

# Aquaculture, Fisheries and Competition: The Future of the Seafood Sector

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# Seafood vs Other Animal Protein

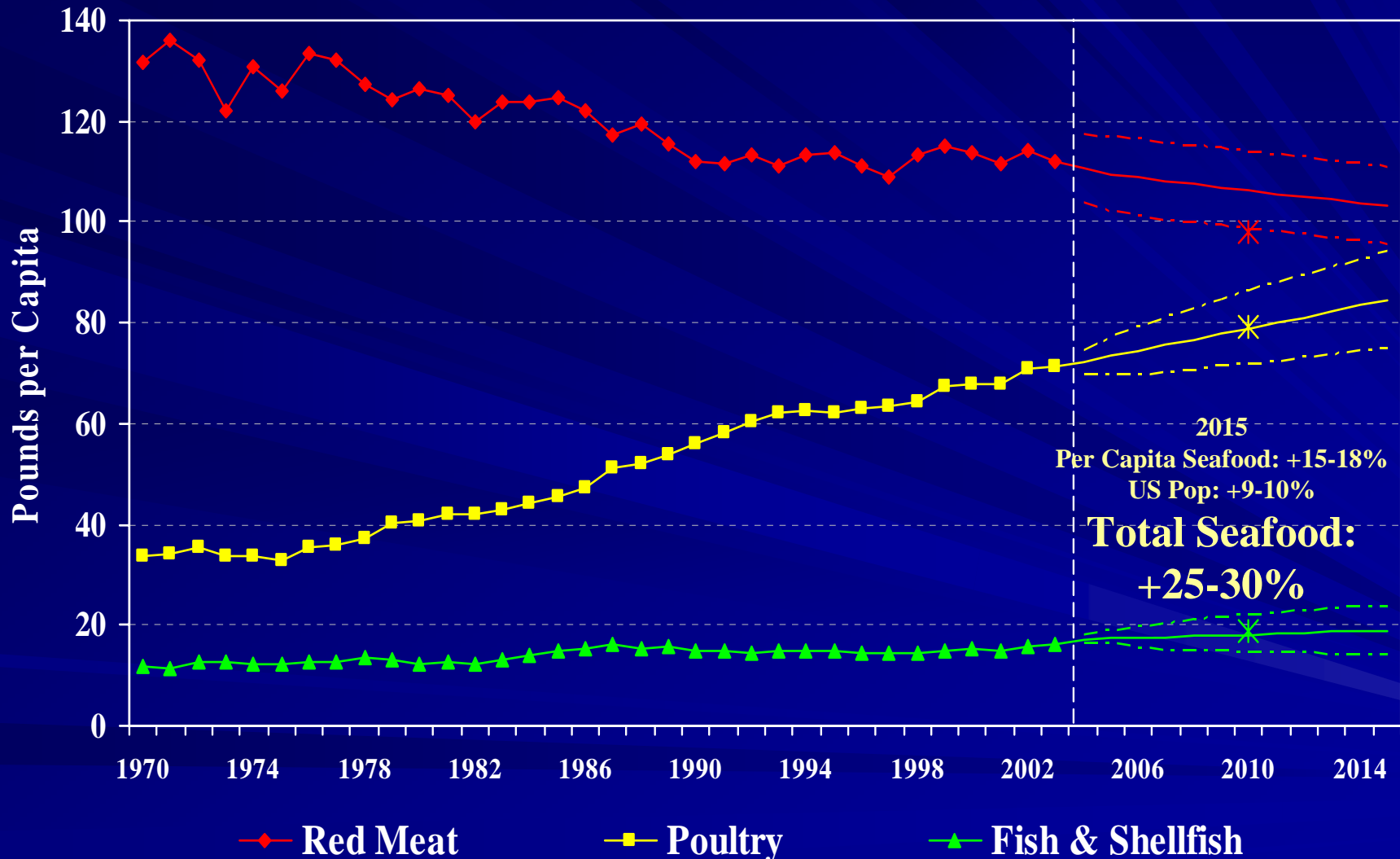
- Most Complex and Diverse (ex. Species & Technology)
- Most International
- Most Fragmented
- Most Volatile
- Most Bureaucratic Regulatory Environment
- Most Wasteful
- Most Misunderstood by Consumers including Chefs
- Least Transparent

# Successful Seafood in the Future

- Less Complex and Diverse (ex. Species & Technology)
- More International
- Less Fragmented
- Less Volatile
- Less/More? Bureaucratic Regulatory Environment
- Less Wasteful
- Less/More? Misunderstood by Consumers and even Chefs
- More Transparent

Take Control through technology, institutions and markets

# U.S. Per Capita Consumption of Red Meat, Poultry, and Fish and Shellfish Actual (1970-2003) and Forecast (2004-2015)

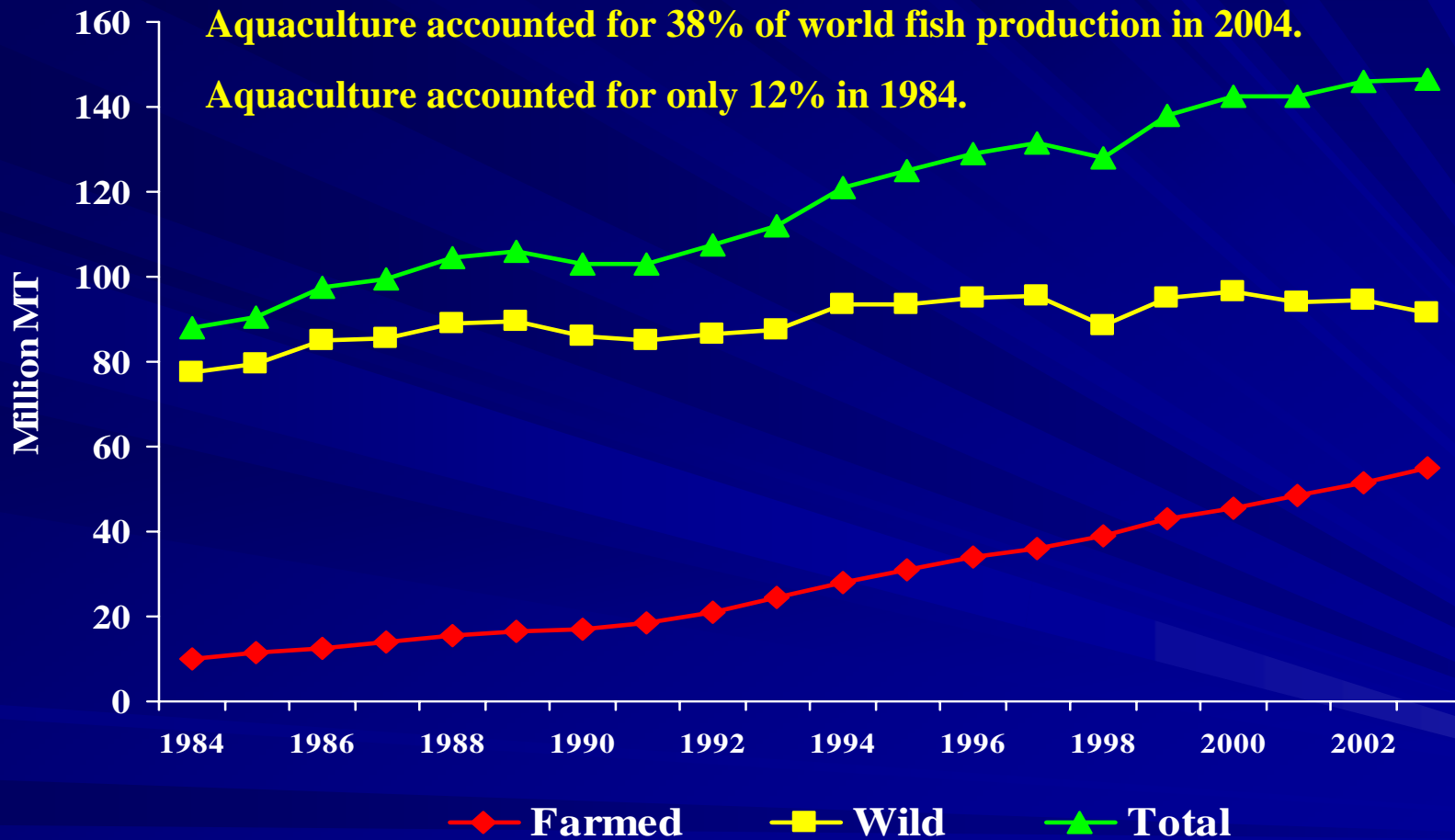


Source: USDA/Economic Research Service.

Upper and lower bounds represent a 95% confidence interval.

Starred dots indicate 2010 forecasts made by Anderson & Anderson (1994).

# World Fisheries Production



Source: FISHSTAT (2005).

# What if only 'Food' fish are considered?

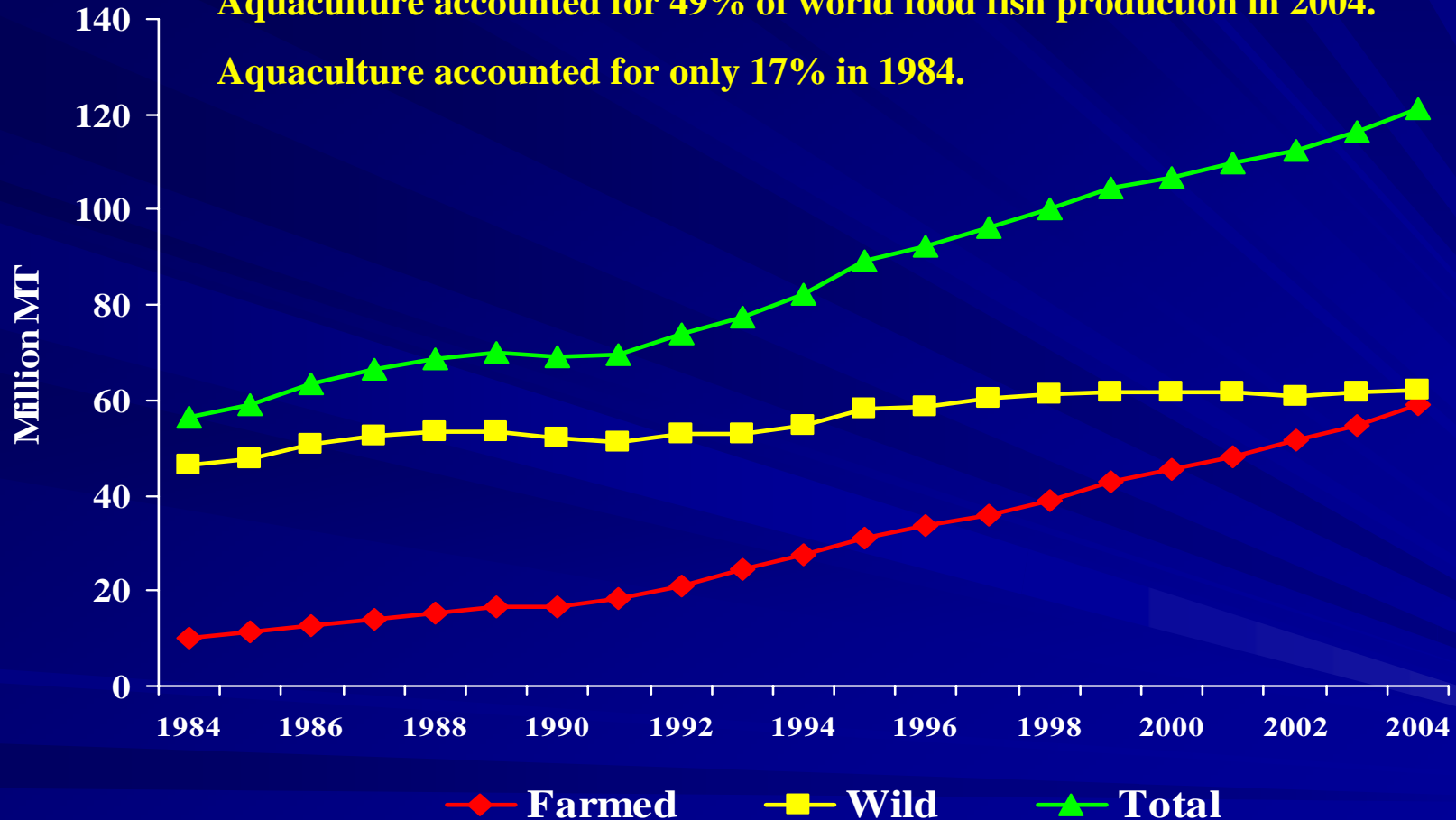
## Exclude...

- Species targeted by reduction fisheries (menhaden, sardines, anchovies, small pelagics);
- Non-edible invertebrates (corals, sponges, pearls);
- Most marine mammals (whales) and reptilians (sea turtles);

# Approx. World Production of "Food" Fish and Seaweeds

**Aquaculture accounted for 49% of world food fish production in 2004.**

**Aquaculture accounted for only 17% in 1984.**



Source: FISHSTAT (2005).

# Simple reality

Poor fisheries management and increasing demand are the stimuli for Aquaculture and Innovation

- Avoid mismanagement
- Minimize environmental shocks
- Control fish stock and growth rates
- Manage to meet the market demand

Take **CONTROL** of production and marketing  
through ownership, information and technology

Are Aquaculture and Fisheries Competitive or  
Complementary?

Is Competition 'Negative' or 'Positive'?  
Are Complementarities 'Negative' or 'Positive'?

## ■ Competition

- “Positive” – Improve efficiency and increase innovation
- “Negative” – Bankruptcy, Displaces the industry

## ■ Complement

- “Positive” – Expands demand, revitalizes growth
- “Negative” – Enables inefficiency, stifles innovation

“Negative” or “Positive” – Depends who you are – aquaculturist, fishermen, fisheries manager, trader, consumer or environmentalist

How do the aquaculture and fisheries sector interact?

What does it mean for the future of the seafood market?

# Aquaculture and Fisheries: International Trade and the Market

- influenced prices through increased supply
- changed consumer behavior and has resulted in the development of new markets
- accelerated globalization
- increased concentration and vertical integration in the seafood sector
- resulted in the introduction of new product forms and improved quality and consistency
- Forward thinking and market driven
- Improve Stability and reduce uncertainty

# Aquaculture and Fisheries: Environment

- influenced fish stocks through its use of wild fish stocks for inputs
- influenced both wild and farmed fish stocks through disease transmission and related interactions
- influenced fish stocks through intentional releases or through unintentional escapes
- influenced wild fish through its use or enhancement of habitat

# Influenced fish stocks through its use of wild fish stocks for inputs

## ■ Feed

- Small Pelagics for fishmeal and fish oil

## ■ Juveniles

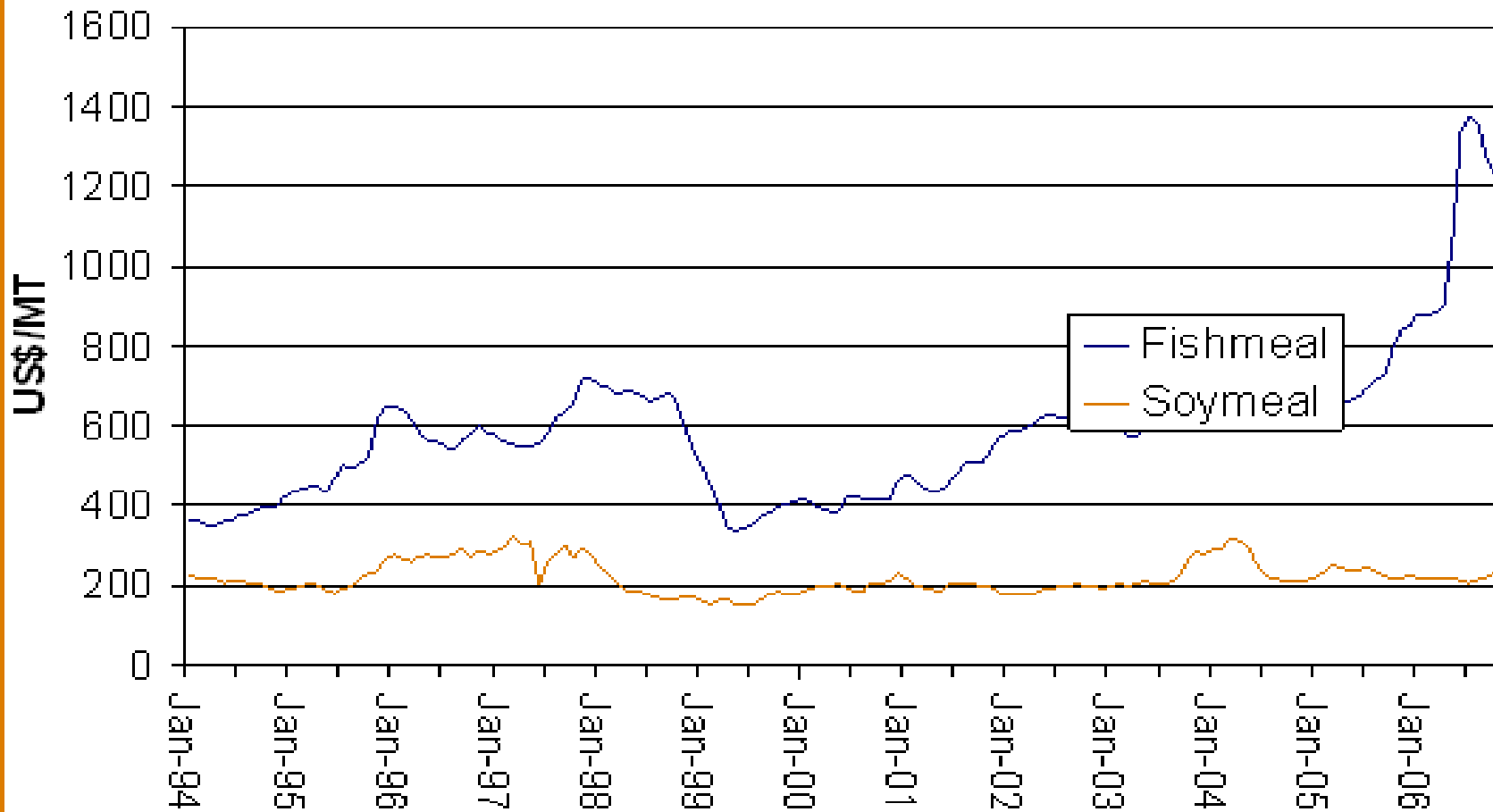
- Tuna
- Post-larval shrimp
- Oyster
- Mussel

## ■ Broodstock

- Salmon
- Shrimp

# The feed Issue

## Fishmeal and soymeal prices



Source: FAO Globefish: Fishmeal Market Report - November 2006

# The feed Issue

- Empirical evidence indicates the increased relative price for fishmeal & oil
- If fisheries are well managed this implies:
  - **Opportunity** to wild fisheries sector to increase net revenue
- If fisheries are poorly managed this implies:
  - Increased risk of overfishing
- Provides economic incentive for innovation.
  - Declining FCR, new feed formulations

# Influenced fish stocks through its use of wild fish stocks for inputs

## ■ Juveniles

- Tuna for growout – direct influence on wild stocks
- Post-larval shrimp for growout – may reduce wild stock
- Oyster - may enhance wild stock through increased survival
- Mussel - may enhance wild stock through increased survival

# Invasions & Disease

## Examples:

- Disease: MSX from Asia (probably in ballast water)
- Disease: Parasite, *B. ostreae*, was probably introduced into France in oysters imported from California which originated from the NMFS Milford Lab in CT
- Oyster drills, worms, snails, mussels and clams
- Tilapia introduction – Asia and the Americas
  - May create fisheries
  - May undermine native stocks

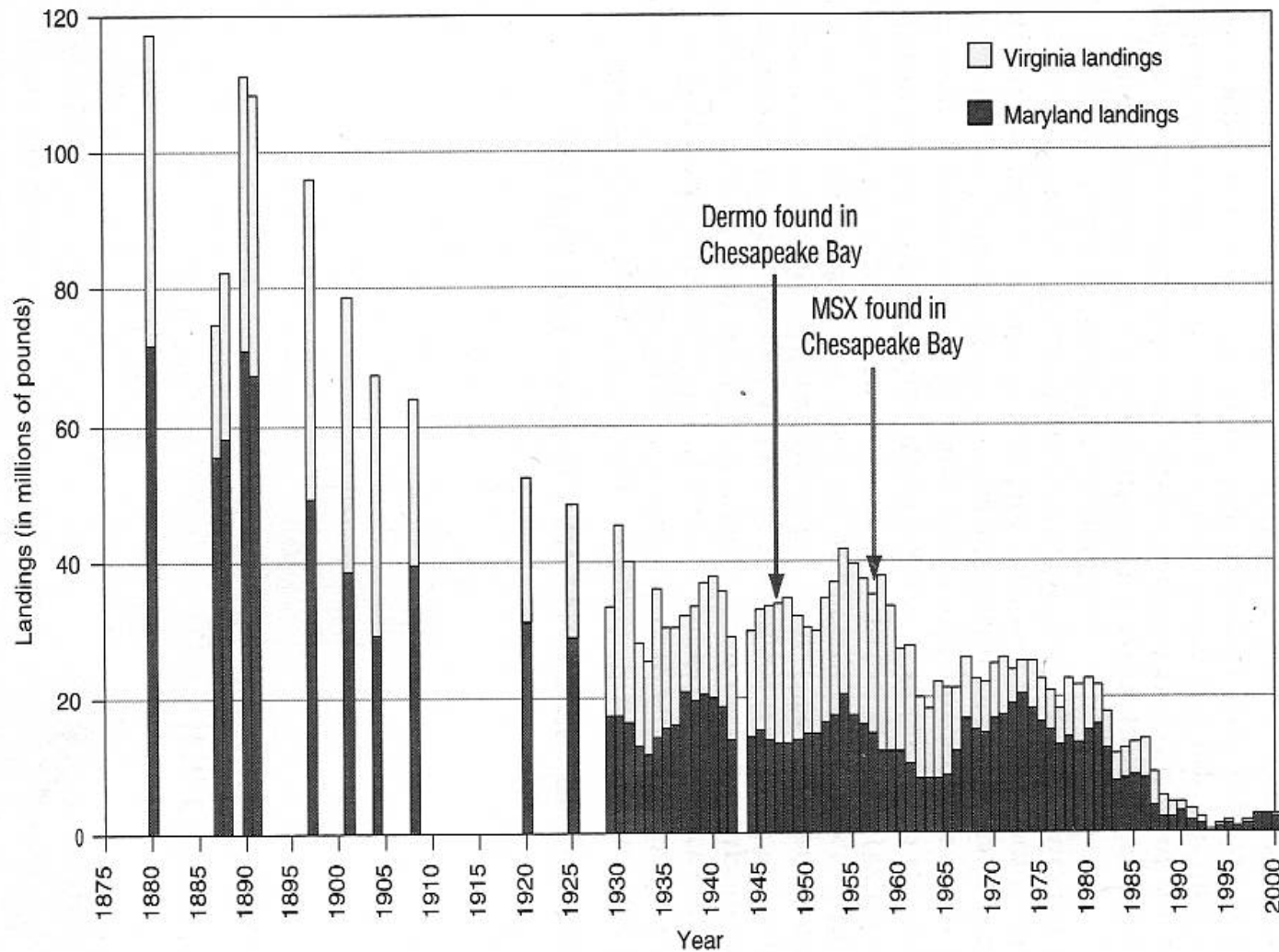


FIGURE 2.1 History of commercial oyster landings in the Chesapeake Bay.

SOURCES: Data from Chesapeake Bay Program, <http://www.chesapeakebay.net/data/historicaldb/livingresourcesmain.htm>; National Marine Fisheries Service, [http://www.st.nmfs.gov/st1/commercial/landings/annual\\_landings.html](http://www.st.nmfs.gov/st1/commercial/landings/annual_landings.html)

Introduction non-native oyster may help  
save an industry and an ecosystem that  
was damaged by a non-native disease

Aquaculture may be part of the solution to  
the problem of damage and overfished  
wild stocks

# Why not introduce nonnative *C. ariakensis* from Asia into the Chesapeake Bay in the USA?

- Resistant to MSX (introduced from Asia)
- Restoration (building habitat) has failed - to date
- Nonnative Pacific oyster, *C. gigas*, is the mainstay of the Pacific US and Canadian oyster industry
- Nonnative Pacific oyster, *C. gigas*, is the mainstay of the France oyster industry

## NONNATIVE OYSTERS IN THE CHESAPEAKE BAY

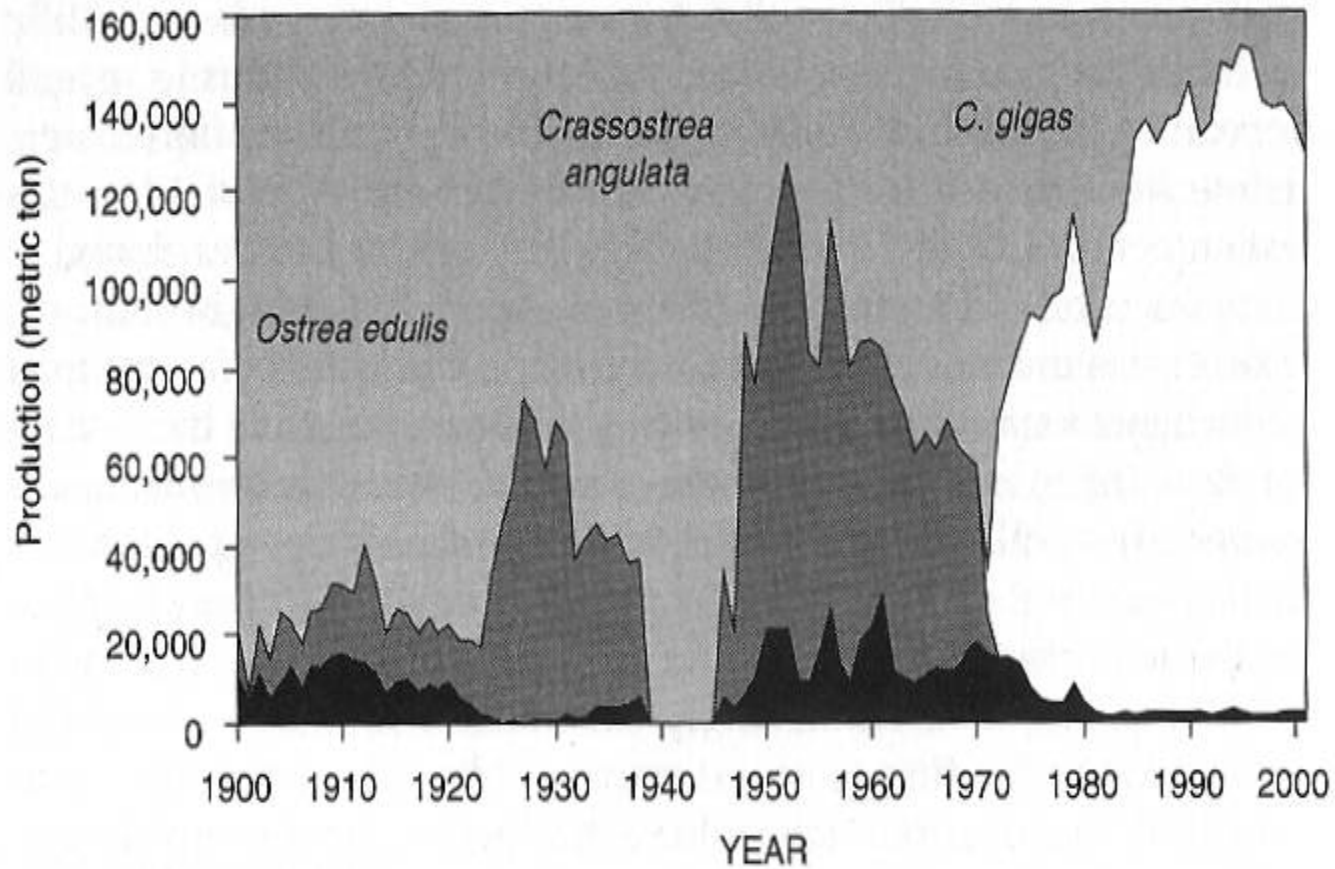


FIGURE 3.2 French oyster landings

SOURCE: Modified from Gouletquer and Héral (1997).

# Introduction of a non-native may help save or create an industry

## Other examples

Introduction of White Shrimp from S. America to Asia

Introduction of Salmon to Chile, Australia and New Zealand

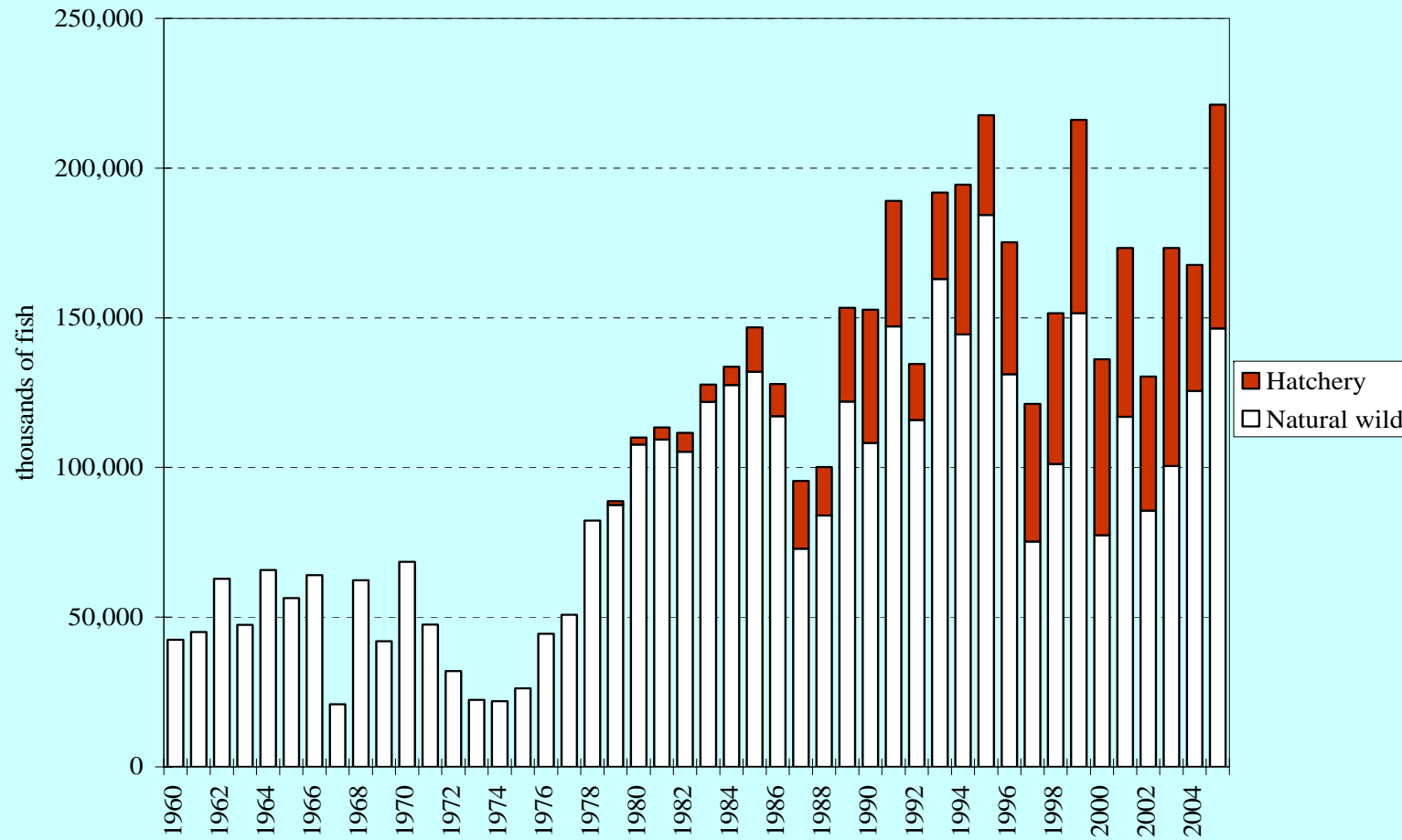
Introduction of Channel catfish from the US to China

Introduction of Tilapia from Africa to Everywhere

# Aquaculture (Hatchery)-Based Fisheries

- Can result in increased harvest - so fishermen like it, but.....
- It is inefficient
- In some cases it has resulted in large production of lower-valued species (AK chum and pink; Japan chum; Russia pink and chum)
- Problems with genetic diversity and integrity of wild stocks

## Alaska Commercial Salmon Catches Since 1960: Natural Wild Salmon and Hatchery Salmon



Source: Data for 1960-1978: ADF&G Catch Data; Data for 1979-2005: ADF&G Hatchery Data

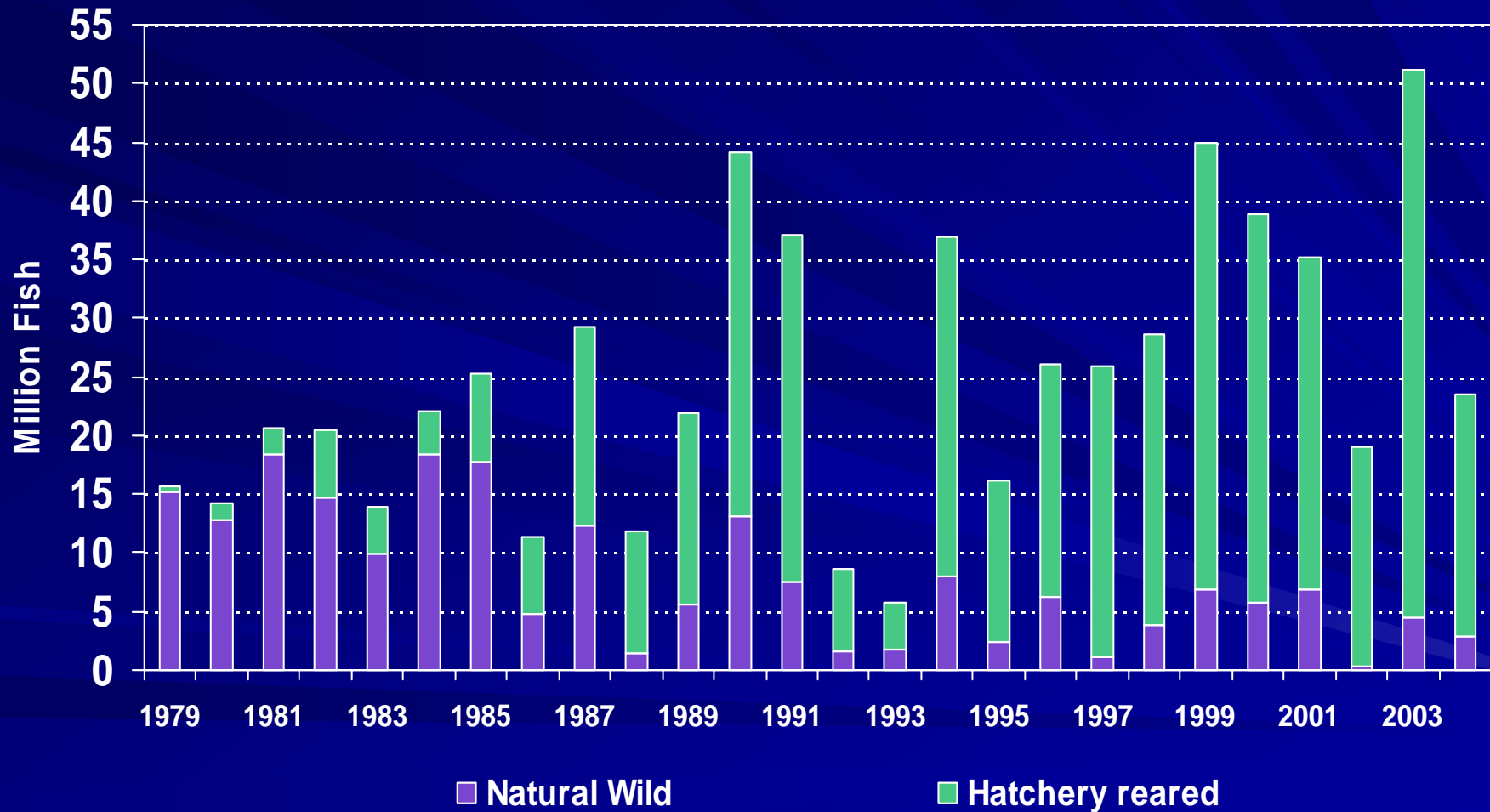
# Aquaculture (Hatchery)-Based Fisheries: Integrity of wild stocks

- Hatchery fish do not face the same selective pressure as wild stocks
- Hatchery releases can displace wild stocks and compete for food and habitat

# Aquaculture (Hatchery)-Based Fisheries: Integrity of wild stocks

- Hatchery stocks have reduced mortality from fertilization through the early life stages relative to wild stocks
- Therefore, if the hatchery-based fishing is not managed to separate the harvest wild and hatchery fish - the 'true' wild stocks will eventually be decimated

# Historical Hatchery Contribution to Total Commercial Harvest of Pink Salmon Prince William Sound, Alaska



Source: Prince William Sound Annual Management Reports, ADF&G (2007, 2006).

# Aquaculture and Habitat

Negative for wild fish stocks

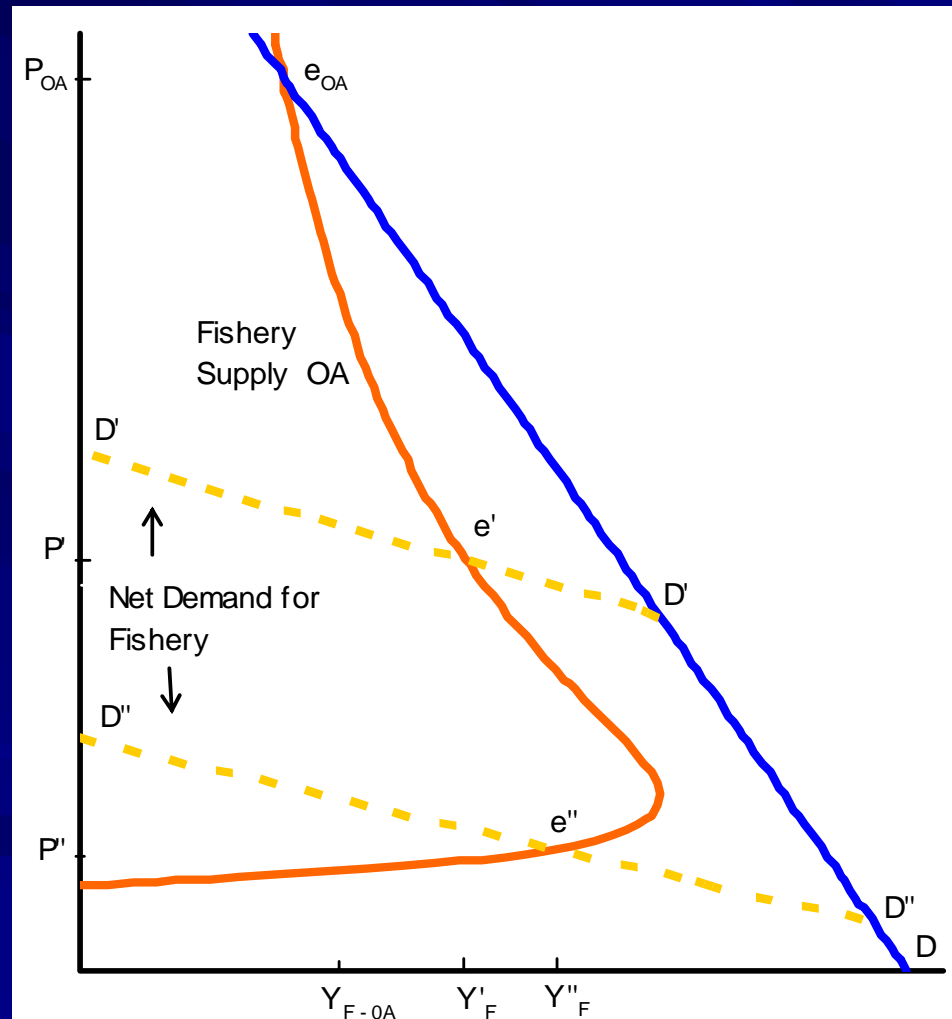
- Shrimp farms in the estuary - mangrove
- Excessive finfish cage culture and pollution

Positive for wild fish stocks

- Oyster reef building
- Profitable fish farming has helped reestablish ecosystem in some cases - mangrove

# Aquaculture and Fisheries: International Trade and the Market

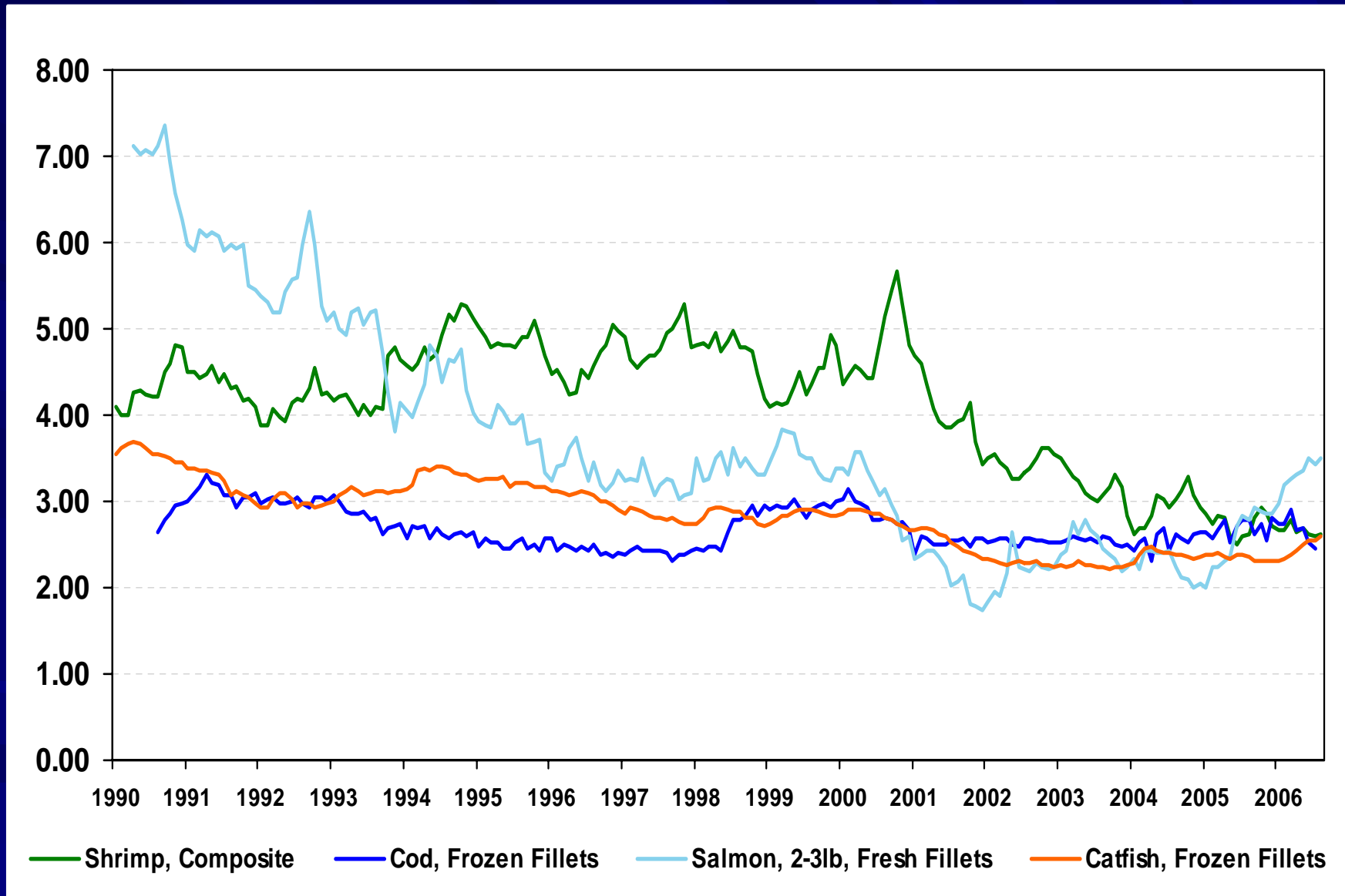
# Market Interactions between an Open-Access Fishery and an Aquaculture Sector



# Trends in Real Seafood Prices

Sources: SeafoodReport.com (2006), USDA (2006).

2000 US\$/lb



# Growing Market Share and Product Innovation

- Consistently Available
- Consistent Quality
- Stable or Declining Cost

Create Diversity - Sell the “Sauce”...  
Sell the “Image”

# Seafood Consumption is Concentrating on Fewer Species

## Edible kg per Capita

	1987		2005	% change		
71%	1 Tuna	1.59	93%	Shrimp	1.86	+79
	2 Shrimp	1.04		Tuna	1.41	-12
	3 Cod	0.76		Salmon	1.10	+451
	4 AK Pollock	0.40		AK Pollock	0.67	+67
	5 Flatfish	0.33		Catfish	0.47	+73
	6 Clams	0.30		Tilapia	0.39	N/A
	7 Catfish	0.27		Crab	0.29	+94
	8 Salmon	0.20		Cod	0.26	-66
	9 Crab	0.15		Clams	0.24	-33
	10 Scallops	0.15		Flatfish	0.17	-49
	Other	2.16	Other	0.54	-75	
	Total	7.35	Total	7.35	0	

Sources: Fisheries of the United States (2007) and NFI (2007).

# U.S. Retail Sales, 1994 vs. 2006

Source: *Seafood Business*

## Best Sellers (Seafood Case)

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	<b>1994</b>	<b>2006</b>
1	Shrimp	Shrimp
2	Salmon	Salmon
3	Pollock, Cod, Haddock	Tilapia
4	Catfish	Crab
5	Flounder	Catfish

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Sources: Perkins, C. (1994) and Robinson, R. (2006)

## Cost Share: Aquaculture vs. Fishery

<b>Item</b>	<b>Aquaculture</b>	<b>Fishery</b>
Labor	4-10%	25-45%
Maintenance	2-4%	9-23%
Fuel	1-4%	4-11%
Fingerlings	2-15%	—
Feed	40-60%	—

# Cost Factors Influencing Competitiveness

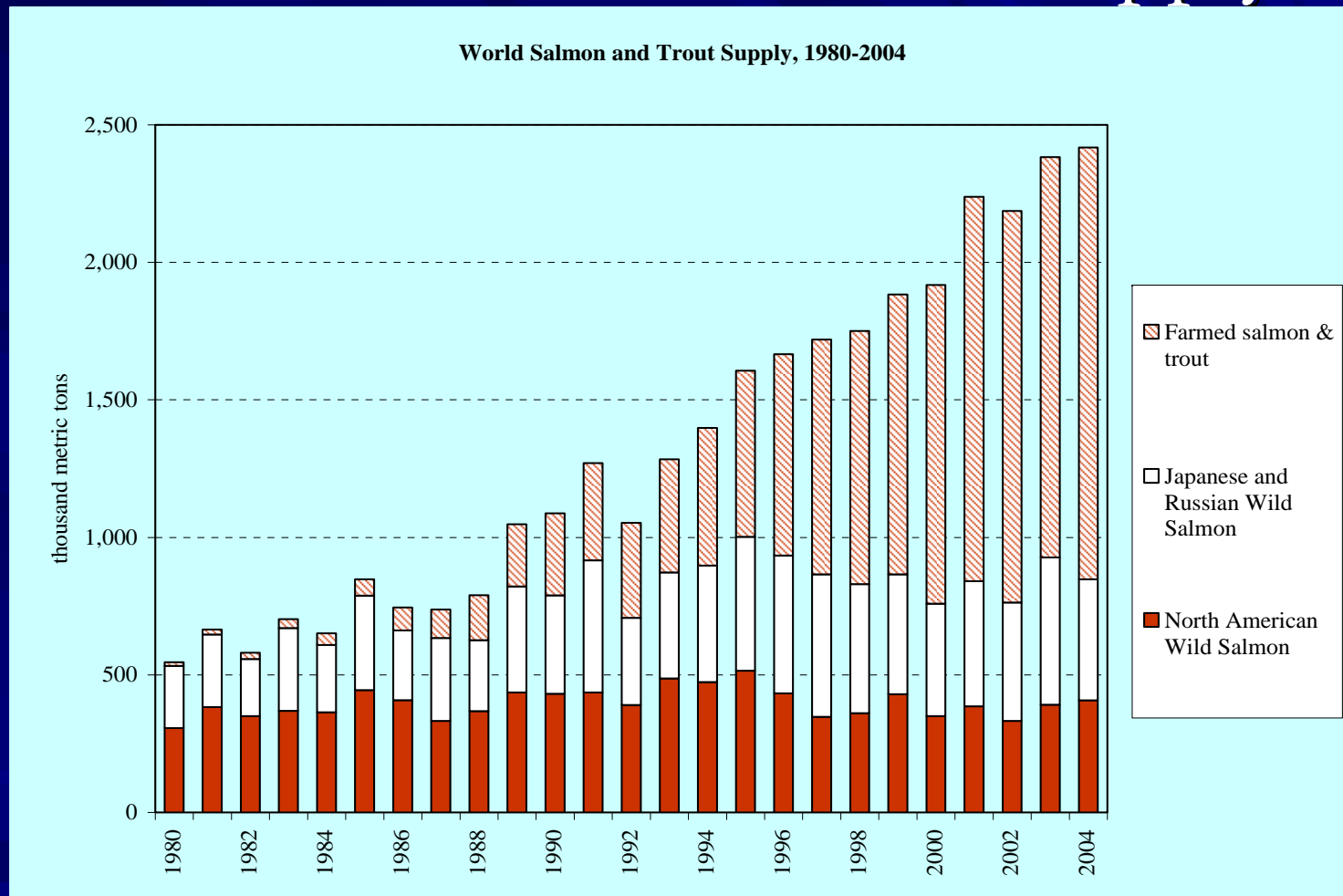
## Aquaculture

- Biotechnology
- Disease Management
- Feed Cost/ Quality
- Consolidation/  
Restructuring
- Farm Management
- Regulations

## Fishery

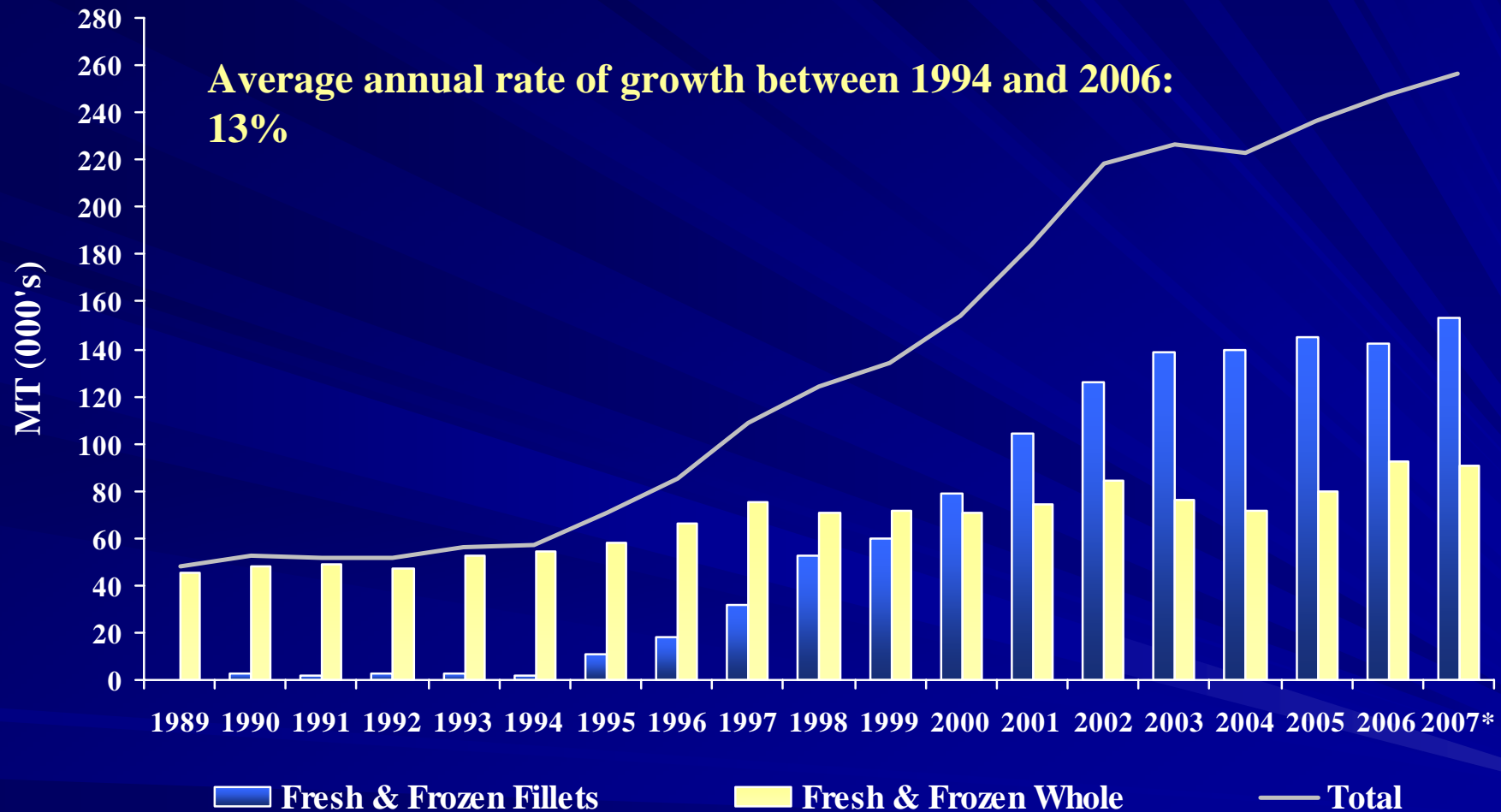
- Fishery Regulations
- Fish Stock
- Environment
- Crew-share  
Arrangements
- Maintenance/Repair

# World Salmon & Trout Supply



Source: All data are FAO Fishstat+ data except that data (used to calculate North American wild salmon catches) for Alaska are CFEC Alaska Salmon Summary Data 1980-2005 and data for the Pacific Northwest are NMFS catch data. "Farmed trout" includes only farmed rainbow trout raised in salt water.

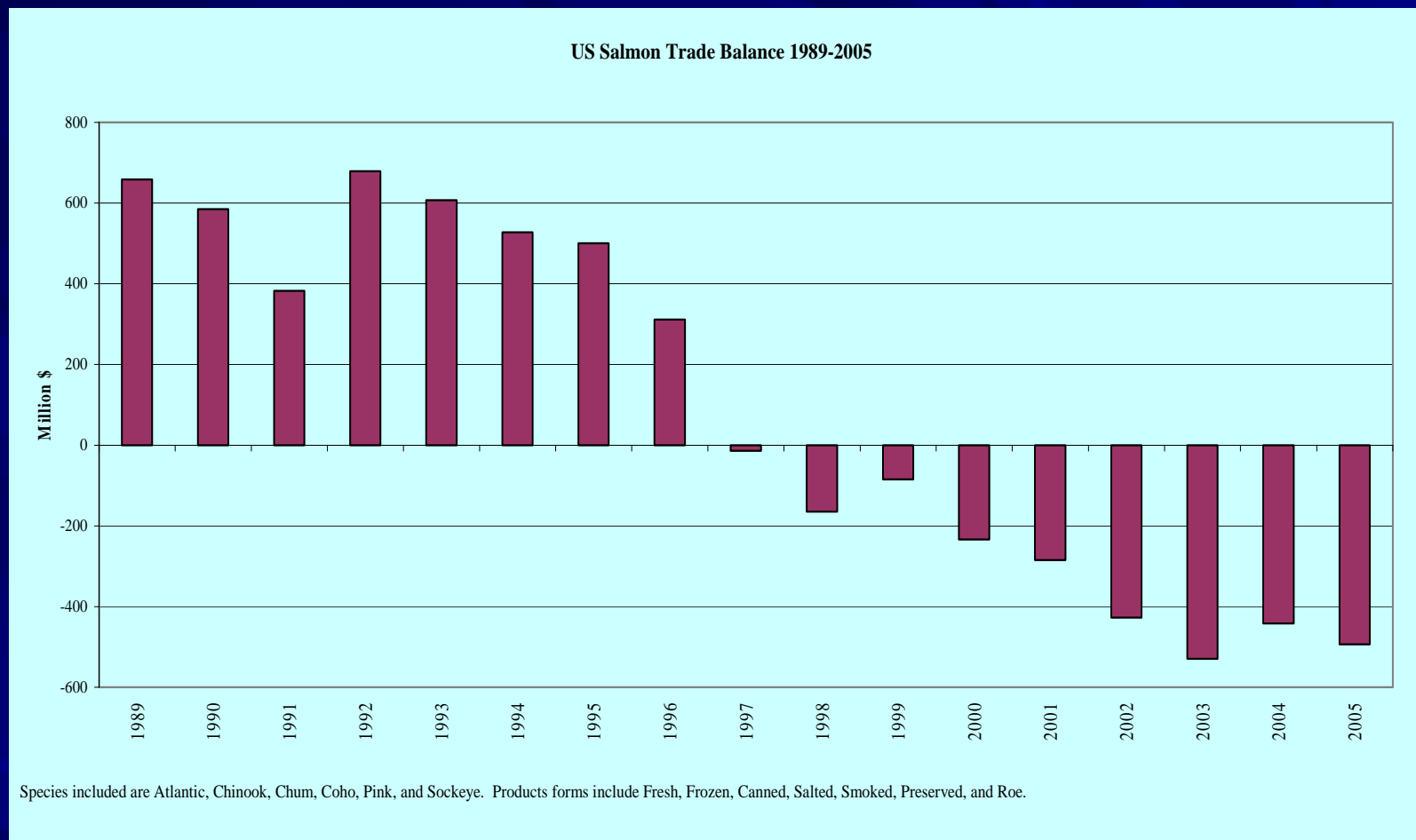
# US Imports of Salmon and Trout



Source: USDC (2007).

\* Estimated.

# US Salmon Trade Balance



USDC/NMFS (2006)

# Wild Fishery Management

Wild fishery  
management often  
imposes significant  
costs and hampers  
innovation, quality,  
and marketing.

*Alaska's Bristol Bay drift gillnet salmon  
fishery -2005.*

*(Photograph by Bart Eaton,  
Source:Gunnar Knapp)*



# Quality

- Better and more consistent quality is essential for improving markets for wild seafood.
- Fundamental changes in management and fishing practices may be needed to improve quality for some fisheries.



*Internal bruises in a wild chum salmon fillet Source G.*

*Knapp*

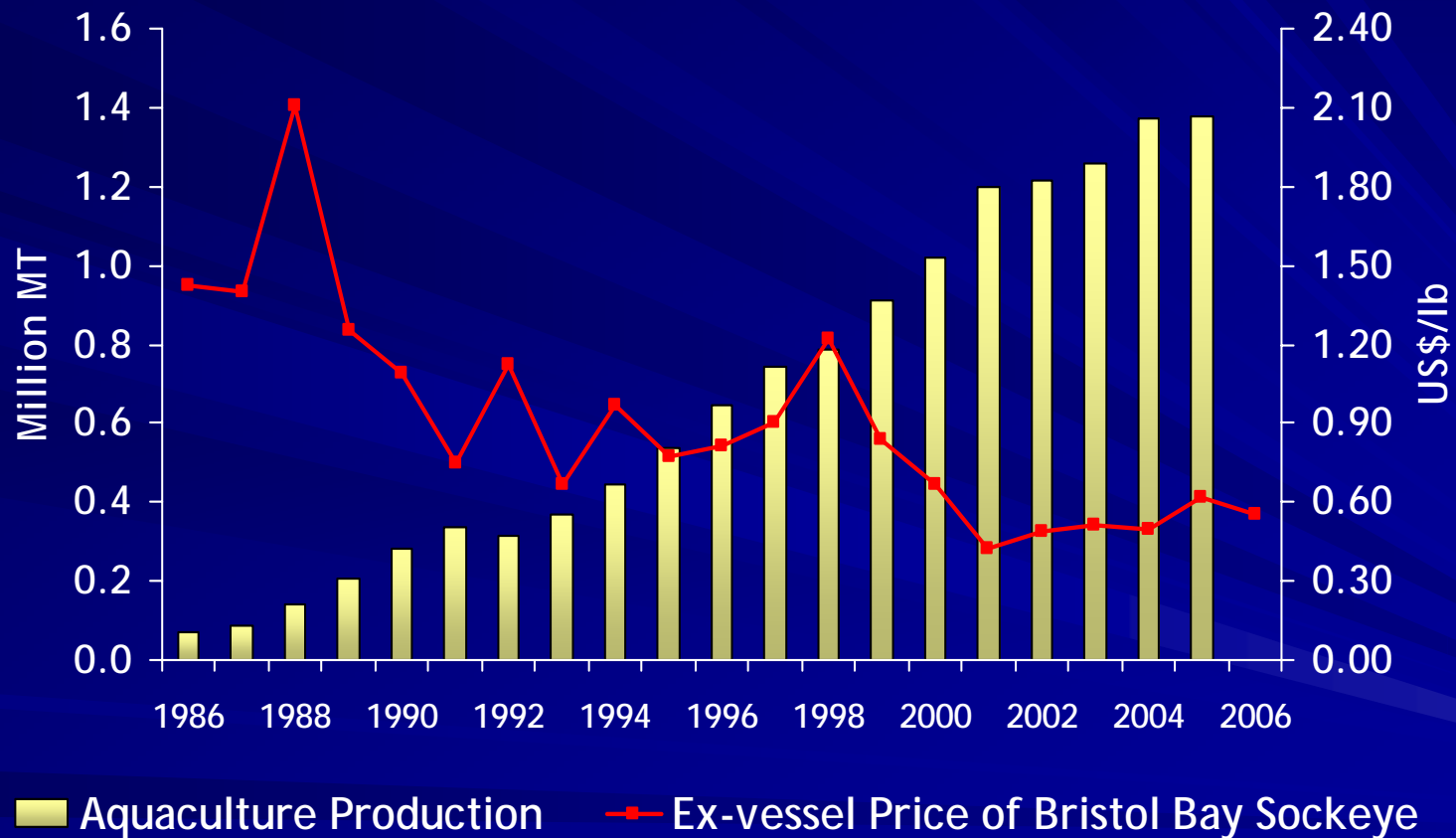
*Sockeye salmon  
in a Bristol Bay  
gillnet at low tide*

*— Source G.*

*Knapp*

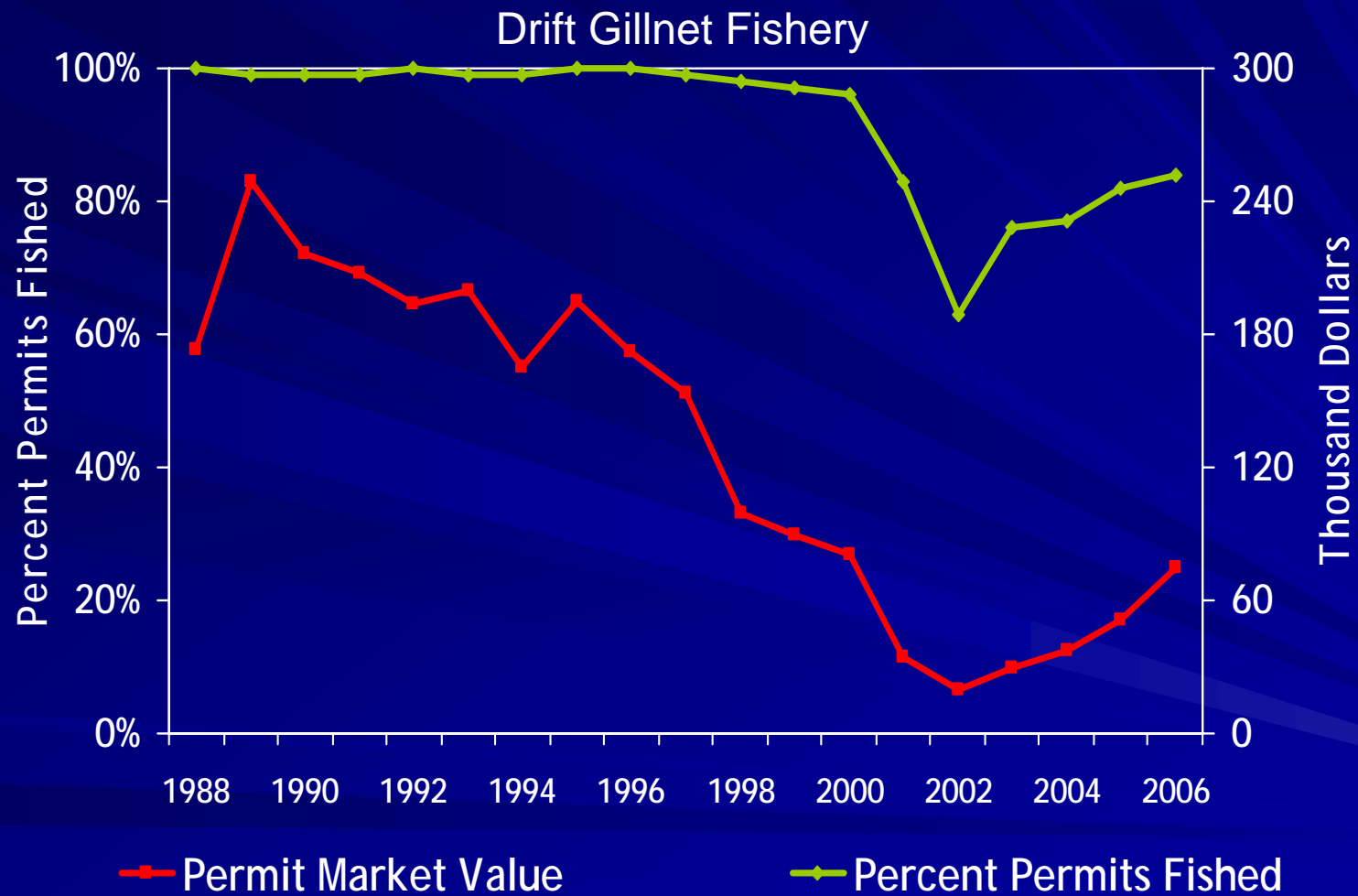


## World Aquaculture Production of Atlantic, Chinook, and Coho Salmon Vs. Ex-vessel Price of Bristol Bay Sockeye Salmon



Sources: FAO (2007); ADF&G (2007).

# Permit Market Value and Percent of Permits Fished in the Bristol Bay Sockeye Fishery



Source: CFEC (2007).

- Competition with farmed salmon has increased efficiency through reduction of effort

- Bristol Bay Salmon, Alaska

- Competition with farmed salmon has increased efficiency through restructuring of fleet

- Chignik Salmon Coop., Alaska

# Salmon Fishery in Chignik, Alaska

## Average Harvest per Active Permit by Fleet

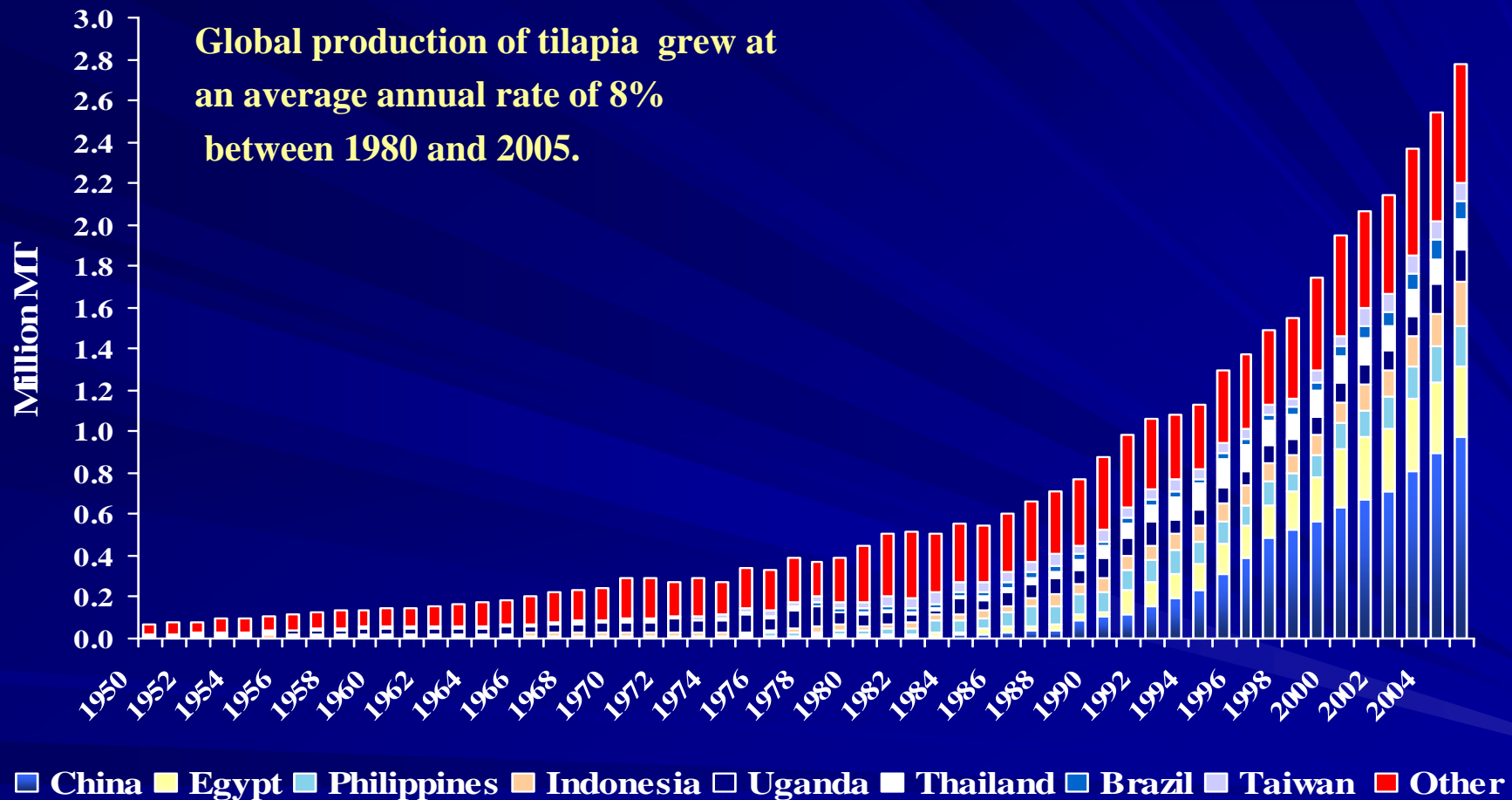


Source: ADF&G (2007, 2006).

# Creation of New Markets

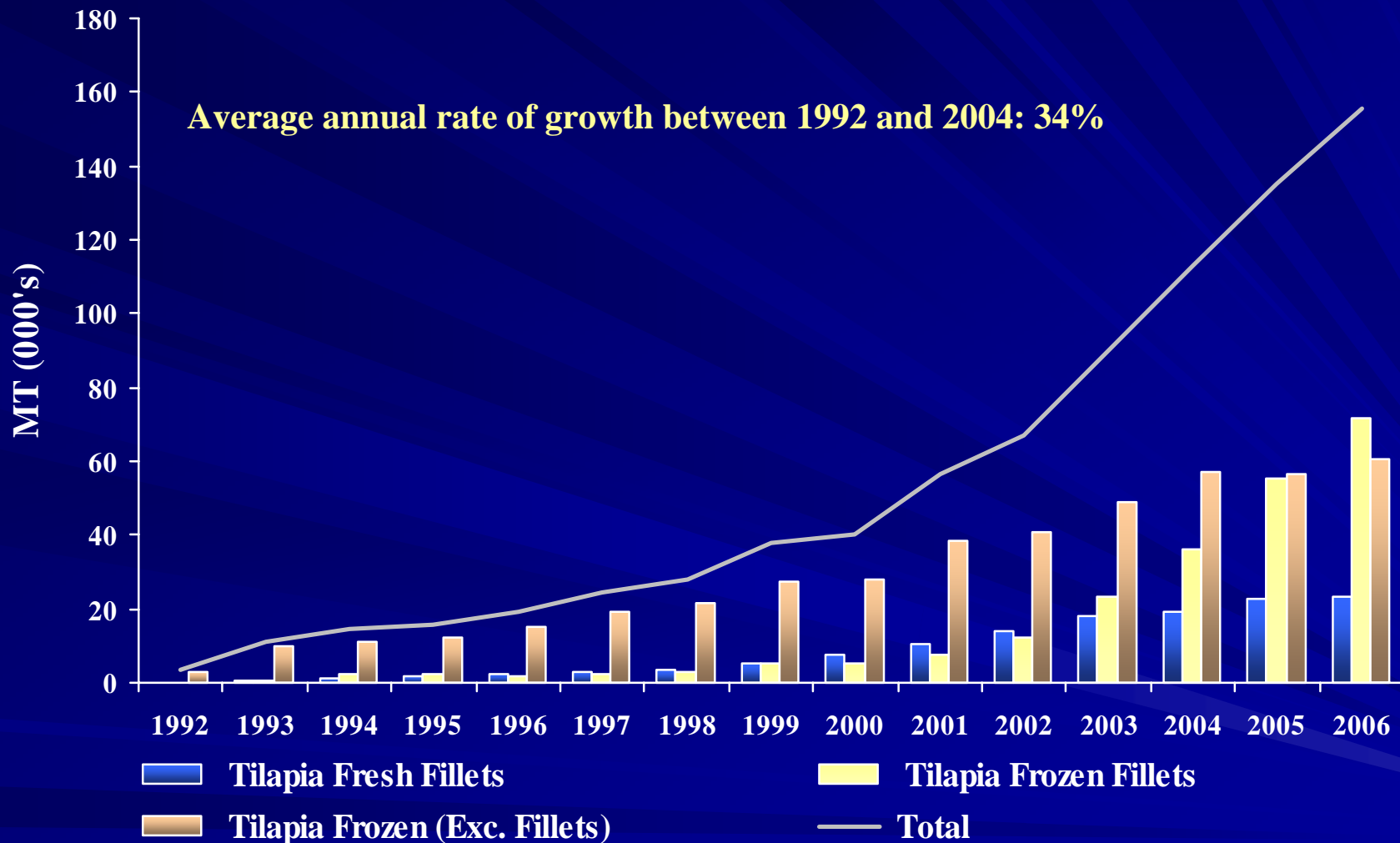
- Salmon Farmers created new markets in southern US
- Farmed Salmon created new markets premium wild salmon
- New Products – Pin-Bone-Out Salmon Fillet
- Mussels in Northeast US - Mussel farmers created demand and revitalized mussel fishing
- New markets for sturgeon, barramundi, tilapia and oysters are all being developed by aquaculturists

# World Tilapia Production: 1950-2005



Sources: FISHSTAT (2007)

# US Imports of Tilapia



Source: USDC (2005); Seafood Market Analysis, Seafood Importation

\*Estimated

# Tilapia market

- Very Rapid growth
- Competition for flatfish, snapper and other whitefish
- Fillets – Market innovation
- Many environmental NGOs are positive about tilapia
- Increase Globalization
- Walmart

# Retail and Restaurant Demands

Large chain restaurants and supermarkets will increasingly source their fish (salmon, as well as other species) from aquaculture.

Consistent quality, portion control, value added processing, better handling, consistent availability, economies of size, globalization

# Risk and Uncertainty: Environment and Growth Processes

**LOW** ←————→ **HIGH**

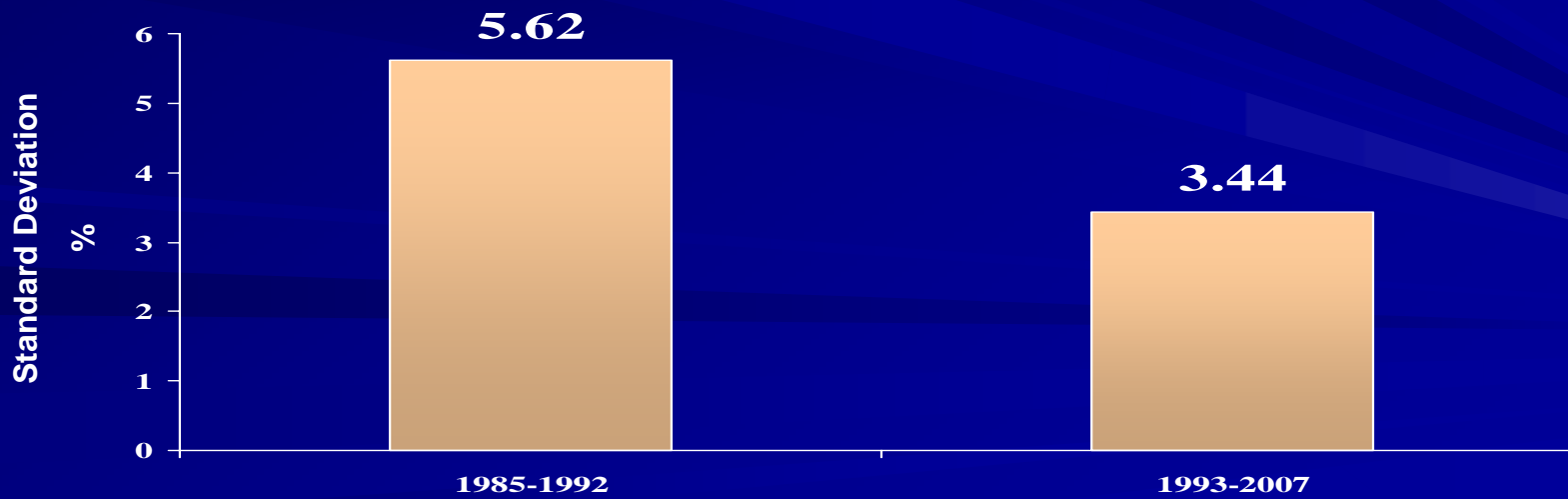
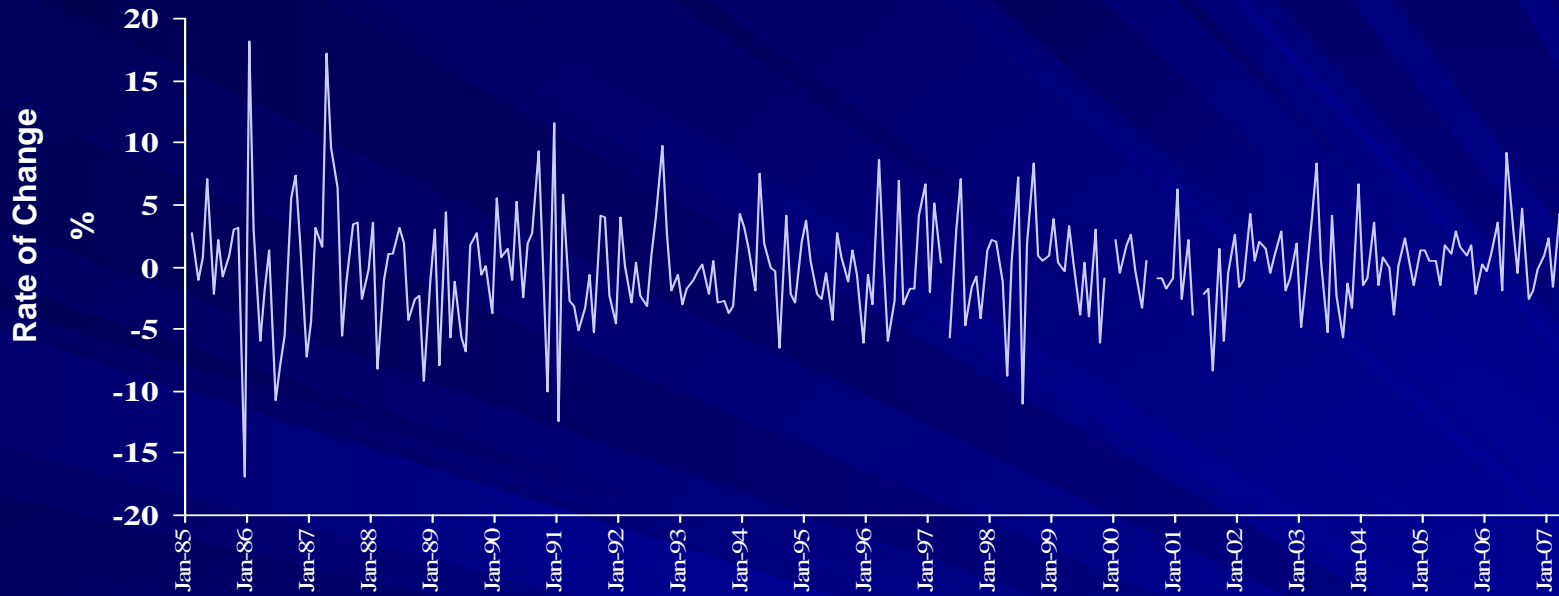
Storms	<b>Catfish</b>	<b>Salmon</b>	<b>Shrimp</b>	<b>Wild</b>
Disease Mortality	<b>Catfish</b>	<b>Salmon</b>	<b>Wild</b>	<b>Shrimp</b>
Other Mortality	<b>Catfish</b>	<b>Salmon</b>	<b>Shrimp</b>	<b>Wild</b>
Seasonality	<b>Shrimp</b>	<b>Catfish</b>	<b>Salmon</b>	<b>Wild</b>
Growth Rate	<b>Catfish</b>	<b>Salmon</b>	<b>Shrimp</b>	<b>Wild</b>

# Risk and Uncertainty: Government Policy and Regulation

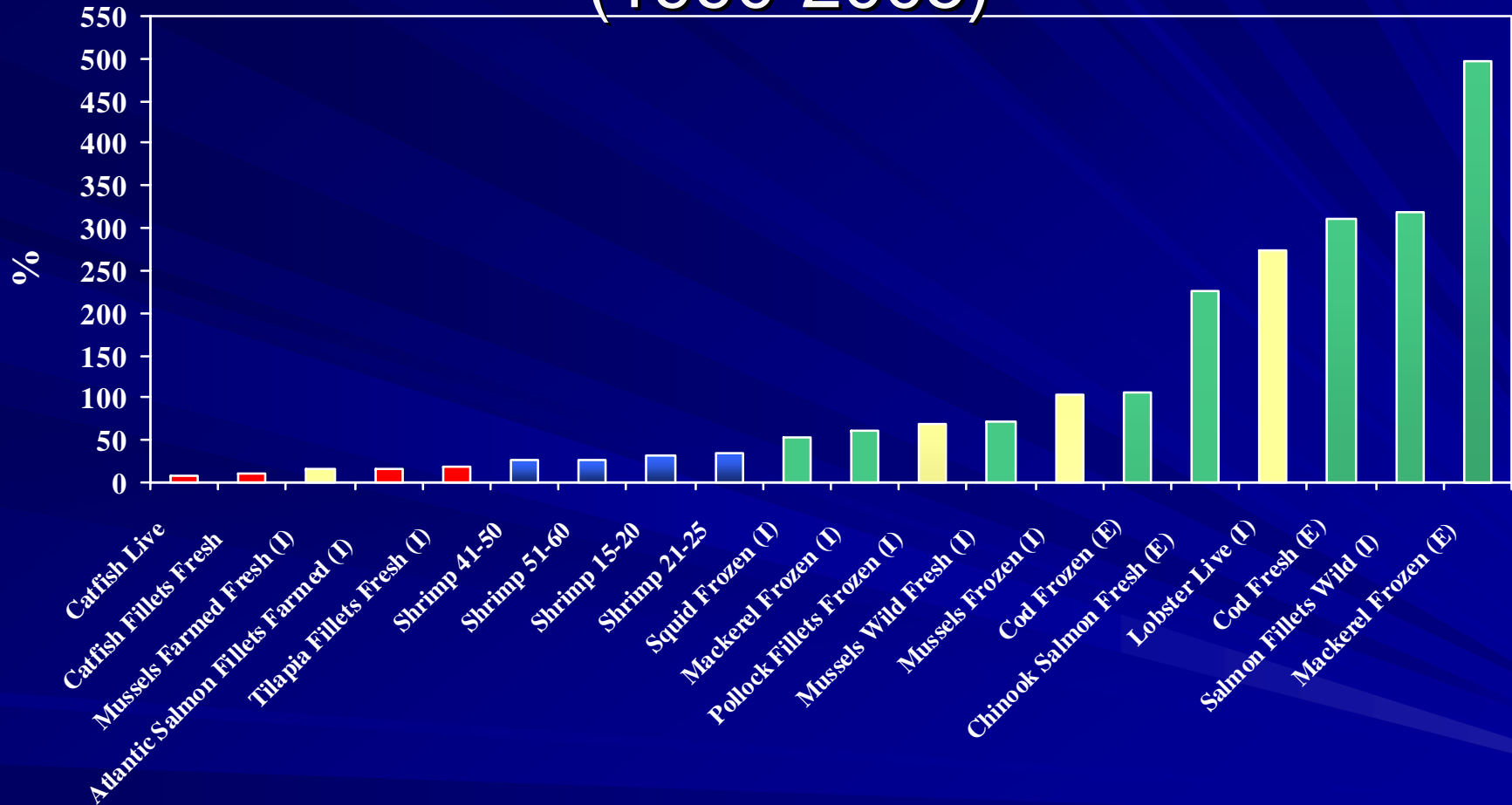
**LOW** ←————→ **HIGH**

Location	<b>Catfish</b>	<b>Shrimp</b>	<b>Wild Salmon</b>	
Operational Regulation	<b>Catfish</b>	<b>Salmon</b>	<b>Shrimp</b>	<b>Wild</b>
Property Rights	<b>Catfish</b>	<b>Salmon</b>	<b>Shrimp</b>	<b>Wild</b>
Trade Barriers	<b>Catfish</b>	<b>Salmon</b>	<b>Shrimp</b>	<b>Wild</b>
Labeling	<b>Catfish</b>	<b>Salmon</b>	<b>Shrimp</b>	<b>Wild</b>
Endangered Sp.		<b>Catfish</b>	<b>Wild</b>	<b>Shrimp</b>
		<b>Shrimp</b>	<b>Salmon</b>	

# US Fresh Atlantic Dressed Imports – Price Monthly Percentage Rate of Change and Standard Deviation

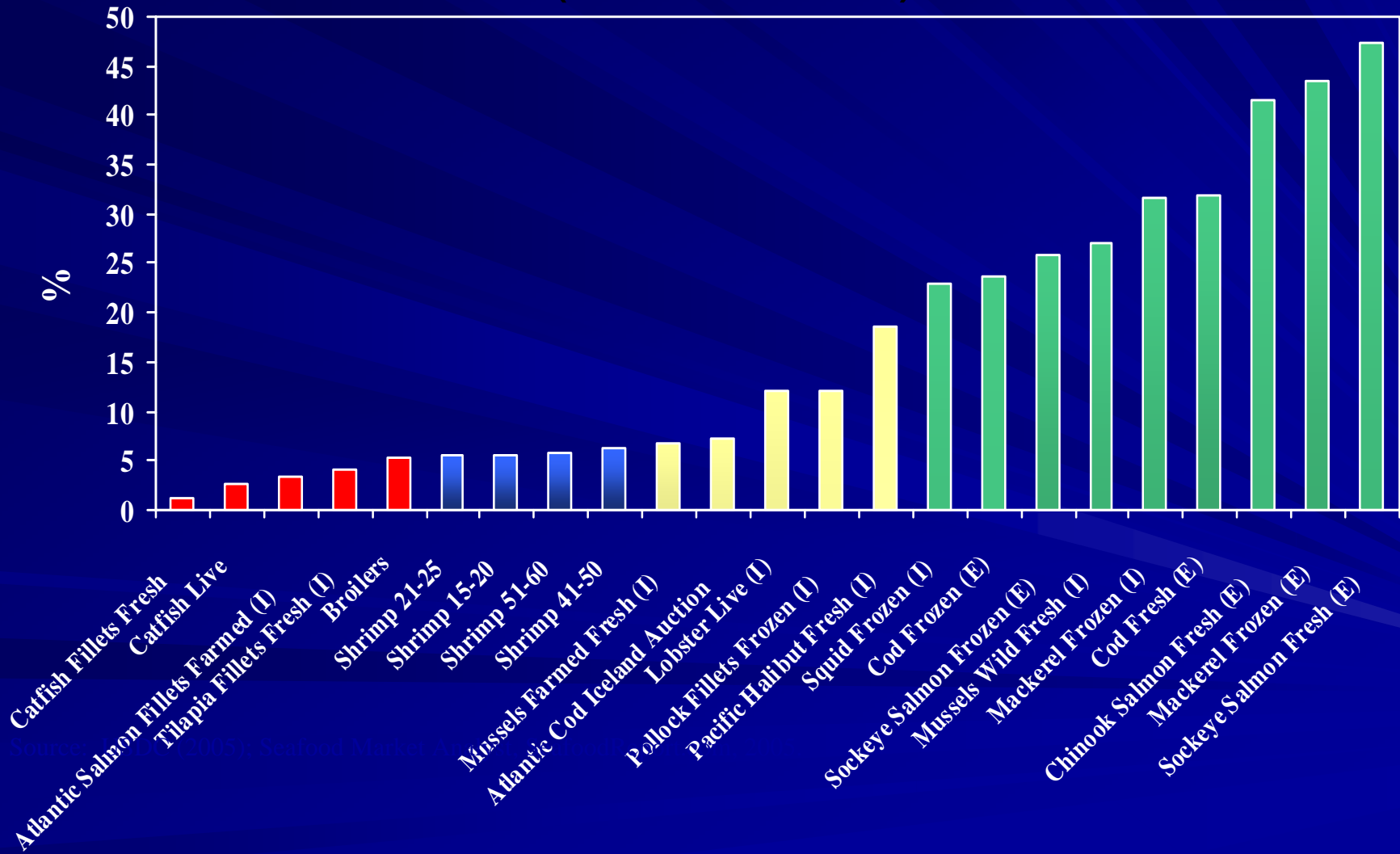


# Quantity - Standard Deviation of Monthly Percentage Rate of Change (1990-2005)



Source: USDC (2005), Seafood Market Analysis, Seafood

# Price - Standard Deviation of Monthly Percentage Rate of Change (1990-2005)



Source: <http://www.fishbase.org>

# Aquaculture and Integration & Globalization

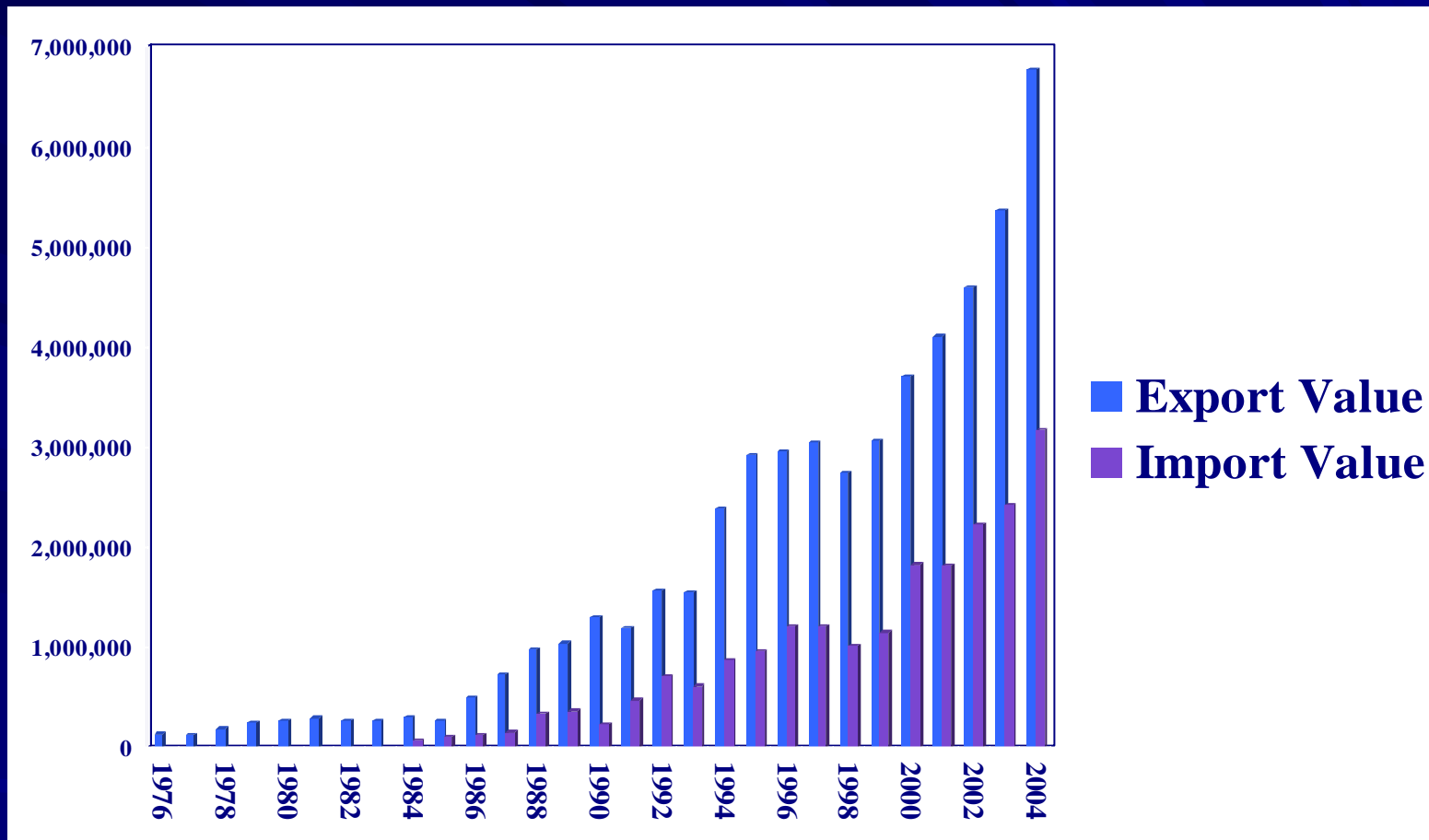
Aquaculture's forward looking orientation and large retail and restaurant demands has:

- Encouraged vertical and horizontal integration
  - Stimulated globalization

ex. FARMED SALMON  
SHRIMP

# China: International Seafood Trade

(\$1000)

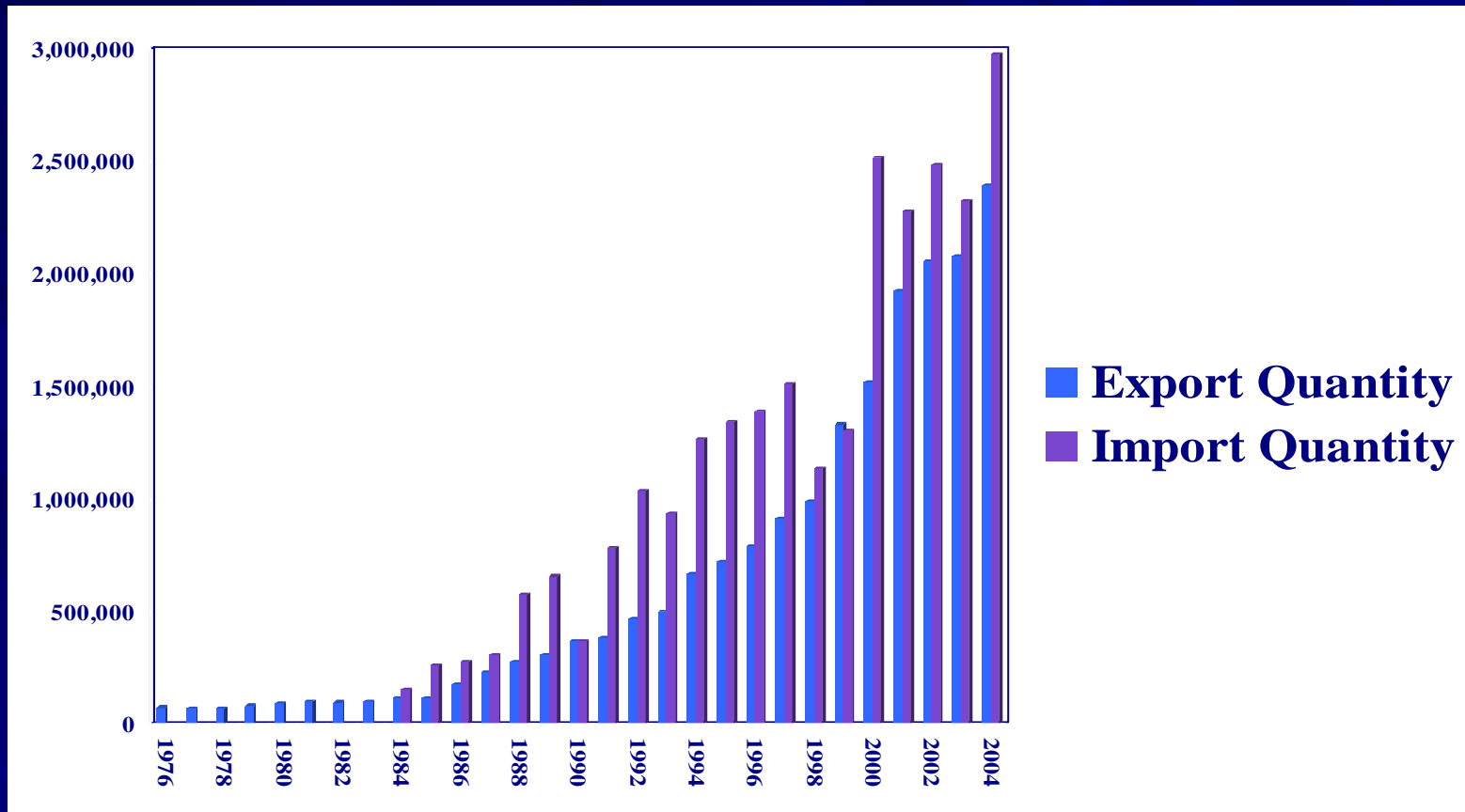


China: #1 Seafood Exporter #6 Seafood Importer

Source: FishStat, FAO 2007

# China: International Seafood Trade

(MT)



China: #1 Seafood Exporter #1 Seafood Importer

Source: FishStat, FAO 2007

# US Imports from China: 2006

(Source; NMFS 2007)

**Total - #1 in Quantity.. #2 in Value (Canada - #1)**

**All Finfish - #1**

**Frozen Seafood - #1**

**Processed Seafood - #2 (Thailand - #1)**

**Breaded Shrimp - #1    Squid - #1    Scallops - #1**

**Tilapia - #1    Flatfish Fillets - #1**

**Cod Fillets - #1    Alaska Pollock Fillets - #1**

# US Exports to China:2006

(Source; NMFS 2007)

Total - #2 in Quantity.. #3 in Value

(Japan #1)

Frozen seafood #2 (Japan #1)

**Salmon - #1** (Canada #2)

**Groundfish - #1** (Germany #2)

**Flatfish - #1** (Korea #2)

# Trends Shaping the Future the Seafood Industry?

- There will be continued growth but most of it will be fueled by **aquaculture imports**. This continues an existing trend.
- **Per capita seafood consumption** will see **increases** but it will be concentrated on fewer species produced primarily in **aquaculture** facilities. This phenomenon also took place in agriculture. The Diversity is in the “sauce”
- Growth in aquaculture parallels a **shift in the market** towards **value-added products** that enhance consumer convenience.

# Which Trends are Shaping the Future of the Seafood Industry?

- Technological innovations, better nutrition and disease management will continue to reduce costs in aquaculture production.
- Lower production costs and increased supplies from aquaculture will hold prices down.
- The trend towards value-added creation will drive processing to countries where labor costs are lower – China.

# Which Trends are Shaping the Future of the Seafood Industry?

- Despite criticism from **environmental organizations**, aquaculture will not go away.
- Potential **constraints** for aquaculture development (e.g., “**fishmeal trap**”) will be circumvented by new **technology and substitution**.
- Aquaculture will dominate the commodity market, but there will be **increasing opportunities** for **wild** products in the **upper-end** segment of the market (e.g., natural food retailers and luxury restaurants).

# Which Trends are Shaping the Future of the Seafood Industry?

- **Retail outlets** are increasingly important for the seafood industry.
- Steady growth in **supermarkets** and **clubs/warehouses**, but specialty stores are declining.
- **Chain restaurants** will see higher growth than independently-owned restaurants.
- **Supply stability** and **product standardization** are foremost for large retailers and chain restaurants. Aquaculture is in a better position to satisfy these demands than capture fisheries.
- **Longer-term contracts** will be increasingly common.

# Which Trends are Shaping the Future of the Seafood Industry?

- **Anti-Globalization and trade barriers are likely to increase** – may undermine economic growth.
- **Increasing use of labeling – MSC Wild Fisheries, Aquaculture Certifications, organic** This is likely to become increasingly controversial. Credibility is in question.
- **China** will become an increasingly important force - both as the world's seafood processor and as a significant consumer.

# Conclusion

- Aquaculture enters when fisheries have failed to meet market demands
- Aquaculture is forcing change in fisheries
  - Through competition (supply)
  - By developing new technology (hatchery-based fisheries)
    - By example (quality control)
  - By creating new demand – both for inputs (fishmeal) and outputs (seafood)

# Conclusion

In the Long Run

All significant commercial Seafood supplies will come from three sources:

- I. Fish Farms/Aquaculture
  - II. Aquaculture-Enhanced Fisheries
  - III. Fisheries that adopt systems of management that are more like aquaculture management
    - clearly define rights and responsibilities
    - incorporate principles of husbandry, range management, forestry and farming
    - More market and quality driven
- Fisheries that do not will be marginalized or driven into niches – wild fisheries must change to compete

Thank You