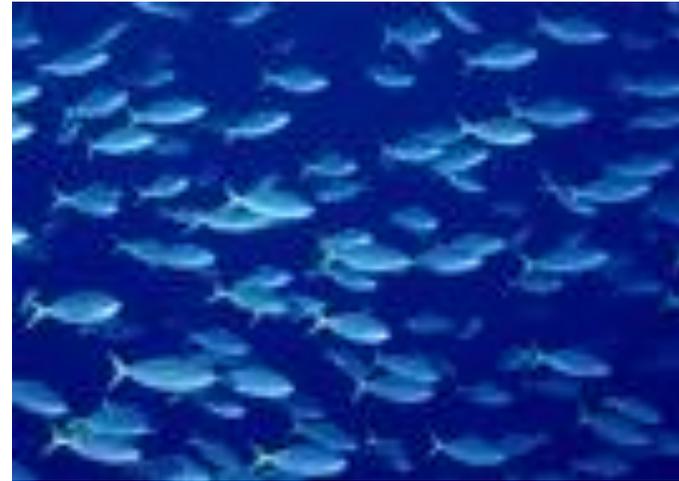


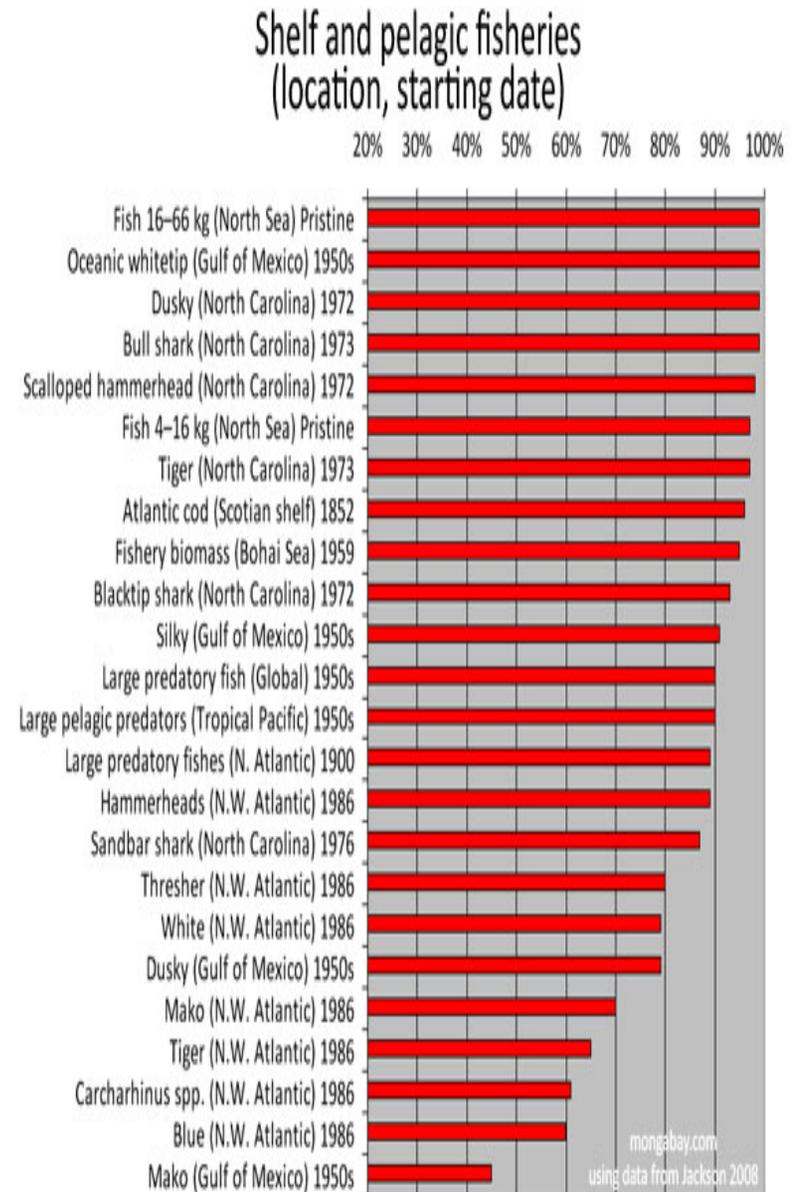
# Human Impact in Aquatic Systems: Fish Catching vs. Fish Raising

What are human impacts?

- Fish and aquatic invertebrates (clams, crabs, squid, etc.) currently supply 16% of world protein, higher in developing countries
- Also important raw materials for pigments, medicines, agricultural fertilizer
- According to UN Food & Agriculture Organization (2005):
  - 3% of commercially valuable fish spp. are under-harvested
  - 21% “moderately” exploited, could support a little more fishing
  - 52% fully exploited
  - 16% overexploited
  - 7% seriously depleted
  - 1% “recovering” from depletion



- Some assessments are even more pessimistic: Nature (2006) study estimated that large, predatory ocean fish were only at 10% of their abundance prior to the 20<sup>th</sup> century
- On a global level, catches peaked in mid-1990s, fell 13% between 1994 and 2003
- Modern ‘industrial’ fishing tends to catch many unintended species, disturb ocean floor, and catch younger fish before they have time to reproduce
- Today, many fisheries can survive only by being heavily subsidized

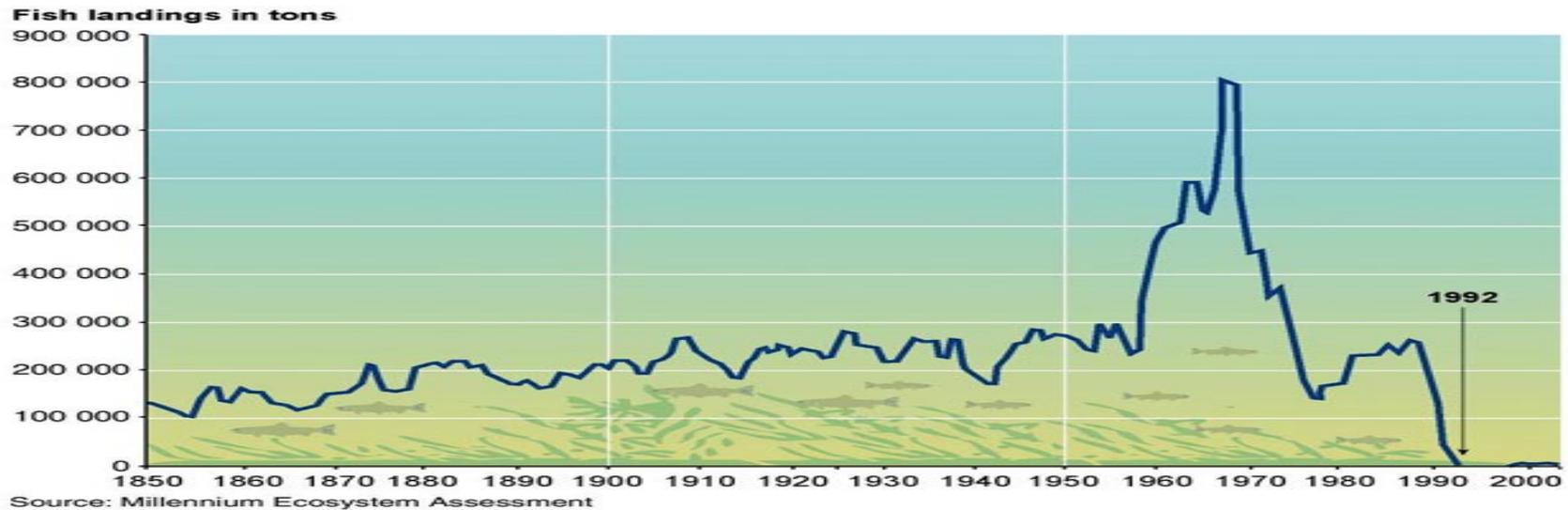


- **Case studies....**

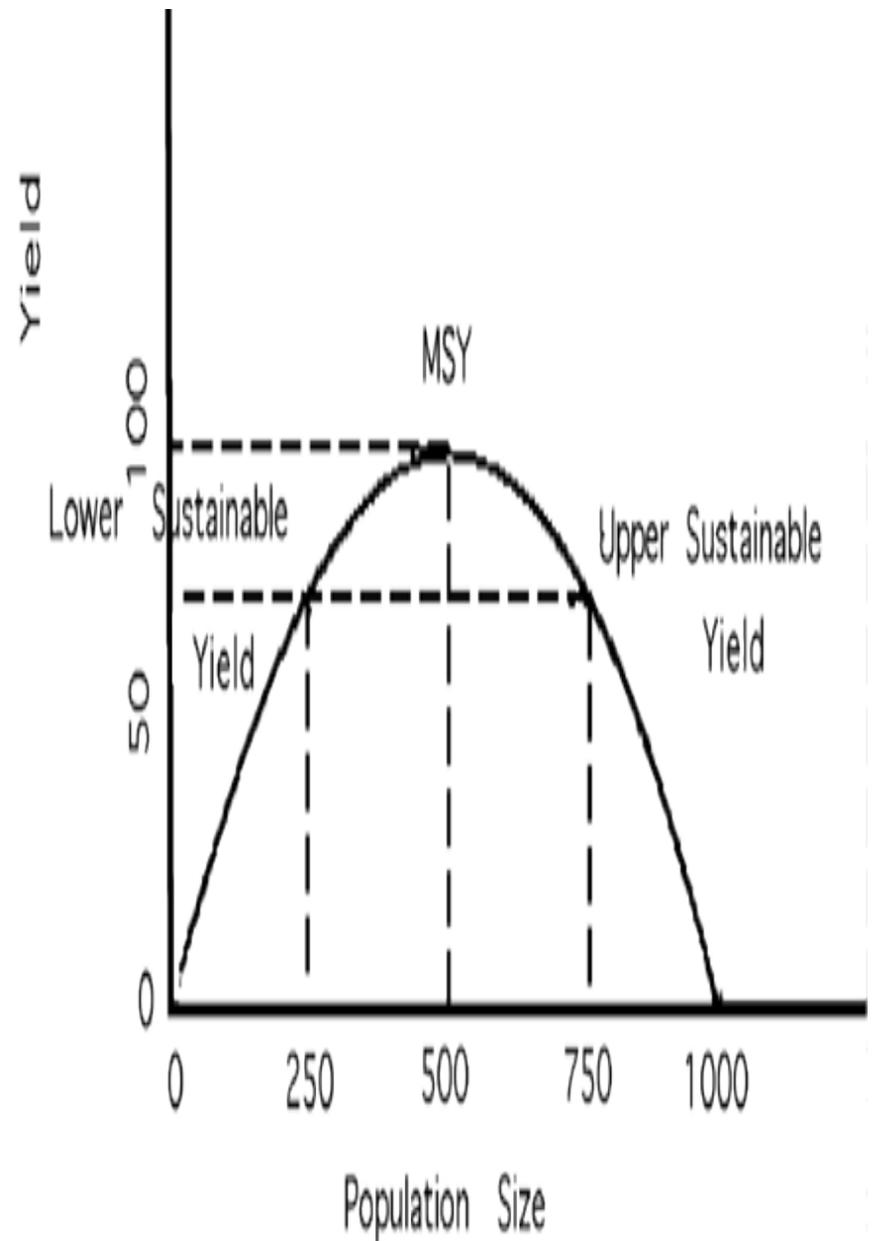
- Traditionally cod was extremely abundant in North Atlantic
- Until 1960, steady harvests of about 300,000 tons per year
- In 1960s, increased to 800,000 tons .... led to collapse of fishery
- When Canada closed the fishery in 1992, cod stocks at 1%-10% of historical levels

- Crab fishing in Newfoundland exhausted most of the stock in just 6 years, going from 8600 tons in 1981 to 75 tons in 1985

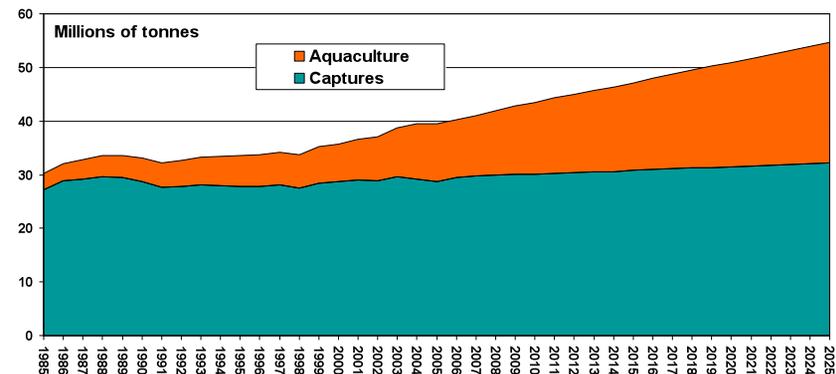
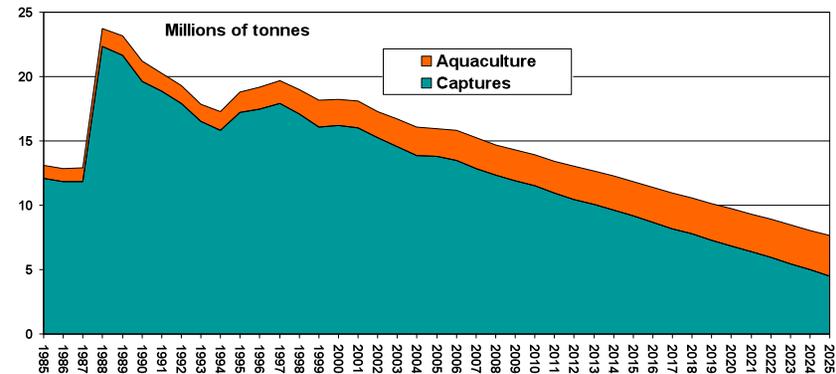
- Hake in Puget Sound went from 45 million lbs in 1983 to 1 million in 1998



- Theory of sustainable harvesting:  
Maximum Sustained Yield
- The idea is that when fish populations are reduced from their carrying capacity, they will reproduce at a faster rate (because there are more available resources)
- When the number removed each year is equal to the net production of young, then the population will stay stable
- Can stay stable at low or high levels
- This can work, but needs to take account of population fluctuations, and has to be done correctly!

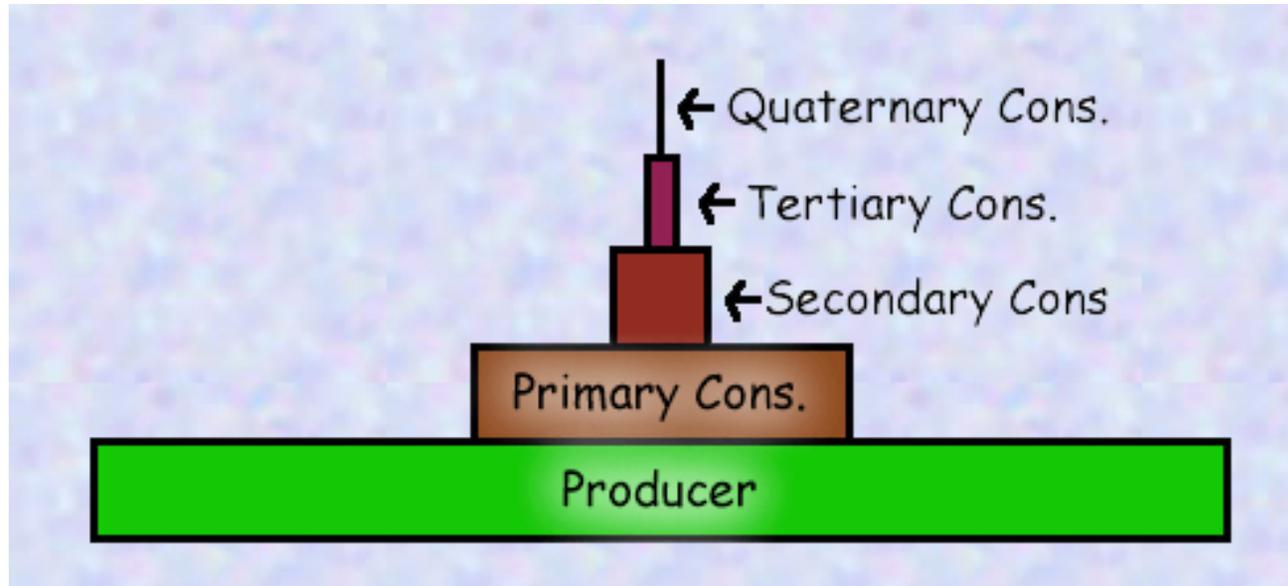


- Fish culture as an alternative
- Currently 33% of all fish and shellfish is raised on fish farms
- Practiced for centuries in China and Southeast Asia, now becoming popular in developed and developing countries
- Tilapia, carp, salmon, milkfish, trout, catfish, as well as crustaceans (shrimp, crayfish) and mollusks (clams, oysters, etc)
- Aquaculture is rapidly rising in importance while wild-caught fisheries stagnate
- May raise fish on farms their whole lives, or raise & release (esp. with shellfish)



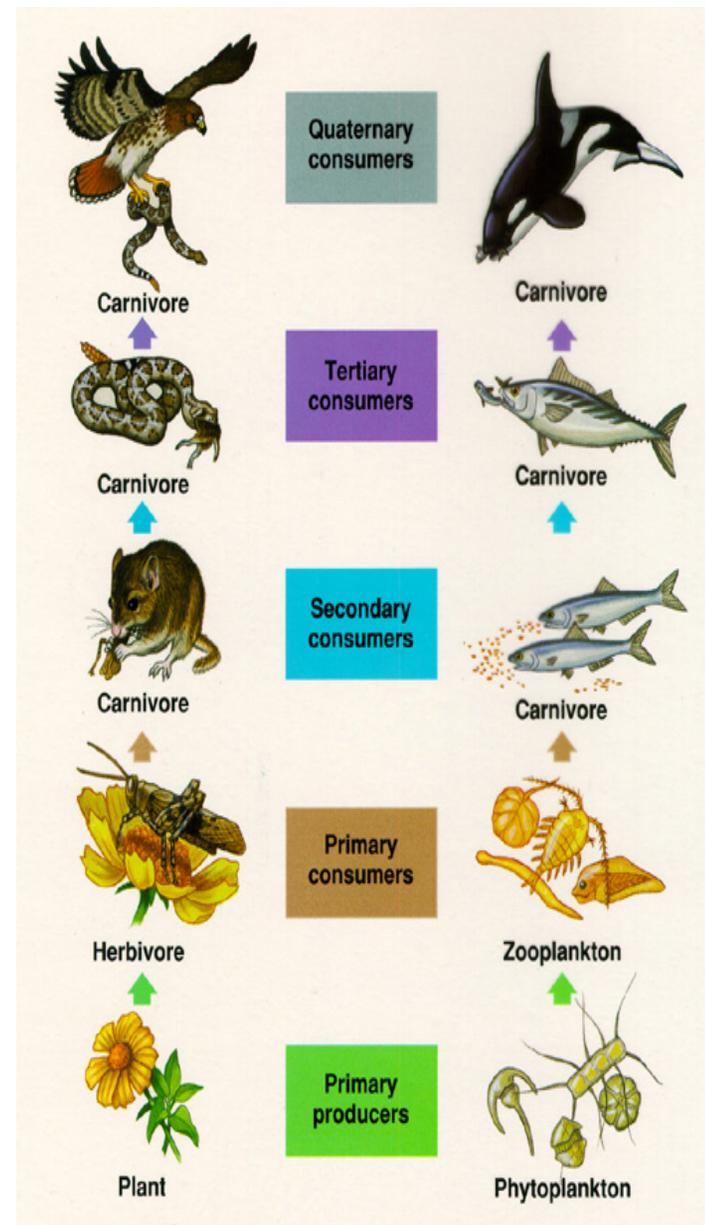
- **Problems of fish culture**
- Carnivorous fish and shellfish (salmon, trout, shrimp) require fish meal for food, which has in turn placed heavy pressure on wild stocks of anchovies and other small fish
- Deforestation of mangroves to make room for shrimp and milkfish farming
- Intensive aquaculture may foster diseases and parasites which can escape to wild populations Waste and effluents can damage marine habitat
- Almost 10% of global mangrove habitat replaced by shrimp farms since 1980
- Shrimp farming in, e.g. Brazil increased by 3000% in last 10 yrs so the problems we see beginning today will only become bigger





In nature, only about 10% of the energy from one trophic level makes it to the next trophic level—the rest is lost as waste. (For example, it should take 10 lbs of prey to make 1 lb of predator.)

- General problems with consuming predatory animals (e.g. shrimp, tuna, salmon)
- Energy is lost as we go to higher trophic levels
- Conversion efficiency = how much of an organism's food goes into increasing its body mass
- 5-20% efficiency in land systems, 10-40% in marine systems
- So raising herbivorous fish is more efficient than raising cows or chickens.....BUT more fish are carnivorous
- Greater conversion efficiency in fish (cold-blooded) leads to more trophic levels in the ocean



- Trophic cascades: Caribbean Coral reefs
- Coral reefs critical for soaking up excess CO<sub>2</sub> and limiting global warming
- Also one of the world's most productive environments, comparable to saltmarshes and tropical rainforests
- Overfishing has had indirect damaging effects on coral reefs
- Depletion of sharks leads to more medium-sized fish, which reduce population of parrotfish, which lead to more algae....algae are taking over from coral



- **Trophic Cascade in North Pacific**

- Fishing for pollock reduces this highly productive fish to a low but stable level
- However this is not enough to support sea lion population
- Decline in pollock → decline in sea lions → need to switch food source among killer whales
- Killer whales switch to sea otters → decline in otters → increase in sea urchins → decline in kelp forest, and many species that depend on the kelp suffer



- **Food for thought.....Where should we get the fish we eat?**
  - **Are there sustainable ways to get fish? (look at your handouts)**
  - **What is sustainability?**
- 
- **Time for activity & debate!**

