

Danish Experience on Recirculation – From the AquaCircle network

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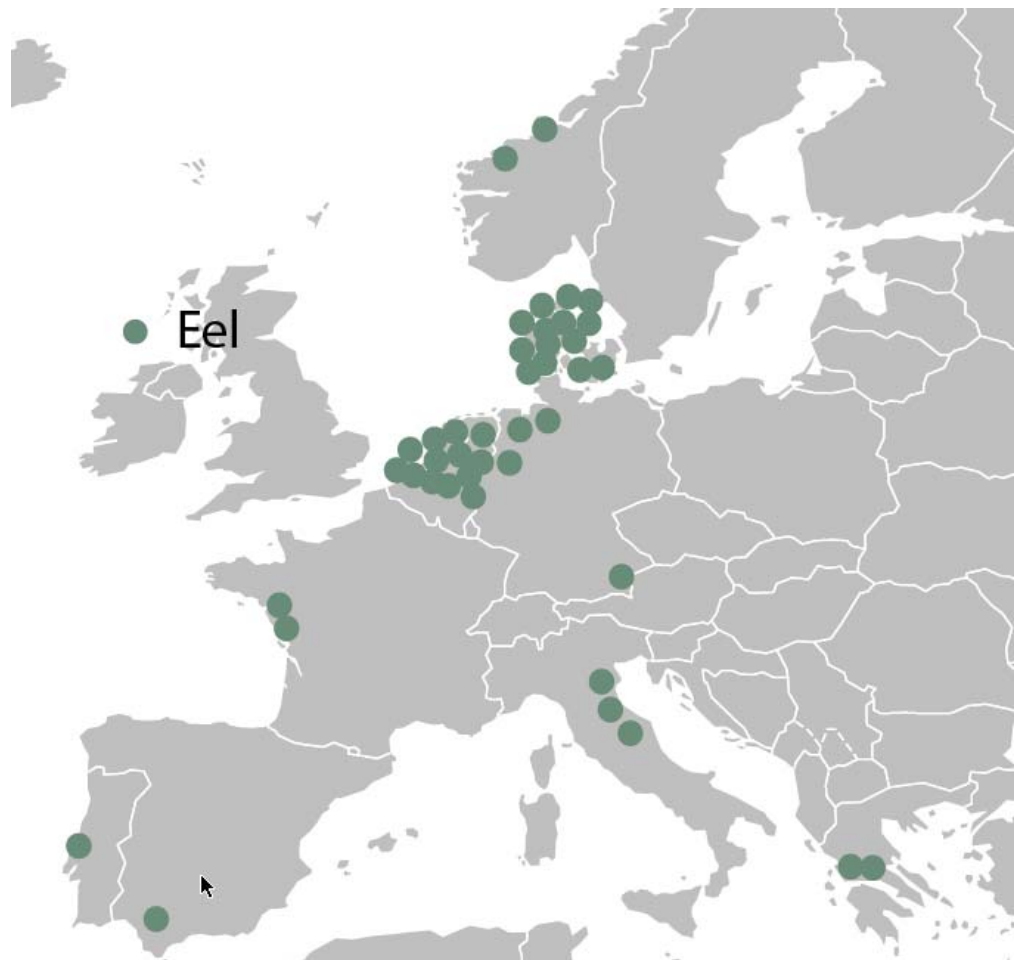
How it All Started

- The Dream of Eelfarming in Denmark
 - Frederiksværk Åleeksport
- Energy Conservation
 - Not water nor Environment
- Danish Shell: Diversification
- Early Eighties
- A 20 tons / yr pilot facility constructed in Hørsholm



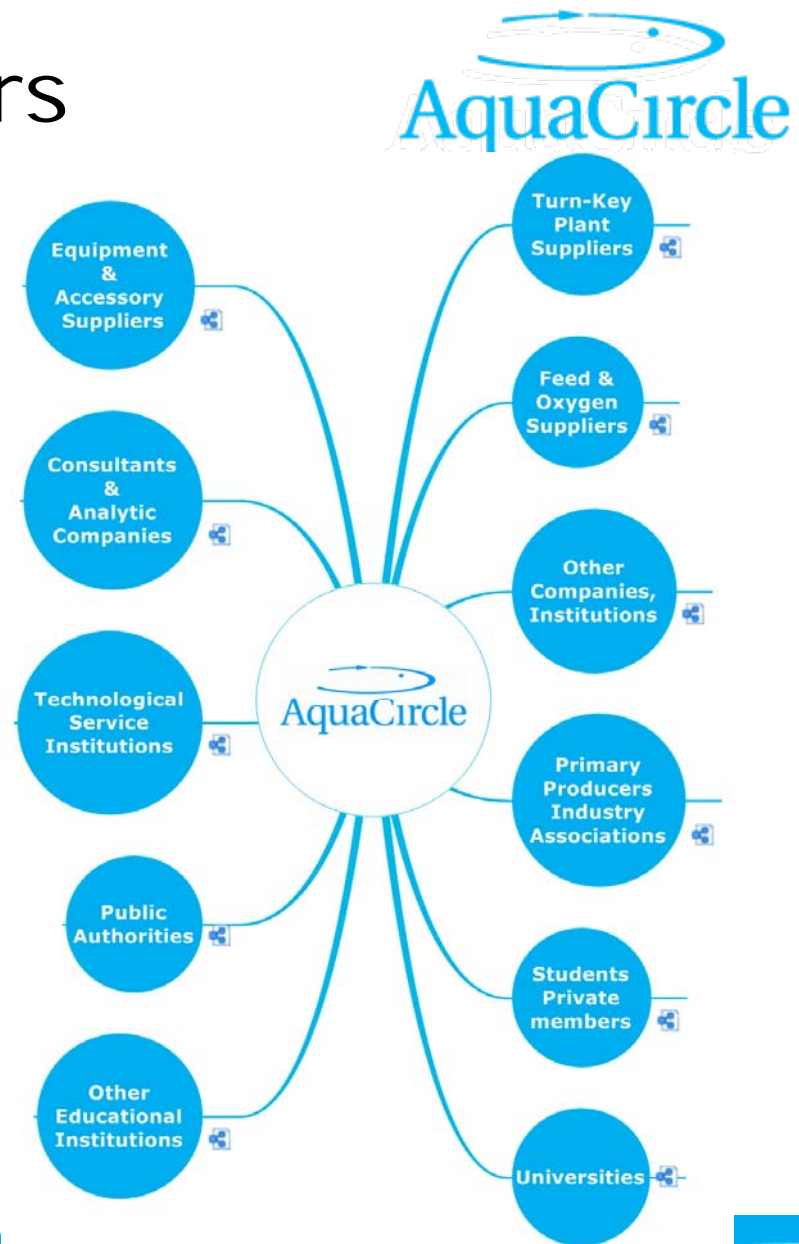
What Happened? Eels in Europe

- A capacity of up to 10.000 tons/yr
- Mainly supplied by AquaCircle members
- Eelfarming now in jeopardy
 - Too few Glasseels

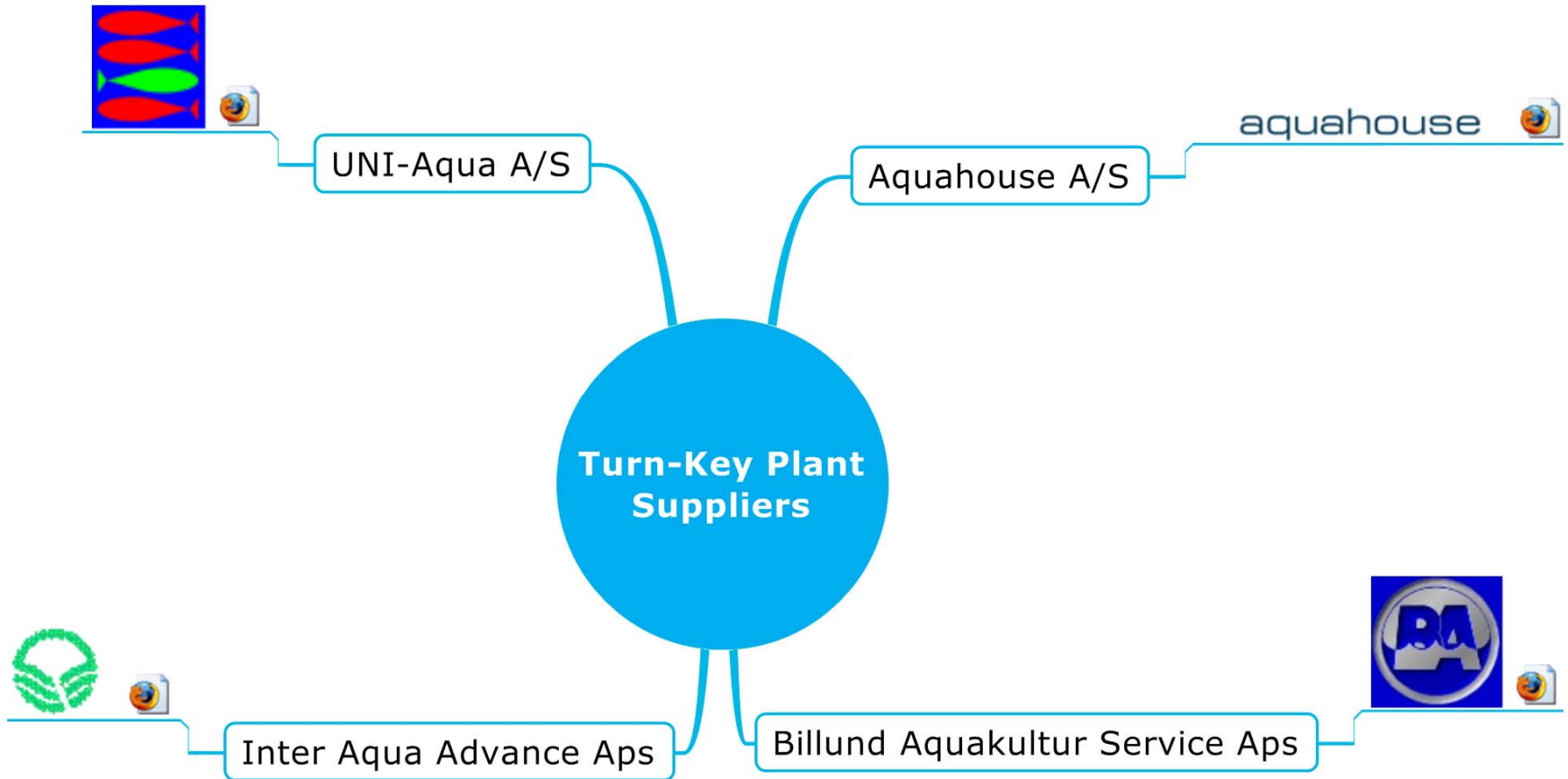


AC Equipment Suppliers Business

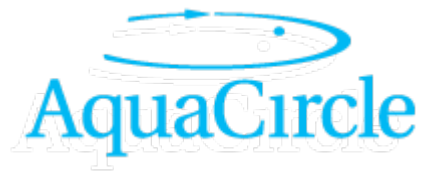
- 174 Installations
- Production Capacity: 25-50.000 Tons/yr
- Smolt Capacity: 340 million Smolt/yr
- Turnover: App. 250 mio. Dkr/yr



AC Turn-Key Suppliers Group



World of AquaCircle: 174



AquaCircle in Chile



Salmon Smolt in Europe: 13



Modeldambrug: Recirculation in Fresh Water Ponds



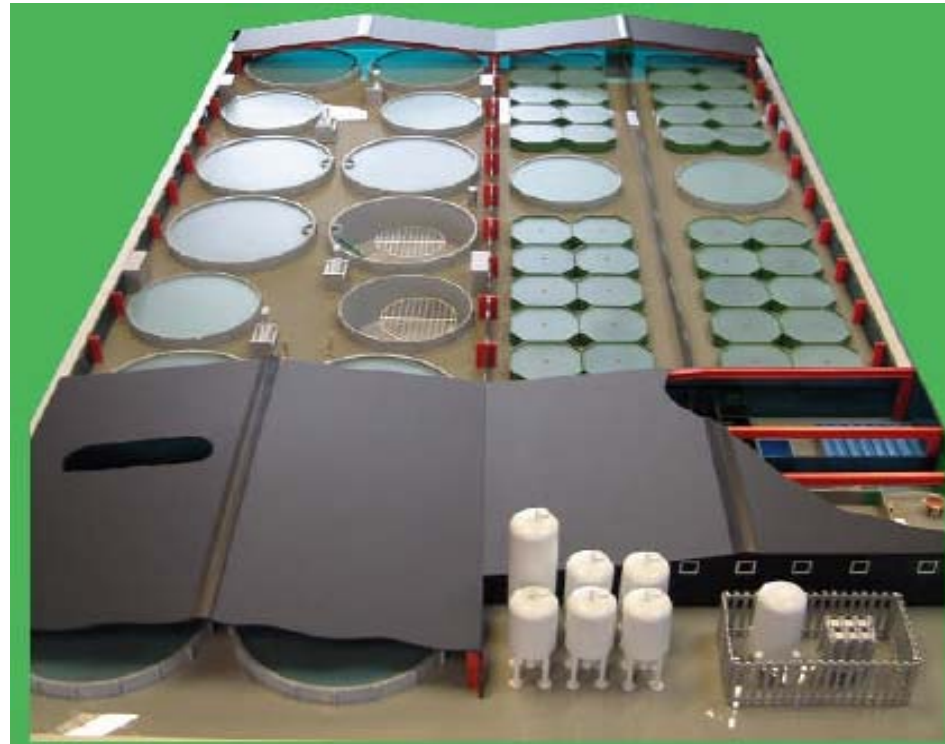
- 3 times more fish with 10 times less water
- Economy is ok



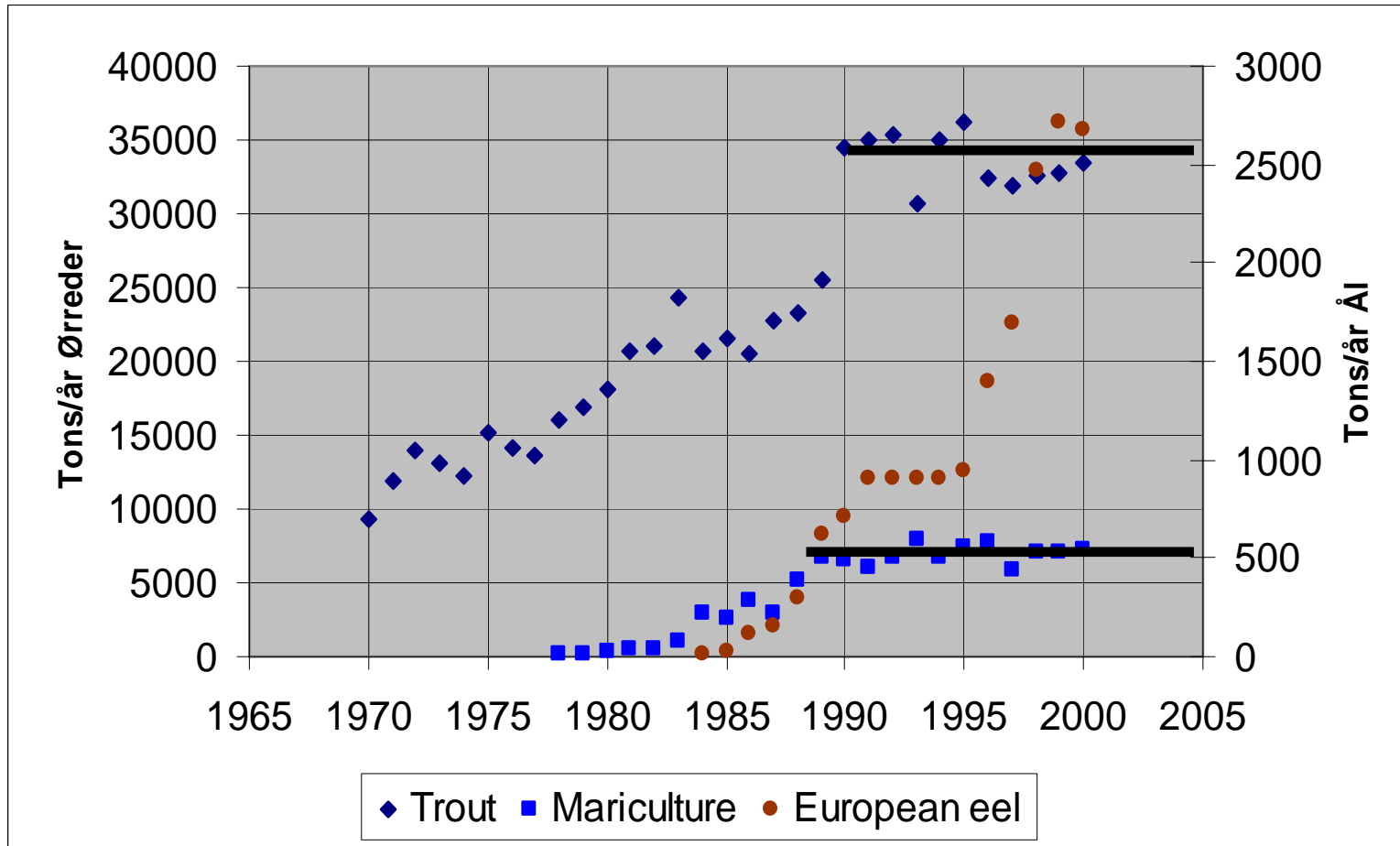
FREA: Fully Recirculated Trout Farm to be Constructed



- Capacity 3000 tons small trout/yr (350 g)
- Water Exchange: 25-75 l/s
- Production costs inclusive finance/depreciation: 13 Dkr/kg



AC Start: The Sorry State of Danish Aquaculture?



Stagnation! Misguided Environmental Concerns

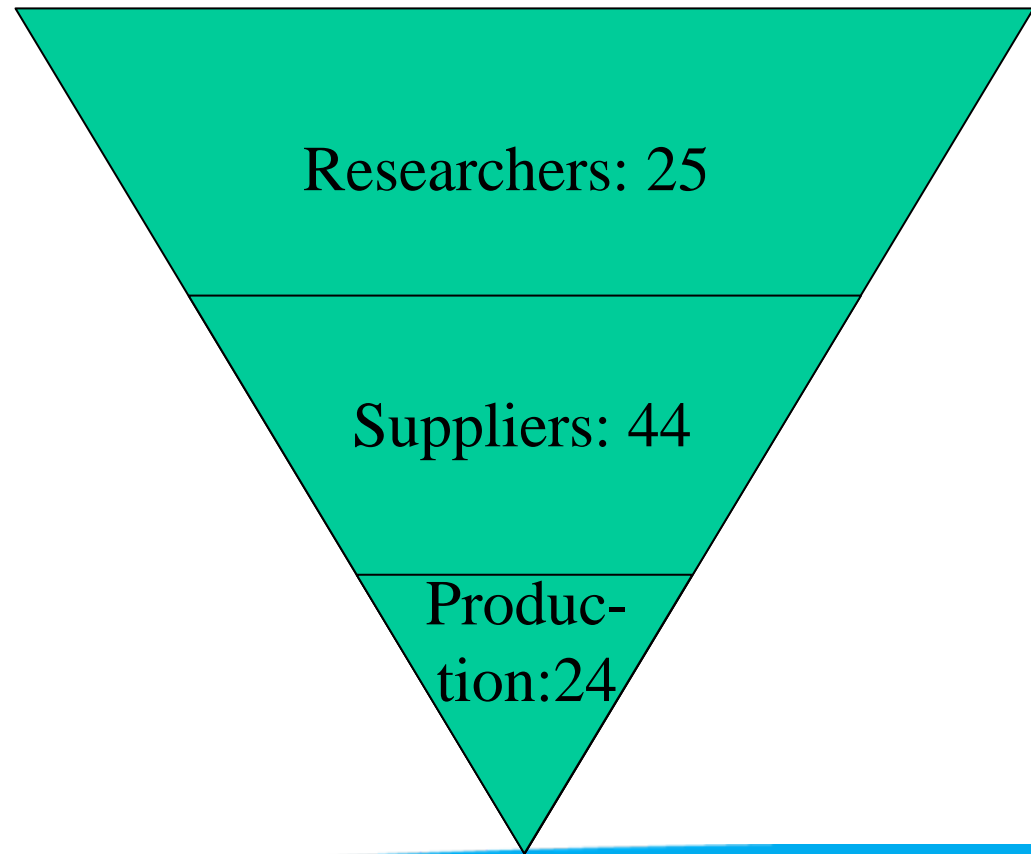
Industry & Politicians Acted

1. Fresh water & Seafarm National Committees reported 2002 & 2003
2. Recommended R/D in recirculation
3. Konference on: *"Need & Opportunities for establishment of a Danish Center of Knowledge for recirculation technology in aquaculture"*. Over 100 participants from the sector (autumn 2005).
4. Industry took the drivers seat
5. And is now providing the R&D needs



Can Norwegians Take Advice☺

- Existing Situation: Reverse Pyramid
- R&D reversely correlated with production?
- R&D only one important industry factor
- The equipment suppliers and farm managers know best!



New Experimental Fish Farms Are Expensive Toys!?

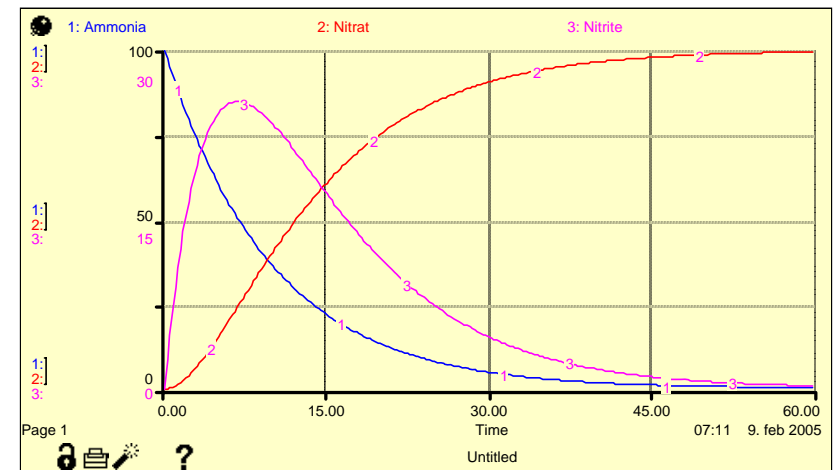
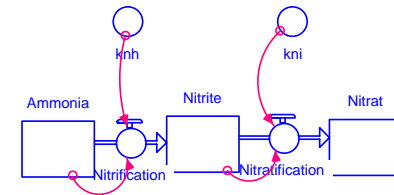
- Is it necessary to build new pilot scale facilities?
- Do they have to be situated in far away places?
- And how to choose suppliers in a professional manner
- Does a Norwegian experimental farm necessarily have to be supplied by a Norwegian Company?
- Can we make a Nordic project? European: EATP



Benchmarking / Auditing

Ru
n

- There are many recirculated farms out there
- How do they do?
 - Design capacity > < Realised capacity
 - Projected economy > < realised economy
 - Impartial benchmarking / auditing is needed
- Better and more complete measurements on existing farms



Call for the Engineer

- The suppliers, often biologists, are:
 - Empirical
 - Somewhat calculation challenged
- We need hard-core engineers
- To make mathematical models of the fish farm and the treatment processes
- Using on-line measurement equipment to know the dynamics

Kinetik i biofiltre

0. ordens proces i biofilm

Omsætning i vandfasen udenfor biofilmen:

0. ordens tilfældet: $\beta > 1$

$$r_A = k_{0f} \cdot L$$

r_A = arealspecifik omsætningshastighed i vandfasen $[\text{gS}/\text{m}^2/\text{d}]$

k_{0f} = omsætningshastighed i biofilmen $[\text{g}/\text{m}^3\text{biofilm}/\text{d}]$

L = biofilmens tykkelse $[\text{m}]$

0. ordens tilfældet: $\beta < 1$

$$r_A = k_{1/2A} \cdot \sqrt{S}, \quad k_{1/2A} = \sqrt{2 \cdot D \cdot k_{0f}}$$

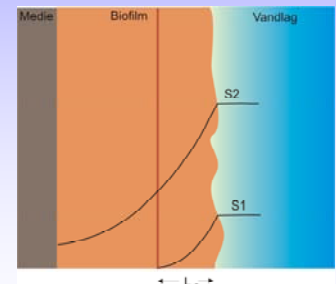
r_A = arealspecifik omsætningshastighed i vandfasen $[\text{gS}/\text{m}^2/\text{d}]$

$k_{1/2A}$ = $1/2$ ordens hastighedskonstant $[\text{gS}^{1/2} \cdot \text{m}^{-1/2} \cdot \text{d}^{-1}]$

S = substrat koncentrationen i vandfasen $[\text{gS}/\text{m}^3]$

D = diffusionskonstant, S $[\text{m}^2/\text{d}]$

k_{0f} = omsætningshastighed i biofilm $[\text{gS}/\text{m}^3\text{biofilm}/\text{d}]$



Henze et al. (2000). Wastewater treatment, biological and chemical processes

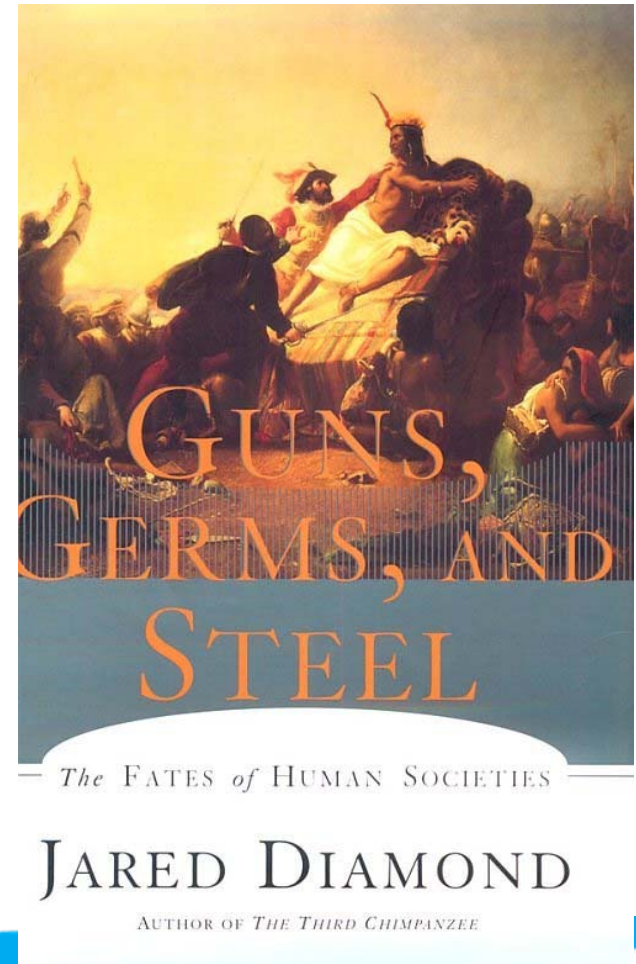
Financing and Management of R&D



- A strong and profitable industry finances its own R&D
- Universities to deliver basic research and good candidates
- Industry and suppliers will do the rest
- Support realistic productions
- Do not reinvent the wheel

The Future of Recirculation in Aquaculture

- Expensive fish: eel, tuna, pikeperch, hatcheries etc.
- Higher degree of recirculation for small trout
- Cheap whitefish: Tilapia, not cod
- Production of big fish for consumption:
In open systems / seafarms
- Let's work together



A painting of a sailboat on a colorful, abstract sea and sky. The sailboat is on the left, with its sails up. The background is a vibrant, abstract composition of warm and cool colors, suggesting a sunset or sunrise. The word "Discussion" is written in a large, white, serif font across the center of the image.

Discussion