An Ecosystem Approach to Marine Aquaculture – Are we Already There?

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Outline

• Legal drivers in the US

• The nature of the beast – Aquatic organisms under culture, relative to fisheries and terrestrial agriculture - Resilience and sustainability of the ecosystem

• Technology, regulation, certification as drivers for change – the scope for continuous improvement – Trade-offs
U.S. National Aquaculture Act of 1980

“It is, therefore, in the national interest, and it is the national policy, to encourage the development of aquaculture in the United States”.

However! Do so under previsions of other environmental laws:

- Marine Mammal Protection Act
- Clean Water Act
- Endangered Species Act
- NEPA, MSA, and so on…
Marine aquaculture is regulate using environmental and social laws!

Industry must comply with laws protecting:
- Fisheries
- Habitat
- Marine Mammals
- Endangered Species
- Water quality-clean water
- Air quality
- Food safety and quality
- Truth in marketing
- And so on....
Industry must sell products and get permission to operate that:

• Minimizes impacts on the Environment
• Maximizes positive impacts on the Economy
• Is "fair" and "honest"
• That follows laws
• Produce healthy local food
• That benefits society
• Looks after animal welfare…

• And we import the majority of our seafood….

Also! Because our society has strong environmental and social values!
Legal drivers

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), has provisions related to:

1) integrating ecosystem considerations into fishery conservation and management actions,
2) minimizing the impacts of fishing on ecosystem components, and
3) conserving important ecosystem components from non-fishing threats

What about activities which are actually produce seafood and are restorative?
NOAA Fisheries defines Ecosystem Based Management as a systematic approach to manage fisheries in a geographically specified area that contributes to the resilience and sustainability of the ecosystem; recognizes the physical, biological, economic, and social interactions among the affected fishery-related components of the ecosystem, including humans; and seeks to optimize benefits among a diverse set of societal goals.
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2) Resilience and sustainability of the ecosystem

Environmental Change and Variability

Vulnerabilities to aquaculture directly

Vulnerabilities to related activities
Impacts to Fisheries
Impacts to Agriculture

Industry Impacts

1. Making marine aquaculture change resilient
2. Environmental improvement
   Stabilizing wild populations
3. Making up for lost wild seafood
   Making up for lost agriculture
2) Resilience and sustainability of the ecosystem

Impacts to aquaculture production due to environmental change (e.g., ocean acidification impacts on shellfish aquaculture).

- More hatcheries
- Feed choice
- Engineering solutions
- Species selection
- Genetic selection
- **Resiliency through application of science and technology.**
2) Resilience and sustainability of the ecosystem

Potential for aquaculture of shellfish and seaweed (algae) to mitigate impacts of climate change (e.g., sequestering carbon, bioextraction),

Resiliency through intelligent use of aquaculture/ecosystem synergy
2) Resilience and sustainability of the ecosystem

Use of aquaculture to recover or enhance wild populations impacted by climate change – Aquaculture as a tool to improve resiliency of Wild Fisheries

- Abalone restoration
- Alaskan King Crab
- Salmon
- Corals?
- Pacific Cod?
Convergent results are showing that climate change will fundamentally alter global food production patterns – Fishing and Farming.
2) Resilience and sustainability of the ecosystem

Use of marine aquaculture to make up the potential seafood deficit due to loss of wild fisheries impacted by climate change – improve resiliency of seafood supply.
Use of marine aquaculture to make up potential food deficits due to impacts of change on agriculture inputs. Aquaculture as a way to improve resiliency in the food production system?

Limiting resources for food production:
- Farm land
- Freshwater
- P and other nutrients
- Weather
- Green house gas
- Energy use

None are limited or are buffered in the marine environment.

Resiliency through Social and Economic forces
Terrestrial vs ocean-based agronomy in terms of water use, greenhouse gasses and land use. Resiliency through efficiency.

Sources: WRI (2014) (mollusks, chicken, pork, and beef) and Pahlow et al. (2015)
Tons CO₂e/T edible protein
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3) ...the physical, biological, economic, and social interactions among the components of the ecosystem (including humans)
Dealing with Trade-offs

...optimize benefits among a diverse set of societal goals

“We identify >250,000 MSP solutions that generate significant seafood supply and billions of dollars in revenue with minimal impacts (often < 1%) on existing sectors and the environment.”

From Lester et al 2018 – if you only read one paper this year - make it this one
A Paradigm for Change: The inverted “U”

- Scary part of the curve where negative social and/or environmental impacts are positively correlated with economic growth.

- Transitional part of the curve where issues are being resolved due to social or economic pressure.
  - Often technology driven

Production under acceptable levels of impacts

Science

Public

Special Interests

Special Interest

NOAA FISHERIES
Examples from Aquaculture

% Escapes from BC farms

- Seen time and time again as industries mature

Pulling, Pushing and Creating Change

Limits can truncate the industry cutting off the lowest performers and may push the industry.

However - Limits are not set this way – they depend on what is being protected.
Pulling, Pushing and Creating Change

BMP’s and certification schemes tend to pull the best farms and can split the industry unless the whole industry can make the bar.
Innovation (structural change) tends to move the whole industry to higher standards if economic gain and environmental gain are both achieved.
Ecosystem Based Aquaculture Management as a systematic approach to aquaculture management in a:

(1) **geographically specified area** that contributes to the
(2) **resilience and sustainability of the ecosystem**;
(3) recognizes the **physical, biological, economic, and social** interactions among the affected Aquaculture and Fishery-related components of the ecosystem, including humans; and seeks to
(4) **optimize benefits** among a diverse set of societal goals.