

# Impact of substratum colour on macrofouling

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## Background

Biofouling of ship hulls is a natural process which may cause detrimental ecological and economic problems (e.g. transport of invasive species, increased drag and therefore increased fuel consumption and higher CO<sub>2</sub> emissions etc.)

The most common way of preventing biofouling currently consists in the use of biocide-leaching antifouling paints. However, biofouling is a complex process which is affected both by the environmental conditions and by the physico-chemical properties of the substratum. Thus, antifouling paints have to be recoated regularly in order to maintain their efficiency and this leads to higher levels of pollution, especially in harbours.

The **aim** of this study was to observe the effect of substratum colour on the settlement of different macro-organisms in brackish water.

## Materials and Methods

**Study area:** Askö, Sweden (reference area, not polluted by antifouling paints).

- Water salinity ~ 6.5 psu (brackish water).

**Colours tested:** black, blue, red and white (the most common colours of boat hulls).

**Substratum control:** transparent (colourless) panels.

**Source of plastic:** food packaging ('non-toxic').

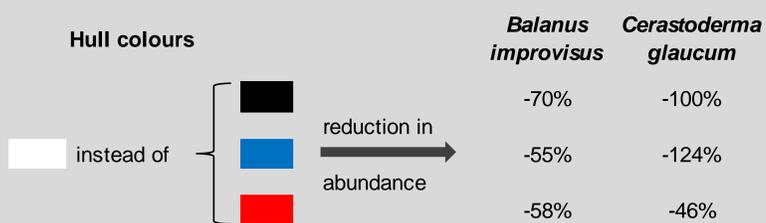
**Setup:** Panels with an area of  $69.4 \pm 15.2$  cm<sup>2</sup> were tied on a PVC tube and immersed in a vertical position, at a depth of 1.5m, facing either North-East (NE) or South-East (SE).

**Exposure time:** 21 days, during which light and temperature were continuously measured.

**Endpoints:** identification and counting of the main macrofouling organisms and determination of the total dry weight of each biofouling sample.

## Implications

Provided that the active ingredients\* in paints are the same, paints of lighter colours (white) may be 9 % or 17 % more efficient in preventing biofouling, compared to black or red colours, respectively (in terms of total, dry biomass).



In order to minimize the detrimental effects on the environment, we recommend using coatings of lighter colours instead of increasing the amounts of biocides in antifouling paints, especially in more sensitive areas of low salinity, where biofouling is not as severe as in truly marine environments.

\*It is important to keep in mind that the actual formulation of the active substance in the paint (e.g. copper thiocyanate vs copper oxide) can lead to very different levels of biofouling, in which case the effect of surface colour might not be observed.

## Results and Discussion

The main macrofouling organisms identified (and percentage occurrence on all panels):

- Green algae: *Ulva* sp. (83 %) and *Cladophora* sp. (85 %)
- Crustaceans: *Balanus improvisus* (69 %) and ostracods (54 %)
- Molluscs: *Cerastoderma glaucum* (51 %).

**There was a significant effect of substratum colour on biofouling, with both barnacles and clams preferring darker colours (fig.1).**

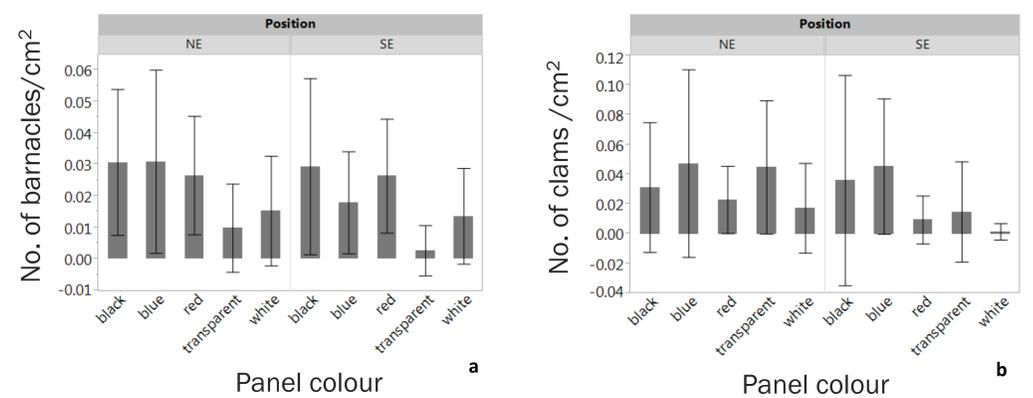


Figure 1ab. Average densities of barnacles (a) and clams (b) found on plastic panels of different colours, facing NE or SE; error bars indicate standard deviations

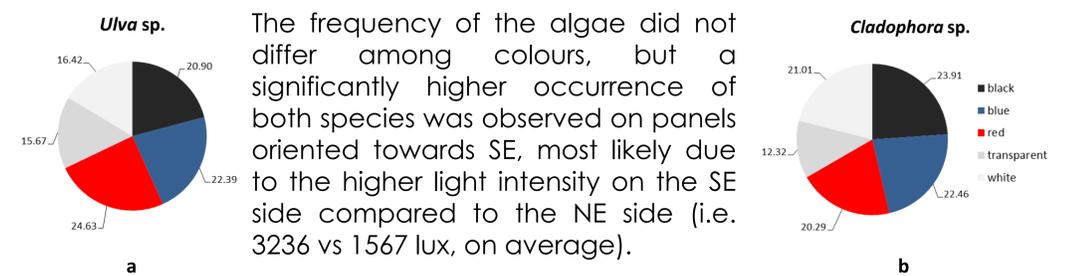


Figure 2ab. Frequencies of green algae found on plastic panels of different colours

Significantly lower densities of *Balanus improvisus* were found on panels on which the algae *Ulva* sp. and *Cladophora* sp. were present, indicating competition for space between these species (data not shown).

The figures below show the relative abundance of the main groups of macro-organisms identified on each colour.

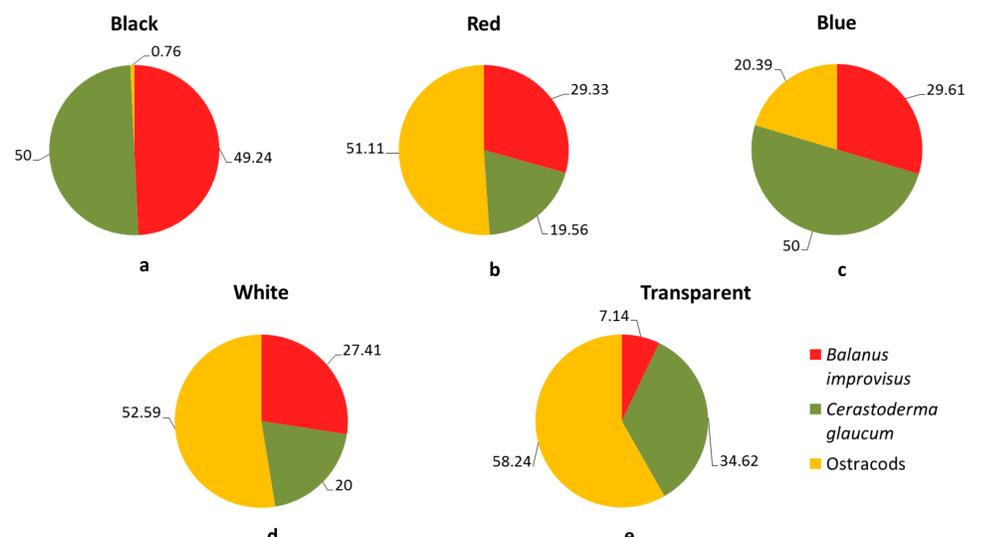


Figure 3abcde. Relative densities of *Balanus improvisus*, *Cerastoderma glaucum* and ostracods found on plastic panels of different colours