Advancing Aquaculture in a Changing World

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FAU Harbor Branch Oceanographic Institute
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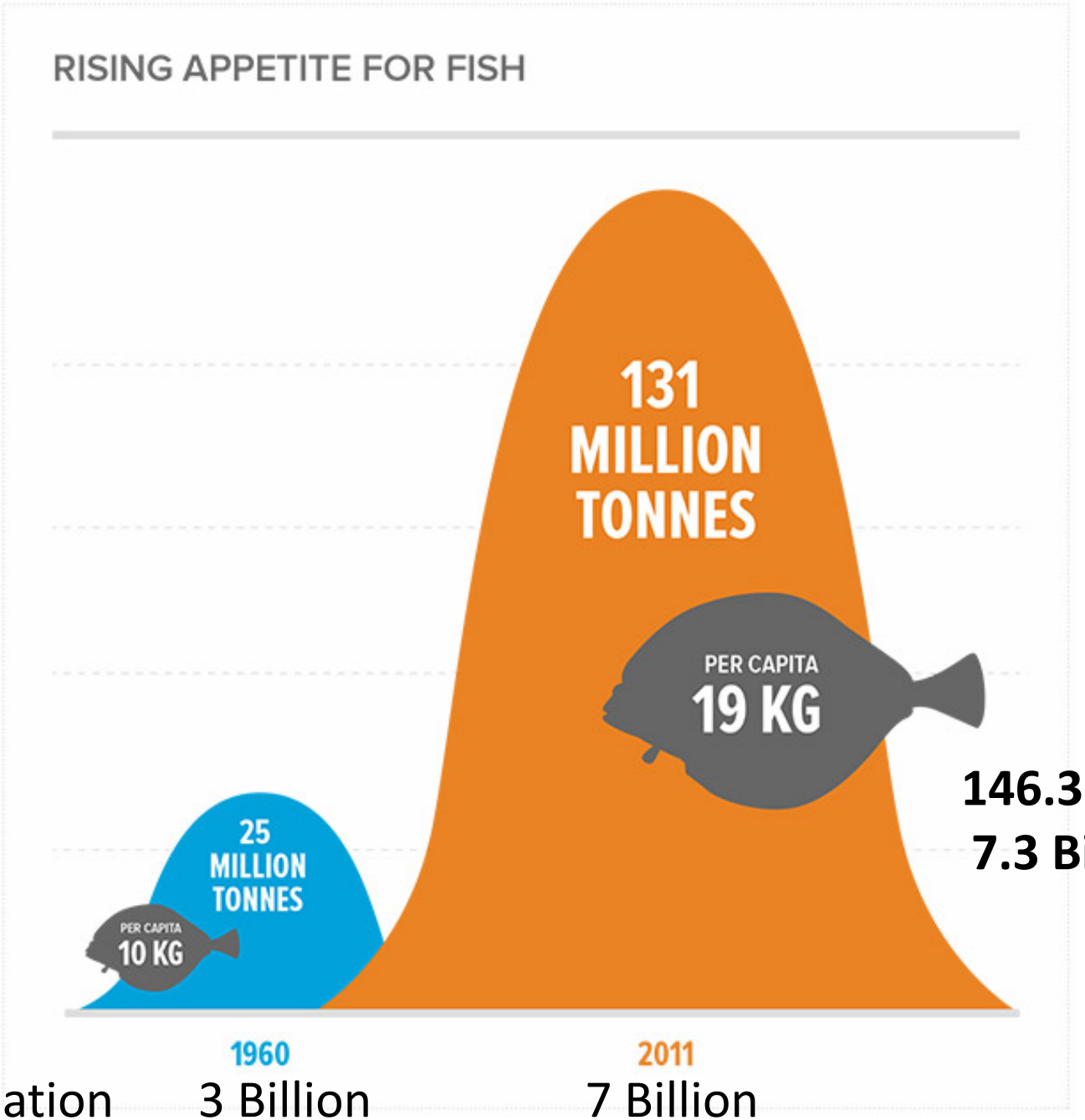
Consumers want:

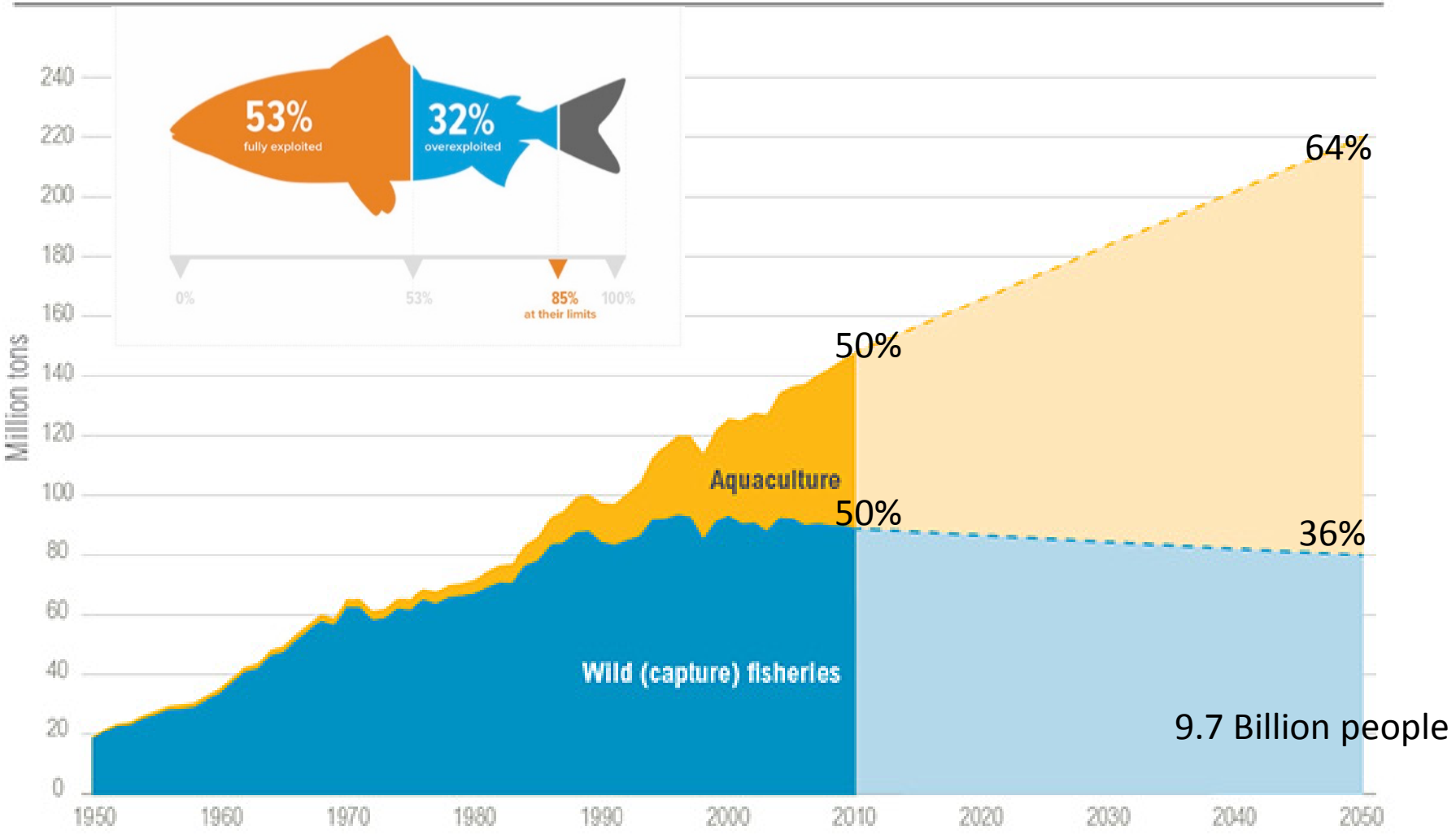
- Healthy
- Nutritious
- Convenient
- Variety
- Value
- Sustainability
- Safe



146.3 MT; 20.1Kg
7.3 Billion (2014)

Population 3 Billion 7 Billion

Aquaculture Is Expanding to Meet World Fish Demand

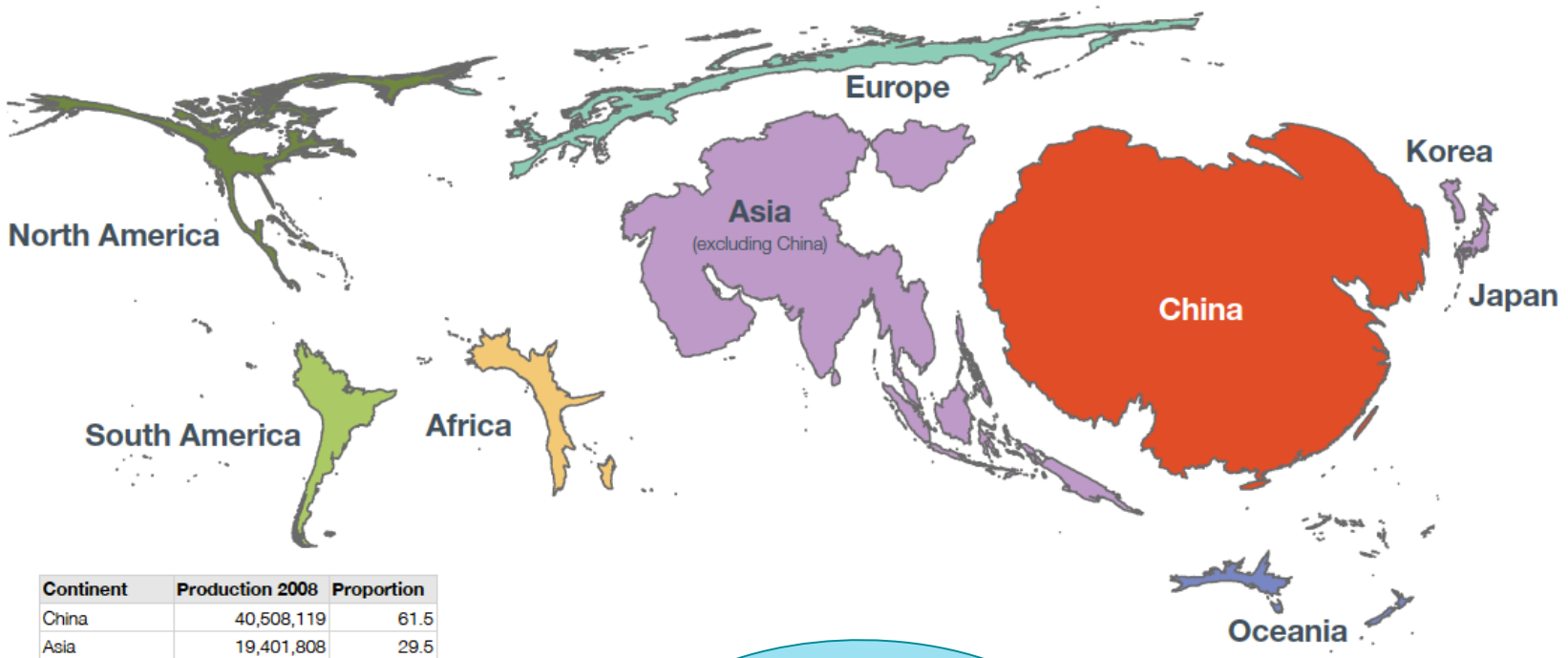


Source: Historical data 1950–2010: FAO. 2014. "FishStatJ." Rome: FAO. Projections 2011–2050: Calculated at WRI, assumes 10 percent reduction in wild fish catch between 2010 and 2050, and linear growth of aquaculture production at an additional 2 million tons per year between 2010 and 2050.

See www.wri.org/publication/improving-aquaculture for full paper.

WORLD RESOURCES INSTITUTE

Aquaculture Production Worldwide



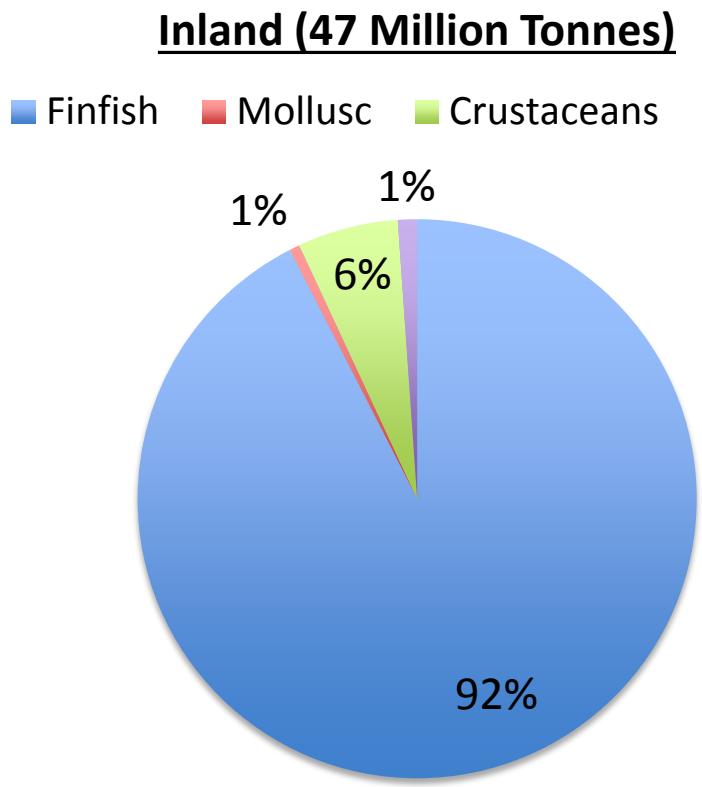
Continent	Production 2008	Proportion
China	40,508,119	61.5
Asia	19,401,808	29.5
Europe	2,341,646	3.6
South America	1,461,061	2.2
North America	965,792	1.5
Africa	952,133	1.4
Oceania	176,181	0.3

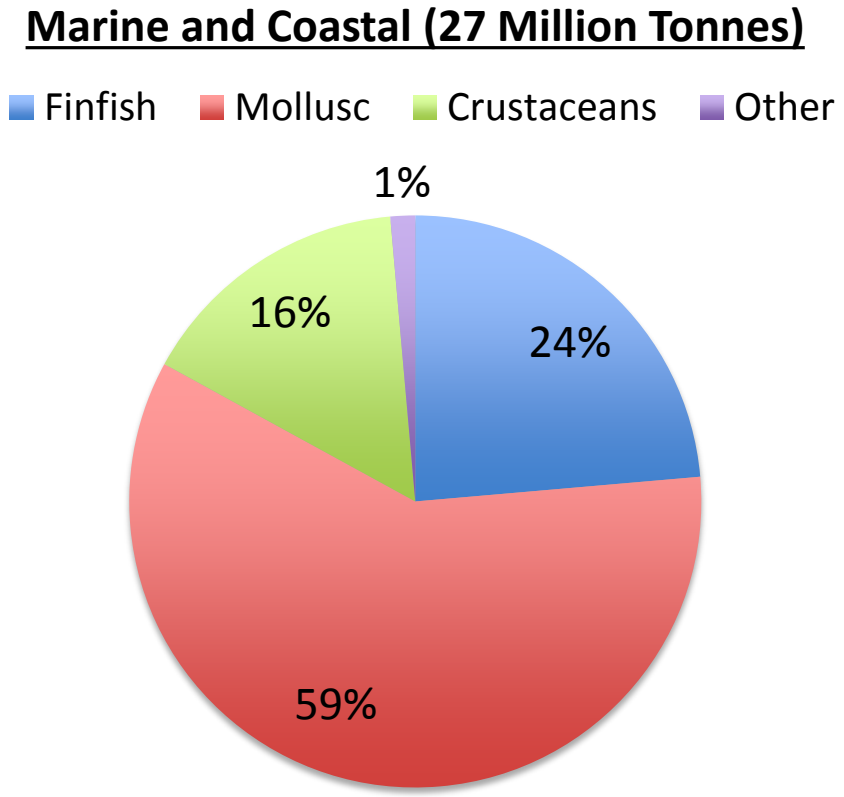
91% of all aquaculture is produced in Asia

Fisheries & Aquaculture = 167 M Tons (2014)

	Fisheries (M Tons)	**Aquaculture (M Tons)**
Inland	12	47
Marine	81	27
Totals	93 (56%)	74 (44%)

World Aquaculture Production 2014 (FAO)

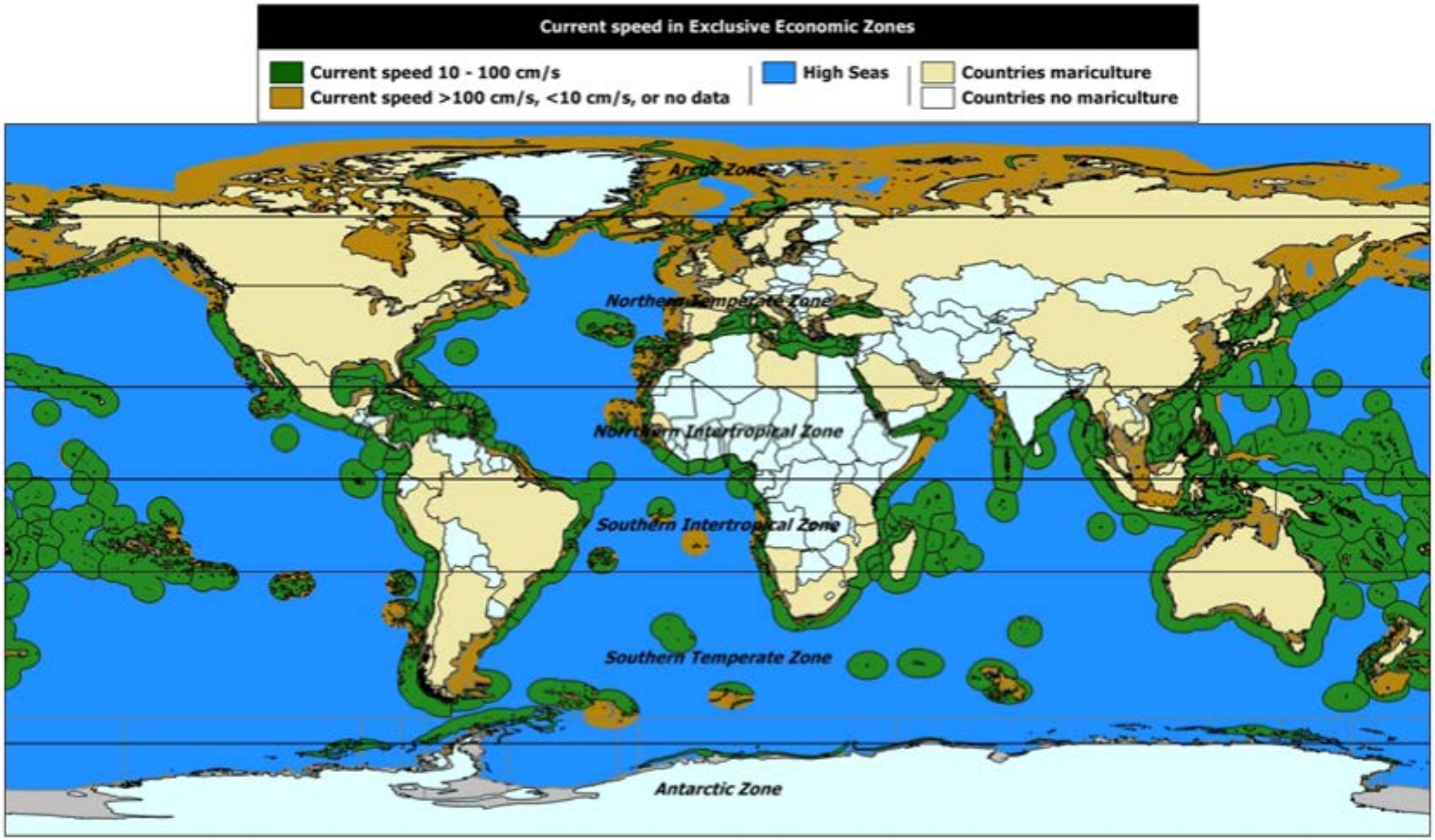




Offshore Aquaculture

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

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



Kapetsky et al., 2010. FAO Workshop, Rome, 2010.

Marine Cage Aquaculture


HARBOR BRANCH
FLORIDA ATLANTIC UNIVERSITY

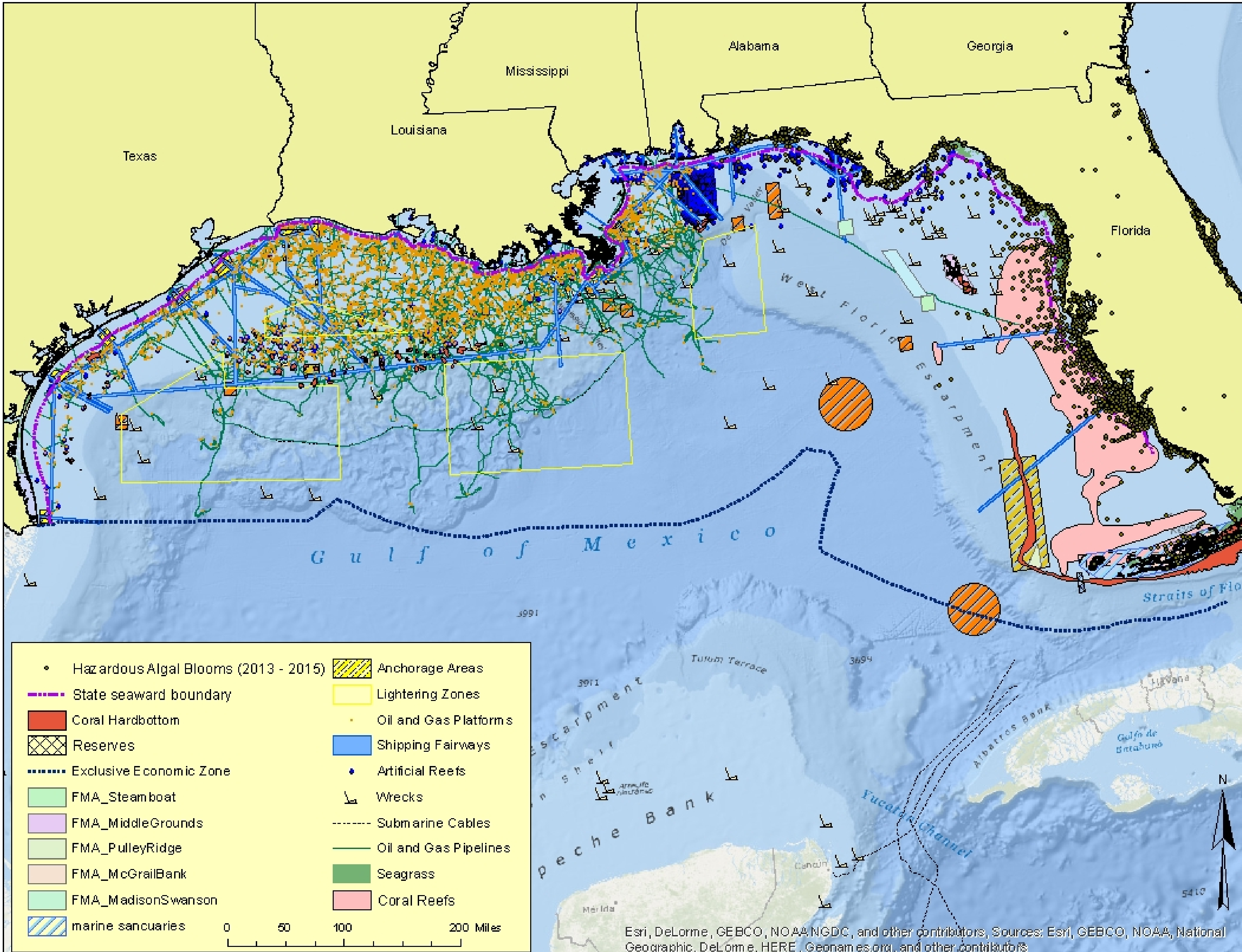
USDA National Center Cool & Cold Water Aquaculture Research Leetown, WV

Freshwater Institute Shepherdstown, WV

What does it mean to increase the aquaculture footprint in the coastal zone

Expanding Offshore Aquaculture – What is needed?

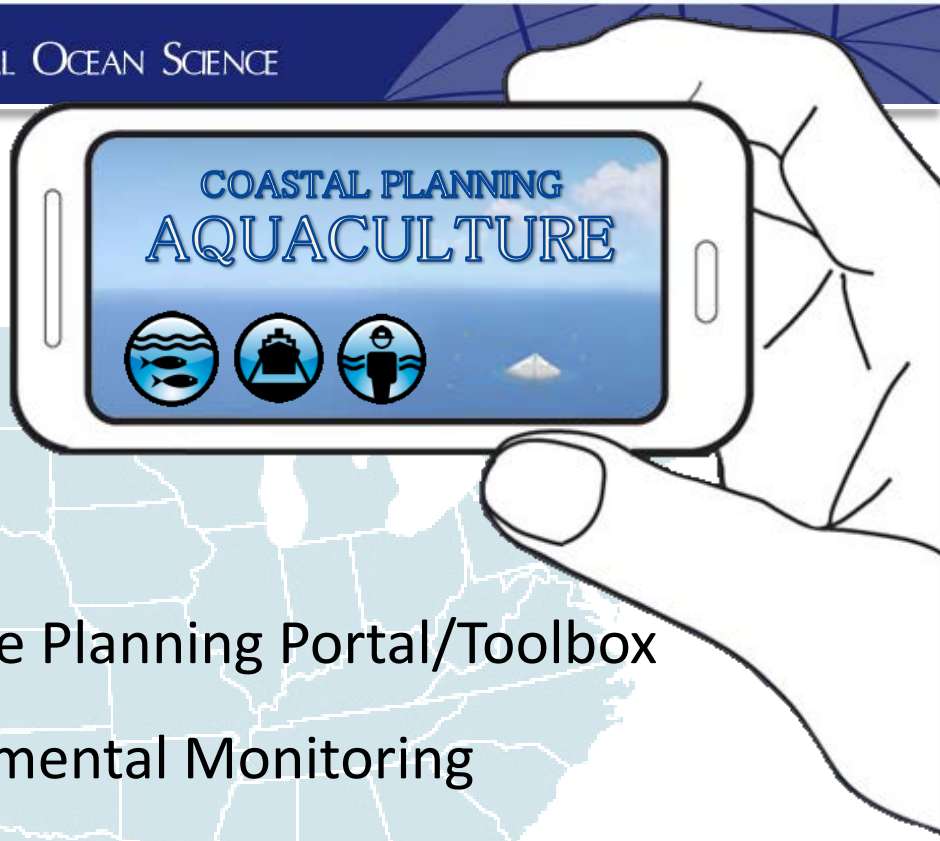
- **Siting Aquaculture Enterprise**
- **Monitoring the Environment** (HABs, water quality parameters including nutrients, weather, oil spills, chemical and toxins, pathogens)
- **Monitoring Aquaculture Enterprise** (nutrient pollution, feeds, pathogens, escapees, location)
- **Selecting Species for Local Conditions** (genomics, domesticated breeding)



Texas
Louisiana
Mississippi
Alabama
Georgia
Florida
West Florida Escarpment
Gulf of Mexico
Straits of Flor
Tulum Terrace
Campeche Bank
Yucatan Channel
Albatros Bank
Havana
Golfo de Batabanó
Cancún
Mérida
3991
3911
3694
5410
Hazardous Algal Blooms (2013 - 2015)
State seaward boundary
Coral Hardbottom
Reserves
Exclusive Economic Zone
FMA_Steamboat
FMA_MiddleGrounds
FMA_PulleyRidge
FMA_McGrailBank
FMA_MadisonSwanson
marine sancuaries
Anchorage Areas
Lightering Zones
Oil and Gas Platforms
Shipping Fairways
Artificial Reefs
Wrecks
Submarine Cables
Oil and Gas Pipelines
Seagrass
Coral Reefs
0 50 100 200 Miles
N
Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors, Sources: Esri, GEBCO, NOAA, National Geographic, DeLorme, HERE, Geonames.org, and other contributors

Siting Offshore Farms

- Use temporal and spatial observing data systems to refine ocean circulation models
  - Agency and industry data
- Outcomes from disasters provide additional models (e.g., Deep Horizon Oil Spill)
- New offshore aquaculture ruling in Gulf of Mexico



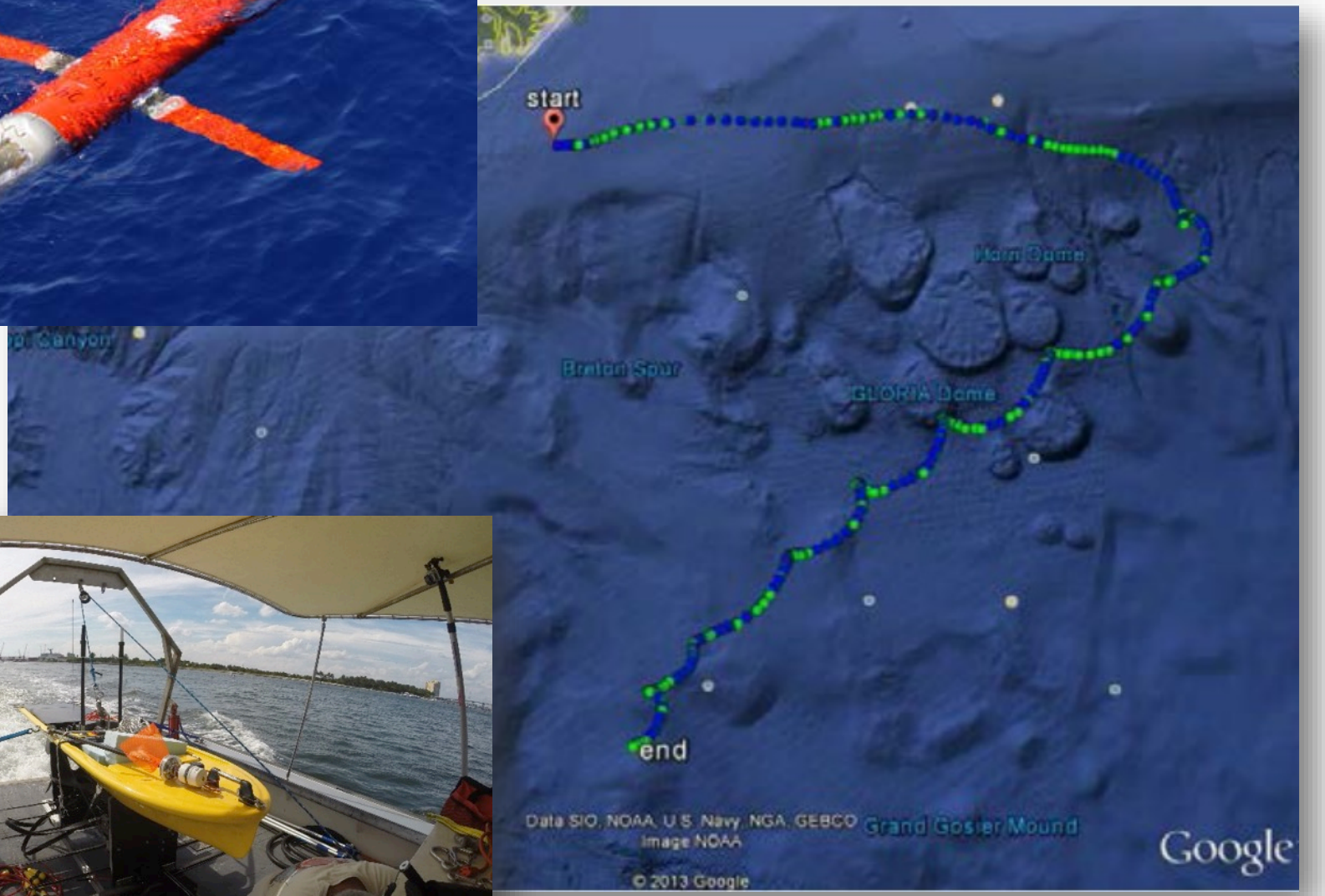
National Projects

- ✓ Building the Coastal Aquaculture Planning Portal/Toolbox
- ✓ National Guidelines for Environmental Monitoring
- ✓ Global review of aquaculture environmental models
- ✓ SAV interactions with shellfish aquaculture
- ✓ Eutrophication management and shellfish culture (Bricker/CCMA)

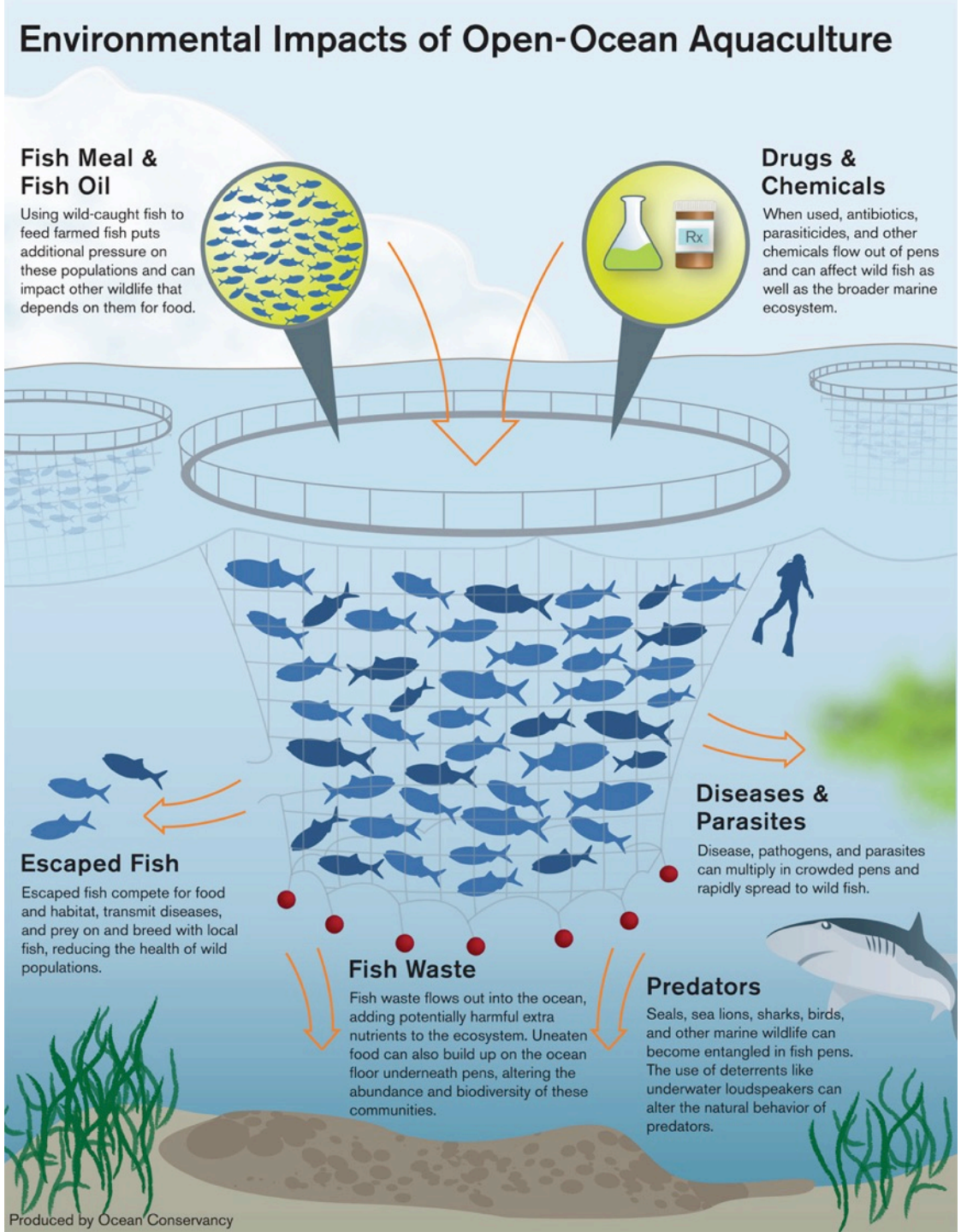
K. Riley, NOAA

Monitoring the Environment

- **Ocean observing systems** are used to monitor the environment (sea level rise, environmental changes, weather)
- **Environmental tracking** – (*Vibrio* and other pathogens, nutrient loading, temperature, salinity, acidification, phytoplankton)


start
Main Dome
Bretan Spur
GLORIA Dome
end
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image NOAA
Grand Goster Mound
© 2013 Google
Google

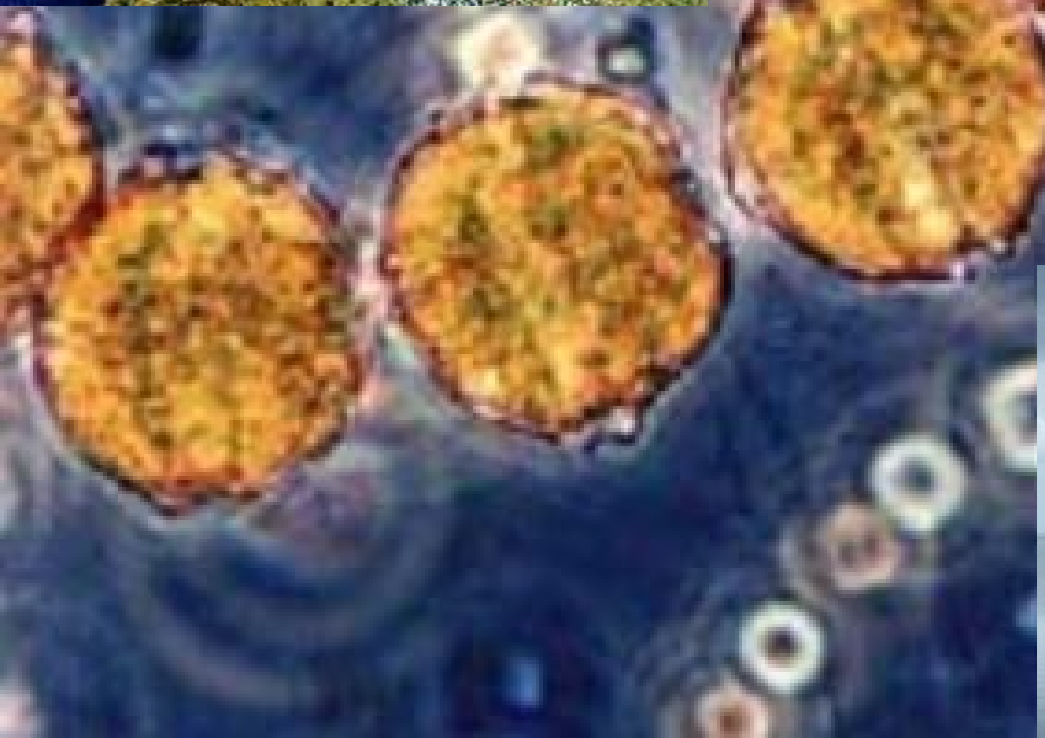
The Indian River Lagoon Observatory Network (IRLON)



Monitoring Aquaculture

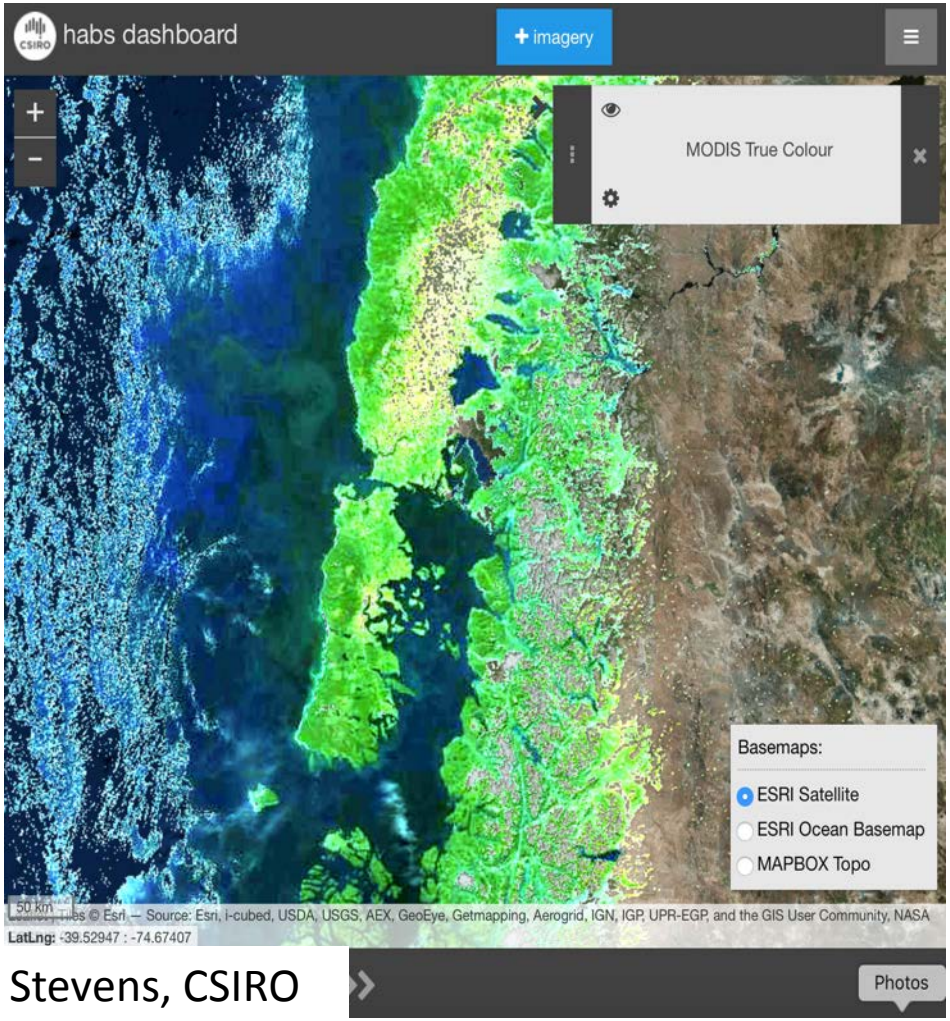
- Water quality
- Entanglements
- Escapements
- Algal blooms
- Food wastage
- Nutrients
- Cage location

Farmed Salmon

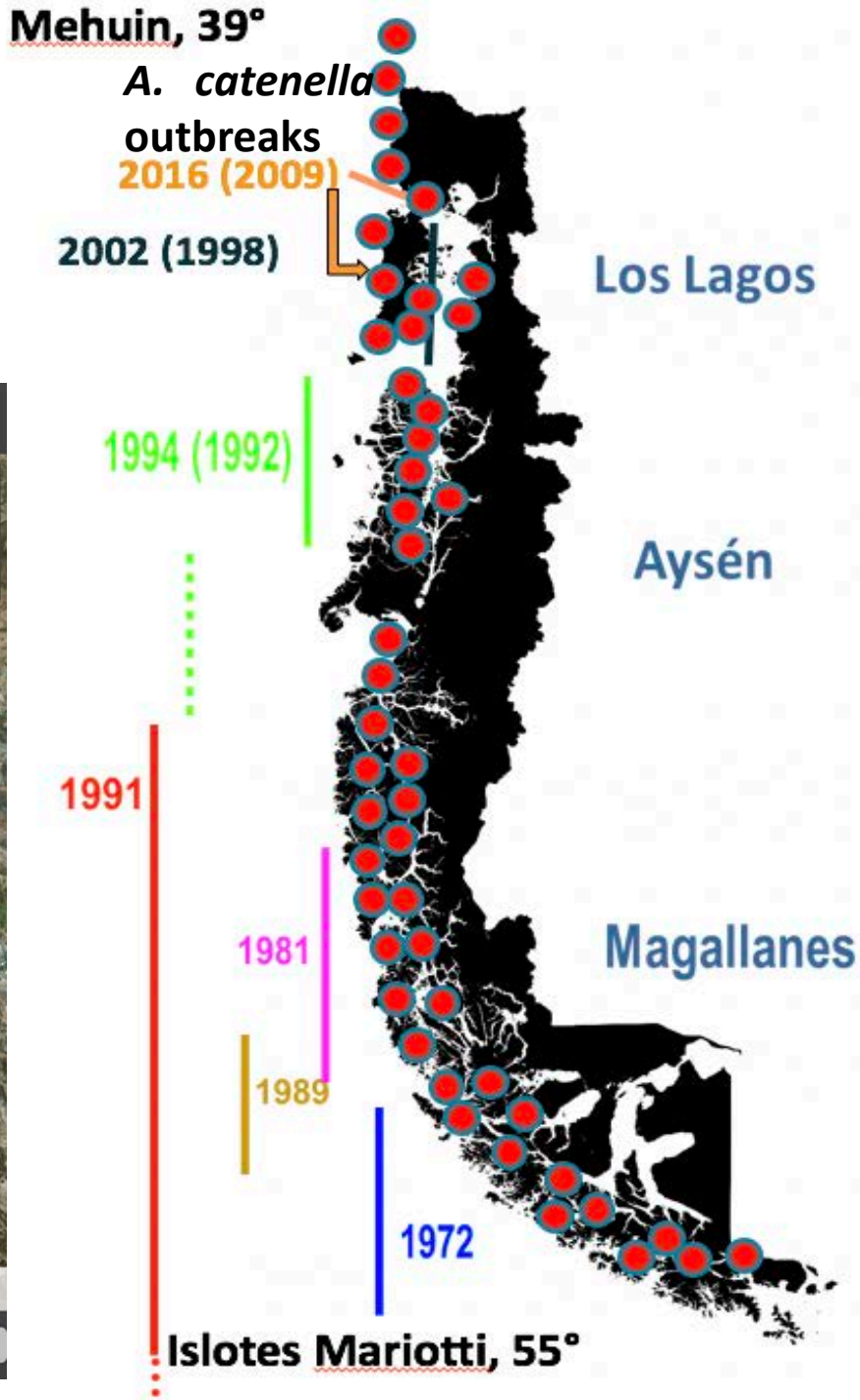


Chile HABs warning system project

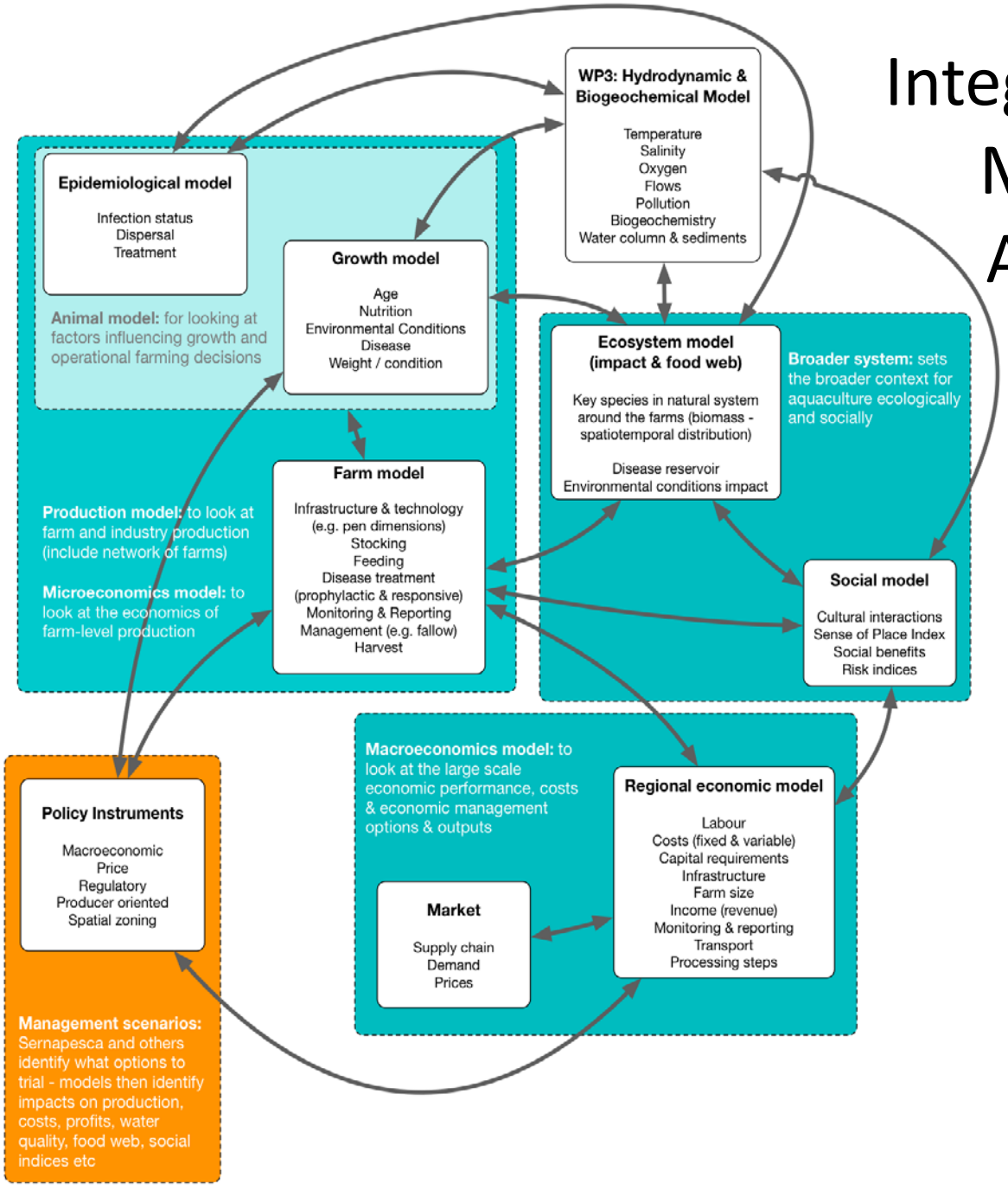
objective: Develop a prototype early warning system for algal blooms in the Southern regions (X, XI and XII)



A. Stevens, CSIRO



Integrated Systems Modelling of Aquaculture



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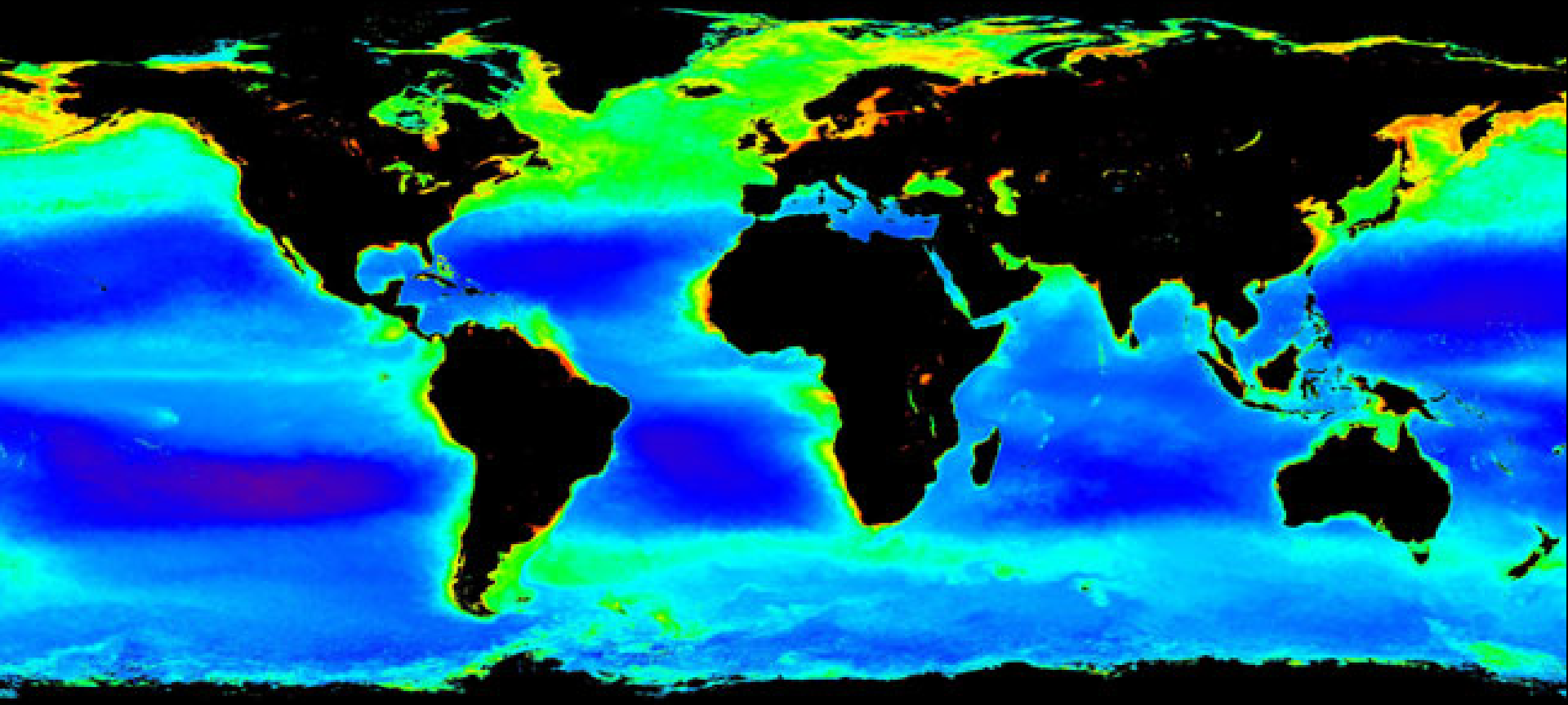
Shellfish Farms

satellite mission



satellite mission

Eutrophication

Harmful Algal Blooms

Climate

Ocean acidification

Sustainable Fisheries

Particle science

Habitat management

Coral reef conservation

Water quality

Unoccupied Aircraft Systems Give New Perspectives of Aquaculture

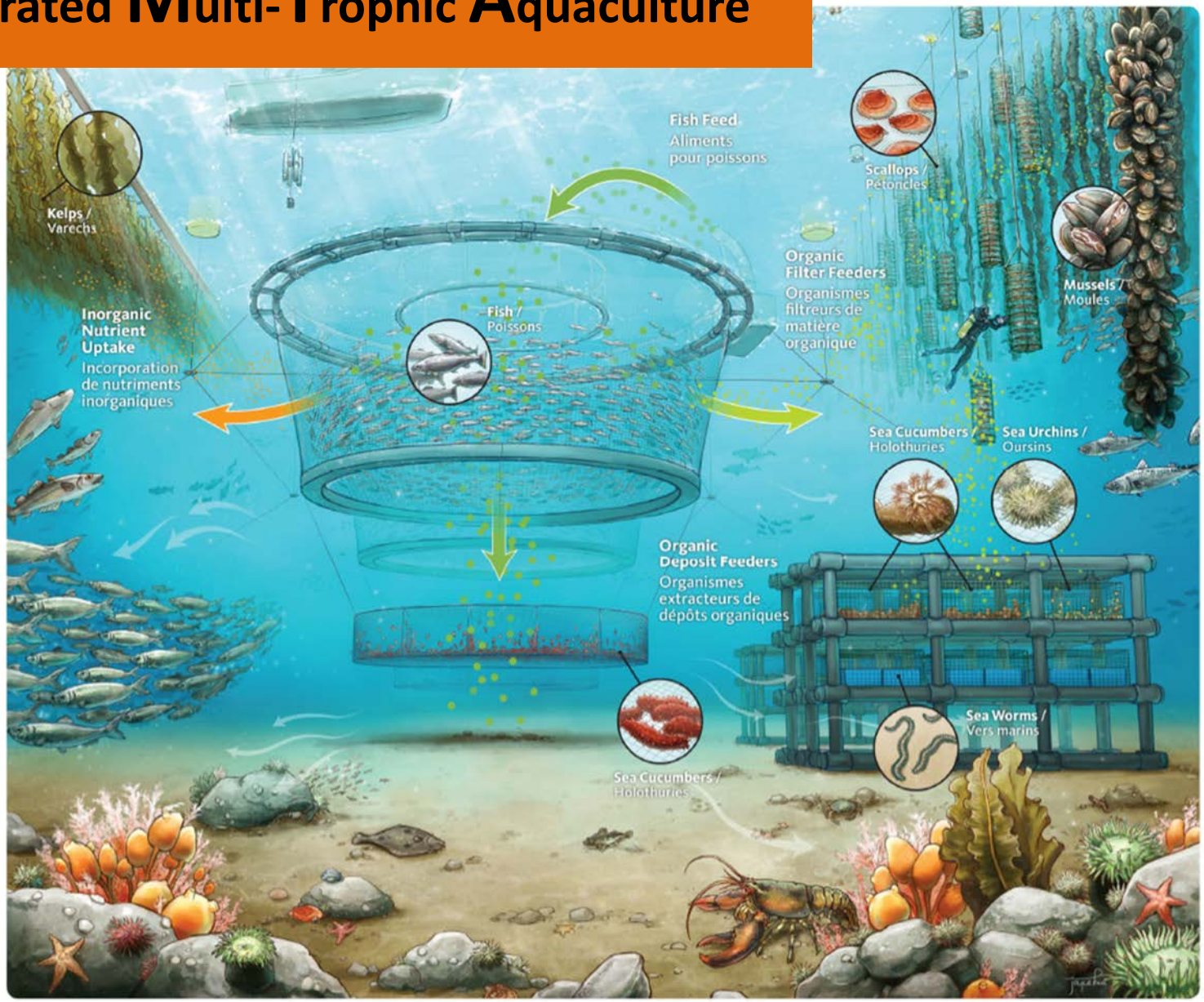
Wellfleet, Massachusetts

SPAT, Inc. / SkyBandit Media

What does the future look like?
--to meet the growing seafood needs--

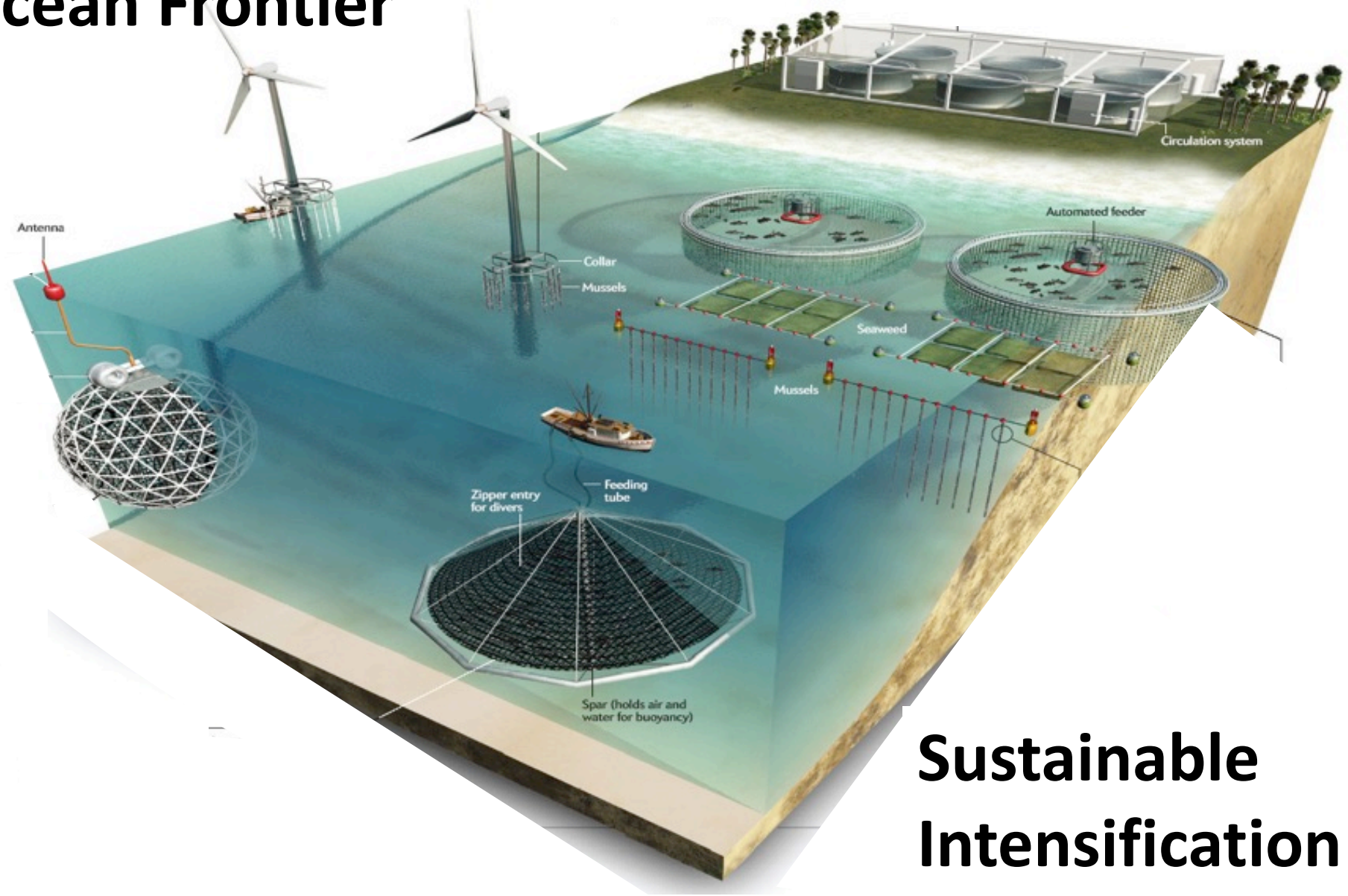
- Move from **hindcast** to **forecast models** (mitigation, emergency harvests, healthy & safe seafood)
- **Integrated aquaculture systems**
- **Selecting species** for local conditions
- **Sustainable aquaculture**
  - For the environment
  - For food security
  - For consumer confidence

Integrated Multi-Trophic Aquaculture



Seaweed Culture

Ocean Frontier



Sustainable Intensification