

Assessment of Atlantic Salmon Farming in Floating Closed- Containment Systems

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Nekton AS /
Smola Hatchery and Smolt Farm,
Norway

Agenda

- Salmon production in Norway
- Smolt production in Norway
- Environmental effects
- Why closed containment systems?
- The (possible) benefits of a larger postsmolt
- Closed containment systems at Smøla

RAS technology

Floating closed containment system

Waste management

- Biogas from sludge
- aquaponics

IMTA

- macroalgae



Grow out farming locations



1000 locations

6000 net cages

Average production;
1000 t / location

Annual production of
1.300.000 tons

6.000 direct employed

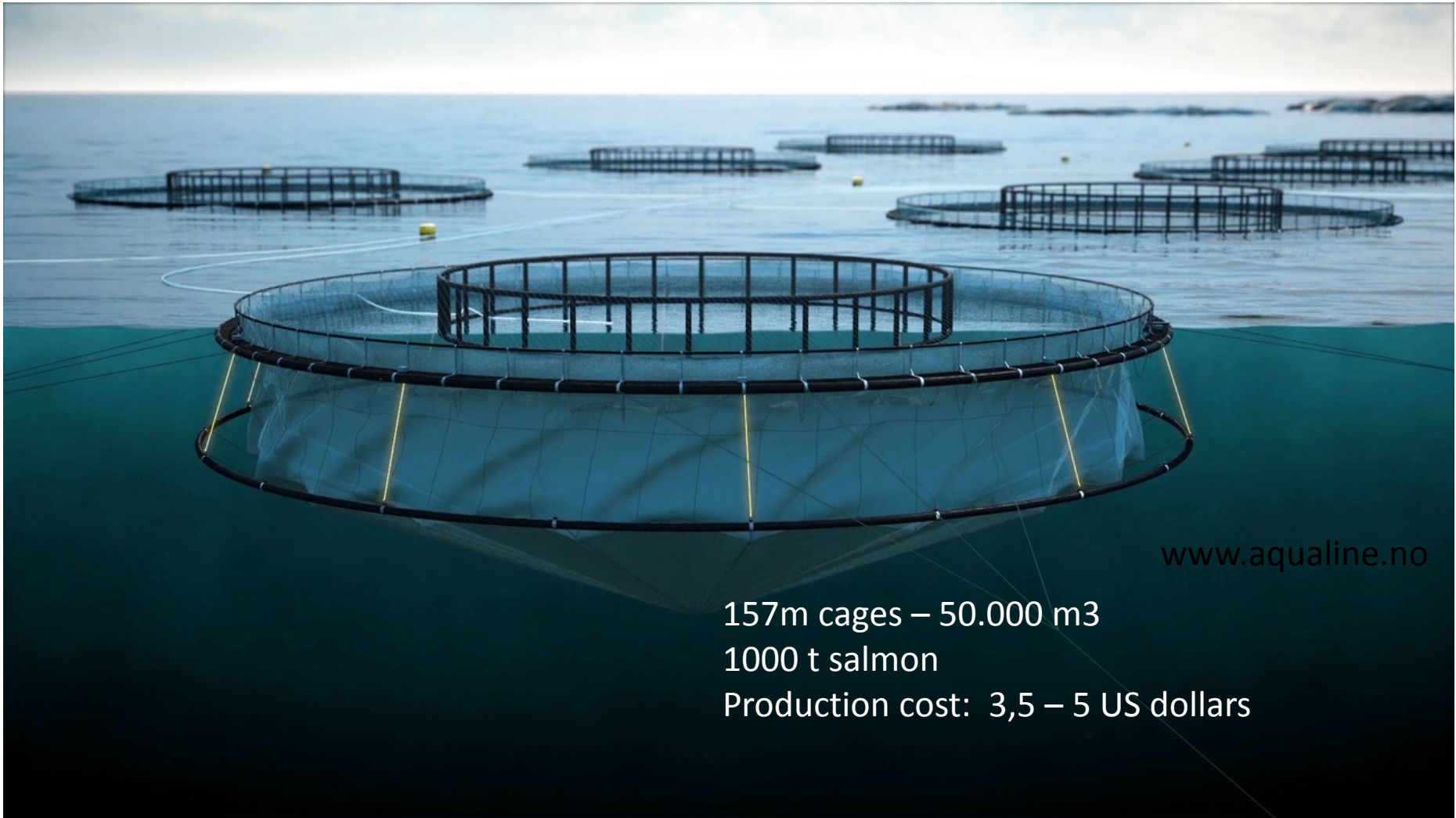
>20.000 indirect
employed

2nd largest export
industry (value)

Grow out farming



State of the art technology



www.aqualine.no

157m cages – 50.000 m³

1000 t salmon

Production cost: 3,5 – 5 US dollars

Smolt farming locations



200 farms

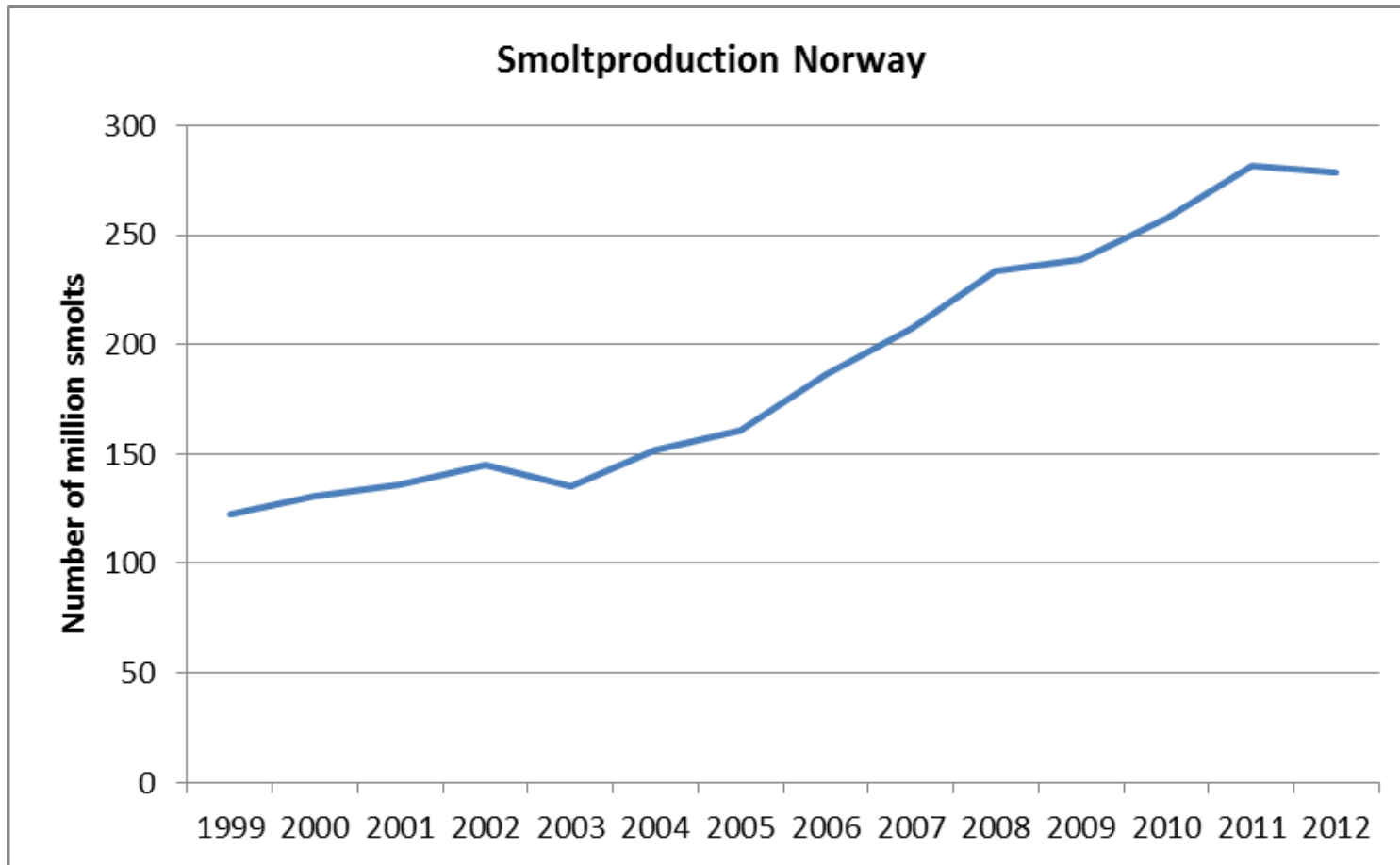
Average production; 1,5 million smolt pr location

Annual production of 300 million smolt (2012)

Appr. 15% of smolt production origin from RAS farms

Increased focus on RAS technology

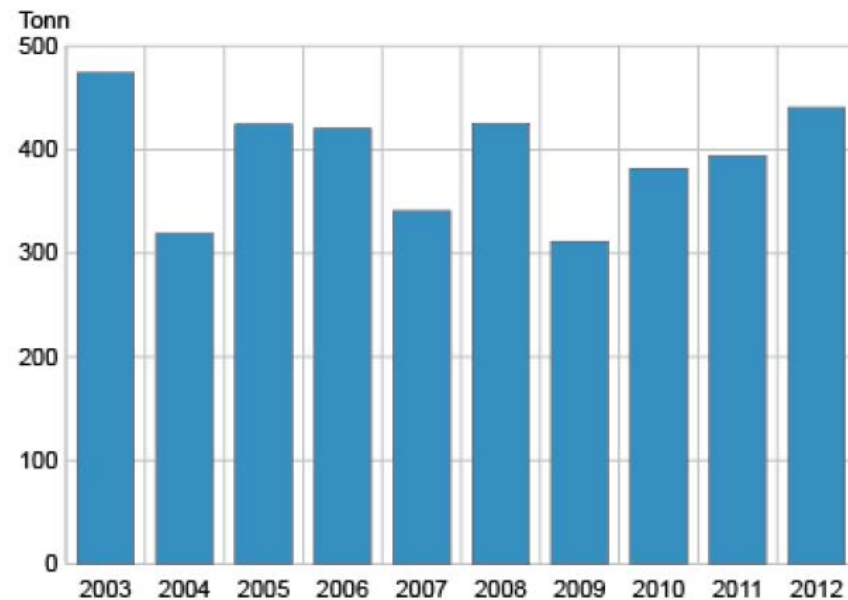
Smolt production



Environmental effects - wild salmon

Sealice
Escaped salmon
Organic waste

Wild salmon catches in rivers

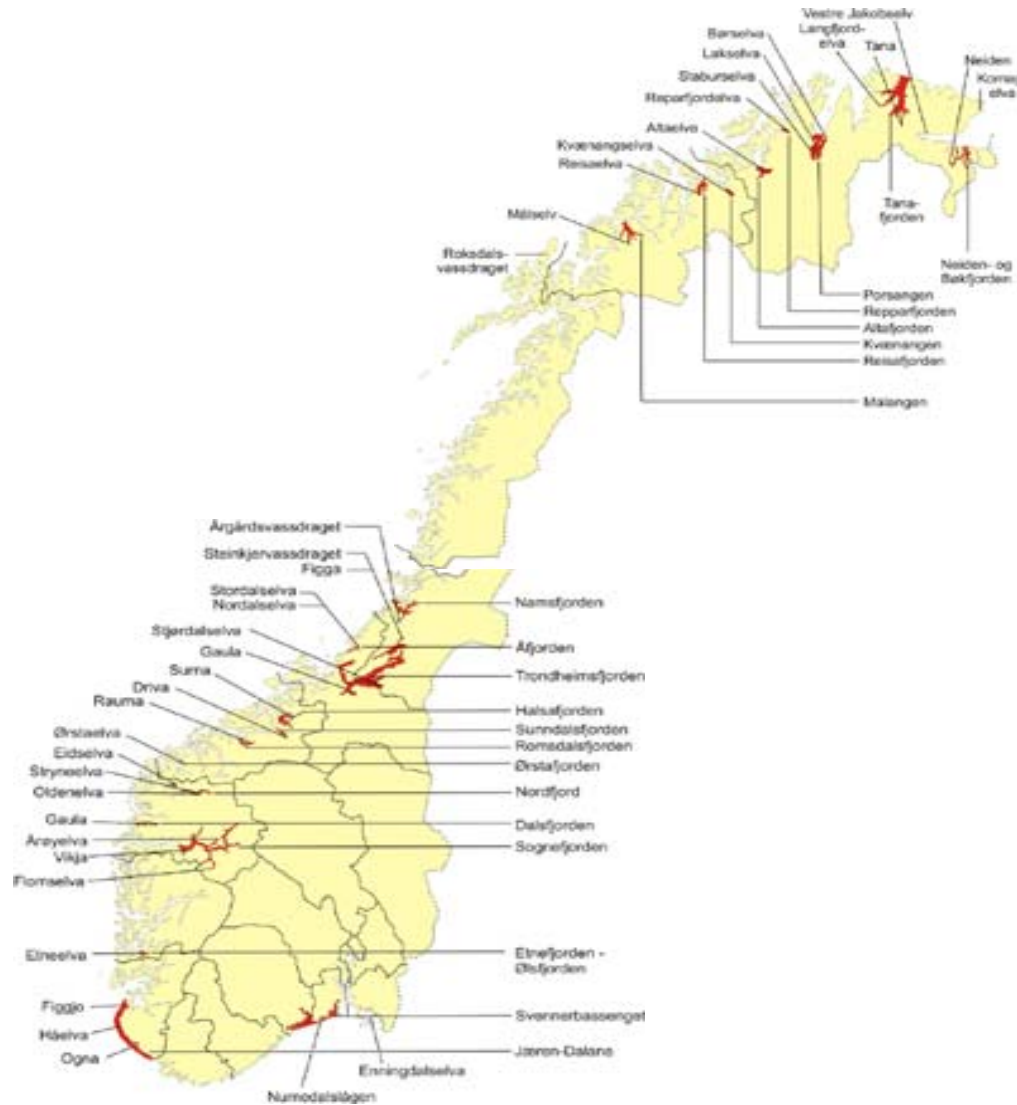


www.ssb.no/elvefiske/

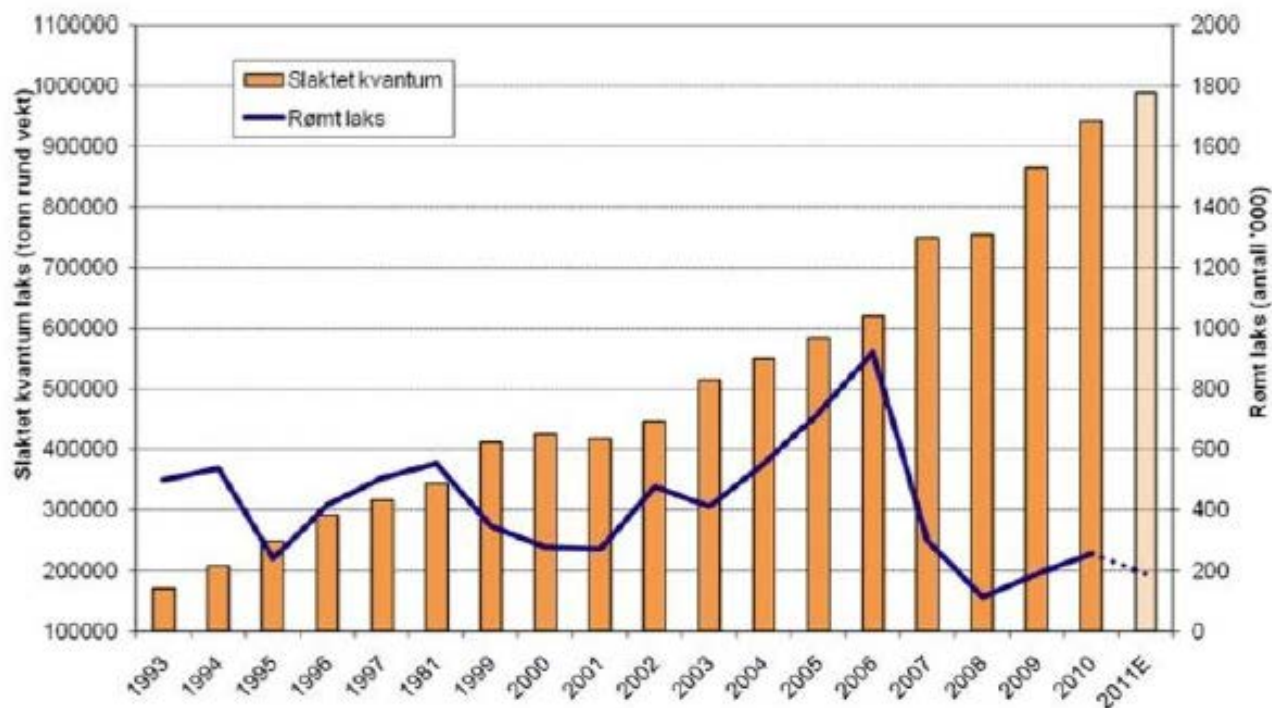
arming in
/stems

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Environmental effects - wild salmon



Escapes

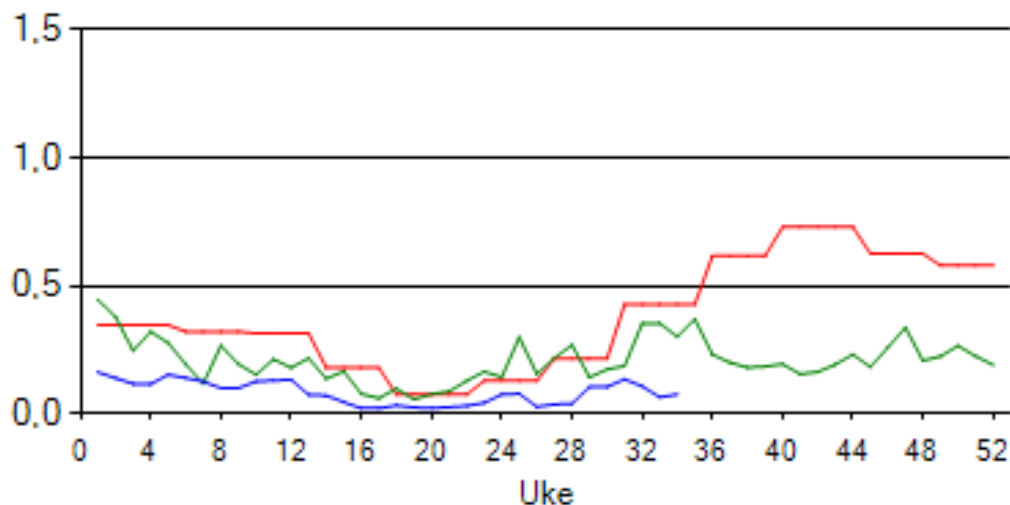


Number of escapes vs production

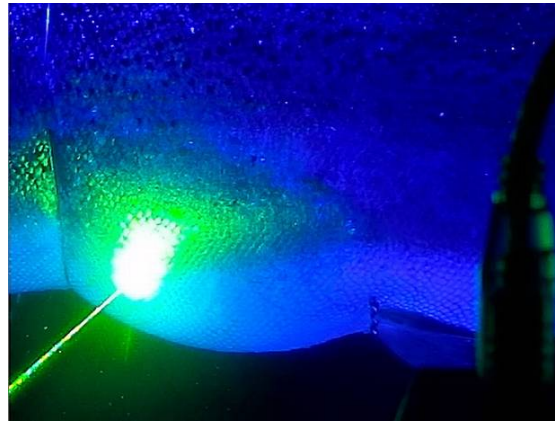
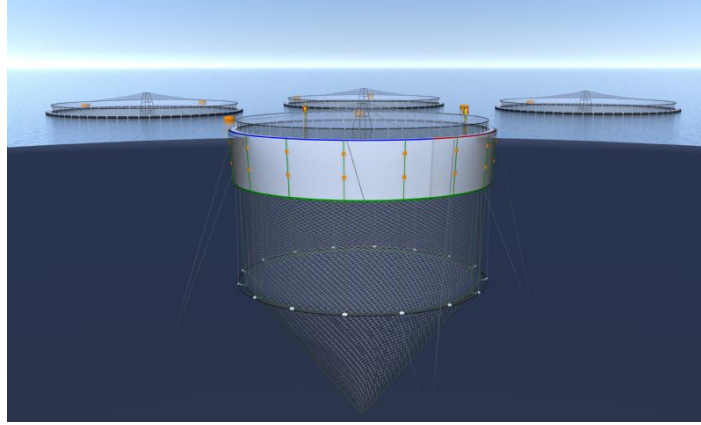
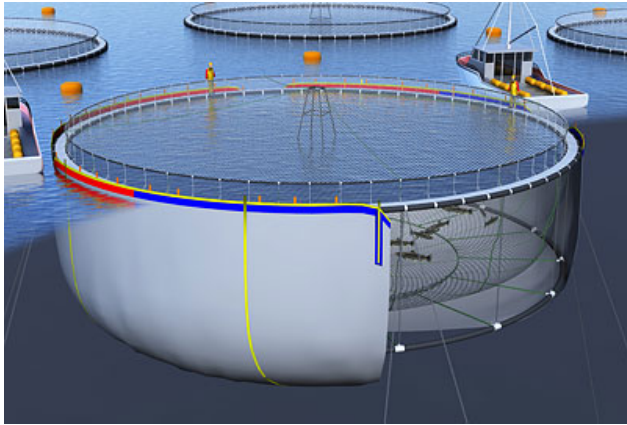
2012; 38.000 fish
2013; 25.000 fish

Sealice

- Co-ordinated challenge (geographic, treatment)
- 0,5 adult female sealice pr fish at maximum (treshold for treatment)
- All farms perform regular lice counting and reporting
- Development of new technology for mechanical treatment and removal



Sealice treatment



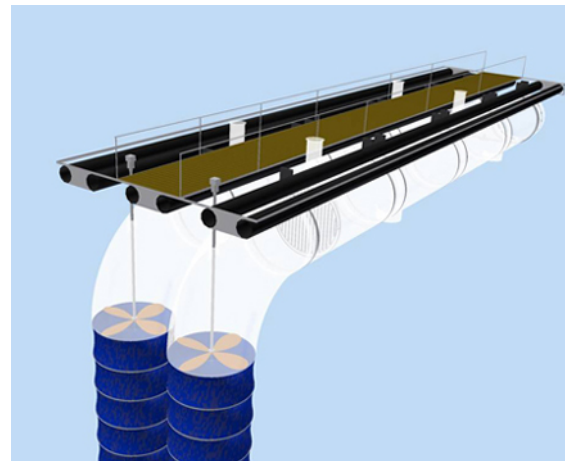
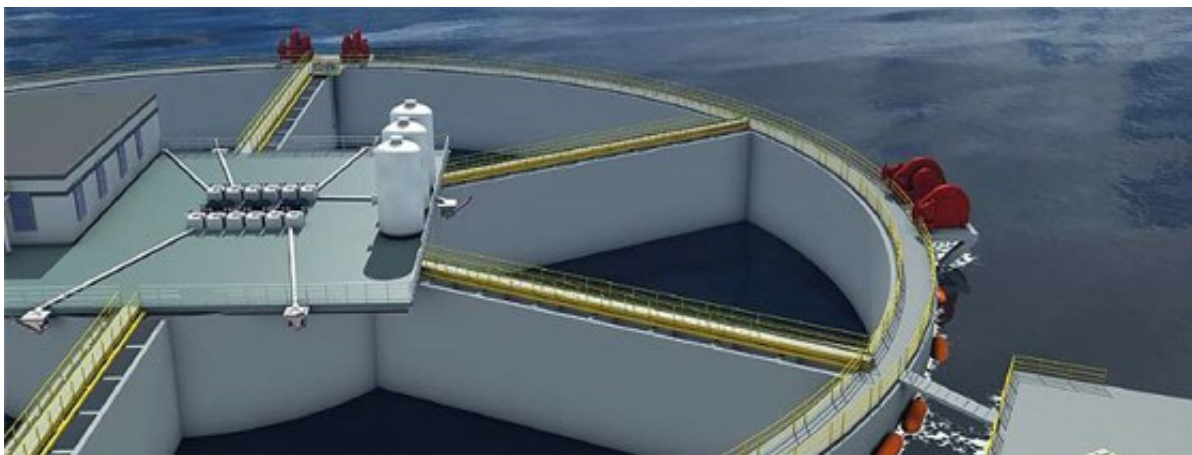
Why closed containment systems?

- Opinion demands reduction in escapes and sealice influence from salmon industry, and claim that the only solution is closed containment systems
- Authorities provide inducement (ref. green licenses, R&D licences) to improve the technological development
- Debate mainly aims at floating systems, not landbased
- Expectations that FCCS will solve problems regarding;
 - Sealice
 - Escapes
 - Organic waste

...but will they?

- The industry in general is reluctant to convert into closed containment systems
 - Production cost?
 - Risk of escapes?
 - Investment cost?
 - Fish welfare?
 - Technology not available, small industrial companys or development projects
- Some see advantages;
 - no change of nets
 - Exploit new locations
 - Increased exploitation of MAB system
 - Increased production pr location

Developing new technology



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Developing new technology



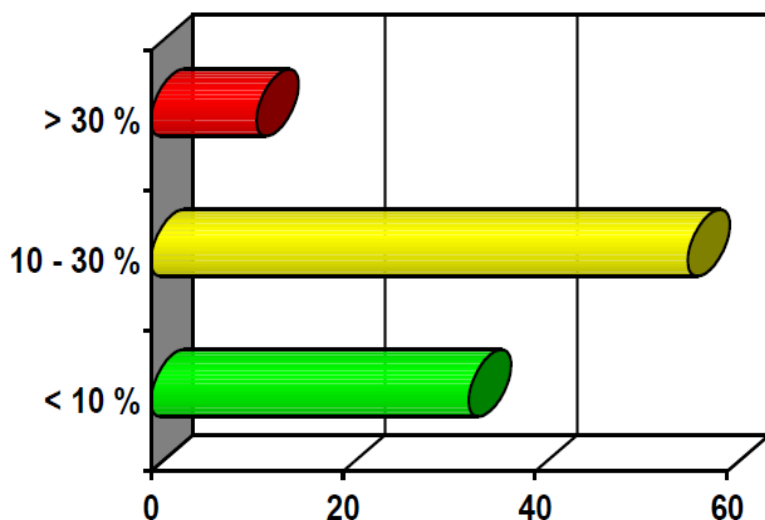
Aquafarm Equipments - 21 000 m³

Our focus is postsmolt production

- Increase the smolt size to 200 – 800 gram
- Robust smolt
- Reduce production time in open cages
- Reduce exposure to sea lice
- Exploit shallow and sheltered locations
- Dynamic stocking strategy (maximum allowed biomass)
- Possibility for waste treatment

Hypothesis 1. Loss reduction

- Average loss in production is > 20% (60 million fish)
- 10-30% of this loss is directly related to smolt quality (6 – 18 million fish)
- Smoltification, immune system, deformities, cold water bacteria



127 groups investigated;

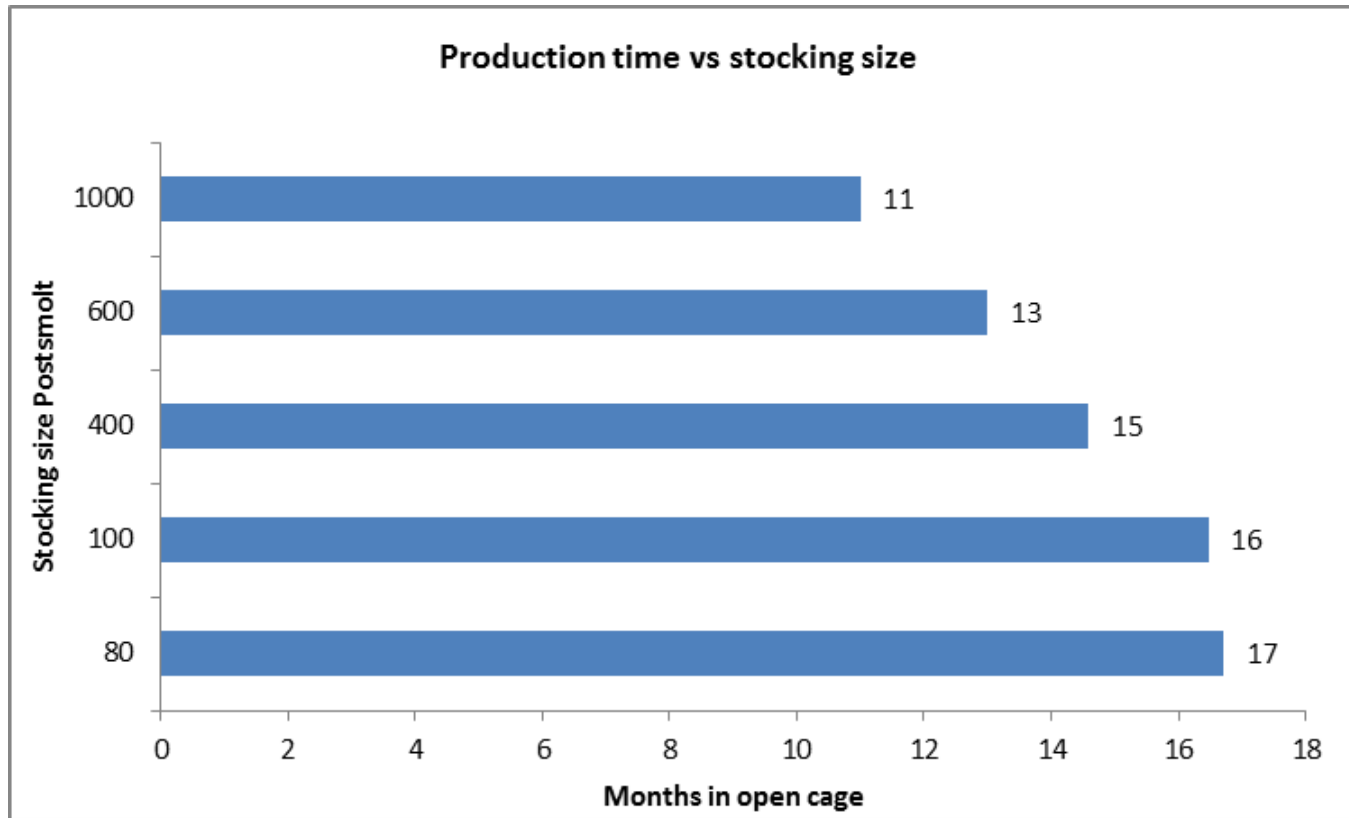
11 groups with > 30% mortality

71 groups with 10 – 30% mortality

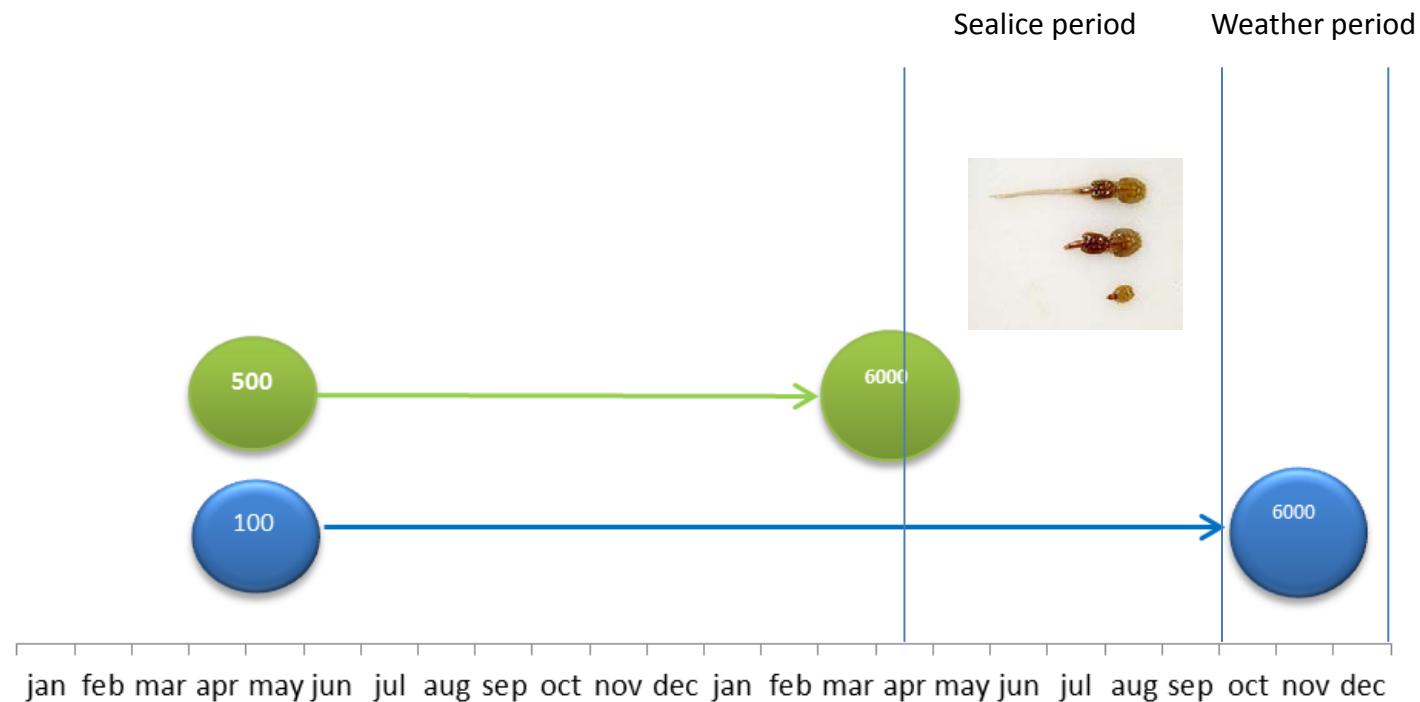
42 groups with < 10% mortality

www.mattilsynet.no

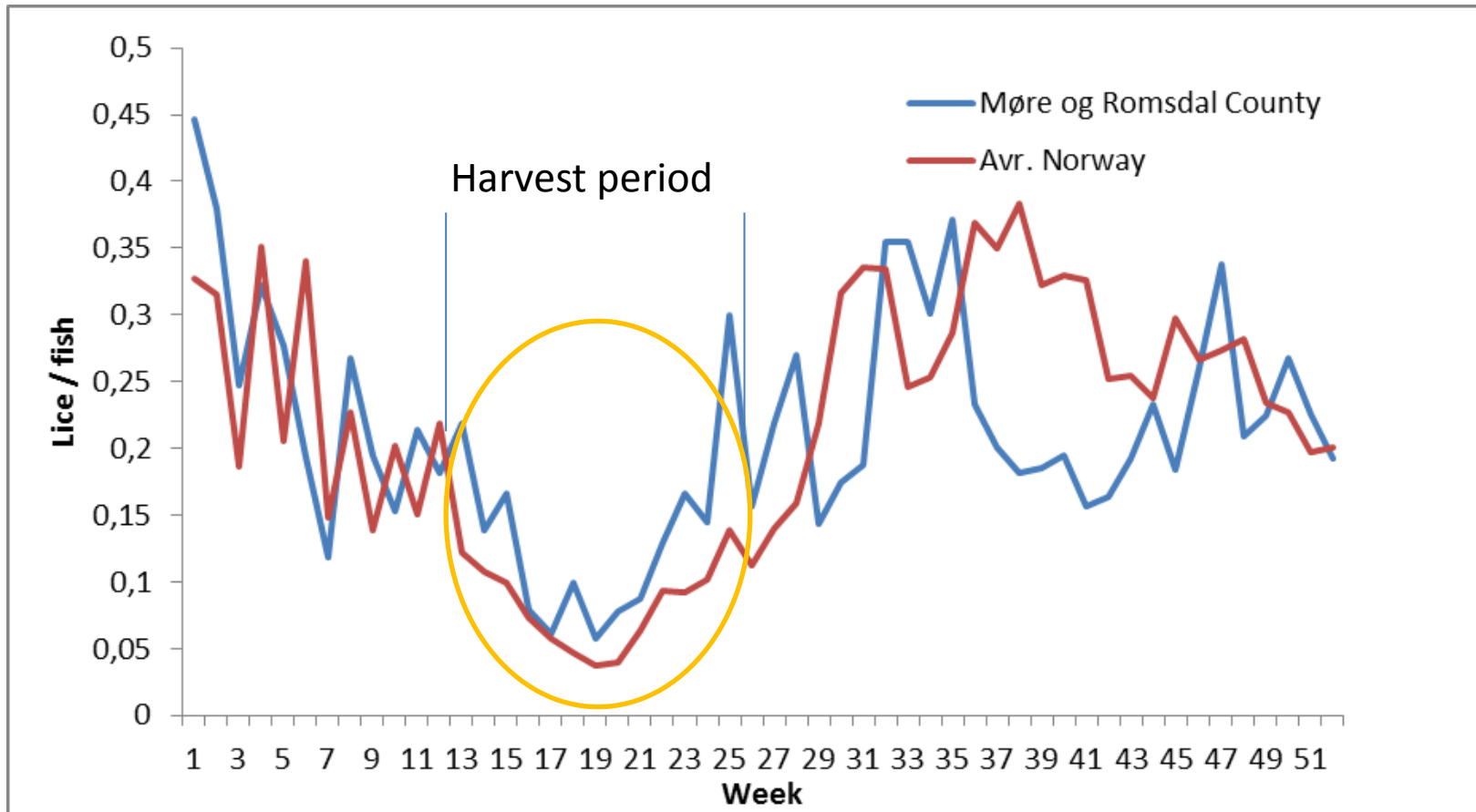
Hypothesis 2. Reduced production time



Dynamic production planning



Hypothesis 3. Reduction of sealice exposure



Hypothesis 4. Risk reduction?

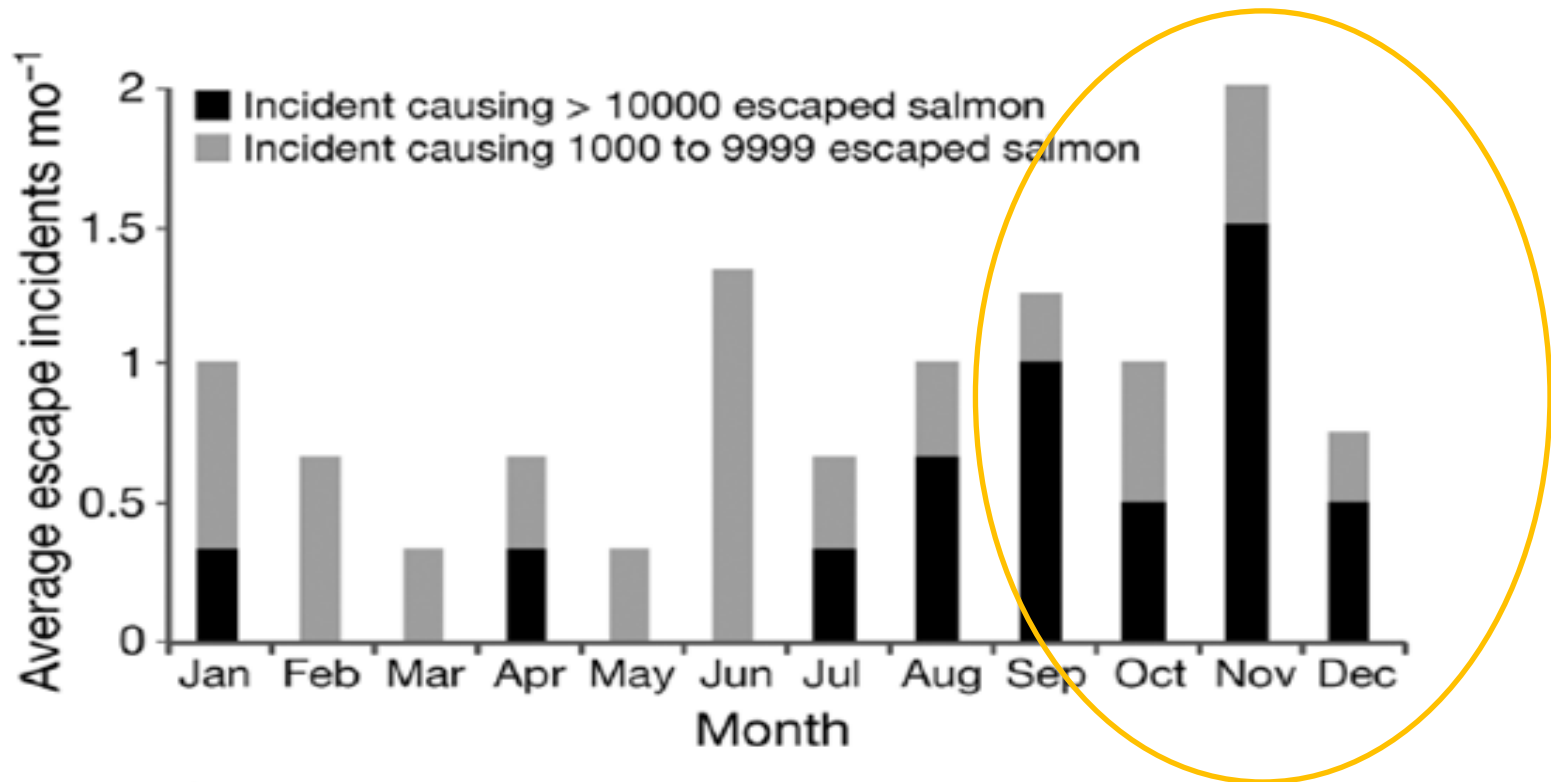
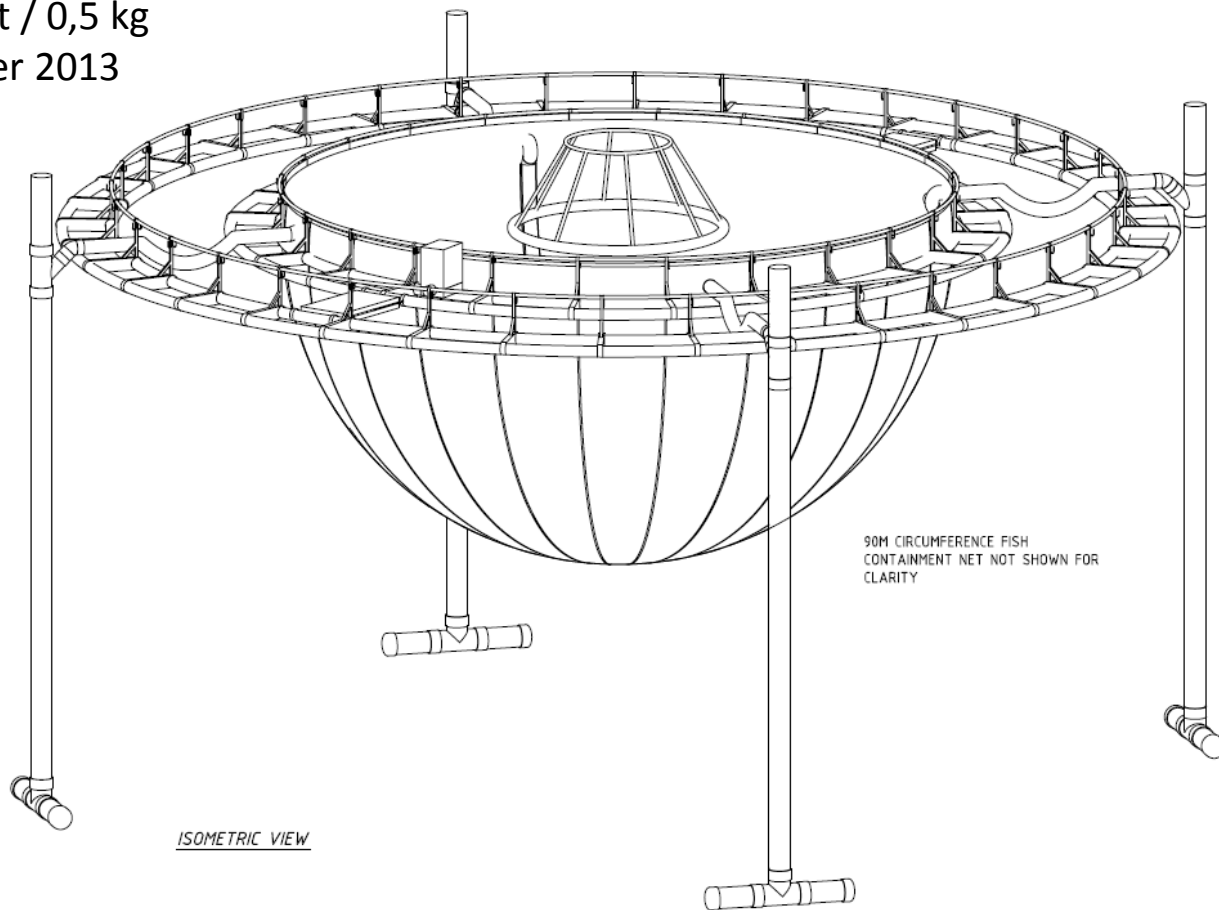


Fig. 4. *Salmo salar*. Seasonality of escape events for Atlantic salmon reported to the Norwegian Fisheries Directorate from 1 September 2006 to 31 December 2009

Closed containment system Smøla

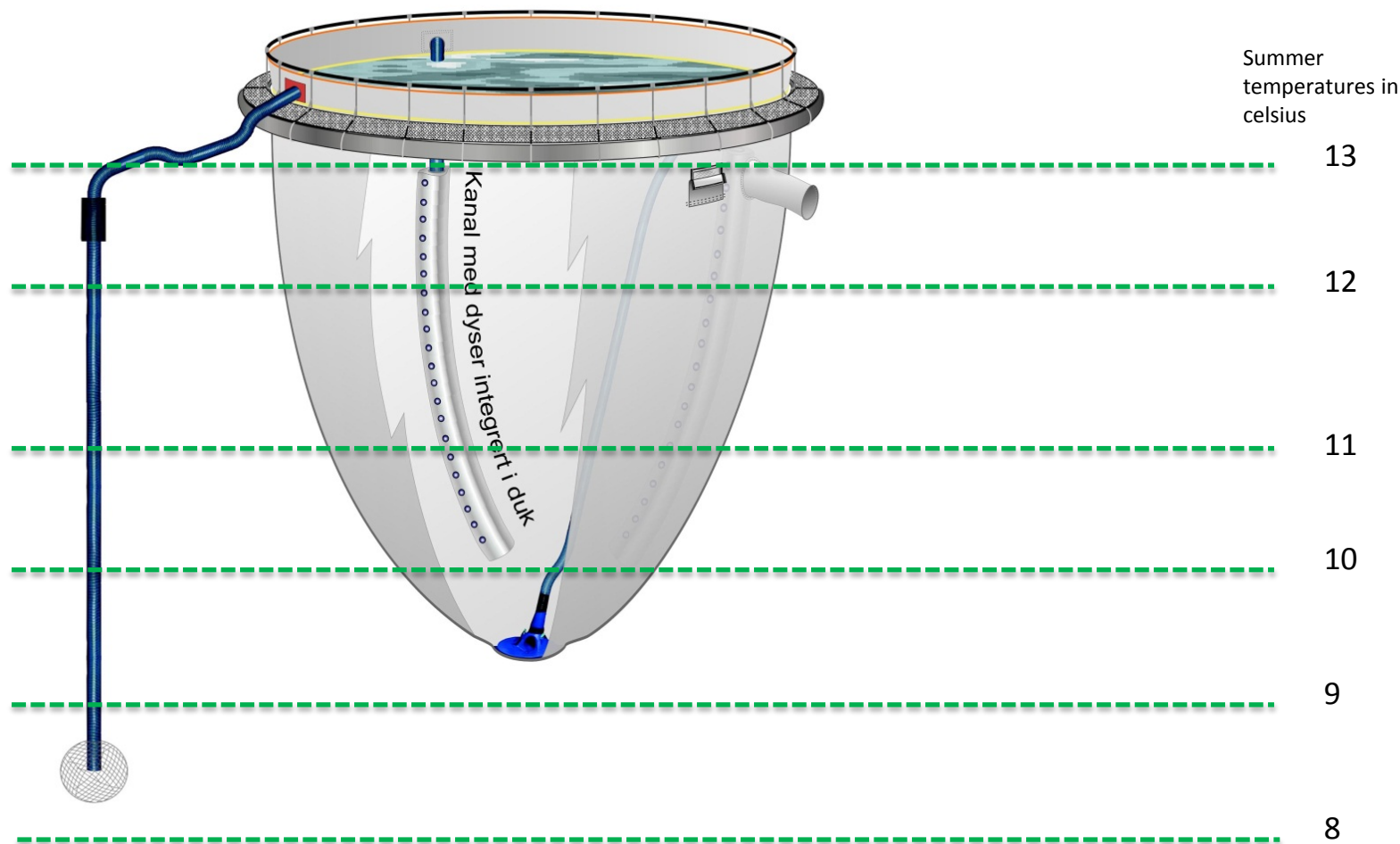
Flexibel bag system
1700m³ prototype
200.000 postsmolt / 0,5 kg
Installation october 2013



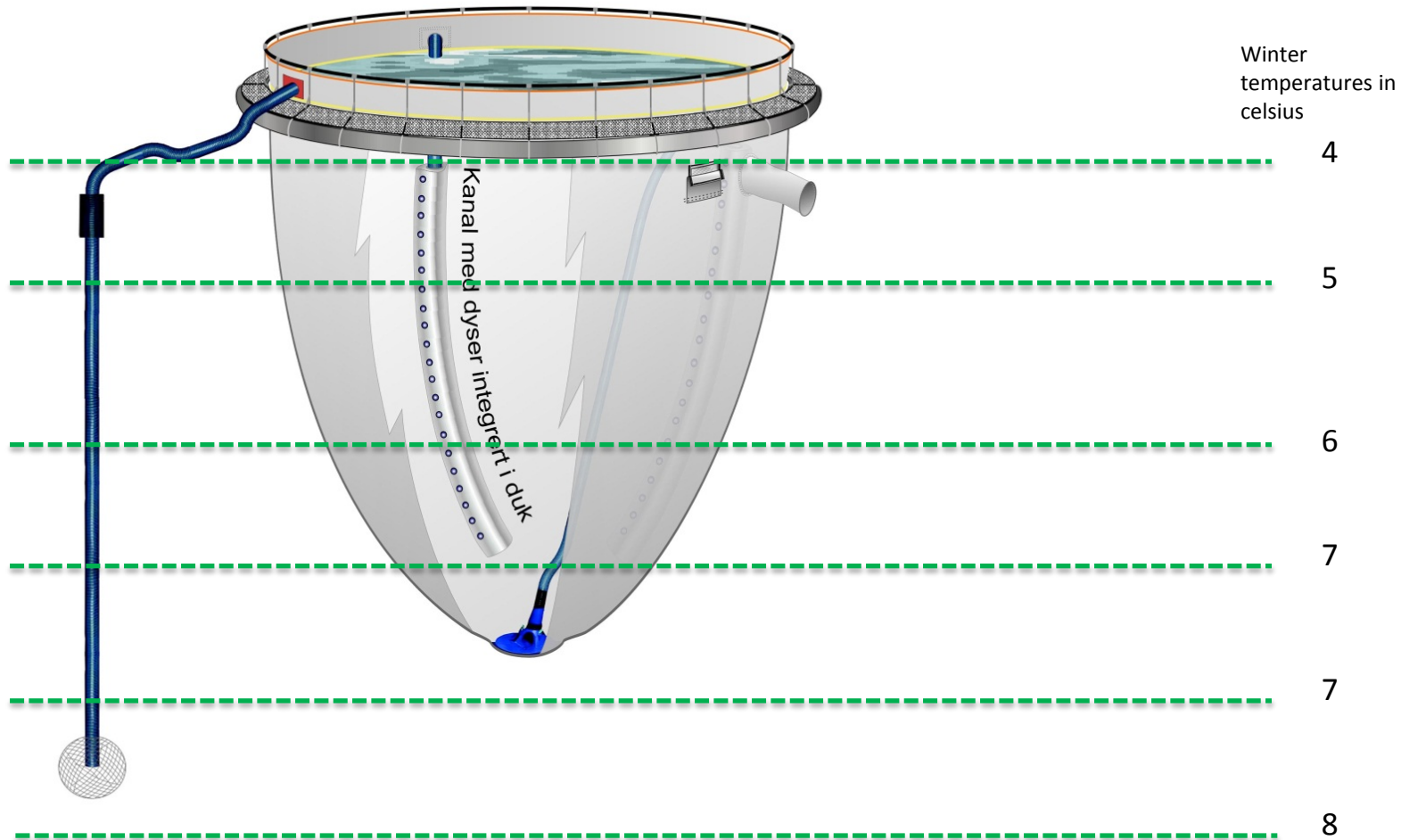
NOT FOR CONSTRUCTION; REPRESENTATION ONLY



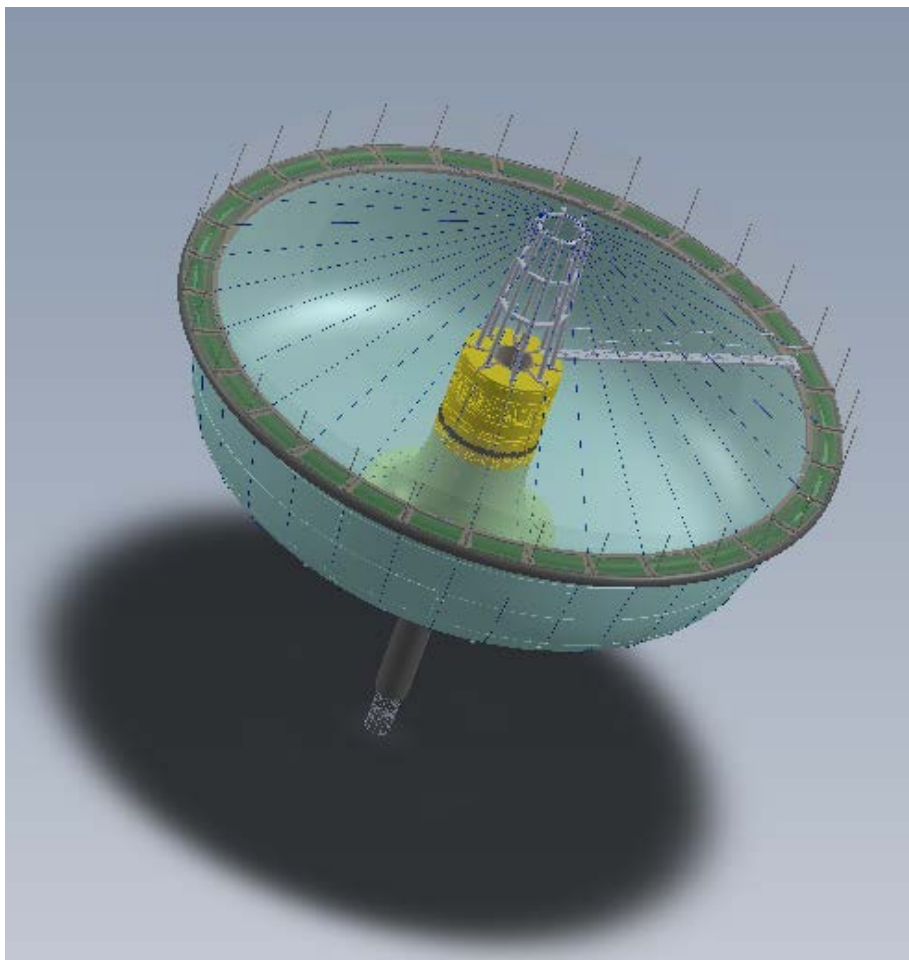
Closed containment system Smøla



Closed containment system Smøla

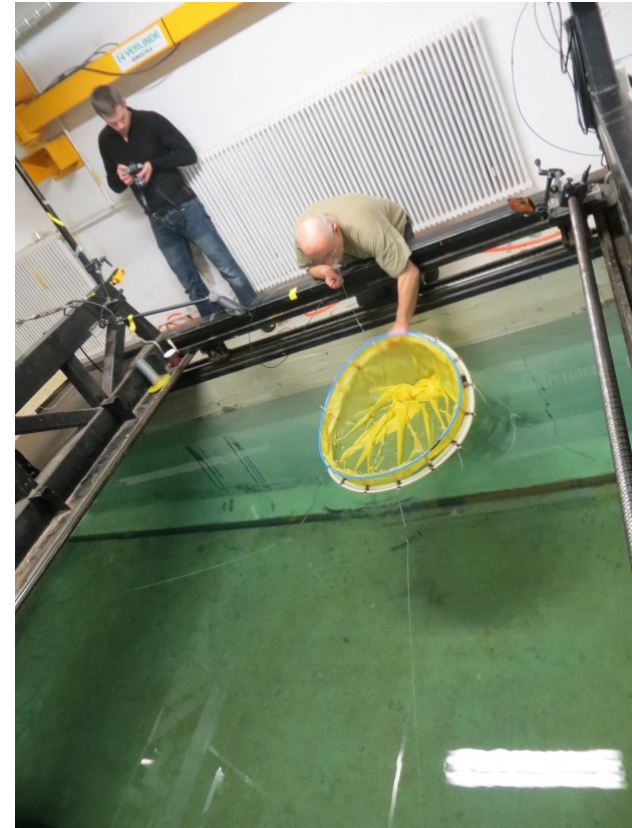
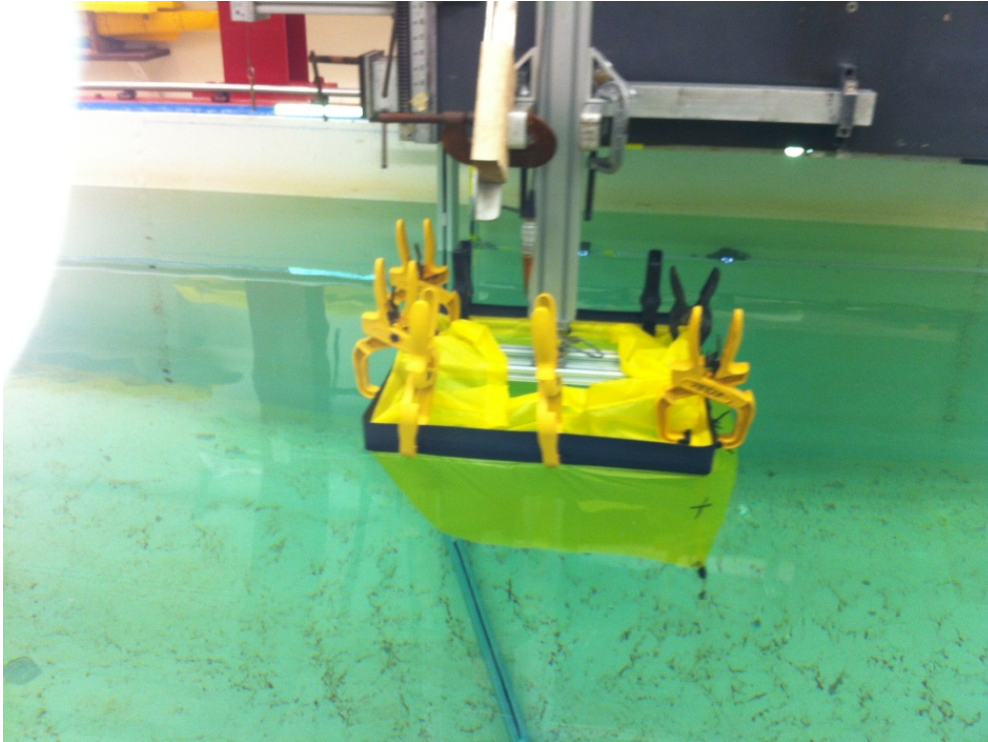


Closed containment system Smøla



Agrimarine technology

Development project industry + R&D



Smøla Hatchery and smoltfarm
Botngaard AS
Aqualine

Xylem
Yara Praxair
Aquastructures

Osland Havbruk
Lingalaks

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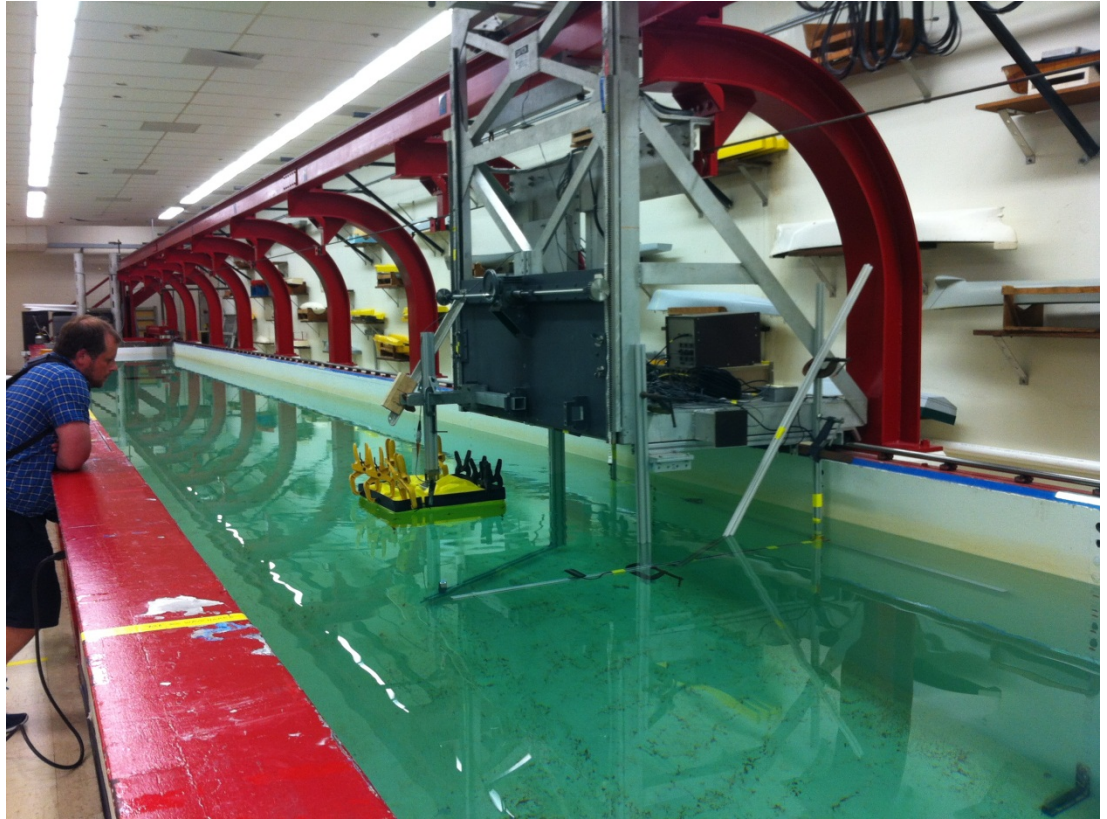
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Development project industry + R&D



Sintef Fiskeri og havbruk
NOFIMA
Freshwater Institute

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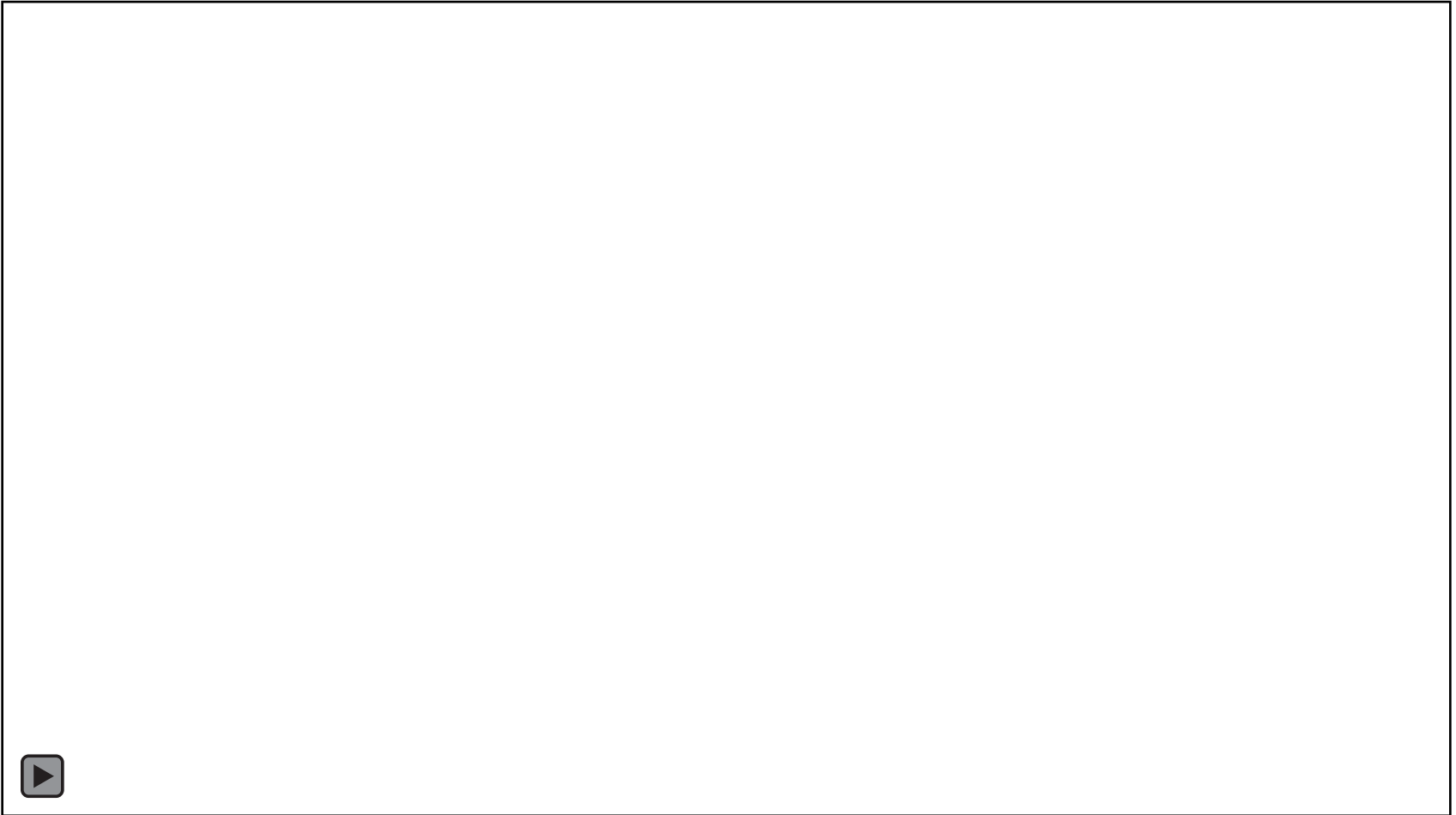


University of New Hampshire
US Naval Academy

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Safety first...



Wave forces



100 % fyllingsgrad

$$l/h = 30$$

Sett fra side

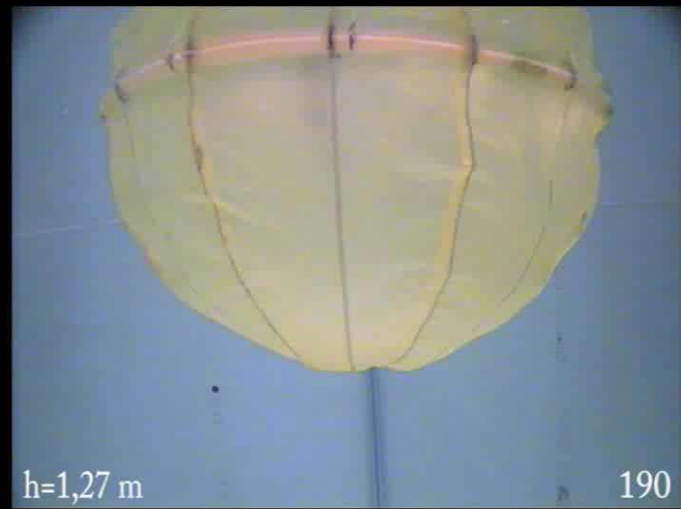
Ellipse

Sylinder

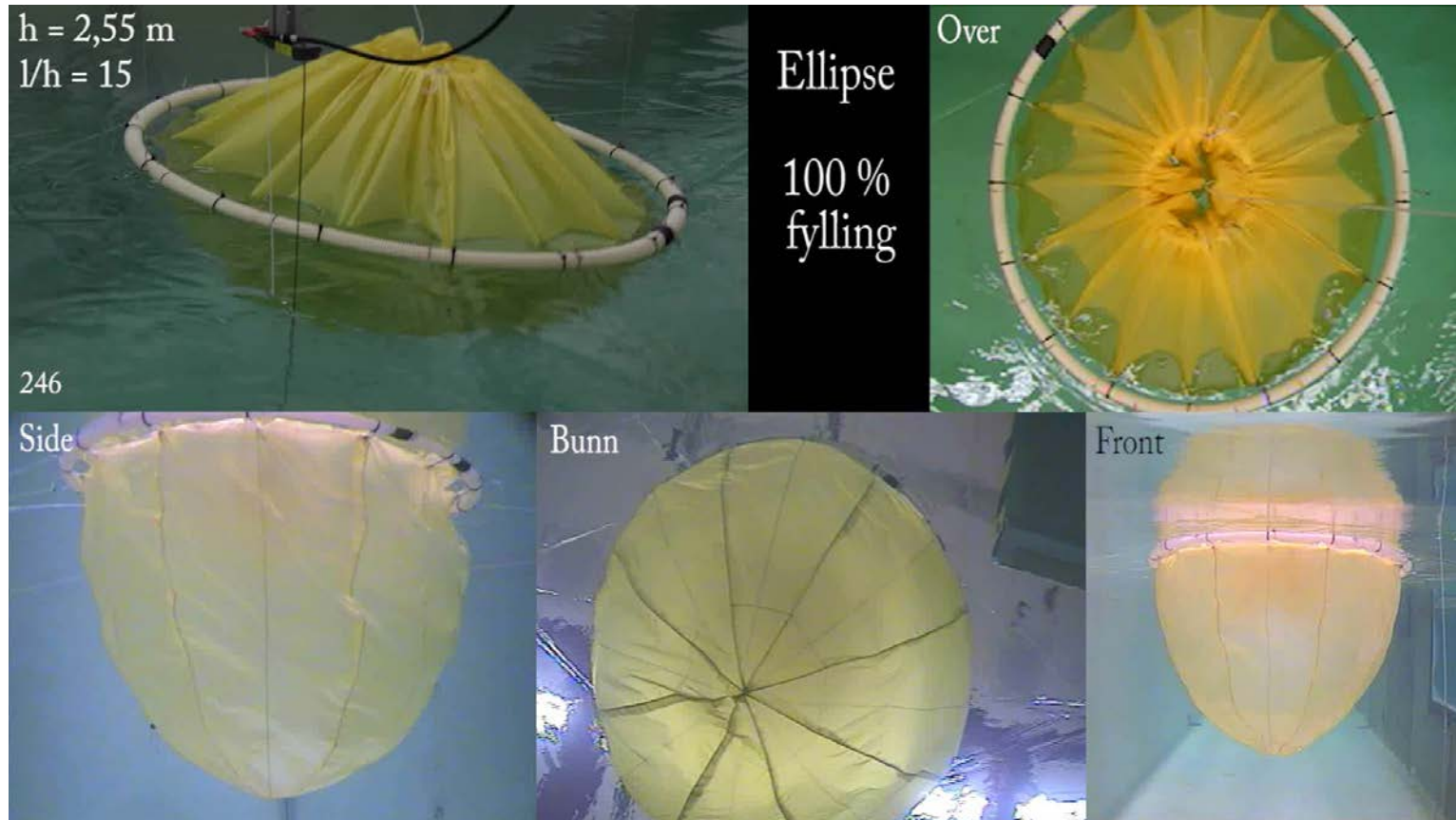


Ellipse
med duk
innenfor
flytering

Halvkule



Maximal force



Then biology....

- waterquality,
 - biological factors
 - fish health and welfare
 - So many things....
-
- And will the farm manager sleep at night?

Conlusions; what remains to be proved?

- The risk of escapes?
- The effect of sealice?
- The risk of disease?
- The risk of failures?
- Fish welfare?
- Investments cost?
- Production cost?