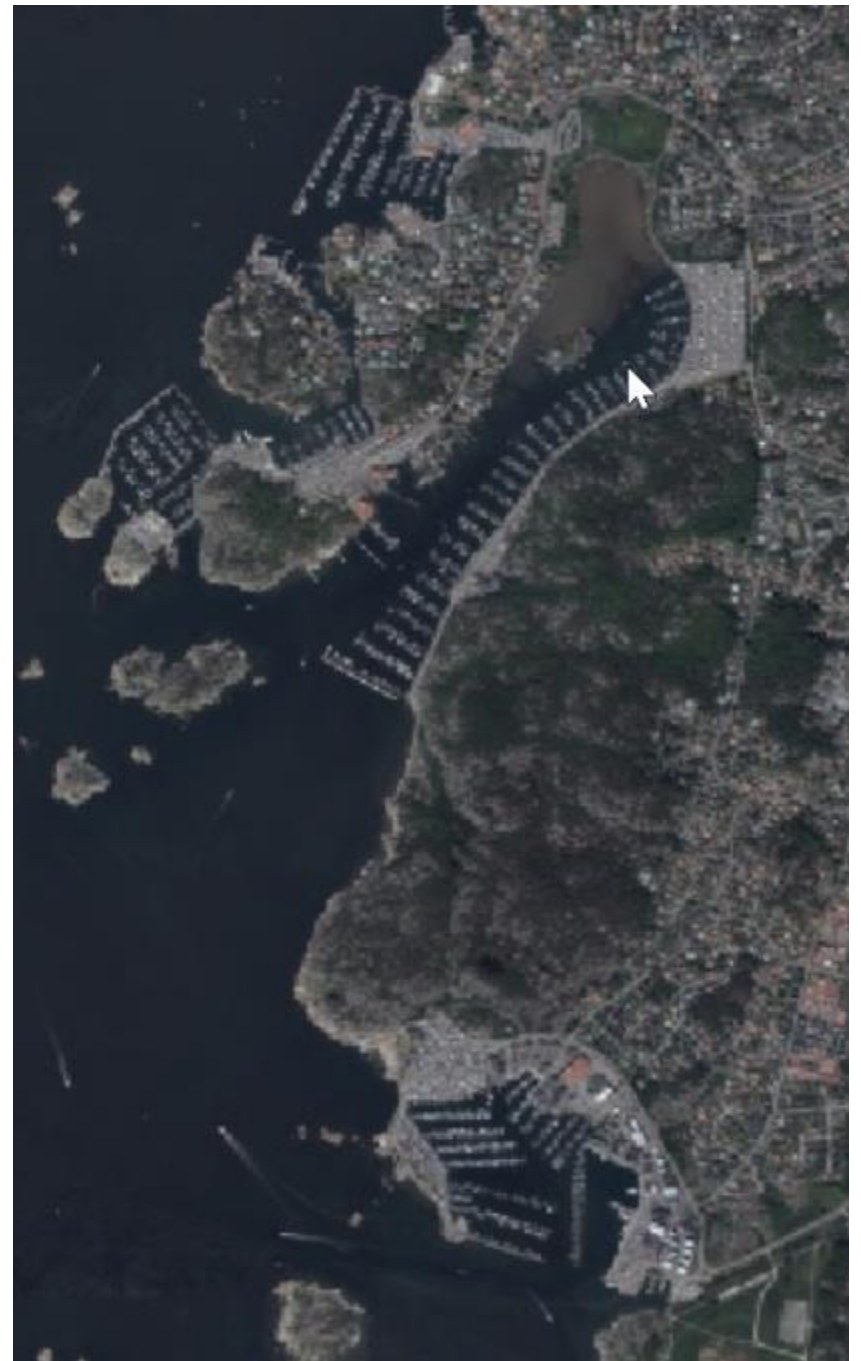
THE CURRENT SITUATION WITH TRIBUTYLTIN IN SWEDEN

– CONTAMINATION SITUATION,
SOURCES, TRANSPORT PATHWAYS AND
ONGOING RESEARCH

Tobias Porsbring, PhD

BOATING IN SWEDEN

- Approximately 700,000 leisure boats and 2654 marinas
- Marinas are often situated on shallow soft bottom bays causing pollution of habitats that are intrinsically ecologically important and sensitive



TRIBUTYL TIN

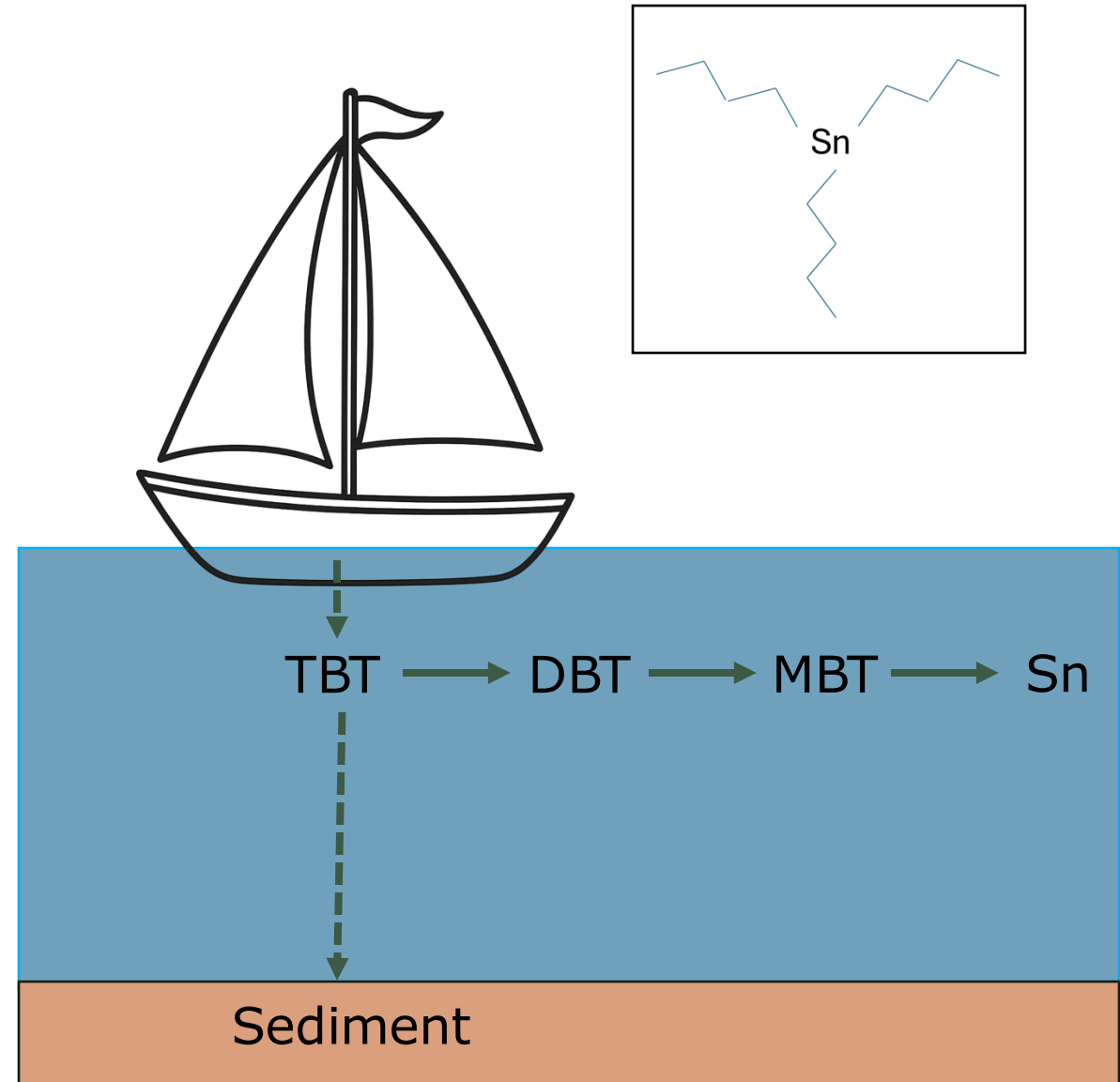
- Used as antifouling agent since the 1960's
- Following concerns about large-scale contamination and impacts on the marine environment, its use as an antifouling agent has been restricted nationally/EU (1989), and banned globally (2008)



Photo: Henrik Bengtsson

FATE

- Leached TBT from antifouling paints degrades to DBT – MBT – Tin
- High affinity to particles -> sediment
- Can be very persistent in sediment, especially under anoxic conditions (half life months to years)



SITUATION IN SEDIMENTS NEAR MARINAS AND OTHER MARITIME POINT SOURCES

- A nation-wide survey was conducted in 2020-2022, aiming to improve the knowledge on the occurrence of contaminated sediments in relation to different types of recipients and pressures from industries and human activities



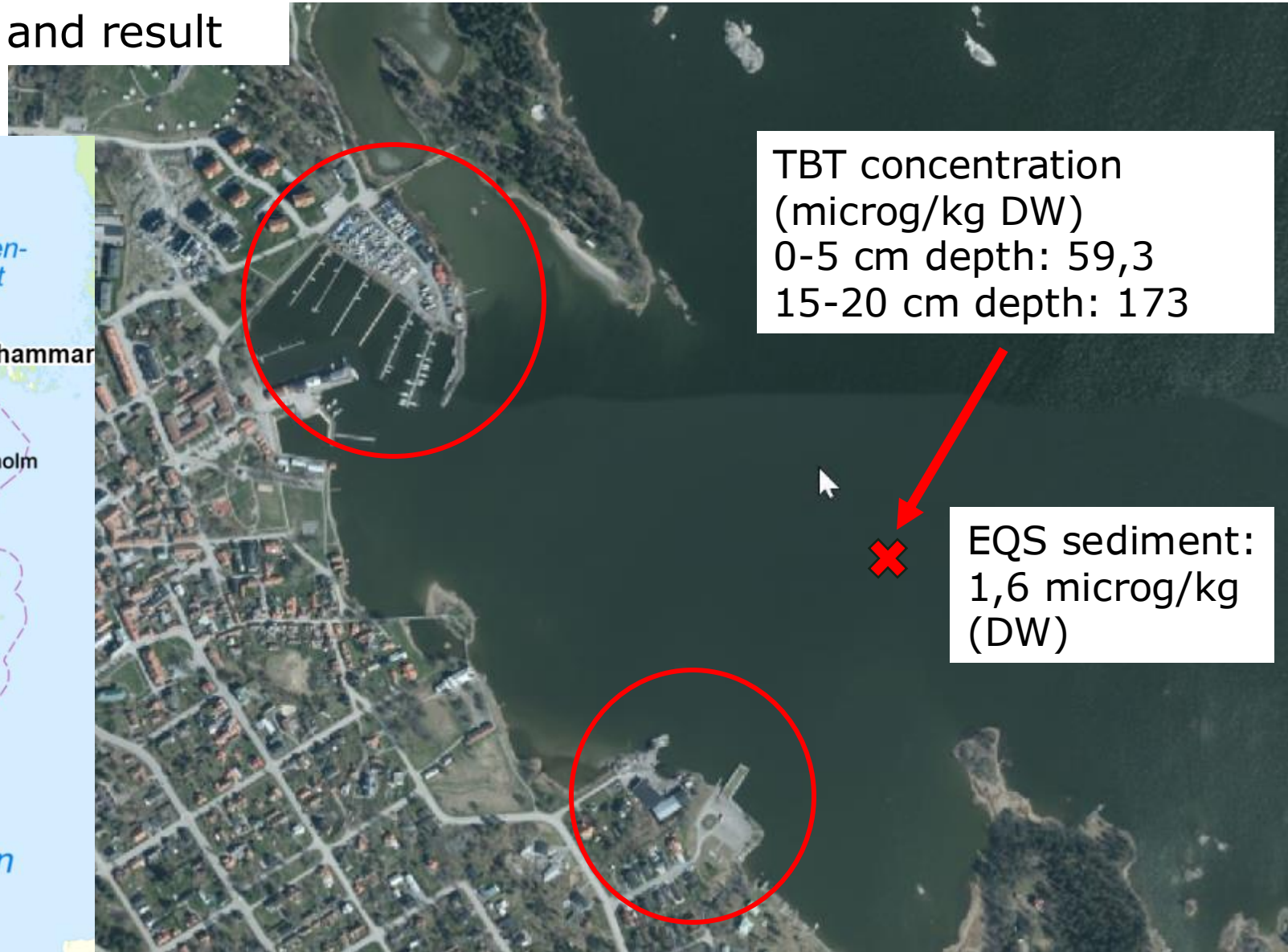
71 areas

*Surface (0-5 cm) and
deeper (15-20 cm)
sediment were sampled*

*Total of 176 samples were
analysed for a wide range
of organic and inorganic
pollutants*



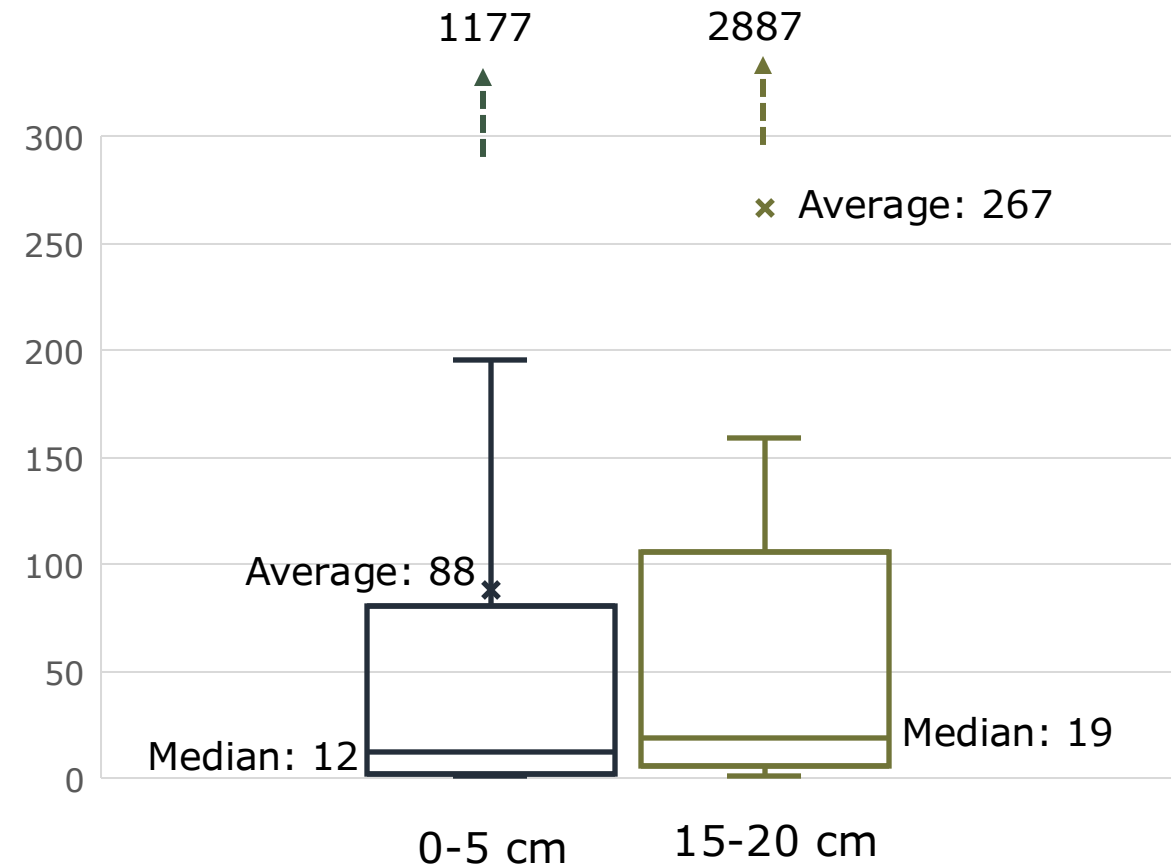
Example of survey area and result



In the 22 areas with maritime point-sources investigated in the nation-wide survey:

- More recently deposited surface sediment is usually cleaner (but not clean)
- Concentrations within the bioturbation zone are often >>EQS (1,6 microg/kg (DW) at 5% TOC)

Max detected TBT hazard quotient per area in surface and deeper sediment



EMISSIONS ON LAND AS ANTIFOULING PAINT PARTICLES (APP)

- APP:s – Particles from antifouling paints consisting of plastic polymer with embedded biocide
- Released during maintenance work, especially abrasion



BOAT STORAGE SITES CONTAMINATED WITH APP:S

- In Sweden many boats are stored on land off-season, on non-hardened (gravel) surfaces or sometimes asphalt
- Due to historic and ongoing maintenance work these sites are often severely contaminated with TBT and other biocides (Cu, Zn, Irgarol)
- Several potential transport pathways to usually nearby aquatic recipients



THE "MAST" PROJECT - FIELD TESTING METHODS TO REDUCE EMISSIONS FROM CONTAMINATED SOIL AT BOAT STORAGE SITES

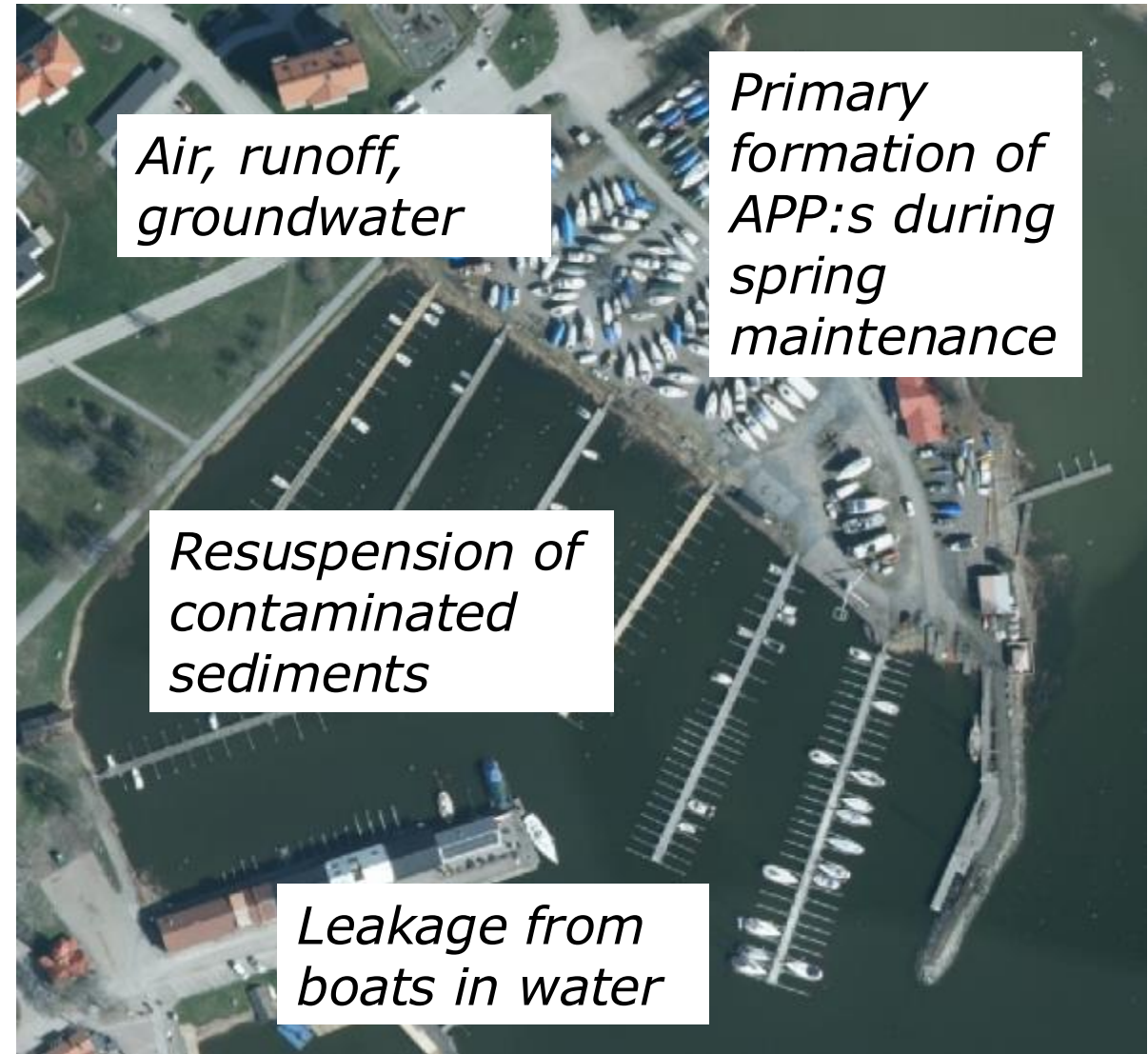
- Low-cost methods that can be applied in-situ:
 - Oxidation
 - Adsorption
 - Solidification
 - Clean new surface layer
- Aim to also reduce costs for waste management
- Runs 2025-2029 in 4 marinas



INVESTIGATIONS OF SOURCES AND TRANSPORT PATHWAYS TO WATER AND SEDIMENT

- Aim to assess emissions from boat storage sites, in relation to other sources and transport pathways
- Measurements in:
 - Seawater
 - Groundwater
 - Surface runoff
 - Air and deposition
 - Sediment
 - Sediment traps

Sources and transport pathways



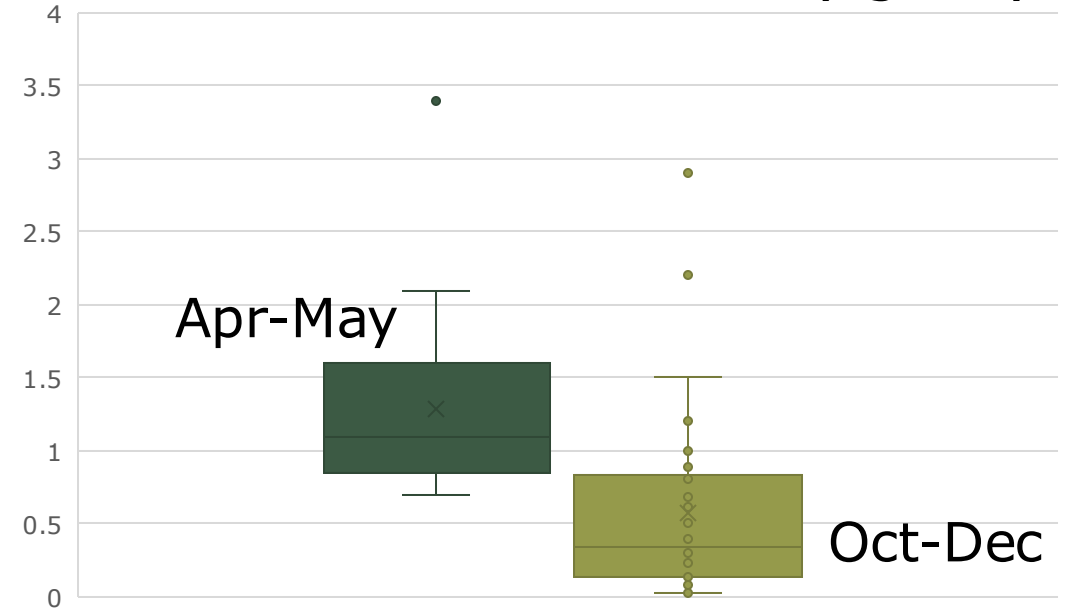
Example of site with air and deposition measurements



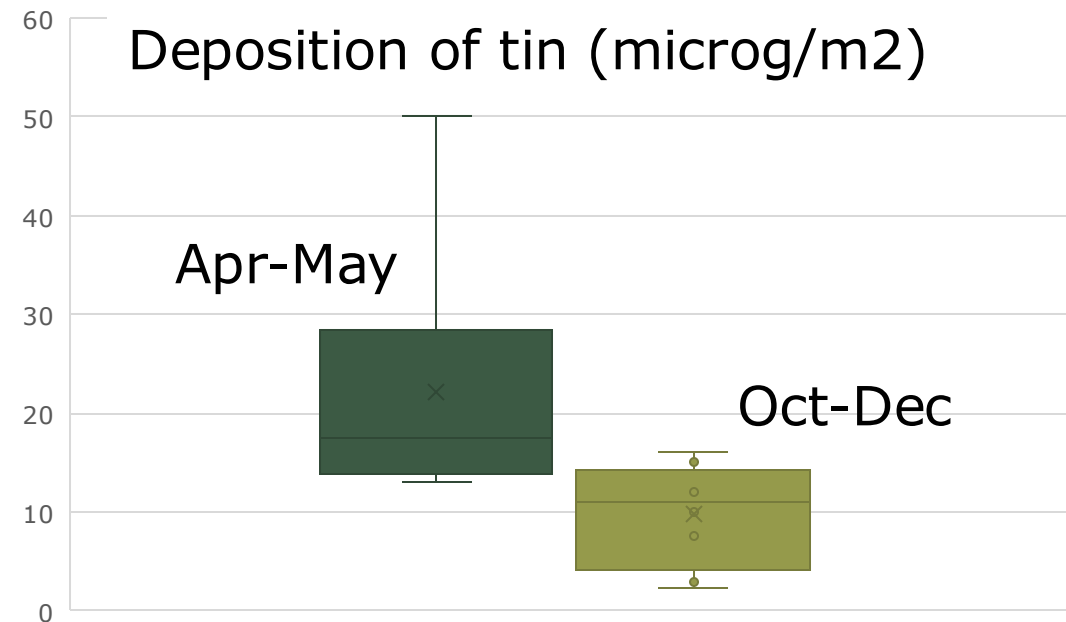
EMISSIONS OF TBT- CONTAINING DUST TO AIR IS HIGHEST DURING SPRING

- Generally higher activity on-site and dry weather leads to higher dust formation in spring
- Deposition in vicinity of site during on month alone in spring is enough to contaminate 0,5 cm of sediment to >>EQS
- Secondary emissions from land via wind erosion still occur off-season - in total same amount as in spring alone

Concentration of tin in air (ng/m³)



Deposition of tin (microg/m²)



PRIMARY (NEW) EMISSIONS ARE SUBSTANTIAL AND CAN BE TRANSPORTED VIA SURFACE RUNOFF

- After spring season, 150-500 grams of particles were collected per drain, with concentrations of up to 100 mg/kg TBT
- *Assuming 50 mg of TBT per drain this alone is enough to contaminate the top 0,5 cm of roughly 4000 m² sediment to the EQS (1,6 microg/kg)*

Photo: Ultika Almqvist

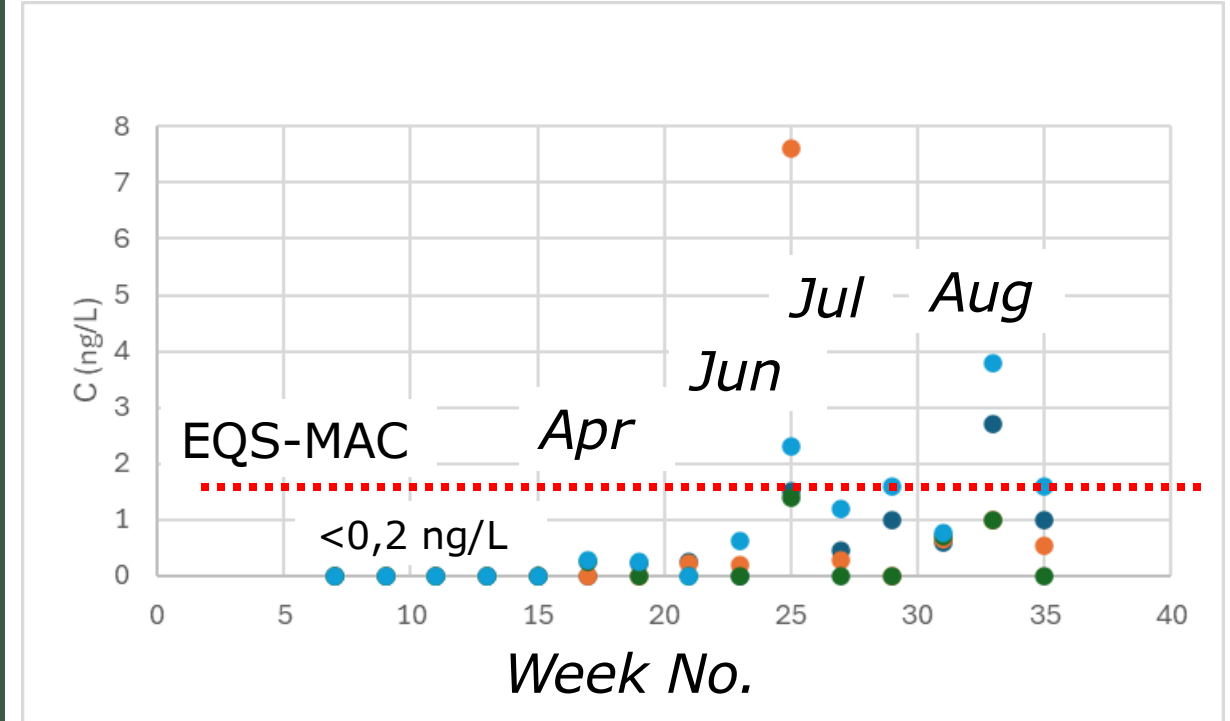
Particle filters
are installed in
storm water
drains in two
marinas with
hardened asphalt
surface



TBT IN SURFACE WATER IS HIGHEST DURING BOATING SEASON

- Leakage from boats, resuspension or leakage from sediments, deposition of primary emissions from land, combinations of above?
- Concentrations high enough to signify possible (local) impacts on marine life in summer (EQS-MAC = 1,5 ng/L)

Concentration of TBT in surface water sampled in the 4 MAST marinas



TENTATIVE CONCLUSIONS FROM EARLY RESULTS

- Both wind erosion and surface runoff can be significant transport pathways of TBT containing APP:s from boat storage sites to the recipient – can hopefully be reduced via measures being evaluated
- Primary emissions during maintenance in spring seem substantial (despite TBT ban) and needs other types of measures to deal with
- Beware of possible re-contamination when remediating contaminated soil or sediments in marinas!

MORE RESEARCH ON APP:S WOULD BE NICE

- A substantial share of residual TBT contamination in sediments is probably in the form of APP:s. To what extent does this influence environmental fate and impacts of TBT (and other antifouling biocides)?
- Is there a need to adjust risk assessment methods and assessment values to take APP:s into consideration?



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THANK YOU

FOR YOUR ATTENTION

Thank you to: Swedish EPA (funding), Peter Harms Ringdal (EnviFix AB), SWEBOAT AB, Jenny Lindén (IVL), Marinas participating in the MAST project