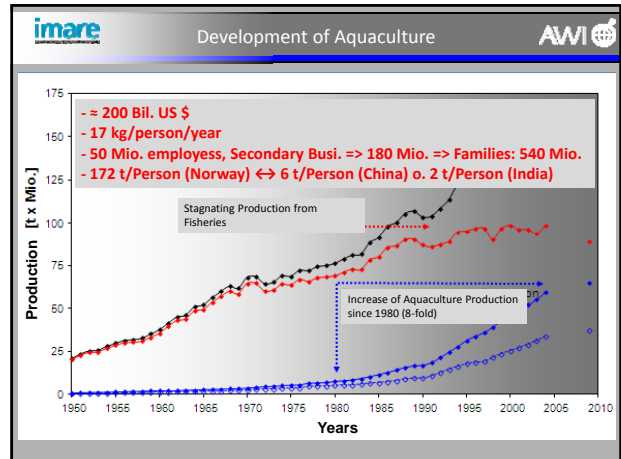


Status Quo of Offshore Aquaculture in Germany:
a new vision for a "green economy" in the marine realm



Bela H. Buck

3rd Marine Board Forum
"NEW TECHNOLOGIES FOR A BLUE FUTURE"
18 April 2012, Brussels


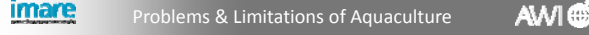
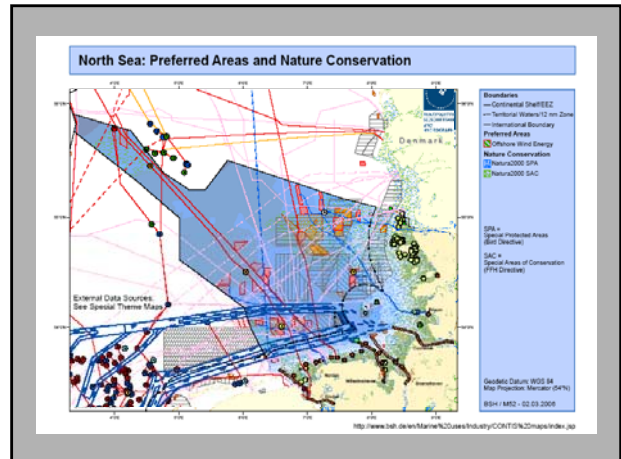



Problems & Limitations of Aquaculture

Limited development in Germany?

- shallow coastal sea (low depth)
- high sediment load (Wadden Sea)
- harsh conditions
 - high waves
 - strong currents
 - wind speed
- high tidal level (4 m)
- conflicts
 - user and consumer
 - regulations
 - environment (impacts and quality)
 - health


Buck et al. (2004), *Ocean & Coastal Mgmt.*
Buck et al. (2003), *Kluwer Law International*

Maximizing the Benefit

Multi-use ideas to maximize the benefit of an offshore area:

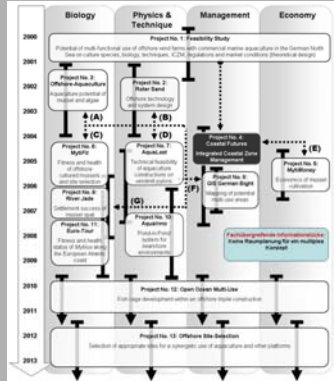




1. Ecology
 - Creating MPA's (nursery, sustainable fisheries...)
 - Set-up artificial reefs
2. Tourism
3. Additional energy resources
4. Offshore Aquaculture
5. Bio-Remediation / Bio-Extraction
6. Use of fouling organisms



Maximizing the Benefit





Offshore-AQ-Projects in the German Bight

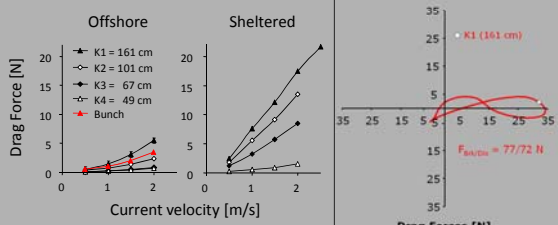
Modified after Buck et al. (2008), *Helv. Marine Research*

Candidate Species

Saccharina Latissima (*Laminaria saccharina*)
Sugar Kelp


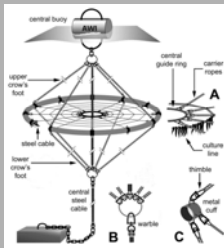


=> Kauloids & phylloids resist storms



Buck & Buchholz (2004), *J. Appl. Phycol.*


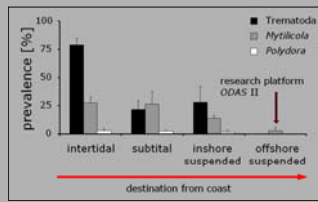
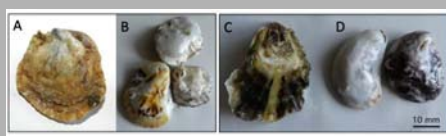
Candidate Species

Buck & Buchholz (2004), *J. Appl. Phycol.*

Candidate Species

Mytilus edulis
Blue Mussel

Buck et al. (2005), *J. Appl. Ichthyology*

Pogoda, Jungblut, Buck, Hagen (2012), *J. of Applied Ichthyology*
Pogoda, Buck, Hagen (2011), *Aquaculture*

Ostrea edulis - European Oyster

Candidate Species

Bivalve transfers in Europe (ICES – WGMASC)

	Local	National	Regional (within EU)	International (to and from the EU)
Belgium	X	X		
Denmark	X	X	X	
France	X	X	X	X
Germany	X	X	X	X
Iceland	X	X	X	
Ireland	X	X	X	
Netherlands	X	X	X	
Norway	X	X	X	
Portugal	X	X		X
Spain	X	X	X	X
Sweden	X	X	X	X
UK	X	X	X	X
Poland			X	

hitchhiking organisms

Fraser et al. (2012), subm. to Aquac. Int.
Brenner et al. (2012), subm. to Aquac. Int.

Candidate Species

Mussel cultivation designs

Buck (2007), Helv. Mar. Res.

System Design for Grounding Structures

Consideration of mechanical loads on grounding constructions of windmills by aquaculture devices

Longline for bioextraction / AQ

Loads on Grounding Structures

Development of representative load cases (for 50 MW turbine) by dissipation simulations

Buck et al. (2006), Ocean, Offshore, and Arctic Engineering

Project OOMU

Manned service platform
Submerged fish cage or longline constructions
Available space for aquaculture
Tripile-Foundation

Buck & Krause (2010), Springer Encyclopedia

Hydraulic modelling in the wave flume

Experimental setup


- Analysis of flow velocities/forces/qualitative scouring
- Length scale 1 : 40
- Wave parameter:
 - Medium wave: T = 6 s, Hs = 1,5 m
 - Maximum wave: T = 14 s, Hs = 11 m
- Variation of fish cage design
 - Cylinder / Sphere

imare Velocity Measurements **AWI**

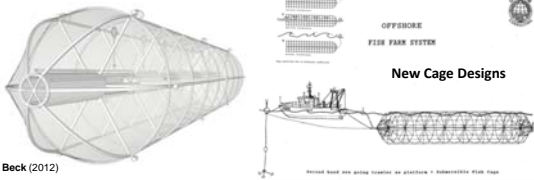
- Stereo Particle Image Velocimetry (PIV): Flow field near structure




imare Additional Investigations **AWI**



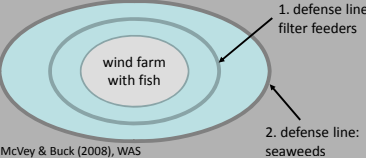
Scouring Measurements



OFFSHORE FISH FARM SYSTEM
New Cage Designs

Beck (2012)

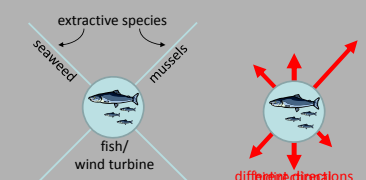
imare IMTA = nutrient budgets in balance (0 discharge) **AWI**



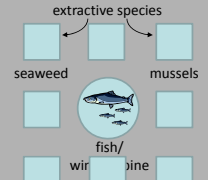
1. defense line: filter feeders
2. defense line: seaweeds

Compatibility of current aquaculture techniques with establishment on a multi-use platform and possible innovations

McVey & Buck (2008), WAS



extractive species
seaweed mussels
fish/wind turbine



extractive species
seaweed mussels
fish/wind turbine

diffusion directions

Key Issues:

1. Upscaling aquaculture requires a move offshore.
2. IMTA concepts should form the basis for new enterprises to fulfill criteria of sustainability and environmental friendly techniques => acceptance
3. Offshore aquaculture can only be conducted by a consortium and not by single farmers/fishermen.
4. Multi-use concepts will have a better acceptance for both stakeholders and would save costs.

Thank you

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