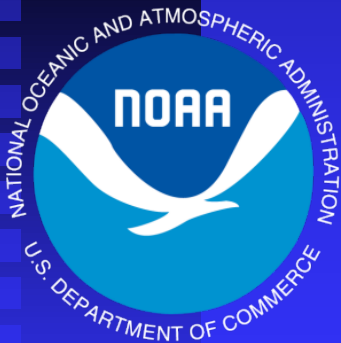


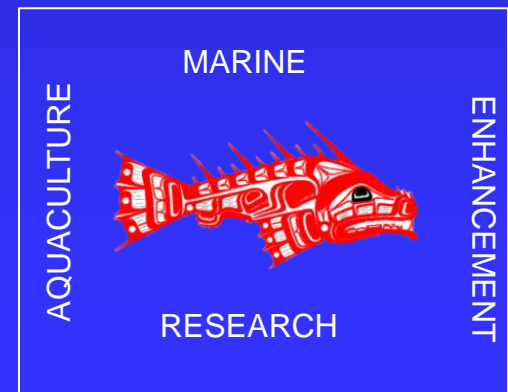
# Alternative Feeds Research at the National Oceanic and Atmospheric Administration (NOAA)

Ronald Johnson

Aquaculture Program, Northwest  
Fisheries Science Center, NOAA  
Fisheries, Seattle, USA

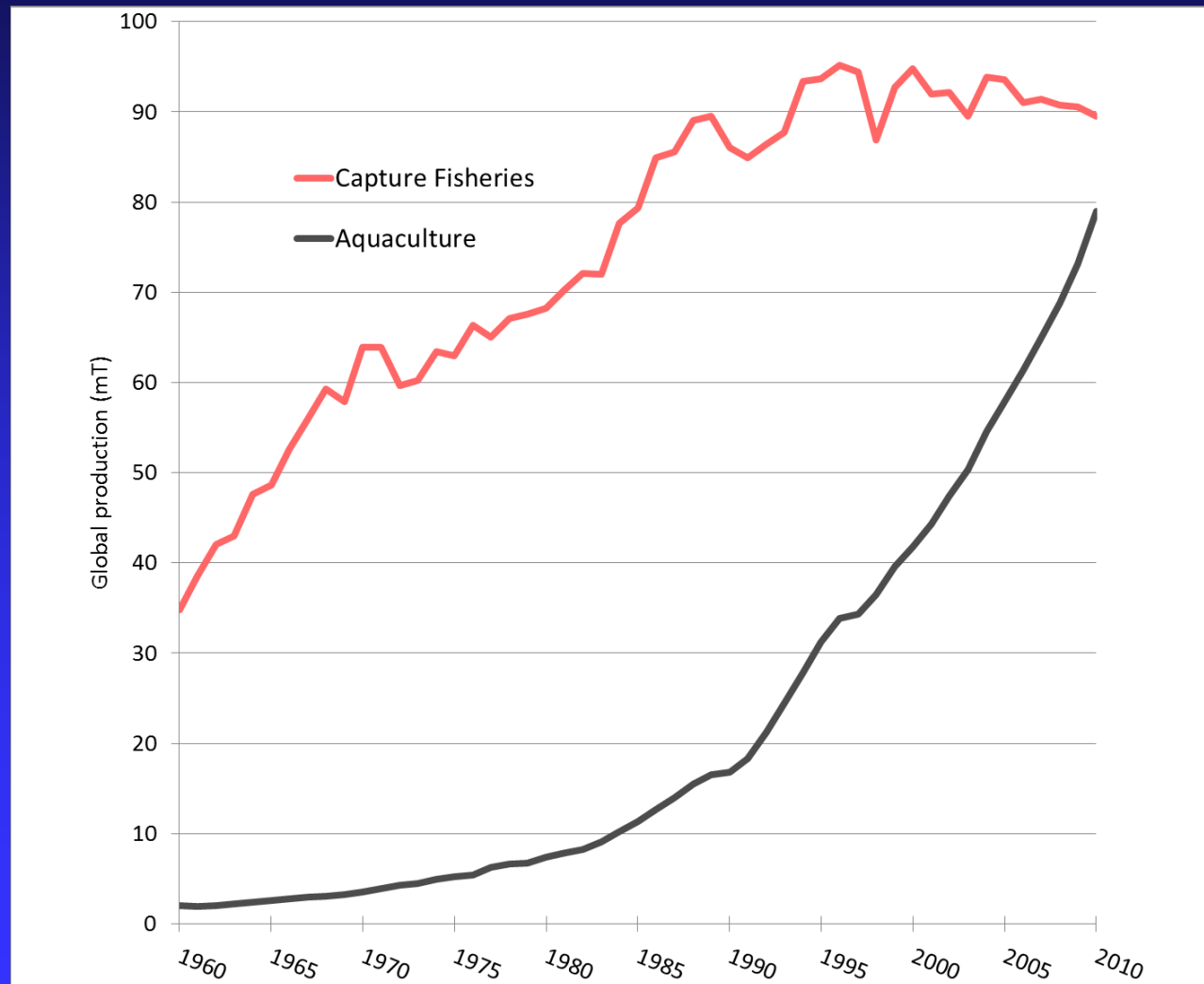


**NOAA**  
**FISHERIES**

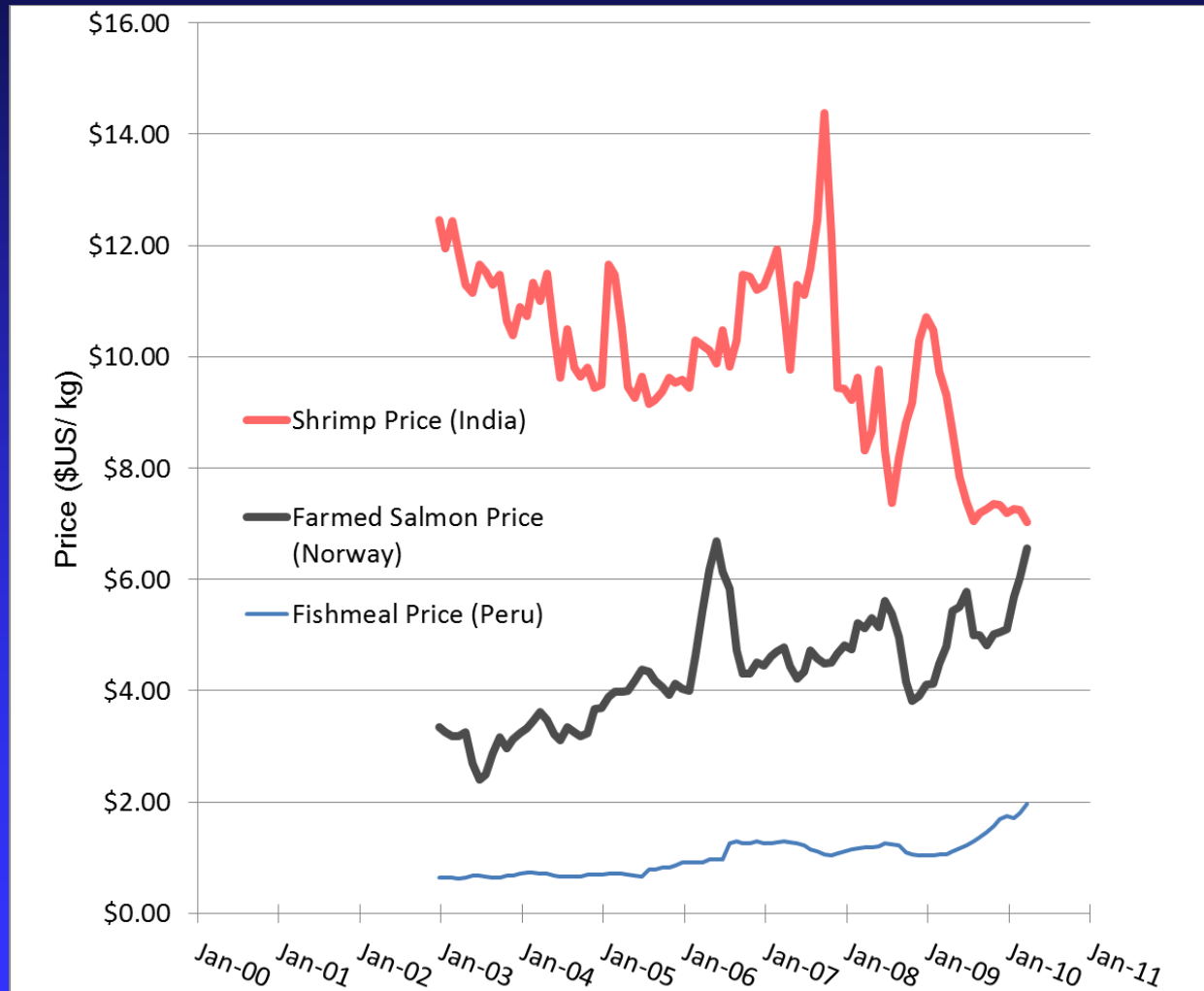


# World Fisheries

## -Capture vs. Aquaculture



# Rising cost of fishmeal

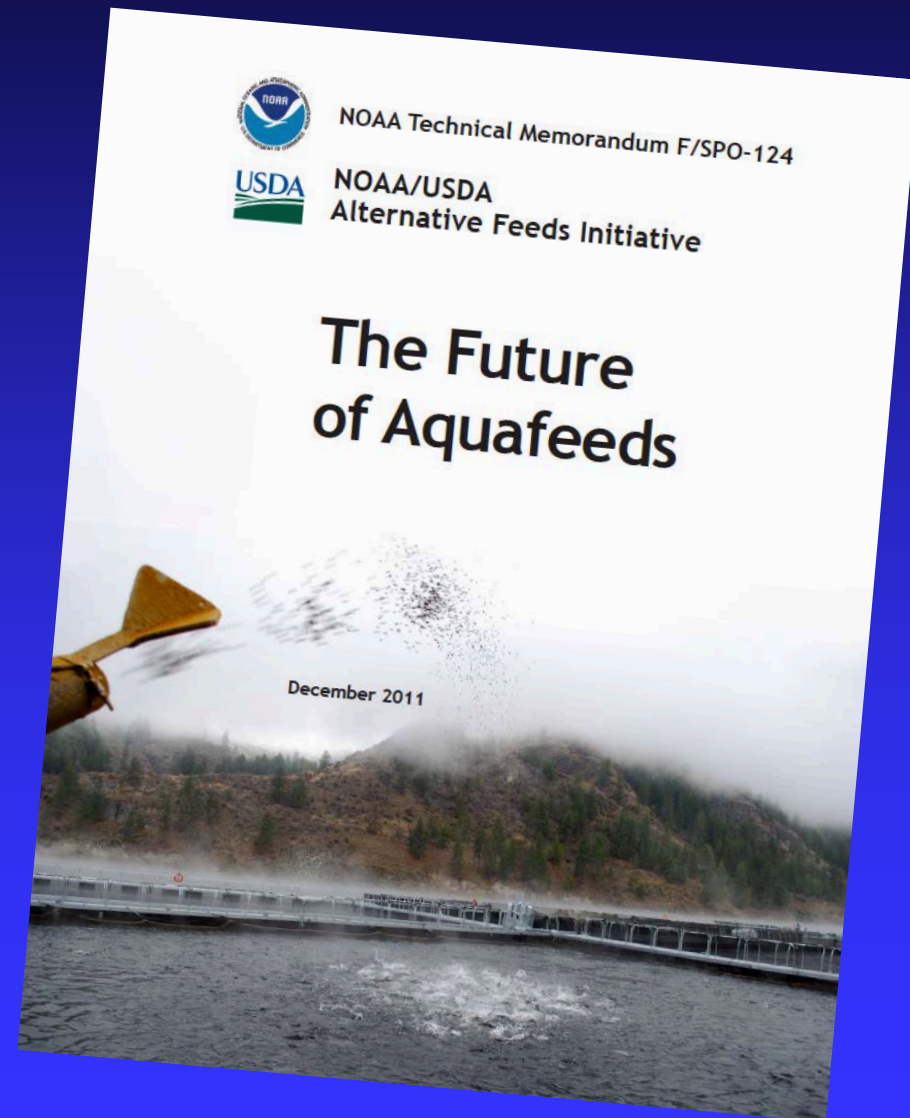


# NOAA/ USDA

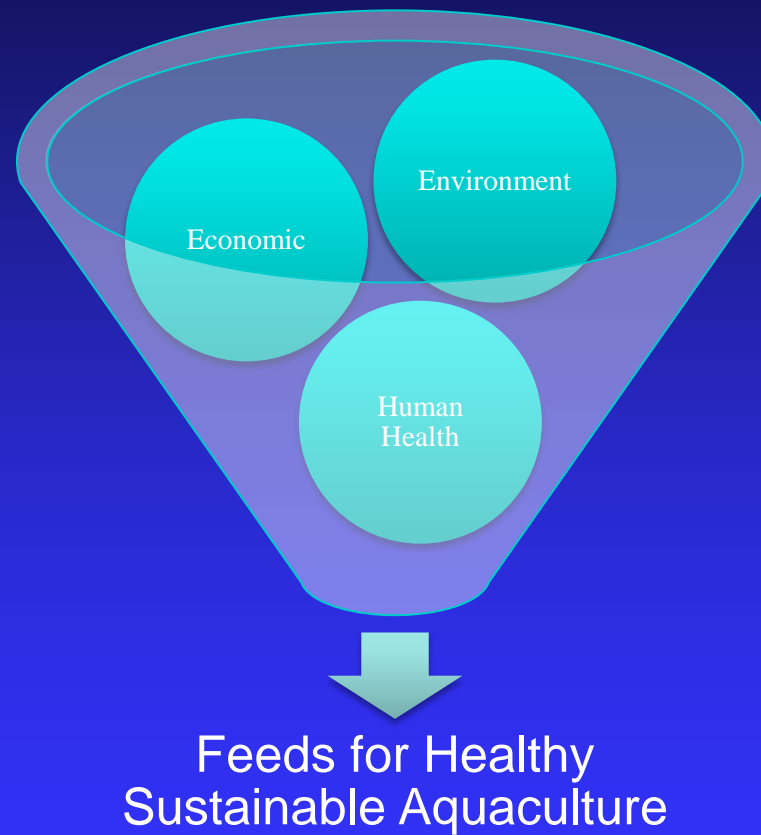
## Alternative Feeds Initiative

### Goals

- Alternative feed ingredients
  - cost effective
  - maintain fish growth
- Maintain human health benefits
- Low environmental impact



# Triple Bottom Line Approach

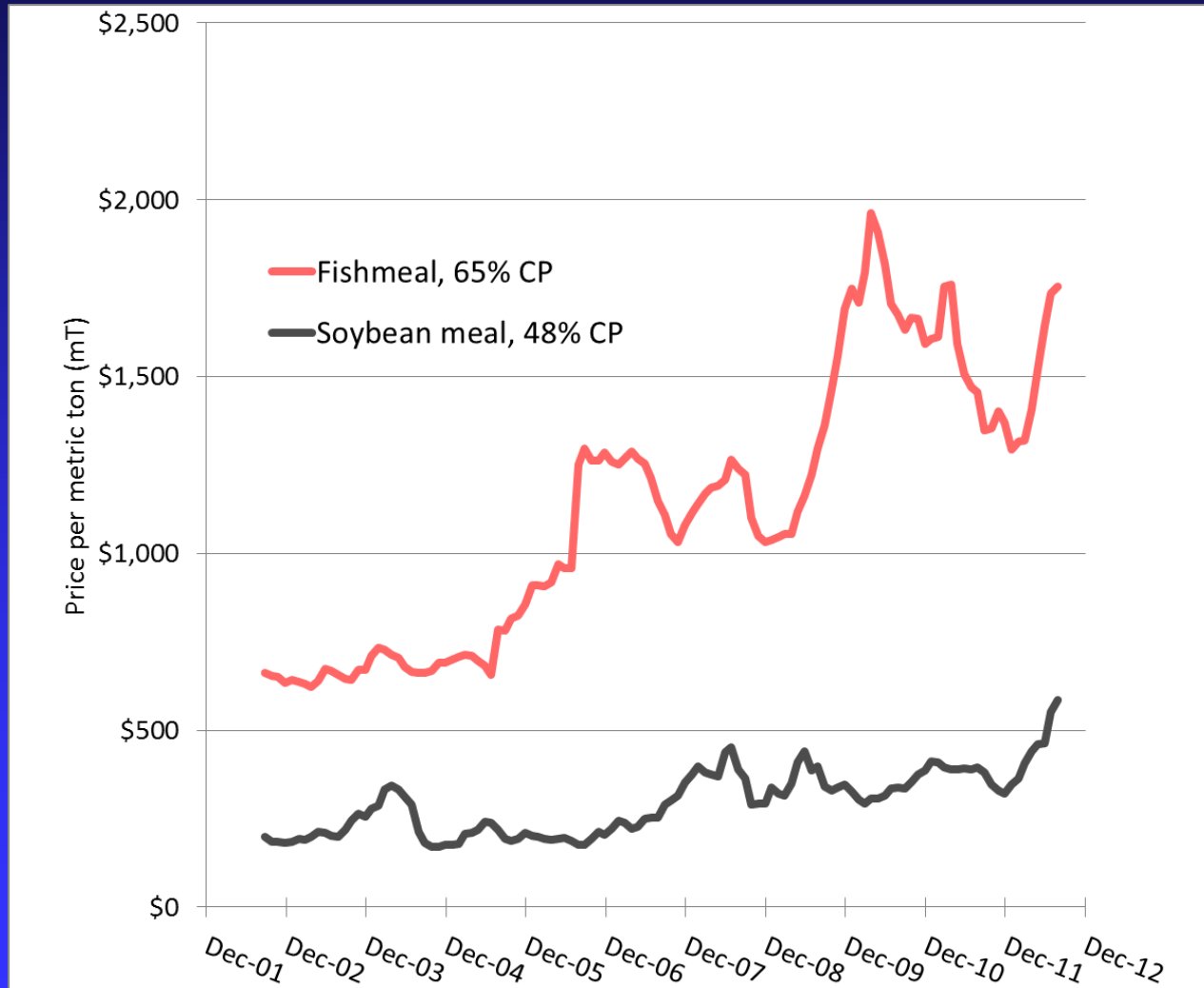


# Plant proteins and oils



- Advantages
  - Low cost
  - Biotechnology can keep costs down and improve nutrient composition
  - Largest quantity of proteins and oils
- Disadvantages
  - Nutritionally incomplete
  - Anti-nutritional factors

# Fishmeal vs. soybean meal prices



# Animal by-products



- Advantages
  - Well utilized by a variety of fish species
  - Similar to fishmeal in nutrient composition
  - Recycles animal processing wastes back to fish
- Disadvantages
  - BSE
  - Prohibited in some markets
  - Low in n-3 HUFAs and high in saturated fats



## Fish by-products



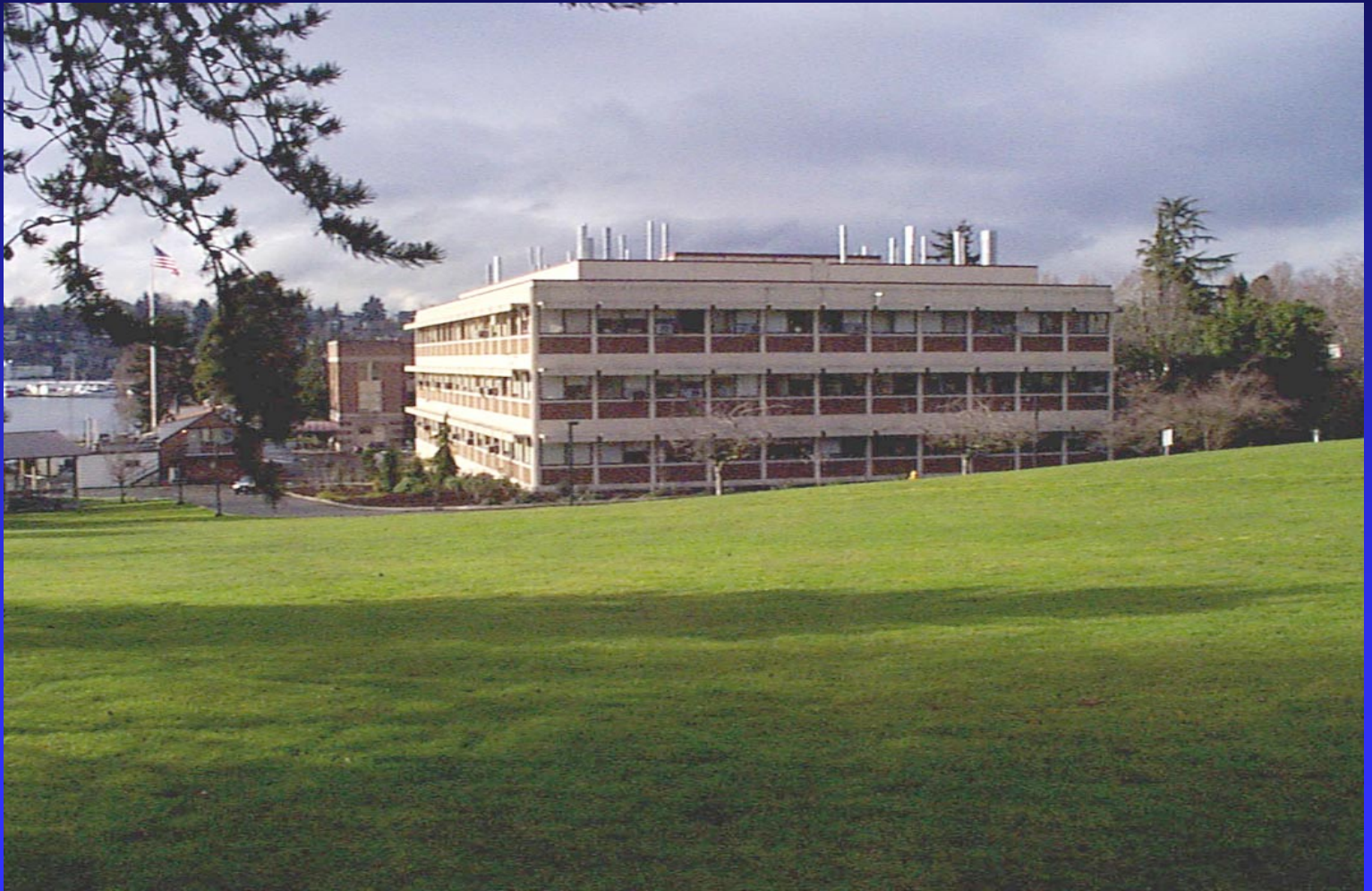
- Advantages
  - High palatability
  - Easy to replace fish meal and oil with high quality meal
  - Reduces nutrient pollution of marine areas
  - High in n-3 HUFAs and other nutrients
- Disadvantages
  - Located in small quantities from diverse sources
  - Highly perishable until dried

## Other alternatives

- Algae
- Ethanol by-products
- Insect products
- Single cell protein
- Marine invertebrates



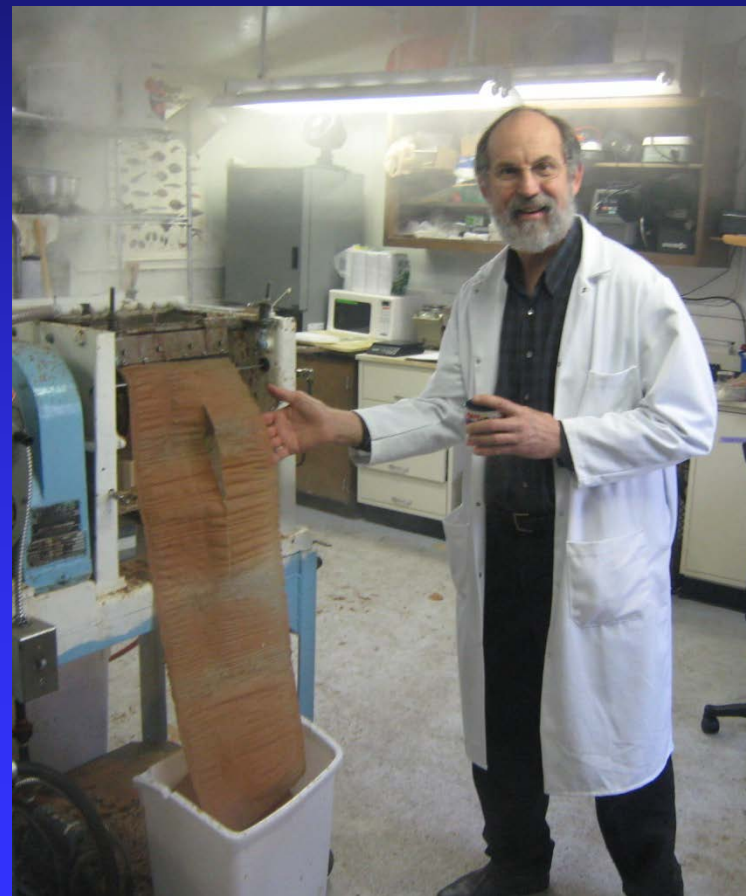
# Northwest Fisheries Science Center, NWFSC Seattle, WA, USA



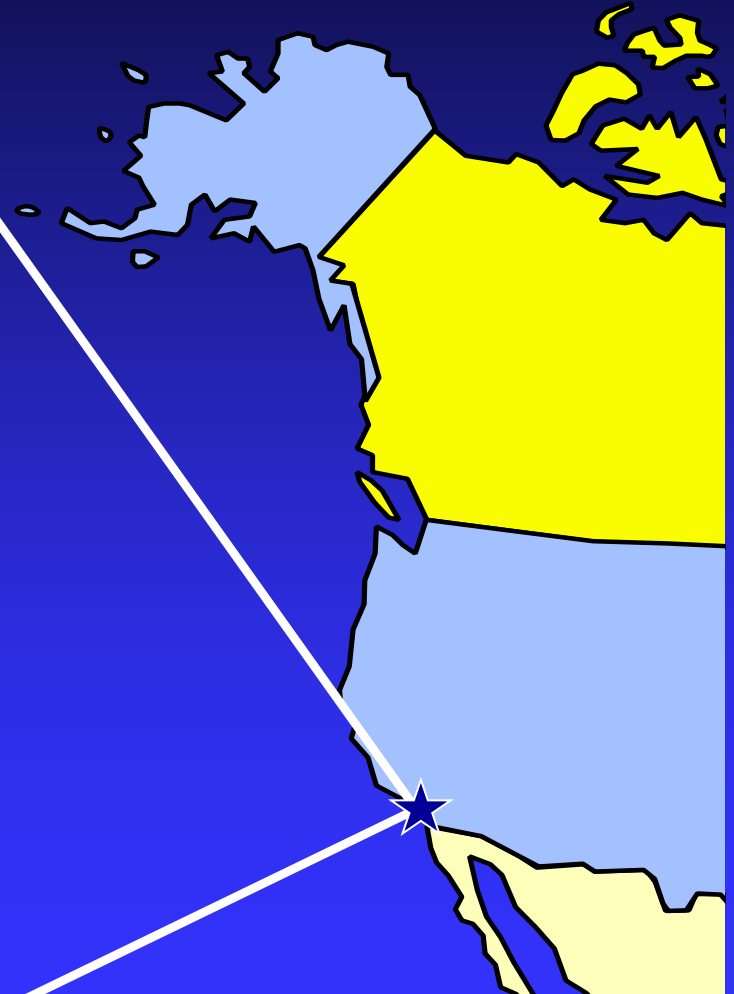


# Fisheries by-product research at NWFSC

- Whitefish meal
- Salmon by-products
- Feeds for
  - salmon
  - sablefish



# Hubbs SeaWorld Research Institute, HSWRI Carlsbad and San Diego, CA



# Fisheries by-product research at HSWRI

- Mixed species whitefish meal
- Farmed salmon by-products
  - Head meal
  - Frame and trim meal
- Feeds for
  - California yellowtail
  - White seabass





# Hollings Marine Lab in North Carolina

## -Nutrigenomics Research

- Nuclear Magnetic Resonance (NMR)
- Metabolite research
- Low pollution feeds development



# Future Studies

## Joint US-China Alternative Feeds Research

- Fishmeal replacement feeds
  - Fisheries byproducts meals
  - Plant protein meals
    - Soybean
    - Corn
    - Algae
- Nutrient requirement studies
  - n-3 fatty acids





Thank you

