Fisheries Management Law & Economics

Traditional Fisheries Management

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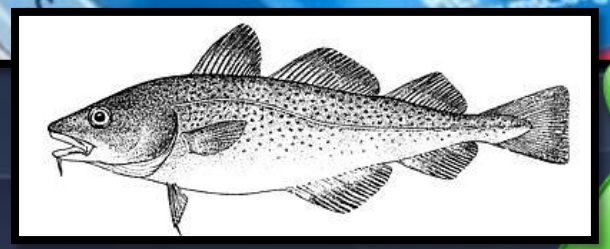
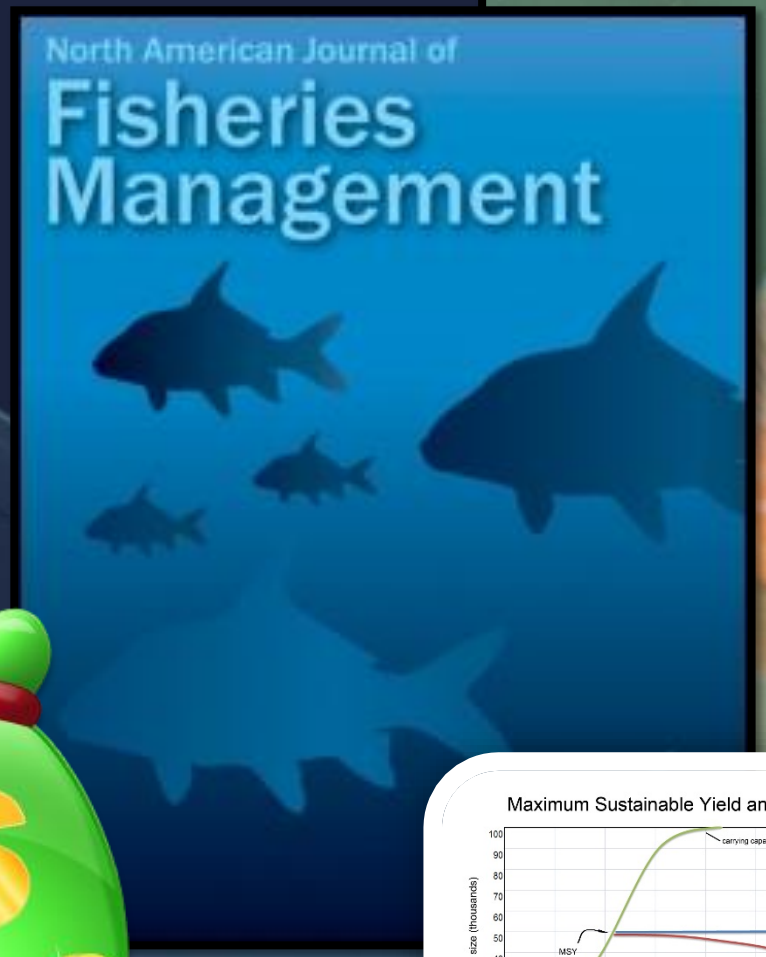
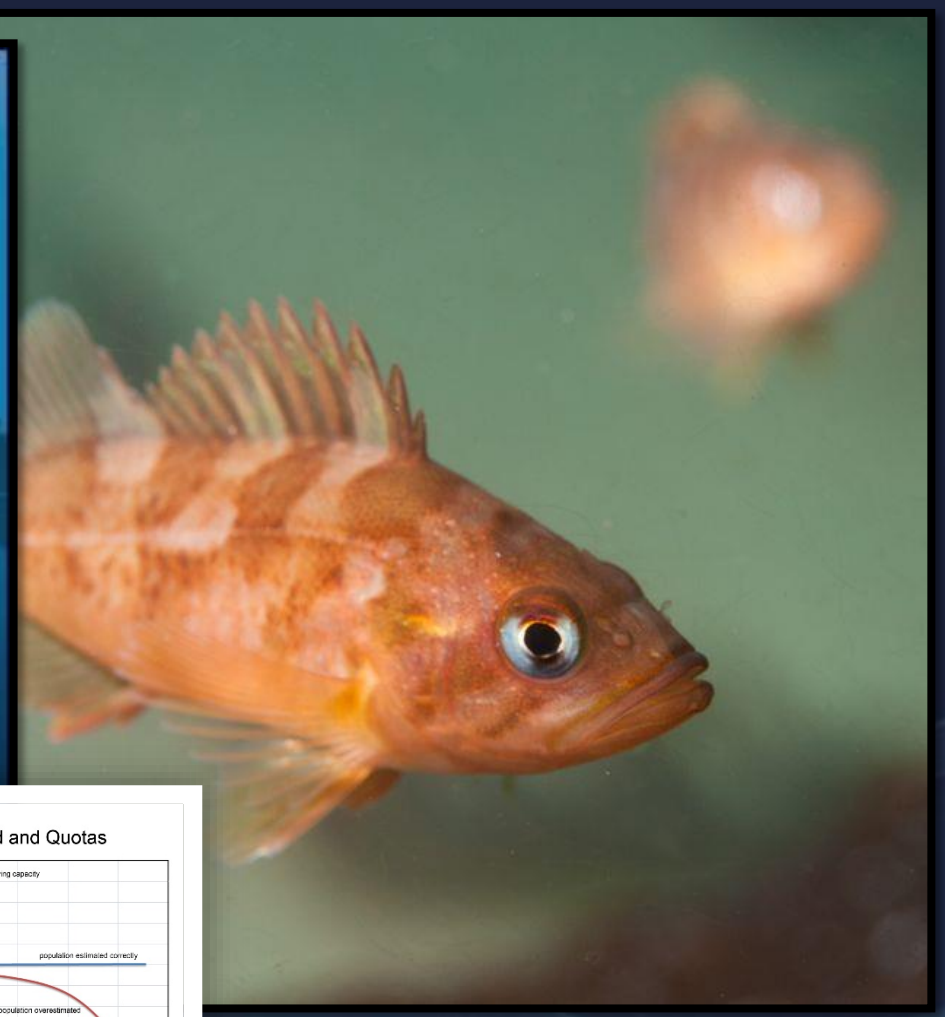
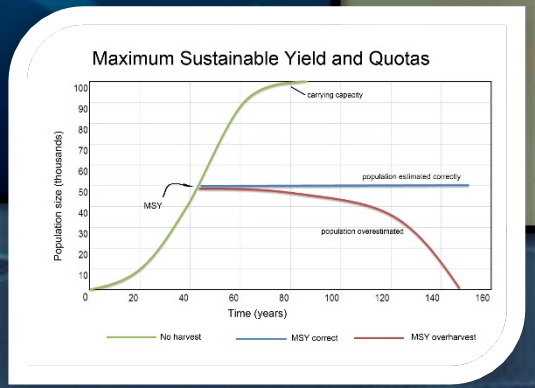
Traditional Fisheries Management









Outline

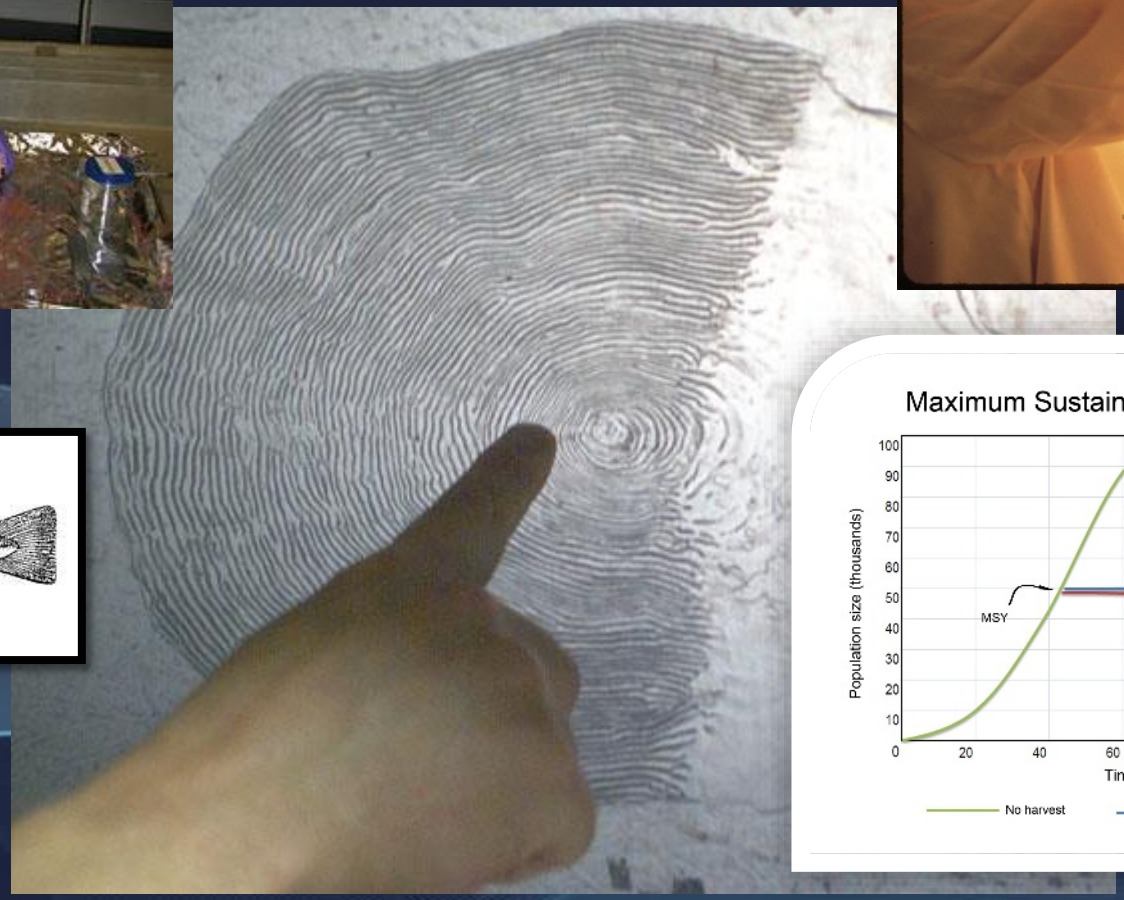
- Fisheries Management & Cod recap
- Population Dynamics
- Traditional Fisheries Management
  - MSY
  - Quota
  - Legislation
  - Closures
  - Gear Restrictions
- Market Based Management

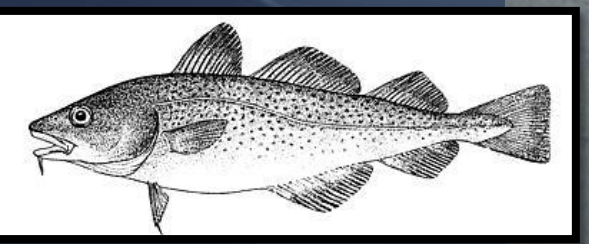
Student Learning Outcomes

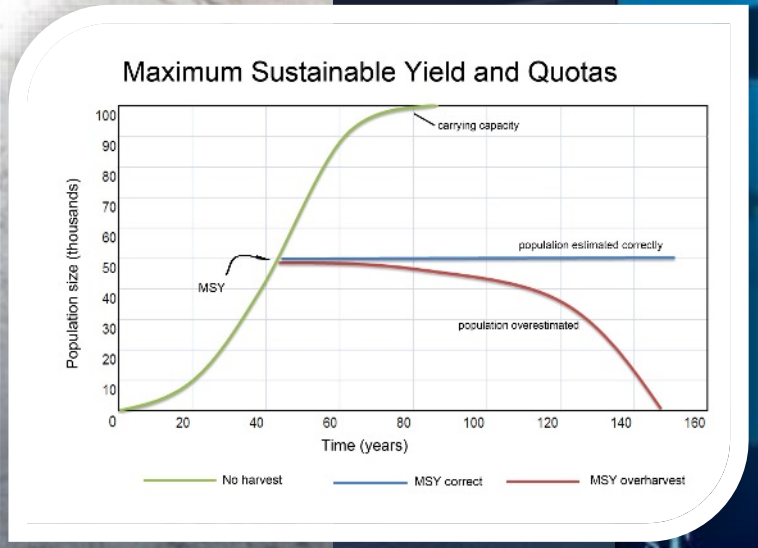
Students Will be able to:

- Summarize traditional fisheries management and why management is necessary in modern times
- Describe general population dynamics and the factors that influence population growth
- Define Maximum sustainable Yield and how it is applied in fisheries management
- Summarize quota based approaches to fisheries management
- Outline the role legislation plays in fisheries management
- Describe fisheries closures and how they are used in fishery management
- Describe how gear restrictions play a role in fisheries management and provide examples
- Summarizer market based approaches to fisheries management and provide examples

What is Fishery Management?

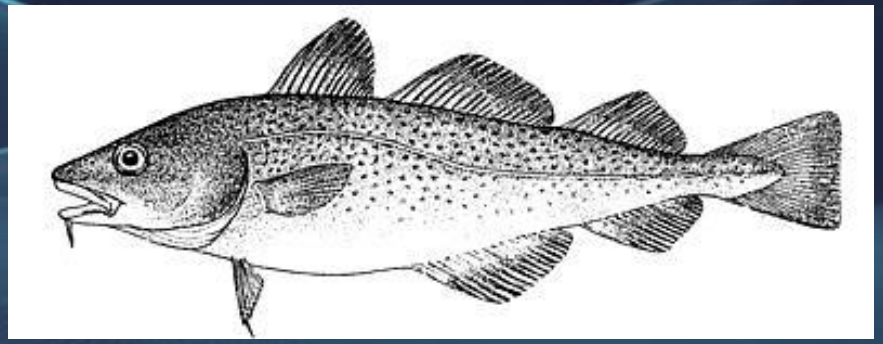






Recap

- Fisheries Management
- Need for Management
- Atlantic Cod
  - Cultural and economic resource for centuries
  - Decades of overfishing led to a catastrophic collapse in 1992
  - Many factors contributed
  - Recovery has been slow despite reduced fishing effort
  - An ecosystem-based approach is required
- Management strategies



Cod Review by Mason

The Newfoundland Cod Stock Collapse: A Review and Analysis of Social Factors

Fred Mason
School of Kinesiology, University of Western Ontario, Canada

- Tragedy of
- Overfishing
  - Inshore
  - Canadian Deep Sea “draggers & Trawlers”
  - Foreign Dep Sea fishing
- Critique of T of C Model
- Government mismanagement & Capitolism
- 1990 – 1994 95% Decline in Cod Stocks

Recap

- Fisheries Management
  - Removal of a fishery resource
  - Removal should be sustainable
  - Resources should be monitored

- Management varies greatly between fisheries
  - Fish Biology
  - Ecological considerations
  - Fishery economics
  - Historical fishing practices
  - Government structure
  - Fisheries data
  - Research programs and many other factors

Traditional Fisheries Management

- MSY Maximum Sustainable Yield
- Quotas (Total allowable catches)
- Legislation
- Closures
- Gear Restrictions

WHY?

- Global fisheries considered “open access”
  - Not owned by Anyone "first come, first served”
- This lead to Overexploitation & Declines & ↓ $$$
  - Need for fisheries management
- Allocation was traditionally used to try and sustain fisheries “politically acceptable”
- Traditional fishery management
  - Single species focused on Production or ‘Yield’

What drives management?

"The application of scientific knowledge to the problems of providing the optimum yield of fishery products, whether stated in tons of commercial products or in hours of angling pleasure"

Principles of Fishery Science
Everhart and Youngs, 1975

Self Check

- Fisheries management uses economics and politics to exploit fisheries resources
  - True
  - **False**
- Fisheries Management approaches vary widely for numerous reasons. Select the reason that does not change management approaches
  - **Political pressure**
  - Fish biology
  - Ecological considerations
  - Fishery economics
  - Historical fishing practices

General Management Approaches

- Maximum sustainable yield MSY
- Quotas (Total Allowable Catches)
- Legislation
- Closures
- Gear restrictions

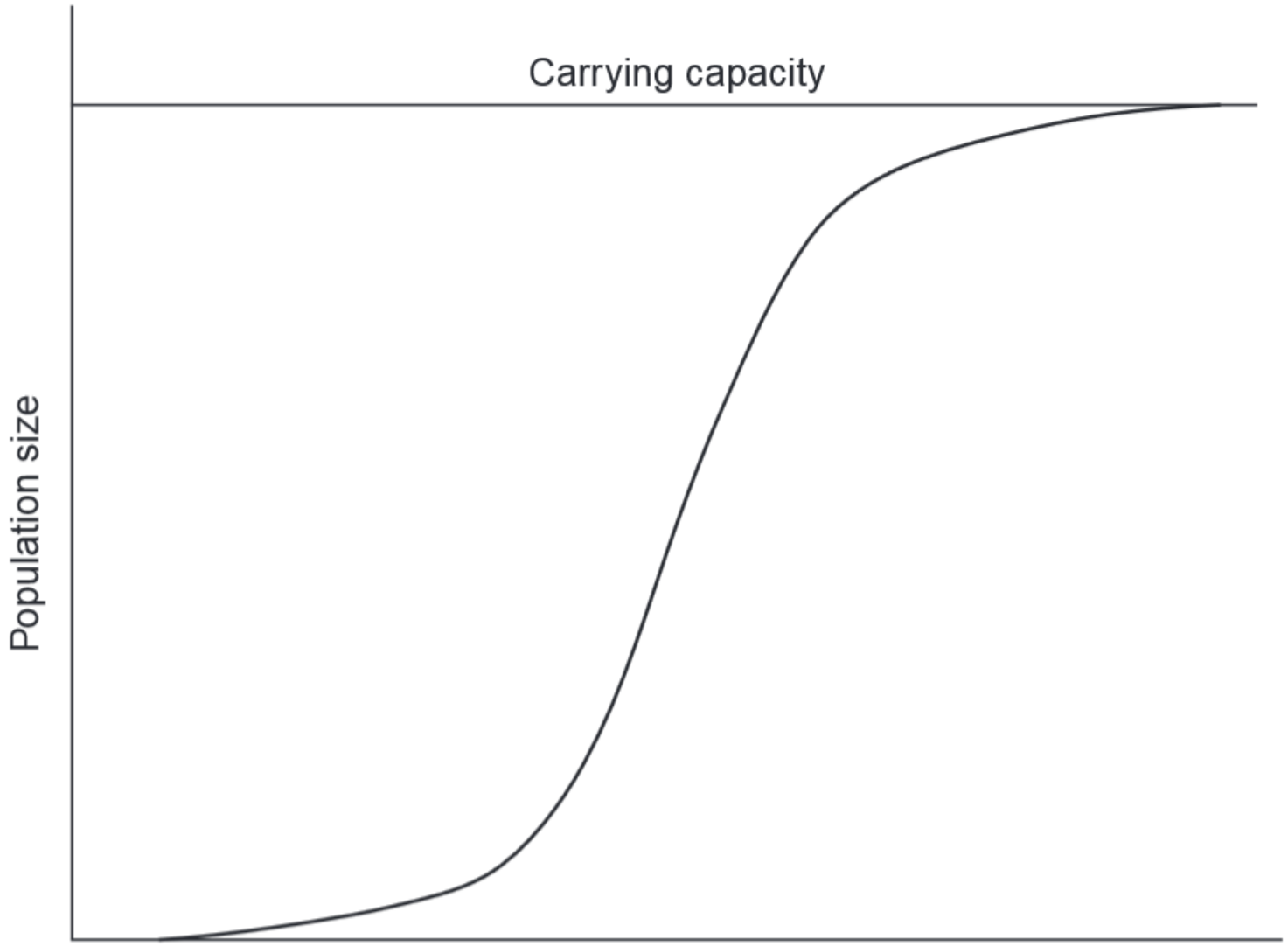
A few definitions

- **Species** – group of fish capable of interbreeding successfully
- **Population** – is a summation of all the organisms of the same group or species, which live in the same geographical area, and have the capability of interbreeding.
- **Stock** – an interbreeding group of fish that is distinguished by similar genetic, life history, phenotypic, or habitat characteristics and is managed as a unit

Definitions

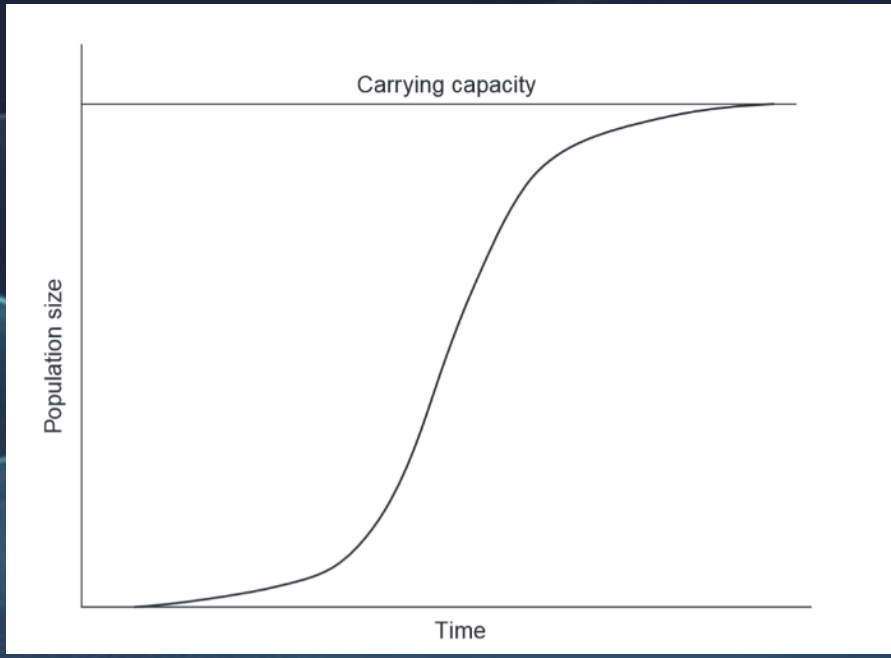
- **Recruitment** – the number of fish that are added to the exploitable stock (available for harvest) each year due to either growth or migration of new fish into the area. This rate is variable and highly dependent on ocean conditions, habitat changes, fishing pressure, etc.

Population Dynamics

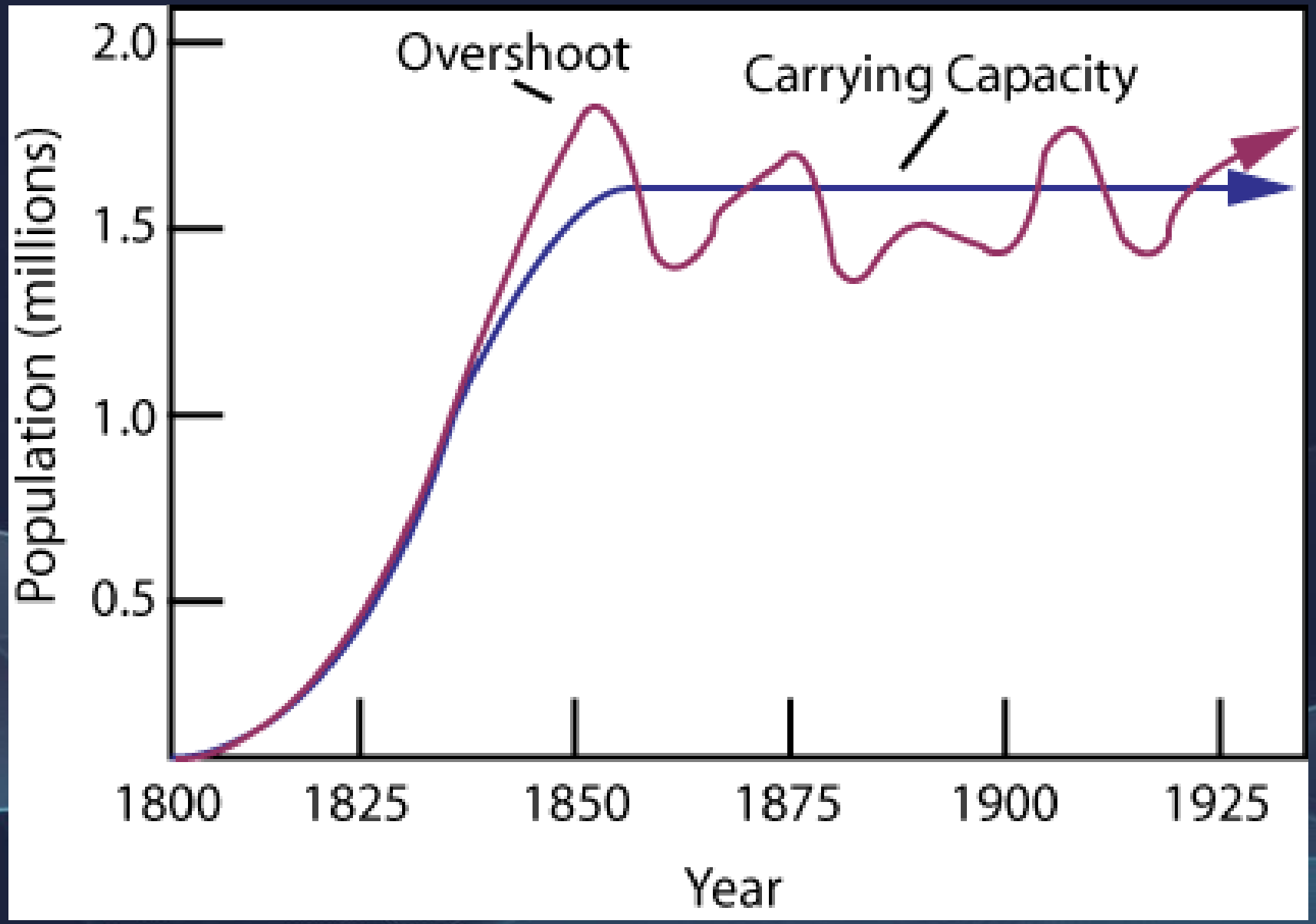


Population Dynamics

- S shaped logistic growth
- Unexploited populations
  - Typically at Carrying Capacity K
  - Restricted by food, shelter, Predators, or ecological factors
- The slope (rise/run) of this line ‘Growth Rate”

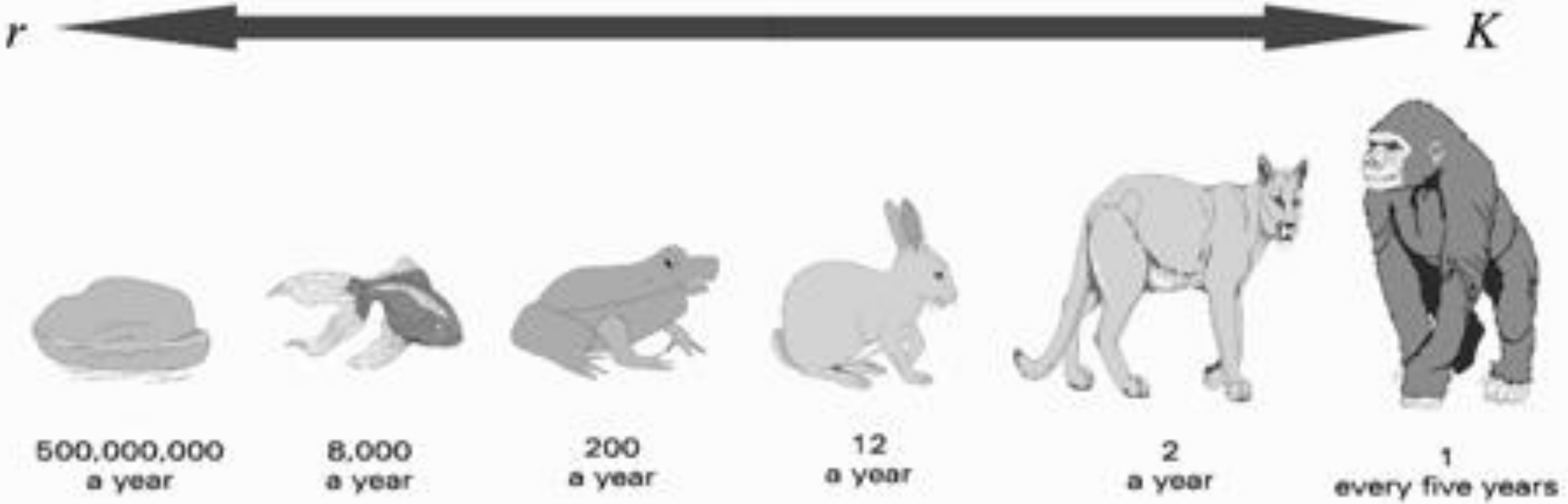


Reality of K


Overshoot
Carrying Capacity
Population (millions)
2.0
1.5
1.0
0.5
1800
1825
1850
1875
1900
1925
Year

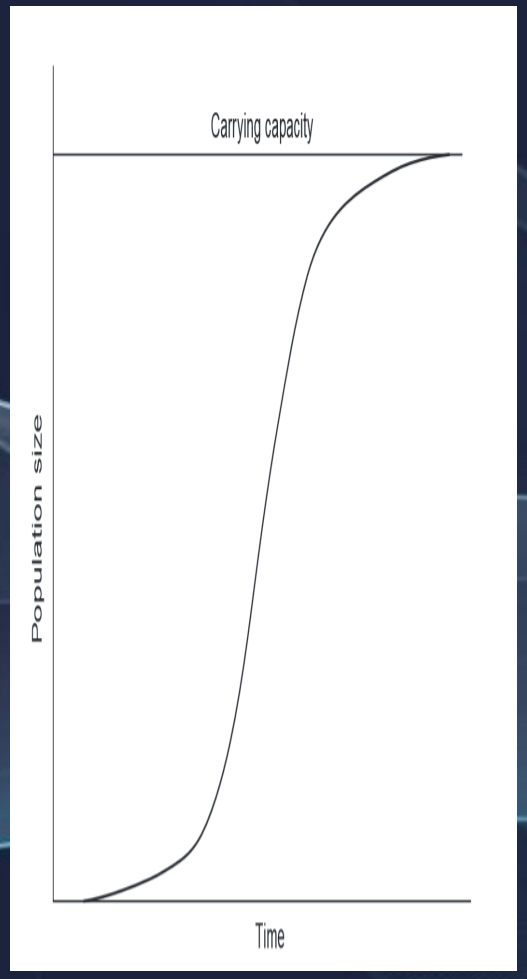
R vs K Strategist

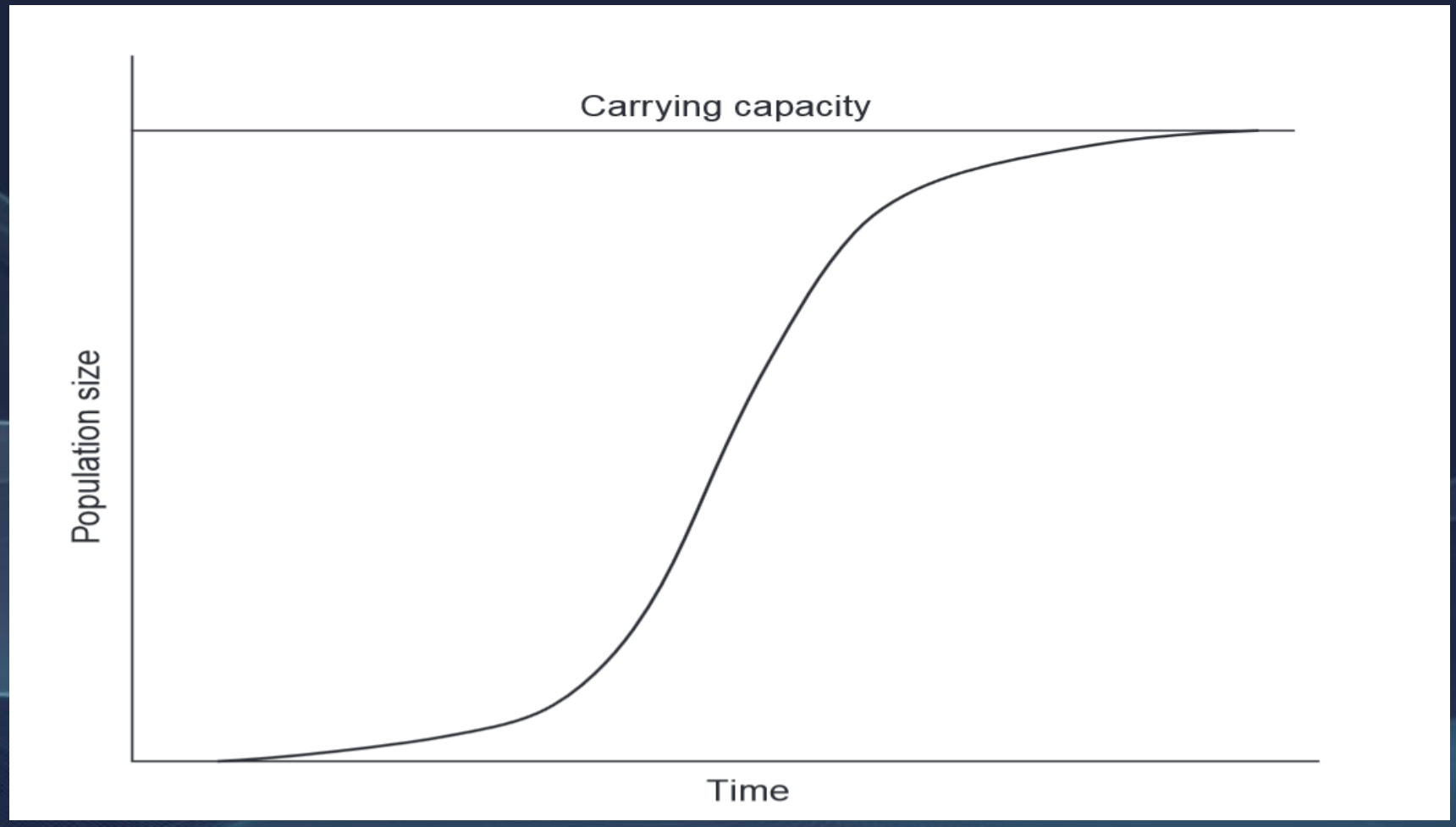
- Some species reproduce faster than others



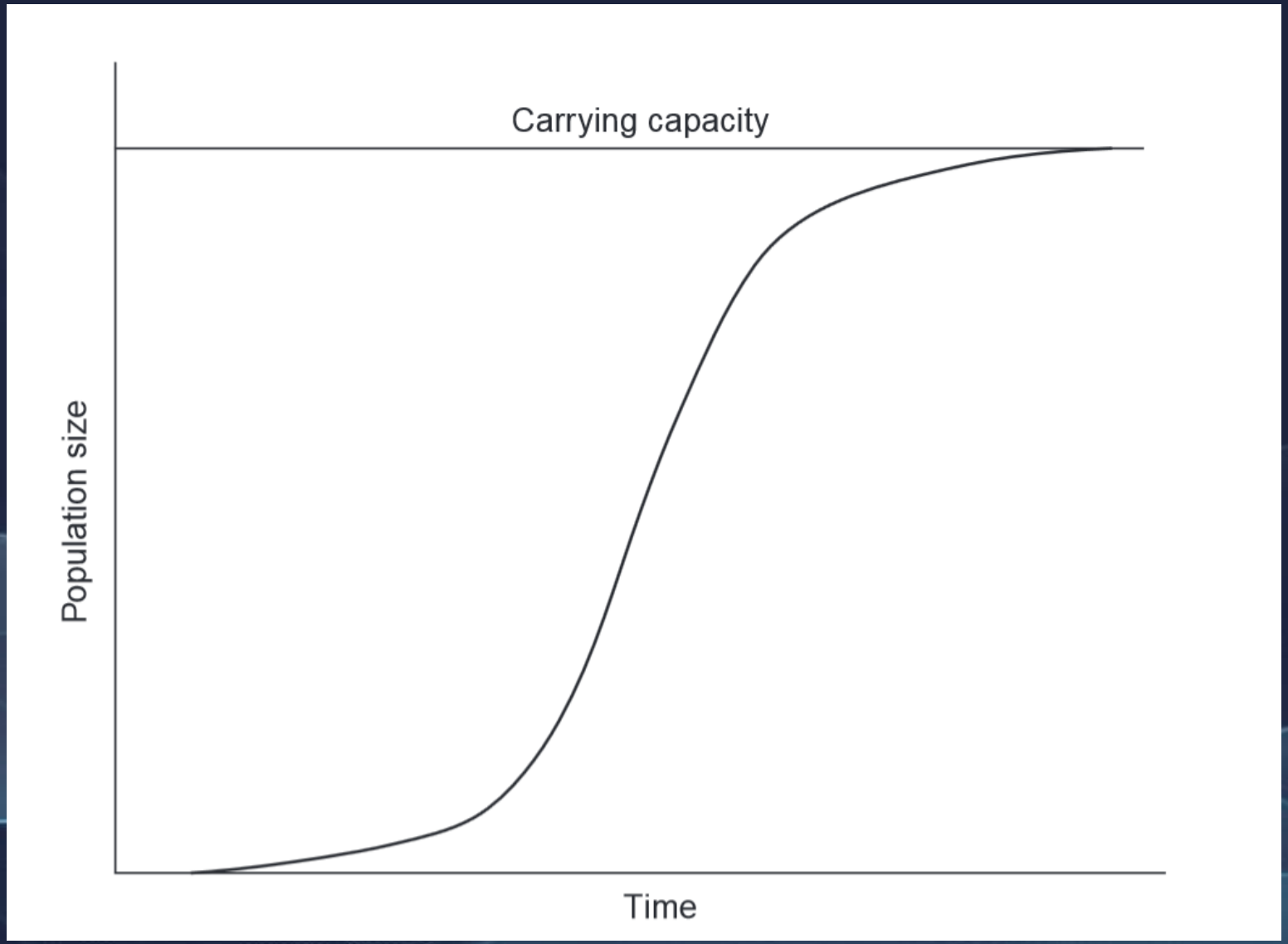
R vs K Strategist

- This impacts the population growth rate



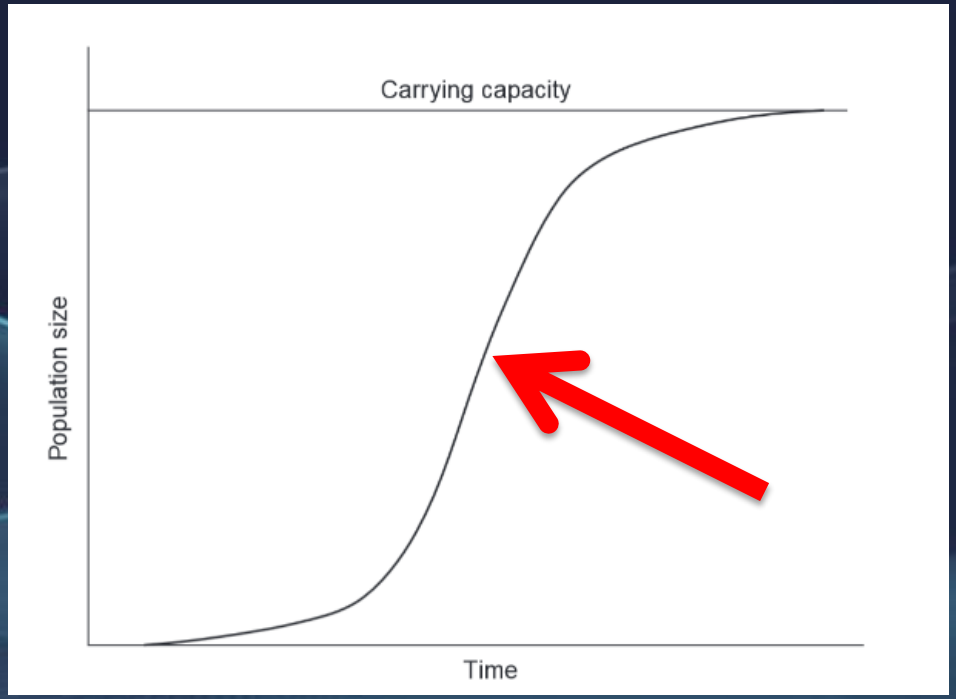


Where is fastest growth?



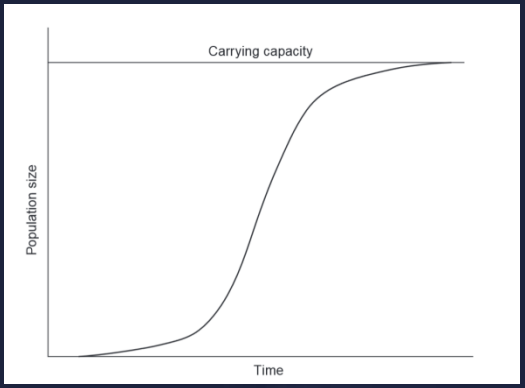
Maximum Growth Rate

- Growth rates change according to population size and in relation to carrying capacity
- Maximum Growth rate 50% CC
- At what level would we want to harvest or maintain a population?



Self Check

- On the figure identify the point of maximum population growth



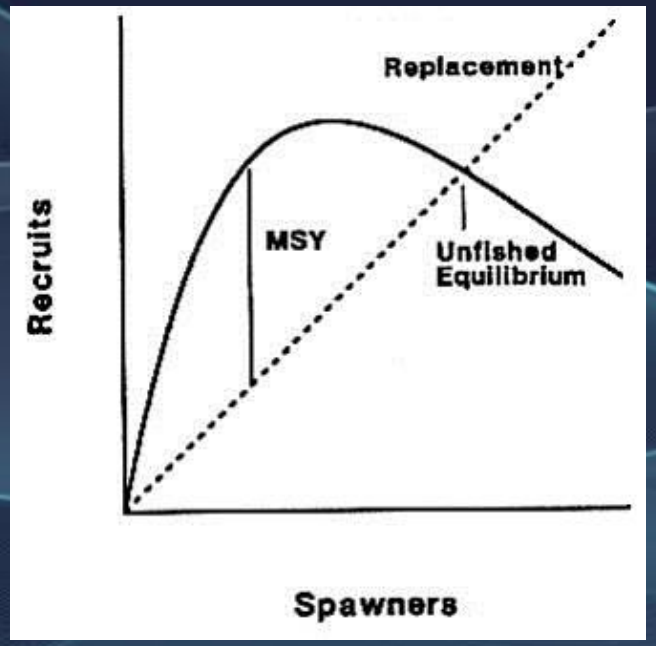
- When a population reaches a point where growth begins to level off and the population is limited by food, shelter, predators, or ecological factors this is called
  - Logistic growth point
  - Carrying capacity
  - MSY
  - K Strategist
  - None of the above

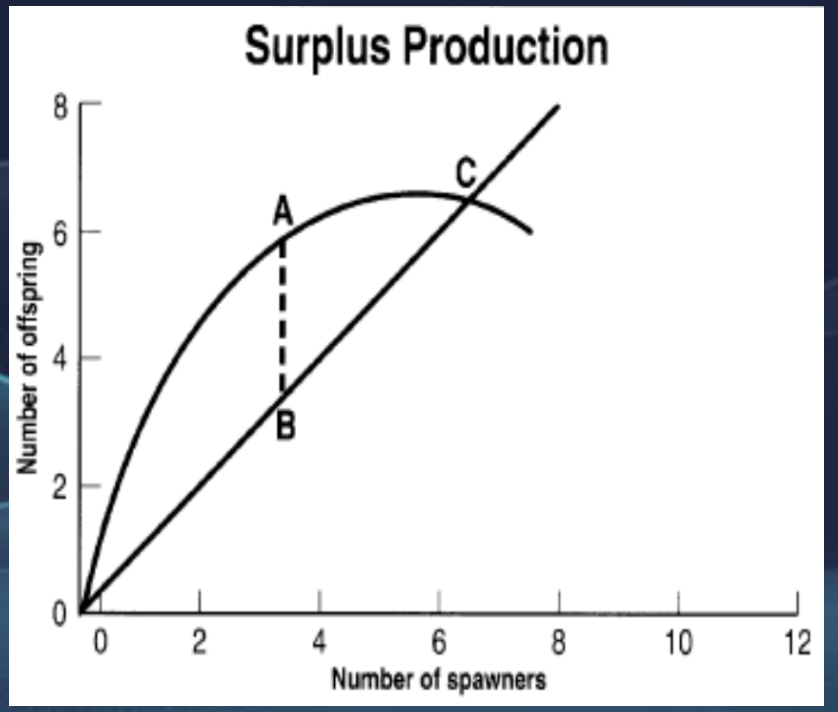
Maximum Sustainable Yield

- The concept of maximum sustainable yield (MSY) has been a guiding principle of fisheries management since the 1950s.
- It is based on the relationship between fish population dynamics and fish harvest.
- It relies on the inherent nature of fish populations to replenish themselves based on their “surplus production”

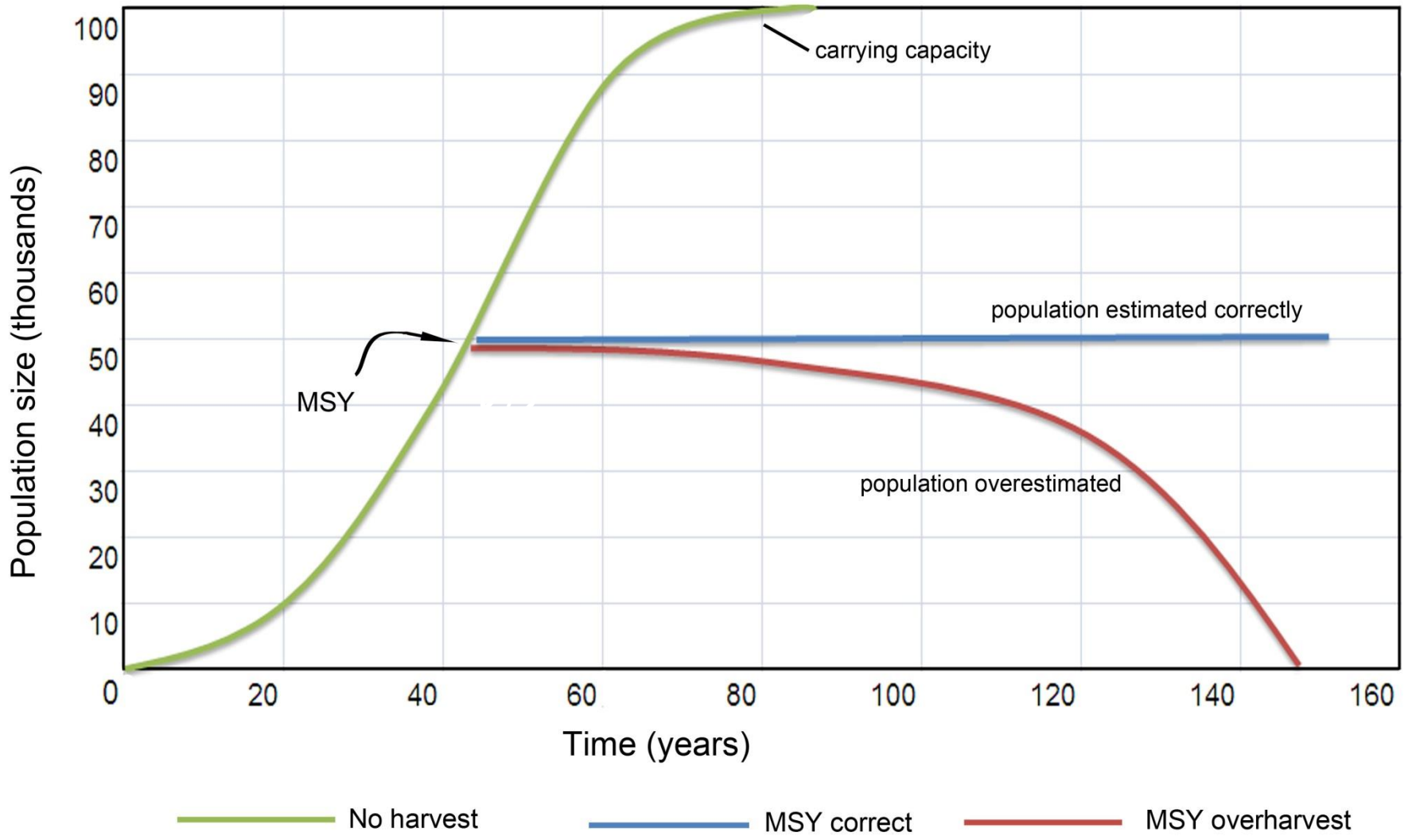
Surplus Production

- Natural ability for a population to compensate for increased mortality (i.e. as more fish are captured, individuals in the population compensate by increasing their reproductive rate or survival of fish recruiting into the population is enhanced)





Maximum Sustainable Yield = K/2



MSY

- Population size is determined in part by population growth rate
- Growth rates are lowest when the population is small (the lag phase of logistic population growth) and large (population is near the carrying capacity and population growth is limited by density dependent factors like food availability)
- Intermediate-sized populations have the greatest growth capacity and the ability to produce the greatest number of fish that can be harvested each year.
- Therefore, fisheries can maximize production by keeping the population at an intermediate level (1/2 of carrying capacity ‘K’).

MSY

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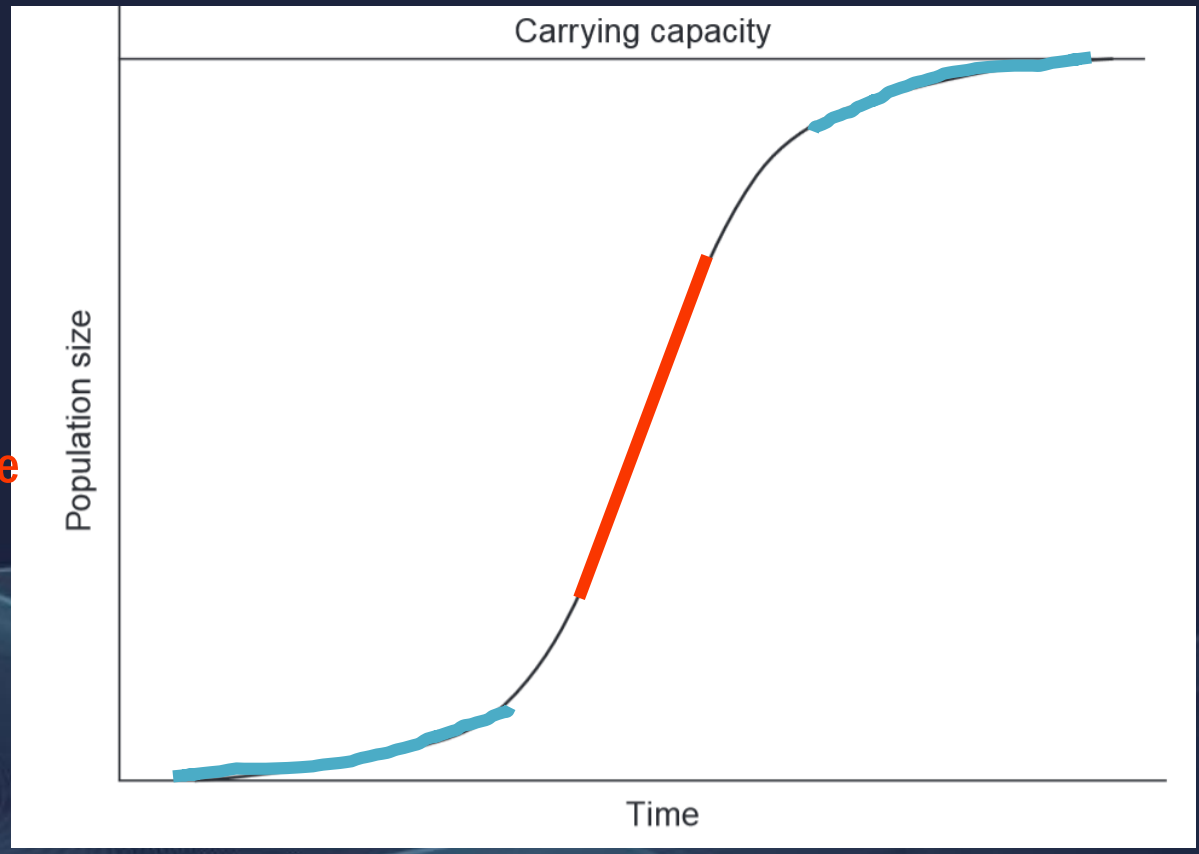

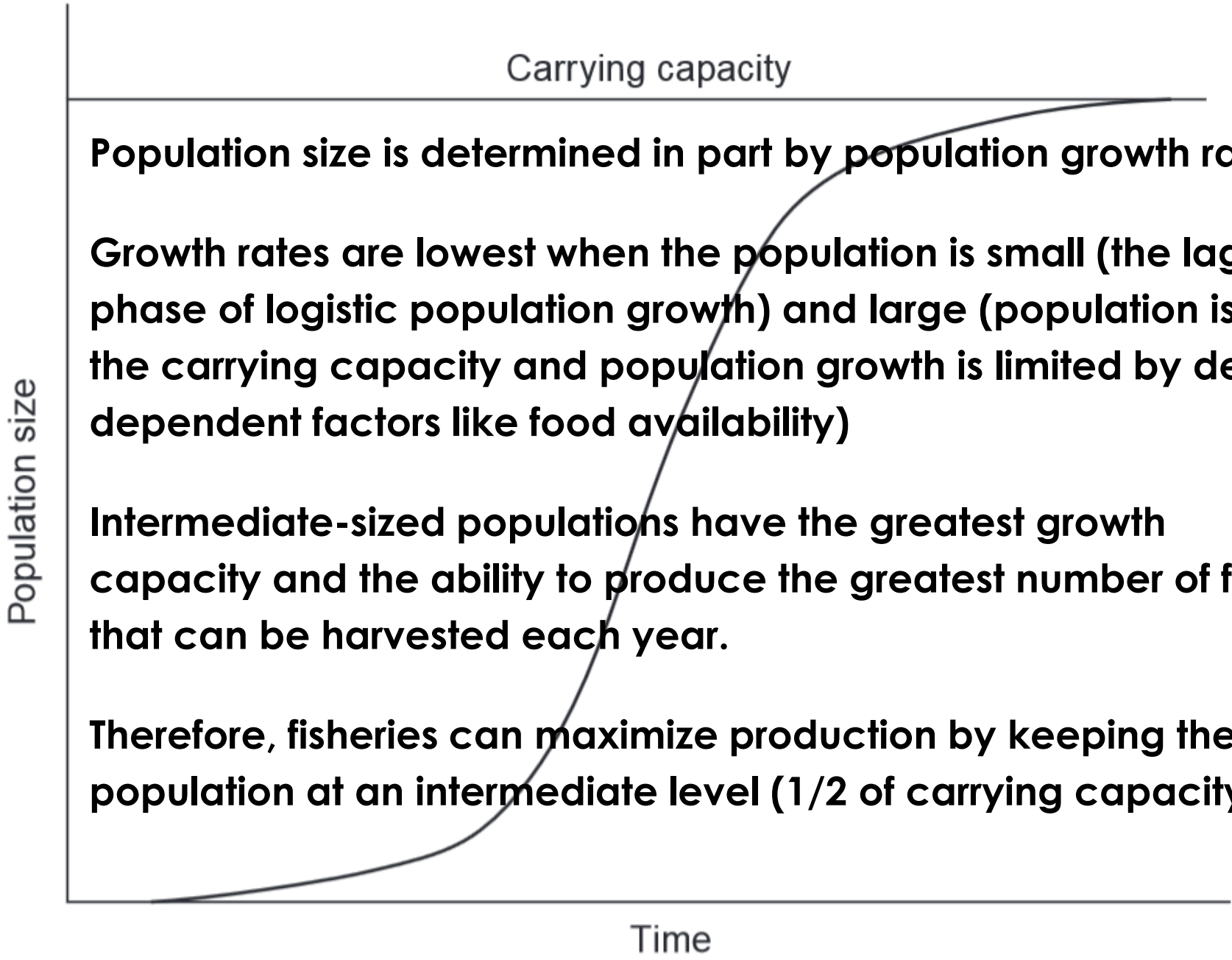

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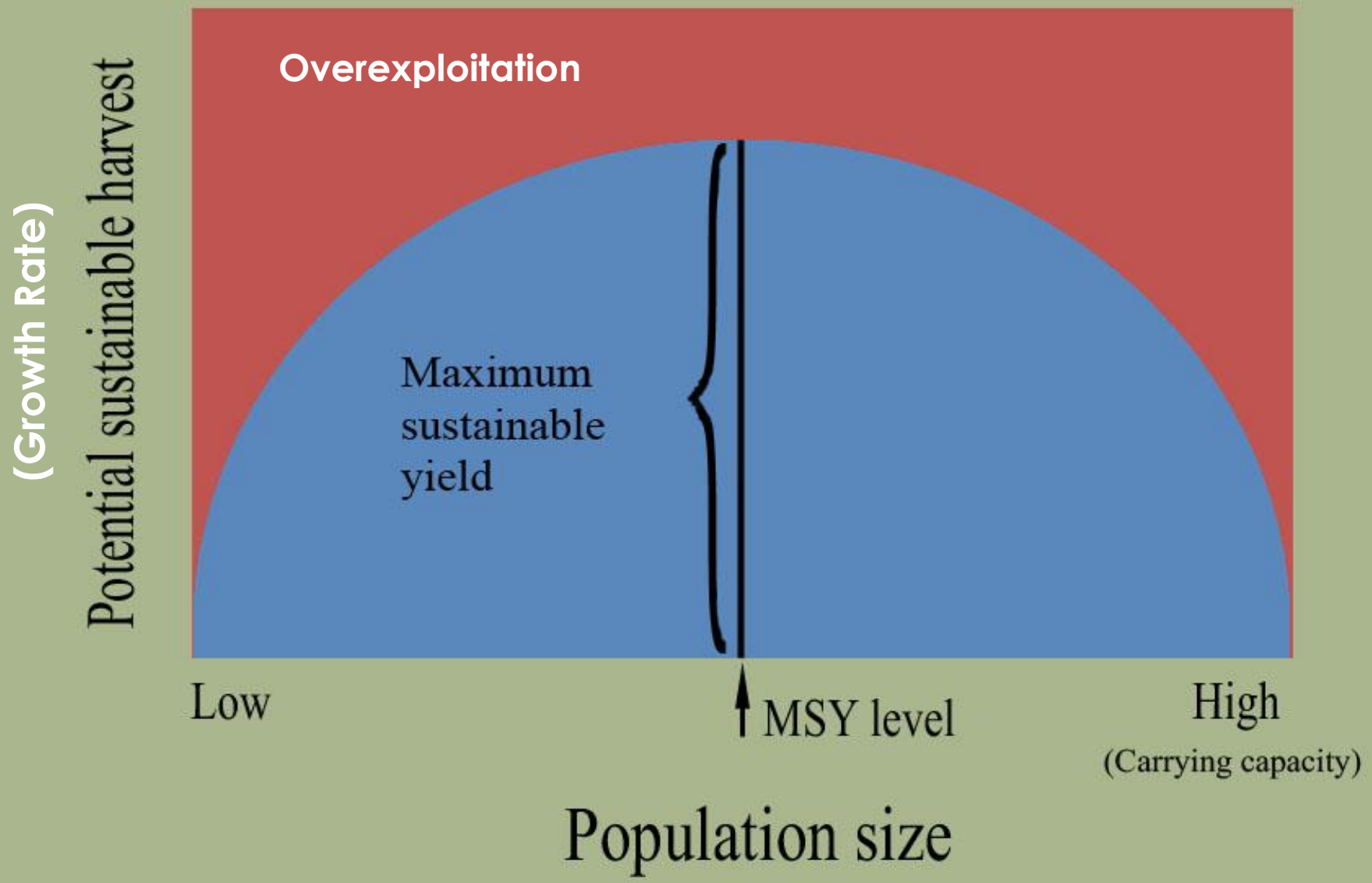
Maximum Sustainable Yield



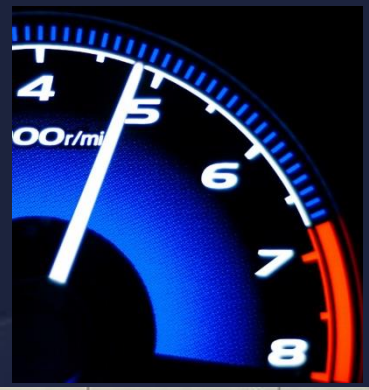
Challenges of MSY

- Estimating population size is difficult
  - Time-consuming, expensive, regular basis
  - Frequently over-estimated , natural fluctuations MSY assumes exponential growth
- MSY Assumes exponential Growth
- MSY is a single-species approach and does not take ecosystem effects into account
- Societal pressure to overestimate stock size and underestimate fishing effort

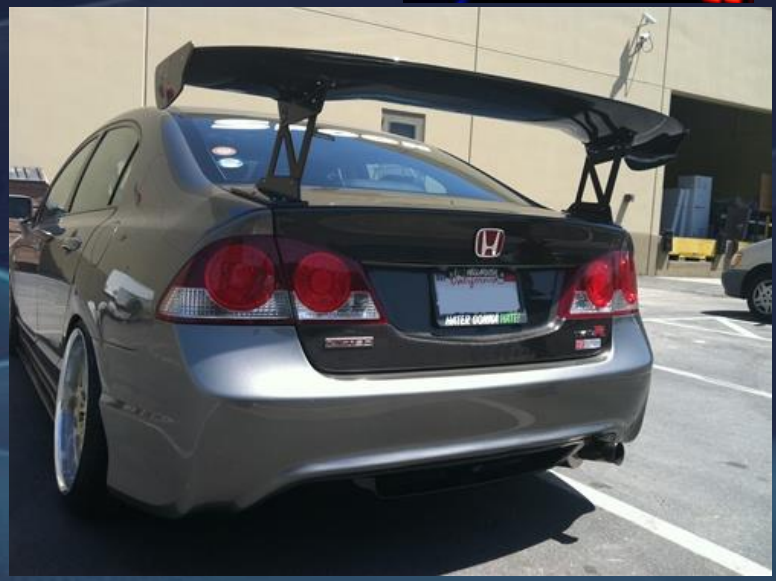
MSY

"Critics of MSY as a management strategy contend that the model has many shortcomings and that attempts to implement MSY have resulted in the collapse of several fisheries."

Atlantic Swordfish
Bluefin Tuna
Atlantic Cod
Alaskan Halibut
Salmon



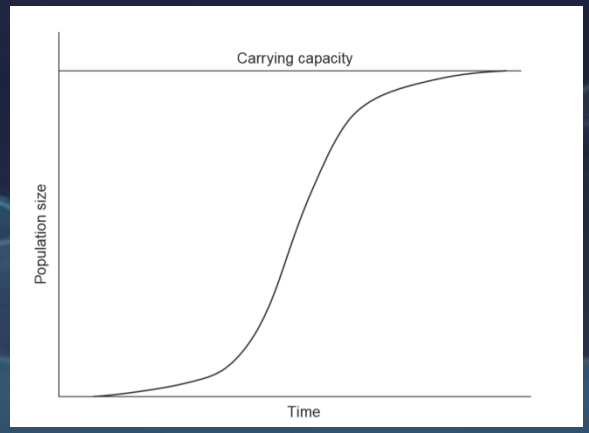
- Like redlining your Honda Civic…For 100k mi
- 1 Fish 2 Fish Reading…



Self Check

- Managing a resource for Maximum sustainable yield is like redlining your Honda civic
  - **True**
  - False

- In the above figure identify Maximum Sustainable Yield MSY



So how many fish CAN we remove?

- This is the fundamental goal of fishery biology in relation to management
- Always balance removal while keeping stock healthy
- MSY altered with economic social and political issues to produce OY
- COMPLEX issues related to this question

Complex issues - habitat

- Carrying capacity is directly related to a given habitat and assumed condition. In an unchanged area – carrying capacity of a given habitat for a given species is generally very stable

- Loss of habitat – human activity greatly changes marine habitat. Water pollution, loss of wetlands and seagrass beds, destruction of spawning grounds, changes in freshwater flows and habitat destructive fishing practices are a few examples

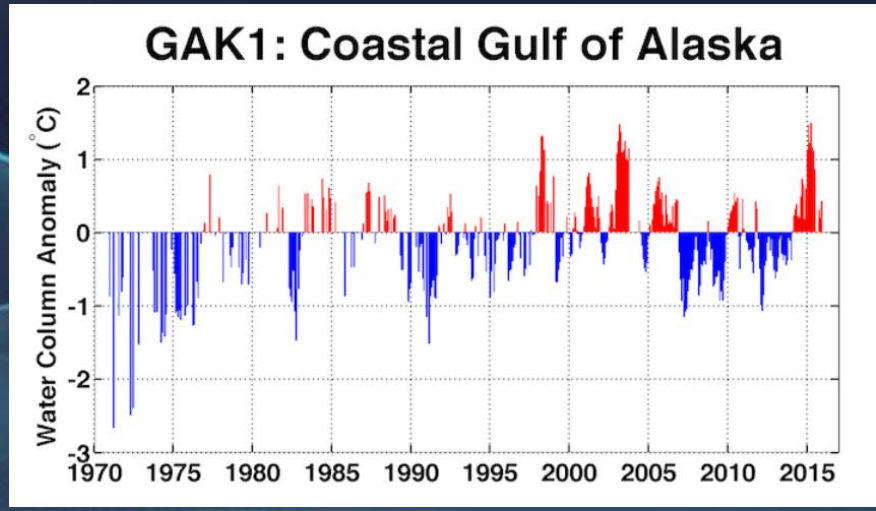
- Inclusion of essential fish habitat in federal management
  - "EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity and may include migratory routes, open waters, wetlands, estuaries, artificial reefs, shipwrecks, mangroves, mussel beds and coral reefs."

Carrying Capacity changes

- Influenced by environmental factors (heavy rain, drought, climate change, habitat loss…)
- Influenced by severe storms (damage habitat)
- What ELSE?

Recap

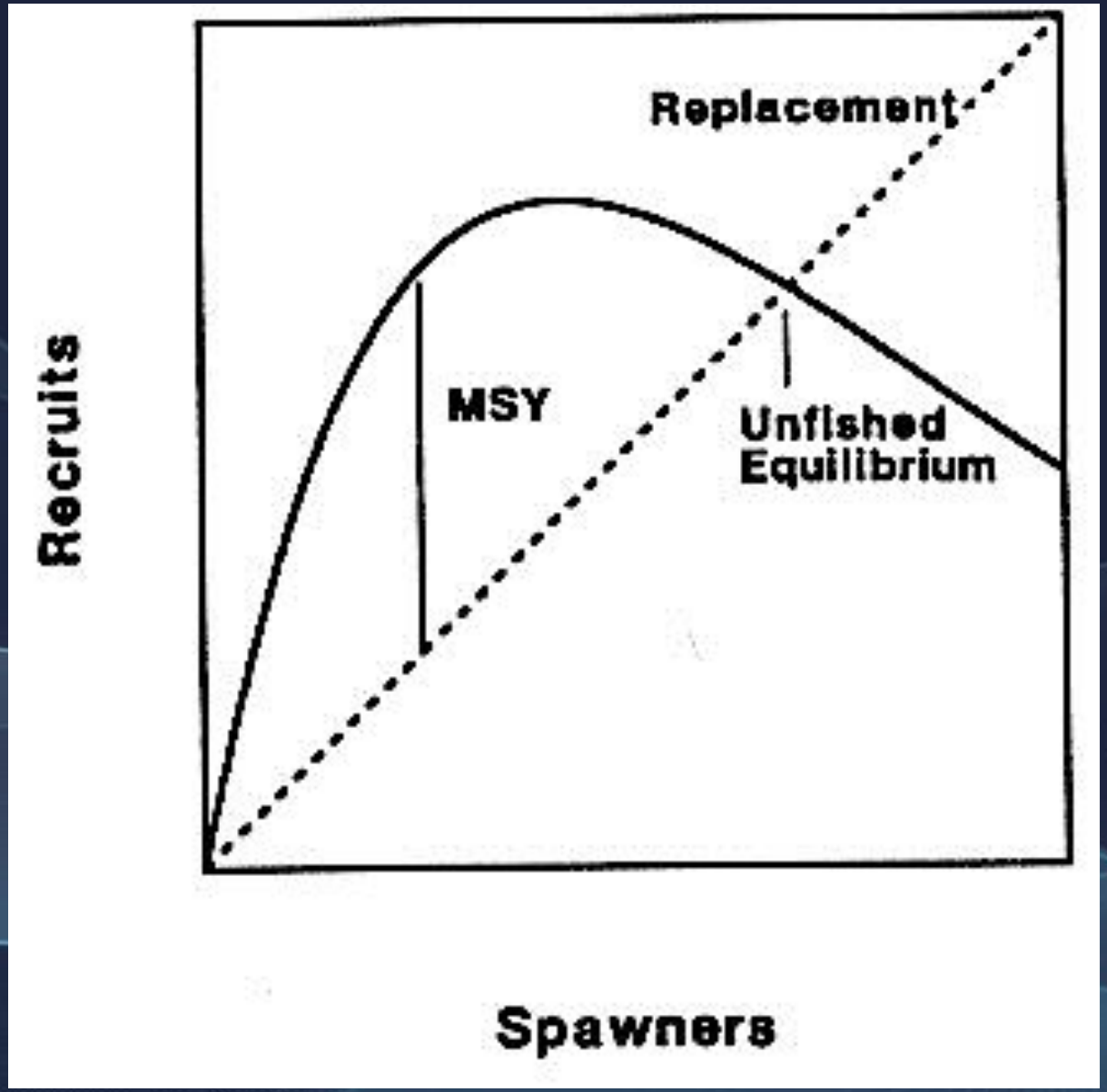
- Fishing reduces population below carrying capacity of a given environment
- Continuation of harvest then relies upon ability of remaining population to produce enough offspring to move toward maximum cc
- Natural conditions cause annual variations



Surplus Production

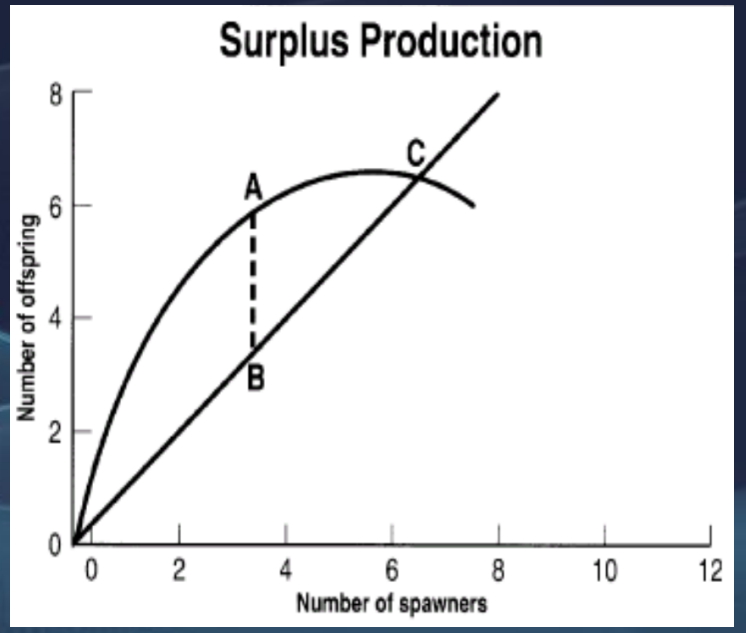
- In unfished population, biomass will approach carrying capacity of a given habitat
  - Unfished populations have larger number of big, old fish which keep juveniles from growing
- In fished populations, older big fish removal, reduces biomass well below carrying capacity.
  - Smaller fish have better chance to grow and survive.
- Must leave adequate population to reproduce
- Theory is that the “surplus” can be removed via fishing

Surplus Production



Surplus in Detail

- Harvest beyond quantity A-B is overfishing
- Surplus production is necessary for a population to sustain itself due to forces of natural mortality, but also gives an opportunity for limited harvest and sustainable management in fisheries
- The slope of the R/S line at the origin is “intrinsic rate of increase” for a species
  - Regionally specific population, depends on fecundity, life history, maturation, longevity, growth rate, mortality factors- the density independent parameter
- The bend in the R/S curve is then caused by density dependent mechanisms: competition among juveniles, or competition among adults (eg. Spawning limited)



Self Check

- The concept of surplus production relies on the idea that there is a surplus of fish that can safely be removed
  - True
  - False

Quotas are a type of MSY

- A quota (or total allowable catch) is simply the maximum amount of catch that is allowed before a fishery is closed.
- Traditionally established using principles of maximum sustainable yield.
- Quotas are then allocated among user groups and gear types.
  - this is usually contentious

Quotas – Catch Share Programs

- More recently quotas have been used with greater success
- Addition of conservative factors for
  - Uncertainty
  - Environmental
  - Ecosystem interactions
- MSY – minus some

Quotas in Alaska

North Pacific

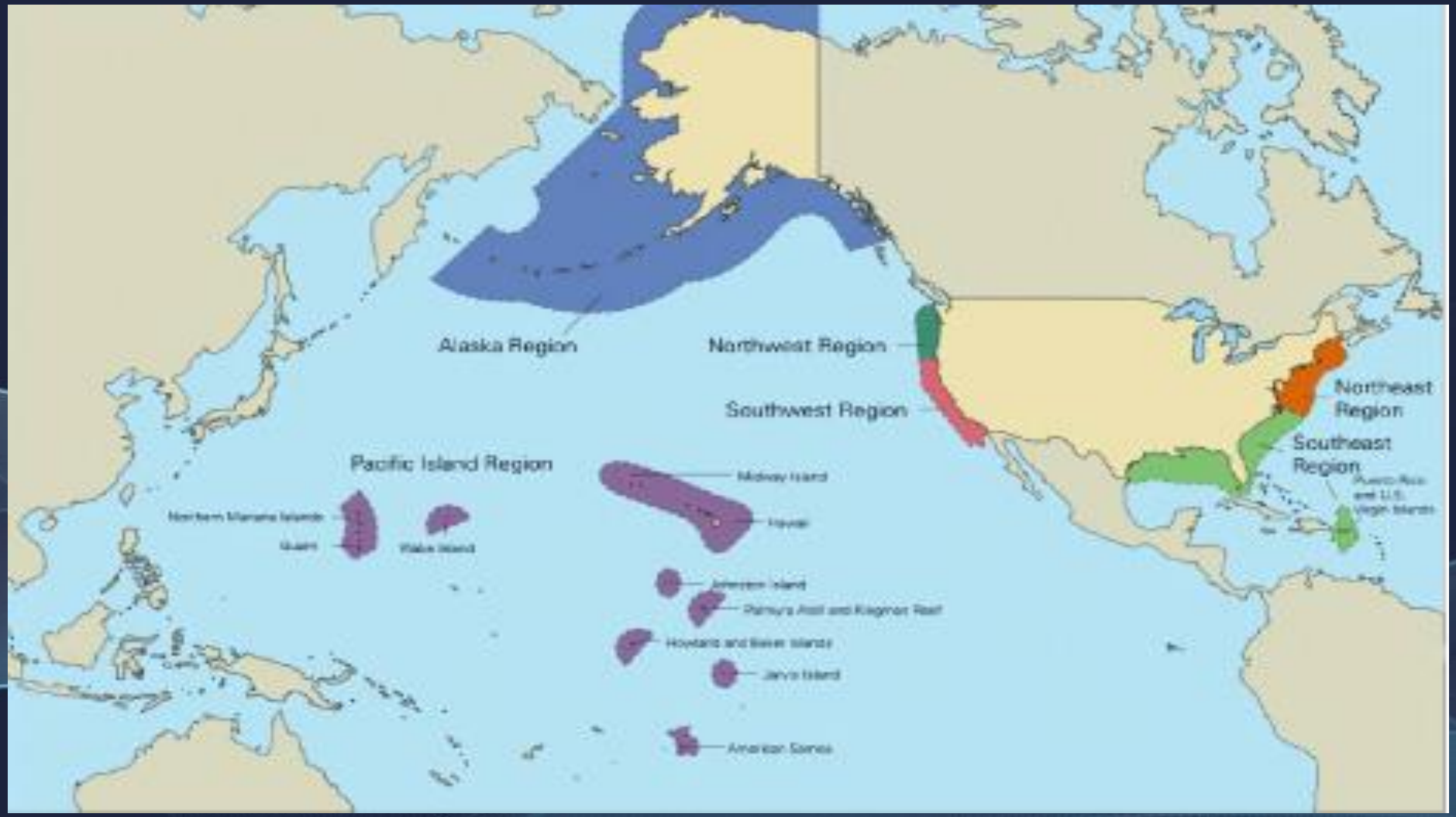
- Halibut & Sablefish (1995)
- Western Alaska CDQ (1992)
- Bering Sea AFA Pollock Cooperative (1999)
- Groundfish (non-Pollock) Cooperatives (2008)
- Bering Sea King & Tanner Crab (2005)
- Central Gulf of Alaska Rockfish (2011)

Legislation

- United Nations Convention UNCOLS (1982)
- Magnuson-Stevenson (1976)
- Sustainable Fisheries Act (1996)
- National Environmental Policy Act (1970)
  - requires an assessment of both the biological and socioeconomic consequences
- Endangered Species Act (1973)
- Marine Mammal Protection Act (1972)
  - Bycatch
- Pacific Salmon Treaty

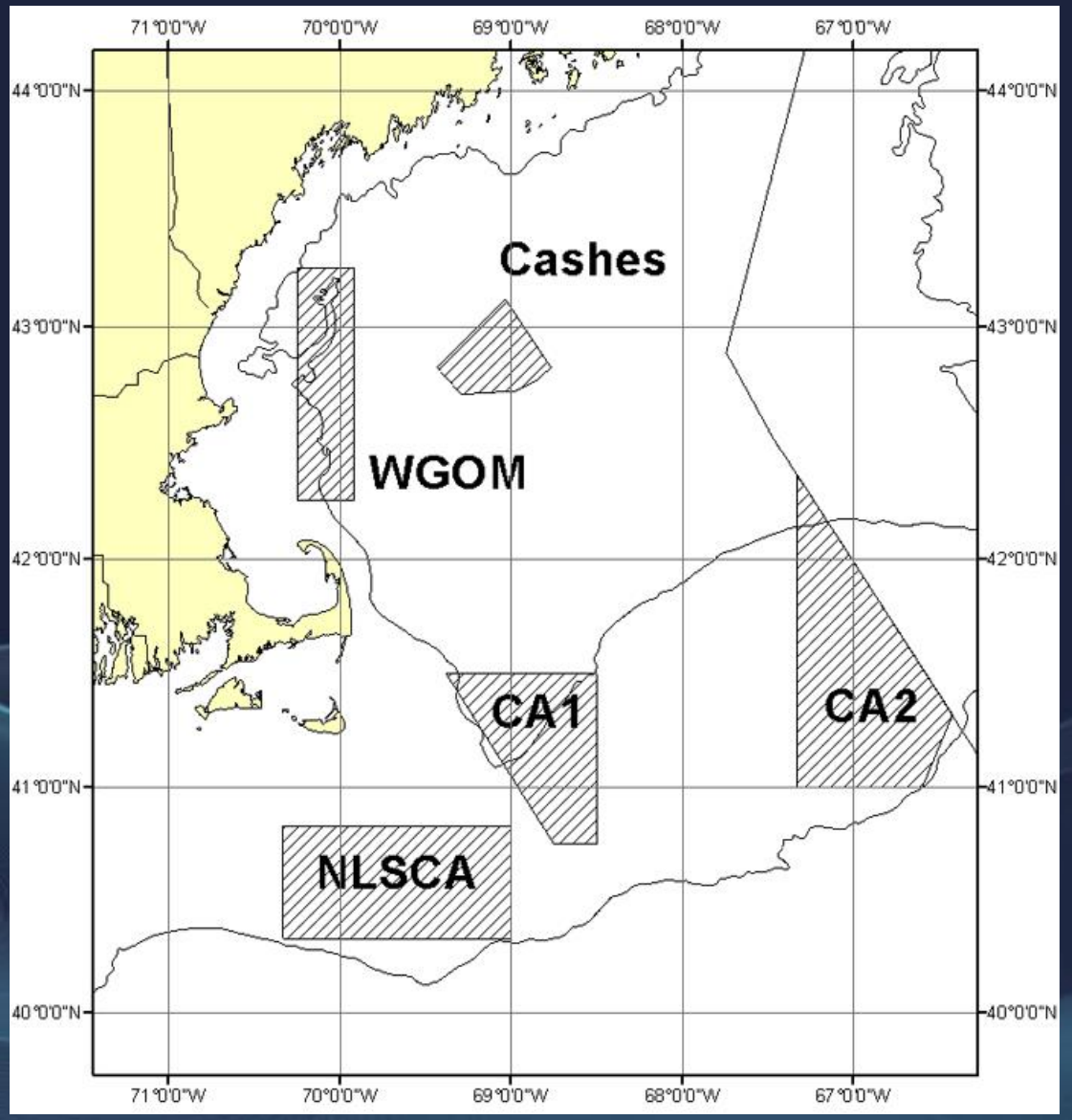
EEZ established by what?

- 2nd Largest in World – 1.7X US landmass



Closures – an example

- Closed areas in the Gulf of Maine and Georges Bank implemented in the early 1990s to protect Atlantic cod

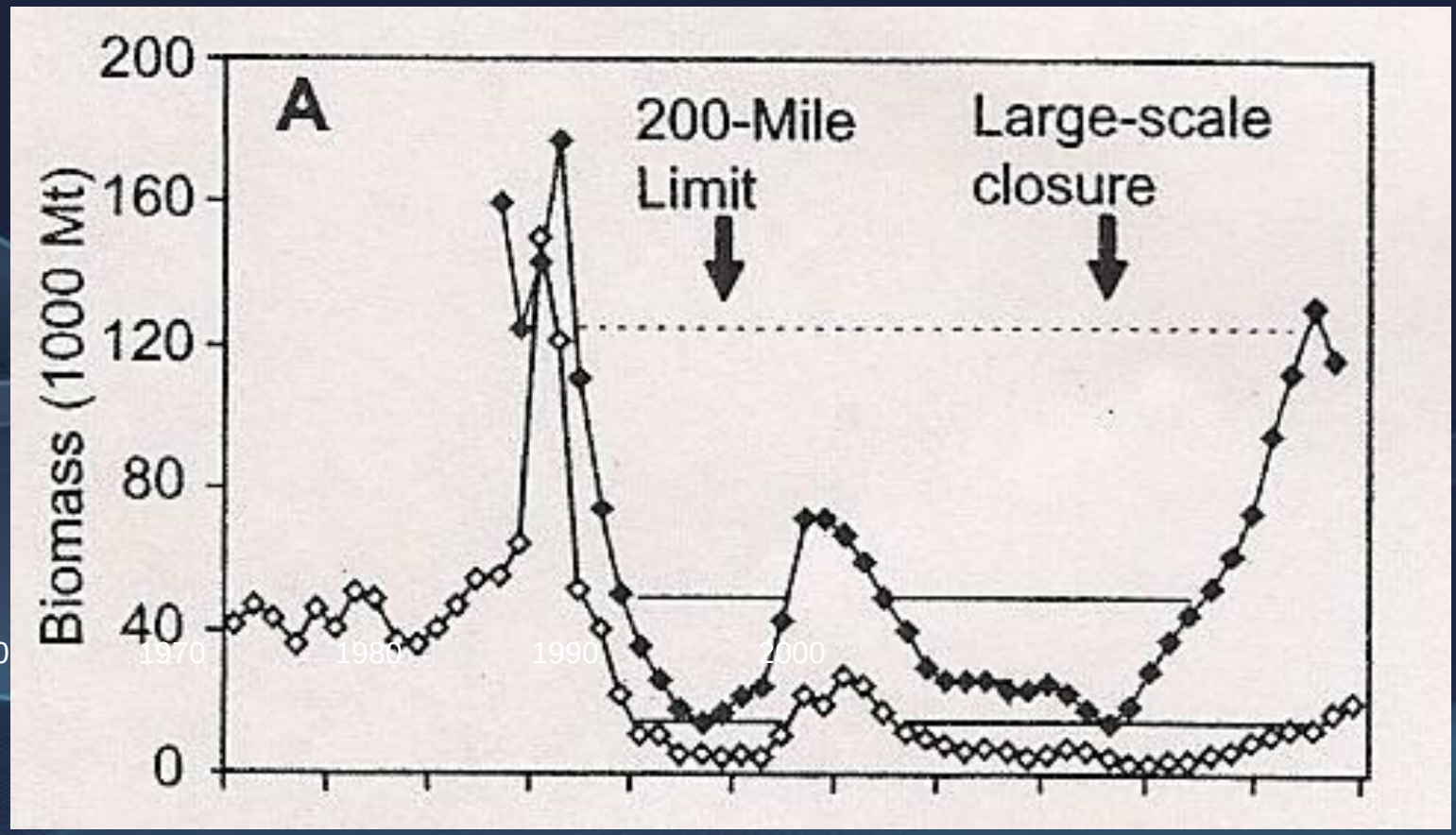


An example of closures:

- In response to the collapse of the cod fishery in the early 1990s,
- year-round closures Key groundfish areas
- These areas were closed to any bottom-fishing gear.
- Closures are an extreme method of reducing fishing mortality and implemented most often on a temporary basis to allow a fish stock to recover.

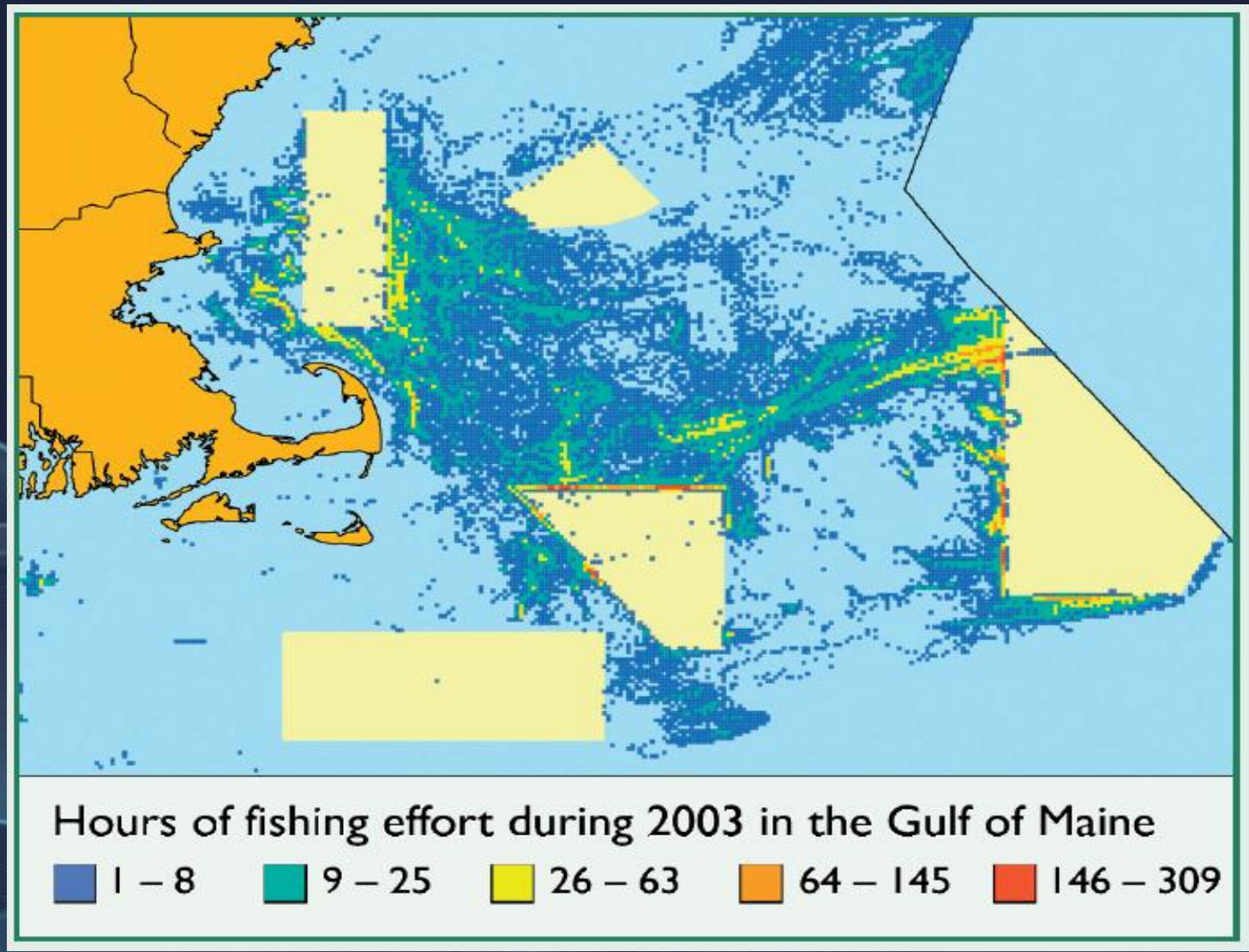
Georges Bank Haddock catches and spawning stock biomass

- White = catch
- Black = Biomass
  - Dotted – Overfished
  - Solid – 90% decline



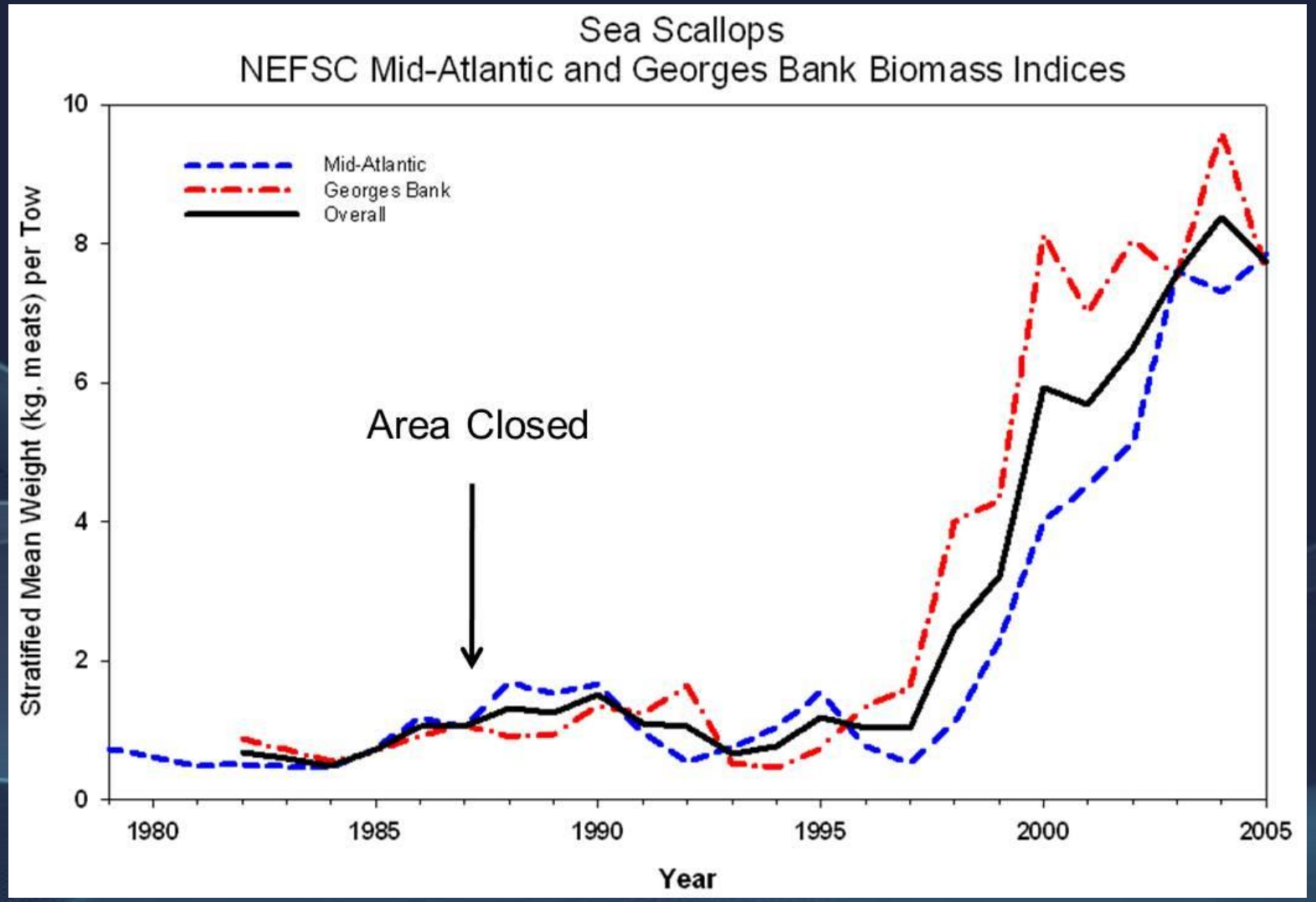
Fishing Effort Along Closed Regions

- From 2001 – 2003
- 42% of total U.S. Haddock catch was within 0.6 mi. of closed areas
- 73% within 3.1 mi.
- Spillover



Scallops on Georges Bank

- Scallop closures were highly successful

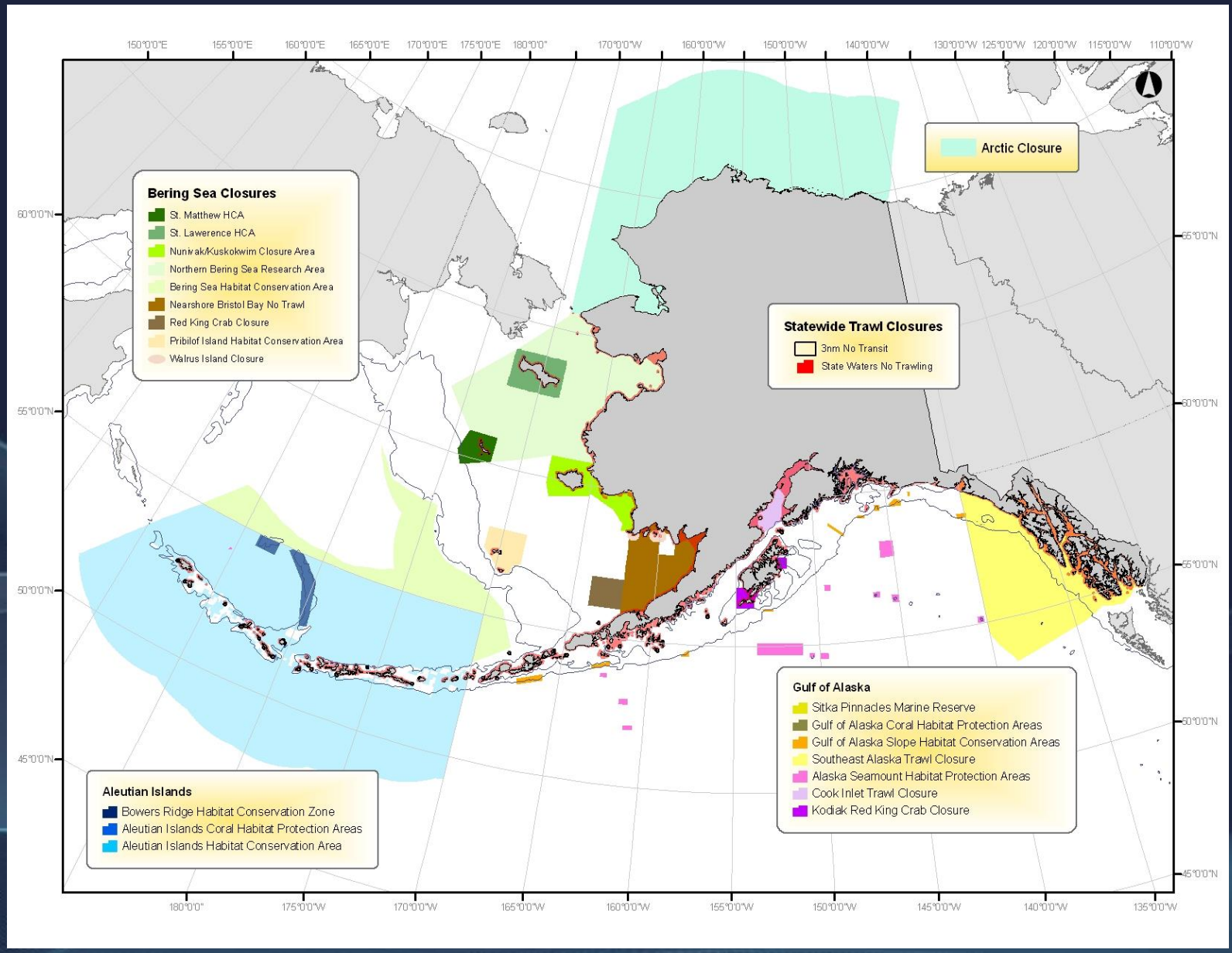


Scallop increases

- Sea scallops increased dramatically inside the closed areas
  - 20 fold increase In 2003 pre to post
  - 4 – 5 times greater inside the closed areas.
  - 10 years
- For some species, recovery can be rapid once fishing pressure is removed.
- Some long-lived, slow-growing species and complex habitats recover only on longer time frames.

Closures in Alaska

- Southeast Trawl Closure
  - Salmon Bycatch
- Cook Inlet Trawl
- Bristol Bay no Trawl
  - Crab EFH
- Seamount HPA
- Aleutians
  - Habitat Conservation



Self Check

- Closures is a sure fire way to recover a depleated or depressed population
  - True
  - False

- Closures are often a last ditch effort to try and stop population declines
  - True
  - False

Gear Restrictions

- Gear type
- Mesh size
- Hook size and number
- Numbers of traps or pots

Gear Restrictions

- Managers commonly regulate fisheries with restrictions on the type of gear that is allowed to be used
- Restrictions designed increase escapement / reduce mortality
- Some examples:
  - Only certain gear types may be allowed in some areas (trawl ban, rivers)
  - There may be a minimum mesh size on gill nets or trawls to allow the escape of smaller fish (Salmon, groundfish)
  - On longline gear there may be limits on the size and number of hooks that are allowed
  - Crab and lobster fisheries often limit the number of traps or pots allowed per vessel

Self Check

- Gear restrictions can include size, type, and number depending on the regulation
  - True
  - False

- Gear restrictions can
  - Increase escapement
  - Reduce mortality
  - Reduce bycatch
  - Limit fishing capacity
  - All of the above

Other Management: Market-based Solutions

- Certification
- Consumer-based solutions
- Purchase of fishing rights
- Aquaculture
- Increased use of underutilized species
- Reduce government subsidies

Certification of Seafood

- Akin to ‘Organic’ Sustainably Produced
- Marine Stewardship Council (MSC)
- Alaska Responsible Fisheries Management (RFM) Certification
  - Status of the target fish stock
  - Impact of the fishery on the ecosystem
  - Performance and effectiveness of the fishery management system
- Usually 3rd Party Cert

- Alaska Salmon
- Alaska Halibut
- Alaska Black Cod/Sablefish
- Alaska Pollock
- Alaska Crab
- Alaska Cod
- Alaska Flatfish

Consumer-based solutions

Seafood guides

- Categorizes seafood into
  - Best, Good, Avoid
  - Based on management and stock status
- Monterey Bay Aquarium in US

CleanFish™
fish you can trust.

Avoid
Take a pass on these for now, they're overfished or caught or farmed in ways that harm other marine life or the environment.

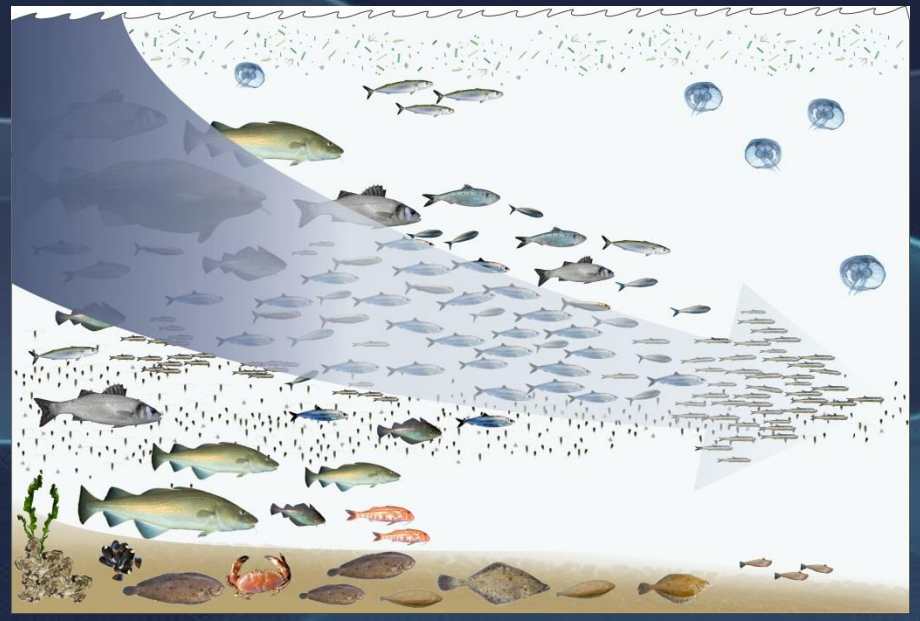
Purchase of fishing rights

- Buy Back Programs
- Governments may buy out willing fishing permit holders to reduce fishing effort
  - Boats can never work in commercial fishing again

"This vessel cannot fish legally world wide, including tendering and charter fishing operations and cannot be deleted from US registry"

Aquaculture

- Farming of Aquatic Organisms
  - Fish, Crustaceans, Mollusks and Plants
- Fish farming has the potential to reduce the pressure on wild-caught fish
- Farmed organisms that **do not consume fish meal are most sustainable**
  - Bug protein



World Aquaculture Production

- Aquaculture has increased dramatically in last decade
- In AK as muck as 77 million or 48% of commercial catch
  - 1.5 billion releases

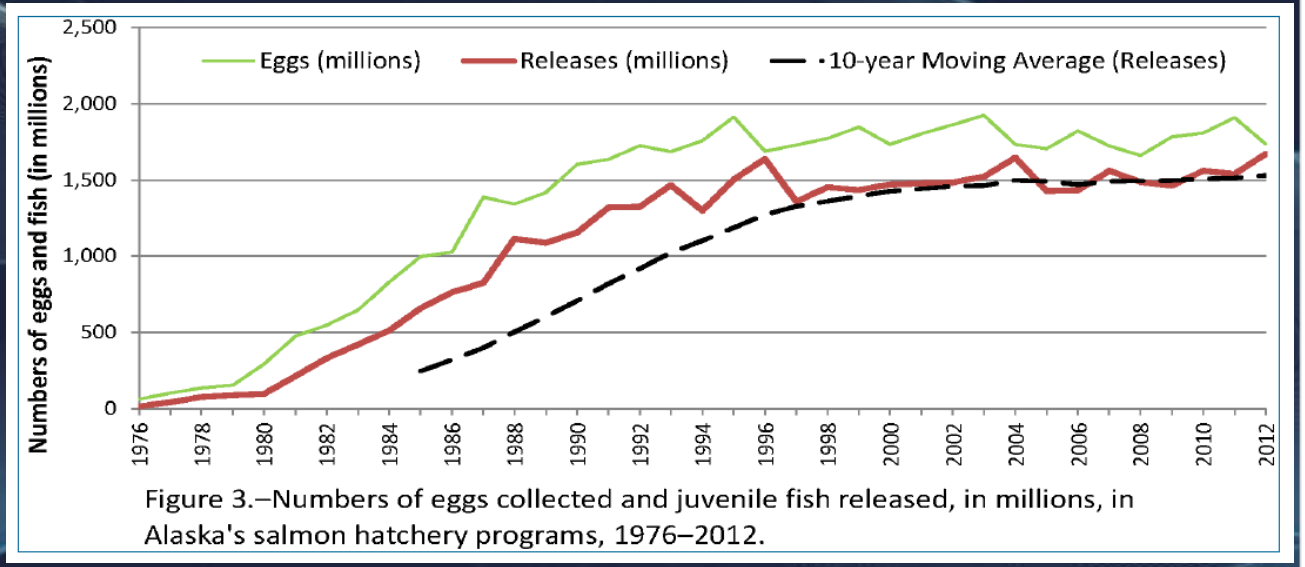
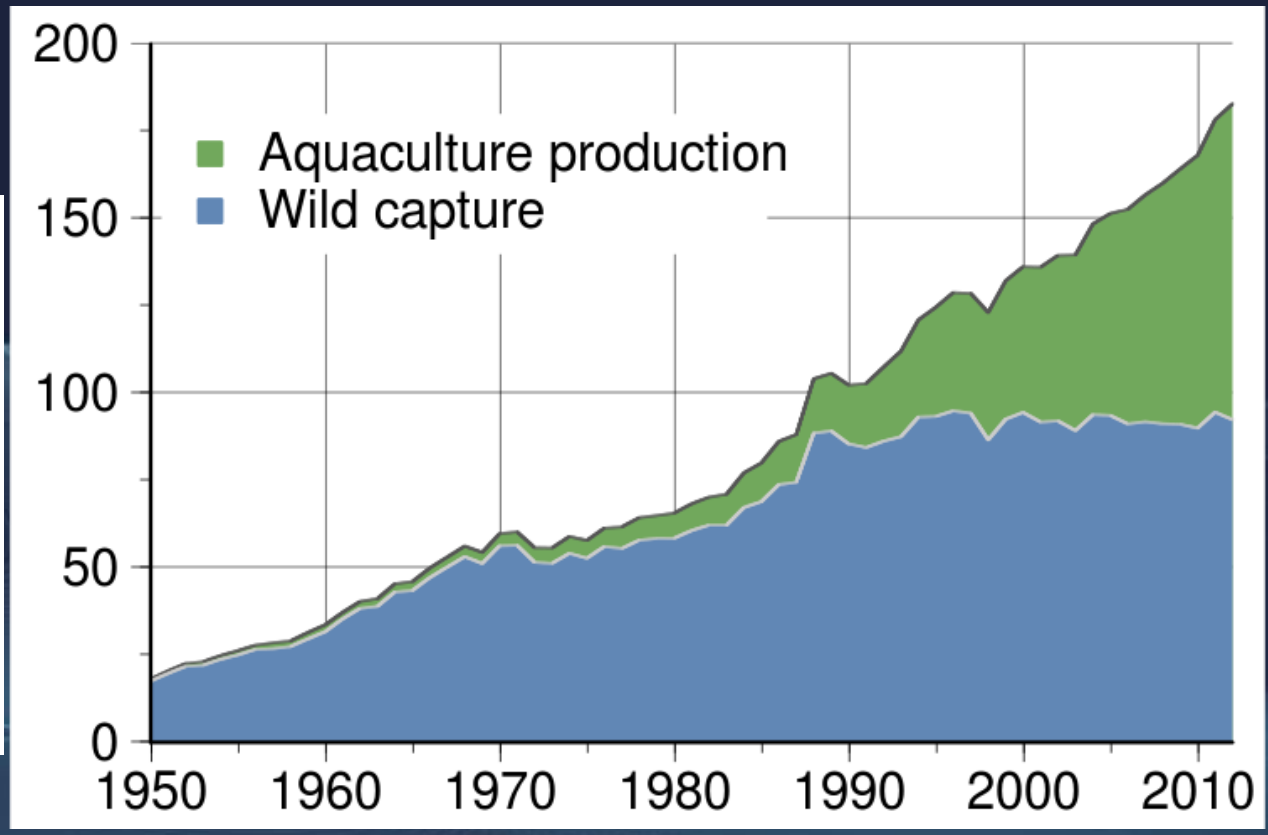


Figure 3.–Numbers of eggs collected and juvenile fish released, in millions, in Alaska's salmon hatchery programs, 1976–2012.



Underutilized Species

Increased use and marketing

- Silver hake = “Whiting”
- Slimeheads = “Orange Roughy”
- Patagonian Toothfish = “Chilean Sea Bass”
- Deep Sea Angler = “Monkfish”

Underutilized Species

A Cautionary Tale

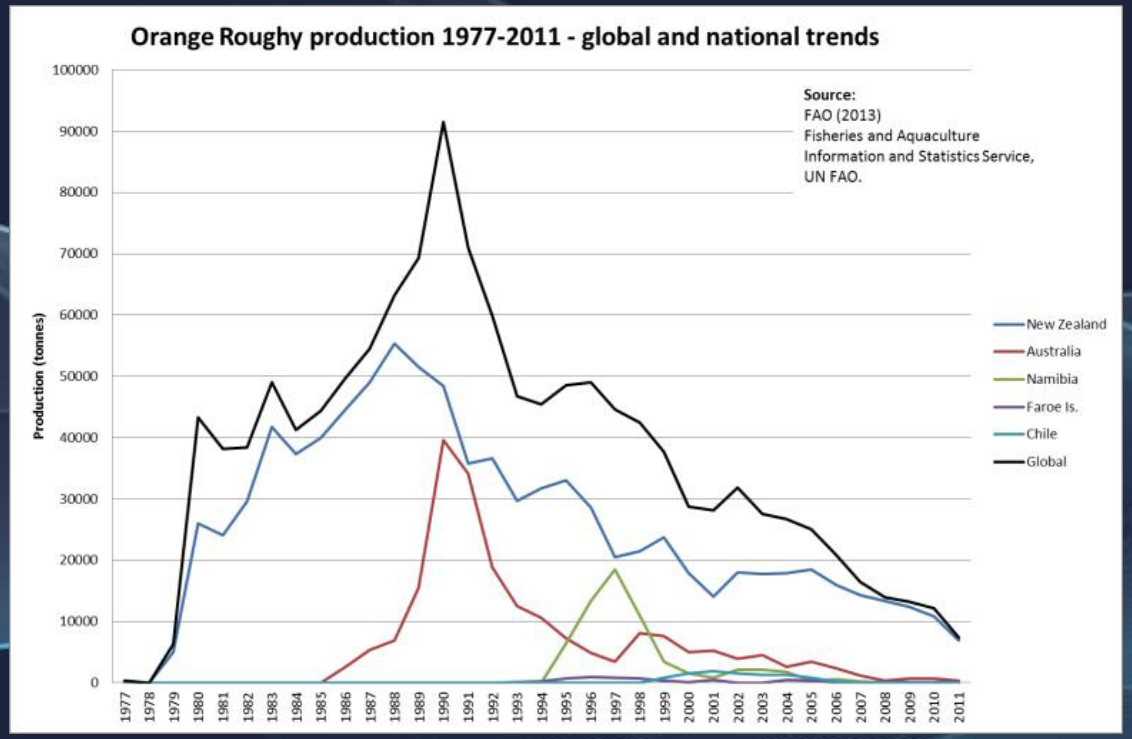
- Considered “trash fish” prior to 1980s
- Targeted fishery developed after decline of other species
- Renamed “rock salmon” or “cape shark”

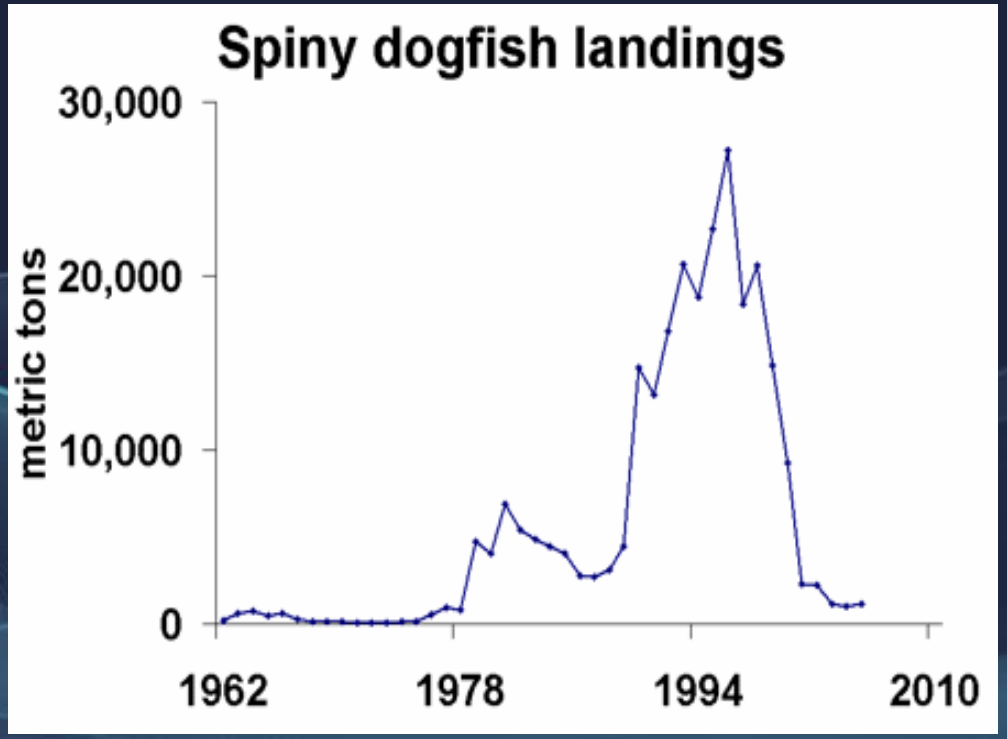
Spiny Dogfish Shark

“Fish and Chips”

From “underutilized” to “overfished”

- Fishing effort increased 10X from 1987 to 1996
- Declared overfished in 1998
- Female population falls 80% by 2000
- NMFS implements management plan in 2002





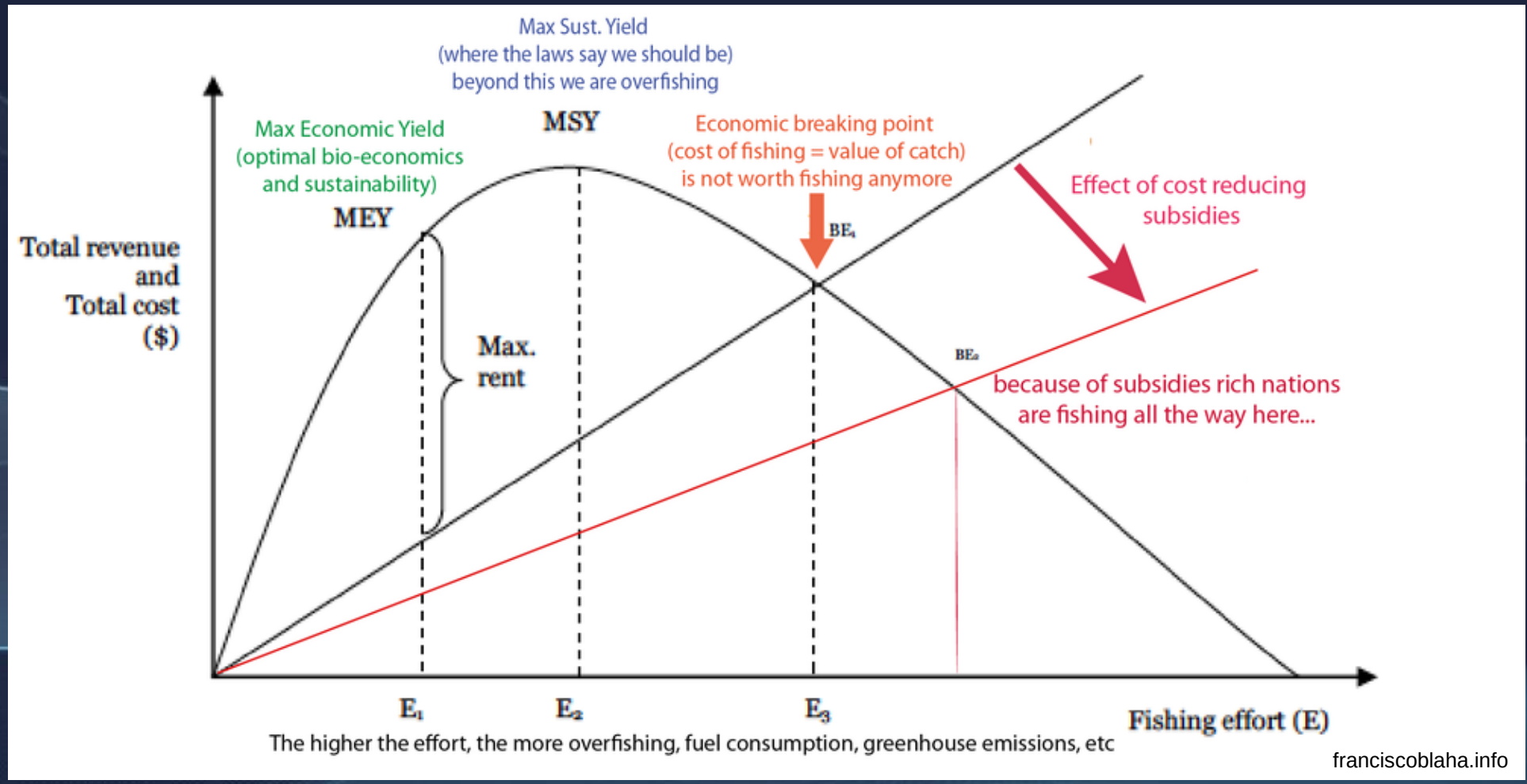
(U.S. East Coast)

Reduce government subsidies

- The government subsidizes fisheries as stocks decline to try and minimize economic impact
- Fishing capacity remains the same despite low catches and dwindling populations
- Reduction and eventual elimination of government subsidies allows price to be a more reliable indicator of scarcity.
  - If you have to fish 2x as hard to catch fish you will want to charge more for those fish
  - If the market isn't willing to pay more you won't fish

Economics of Subsidies

- Subsidies increase fishing effort and deplete stocks



Self Check

- Seafood certification is a way to promote sustainable fisheries and fisheries management
  - True
  - False

- Aquaculture has the potential to reduce the pressure on wild caught fisheries
  - True
  - False

Summary

- Fisheries Management & Cod recap
- Population Dynamics
- Traditional Fisheries Management
  - MSY
  - Quota
  - Legislation
  - Closures
  - Gear Restrictions
- Market Based Management

Readings

1 FISH, 2 FISH...

Do you really want to know about Maximum Sustainable Yield?

Salmonguy Design Co.

ALASKA SALMON HATCHERIES

CONTRIBUTING TO FISHERIES AND SUSTAINABILITY

Lorraine Vercessi
Alaska Department of Fish and Game — Division of Commercial Fisheries — P.O. Box 115526 Juneau, AK 99811-5526

ALASKA HATCHERY PROGRAM

The Alaska hatchery program was designed to increase salmon abundance and enhance fisheries, while protecting wild stocks. The program was built in response to depressed commercial fisheries, to meet the needs of the people of the state.

Fisheries enhancement projects are not permitted if they are anticipated to have a significant negative effect on natural production. Our fisheries enhancement program is designed to supplement natural production, not replace or displace it.

Alaska commercial salmon harvests have improved greatly since the inception of Alaska's hatchery program and natural stocks remain healthy (Figure 1).

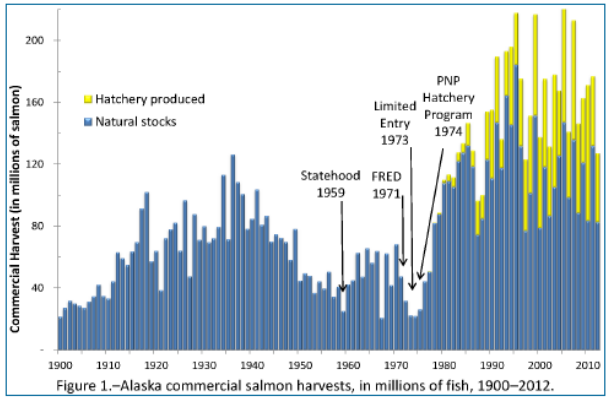
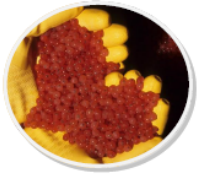


Figure 1.–Alaska commercial salmon harvests, in millions of fish, 1900–2012.

Salmon produced by Alaska's fisheries enhancement program remain wild. Our programs only protect the fish during the early juvenile life stage; if fish are not fit they will not return from the wild as adults.



By design, the hatchery program in Alaska has attempted to minimize interactions between natural and hatchery stocks by locating hatcheries away from significant naturally-occurring populations of salmon.

Only local stocks are permitted for use so that hatchery-produced fish are locally adapted and have local genetic profiles. Breeding or manipulation of stock characteristics is prohibited and large numbers of broodstock are used in order to maintain diversity, so that Alaska's fish remain wild.

Alaska's salmon fisheries are managed with wild stock priority, to ensure adequate numbers of salmon reach natal freshwater spawning areas to maintain healthy, sustainable, naturally-spawning populations. ADF&G biologists estimate escapement goals for key wild stock systems and monitor returns to these systems annually.

Cooperative development of annual management plans guide hatchery operations, production, and harvest management of returns, lending to success in fisheries management and contribution while maintaining hatcheries' production goals.

FISHERIES CONTRIBUTION