Antifouling biocides in German coastal & inland waters - How reliable are exposure prognoses of EU scenario models for marinas?

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Introduction

A prerequisite for robust modelling of environmental antifouling (AF) concentrations released from leisure boats is a reliable inventory of boats and the regional distribution of marinas and further mooring sites. For Germany, such area wide data were lacking so far. For that reason, a comprehensive survey was initiated, funded by the Federal Environment Agency (UFOPPLAN 2011, FKZ 3711-67 432) to close the gap for both, inland and coastal waters.

As initial milestone (WP1) an area-wide census of the number of leisure boats at berth in German waters was carried out to identify or quantify:

- the total amount of leisure boats which are predestinated for antifouling application,
- the relevance of water sport for inland fresh waters compared to coastal brackish and marine waters,
- the specific characteristics of marinas,
- additional infrastructure at the site, which may increase AF releases

The agglomeration of leisure boat parks on a regional or local scale

In a second work package (WP2), water concentrations of antifouling biocides currently in use and some selected breakdown products were screened in 50 selected marinas in order to demonstrate their variety found in German marinas at coastal and inland sites.

Finally (WP3) antifouling concentrations will be compared with those calculated by use of the model MAMPEC. Especially for freshwater sites the absence of available EU emission scenarios will be discussed on the basis of the situation in Germany.

Selected results from WP1 and WP2 are presented here. The project will be finalised end of 2014.

WP1 - Census

Material & methods

Sources: aerial photos, marina guides, nautical harbour charts etc.

Period: census reflects period 2009-12

Counting: berths for all boats being relevant for AF application, excl. small devices like dinghies and skiffs

Results

- c. 3,100 marinas with c. 206,300 leisure boats in total, relevant for AF-application, theretofrom:
- 146,400 (=71%) boats in freshwater,
- 54,100 (=26%) boats in brackish waters (sal <18‰),
- 8,500 (=3%) boats in marine waters (salinity >18‰)

Areas with a high density of leisure boats:

- on regional scale (=10,000 berths) (Fig. 1):
  - 5 freshwater sites (total ~102,500 = 50%)
  - 2 salt to brackish water areas (in total ~51,500 = 26%)

- on local inland scale (Fig. 2):
  - marinas & landing stages: often closed-packed at lakefronts & riverbanks
  - at slow running or stagnant inland waters: clusters of small marinas often exceed >1,000 berths in total

WP2 - Screening

Material & methods

Sites: 50 marinas from North to South of Germany representing all types & incl. salt, brackish & freshwater sites

Sampling: at 0.5 m water depth in the centre of marinas, filled in glass or plastic jars, metal samples filtered at 0.45 µm HNO₃ added on-site, pH, elect. conductivity +/- by use of field probes, secchi depth

Results

- Agents with positive results (> LoQ) (Fig. 5):
  - Organic AF agents: cybutryne & breakdown products (BDP) of cybutryne (M1), tolyfluanid (DMT), and dichlofluanid (DMOA) as well as the metals Cu & Zn

- Reasons for negative results (< LoQ)

  - agent specific LoQ was too high,
  - rapid degradation of parent substances
  - agent was not in use for leisure boat AF paintings

- In this survey, occurrence of cybutryne and its BDP M1 inside the marinas denotes that it is actually widely in use
- levels of PsP of 6 ng L⁻¹ and PpP of 20 ng L⁻¹ for cybutryne incl. all sites give reason for concern for the aquatic environment at least for some locations in areas with dense boat parks and under low flow or stagnant condition at freshwater sites there may be a concern for the aquatic environment at least for some marinas and - in case of clustered marinas - also for the adjacent water bodies.

Summary

A total stock of 206,000 leisure boats relevant for antifouling coatings on more than 3,000 sites was quantified (Fig. 1).

- Further extensive information on type, dimensions and infrastructure of the marinas was picked up (Fig. 3-4).
- Compared to marinas at the North Sea coasts, medium sized inland marinas were smaller, less often embanked, all most exclusively used for water sports and in- & out-of-season infrastructures with data.
- Berths at freshwater sites reached 71% of the total inventory, indicating their high relevance for German inland waters.
- More than 100,000 boats were found agglomerated at 5 inland regions (Fig. 1).
- Also on a local scale land and landing stages often string together like pearl necklaces at the waterside reaching clusters of 1,000 boats and more (Fig. 1).

The agglomeration of marinas on regional and local scale may increase the level of antifouling agents also in adjacent water bodies outside the marinas.

References

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