Pioneering Offshore Aquaculture Workshop

This workshop will offer discussion of current and future offshore Aquaculture projects in the Gulf. It will include presentations on important topics related to what we have experienced and understand about offshore aquaculture — followed by a facilitated discussion on what knowledge gaps and concerns exist and how they can be addressed to further the development of this industry in the Gulf of Mexico.

June 27,2019

9:00am—9:15am

Welcome
Introductions
Background

Martin Main—FL Sea Grant

Kevan Main—Mote

Michael P Crosby—Mote

9:15am—9:30am

Review Agenda
Activities
Housekeeping

Joy Hazell—FL Sea Grant

Marcy Cockrell—FDACS

9:30am—10:00am

History of Offshore Aquaculture—
Gulf of Mexico Current Status

Abstract | Presentation

Laura Tiu—FL Sea Grant

10:00am—10:30am

Interagency Processes and Guidance
Documents for GOM Aquaculture

Presentation

Jess Beck-Stimpert—NOAA

10:45—11:15am

GOM Aquaculture Permitting and the Application Processes

Presentation

Meghan Wahlstrom-Ramler—EPA

11:15am—11:45am

Spatial Planning and Site Selection

Abstract | Presentation

Ken Riley—NOAA

11:45am—11:15ai

FDACS-Aquaculture:

Permitting Options

Planning and Development

Abstract | Presentation

Charlie Culpepper—FDACS

1:00pm—1:30pm

The Velella Epsilon Project –
Kampachi Aquaculture in Florida

Abstract | Presentation

Dennis Peters—Kampachi Farms, LLC

1:30pm—2:00pm

Manna Fish Farms
Gulf of Mexico Project

Abstract | Presentation

Kelly Lucas—University Southern Mississippi

2:00pm—2:30pm

Sustainable Offshore Aquaculture
Environmental Considerations

Presentation

Dan Benetti—University of Miami

2:30pm—3:00pm

Best Management Practices for Offshore Aquaculture

Abstract | Presentation

LeRoy Creswell—FL Sea Grant

3:15pm—3:45pm

Interaction of Offshore Aquaculture and Fisheries

Abstract | Presentation

Kai Lorenzen—UF

3:45pm—4:15pm

Aquaculture Product Safety: An Essential Concern with Reasonable Solutions

Presentation

Steve Otwell—UF

4:15pm—4:45pm

Offshore Aquaculture Economics Implications for Seafood Market Growth

Presentation

Frank Asche—UF

June 28,2019

9:00am—10:00am

Welcome—Agenda Review

Presenter Panel—Q & A

10:00am—12:00pm

Activities to Identify Additional Offshore Aquaculture Research and Communication Questions

12:45pm—3:30pm

Tour—Mote Marine Aquaculture Facility Lunch and Welcome by Kevan Main

Hatchery and Fingerling Production of Marine Fish

The History of Offshore Aquaculture in the Gulf of Mexico

LAURA TIU, UF/IFAS – Sea Grant, 732 N. 9th Street, DeFuniak Springs, FL 32433, lgtiu@ufl.edu

KEYWORDS: Offshore aquaculture

Open ocean aquaculture is broadly defined as the rearing of marine organisms in exposed areas beyond significant coastal influence[1]. It is also called offshore aquaculture or offshore fish farming. This typically takes place in the U.S. Exclusive Economic Zone (EEZ) or federal waters, generally 3 to 200 nautical miles from shore for most states, but there are exceptions.

Offshore aquaculture is currently well established in many countries with research and commercial facilities in Australia, Chile, China, France, Ireland, Italy, Japan, Panama, Bahamas, Mexico, Vietnam and Norway. In the US, the situation is different. There is one commercial mussel farm in federal waters off California. To date, all other commercial aquaculture facilities have been sited in nearshore waters under state or territorial jurisdiction. Currently, there are currently no commercial finfish or shellfish aquaculture operations in the Gulf of Mexico (GoM) federal waters.

In the US, domestic aquaculture production has been identified as a priority for almost 40 years. In 1980, Congress passed the National Aquaculture Act in recognition of the importance of domestic aquaculture in meeting future food needs in the US[2]. The Act charged the National Oceanic and Atmospheric Administration (NOAA) to carry out the charge as they have a long history of conducting regulatory, research, outreach, and international activities on marine aquaculture issues. This was the beginning of what was termed the “Blue Revolution.”

Progress developing commercial offshore aquaculture facilities in federal waters during the ensuing decades has been hampered for a number of reasons including an unclear regulatory process, technical uncertainties, potential negative impacts and lack of experience. To address these challenges, at the request of the Administration, the 110th Congress introduced the National Offshore Aquaculture Act of 2007 in both the house and the senate[3]. Both bills focused on developing a framework to regulate aquaculture in the EEZ. A hearing was held in the House Committee on Natural Resources, but no further action was taken on either of these bills.

The Gulf of Mexico Fishery Management Council (Council) manages fishery resources in the federal waters of the Gulf of Mexico including reef fish, red drum, and as interpreted at that time, Aquaculture. With this directive, the Council voted on January 28, 2009 to approve a Fishery Management Plan (FMP) to issue aquaculture permits and regulate aquaculture in federal waters of the GoM[4]. The FMP went into effect on September 3, 2009. NOAA immediately announced plans to develop a new National Aquaculture Policy to put the FMP into context. Several groups opposed the Policy and bills[5,6,7] were introduced into the house and senate to rescind the authority of the Secretary of Commerce to permit or regulate offshore aquaculture or delay the process. These efforts died in Committee.

The Department of Commerce and NOAA both released policy in 2011 affirming NOAA’s role in fostering marine aquaculture in the U.S. and announcing intent to move forward with the rule making process for the GoM Aquaculture FMP[8,9]. In August 2014, the National Marine Fisheries Service proposed regulation to implement the FMP, as prepared by the Council in 2009, and requested public comment. They received over 1100 comments and provided 115 responses in the final rule.

The Council’s FMP for regulating offshore marine aquaculture in the GoM final rule was published in the federal register January 13, 2016[10]. It became effective February 12, 2016 and established a regional permitting process to manage the development of an environmentally-sound and economically sustainable aquaculture industry in federal waters of the GoM.

The Center for Food Safety (and others) immediately filed a lawsuit against NOAA arguing that the Magnuson Stevens Fishery Conservation and Management Act (MSA) under which the FMP was developed, was meant to give authority over the harvesting of wild fish, not aquaculture. A judge sided with the plaintiffs and ruled that “existing fisheries management laws were never intended to regulate aquaculture, concluding the NMFS had acted outside of its statutory authority in promulgating its rules."

The development of responsible aquaculture continues to move forward under the existing regulatory framework within the Environmental Protection Agency. NOAA still has input through the Army Corps permit process and can also still advise through siting guidance and the permit process.

A need for definitive Federal legislation to resolve this issue exists. To that end, in June 2018, Senator Roger Wicker of Mississippi introduced the "Advancing the Quality and Understanding of American Aquaculture Act," or AQUAA Act, that provides for a regulatory system for marine aquaculture in the United States exclusive economic zone[11]. Wicker's legislation has the support of high-profile Florida senator Marco Rubio. Wicker's bill may also gain the support of the administration, as Commerce secretary Wilbur Ross has spoken repeatedly about his desire to dramatically reduce the ratio of seafood consumed by Americans that is imported – roughly 90%.

Nearly 40 years after the National Aquaculture Act and 12 years after the National Offshore Aquaculture Act, offshore aquaculture in the GoM is on the verge of occurring. Two projects, Vellela (http://www.kampachifarm.com/) and Manna (https://mannafishfarms.com/), are working through he process of establishing offshore aquaculture in the GoM.

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History of Offshore Aquaculture in the Gulf of Mexico

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UF | IFAS Extension
UNIVERSITY of FLORIDA

Sea Grant
Florida

Offshore Aquaculture

Open Ocean Aquaculture is broadly defined as the rearing of marine organisms in exposed areas beyond significant coastal influence – Upton & Buck, 2010

Offshore Aquaculture = Offshore Fish Farming = Open Ocean Aquaculture

- Federal waters in the Gulf of Mexico (GoM)
- > 3 nautical miles (LA, MS, AL): > 9 nmi West Coast FL, TX
- Cages, net-pens, anchored & others

International Status

Research and Commercial Facilities:

Australia, Chile, China, France, Ireland, Italy, Japan, Panama, Bahamas, Mexico Vietnam and Norway.

SalMar's Ocean Farm 1 arriving in Norway. Credit: Kystmuseet

A fully assembled A3600 Aquapod. Image: Ocean Farm Technologies

US State/Territorial Waters - 2019

- Currently no commercial finfish or shellfish aquaculture operations in GoM federal waters (one commercial mussel farm in federal waters off California)
- Upcoming GoM projects
- Velella Epsilon (EPA/Corps permit applications submitted)
    - 1 cage pilot project (moored); ~40 miles SW of Sarasota
    - Growing out Almaco jack fingerlings for 1 year (~1 year in water)
- Manna Fish Farms (pre-application phase)
    - Up to 18 cages; commercial facility
    - Likely grow red drum (other Gulf finfish species possible)
    - Federal waters off Pensacola

1980

- Congress recognizes the importance of domestic aquaculture in meeting future food needs in the U.S.
- 1980 - National Aquaculture Act

  “it is in the “national interest and national policy to encourage aquaculture development in the United States”

- Charged NOAA, through the Dept. of Commerce, to carry out the charge

1980-2007

Development of commercial aquaculture facilities in federal waters is hampered by

- Unclear regulatory process
- Technical uncertainties working in offshore areas
- Potential environmental impacts
- Potential economic impacts
- Potential impacts on existing commercial fisheries
- Lack of experience

2007

April 24, 2007 - H.R. 2010 the *"National Offshore Aquaculture Act of 2007"* was **introduced** to develop a framework to regulate aquaculture in the EEZ, 9-200 miles offshore. Bill **died** in Committee.

June 16, 2007 – S. 1609 the *"National Offshore Aquaculture Act of 2007"* was **introduced** to establish an operating permit process for the development and operation of offshore aquaculture facilities in areas of the U.S. Exclusive Economic Zone (EEZ). Bill **died** in Committee.

2009

Gulf of Mexico Fishery Management Council (GMFMC)

- One of eight US Regional Fishery Management Councils established by the Magnuson-Stevens Fishery Conservation and Management Act
  - Gulf Council manages fishery resources in the federal waters of the GoM (e.g. reef fish, red drum)
  - NOAA's position that aquaculture is fishing under Magnuson-Stevens Act
- January 28, 2009 - Council **approved** a comprehensive plan to permit aquaculture in federal waters of the GoM
  - Fishery Management Plan for Regulating Offshore Marine Aquaculture in the Gulf of Mexico (FMPROMAGOM) or Gulf Aquaculture FMP
    - Provides comprehensive framework for authorizing and regulating offshore aquaculture
    - Establishes approach for evaluating potential impacts
- Entered into effect "by operation of law" on September 3, 2009

2009

- September 4, 2009 – NOAA announced it would develop a new National Aquaculture Policy. That put the Gulf Aquaculture FMP into context
- Fall 2009 several eNGOs and fishing groups sued NOAA on the Gulf Aquaculture FMP (lawsuit later thrown out because “not ripe for adjudication” (i.e., management plan does not = regulations)

2009-2010

- September 8, 2009 - H.R. 3534 the *"Consolidated Land, Energy and Aquatic Resources Act of 2009"* was **introduced**. Section 704 of the bill would have rescinded the authority of the SOC to develop or approve fishery management plans to permit or regulate offshore aquaculture
  - July 30, 2010 – H.R. 3534 **passed** by House (offshore aquaculture language was removed)
- December 16, 2009 – H.R. 4363 *the "National Sustainable Offshore Aquaculture Act of 2009"* was **introduced** to establish a regulatory system for aquaculture in the US EEZ. Bill died in Committee.
- May 25, 2010 - S. 3417 the "*Research in Aquaculture Opportunity and Responsibility Act*" of 2010 was **introduced** to prohibit OSA until 3 years post impact studies report. Bill died in Committee.

2011-2014

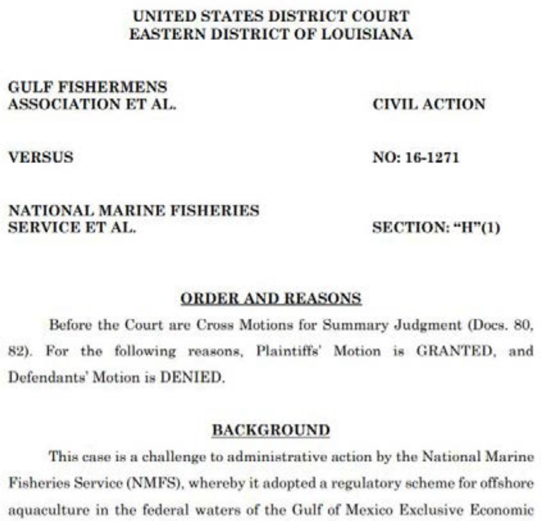
- June 2011 - The U.S. Department of Commerce Aquaculture Policy affirms NOAA's role in fostering marine aquaculture in the US
- June 2011 – NOAA releases of the National Marine Aquaculture Policy and the Agency's intent to move forward with rulemaking for the Gulf Aquaculture FMP.
- August 2014 – Proposed rule published
  - > 1100 public comments received (>90% were form letters/identical comments)
  - 115 responses to comments published in the Final Rule

2016

- January 2016 – NOAA Fisheries publishes the Final rule implementing the Gulf Aquaculture FMP to become effective February 2016
- February, 2016 – NOAA Fisheries sued by several eNGOs, led by the Center for Food Safety, and fishing groups

2018

- September 25, 2018 – CFS wins lawsuit
- **Defendants:** National Marine Fisheries Service (NMFS); National Oceanic and Atmospheric Administration (NOAA); Eileen Sobeck, in his official capacity as Assistant Administrator for Fisheries; Dr. Roy Crabtree, in his official capacity as Regional Administrator for NMFS, Southeast Region; Kathryn Sullivan, in his official capacity as Undersecretary of Commerce for Oceans and Atmosphere and Administrator of NOAA; and Penny Pritzker in her official capacity as United States Secretary of Commerce.
- **Plaintiffs:** are Gulf Fishermen's Association; Gulf Restoration Network; Destin Charter Boat Association; Alabama Charter Fishing Association; Fish For America USA, Inc.; Florida Wildlife Federation; Recirculating Farms Coalition; Food & Water Watch, Inc.; and Center for Food Safety.



UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF LOUISIANA

GULF FISHERMENS ASSOCIATION ET AL.	CIVIL ACTION
VERSUS	NO: 16-1271
NATIONAL MARINE FISHERIES SERVICE ET AL.	SECTION: "H"(1)

ORDER AND REASONS

Before the Court are Cross Motions for Summary Judgment (Docs. 80, 82). For the following reasons, Plaintiffs' Motion is GRANTED, and Defendants' Motion is DENIED.

BACKGROUND

This case is a challenge to administrative action by the National Marine Fisheries Service (NMFS), whereby it adopted a regulatory scheme for offshore aquaculture in the federal waters of the Gulf of Mexico Exclusive Economic

2018

- June 26, 2018 - Senator Roger Wicker, a Mississippi Republican, **introduced** S.3138 the Advancing the Quality and Understanding of American Aquaculture (AQUAA) Act (S. 3138), a bill that would streamline the permitting process for putting aquaculture farms in federal waters -- 3 to 200 miles offshore -- while also providing funds for research purposes.

2019

- Current proposed initiatives still moving forward and utilizing NMFS requirements as a guide to good practices(Vella & Manna)
- NOAA Fisheries has appealed the ruling; lower court ruling still stands while appeal is being considered
- Offshore Aquaculture projects in the GOM continue under EPA and Army Corps permits

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Science, Service, Stewardship

Interagency Processes & Guidance Documents for Aquaculture in the Gulf of Mexico

July 14, 2019

NOAA FISHERIES SERVICE

NOAA FISHERIES SERVICE

Overview

- NOAA's role in federal waters
- Coordinated interagency process
- Guidance documents for GoM aquaculture

NOAA FISHERIES SERVICE

NOAA's role

- Final rule implementing Gulf Council Aquaculture FMP
  - Published final rule January 2016; lawsuit February 2016
  - Eastern District of Louisiana decision in Sept 2018
    - NOAA does not have authority to regulate aquaculture under the Magnuson-Stevens Act
  - NOAA appealed June 2019; decision expected in 2020
- NOAA conducts Endangered Species Act and Essential Fish Habitat consultations for aquaculture projects.
- NOAA works with other federal agencies (EPA, Corps) to coordinate and streamline permitting processes.

NOAA FISHERIES SERVICE

Interagency Process

- Gulf Regulatory Task Force (2014)
- Created a coordinated federal permitting process for the GoM, i.e., align processes and reduce duplicative requirements
- Federal permitting, consulting and authorizing agencies involved in aquaculture
  - NOAA Fisheries, Corps, EPA, BOEM, BSEE, USFWS, Coast Guard, USDA, Air Force and Navy

NOAA FISHERIES SERVICE

Interagency Process

- EPA is currently leading environmental analyses, consultation requests and other regulatory requirements (Section 106 National Historic Preservation Act) for aquaculture projects in the eastern GoM
  - NOAA Fisheries and Army Corps are cooperating agencies on these two projects
- No projects in federal waters of the western GoM

NOAA FISHERIES SERVICE

Interagency documents

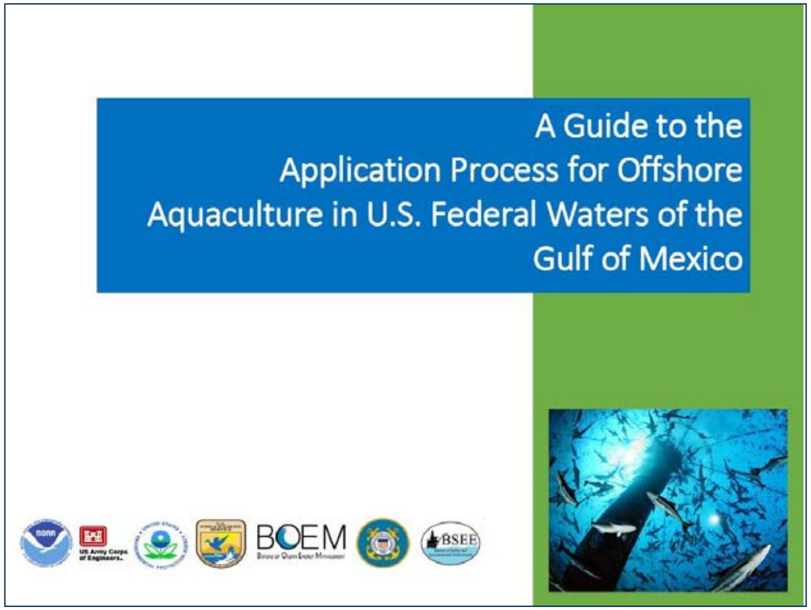
- Permit Applicant Guide – quick guide for federal permitting and authorization processes
- Pre-Application Meeting – first step for potential applicants; meant to identify potential issues with project (*e.g.*, site selection)
- Interagency MOU – outlines agency responsibilities in federal waters

**** Documents currently being revised ****

NOAA
FISHERIES
SERVICE

Permit Applicant Guide

- Outlines federal permitting and authorization requirements
- Summarizes Federal agency statutory and regulatory authorities
- Links to Federal agency websites and resources
- Contact information for each Federal agency



NOAA FISHERIES SERVICE

Pre-Application Meeting & Checklist

- **Pre-Application Meeting** ***(optional)*** is an opportunity for potential applicants to engage in preliminary discussions with the relevant federal agencies.
  - Location of proposed site and general info for operation
  - Identify potential issues prior to applying for federal permits
- A checklist has been created which outlines important information to provide to Federal Agencies in advance of the Pre-Application Meeting.
- The NOAA Regional Aquaculture Coordinator is the point of contact for the Pre-Application Meeting process.

NOAA FISHERIES SERVICE

Interagency MOU

- Establishes a framework for cooperation and information sharing across agencies.
- Establishes the intent to periodically update guidance materials.
- Establishes the intent to coordinate and participate in the pre-application process, coordinate on consultation processes, coordinate public comment periods, etc. as appropriate and practical.

NOAA FISHERIES SERVICE

GoM Guidance Documents

- Baseline Environmental Survey (2016; being revised)
  - EPA and NOAA Fisheries requirements
- Structural Integrity guidance (2019)
  - Developed with marine engineering experts from the U.S. Naval Academy, state and federal agencies
- Under development – recommendations for creating an Aquatic Animal Health Plan
  - NOAA, USDA APHIS

NOAA FISHERIES SERVICE

Baseline Environmental Survey

- Both NOAA and EPA have requirements to ensure that operations are properly sited and that proposed activities do not cause degradation of natural resources.
    - *Seafloor Survey*
    - *Hydrographic Measurements*

- BES information will be used to determine whether particular features exist in the proposed area and what measures must be taken to protect natural resources.

Structural Integrity

- Ocean engineering guidance document aimed at providing potential applicants with information for installing aquaculture operations out to 200 nautical miles in the GoM.
- Provides recommendations for Basis-of-Design, including engineering criteria, techniques, reasoning and decisions employed to develop an aquaculture system in the offshore environment.

NOAA FISHERIES SERVICE

Contact information

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NOAA FISHERIES SERVICE

Questions?

GOM Aquaculture Permitting and the Application Process

June 27, 2019

Pioneering Offshore Aquaculture in the SE Gulf of Mexico

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PROGRAM

Outline

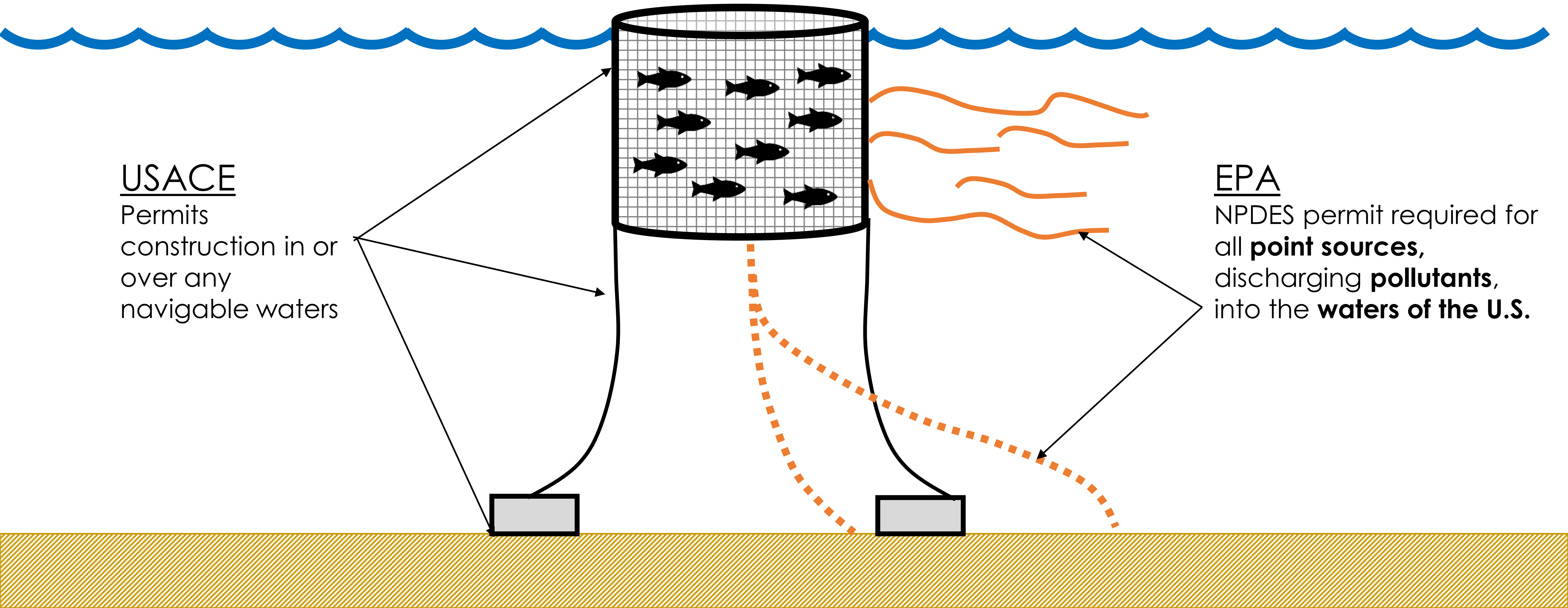
- Required permits for Aquaculture activities in the GOM
- EPA's implementation of the Clean Water Act (CWA)
- Components of EPA's Permit
- EPA Permitting process

Required Federal Permits for Aquaculture

- **U.S. Army Corps of Engineers (USACE) Section 10 permit**
  - Required in navigable waters to protect navigation and commerce
  - Permits construction in or over navigable waters

- **United States Environmental Protection Agency National Pollution Discharge Elimination System (NPDES) Permit**
  - Required for **point sources**, discharging **pollutants** into the **waters of the US**
  - Permits the effluent (discharge)

U.S. Army Corps of Engineers and U.S. Environmental Protection Agency



Clean Water Act (CWA) and Aquaculture

- CWA goal is to restore and maintain the integrity of the nation's waters
- Section 402 requires National Pollutant Discharge Elimination System (NPDES) permits for point source discharges of pollutants into waters of the U.S., including the territorial seas. 40 CFR §122 through 127.
- Section 403 Ocean Discharge Criteria (ODC). As part of the NPDES requirements for these federal permits, an ODC Evaluation is conducted per 40 CFR §125 Subpart M. Ensure that discharge will not cause:
  - Unreasonable degradation – specific requirements (10 criteria)
  - Significant adverse changes in the ecosystem
  - A threat to human health, or
  - Loss of aesthetic, recreation, scientific, or economic values

Section 402 – NPDES Permit

- Is a legal document that:
  - Identifies outfall points from which a facility can discharge
  - Sets requirements to protect the quality of surface water (e.g. pollutant concentration limits, best management practices, record-keeping requirements)
  - Allows an operation to discharge as long as the operation meets the requirements of the permit

- All requirements are enforceable and any violations are subject to enforcement actions.

Components of an NPDES Permit

All Permits

Cover Page

Effluent Limitations
- Technology-based
- Water Quality-based

Monitoring and Reporting

Special Conditions
- Additional Monitoring/Special Studies
- Best Management Practices
- Compliance Schedules

Standard Conditions

Industry Specific

- ELG Guidelines (CAAP Guidelines)
- Case by Case Limitations

- Limits needed to meet ODC

Pollutants of concern

- total suspended solids or settleable solids
- biological wastes
- floating and submerged matter
- Five-day biochemical oxygen demand, dissolved oxygen
- nutrients (phosphorus and nitrogen), ammonia
- therapeutic drugs and chemicals including anti-fouling agents

What Informs Permit Conditions

- Site Characteristics (Depth, Flow, etc)
- Facility Characteristics (Size, Feed, etc.)
- Consultations and Evaluations
- Ocean discharge criteria evaluation (determines the need for additional control mechanisms)
- Applicable Effluent Limit Guidelines (ELGs)

Effluent Limitation Guidelines for Aquaculture Facilities

- Facilities that produce at least 100,000 lbs a year that directly discharge wastewater at least 30 days a year – considered a Concentrated Aquatic Animal Production Facility (CAAP) (40 CFR § 122.24
  - Must meet Effluent Limitation Guidelines for CAAP Facilities set in 40 CFR 451
- Below this criteria does **not mean an NPDES permit is not required**, it just means that the CAAP guidelines do **not automatically** apply.

NOTE: There are separate criteria for identifying cold water CAAP facilities

The CAAP Effluent Guidelines require operators to:

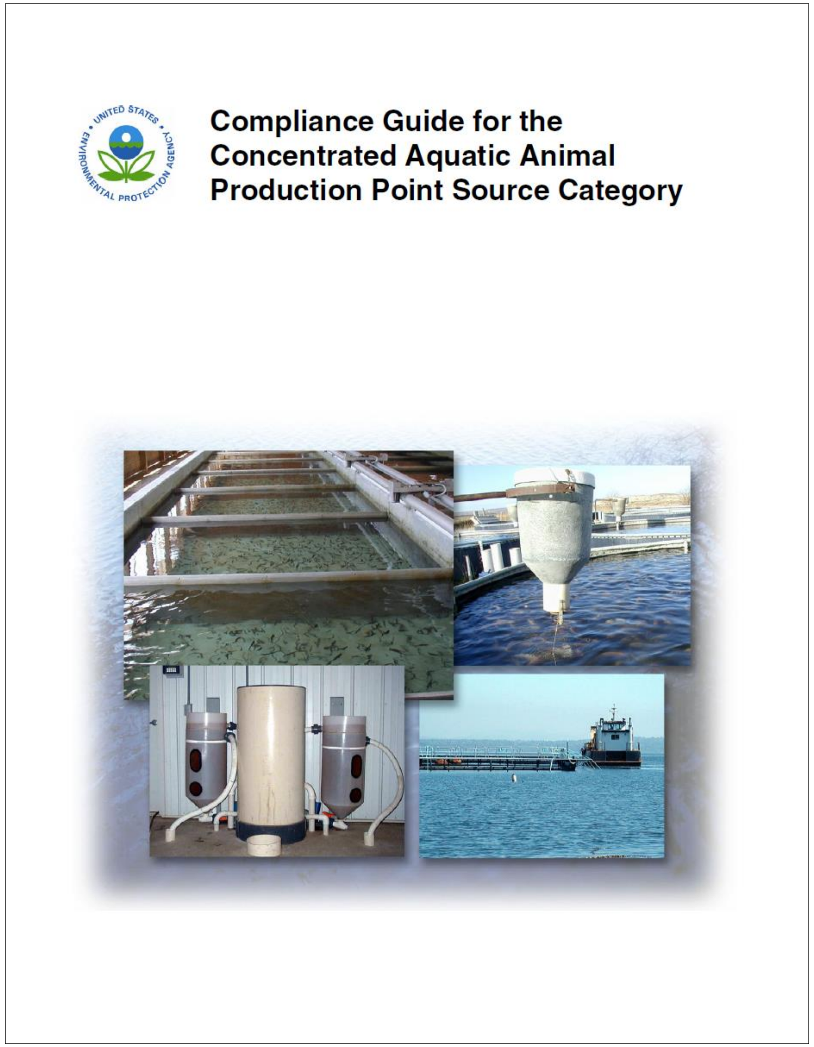
- Control discharge of allowable drugs, pesticides and excess feed.
- Properly dispose of wastes.
- Properly manage/treat production and wastewater, including those from transport and harvest.
- Maintain proper materials storage.
- Properly dispose of mortalities.
- Implement spill prevention and response procedures.
- Report the use of experimental animal drugs or drugs that are not used in accordance with label requirements.
- Keep records and periodically report on numbers and weights of animals, amounts of feed and pharmaceuticals, and frequency of cleaning, inspections, maintenance, and repairs.
- Fully train staff in all of these procedures.

Ocean Discharge Criteria

- Requirements based on Ocean Discharge Criteria (40 CFR Part 125, Subpart M).
  - Ambient monitoring programs
  - Alternative assessments
  - Additional pollution prevention techniques, as needed

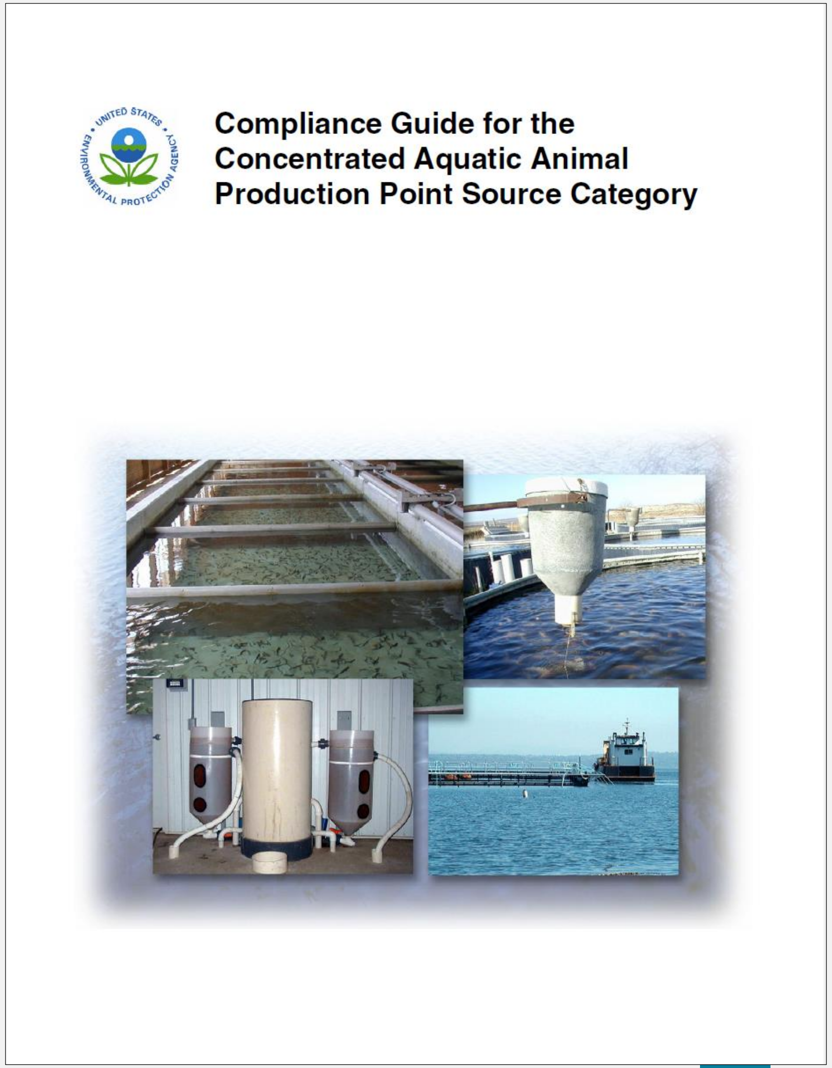
Purpose of Monitoring

- **For the purpose of:**
  - Ensuring compliance with limits in the NPDES permit
  - Establish basis for enforcement actions
  - Assess treatment efficiency
  - Characterize effluents and receiving waters



Typical Monitoring Requirements

- Location of sample
  - Effluent and receiving water
- Sample frequency
  - Continuous, daily, monthly, and annual
- Type of sample
  - Grab or composite
- Sample methods
  - Method detection and hold times
- Sample records
  - Date, time, place, individual, etc.


Compliance Guide for the Concentrated Aquatic Animal Production Point Source Category

Other Possible Permit Requirements

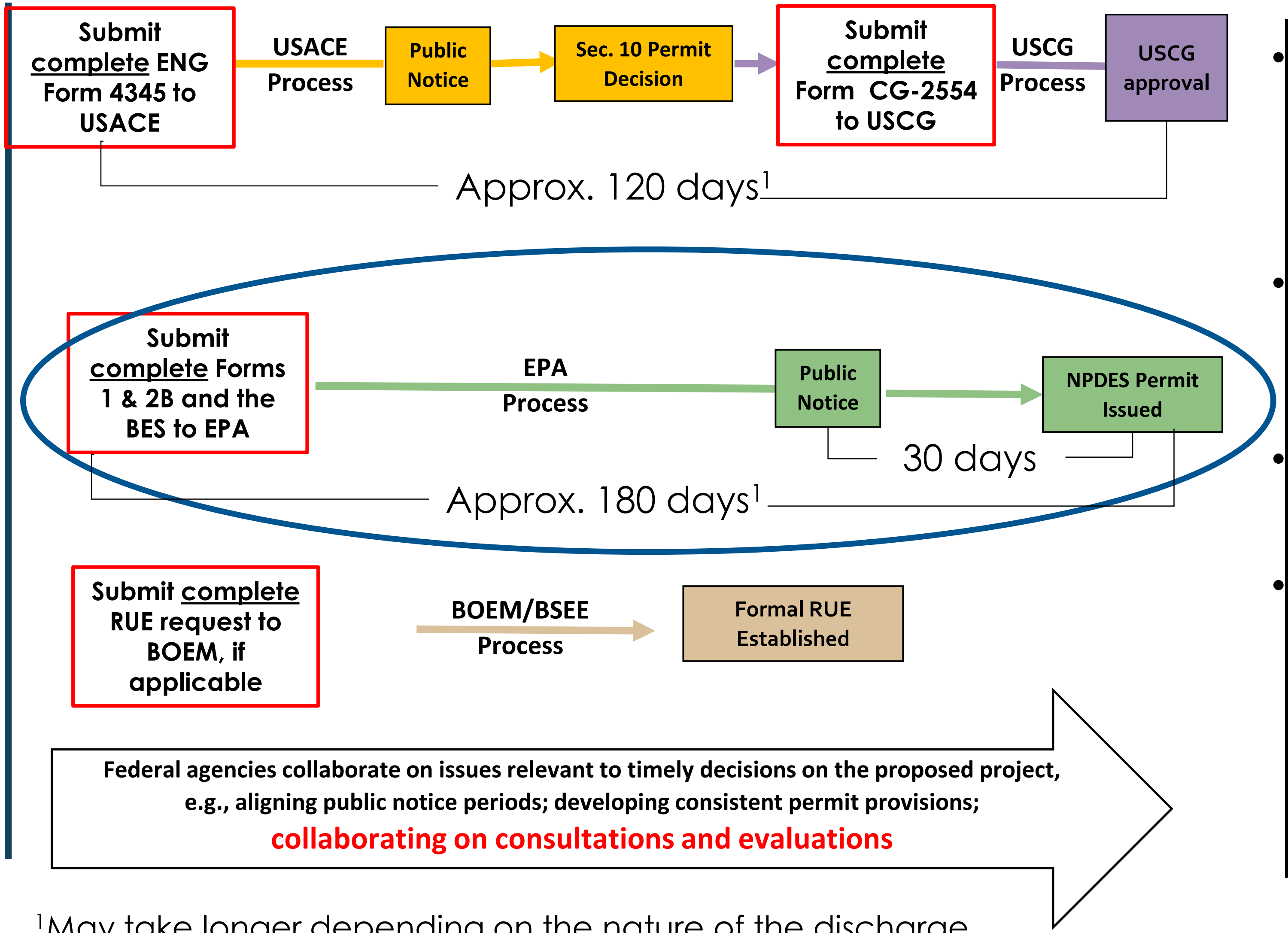
- Narrative limitations (e.g. There shall be no discharge of floating solids or visible foam other than trace amounts)
- Establishment of buffer zone
- Best Management Practices Plan – Implement the ELGs
- Environmental Monitoring Plan – Implement the ODC
- Facility Damage and Prevention Control Plan – Developed to demonstrate facility is being operated and maintained to prevent and mitigate any environmental impacts during a disaster
- Quality Assurance Plan – Ensure that water quality data collected is reliable

Overall Permitting Processes

Pre-application Process

- Pre-application meeting **Not required** but highly **encouraged**
- Brings together various federal agencies – **Not required** but highly encouraged
- Base-line environmental survey (required)
- Pull-together other required information (required)

Formal Application Process



[1] May take longer depending on the nature of the discharge, complexity of public comments and external reviews and consultations

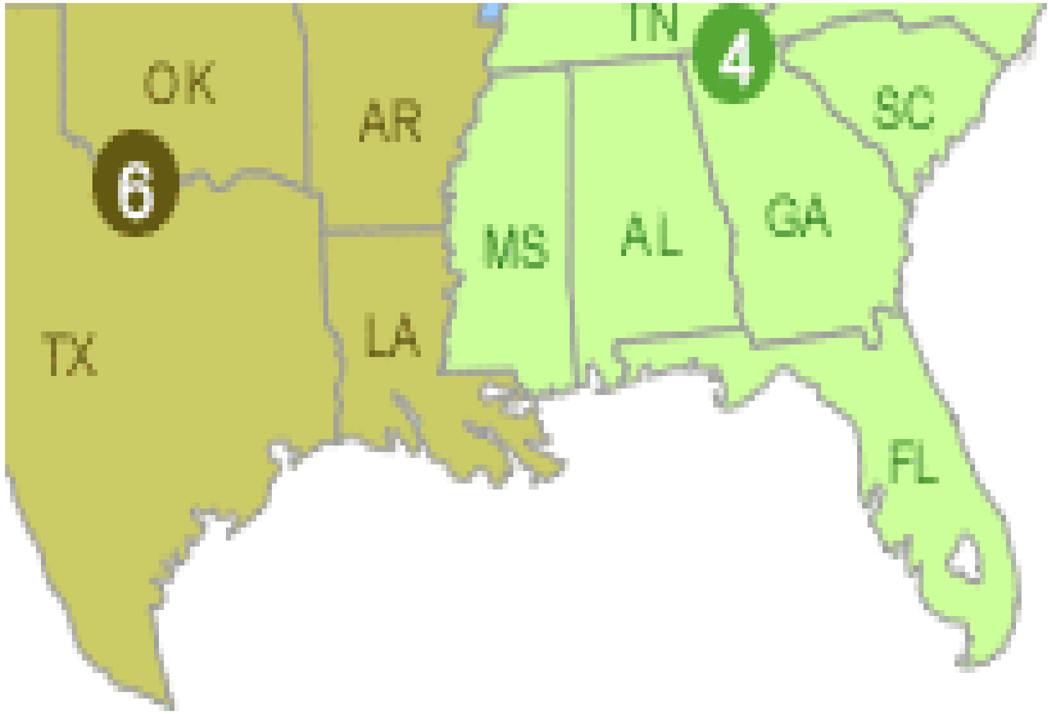
Permit Issuance

- When effective, deploy and begin operation
- Must comply with permit conditions
- NPDES Permits are for 5 years
- Submit application for renewal (for EPA – 180 days prior to expiration date of permit

Federal Consultations and Evaluations

Statutory Requirement	Assess likelihood that the project will affect, and implement measures to abate effects on…	Oversight Agency
Section 7, Endangered Species Act	an ESA-listed species and/or designated critical habitat.	NOAA, National Marine Fisheries Service
Essential Fish Habitat, Magnuson-Stevens Fisheries Conservation and Management Act	essential fish habitat.	NOAA, National Marine Fisheries Service
Section 106, National Historic Preservation Act	historic properties, e.g., shipwrecks, prehistoric sites, cultural resources.	Advisory Council on Historic Preservation; State/Tribal Historic Preservation Offices
Fish and Wildlife Coordination Act	fish and/or wildlife resources.	U.S. Fish & Wildlife Service
Section 304(d), National Marine Sanctuary Resources Act	sanctuary resources.	NOAA, National Marine Sanctuary Program
Section 118, Marine Mammal Protection Act	the incidental capture of marine mammals during commercial fishing operations.	NOAA, National Marine Fisheries Service
Coastal Zone Management Act	the land or water uses or natural resources of the states' coastal zone.	States with approved CZM Plans
National Environmental Policy Act	the quality of the human environment.	Council on Environmental Quality

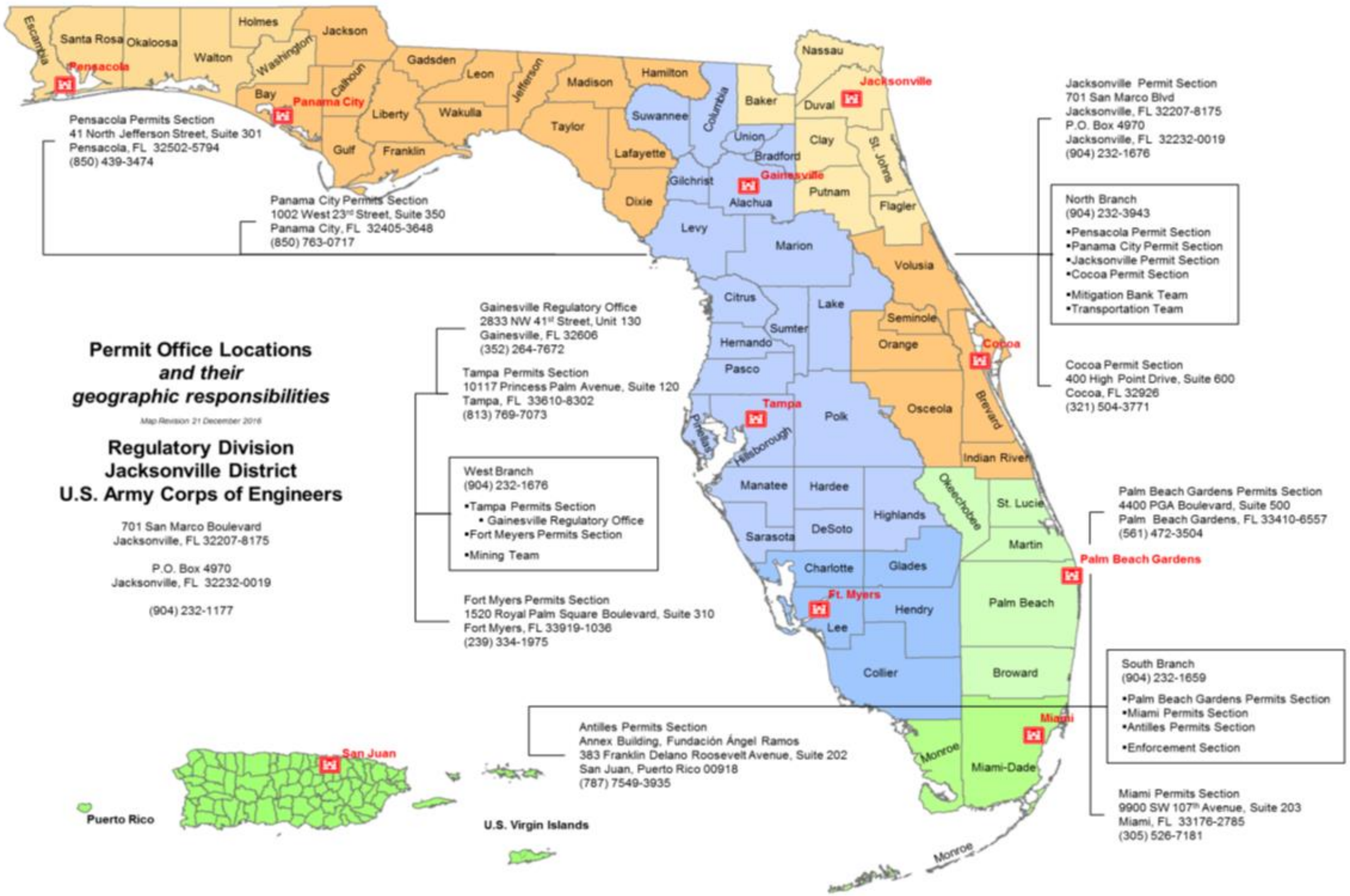
EPA Contacts



- EPA Region 4: offshore from Florida, Alabama and Mississippi
  Meghan Wahlstrom,
  Wahlstrom-ramler.meghan@epa.gov
  404.562.9672

- EPA Region 6: offshore from Louisiana and Texas
  Jim Afghani
  afghani.jim@epa.gov
  214.665.6615

USACE Contacts



Speaker Contact Information

Meghan Wahlstrom-Ramler

wahlstrom-ramler.meghan@epa.gov

Questions?

AquaSmart Planning: Advanced Spatial Analytical Approaches Improve Confidence and Transparency in Aquaculture Site Selection

KENNETH L. RILEY*, LISA C. WICKLIFFE, JONATHAN A. JOSSART, and JAMES A. MORRIS, Jr.

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Keywords: Siting, Spatial Planning, GIS, Marine Aquaculture

With new policies and plans for aquaculture development, the Gulf of Mexico has garnered significant interest from the aquaculture industry, forward-thinking fishermen, and investors that are inspired to bring sustainable seafood, wild and farmed, to market. The Gulf region could support a vibrant finfish aquaculture industry with its warm waters, suitable depths and currents, and access to working waterfronts, processing plants, and wholesale businesses within more than 400 coastal communities. Planning for offshore aquaculture operations in the Gulf of Mexico requires careful spatial and temporal consideration given the diversity of coastal communities, shared natural resources, and multiple ecosystem services provided in the region. A critical element needed by coastal resource managers and stakeholders is awareness and confidence to use science-based decision tools to inform regulation, environmental protection, and equitably resolve points of resistance to industry development.

NOAA is committed to supporting an aquaculture industry that is economically sustainable and environmentally and socially responsible. As part of NOAA's National Centers for Coastal Ocean Science, the Coastal Aquaculture Siting and Sustainability (CASS) program specializes in understanding environmental interactions of aquaculture within marine ecosystems. The CASS team of multidisciplinary scientists and engineers are working with partners throughout the Gulf region to provide spatial planning and siting guidance for aquaculture development. The aquaculture industry and coastal resource managers in this region need high quality and reliable spatial data products to make smart management and business decisions. CASS has significantly invested in developing innovative web-based mapping applications such as OceanReports and the Gulf AquaMapper. These online tools support exploration, permitting, and siting of offshore aquaculture.

OceanReports is the most comprehensive web-based spatial assessment tool for exploring the coastal ocean. Users can select an ocean space and instantaneously obtain over 80 unique infographics containing analyses of the location, its energy and minerals, natural resources, transportation and infrastructure, the oceanographic and biophysical conditions, and the local ocean economy. Users can then select infographics of interest, explore pertinent ocean data through interactive popups and visualizations, toggle each layer related to infographic content, share results, and print reports to inform various permitting processes. OceanReports was developed from the largest known compilation of U.S. ocean data, encompassing over 150 essential data sets, which have been processed for optimal spatial and temporal resolution within an interactive tool.

The Gulf AquaMapper is an easy-to-use online mapping tool used in screening and scoping sites for marine finfish aquaculture in the federal waters of the Gulf of Mexico. The tool was conceived working with partners throughout the Gulf region to provide planning and siting guidance for aquaculture development. Because of the growing complexity of environmental analyses and the high cost of data acquisition, the Gulf AquaMapper was developed to gather authoritative coastal and environmental intelligence that could be used in planning, scoping, and authorizing ocean use to allow for aquaculture development. The tool compiles data that can be used to determine potential major and minor constraints for aquaculture in the Gulf region. Coastal resource managers and industry can explore and screen areas that may already have multiple existing uses, improving decision-making before entering into the actual permitting process for siting a farm. Streamlining the process prevents coastal managers and offshore aquaculture investors seeking permits with logistical and economic inefficiencies. Data layers in the Gulf AquaMapper are standardized so operators have access to authoritative data to use in the site selection process. Data layers in the Gulf

AquaMapper are organized in a way that aids users in looking at major ocean constraints first (e.g., military, navigation, industry) as well as conditional constraints (e.g., sensitive habitats, protected species) that may require in-depth consultation with federal agencies. The Gulf AquaMapper does not provide analyses, but can be used in concert with OceanReports by allowing users to add data from other web services or data files, and to select features to analyze further.

CASS provides marine spatial planning support for aquaculture through screening, alternative siting, and precision siting analyses. Using a form of a Multi-Criteria Decision Analysis (MCDA), a suitability analysis, areas can be screened alternative siting analyses can then occur. This form of suitability analysis examines numerous spatial data layers in an area of interest and identifies low conflict areas with site characteristics suitable for aquaculture. Precision siting is then performed using the best available high-resolution spatial data. These aquaculture siting analyses involve the use of geospatial analytical tools (e.g., GIS – Geographic Information Systems) to integrate pertinent spatial data and generate map products that can be used to inform policy and permitting decisions regarding where operations can be located.





AQUASMART SITING: PLANNING FOR AQUACULTURE EXPANSION IN COASTAL U.S. WATERS

Kenneth Riley, Lisa Wickliffe, Jonathan Jossart, and James A. Morris, Jr.

NOAA National Ocean Service
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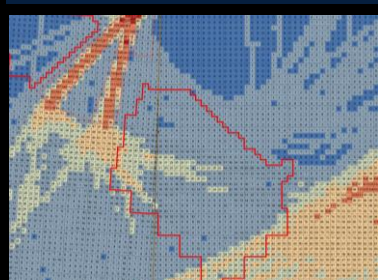
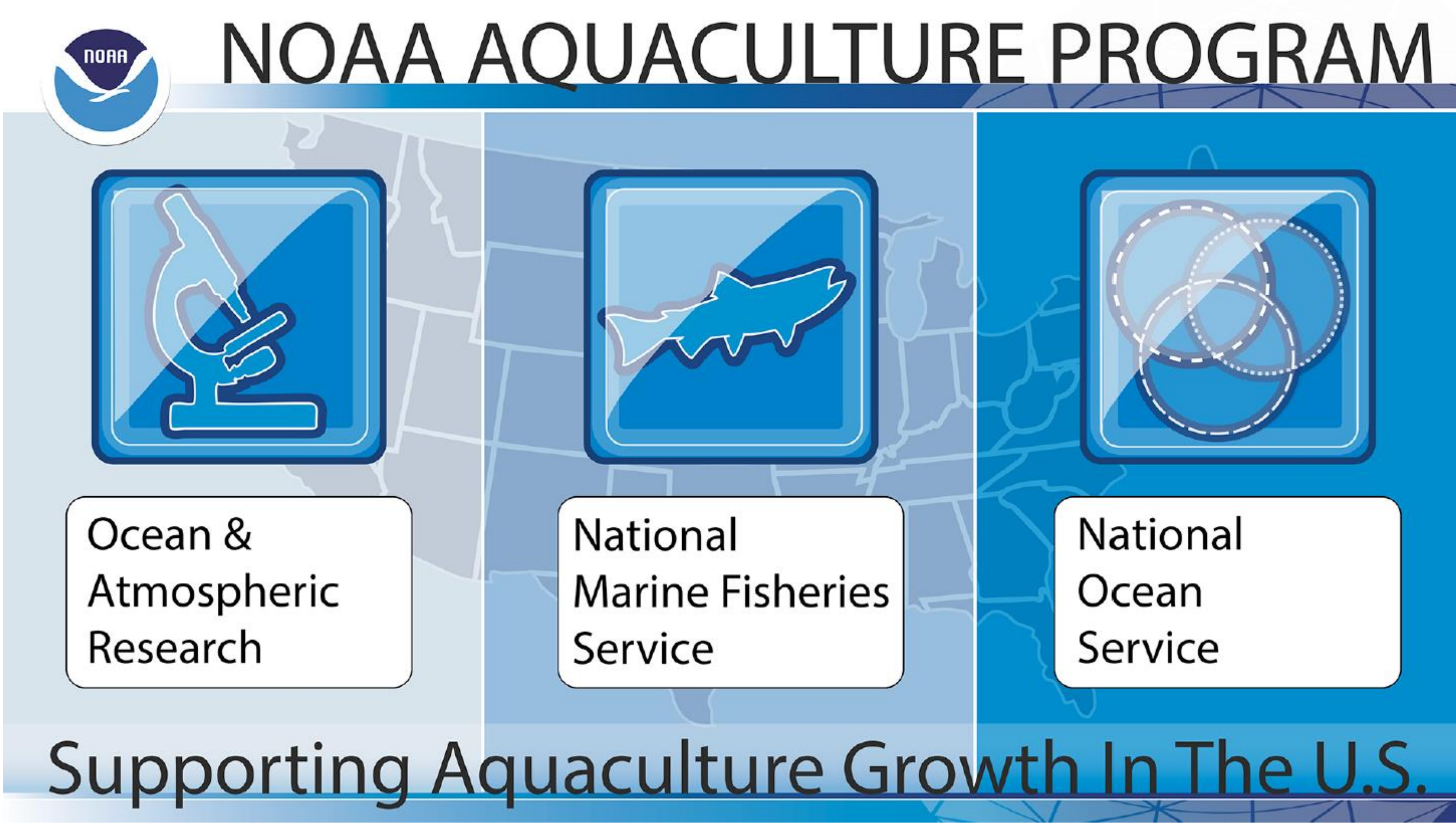
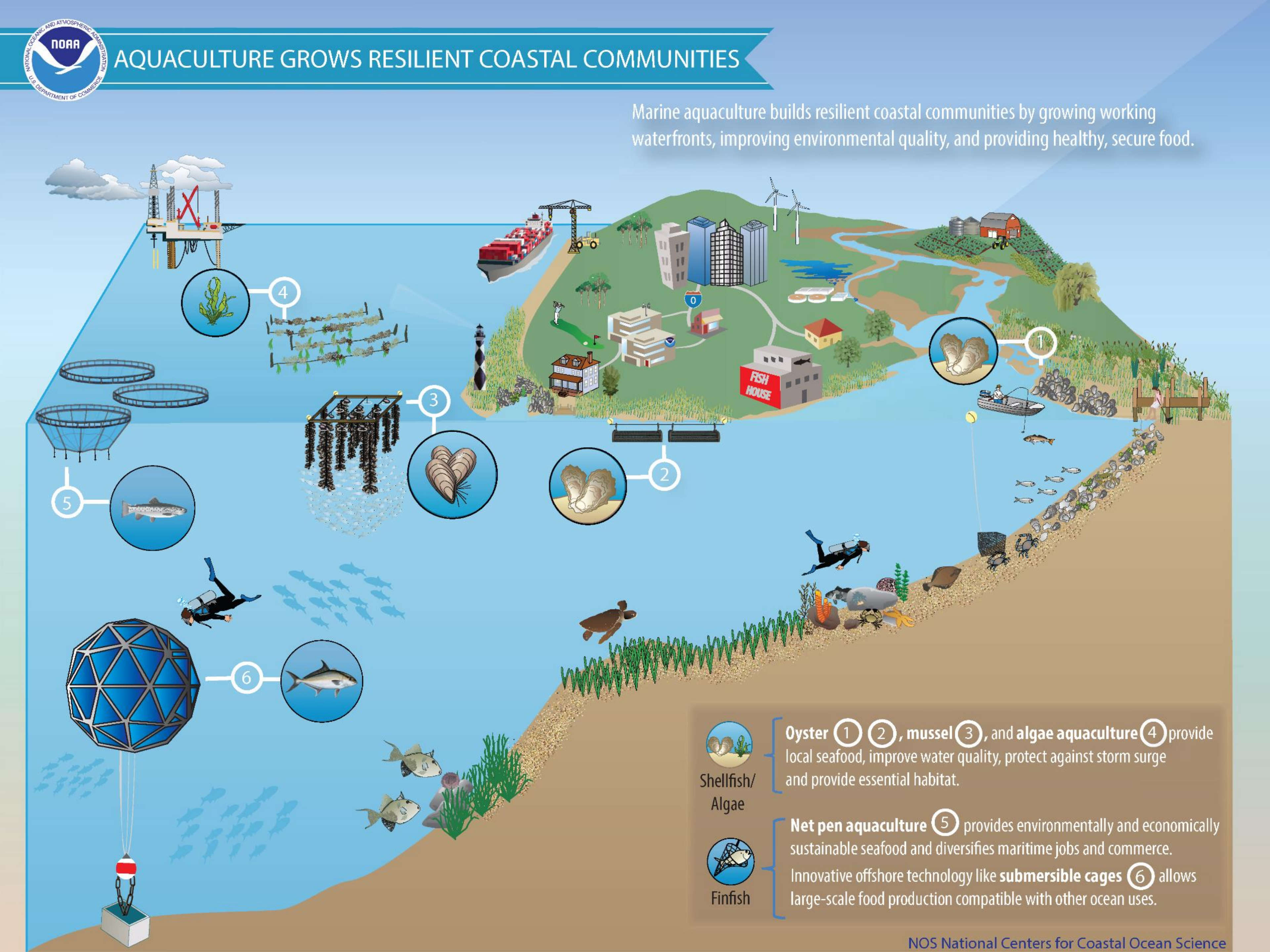
Ken.Riley@noaa.gov





NOAA
NOAA AQUACULTURE PROGRAM
Ocean & Atmospheric Research
National Marine Fisheries Service
National Ocean Service
Supporting Aquaculture Growth In The U.S.

"It is the policy of NOAA...to encourage and foster sustainable aquaculture development that...is in harmony with healthy, productive, and resilient marine ecosystems..."

In this context, every effort should be made to ensure industry growth occurs within a framework of environmental responsibility and ocean stewardship.


AQUACULTURE GROWS RESILIENT COASTAL COMMUNITIES
Marine aquaculture builds resilient coastal communities by growing working waterfronts, improving environmental quality, and providing healthy, secure food.
FISH HOUSE
1
2
3
4
5
6
Shellfish/ Algae
Oyster (1) (2), mussel (3), and algae aquaculture (4) provide local seafood, improve water quality, protect against storm surge and provide essential habitat.
Finfish
Net pen aquaculture (5) provides environmentally and economically sustainable seafood and diversifies maritime jobs and commerce.
Innovative offshore technology like submersible cages (6) allows large-scale food production compatible with other ocean uses.
NOS National Centers for Coastal Ocean Science

Coastal Aquaculture Siting and Sustainability Program

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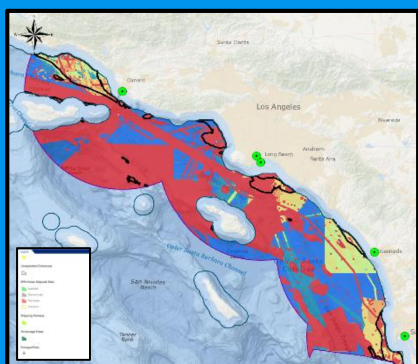
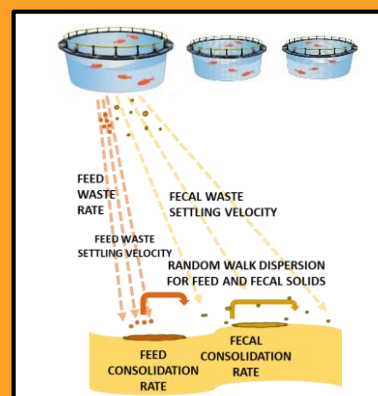
ken.riley@noaa.gov

Coastal Aquaculture Siting and Sustainability Program

Spatial Planning and Siting



Environmental Interactions



Ecosystem Services

Major Customers

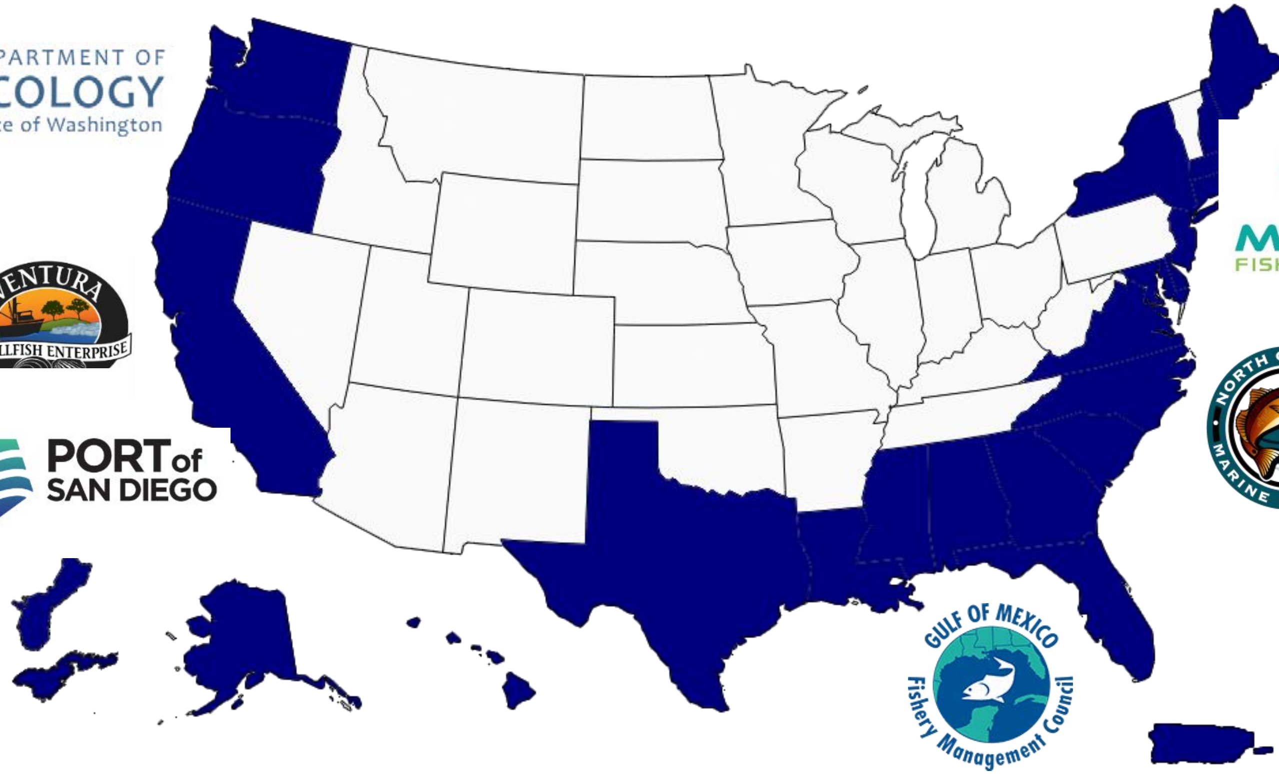
US Army Corps of Engineers®

50 Projects Nationwide

DEPARTMENT OF ECOLOGY State of Washington

VENTURA SHELLFISH ENTERPRISE

PORT of SAN DIEGO



MANNA FISH FARMS, INC.

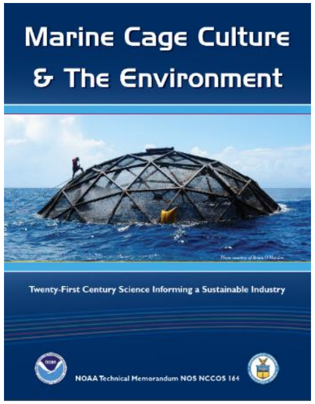
NORTH CAROLINA MARINE FISHERIES

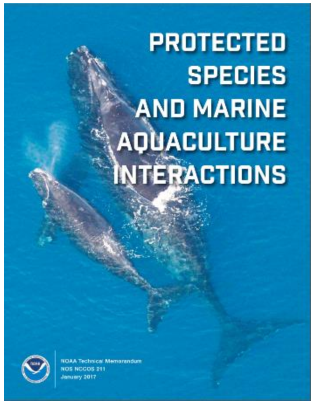
GULF OF MEXICO Fishery Management Council

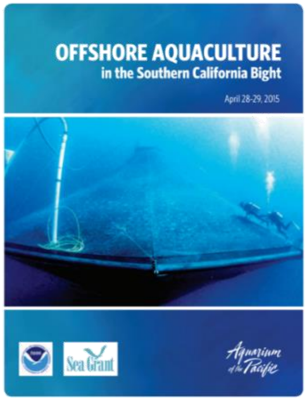
Major Customers

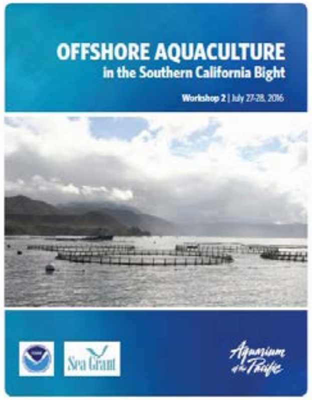
US Army Corps of Engineers

We work to be valued for our experience and expertise and trusted for our environmental ethic.

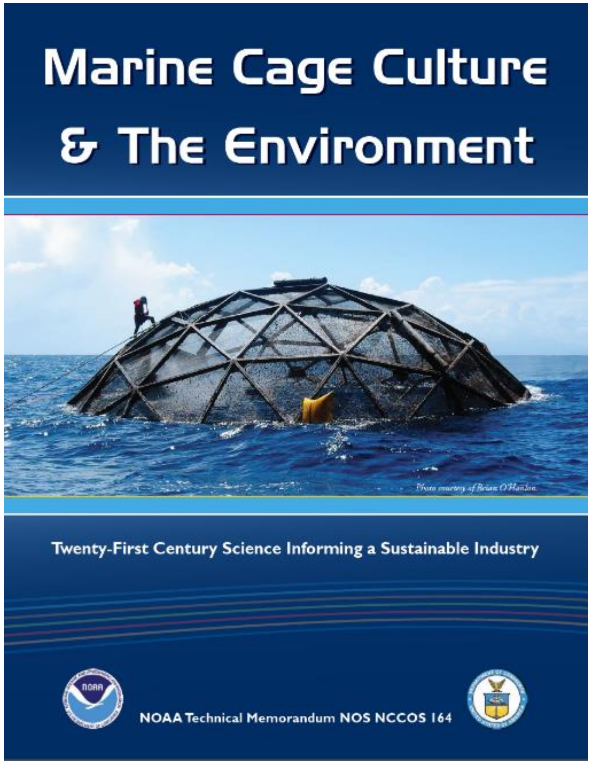








Environmental Interactions



December 2013

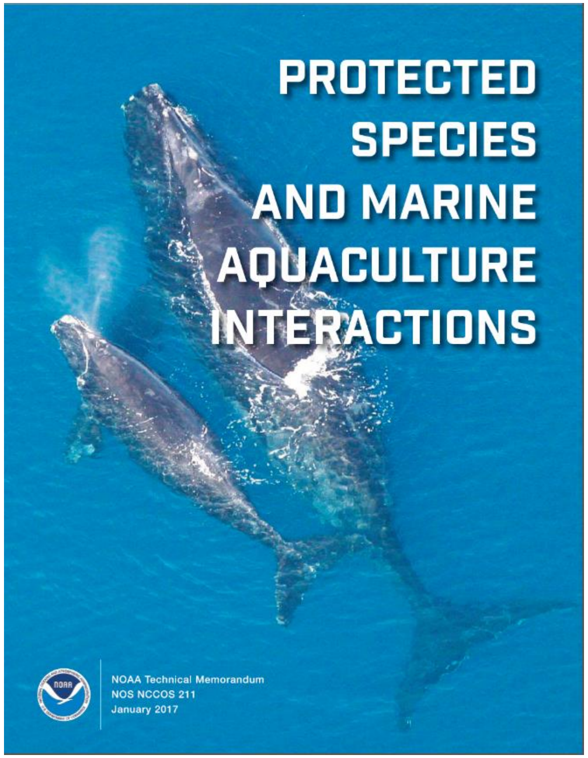
Summary and analysis of environmental interactions of open ocean finfish aquaculture

500+ sources
Peer reviewed science
Global, modern perspective

- **Water Quality**
- **Benthic Geochemistry**
- **Biodiversity**
- **Chemicals**
- **Management Tools**

Included a section on protected species and sensitive habitats

Protected Species Interactions



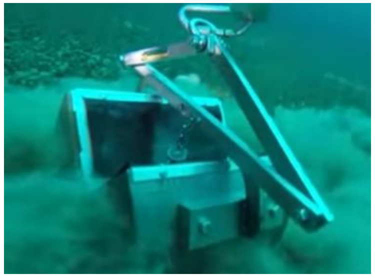
January 2017

- Includes information about protected species and aquaculture sectors
- Nationally relevant
- Tool for agencies, researchers, and industry
- Fishery gear section included expert coauthors
- Draft risk assessment, gap analysis, and best management practices

Guidance Document Series: Environmental monitoring of offshore aquaculture installations

- Baseline environmental surveys
- Water quality and benthic monitoring of offshore farms
- Monitoring wildlife (protected species, invasive species) interactions with offshore aquaculture installations
- Structural monitoring of offshore installations





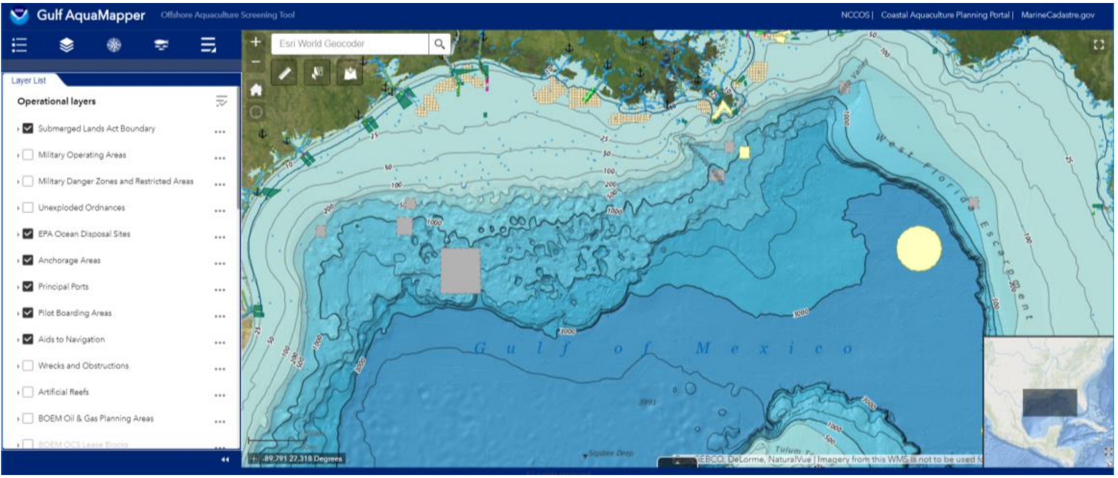

Crisis Response Services

Spatial Science, Disaster Preparedness

NOS provides a broad range of scientific, technical, and policy experts to support the response and inform recovery.

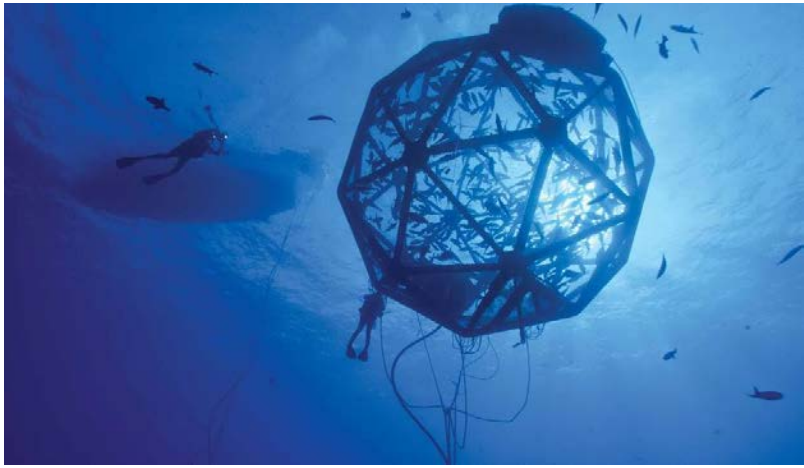
Guidance on spatial technologies for disaster risk management in aquaculture

Drone images following a disaster affecting aquaculture facilities in Washington State



"The solution to sustainable aquaculture is responsible planning and siting of farms."

Dr. Jerry Schubel, Aquarium of the Pacific



The coastal ocean is a busy place!

Coastal and Marine Spatial Planning
can help identify and resolve conflicts

What does spatial planning for aquaculture do?

- ✓ Provides due diligence for managing public resources
- ✓ Identifies aquaculture opportunities
- ✓ Streamlines permitting
- ✓ Increases investor confidence
- ✓ Supports business incubation

Credit: Open Blue

OceanReports Tool

We've Automated Marine Spatial Planning!

POSTCARD FROM THE FIELD

OceanReports Now Live!

OceanReports NOAA Team Leads

James Morris
NOAA Marine Ecologist

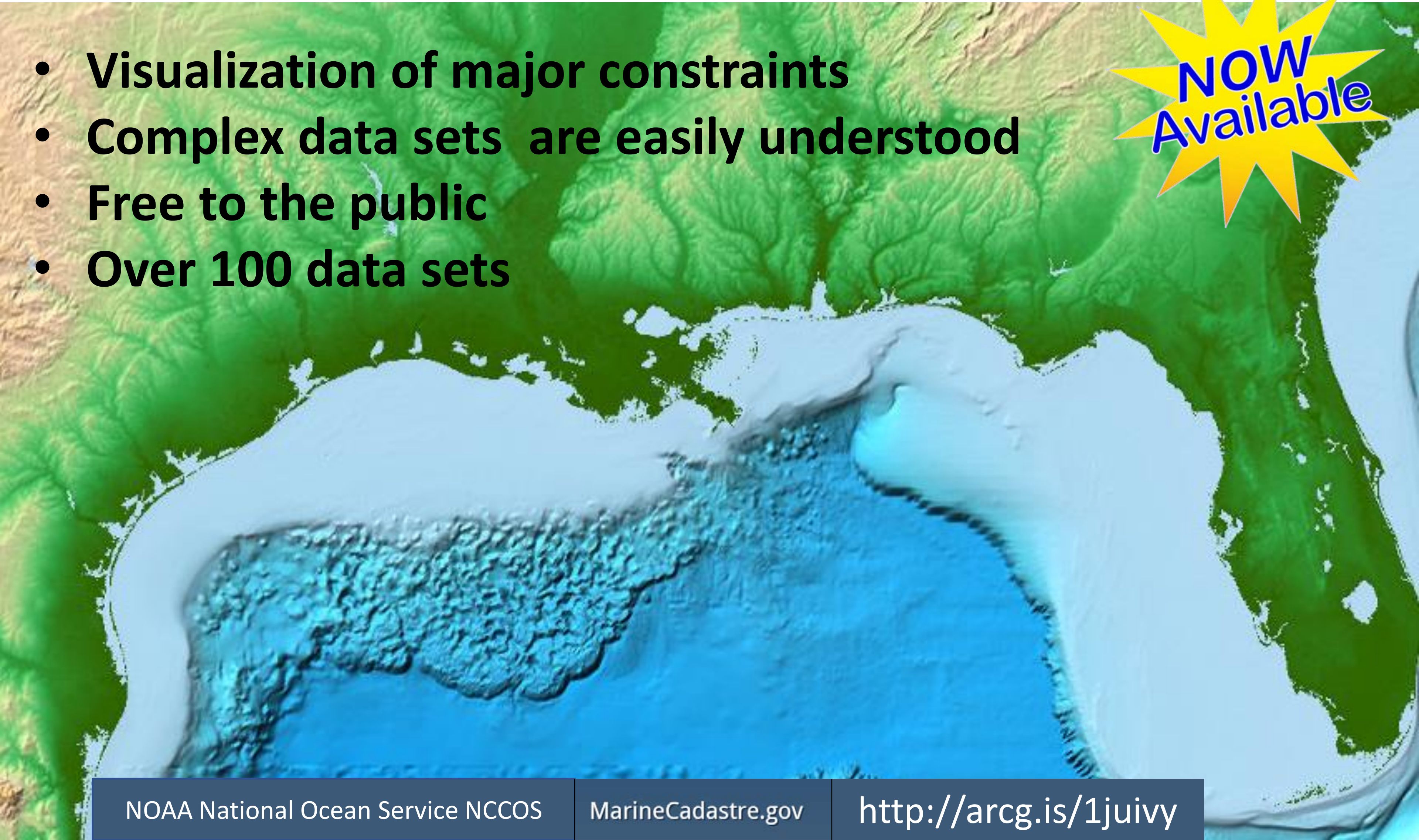
Dave Stein
NOAA Geographer

Today NOAA, Bureau of Ocean Energy Management and many partners introduced the *OceanReports* web tool, enabling anyone to analyze ocean "neighborhoods" for specific needs. Drawing on 100 data sources useful for conservation and industry development, *OceanReports* provides one-stop, fast, open access to custom reports and spatial data. The new tool will save public dollars, cut industry costs, reduce permitting timelines, and support better management of U.S. ocean space.

We've Automated Marine Spatial Planning!

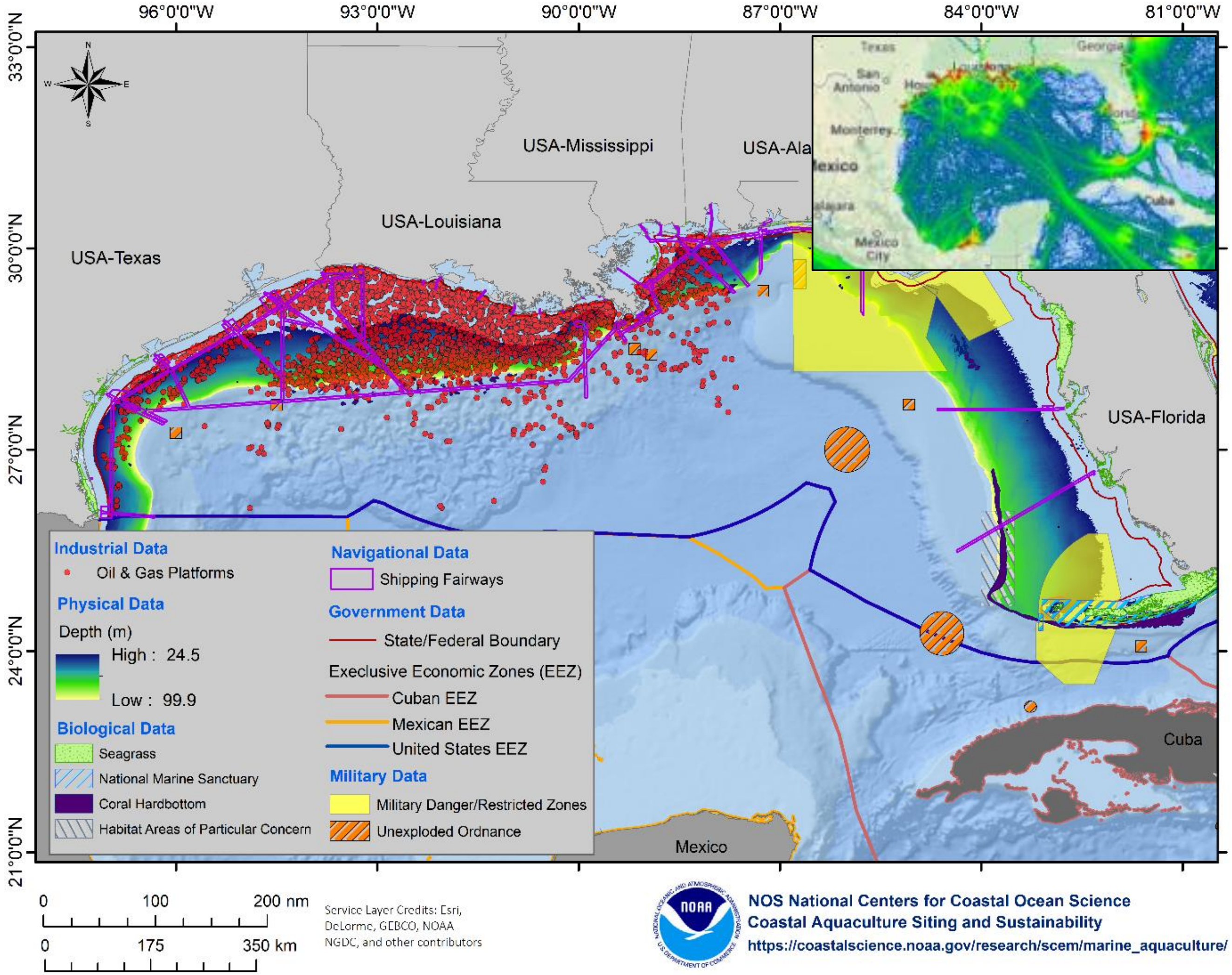
Gulf AquaMapper

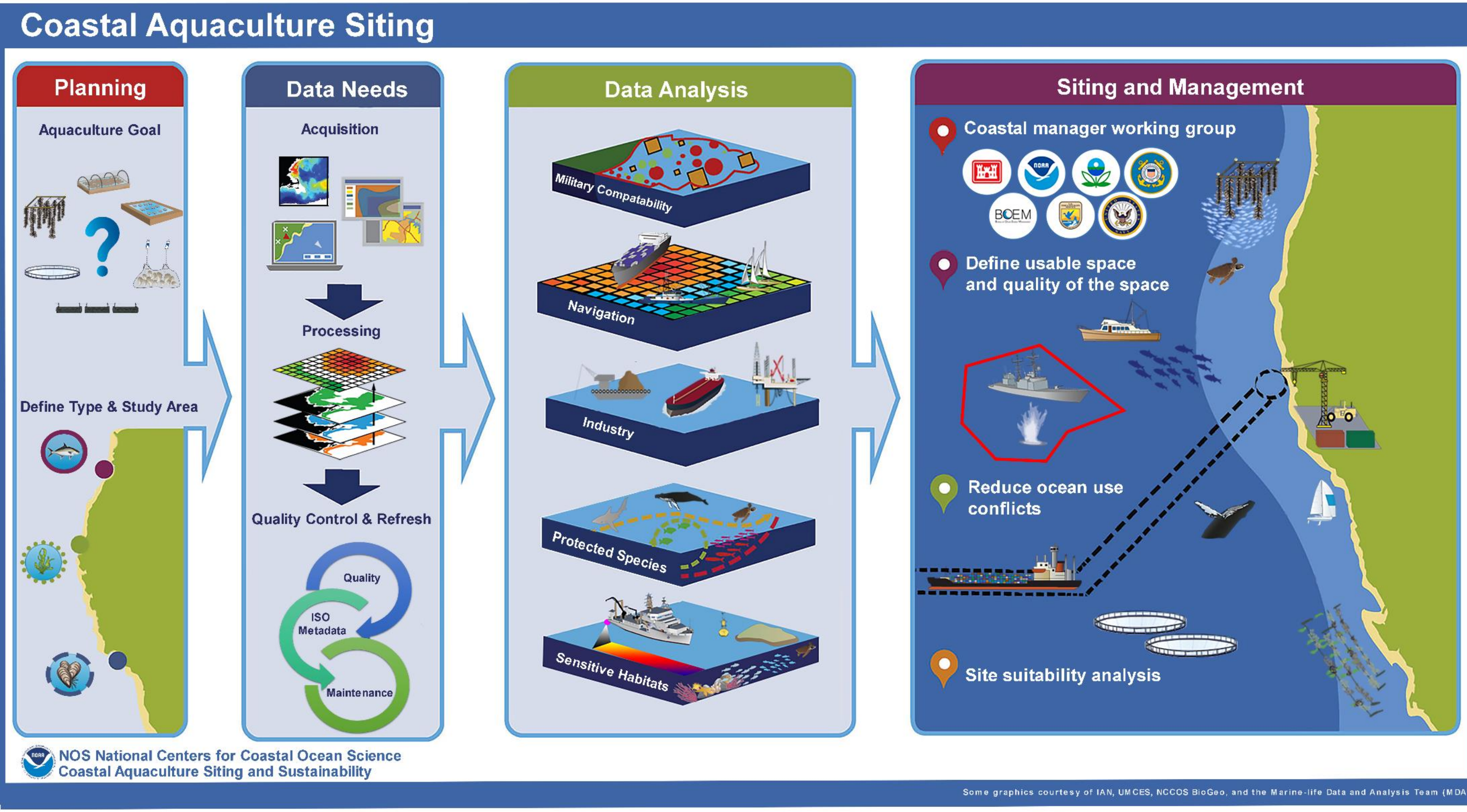
- Visualization of major constraints
- Complex data sets are easily understood
- Free to the public
- Over 100 data sets



NOAA National Ocean Service NCCOS | MarineCadastre.gov | http://arcg.is/1juivy

Why is the Gulf AquaMapper needed?




Coastal Aquaculture Siting
Planning
Aquaculture Goal
Define Type & Study Area
Data Needs
Acquisition
Processing
Quality Control & Refresh
Quality
ISO Metadata
Maintenance
Data Analysis
Military Compatability
Navigation
Industry
Protected Species
Sensitive Habitats
Siting and Management
Coastal manager working group
BOEM
Define usable space and quality of the space
Reduce ocean use conflicts
Site suitability analysis
NOS National Centers for Coastal Ocean Science
Coastal Aquaculture Siting and Sustainability
Some graphics courtesy of IAN, UMCES, NCCOS BioGeo, and the Marine-life Data and Analysis Team (MDAT)

Farming Parameters:

- Preferred port(s):
- Max distance from port(s):
- Min and max depth requirements:
- Min and max seawater temp:
- Min and max current velocity:
- Max wave energy:
- Max farm footprint (including anchorage):

Ventura Shellfish Enterprise – A Case Study for Siting Analysis

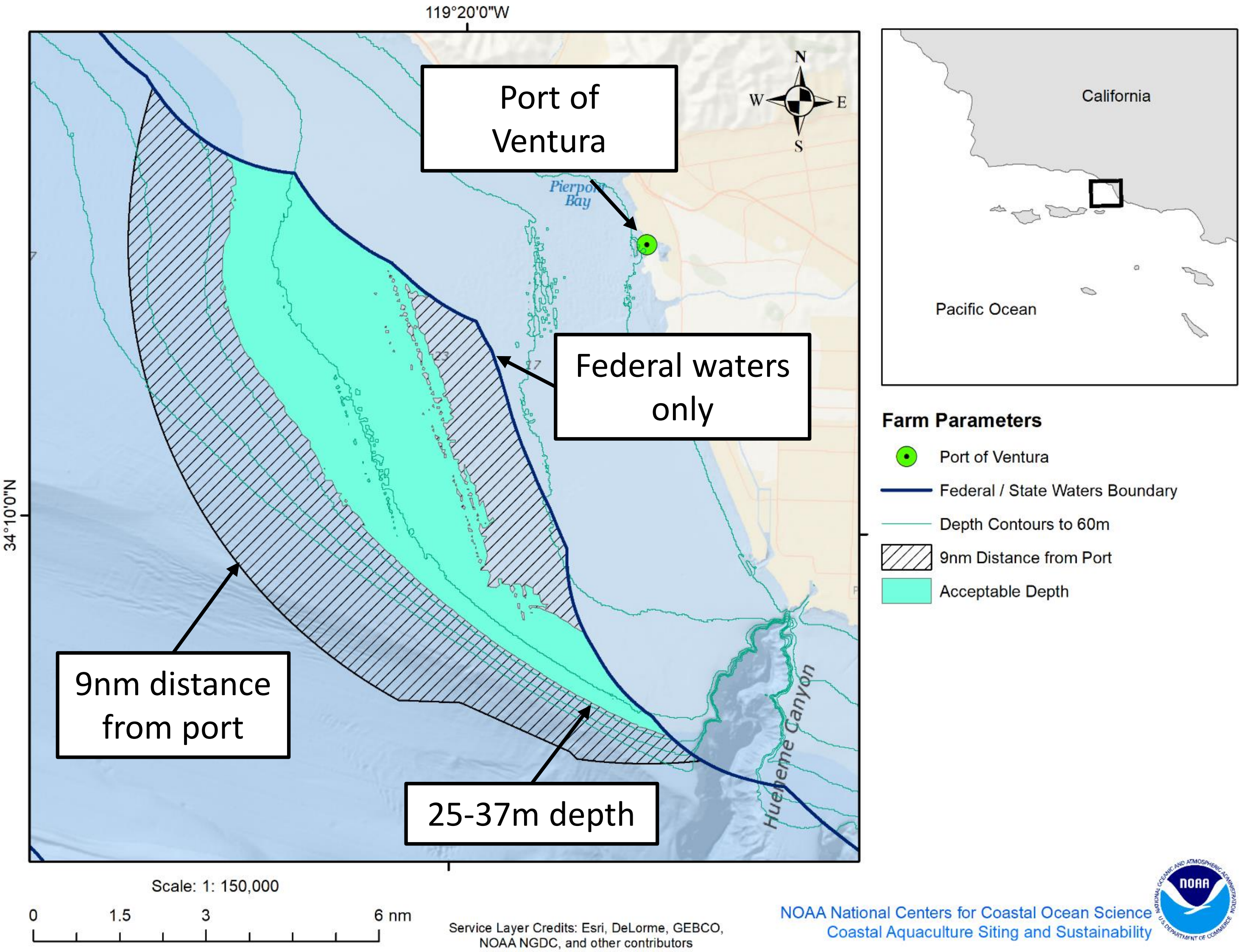
- ✓**Max distance from port(s):** 9 nautical miles from Ventura Harbor
- ✓**Min and max depth requirements:** ≥ 80 ft (25 m) and < 120 ft (37 m)
- ✓**Max farm footprint (including anchorage):** 20 x 100 acre plots [2,000 acres total]
- ✓**Federal waters only**
- ✓**Species:** *Mytilus galloprovincialis*
- ✓**Gear type:** Longline

Spatial Data Collection

Data Type	# of Data Sources Considered
✓ Military	4
✓ Industry	18
✓ Navigation	12
✓ Natural Resources	16
✓ Oceanographic	12
✓ Administrative Boundaries	4

**A total of 60+ data layers considered in analysis*

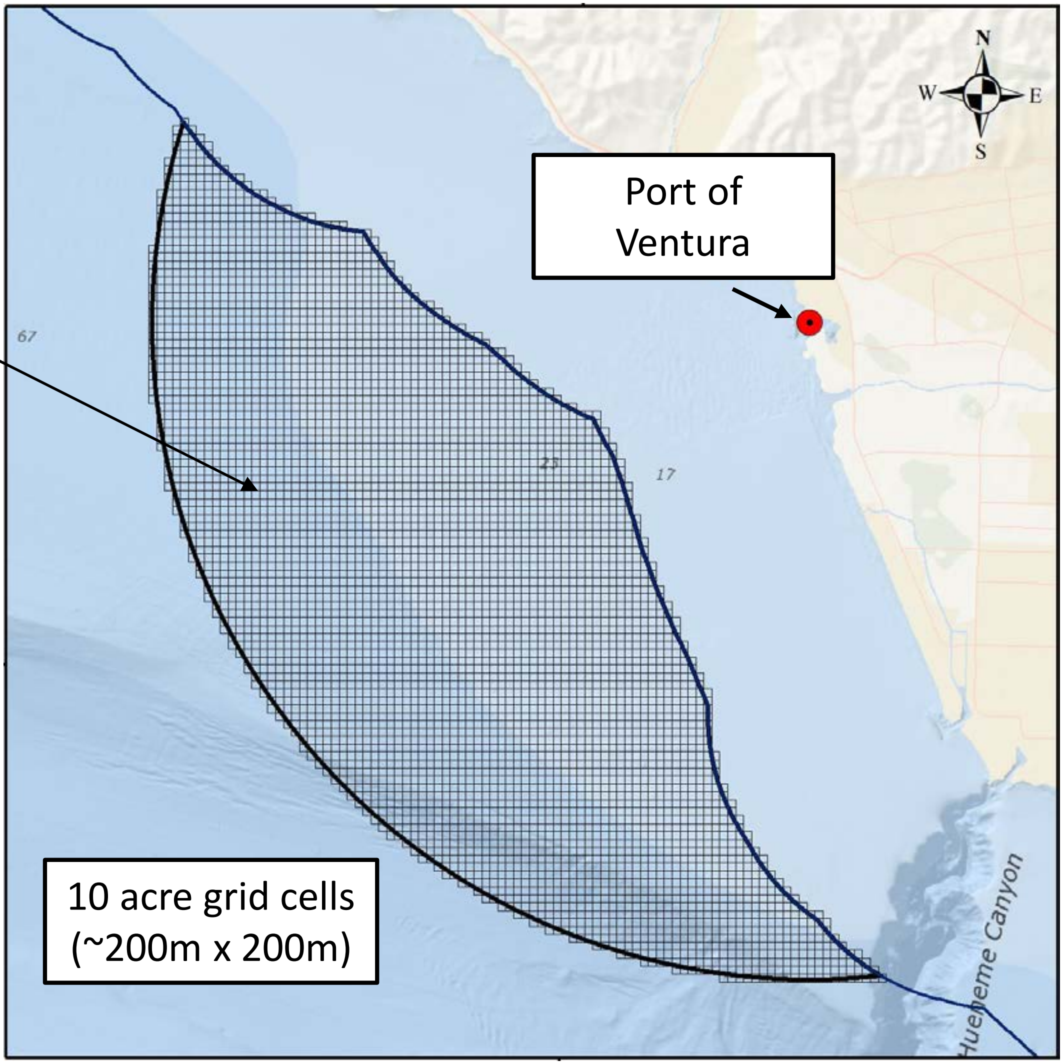
Identify area of interest based on farm parameters



NOAA National Centers for Coastal Ocean Science
Coastal Aquaculture Siting and Sustainability

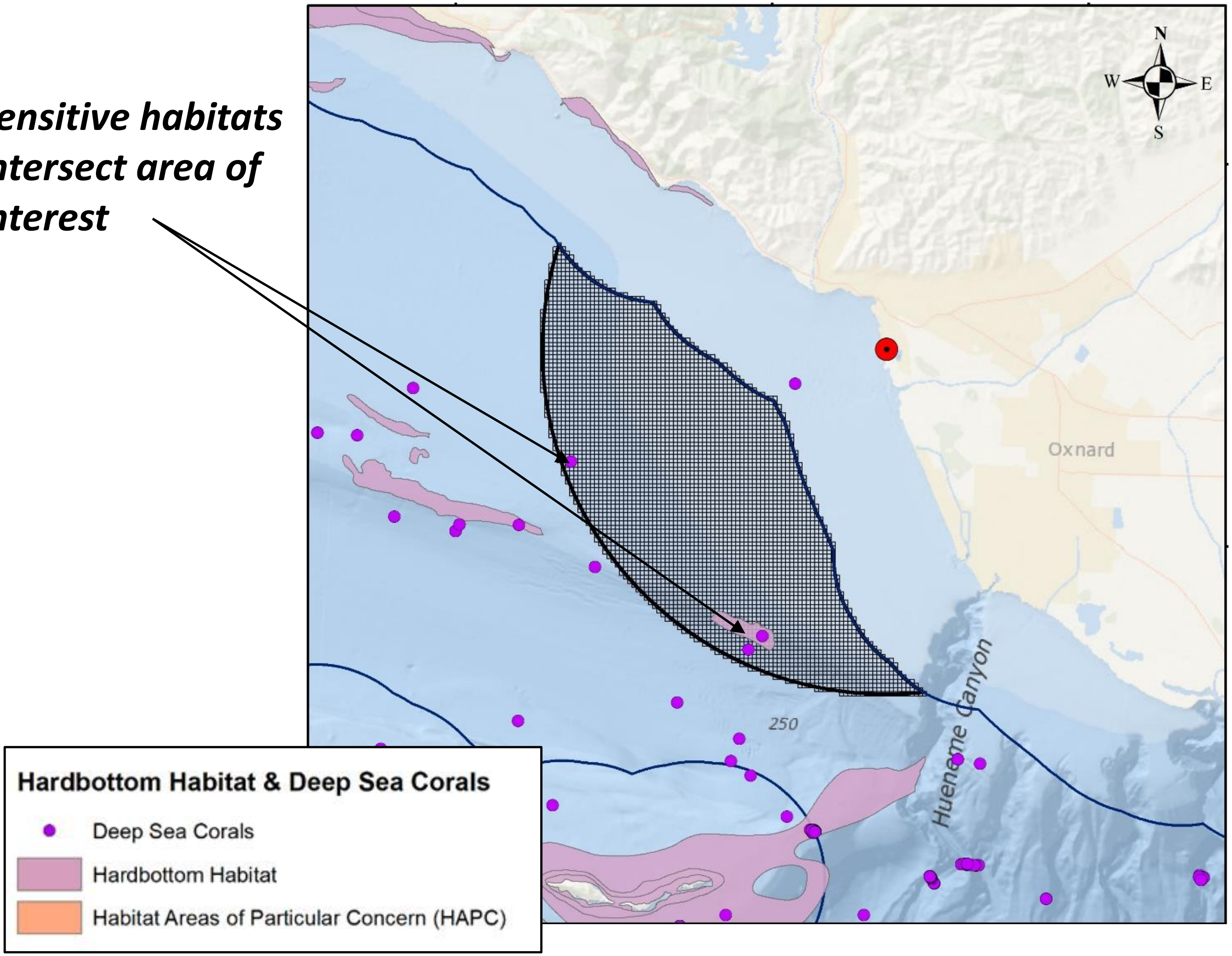
Site Selection and Suitability Methods

Establish a grid for area of interest, select an appropriate cell size



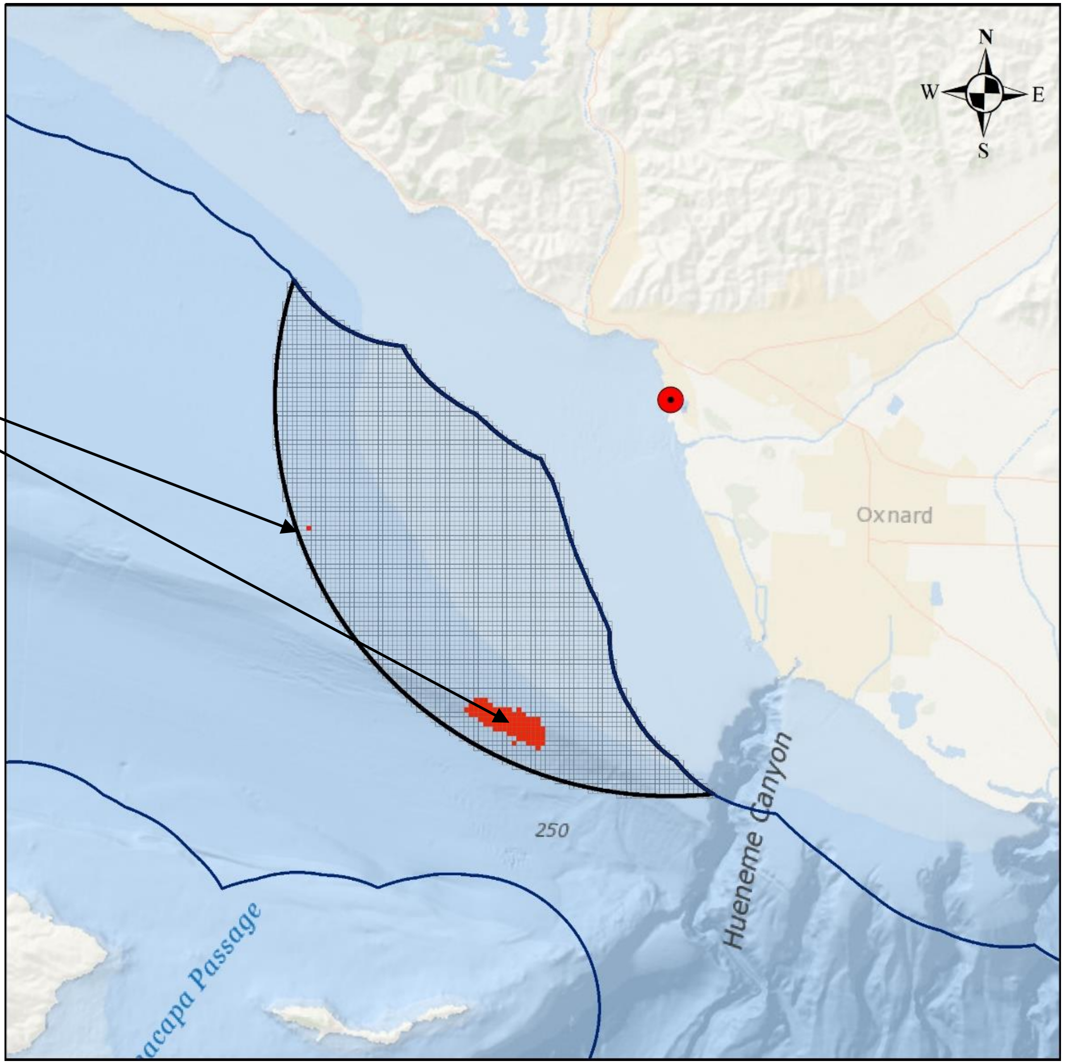
Methods Demonstration

Sensitive habitats intersect area of interest



Methods Demonstration

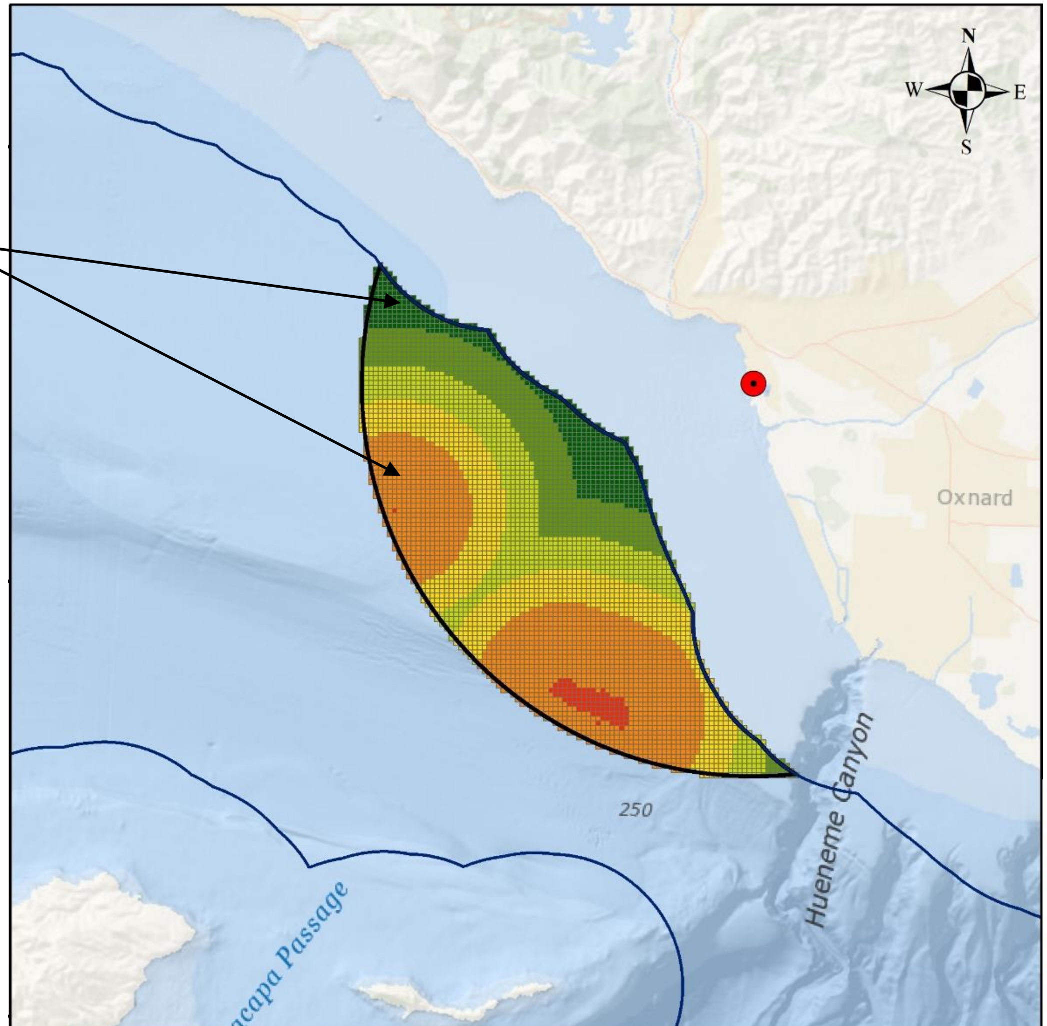
Grid cells intersecting sensitive habitats are excluded from further consideration

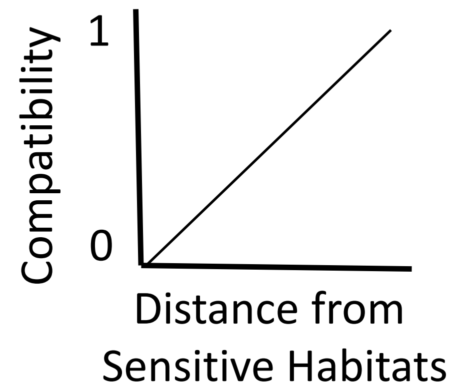


0 - Less Compatible

Methods Demonstration

Grid cells far from sensitive habitats are assigned higher weights than those nearby

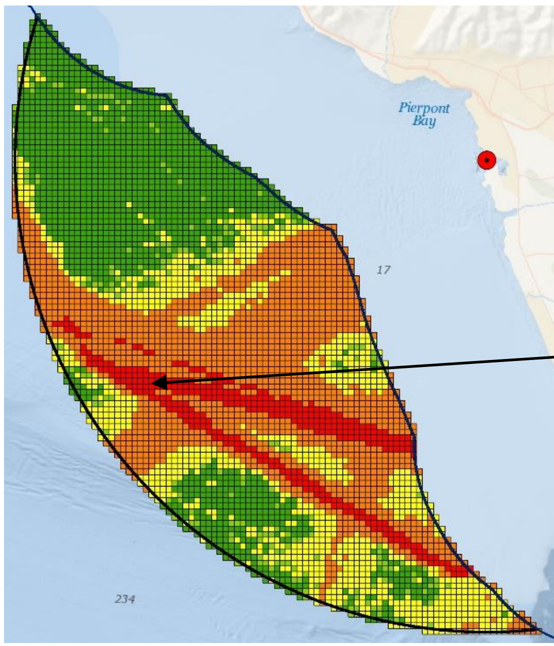




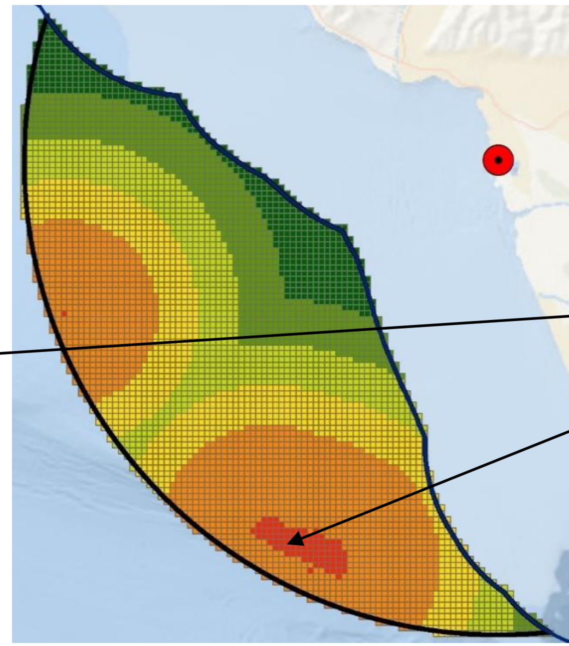
Methods Demonstration

Perform Gridded Suitability Analysis

Vessel Traffic



Sensitive Habitat



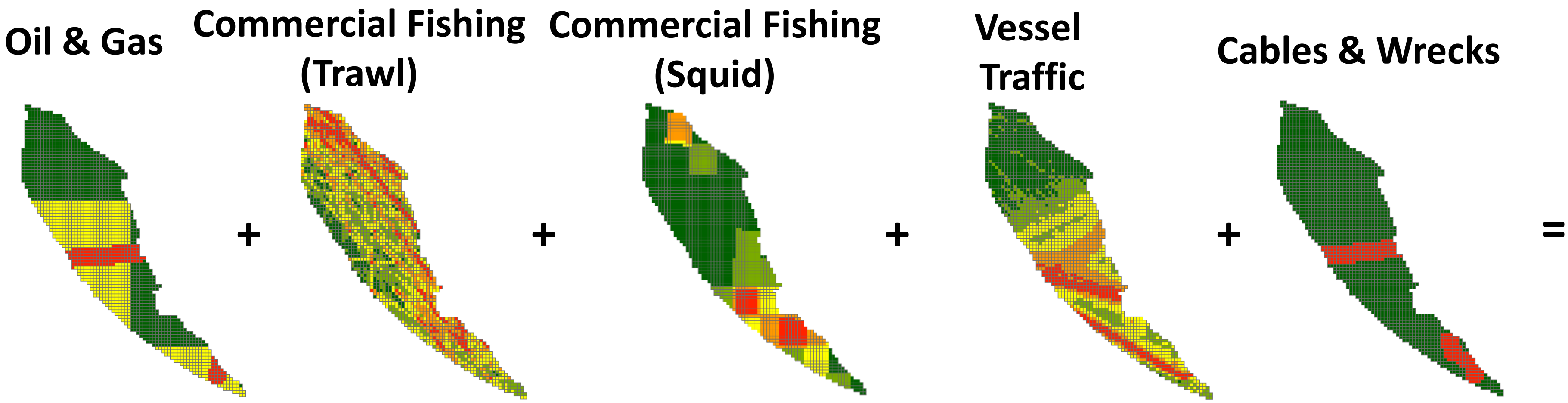
Because these cells have a value of 0, they will be wholly excluded from further consideration within the analysis

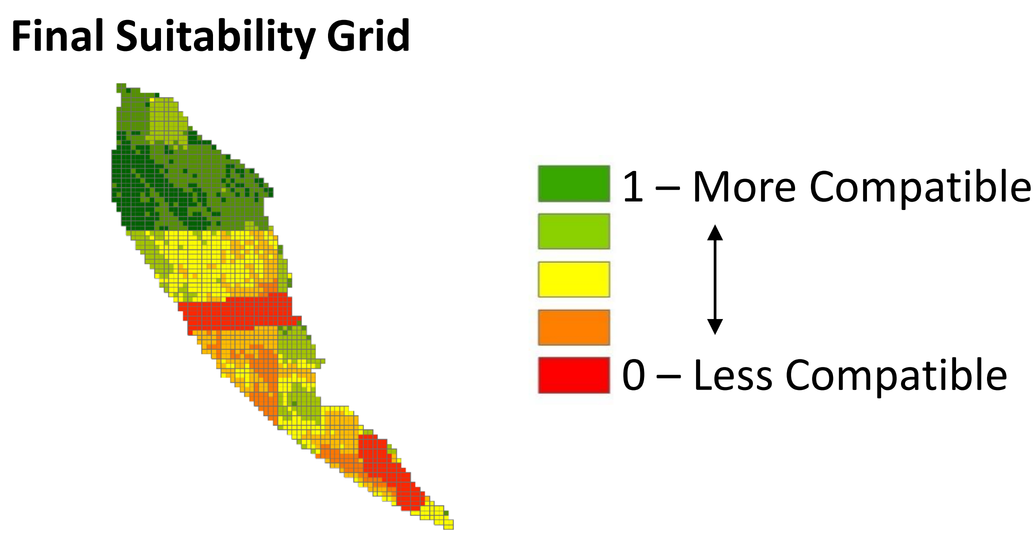
…+ additional layers for other constraints

1 – More Compatible

0 – Less Compatible

Case Study: Ventura Shellfish Enterprise





Putting All The Data Together

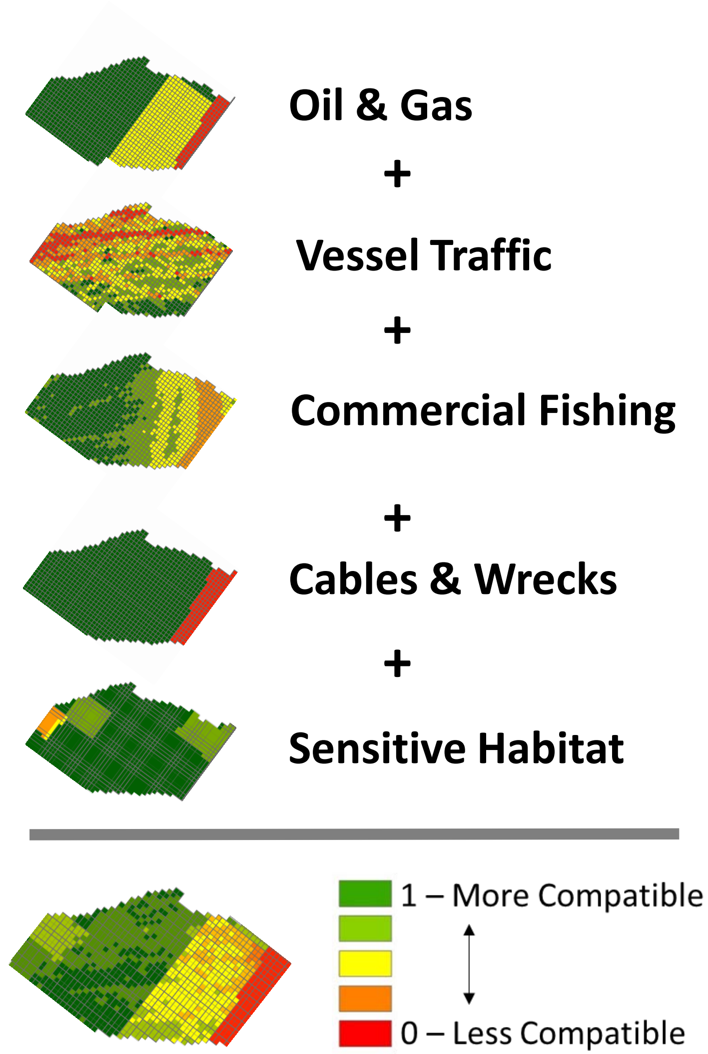
Gulf Aquaculture Happenings

- **Kampachi Farms** will launch Vellela Epsilon Demonstration Project (permits expected Summer 2019)
- **Manna Fish Farms** and **University of Southern Mississippi** pursuing offshore commercial project (permits expected Spring 2020)
- **State of Florida** initiated spatial planning research to explore development of Offshore Aquaculture Management Areas

Data Considered

- Bathymetry
- Military
- Unexploded Ordnance
- Shipping Lanes
- AIS Vessel Traffic
- Shrimp Vessel Activity
- Submarine Cables
- Artificial Reefs
- Lightering Zones
- Oil & Gas Platforms
- Oil & Gas Well
- Oil & Gas Active Leases
- Oil & Gas Pipelines
- Shipwrecks and obstructions
- Deep Sea Coral
- Protected Resources

Aquaculture Suitability Model



Coastal Aquaculture Planning Portal (CAPP)

~80 aquaculture tools!

A Toolbox for Sustainable Aquaculture Coastal Planning and Siting

The Coastal Aquaculture Planning Portal (CAPP) is a toolbox of coastal planning tools designed to assist managers, planners, and industry with sustainable aquaculture development. This toolbox was developed in partnership with Digital Coast, a product of the *NOAA* National Ocean Service Office of Coastal Management.

Choose one of the subportals below.

NCCOS NATIONAL CENTERS FOR COASTAL OCEAN SCIENCE — ABOUT RESEARCH PRODUCTS NEWS

A NOAA scientific diver inspects an offshore netpen for finfish aquaculture. Credit: NOAA

New Aquamapper Tool Available for Aquaculture Siting in the Gulf of Mexico

Published on: 02/14/2018

Research Area(s): Marine Spatial Ecology / Coastal Aquaculture Siting and Sustainability

Region(s) of Study: Waterbodies / Gulf of Mexico

Primary Contact(s): james.morris@noaa.gov

NCCOS is excited to release the newly created Gulf Aquamapper, a web-based tool for exploration, permitting and siting of offshore aquaculture in the Gulf of Mexico. The Gulf Aquamapper is a geodatabase featuring aquaculture-relevant GIS data for biological, navigational, military, social, economic, physical and chemical parameters. The Gulf AquaMapper can be used as a one-stop screening solution for industry and coastal managers focused on identifying suitable and unsuitable areas for aquaculture development. With over 50 data types, the Gulf Aquamapper is the first spatial planning tool designed specifically for aquaculture in the Gulf of Mexico. In particular, the tool aims to streamline the permitting process established by the Gulf Aquaculture Fishery Management Plan (PDF) in 2016, by reducing logistical and economic inefficiencies for coastal managers and aquaculture investors. Multiple data layers can be viewed simultaneously for a more comprehensive assessment of competing uses, and maps can be printed and shared to inform a more detailed site assessment to verify environmental conditions and establish site-specific designs.

A screenshot of the Gulf Aquamapper tool's online interface, which provides data to help with permitting and siting of potential offshore aquaculture ventures. Credit: NOAA


We help coastal managers grow sustainable aquaculture
Want to learn more…
NOAA National Ocean Service
Coastal Aquaculture Siting and Sustainability
www.coastalscience.noaa.gov
Ken.Riley@noaa.gov
NOAA

LEASING and REGULATORY CONDITIONS for OFFSHORE FINFISH AQUACULTURE in FLORIDA STATE WATERS

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To obtain authority to produce, harvest and sell aquaculture products in Florida, individuals must acquire an Aquaculture Certificate of Registration from the Florida Department of Agriculture and Consumer Services, Division of Aquaculture (FDACS) on an annual basis. Certified aquaculturists must adhere to all applicable Aquaculture Best Management Practices (BMPs). These BMPs are intended to preserve environmental integrity while eliminating cumbersome, duplicative and confusing environmental permitting and licensing requirements. Unless authorized in statute, the BMPs do not supersede other applicable federal, state and local regulations not specifically listed.

FDACS is responsible for administering the leasing of sovereignty submerged state lands and the overlying water column for aquaculture production. Aquaculture production in state waters includes, but may not be limited to, the culture of marine bivalve mollusks (clams, oysters or mussels), food, bait or ornamental fish, crustaceans (shrimp, lobster or crabs) and live rock. To date, aquacultural activities on sovereignty submerged lands consists of growing bivalve mollusks and live rock. For detailed information regarding aquaculture on sovereignty submerged lands, see FreshFromFlorida.com/content/download/76600/2214244/FDACS-p-01758-Aquapak_2019.pdf.

Selections from Aquaculture Best Management Practices Manual (Nov. 2016) Chapter VII: Marine Net Pens and Cages, Incorporated into Rule 5L-3, Florida Administrative Code.

Net pens and cages are submerged, suspended, floating or other holding systems that utilize a netting (fiber or metal) to contain and culture marine fish or crustaceans. This chapter pertains only to the operation of net pens or cages (hereinafter referred to as “net pens”) that are located in the marine waters of the State of Florida. Net pen operations must acquire: 1) an annual Aquaculture Certificate of Registration; 2) a sovereignty submerged land and water column lease (Figure 1 details the leasing process); and 3) if the aquaculture facility produces more than 100,000 pounds of live weight product annually, a National Pollution Discharge Elimination System (NPDES) permit. Net pen operators who do not operate their aquaculture facilities in compliance with the sovereignty submerged land and water column lease conditions and this *Aquaculture Best Management Practices Manual* risk the revocation of the lease instrument and/or Aquaculture Certificate of Registration and enforcement action including administrative fines.

SITING

- Select sites with good water exchange, sufficient depth, and adequate current velocity.
- Sites must have a sand or mud bottom.
- Sites for filter-feeding shellfish (mussels, clams, oysters or scallops) can only occur in Shellfish Harvesting Areas classified and managed by FDACS.

FACILITY OPERATION AND MAINTENANCE

- Farmers must conduct annual reviews of their operations and provide those reviews to FDACS personnel during compliance inspections.
- When considering modifications to existing farming practices, procedures or structures, growers must conduct a review of the type and extent of probable environmental impacts that may occur as a result of the new methods and amend their existing operational practices to mitigate potential impacts.
- Any modifications to existing farming practices, procedures or structures must be within the scope of the existing permit and must be approved by FDACS.
- When conducting activities such as stocking/seeding, harvesting, feeding, grading, thinning, transfer, cleaning, gear maintenance or fallowing, all standard operating procedures must include diligent efforts to minimize probable environmental impacts.
- Comprehensive stocking and production strategies that optimize production while minimizing environmental impacts must be used.

- Nets and moorings must be maintained in a whole and intact condition.
- Any net or gear accidentally dropped or lost during storm events that is not recovered immediately shall be tagged with a float, positioned using differential Global Positioning System, and reported to FDACS within 24 hours. The lost net or gear shall be recovered within 30 days of the date lost. FDACS shall be notified on the date the net or gear is recovered.
- Placement of nets or gear on the bottom is prohibited. Pre-approved anchoring systems are exempt from this rule.
- Nets, mooring and rigging lines, and anti-predator equipment must be stretched tight and held taut and maintained in a manner to diminish the likelihood of entangling finfish, decapod crustaceans, sea birds, marine mammals, and sea turtles.
- Maintain and make available to FDACS, upon request, a Marine Entanglement Log for finfish, decapod crustaceans, sea birds, marine mammals, and sea turtles. The Log should identify the species, size, number, date of entanglement, and disposition of the species.
- Consider potential impacts on water circulation patterns when installing net pens and their associated mooring systems. Gear deployment must optimize circulation patterns and maximize water exchange through the pens, thereby improving fish health and reducing benthic impacts.
- Design and operate harvest procedures and equipment in a fashion that reduces any associated discharges. Harvest and post-harvest vessel and equipment clean-up procedures must minimize wastes discharged overboard.
- Farm support vessels must be fueled at licensed fueling stations.
- All fuel or oil spills must be reported as required by law to the appropriate state and federal authorities. Appropriate clean-up and repair actions must be initiated as soon as possible.
- Farm support vessels of the appropriate size must have approved Marine Sanitation Devices (MSD) on board. All human wastes must be disposed of according to applicable state and federal regulations.

<u>GENETICS</u>

- Net pen culture of species not native to Florida waters, genetically engineered or transgenic species is prohibited.
- If genetic studies are not available that indicate broodstock are genetically similar to and originate from the same genetic stock as conspecific wild animals in the net pen locality, the following requirements for broodstock animals apply:
    1. Broodstock must originate from waters of the Gulf of Mexico east of the Mississippi River outflow to produce juveniles for stocking net pens in state waters of the Gulf or broodstock must originate from waters of the Atlantic Ocean to produce juveniles for stocking net pens located in state waters of the Atlantic.
    2. Broodstock for pelagic species may only be collected within a 300-kilometer (186 mile) radius distance from the net pen site or broodstock for estuarine species may only be collected within a 100-kilometer (62 mile) radius distance from the net pen site.
- Net pen facilities must maintain documentation identifying the source of all eggs, fry, fingerlings, or adult fish for at least two years. These records must be available for inspection by FDACS staff upon request.
- Pursuant to Rule Chapter 68B-8, F.A.C., Collection of wild broodstock requires an Aquaculture Broodstock Collection Special Activity License from the Florida Fish and Wildlife Conservation Commission.

<u>HEALTH</u>

- All stocking of live aquatic organisms, regardless of life stage, must be accompanied by an Official Certificate of Veterinary Inspection signed by a licensed and accredited veterinarian attesting to the health of the organisms to be stocked.
- Facilities must notify their aquatic animal health professional and the Florida Department of Agriculture and Consumer Services (FDACS), Division of Animal Industry, State Veterinarian's Office in the event of a suspected or diagnosed outbreak of a State or Federal notifiable disease or pathogen at (850)-410-0900, or after hours at 1-800-342- 5869, or by email at RAD@FreshFromFlorida.com.

- Minimize cross-contamination between groups/lots of organisms through cleaning and disinfection of equipment and biosecurity practices.
- Implement quarantine/isolation or disinfection procedures to reduce the risk of pathogen translocation.
- Health management records must be a component of the farm records and include behavioral changes, other clinical signs of disease, treatment procedures, and unusual morbidity and mortality events. These records must be retained for at least two years and will be made available for inspection by FDACS upon request.

CONTAINMENT/ESCAPE PREVENTION

- Loss-control plans must be designed to address the principle causes of escape (equipment failure, operational errors, and predator attacks) and must include:
    1. minimum equipment and operating standards;
    2. emergency repair procedures;
    3. escape recovery procedures;
    4. practices and equipment that reduce the need for predator reduction/destruction (i.e., anti-predator nets or equivalent equipment); and
    5. preparations for severe weather (i.e., hurricanes).
- The Loss Control and Escape Recovery Plan must include a notification procedure to inform FDACS when fish are not recovered following an escape. The facility manager or designated representative will report, within 24 hours, any escape to FDACS. The report must include species identification, approximate size and number of fish and location.
- Fish transfers such as stocking, grading, transfer, or harvest must be conducted in appropriate weather conditions and under constant visual supervision. Equipment appropriate to the weather and net pen or cage designs must be used.
- Where necessary or appropriate, shields or additional netting must be used to prevent stray fish from escaping during transfer.
- All holding, transportation, and culture systems must be designed, operated, and maintained to prevent escape.
- All nets in use must be made from ultraviolet light stabilized compounds.
- Net pen design, specification, and installation must be commensurate with the prevailing conditions and capable of withstanding the maximum weather and sea conditions prevailing at the site. A written statement from the net pen manufacturer certifying that net pen(s) have been assembled and moored to their specifications must be available to FDACS personnel during compliance inspections.
- To prevent fish from jumping out of the primary containment nets, surface net pens must have jump nets installed that are an appropriate height for the species being cultured.
- Nets must be secured to the cage collar such that the collar bears the strain and not the handrail of the net pen.
- Net weights, when used, must be installed to prevent chafing. A second layer of net must be added one foot above and below wear points. The use of weight rings is recommended at appropriate sites.
- A Net Pen Structure and Mooring System Preventative Maintenance Program must be submitted with an application and maintained, updated, implemented, and made available to FDACS personnel during compliance inspections. The program must have the ability to: 1) Identify individual nets, net pen structures, mooring systems and; 2) Schedule and document regular maintenance and testing. Nets or net pen structural components that fail testing standards must be retired and disposed of properly.
- Mooring system designs must be compatible with the cage systems they secure. Mooring systems must be installed in consultation with the net pen manufacturer or supplier. Mooring system design, specification and installation must be commensurate with the prevailing conditions and capable of withstanding the maximum weather and sea conditions prevailing at the site. A mooring system schematic must be included and updated as a component of the Farm Site Plan. Design maximums must be recorded in the Net Pen Structure and Mooring System Preventative Maintenance Program.

- Facility operators must inspect and adjust mooring systems on a biannual basis and prior to and immediately following a tropical storm or hurricane. New components must undergo their first inspection no later than six months after deployment. A diver or remote camera must regularly and visually inspect subsurface mooring components. Special attention must be given to connectors and rope/chain interfaces. Chafe points must be identified, inspected, and biofouling removed. With the exception of anchors, mooring systems must be hauled out of the water for a visual inspection of all components at least every five years. When considering what inspection method to employ, net pen operators must consider the relative risks and benefits associated with the inspection method.
- Shackles used in mooring systems must be either safety shackled, wire-tied, or welded to prevent pin drop-out.
- Where appropriate, bird nets must be used to cover net pens in order to reduce the risk of escape due to bird predation. Bird nets must be constructed using appropriate materials and mesh sizes designed to reduce the risk of bird entanglement.
- Develop a service vessel Standard Operating Procedure (SOP). Vessel operations around a net pen site can cause escapes. All vessel operators must receive appropriate training in the operation of the vessel. The service vessel SOP must be made available to FDACS prior to compliance visits.

FEEDING

- Operate feed storage, handling, and delivery methods to minimize waste and the creation of fine particles of feed.
- The feeding of wet feeds (ground or whole fish or shellfish and other raw meat or plant materials) is prohibited.
- Maintain feed conversion ratio records by using feed and fish biomass inventory tracking systems.
- Minimize nutrient and solids discharges through optimization of efficient feed formulations. Use formulations designed to enhance nitrogen and phosphorus retention efficiency and reduce metabolic waste output.
- Feed manufacturer labels, or copies thereof, must be retained for the prior two years of operation. Labels must be made available for review by FDACS personnel during compliance inspections.
- Use efficient feeding practices, monitor active feed consumption, and reduce feed loss. Feeding behavior must be observed to monitor feed utilization and evaluate health status.
- Maintain and properly operate feeding equipment.
- Feeding at slack tide is prohibited.
- Conduct employee training in fish husbandry and feeding methods to ensure that workers have adequate training to minimize overfeeding and to optimize feed conversion ratios.
- Wherever practical, interactive feedback feeding systems such as video, “lift-ups,” Doppler, sonar, infrared, or equivalent methods should be used to monitor feed consumption and reduce feed waste.
- Color video or still photographic surveys will be conducted twice per year (January 1 and June 30) of the sea floor under and adjacent to each net pen on a 100 meter transect up the prevailing current from the edge of the net and 100 meters down the prevailing current from the edge of the net pen to determine solids loadings and whether eutrophication of the local environment is occurring as a result of food loss and fish excretion. Monitoring will include recording the date(s) on which monitoring was conducted, a site schematic of the video track(s) or still photos in relation to the net pen, and Global Positioning System (GPS) locations of the beginning and end points for the transects. The video survey shall be continuous. Still photographs shall be taken at least every 5 meters. The video or photographic survey will document sediment type and color as well as features such as erosional and depositional areas, flora and fauna and their relative abundance, feed pellets, and any other manmade debris. Images shall be of sufficient detail and clarity to allow for the accurate assessment of benthic conditions. The camera must be positioned at a height above the substrate that will provide approximately one square meter of bottom coverage and illuminated with sufficient artificial light to enable the accurate identification of epibenthic organisms and sediment conditions. A brief written narrative with the tape or photographs describing current speed and direction and reference points shall be included. The tape or photographs with narrative will be submitted to FDACS within 60 days of the survey completion.

- Physical disturbance of the bottom, such as harrowing, dragging or other mechanical means, shall not be used to mitigate the benthic impacts of feed or fish excretion.

WASTE

- Develop a Solid Waste Management plan. This plan must identify all wastes generated on a site or from an aquaculture facility. The Solid Waste Management Plan must be submitted with an Aquaculture Certificate of Registration application and maintained, implemented, and made available, upon request, to FDACS personnel. At a minimum, waste management plans must address:
    - Human waste
    - Feedbags
    - Scrap rope and netting
    - Buoys and weights
    - Fish mortalities
    - Spoiled feed
    - Packaging materials
    - Fouling organisms
- Mortalities must be collected regularly and as frequently as possible (weather permitting) to avoid accumulation at the net pen bottom.
- Farmers must use collection and removal methods that do not stress remaining animals or compromise net integrity.
- Mortalities must be stored and transported in closed containers with tight fitting lids.
- Mortalities must be returned to shore, disposed of and notification given in accordance with Disposal of Dead Animals BMPs.
- Farmers must avoid the discharge of substances associated with in-place net cleaning. Implement gear and management strategies to reduce biofouling that will minimize or eliminate the need for on-site net cleaning.
- On site mechanical cleaning must include methods to prevent the accumulation of solids on the sea floor or the release of solids that cause or contribute to water quality impairment.
- Copies of antifoulant coating product labels must be provided to FDACS for approval prior to use. Antifoulant coating use and restrictions as described in Chapter 376, Pollutant Discharge Prevention and Removal, F.S.; Chapter 487, Pesticide Regulation and Safety, F.S.; Federal Insecticide, Fungicide and Rodenticide Act, Title 7, Chapter 6, Code of Federal Regulations; and Organotin Antifouling Paint Control Act, Title 33, Chapter 37, Code of Federal Regulations must be followed.
- The use of biocidal chemicals for cleaning nets on site is prohibited.
- The use of organotin or petroleum based antifoulant products such as creosote, oils, bitumen, coal tar, or greases are prohibited.
- All feed bags, spoiled feed, packaging materials, waste rope and netting, or worn structural components must be collected, returned to shore and disposed of properly. Recycling is strongly encouraged.

RECORDS

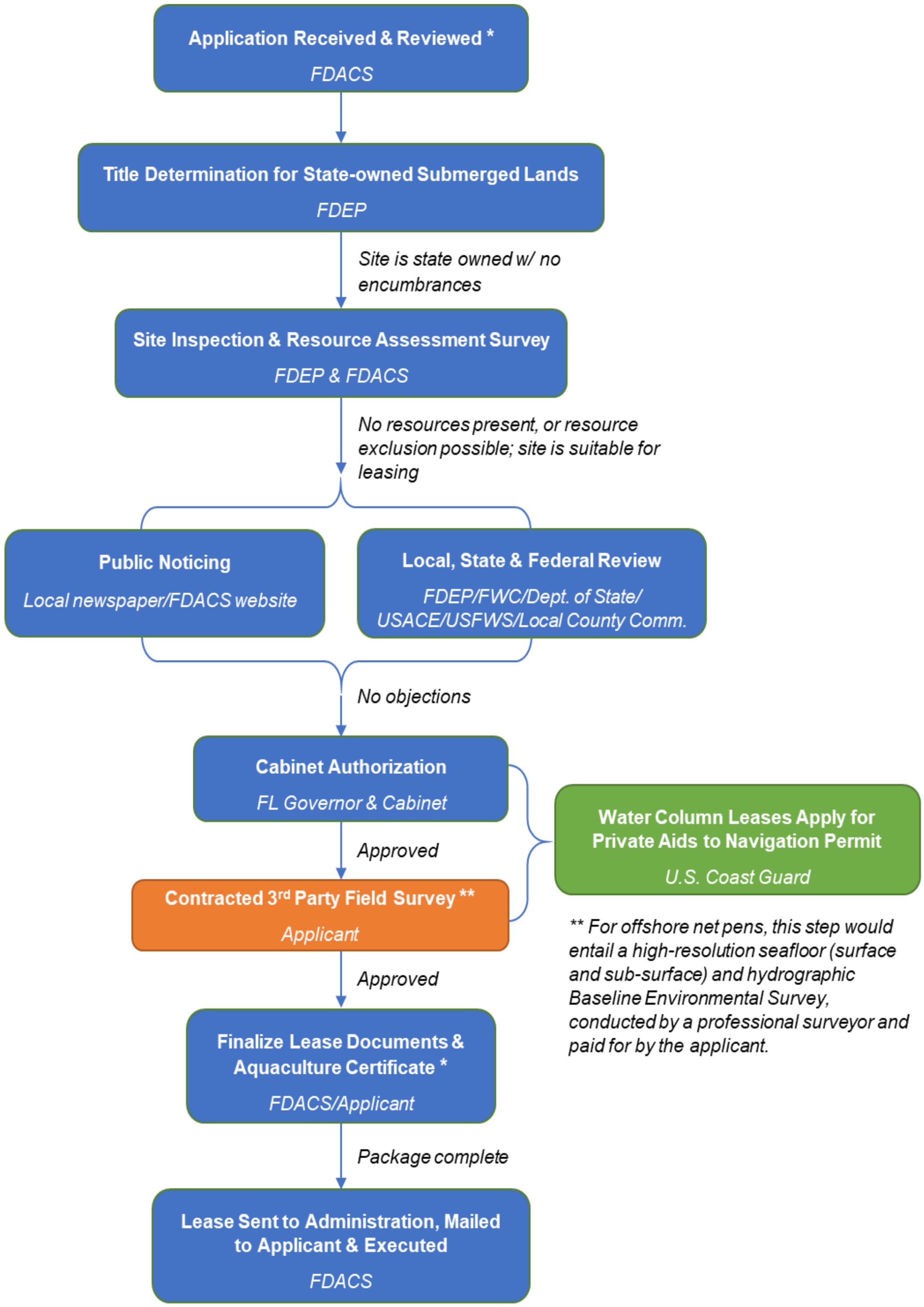
- Maintain the records required by the Aquaculture Best Management Practices for a minimum of two years in a form readily and immediately available to FDACS personnel during compliance visits or to FDACS upon request.
- The processes and procedures utilized to collect and analyze environmental data (physical, chemical or biological) must be documented in a Quality Assurance Project Plan. Farm operators must submit such plans to FDACS during the aquaculture certification process.

PRODUCT LANDINGS

- Aquaculture products must be identified with an Aquaculture Certificate of Registration number, while possessed, transported or sold from harvest to point of sale. The receipt, bills of sale, bills of lading, or other such manifest must show the certificate number and where the product originated. If the product is sold to a Florida grow-out facility, the Aquaculture Certificate of Registration number of the buyer must also be included. Sale records must contain at least the following information:
  - Date of Sale
  - Name and address of Seller
  - Seller's Aquaculture Certificate of Registration number
  - Name and address of the Purchaser
  - Purchaser's Aquaculture Certificate of Registration number (if a Florida Certified Aquaculture Facility) or Wholesale Saltwater Dealers License number, which ever is appropriate
  - Quantity and species identification of aquaculture product sold
- Aquaculture products must be transported in containers that separate aquaculture products pursuant to Identification of Aquaculture Products, Section 597.004(4), F.S., from wild stocks, and such containers must be identified by tags or labels which are securely attached and clearly displayed. Tags/labels must contain information describing the source location, species identification, quantity and date of harvest.
- Facilities must maintain records of all live purchases and/or all live sales of sturgeon, marine shrimp, marine bivalves and live rock/marine life. These records must include the date of shipment, name, address, and Aquaculture Certification of Registration number(s) of the Florida supplier and the Aquaculture Certification of Registration number(s) or Wholesale Saltwater Products License of the Florida seafood dealer if landed and sold in Florida. Records must be retained by the hatchery or farm and made available for inspection for at least two years. Invoices or bills of lading containing the above information is sufficient to meet this BMP requirement.

KEYWORDS: leasing, best management practices, regulations, permitting

Figure 1. Current sovereignty submerged land leasing process for shellfish aquaculture leases in Florida state waters.



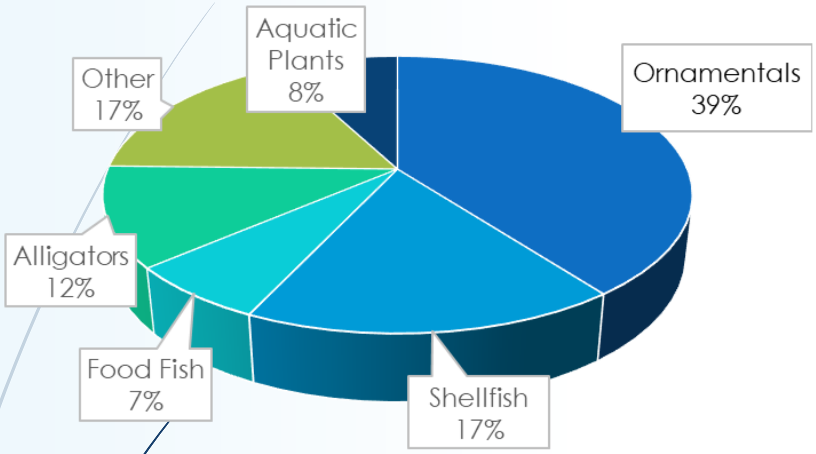
Leasing Process and Regulations for Offshore Finfish Aquaculture in State Waters

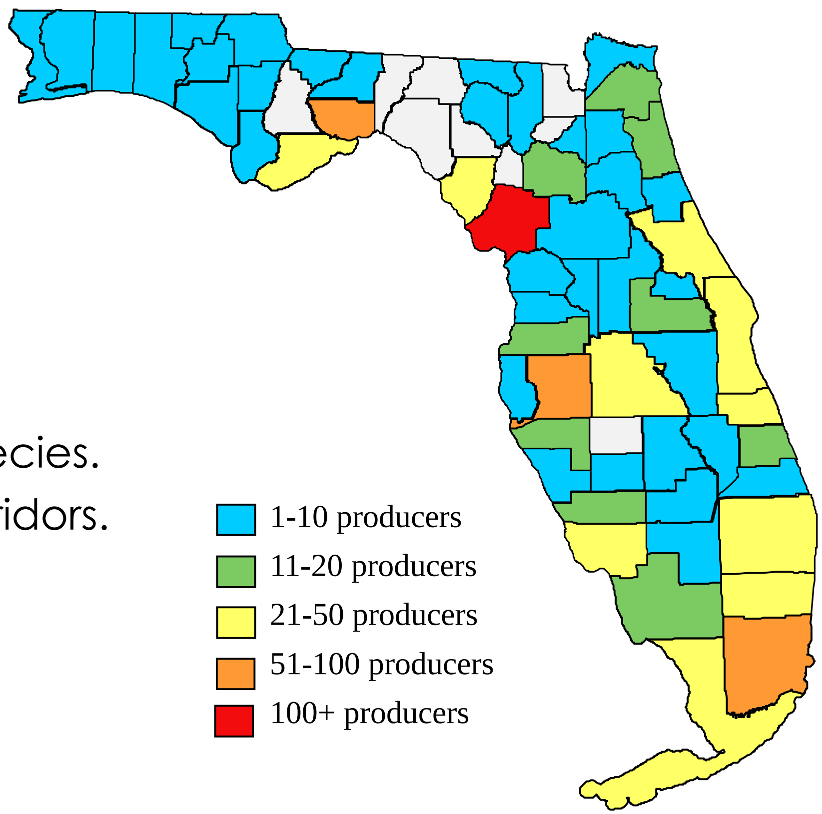
Charlie Culpepper, Assistant Director, FDACS - Division of Aquaculture

Overview

- Aquaculture Certificate of Registration
- Net Pen Application Process
- Sovereignty Submerged Land Leasing Process
- Aquaculture Best Management Practices

Florida's Aquaculture Industry



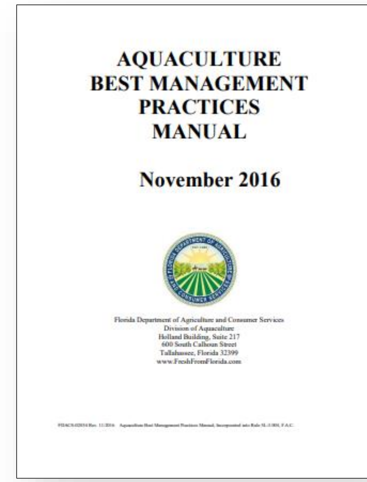


Why Florida?

- Warm climate ideal for tropical species.
- Proximity to ports and shipping corridors.
- Streamlined regulations.

Florida Aquaculture Policy Act

- Established intent of Legislature to enhance the **growth of aquaculture while protecting Florida's environment.**
- Designation of FDACS as the regulatory agency of aquaculture in Florida.
  - **"Aquaculture is Agriculture"**
- Established:
  - Aquaculture Best Management Practices
  - Aquaculture Certificate of Registration



Division of Aquaculture Programs

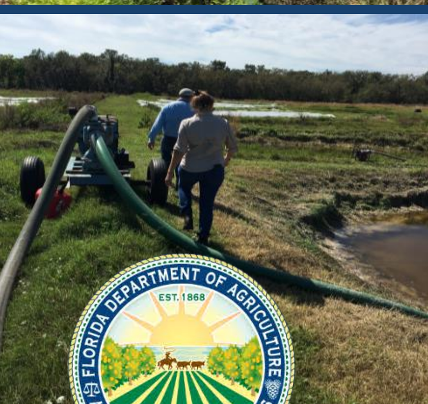
Aquaculture Certificate of Registration and Best Management Practices

Shellfish Harvesting Area Classification

Sovereignty Submerged Land Leasing

Shellfish Processing Facility Certification

Six field offices – 44 staff



Aquaculture Best Management Practices

- Establishes a **streamlined regulatory process**.
- Ensures environmental protection.
- BMP Manual is a "Living Document".
  - Developed in coordination with the industry associations and Aquaculture Review Council.
- Incorporated the requirements of and replaced the need for the following permits:
  - General Fish Farm Permit
  - Marine Bivalve Permit
  - Restricted/conditional species
  - Aquaculture Game Fish License
  - Temporary 370 Permit
  - MSSW
  - Environmental Resource Permits
  - General permits for pond construction
  - SAL (for possession of certain species)
  - Freshwater & Marine Fish Dealers Licenses

Farm Certification

- All facilities engaged in commercial aquaculture in Florida must be **annually certified** by FDACS.
- To be certified, a facility must **implement and maintain compliance** with all applicable BMPs.
- Initial on-site inspections verify farm design/construction requirements.
- **Facility Plan Required:**
  - Facility description
  - Construction plan
  - Production plan
  - Species cultured
  - Intended markets
  - Timeline
  - BMPs to be implemented

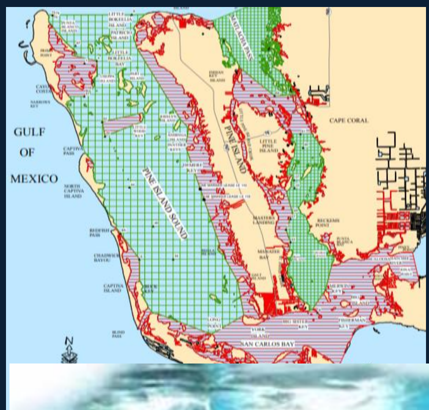
All farms are inspected twice per year.

- Inspectors confirm BMP compliance of:
  - Animal containment
  - Water source and flow
  - Water discharge/effluent treatment
  - Wetland and floodplain impacts
  - Documentation/receipts
    - Species purchases, sales and transfers.
    - Health records
    - Invoices and receipts
    - Shellfish broodstock purchases and seed sales

Offshore Net Pen Application Process

1. Valid National Pollutant Discharge Elimination System (NPDES) permit.
2. Valid Section 10 Rivers and Harbors Act permit.
3. Aquaculture Certificate of Registration Application
   1. Site Selection
   2. Farm Site Plan
   3. Solid Waste Management Plan
   4. Loss-Control and Escape Recovery Plan
   5. Net Pen Structure and Mooring System Preventative Maintenance Program
4. Water Column Lease Application

Site Selection



- Select sites with good water exchange, sufficient depth, and adequate current velocity.
- Sites must have a sand or mud bottom.
- Sites must not have natural resources present, *i.e.* seagrasses, coral reefs, EFH, etc.
- Title encumbrances
- Historical resources
- Other users conflicts

Farm Site Plan

- Schematics for:
  - Net pens
  - Mooring systems
  - Anchors
  - Feeding systems
  - Other fixed structures
- Map of the proposed structures with coordinates which shows configuration.

Solid Waste Management Plant

- **Identify all wastes** generated on a site or from an aquaculture facility.
- At a minimum, **waste management plans must address:**
  - Human waste
  - Feedbags
  - Scrap rope and netting
  - Buoys and weights
  - Fish mortalities and disposal
  - Spoiled feed
  - Packaging materials
  - Fouling organisms
  - Any other solid waste

Loss-Control and Escape Recovery Plan

- Site-specific analysis of the **potential risks of escapes**, their causes, and the specific procedures employed by the farm to reduce risk.
- Fish holding and transportation systems must be **designed, operated and maintained to prevent escape.**
- **Plan must address:**
  - Minimum equipment and operating standards
  - Emergency repair procedures
  - Escape recovery procedures
  - Practices and equipment that reduce the need for predator reduction/destruction (i.e., anti-predator nets)
  - Preparations for severe weather (i.e., hurricanes)

Net Pen Structure and Mooring System Preventative Maintenance Plan

- Identify **maximum loading capacities** of the system:
  - Net pen densities
  - Wind speed
  - Wave and current velocity
- Schedule of **regular maintenance and testing**
- Nets or net pen structural components that fail testing standards must be retired and disposed of properly.
- **Documentation of maintenance and repair** must be available for inspection by FDACS.

Aquaculture on Sovereignty Submerged Land Leases

- Division oversees the application, execution and compliance of all aquaculture leases.
    - **Assess proposed sites** and identify new areas for culture.
    - **Lease permitting** and administration.
    - Enforces **Aquaculture Best Management Practices**.
    - Conducts **inspections and audits** to ensure regulatory compliance.
- To date: Florida has **703 active leases covering 1,556 acres.**

Aquaculture Leasing Process

Application Received & Reviewed *
FDACS

↓

Title Determination for State-owned Submerged Lands
FDEP

↓ *Site is state owned w/ no encumbrances*

Site Inspection & Resource Assessment Survey
FDEP & FDACS

↓ *No resources present, or resource exclusion possible; site is suitable for leasing*

Public Noticing
Local newspaper/FDACS website

Local, State & Federal Review
FDEP/FWC/Dept. of State/ USACE/USFWS/Local County Comm.

↓ *No objections*

Cabinet Authorization
FL Governor & Cabinet

↓ *Approved*

Contracted 3rd Party Field Survey **
Applicant

Water Column Leases Apply for Private Aids to Navigation Permit
U.S. Coast Guard

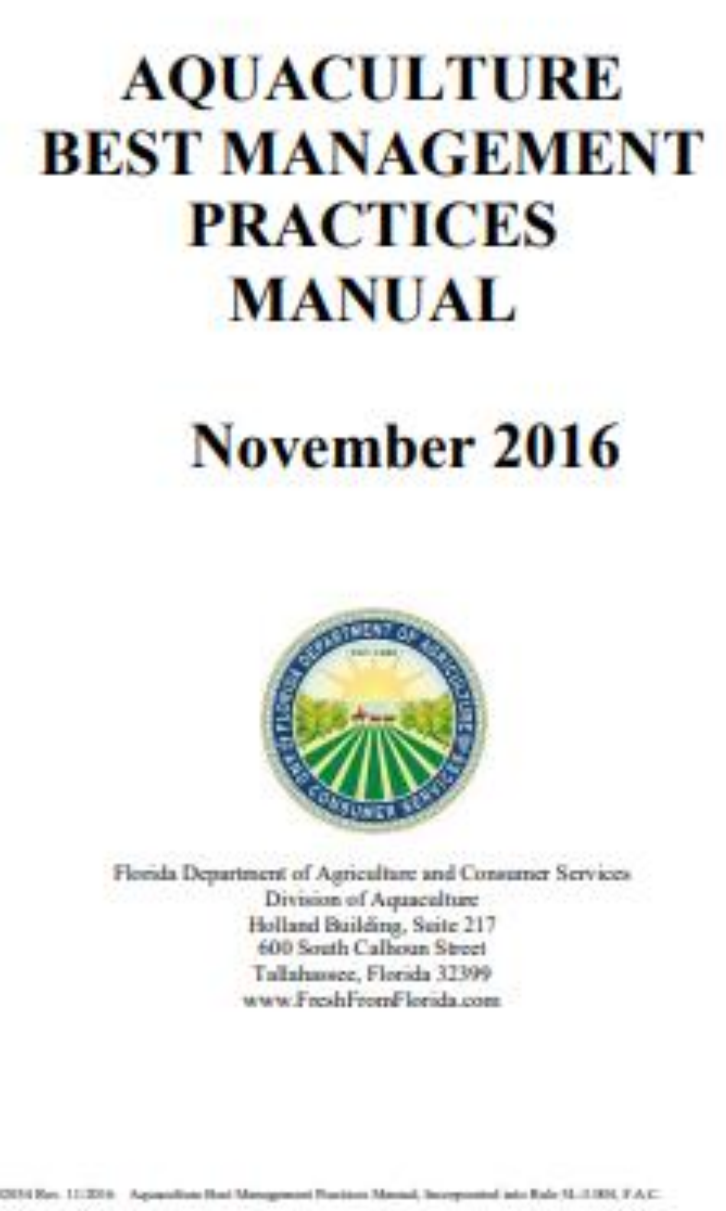
*** For offshore net pens, this step would entail a high-resolution seafloor (surface and sub-surface) and hydrographic Baseline Environmental Survey, conducted by a professional surveyor and paid for by the applicant.*

↓ *Approved*

Finalize Lease Documents & Aquaculture Certificate *
FDACS/Applicant

↓ *Package complete*

Lease Sent to Administration, Mailed to Applicant & Executed
FDACS



AQUACULTURE BEST MANAGEMENT PRACTICES MANUAL

November 2016

Florida Department of Agriculture and Consumer Services
Division of Aquaculture
Holland Building, Suite 217
600 South Calhoun Street
Tallahassee, Florida 32399
www.FreshFromFlorida.com

Selected BMPs for Offshore Net Pen Facilities

BMPs are designed to minimize environmental impacts.

- Facility Operation and Maintenance
- Genetics
- Animal Health
- Containment/Escape Prevention
- Feed Management
- Waste Management
- Records
- Product Landings

Facility Operation and Maintenance

- Document comprehensive **stocking and production methods**.
- Nets and Mooring:
  - Maintained in a whole and intact condition.
  - Placement of nets or gear on the bottom is prohibited.
  - Nets, mooring and rigging lines, and anti-predator equipment must be stretched tight and held taut and maintained in a manner to **diminish the likelihood of entanglement.**
- Maintain and make available to FDACS, upon request, a Marine Entanglement Log.

Genetics

- Culture of **non-native species is prohibited**.
- Genetically engineered or transgenic species are prohibited.
- **Broodstock rules:**
  - GoM facilities muse use stocks that originate from waters of the Gulf of Mexico east of the Mississippi River.
  - Pelagic species must be collected within 186 miles.
  - Estuarine species must be collected within 62 miles.
- Net pen facilities must maintain documentation **identifying the source of all animals**.
- Collection of wild stocks requires an Aquaculture Broodstock Collection Special Activity License from FWC.

Animal Health

- **All stocking of live aquatic organisms must be accompanied by an OCVI and diagnostic results.**
- Facilities must notify FDACS in the event of any notifiable disease outbreak.
- Any medications must be approved by FDA and used as directed by a licensed veterinarian (VFD).
- Implement quarantine/isolation or disinfection procedures that reduce the risk of pathogen translocation.
- **Health management records** must be a component of the farm records.
  - Behavioral changes
  - Clinical signs of disease
  - Treatment procedures
  - Unusual morbidity and mortality events.

Containment and Escape Prevention

- **Any escape must be reported to FDACS within 24 hours.**
- All vessel operators must receive SOP training.
- The service vessel SOP must be made available to FDACS prior to compliance visits.
- **Fish stocking, grading, transfer, or harvest must be:**
  - Conducted in appropriate weather conditions.
  - Conducted to prevent stray fish from escaping, shields or additional nettings must be used.

Containment and Escape Prevention

- **Nets pens must:**
  - Be made from ultraviolet light stabilized compounds.
  - Have jump nets installed at an appropriate height (surface pens only).
  - Be secured in a manner that **minimizes load strains and chafing.**
  - Have **second layer of net** added one foot above and below wear points.
  - Have **bird nets** to prevent predation.
    - Mesh size must be designed to reduce entanglement.

Containment and Escape Prevention

- **Mooring systems must be:**
  - Installed in consultation with the manufacturer or supplier.
  - Maintained under design maximums.
  - **Inspected and adjusted on a biannual basis and prior to and immediately following a severe weather.**
  - Hauled out of the water for visual inspection at least every five years.

Feed Management

- Operate feed storage, handling, and delivery methods to **minimize waste and the creation of feed particles.**
- Wet feeds (ground or whole fish or shellfish and other raw meat or plant materials) are prohibited.
- **Feeding at slack tide is prohibited**.
- Conduct employee training in fish husbandry and feeding methods.
- **Benthic video surveys** must be conducted twice per year, below pens and >100m transect down current.
  - Document features such as depositional areas, flora and fauna, feed pellets and any debris.

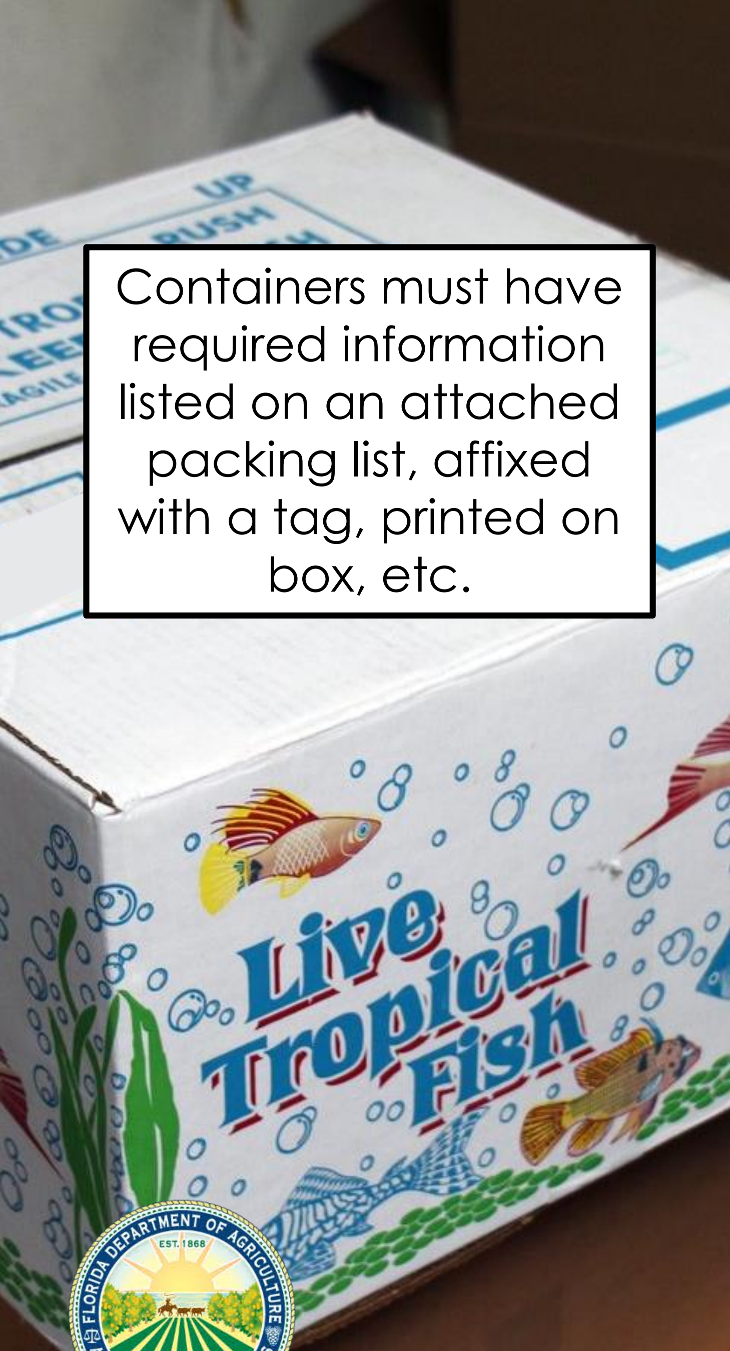
Waste Management

- **Mortalities must be:**
  - Collected regularly and frequently.
  - Stored and transported in closed containers.
  - Returned to shore for disposal.
- **Minimize discharge** of in-place net cleaning debris.
  - Strategies that reduce biofouling are encouraged.
- Antifoulant coating product labels must be approved by FDACS.
- **Biocidal chemicals are prohibited**.
- All trash must be collected, returned to shore and disposed of properly.

Product Landings

- Aquaculture products must be identified with an Aquaculture Certificate of Registration number **while possessed, transported or sold from harvest to point of sale.**

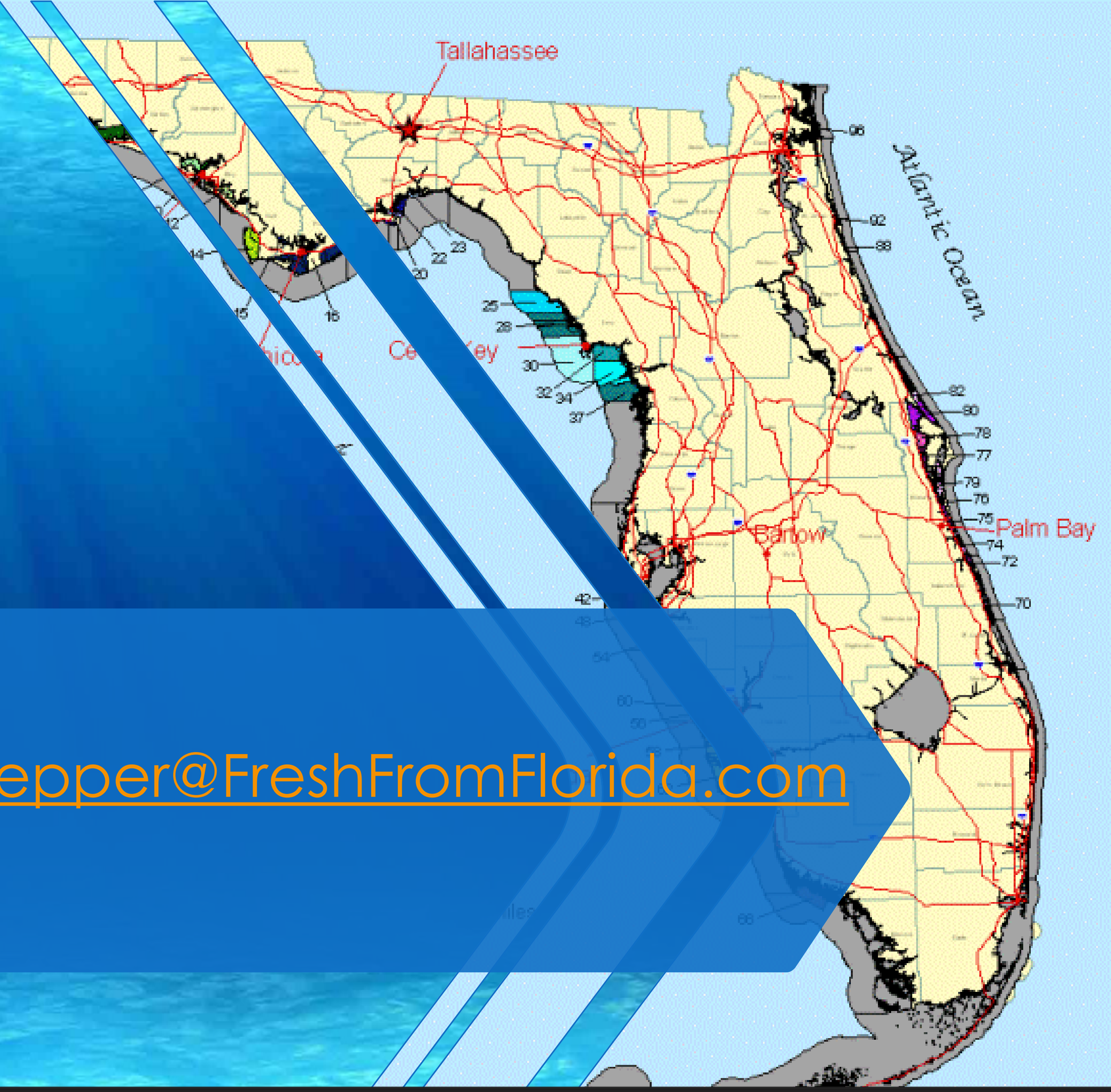
- Aquaculture products must be transported in containers that separate aquaculture products from wild stocks



Containers must have required information listed on an attached packing list, affixed with a tag, printed on box, etc.

Product Landing

- Containers and invoices/manifests must contain the following information:
  - Date
  - Harvest location information (lease number)
  - Name and address of seller
    - AQ number must be listed **for all FL products**
  - Species identification
  - Quantity in container



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The Velella Epsilon Project: Pioneering Offshore Aquaculture in the Southeastern Gulf of Mexico

Neil A. Sims and Lisa D. Vollbrecht
Kampachi Farms, LLC

Dennis J. Peters*
Gulfstream Aquaculture, LLC

June 27, 2019

Velella Epsilon Project

- Objectives
- Description Overview
- Production Summary
- Environmental Permitting Process
- Siting Analysis & Coordination
- Deployment & Staging Area
- Stakeholder Outreach & Engagement
- Proposed Schedule
- Project Outcomes
- VE Project Team Commitments
- Acknowledgements

Velella Epsilon Project

Laying the Groundwork for Wider Acceptance

Objective:

A. Validate the feasibility of a temporary, small-scale, demonstration net pen to stock, culture, and harvest a Federally managed species (Almaco jack; *Seriola rivoliana*);

Velella Epsilon Project

Laying the Groundwork for Wider Acceptance

Objective:

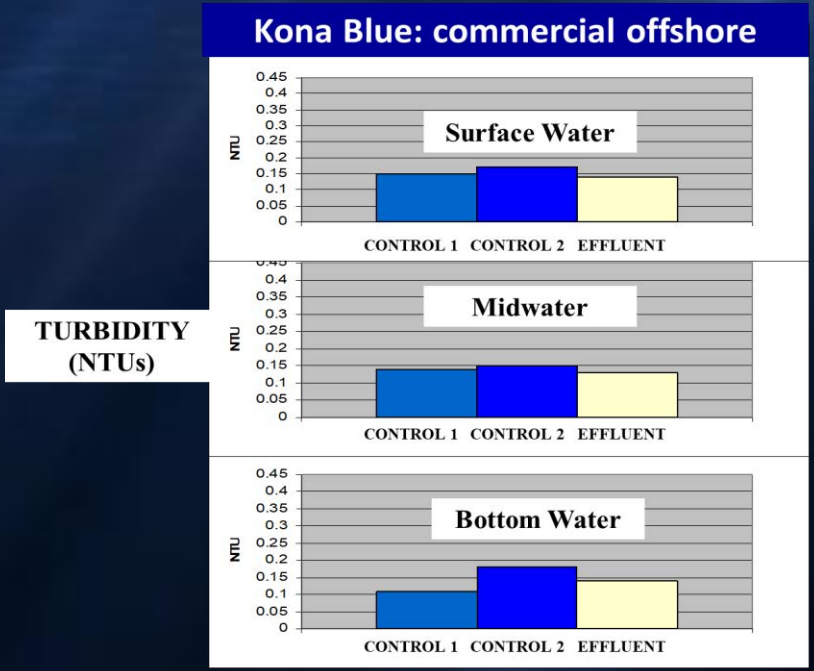
B. Serve as an educational platform for the promotion of rational aquaculture policies, by providing a working net pen example to politicians, constituents, journalists, and other influencers of policy or public perceptions, as well as the local community;

Velella Epsilon Project

Laying the Groundwork for Wider Acceptance

Objective:

C. Serve as a demonstration platform for data collection of water quality, potential benthic impacts, and marine mammal and fish stock interactions resulting from offshore aquaculture in the GOM;



Velella Epsilon Project

Laying the Groundwork for Wider Acceptance

Objective:

D. Provide local recreational, charter, and commercial fishing communities with evidence of the benefits of aquaculture, through the Fish Aggregation Device (FAD) effects of the project, and by documentation of fish aggregation and fishing boat activity around the VE Project; and

Velella Beta Test

Velella Gamma Test

Velella Epsilon Project

Objective:

E. Increase public awareness of, and receptivity towards, offshore aquaculture and the need to grow more seafood in U.S. waters, by providing public tours of the offshore operation, including (possibly) snorkeling inside the net pen, and fee fishing.

Velella Beta Test

Velella Epsilon Project

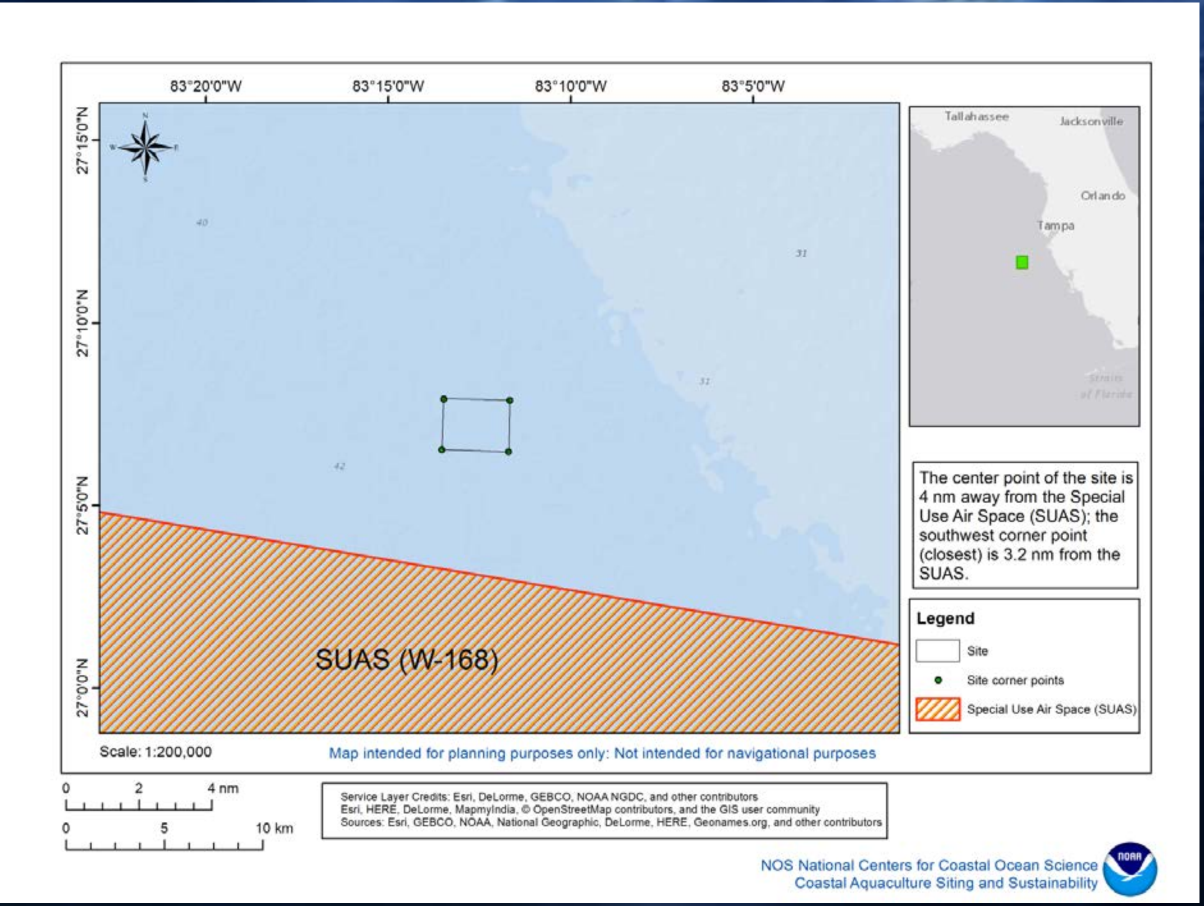
Description Overview:

- Using a single net pen (PolarCirkel-style)
  - offshore-strength submersible system,
  - 17 m diameter x 7 m depth (deep),
  - effective volume ~ 1,600 m^3
- Located ~ 40 nautical miles southwest of Sarasota, Florida;
- In ~ 40 m (130 to 135 ft) water depth;
- On a multi-anchor (3) swivel (MAS)-point mooring system;
- Using concrete block anchor mooring; and serviced by a
- Tender vessel/feed barge tethered to side of net pen system

Velella Epsilon Project

Description Overview:

- Proposed Site Location



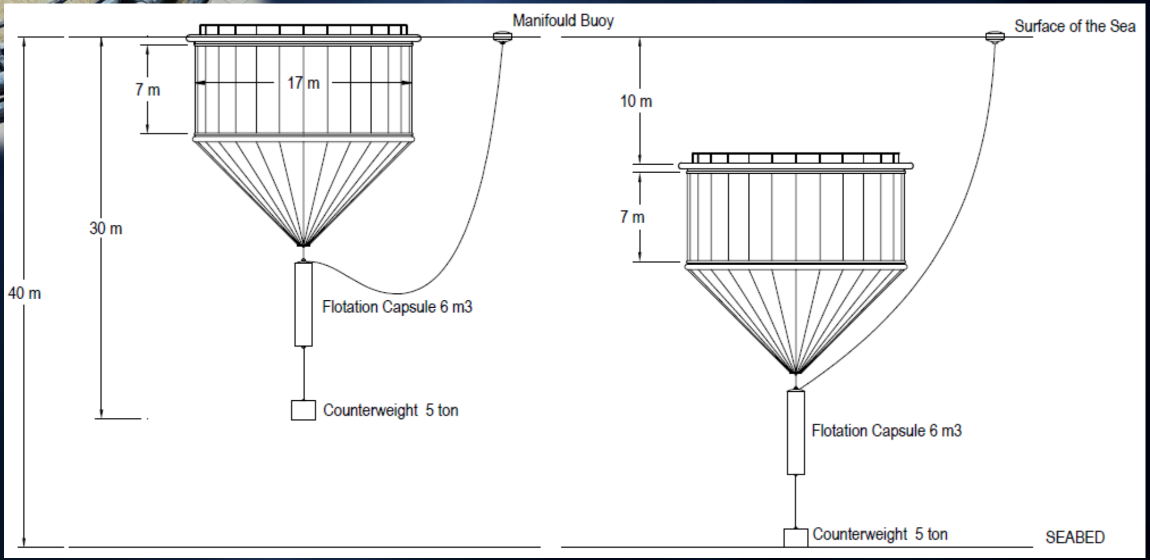
- However…this is the Conclusion of a very Comprehensive Process

Velella Epsilon Project

Description Overview:

- Brass (copper-zinc alloy) Net Mesh

- Net Pen Engineering Design

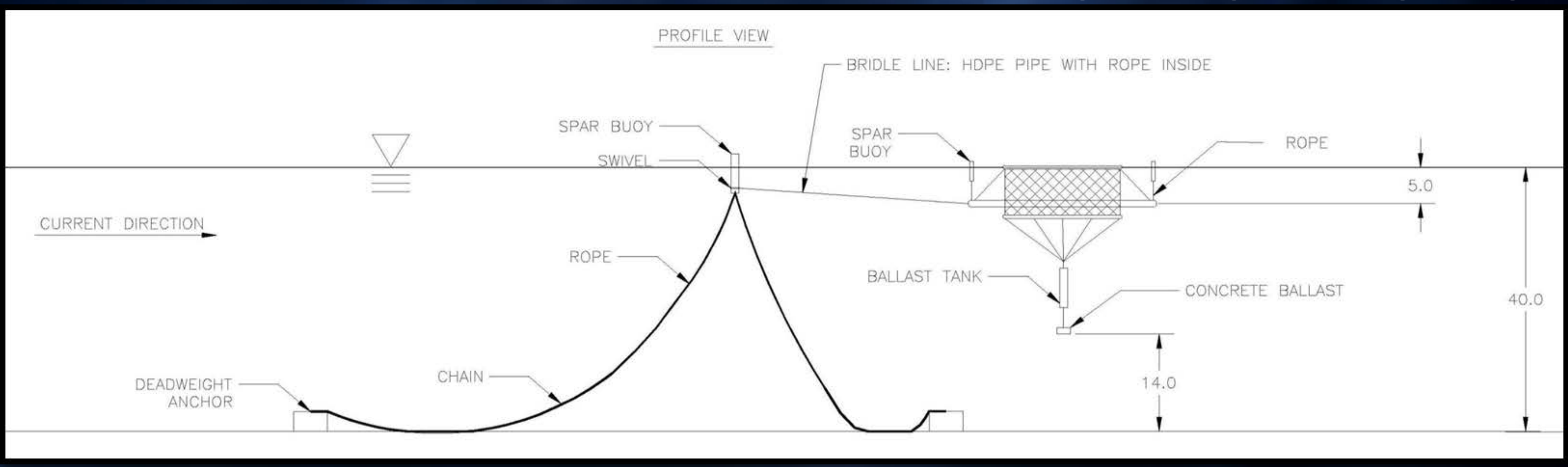


Velella Epsilon Project

Description Overview:

- Structural Integrity Highlights:
  - Withstand 200-Year Storm Submerged 40 Feet Below Surface
  - Three (3) Concrete Mooring Blocks
    - ✓ MAS ensures Net Pen Array can Pivot in Watch-circle
    - ✓ Swivel Ring Shackle & MAS Mooring Line (4.6” diameter)

❑ Engineering Mooring Design



Velella Epsilon Project

Production Summary:

- Rearing one (1) Single Cohort
  - Almaco jack (*Seriola rivoliana*; i.e., kampachi)
- Growout period of ~ 12 months from Net Pen Deployment
- 20,000 fish/cohort stocked x 85% survival rate = 17,000 fish
- 4.4 lbs/fish at harvest x 17,000 fish = 74,800 lbs Total Harvest

Velella Epsilon Project

Environmental Permitting:

- Funding Awarded and VE Project Initiation (10/10/17)
- NOAA Fisheries - Gulf Aquaculture Permit (GAP), or an Exempted Fishing Permit (EFP) –
  - At that time, the Lead Agency for Aquaculture in Federal Waters and for the VE Project
  - Pre-Application Kickoff Teleconference (11/01/17)
    - Review Project Scope; Identify Cooperating Agencies; Review Schedule; Identify other Federal and state Permits, Certifications, or Requirements; and Identify Briefing Requirements for the Gulf of Mexico Fisheries Management Council (GMFMC)
  - EFP Application submittals (01/12/18 and 04/01/18)
  - GMFMC Presentation #1 (New Orleans) – Received a list of data needs (02/01/18)
  - GMFMC Presentation #2 (Ocean Springs) – Received a Unanimous Vote/ Recommendation by the Council for NOAA Fisheries to approve the EFP (04/20/18)
  - Multiple Aquaculture EFP Interagency Coordination Meetings (teleconferences and onsite meetings)
  - However, as of the 09/25/18 U. S. District Court, Eastern District of Louisiana ruling, the EFP (and GAP) are no longer required
  - As such, USEPA is now Lead Agency; however, the Strong Collaboration with NOAA Fisheries and USACE Remains

Velella Epsilon Project

Environmental Permitting:

- USEPA National Pollutant Discharge Elimination System (NPDES) Permit
  - USEPA Form 1 and USEPA Form 2B
    - Multiple submittals (05/18/18, 10/27/18, and 11/09/18)
    - <u>Application considered complete (11/09/18)</u>
  - Baseline Environmental Survey (BES) and Report
    - Compliant with the "*BES Guidance and Procedures for Marine Aquaculture Activities in U.S. Federal Waters of the Gulf of Mexico*", October 24th, 2016
      - Single beam bathymetry, side scan sonar,
      - Sub-bottom profiler (seismic reflection), and
      - Magnetometer data
      - Hydrographic Data
    - Multiple interagency review and coordination meetings
      - Archaeological Review with FL SHPO and Dr. Gordon Watts (10/05/18)
    - Multiple BES Report iterations and submittals
    - <u>Final BES Report (10/26/18)</u>
  - BMP Plan, Environmental Monitoring Plan, Emergency Response Plan, Quality Assurance Plan (all currently in progress and to be completed by month end)

Velella Epsilon Project

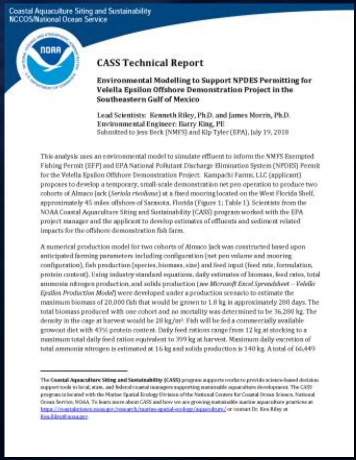
Environmental Permitting:

- USEPA – (NMFS/USACE/USFWS) Endangered Species Act (ESA) Section 7 Consultation (Informal) and Concurrence
- USEPA – (NMFS/USACE) Marine Mammal Protection Act (MMPA) Compliance
- USEPA – (NMFS/USACE) National Environmental Protection Act (NEPA) Environmental Assessment (EA) with a signed Finding of No Significant Impact (FONSI)
- USEPA – (NMFS/USACE) Magnuson-Stevens Fishery Conservation and Management Act (Magnuson Stevens Act, MSA); Essential Fish Habitat (EFH) Assessment
- USACE – (USACE/NMFS/USFWS/FWC) Section 10 Permit (05/18/18, 10/27/18, and 11/09/18)
- Kampachi Farms, LLC – (Florida State Clearinghouse) - Coastal Zone Management Act (CZMA) Coastal Consistency Determination (CCD) Concurrence and/or Waiver
  - FL SHPO - National Historic Preservation Act (NHPA) Section 106 Concurrence
  - CZMA CCD Concurrence (02/25/19)
- FDACS – Aquaculture Certificate

Velella Epsilon Project

Environmental Permitting:

- **Other Environmental Collaborations –**
  - Protected Species Monitoring Plan with NOAA Fisheries (04/16/18)
    - University Graduate Student Participation
  - Close Coordination with Florida State Partners: FWC, FDACS, & FDEP
  - Discussions with NOAA Fisheries & USDA to Identify an
    - Animal & Plant Health Inspection Service, and an
    - Aquatic Animal Health Expert
  - NOAA NCCOS/EPA Coordination for Water Quality Effluent Estimates
  - USCG Coordination with Aids to Navigation, Notice to Mariners
  - Former EFP Application Transformed into the Supplemental Data Document
    - Provided to Support the FL State Clearinghouse Concurrence with the Coastal Consistency Determination for CZMA Compliance



Coastal Aquaculture Siting and Sustainability
NCCOS/National Ocean Service

CASS Technical Report

Environmental Modelling to Support NPDES Permitting for Velella Epsilon Offshore Demonstration Project in the Southeastern Gulf of Mexico

Lead Scientists: Kenneth Riley, Ph.D. and James Morris, Ph.D.
Environmental Engineer: Barry King, PE
Submitted to Jess Beck (NMFS) and Kip Tyler (EPA), July 19, 2018

This analysis uses an environmental model to simulate effluent to inform the NMFS Exempted Fishing Permit (EFP) and EPA National Pollutant Discharge Elimination System (NPDES) Permit for the Velella Epsilon Offshore Demonstration Project. Kampachi Farms, LLC (applicant) proposes to develop a temporary, small-scale demonstration net pen operation to produce two cohorts of Almaco Jack (*Seriola rivoliana*) at a fixed mooring located on the West Florida Shelf, approximately 45 miles offshore of Sarasota, Florida (Figure 1; Table 1). Scientists from the NOAA Coastal Aquaculture Siting and Sustainability (CASS) program worked with the EPA project manager and the applicant to develop estimates of effluents and sediment related impacts for the offshore demonstration fish farm.

A numerical production model for two cohorts of Almaco Jack was constructed based upon anticipated farming parameters including configuration (net pen volume and mooring configuration), fish production (species, biomass, size) and feed input (feed rate, formulation, protein content). Using industry standard equations, daily estimates of biomass, feed rates, total ammonia nitrogen production, and solids production (*see Microsoft Excel Spreadsheet – Velella Epsilon Production Model*) were developed under a production scenario to estimate the maximum biomass of 20,000 fish that would be grown to 1.8 kg in approximately 280 days. The total biomass produced with one cohort and no mortality was determined to be 36,280 kg. The density in the cage at harvest would be 28 kg/m³. Fish will be fed a commercially available growout diet with 43% protein content. Daily feed rations range from 12 kg at stocking to a maximum total daily feed ration equivalent to 399 kg at harvest. Maximum daily excretion of total ammonia nitrogen is estimated at 16 kg and solids production is 140 kg. A total of 66,449

The **Coastal Aquaculture Siting and Sustainability (CASS)** program supports works to provide science-based decision support tools to local, state, and federal coastal managers supporting sustainable aquaculture development. The CASS program is located with the Marine Spatial Ecology Division of the National Centers for Coastal Ocean Science, National Ocean Service, NOAA. To learn more about CASS and how we are growing sustainable marine aquaculture practices at: https://coastalscience.noaa.gov/research/marine-spatial-ecology/aquaculture/ or contact Dr. Ken Riley at Ken.Riley@noaa.gov

Velella Epsilon Project

Siting Analysis and Coordination:

Importance of Each of these can not be Underestimated

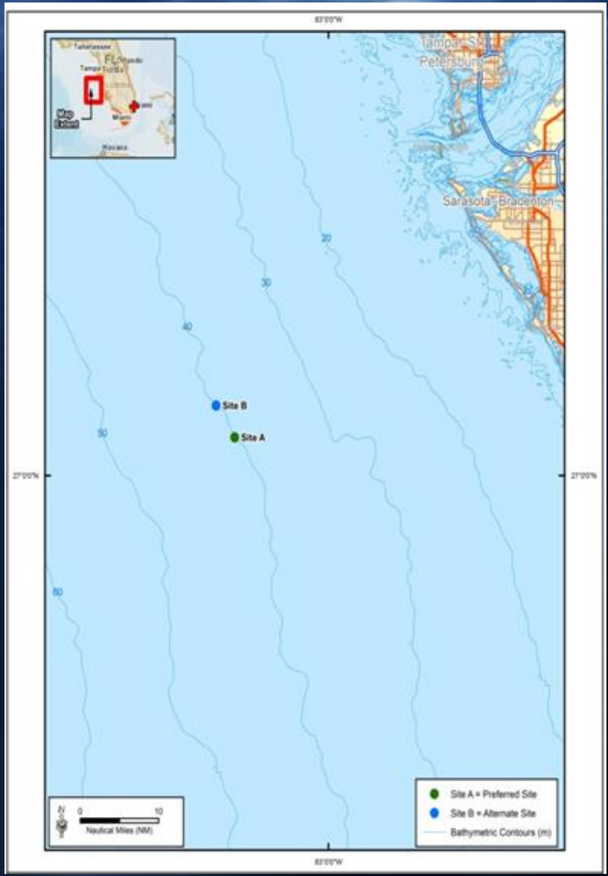
- NOAA's National Centers for Coastal Ocean Science (NCCOS):
  - Comprehensive Alternative Siting Analysis
    - ❑ Considered Farming Parameters
      - Distance to ports of entry (POE)
      - Depth and Substrate Requirements
      - Min and Max Seawater Temperature
      - Min and Max Current Velocity
      - Max Wave Energy
      - Project Footprint
    - ❑ Utilized the Gulf AquaMapper
      - Offshore Aquaculture Screening Tool
    - ❑ Originally Identified 18 Potential Sites
    - ❑ Narrowed Possible from 6 Sites to 3 Sites
    - ❑ Finalized 2 Potential Sites for BES
      - No Overlap with Anthropogenic Structures or Activities
      - Considered Proximity to and Sensitivity with EFH
      - Deconflicted Interests with Military Areas
  - Environmental Modeling (NPDES Support)

Velella Epsilon Project

Siting Analysis and Coordination:

Initiated Baseline Environmental Survey (BES)

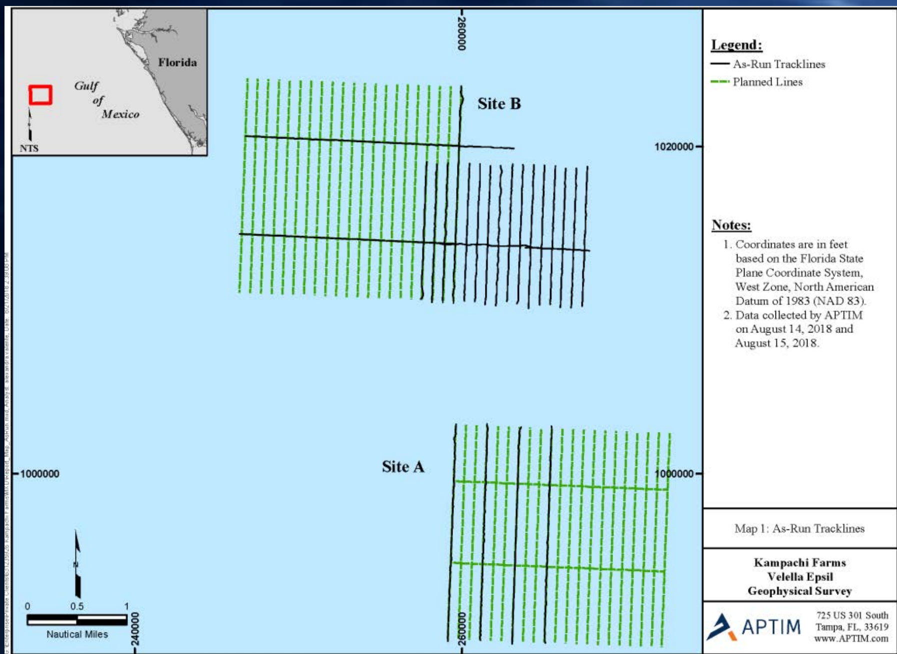
- Site A = Preferred Site
- Site B = Alternative Sites



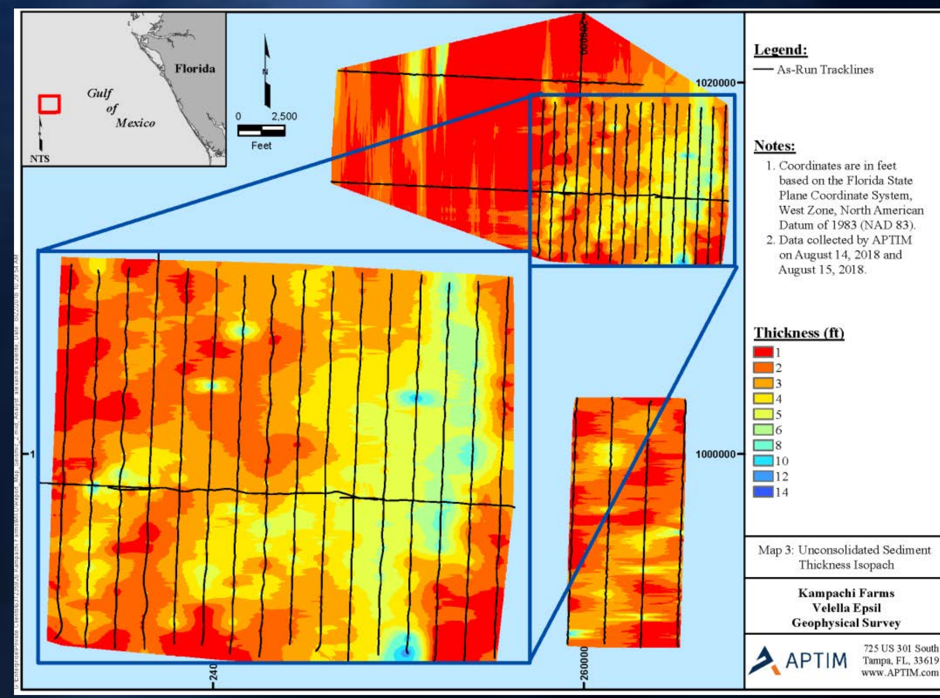
Velella Epsilon Project

Siting Analysis and Coordination:

- ❑ From Site A to Site B



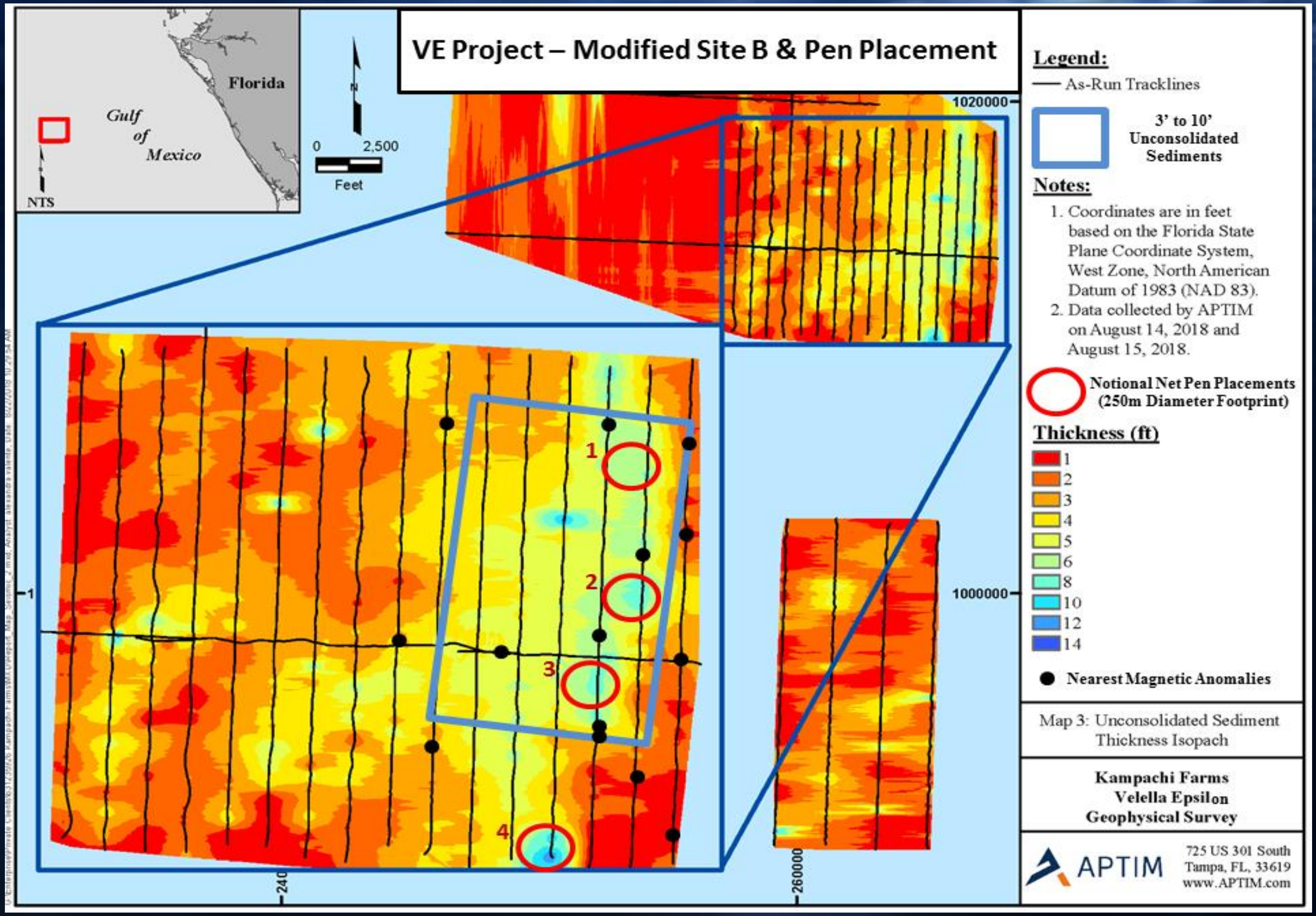
- ❑ From Site B to Modified Site B



Velella Epsilon Project

Siting Analysis and Coordination:

- Modified Site B - Post Data Analysis



Velella Epsilon Project

Siting Analysis and Coordination:

- Modified Site B Coordinates

Position	° Decimal ' Latitude	° Decimal ' Longitude	Decimal ° Latitude	Decimal ° Longitude	Perimeter (km)	Area (km^2)
Modified Site B from BES Report						
Upper Left	27° 7.86863' N	83° 13.45827' W	27.131143° N	83.224303° W		
Upper Right	27° 7.83079' N	83° 11.63237' W	27.130512° N	83.193872° W		
Lower Right	27° 6.43381' N	83° 11.69349' W	27.107230° N	83.194890° W		
Lower Left	27° 6.50261' N	83° 13.52658' W	27.108377° N	83.225442° W		
Center	27° 7.11266' N	83° 12.58604' W	27.118543° N	83.209767° W	11.1571	7.7237
Targeted Subset Area of Modified Site B from BES Report (3' to 10' Unconsolidated Sediments)						
Upper Left	27° 7.70607' N	83° 12.27012' W	27.128445° N	83.204502° W		
Upper Right	27° 7.61022' N	83° 11.65678' W	27.126837° N	83.194278° W		
Lower Right	27° 6.77773' N	83° 11.75379' W	27.112962° N	83.195897° W		
Lower Left	27° 6.87631' N	83° 12.42032' W	27.114605° N	83.207005° W		
Center	27° 7.34185' N	83° 12.02291' W	27.122365° N	83.200382° W	5.2273	1.6435
Notional Net Pen Placements within Modified Site B from BES Report						
1	27° 7.54724' N	83° 11.85393' W	27.125787° N	83.197565° W		
2	27° 7.17481' N	83° 11.82576' W	27.119580° N	83.197095° W		
3	27° 6.93930' N	83° 11.94780' W	27.115655° N	83.199130° W		
4	27° 6.52579' N	83° 12.09175' W	27.108763° N	83.201530° W	0.7854	0.0491

Velella Epsilon Project

Siting Analysis and Coordination:

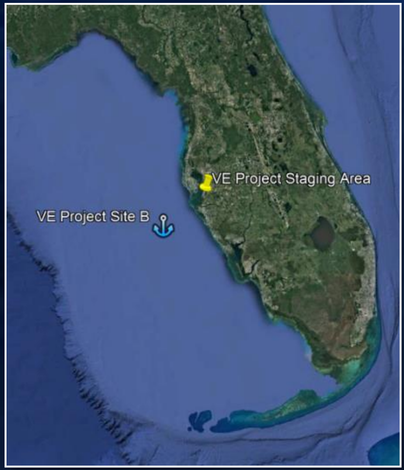
Importance of Each of these Can Not Be Underestimated

- VE Project Completed Baseline Environmental Survey (BES)
  - Greater Depths of Unconsolidated Sediments on Site B
  - Site Relocated Southwesterly to new Modified Site B
  - <u>BES Report Finalized with Archaeological Review Completed</u>
- NOAA's National Centers for Coastal Ocean Science (NCCOS):
  - Comprehensive Alternative Siting Analysis
  - <u>Verified Modified Site B is Deconflicted with Military Areas</u>
- Southern Shrimp Alliance (SSA):
  - Continued 16 Months of Coordination & Collaboration
  - <u>Site Selection Partnership – Modified Site B is an Agreeable Site</u>
- <u>All Environmental Permit Applications, Documentation, and Consultation Activities</u>
  - <u>Relied Upon a Successful Identification and Collaboration of Project Siting</u>
  - This is Why it is "*More than just Permitting*"

Velella Epsilon Project

Deployment and Staging Area:

- Manatee County Port Authority (Port Manatee)



Velella Epsilon Project

Stakeholder Outreach & Engagement:

- ❑ Commercial and Recreational Fisheries
  - Charter Fisherman's Association (CFA)
  - GOM Reef Fish Shareholder's Alliance (Shareholder's Alliance)
  - Southern Shrimp Alliance (SSA)
  - Fishing Communities Coalition
  - Seafood Harvesters of America
  - Gulf Fishermen's Association
  - Southern Catch - South Atlantic Fishermen's Association
  - Southeastern Fisheries Association
  - Southern Offshore Fishing Association
  - Pensacola Charter Boat Association
  - Destin Charter Boat Association
  - Organized Fishermen of Florida
  - Florida Sport Fishing Association

Velella Epsilon Project

Stakeholder Outreach & Engagement:

- Private / Not-for-Profit Organizations
  - The Marine Fish Conservation Network
  - Mote Marine Laboratory / Mote Aquaculture Park
  - Coastal Conservation Association of Florida
  - International Game Fish Association
  - International Game Fish Tournament Observers
  - Directed Sustainable Fisheries
  - Sierra Club
  - Ocean Conservancy
  - The Nature Conservancy
  - The PEW Charitable Trust

Velella Epsilon Project

Project Schedule:

Milestone Activity	Start Date	Finish Date	Months
Obtain All Environmental Permits and Approvals			
VE Demonstration Project Permits	Jan-18	Aug-19	20
Initiate Pusuit of Commercial Permits	Sep-19	Aug-20	12
Deploy Demonstration Netpen/ Tender Vessel Array			
Lease Harbor Space	Sep-19	Sep-19	1
Obtain Mooring and Deployment Equipment	Sep-19	Oct-19	2
Net Pen Delivery	Oct-19	Oct-19	1
Construct & Deploy Net Pen Array	Oct-19	Nov-19	2
Rear a Single Cohort of Almaco Jack			
Larval Runs & Fingerling Production	Nov-19	Jan-20	3
Ship Fingerlings & Stock Net Pen	Jan-20	Jan-20	1
Feeding, Cleaning, & Monitoring	Jan-20	Dec-20	12
Water Quality & Benthic Monitoring	Nov-19	Jan-21	15
Environmental & Data Reports	Nov-19	Jan-21	15
Engagement in Stakeholder & Public Outreach	Jan-18	Jan-21	36
Source Buyer(s)/Dealer(s)	Apr-20	Sep-20	6
Harvest Fish	Nov-20	Dec-20	2
Project Closeout			
Project and Environmental Summary Report	Dec-20	Jan-21	2
Manual for Aquaculture Permitting Pathway (MAPP)	Jan-21	Jan-21	1

Velella Epsilon Project

Project Outcomes:

- (a) Serving as a Platform for the Promotion of Rational Aquaculture Policies and demystification of the industry, by providing a working net pen example to politicians, constituents, journalists, and other influencers of policy or public perceptions, as well as the local community;
- (b) Increasing Public Awareness of, and Receptivity Towards, Offshore Aquaculture and the need to culture more seafood in U.S. waters, by providing public tours of the offshore operation, including (possibly) snorkeling inside the net pen, and fee fishing;
- (c) Acting as a Demonstration Platform for Data Collection of Water Quality, potential benthic impacts, and marine mammal and fish stock interactions resulting from offshore aquaculture in the GOM; and
- (d) Providing local recreational, charter, and commercial fishing communities with Evidence of the Benefits of Aquaculture, through the Fish Aggregation Device (FAD) effects of the project, and by documentation of fish aggregation and fishing boat activity around the VE Project.

Velella Epsilon Project

VE Project Team Commitments:

- Commitment to Comply with All State and Federal Requirements
- Continue Close Coordination with State & Federal Agencies, & Stakeholders
- Set an Example for Other Aquaculture Practices to Follow in the Future

Manual for Aquaculture Permitting Pathway, or MAPP

Velella Epsilon Project

VE Project Team Commitments:

As with Kampachi's parent operations in La Paz, Mexico, commercial operations in the U.S. will:

Vigorously pursue –
<u>Aquaculture Stewardship Council (ASC)</u> certification for environmentally and socially responsible seafood production!

Velella Epsilon Project

Acknowledgements:

(*"It Takes a Village"*)

- NOAA Sea Grant 2017 Aquaculture Initiative
  - Integrated Projects to Increase Aquaculture Production
- University of Florida Sea Grant
- Mote Aquaculture Research Park (Mote)
- University of Miami - Rosenstiel School of Marine and Atmospheric Sciences (RSMAS)
- Gulf of Mexico Fisheries Management Council (GMFMC)
- Gulf States Marine Fisheries Commission (GSMFC)
  - 2018 Marine Aquaculture Pilot Projects Grant Opportunity
- NOAA Fisheries HQ and Southeast Region (SERO)
- NOAA's National Centers for Coastal Ocean Science (NCCOS)
- U.S. Environmental Protection Agency (USEPA) Region 4
- U.S. Army Corps of Engineers (USACE), Jacksonville District
- U.S. Coast Guard (USCG), Sector St. Petersburg
- Florida Fish and Wildlife Conservation Commission (FWC)
- Florida Department of Agriculture and Consumer Services (FDACS)
- Florida Department of Environmental Protection (FDEP) & FDEP Florida Coastal Office
- APTIM Environmental Services (APTIM)
- Tidewater Atlantic Research (TAR)
- Manatee County Port Authority (Port Manatee)
- Southern Shrimp Alliance (SSA)
- Gulf of Mexico Reef Fish Shareholders' Alliance (Shareholder's Alliance)

A True Public-Private Collaboration

Velella Epsilon Project

Thank you!

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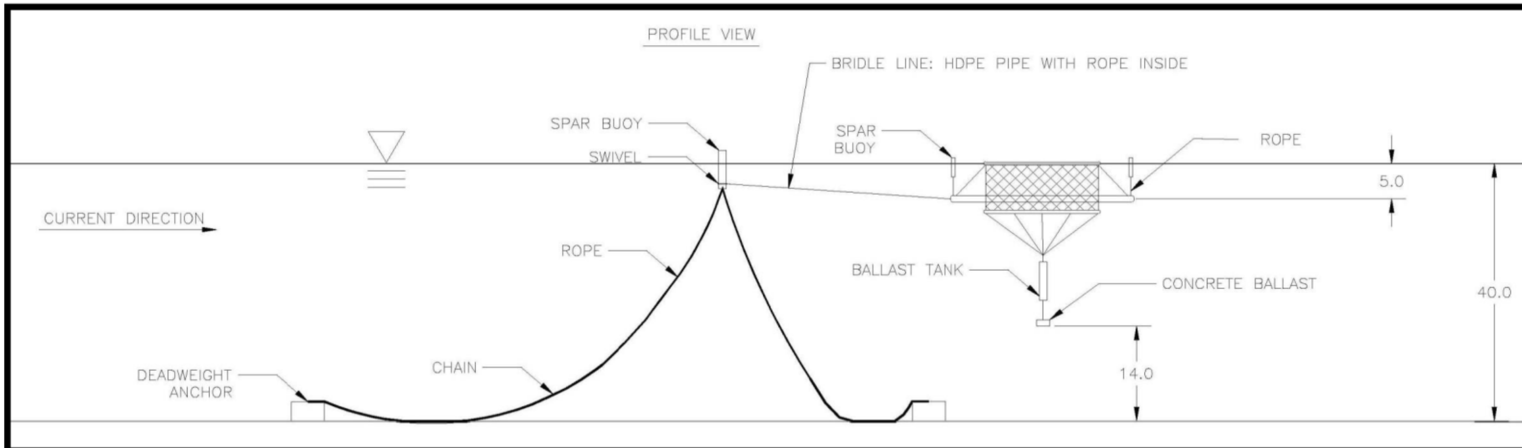
Velella Epsilon Project

Velella Epsilon Project



1) Deadweight Anchors (concrete):
- Three (3) anchors equally spaced @:
  - 120m from mooring centerline
  - 120 degrees from each other
- Each @ 4.5m x 4.5m x 4.5m (91 m3)
- Concrete friction factor = 0.5 on wet sand
- Each has an effective weight of 217 MT

2) Mooring Chain (Grade 2 steel):
- 80m length on each anchor
- 50mm (2") thick links
- No load = 70m length of each on seafloor
- Design load = some entirely off seafloor/ others completely on seafloor

3) Mooring Lines (rope):
- 40m length on each chain
- AMSTEEL®-BLUE
- 36mm (1 1/2") thick lines

4) Spar Buoy w/ Swivel (steel):

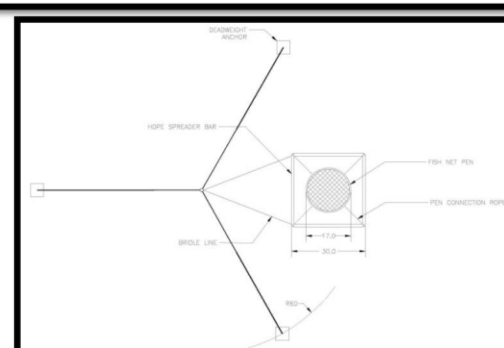
5) Bridle Lines (rope inside HDPE pipe):
- Three (3) ~30m bridle lines (rope) from swivel to spreader bar
- AMSTEEL®-BLUE
- 33.3mm (1 5/16") lines inside HDPE pipe

6) Spreader Bar (HDPE):
- Header Bar (load bearing) connected to Bridle Lines
  - 30m in length
  - 0.36m OD DR 11 HDPE pipe
- Side and Rear Bars (smaller load bearing)
  - 30m in length
  - 0.36m OD DR 17 HDPE pipe
- Four (4) corner spar buoys

7) Net Pen Connection Lines (rope):
- Four (4) ~13m connection lines (rope)
- Connected from Spreader Bar to Net Pen Float Rings
- AMSTEEL®-BLUE
- 33.3mm (1 5/16") lines

8) Net Pen Frame Structure (HDPE):
- Top Frame Structure
  - 18m in diameter
  - One (1) HDPE side-by-side Float Rings
    - On the sea surface
    - ~0.36m OD DR 11 HDPE pipe
  - One (1) HDPE net ring (railing)
    - Connected ~ 1.0m above Float Rings
    - Connected to Net Pen Mesh
    - ~0.15m OD DR 17 HDPE pipe
- Bottom Frame Structure
  - 18m in diameter
  - One (1) HDPE sinker ring
    - 7.0m below Float Rings
    - Connected to Net Ring
    - ~0.36m OD DR 11 HDPE pipe
  - One (1) HDPE net ring
    - 7.0m below float rings
    - Connected to copper alloy mesh
    - ~0.15m OD DR 17 HDPE pipe

9) Net Pen Mesh (copper alloy):
- 17m diameter x 7m depth
- Top connected to top net ring (railing)
- Bottom connected to bottom net ring
  - 4mm wire diameter
  - 40mm x 40mm mesh square
- Effective volume of 1,600m^3



10) Shackle Point Connection (steel):
- One (1) ~0.13m^2 shackle plate
- Four (4) connection lines
  - 12 mm in diameter x 10m in length
  - Connected from shackle plate to HDPE sinker ring
- ~1m Grade 2 steel chain (32mm) connected to Floatation Capsule

11) Floatation Capsule (steel):
- ~1.5m in diameter x ~3.45m in length
- Effective floatation volume = 6m^3
- ~3m Grade 2 steel chain (32mm) connected to Counter Weight

12) Counter Weight (concrete):
- ~1.1m in diameter x ~2.2m in length
- Effective weight of 5 MT

Permitting Manna Fish Farms, Gulf of Mexico Operations

KELLY LUCAS[a], REGINALD BLAYLOCK[a], MICHAEL CHAMBERS[b], STEPHANIE OTTS[cd], KRISTINA ALEXANDER[ce], JAMES MORRIS[f], KENNETH RILEY[f], DONNA LANZETTA[g], MIKE MEEKER[gh]

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d. National Sea Grant Law, Kindard Hall, Wing E, Room 256 University, MS. 38677
e. Mississippi-Alabama Sea Grant, Kindard Hall, Wing E, Room 256 University, MS. 38677
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Email: kelly.lucas@usm.edu, reg.blayloc@usm.edu, micheael.chambers@unh.edu, sshowalt@olemiss.edu, kalexan@olemiss.edu, James.morris@noaa.gov, ken.riley@noaa.gov, donna@mannafishfarms.com, mtmaqua@xplornet.com

Keywords: Finfish farm, permitting, Gulf of Mexico

Objectives:

The purpose of this project is to permit a commercial-scale finfish aquaculture operation in federal waters of the Gulf of Mexico. The objectives for phase 1 of the project include preliminary site screening, completion of the pre-application meeting, collection of bathymetric and hydrographic data, preliminary structural analysis, submission of a permit application, and outreach with the public as well as federal and state agencies.

Background:

The final rule for the Gulf of Mexico Fishery Management Plan for Regulating Offshore Marine Aquaculture in the Gulf of Mexico (GOM) was published in January 2016[1]. The plan established a regional permitting process to manage offshore aquaculture in an environmentally sustainable manner, and NOAA worked with federal permitting agencies to create a coordinated permit process[1]. NOAA estimated the cost for engineering, siting, and environmental assessment for permitting an offshore commercial structure to be in excess of $1 million. However, investors have expressed concerns regarding the time, actual cost, uncertainty with respect to permit approval, and the potential lack of social acceptance in the Gulf community[2]. To alleviate the uncertainty and move the industry forward, the University of Southern Mississippi partnered with Manna Fish Farms, The University of New Hampshire, Mississippi-Alabama Sea Grant, The University of Mississippi and NOAA Coastal Aquaculture Siting and Sustainability Program to site and permit a commercial-scale offshore finfish facility for the GOM and evaluate the regional aquaculture permitting process. The team was awarded a grant through the Gulf States Marine Fisheries Commission in June 2018 to assist in achieving phase 1 project objectives. Shortly after the project commenced, the United States Eastern District Court of Louisiana ruled in favor of Gulf Fishermen's Association et al. in their legal challenge to the National Marine Fisheries Service's (NMFS/ NOAA Fisheries) authority to regulate aquaculture under the Magnuson-Stevens Act[3]. The ruling occurred September 2018, and final judgement was signed in November 2018[4]. The NMFS filed a notice of appeal in December 2018, and their appellate brief was filed in June 2019. The Center for Food Safety has been given until August 2019 to file their reply brief for the Government's appeal. Although on appeal, currently NOAA has no authority to issue a Gulf Aquaculture Permit. Regardless of NOAA's permit authority, aquaculture can occur in federal waters under permits issued by other federal regulatory agencies, specifically a National Pollutants Discharge Elimination Systems (NPDES) permit from the Environmental Protection Agency (EPA) and a Section 10 permit from the US Army Corps of Engineers (USACE). Therefore, the team has continued the project to permit the finfish farm.

Process:

The first task was to identify the site characteristics necessary for the 48ha farm. The team outlined a regional area of interest that spanned the 50-55m depth range south of Mississippi, Alabama and the Florida Panhandle. The team focused on proximity to the ports of Gulfport, MS, Pascagoula, MS, and Pensacola FL to minimize farm to port distance and user conflicts, while selecting areas with currents greater than $15m^{-sec}$, and areas with the potential for sand bottom. Species under consideration for growout on the farm also were provided so that temperature could be considered for potential locations. The NOAA Coastal Aquaculture Siting and Sustainability Program used the site characteristics supplied by the team to scientifically screen for suitable locations. The siting model considers multiple layers of data such as oceanographic and biological growing conditions on the farm, but also considers potential conflicts with navigation, military or industrial uses, protected species, and the presence of critical and sensitive habitats. The output is a relative suitably rating displayed by mapping units for the area of interest. Using the relative suitability rating for the entire area of interest, five potential sites that minimized farm to port distance were selected. Considering multiple characteristics for the five sites, a preferred site was selected.

Next, the team completed a pre-application checklist that supplied siting details on all five potential locations, the preferred cage design, a draft layout of the farm, and production and feed information. Although this step was not necessarily required because it was part of the Gulf Aquaculture Permit process, the team determined that this checklist provided the necessary information to engage in an interagency pre-application meeting. A pre-application meeting provided an opportunity for federal agencies to ask questions, raise potential concerns, and provide information on what they may need moving forward with the project. After receiving feedback from federal agencies on the preferred site selection and other information supplied, the team began conversations with Florida state agencies that would also have review of the project through the Coastal Zone Management Act.

The team conducted the seafloor survey for the preferred site including a 0.5km buffer around the preferred location in April and May 2019. A multibeam echosounder and side scan imaging sonar was used to map the seafloor and detect any potential sensitive habitat such as hard-bottom or coral. Additionally, a magnetometer and sub-bottom profiler collected information such as debris, pipelines or potential archaeological resources below the sea floor surface. This information will be used to select the final location for the 48ha farm and guide final design and mooring decisions. A baseline environmental report that supplies the processed maps and information on potential physical, biological, and archaeological resources also will be produced for the permitting and consultation agencies.

Prior to submitting a NPDES permit to the EPA and a Section 10 permit to the USACE, the team will finalize the farm site and conduct structural modeling for the cages. The structural modeling will occur following conversations with permitting and consultation agencies on selected materials. Information regarding feed and effluent characteristics will be supplied to the EPA for inclusion in effluent models.

Feedback for this project has been obtained through discussions with multiple stakeholders. The team has engaged the NOAA Southeast Region Aquaculture coordinator, the EPA Region 4 office, and the USACE from the beginning of the project. The guidance and feedback from these agencies has been instrumental in moving this project through the process in a timely manner. Additional guidance from the Florida Department of Agriculture and Consumer Services Division of Aquaculture has been instrumental in aiding project development. Recreational anglers, commercial fishermen, and members of non-governmental organizations also have supplied important feedback for this project. The team looks forward to completing the remaining objectives and submitting permit applications later this summer.

Literature Cited

1. Aquaculture homepage: Southeast Regional Office, Web. 1 Jan . 2018. <http://sero.nmfs.noaa.gov/sustainable_fisheries/gulf_fisheries/aquaculture/>
2. Gulf Seafood Institute (GSI). 2016. Summary Report on the Gulf Aquaculture Roundtable, 14-15 November 2016, New Orleans, Louisiana. Submitted to the Gulf States Marine Fisheries Commission. Grant Number ACQ-210-039-2016-GSI. 10pp.
3. Gulf Fishermen's Association et al. versus NMFS et al. No. 2:2016cv01271 - Document 94 (***E.D. La***. 2018)
4. Gulf Fishermen's Association et al. versus NMFS et al. No. 2:2016cv01271 - Document 98 (***E.D. La***. 2018)

Manna Fish Farms, Gulf of Mexico Finfish Farm Operations

Presenter: Kelly Lucas

Agent, University of Southern Mississippi,

Thad Cochran Marine Aquaculture Center

Overview

- Team introductions
- Applicant introduction, Manna Fish Farms
- Timeline
- Site requirements and species information
- Site screening
- Draft site plan and cage information
- Production plan and feed usage
- Next Steps

Introductions

- Donna Lanzetta, CEO and founder of Manna Fish Farms
- Mike Meeker, COO Manna Fish Farms, and inventor Storm Safe Submersible Cage
- Reg Blaylock & Anand Devappa Hiroji, University of Southern Mississippi
- Stephanie Showalter Otts & Kristina Alexander, University of Mississippi, MS-AL Sea Grant & Sea Grant Law Center
- Michael Chambers, University of New Hampshire & NH Sea Grant
- Ken Riley, James Morris Jr., Lisa C. Wickliffe, & Jon Jossart - NOAA, National Centers for Coastal Ocean Science
- Dan Warren, P&C Scientific, LLC

Manna Fish Farms

- Committed to:
  - Sustainability
  - Transparency
  - Best Aquaculture Practices
- Permitting Finfish Farms
  - Gulf of Mexico, off Pensacola FL
  - Northeast, off Eastern Long Island NY
- Learn more:
  - www.mannafishfarms.com
  - Social Media:
  - https://twitter.com/mannafishfarms
  - https://www.facebook.com/mannafishfarms/

MANNA FISH FARMS, INC.™

MANNA OCEAN FOUNDATION™

Timeline of Past Events

GSMFC Grant, *"Permitting a finfish aquaculture operation in the Gulf of Mexico"*
June, 2018

USM & Manna Fish Farms, MOA
Aug., 2018

Farm area of interest and growing criteria identified
Summer, 2018

Site Screening Analysis
Fall, 2018

Final Judgement Gulf Fishermen's Association et al., V. NMFS et al.
Nov., 2018

Pre-Application Checklist
Nov., 2018

Interagency Briefing
Dec., 2018

Department of Defense Military Aviation and Installation Assurance Siting Clearinghouse
Feb., 2019

Baseline Environmental Survey
Spring, 2019

Timeline (Milestones Pending)

- Finalize 120 Acres of the 724 acres surveyed (Summer, 2019)
- Effluent Modeling (Summer, 2019)
- Structural Modeling (Summer, 2019)
- Additional Current Measurements (Aug., Sept., Oct. 2019)
- EPA, National Pollutants Discharge Elimination System Permit Application (Summer, 2019)
- USACE, Section 10 Permit Application (Summer, 2019)
- USCG, CG-2554 Authorization, Private Aids to Navigation Application (Summer, 2019)

Manna Fish Farms Offshore Demonstration Project

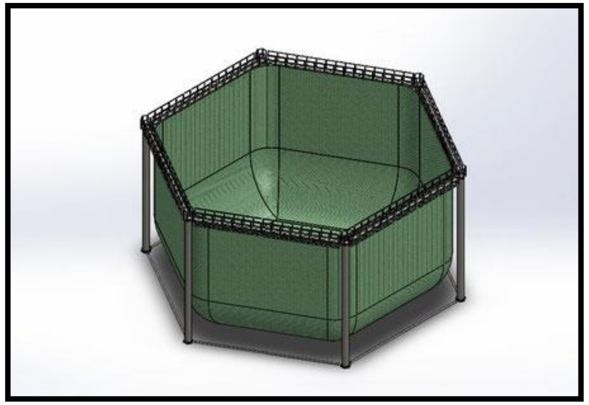
MANNA FISH FARMS, INC.

STORM SAFE Submersible Cage System

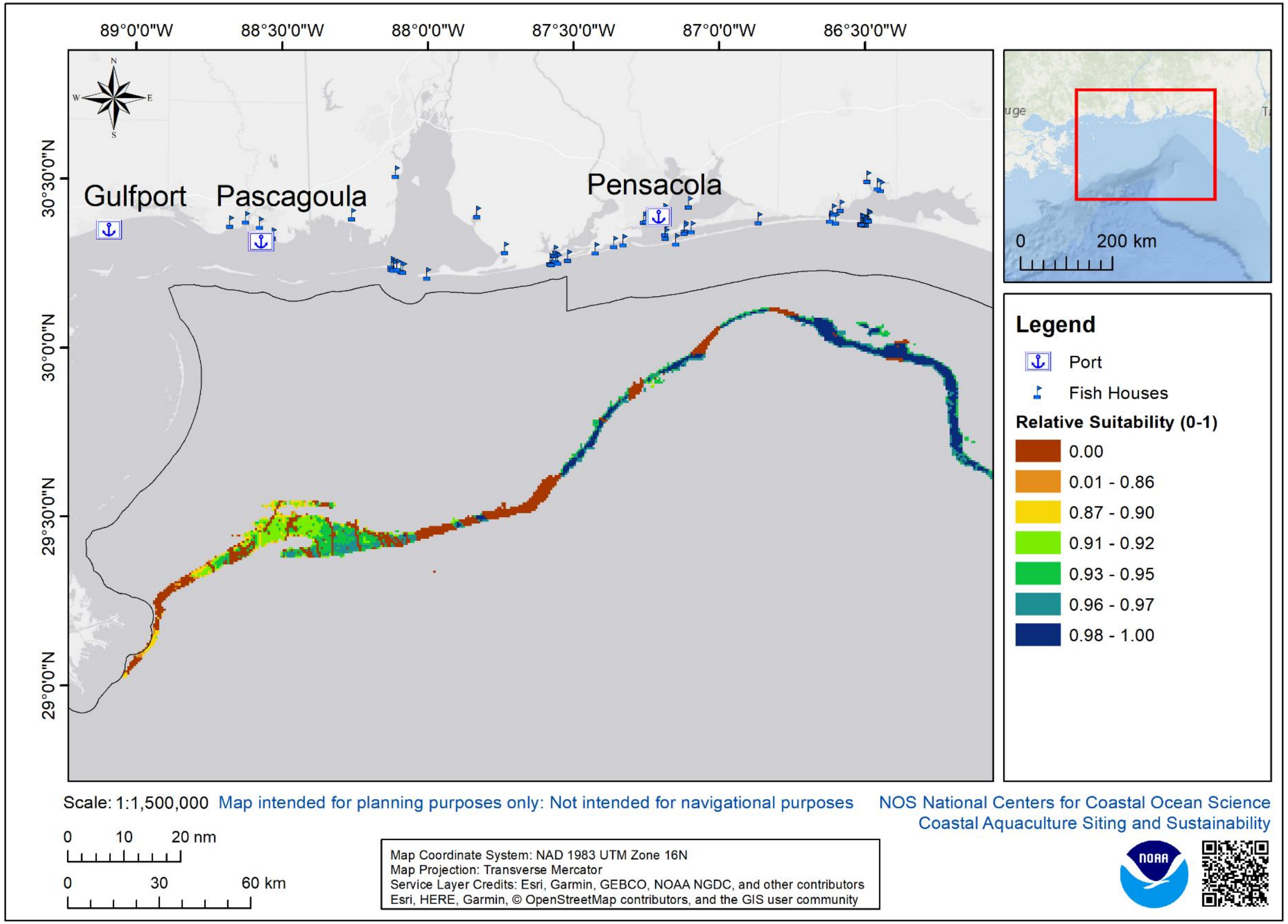
- Commercial-scale aquaculture demonstration project
- **Area of interest**: Mississippi, Alabama, Florida panhandle
- **Depth requirements**: 50 – 55 meters
- **Preferred Ports**: Pascagoula/Gulfport, MS or Pensacola, FL (Minimize farm to port distance and user conflicts)
- **Sea water temperature**: 6 – 30 °C
- **Current Speed**: > 0.15 m/s
- **Species**: *Red drum (Sciaenops ocellatus)

  Almaco jack (Seriola rivoliana)

  Striped bass *(Morone saxatilis) and others.*



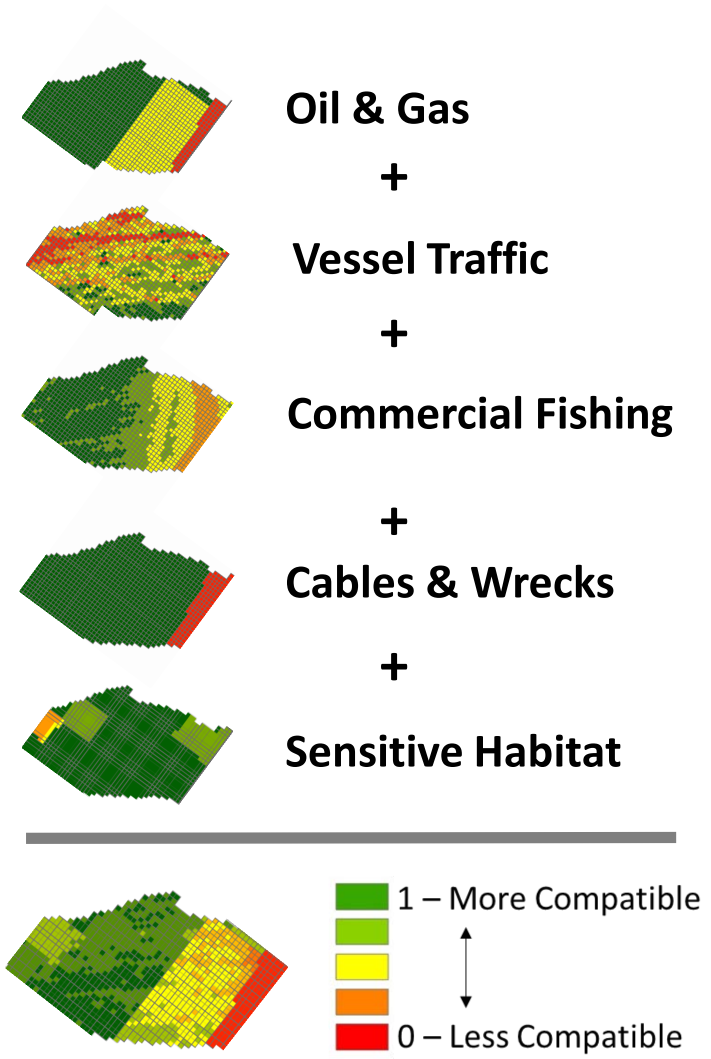
Relative Suitability within Area of Interest



Data Considered

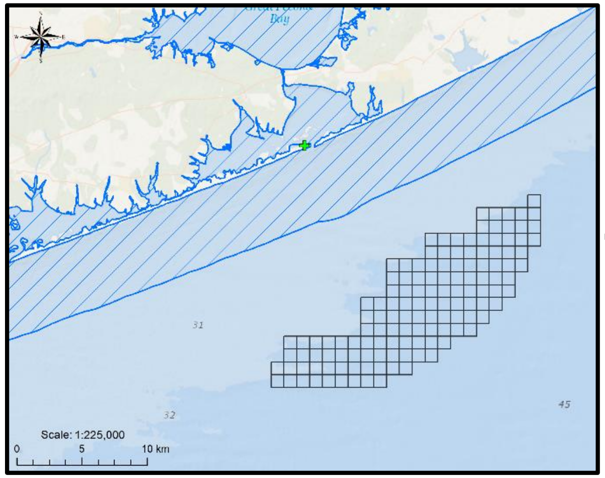
- Bathymetry
- Military
- Unexploded Ordnance
- Shipping Lanes
- AIS Vessel Traffic
- Shrimp Vessel Activity
- Submarine Cables
- Artificial Reefs
- Lightering Zones
- Oil & Gas Platforms
- Oil & Gas Well
- Oil & Gas Active Leases
- Oil & Gas Pipelines
- Shipwrecks and obstructions
- Deep Sea Coral

Siting Model

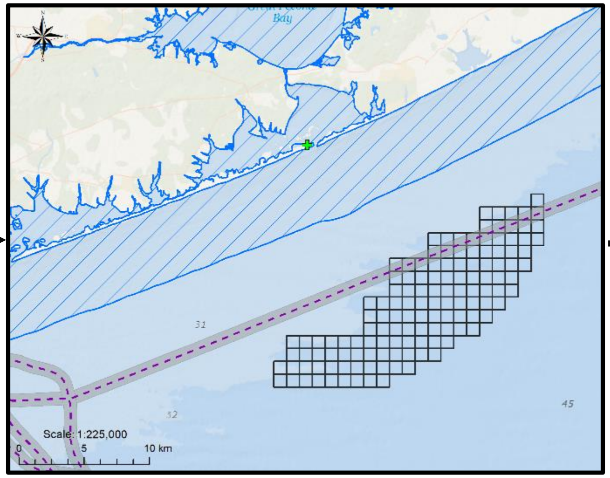


Suitability Model Methodology

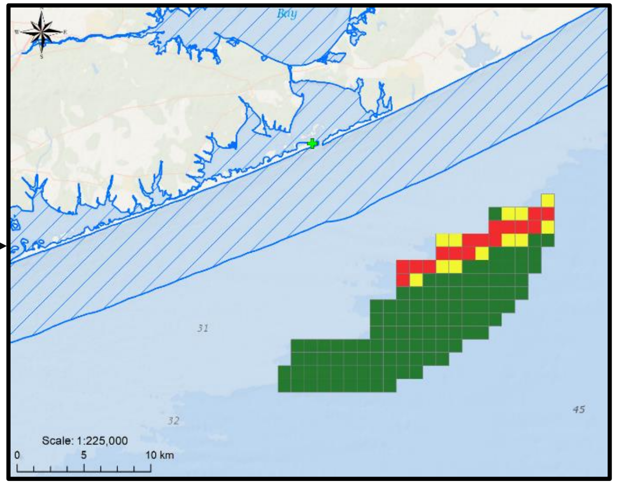
Gridded area of interest

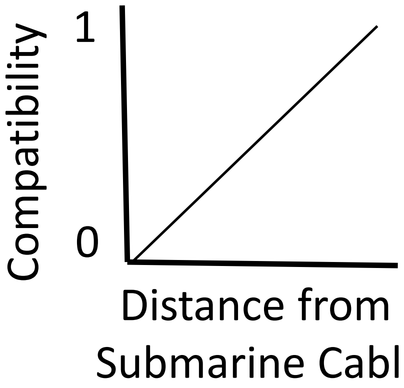


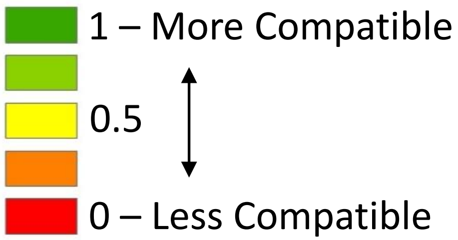
Submarine cable intersects area of interest



Grid cells far from submarine cable are assigned higher weights than those nearby

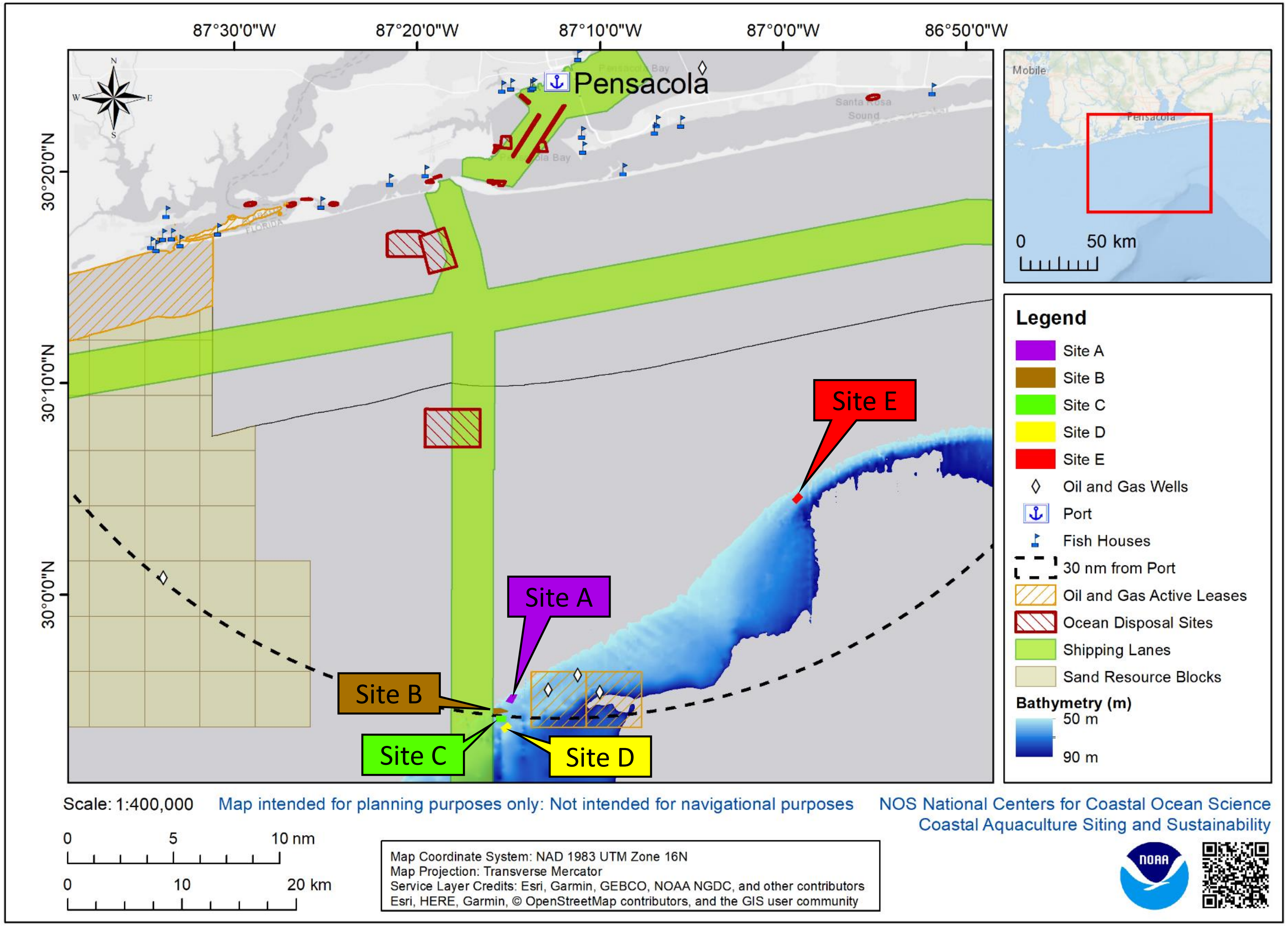




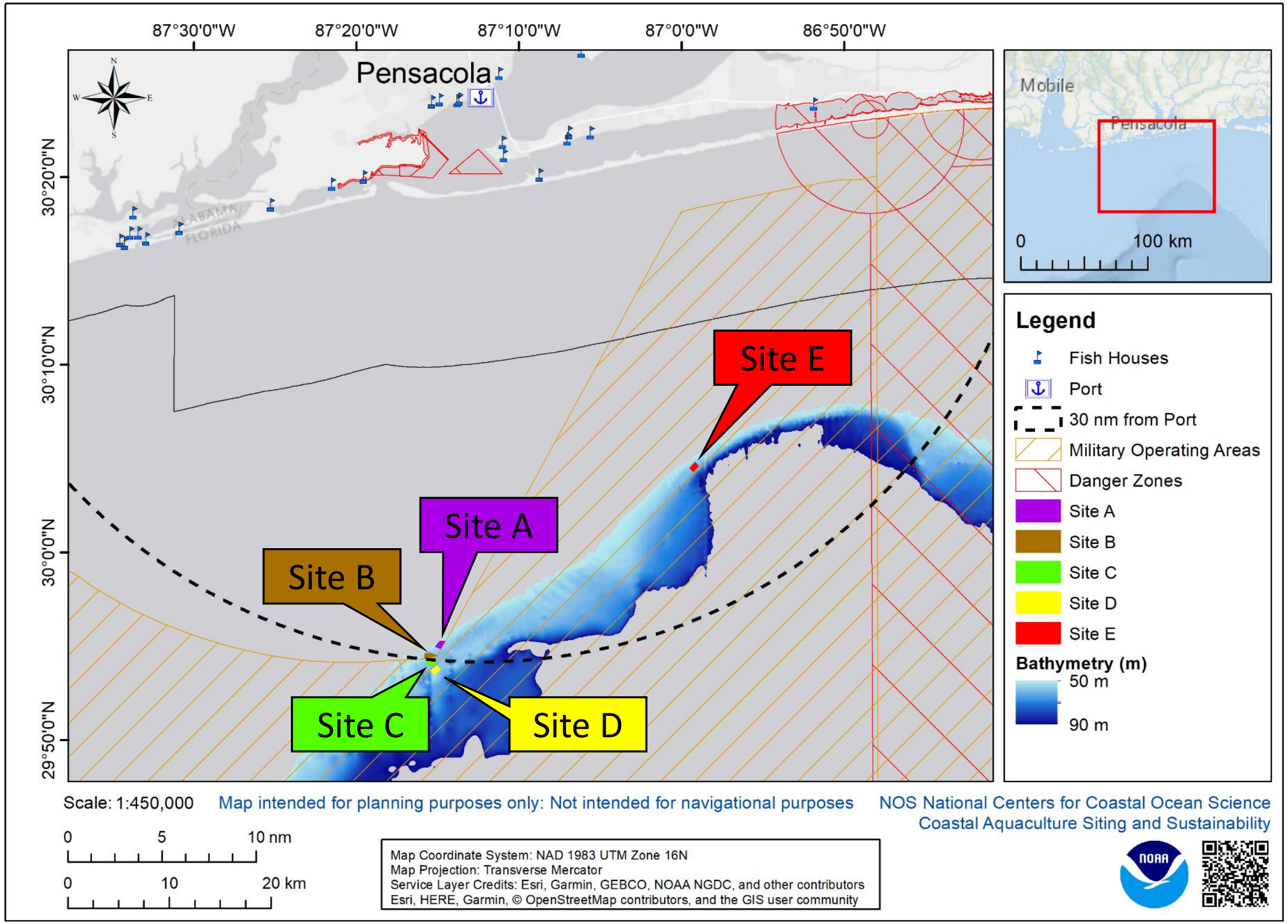


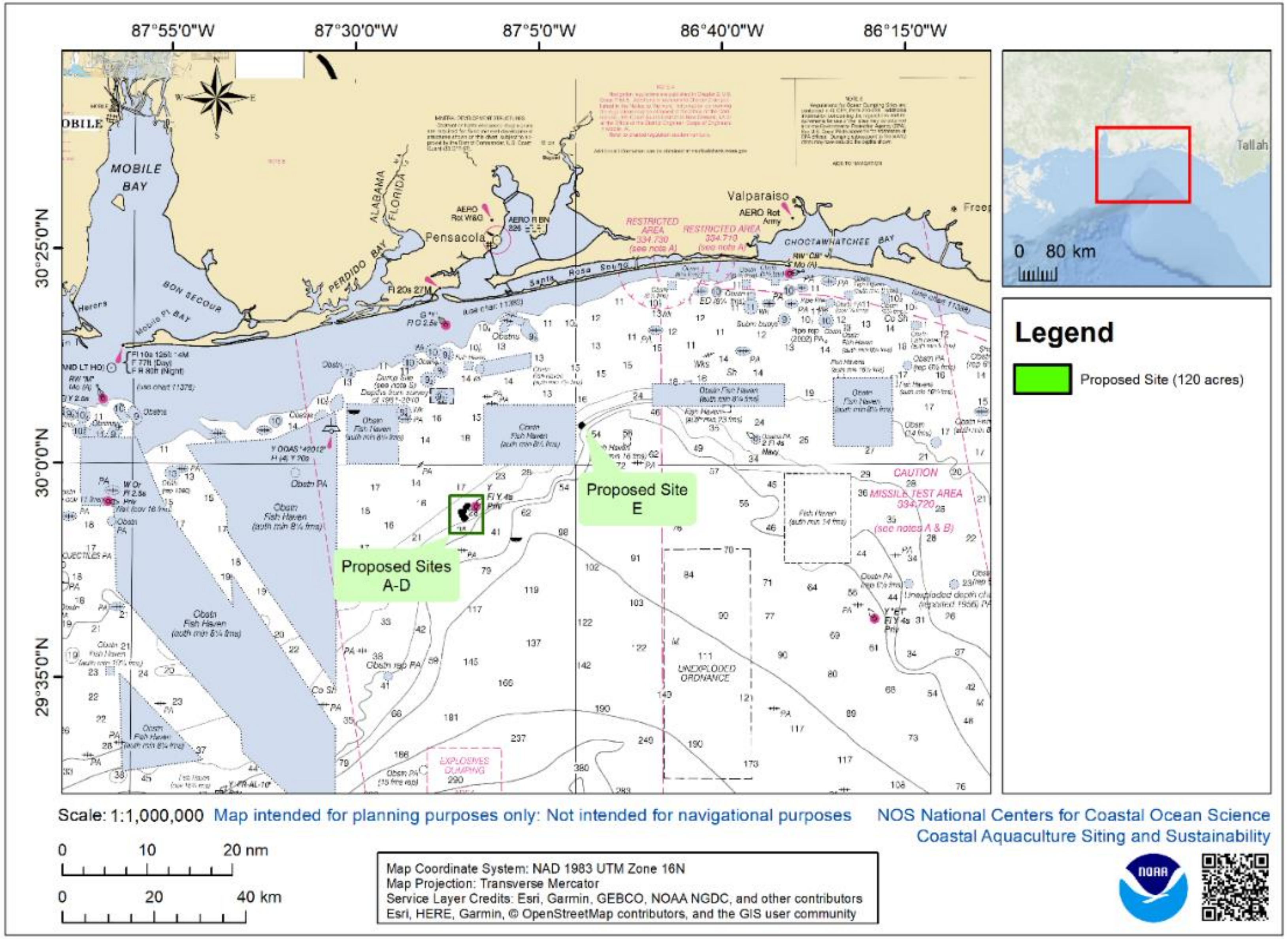
For demonstration purposes only

Navigation and Other Factors



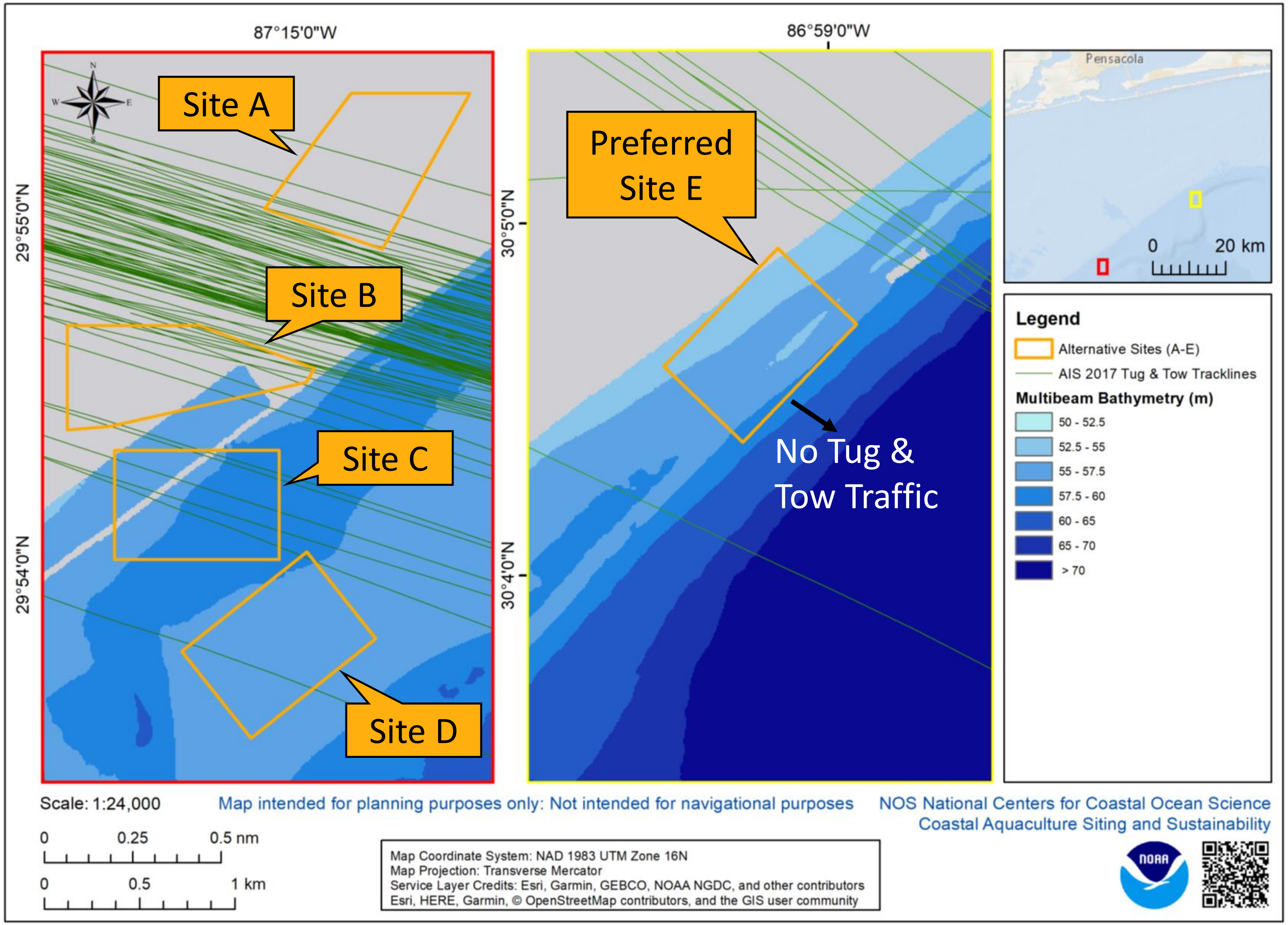
Sites (50-m depth)



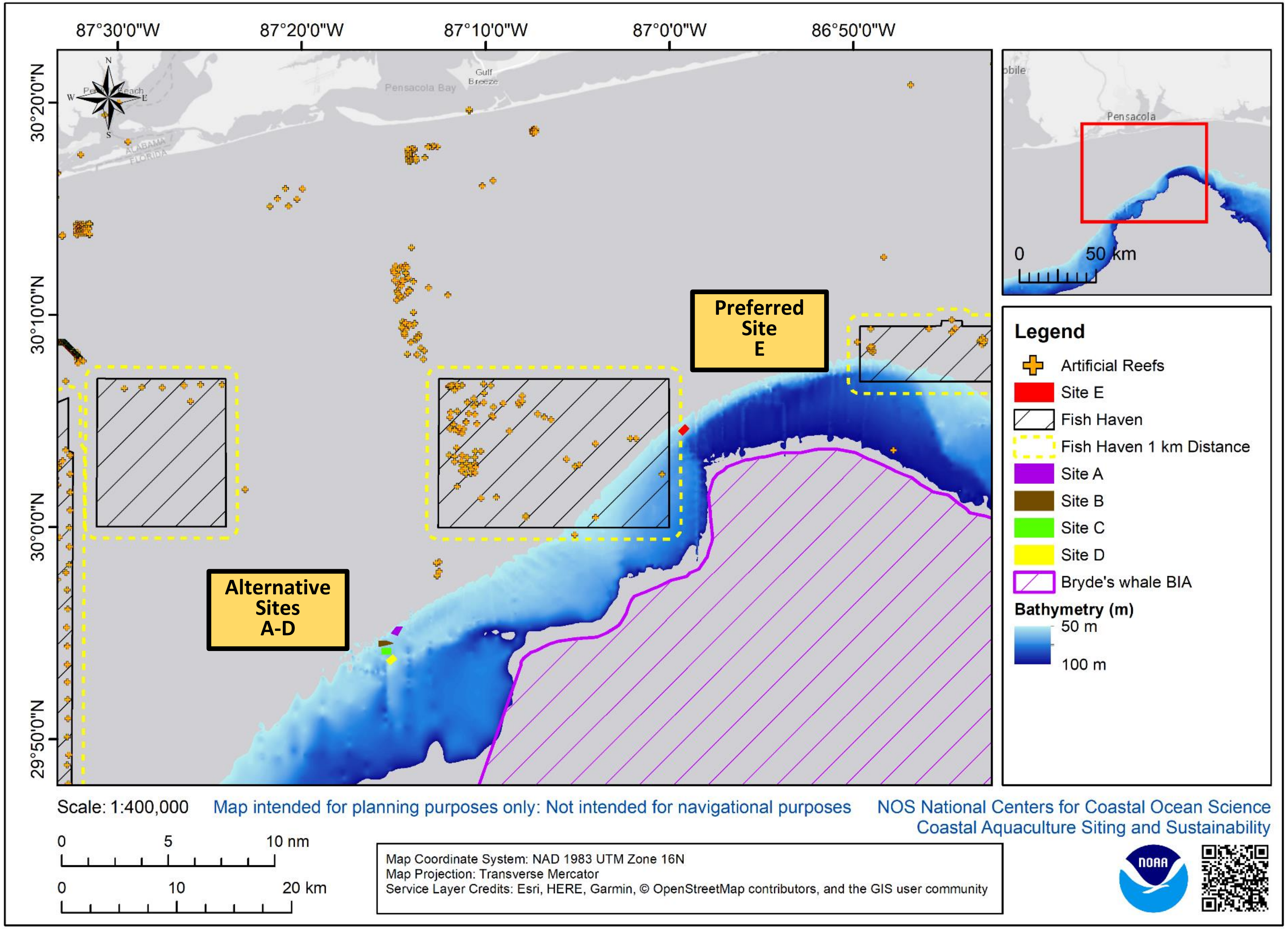

87°55'0"W
87°30'0"W
87°5'0"W
86°40'0"W
86°15'0"W
30°25'0"N
30°0'0"N
29°35'0"N
MOBILE BAY
BON SECOUR BAY
PERDIDO BAY
ALABAMA
FLORIDA
Pensacola
Valparaiso
CHOCTAWHATCHEE BAY
Santa Rosa Sound
RESTRICTED AREA 334.730 (see note A)
RESTRICTED AREA 334.710 (see note A)
CAUTION
MISSILE TEST AREA 334.720
(see notes A & B)
UNEXPLODED ORDNANCE
EXPLOSIVES DUMPING
Proposed Sites A-D
Proposed Site E
0 80 km
Tallah
Legend
Proposed Site (120 acres)
Scale: 1:1,000,000
Map intended for planning purposes only: Not intended for navigational purposes
NOS National Centers for Coastal Ocean Science
Coastal Aquaculture Siting and Sustainability
0 10 20 nm
0 20 40 km
Map Coordinate System: NAD 1983 UTM Zone 16N
Map Projection: Transverse Mercator
Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors
Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community

NCCOS National Centers for Coastal Ocean Science

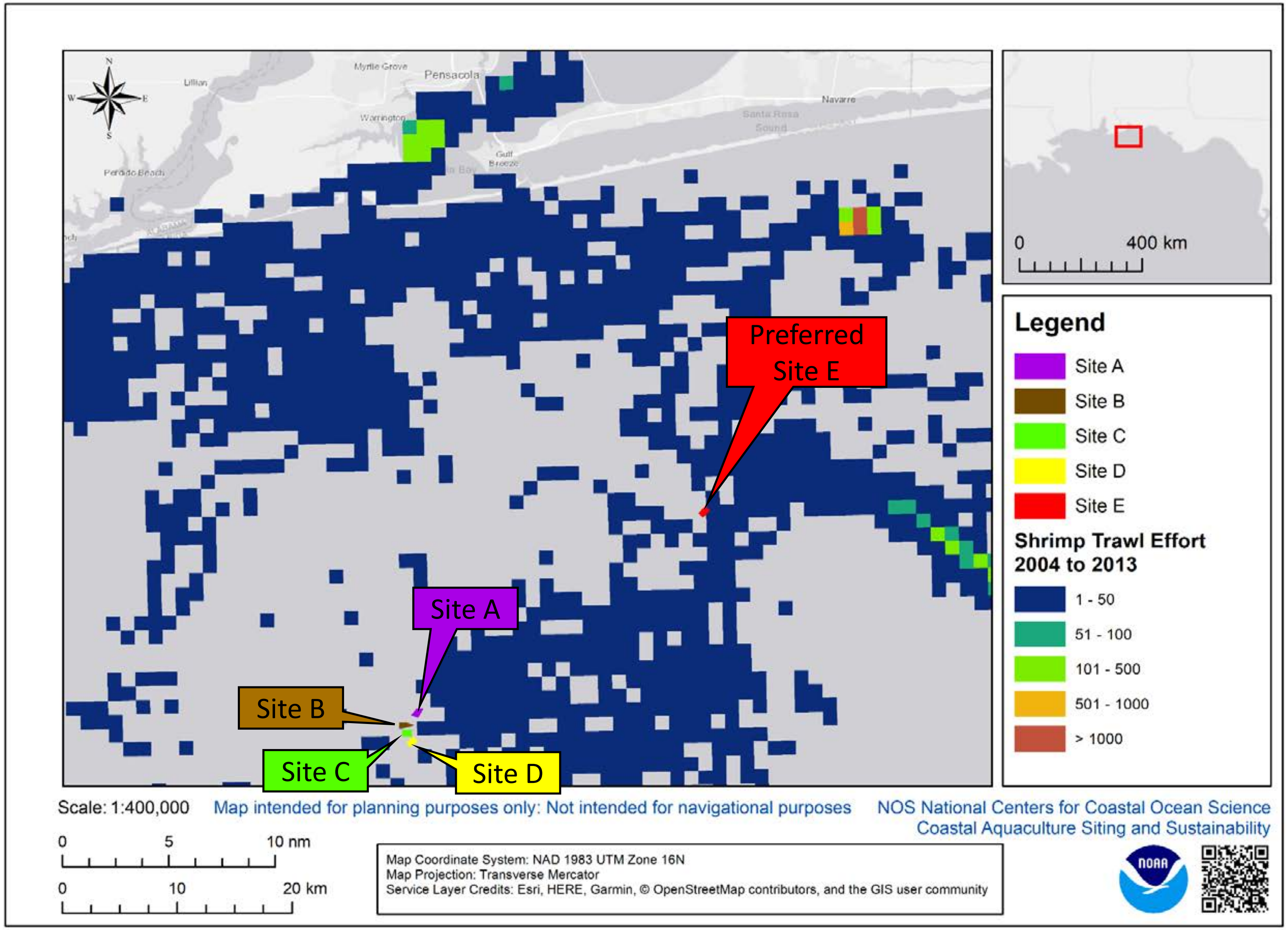
Vessel Traffic Assessment



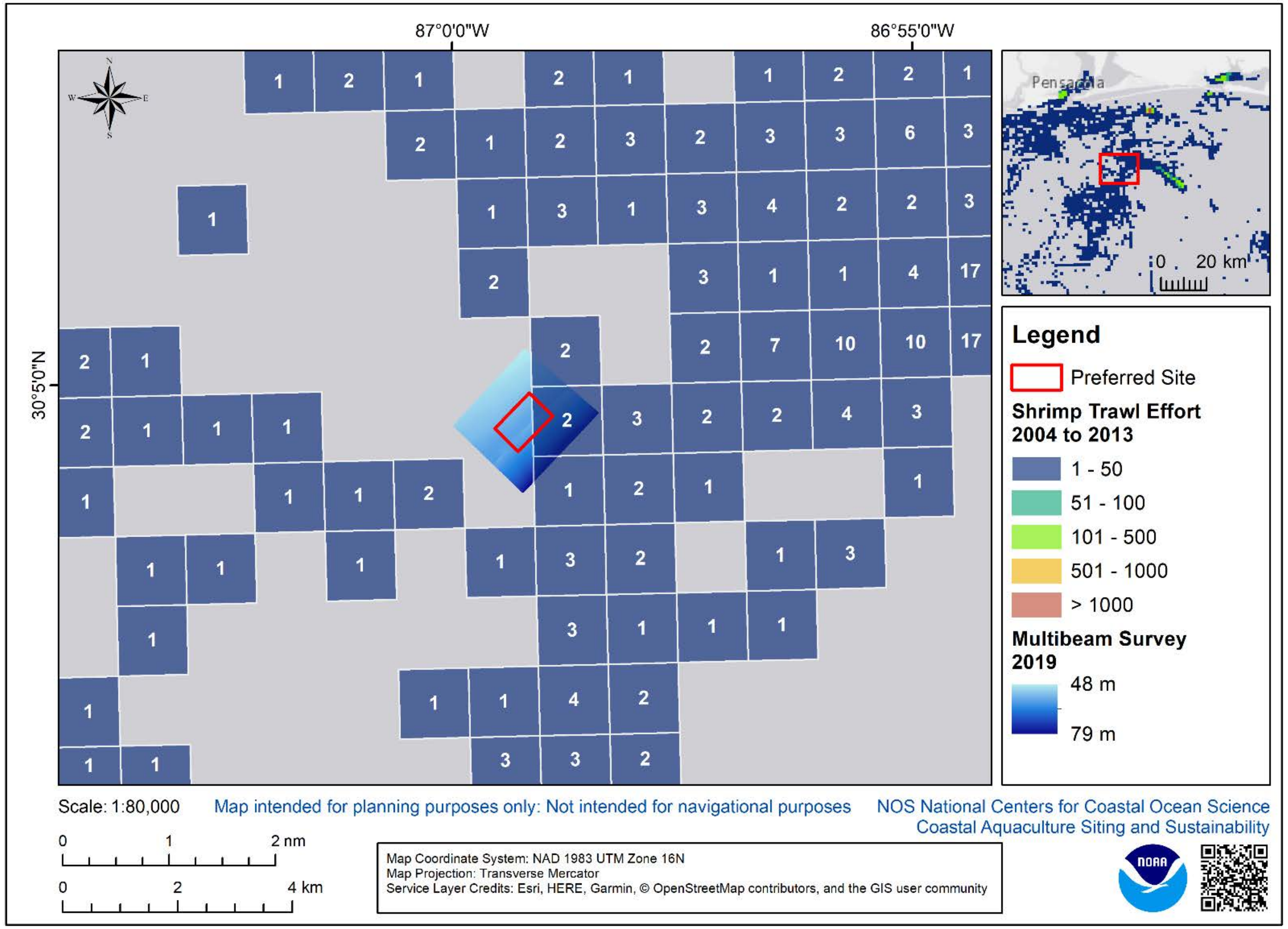
Preferred Site and Alternatives



Shrimp Trawl Effort 2004 to 2013

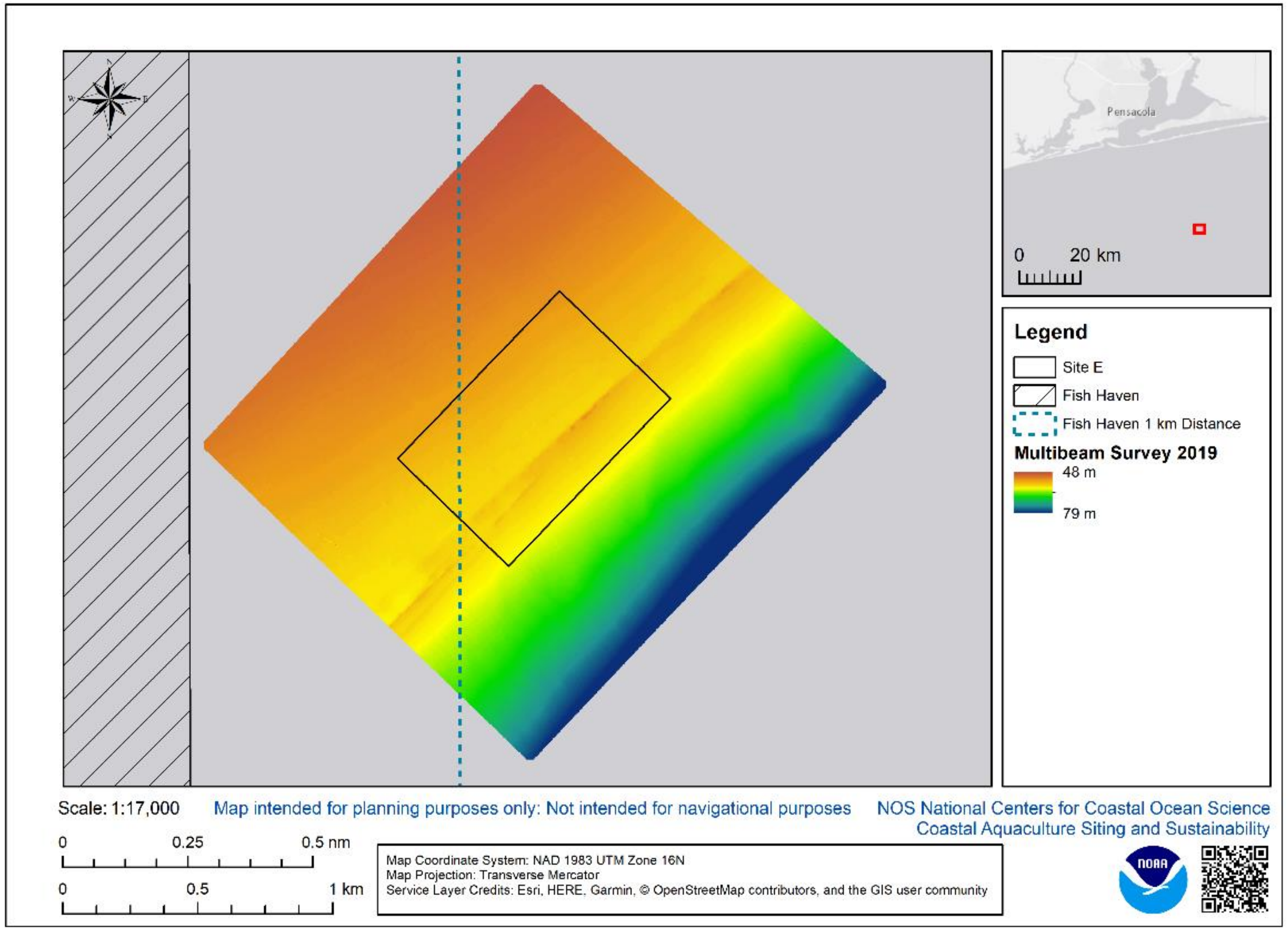


Shrimp trawl effort (sum 2004-2013) and preferred site



*More information on the shrimp data, which encompasses all species of shrimp important to Gulf of Mexico fisheries, can be found at: http://gulfcouncil.org/wp-content/uploads/A-7a-White-Paper-on-Artificial-Reefs.pdf (GMFMC 2015).

Preliminary Results
Baseline Environmental Survey

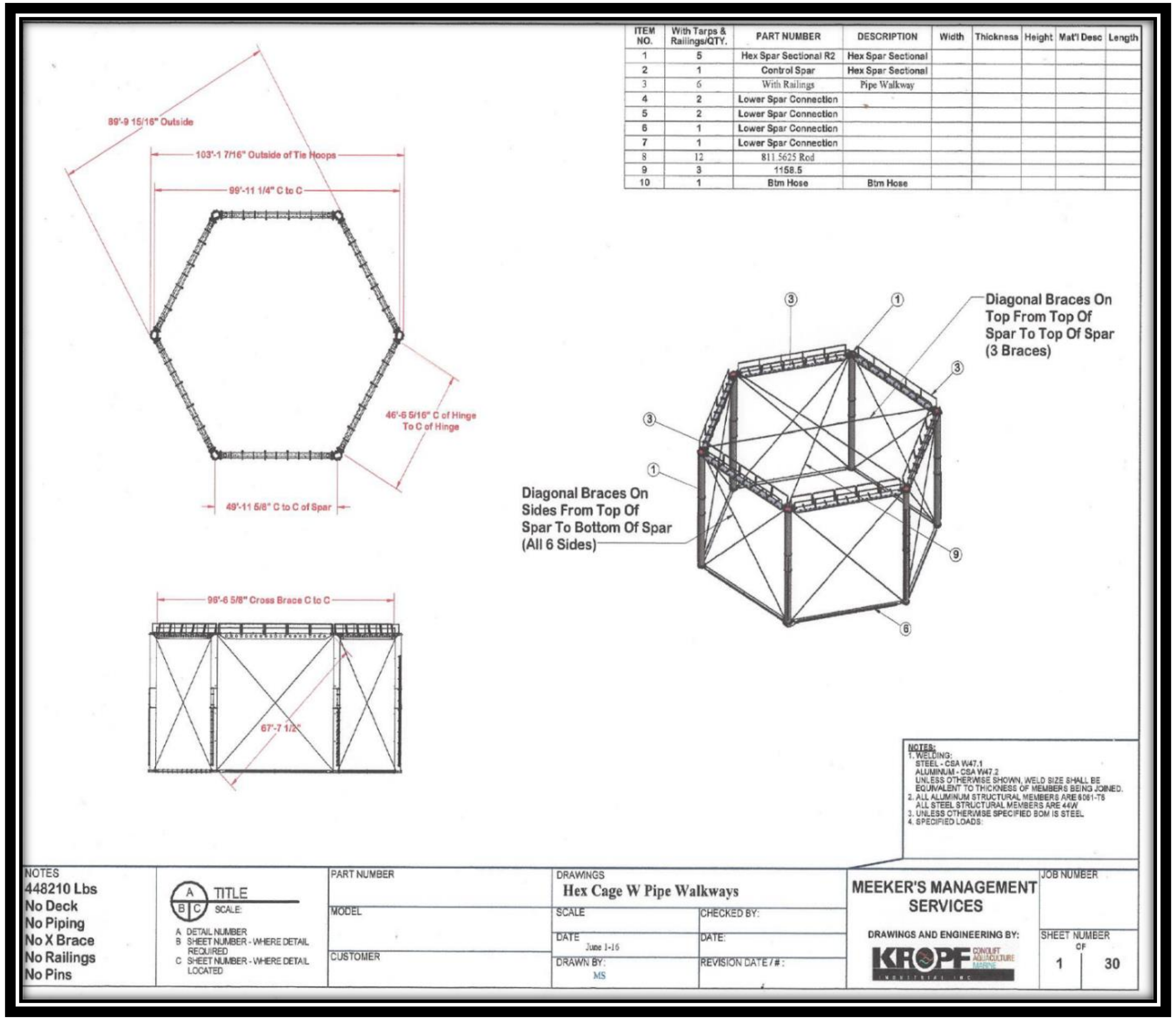


Results of multibeam survey completed April 2019

- Surveyed 0.5 km beyond area of interest
- 2-m resolution
- Depths confirmed 48-70m
- Minimal slope across site
- Small ridge detected
- Sand substrate

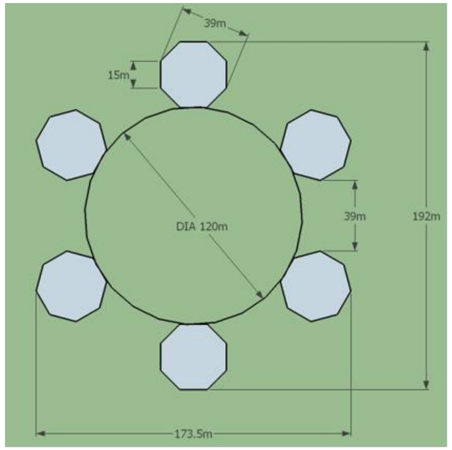
Side-scan and sub-bottom survey May 2019

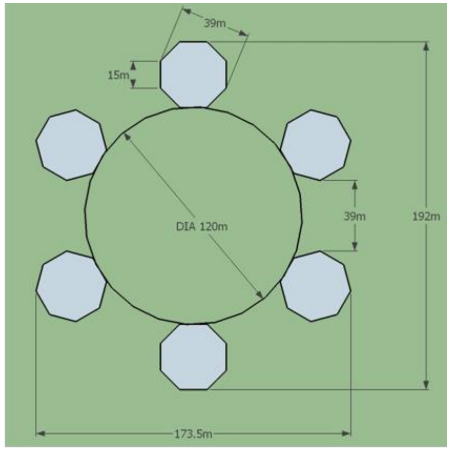
Storm Safe Submersible

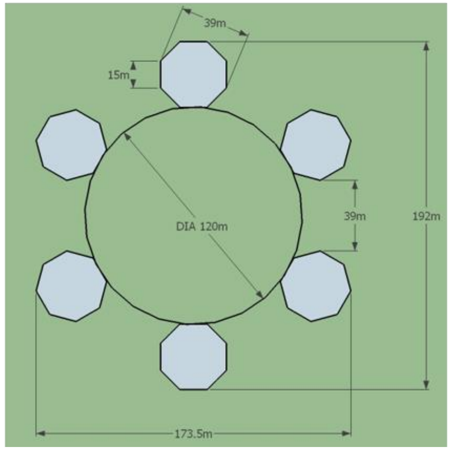


ITEM NO.	With Tarps & Railings/QTY.	PART NUMBER	DESCRIPTION	Width	Thickness	Height	Mat'l Desc	Length
1	5	Hex Spar Sectional R2	Hex Spar Sectional					
2	1	Control Spar	Hex Spar Sectional					
3	6	With Railings	Pipe Walkway					
4	2	Lower Spar Connection						
5	2	Lower Spar Connection						
6	1	Lower Spar Connection						
7	1	Lower Spar Connection						
8	12	811.5625 Rod						
9	3	1158.5						
10	1	Btm Hose	Btm Hose					

Storm Safe Cage Site Plan







- 18 Cages
- 9000m^3/cage
- 6 cages per circular array
- Each array (14 Acres)
- Final design and mooring decisions will be guided by information from the Baseline Environmental Survey.

Production Timeline

Year(s)	No. of Cages Stocked	Cages/fish production stage	Production (lbs/year)
Year 0 - 1	2	2	936,000
Years 2 - 3	4	2	1,870,000
		2	
Years 3 -4	12	4	5,620,000
		4	
		4	
Years 4-5	18	6	8,426,900
		6	
		6	

Feed Information

Type	Slow sinking pellet with estimated 44% protein and 13% lipid
Mechanism	Feeding by vessel in the beginning moving to feed buoy or barge
Feed Frequency	Will vary by species and biomass. Feed calculations were calculated at a feed conversion rate (FCR) 1.7.
Stock ($9000m^3$ cage)	Weight of fingerlings at stocking = 50g Total weight at initial stocking cage = 10,045kg Target harvest density = $25kg/m^3$
Amount ($9000m^3$ cage)	Daily feeding amount at initial biomass = 503 kg Daily feeding amount at max biomass = 4,500 kg

Next Steps

- Submit Baseline environmental survey data
  - Finalize farm site
  - Structural modeling
    - Discuss mooring, materials and structure with NOAA Protected Resources
- Provide Feed and effluent characteristics to the EPA for discharge models
- Submit for EPA, NPDES Permit
  - Best Management Practices Plan
  - Environmental Monitoring Plan (Includes baseline sampling)
  - Emergency Response Plan
  - Quality Assurance Plan
- Submit for USACE, Section 10 Permit and CG 2554 Authorization
- Operations Plan
- Health Management Plan

Contact information

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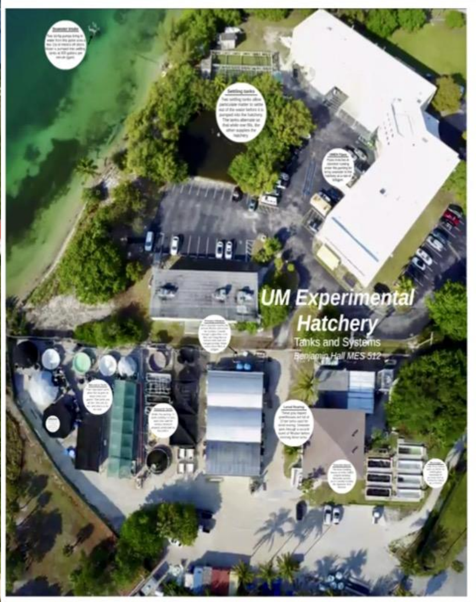
Sustainable Offshore Aquaculture: Environmental Considerations

Daniel Benetti, PhD, and Aaron Welch, J.D., PhD.
University of Miami - RSMAS
Marine Aquaculture Program

UNIVERSITY OF MIAMI EXPERIMENTAL HATCHERY
An Incubator of Technology



AQUACULTURE

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Sea Grant

NOAA

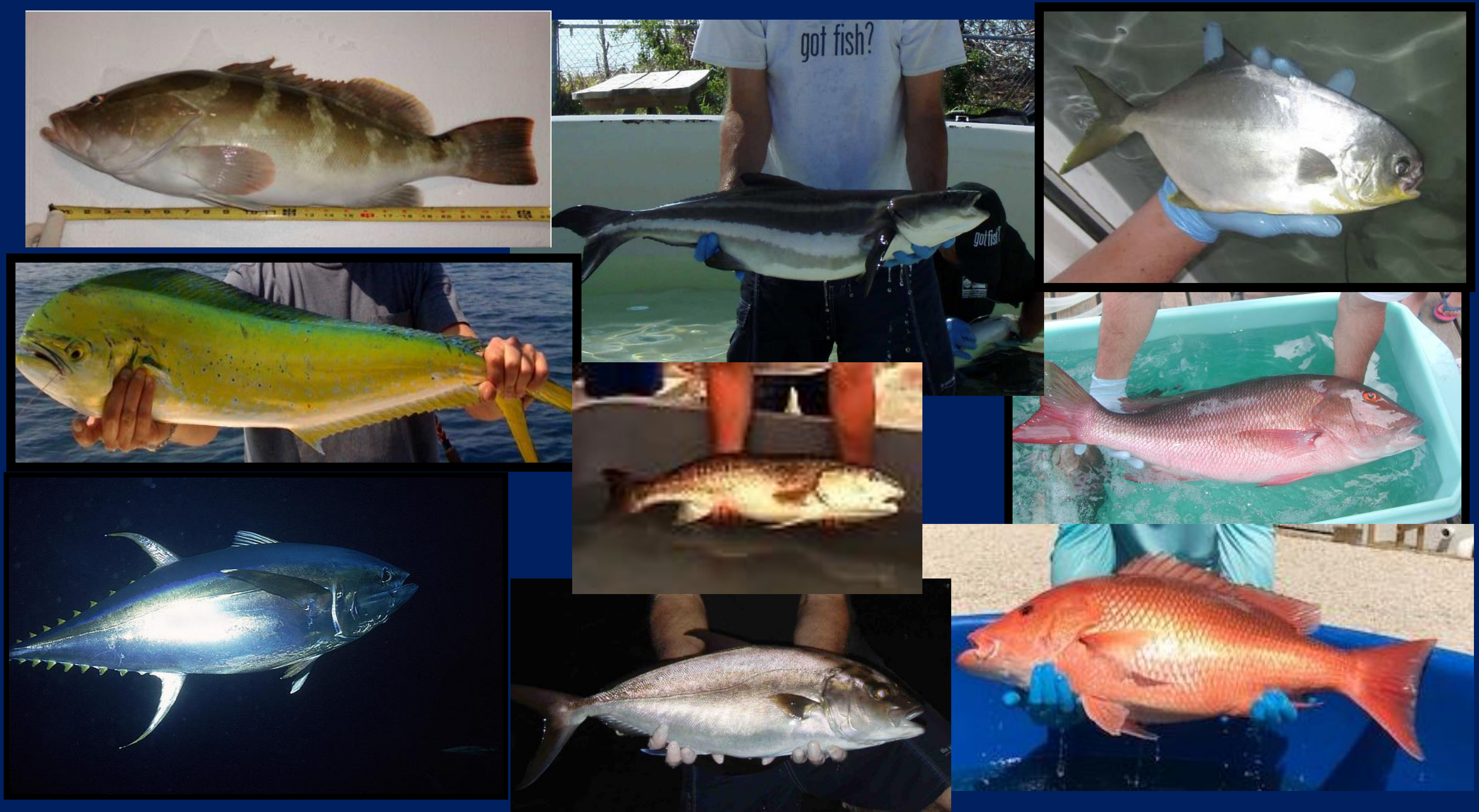
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

DEPARTMENT OF COMMERCE
UNITED STATES OF AMERICA

LARVAL REARING TECHNOLOGIES PRODUCING HIGH QUALITY OFFSPRING OF A NUMBER OF HIGH-VALUE MARINE FISH SPECIES

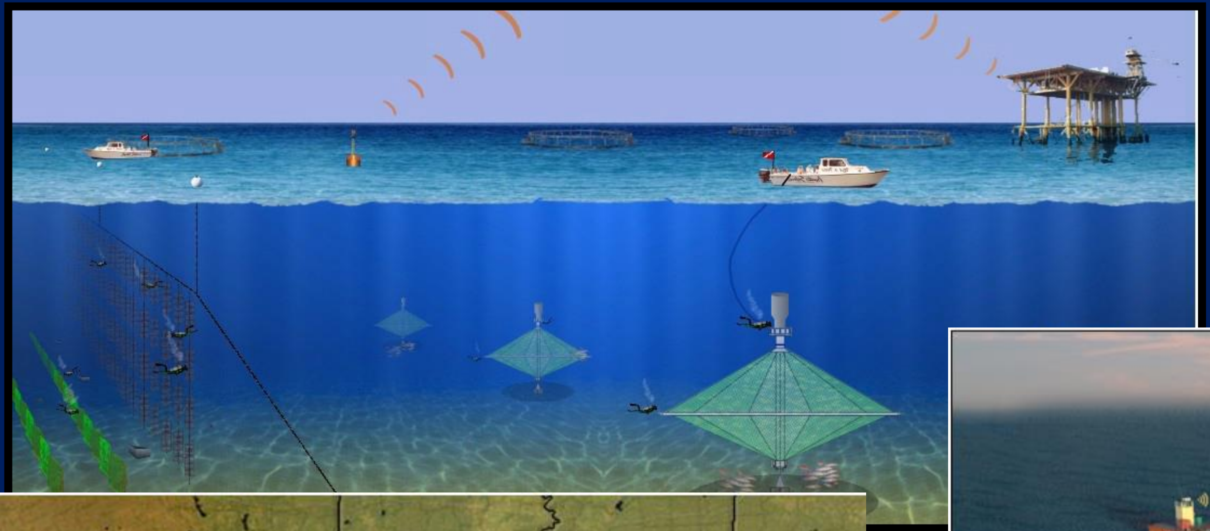
PROACTIVE HEALTH MANAGEMENT STRATEGY USING PROPHYLAXIS, ADEQUATE NUTRITION, PROBIOTICS, PROTEASES, ADDITIVES, ORGANIC ACIDS, ESSENTIAL OILS, BACTERIOPHAGES, ETC

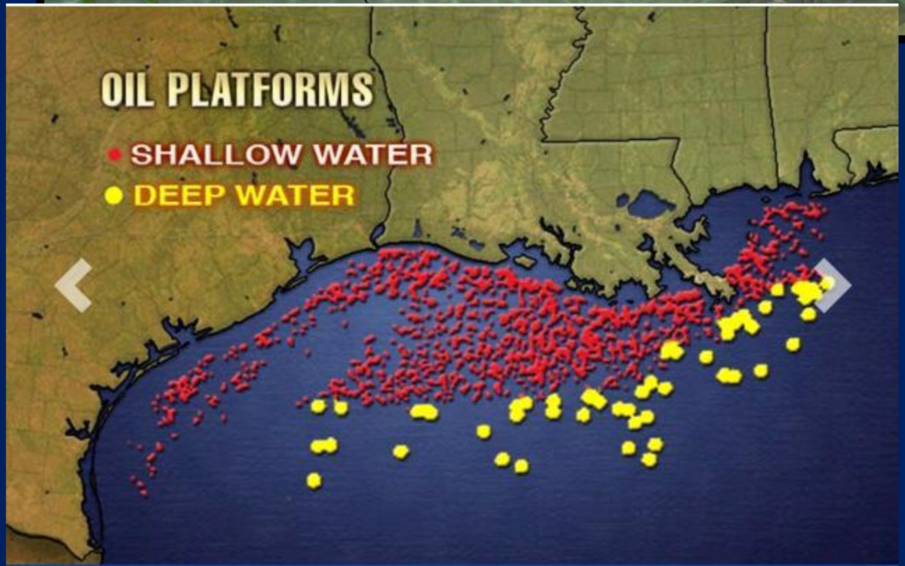
CANDIDATE SPECIES FOR OFFSHORE AQUACULTURE DEVELOPMENT
IN THE GULF OF MEXICO
AT DIFFERENT LEVELS OF FEASIBILITY

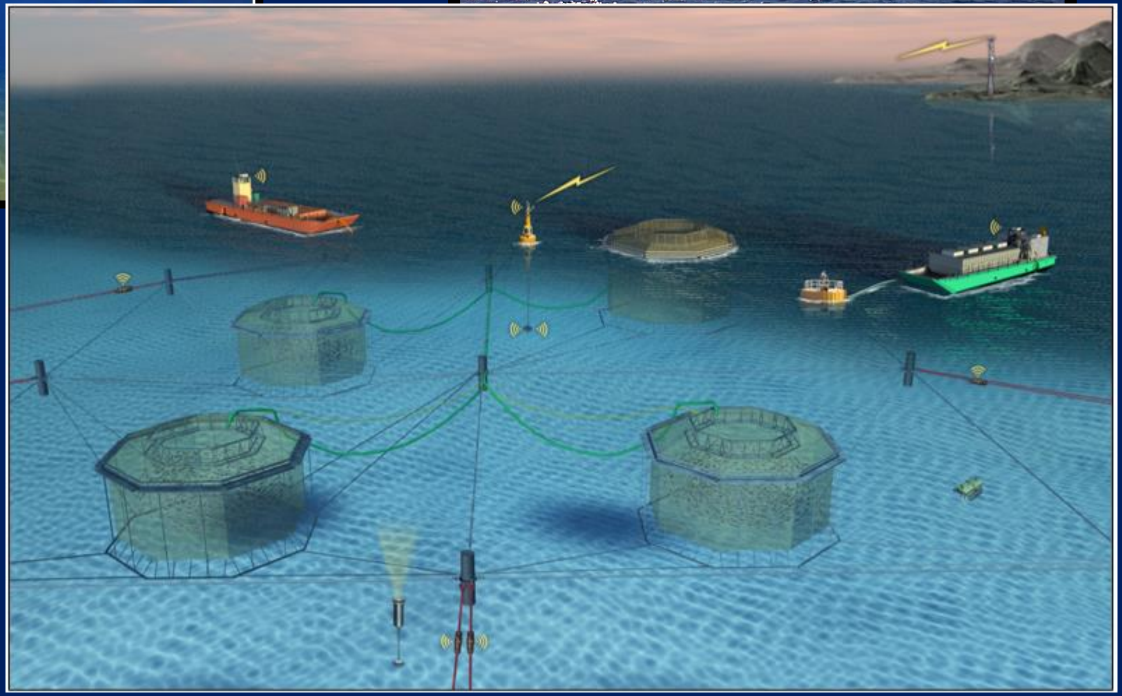


CURRENT STATUS

- Technology still limits move towards fully automated, farms offshore
- Challenges/limitations: Permits, distance/depth, circulation/currents
- Oil/gas platforms hold promise but legislation/cost/liability still prohibitive







The environmental argument against offshore aquaculture:

- Industrial aquaculture in open waters, such as the ones proposed, are associated with many serious environmental and health concerns, including: the ***escape of farmed fish*** into the wild; ***outcompeting wild fish for habitat***; food and mates or intermixing with wild fish and altering their genetics and behaviors; ***the spread of diseases and parasites from farmed fish to wild fish*** and other marine life; and ***pollution from excess feed, wastes and any antibiotics or other chemicals*** used flowing through the open pens into natural waters.

The Center for Food Safety: September 25, 2018.

UNIVERSITY OF MIAMI
ROSENSTIEL
SCHOOL of MARINE &
ATMOSPHERIC SCIENCE

The environmental argument against offshore aquaculture:

- Contrary to claims that farmed fish production will alleviate pressure on wild fish stocks, industrial aquaculture has actually exacerbated the population declines of wild fish. This will be especially true in offshore aquaculture facilities that farm carnivorous fish, which require a diet often derived from wild-caught fish such as menhaden, mackerel, herring, and anchovies. ***The industry's ever-growing demand for fish in feed jeopardizes the survival of wild fish and disrupts the balance of the marine ecosystem.***

The Center for Food Safety: September 25, 2018.

UNIVERSITY OF MIAMI
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ATMOSPHERIC SCIENCE

Five Issues.

1. Marine Resource Use? (fishmeal)
2. Pollution? (effluent, N, P)
3. Domestication of wild fish? Non-natives? GMOs? Escapism?
4. Disease. Spread to Wild Fish? Chemicals and Antibiotics?
5. Habitat Destruction?

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ATMOSPHERIC SCIENCE

The Problem with Nutrients.

- Nutrient pollution a considerable concern surrounding aquaculture development in the U.S.
- Has been a large problem at aquaculture installations around the world (e.g. Islam 2005).
- Politics: Numerous groups have objected to the development of aquaculture citing effluent concerns.
- Legal implications: CWA NPDES Permits, CAFO regulations, Ocean Discharge Criteria, etc...

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ATMOSPHERIC SCIENCE

Our Work

- Environmental monitoring at the world's first commercially scaled offshore aquaculture facility.
- 16 to 21 cages. 6,400 m^3 per cage.
- Located in the Costa Arriba Region of Panama, on the Caribbean/Atlantic coast.
- 8 miles offshore. ~ 60 m depth. Strong alongshore currents (~ 0.3 to 0.5 $m\ s^{-1}$). Relatively oligotrophic.
- Culturing Cobia (*Rachycentron canadum*)

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Monitored Parameters

PELAGIC ENVIRONMENT

- NO_3+NO_2, NH_4, TDN, PN,
- PC.
- Chl-a
- CTD Profiles
    - D.O.
    - Temp
    - Salinity
- C6 Profiles
    - Chl-a.
    - Turbidity
    - Rhodamine
    - CDOM

BENTHOS

- PN
- PC
- Chl-a
- TOC

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Received: 25 July 2018 | Revised and accepted: 10 January 2019

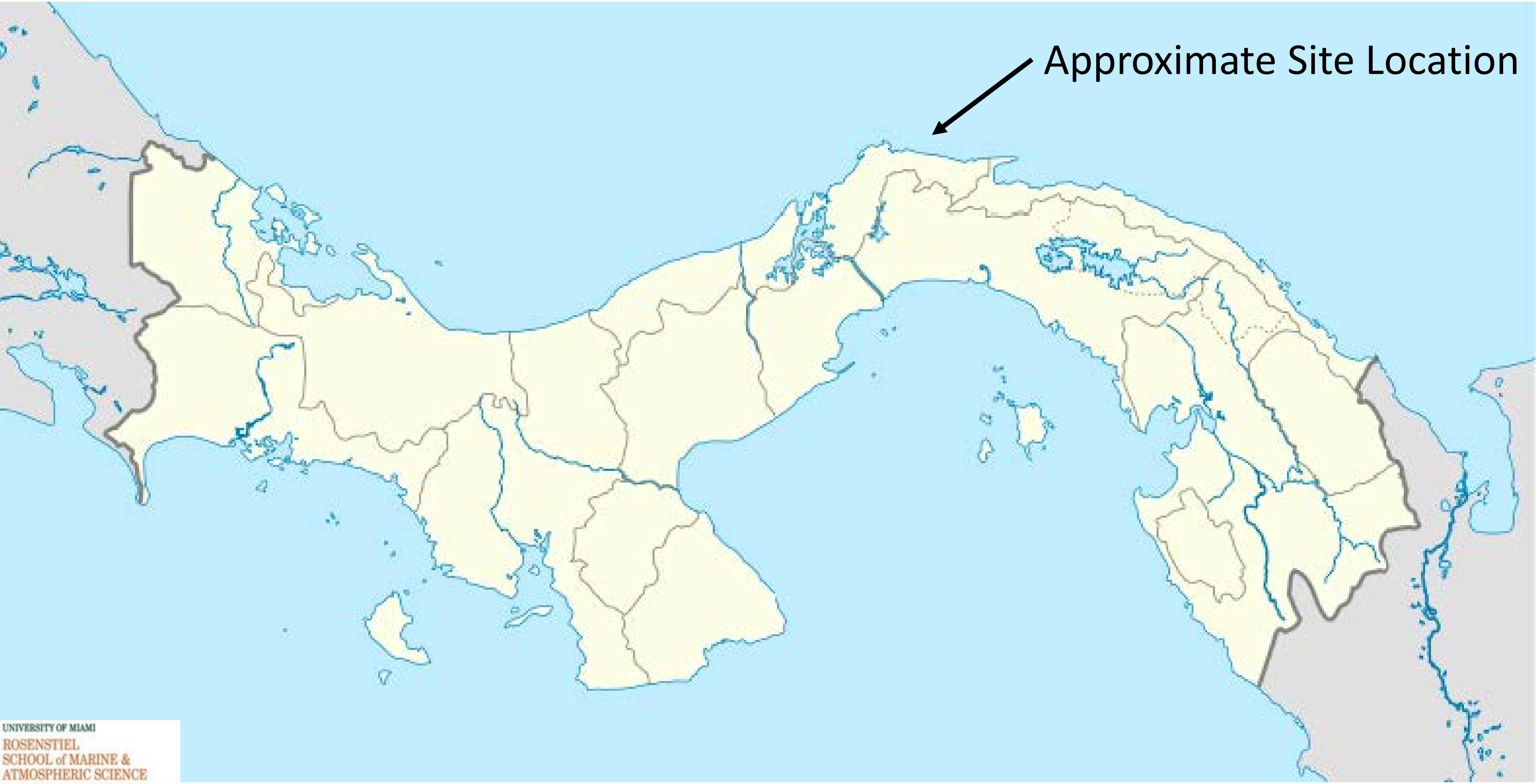
DOI: 10.1111/jwas.12593

WILEY Journal of the World Aquaculture Society

APPLIED STUDIES

The nutrient footprint of a submerged-cage offshore aquaculture facility located in the tropical Caribbean

Aaron W. Welch[1,2] | Angela N. Knapp[3] | Sharein El Tourky[1] | Zachary Daughtery[1] | Gary Hitchcock[1,2] | Daniel Benetti[1]



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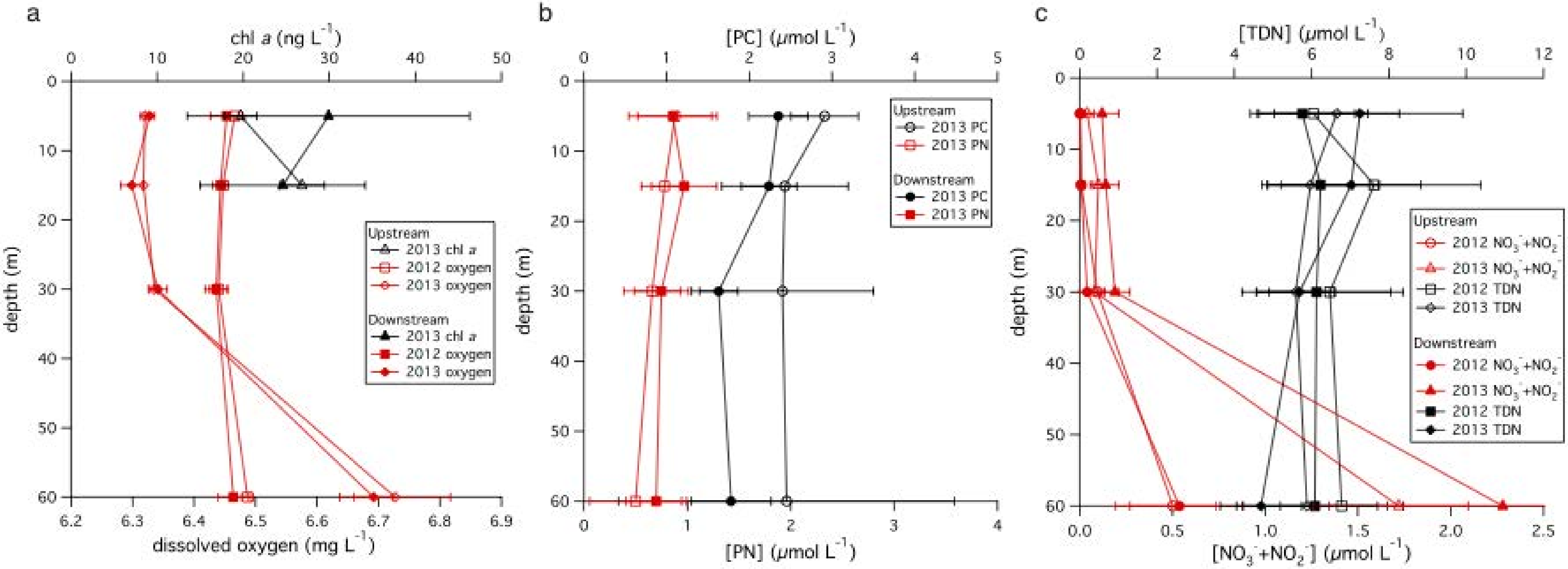
Water Column Measurements (2012-2013)



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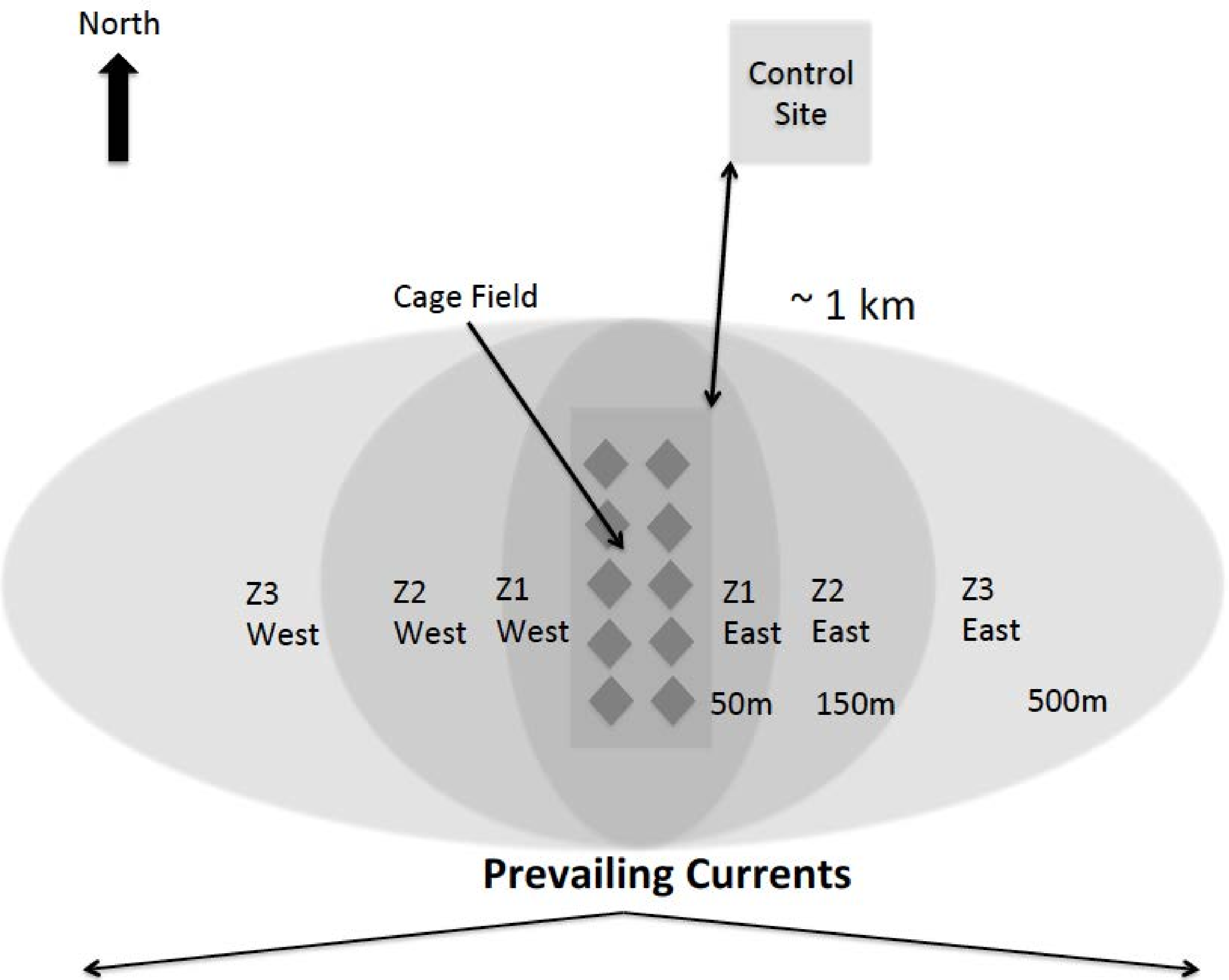
Phase 1 Sampling Scheme (2012-2013)



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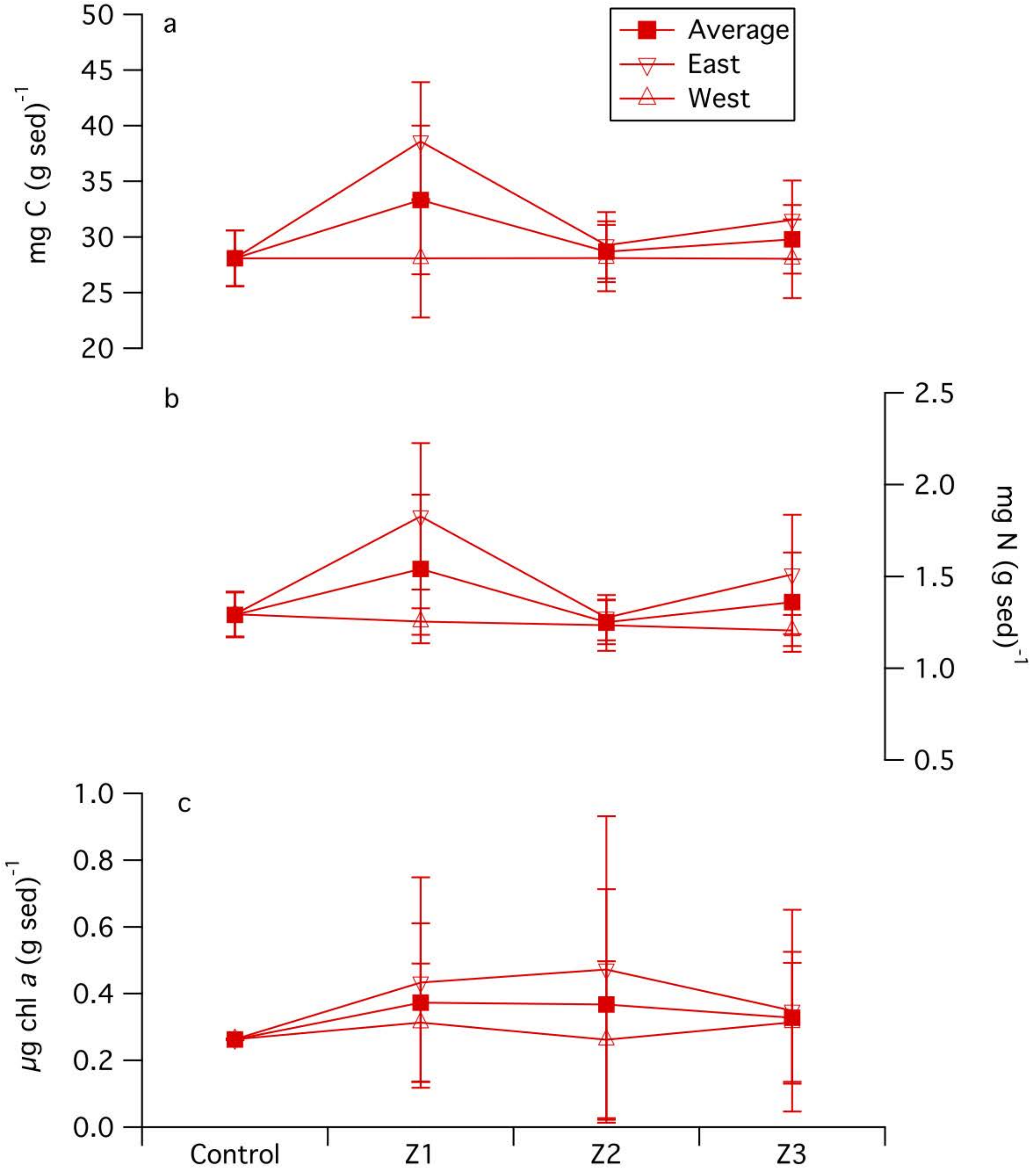
Sediment Measurements 2012-2013



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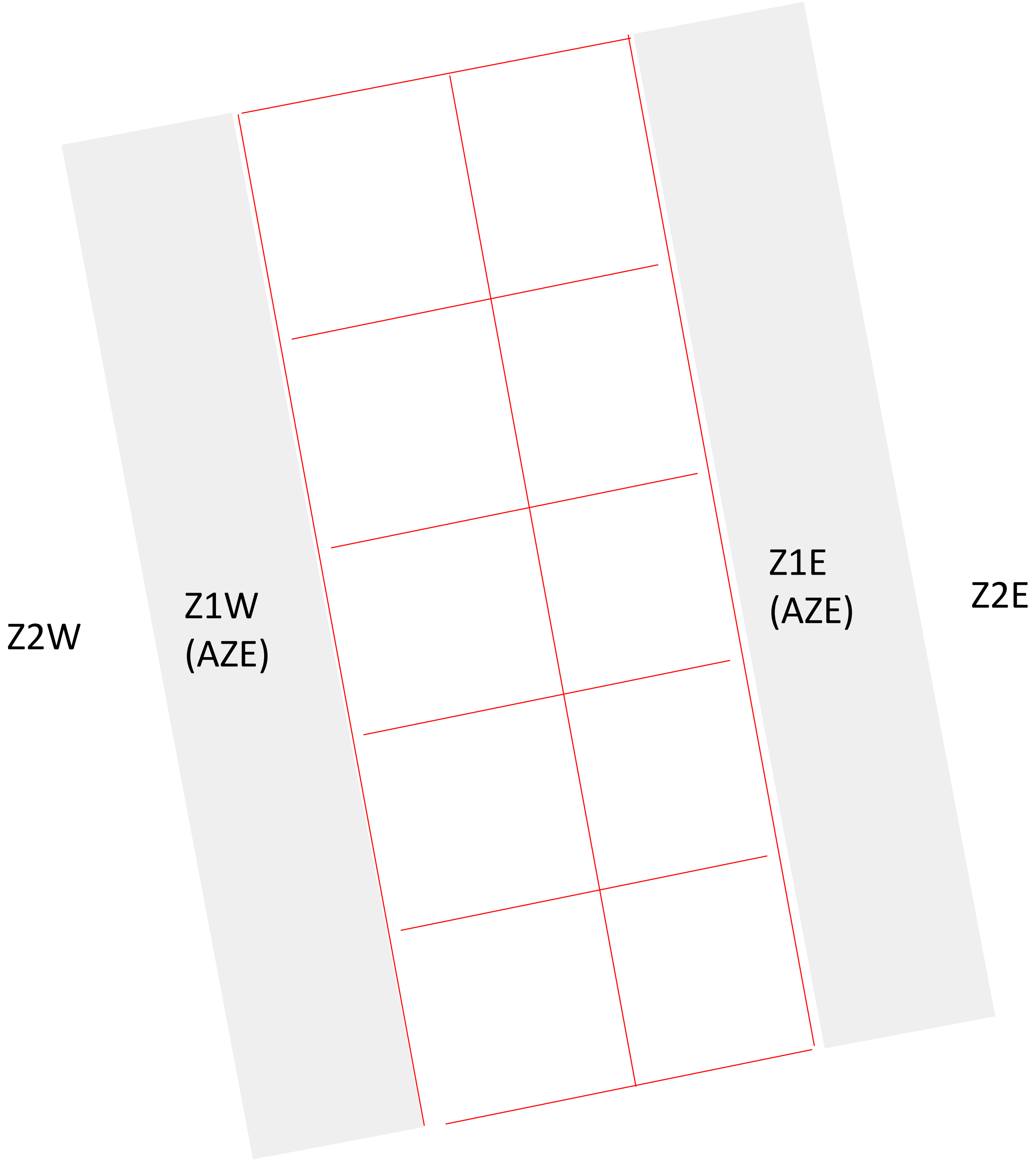
Current Sediment Sampling Scheme



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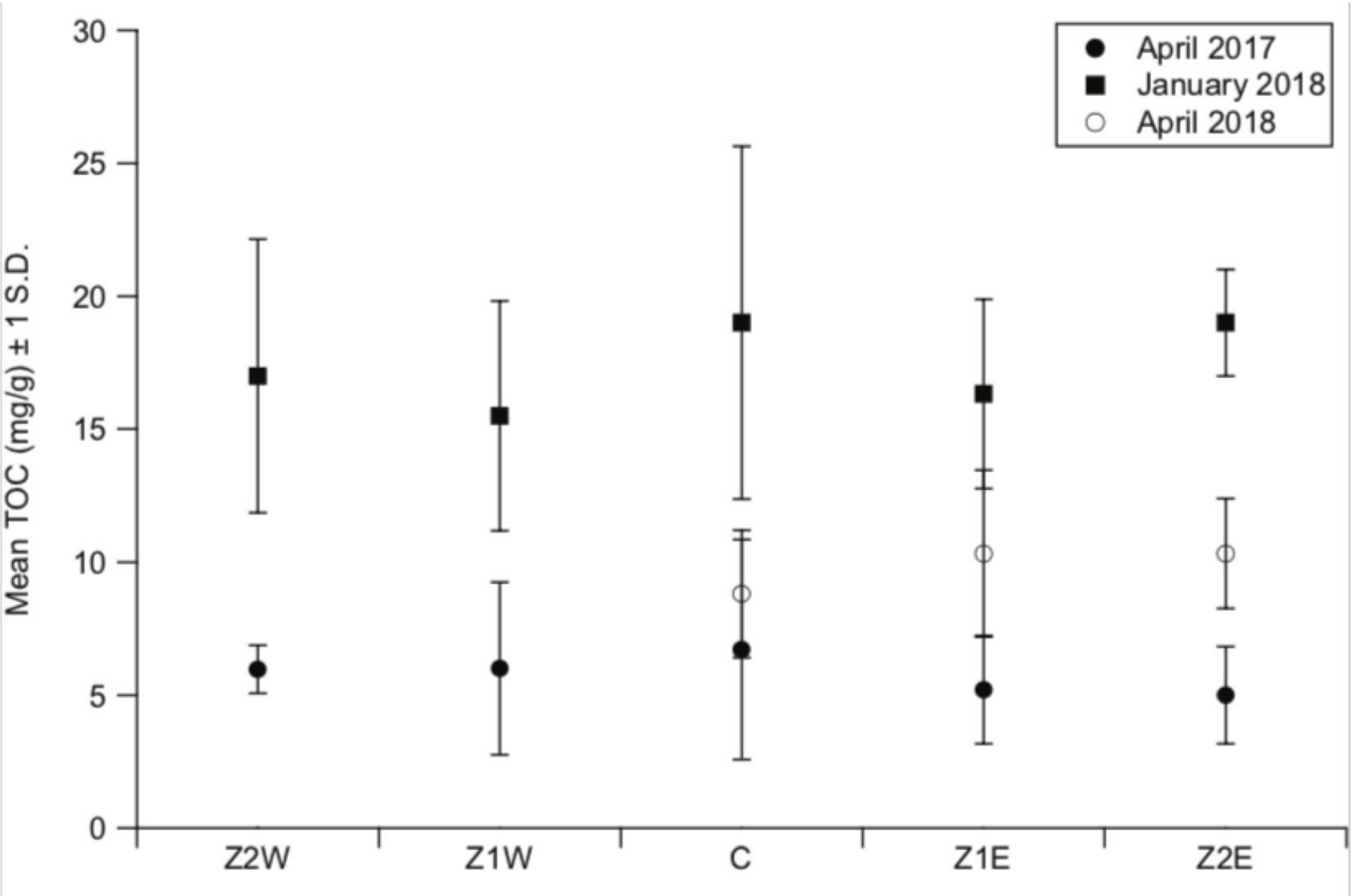
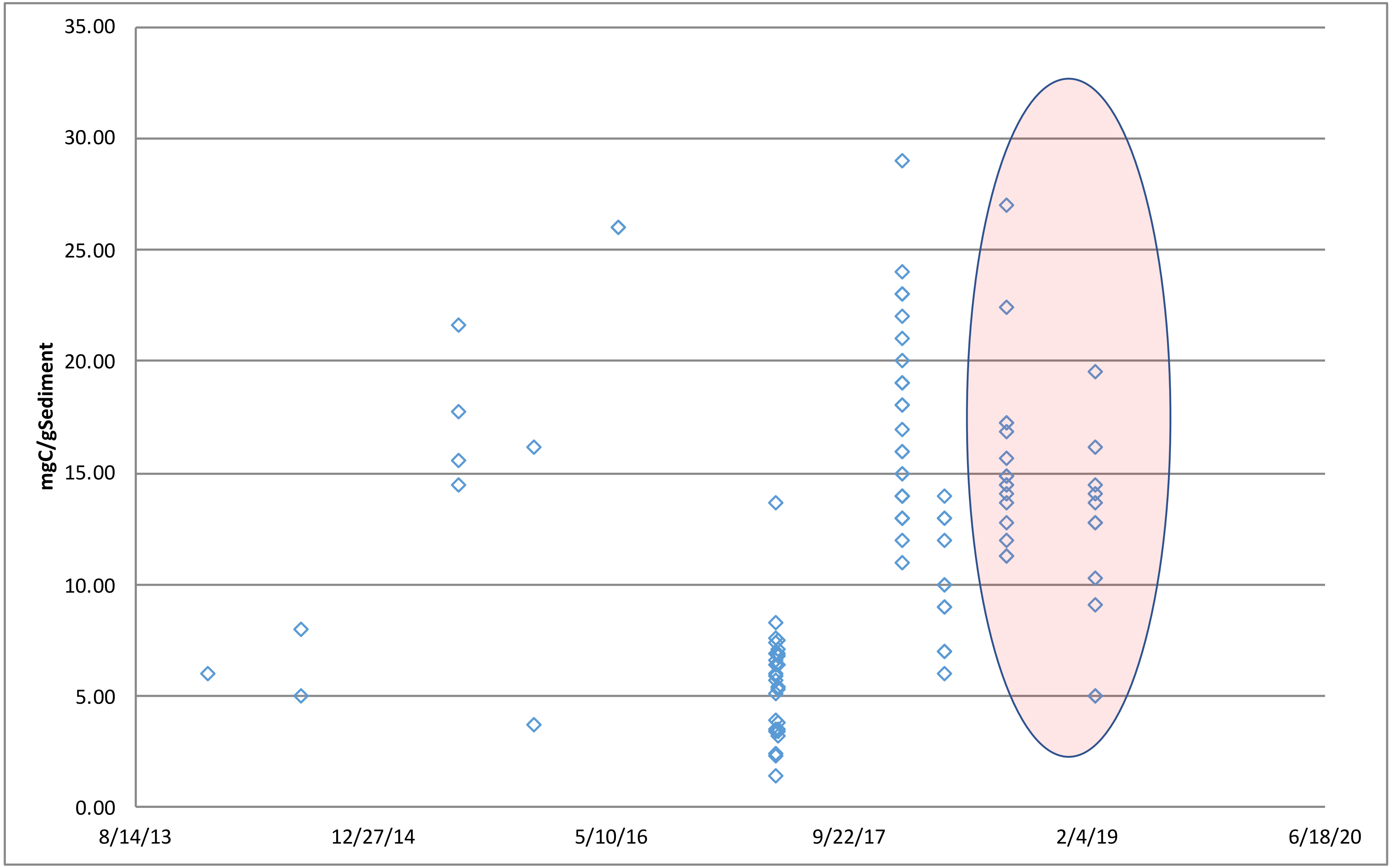


April 2017
January 2018
April 2018
Mean TOC (mg/g) ± 1 S.D.
30
25
20
15
10
5
0
Z2W
Z1W
C
Z1E
Z2E

The Current Situation



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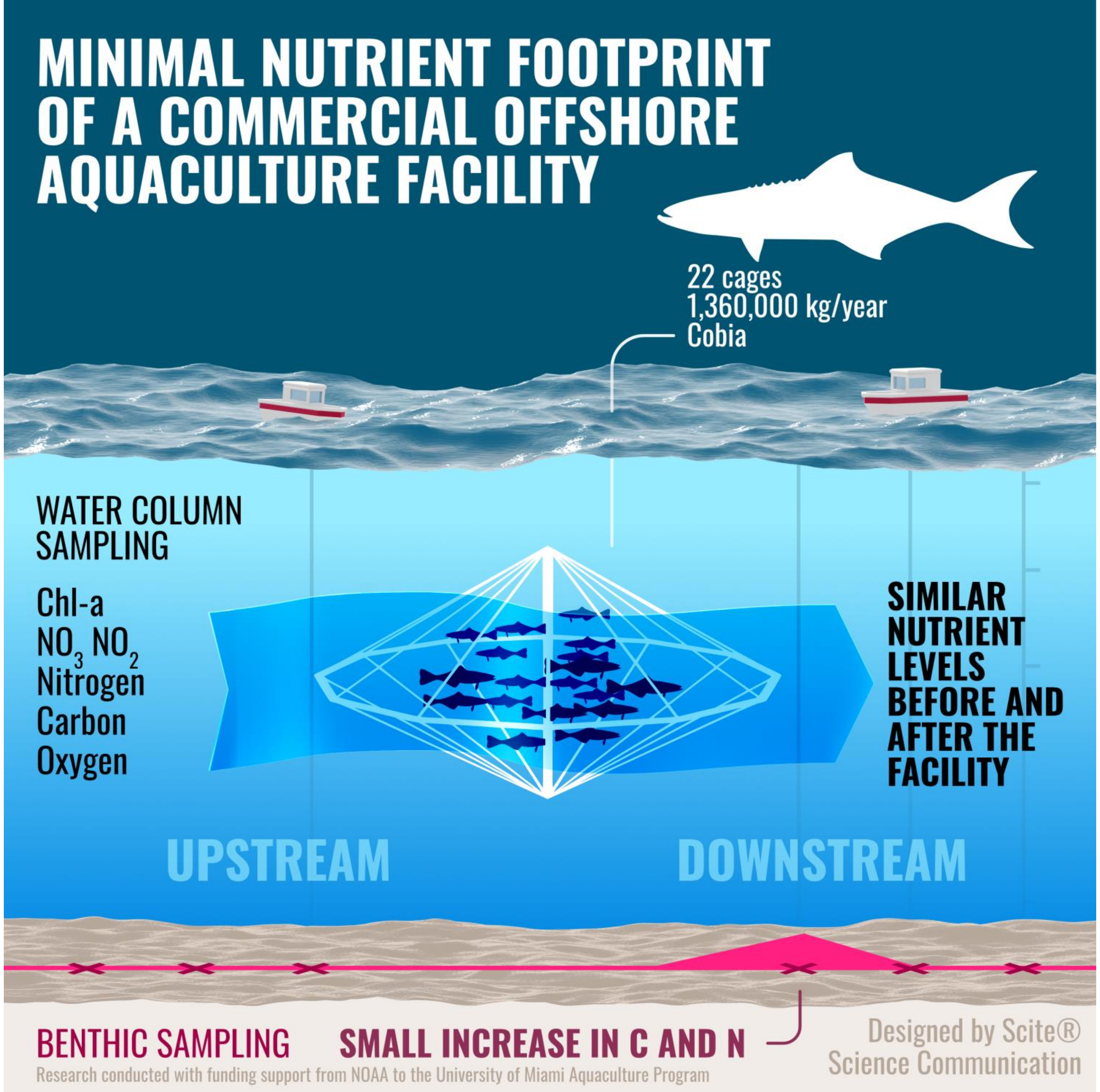

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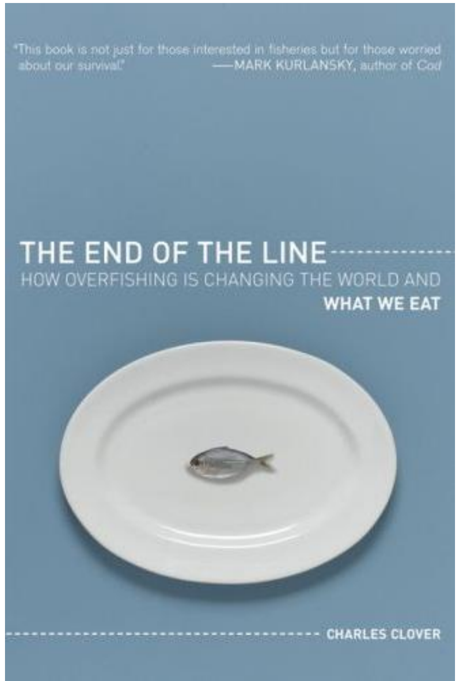
The FISH IN-FISH OUT Objection

Marine aquaculture relies on large amounts of fishmeal and fish oil processed from wild caught “reduction” fish to produce small amounts of farmed fish. ***As the industry grows, demand for fishmeal and fish oil will eventually outstrip the productive capacity of reduction fisheries and the entire enterprise must fail.***

“***Aquaculture is not the answer. It takes 5 pounds of wild fish to make 1 pound of farmed salmon***.”
Ted Danson. Former ‘Cheers’ star and founder of the conservation group Oceana.

“***We are robbing Peter to pay Paul***.” Daniel Pauly. Fisheries biologist and founder of the The Sea Around Us Project



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Fishmeal and Fish Oil…
Are we "Robbing Peter to Pay Paul?"

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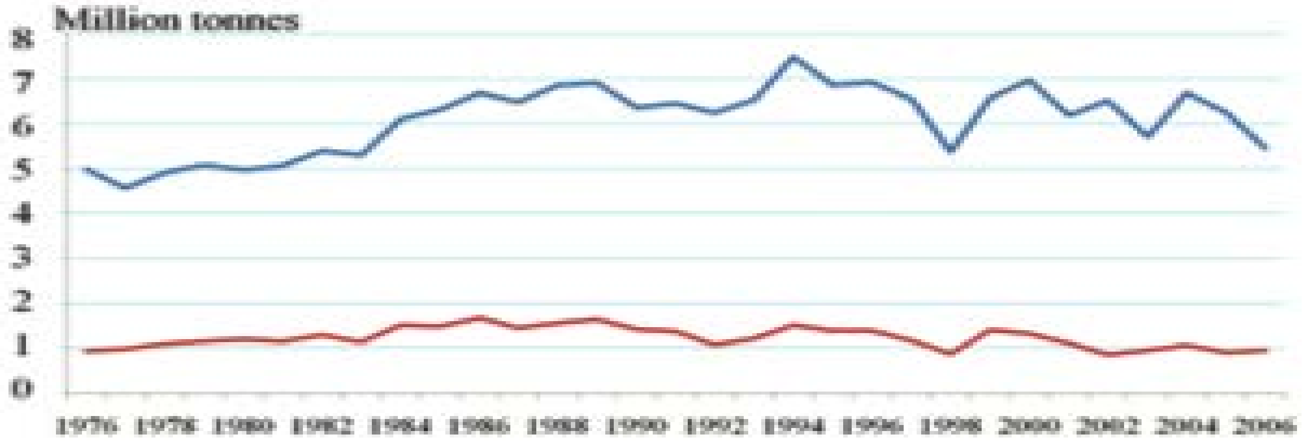
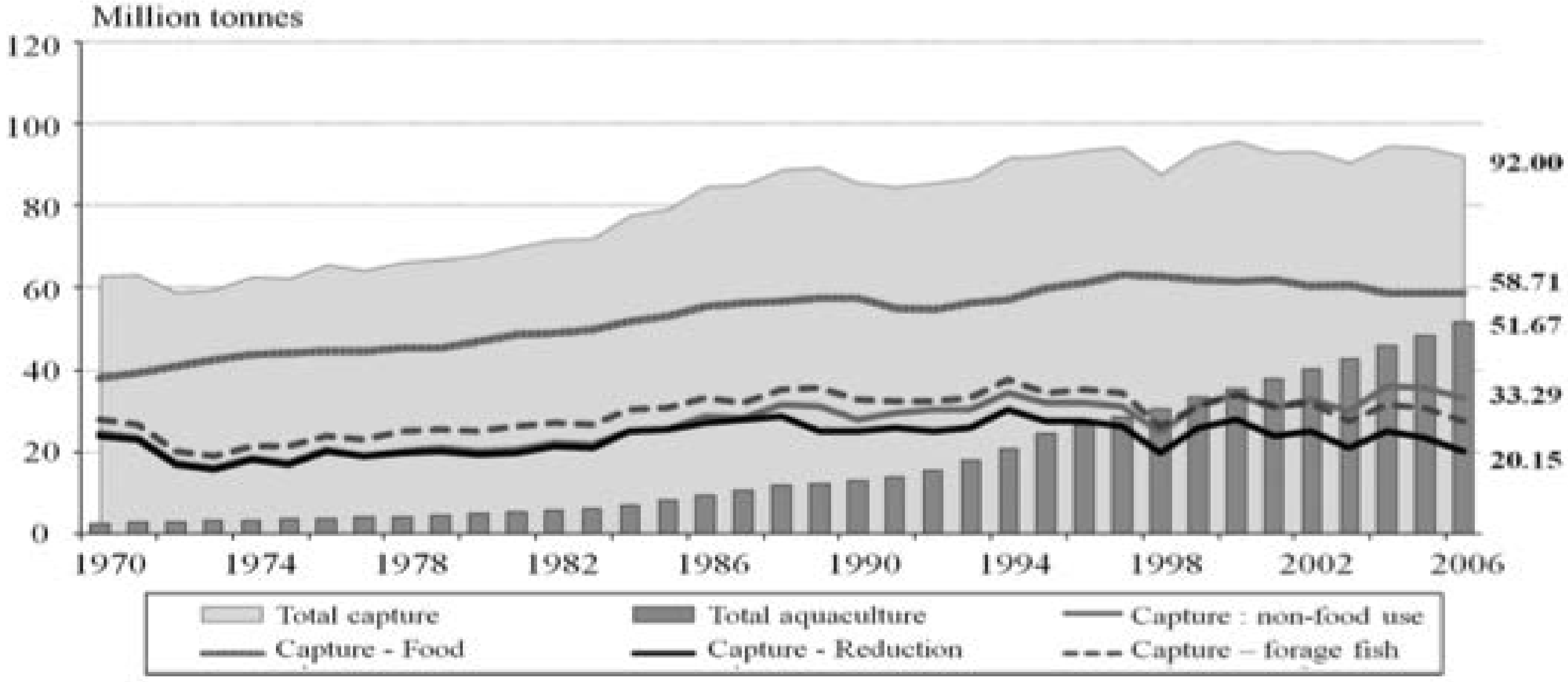
Total Global Fishmeal and Fish Oil Consumption: 1975 to Present



Source: Tacon and Metian 2009

NON–FOOD USE OF SMALL PELAGIC FORAGE FISH



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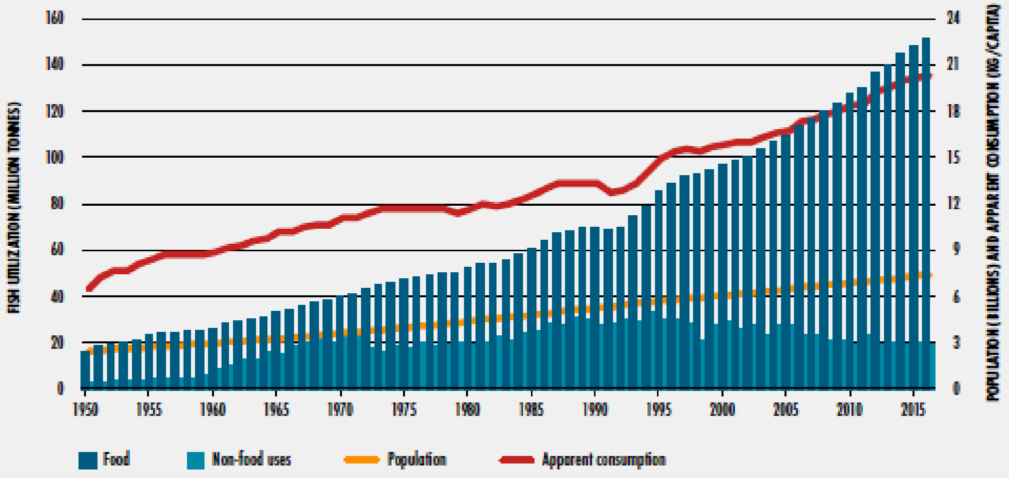
Non Food Use of Fish Since 2006

FIGURE 2
WORLD FISH UTILIZATION AND APPARENT CONSUMPTION

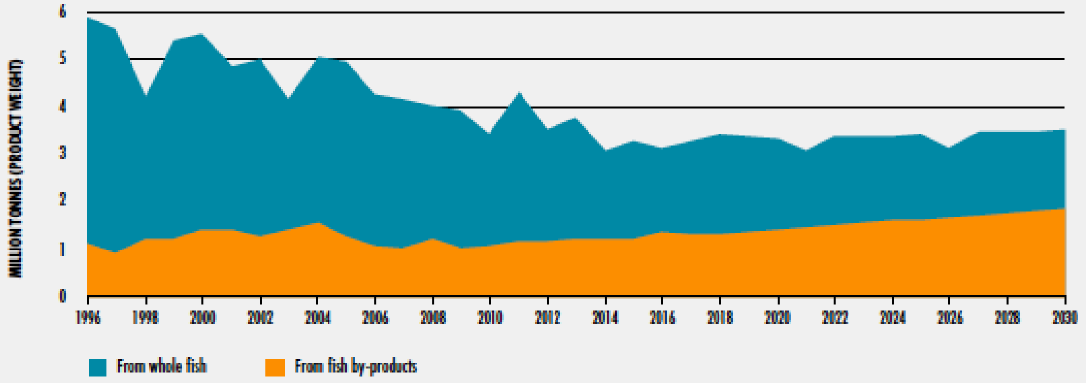


NOTE: Excludes aquatic mammals, crocodiles, alligators and caimans, seaweeds and other aquatic plants

| 3 |

Global Fishmeal Production Since 2006

FIGURE 51
WORLD FISHMEAL PRODUCTION, 1996–2030



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How is this Possible?

1. **<u>Markets:</u>**

The global fishmeal industry did not expand due to aquaculture. Instead, fish farmers priced other fishmeal users out of the market.

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The Changing Global Fishmeal Market

Table 1 Reported global usage of fish meal and fish oil by major user (values given in %)

Year	Use	Aquaculture	Poultry feed	Pig feed	Other feeds	References
1988	Fishmeal	10	60	20	10[1]	New and Csavas (1995)
1990	Fishmeal	14	58	20	8[2]	Pike (1991)
1994	Fishmeal	17	55	20	8[3]	Pike (1998)
1995	Fishmeal	15	50	25	10[4]	Kilpatrick (2003)
2000	Fishmeal	35	24	29	12[5]	Barlow and Pike (2001)
2001	Fishmeal	40	39	14	7[6]	Kilpatrick (2003)
2002	Fishmeal	46	22	24	8[7]	Pike (2005)
2006	Fishmeal	57	13	21	6	Jackson (2007a)
Year	**Use**	**Aquaculture**	**Edible[8]**	**Indust/Pharm[9]**	**Animal feed**	
1994	Fish oil	24.7[10]	68.5	6.8	—	Pike (1998)
1995	Fish oil	18	70	7[11]	5	Kilpatrick (2003)
2000	Fish oil	54	34	26[12]	—	Barlow and Pike (2001)
2001	Fish oil	70	19	8[13]	3	Kilpatrick (2003)
2002	Fish oil	81	14	5	—	Pike (2005)
2006	Fish oil	87[14]	—	—	—	Jackson (2007a)

Source: Tacon and Metian 2009

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How is this Possible?

1. Markets:

The global fishmeal industry did no expand due to aquaculture. Instead, fish farmers priced other fishmeal users out of the market.

2. Technology:

Fish farmers began to find substitutes for fishmeal. Fish, even carnivorous marine finfish, do not need fishmeal per se. The need the omega-3 fattch acids and other nutrients found in fishmeal.

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Table 1. Feed use and efficiencies (1995 and 2007)

Species group	Percentage on feeds[*]	Average FCR[†]	Average % fishmeal in feed[‡]	Average % fish oil in feed[‡]	Total feeds used[§]
Shrimp					
1995	75	2.0	28	2	1,392
2007	93	1.7	18	2	5,603
Salmon					
1995	100	1.5	45	25	806
2007	100	1.3	24	16	1,923
Marine fish					
1995	50	2.0	50	15	498
2007	72	1.9	30	7	2,311
Chinese carp (nonfilter feeding)					
1995	20	2.0	10	0	1,970
2007	47	1.7	5	0	8,578
Tilapia					
1995	70	2.0	14	1	
2007	82	1.7	5	0	

Naylor et al. 2009

Long term trend towards reduced fishmeal....made possible by increased use of novel ingredients (e.g. algal meal).

Salze et al. 2009

Table 2

Dietary composition of the experimental diets utilized in feeding trial 2. The + sign indicates MOS supplementation; SB = soybean-based diet; MXSB = soybean-based diet in which the incorporation of soybean meal has been maximized; NOFM = fish meal-free and fish oil-free diet. Values are in g/100 g of dry diet.

Ingredients	Control	SB	SB+	MXSB	MXSB	NOFM
Herring meal	25.3	12.6	12.6	8.5	8.5	[illegible]
SPC	12.6	25.3	25.3	23.8	23.8	25.3
Soybean meal	32.4	32.4	32.4	39.9	39.9	0.0
Worm meal	0.0	0.0	0.0	0.0	0.0	30.0
Dextrin	10.0	10.0	10.0	8.6	8.3	9.5
Soy oil	0.0	0.0	0.0	0.0	0.0	7.3
Fish oil	8.7	10.0	10.0	10.2	10.2	0.0
DHA Gold	0.0	0.0	0.0	0.0	0.0	1.5
Mineral mix	4.0	4.0	4.0	4.0	4.0	4.0
Vitamin mix	3.0	3.0	3.0	3.0	3.0	3.0
CMC	1.0	1.0	1.0	1.0	1.0	1.0
Amino acid mix	0.0	0.0	0.0	1.0	1.0	0.0
BioMos	0.0	0.0	0.3	0.0	0.3	0.3
NuPro	0.0	0.0	0.0	0.0	0.0	17.5
Cellufil	3.0	1.7	1.4	0.0	0.0	0.6
Crude protein	43.3	43.8	44.2	43.5	43.9	43.2
Crude lipid	10.5	10.9	10.2	10.8	11.0	10.6
Available energy (kJ/g diet)	12.9	13.1	12.9	12.8	12.9	12.8

Changing Feed Technologies

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So What?

- Pollution and Fishmeal/Fish oil use are ***two of the most contentious issues*** surrounding offshore aquaculture.

- Skepticism among environmental community is considerable, and, frankly, not unreasonable.

- Progress on regulatory initiatives (e.g. ***Gulf Council FMP***, Rose Canyon Proposal, AQUAA Act, etc...) will require industry to be able to speak authoritatively about the impacts of the proposed enterprises.

- Data is the path to achieving consensus within the stakeholder community.

Thanks to the

- NOAA S/K
- FL Sea Grant
- Open Blue

Thanks to you for your time.

Questions?

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openblue

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

Best Management Practices for Offshore Aquaculture

R. LEROY CRESWELL
Florida Sea Grant
Indian River Research and Education Center
2199 S. Rock Road, Fort Pierce, FL 34945

Offshore aquaculture is a developing industry in the Gulf of Mexico that is receiving substantial public interest, particularly from coastal communities and commercial and recreational fisheries. The environmental sustainability and economic viability of offshore aquaculture will be dependent on appropriate site location, facility design, and operational protocols. This presentation will focus on the potential ecological impacts of offshore aquaculture and the "Best Management Practices" that will minimize and/or mitigate those impacts. The content of this presentation was excerpted from the Gulf and Caribbean Fisheries Institute Special Publication Series #4 (Price and Beck-Stimpert, 2014).

The primary ecological impacts of offshore aquaculture on the marine environment include:

- *Nutrient Enrichment — Water Column*
- *Sediment Accumulation — Anoxia*
- *Wildlife Interactions — Biodiversity*
- *Fish Health*

The ecological effects to water quality can be summarized as:

- *Excessive nutrient loads — Nitrogen and Phosphorus*
- *Increased BOD — Biological Oxygen Demand*
- *Toxicity from net cleaning agents, boat fuel, and equipment*

Best Management Practices to provide a high water quality environment in and adjacent to netpens:

- *Site in deep, well-flushed waters*
- *Avoid excessive net fouling*
- *Establish nutrient and water quality thresholds, and tailor monitoring plans to account for threshold concentrations* in *sensitive marine habitats*
- *Discourage the use of chemical anti-foulants and, when possible, employ mechanical cleaning methods*
- *Quickly remove and properly dispose of fish mortalities*
- *Consider the use of integrated multi-trophic aquaculture (IMTA), when practicable*
- *Encourage clean harvest methods and off-site processing* and c*ollect operational waste for off-site disposal*
- *Take measures to prevent discharge of contaminants from farm and develop a chemical spill response plan*
- *Properly maintain and operate farm vessels and equipment to minimize leaks, spills, or waste loss*

The ecological effects to the sediments beneath and adjacent to netpens can be summarized as:

- *Sediment accumulation under farms creating anoxic benthos*
- *Settlement of feces and uneaten food*
- *Detachment of fouling debris from nets or sloughing of antifouling materials*

Best Management Practices to minimize the impact on the sediment and benthic environment beneath and adjacent to netpens:

- *Site in well-flushed area to disperse nutrients and suspended solids — hydrographic study*
- *Monitoring protocols for "footprint of deposition" or "sediment impact zone"*
- *Establish "allowable benthic impacts" using the chemical sediment properties as indicators (DO, sulfides, organic carbon)*
- *Establish and monitor a "Benthic Enrichment Index" (BEI) – forming anoxia*
- *Implement a netpen rotation or fallowing plan*
- *Monitor and mitigate net fouling debris*

What are the ecological and genetic risks of aquaculture fish that escape from netpens?

- *Establishment of exotic species*
- *Interbreeding to the alteration of the gene pools of local crustacean or fish* populations
- *Release of fertilized eggs and larvae*
- *Disease transmission by escapees to wild fish*

Best Management Practices to minimize the ecological and genetic risks of escapes include:

- *Culture local (native or naturalized) species and discourage or prohibit the culture of non-native species*
- *Conduct a risk assessment for non-local species*
- *Develop a broodstock program that conserves genetic diversity (integrated approach) or selects for low wild fitness (segregated approach)*
- *Avoid unintended releases of cultured gametes, eggs, and larvae — harvest prior to sexual maturation*
- *Consider stocking sterile fish, when practicable*
- *Develop and regularly update an escapes reduction and mitigation plan for each farm*
- *Use cage designs that are properly engineered to minimize the possibility of escape*
- *Routinely monitor cages for escapement and properly maintain cage equipment and boat propellers*
- *Establish predator deterrence procedures*
- *Initiate Coast Guard approved warning protocols for non-farm traffic*

Best Management Practices to consider for developing formulated fish feeds of use in offshore netpens:

- *Eliminate raw feed ingredients such as small fish, squid, and fish processing and animal slaughter waste*
- *Provide feed companies with composition, performance and practical feeding requirements (sinking rate, fines, pellet hardness, etc.) for each cultured species*
- *Promote techniques to improve feed conversion ratio and minimize excess feed input*
- *Maintain and analyze records of fish growth, survival, feed used, feeding times, and ration amounts*
- *Encourage feed companies to use feedstuffs from environmentally responsible sources and practice continuous improvement in all aspects of feed formulation and manufacture*
- *Procure feed with an adequate amount of long chain omega-3 fatty acids to produce a final product with equal or greater levels of these fatty acids compared to that of the same species from the wild*
- *Handle and store food appropriately to maintain quality*

What are the impacts of netpen aquaculture on fish health?

- *Without a healthy, clean cage environment fish can soon become stressed or sick, resulting in poor health, impaired growth, and possibly death*
- *Buildup of biofouling organisms on netpens will impede water flow and potentially cause fish abrasions*
- *Inappropriate stocking density can create stress, reduce feeding activity, and impede growth*

Best Management Practices to promote fish health in aquaculture netpens include:

- *Develop a health monitoring plan and implement protocols*
- *Consult and cooperate with aquatic animal health experts or veterinarians at various levels of operation*
- *Develop and employ biosecurity practices and quarantine protocols*
- *Use appropriate stocking densities and employ techniques to minimize physiological stress to cultured organisms*
- *Provide prophylaxis, such as fish vaccination prior to stocking into cages — if available and necessary*
- *Use only FDA-approved drugs, and minimize the use of antimicrobials*

Best Management Practices to minimize the ecological effects of offshore netpen aquaculture interacting with native wildlife:

- *Avoid disruption to native biodiversity, especially protected species*
- *Prevent predator interactions and use non-lethal predator deterrents, when necessary*
- *Use proper cage design to minimize entanglement with marine animals and other protected species*
- *Site farms away from corals, seagrass, mangroves, and other sensitive habitats*

- *Exercise caution when operating vessels to avoid collisions with sea turtles and marine mammals*

The "Human Dimension" will play a considerable role in moving forward with offshore aquaculture:
- *Carry out public input process prior to permit issuance*
- *Conduct economic/market analysis to project local economic effects*
- *Hold informational meetings in local area*
- *Identify potential or perceived conflicts with wild harvest, markets, tourism, recreational use, aesthetic value, cultural activities, or navigation*
- *Provide educational materials and work on outreach issues with local community*
- *Meet community needs when possible/practical (e.g., jobs) — Train/employ local workforce*
- *Consider including tourism and recreational fishing in operations*
- *Avoid traditional fishing areas and areas of aesthetic importance*
- *Avoid flooding local market(s) with cultured fish*
- *Work with local community to market cultured fish when/where possible*

In summary, the Best Management Practices to minimize the ecological effects of offshore netpen aquaculture are:
- *Minimize nutrient accumulation at the site*
- *Optimize feeding protocols*
- *Implement cage rotation or fallowing if nutrient loading exceeds ecological threshold*
- *Employ methods to minimize physical disturbance to habitat and biodiversity*
- *Utilize responsible cage cleaning methods*
- *Be responsive to stakeholders in coastal communities and the maritime industries*

LITERATURE CITED

Price, C.S. and J. Beck-Stimpert (editors). 2014. Best Management Practices for Marine Cage Culture Operations in the U.S. Caribbean. GCFI Special Publication Series Number 4. 52 pp.

Best Management Practices for Offshore Aquaculture

R. LeRoy Creswell
Sea Grant
University of Florida

Marine Cage Culture
Ecological Effects on Marine Environment

Nutrient Enrichment — Water Column

Sediment Accumulation — Anoxia

Wildlife Interactions — Biodiversity

Fish Health

ECOLOGICAL EFFECTS TO WATER QUALITY

Excessive nutrient loads —
Nitrogen and Phosphorus

Increased BOD — Biological Oxygen Demand

Toxicity from net cleaning agents,
boat fuel, and equipment

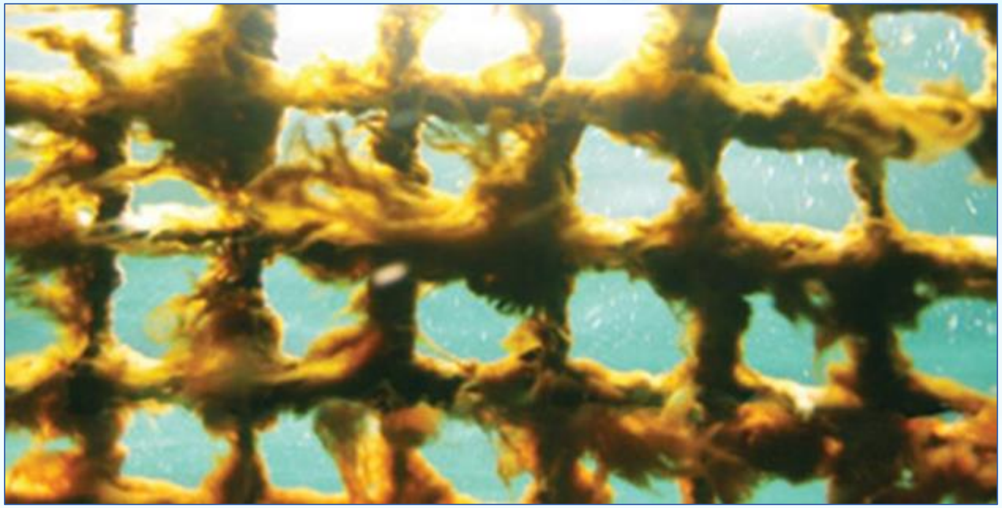
Best Management Practices for Water Quality

- *Site in deep, well-flushed waters*
- *Avoid excessive net fouling*
- *Establish nutrient and water quality thresholds*
- *Tailor monitoring plan(s) to take into account impacts to sensitive marine habitats — threshold concentrations*
- *Discourage the use of chemical anti-foulants and, when possible, employ mechanical cleaning methods*
- *Quickly remove and properly dispose of fish mortalities*
- *Consider the use of integrated multi-trophic aquaculture (IMTA), when practicable*

Best Management Practices for Water Quality

- *Encourage clean harvest methods and off-site processing*
- *Collect operational and human waste for off-site disposal*
- *Take measures to prevent discharge of contaminants from farm and develop a chemical spill response plan*
- *Properly maintain and operate farm vessels and equipment to minimize leaks, spills, or waste loss*
- *Provide employees with approved marine sanitation devices aboard vessels or working platforms*

ECOLOGICAL EFFECTS TO SEDIMENT

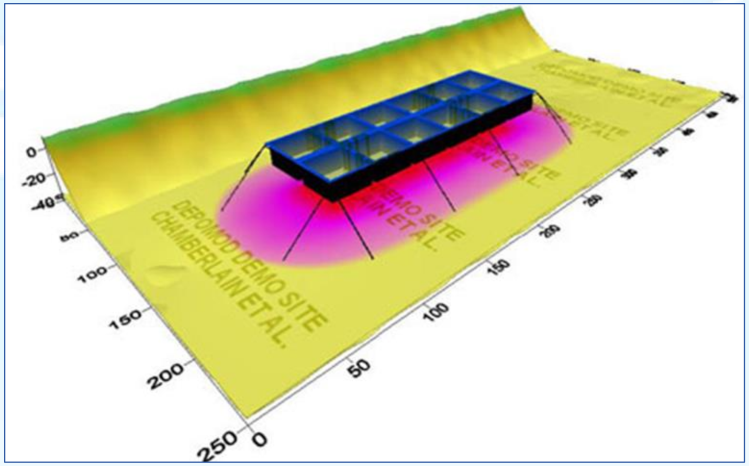


Sediment accumulation under farms creating anoxic benthos

Settlement of feces and uneaten food

Detachment of fouling debris from nets or sloughing of antifouling materials.

SEDIMENT MANAGEMENT



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- *Monitoring protocols for "footprint of deposition" or "sediment impact zone"*
- *Cage rotation or fallowing plan*
- *Monitor and mitigate net fouling debris*

ECOLOGICAL AND GENETIC RISKS **OF ESCAPES**

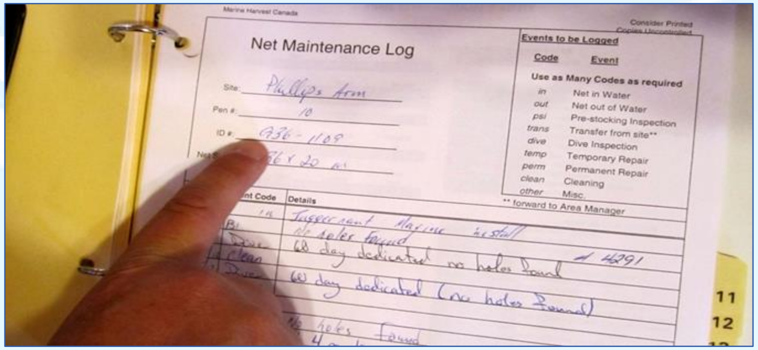
Interbreeding to the alteration of the gene pools of local crustacean or fish populations

Release of fertilized eggs and larvae

Disease transmission by escapees to wild fish

Establishment of exotic species

Best Management Practices for Fish Escapes

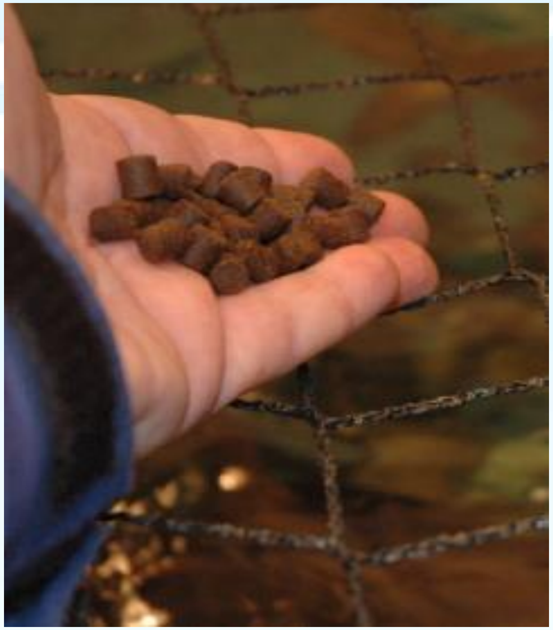


- *Culture local (native or naturalized) species and discourage or prohibit the culture of non-native species*
- *Conduct a risk assessment for non-local species*
- *Develop a broodstock program that conserves genetic diversity (integrated approach) or selects for low wild fitness (segregated approach)*
- *Avoid unintended releases of cultured gametes, eggs, and larvae — harvest prior to sexual maturation*
- *Consider stocking sterile fish, when practicable*

Best Management Practices for Fish Escapes

- *Develop and regularly update an escapes reduction and mitigation plan for each farm*
- *Use cage designs which minimize the possibility of escape — properly engineered*
- *Routinely monitor cages for escapement and properly maintain cage equipment and boat propellers*
- *Establish predator deterrence procedures*
- *Coast Guard approved warning for non-farm traffic*

Best Management Practices for Fish Feeds



- *Eliminate raw feed ingredients including small fish, fish processing waste, squid, and animal slaughter waste*
- *Provide feed companies with desired composition, performance and practical feeding requirements (sinking rate, fines, pellet hardness, etc.) for each cultured species*
- *Promote techniques to improve feed conversion ratio and minimize excess feed input*
- *Maintain and analyze records of fish growth, survival, feed used, feeding times, and ration amounts*

Best Management Practices for Fish Feeds

- *Encourage feed companies to use feedstuffs from environmentally responsible sources and practice continuous improvement in all aspects of feed formulation and manufacture*
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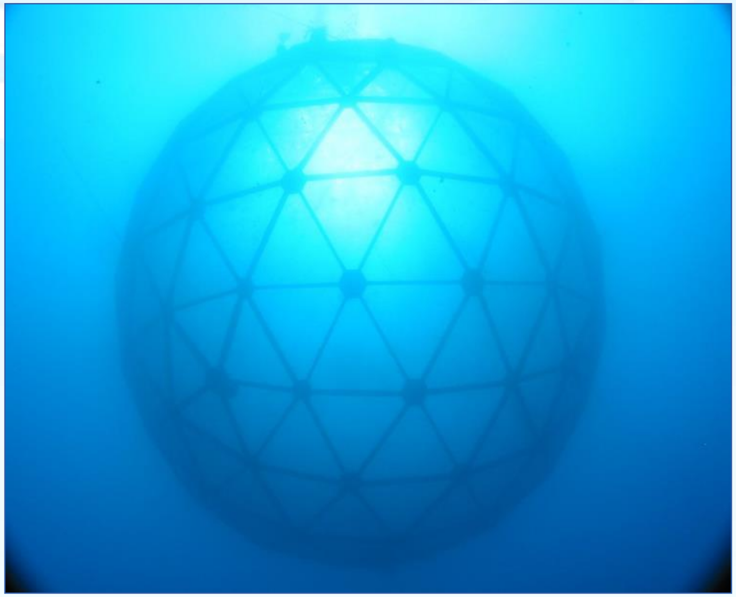
- *Handle and store food appropriately to maintain quality*

ECOLOGICAL EFFECTS TO FISH HEALTH



- *Without a healthy, clean cage environment fish can soon become stressed or sick, resulting in poor health, impaired growth, and possibly death.*
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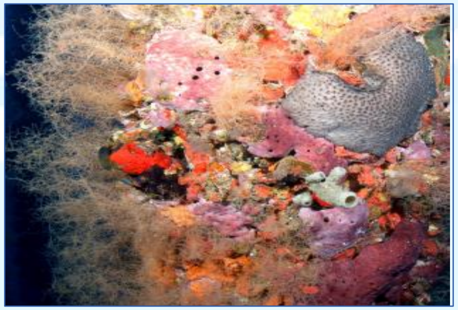
- *Consult with an aquatic animal health expert or veterinarian at various levels of operation*
- *Develop and employ biosecurity practices and quarantine protocols*
- *Use appropriate stocking densities and employ techniques to minimize physiological stress to cultured organisms*

Best Management Practices for Fish Health

- *Vaccinate fish prior to stocking into cages, if available and necessary — prophylaxis*
- *Use only FDA-approved drugs*
- *Minimize the use of antimicrobials*
- *Cooperate with animal health regulators*
- *Coordinate with veterinary, husbandry, and fish pathology researchers, when possible*

Best Management Practices for Ecological Effects — Wildlife Interaction



- *Avoid disruption to native biodiversity, especially protected species*
- *Prevent predator interactions and use non-lethal predator deterrents, when necessary*
- *Use proper cage design to minimize entanglement with marine animals and other protected species*
- *Site farms away from corals, seagrass, mangroves, and other sensitive habitats*
- *Exercise caution when operating vessels to avoid collisions with sea turtles and marine mammals*

Best Management Practices for Ecological Effects Summary

- *Minimize nutrient accumulation at the site*
- *Optimize feeding protocols*
- *Implement cage rotation or fallowing if nutrient loading exceeds ecological threshold*
- *Employ methods to minimize physical disturbance to habitat and biodiversity*
- *Utilize responsible cage cleaning methods*

THE HUMAN DIMENSION

- *Carry out public input process prior to permit issuance*
- *Conduct economic/market analysis to project local economic effects*
- *Identify potential or perceived conflicts with wild harvest*
- *Hold informational meetings in local area*
- *Identify potential or perceived conflicts with wild harvest market, tourism, recreational use, aesthetic value, cultural activities, or navigation*
- *Provide educational materials and work on outreach issues with local community*

THE HUMAN DIMENSION

- *Meet community needs when possible/practical (e.g., jobs) Train/employ local workforce*
- *Consider including tourism and recreational fishing in operations*
- *Avoid traditional fishing areas and areas of aesthetic importance*
- *Avoid flooding local market(s) with cultured fish*
- *Work with local community to market cultured fish when/where possible*

OFFSHORE AQUACULTURE CERTIFICATION

BEST AQUACULTURE PRACTICES

Global Aquaculture Alliance

https://www.aquaculturealliance.org/

THANK YOU!

And thanks to BAP/GAA, GCFI, and NOAA for providing the content of this presentation:

Interactions between Offshore Aquaculture and Fisheries

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EXTENDED ABSTRACT

Offshore cage aquaculture offers substantial untapped potential to increase seafood production (Bostock et al. 2010; Gentry et al. 2017; Lester et al. 2018). However, offshore aquaculture can interact with wild fish stocks and capture fisheries and this presents significant concerns for the aquaculture, fisheries and conservation communities (Knapp & Rubino 2016; Gentry et al. 2017). Potential interactions and issues of controversy include loss of access to fishing grounds, pollution, interactions between escaped farmed fish and wild fish, attraction of wild fish to cage sites, disease transmission, fisher responses to altered fishing opportunities, and market interactions between products from aquaculture and capture fisheries (Lorenzen et al. 2012; Clavelle et al. 2018).

Here, we focus primarily on biological interactions between cultured and wild fish. The nature and outcome of such interactions depends on a variety of factors including the abundance and conservation status of wild fish populations, the number of fish being farmed, husbandry and genetic management of farmed fish, escape rates of farmed fish, health management of farmed fish, behavioral responses of wild fish to cage aquaculture, and responses of fishers to altered fish abundance and distribution (Lorenzen et al. 2012). The relative abundance of the interacting fish populations is a major factor: most interactions (except those involving introductions of invasive fish or pathogens) are strongest when farmed fish are abundant relative to wild fish. Furthermore, wild populations that are small or endangered may be particularly vulnerable to such interactions.

Rearing of fish in aquaculture implies radical modifications of the organism's environment and often deliberate manipulations of its biology, e.g. through selective breeding. Cultured fish thus enter a process of domestication: a process of developmental and genetic change in response to culture. Domestication gives rise to organisms that perform well in culture but tend to perform less well than their wild conspecifics following escape into natural environments. Domestication effects usually become apparent within the first generation in captivity and become more pronounced in subsequent generations.

Population-level ecological interactions between farmed and wild fish occur as a result of the increase in population abundance following escapes, and from differences in the biology of cultured and wild fish which have a modifying effect on the nature and strength of interactions. Ecological interactions have genetic consequences where cultured and wild fish interbreed (direct genetic interactions), or where the ecological interactions alter the selection regime (indirect genetic interactions). Interactions can be analyzed and their outcomes predicted using population dynamics models that account for fitness differences between farmed and wild fish, such as those used for assessing intentional releases of hatchery fish in fisheries enhancements (Lorenzen 2005). The strongest population-level interactions occur when farmed fish abundance is high relative to the wild population and when maladaptation of farmed fish to life in the wild is only moderate and genetically based. When farmed fish abundance is very low relative to wild fish, interactions are minimal regardless of farmed fish fitness in the wild. When farmed fish abundance is high relative to the wild, there are two alternative husbandry and genetic management approaches to minimizing impacts on wild fish (Lorenzen et al. 2012). Management to minimize domestication, if successful, would lead to interactions that are strong but inconsequential because wild and farmed fish would be effectively identical. However, this approach is unrealistic because it is virtually impossible to avoid inadvertent domestication effects and moreover, it negates the production benefits to aquaculture that result from domestication. The alternative approach, advancing domestication while inadvertently or intentionally reducing the fitness of farmed fish in the wild, is likely to be a more promising approach. In any case, it is important to take measures to minimize escapes and facilitate recovery of escaped fish. Escapes are typically in the order of 2-5% of stock per year in cage operations, but can be effectively minimized integrated approaches.

Cage aquaculture operations have impacts on the behavior of wild fish, often attracting and aggregating fish in ways similar to fish aggregation devices or artificial reefs (Sanchez-Jerez et al. 2011; Sims 2013; Calllier et al. 2018). This behavior may enhance the scope for certain biological interactions such as disease transmission, but also amplify harvesting opportunities for fishers.

Confinement of fish in culture facilities greatly reduces transmission of metazoan parasites with complex life cycles (because intermediate or final hosts are typically absent), but provides ideal conditions for transmission of parasites with direct life cycles including bacteria, viruses, many protozoa and some metazoans such as sea lice

(Murray & Peeler, 2005). Impacts on wild stocks from disease interactions may occur via three mechanisms: (1) introductions of alien parasites (2) transfer of parasites that have evolved increased virulence in culture, (3) changes in host population density, age/size structure or immune status that affect the dynamics of established parasites (Lorenzen et al. 2012). Controlling parasites in cultured fish is crucial to minimizing disease interactions with wild fish, but is not always effective and may not be sufficient. It is therefore important to implement an epidemiological, risk-based approach to managing disease interactions that accounts for ecological and evolutionary dynamics of transmission and host population impacts (Murray & Peeler, 2005).

Fishers may seek out and benefit from harvesting opportunities provided by escaped farmed and aggregated wild fish (Sims 2013; Dempster et al. 2018). This can reduce interactions between farmed and wild fish, but also affect the exploitation level of wild stocks in ways similar to fish aggregating devices. Offshore cage aquaculture therefore has the potential for complex interactions with fisheries that require concerted attention from both sectors. Recent research advances provide us with a good conceptual understanding of potential interactions between offshore aquaculture and fisheries and with increasingly sophisticated quantitative models and tools for risk assessment and management planning. Small-scale pilot projects for the culture of native species that are abundant in the wild pose limited risks and can provide important empirical information on interactions with fisheries that can help to test and refine models, risk assessments and management plans. We strongly recommend that fisheries interaction studies should complement pilot aquaculture projects. Such studies should be accompanied by a stakeholder process involving fisheries and aquaculture stakeholders including regulators in order to develop sound management approaches for such interactions.

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Interactions between Offshore Aquaculture and Fisheries

Kai Lorenzen & Edward V. Camp

University of Florida

UF UNIVERSITY of FLORIDA

MOTE MARINE LABORATORY

Photo: NOAA

Potential interactions and concerns

- Loss of access to fishing grounds
- Pollution
- Interactions between escaped farmed fish and wild fish
- Attraction of wild fish to cage sites
- Disease transmission
- Fisher responses to altered fishing opportunities
- Market interactions between products

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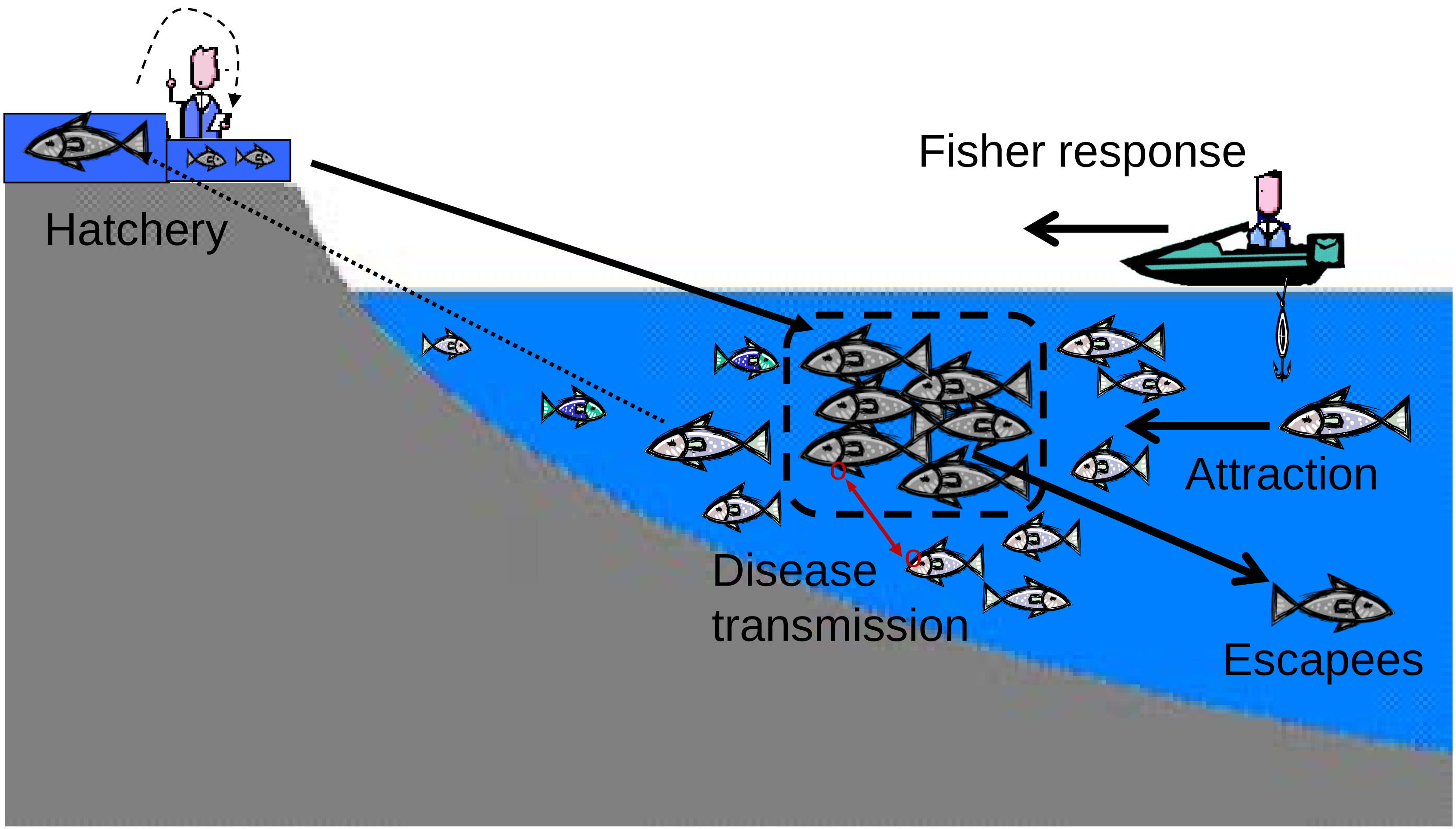
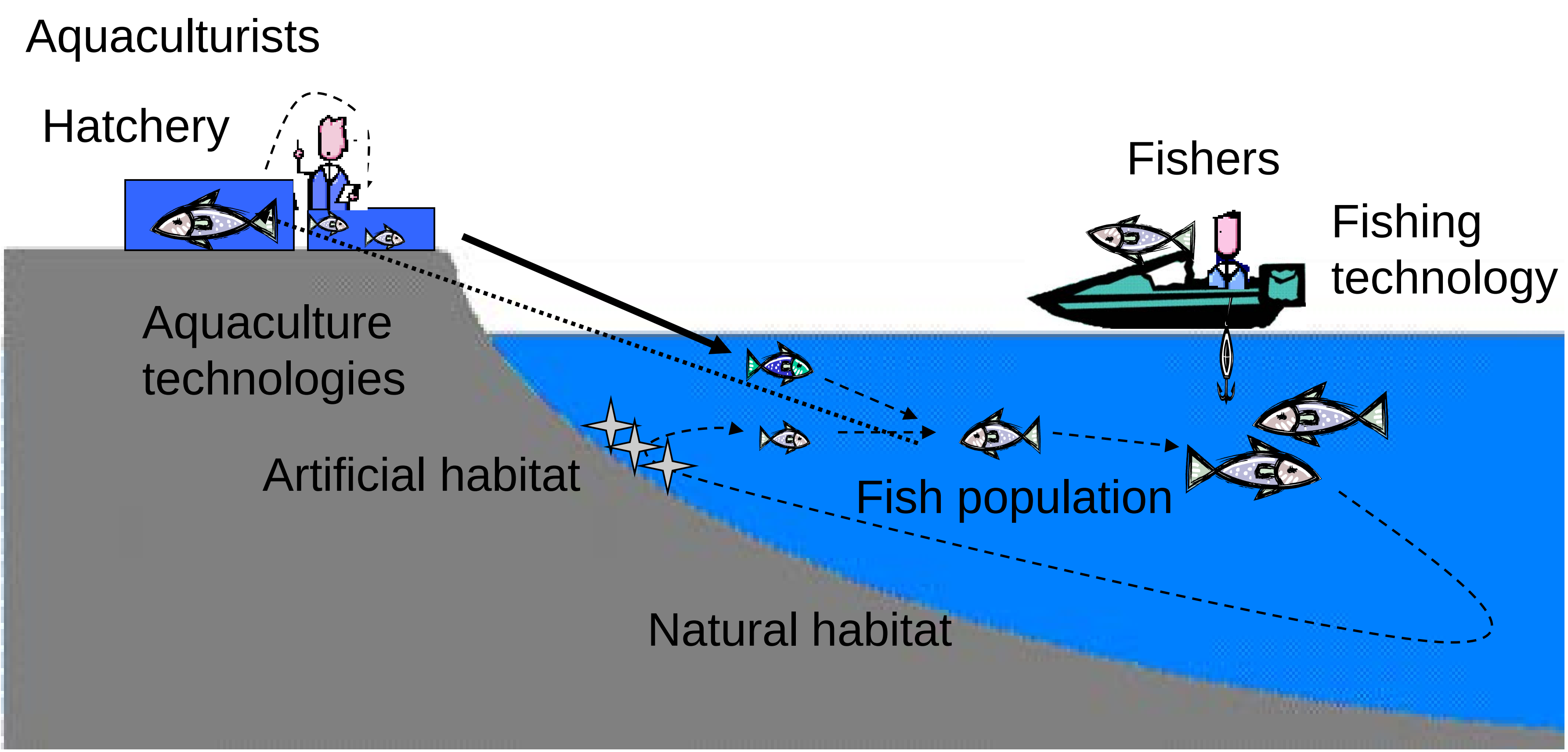
Interactions between Offshore Aquaculture and Fisheries



Much can be learned from the practice and science of fisheries enhancement: hatchery fish and artificial habitat



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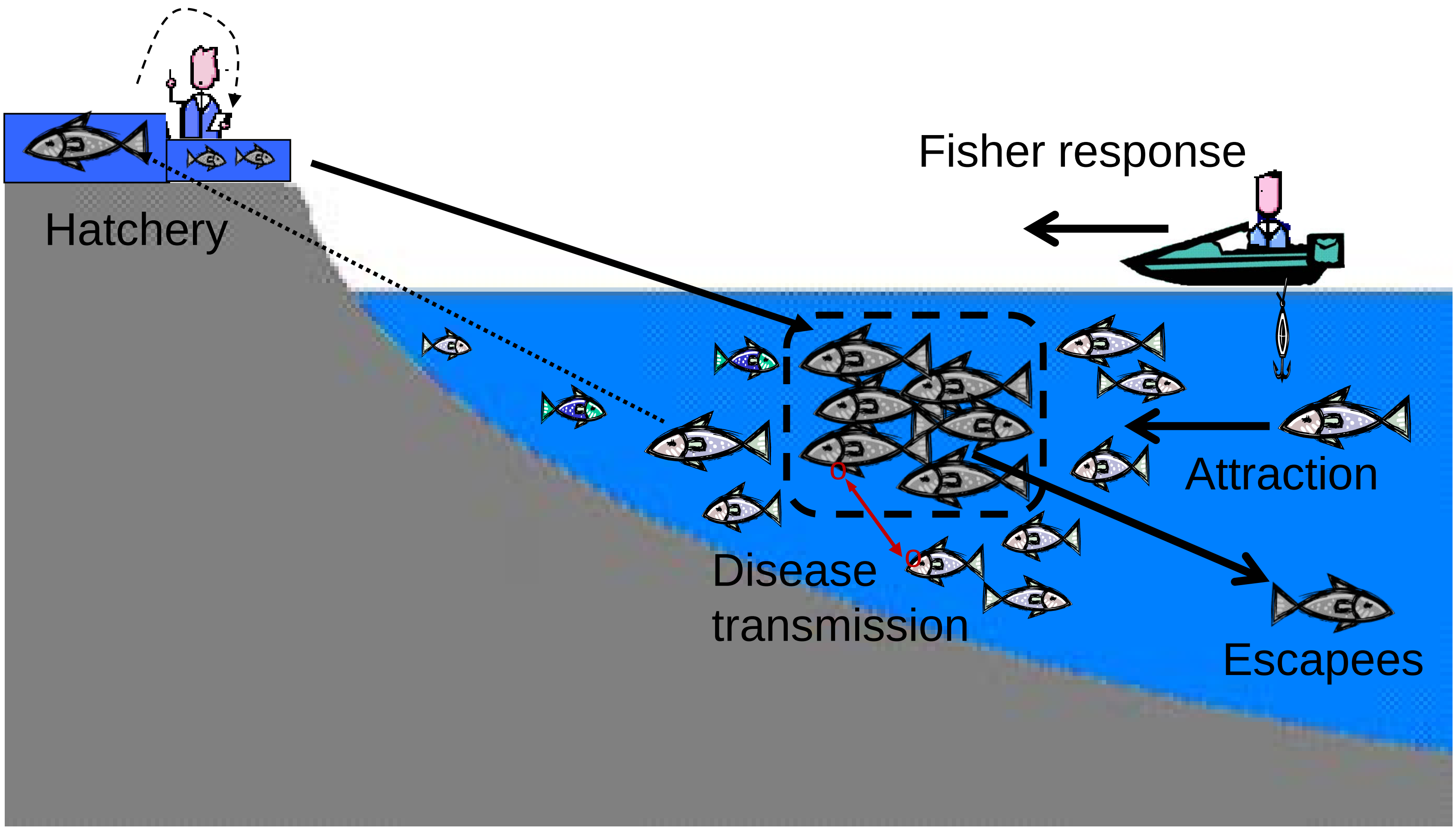
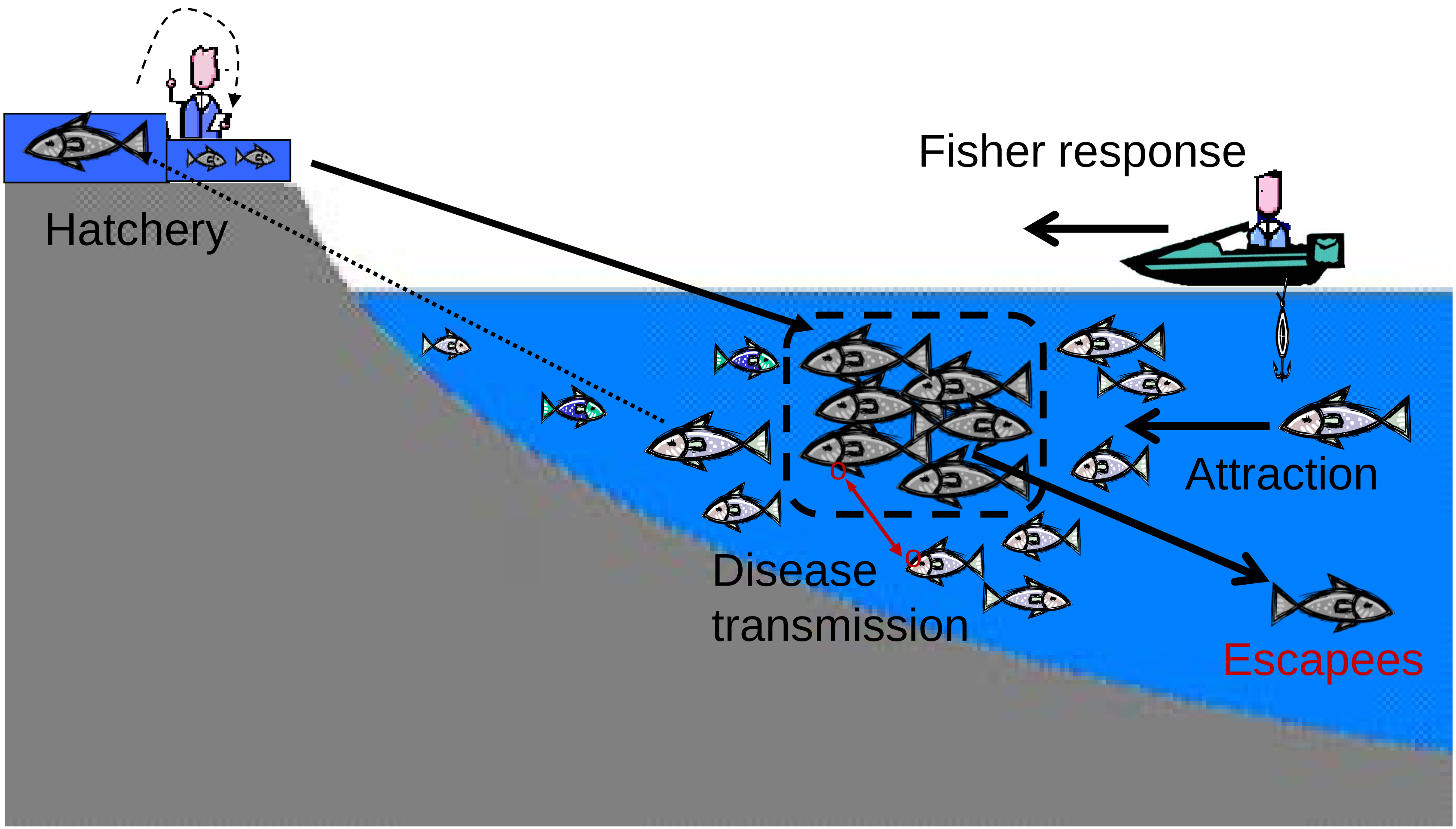


Interactions between Offshore Aquaculture and Fisheries

Escapees



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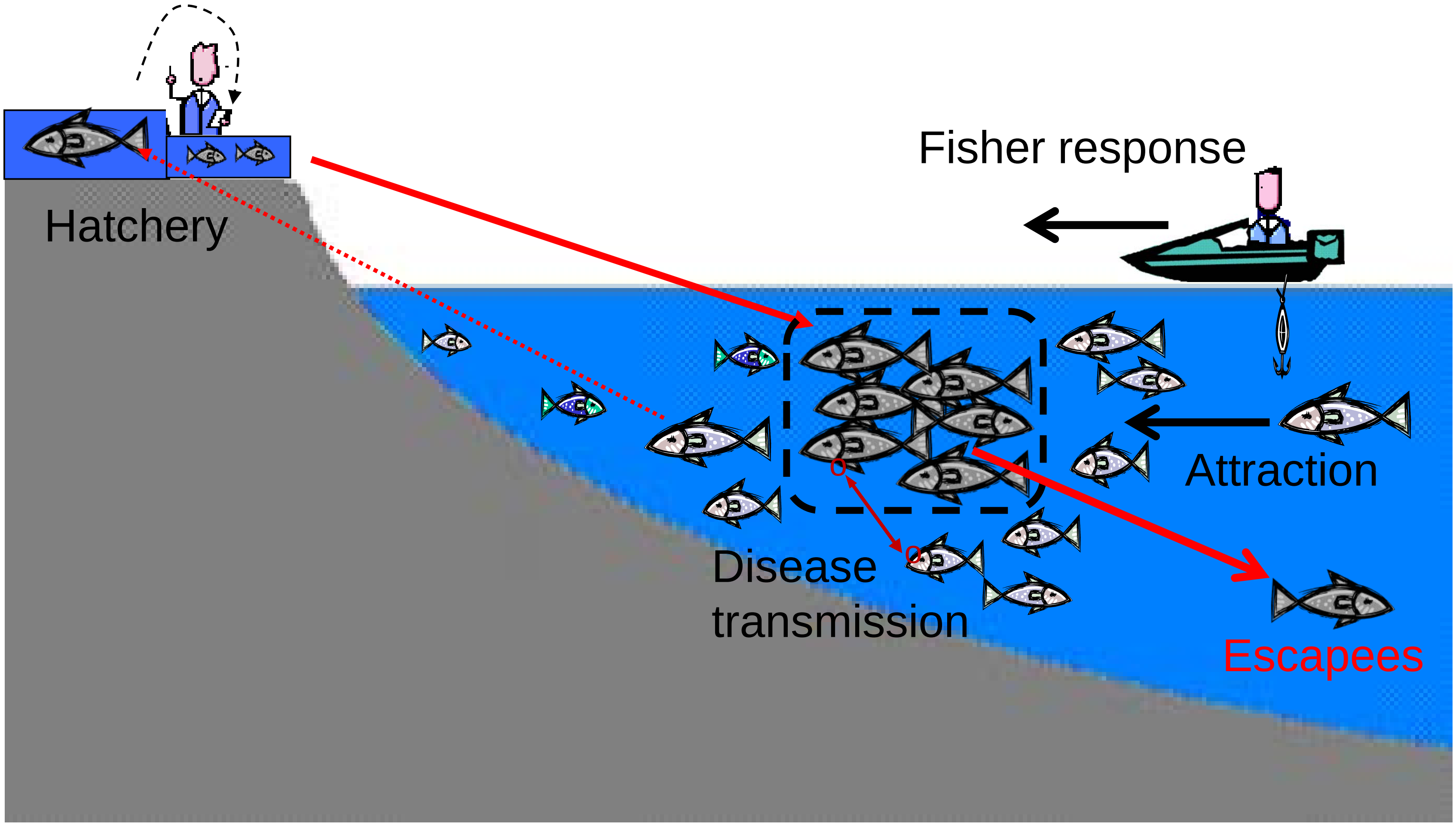
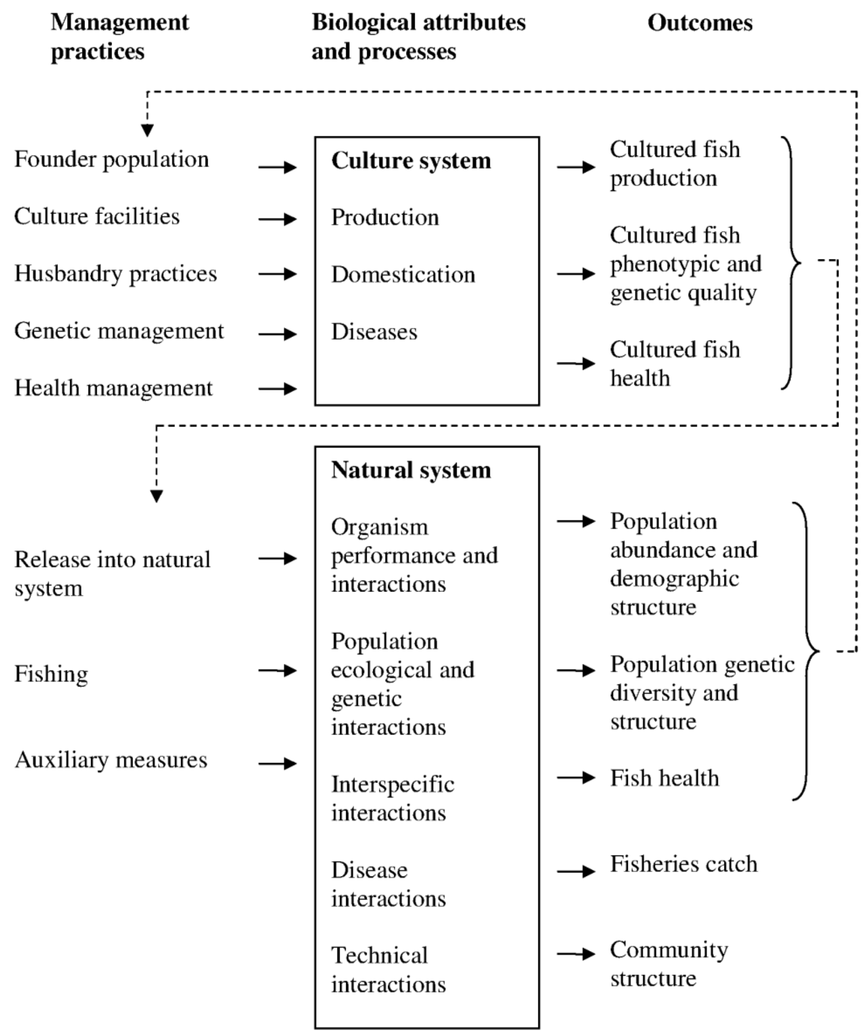
Escapees



Interactions between farmed and wild fish



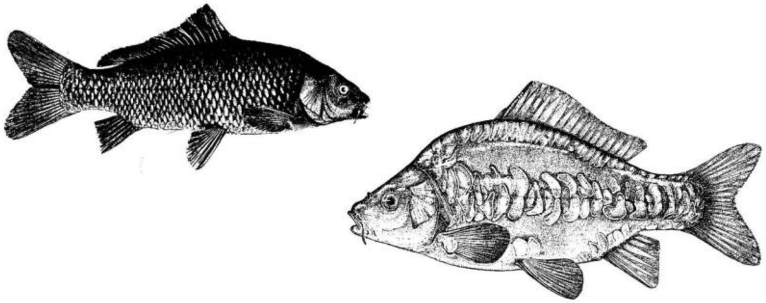
Lorenzen, Beveridge & Mangel *Biological Reviews 87:* 639–680, 2012

Key factors: relative abundance and conservation status of the wild population

- Most interactions* are strongest when farmed fish are abundant relative to wild fish.
- Small/declining wild populations may be particularly vulnerable to such interactions.
- Consider Atlantic salmon in Norway vs. Almaco jack or red drum in the Gulf

* Exceptions: introduction of invasive fish or parasites/pathogens

Cultured fish undergo a process of domestication



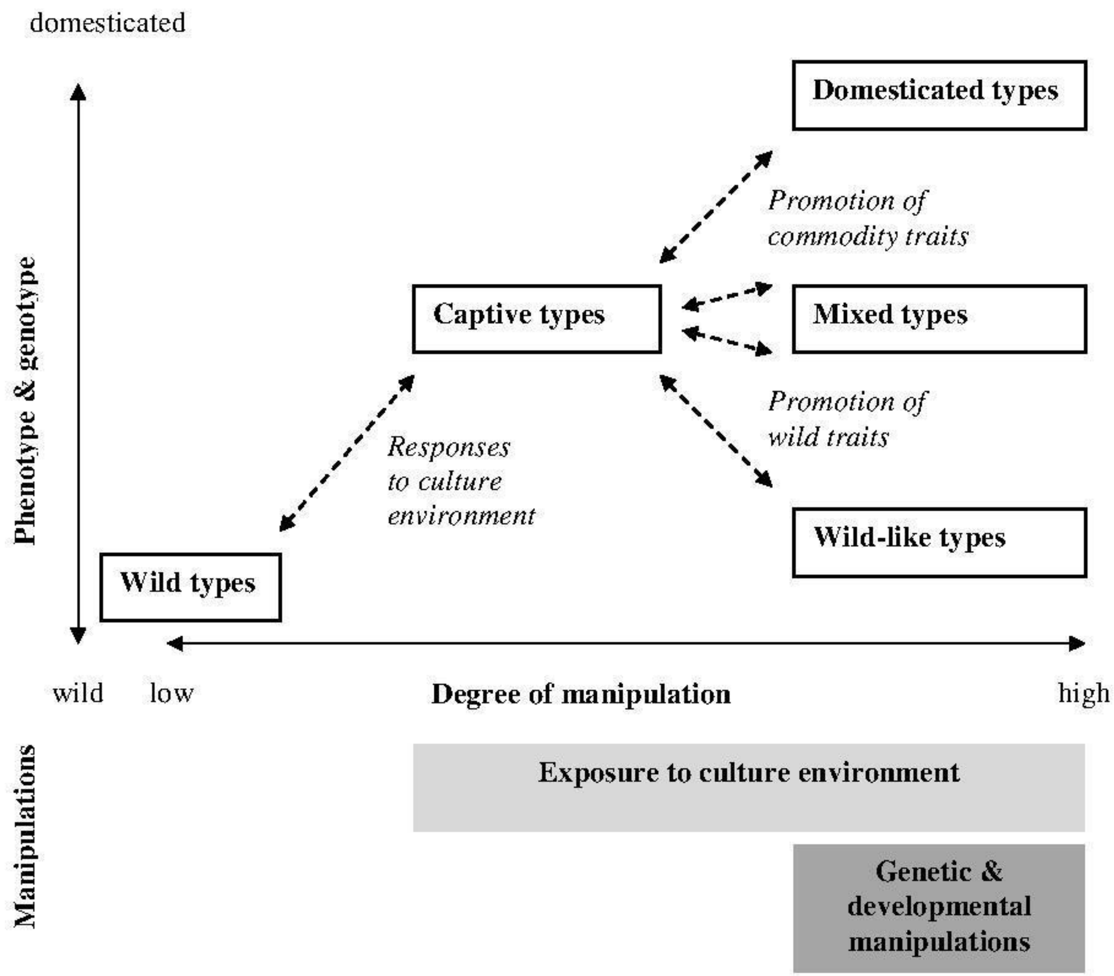
Domestication involves (Price 2002):

- genetic changes occurring over generations and
- developmental effects (phenotypic plasticity) recurring during each generation

-> Improved performance in culture

-> Reduced performance (fitness) in the wild

Processes and modes of domestication

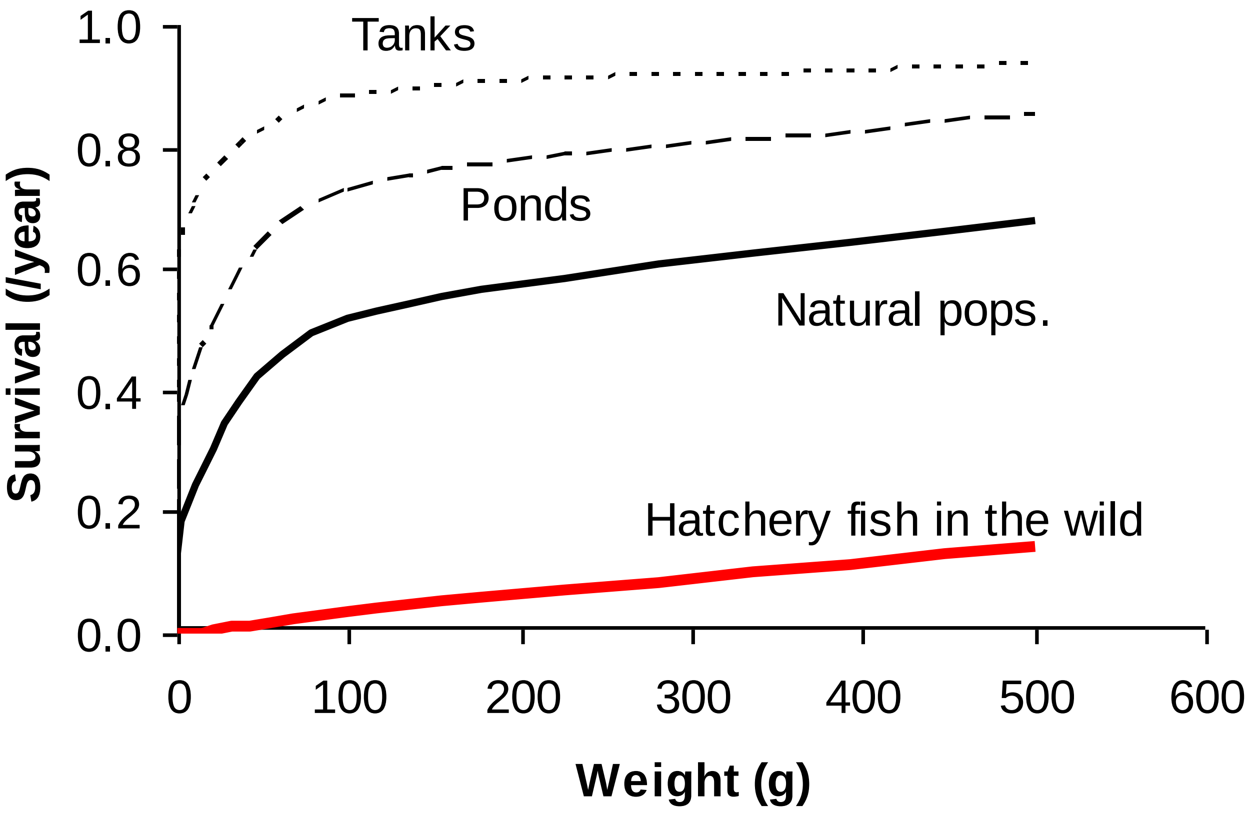


Lorenzen, Beveridge & Mangel *Biological Reviews 87:* 639–680, 2012

Natural vs. aquaculture environment

Attribute	Natural habitats	Aquaculture
Overall extent	Large, often open	Small, confined
Complexity	High	Low
Resource availability	Lower than uptake capacity, unpredictable	Matching or exceeding uptake capacity, predictable
Predation risk	High	Very low
Disease risk	Variable	High (but controllable)
Population density	Low	Very high
Disturbance	Rare	Very common
Selection	Natural, sexual	Artificial, natural

Comparative survival of fish



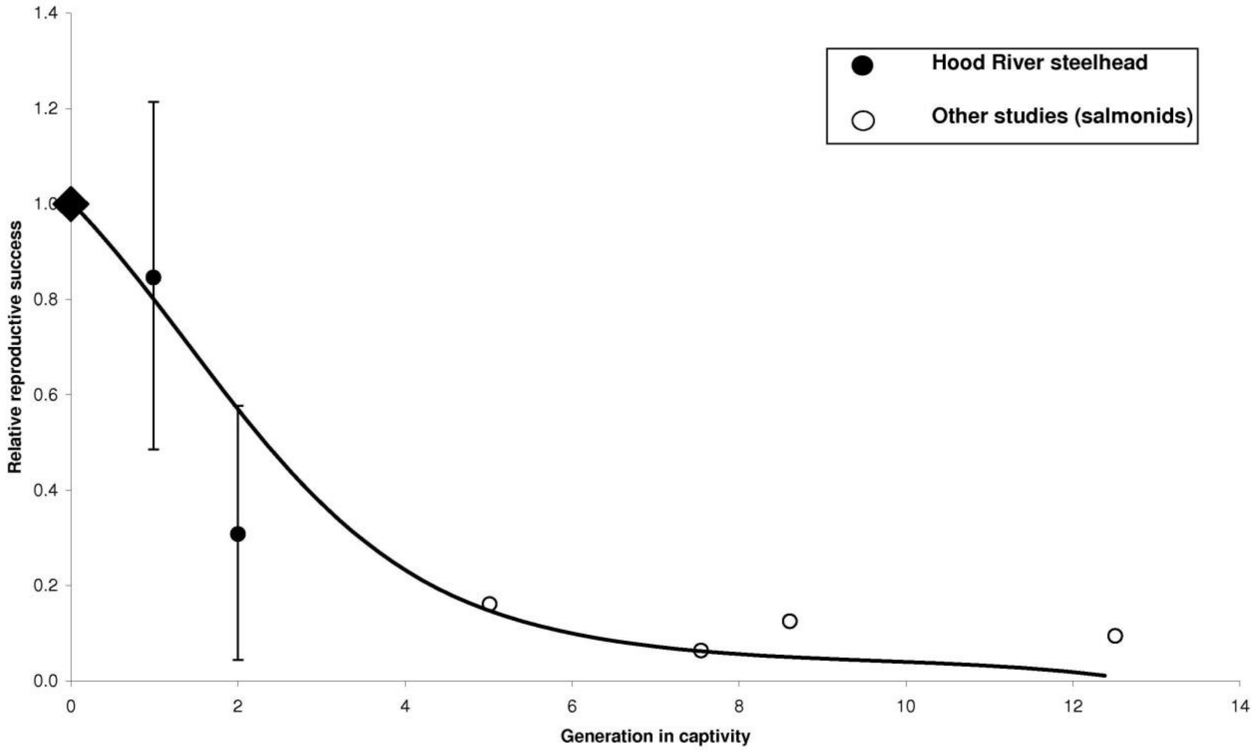
In aquaculture

In wild populations

Escaped farmed fish in the wild

Based on data from Lorenzen 1996, 2000

Genetic loss of fitness-in-the-wild vs. number of generations in captivity



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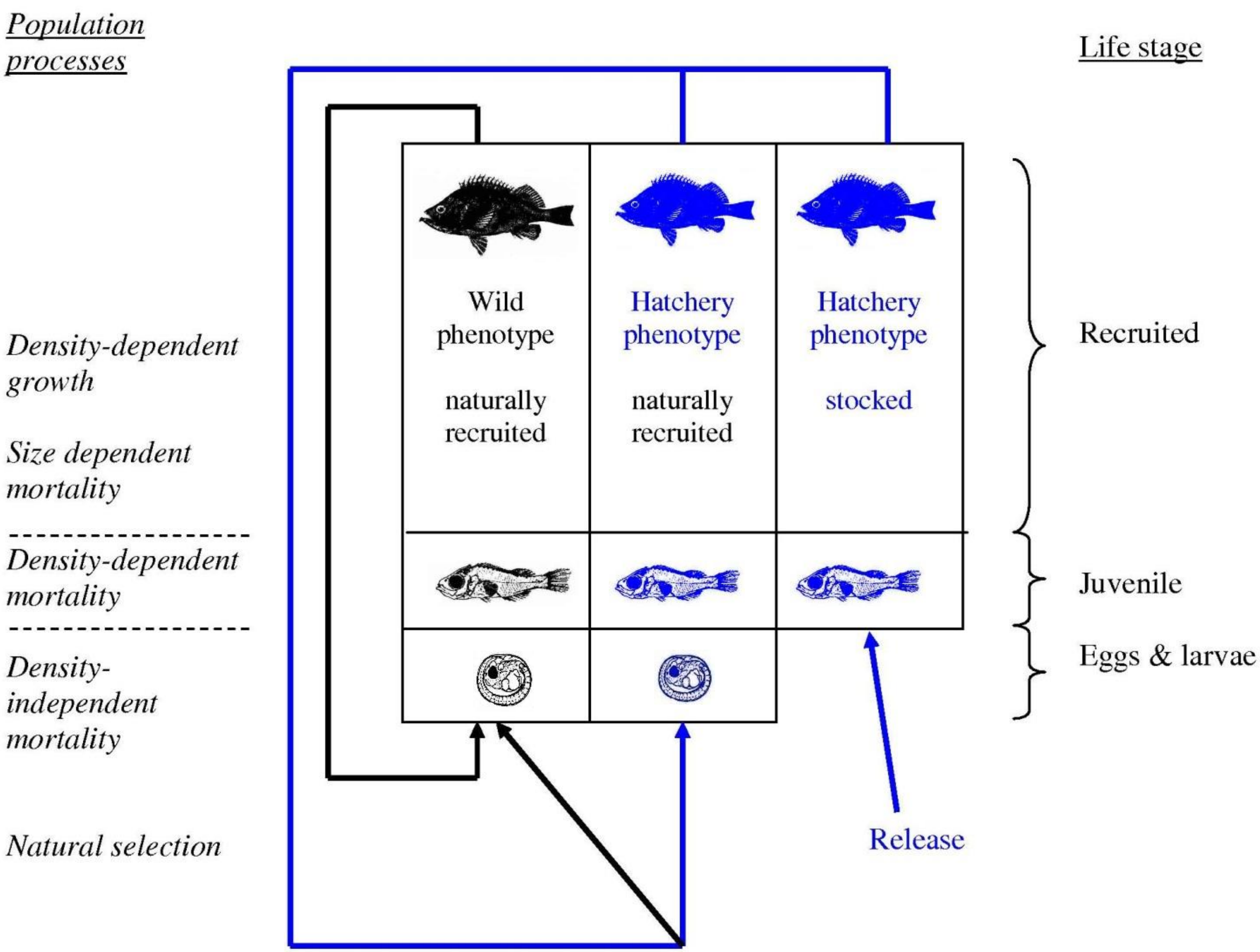
How do escapees interact with wild conspecifics? Population model for enhanced fisheries



Lorenzen, *Phil Trans Roy Soc B* 360: 171–189, 2005

Some generic results

Strongest interactions when:

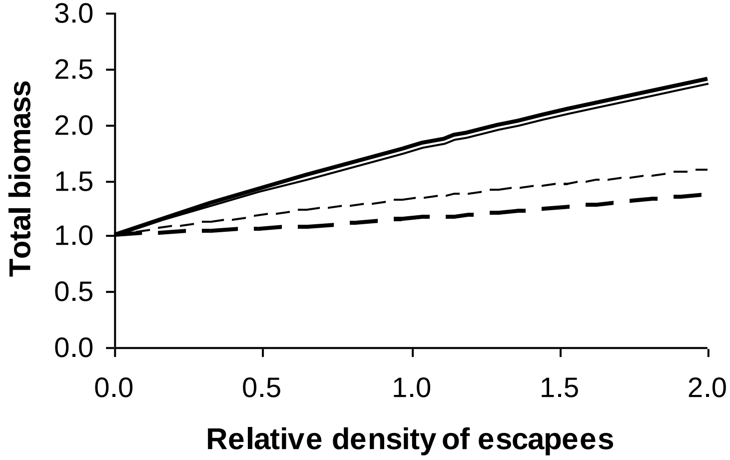
- farmed fish abundance is high relative to wild
- maladaptation to life in the wild is only moderate and genetically based.

-> When farmed fish abundance is very low relative to wild fish, interactions are minimal.

-> When farmed fish abundance is high, alternative husbandry and genetic management approaches can give very different outcomes

Impacts of farm escapees on wild populations: effects of survival and reproduction

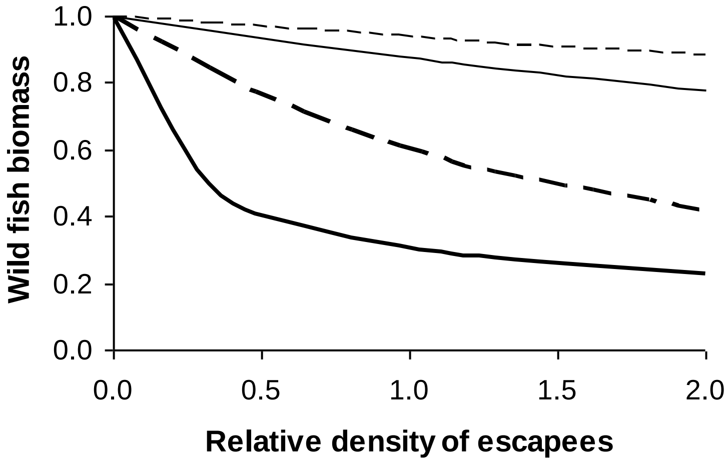
Total biomass



Wild-like survival, no reprod.
Wild-like survival, reprod.

Low survival, no reprod.
Low survival, reprod.

Wild type biomass



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Impacts of farm escapees on wild populations: effects of survival and reproduction

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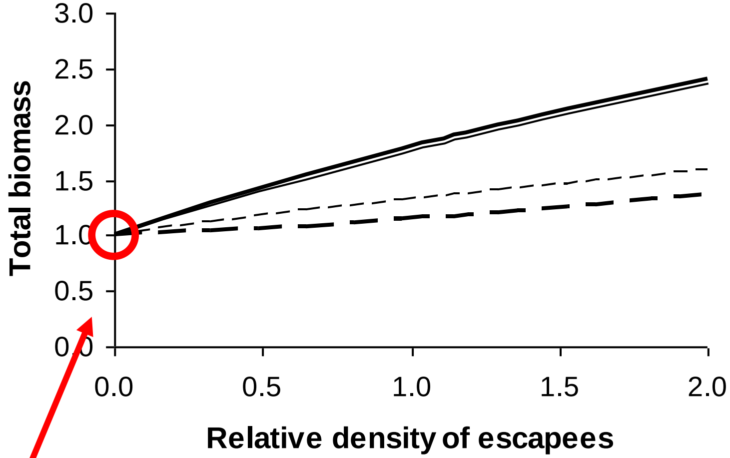
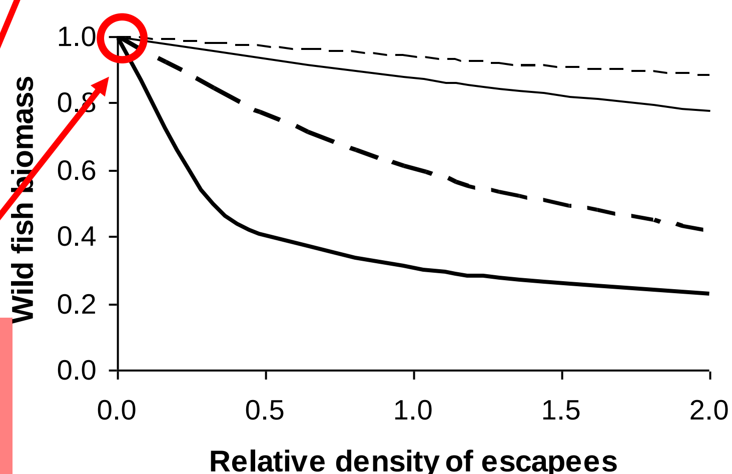


Wild-like survival, no reprod.
Wild-like survival, reprod.

Low survival, no reprod.
Low survival, reprod.

Wild type biomass



Low survival, no reprod.
Wild-like survival, no reprod.

Low survival, reprod.
Wild-like survival, reprod.

If the number of escapees is very low, non of this matters

Minimizing risks from escapes: alternatives

1. Reduce escapes (review when and where escapes occur and improve facilities/management)
2. Produce sterile fish (triploids)
3. Advance domestication: benefit aquaculture and reduce performance in the wild (multiple traits?)
4. Preserve wild attributes in cultured fish (stock structure, adaptation)
5. Multiple measures (1–3) may be most effective

Minimizing risks from escapes: alternatives

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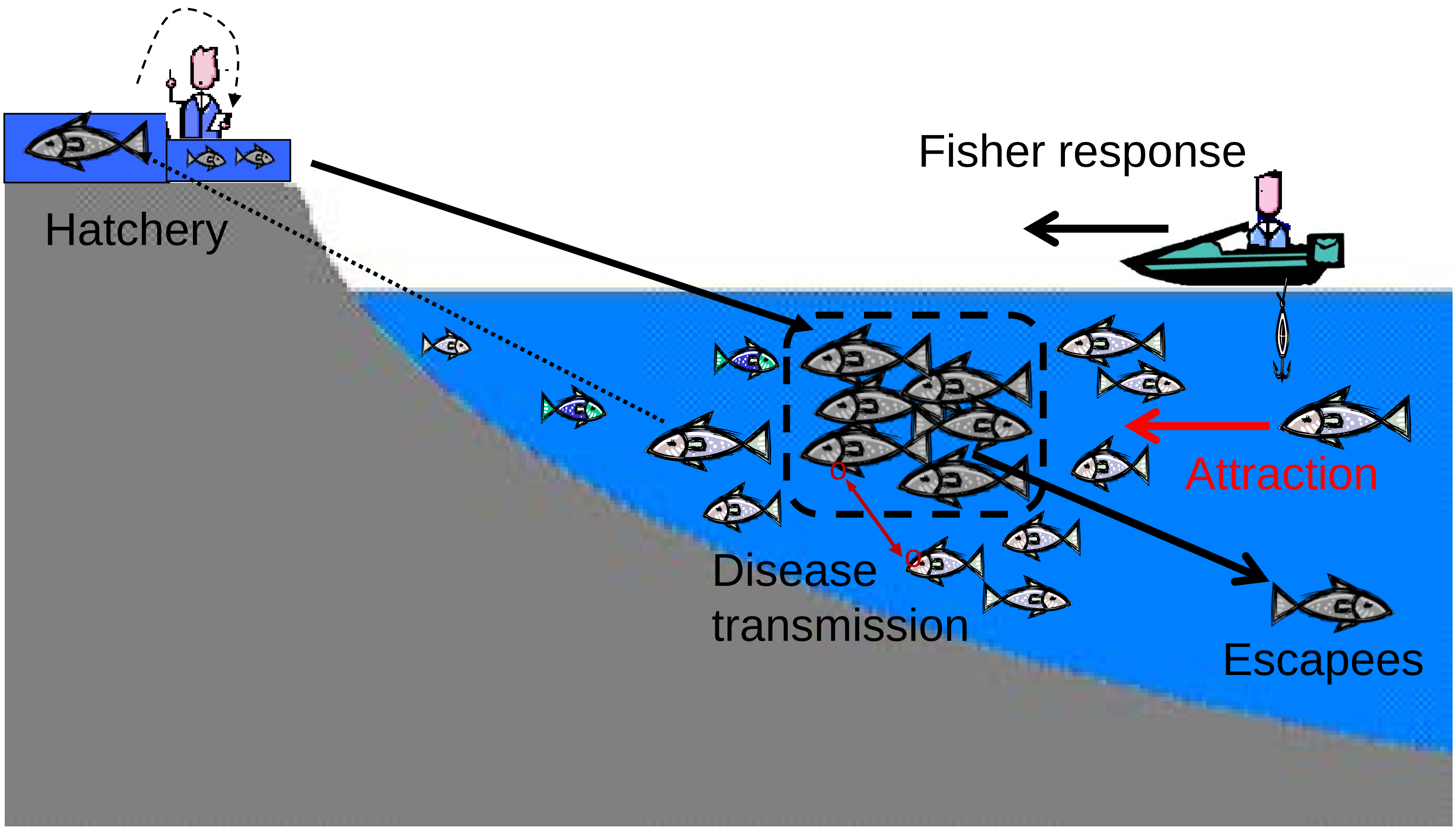
Interactions between Offshore Aquaculture and Fisheries

Attraction of wild fish to cages

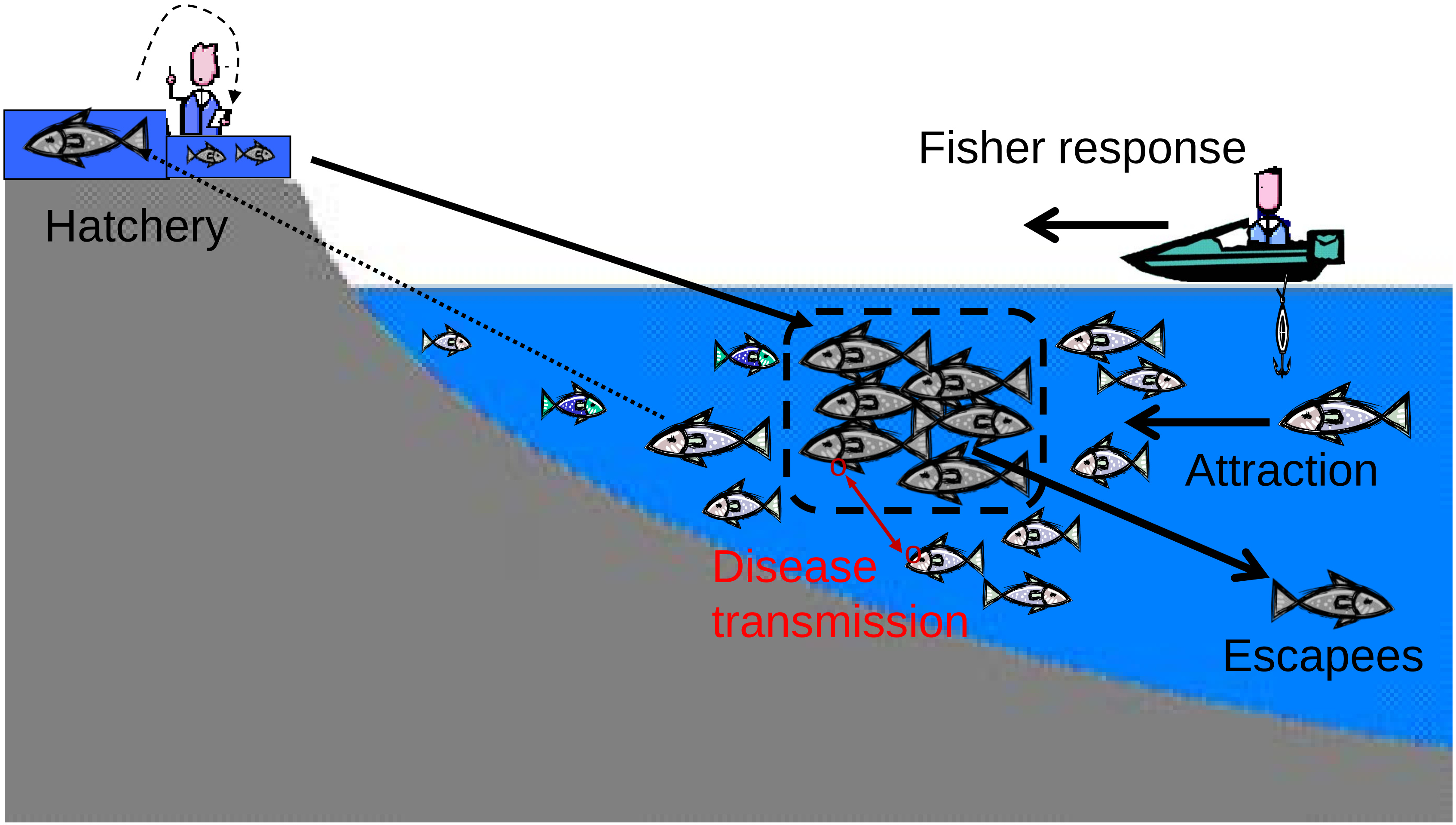


Attraction and aggregation of wild fish

- Cage aquaculture operations have impacts on the behavior of wild fish
- Attracting and aggregating fish in ways similar to fish aggregation devices or artificial reefs
- Enhances the scope for certain biological interactions such as disease transmission
- Enhance harvesting opportunities for fishers.

Interactions between Offshore Aquaculture and Fisheries

Disease (parasite) transmission

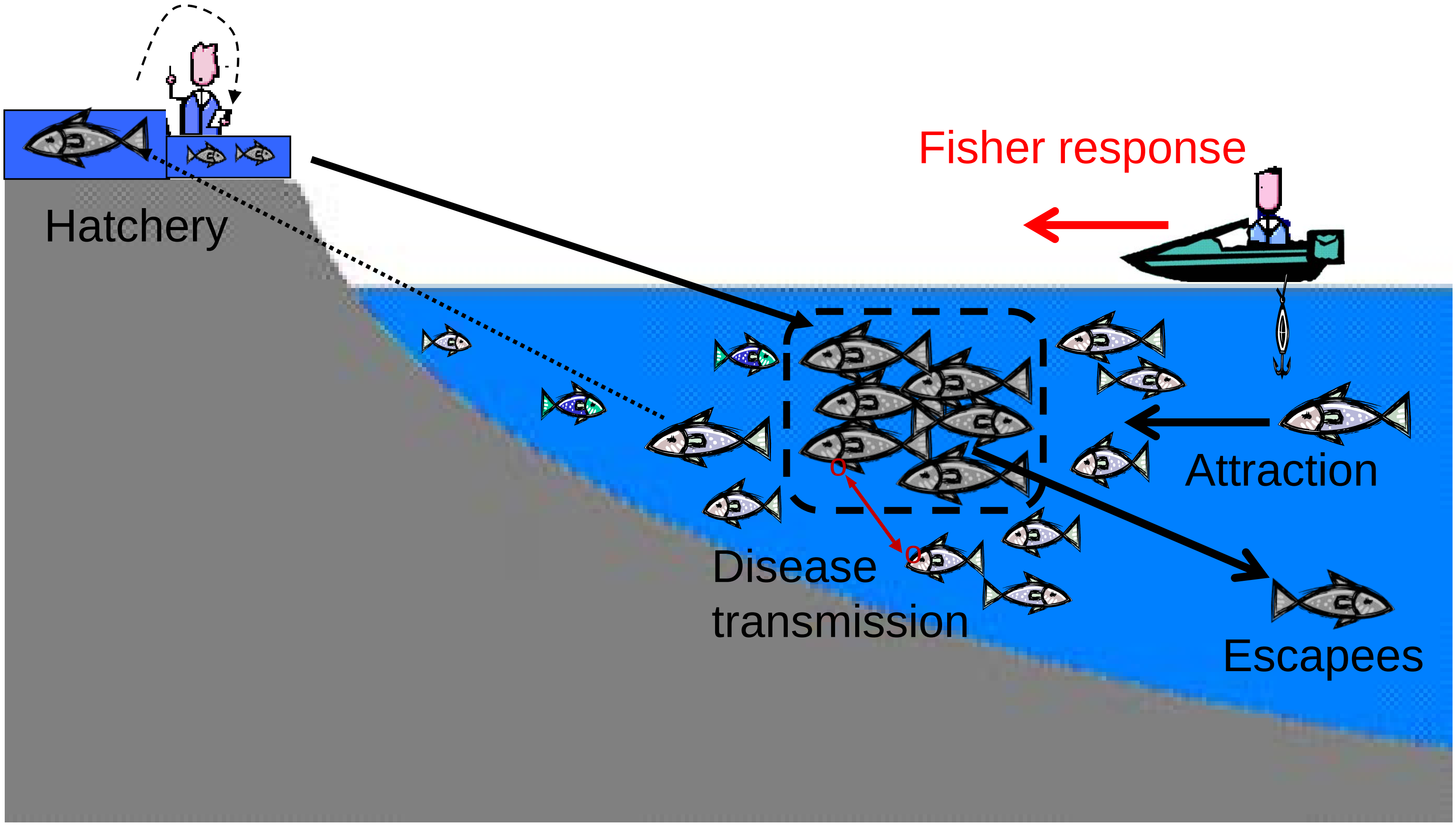


Disease (parasite) transmission

- Formulated feed & low predation in culture largely eliminate transmission of macroparasites with complex life cycles
- High density in culture enhances transmission of microparasites with direct lifed cycles (e.g. bacteria, viruses, sea lice) an may lead to evolution of higher virulence
- Open nature of cage farm allows transmission of microparasites to wild fish
- Health management (vaccination, treatment) on the farm is key to minimizing risk of transmission to wild stocks but is not always sufficient

Interactions between Offshore Aquaculture and Fisheries

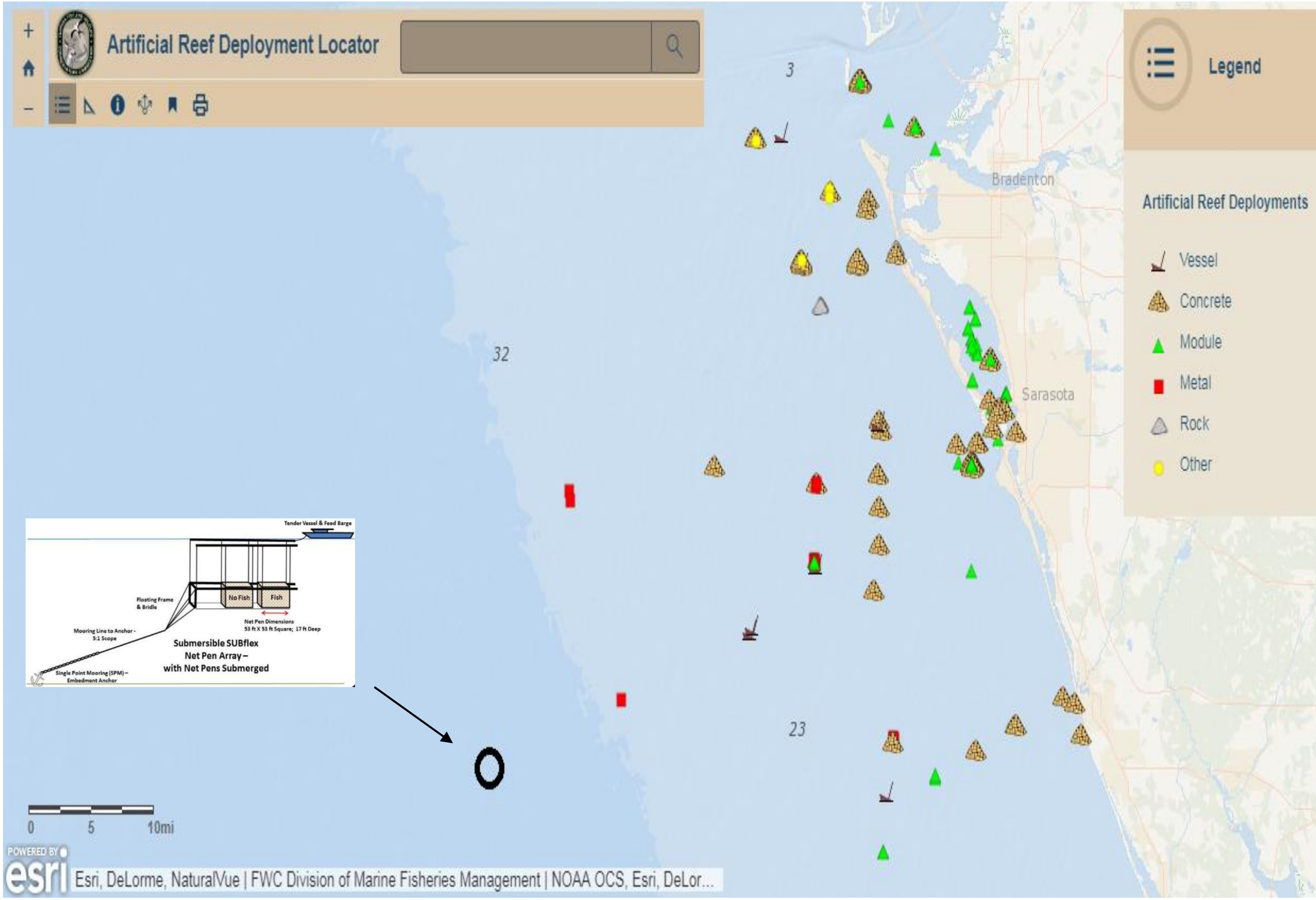
Fisher responses



Fisher responses

- Fishers may seek out harvesting opportunities provided by escaped farmed and aggregated wild fish.
- Can reduce interactions between farmed and wild fish
- Can affect the exploitation level of wild stocks in ways similar to fish aggregating devices.
- Potential for complex interactions with fisheries that require concerted attention from both sectors

Velella Epsilon cage as a FAD/AR



Conclusions and outlook (I)

- Good conceptual understanding of potential interactions between offshore aquaculture and fisheries
- Increasingly sophisticated quantitative models and tools for risk assessment and management planning
- Learning from fisheries enhancements

Conclusions and outlook (II)

- Small-scale pilot projects for the culture of native species that are abundant in the wild pose limited risks
- Provide important empirical information on interactions with fisheries that can help to test and refine models, risk assessments and management plans.
- Fisheries interaction studies should complement pilot aquaculture projects.
- Studies should be accompanied by a stakeholder process involving fisheries and aquaculture stakeholders.

Conclusions and outlook (III)

Some issues and approaches are likely to change when/if the industry expands and develops, due to:

- Increase in numbers of facilities
- Increase in number of farmed fish and escapees
- Advancing domestication
- Emerging diseases

Aquaculture Product Safety ?

Essential Concern with Reasonable Solutions

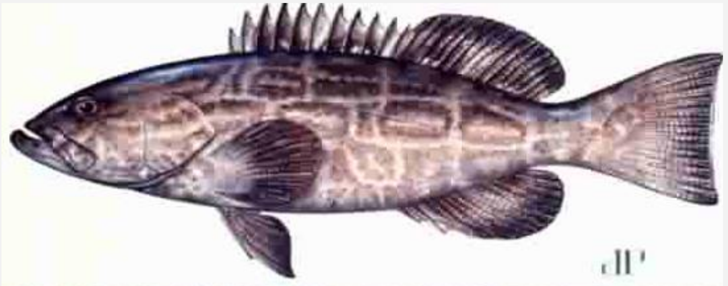
Steve Otwell
Professor Emeritus

Aquaculture products as consumed in the United States remain one of the safest sources of healthful muscle food eating in the world,

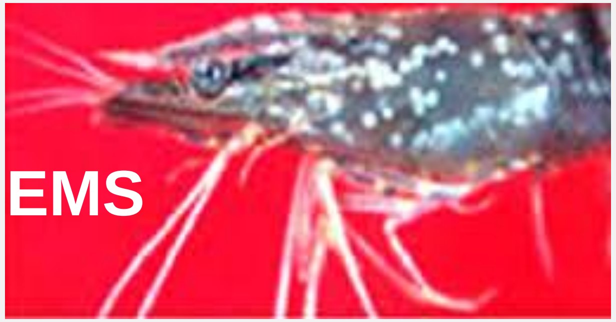
YET, food safety remains one of the most often questioned concerns for aquaculture products

Multiple Misperceptions imply or assume aquaculture products are unsafe ....

- New, different, foreign sources (suspect)
- Sustainability and environmental problems
- Species substitution



Persistent issue …. Illegal or improper use of therapeutic drugs (antibiotics)



- Current aquaculture production is comparatively young and lacks experience and control options
- Diseases are persistent and anticipated due to some current practices and predicted environmental consequences
- New species and new areas mean more issues

Thoughtless claims to gain notice and perceived advantages in research and markets

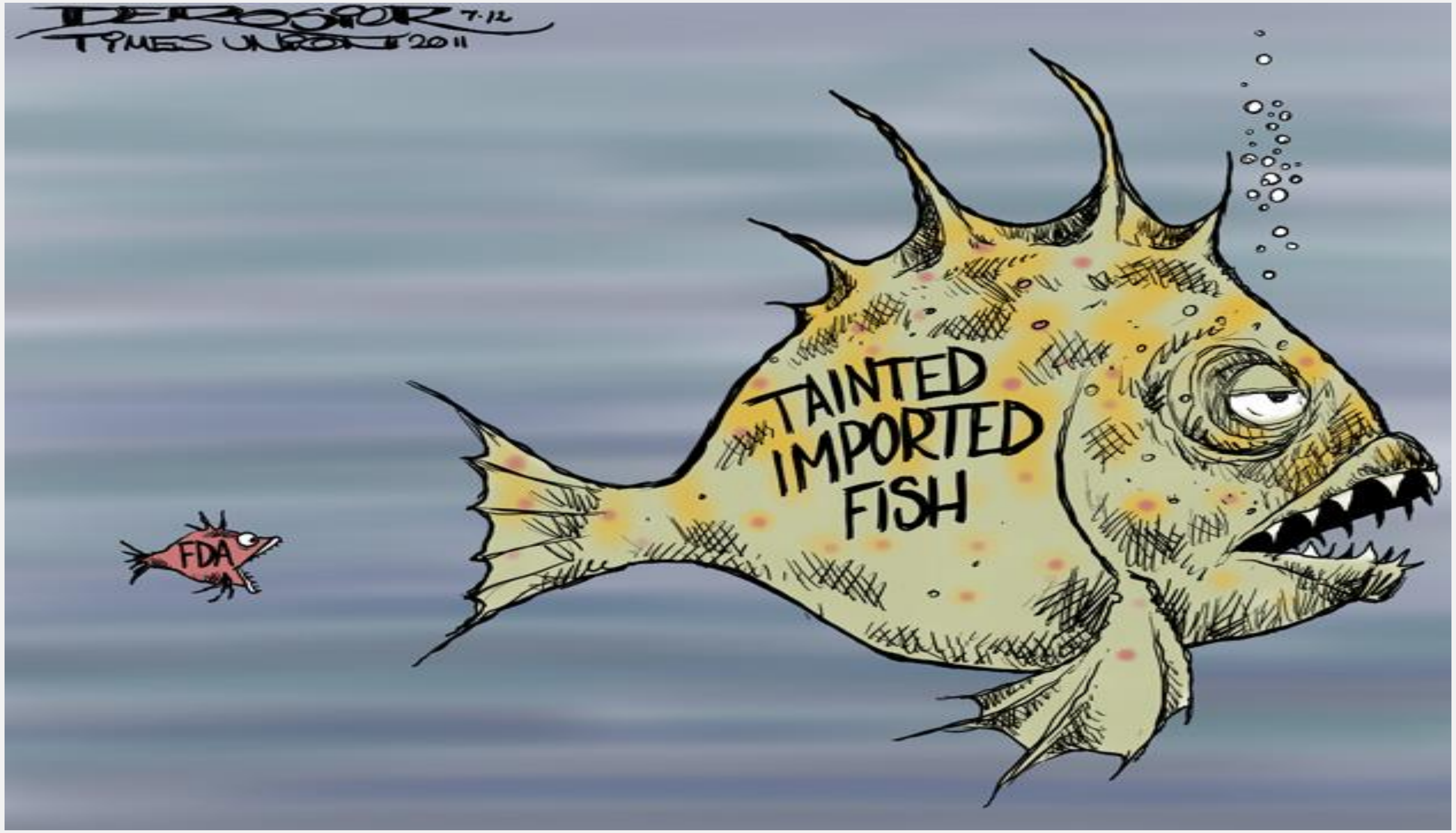
Competition errantly using food safety to get advantage (no regulation, contaminated, less fatty acids, PCB's, drugs, etc…)

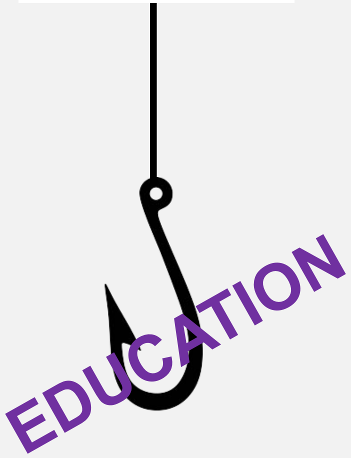
Tilapia worse than Bacon

Calls for alternative regulation and efforts to prove a more effective agency

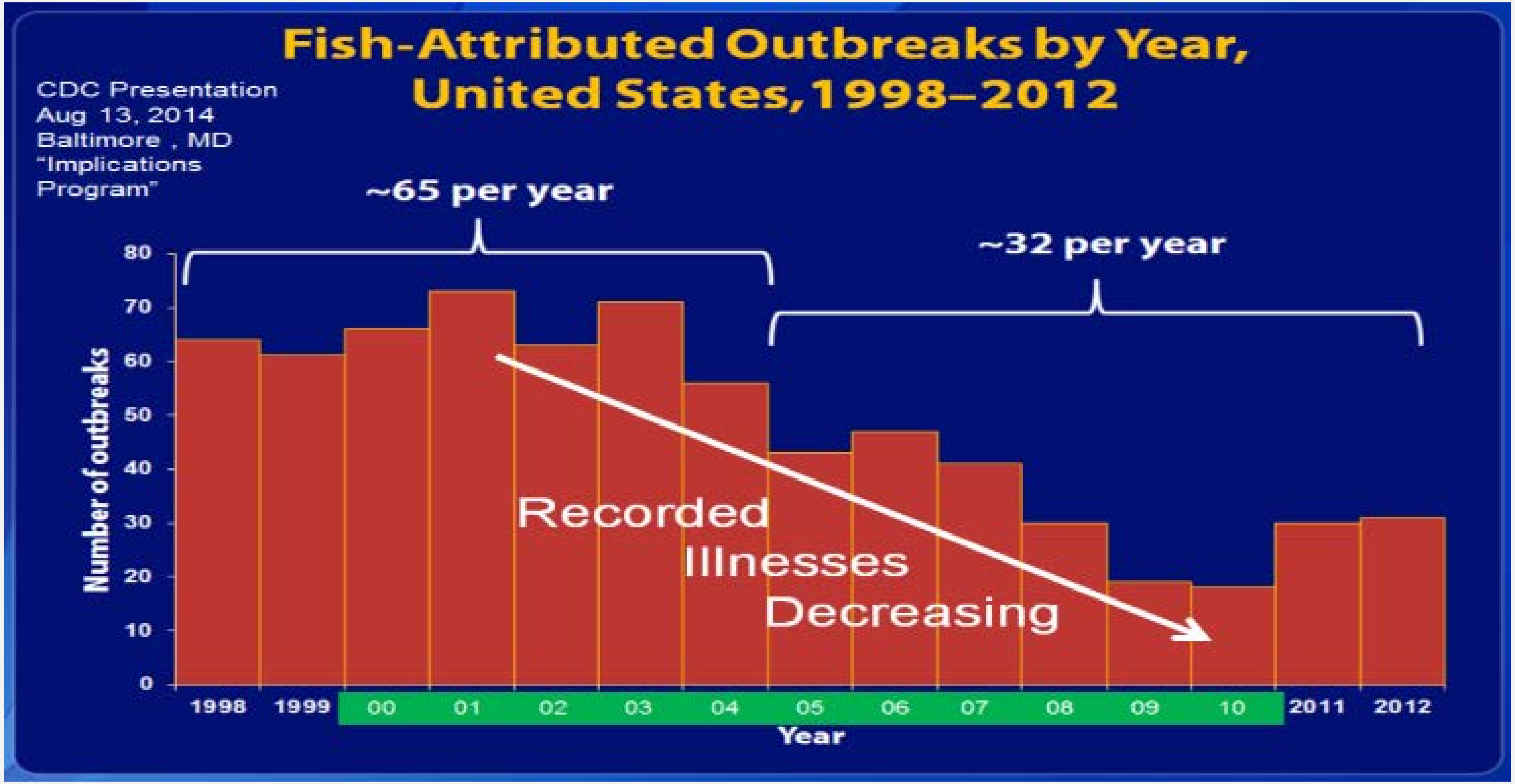
USDA vs. FDA

Public Perceptions and Expectations are calling for More Response





Based on actual illnesses, aquaculture products have not and should not poise more significant food safety problems



USA Per Captia Consumption

Rank	1990		2000		2010		2016	
1	Tuna, C	3.7	Tuna, C	3.5	Shrimp	4.0	Shrimp	4.1
2	Shrimp	2.2	Shrimp	3.2	Tuna, C	2.7	Salmon	2.2
3	Cod	1.4	Pollock	1.6	Salmon	2.0	Tuna, C	2.1
4	Pollock	1.3	Salmon	1.6	Tilapia	1.5	Tilapia	1.2
5	Salmon	0.7	Catfish	1.1	Pollock	1.2	Pollock	1.0
6	Catfish	0.7	Cod	0.8	Catfish	0.8	Pang.+	0.9
7	Clams	0.6	Clam	0.5	Crab	0.6	Cod	0.5
8	Flatfish	0.6	Crab	0.4	Cod	0.4	Crab	0.5
9	Crabs	0.3	Flatfish	0.4	Pang.+	0.4	Catfish	0.5
10	Scallops	0.3	Scallops	0.3	Clams	0.3	Clam	0.3

Tuna, C = Canned Tuna; Pang.+ = Pangasius (Basa and Swai)

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5	Salmon	0.7	Catfish	1.1	Pollock	1.2	Pollock	1.0
6	Catfish	0.7	Cod	0.8	Catfish	0.8	Pang.+	0.9
7	Clams	0.6	Clam	0.5	Crab	0.6	Cod	0.5
8	Flatfish	0.6	Crab	0.4	Cod	0.4	Crab	0.5
9	Crabs	0.3	Flatfish	0.4	Pang.+	0.4	Catfish	0.5
10	Scallops	0.3	Scallops	0.3	Clams	0.3	Clam	0.3

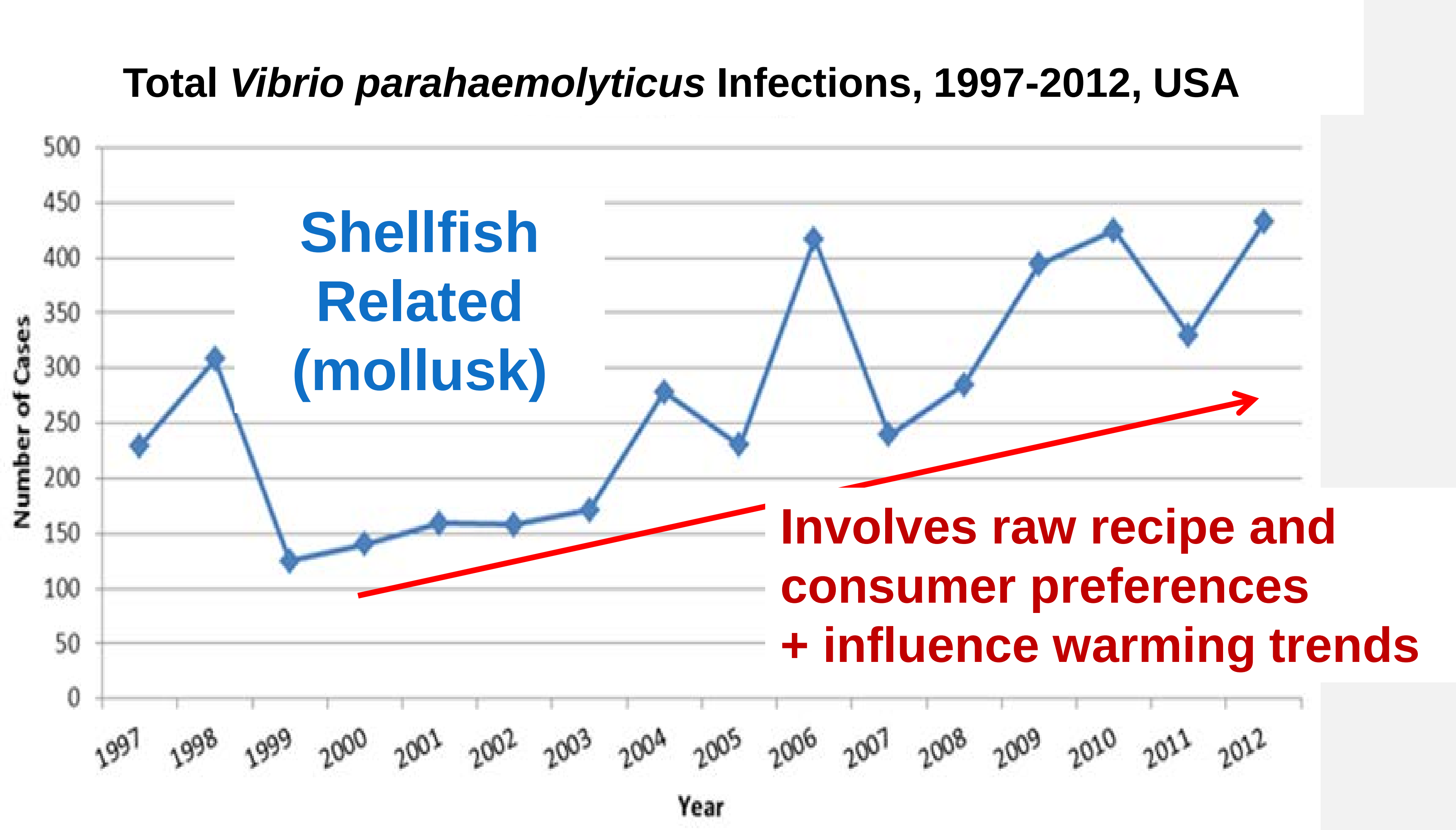
Tuna, C = Canned Tuna; Pang.+ = Pangasius (Basa and Swai)

USA Per Captia Consumption

Rank	1990		2000		2010		2016	
1	Tuna, C	3.7	Tuna, C	3.5	Shrimp	4.0	Shrimp	4.1
2	Shrimp	2.2	Shrimp	3.2	Tuna, C	2.7	Salmon	2.2
3	Cod	1.4	Pollock	1.6	Salmon	2.0	Tuna, C	2.1
4	Pollock	1.3	Salmon	1.6	Tilapia	1.5	Tilapia	1.2
5	Salmon	0.7	Catfish	1.1	Pollock	1.2	Pollock	1.0
6	Catfish	0.7	Cod	0.8	Catfish	0.8	Pang.+	0.9
7	Clams	0.6	Clam	0.5	Crab	0.6	Cod	0.5
8	Flatfish	0.6	Crab	0.4	Cod	0.4	Crab	0.5
9	Crabs	0.3	Flatfish	0.4	Pang.+	0.4	Catfish	0.5
10	Scallops	0.3	Scallops	0.3	Clams	0.3	Clam	0.3

Tuna, C = Canned Tuna; Pang.+ = Pangasius (Basa and Swai)

Critics will suggest otherwise …



Critics will suggest otherwise …

SEAFOOD* IMPORT REFUSALS

*wild & farm raised

REFUSAL CHARGES	ENTRIES REFUSED
FILTH	695
SALMONELLA	503
VET DRUGS	144
MFR HACCP ISSUE	135
LISTERIA	85
INSANITARY	60
HISTAMINE	50

- Most not aquaculture specific
- Most not resulting in illnesses

Based on actual illnesses, aquaculture products have not and should not poise more significant food safety problems

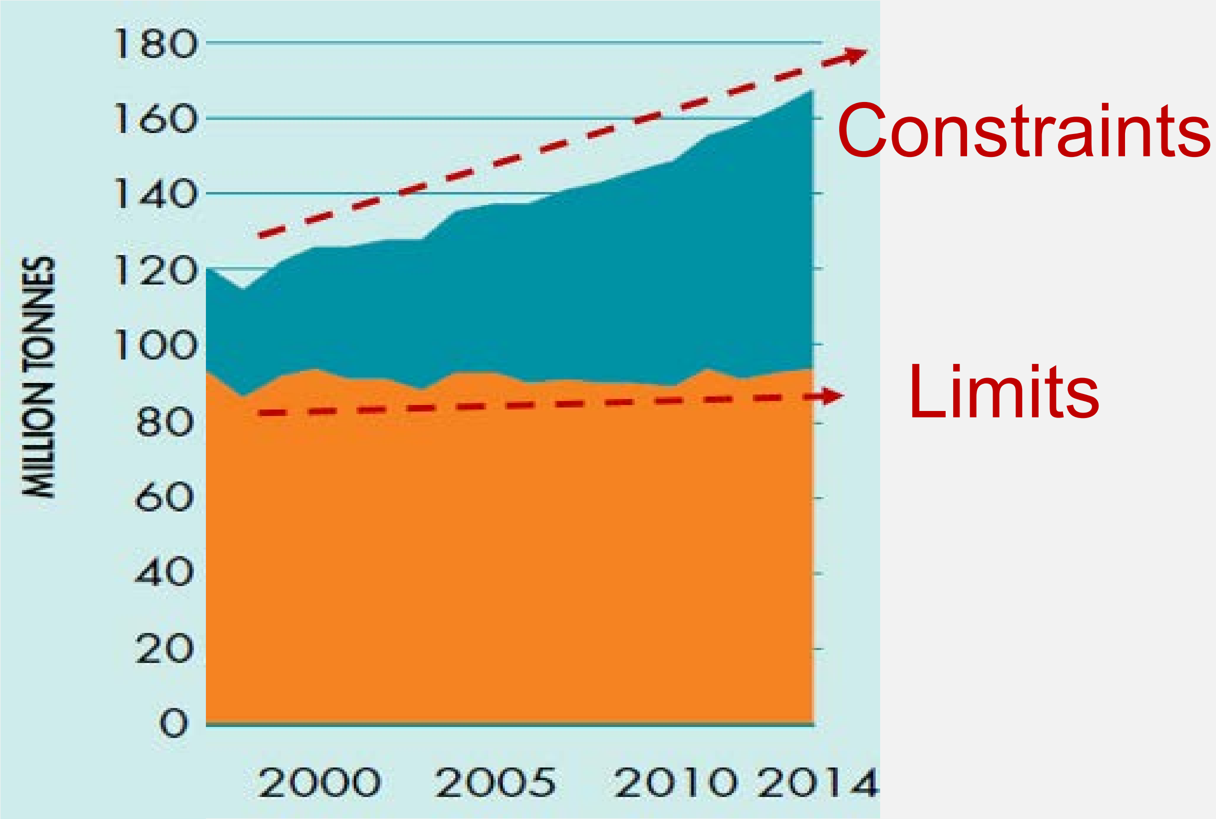
- Likely hazards (species-related) are known and most are similar to wild seafood in terms of occurrence prior to or during harvest
- Aquaculture can offer more controls prior to harvest
- Processing hazards are similar for all seafood and HACCP controls have proven effective

"The number one seafood safety problem in the world is product availability and access … not enough"

Otwell, Sarasota June 2019

Aquaculture is the best answer, but 'potential' problems prevail …

Henceforth, aquaculture will be the primary source for the majority of seafood consumed, and seafood demand will exceed supply



Demand >> Supply

'Supplier' Driven situation favors:

- Competition for supply
- Indifference to details
- Temptations
- Less incentives to comply

Prevailing Regulation - 21 CFR Part 123

FDA Seafood HACCP Regulation

Any fish or fishery products destined for commerce in the United States that are processed or imported in violation of this regulation can be considered adulterated and subject to regulatory action

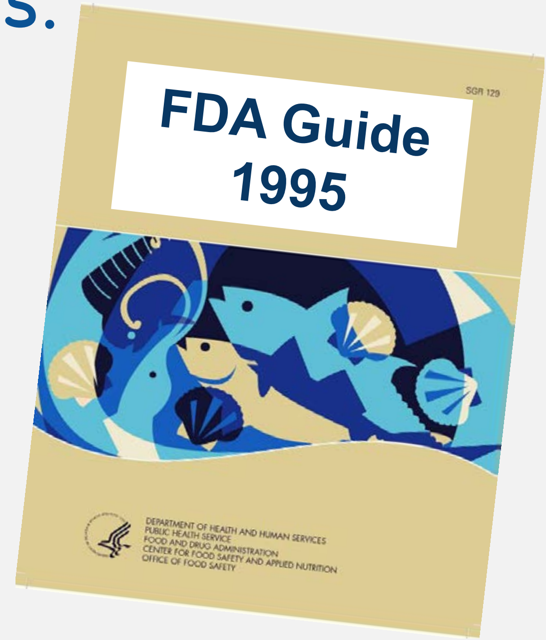
Obligations for regulatory compliance involves Primary Processors and Importers of fish and fishery products, including farm-raised products

What are Fish and Fishery Products?

- Fish means: fresh or salt water finfish, crustaceans, mollusks, other forms of aquatic animal life (e.g., alligator, frog, aquatic turtle, jellyfish, sea cucumber, sea urchin, roe), other than birds or mammals.

harvested or farmed

- Fishery Product means: any food product where fish is a characterizing ingredient.



Pathogens Present
- Bacterial
- Viral

Chemical Contamination
- Environmental (pesticides, herbicides, fertilizers, etc.
- Product Treatments (sulfites, etc..)

Natural Toxins
- Algal Blooms

Parasites
- Water origin
- Feed origin

Aquaculture Drugs
- Illegal
- Improper Use

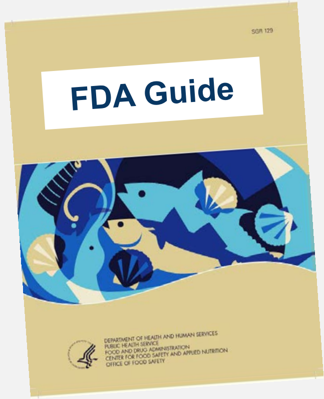
Physical Contamination
- Metal, glass, debris,

Thermal Abuse
- Elevated histamines
- Pathogen growth

Processing Errors
- Pathogen Growth
- C. botulinum
- Food Additives
- Allergens
- Improper cooking
- Physical contaminants

Likely problems are known, and experience has shown that methods to prevent problems are more effective than trying to catch problems …

… yet, knowledge for preventation is lacking



Kampachi

Seriola rivoliana

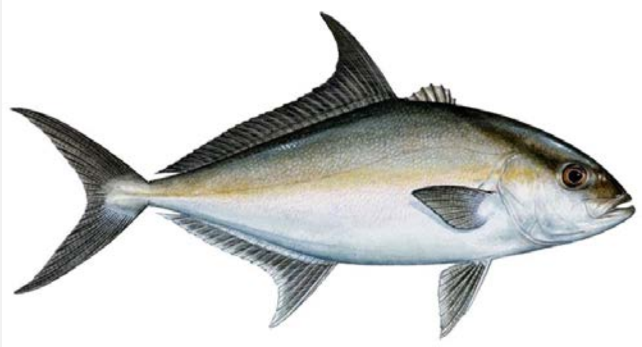
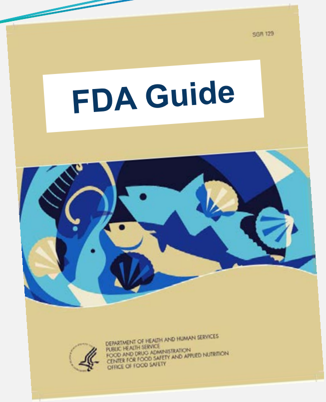


TABLE 3-2

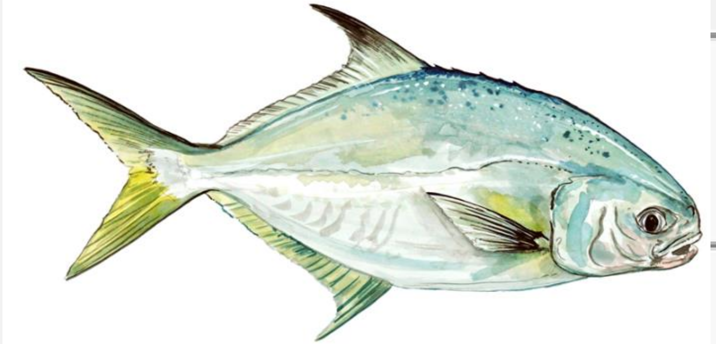
POTENTIAL VERTEBRATE SPECIES-RELATED HAZARDS

Note: You should identify pathogens from the harvest area as a potential species-related hazard if you know or have reason to know that the fish will be consumed without a process sufficient to kill pathogens, or if you represent, label, or intend for the product to be so consumed. (See Chapter 4 for guidance on controlling pathogens from the harvest area.)

MARKET NAMES	LATIN NAMES	HAZARDS				
		PARASITES	NATURAL TOXINS	SCOMBROTOXIN (HISTAMINE)	ENVIRONMENTAL CHEMICALS	AQUACULTURE DRUGS
		CHP 5	CHP 6	CHP 7	CHP 9	CHP 11
AMBERJACK	*Seriola spp.*		CFP	√		
AMBERJACK OR YELLOWTAIL	*Seriola lalandi*			√		
AMBERJACK OR YELLOWTAIL, AQUACULTURED	*Seriola lalandi*			√	√	√



Coryphaena hippurus



Trachinotus blochii

TABLE 3-2

POTENTIAL VERTEBRATE SPECIES-RELATED HAZARDS

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MARKET NAMES	LATIN NAMES	HAZARDS				
		PARASITES	NATURAL TOXINS	SCOMBROTOXIN (HISTAMINE)	ENVIRONMENTAL CHEMICALS	AQUACULTURE DRUGS
		CHP 5	CHP 6	CHP 7	CHP 9	CHP 11
MAHI-MAHI	*Coryphaena spp.*			√		
MAHI-MAHI, AQUACULTURED	*Coryphaena spp.*			√	√	√
POMPANO	*Alectis ciliaris*		CFP			
	Parastromateus niger					
	Trachinotus spp.					
POMPANO OR PERMIT	*Trachinotus kennedyi*					
	Trachinotus falcatus					

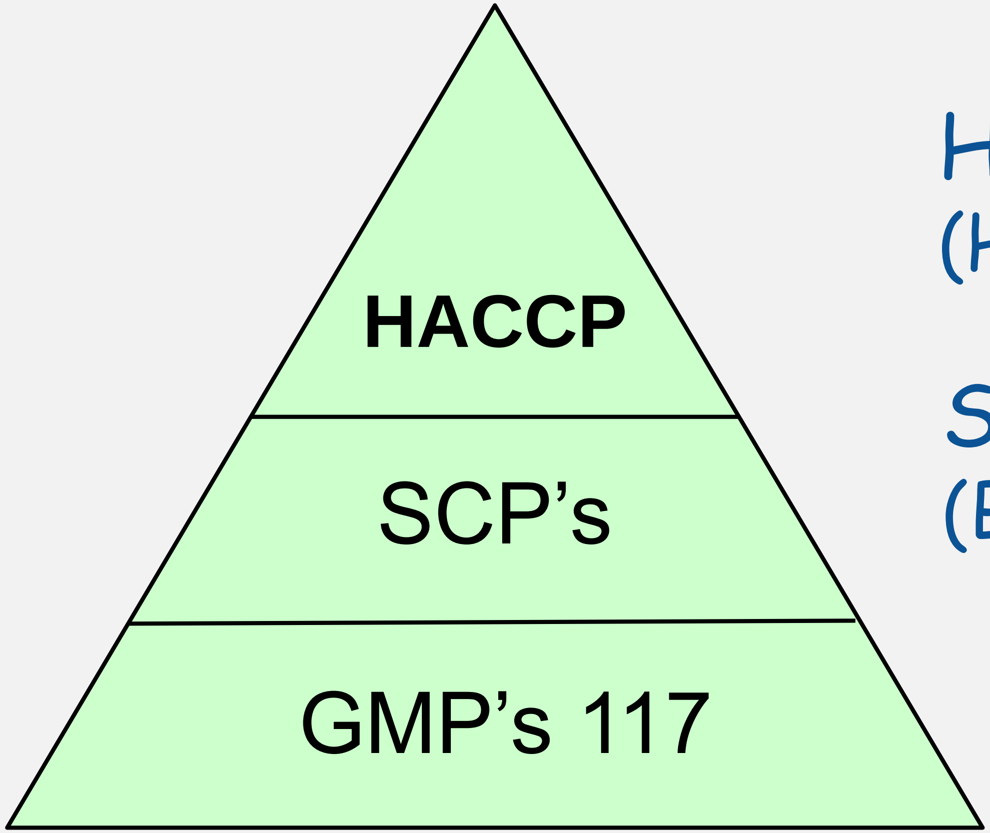
Process-related Hazards

TABLE 3-4

POTENTIAL PROCESS-RELATED HAZARDS

FINISHED PRODUCT FOOD[1]	PACKAGE TYPE	HAZARDS									
		PATHOGENIC BACTERIA GROWTH - TEMPERATURE ABUSE	C. BOTULINUM TOXIN	S. AUREUS TOXIN - DRYING	S. AUREUS TOXIN - BATTER	PATHOGENIC BACTERIA SURVIVAL THROUGH COOKING OR PASTEURIZATION	PATHOGENIC BACTERIA SURVIVAL THROUGH PROCESSES DESIGNED TO RETAIN RAW PRODUCT CHARACTERISTICS	PATHOGENIC BACTERIA CONTAMINATION AFTER PASTEURIZATION AND SPECIALIZED COOKING PROCESSES	ALLERGENS/ ADDITIVES	METAL INCLUSION	GLASS INCLUSION
		CHP 12	CHP 13	CHP 14	CHP 15	CHP 16	CHP 17	CHP 18	CHP 19	CHP 20	CHP 21
Raw fish other than oysters, clams, and mussels (finfish and non-finfish)	Reduced oxygen packaged (e.g. mechanical vacuum, steam flush, hot fill, MAP, CAP, hermetically sealed, or packed in oil)	√[2]	√						√	√	
Raw fish other than oysters, clams, and mussels (finfish and non-finfish)	Other than reduced oxygen packaged	√[2]							√	√	

Required Controls …… layers of prevention ?

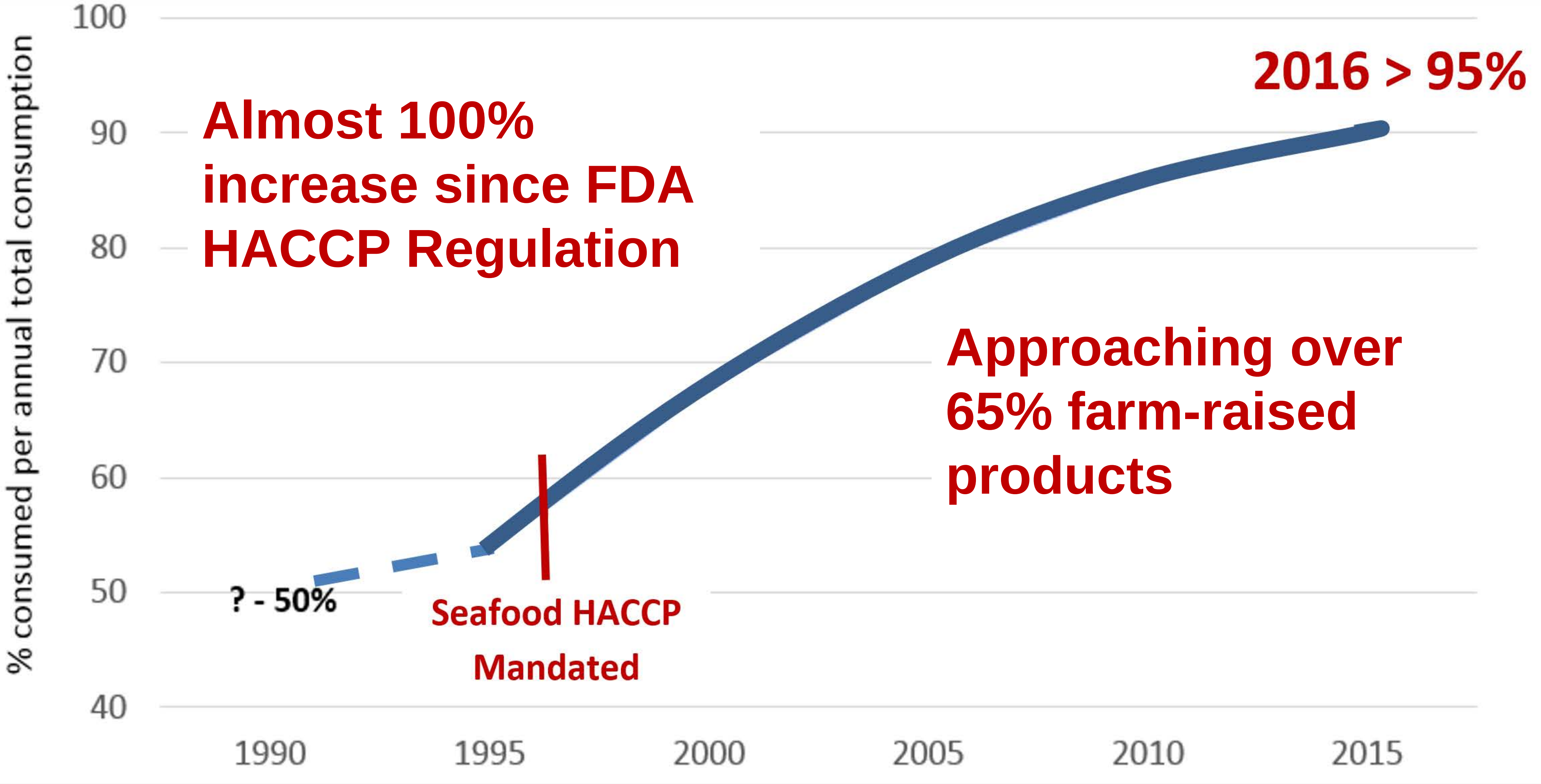


HACCP Program
(HACCP Plan based on hazard analysis)

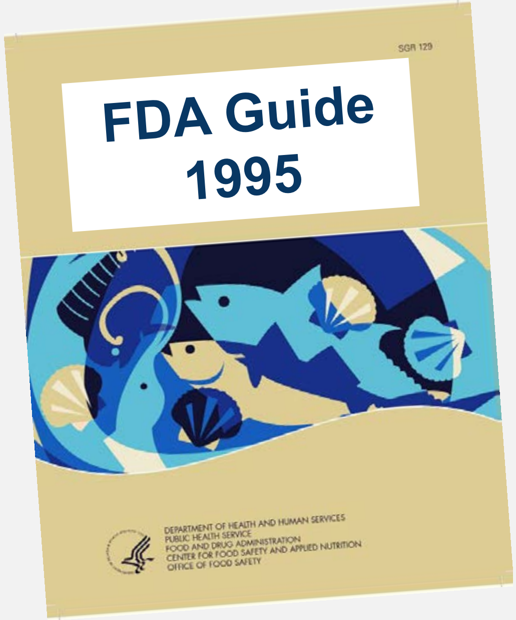
Sanitation
(Based on Sanitation Control Procedures)

Foundation
(Good Manufacturing Practices; GMP 117)

Did the regulation anticipate Aquaculture ?



HACCP did not fully anticipate the aquaculture situation …. less ability to 'prevent'



Control Strategies ?

- On-farm visits
- Supplier Certificates
- Chemical Analysis
- Drug Use Records
- 3rd Party Certifications

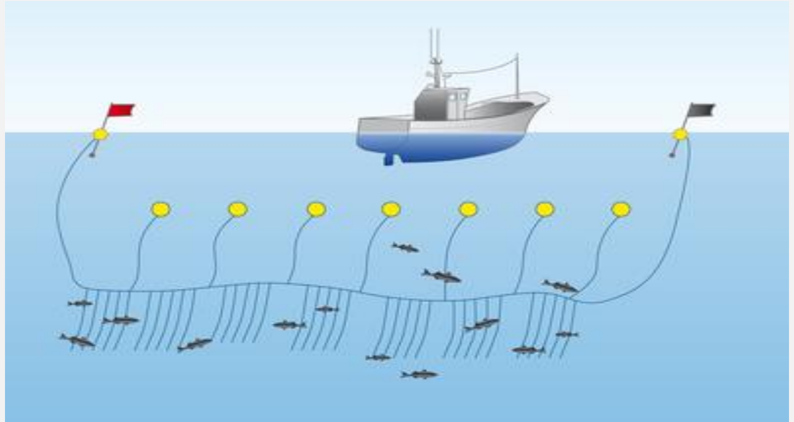
Reverting to reliance on 'testing' to catch problems

What Does Processing Include?

Handling, storing, preparing, heading, freezing, eviscerating, changing to different market forms, manufacturing, shucking, preserving, packing, labeling, dockside unloading, or holding

Seafood HACCP Regulations do not apply to:

- Harvesting (*wild sources*) and Transporting without engaging in processing
- Heading, eviscerating or freezing intended solely for holding the 'fish' (wild source) on the harvest vessel
- Retail Operations



Seafood HACCP Regulations do not apply to:

- **Aquaculture producers** (farming operations); ……including bleeding, washing, and icing of otherwise unprocessed 'fish' by the aquaculture producer

- **HOWEVER** ….. heading, eviscerating, or packaging (e.g., retail or wholesale units) performed by the aquaculture producer is considered processing subject to HACCP regulations

All fish products are subject to HACCP Controls

REMEMBER!

No fish or fishery products, either harvested or farmed, can enter commerce in the USA unless they have been processed under an appropriate HACCP program for seafood safety

Vessels and Farms share the responsibility for food safety with Processors and Importers

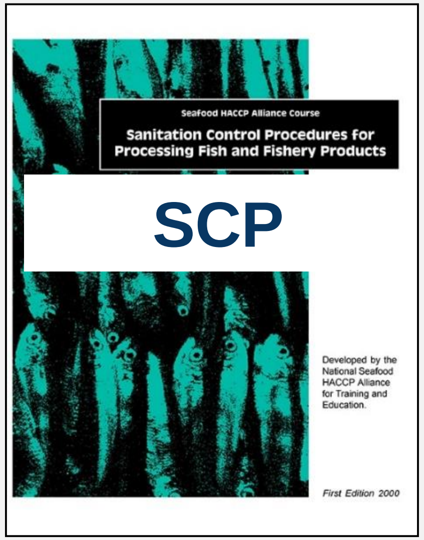
What MUST all Procesors do?

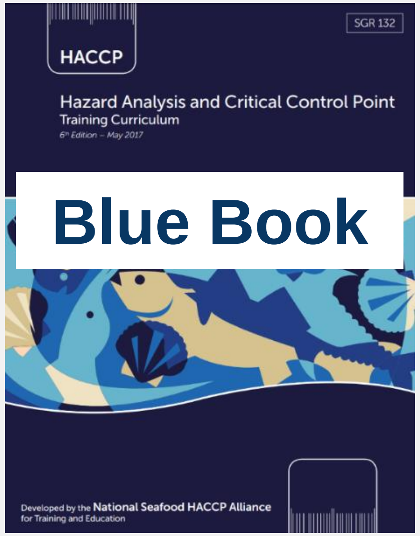
1. Monitor and keep records of monitoring results and corrections taken for the 8 specified areas of Sanitation

2. Conduct a Hazard Analysis to determine if there are any significant hazards associated with your products or process (Should be written)

3. Develop and implement a HACCP Plan to control any significant food safety hazards that are identified (Must be written)

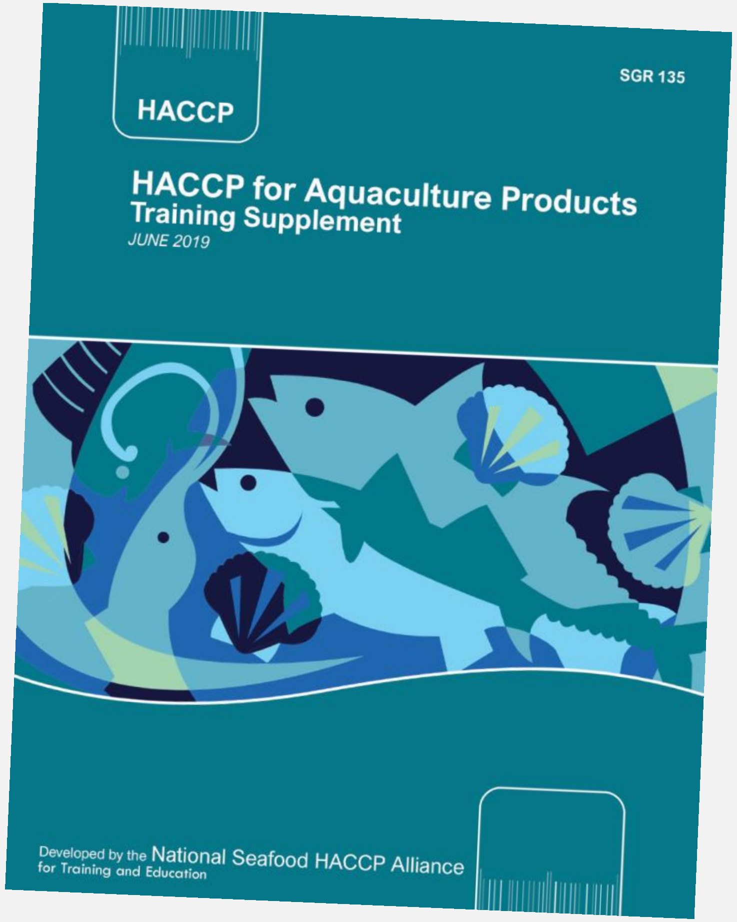
Seafood HACCP Alliance: AFDO and Sea Grant Response





June 2019

What happens if the Mahi is Farm-Raised ?



APPROACH …… for Primary Processors

FARMS with
related obligations

RECEIVING

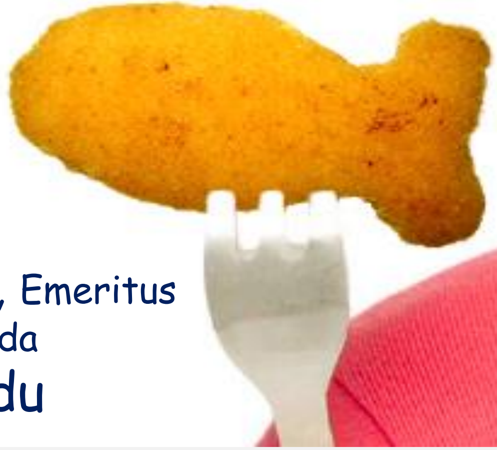
PROCESSORS with
HACCP obligations

Farm based Controls
GAqP's
Biosecurity

HACCP
SCP's
GMP's 117

We must assure healthful choices for the next generation!

Aquaculture is an answer



Steve Otwell, PhD, Emeritus
University of Florida
otwell@ufl.edu

Models

The editorial committee of the Alliance has developed a number of extra Model HACCP Plans that can be used during the third day of the basic HACCP course or the Segment Two HACCP one-day course. These models are intended to help participants understand the basic principles of HACCP by going through the process of developing their own Hazard Analysis and HACCP plan using the FDA Fish and Fishery Products Hazards and Controls Guide.

- An Introduction to Using the Models (pdf) (revised September 2017)
- Tips for Trainers Conducting Practical Exercises Using HACCP Models (pdf) (revised September 2017)
- Shrimp (Wild) Cooked, Frozen (pdf) (revised September 2017)
- Shrimp (Farm-Raised) Raw, Frozen (pdf) (revised September 2017)
- Fish Sticks Breaded and Frozen (pdf) (revised September 2017)
- Hot Smoked Salmon Reduced Oxygen Packed (pdf) (revised September 2017)
- Shucked Oysters (pdf) (revised September 2017)
- Oyster Shellstock (pdf) (revised September 2017)
- Fresh Tuna Loins (pdf) (revised September 2017)
- Wild Salmon Sushi Rolls (pdf) (revised September 2017)
- Wholesale/Distribution/Warehouse Facilities (pdf) (revised September 2017)
- Wholesale/Distribution of Histamine Fish (pdf) (revised September 2017)
- Tilapia (Farm-raised), Fresh and Frozen (pdf) (New! September 2017)

Seafood HACCP Alliance

What are the Food Safety Challenges with Farm Raised Seafood ?

Offshore Aquaculture Economics:

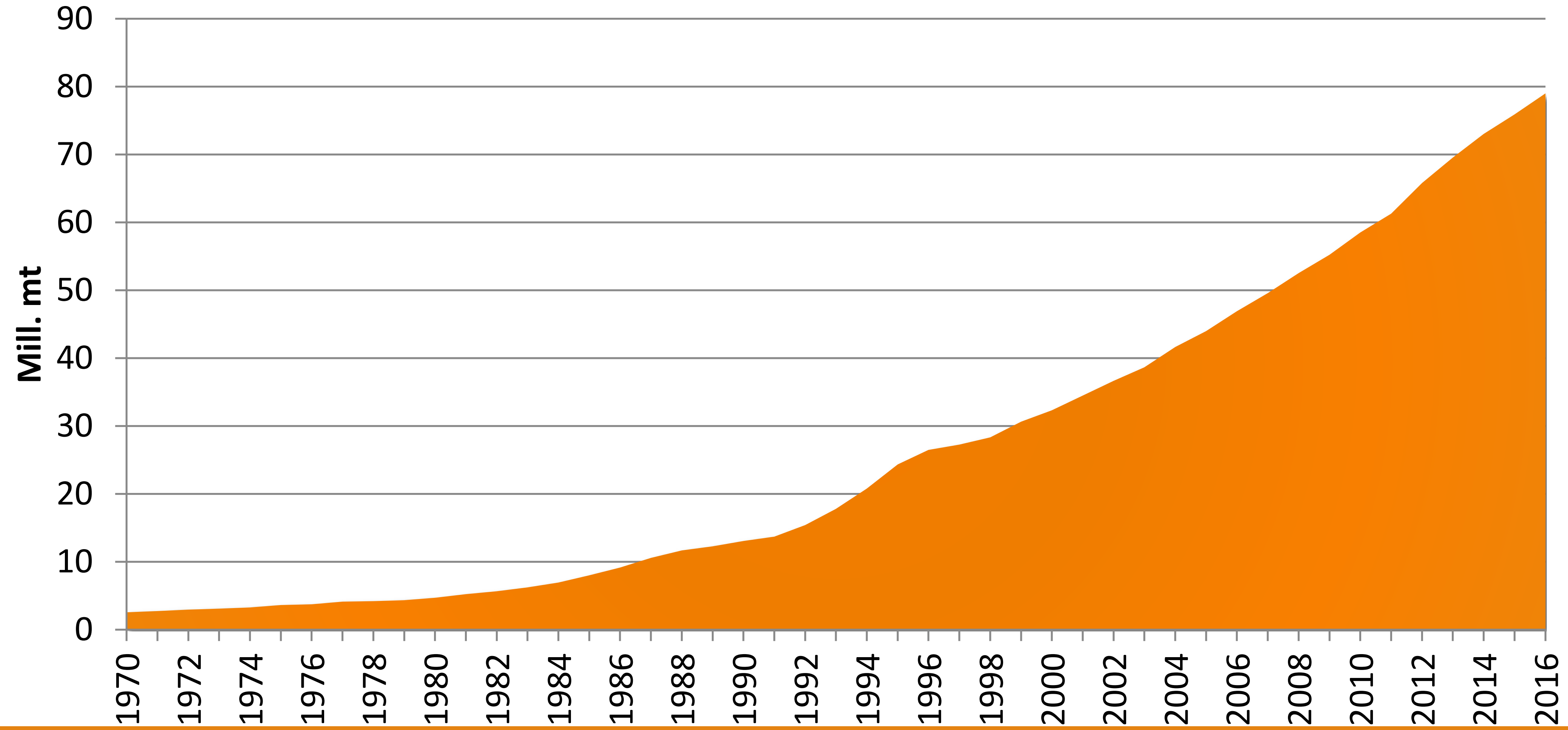
Implications for Seafood Market Growth

FRANK ASCHE

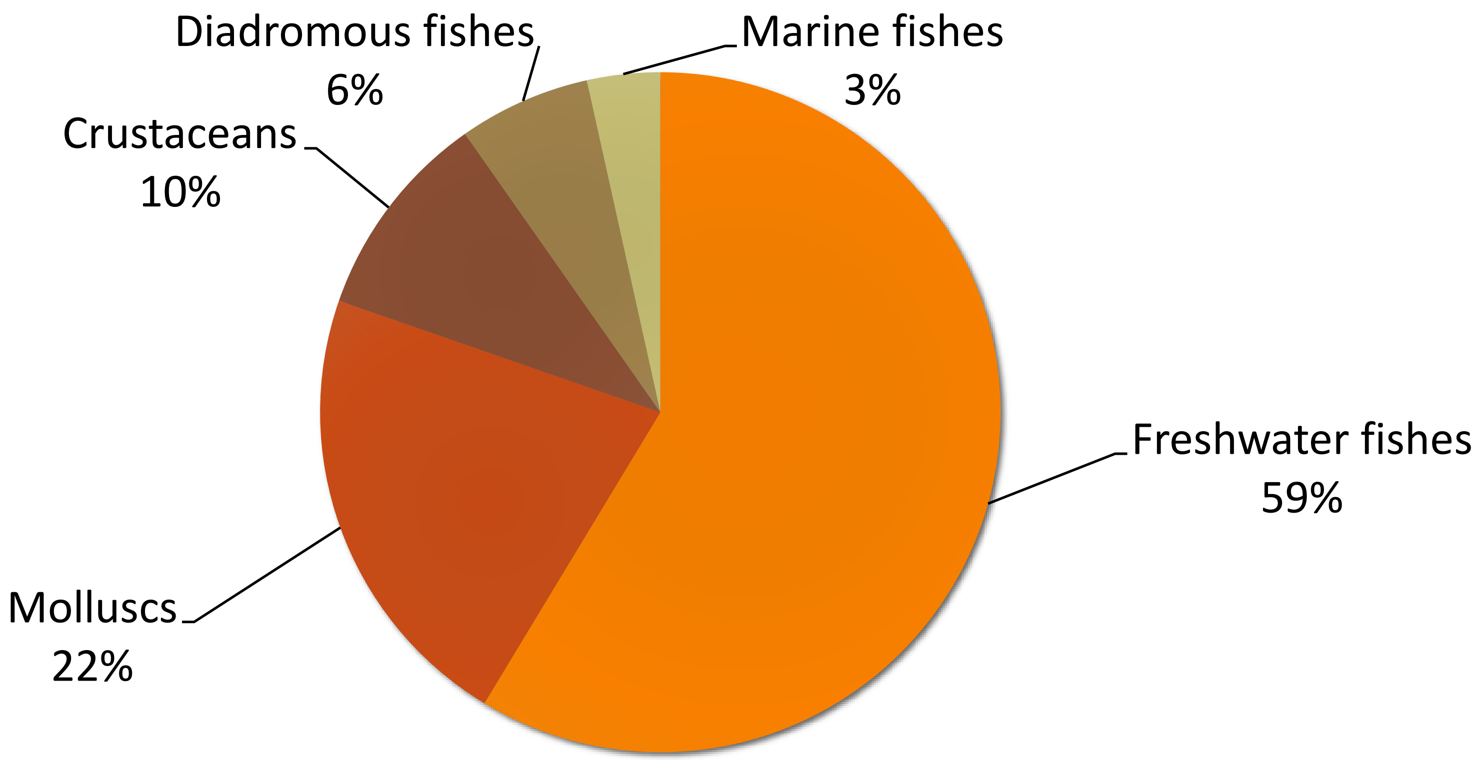
06.27.19

UF|IFAS UNIVERSITY of FLORIDA
Institute for Sustainable Food Systems

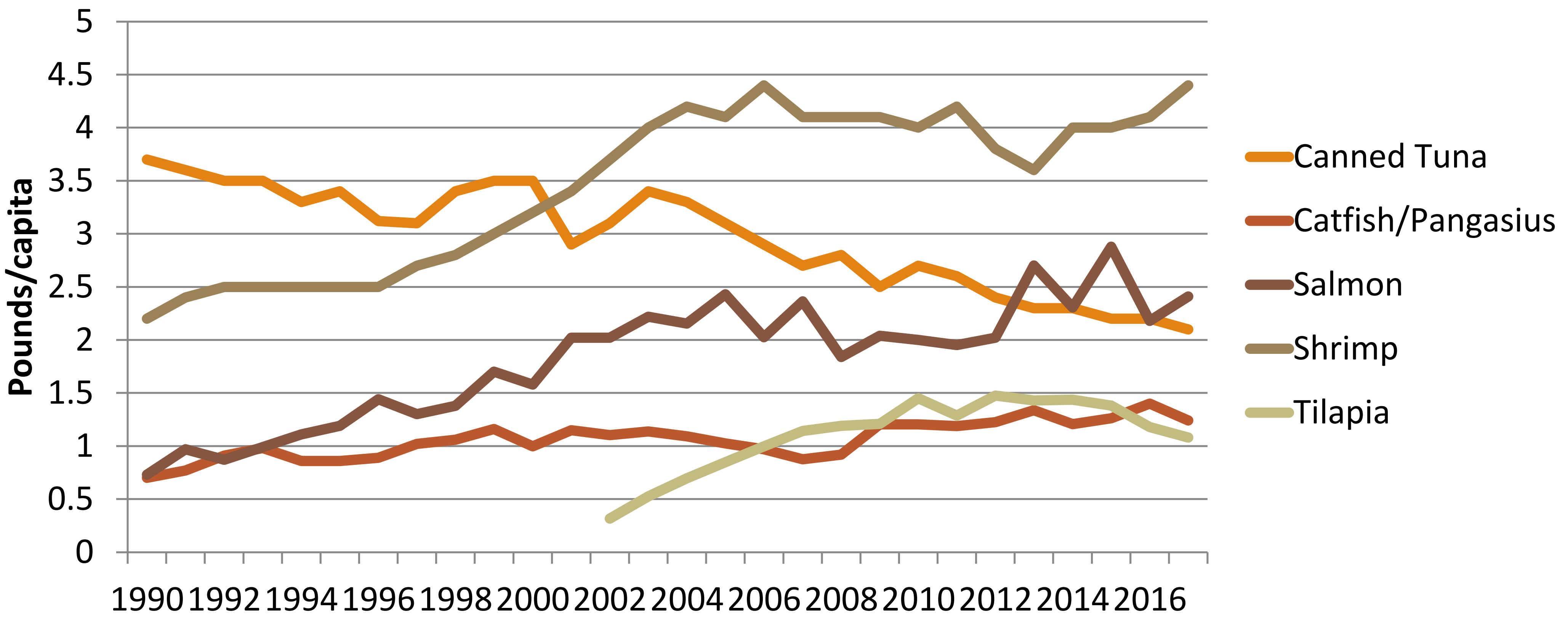
Global aquaculture production growth remains rapid, no apparent barriers: Global production 1970-2016



In contrast to fisheries, marine species are not very important in aquaculture, even if diadromous fish are counted as marine



This development strongly influence what is available at the U.S. Seafood market
U.S. Seafood consumption of top 5 species



Why are freshwater fish (and molluscs) so popular in aquaculture?

1. Because it is relatively easy to keep control with the production process

- This also tends to make production cost low
- Most freshwater fish being farmed is relatively small, but with fast growth

2. Because production can take place close to the market

- The U.S. is the only of the world´s 4 most populated countries which is not in the top for when it comes to aquaculture production

Why bother with marine fish?

1. Because they grow bigger and are more valuable, and even more so if they can be marketed as fresh

2. Because, in principle, they can be farmed in countries where people do not want to see the production process

2.5 Because the oceans are poorly utilized as a source for food, and there are lots of potential locations available (Gentry et al. 2017)

Why bother with marine fish?

1. Because they grow bigger and are more valuable, and even more so if they can be marketed as fresh

2. Because, in principle, they can be farmed in countries where people do not want to see the production process

2.5 Because the oceans are poorly utilized as a source for food, and there are lots of potential locations available (Gentry et al. 2017)

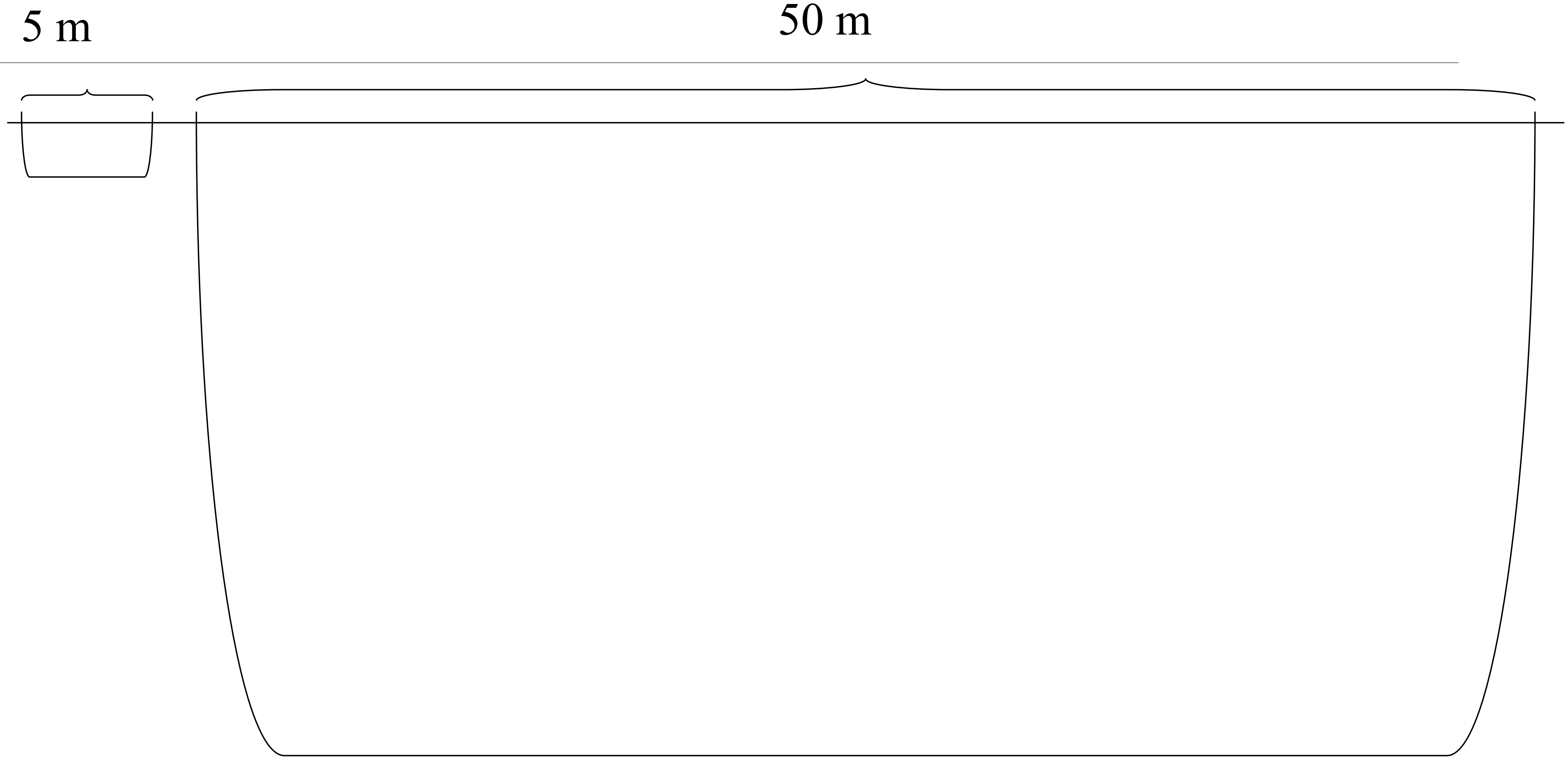
But it is challenging, and costly

Marine aquaculture is a child of the 1960s, and was made possible with the invention of the netpen

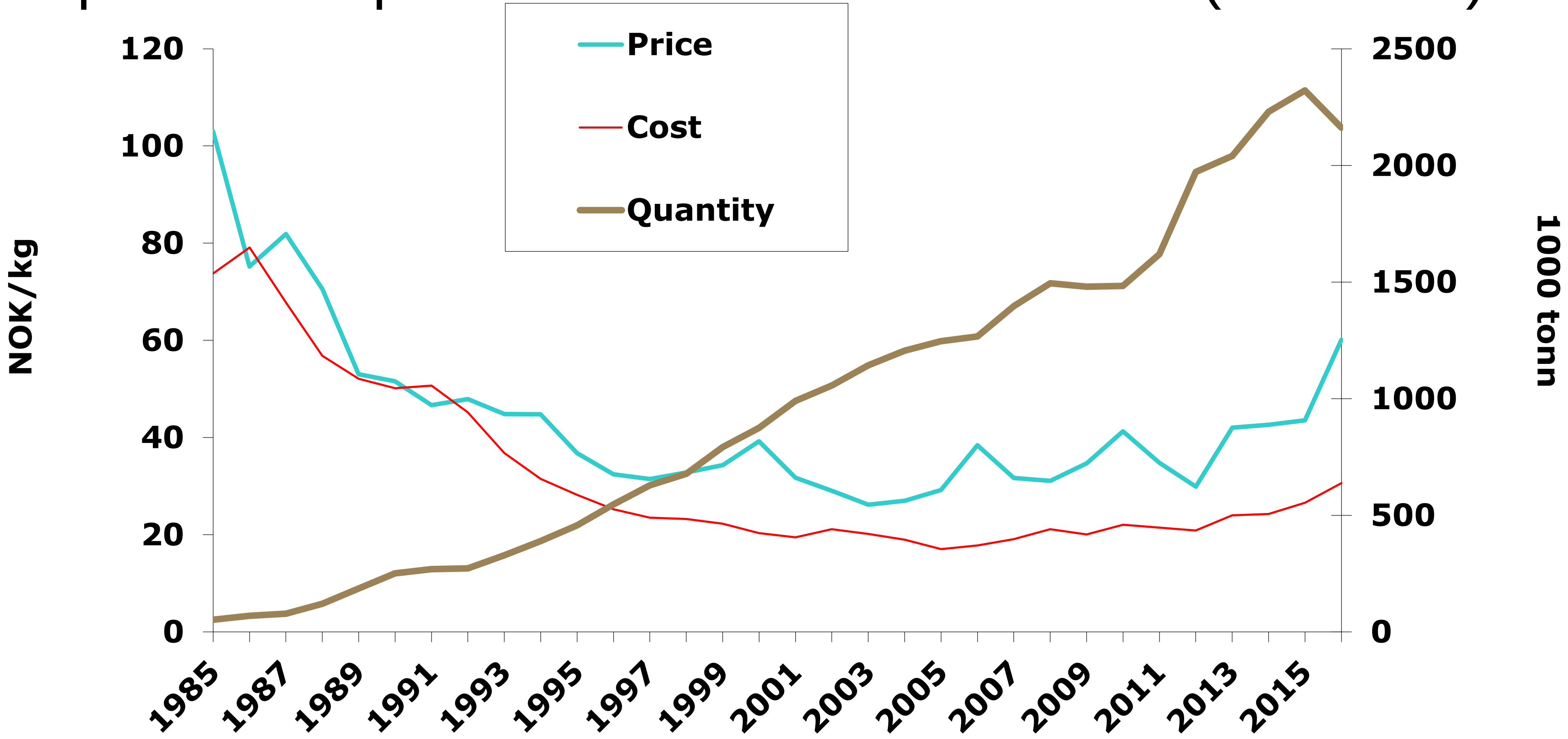
Technology developed rapidly, and the plants became larger.....

….. and larger

Innovations increase scale – a salmon pen from 1980 and one from 2015



And with increased knowledge and better technology, production cost came down: Global salmon production, price and production cost 1985-2016 (2016=1)



Netpens is a technology that require particular types of coastline, although they have become more robust

For salmon, demand is sufficiently strong that even though production has increased rapidly, prices have had an increasing trend for over ten years

Wild landings are stagnant for most species

- Increasing trend in prices in markets not dominated by aquaculture

This is largely due to lack of access to new production cites, which is partly a regulatory and partly a technology question

- A license to hold 780 mt of salmon in Norway is now worth more than 10 mill $

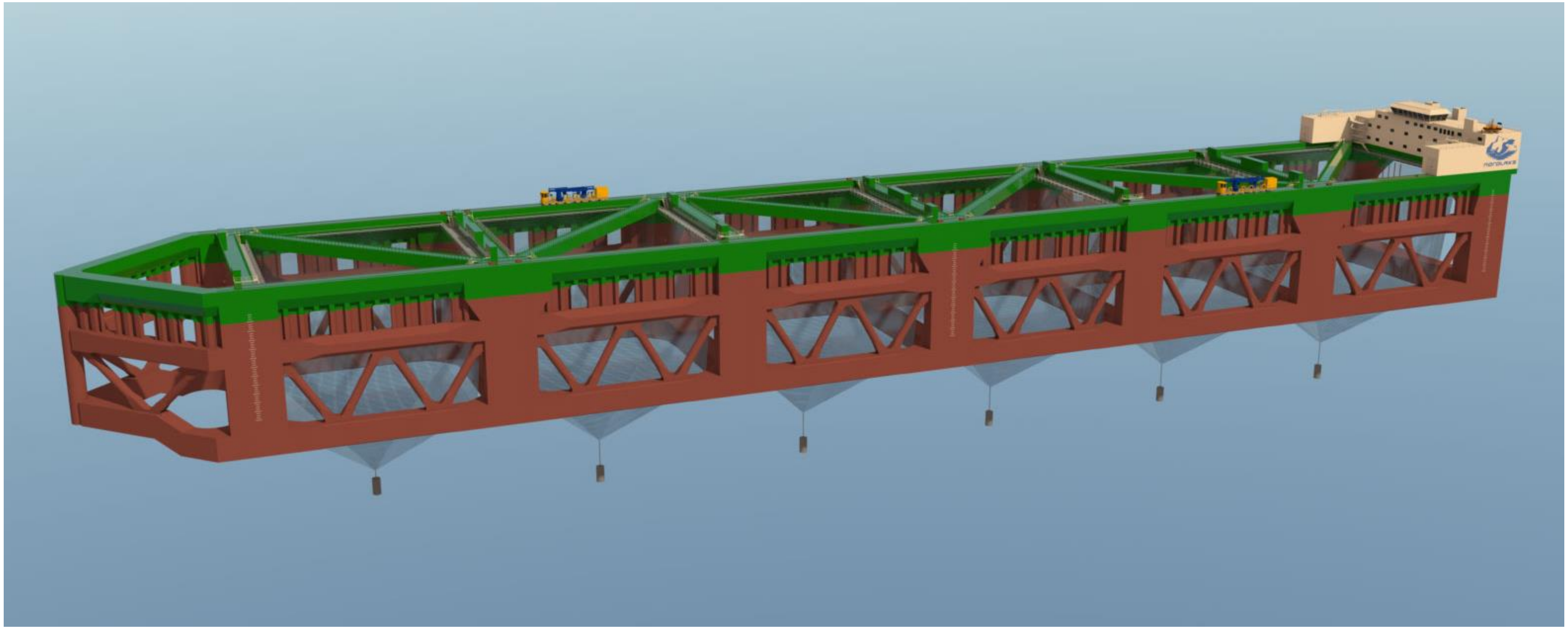
Two types of technologies are being tried: Offshore and land based

Offshore aquaculture is happening for salmon and other species (as is landbased aquaculture)

This farm started operation in 2018. It´s diameter is 110m and it will produce 8000 mt per year. Building cost: $100 mill.

This is 385m long and 65m wide with a capacity to produce 11000 mt. Has been built

Will become operative in 2019.
Construction cost is about $120 mill



Ocean aquaculture is expensive

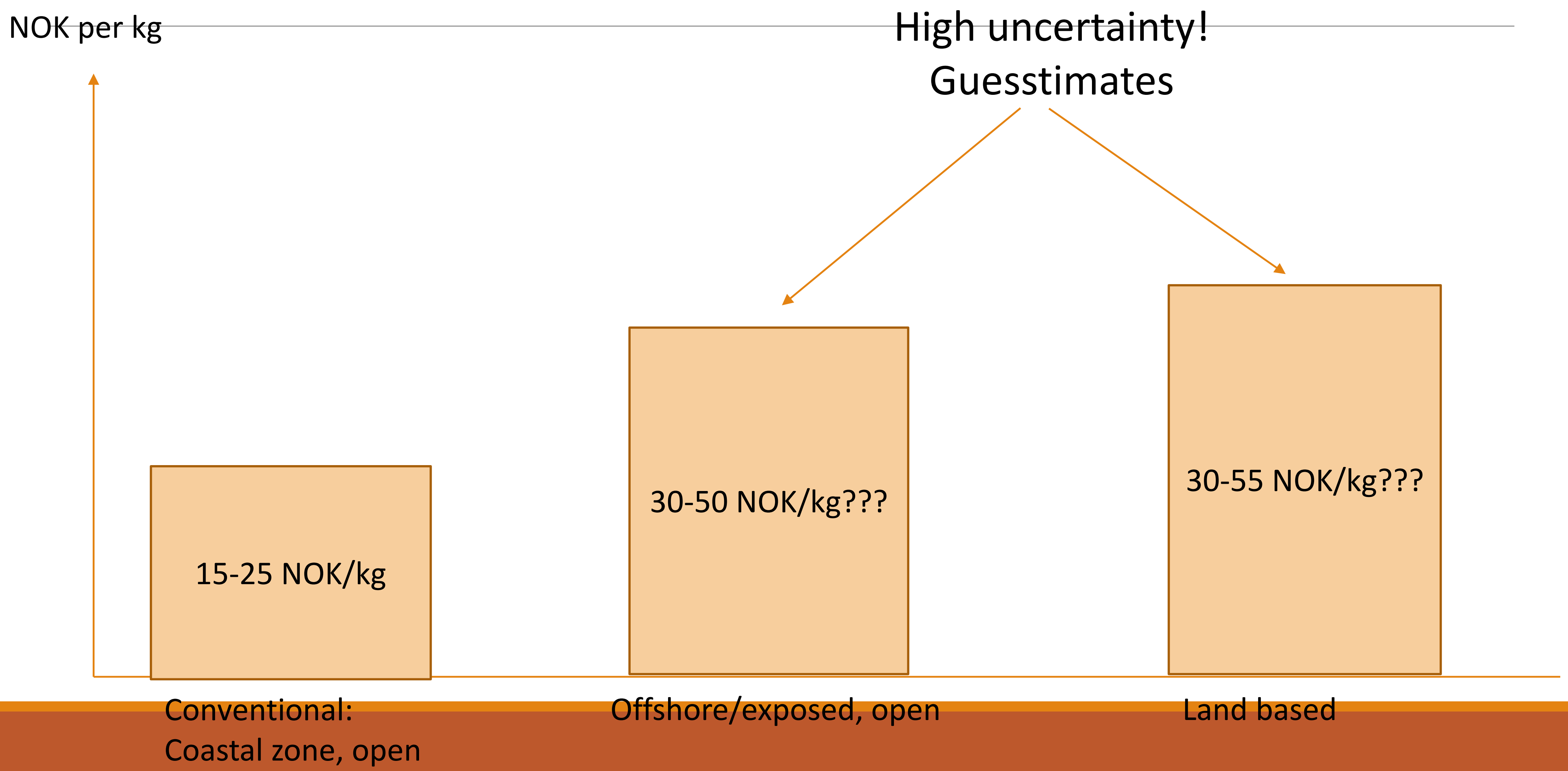
These facilities are much bigger than coastal farms

This may not be necessary, but economies of scale makes it more likely that it will be economically viable

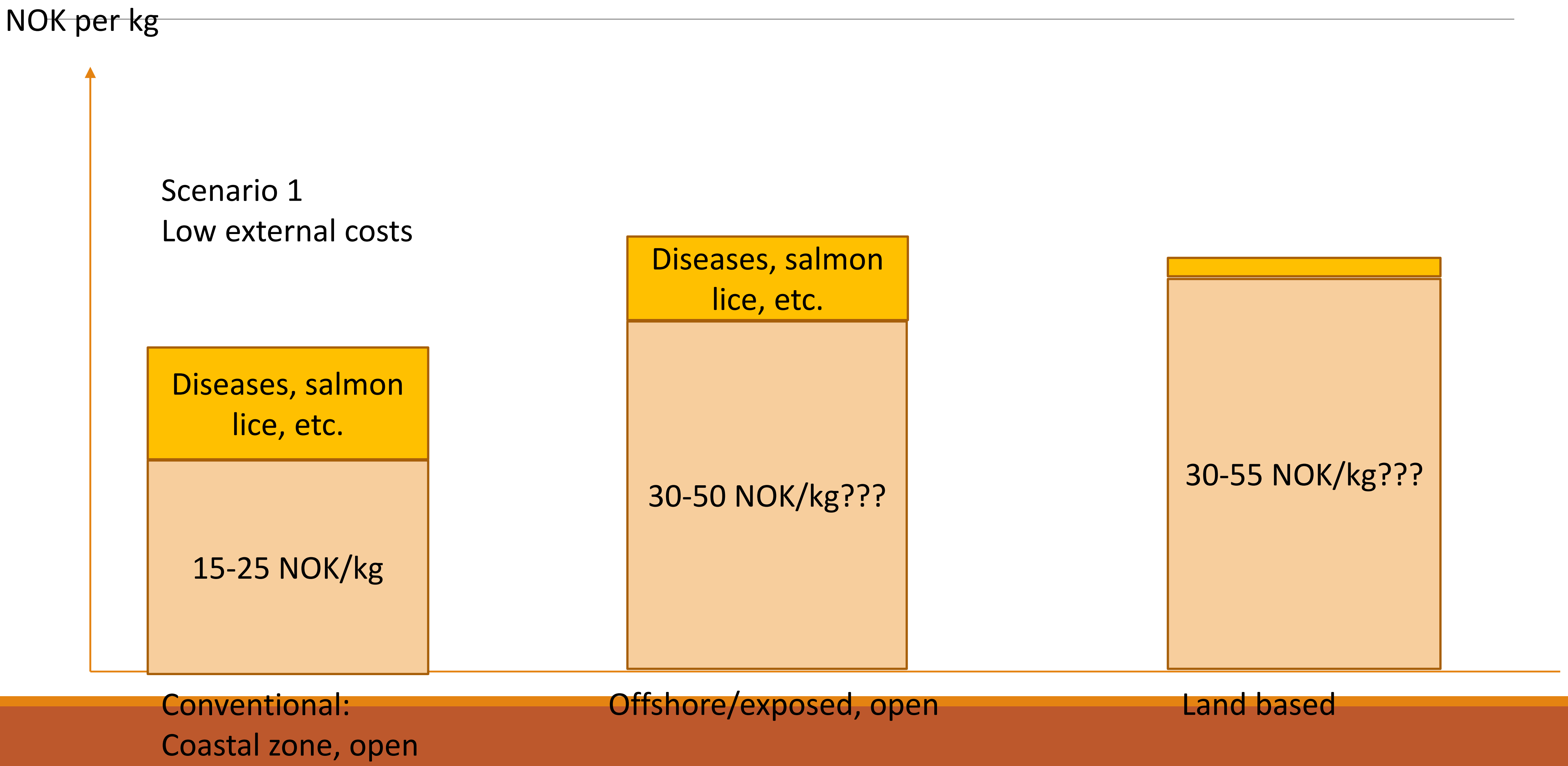
It also makes it easier to justify investments in supporting facilities

Depending on where you are in the world, it may also be necessary to handle weather issues

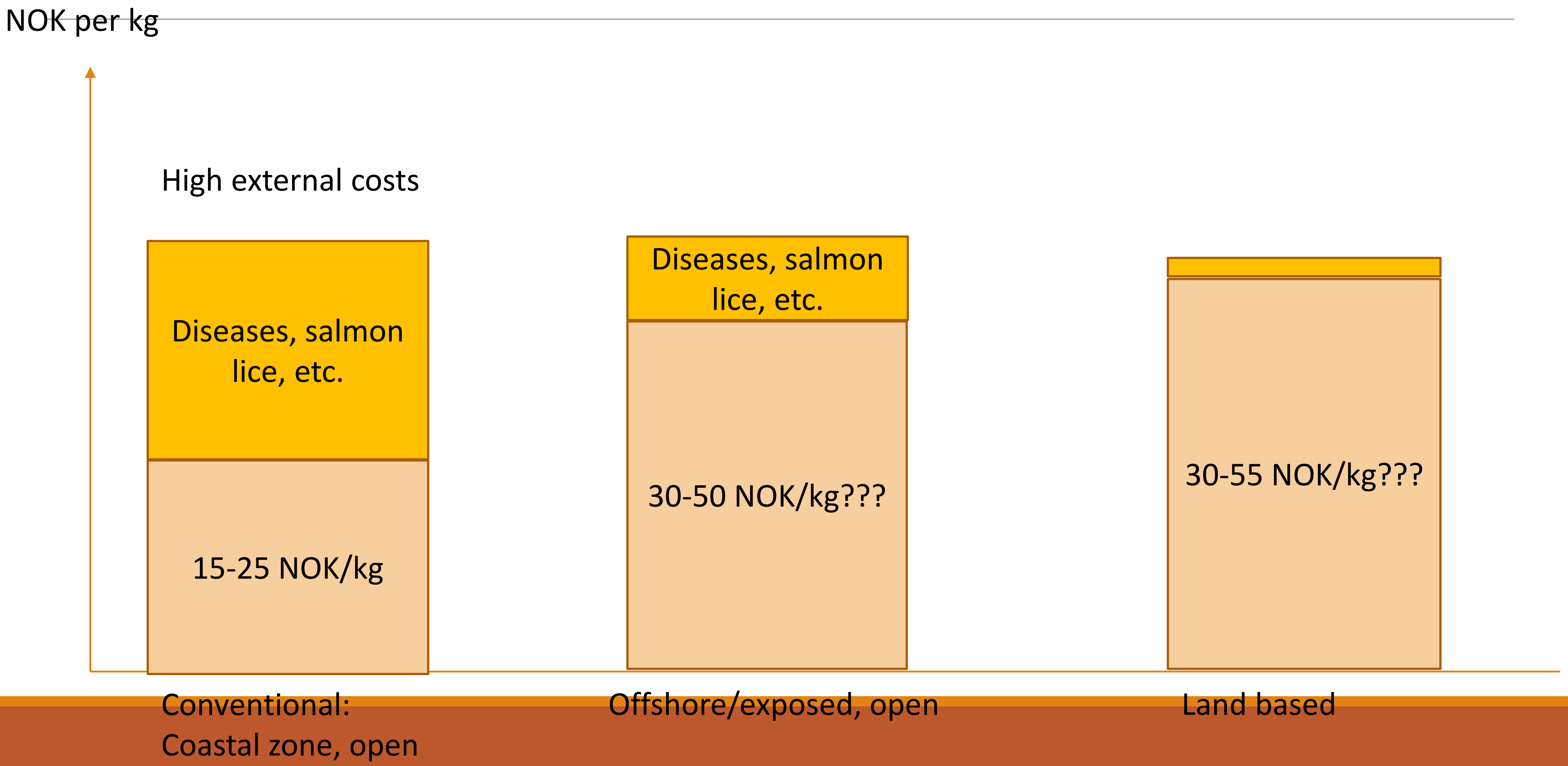
Production costs alternative technologies for salmon: Before environmental costs and license issues



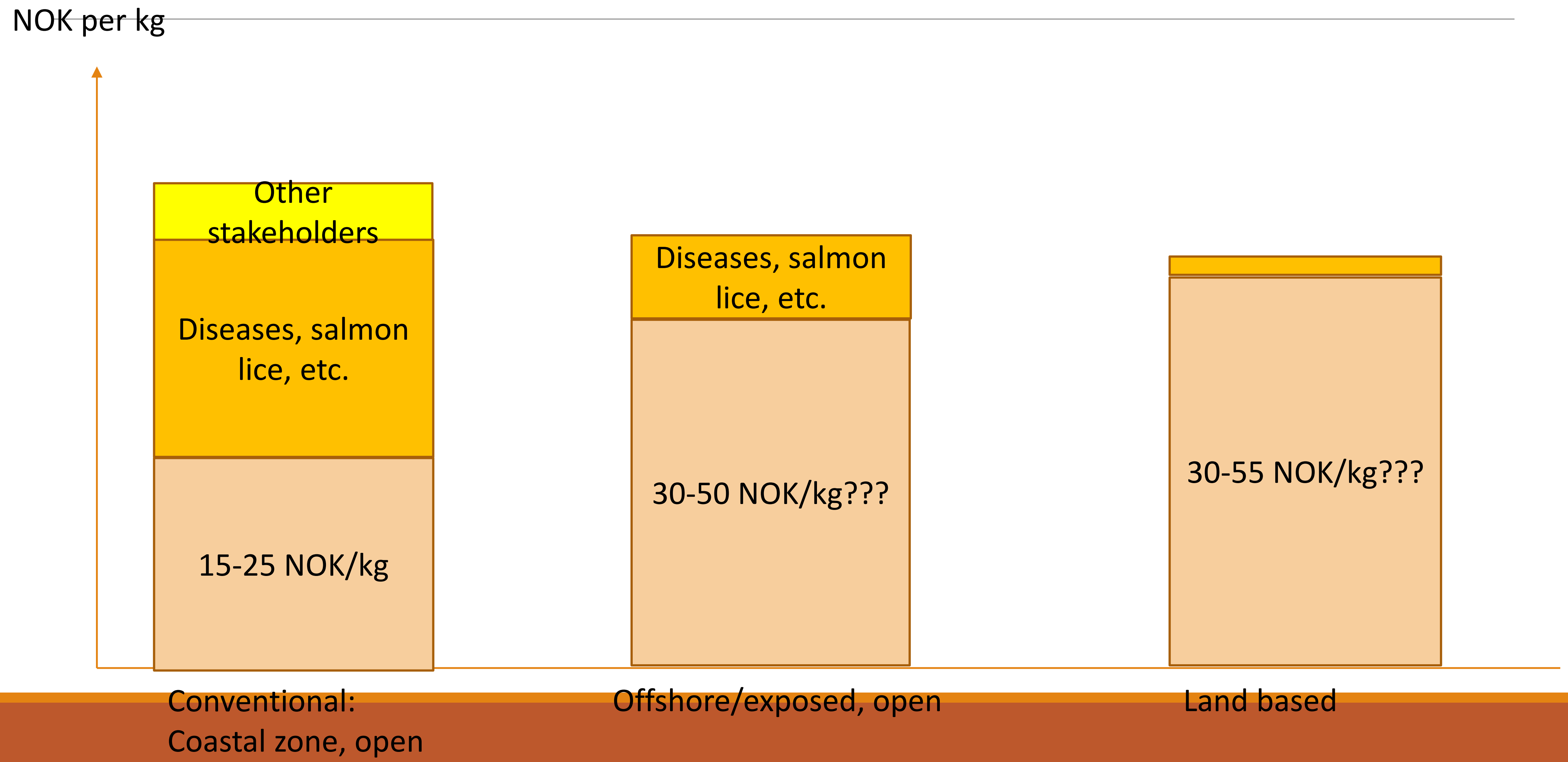
Production costs alternative technologies: Costs due to disease and other environmental issues



Production costs alternative technologies: Costs due to disease and other environmental issues



And it becomes harder when there is additional fees associated with traditional technologies



In Norway, real offshore fish farming is happening

It is largely caused by difficulties in getting traditional production sites

Capital costs are high, but while it is not obvious that they will come down to the level of a traditional set of pens, they are likely to come down

Distance to shore makes operation costs somewhat higher, but it does not make too much of a difference

- Also for traditional plants, the distance to the harvesting plant is significant

Variable costs, mostly feed, are basically the same

There are trails and a few operations other places in the world, but generally with smaller scale systems

In not too many years, there will be suppliers providing this kind of systems off-the-shelf

The development internationally increase the likelihood that aquaculture in the gulf will succeed

But it is still impeded by:

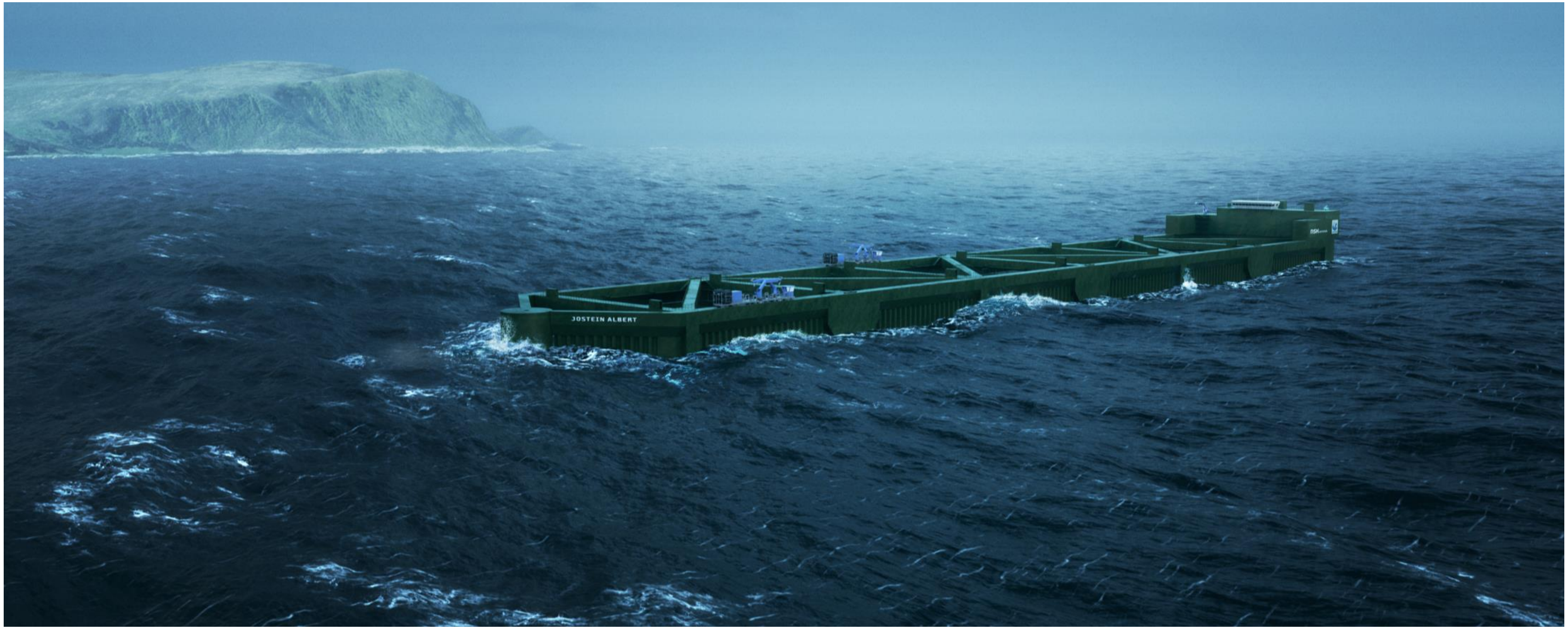
Not being able to buy fish of-the-shelf, and not to utilize existing breeding programs

Not being able to buy feed, vaccines etc. of the shelf

And the cost will be higher because one also have to invest in the infrastructure to serve the facilities since there does not exist an industry of well boats, feed producers etc.

But competition will be keen if one are producing species that are exposed to import competition, as globally, seafood availability continue to increase

So is this the future?



Will one move to a more controlled environment?