# OFFSHORE AQUACULTURE AND THE FUTURE OF SEAFOOD PRODUCTION

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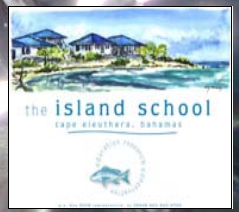
Snapperfarm, Inc.

aquasense ELEUTHERA

RSMAS UNIVERSITY OF Miami
ROSENSTIEL SCHOOL OF MARINE & ATMOSPHERIC SCIENCE




Sea Grant

NOAA

Aquaculture Center of the Florida Keys, Inc.

# The Future of Seafood Production
## Why Aquaculture / Why Offshore?

### Facts and trends:

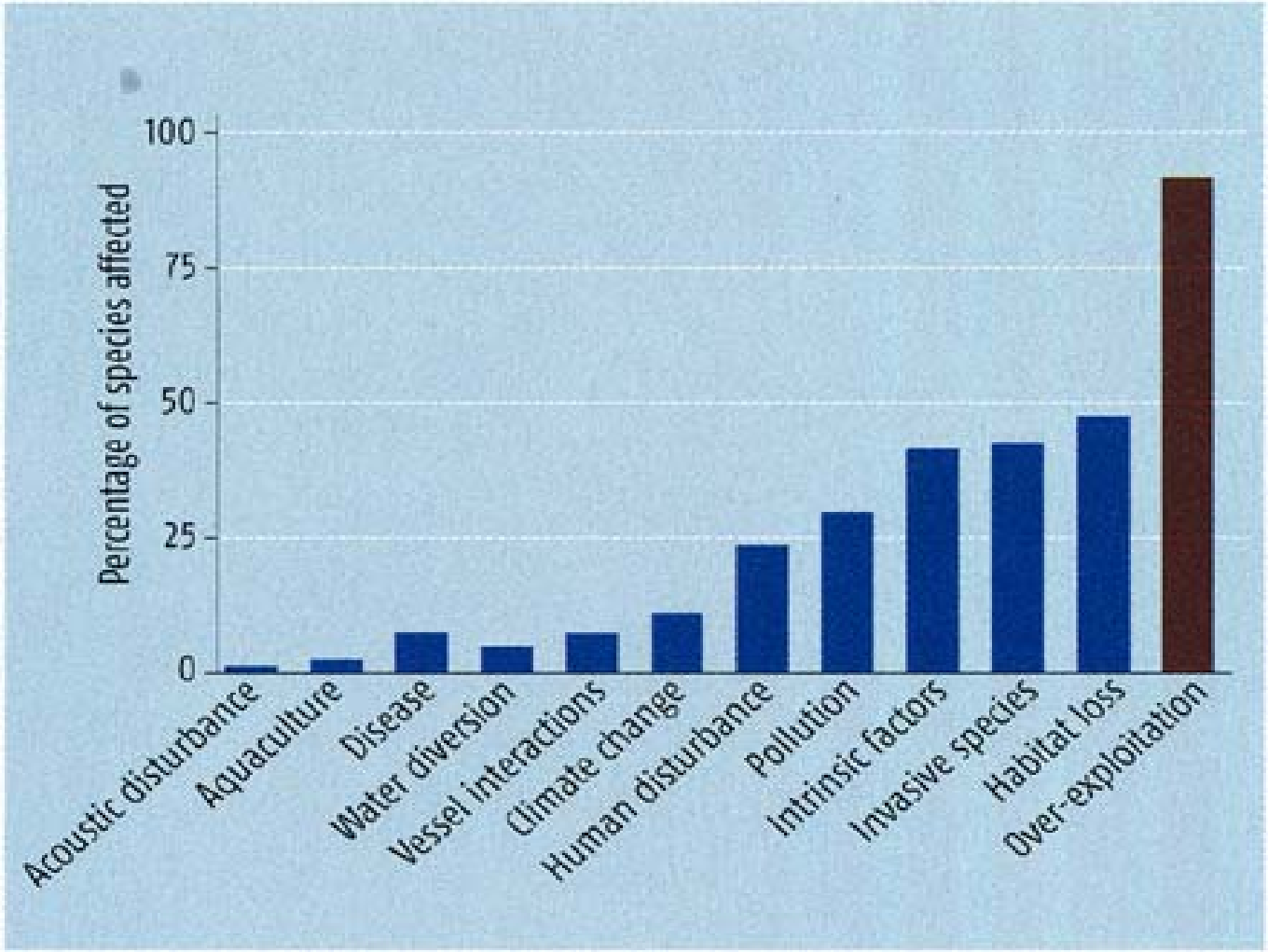
- Fish consumption increasing, world population growing (FAO, 2003)
- Overfishing: 75% of ocean fisheries fully exploited (many stocks collapsed)
- Oceans are in deep trouble (2004 Ocean Comm. Rep.; 2004 PEW Rep.)
- US seafood trade déficit > $ 8 Billion /year and growing

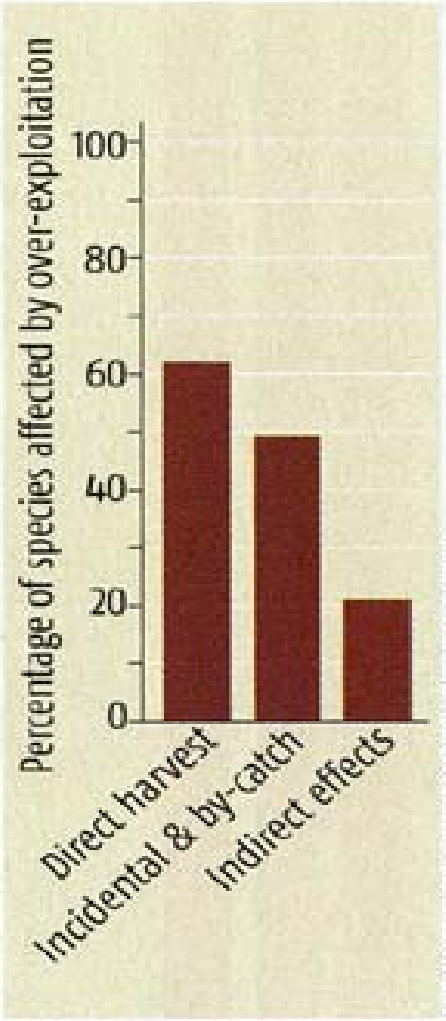
### Bottom line:

- Increases in seafood production are unlikely to come from fisheries
- Over 30% of total world fishery production from aquaculture
- World aquaculture production has been steadily increasing at >10% per year over the last decade

## DANGER IN THE SEA

**Threats to marine species listed as "vulnerable" on the World Conservation Union Red list**

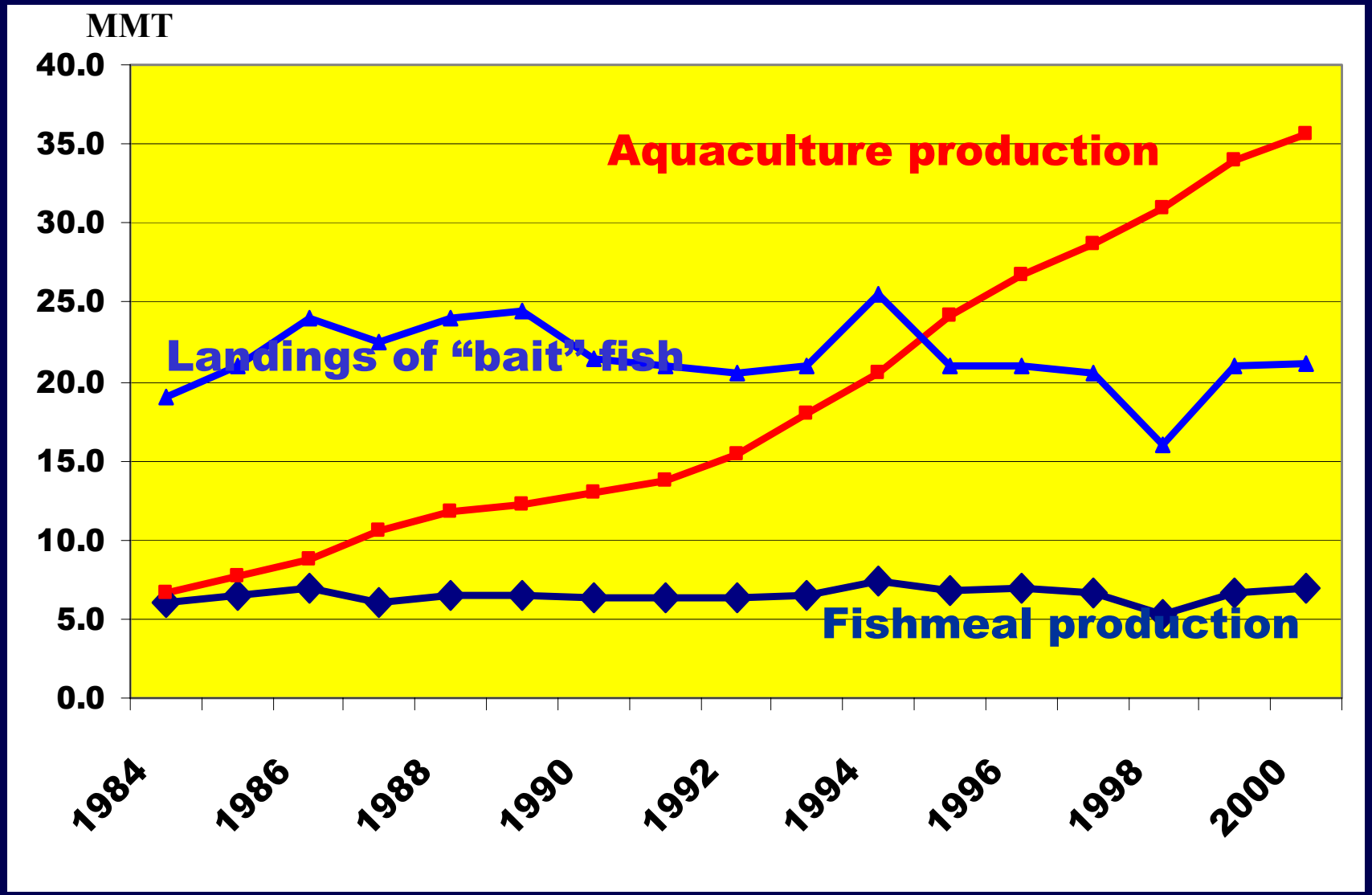



SOURCE: FRONTIERS IN ECOLOGY AND ENVIRONMENT

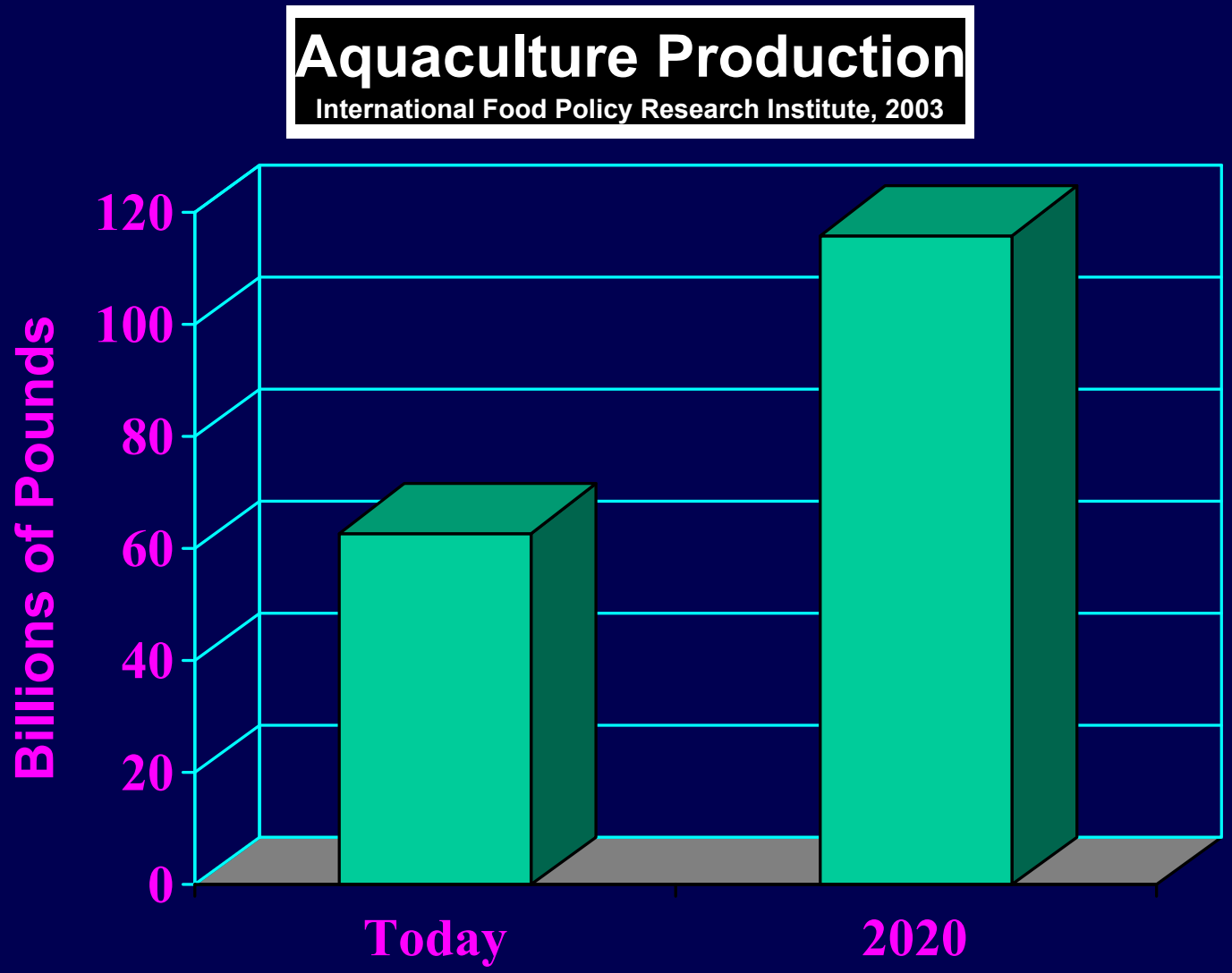
# Aquaculture, bait fish & fishmeal

Data from Tacon, A.G.J., 2003 and Allen, G. 2004



# Global Aquaculture Growth Jobs and Production

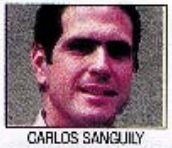
- Currently, the global aquaculture industry employs over 100 million people.
- By 2020, employment from aquaculture is predicted to grow substantially.




**"A new way to feed the world"**
**"The future of food"**
**"Aquaculture is a good thing, in spite of environmentalists concerns"**
**"… the inevitable.."**
**J. Marras (Nature, July 2005)**

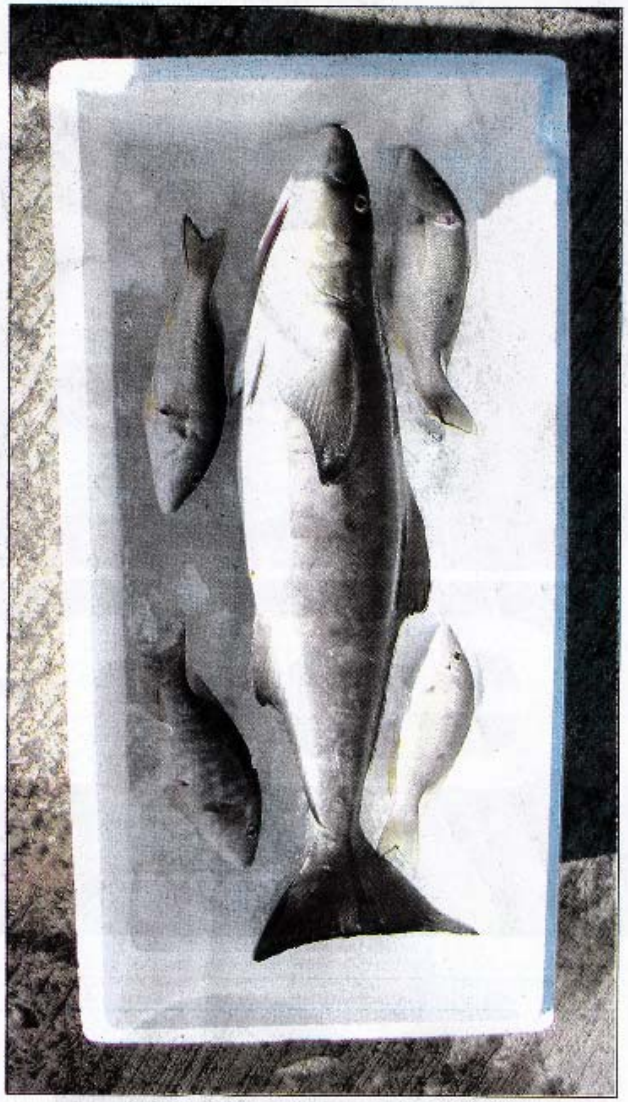
ETHNIC EXPLORER BY LINDA BLADHOLM

# Wild a catch


CARLOS SANGUILY


DANIEL BENETTI


JIMMY O'HANLON


BRIAN O'HANLON/For The Herald

## Firm-fleshed, farm-raised cobia are an environmentalist's dream and a diner's delight

Cobia are fast-growing even in the wild, but put these jut-jawed, cigar-shaped fish in a pen deep in the ocean and they go totally alpha, reaching 8 to 10 pounds in less than a year. A mutton snapper raised in the same conditions won't even be a pound, making cobia enticing as a profitable fish to farm-raise.

That is just what Jimmy O'Hanlon and Carlos Sanguily of JC Seafood are doing, working with Daniel Benetti, director of the aquaculture program at the University of Miami, and his partners Brian O'Hanlon (Jimmy's nephew) and Joe Ayvazian of Snapperfarm, an operation based on environmental sustainability.

Their "farm" is two galvanized steel-and-mesh pods, each large enough to hold 38 tractor trailers, moored several miles off the coast of Culebra, Puerto Rico. The pristine water is the perfect temperature and its fast flow acts as a natural filter.

One pod holds the cobia now being harvested; the other is home to mutton snapper that they expect will be big enough for market early next year. Hatched fingerlings are fed pellets made of fish and corn meal, soybean meal, vegetable fibers and yeast extracts, with no growth hormones, antibiotics or pigments added. There are no harmful pollutants or negative impact on the coastal mangrove swamps or coral reefs, UM's Benetti says.

Best of all, these politically correct fish, related to dolphin and also called black kingfish, taste fantastic.

"We think it will be bigger than tilapia," says Benetti, referring to the species that has until now cornered the farm-raised market.

Farm-raised cobia are whiter and have more fat, making them tastier with less granular flesh than their hard-swimming wild brethren.

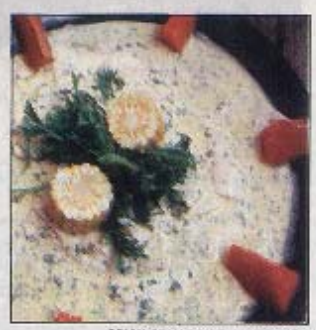
In a tasting held at Pescado in the Village of Merrick Park, executive chef Peter Hansen showcased its versatility. Starters included coconut tempura cobia and *tiraditos* (Peruvian-style sashimi). Cobia just might be best raw. The supple slices are light and delicate but durable and not fishy tasting at all.

When cooked the flesh is gorgeous, too — pure white, muscular, mild and flaky, as in Hansen's main course of pan-seared cobia fillets atop black-bean polenta with a salsa of chopped Kalamata olives, sun dried tomatoes, feta, fresh basil and red wine vinegar.

Cobia would also be great steamed, baked or broiled. Or mince the meat, form it into fish balls bound with egg white and drop it into rice noodle soups. For an all-American treatment, grind it with chiles, fresh herbs and black pepper and make it into burgers, served with fruity ketchup.


LINDA BLADHOLM / FOR THE HERALD

**ASIAN APPROACH:** Chef Peter Hansen served nuggets of coconut tempura cobia with a sweet chile glaze and plated it with sweet-sour red cabbage at Pescado.


BRIAN O'HANLON/For The Herald

**BIG BOY:** A cobia dwarfs mutton snapper the same age, top; above, in the tiraditos served at Pescado, cobia sashimi was served in a citrus juice and cream reduction.

With the environmental cloud surrounding Chilean sea bass, the timing couldn't be better for a farm-raised fish that tastes even better than wild-caught.

*Cobia is $4.95 a pound whole, $10.95 filleted at Captain Jim's Seafood Market, 12950 W. Dixie Hwy., North Miami, 305-892-2812.*

*Restaurants serving cobia include Pescado, Village of Merrick Park, 320 Avenue San Lorenzo, Coral Gables, 305-443-3474; Norman's, 21 Almeria Ave., Coral Gables, 305-446-6767; Nobu, 1901 Collins Ave., Miami Beach, 305-695-3232; and Café Ibiza, Village of Merrick Park, 370 Avenue San Lorenzo, Coral Gables, 305-443-8888.*

### PAN-SEARED COBIA

Peter Hansen, executive chef at Pescado, shared these directions for his spice-seared fillet. (Black cod or wahoo can be substituted for cobia.) Serve it with couscous and a wedge of lemon:

- Heat the oven to 400 degrees.
- Rub a large cobia fillet with olive oil, a little salt and garam masala (a blend of cinnamon, cloves, coriander, cardamom, black pepper, cumin, dried chiles, fennel, mace and nutmeg available at Indian markets).
- Heat an oven-proof skillet over high heat; add oil and a little butter.
- Carefully lay the fish in the pan and let it sear until the spice mixture forms a nice crust.
- Remove the pan from the heat, turn the fish over carefully with a spatula and finish it in the oven for about 6 minutes. Makes 2 servings.

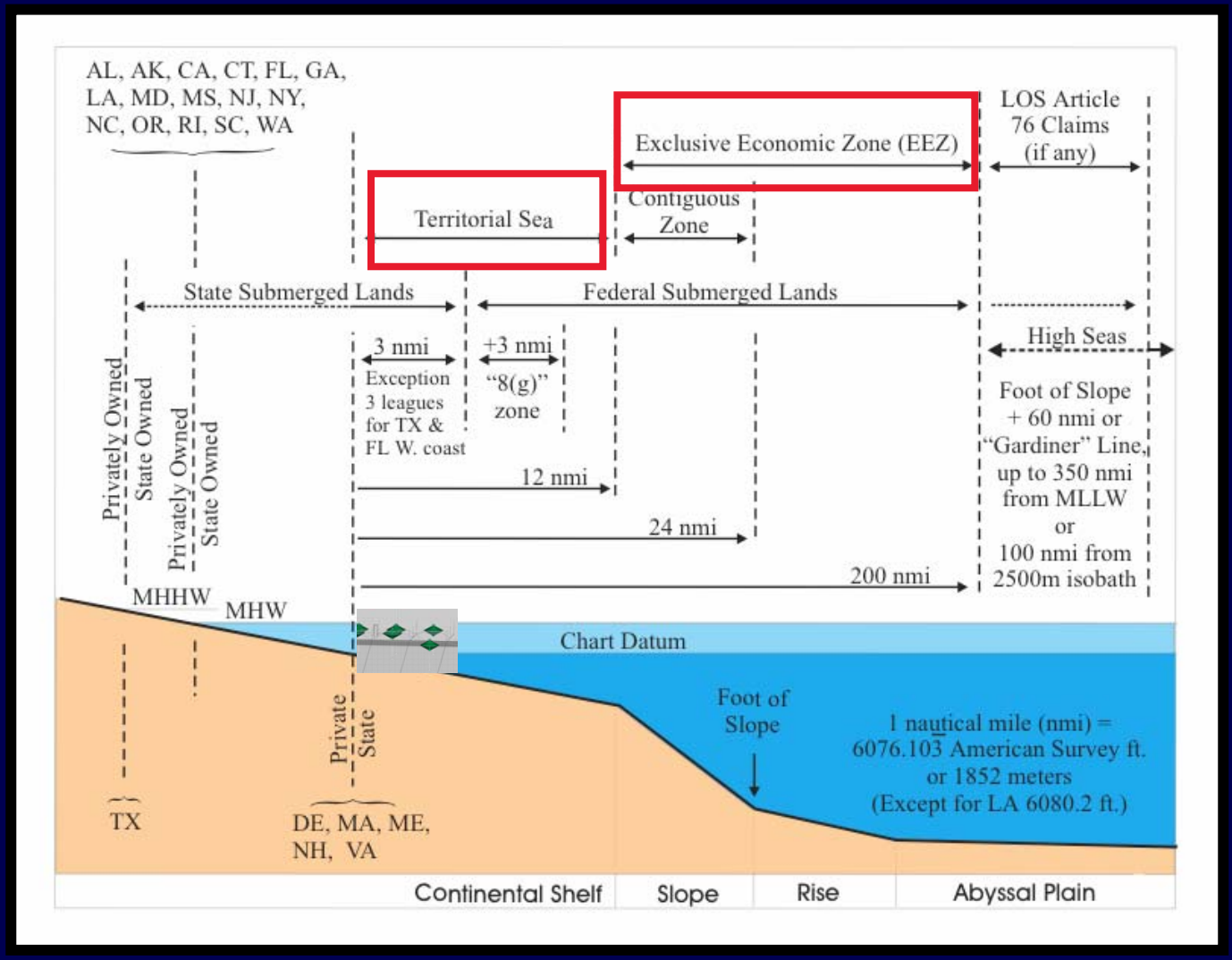
## At stake:

- Not *whether*, *if* or *when* but *how* and *where* it will expand:
  - Traditional or new technology?
  - Inland/Coastal /Open ocean / Offshore?
  - US or abroad?
- What can happen/What should happen (seafood/energy)
- Precautionary approach/sustainable development
- *What ifs?* California wine industry Napa; Silicone Valey
- Can "sustainable" aquaculture be economically feasible?
- Is the technology to move/expand aquaculture offshore (into the EEZ) in place?

# CURRENT STATUS

- Technology limits move towards futuristic, fully automated, "self-sustained" farms offshore (EEZ)
- Oil/gas platforms hold promise but cost/liability prohibitive

# WHERE ARE WE AT?




Exposed areas (adequate depth+current)
Near shore, within State waters


CULEBRA, PUERTO RICO


ELEUTHERA, BAHAMAS

# SeaStation 3000 - Ocean Spar, Net Systems (U.S.)

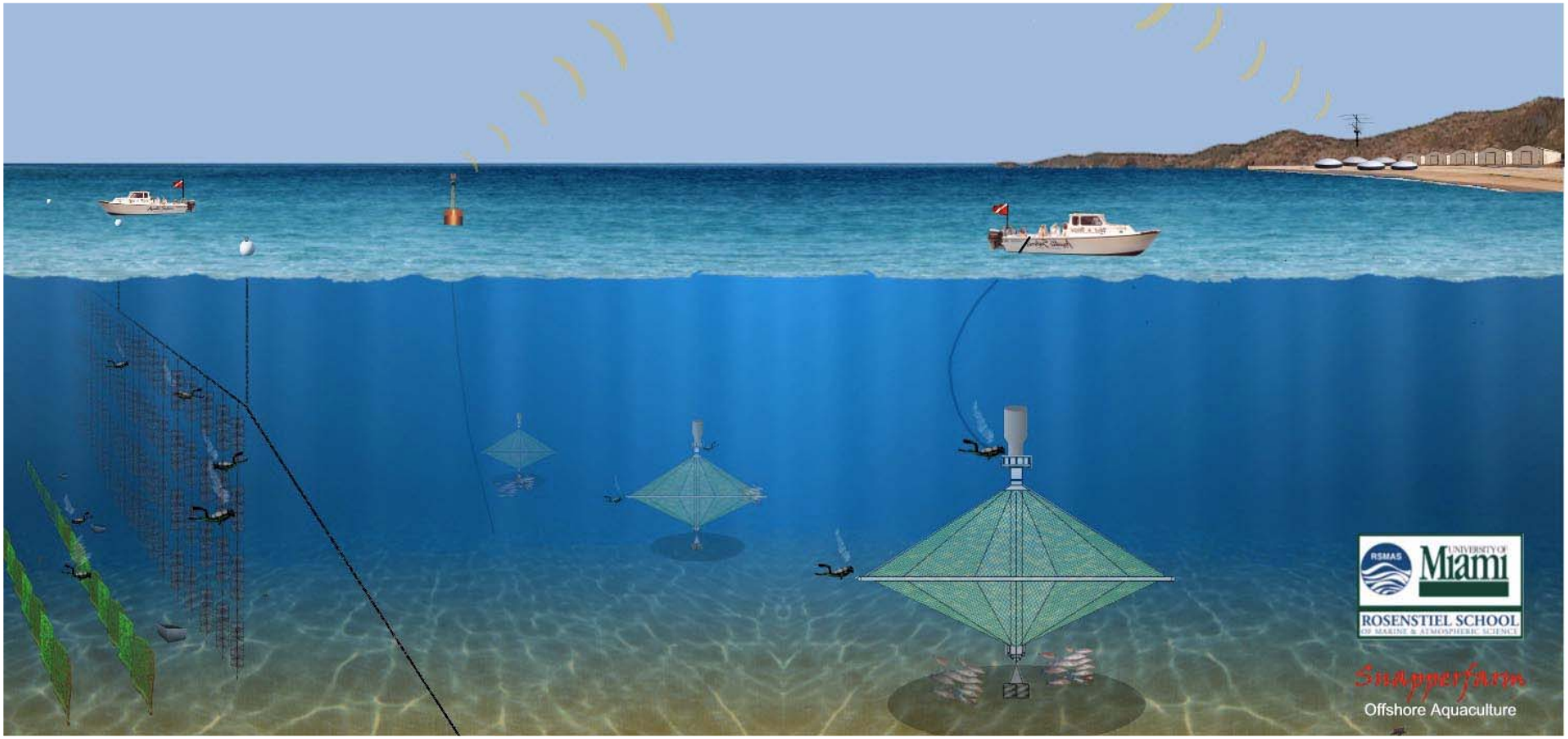
**Culebra, Puerto Rico**
**Snapperfarm, Inc.**

**Cage volume = 3000 $m^3$**
**Average current velocity = 0.5 knot**
**Depth = 25-30 m (90-100 ft)**

**$H_2O$ flow > 2 billion liters/day**
**(>600 million gl/day)**

**Eleuthera, Bahamas**
**AquaSense Bahamas, Ltd.**

# OPEN OCEAN AQUAFARM - NOT JUST A CONCEPT ANYMORE…




## CONCEPTUAL OFFSHORE SUSTAINABLE AQUAFARM

http://www.rsmas.miami.edu/groups/aquaculture

# SPECIES

1) Native /endemic to the region (SE US, Gulf and the Caribbean)
2) High market demand and value
3) Technology developed/available from egg to market (hatchery produced)
4) High Aquaculture performance: growth, survival and feed conversion rate

Cobia (*Rachycentron canadum*)

Mutton Snapper (*Lutjanus analis*)

# HATCHERY TECHNOLOGY DEVELOPED IN THE U.S.

## COBIA *Rachycentron canadum*

Yolk-sac larvae - 1 day old

20 days old

2 days old

45 days old (4.5 in)

10 days old


8 weeks (80 grams!)

# Comparative Growth During Early Developmental Stages
# 45 DPH (Days Post Hatch) – 6 weeks


**Cobia**
**5.5 g; 11.5 cm (4.5 in)**

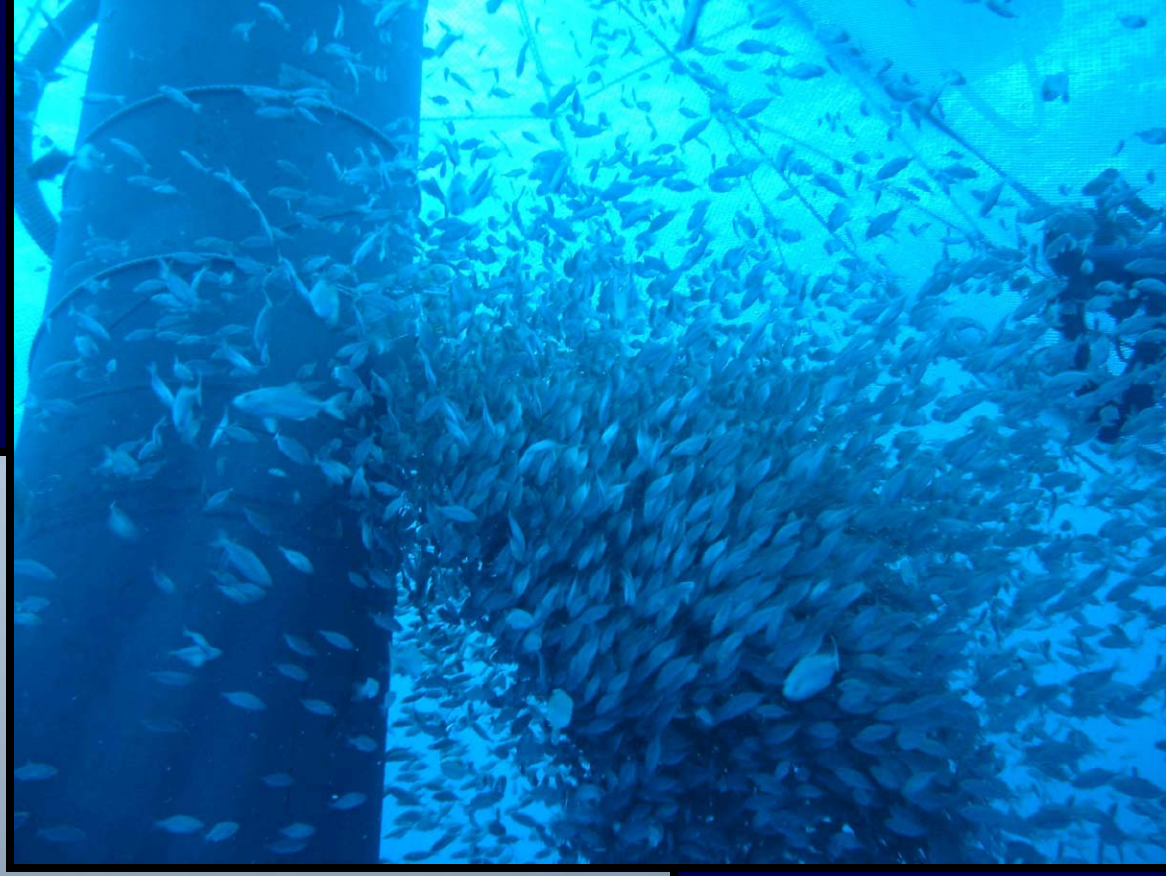
**Snapper**
**0.2 g; 2.0 cm (1.0 in)**

# HATCHERY TECHNOLOGY
## Extensive larval rearing in ponds (natural plankton blooms)

Fist trials carried out at the University of Miami Experimental Hatchery in May/June 2005 produced tens of thousand of healthy cobia fingerlings

# KONA BLUE HAWAII

**KAHALA**
**(a.k.a. *Seriola rivoliana*)**



My goodness.


Horizon Organic® Milk is produced without the use of antibiotics, added growth hormones or dangerous pesticides.

That's why Horizon Organic milk is as wholesome as it gets. Not only does it taste creamy, fresh and delicious, but it's also very good for you. And that'll have you feeling good inside and out.

HORIZON™ ORGANIC

Good from the beginning

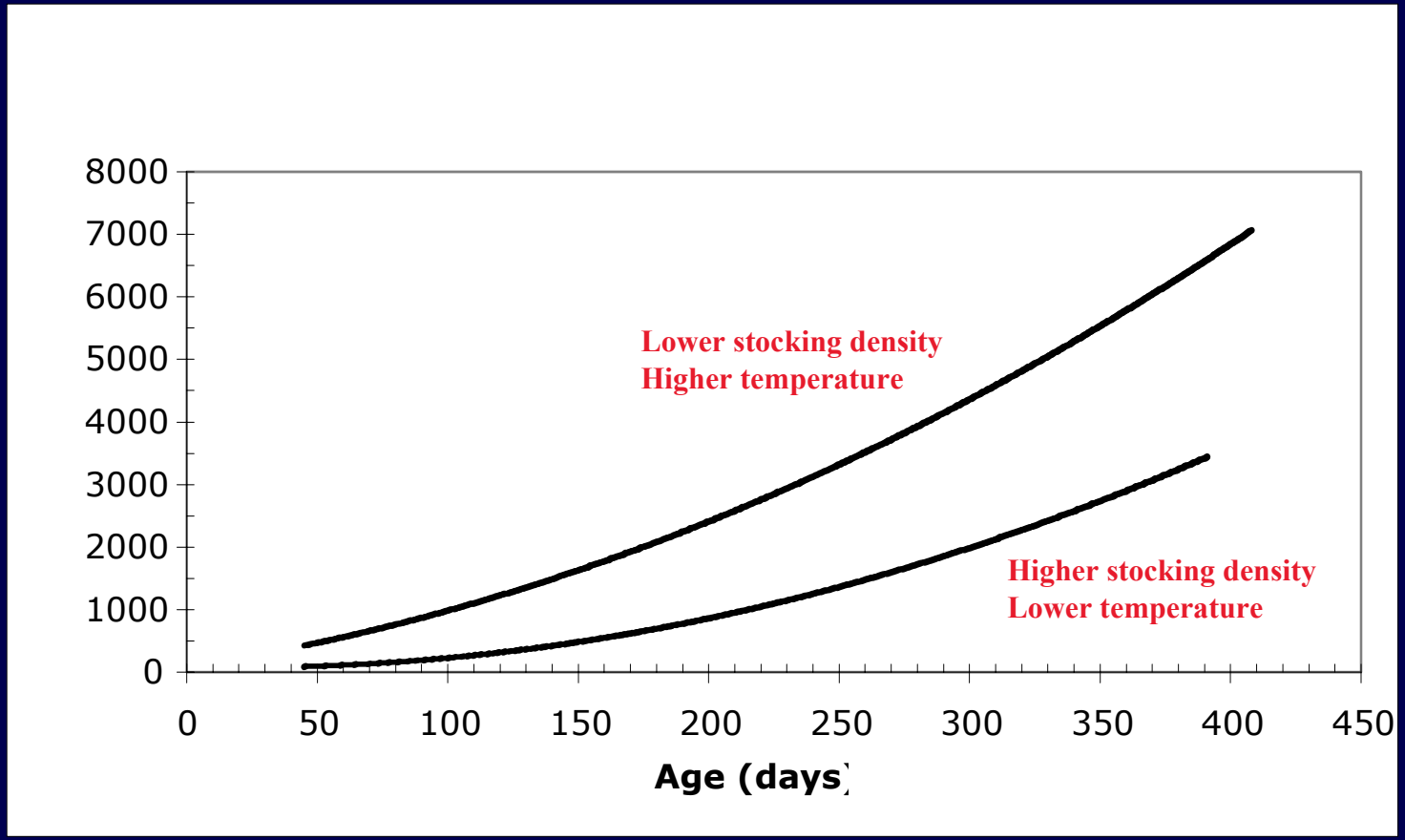
# GROWOUT

**Snapperfarm and AquaSense cobia are produced without the use of any antibiotics, hormones, pigments, or pesticides.**
**Grown offshore, far from pollution sources**

***Organic Cobia!?***
**[Ethoxyquin, a synthetically-derived antioxidant (stabilizer) used to prevent oxidation, rancidity.]**

**Extraordinary Rates of Growth and Feed Conversion Efficiency (FCR) at Low Environmental Impact**

# GROWTH RATES OF COBIA CULTURED IN OPEN OCEAN CAGES IN PUERTO RICO AND THE BAHAMAS



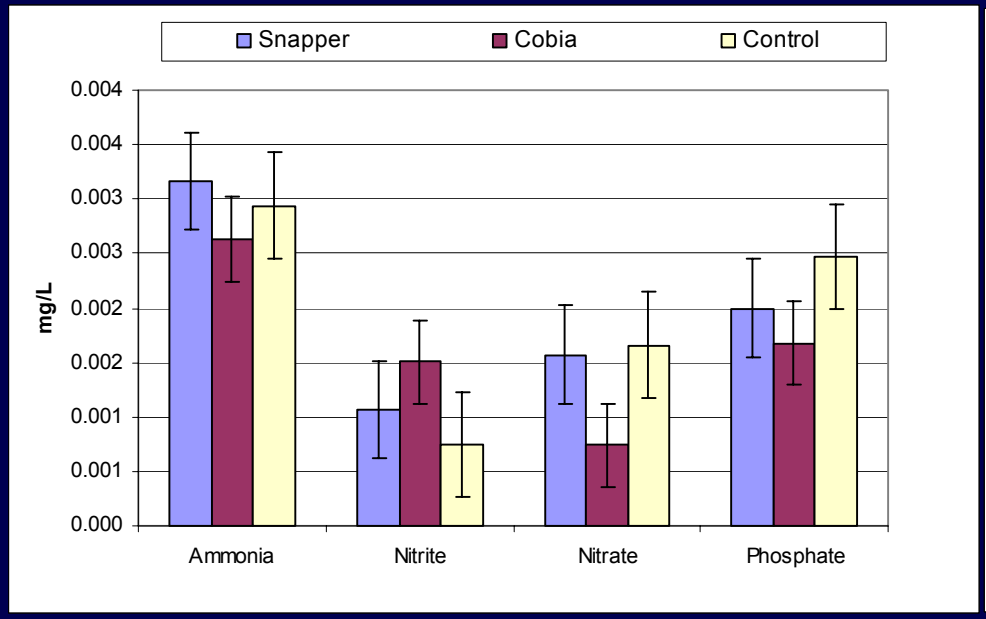

**Environmental and economic sustainability of operations?**
**Growth rate is inversely proportional to stocking density**
**Mortality rate is directly proportional to stocking density**

# Environmental Assessment

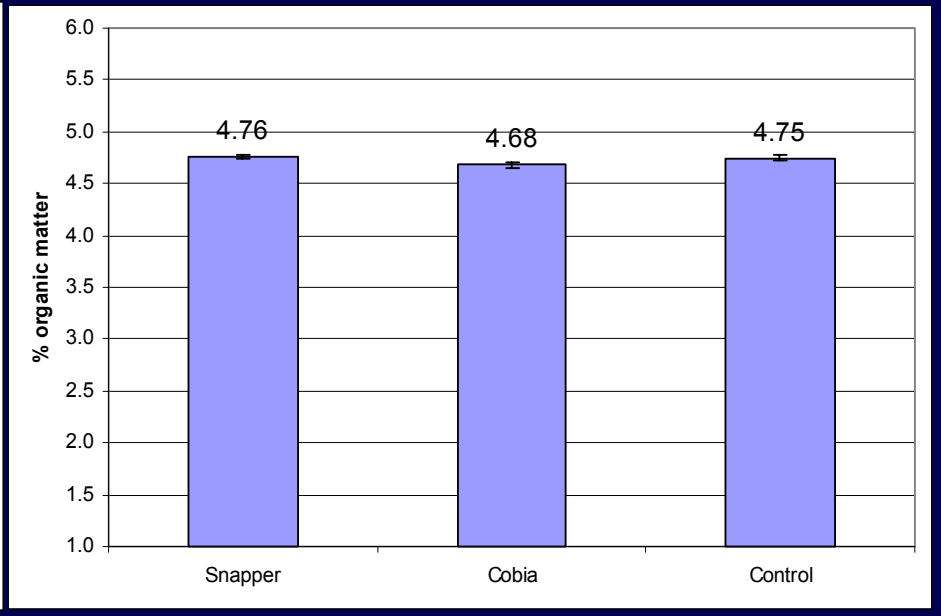
- **Physical factors**
  - Bathymetry (depth profile)
  - Bottom type (preferred sandy)
  - Coastal topography
  - Wind velocity/direction/fetch
  - Currents and tides
  - Wave height (max/min/average)
  - Air and water temperature
  - Turbidity
- **Biological factors**
  - Fouling
  - Chlorophyll
  - Productivity
  - HABs
  - Assemblage
  - Benthic studies
- **Chemical factors**
  - Total suspended solids
  - Ammonia
  - Nitrite
  - Nitrate
  - Phosphate
  - Dissolved oxygen
  - Organic matter
  - Nitrogen
- **Socio-economic factors**
  - Acceptance of project
  - Local communities
  - Partnership Fishermen Association
- **Educational factors**
  - Elementary / High School / Technical Level Curricula
  - Teachers' Materials / Talks, etc.

# Environmental Assessment
## Summary of Results - Puerto Rico

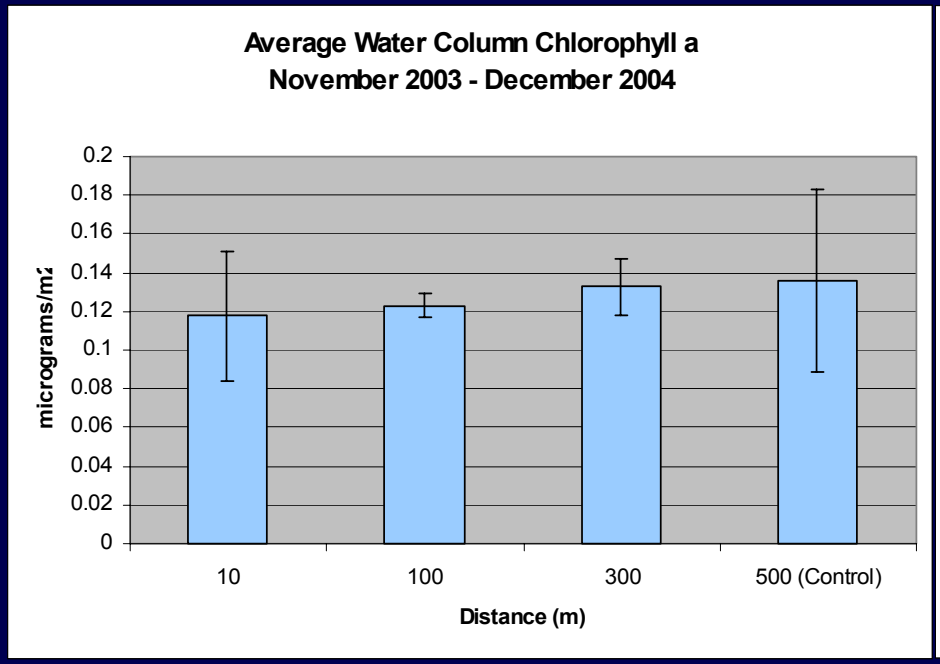
### Dissolved nutrients in the water column

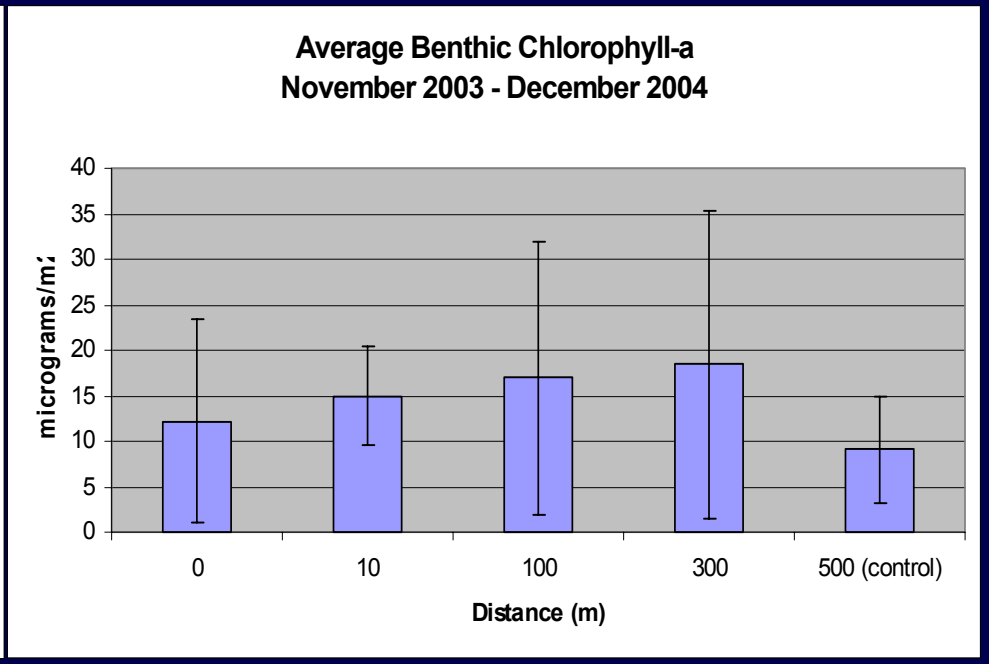



### Organic matter in the sediments at the cages and control site



# Environmental Assessment
## Summary of Results - Bahamas



# Summary of Environmental Studies (Puerto Rico, Bahamas, Hawaii, New Hampshire)

- *Environmental data from Puerto Rico and the Bahamas indicate that there are no significant changes in the water column and benthic ecosystems near the area.*

- *There were no significant differences in any of the water quality parameters measured in the area surrounding and beneath the cages - except for small localized benthic impact just underneath the cages*

- *No samples had values in excess of allowable values under the NPDES permits*

- *Data are from small scale, demonstration projects*

- *Need to continue environmental monitoring studies as operations expand to determine whether/when a threshold level may occur*

Benetti, Brand, Helsey, Langan, Alston, Cabarcas, Collins (in prep)

# PROBLEMS:

## HURRICANES

- In 2004, the cages were exposed to severe storms, including category 4 Hurricane Frances

Cage Location

- WINDS ranging from 70-100 miles/hr prevailed in the area where one of the cages is deployed in South Eleuthera for almost 24 hours

- No damage to the cage or fish mortality were observed

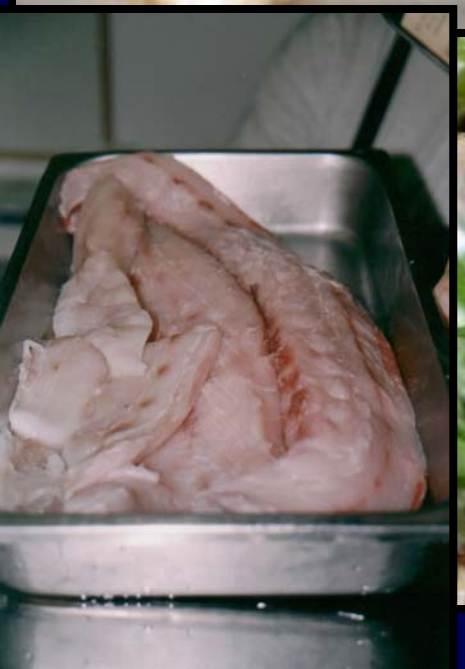

## SHARK PREDATION ESCAPEMENTS

# HARVESTING/PROCESSING/SHIPPING



# HIGH-QUALITY PRODUCT…


# … FOR A HIGH-END MARKET



# SUMMARY

- **Objective is to produce high-quality fish for high-end market seeking profits and lowering US seafood trade deficit ($ 8B)**
- **New technology has been developed from egg to market: new species (moi, kahala, cobia) production has been added to market**
- **Results suggest that growing this species in exposed sites *can* produce high yields of fish with low environmental impact**
- **Results suggest that, properly sited and managed, aquaculture of high-value fish *can* be conducted responsibly**
- **Must be integral component of NOAA Ecosystem-Based Fishery Management Plan and Coastal Management Plans**
- **It will be difficult to compete with production from abroad; environmental and technological prospects seem great; economic prospects do not**

# SUMMARY - THE FUTURE

- Anti-predator systems including predator nets, shark pods, electromagnetic fields and chemical/electrical repellants (passive deterrent methods)
- Facilitate permits for demonstration projects and to expand currently permitted operations to reach economic feasibility
- Continue mandatory environmental monitoring studies to ensure sustainability and determine threshold to limit production/unit area
- Expansion of offshore aquaculture will be driven by economic and environmental concerns combining the needs from the industry, government agencies, NGO's, press and the public at large
- Move/develop the industry abroad with great losses (e.g. quality control, employment, social/economic losses, dependence foreign production; seafood trade déficit)
- What can happen: to buy more seafood/energy abroad
- What should happen: to produce more seafood/energy at home

# THANKS!

Snapperfarm, Inc.

aquasense ELEUTHERA

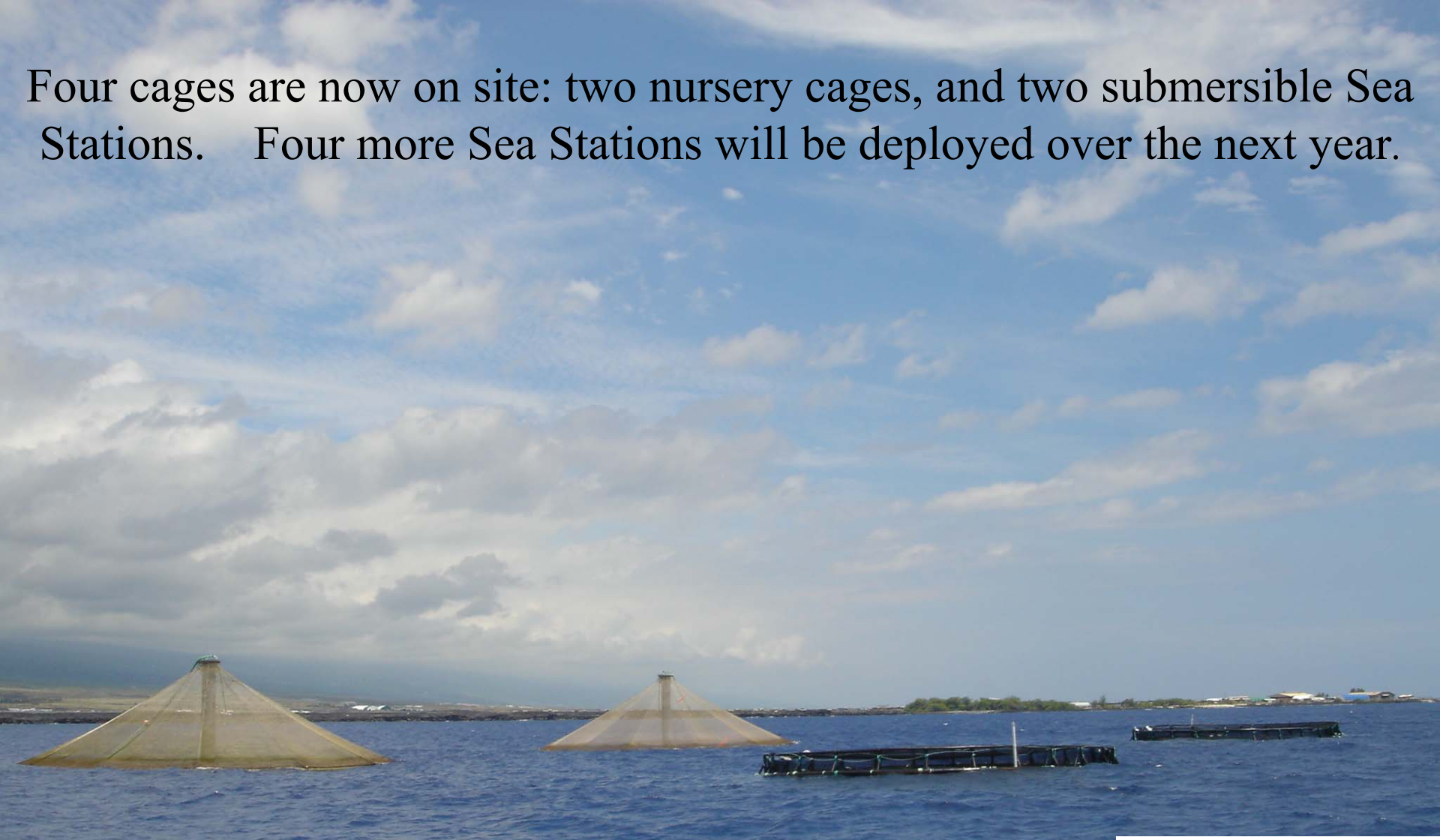
RSMAS UNIVERSITY OF Miami ROSENSTIEL SCHOOL OF MARINE & ATMOSPHERIC SCIENCE

Sea Grant NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE DEPARTMENT OF COMMERCE UNITED STATES OF AMERICA

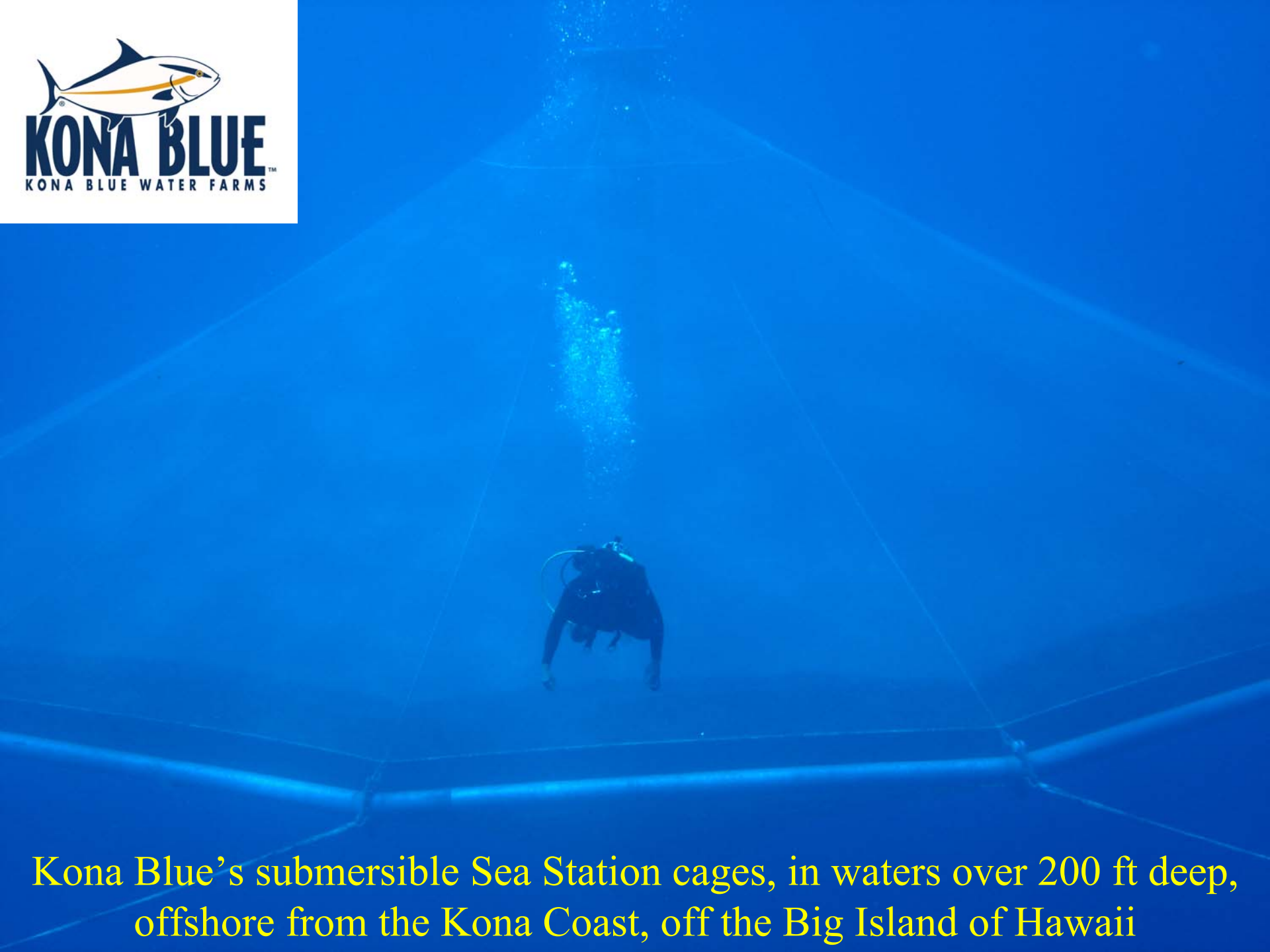
**Aquaculture Research Council**

**Florida Department of Agriculture - Division of Aquaculture**

Four cages are now on site: two nursery cages, and two submersible Sea Stations. Four more Sea Stations will be deployed over the next year.



KONA BLUE™
KONA BLUE WATER FARMS




Kona Blue's submersible Sea Station cages, in waters over 200 ft deep, offshore from the Kona Coast, off the Big Island of Hawaii


Total of 90,000 fish stocked in offshore cages to date.
First harvest September 1st, 2005. Mean weight 3.5 lbs
KONA BLUE
KONA BLUE WATER FARMS

Kona Blue's **Kona Kampachi™** *(Seriola rivoliana)*

KONA BLUE™
KONA BLUE WATER FARMS