



FOULING AND ANTIFOULING IN AQUACULTURE – A REVIEW

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CRAB

- CRAB: Collective Research in Aquaculture Biofouling
 - Objective: non-toxic antifouling strategies for the European Aquaculture Industry



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The Problem

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5 -10% industry value, up to
€260 million per year



Review

- Define & identify the biofouling problem
- Identify present state-of-the-art
- Identify technologies that could be transferred from other industries
- Help select strategies to be tested within the CRAB project

Tools

- Questionnaire for finfish and shellfish farmers in English, French and Spanish
- Literature review
 - Internet searches (web searches, patent offices, aquaculture institutes and organisations)
 - Consortium partners
 - Peer and non-peer reviewed literature
- Interviews
 - Industry groups
 - Manufacturers of infrastructure
 - Industry workers

Fouling in Aquaculture I

■ General Problems

■ Direct

- Reduction in water flow up to 100%
- Increase in weight of infrastructure up to 11 times
- Competition for food with stock species
- Decrease in product value up to 90%

■ Indirect

- Increase in labour up to 20%
- Increase in production costs up to 80 000€ per farm and year
- Harbours of disease organisms

Fouling in Aquaculture II

■ Extent

- Equipment/stock specificity (e.g. scallop farm in SW-Ireland: algae on ropes, tube worms and barnacles on trays)
- Variable for different species/regions (e.g. N-Norway mussel and hydroid problem, S-Norway ascidian problem)

■ Timing

- timing data very basic (e.g. more fouling in the warmer months)

Fouling in Aquaculture III

- Top 6 fouling groups:
 - Mussels (e.g. *Mytilus edulis*)
 - Algae (e.g. *Laminaria saccharina*)
 - Barnacles (e.g. *Megabalanus* sp.)
 - Tubeworms (e.g. *Pomatoceros* spp.)
 - Ascidians (e.g. *Ciona intestinalis*)
 - Hydroids (e.g. *Obelia* sp.)



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Fouling in Aquaculture – Specified I

■ Groups

– Algae

- Problems for infrastructure/equipment
- Increase in weight

– Tubeworms

- Problem for stock
- Reduction in shellfish value (downgrade from class A to B, 730€ per tonne less)

– Mussels

- Problem for infrastructure/equipment
- Increase in weight
- Competition for food



Fouling in Aquaculture – Specified II

■ Groups

– Barnacles

- Problem for stock
- Reduction in shellfish value
- Problem for infrastructure

– Ascidians

- Problem for stock
- Problem for infrastructure
- Competition for food
- Reduction in shellfish growth
- Disease (e.g. Amoebic Gill Disease)



Antifouling Strategies I

■ Cleaning = Physical Removal

- Burning
- Air drying (1 empty cage needed = 15% of total volume)
- Immersion in hot water/brine/freshwater
- Scraping/brushing (in Portugal: 6 persons per day, 210€; up to 20% of product value)
- High pressure washing (approx. 1000€)
- Net Washers (start from 150000€; net washing station starts at 1 million €)
- Cleaning disks (up to 30000€)
- Pergolari Washer



Antifouling Strategies II

■ Biological control

- e.g. Fish, crabs, snails, sea urchins

■ Chemical control

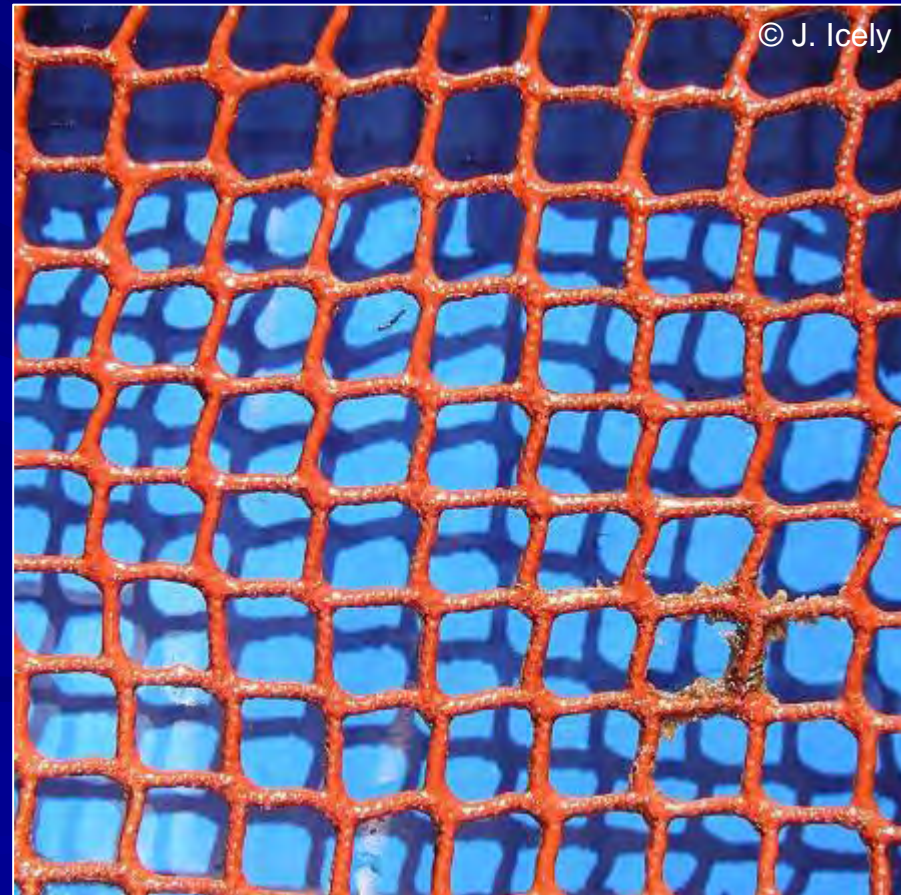
- Acid
- Coatings (e.g. copper, copper oxide, zinc oxide & halogenids)

Cost: 3€ per kg net
2000€ per cage



Antifouling Strategies III

- Strategies from other industries that can be adapted
 - Biocide free coatings
 - Foul release
 - New types of coatings
 - Ultrasound
 - Electricity
 - UV



Conclusions

- Large gaps in printed knowledge
 - Essential:
 - Questionnaire
 - Fouling baseline study
- Type of fouling problem variable
- Fouling control limited to cleaning, husbandry and copper-based coatings
- Not much is known about actual costs
- Unhappy farmers



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