Development of Marine Aquaculture
A National Imperative
HSWRI Founders

envisioned an independent, highly creative and results oriented scientific research organization.

Since 1963

“to return to the sea some measure of the benefits derived from it.”
Leon Raymond Hubbard Jr. Marine Fish Hatchery
Carlsbad, CA

H-SWRI Headquarters
Mission Bay Laboratory, San Diego, CA

Laboratories in Orlando & Melbourne Beach, FL
Core Areas of Research

**Ecology**: Understanding the oceans and its inhabitants

**Bioacoustics**: It’s not a silent world

**Physiology and Health**: Understanding how animals respond to a changing world

**Aquaculture**: Helping to feed a hungry world
Establishing cleaning and treatment protocols for marine animals after oil spills

Discovering new marine mammal viruses and studying their impact on population health
Ecology: Understanding the Ocean and its Inhabitants
Aquaculture

Sportboat Catch of White Seabass

Year

Sport Catch (x 1000)

Location of White Seabass Hatchery and 14 Satellite Growout Facilities

- Santa Barbara
  - Port Hueneme
  - Channel Islands Harbor
- Los Angeles
  - Marina del Rey
  - King Harbor
  - Huntington Harbor
  - Newport Bay
  - Dana Point Harbor
- San Diego
  - Agua Hedionda Lagoon
  - Mission Bay (2)
  - San Diego Bay (2)
  - Catalina Island (2)
The Aquaculture Imperative

Hatch fish farming

Aquaculture belongs in U.S. waters.

It's a much-needed way to ensure a steady supply of fish, which is crucial for both the food industry and the environment. In the U.S., aquaculture has the potential to provide a much-needed boost to the seafood market, helping to address the growing demand for sustainable seafood.

The Economist

Blue revolution

The promise of fish farming

The aquaculture industry is growing rapidly around the world, with significant potential for the U.S. as well. By investing in sustainable aquaculture practices, we can ensure a steady supply of fish for years to come.

NATIONAL GEOGRAPHIC

Saving the Sea’s Bounty

The Magpie Mantis Shrimp

Safe haven in New Zealand

Village of Empty Nets

Research shows that California’s ocean resources, including its valuable shrimp, are under threat from pollution and overfishing. By taking action to protect our oceans, we can ensure a healthy future for marine life and the livelihoods that depend on it.
40 million more tonnes of aquatic food will be required by 2030 to maintain the current per capita” – FAO 2006

At a landed price of $3/kg this is $125 billion.

At retail prices - $500+ billion.
The Need for Demonstration Projects
The Economic Imperative
U.S. Seafood Trade Deficit

Year

Trade Balance (Billions USD)
Benefits of a Domestic Fish Farming Industry

- Create U.S. jobs
- Promote feed efficiency
- Use domestic ingredients
- Minimize carbon footprint
- Meet our environmental and food security standards
California’s Living Resources Industries

Between 1990 and 2000 California has lost:

• 725 jobs in fishing, aquaculture and seafood processing
• Over $40 million in wages and
• Over $160 million in the Gross State Product
Catalina Demonstration Project
NOAA/Saltonstall Kennedy Funded

• Reached marketable size in 18 months
• 97% survival and no disease related mortality
• Zero escapes
• Product quality was deemed “excellent”
• “…net cages can influence the fish community in a positive way”*

* Oakes and Pondella; 2009; J. World Aquaculture Soc.; Vol. 40, No. 1; pp 1-21
HSWRI proposes to:

- Permit, install and operate a commercial scale fish farm
- Location to be five miles off the coast of San Diego in federal waters (EEZ)
- Assess ability to increase domestic supply of seafood in an environmentally sustainable manner
- Highlight to the nation San Diego’s leadership in the development of offshore aquaculture
Site Requirements

• Need
  – Greater than 100 feet and less than 350 feet deep
  – Clean water with consistent current

• Southern California area offers a nearly ideal climate
  – Consistent (i.e., predictable) water temperature
  – Infrequent extreme weather and wave conditions

• Avoid user and habitat conflicts
  – Outside busy coastal zone (and contaminants)
  – Sandy bottom (no kelp or hard-bottom habitat)

• Close to existing infrastructure
  – Commercial fishing industry
  – Market and distribution centers
Proposed Project Location

🌟 Site Avoids:
- Coastal conflicts
- US Navy ops
- Fishing grounds
- Kelp & reefs
- Pollution
San Diego has Everything Needed
Species to be Permitted

Striped Bass

White Seabass

California Yellowtail

California Halibut
Identified Concerns

1. Using wild fish to feed farmed fish
2. Impacts of escapes on wild stocks
3. Polluting the bottom and algal blooms
4. Potential spread of disease
5. Competition with commercial fishermen
6. Farm domination of the offshore environment
Concern 1.
Using Wild Fish to Feed Farmed Fish

Fish meal harvest is sustainable, but fixed

- Species specific diets
- Life stage specific
- Micronutrients
- Alternative proteins
- Live feeds
- Microencapsulated diets

Courtesy: Jingjie Cho, NOAA Aquaculture
Concern 2.
Impacts of Escapes on Wild Stocks

- Grow local species to avoid introducing new species or parasites
- Use “wild” genotypic fish until escapement is demonstrated to be non-problematic
- Systems are well-designed to prevent escapement and have been tested around the world
Concern 3.
Polluting the Bottom and Algal Blooms

Benthic Dynamics

- SO4 → CO2 → O2 → H2S

Water Boundary Layer

- POC

Sediment Boundary Layer

- particle deposition & resuspension

- aerobic biomass

- anaerobic biomass

- O2

- CO2

- H2S

- H2O

FARM

- Fish metabolism

- Feces

Harvest

- (Tissue Carbon & Nitrogen)

Soluble Nitrogenous Waste

Phytoplankton

Grazing

Recycling

Egestion

Photosynthesis

Particulate Organic Waste

Aerobic Respiration

Deposition

Food Web Assimilation

Ecosystem

Anoxic

Anaerobic Respiration
Concern 3.
Polluting the Bottom and Algal Blooms

Bottom Sediment and Water Column Simulations

Results:

1. Depth and current combine to disperse carbon to very low levels

2. Peak TOC within footprint is 0.0062g C/g sediment (~1%) above ambient

3. [N] never exceeds 2 mg/m³ which is below the threshold for phytoplankton growth and downstream dilution diminishes nutrients

4. Based on observations of existing farms, these results are either correct or overstated

5. Eutrophication will not result from the farm and will not stimulate algal blooms

6. The HSWRI demonstration site far exceeds any standards utilized in any jurisdiction worldwide
Concern 4. Potential Spread of Disease

Disease Research
- Diagnostic tools
- Biosecurity protocols
- Health management
- Treatment protocols
- Evaluate wild populations

Best Management Practices Prevent Disease
1. Use lower stocking densities
2. Increase cage spacing
3. Optimize water quality
Concern 5.

Competition with Commercial Fishermen

Value of Fish Landed in San Diego for 2006
(Values are in $1,000 USD)

- Spiny Lobster: $2,881
- Thornyhead: $500
- Swordfish: $1,477
- Sea Urchin: $503
- Spot Prawn: $648
- All Others: $1,060

Total harvest = $7 million
Concern 5.
Competition with Commercial Fishermen
2006 Landing Weight and Value by Port

Source: http://www.dfg.ca.gov/marine/landings06/table15.pdf

Landings (MT) - Value (USD)
Concern 6.
Farm Domination of the Offshore Environment

S. Calif. Fishing Areas:
194 x 100 sq. mi. = 19,400 sq mi

Commercial Fishing:
100K mt worth $59 MM/19K sq mi =
$3,041/sq. mi.

Offshore farms:
100K mt/yr in 40 farms in 20 sq. mi.
worth $300 MM at $3/kg =
$15 million/sq. mi.
Next Steps

• Federal permits
  – Army Corps of Engineers
    • Section 10 permit
    • NEPA Review *(still awaiting public scoping process)*
  – Environmental Protection Agency NPDES

• State reviews
  – Dept. of Fish & Game aquaculture registration
  – Coastal Commission consistency certification

Visit www.hswri.org/offshore for more information
Summary Observations

• Economic Effects
  – Proposed project would increase existing landed value by more than 300%
  – 100K MT operation would add $300 million to landings
  – Boost ailing commercial fishing and processing economy

• Environmental Impacts
  – Cages will likely provide increased habitat for wild fish
  – Predicted negligible impacts to water column and benthic habitats

• Policy Implications
  – Provide net conservation benefits to ocean management
  – Sets template for development of larger industry
  – Begins to delineate rate limiting factors to a larger industry
Sustainable Development is the management and conservation of the natural resource base and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development (in the agriculture, forestry, and fisheries sectors) conserves land, water, plant, and animal resources, is environmentally non-degrading, technically appropriate, economically viable, and socially acceptable.

“The answers to our problems don't lie beyond our reach. They exist in our laboratories and our universities, in our fields and our factories, in the imaginations of our entrepreneurs and the pride of the hardest-working people on Earth.”

“I do not accept a future where the jobs and industries of tomorrow take root beyond our borders...It is time for America to lead again.”

President Barack Obama
Address to Joint Session of Congress
February 24, 2009
Questions?

“We must learn to farm the sea as we farm the land.”

Jacques Cousteau Conservationist

“California is a world leader in agriculture, why can’t we be a world leader in aquaculture?”

Dr. Devin Bartley, CA Aquaculture Coordinator

“As wild fish stocks decline, it is important to be able to have more aquaculture.”

Honorable Gary Locke, Secretary of Commerce