# FOULING AND ANTIFOULING IN AQUACULTURE – A REVIEW


Simone Dürr

School of Biology and Psychology
Division of Biology
Newcastle University
UK

Douglas I. Watson

Aquaculture & Fisheries Development Centre
Dept. Zoology, Ecology & Plant Science
University College Cork
Ireland

D. Watson, D. Beaz, E. Bergtun, R. Breur, J. Cebria, J. Davenport, D. Fowler, C. Hough, J. Icely, A. Lane, J. Maguire, A. Manjua, M. Marhuenda, K. Maroni, J. McElwee, H. Mortensen, D. Murphy, J. Murphy, J. Newman, A. Pereira, J. Power, S. Prieto, J. Thomason, J. Watters, P. Willemsen

# CRAB

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


www.crabproject.com

# The Problem



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

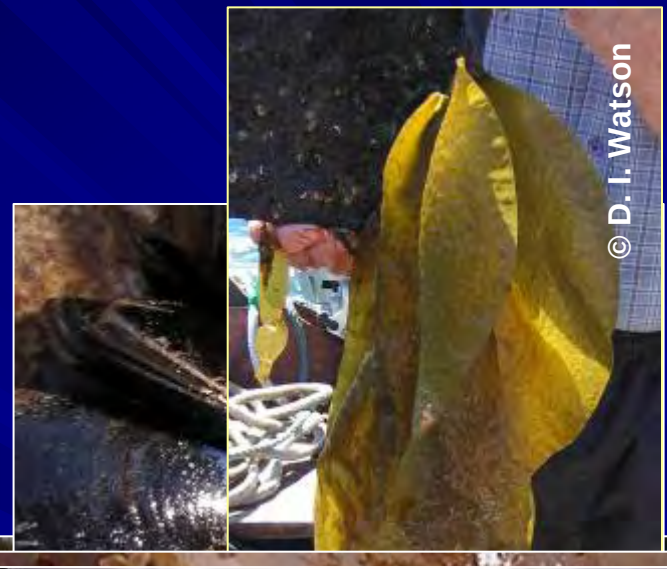
- General Problems
  - Direct
    - Reduction in water flow up to 100%
    - Increase in weight of infrastructure up to 11 times
    - Competition for food with stock species
    - Decrease in product value up to 90%
  - Indirect
    - Increase in labour up to 20%
    - Increase in production costs up to 80 000€ per farm and year
    - Harbouring 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.*)





© S. Dürr

# 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

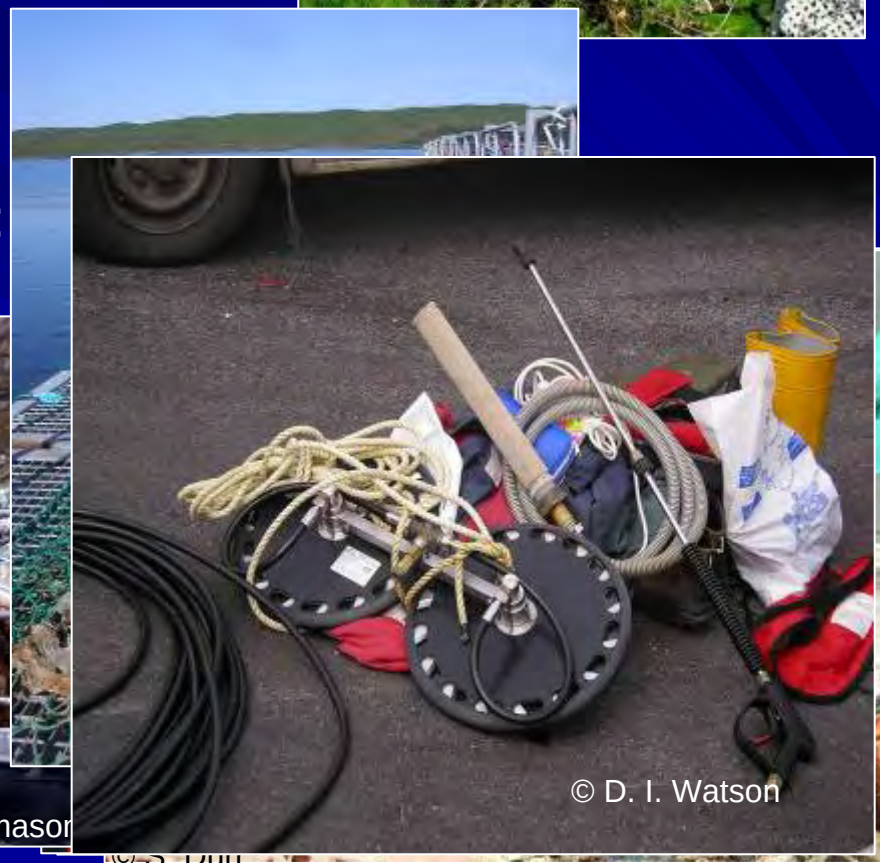

# Fouling in Aquaculture – Specified II

- 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 pr (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

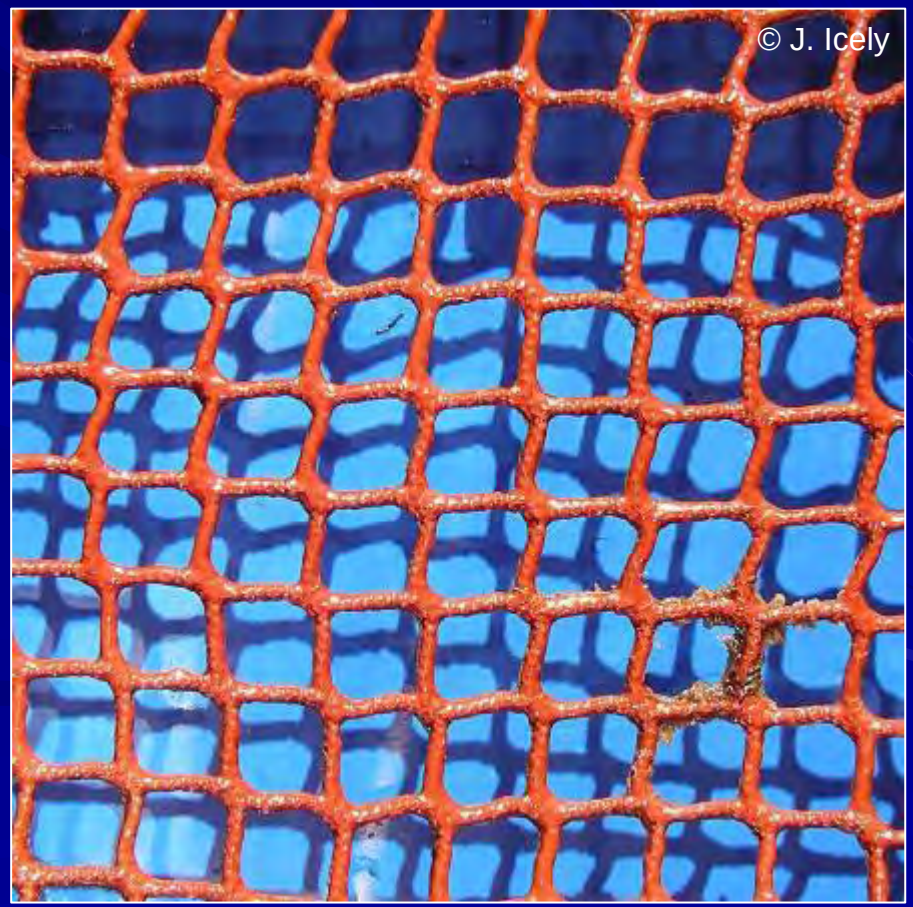


- Chemical control
  - Acid
  - Coatings (e.g. copper, copper oxide, zinc oxide & halogenids)

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

# Acknowledgements


- Thanks to all those who provided information for the review. A special thanks to all the aquaculture farmers who filled out the questionnaire or provided other information
- Financed by EC contract COLL-CT-2003-500536-CRAB (Collective Research, FP6)
- www.crabproject.com
- Contact: s.t.duerr@ncl.ac.uk