Atlantic Forum Workshop
Maritime space management and climate change mitigation under the ecosystem approach
WS2 – Offshore Aquaculture

Application of models to support decision-making in offshore aquaculture

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Different types of carrying capacity for aquaculture

US, Europe, Canada

The four pillars of carrying capacity

Southeast Asia, China

| Production |
| Ecological |
| Governance |
| Social |

Highest

Highest
Interaction of aquaculture with other ocean activities

- Competition for space: in the EU and US, shorefront use is a critical limitation;
- Social concerns re: visibility, both of culture sites at sea and processing plants on land;
- Environmental and genetic pollution, escapes, disease;

EU COEXIST project ([http://coexistproject.eu/](http://coexistproject.eu/))

- European scale - example case studies: Hardangerfjord, southern North Sea, Adriatic Sea, SE Portugal;
- Interaction matrices – among uses, interaction types;
- Reconciling offshore activities – e.g. mussel farms in wind parks;
- Reducing the environmental footprint: Integrated multitrophic aquaculture (IMTA).
Combination of offshore windfarms and aquaculture

Potential use of wind turbines and enclosed space for cultivating finfish, shellfish, and seaweeds
Offshore aquaculture

Current speeds: 0.1-1 m s$^{-1}$, suitable depth range for cages and longlines

123 countries with at least 100 km$^2$ that meet these criteria: $10^6 - 10^7$ ton y$^{-1}$

Offshore aquaculture

Areas within 25 nautical miles (46.3 km) of a port

UK has 120,000 km² that meet criteria for cages, longlines, and 25 nm to port

FARM model analysis
Offshore current speed effects on finfish culture

To the right of the dotted line, finfish culture becomes economically uninteresting due to excessive metabolic cost of swimming.
Goods and services from bivalves

- Removal of organic waste from finfish aquaculture
- Detrital organic material enhances shellfish growth
- Bivalves may act as firewall to prevent disease spread

Up to 70% finfish
At least 30% bivalves

Several large areas in the Algarve, Portugal are currently designated for offshore aquaculture
Virus Particle tracking:
Ratio between concentrations at XYZ and emission concentration

- Disease source: APPAA
- Virus concentration: Up to $2 \times 10^6$ ml$^{-1}$
- Forcing functions: wind and tide
- No decay
- 6 day model run
- Release in mid-water layer

Background virus release the first 2 days, high release on days 3, 4 and 5, then a reduction by a factor of a hundred on the last day.
Number of hours of exposure to 0.5% of the shedding concentration as a measure of potential infection.
EcoWin2000 - Simulated change in clam harvest due to offshore aquaculture of mussels

An annual loss of 120 t of clams (1.2 million €) is offset by 13,000 t of mussels
Synthesis

- Offshore aquaculture can potentially fill a gap in European production, while mitigating social aspects of carrying capacity;
- The technological challenges of the open sea are significant, and will be reflected in business costs, including insurance;
- Potential negative interactions with coastal areas include species exchanges and disease;
- Models of various types and scales can help in site selection, and assessment of stocking density and environmental effects;
- Strong governance, together with approaches such as all in all out plus fallowing, will help offshore ventures succeed;
- The Bremerhaven Declaration has nine recommendations for furthering offshore aquaculture, in a range of subject areas.

http://ecowin.org/EC2012