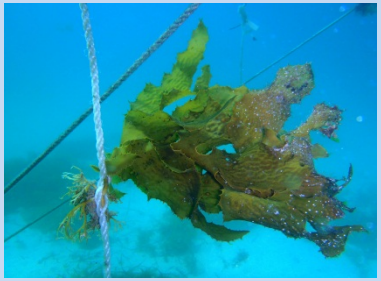

Coastal Aquaculture Planning & Environmental Sustainability

NOAA / NOS National Centers for Coastal Ocean Science

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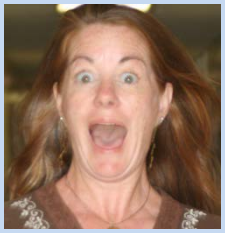
Our team

Dr. James Morris,
Marine ecologist, CCFHR

Dr. Suzanne Bricker,
Marine ecologist, CCMA

Dr. Ken Riley, JHT
Biologist, CCFHR



Dr. Carol Price, JHT
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Andy Ostrowski, JHT
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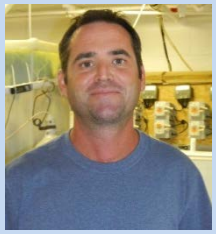

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Biologist, CCFHR

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Hydrodynamic modeler,
CCFHR

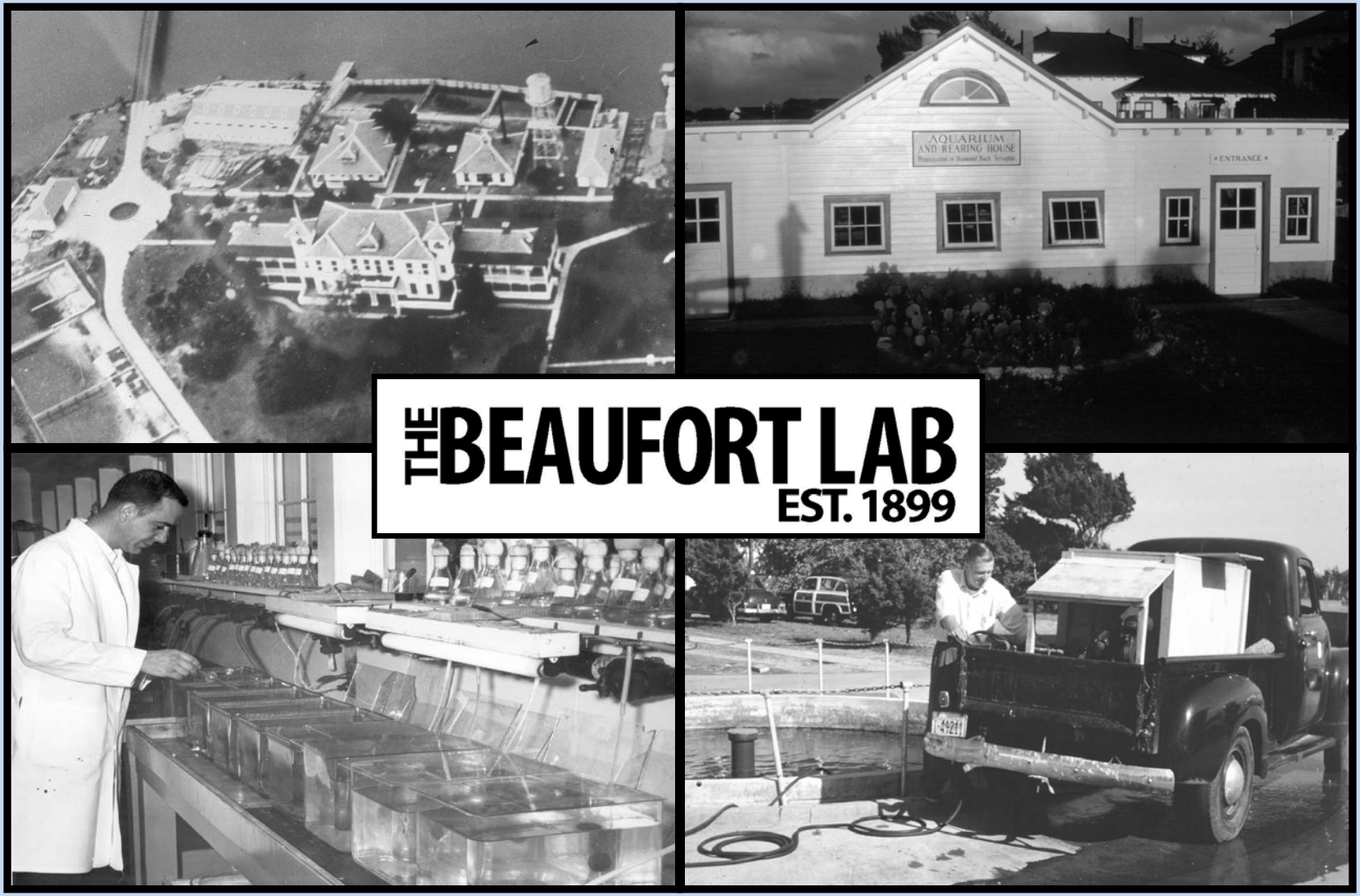
Gary Fisher, Biological
Tech, CCFHR

NOS

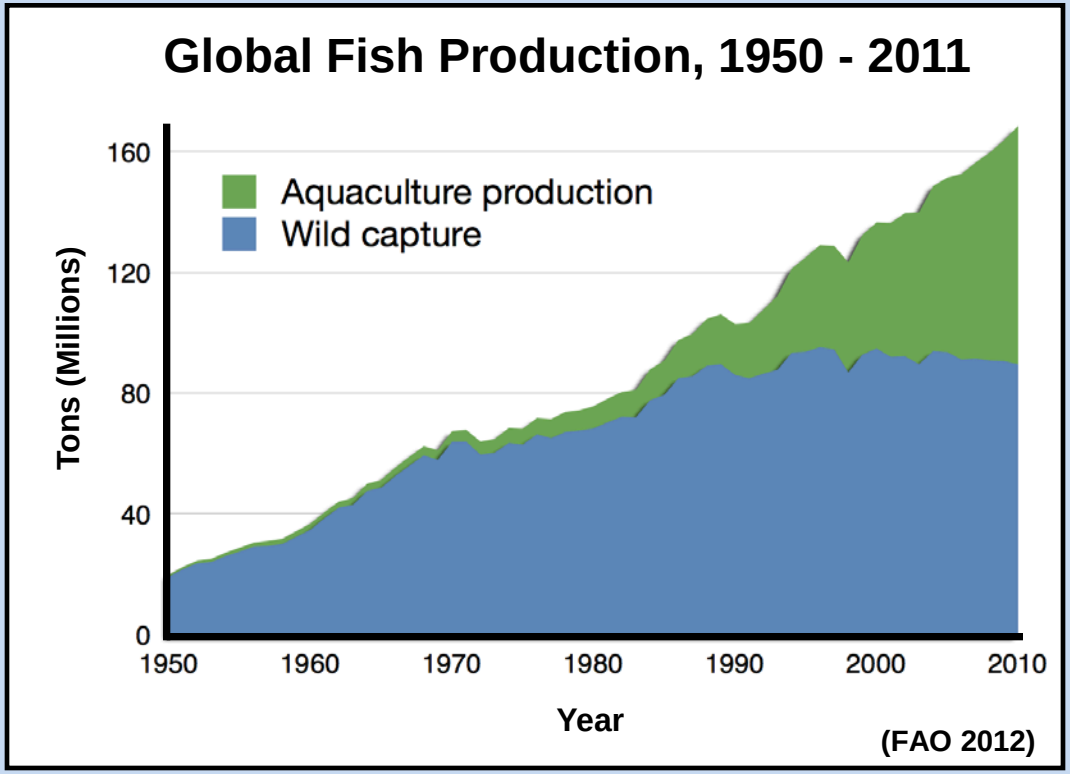
NATIONAL CENTERS FOR COASTAL OCEAN SCIENCE

NATIONAL OCEAN SERVICE

NOAA


AQUARIUM
AND REARING HOUSE
ENTRANCE
THE BEAUFORT LAB
EST. 1899

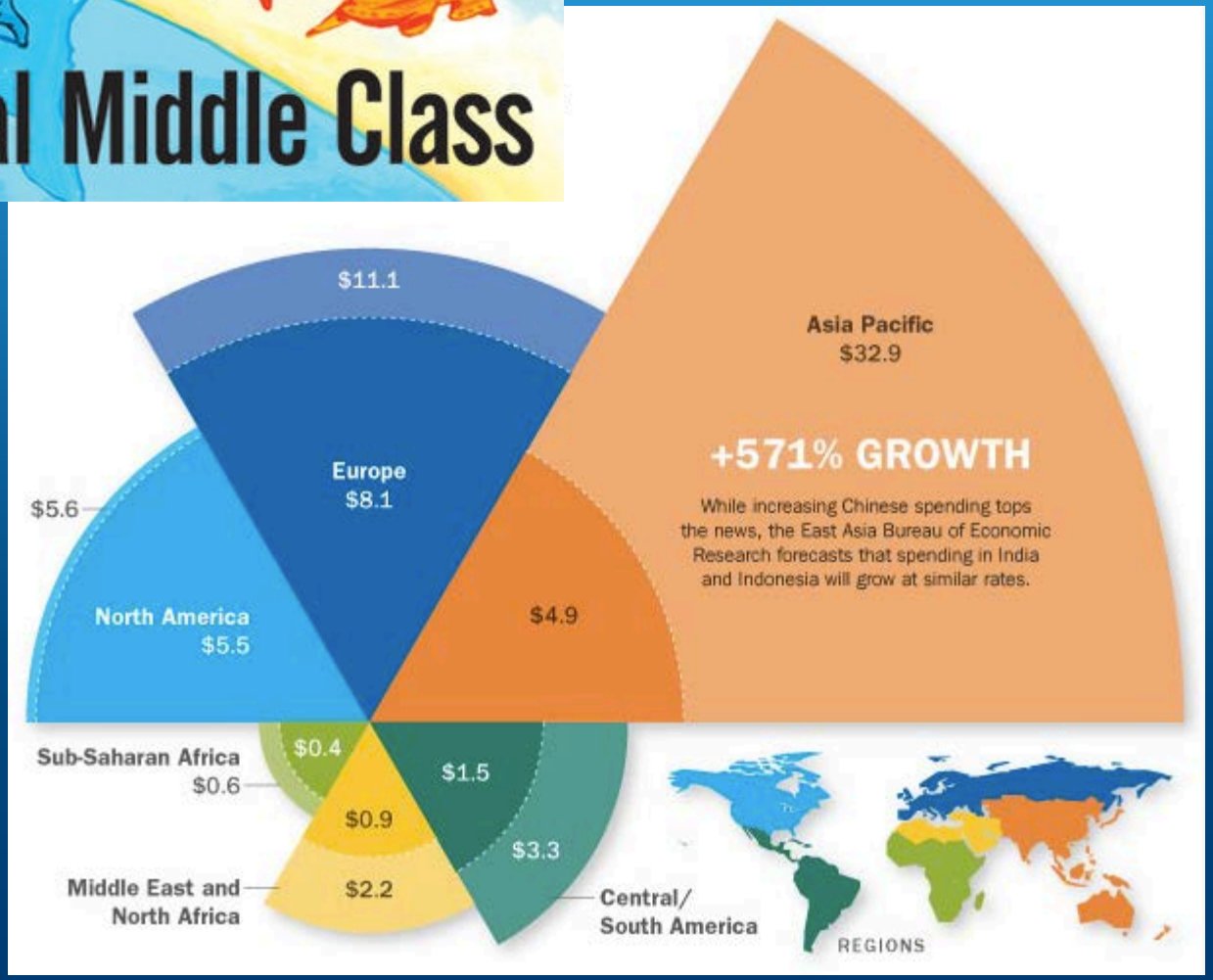
Research facilities include 8,000 sq. ft. of hatcheries, nursery, and growout systems that incorporate recirculating technology to recycle and reuse water


Global Fish Production, 1950 - 2011
Aquaculture production
Wild capture
Tons (Millions)
160
120
80
40
0
1950
1960
1970
1980
1990
2000
2010
Year
(FAO 2012)

Middle Class Consumer Spending

Outer Ring: 2030 in USD $ trillions (projected)

Inner Ring: 2009 in USD $ trillions



(OECD 2013)

NOAA aims to increase aquaculture production by 1 million mt by 2025

June 2011

National Oceanic and Atmospheric Administration
MARINE AQUACULTURE POLICY[1]

Purpose

The purpose of this policy is to enable the development of sustainable marine aquaculture within the context of the National Oceanic and Atmospheric Administration's (NOAA) multiple stewardship missions and broader social and economic goals. Meeting this objective will require NOAA to integrate environmental, social, and economic considerations in management decisions concerning aquaculture. This policy reaffirms that aquaculture is an important component of NOAA's efforts to maintain healthy and productive marine and coastal ecosystems, protect special marine areas, rebuild overfished wild stocks, restore populations of endangered species, restore and conserve marine and coastal habitat, balance competing uses of the marine environment, create employment and business opportunities in coastal communities, and enable the production of safe and sustainable seafood.

Statement of Policy

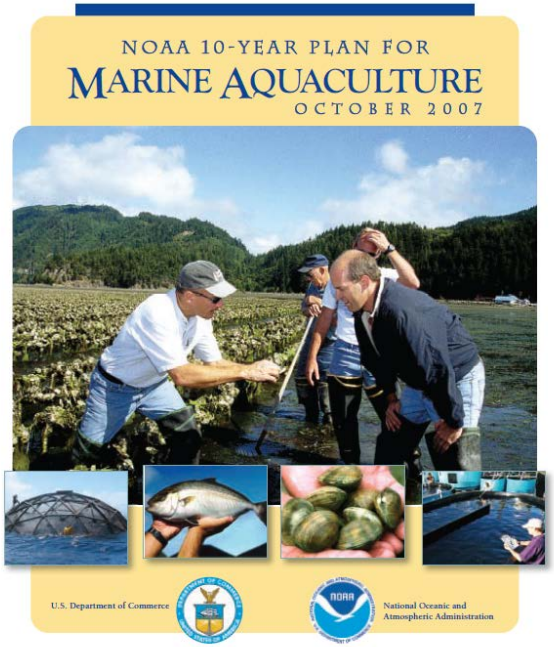
For purposes of this policy, aquaculture is defined as the propagation and rearing of aquatic organisms for any commercial, recreational, or public purpose. This definition covers all production of finfish, shellfish, plants, algae, and other marine organisms[2] for 1) food and other commercial products; 2) wild stock replenishment for commercial and recreational fisheries; 3) rebuilding populations of threatened or endangered species under species recovery and conservation plans; and 4) restoration and conservation of marine and Great Lakes habitat.

It is the policy of NOAA, within the context of its marine stewardship missions and its strategic goals with respect to healthy oceans and resilient coastal communities and economies, to:

1. Encourage and foster sustainable aquaculture development that provides domestic jobs, products, and services and that is in harmony with healthy, productive, and resilient marine ecosystems, compatible with other uses of the marine environment, and consistent

[1] The term "marine aquaculture" is used because the majority of NOAA's aquaculture authorities and activities relate to marine species. However, this policy applies to all of NOAA's aquaculture authorities and activities, including those related to marine, freshwater, and anadromous species and includes the Great Lakes.
[2] This definition does not include marine mammals or birds.

1



June 2011

U. S. DEPARTMENT OF COMMERCE
AQUACULTURE POLICY

Purpose

The purpose of this policy is to support the development of sustainable aquaculture within the context of the Department of Commerce's (DOC) goals of encouraging economic growth and employment opportunities in the United States and of enhancing United States competitiveness in, and exports to, global markets. This policy applies to a broad range of responsibilities at DOC relating to trade, technology, innovation and entrepreneurship, economic development, and environmental stewardship. The National Oceanic and Atmospheric Administration, which is the primary bureau within DOC with programmatic aquaculture responsibilities, has a more detailed marine aquaculture policy that complements this overarching policy.

For purposes of this policy, aquaculture is defined as the propagation and rearing of aquatic organisms for commercial, recreational, or public purposes. This definition covers all authorized production of finfish, shellfish, plants, algae, and other aquatic organisms for 1) food and other commercial products; 2) wild stock replenishment for commercial and recreational fisheries; 3) rebuilding populations of threatened or endangered species under species recovery and conservation plans; and 4) restoration and conservation of aquatic habitat.

The U.S. aquaculture industry (currently valued at about $1 billion/year) is dominated by the production of freshwater fish for human consumption. The marine aquaculture segment (about 20 percent of current production) is mainly comprised of shellfish, but also includes farming of finfish and algae in coastal waters and on land. Another major component of U.S aquaculture is hatchery production to replenish stocks of important commercial, recreational, and endangered species and to restore habitat (e.g., oyster reefs). Emerging technologies include land-based recirculating systems, algal rearing technologies for production of biofuels and other non-food products, systems that integrate different types of aquaculture or combine aquaculture with other uses, and systems in exposed open-ocean waters.

Aquaculture in the United States can make major contributions to the local, regional, and national economies by providing employment and diverse business opportunities from coastal communities to the agricultural heartland. By implementing this policy and working with partners, including the Department of Agriculture, U.S. Food and Drug Administration, Department of the Interior, and the Joint Subcommittee on Aquaculture, DOC can also help to make the United States a world leader in developing, demonstrating, and employing innovative and sustainable aquaculture technologies and in encouraging worldwide adoption of sustainable aquaculture practices and systems.

Background

Fisheries and seafood are important components of American life. In 2007, Americans consumed a total of nearly 5 billion pounds of seafood, which equates to approximately 16 pounds per person per year. The most recent Dietary Guidelines for Americans (2010)

1

NOAA's Aquaculture Goals

Competitive aquaculture businesses

Healthy aquatic environments

Aquaculture valued by the public

NOAA Aquaculture Strategic Plan 2012

Assisting Coastal Management

- Feeds
- Genetics
- Cage culture sustainability
- Ecosystem impacts
- GIS models for site selection
- Finfish animal health
- Best management practices

CAPES Vision

We develop decision support tools for ***coastal managers*** *enabling them to safeguard the environment while supporting aquaculture development in the coastal zone.*

Program priorities

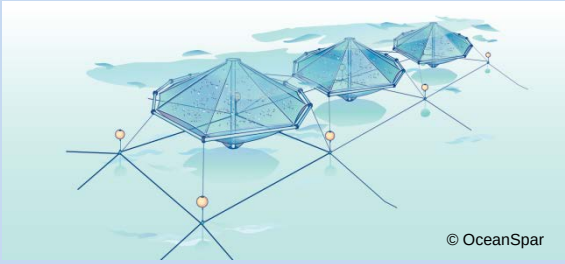
- Environmental Interactions
- Marine Spatial Planning to Inform Siting
- Climate Change Interactions
- Technology Development

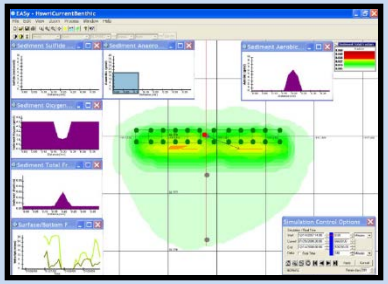
Aquaculture Modeling

- Developing a hub for aquaculture modeling
- Developing a framework to evaluate existing models
- Identifying thresholds for pollutant effects
- Conducting modeling simulations in varying environmental regimes
- Developing spatial plans and management tools

Why invest in modeling?

- Modeling is used in permitting (EIS) and spatial planning
- Consultants do modeling for industry
- Coastal managers need support with interpretation
- Standardized modeling methods are needed
- Spatial planning requires simulation of various production scenarios

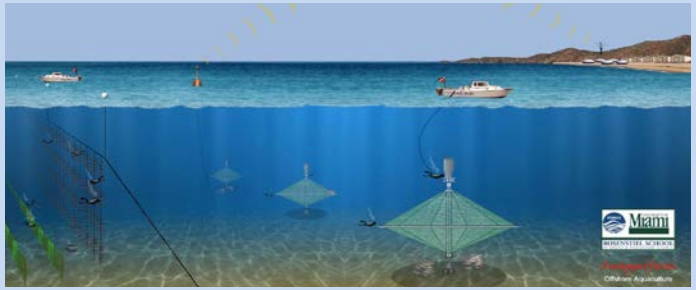




Evaluating marine aquaculture effects models

Environmental Models

- AquaModel
- Depomod
- FARM
- MOM
- CSTT Model
- LESV
- ShellSIM
- EcoWin
- Longline
- DEB
- DDB
- Hydro



Data Requirements Can Be High

Operations

- Feed rate
- Wasted feed (fraction)
- Initial pen oxygen
- Initial pen nitrogen
- Fecal/feed settling rate
- Fish growth rate min/max

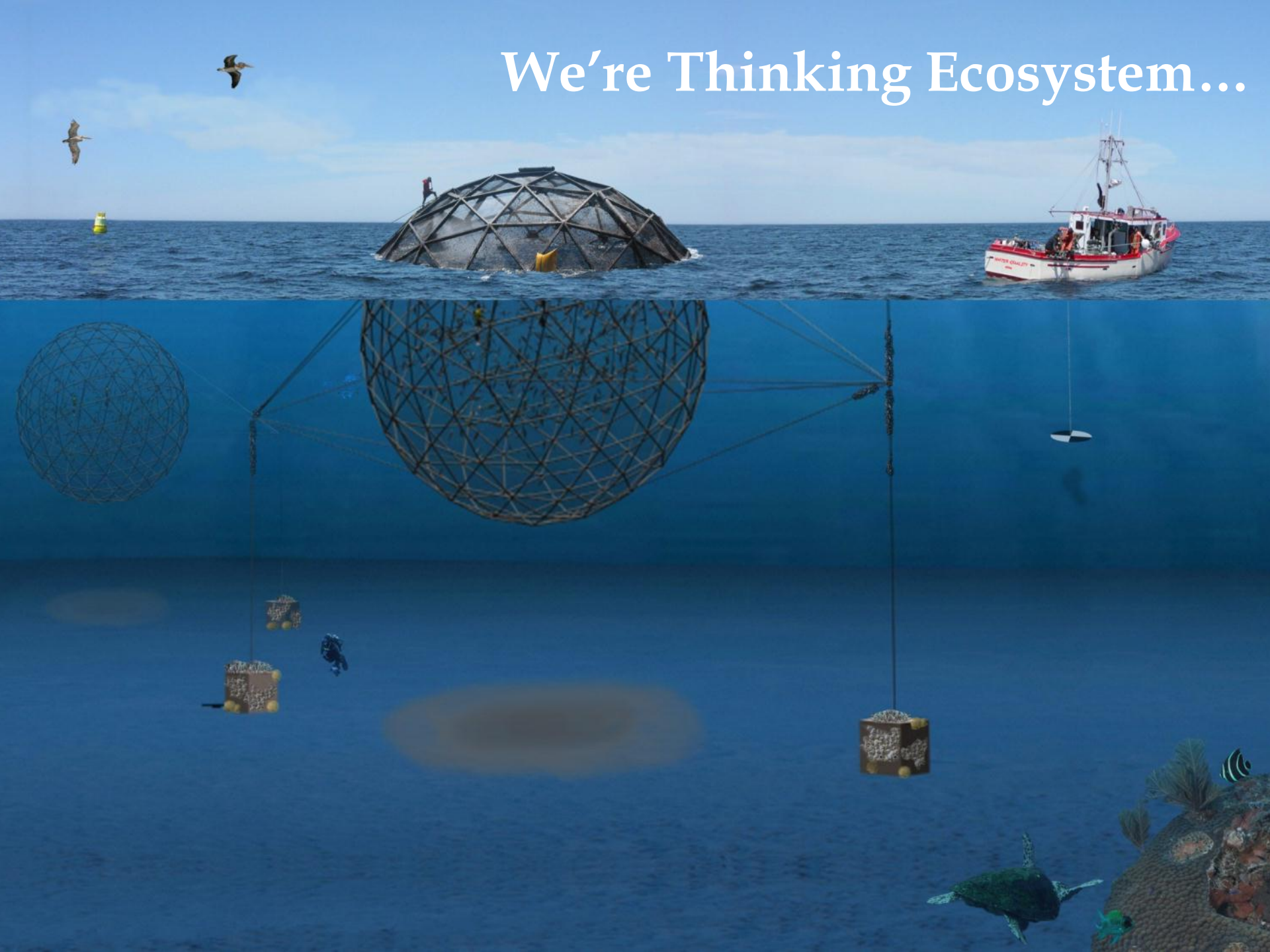
Water column

- Surface temperature
- Bottom temperature
- Irradiance
- Mixed layer depth
- Wind speed
- Tidal flow
- Current velocity
- Oxygen
- Nitrogen
- Phytoplankton
- Zooplankton

Benthic

- Aerobic biomass
- Anaerobic biomass
- Sediment O_2 and CO_2
- Sediment sulfide
- Sediment TOC
- Suspended O_2
- Water POC
- Fecal POC deposition
- Fecal TOC consolidation
- Fecal deposition threshold
- Fecal erosional threshold
- Fecal erosional rate

We're Thinking Ecosystem…



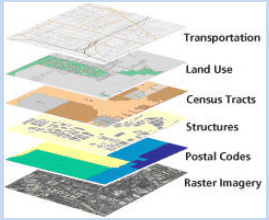
Marine Aquaculture Research

Coastal Aquaculture Planning and Environmental Sustainbility

Spatial Planning Tools for Marine Aquaculture

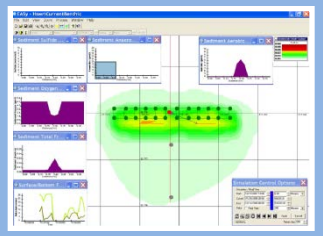
Site screening

- Proximity to ports
- Bathymetry
- Temperature
- User conflicts
- Protected species
- Viewshed
- Management areas
- ….



Environ. modeling

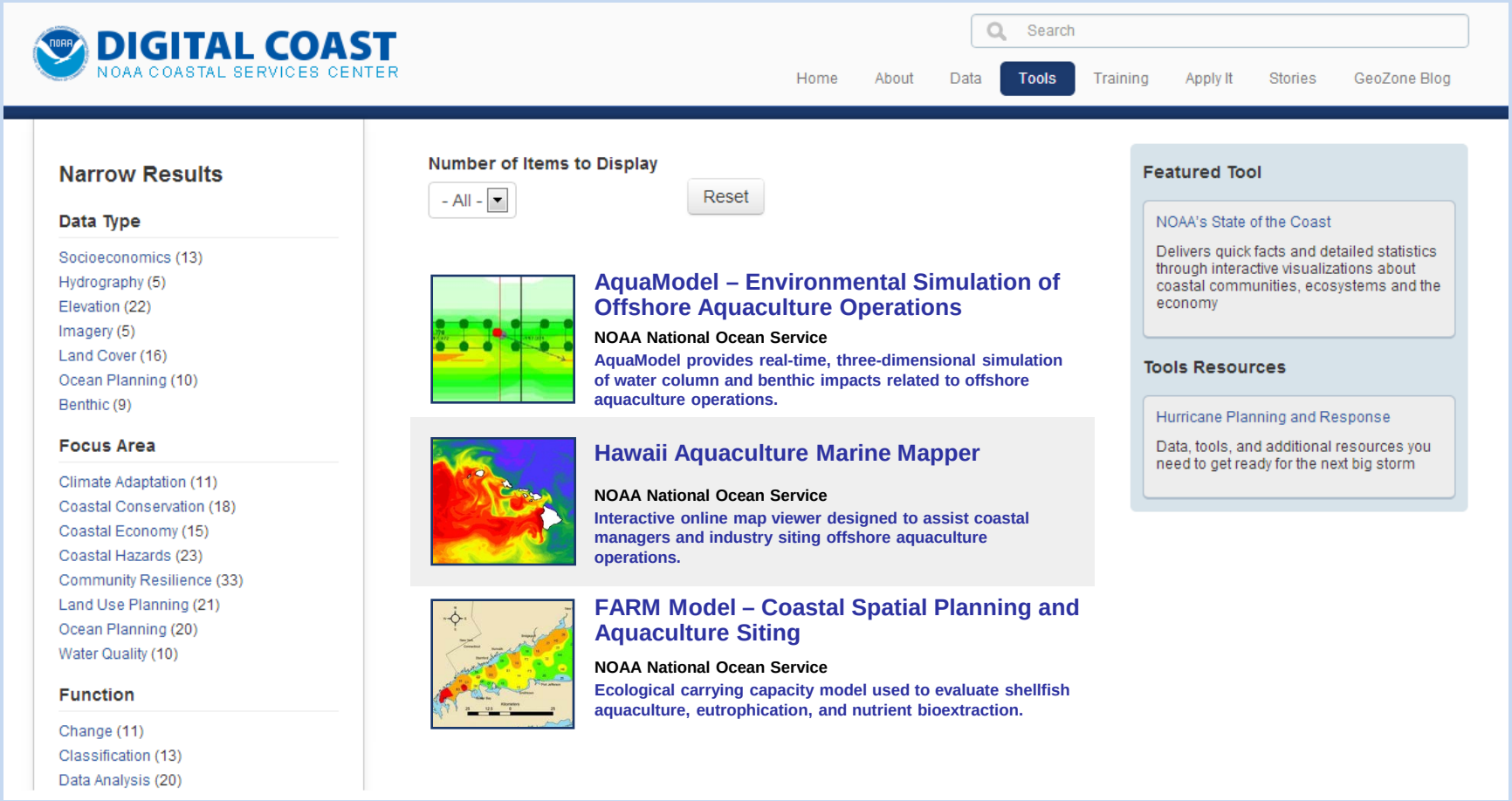
- Env. data required
- Pollution thresholds
- Production capacity
- Spatio-temporal dynamics
- Fish energetics
- Scenario simulations
- ….



Site selection

- Abiotic and biotic considerations
- Validation process
- Permitting process
- Socio-economics
- ….

Building the Coastal Aquaculture Planning Portal

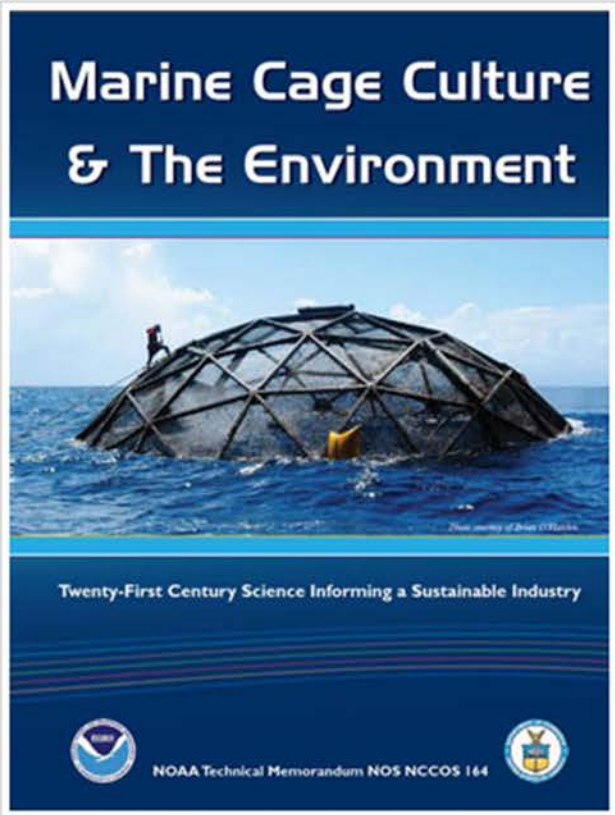


NOAA: Coastal ocean aquaculture can be environmentally sustainable

Little to no effects on coastal ocean environment seen with proper safeguards, planning

December 18, 2013

Specific types of fish farming can be accomplished with minimal or no harm to the coastal ocean environment as long as proper planning and safeguards are in place, according to a new report from researchers at NOAA's National Ocean Service.



The study, led by scientists at National Ocean Service's National Centers for Coastal Ocean Science (NCCOS), evaluated the environmental effects of finfish aquaculture, including interactions with water quality, benthic habitats, and marine life across various farming practices and habitat types.

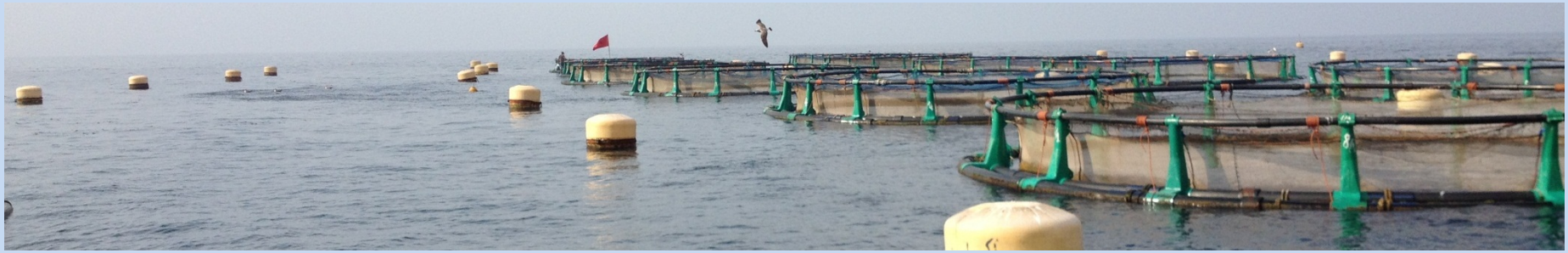
"We did this study because of concerns that putting marine finfish farms in the coastal ocean could have adverse effects on the environment," said Dr. James Morris, NCCOS ecologist. "We found that, in cases where farms are appropriately sited and responsibly managed, impacts to the environment are minimal to non-existent."

"This report provides coastal and farm managers with a global perspective on a range of potential environmental effects and their relative intensity,"

Recent International Exchanges

Morocco, Bermuda, Bahamas, Korea, Mexico, Scotland

- Provided information on spatial planning, zoning, and environmental modeling
- Visited commercial operations and established contacts for technology exchange
- Many collaborative opportunities working with coastal managers on marine aquaculture zoning, carrying capacity, and environmental monitoring



Opportunities for China/U.S. collaborations

- Monitoring and modeling
  - Compare models to forecast environmental interactions
  - Compare monitoring approaches
  - Discuss IMTA modeling

- Marine Spatial Planning
  - Moving mariculture offshore
  - Local, regional, and national approaches

Questions?