The Road from Approval to Compliance

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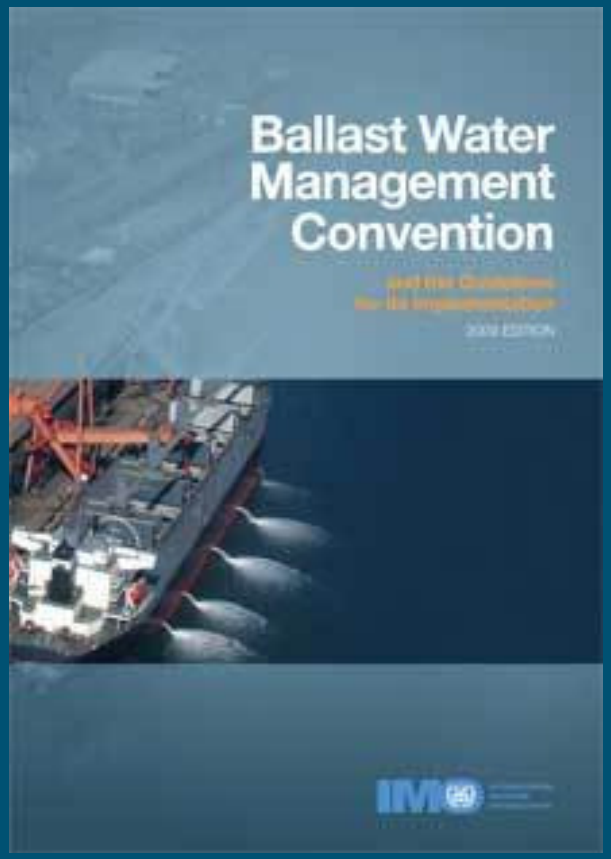
Ballast water treatment



- 2004 Ballast Water Management Convention
- 14 guidelines
- G8 ‘Type approval’
- G9 ‘active substances’

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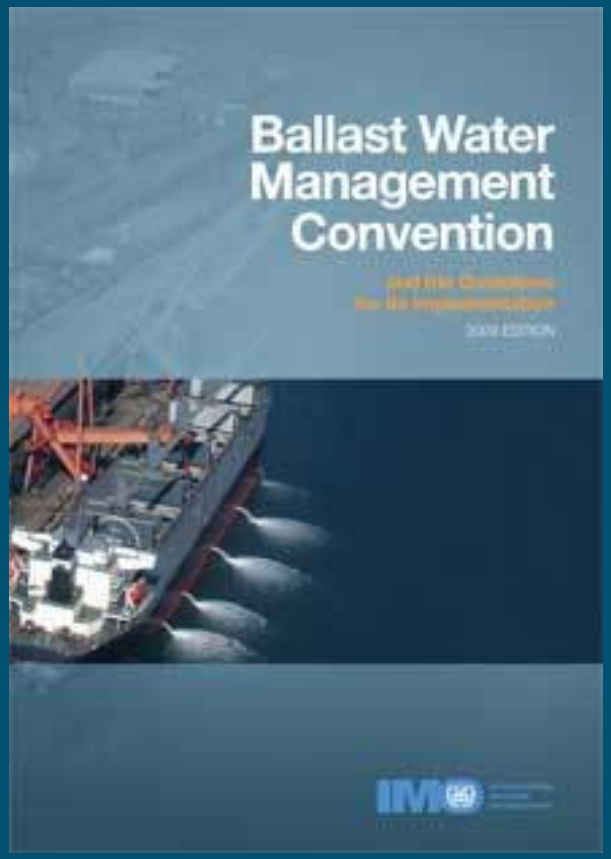
Ballast water treatment



- Entry into force 12 months after ratification by 30 states representing 35% of world merchant shipping tonnage
- 30 sept 2010:
  27 states
  25.3%

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Goal of the International Ballast Water and Sediment Convention

- Reduce the number and rate of invasions of species outside their native range

Challenges in developing BWMS

- Be very efficient in removing or killing organisms, without posing an environmental risk at discharge

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From Approval to Compliance

- Check Efficacy:
  - Was the treatment successful?
  - The search for the most insensitive species
- Check Environmental Risk:
  - Is there residual toxicity?
  - The search for the most sensitive species

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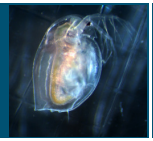
Efficacy testing – Regulation D-2

ORGANISMS	Start of experiment (inlet water)	Discharge After treatment	Discharge Control water
10-50 µm 	1000 viable/ml (10^6 viable/l)	<10 viable/ml	>100 viable/ml
>50 µm 	100 viable/l (10^5 viable/m^3)	<10 viable/m^3	>100 viable/m^3
Vibrio cholerae (O1, O139)	-	<1 cfu/100 ml	>10 cfu/100 ml
Escherichia coli	-	<250 cfu/100 ml	>2500 cfu/100 ml
Enterococci	-	<100 cfu/100 ml	>1000 cfu/100 ml

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Efficacy testing - Barnacles

Cyprid larvae survived chlorine treatment

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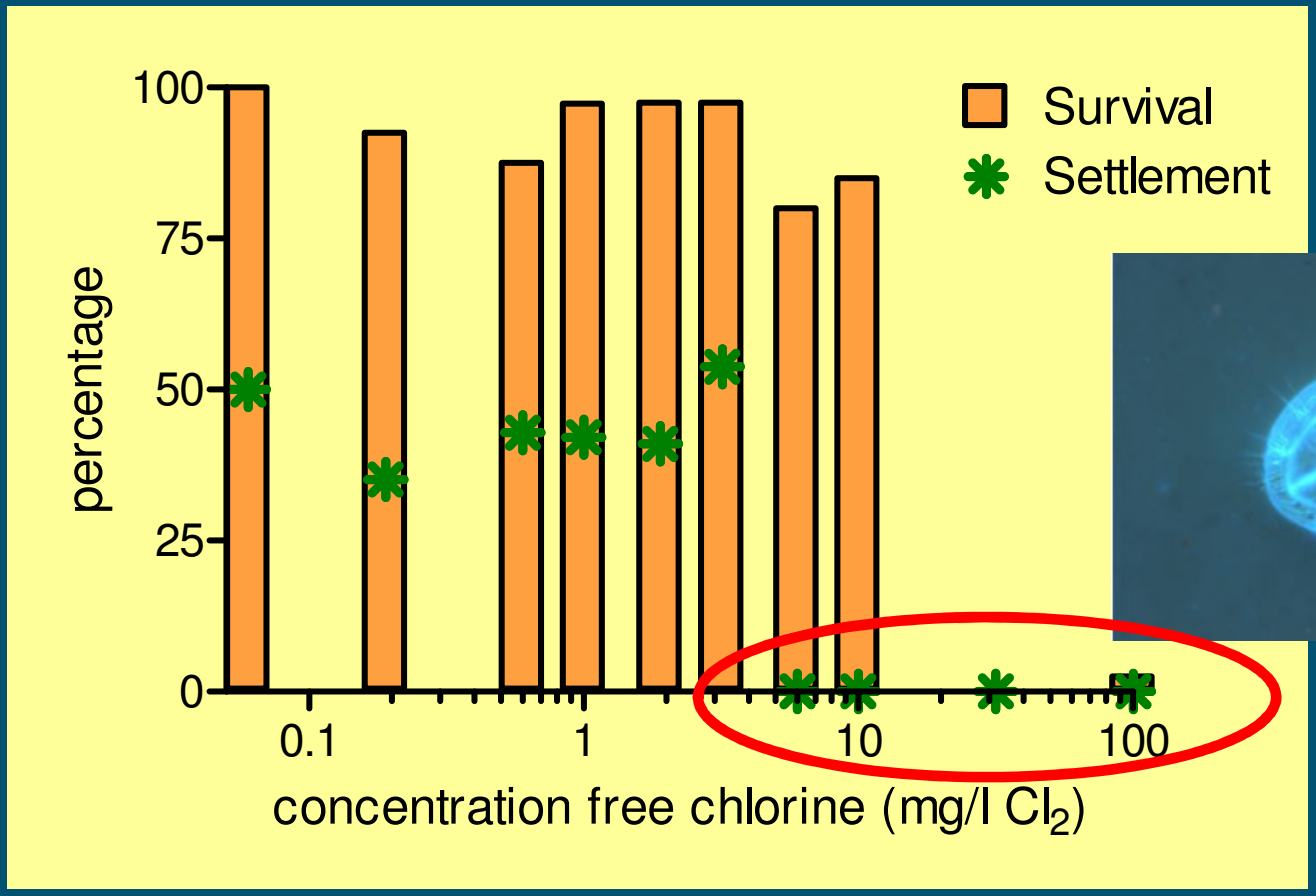
Efficacy testing - Barnacles



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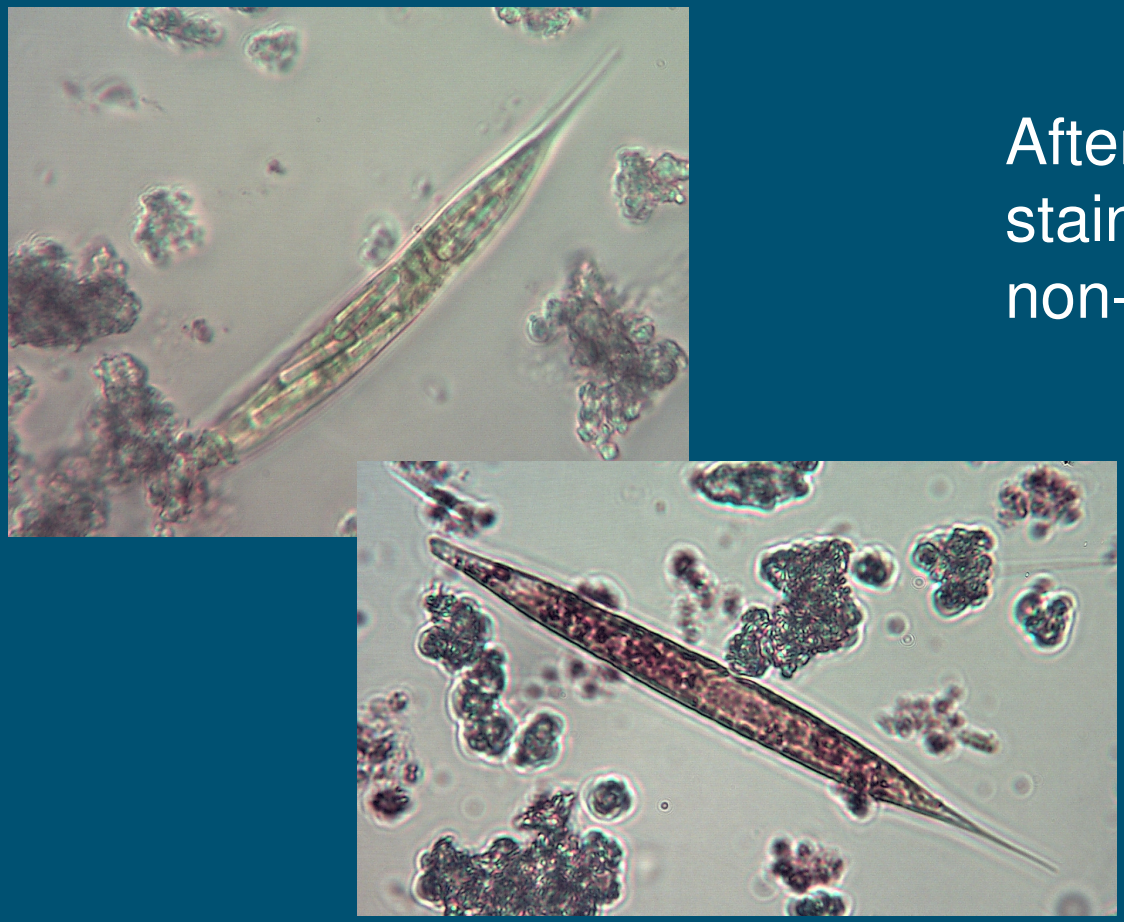
Efficacy testing - Algae



After treatment staining showed only non-viable algae

Staining technique:
Neutral red

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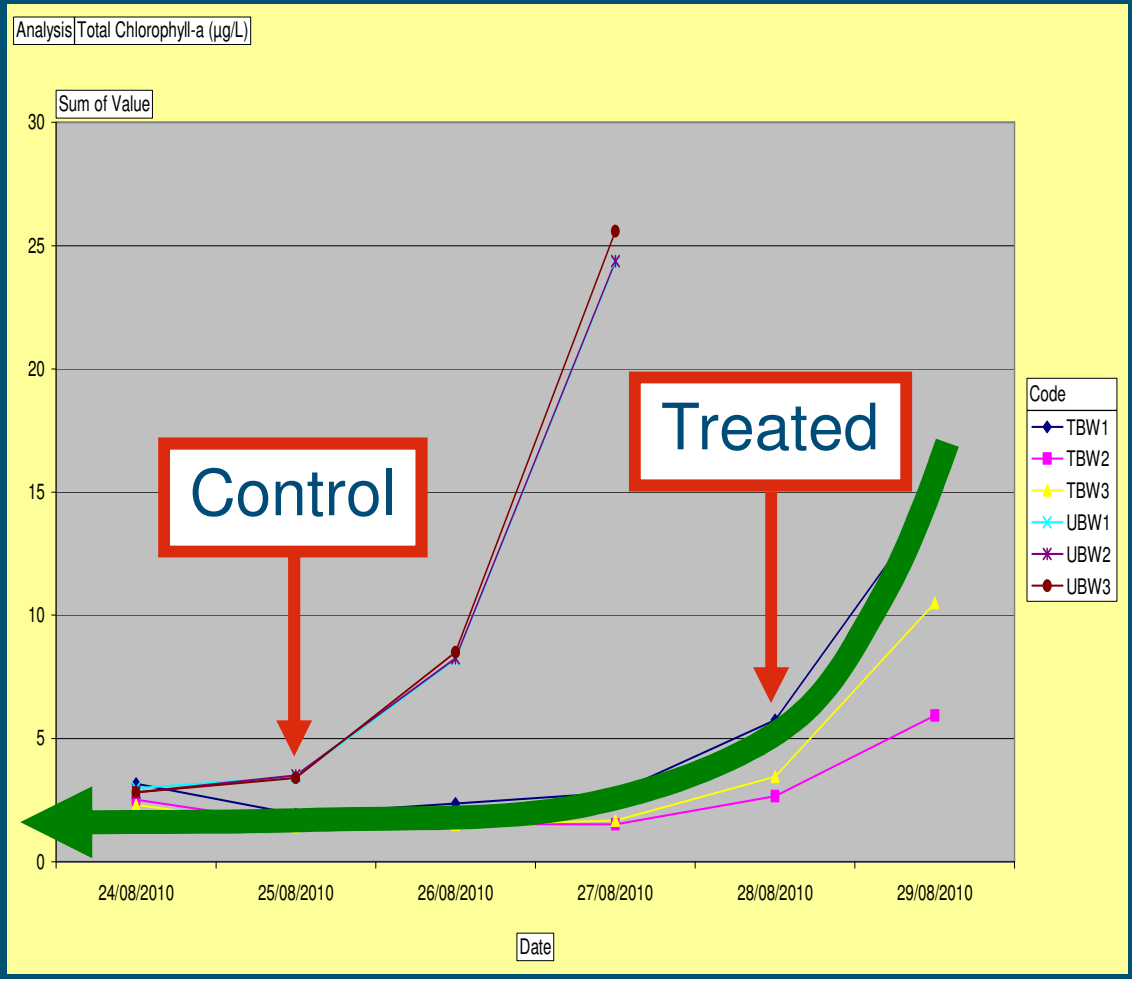
Efficacy testing - Algae



- Re-growth tests show vigorously growth after a few days

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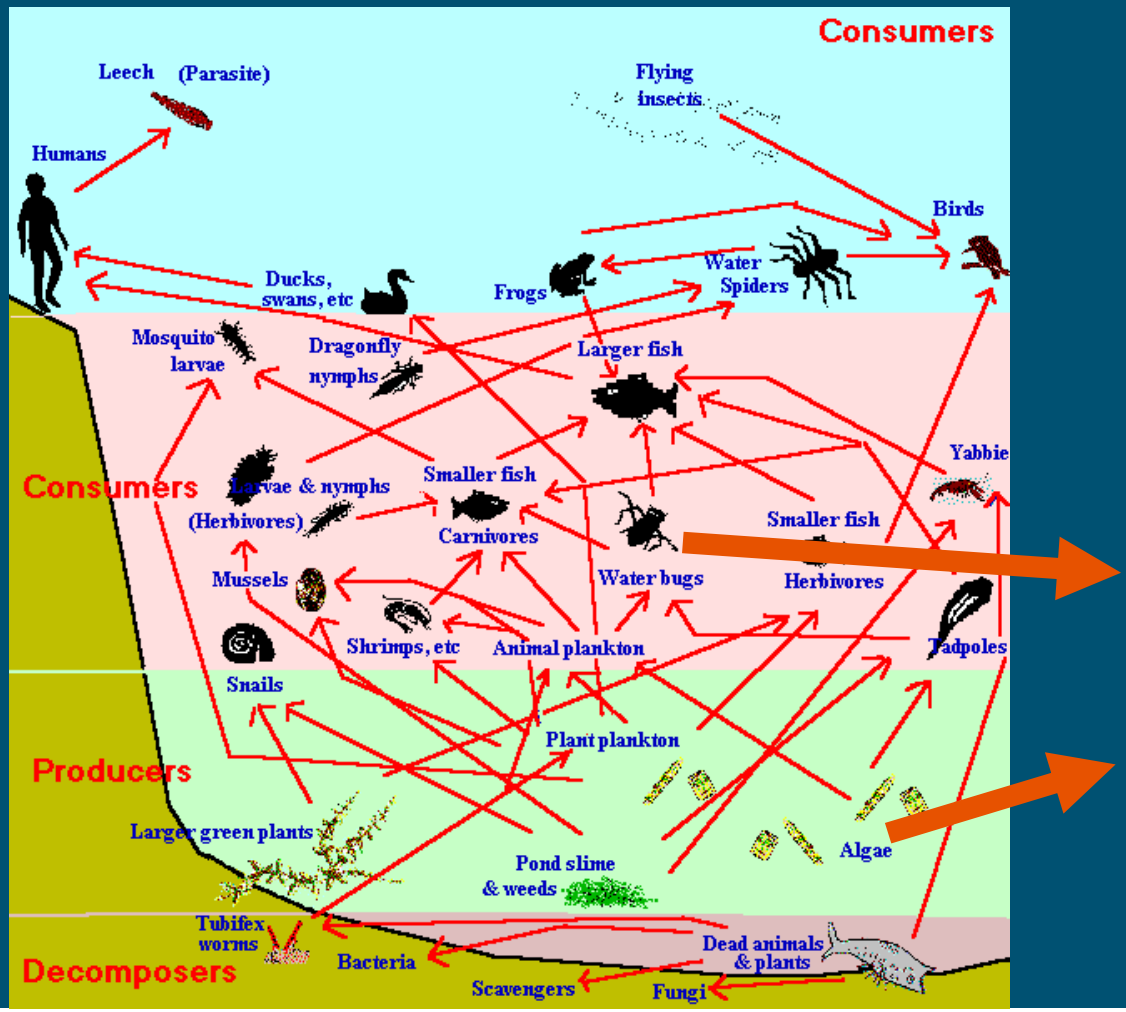
Environmental Risk – Toxicity testing

Determining no negative effect to environment



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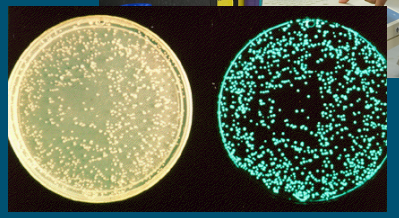
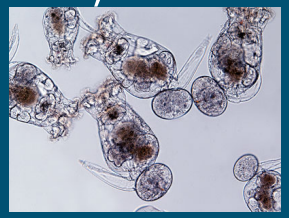
Environmental Risk - Bioassays



- Bacteria
- Micro algae growth inhibition
- Crustacea (Daphnia, Artemia, Acartia)
- Rotifera
- Oyster larvae
- Fish



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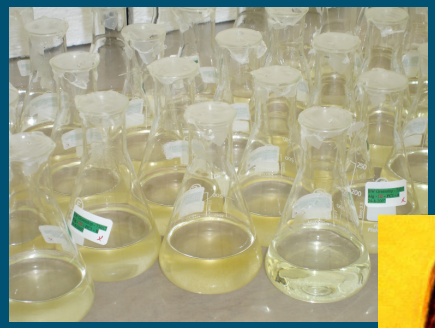
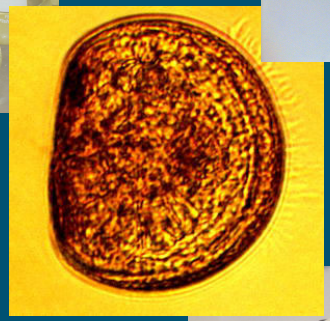
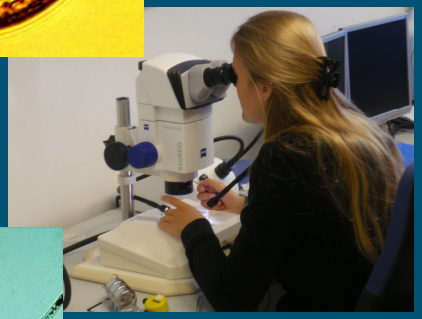
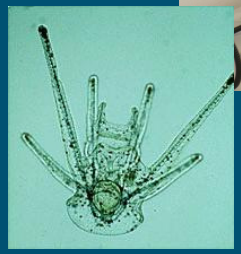
Environmental Risk - Bioassays

Endpoints in tests:

- Mortality
- Immobility
- Development
- Reproduction/growth inhibition
- Luminescence inhibition
- Morphological change



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Ecological risks - Bioassays

Standardised	Single substance
‘Easy to use’	Lab conditions
Comparable results	Effluents difficult
QA	Timing
Accepted	Field relevance?

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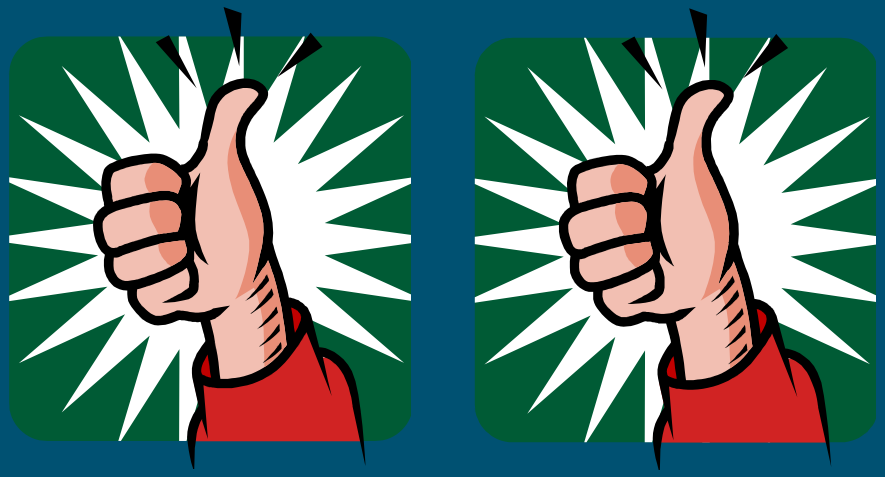
Compliance monitoring

Two questions:

- Was the treatment sufficient?
- Is there no risk at discharge?



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Compliance monitoring – Type Approval

Standardized test requirements
vs.
Variability in harbour conditions

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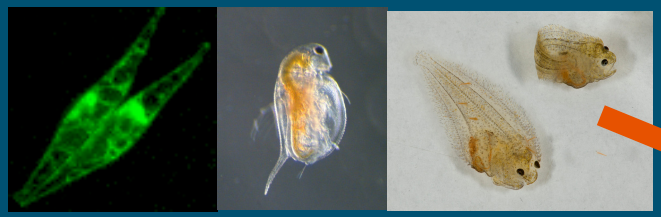
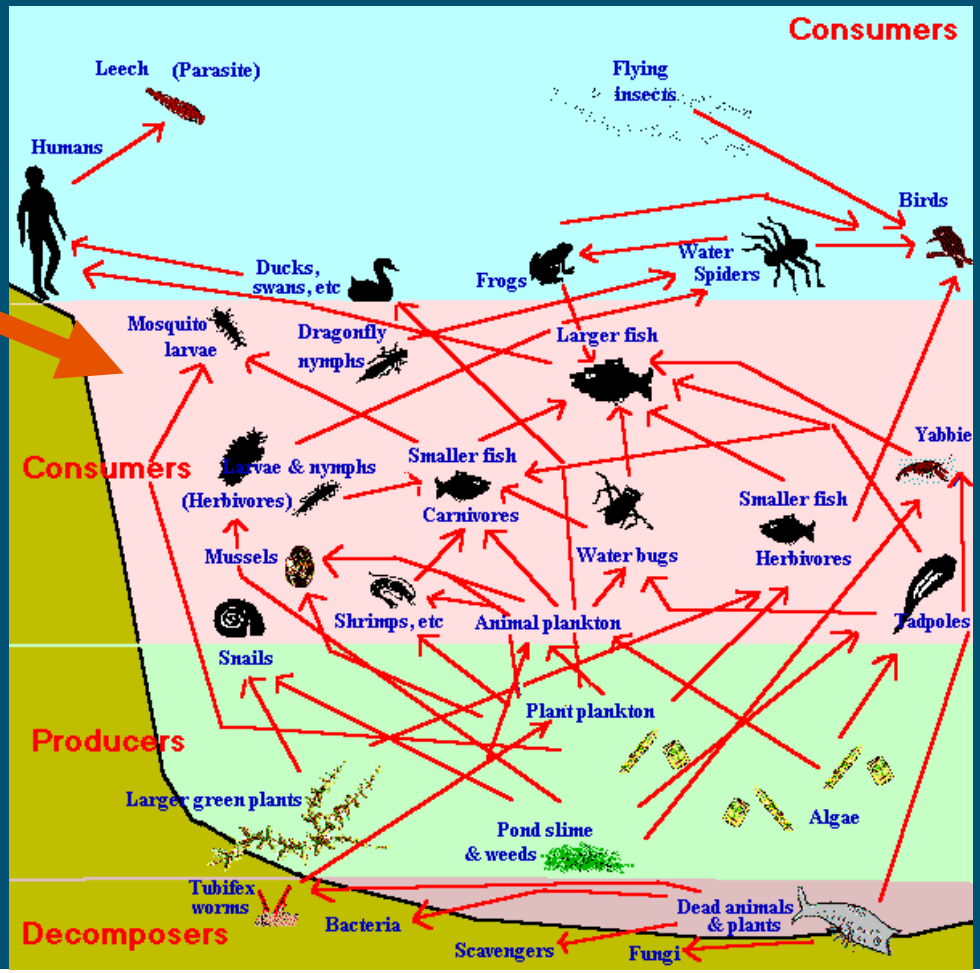
Compliance monitoring – Type Approval



- Bioassays vs. wide variety of ecosystems



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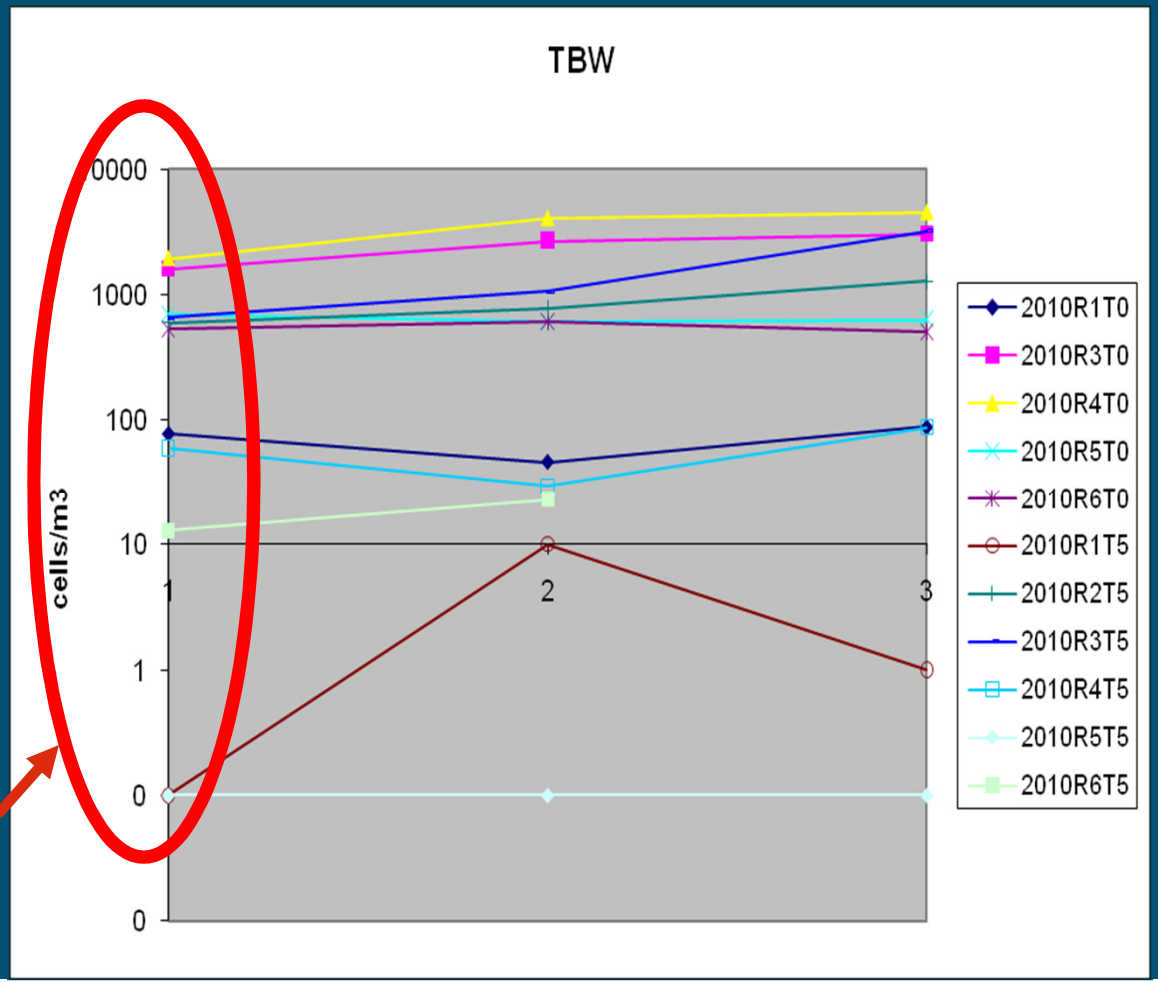
Compliance monitoring – Efficacy testing

- >50 µm from land based testing
- Replicates
  begin-middle-end

One sample already indicative for success



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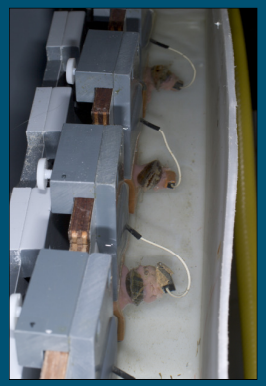
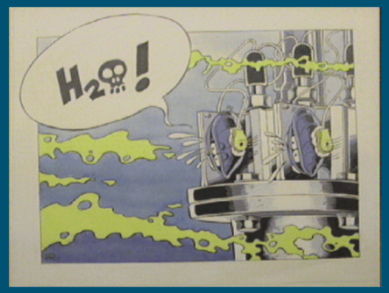
Compliance monitoring – Environmental Risk

- Chemical analysis
- Bioassays
- Screening assays
- BEWS





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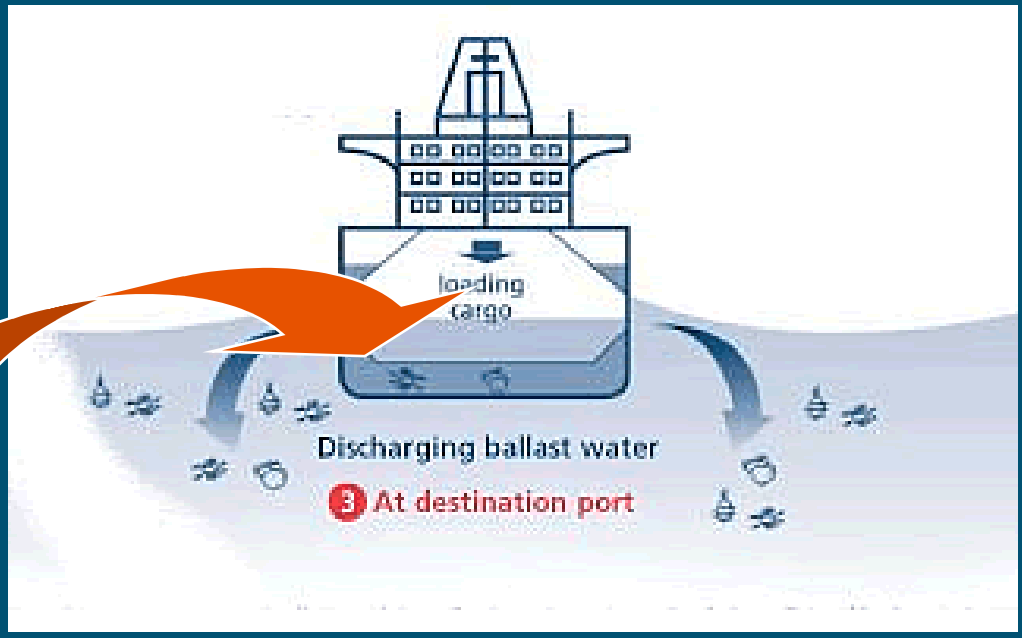
Blowing smoke

- What about toxicity of the water taken in?



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Thank you!

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