BONUS
SCIENCE FOR A BETTER FUTURE OF THE BALTIC SEA REGION

BONUS CHANGE

BONUS CHANGE Recommendations

towards Regulations for Sustainable Antifouling practices in the Baltic Sea

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Preface

This set of five recommendations to Competent Authorities and marina operators across the Baltic Sea is a result of the 4-year project BONUS CHANGE – changing antifouling (AF) practices on leisure boats in the Baltic Sea. The recommendations are formulated both as a goal (Recommendation 1) and as practical recommendations that, if followed, would considerably reduce the current overuse of biocides, mainly copper, in marine AF paints used on leisure boats and as a result would lead to a much better situation for the environment in the sensitive coastal ecosystems of the Baltic Sea. The recommendations rest on BONUS CHANGE's scientific results that have shown that full protection of leisure boat hulls against biofouling can be achieved without using any biocides; the biocide, i.e., copper, content of AF paints can be reduced to one-seventh compared to the copper content in the most popular paints used by boaters, without renouncing AF performance; the present EU and national regulations can be used by Competent Authorities to achieve sustainable AF practices on leisure boats to protect the environment in the Baltic Sea.

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RECOMMENDATION 1

Phasing-out of biocidal antifouling products in the Baltic Sea on leisure boats including adjacent freshwater areas until 2030

On the background of emerging new technologies in coating formulation and hull cleaning techniques in the maritime industry, the future of biofouling prevention will be biocide-free. This perspective comprises commercial shipping, offshore industry and mariculture. It's time for leisure boating to keep up with this development.

Our first recommendation is formulated as a goal for the Baltic Sea member states to endorse and work towards through regulations – present and future. In order to fully phase-out biocidal antifouling (AF) products on leisure boats political decisions are needed within the EU or the Helcom[1]. This entails changing how biocidal AF products are authorized under the Biocidal Products Regulation in the different Baltic Sea member states[2].

If the Environmental Quality Standards (EQS) described in the EQS Directive[3] are not met in a certain geographical area (water body, marina waters) there is legal support under the Water Framework Directive (WFD) for not allowing biocidal AF products to be used in that particular area. Discussions and initiatives to classify marinas as Technical Areas or synonymously, as "heavily modified water bodies" would exempt them from the requirements of the EQSD and subsequently, from requirements under the WFD.
The BONUS CHANGE project urges competent authorities to strongly oppose to this classification of marinas. This is because many of the marinas that we have mapped within the BONUS CHANGE project are in the vicinity or actually, located within Marine Protected Areas (MPAs) and moreover, marinas are located in areas which have very high recreational values, other than boating, for the wider public.

It is important to stress that there are fully functional, top-performing biocide-free antifouling techniques available on the market in the Baltic Sea member states. Thus, it could be questioned by decision-makers and competent authorities what the utility is to use toxic biocide-based AF paints in sensitive coastal seas as compared to use biocide-free AF techniques, which protect and does not further deteriorate the marine environment.

[1] Helcom - BALTIC MARINE ENVIRONMENT PROTECTION COMMISSION. Contracting parties are Denmark, Estonia, European Union, Finland, Germany, Latvia, Lithuania, Poland, Russia and Sweden. Headquarters in Helsinki, Finland.

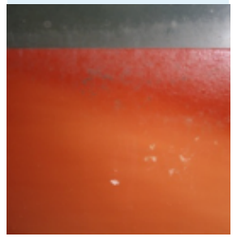
[2] REGULATION (EU) No 528/2012 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 22 May 2012 concerning the making available on the market and use of biocidal products.

[3] Directive 2008/105/EC of the European Parliament and of the Council of 16 December 2008 on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC of the European Parliament and of the Council. The EQSD lays down environmental quality standards (EQS) for priority substances and certain other pollutants as provided for in Article 16 of the Water Framework Directive 2000/60/EC (WFD), with the aim of achieving good surface water chemical status and in accordance with the provisions and objectives of Article 4 of that Directive.

BONUS CHANGE urges **a promotion** of effective biocide-free alternatives by the Baltic Sea Environmental Agencies and Competent Authorities.

List of biocide-free AF techniques, a short description on how they function and the suppliers and producers of these techniques.

BIOCIDE-FREE AF TECHNIQUE	Performance in different fouling pressures	Description of technique	Supplier, producers	How to buy and deliver/lease these techniques
BRUSH WASHING STATIONS 	Full AF performance in all fouling pressures (high, medium, low). The brush intervals in high fouling pressure need to be more frequent.	Suitable for all kind of boats up to 16 m LOA. Needs to be within a convenient distance for boaters	Boatwasher www.boatwasher.se Rent under http://driveinboatwash.com/sv/om-rentunder/	Lease
HULL COVERS  	Full AF performance in all fouling pressures (high, medium, low). Sometimes the hull cover does not protect the stern of the boat from fouling (depending on the shape of the stern). Therefore the stern of the boat sometimes need to be cleaned with a hand held cleaning device once or twice per season (depending on fouling pressure).	Suitable for motorboats up to 10 m LOA. used for day cruising. If the boat has overnight accommodation and is used for trips which lasts for more than two weeks a combination of a hull cover and cleaning in a Brush washing station can be an option.	Clean Marine http://www.cleanmarine.se CleanBoat http://www.cleanboat.se/	Sold directly from producers to consumers.
HULL COVER WITH BUILT IN FRICTION SCRUBBING AWAY THE FOULING 	Full AF performance in all fouling pressures (high, medium, low). Sometimes the hull cover does not protect the stern of the boat from fouling (depending on the shape of the stern). Therefore the stern of the boat sometimes need to be cleaned with a hand held cleaning device once or twice per season (depending on fouling pressure).	Suitable for motorboats up to 7,6 m LOA. used for day cruising. If the boat has overnight accommodation and is used for trips which lasts for more than two weeks a combination of a hull cover and cleaning in a Brush washing station can be an option.	SeaBoost Powerturf http://www.seaboost.fi/products/seaboost-power-turf/?lang=en	Sold directly from producers to consumers and from selected retailers.

BIOCIDE-FREE AF TECHNIQUE	Performance in different fouling pressures	Description of technique	Supplier, producers	How to buy and deliver/lease these techniques
HAND HELD CLEANING DEVICE 	AF performance depends on the cleaning intervals.	Suitable for smaller boats.	SeaBoost Powerbrush http://www.seaboost.fi/seaboost-power-brush-2/?lang=sv	Sold directly from producers to consumers and from selected retailers.
HARD EPOXY COATING WITH A NON-STICK SURFACE. 	This coating has not sufficient antifouling properties in itself as a stand-alone product. The coating should be used in combination with other biocide free methods, like hull covers, brush washing stations or a hand held cleaning device. The epoxy coat with low-stick properties gives the boat a hard surface and protection for the gelcoat and is more easy to clean because of the silicone content.	Suitable for smaller boats.	SeaBoost Overdrive http://www.seaboost.fi/seaboost-coatings/?lang=sv	Sold directly from producers to consumers and from selected retailers.
FOUL RELEASE COATING  	Performs in marine, brackish-, and freshwater even exposed to strong fouling pressure	Suitable for all boats. Removal or sealing of existing antifouling paints.	www.hempel.com	Sold directly by retailers

BIOCIDE-FREE AF TECHNIQUE	Performance in different fouling pressures	Description of technique	Supplier, producers	How to buy and deliver/lease these techniques
HAND HELD CLEANING DEVICE 	AF performance depends on the cleaning intervals.	Suitable for motorboats and sailing boats with liftable center board.	www.toplicht.de	Sold directly by the manufacturer

Combination of biocide-free techniques

All fouling prevention methods described in the table above can be combined based on how the boat owners use their boats. For example, if the home berth is equipped with a hull cover and the boat is taken to longer sails extending to weeks away from the home berth, the hull may be painted with an easy-to-clean, low-stick paint like the Seaboost Overdrive-paint and the hull may be scrubbed with a cleaning device or taken to a brush washing station during the sails away from the home berth.

However, the fouling release paint SilicOne from Hempel possess a self-cleaning function, but the paint film itself is too fragile and soft to be cleaned in a brush washing station or with a stiff and hard handheld brush. In case of fouling development at the end of the season the silicon coatings should be cleaned by tap water and a sponge or light HP-washing only.

RECOMMENDATION 2

Substantially reduce the copper content in antifouling (AF) paints for leisure boat use and improve estimates of release rates used for risk assessment

Antifouling paints containing biocides are subject to product authorization after risk assessment by competent authorities in the EU Member States. This authorization is governed by the Biocidal Products Regulation (BPR)[4] and the procedure for risk assessment is described in article 19 and the Annex VI to the BPR. Also, Article 22 describes that an authorisation decision can be conditioned. This is an important point for the possibility for competent authorities to apply a restrictive approach. The BPR was put into force in 2012 and leaves a limited, but present, room for Member States for national interpretation of the risk assessment in the regulation (art 19; Annex VI).

Indeed, the prevailing restrictive legislation in Sweden concerning the risk assessment in the AF product authorisation is a national interpretation of the BPR. **The legal assessment in BONUS CHANGE concludes that there is room for restrictive interpretation, like the one in Sweden, for all Member States in the Baltic Sea in article 19. The sensitivity of the Baltic Sea is one science-based background that can be used for restricting biocidal AF paints in the sea, but how the regulation will be interpreted by the Court and thus, the exact room for national interpretation, is not yet clear.**

The BPR leaves some room for that biocidal products should not contain excessive amounts of biocides. **BONUS CHANGE results conclude that most biocidal AF products for leisure boats are unnecessarily toxic.** The results produced by BONUS CHANGE on AF efficacy under field conditions are a strong support for that (see the forthcoming section on field AF efficacy of low and high copper-content paints).

Thus, during the transition-phase to reach the goal of a Baltic Sea free from biocide-based AF paints, we recommend using the minimum amount of copper in the AF paint that reflects the service-life[5] of the paint and with a release rate of copper that ensures antifouling efficacy for that service-life.

Moreover, calculations performed by BONUS CHANGE based on the release rates of copper that the industry have provided to the Competent authorities show that **only 30-50% of the copper content in commercial paints is released during the time the boat is in the water,** which is when the paint serves its biocidal products function. Some 50-70% of the biocide, i.e., copper, remains on the hull. Thus, an excessive toxicity is being built up on the hull since the common practice among leisure boaters is to apply new paint each year.

In the BPR there are provisions for mutual recognition of product approval, meaning that when an AF product has been authorized in a Member State the producer of the product may apply for mutual recognition of the approval in all member states. In article 37 of the BPR, member states may request for a derogation of mutual recognition due to environmental concerns. **However, the legal scholars in BONUS CHANGE suggest that this might be more difficult than restricting the availability of AF products under the national authorisation procedure.** The burden of proof in article 37 instead lies with the competent authority where the competent authority must prove that the product is not acceptable out of environmental concerns. This also must be done within a short time frame.

The BONUS CHANGE project has scientific results on various angles of AF products that could be compiled into a dossier to support Baltic Sea member states that would like to apply article 37 in the BPR for a restrictive authorisation of AF product for the protection of the marine environment. Below, the main results are summarised.

A. Substantially reduce the copper content in antifouling (AF) paints for leisure boats

There is ample scientific evidence from studies performed within BONUS CHANGE that excessive amounts of copper are present in current commercial AF paints. Not only are the **copper release rates unnecessarily high** for some products, i.e. more copper is released than what is needed for fouling protection, but **the specified lifetime of the products is generally not representative,** leading to needlessly high frequencies of paint re-application. The latter leads to build-up of copper on boat hulls, and ultimately, pollution of boatyard grounds.

Provided a product both passes the environmental risk assessment and can provide evidence of antifouling efficacy, **future authorization of AF paints should also require paint producers to show that their product does not contain excessive amounts of copper.** The specified lifetime of the product should be shown to be realistic i.e. if the recommended life span of the paint is one season (5 months), manufacturers must show that the majority of the copper is utilized during that time. This is not a requirement today. As the release rates of copper (Cu), and sometimes zinc (Zn), are salinity-dependent (see part B), the lifetime of the paint will be dependent on the location of use. Through determination of release rates under field conditions reflecting the intended use of the product, more realistic recommendations regarding product lifetime (and paint re-application) could be made, tailored to specific geographical areas.

BONUS CHANGE scientific results that support a substantial reduction of excess copper in AF paints:

- A substantial proportion of boats in SE, DK, FI and DE carry excessive amounts of Cu on their hulls as measured by XRF (Eklund & Watermann, submitted manuscript).
- Furthermore, commercial paints containing 6.9 and 7.5% copper oxide (with 10-25% zinc oxide) **work equally well** as paints containing 13-35% copper oxide (Wrange et al. manuscript in prep.), highlighting the overuse of copper in AF paints today
- The excess copper serves no AF function but instead contributes to the pollution in marinas from maintenance work over unprotected grounds (Lagerström et al. 2016).

[4]REGULATION (EU) No 528/2012 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 22 May 2012 concerning the making available on the market and use of biocidal products

[5]The service-life for an AF paint on a leisure boat for one season is on average 5 months

- Commercial paints with low Cu content (7.5%) are fully efficient against fouling during two full boating seasons (2 x 150 days) without re-painting in both the Baltic and Kattegat (Wrange et al. manuscript in prep.).
- A paint **with even lower copper content (4.3% copper oxide with 10% zinc oxide) has the same antifouling efficacy as high-copper content paints (13-34.6%)** and not only in the Baltic Sea Proper, but also in the Kattegat area during a full boating season (150 days) (Wrange et al. manuscript in prep.).
- For five studied commercial paints, the release rates measured by XRF (between day 14 and 56), show that the following release rate ranges were efficient in deterring fouling at low and high salinity (Lagerström et al. in press):
  - Low salinity (5 PSU): 3.3 – 5.0 µg cm^{-2} day^{-1}
  - High salinity (14 PSU): 4.9 – 10.8 µg cm^{-2} day^{-1}

These results show that it is possible to reduce the release rates of copper in AF paints to meet the lower end of these ranges, without affecting the antifouling efficacy. It is also possible that release rates below these ranges are efficient in deterring fouling too, however this requires further evaluation.

B. Improve estimates of release rates used for risk assessment

Under the Biocidal Products Regulation (BPR, 528/2012), antifouling (AF) paints require authorization before placing on the market in EU member states. To gain approval from the relevant national authority, manufacturers must demonstrate that the use of the product is not associated with unacceptable risks to the environment. The release rate of biocide (defined as µg cm^{-2} day^{-1}) from a paint determines the antifouling efficiency and the environmental risk. There are currently only two standardized release rate methods that are accepted by regulatory bodies in the EU member states (a laboratory method and calculation method), but concerns have been raised whether these yield realistic release rates (Finnie, 2006; IMO, 2009). In particular, as the two methods have been developed to yield release rates in fully saline (33-35 PSU) and warm (24-26°C) waters, one can question whether their generated release rates are representative for the Baltic Sea. Both methods have also been shown to overestimate the release rate of Cu when compared to the only field based method that has been evaluated so far (Dome method, Finnie et al. 2009) and therefore default correction factors have been defined (2.9 and 5.4 respectively).

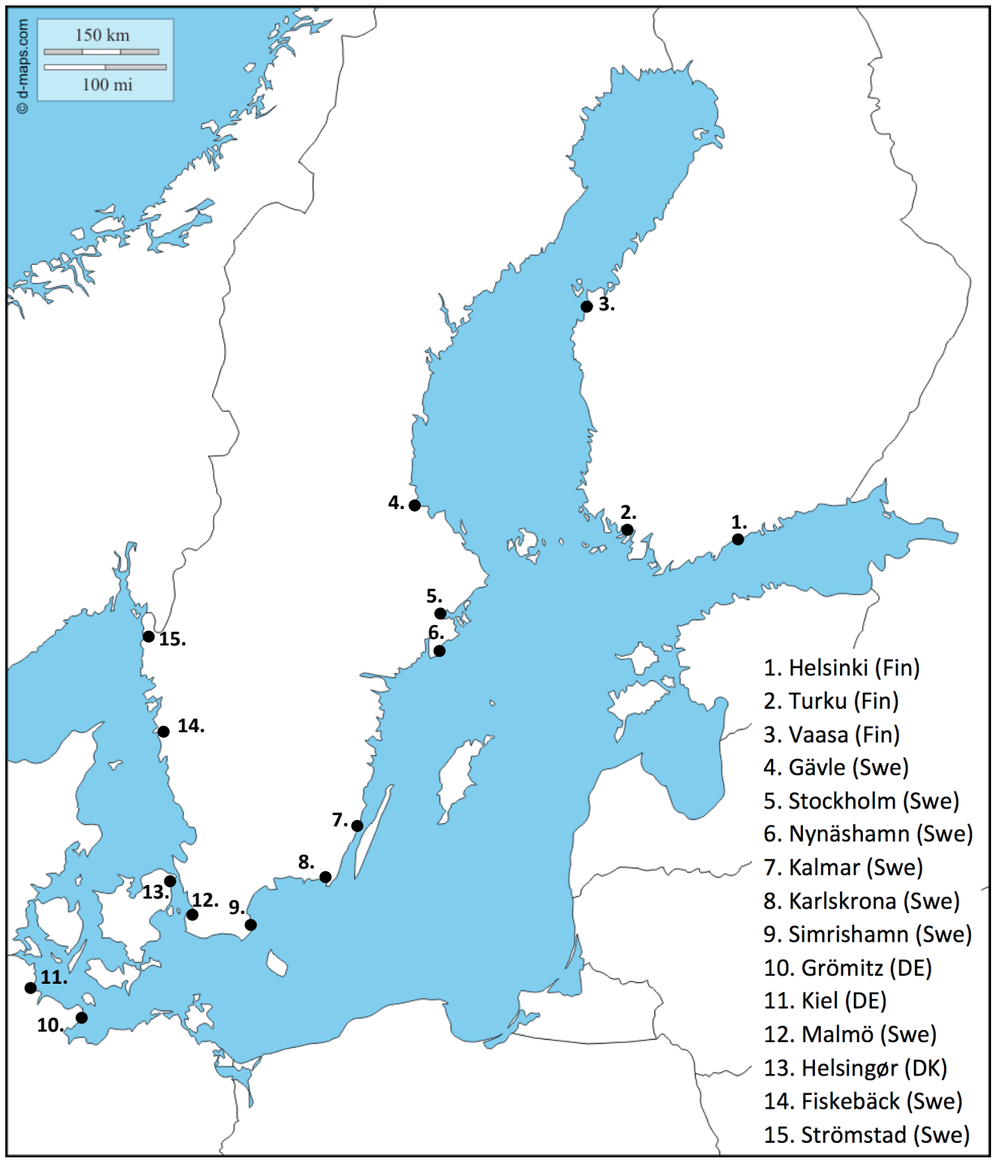
Using a new XRF (X-Ray Fluorescence) method for quantitative measurements of metals in AF paints, we have been able to measure field release rate for a number of copper-based AF paints under environmental conditions reflecting those of the intended use. Through the determination of field release rates of Cu and Zn from AF paints using this quantitative XRF method, substantial shortcomings of the current standardized release rate methods, i.e. the rotating cylinder and the CEPE mass balance equation, were revealed. For one, the use of the correction (reduction) factors for Tier 2 assessments was found to be inappropriate. It is therefore **recommended that the default correction factors should no longer be applied.** Additionally, release rates were found to be significantly affected by environmental parameters (e.g. salinity). The release rate behaviour was also found to be paint-specific, revealing the unsuitability of applying one release rate prediction model (such as the CEPE mass balance equation) to all types of AF paints, regardless of difference in paint formulation. The **findings highlight the need for the derivation of both condition-specific** (with conditions reflecting the intended use of the product) **and paint-specific release rates** for more realistic environmental risk assessments. For this reason, we **recommended that the XRF method be made a standardized method for evaluating AF paints and thereafter used to determine release rates for risk assessments.**

BONUS CHANGE main scientific results that support the recommendation to improve release rate estimates for risk assessment:

- In BONUS CHANGE we have found that the use of the default correction (reduction) factors for Tier 2 assessments using release rates derived with the current standardized methods (Mass Balance and Rotating Cylinder) leads to underestimations of the release rate of Cu (up to 8-fold) and Zn (up to 3-fold) for five studied commercial paints (Lagerström et al. in press). Therefore, we recommend that the default correction factors should no longer be used.
- Release rates are significantly affected by salinity, with increased Cu release rates with increasing salinity (Ytreberg et al 2017, Lagerström et al. in press). A significant increase in the release of Zn was also observed with higher salinity, but was found to be paint-specific, as it was not observed for all studied paints. (Lagerström et al. in press).
- For the five studied commercial paints, no correlation between the copper oxide content and the release of Cu could be found (Lagerström et al. in press). The copper oxide content of an antifouling paint is therefore not a good predictor of Cu release rate.
- We can also confirm that the ZnO content of a paint strongly affects the release rate of copper (more Cu is release with a higher addition of ZnO) (Lindgren et al. submitted manuscript). This finding highlights again the importance of considering the full paint composition and the need for paint-specific release rates.
- Studies in BONUS CHANGE have also revealed that release rates of copper from AF paints are not constant over a season and suitable time points for measuring release rates should be carefully selected (Lagerström et al. in press).
- Static field panel tests combined with XRF (Ytreberg et al. 2015), is a highly promising tool for estimating realistic release rates of AF paints under natural environmental conditions (Lagerström et al. in press). Panel tests are already prescribed in the TNsG for PT21 as part of the authorization process to prove the efficacy and have to be submitted.
- Following standardization of the XRF method for AF paints, we recommend that this method should be used for more realistic estimations of release rates in the future.

BONUS CHANGE results on Antifouling Performance of high vs low copper content AF paints as well as background fouling pressure in marinas across the Baltic Sea Region

To evaluate the performance of different copper-based antifouling paints, panels were coated with paint and placed inside marinas at 15 locations around the Baltic Sea-Kattegat-Skagerrak (Figure 1).



The panels were submerged during May-October 2014-2016 and the fouling intensity (% coverage of panel) was evaluated after five months, at the end of the boating season. The static panels represent a 'worst-case' scenario; i.e. that the boat does not move during the whole season. The more the boat is used, the better the antifouling paint will perform, and the less the fouling will adhere. The evaluated paints are shown in the table below.

Information about the evaluated antifouling paints in BONUS CHANGE

Paint	Producer	Type	Cu content (%)	Zn content (%)
Lago racing	International	biocide-free	0	0
Mille Light Cu	Hempel	rosin based self-polishing	6.9	10-25
Biltema BS	Boero Group	rosin based self-polishing	7.5	20-25
Cruiser One	International	rosin based self-polishing	8.5	10-25
Biltema West	Boero Group	rosin based self-polishing	13	15-20
MilleXtra	Hempel	rosin based self-polishing	34.5	10-25
Test paint	experimental	rosin-based	4.3	10-20

In the following section, the results from the panel tests in 2015 (photos) are presented. However, similar results of antifouling performance for copper-based paints were obtained during all years, despite some variation in natural fouling pressure between years. The fouling pressure classification (High/Medium/Low) is based on an average of fouling from three consecutive years (2014-2016), where both fouling intensity (% coverage of panel) and severity (type of fouling, e.g. hard fouling vs. soft fouling) is taken into account.

In general, fouling coverage on control panels (biocide-free Lago racing) was relatively high in many parts of the Baltic Sea, however the intensity was much lower inside the Baltic Sea compared to the Swedish West coast (Kattegat/Skagerrak), which had more layers of fouling and higher species richness. In most locations throughout in the Baltic Sea, all paints containing copper performed very well. Only a few exceptions were found, which may, to some extent, be explained by paints not being designed for low salinity conditions.

Helsinki (Finland)

The marina in Helsinki (Kivenlahden Boat club, Esbo) is located outside Helsinki in Finland. There are 540 mooring places in the marina and the salinity is around 6 psu.

Fouling pressure: LOW

The fouling varies to some degree between years but consists mainly of bryozoans, hydroids and some barnacles (see Lago racing). All copper based paints were effective against fouling. Only biofilm and silt/clay was present on these panels. All copper-based paints were effective against fouling during two full boating seasons (5months x2) given that the coatings were gently cleaned between seasons). This shows that fouling protection can be achieved without re-painting each year.

Photos of panels (Helsinki):


Lago racing (biocide-free)


Test paint (4.3% Cu+10%Zn)


Mille Light (6.9% Cu)


Biltema Baltic (7.5% Cu)


Cruiser one (8.5% Cu)


Biltema West (13% Cu)


MilleXtra (34.5% Cu)

Turku (Finland)

The marina in Turku (Turum Pursiseura Ry) has 200 mooring places and a salinity of 6 psu.

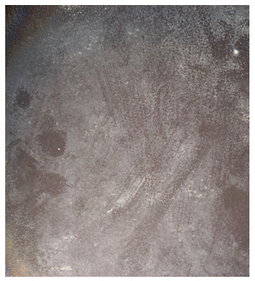
Fouling pressure: HIGH

The fouling is strongly dominated by high intensities of barnacles. All except two of the copper based paints were efficient against barnacles (including the two with lowest copper content). The two paints that did not perform well (Cruiser One and Millextra) were still less fouled compared to the biocide-free paint. The reason for the low performance for these paints can, to some extent, be explained by the paint not being designed for low salinity environments, thus reducing the copper leakage from the paint and facilitating organisms to attach. However, other environmental factors may also have influenced these results.

Photos of panels (Turku):


Lago racing (biocide-free)


Mille Light (6.9% Cu)


Biltema Baltic (7.5% Cu)


Cruiser one (8.5% Cu)


Biltema West (13% Cu)


MilleXtra (34.5% Cu)

Vaasa (Fin)

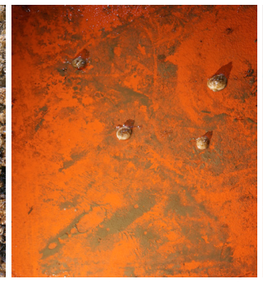
The marina in Vaasa (Vaasa Motor Yacht Club) contains 194 mooring places and the salinity lies around 4 psu.

Fouling pressure: MEDIUM-LOW

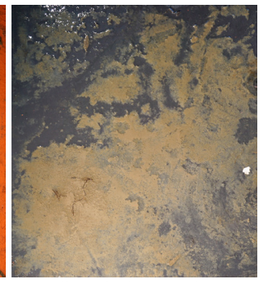
The fouling varies to some extent between years but consists of mainly barnacles and hydroids. Out of the commercial paints that were tested, all except one (Millextra with the highest copper content) were efficient against fouling. The can be explained by low salinity reducing the release rate of copper from the paint, which is designed for high salinities. The test paint containing 4% copper was 100% effective only when combined with 20% zinc, but showed relatively high performance also with lower zinc content (10%).

Photos of panels (Vaasa):


Lago racing (biocide-free)


Test paint (4.3% Cu+10%Zn)


Test paint (4.3% Cu+20%Zn)


Mille Light (6.9% Cu)


Biltema Baltic (7.5% Cu)


Cruiser one (8.5% Cu)


Biltema West (13% Cu)


MilleXtra (34.5% Cu)

Gävle (Swe)

The marina in Gävle (Fliskärsvarvet) has 635 mooring places and a salinity around 4.9 psu.

Fouling pressure: LOW

The fouling was strongly dominated by hydroids. Barnacles (low coverage) only occurred during one out of three years. All copper paints were efficient against fouling. Only biofilm and silt was present on the panels painted with copper paints.

Photos of panels (Gävle):


Lago racing (biocide-free)


Mille Light (6.9%)


Biltema Baltic (7.5% Cu)


Cruiser one (8.5% Cu)


Biltema West (13%)


MilleXtra (34.5% Cu)

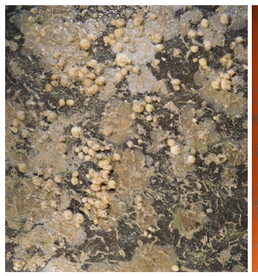
Stockholm (Sweden)

The marina in Stockholm archipelago (Bullandö marina) is one of the largest in Sweden and has 1400 mooring places and a salinity of around 5 psu.

Fouling pressure: MEDIUM-HIGH

The fouling was dominated by barnacles and bryozoans. All paints containing copper (including 4.3% Cu) were highly effective against fouling, with only biofilm/silt present on the panels. All copper-based paints were effective against fouling during two full boating seasons (5 months x2) given that the coatings were gently cleaned between seasons). This shows that fouling protection can be achieved without re-painting each year.

Photos of panels (Bullandö):



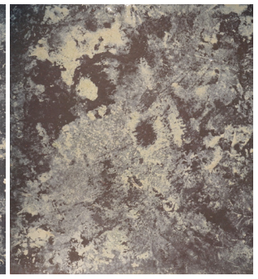
Lago racing (biocide-free)

Test paint (4.3% Cu+10%Zn)

Mille Light (6.9% Cu)

Biltema Baltic (7.5% Cu)

Cruiser one (8.5% Cu)



Biltema West (13% Cu)

MilleXtra (34.5% Cu)

Nynäshamn (Sweden)

The marina in Nynäshamn (Fagerviken) is located in the Baltic Proper and has 210 mooring places and a salinity around 6 psu.

Fouling pressure: MEDIUM-HIGH

The fouling consisted mainly of barnacles and bryozoans, but mussels and hydroids did occur at low frequencies too. All copper-based paints were highly effective against fouling. Only biofilm and silt were present on the panels.

Photos of panels (Nynäshamn):

Lago racing (biocide-free)

Mille Light (6.9% Cu)

Biltema Baltic (7.5% Cu)

Cruiser one (8.5% Cu)

Biltema West (13% Cu)

MilleXtra (34.5% Cu)

Kalmar (Sweden)

The marina (at Kalmarsundsparken) has 150 mooring places and the salinity lies around 7 psu.

Fouling pressure: LOW

The fouling consists mainly of bryozoans, with some barnacles present at times. All copper-based paints were highly effective against fouling. Only biofilm was present on the panels.

Photos of panels (Kalmar):

Lago racing (biocide-free)

Mille Light (6.9% Cu)

Biltema East (7.5% Cu)

Cruiser one (8.5% Cu)

Biltema West (13% Cu)

MilleXtra (34.5% Cu)

Karlskrona (Sweden)

The marina in Karlskrona (Jämjö Boat Club) has 83 mooring places and the salinity lies around 7 psu.

Fouling pressure: MEDIUM-HIGH

The fouling consists mainly of barnacles, bryozoans and red filamentous algae. The only commercial paint that was 100% effective against macroscopic fouling was the MilleLight Cu (6.9%), highlighting the importance of total paint composition rather than only the amount of copper, for paint performance. Biltema West had only few barnacles present, whereas Cruiser One and MilleXtra had relatively high numbers. The larger size of the barnacles on the copper paints is most likely due to less competition for food and space on these panels, compared to the control panel. The results in Karlskrona can to some extent be explained by low salinity, but there are likely other factors that have not yet been clarified.

Photos of panels (Karlskrona):

Lago racing (biocide-free)

Mille Light (6.9% Cu)

Biltema East (7.5% Cu)

Cruiser one (8.5% Cu)

Biltema West (13% Cu)

MilleXtra (34.5% Cu)

Simrishamn (Sweden)

The marina in Simrishamn (Municipal marina) has 280 mooring places and the salinity lies around 8.1psu.

Fouling pressure: MEDIUM-LOW

The dominant fouling taxa on the control panels varied between years, but consisted of barnacles, hydroids, bryozoans and mussels. All copper-based paints were highly effective against fouling. Only biofilm and silt were present on the panels.

Photos of panels (Simrishamn):

Lago racing (biocide-free)

Test paint (4.3% Cu+10%Zn)

Mille Light (6.9% Cu)

Biltema East (7.5% Cu)

Cruiser one (8.5% Cu)

Biltema West (13% Cu)

MilleXtra (34.5% Cu)

Grömitz (Germany)

The marina in Grömitz (Jachthafen, Köningsredde) has 780 mooring places in the marina and the salinity lies around 12.9psu.

Fouling pressure: HIGH

Half of the fouling was barnacles each year, and the rest consisted of bryozoans, mussels and hydroids. All copper-based paints were highly effective against fouling. Only biofilm and silt were present on the panels.

Photos of panels (Grömitz):

Lago racing (biocide-free)

Mille Light (6.9% Cu)

Biltema East (7.5% Cu)

Cruiser one (8.5% Cu)

Biltema West (13% Cu)

MilleXtra (34.5% Cu)

Kiel (Germany)

Short description of marina: 15 psu

Fouling pressure: HIGH

The fouling was dominated by barnacles forming the bottom layer of fouling. On top, mussels and tunicates formed dense aggregates, which often seemed to have fallen off when too heavy, hence potentially reducing the total fouling coverage at the end of the boating season. Tunicates and mussels are more easily removed during vessel movements and thus may not be as problematic for boat owners as it may seem from the panels. All copper-based paints were highly effective against fouling. Only biofilm and silt were present on the panels.

Photos of panels (Kiel):

Lago racing (biocide-free)

Test paint (4.3% Cu+10%Zn)

Mille Light (6.9% Cu)

Biltema BS (7.5% Cu)

Cruiser one (8.5% Cu)

Biltema West (13% Cu)

MilleXtra (34.5% Cu)

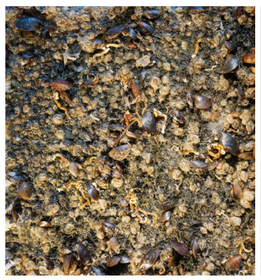
Malmö (Sweden)

The marina in Malmö (Lagunen) has 550 mooring places and the salinity lies around 10.9psu

Fouling pressure: HIGH

The fouling consisted mainly of barnacles, mussels and bryozoans, but also a new invasive species of tubeworm *(Ficopomatus enigmaticus)* was found each year (2013-2016) on the panels in this marina. All copper-based paints were highly effective against fouling. Only biofilm and silt were present on these panels.

Photos of panels (Malmö):



Lago racing (biocide-free)

Mille Light (6.9% Cu)

Biltema East (7.5% Cu)

Cruiser one (8.5% Cu)

Biltema West (13%Cu)

MilleXtra (34.5% Cu)

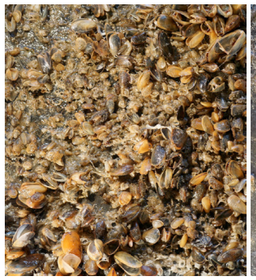
Helsingør (Denmark)

The marina in Helsingör (North harbor) was 1000 mooring places and a salinity of 12.6psu.

Fouling pressure: HIGH

The fouling was dominated by barnacles and mussels, but bryozoans were also present. Most copper-based paints were highly effective against fouling. Only biofilm and silt were present on these panels. A few mussels were visible on the Mille Light Cu and Cruiser One paints.

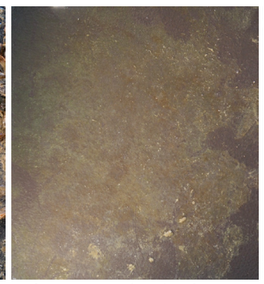
Photos of panels (Helsingør):


Lago racing (0% Cu)


Mille Light (6.9% Cu)


Biltema Baltic (7.5% Cu)


Cruiser One (8.5% Cu)


Biltema West (13% Cu)


MilleXtra (34.5% Cu)

Gothenburg (Sweden)

Fiskebäck marina is located just outside of Gothenburg on the Swedish west coast. There are 950 berths in the marina and the salinity is around 16psu, due to a close-by river outflow (from Göta Älv).

Fouling pressure: HIGH

The fouling consisted mainly of barnacles, bryozoans and mussels but many other species occurred too including colonial tunicates, algae and hydroids. Both fouling intensity (% coverage of panel) and severity (hard fouling, multiple layers) was high in this marina over all years studied. All copper based paints were efficient against macroscopic fouling. Only biofilm, which can be removed with a gentle brush/sponge, was present on AF painted panels. Three of the copper-based paints (Biltema BS, Biltema West and MilleXtra) were effective against fouling during two full boating seasons (5 months x2) given that the coatings were only gently cleaned between seasons). This shows that fouling protection can be achieved without re-painting each year.

Photos of panels (Fiskebäck)


Lago racing (biocide-free)


Test paint (4.3% Cu+10% Zn)


Mille Light (6.9% Cu)


Biltema East (7.5%)


Cruiser One (8.5% Cu)


Biltema West (13% Cu)


MilleXtra (34.5% Cu)

Strömstad (Sweden)

The marina in Holkedalen is located south of Strömstad, in the Skagerrak. There are 176 berths and the salinity is around 26 psu.

Fouling pressure: HIGH

The marina is located close to the Kosterhavet National Park, an area with the highest species diversity along the Swedish coast, and also the highest fouling pressure. The fouling on the control panels was dominated by barnacles (bottom layer), mussels (high densities!) and tunicates (dominant during some years), but other species occur too including bryozoans, colonial tunicates, algae and hydroids. High quantities of mussels and tunicates are likely to be removed during movement of the boat; e.g. traces of mussel attachment indicate that mussels have fallen off the panels due to high densities (e.g. on Biltema East). The most efficient paint against macroscopic fouling was Biltema West (13% Cu) that had only biofilm present, which can be removed with a gentle brush/sponge. Although several paints had mussels/traces of mussel attachment, most Cu-paints were free from barnacles and reduced the total fouling considerably compared to the control panels.

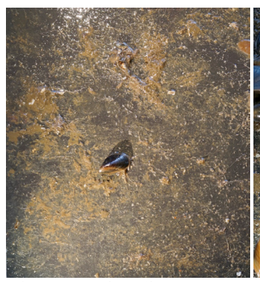
Photos of panels (Strömstad):


Lago racing (biocide-free)


Test paint (4.3% Cu+**10**% Zn)


Test paint (4.3% Cu+**20**% Zn)


Mille Light (6.9% Cu)


Biltema East (7.5%)


Cruiser One (8.5% Cu)


Biltema West (13% Cu)


MilleXtra (34.5% Cu)


Photo of a control panel (Lago racing) in Strömstad 2016, for comparison.

RECOMMENDATION 3

Baltic Sea member states competent authorities are urged to apply the Biocidal Product Regulation's articles and paragraphs which support a restrictive national implementation to object to the use of any organic biocidal antifouling products.

This recommendation from the BONUS CHANGE project covers all AF biocides and should be harmonized throughout the Baltic Sea including the Swedish West Coast, in order to promote harmonization of product authorisation, placing on the market and use of sustainable AF products.

The PT 21 (Product type 21, Antifouling products) under the BPR provides one advantage and it is that **AF products are deemed as relatively dangerous.** Thus, it is possible for member states which have employed restrictions for certain types of biocides before the entry into force of the BPR, can refuse authorisation of a product containing those and new biocides because if they would allow them, the level of protection of the environment would be lower. Member States need however, to submit a short dossier of the biocides in question regarding eco-toxicity, human toxicity or efficacy.

It is recommended by the BONUS CHANGE project that Baltic Sea member states should object to organic AF biocides because it will lower the protection of the environment compared to the present situation.

Firstly, and most importantly, there is no need for using these biocides in AF paints in the Baltic Sea since available biocide-free methods and low copper-containing AF paints work excellent.

Furthermore, the rationale for not approving AF products with organic biocides according to the BONUS CHANGE is that these will not be allowed for use in freshwater areas (see below). Both SE, DE and FI have freshwater bodies connected to the Baltic Sea. To monitor the large number of leisure boats that sail from marine to freshwater bodies will be extremely difficult since these biocides cannot easily be detected at site but need thorough chemical analysis in the laboratory for their identification. Thus, surveillance of the compliance with the rules of a ban of these biocides in freshwater will be extremely difficult. There are at present no chemical analyses developed for the full identification of degradation products of these biocides making their surveillance even more difficult.

In addition to the above, the potential risks associated with poor maintenance practices of leisure boats and irresponsible use of AF products by boat owners could result in unpredicted impact on both humans and the marine environment. Also, the current authorisation of AF paints in Sweden indicates that since products containing these substances have not been approved in Sweden so far, there is no need for using these biocides in AF products.

List of approved AF organic biocides in PT 21 under the BPR with their respective Hazard classification & labelling on the ECHA homepage

Approved organic AF biocide PT 21	Hazard classification & labelling
Tolylfluanid (not allowed in freshwater including the Bothnian Bay):	***Danger!*** According to the classification provided by companies to ECHA in CLP notifications this substance is fatal if inhaled, is very toxic to aquatic life, causes damage to organs through prolonged or repeated exposure, is very toxic to aquatic life with long lasting effects, causes serious eye irritation, causes skin irritation, may cause an allergic skin reaction and may cause respiratory irritation. 
Isothiazolinon (DCOIT):	***Danger!*** According to the classification provided by companies to ECHA in CLP notifications this substance is fatal if inhaled, causes severe skin burns and eye damage, is very toxic to aquatic life, is very toxic to aquatic life with long lasting effects, causes damage to organs through prolonged or repeated exposure, is harmful if swallowed, is harmful in contact with skin, causes serious eye damage, may cause an allergic skin reaction and may cause respiratory irritation. 
Zineb:	***Warning!*** According to the harmonised classification and labelling (CLP00) approved by the European Union, this substance may cause an allergic skin reaction and may cause respiratory irritation. 
Di-chlofluanid (not allowed in freshwater including the Bothnian Bay):	***Warning!*** According to the harmonised classification and labelling (ATP10) approved by the European Union, this substance is very toxic to aquatic life, causes serious eye irritation, is harmful if inhaled and may cause an allergic skin reaction. 
Tralopyril:	***Danger!*** According to the classification provided by companies to ECHA in CLP notifications this substance is very toxic to aquatic life, is very toxic to aquatic life with long lasting effects, is toxic if swallowed and is toxic if inhaled. 
Medetomidine:	Candidate for substitution which will be subject to comparative assessment under the BPR[5]. No information on found on the ECHA homepage regarding hazard classification & labelling.

In addition, during the transition-phase (2020-2030) to reach the goal of a Baltic Sea free from biocide-based AF paints, BONUS CHANGE recommends that the below three, **and only these three copper AF biocides,** should be present in AF paints for use on leisure boats in low amounts (see Recommendation 2). However, these three copper biocides are a threat to the marine environment due to their collective classification as being "very toxic to aquatic life with long lasting effects". Thus, during the process of product approval we urge the competent authorities in the Baltic Sea to duly consider their risk to the sensitive Baltic Sea environment.

List of approved copper AF biocides in PT 21 to the Biocidal Products Regulation

Approved copper AF biocide PT 21	Hazard classification & labelling
Copper (copper flakes)	***Danger!*** According to the classification provided by companies to ECHA in REACH registrations this substance is very toxic to aquatic life, is very toxic to aquatic life with long lasting effects, is toxic if inhaled, is harmful if swallowed and causes serious eye irritation. 
Dicopper oxide	***Danger!*** According to the harmonised classification and labelling (ATP09) approved by the European Union, this substance is very toxic to aquatic life, is very toxic to aquatic life with long lasting effects, is harmful if swallowed, causes serious eye damage and is harmful if inhaled. 
Copperthiocyanate	***Warning!*** According to the harmonised classification and labelling (ATP09) approved by the European Union, this substance is very toxic to aquatic life and is very toxic to aquatic life with long lasting effects. 

[5]Concerning biocidal products containing active substances that are considered candidates for substitution according to Art. 10 BPR, a comparative assessment shall be performed in accordance with Art. 23 BPR. This means that the benefit from using the biocidal substance in question is compared to the availability and effectiveness of other biocides and biocide-free methods for controlling the target pests.

RECOMMENDATION 4

Promote an initiative inside of HELCOM with reference to the Baltic Sea Action Plan goals on hazardous substances to make the Baltic Sea free from antifouling biocides on leisure boats through HELCOM recommendations

The Swedish Transport Agency has initiated an initiative inside the Helcom Maritime but so far it has been presented as an information point (Annex I to this document). This was presentented at Helcom Maritime's meeting in St Petersburg, mid-October 2017.

"Sweden invites the HELCOM member states to take note of the information and be inspired to join the aim of reducing the negative impact of harmful antifouling systems."

The Swedish Environmental Protection Agency has taken an initiative to present the same material as in Annex I to the Helcom Pressures group on its meeting in Talinn in late October 2017.

RECOMMENDATION 5

Improvement of antifouling practices and maintenance work in marinas through regulations and infrastructures in Baltic Sea member states

Hull maintenance work (sanding; scraping; applying new paint; high-pressure hosing) are contributing to the spread and supply of antifouling toxins to the ground, the water and the sediment. For the Do-It-Yourself boater it should be clearly depicted what to do and what not to do in terms of maintenance work that may cause contamination of marinas and nearby waters. **It is the marinas responsibility to provide the boater with all the necessary infrastructure and equipment needed for sustainable hull maintenance work.**

Moreover, boat yards and marinas are responsible for their working staff and according to EU rules, e.g., Directive 89/391/EEC - OSH Framework Directive **"must guide and train their staff".** Marinas are responsible for their work and have to supply the facilities and personal protection equipment (PPE). In the EU, yards and marinas are defined as such if they have more than 20 berths.

For small leisure boat marinas below 20 berths requirements and regulations differ between the countries around the Baltic Sea. Below we list the recommendations for sustainable marinas and these recommendations should be considered valid for small marinas as well.

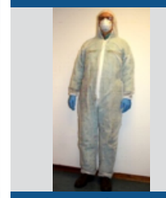
Improvements in marinas

Target	Action for marinas
Hull cleaning, in-water cleaning	**Wash area in the marina** Construction of a clearly depicted wash area with a wastewater treatment facility for the collection and filtration of waste water, and sedimentation of particles in tanks.
Hull cleaning	**Only allow high pressure hosing in the wash area** High pressure (hp) hosing should be restricted to the wash area with wastewater treatment facility. No permission should be given of pressure washing outside designated areas. Only boats with hard macrofouling on the hull should be hp hosed. Boats with soft fouling should be cleaned with a soft sponge and tap water
Sanding and scraping the hull	**Designated areas for scraping and sanding** Provision of clearly mark designated work areas for hull scraping and sanding. Recommendations for maintenance areas that have not been sealed, the work should be performed over tarps, drop cloths or other impervious cover.
Hull painting	**Painting the hull** Painting on land should occur over an impermeable surface or over a protective tarp
Marina waste infrastructures	**Receptacles for hazardous waste and collection equipment in the marina** • Provision of adequate numbers of trash cans, dumpsters or other receptacles placed around the marina at convenient and clearly marked locations for hazardous waste* from hull maintenance. • Provision of receptacles for dust waste* and paint particles* from sanding and scraping the hull • Properly designed containers for empty paint cans and flasks/containers/bottles containing hazardous liquids. • Provision of adequate number of dustless vacuum sanding machines and vacuum tools for scraping by the marina to the boaters in pollution prevention measures to prevent the release of contaminants produced during hull maintenance activities from reaching the soil, air and surface waters.

Target	Action for marinas
	• Provision of receptacles for the catchment of scraped-off bio-fouling *Hazardous waste is comprised of paint chips (antifouling and superstructures), sand dust, ignitable paint waste, parts cleaning solvents, heavy metal containg waste like batteries, sacrificial anodes etc. Paint chips of antifouling paints should due to their biocide content be classified as hazardous waste. Hull scraping and sanding produce solid waste such as paint chips and dust that can contaminate air, soil, surface waters and bottom sediments and should also be regarded as hazardous waste. Liquid hazardous waste comprise antifreeze liquids like glycol, bilge water, solvents, and black and grey waste water.
Clear instructions to boaters	**Signs and information in the marina on where to dispose hazardous waste** • Installation of adequate signs identifying hazardous waste and proper disposal by pamphlets, flyers, newsletters • Installation of adequate signs identifying proper painting and scraping practices by pamphlets, flyers, newsletters.

Antifouling maintenance equipment for environmental protection (EPE) and personal protection (PPE)

The table below displays examples of technologies and tools that are available on the market today (2017). The table is not exhaustive but more technologies and tools are available on the local markets in different countries.

Mobile vacuum cleaners	Vacuum scraper	Personal Protection Equipment (PPE)	Easy folding tank for environmental protection, made in ten sizes	Building a wash station with collection and filter systems
				
www.festool.com www.rupes.com	http://www.gel-plane.co.uk/	www.yachtpaint.com	www.eccotarp.com	http://www.summitgreentech.com/axon-marine-filter/
Mobile vacuum cleaners	Comfortable and efficient hand tool that attaches to any domestic vacuum cleaner.	Face mask Hard hat Safety glasses and goggles	This collapsible spill bund is designed for a quick response to accidental leaks of water.	Wash area with collection, filtering of waste water in combination with building of a wash platform with drainage and installation of a pump well.
Universal use for extraction of ordinary dust and grinding products Equipped for connection to sanding tools	Waste is sucked away through the hollow core as scraping paint, varnish.	Safety boots Chemical resistant gloves Overall Barrier cream	Simple assembly and easy handling, ready to be used even in inaccessible areas. The spill bunds are delivered in several sizes.	Mostly used components: Separator-sedimentation coarse filter/tank Carbon filter
Available in all EU countries by local distributors	Available in all EU countries by local distributors	Available in all EU countries in local retail markets or via orders placed on the internet	Available in all EU-countries by local suppliers markets or via orders placed on the internet	Available in Scandinavian countries and Germany

Possibilities for regulating marina antifouling practices

Generally, there are two different ways of regulating marina antifouling practices and those are:

A) Regulate the environmental consequences of the practices

B) Regulate the practices through explicit prohibitions

Both of these types of regulations are used in the three countries, where the activities of boat owners and marinas are, in varying ways, regulated mainly through general environmental protection regulation.

Regarding A): a system that targets the environmental consequences of practices has the advantage that **it targets all practices** that will have a negative impact on the environment and such a system is thus not easily evaded.

In Sweden, there are general requirements in the Environmental Code through the general rules of consideration. But an activity is only illegal if it's impact is not insignificant in the individual case. That is, for a municipality to enforce the boat owner's obligations the activity must have a negative impact on the environment.

Regarding B): the system described above can be complemented with requirements directed at the actual practices. In Germany there is such a system: the practices are regulated irrespective of their impact on the environment.

In addition to these systems, antifouling practices can also be targeted through **regulations on hazardous waste.** Paint residues, sludge and other assembled materials from the cleaning of hulls must be collected and due to the high concentration of hazardous substances must be treated in accordance with the rules for hazardous waste. This encompasses, inter alia, the transport and disposal of the waste by authorised companies. The municipalities are the relevant authorities on waste management, in all three countries. In most municipalities, chemical waste like dust and scrapings from leisure boats will have to be delivered by the boat owner or the marina at municipal waste facilities.

Private law arrangements

Requirements regarding the activities of boat owners and marinas may not only be established through **public law,** but also through **private law arrangements.** For boat owners' activities, this includes e.g. codes of conduct at boat clubs and marinas and berth rental contracts between the boat owner and the marina. Policies established by national or regional boat owner associations, as well as land tenancy contracts between the land owner, usually a municipality, and the marina, could possibly target both the activities of marinas and boat owners.

Annex I.
Swedish information point to Helcom Maritime (St. Petersburg, 10–12 October, 2017) and to Helcom Pressures (Tallinn 25th of October, 2017)

Baltic Marine Environment Protection Commission

Maritime Working Group — MARITIME
St. Petersburg, Russia, 10-12 October 2017 — 17-2017

Document title	Hull Detox and BONUS CHANGE – Reducing the use and presence of harmful antifouling systems on recreational craft
Code	7-x
Category	INF
Agenda Item	7 - Anti-fouling systems
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Submitted by	Sweden
Reference	

Background

Information about the two Swedish projects Hull Detox and BONUS CHANGE, with the aim to reduce the use and presence of harmful antifouling systems on recreational craft. These projects are carried out to fulfil Sweden's obligations under Regulation (EC) 782/2003 and Directive 2000/60/EG, as well as other national goals for the environment.

Action requested

Sweden invites the HELCOM member states to take note of the information and be inspired to join the aim of reducing the negative impact of harmful antifouling systems.

BONUS CHANGE Antifouling toxin spread to the Baltic Sea from leisure boat practices

Background

The continuous use of toxic antifouling (AF) paints containing the biocides copper and zinc on leisure boats in the Baltic Sea is a major environmental concern. It is becoming increasingly apparent that coming to terms with the spread of these toxins to the sensitive coastal areas of the Baltic Sea is urgent.

Leisure boating and antifouling

Leisure boating is contributing to the high levels of contaminants in the Baltic Sea. A staggering 3-3.5 million boats have their homeports in the countries bordering the Baltic. In particular, the use of toxic leaching antifouling paints that aim to deter settlement of marine organisms on constructions in the sea, continuously adds to the supply of biocides in the coastal ecosystem.

Marine biofouling is the colonization and subsequent growth of sessile organisms on all manmade surfaces in the sea, including boat hulls. Marine biofouling is made up of a wide range of organisms, i.e., slime-forming microorganisms, algae and invertebrates. The barnacle is considered to be the most serious fouler because of great difficulties in removing barnacle base plates from boat hulls. Biofouling increases drag and weight and thereby fuel consumption. Biofouling also decreases vessel manoeuvrability. Consequently, biofouling is a safety issue and a continual economic and technical problem for leisure boat owners.

Biofouling prevention methods

The first method of choice for leisure boat owners is the use of traditional toxic biocide paints containing copper and zinc. These paints that kill-off fouling organisms dominate the market of AF products. A typical biocide-based paint erodes slowly over time, giving rise to a slow, but controlled release of biocides in the water. Leisure boat marinas or harbours are sites of contaminant accumulation, due to their semi-enclosed nature which allows only limited water circulation. Waste oil, fuel, paints and solid waste are the main contaminants in such locations. In particular, AF paints are releasing toxic heavy metals such as copper and zinc into the water and studies have shown a high accumulation of these metals in sediment and biota from harbours.

Boating maintenance

The overall problem of the spread of AF toxins to the marine environment includes some important practices performed by the boat owners themselves; by service companies; or by marina operators that all contribute to the spread of AF toxins to the marine environment. These include:

Choice of AF paint (boat owners prefer paints with high copper content (30-35% (w/w))

When washing the hull at boat uptake with high-pressure hose (this method is intrusive to the paint film and makes higher amounts of copper and zinc to come off)

When sanding and scraping the hull before applying new paint (paint flakes and scrape-offs fall to the ground and is in the majority of cases not collected).

BONUS CHANGE conclusions

The BONUS CHANGE project has been working for 4 years to gather scientific results on how AF practices on leisure boats can be changed into sustainable practices (https://www.bonusportal.org/projects/viable_ecosystem_2014-2018/change).

The gathered results are now summarized in **7 statements regarding A) Regulation and B) Dissemination to relevant actors on how to move to sustainable practices:**

A) Regulation

1. Phasing-out of biocidal antifouling products in the Baltic Sea on leisure boats including adjacent freshwater areas until 2030
2. Reduce the copper content substantially in antifouling (AF) paints for leisure boat use and improve estimates of release rates used for risk assessment
3. Apply the Biocidal Product Regulation's articles and paragraphs which support a restrictive national implementation to restrict the use of biocidal antifouling systems by Baltic Sea member states competent authorities
4. Promote an initiative inside of HELCOM with reference to the Baltic Sea Action Plan goals on hazardous substances to make the Baltic Sea free from antifouling biocides on leisure boats through HELCOM recommendations
5. Improvement of antifouling practices and maintenance work in marinas through regulations and infrastructures in Baltic Sea member states

B) Dissemination campaigns

6. **Call to** paint less and paint only when necessary as a first step
7. **Promotion** of effective biocide-free alternatives by the Baltic Sea Environmental Agencies and Competent Authorities

What has the BONUS CHANGE project found?

- Biocide-free silicone paints have the same AF performance as high-copper content paints in repeated boat tests
- Low-copper content paints, i.e., 4.3 % copper, have the same AF performance as high-copper content paints in repeated field tests
- Release rates of copper (Cu) are significantly affected by environmental conditions (salinity), with increased Cu release rates with increasing salinity
- There is no correlation between the copper oxide content and the release of copper. The copper oxide content of an antifouling paint is therefore not a good predictor of Cu release rate.
- Static field panel tests combined with the new XRF method for AF paints is a highly promising tool for estimating realistic release rates of AF paints under natural environmental conditions.
- Studies in CHANGE have also revealed that release rates of copper from AF paints are not constant over a season and suitable time points for measuring release rates should be carefully selected
- Commercial paints with low-copper content have 100 % AF performance a second year without applying new paint. There is no need for painting every year
- The legal assessment in BONUS CHANGE concludes that there is room for restrictive interpretation of the Biocidal Products Regulation, like the one in Sweden, for all Member States in the Baltic Sea in article 19, Annex VI. The sensitivity of the Baltic Sea and the need for use of biocides such as copper are grounds that can be used for restricting biocidal AF paints in the sea
- Mechanical AF methods work equally well as toxic copper-containing AF paint in BONUS CHANGE's extensive field tests with boat owners
- Boat washers need to be part of the marina infrastructure or within convenient steaming/sailing distance
- Material infrastructure improvements needed for boat maintenance work to reduce spread of AF toxins to the ground and to the sea:

- the use of clearly depicted boat wash sites with water treatment facilities
- the mandatory use of tarps for trapping old paint scrapings and new paint droplets
- receptacles specifically identified for paint scrap collection in marinas

- Old TBT paint layers on leisure boats are still an environmental problem. There is a need for policy makers to address this issue
- XRF-screening detecting tin on boat hulls, is an indicator for organotin compounds
- Biocides used in antifouling paints affect marine organisms. Field studies have given us evidence of the toxicity of copper and zinc in marinas and guest harbours

BONUS
SCIENCE FOR A BETTER FUTURE OF THE BALTIC SEA REGION

BONUS CHANGE

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Aalto University

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