

Sustainable Aquaculture: **What does it mean and how do we get there?**

James L. Anderson

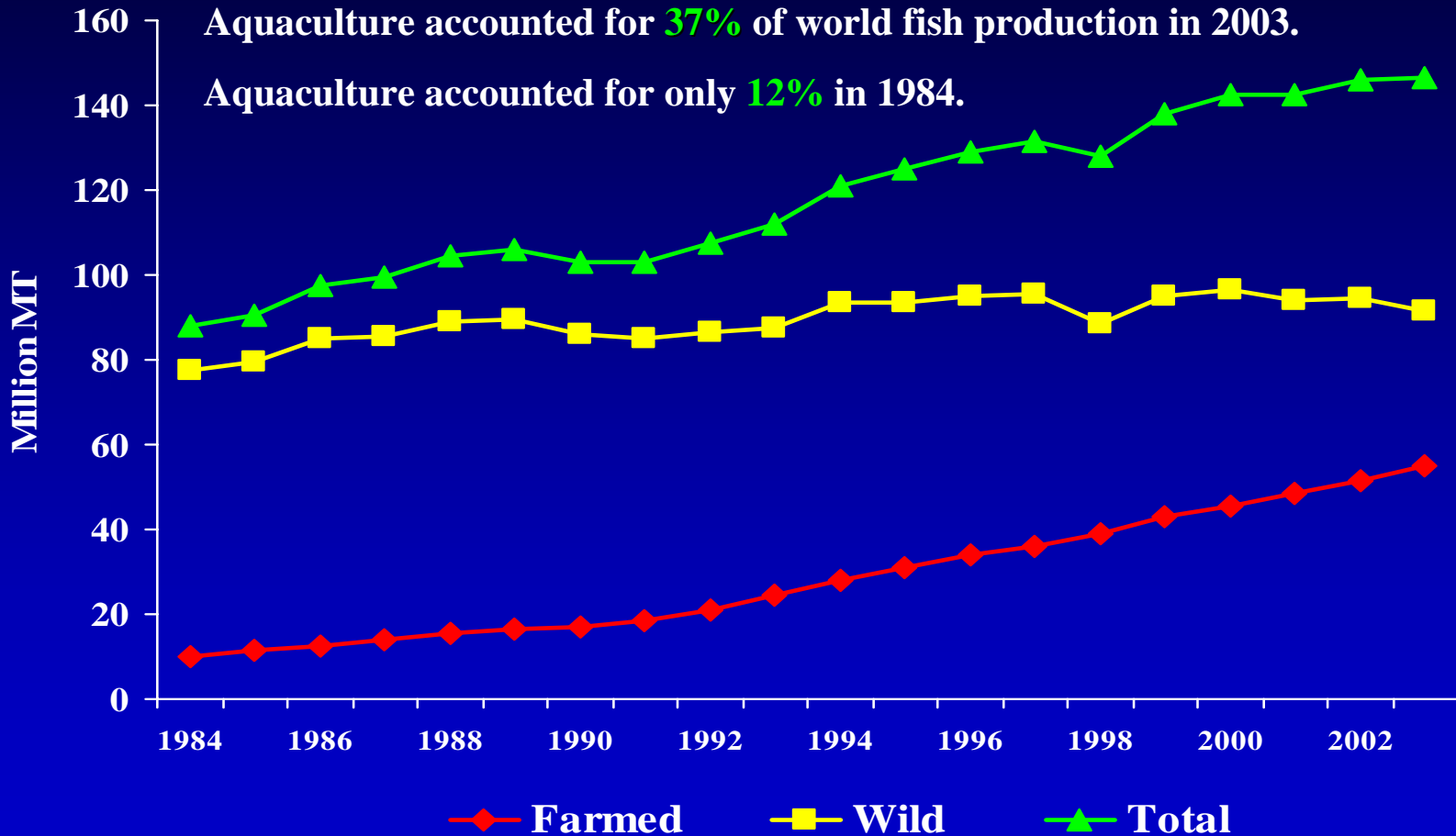
Dept. of Environmental & Natural Resource Economics
University of Rhode Island



The Future Belongs to Aquaculture

(Well, most of it anyway)

World Fisheries Production



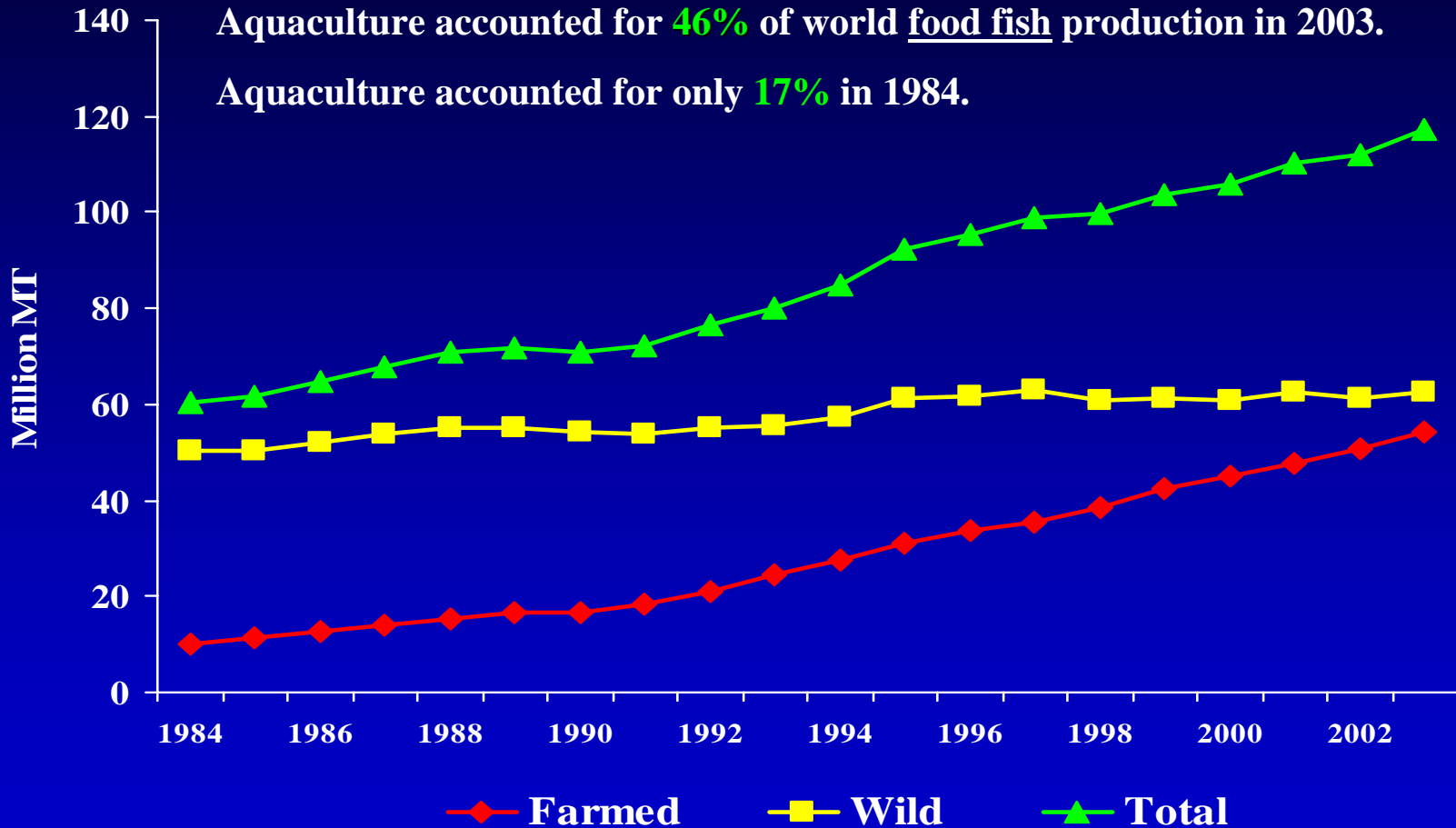
Source: FISHSTAT (2005).

What if only 'Food' fish are considered?

Exclude...

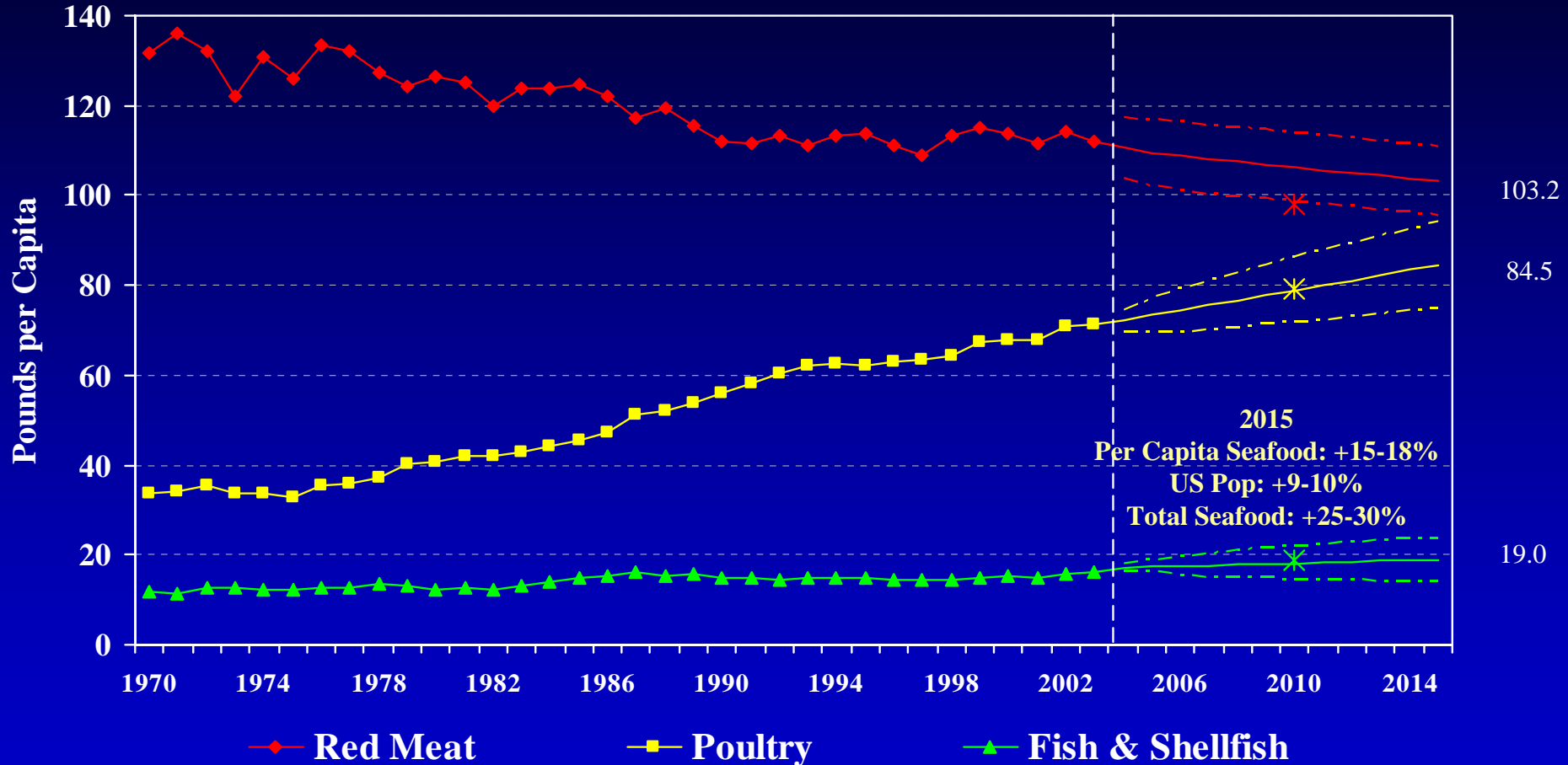
- Species targeted by reduction fisheries (**menhaden, sardines, anchovies**);
- Non-edible invertebrates (**corals, sponges, pearls**);
- Most marine mammals (**whales**) and reptilians (**sea turtles**);

World Production of "Food" Fish



Source: FISHSTAT (2005).

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).

Seafood Consumption is Concentrating on Fewer Species

Edible kg per Capita

	1987		2003	% change		
71%	1 Tuna	1.59	93%	Shrimp	1.81	+74
	2 Shrimp	1.04		Tuna	1.54	-3
	3 Cod	0.76		Salmon	1.01	+403
	4 AK Pollock	0.40		AK Pollock	0.77	+93
	5 Flatfish	0.33		Catfish	0.52	+91
	6 Clams	0.30		Cod	0.29	-62
	7 Catfish	0.27		Crab	0.28	+84
	8 Salmon	0.20		Tilapia	0.25	N/A
	9 Crab	0.15		Clams	0.24	-21
	10 Scallops	0.15		Scallops	0.15	0
	Other	2.16	Other	0.55	-75	
	Total	7.35	Total	7.40	+1	

Sources: Fisheries of the United States (2003) and NFI (2005).

Seafood Business Survey: **U.S. Retail Sales, 1994 vs. 2004**

Best Sellers

	1994	2004
1	Shrimp	Shrimp
2	Salmon	Salmon
3	Pollock, Cod, Haddock	Tilapia
4	Catfish	Tuna
5	Flounder	Catfish

Fastest Growing Items

	1994	2004
1	Salmon	Salmon
2	Shrimp	Tilapia
3	Tilapia	Shrimp
4	Catfish	Tuna
5	Orange Roughy	Crab

Sources: Perkins, C. (1994) and Robinson, F. (2004)

Diverse Technology

- Recirculation Systems, Earthen ponds, Raceways, Cages, Racks
- Biofilters, Ozone Water Quality Systems, Oxygen Injection
- Disease Management, vaccines, antibiotics
- Feed Systems and nutrition
- Selective breeding, triploids, genetic engineering
- Ranching, crop rotation

- Artisanal to multinational corporation
- Desert to miles off shore in the ocean

Many issues

- Environmental impact, effluent discharge, habitat destruction
- Genetic pollution, disease transmission, fishmeal use
- Fairness, equity, income distribution, consumer health
- Aesthetics, profitability,
- Misinformation
- Regulatory bureaucracy
- Plethora of adversary groups

Seafood Sector (Fisheries & Aquaculture) vs Agriculture

- 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

Aquaculture – Complex, Dynamic and Politically- charged

**Can any generalizations be made about
sustainability?**

Is every case a special case?

Is more government the answer?

Sustainability – “Keep in existence; keep up; maintain”

Webster’s New World Dictionary, 2005

Popular, but Not meaningful

Sustain what?

At what level?

**Any Sustainable Industry (Incl.
Aquaculture)
must be
Economically Sustainable**

**The other “sustainabilities” are not
relevant unless economic sustainability has
the possibility of being achieved**

Aquaculture –

“the propagation and rearing of aquatic organisms in controlled or selected environments, including, but not limited to ocean ranching”
US National Aquaculture Act of 1980

“the husbandry of aquatic animals and plants” NRC 1992

Husbandry – “1. agriculture, 2. Careful management or conservation of resources” American Heritage Dictionary 2000

Aquaculture?

There is really a continuum between

True Open Access Fisheries – Sea Ranching
& Range (ie Marine Reserves)
Management and True Aquaculture

Fisheries Management -

- “The integrated process of information gathering, analysis, planning, decision-making, allocation of resources and formulation and enforcement of fishery regulations by which the fishery management authority controls the present and future behavior of interested parties in the fisheries, in order to ensure the continued productivity of the living resources.” (FAO 1999).

CONTROL -The difference between traditional fisheries management and aquaculture management boils down to *Who* is in **CONTROL** and *What* is being **CONTROLLED**

- Traditional fisheries management is about the governing institution's **CONTROL** of individual or group – but not the organism
- **Agriculture (aquaculture), the individual or group, CONTROLS the production, harvest and marketing of the aquatic organism - the individual or group is in CONTROL; not CONTROLLED by the governing institution**

Essential-

**Creating and developing economic
institutions and governance
systems**

**Is the model agriculture management
or marine fisheries management?**

The track record of ‘command and control’ fisheries management has been unacceptable in managing for sustainable fisheries

Overcapitalization

Rent dissipation

Overfishing

Poor seafood quality

Market gluts and shortages

Wasteful stakeholder/government negotiations

Rent-seeking behavior

Let’s not keep going there!

....But in the many areas we already have

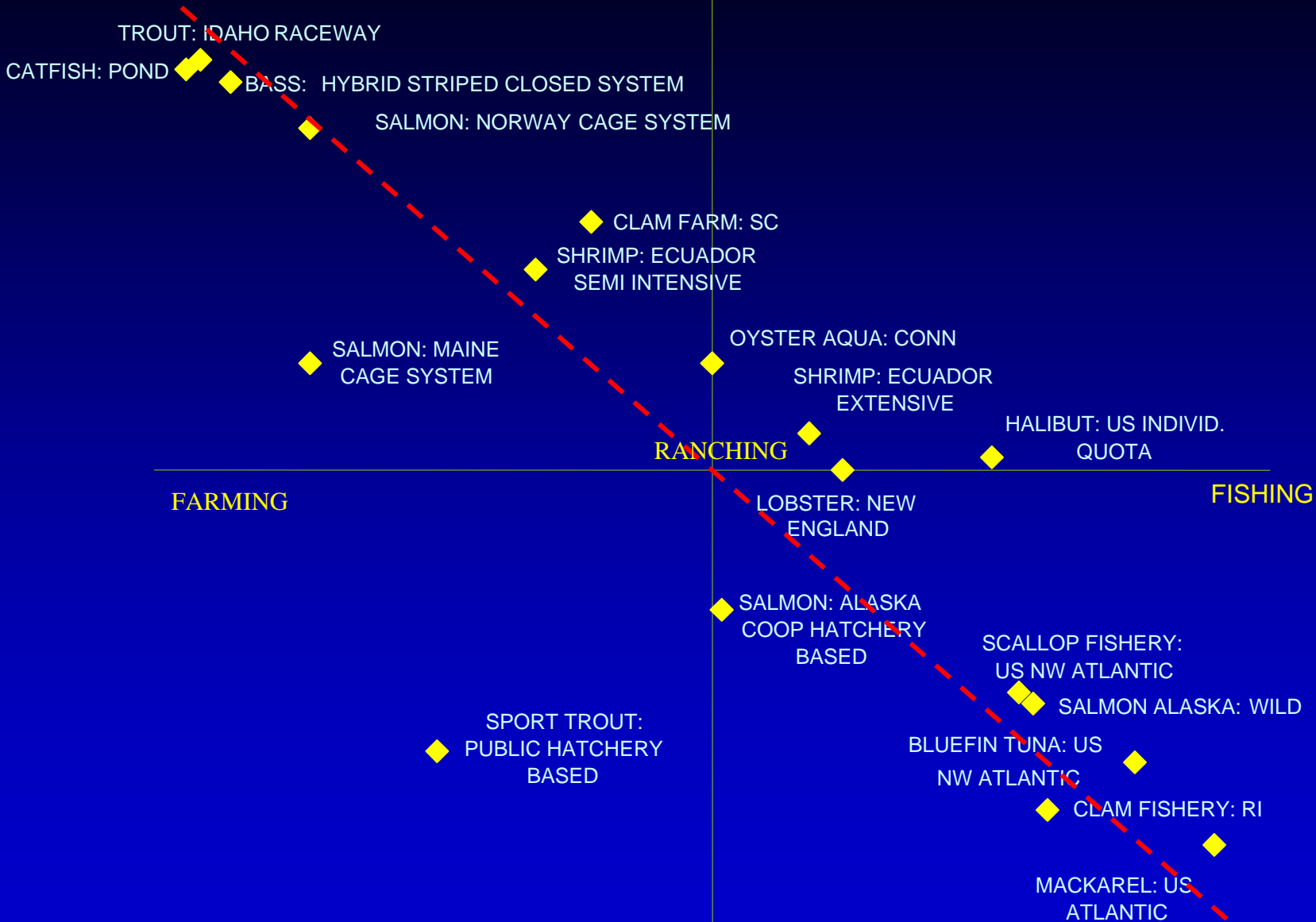
- Clam farmers in Rhode Island must harvest using commercial fishing methods and they are also required to follow the commercial fishery size limits**
- In the US, it is illegal to commercially farm striped bass**
- Raising finfish for profit in Alaska is illegal. Paradoxically, their largest “agricultural industry” is nonprofit salmon ranching to support the commercial fishing methods. Is this sustainable?**

....There are some examples where stakeholders have greater control

- Fisheries Cooperative Associations of Japan (2005) Fisheries Recovery Plan - “more fishermen are addressing resource control” and taking the following actions:
 - Reduce fishing effort
 - Release and properly manage fry
 - Maintenance and recovery of fishing grounds, clean the sea bottom and plant vegetation
 - Setting up protected areas
- New Zealand Challenger fisheries for scallops - release of seed scallops and are practicing rotational management
- Salmon Farming in Norway or Chile
- Catfish farming in the US

PROPERTY RIGHTS

STRONG



FARMING

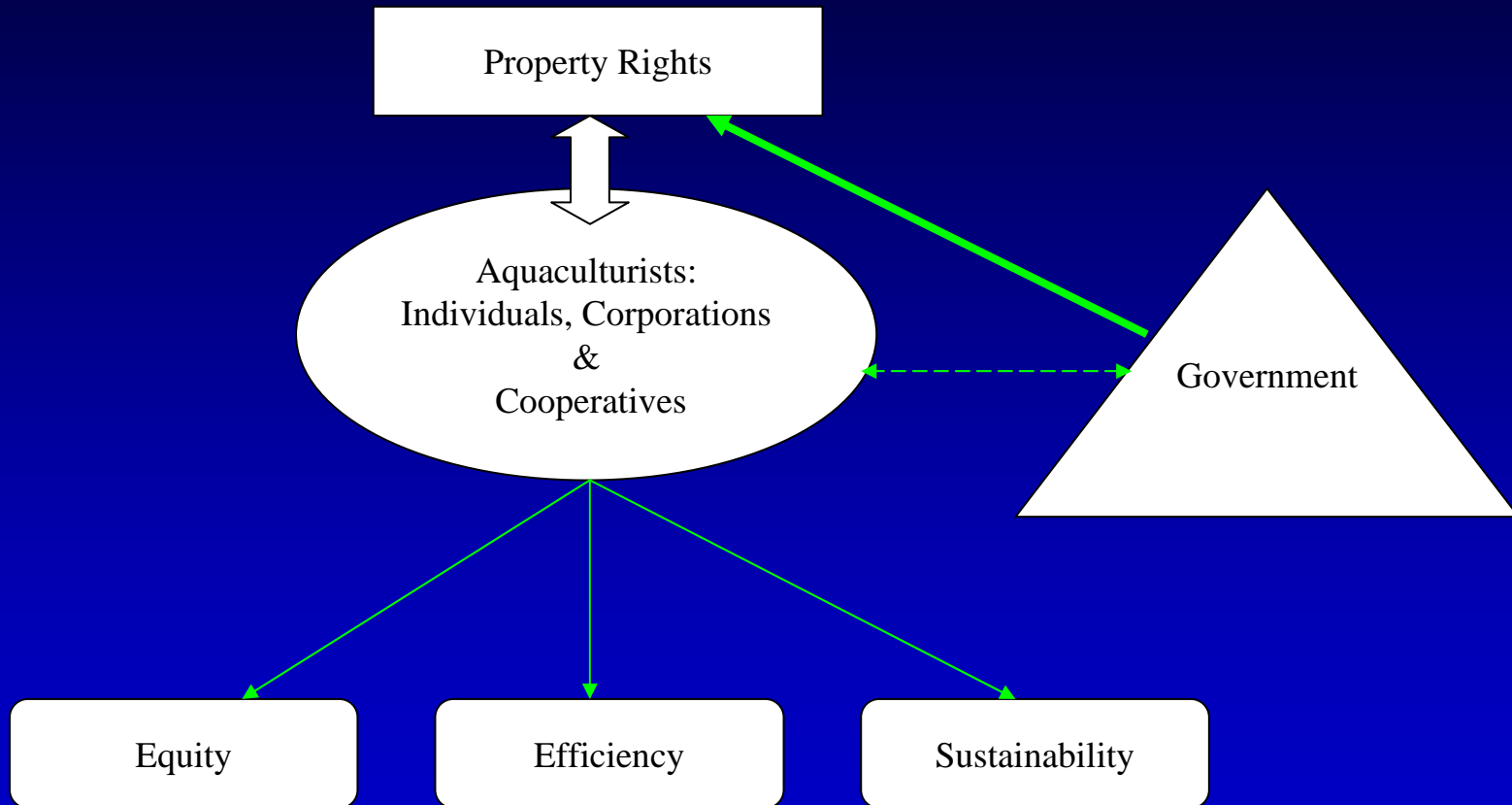
RANCHING

FISHING

- Control comes from technology, information and ownership.
- Ownership comes from well defined property rights

Defining the rights and responsibilities of property is the essential first step

- The governing institutions need to take responsibility for establishing, protecting and enforcing property rights as a primary responsibility.
- The growers' primary responsibility is to manage their enterprises for sustainability.



Getting the Rights Right

- *Security*
- *Transferability*
 - *Duration*
 - *Exclusivity*

Security

Secure rights are well-enforced through enforcement and the legal system

Relatively secure - US Catfish farms

Relatively insecure - Most Fisheries - Many Shrimp farms in S. America

Transferability

**Fully transferable with well-established,
efficient market institutions**

Relatively transferable - US Catfish farms

Relatively nontransferable - Oyster farm in RI

Duration

Strong rights are in place for perpetuity

Relatively long duration - US Catfish farms

Relatively short duration – Anything less than 10
years – (Forget conventional financing)

Exclusivity

All decisions and access to the property are controlled by the right holder

Relatively exclusive - US Catfish farms

Relatively not exclusive – Open access fishery

Helping Rights Work

- *Protect Economic Freedom*
- *Create Design and Develop Efficient Markets*
- *Zoning*
- *Inform, Educate and conduct Research*

Protect Economic Freedom

- Regulations and permitting procedures are straightforward, stable and uniformly applied, corruption is low
- Efficient markets determine wages and prices
- Low levels of trade protection and corruption in customs services.
- Low income and corporate taxes
- Government expenditures account for a small share of GDP
- Inflation is low
- Few restrictions on capital flow and investment
- Limited restrictions on the banking and finance institutions
- Low levels of black market activity.

Create Design and Develop Efficient Markets

- **Not all markets work well - esp. seafood markets in the US**
 - **Improve Transparency**
- **Markets for many goods & services (such as environmental goods & services) don't exist - Create them!**

Zoning

Where is aquaculture OK?

*(This shouldn't be that hard – We can do it for
agriculture)*

Inform, Educate and conduct Research

- *Uninformed aquaculturists are more likely to fail, to not use best practices and be less aware of environmental*
- *Research helps find solutions and is necessary to improve productivity*

Conclusions

- The continuum between fisheries and aquaculture is directly related to the degree of control. The degree of control is related to the definition of property rights, information & technology.
- The degree of control is directly related to the likelihood of sustainability.
- With strong property rights firms become more forward looking, invest in new technology, and control the production and marketing.
- Strong property rights are characterized by: 1) transferability, 2) exclusion, 3) security and 4) duration.
- Facilitate property rights through: 1) economic freedom, 2) a thoughtful zoning plan to facilitate property rights definition, 3) conduct aquaculture research and education and 4) create and develop market institutions.

