

Fisheries Management Law & Economics

Ecosystem Based Fishery Management

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Outline

Ecosystem Based Management

- Reduce bycatch
- Marine reserves
- Monitoring of population characteristics
- Catch share programs
- Ecologically sustainable yield

Student Learning Outcomes

- Describe the framework behind ecosystem based management and why it is becoming more and more popular
- Illustrate the benefits and challenges of reducing bycatch, and identify tools used to do so
- Describe the purpose and extent of marine reserves, and differentiate among different kinds
- Summarize how managers monitor characteristics of a population, and how this information can be applied to regulations
- Discuss how catch share programs work, and recall fisheries where they have been applied
- Describe the meaning of ecologically sustainable yield, and how the technique is being applied

Recap

Management

Informed + Uninformed

Stock Assessments

Fishery Dependent

Fishery Independent

Stock Assessments

Population (How Many)

Life History Data (size, weight, age, sex)

Catch Information (fish tickets)

Fisheries Management

Outlined the need for management

- Unregulated = Tragedy of Commons

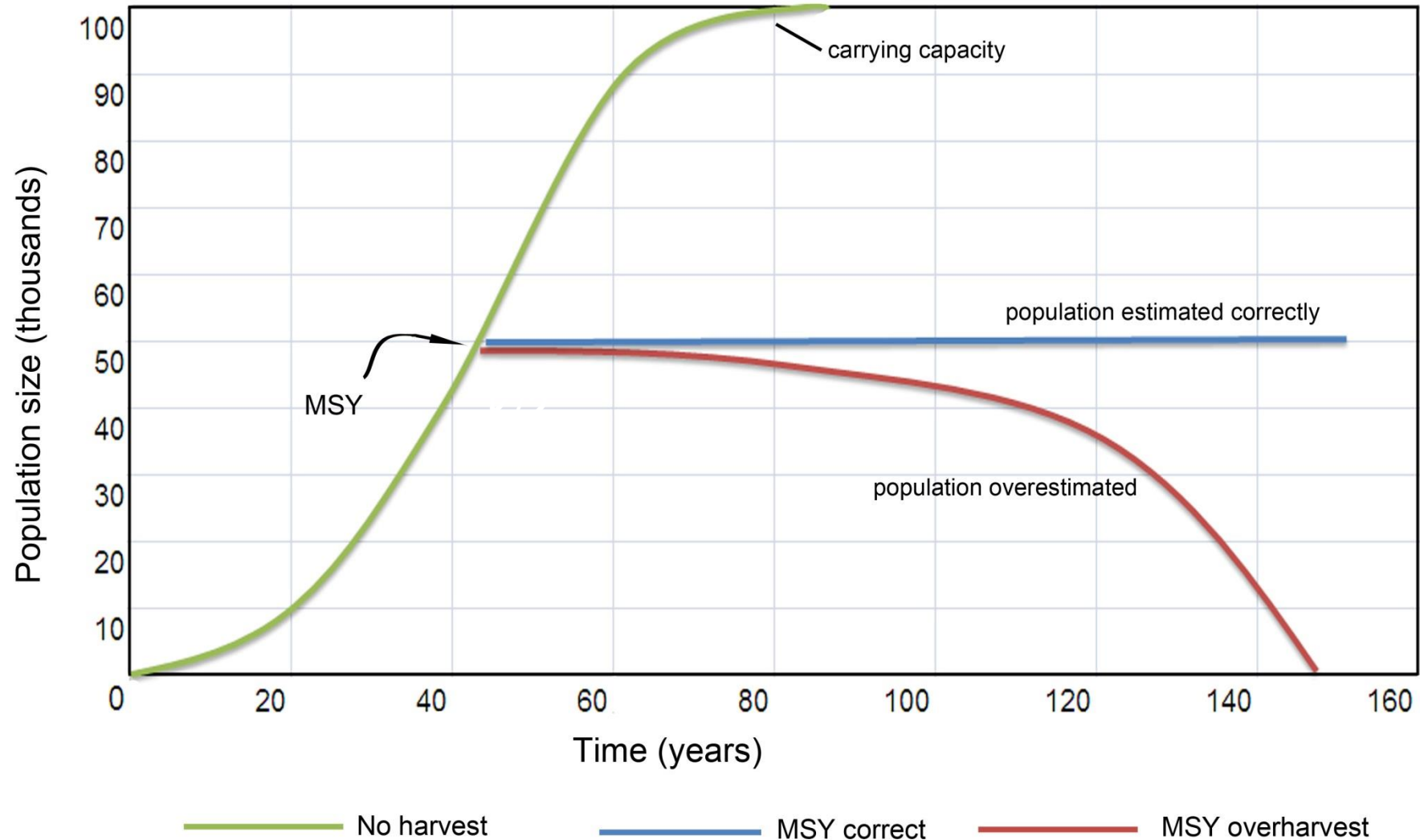
Talked about fishery management

- MSY – Outlined in our State constitution

Fisheries are Complex

- Despite best efforts and intentions...
 - Many collapses
 - Socio-economic & political challenges

Maximum Sustainable Yield = $K/2$



Current Trends

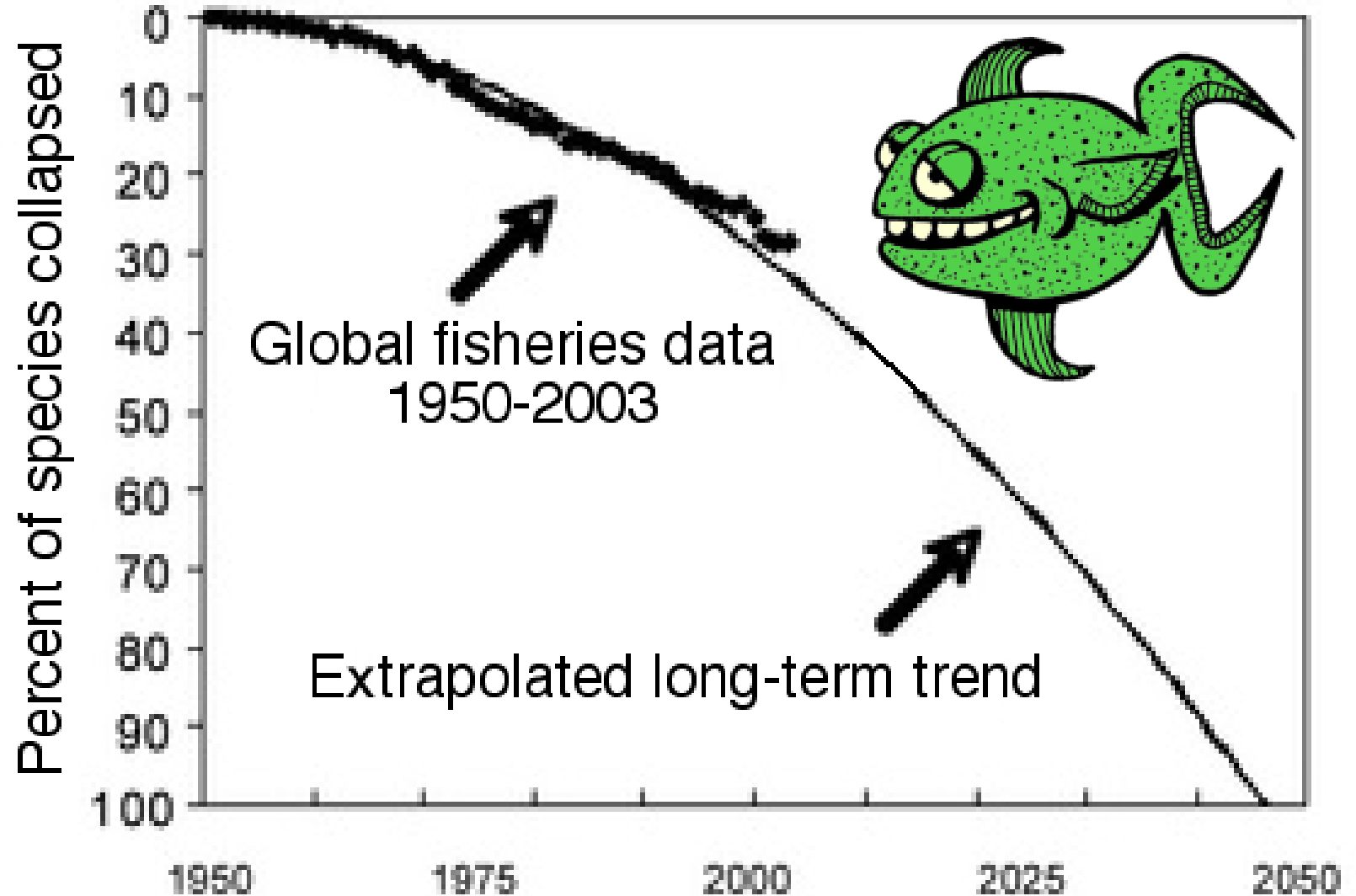
Fisheries' Downfall

If current fishing trends continue, all of the commercial fisheries will have collapsed by 2050, according to a peer-reviewed study.

Percentage of fisheries collapsed



SOURCE: Science | The Washington Post



Fisheries Management

- Thus far one species at a time
- Single-species management
- Ignore impacts on other species / habitat
 - Might be commercially insignificant
 - Might **ALSO** be vital to the function and health of ecosystem.
- A management approach that looks at more than one species might be more effective in maintaining the health of fishery stocks.
- Ecosystem-based management (EBM),
- considers the interconnectedness of all components within an ecosystem, including fish, plants, marine mammals, climate, and humans.

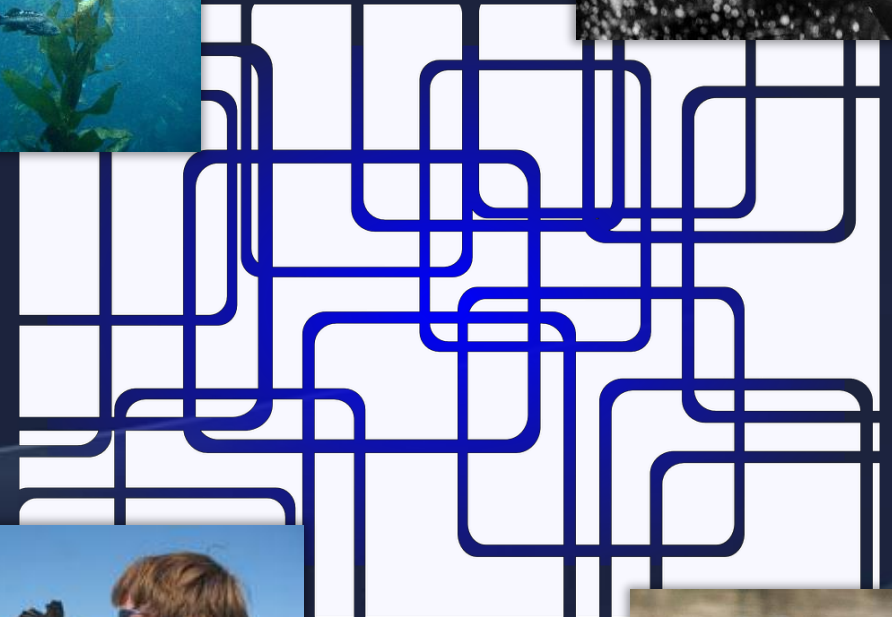
Ecosystem Based Management (EBM)



Alaska Digital Graphics

Ecosystem Based Management (EBM)

- **SUSTAINABILITY** in exploiting natural resources
- Considers the interconnectedness of all components within an ecosystem, including fish, plants, marine mammals, climate, and humans.
- Place-based approach to natural resource use that aims to restore and protect the health, function and resilience of Entire Ecosystems for the benefit of all organisms.



Ecosystem Based Management

The Foundation

1. Maintaining the natural structure and function of ecosystems, including the biodiversity and productivity of natural systems and identified important species, is the focus for management.
2. Human use and values of ecosystems are central to establishing objectives for use and management of natural resources.
3. Ecosystems are dynamic; their attributes and boundaries are constantly changing and consequently, interactions with human uses also are dynamic.

Ecosystem Based Management

The Foundation cont.

4. Natural resources are best managed within a management system that is based on a shared vision and a set of objectives developed amongst stakeholders.
5. Successful management is adaptive and based on scientific knowledge, continual learning and embedded monitoring processes.

EBM - Implementation

1. Identify the stakeholders: the interested parties.
2. Prepare a map of the ecoregions: species, habitats and oceanographic features.
3. Identify the partners and their interests: stakeholders directly interested or affected by the fishery.
4. Establish the ecosystem values: habitats, species and uses.
5. Determine the main potential hazards of the fishery to the ecosystem values.

EBM - Implementation

6. Conduct an ecological risk assessment: determine the actual risks of the fishery.
7. Establish the objectives and targets: agreed goals for the ecosystem and the fish stock.
8. Establish strategies for achieving targets.
9. Design the information system: includes monitoring of stock and ecological indicators.
10. Establish information needs and research priorities.
11. Design performance assessment and review process.
12. Design and implement an EBM training and education package for fishers and managers.

Self Check

- Ecosystem based management focuses on a variety of elements in nature but leaves the human dimension to economists and social scientists
 - True
 - False
- Current trends in single species fisheries management points toward the need for taking a more holistic approach and including more factors in setting catch limits and managing fisheries resources
 - True
 - False

Ecosystem-based Fishery Management

Some of the main tools

- Reduce bycatch
- Marine reserves
- Monitoring of population characteristics
- Catch share programs
- Ecologically sustainable yield

Reduce Bycatch

The incidental capture of non-target species

- Wherever there is fishing, there is bycatch
- Fishery Leaders Increasingly realize the need to reduce bycatch
- Modifying fishing gear so that fewer non-target species are caught or can escape is one way
 - can be simple and inexpensive
 - often come from fishers themselves



Shrimp Bycatch

Reduce bycatch

Turtle excluder device (TED) on shrimp boat in Gulf of Mexico

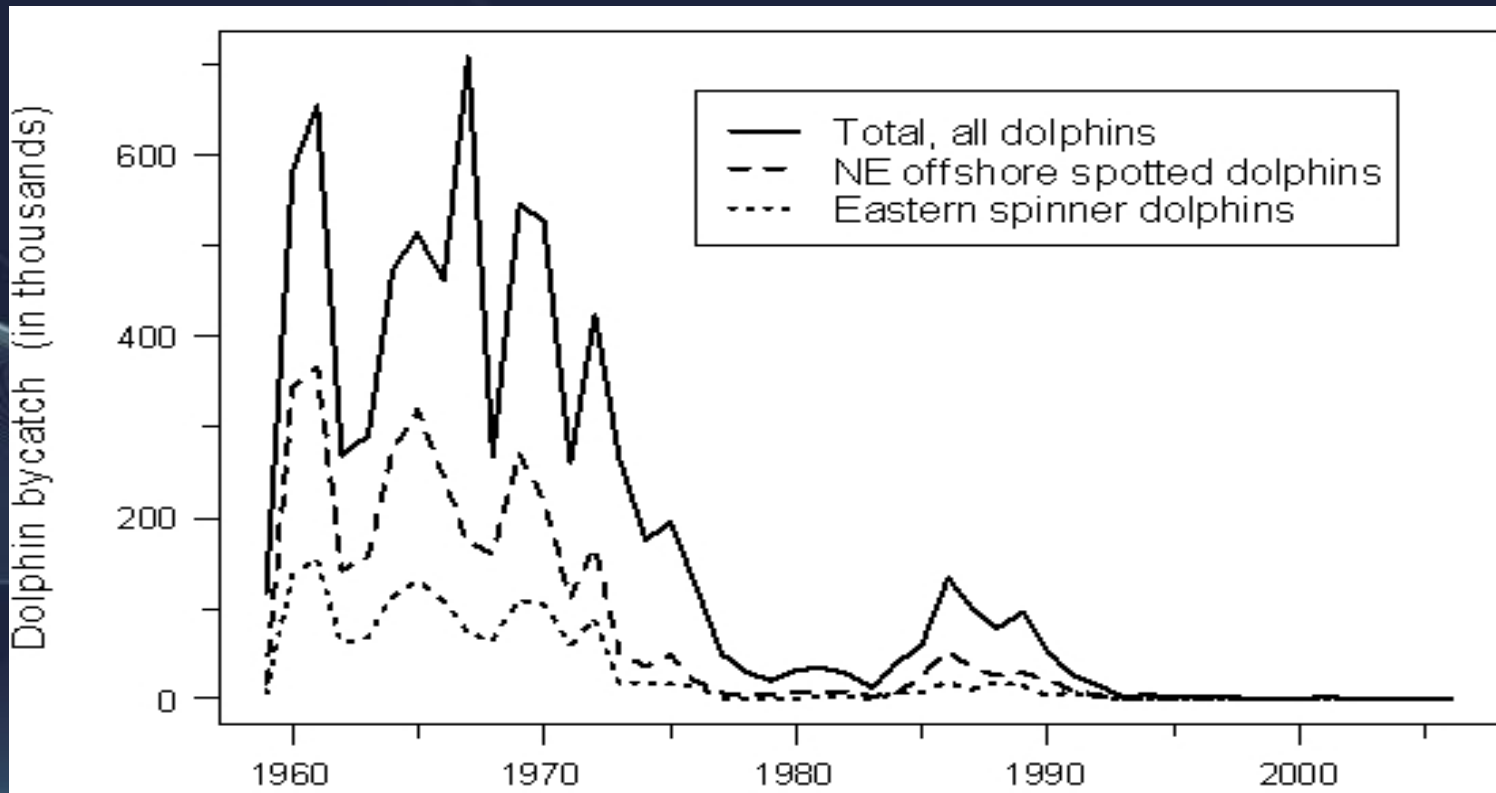




Methods for Bycatch Reduction

- Fishery closures
- Improve selectivity of fishing methods
- Reduce contact between fishing gear and non-target species
 - Seabird/longline, pingers MM, Scallop Hydroscop
- Separate species on the basis of size
 - TED, Mesh size sein, gill net
- Exploit behavioral differences
 - Electric shrimp, snapper/travally horizontal
- Change in Timing

Dolphin Bycatch Reduction in the Tuna Fishery



Estimated dolphin mortality in eastern tropical Pacific purse seine tuna fishery

Purse seine set for tuna

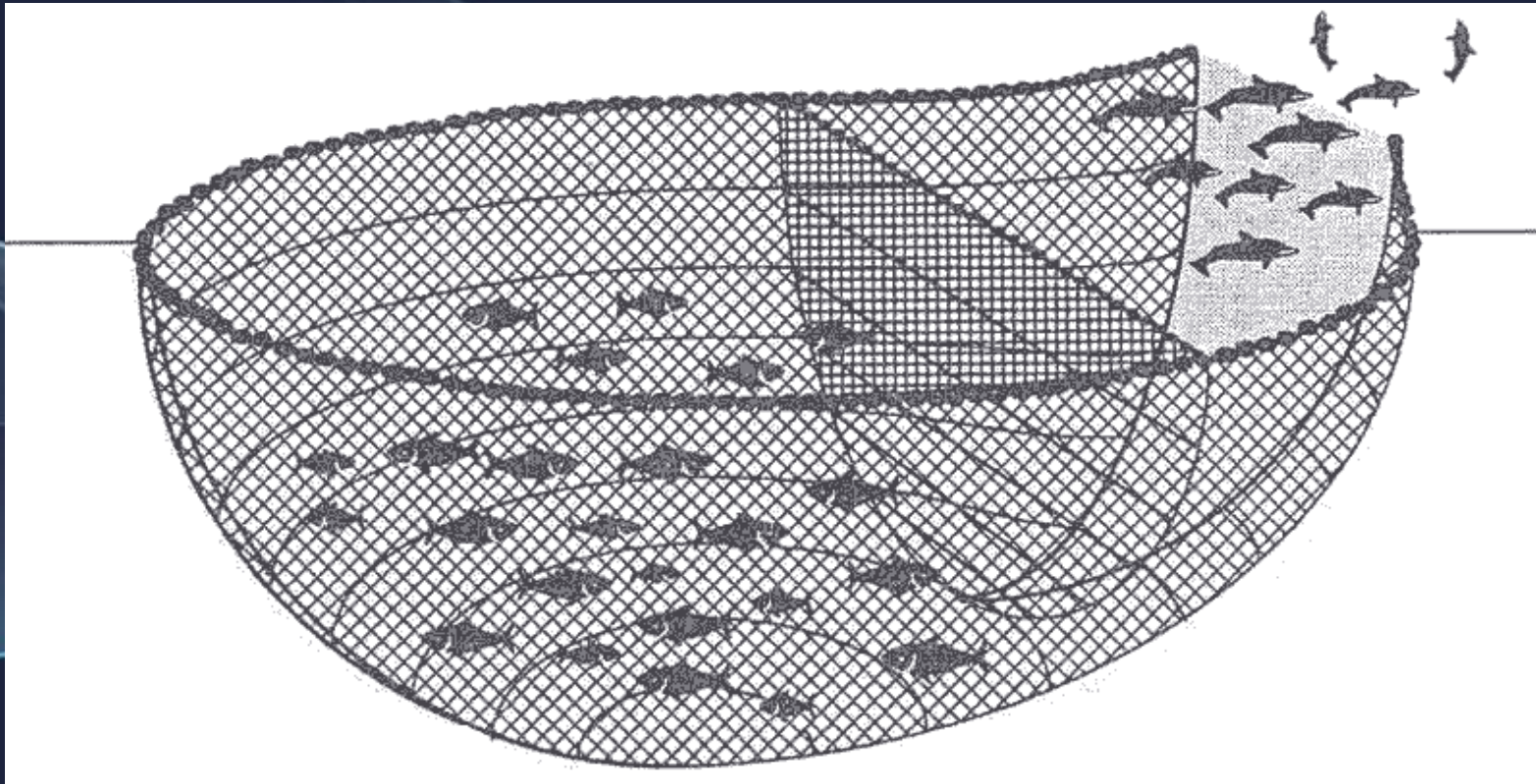


“Backdown” procedure



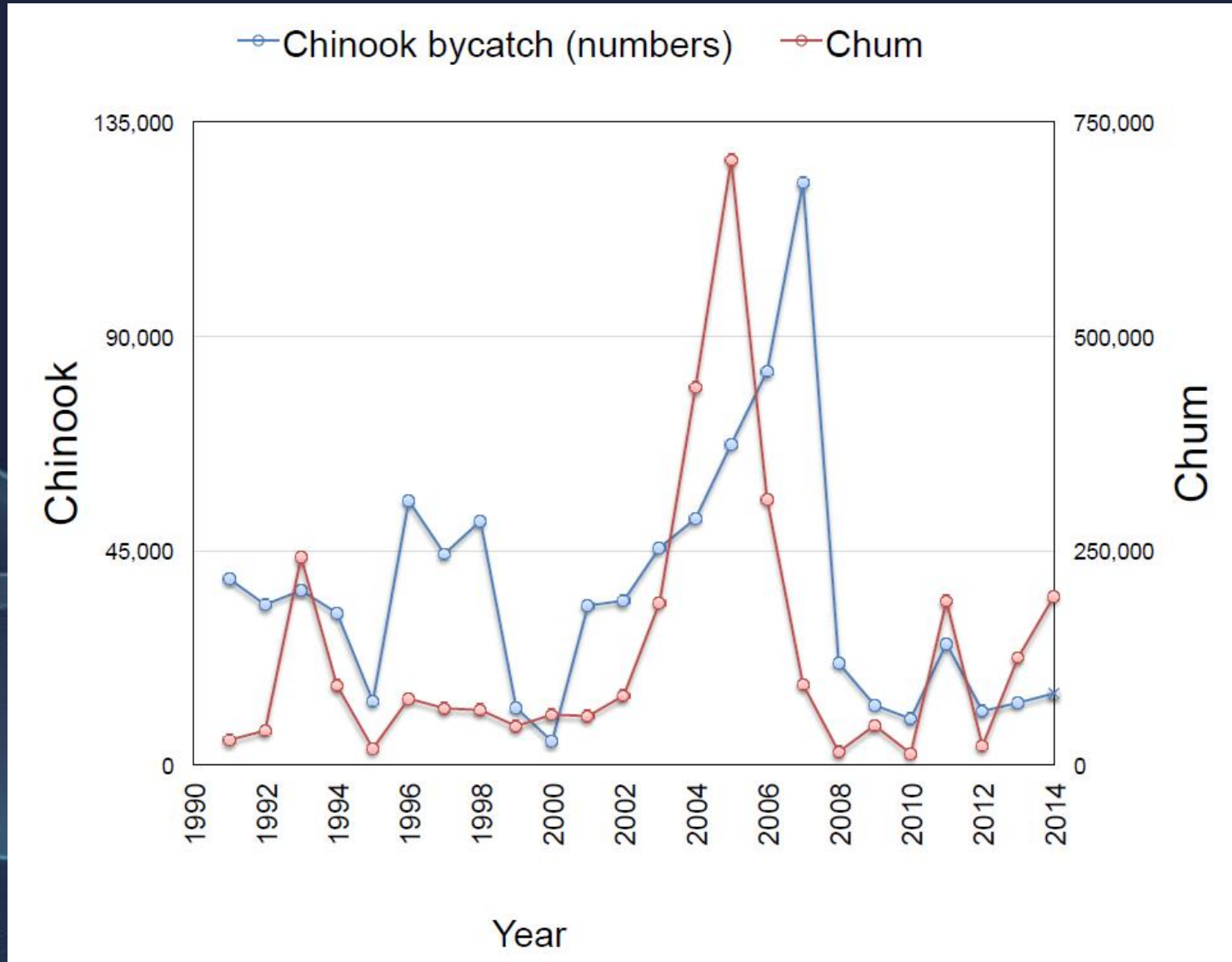
Medina Panels

- Medina panels are sections of fine mesh net that are added to purse seines to reduce dolphin entanglement



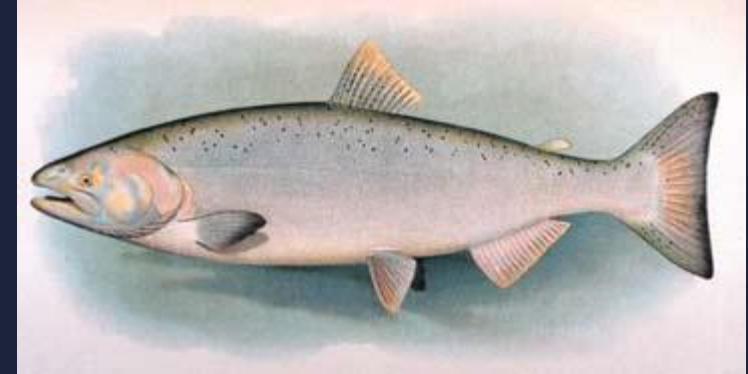
Chinook Salmon Bycatch Management

- Chinook & Chum salmon are accidentally caught in the federally managed pollock fisheries in the Gulf of Alaska (GOA) and in the Bering Sea and Aleutian Islands (BSAI).



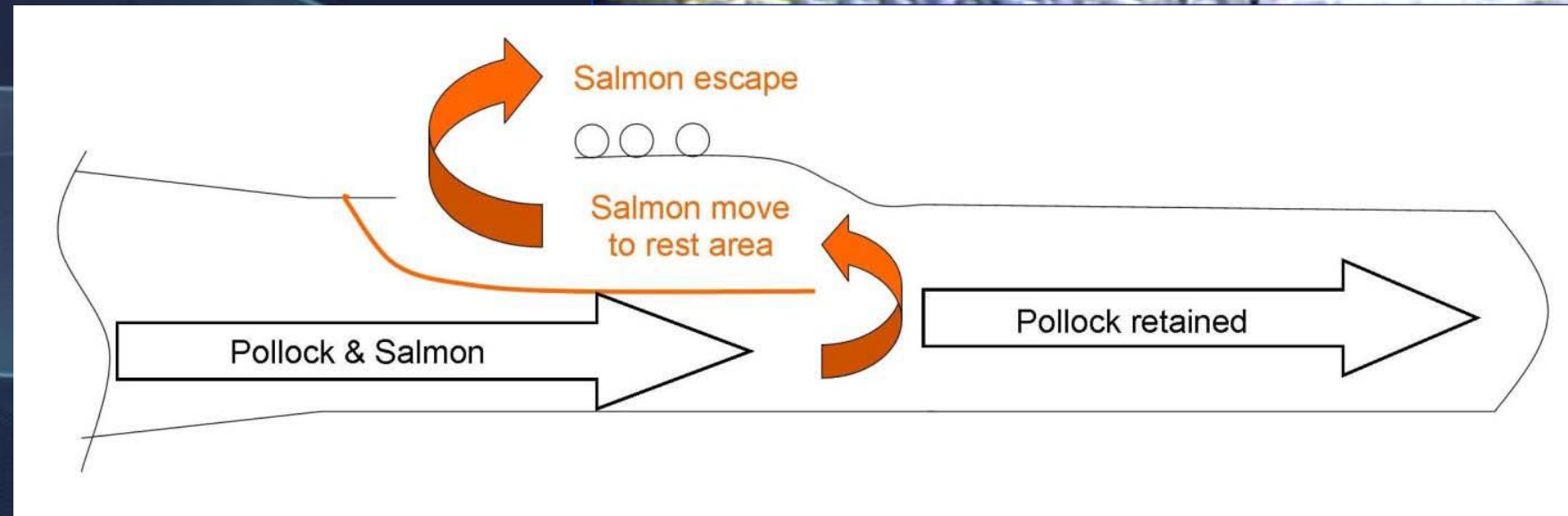
Chinook Salmon Bycatch Management

- Amendment 91 establishes separate prohibited species catch (PSC) limits in the Central and Western GOA for Chinook
- Hard upper cap (60,000) but lower cap 47,000
- Incentive Programs – Individual Vessel Closures
- 100% observer Coverage



Salmon Bycatch

- Salmon Excluders
 - Allow salmon to escape, but not Pollock
 - Exploits swimming behaviors of both species



Salmon Bycatch

Proposed Measures

- Mandate use of salmon excluders
- Closures if weekly bycatch rates exceed a specified threshold
- Penalties/restrictions on vessels with highest bycatch rate

Self Check

- Which of the following is not a method used for reducing fishery bycatch
 - Fishery Closures
 - Improve selectivity of fishing methods
 - Reduce contact between fishing gear and non-target species
 - Exploit behavioral differences
 - Change in Timing of fishery
 - All of the above are used in reducing Bycatch
- TED Excluders are used in what fishery?
 - The Pollock trawl fishery to exclude salmon
 - The shrimp fishery to exclude turtles
 - The tuna seine fishery to exclude dolphins
 - None of the above

Break

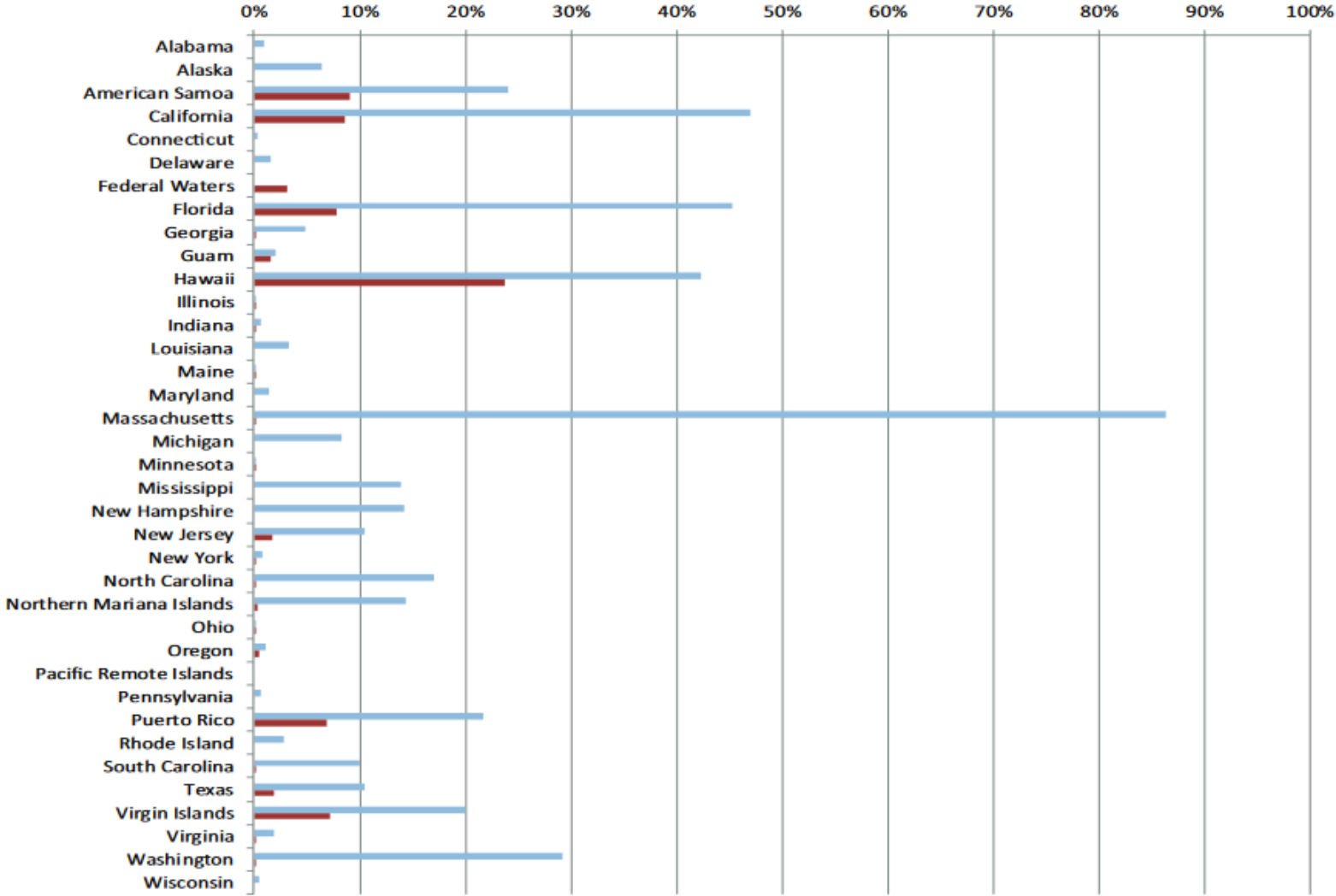
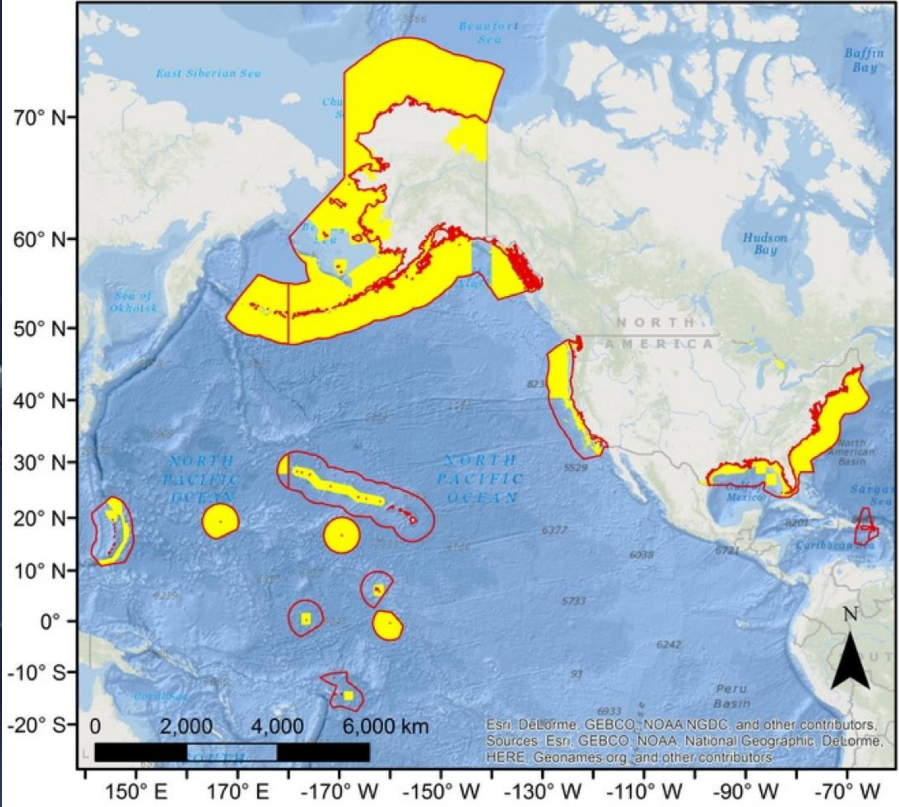
Marine Protected Areas



- 12% of the land area of the United States (protected in some way)
- 41% percent of the total marine area of the United States (protected in some way)
 - *Nearly all (85 percent) allow for resource extraction

MPA's by State

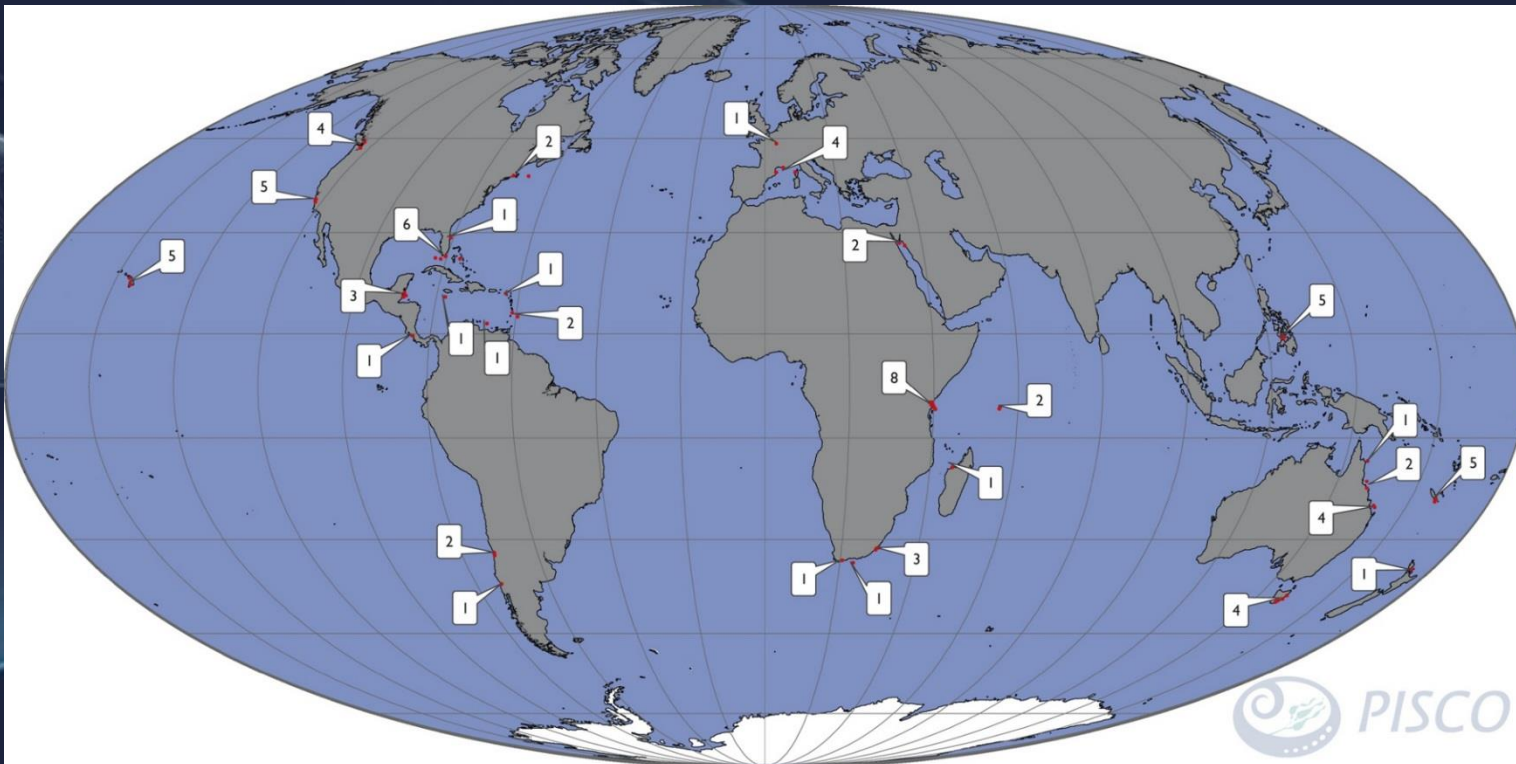
- Alaska



■ Percent of State Waters in MPAs ■ Percent of State Waters in No-Take Reserves

Marine Reserves

- Extractive activities such as fishing, mining and oil drilling are prohibited
- most restrictive type of "marine protected areas"
- US waters is less than 1% vs. 3.4% NPS



Types of Marine Reserves

- Lots of Names
- Multi-Use – Tourism, Fishing, Aquaculture
- Buffer Zone – limited activities
- No Take Zone – non extractive activities permitted (Diving, Anchoring, Tourism)
- No-Use Zone – No activities permitted, even transit

Features of Marine Protected Areas Worldwide

No-Use Zone

No activities permitted.

No-Take Zone

Measures are taken to protect species whose populations may be affected in other zones/areas. Examples include spawning and nursery grounds.

Non-extractive activities are permitted, such as diving and mooring.

Buffer Zone

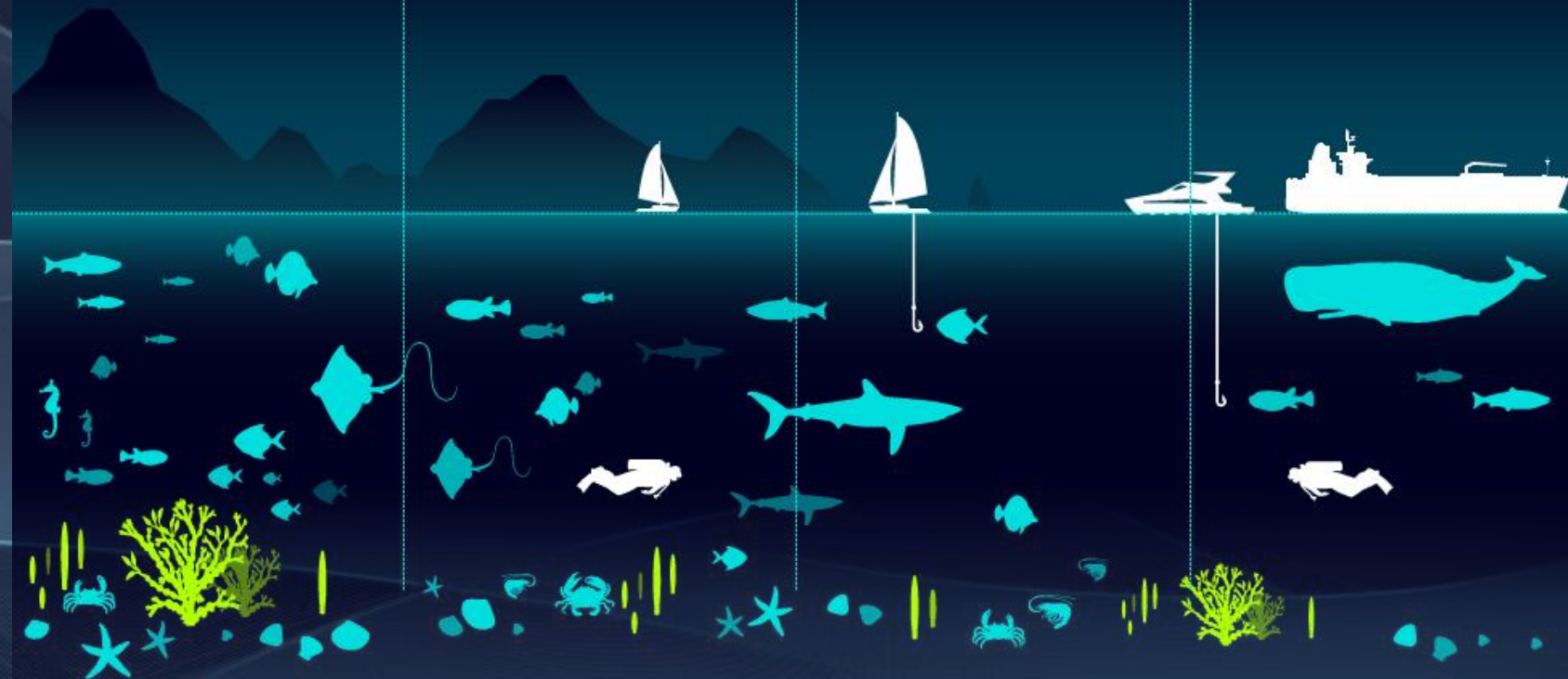
Transitional zones from no-take zones to multiple-use zones.

Moderate activities, such as hook-and-line fishing, limited aquaculture, and limited tourism are permitted.

Multi-Use Zone

All tourism, fishing and aquaculture activities permitted.

Permitted activities include diving and snorkeling, artisanal fishing, large-scale commercial fishing, and aquaculture.



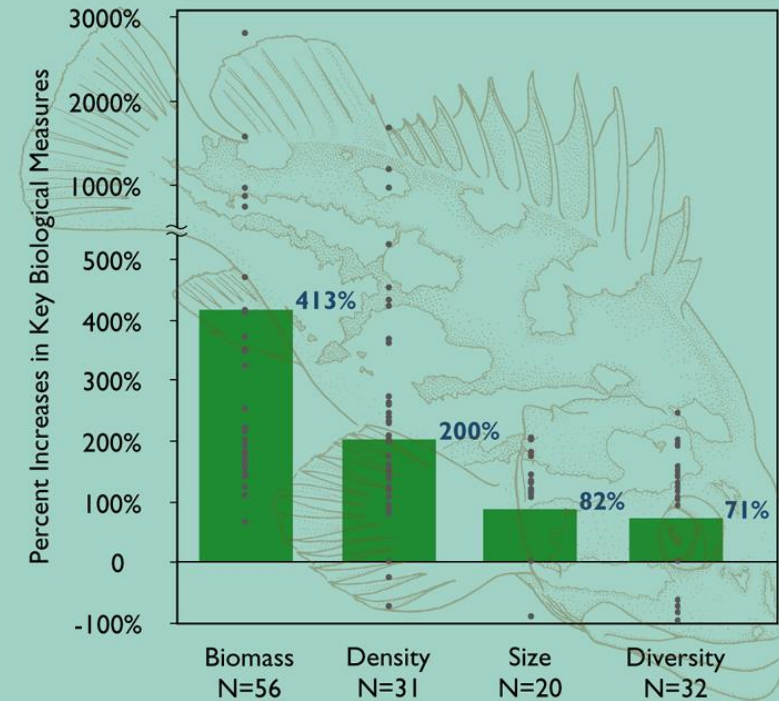
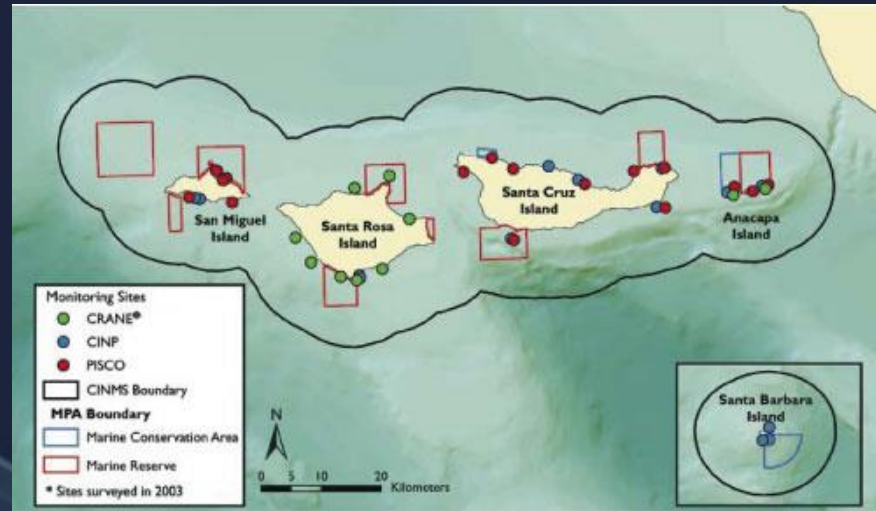
Marine Reserves

- Extractive activities such as fishing, mining and oil drilling are prohibited
- Most restrictive type of "marine protected areas"
- Channel Islands NP&P
- Olympic NP&P



Marine Reserves

- Channel Islands Marine Reserve California
- 250K acres



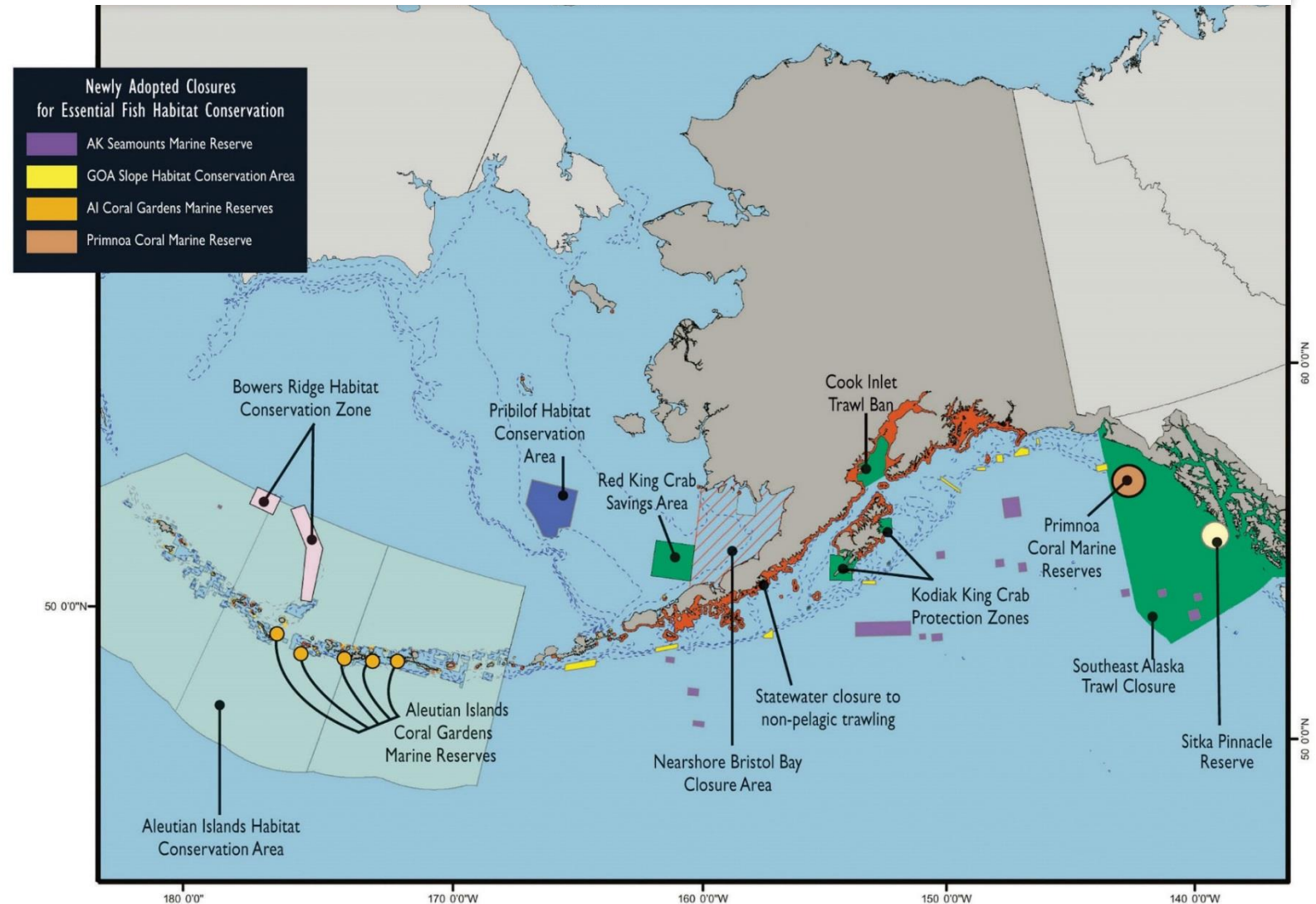
N = the number of reserves in which a particular characteristic was measured

Marine reserves usually increase the biomass, density, size, and diversity of species living within their boundaries. The bar graph (modified from Halpern, in press, and Palumbi, in press) indicates the percent change in key biological measures inside marine reserves. The average increases (green bars) are based on data from marine reserves around the world. The actual changes at particular reserves varied (gray dots), but the vast majority of all reserves showed positive responses in all biological variables.

(Data courtesy Halpern 2003 and Palumbi 2003)

MPA's in Alaska

- Numerous
- Papahānaumokuākea Marine National Monument 582,578 square miles
Northwestern Hawaiian Islands

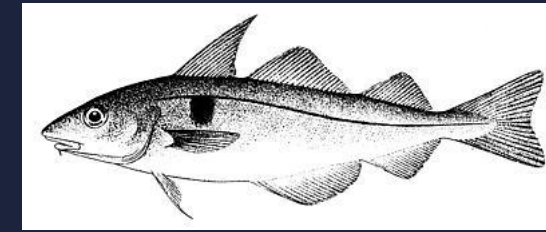


Self Check

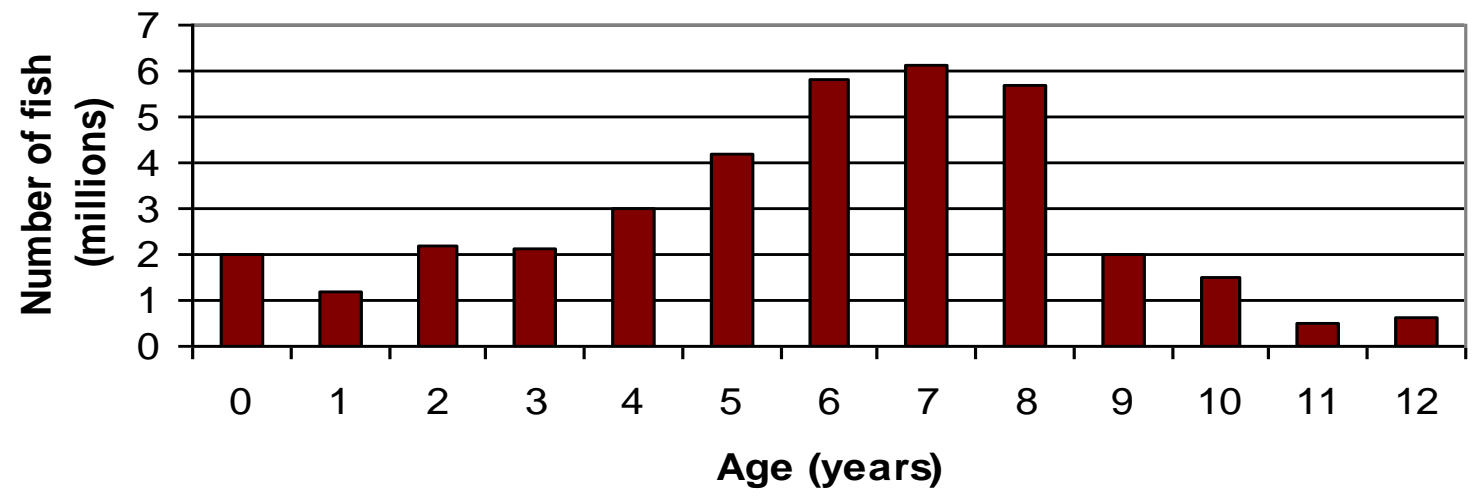
- There are currently no marine reserves in Alaska
 - True
 - False
- 40% of US waters are protected and do not allow for any kind of fishing or resource extraction
 - True
 - False

Monitoring of Population Characteristics

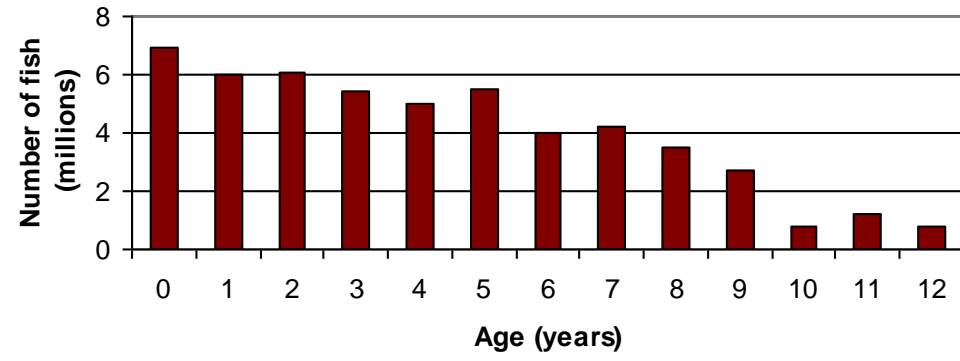
- Altered age structure may be an indication of overfishing
 - Lack of recruitment



Hypothetical Age Structure for 1975 Haddock Stock



Hypothetical Age Structure for "Healthy" Haddock Stock



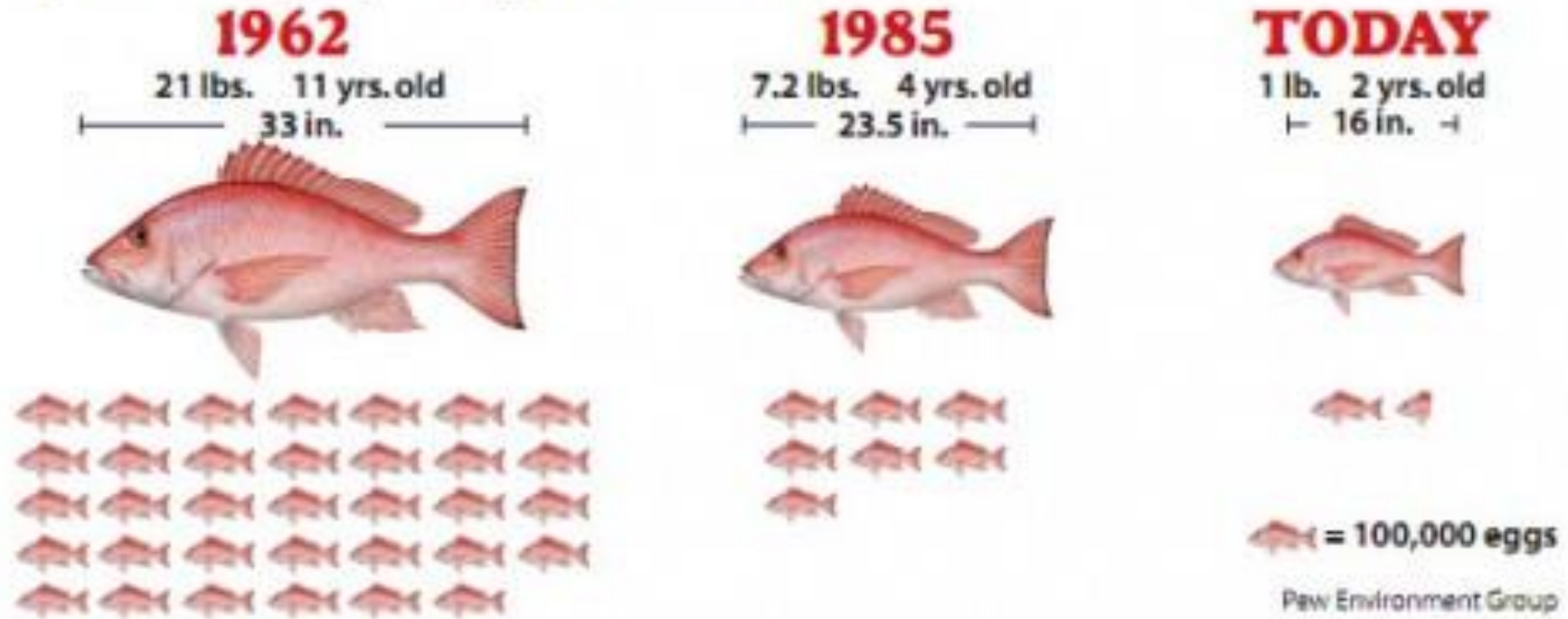
Population Characteristics

Change in size at age can indicate

- Selectivity
- Competition

TIME TO SPAWN

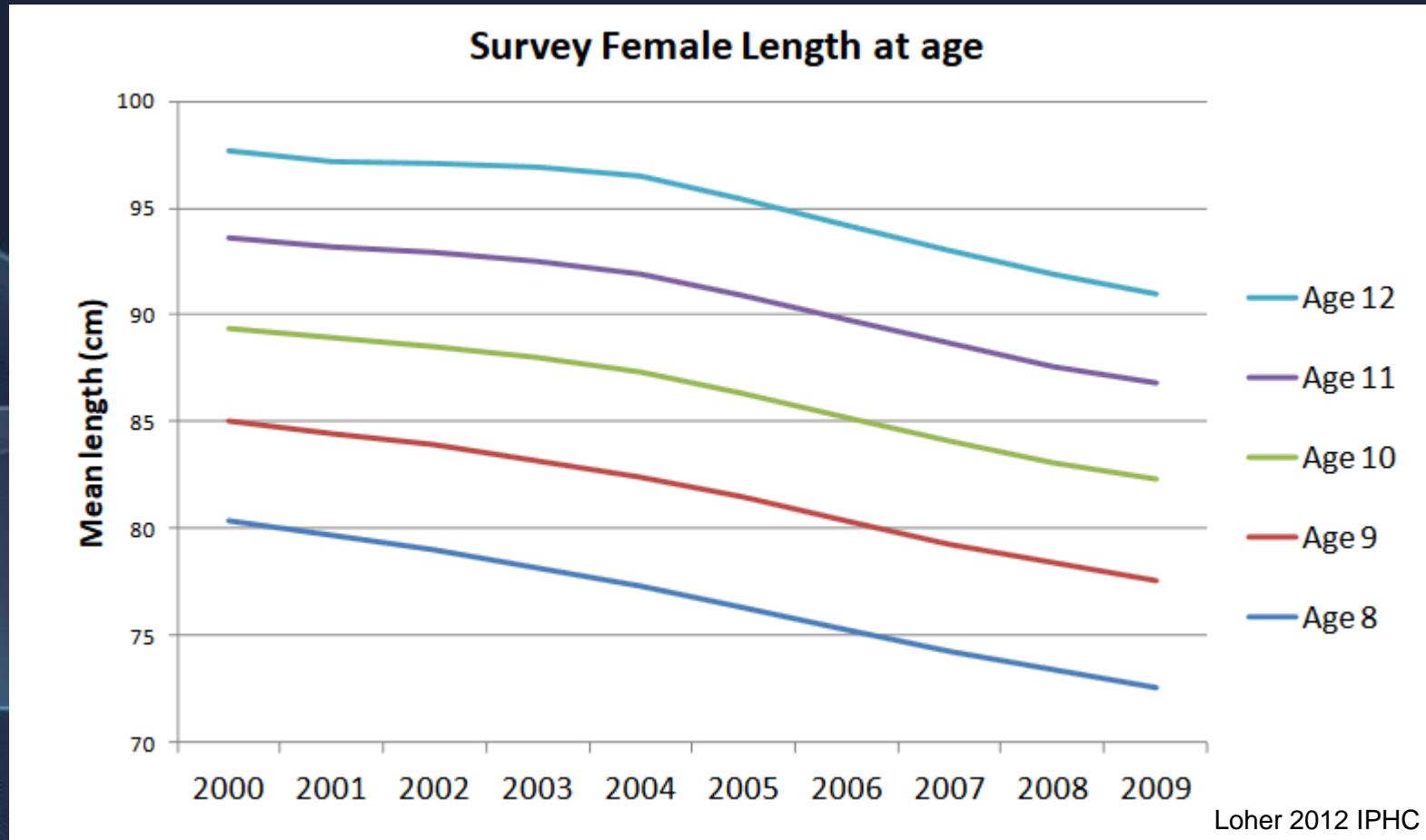
Although red snapper can live up to 54 years, today too few are older than 10. Older fish are the best spawners. Since the 1960s, average weight, age, size and reproductive capacity of snapper have diminished.



Population Characteristics

Halibut in the North Pacific

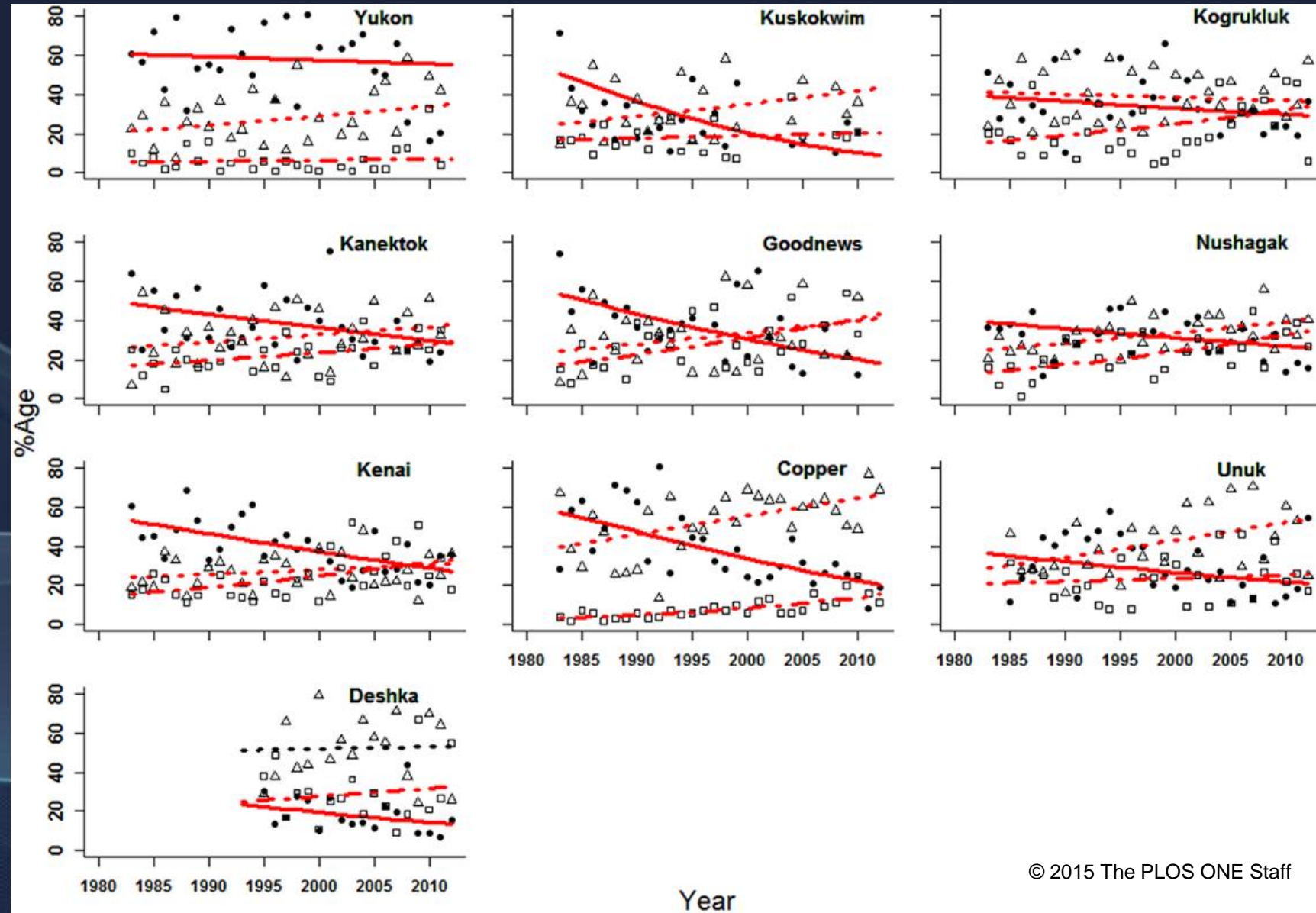
- Length at Age
- ↓ since mid 80's
- Females are smaller
 - Less Fecundity
 - Smaller Biomass
 - Halibut measured in Lbs



Population Characteristics

- Chinook Salmon Proportional Age Class

- ↓ Age 4 fish All areas



Self Check

- Changes in the population characteristics can be indicative of problems in a fishery
 - True
 - False
- Typically larger Female fish have lower fecundity
 - True
 - False

Catch Share Programs

- Individual Fisheries Quota (IFQ)
- Limited Access Privilege Programs (LAPP)
- Individual Transferable Quotas (ITQ)

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)



The screenshot shows the NOAA Fisheries website for the Alaska Regional Office. The header includes the NOAA logo and the text "NOAA FISHERIES" and "ALASKA REGIONAL OFFICE". Below the header is a navigation menu with links for "ONLINE SERVICES", "FISHERIES", "PROTECTED RESOURCES", "HABITAT", "NEWS", "GRANTS", and "ABOUT US". The main content area features a large image of a halibut being pulled by a rope. Below the image, there is a breadcrumb trail "Home » Fisheries" and a section titled "IFQ Halibut and Sablefish Fisheries". The text under this section describes the program's adoption by the North Pacific Fishery Management Council and its objectives: to eliminate gear conflicts, address safety concerns, and improve product quality.

Catch Share Programs

Benefits

- Ensuring annual catch limits are not exceeded
- Provide fishers with a direct financial stake in the health of fish stocks
- Fishers can more effectively plan their fishing effort
- Improved product quality and value
- Bycatch reduction
- Improved safety
- Increased predictability

Concerns

- Allocation of shares
- Transition to a new regulatory system
- Privatization of public resources
- Monopolization of resource by largest operators

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Current Catch Share Programs

Mid-Atlantic Surfclam & Ocean Quahog IFQ (1990)

South Atlantic Wreckfish ITQ (1992)

Western Alaska Community Development Quota (1992)

Pacific Halibut & Sablefish IFQ (1995)

Bering Sea AFA Pollock Cooperatives (1998)

Pacific Sablefish Permit Stacking Program (2001)

Bering Sea King and Tanner Crab (2005)

Gulf of Mexico Red Snapper IFQ (2007)

Bering Sea Groundfish (non-Pollock) Cooperatives (2008)

Mid-Atlantic Golden Tilefish IFQ (2009)

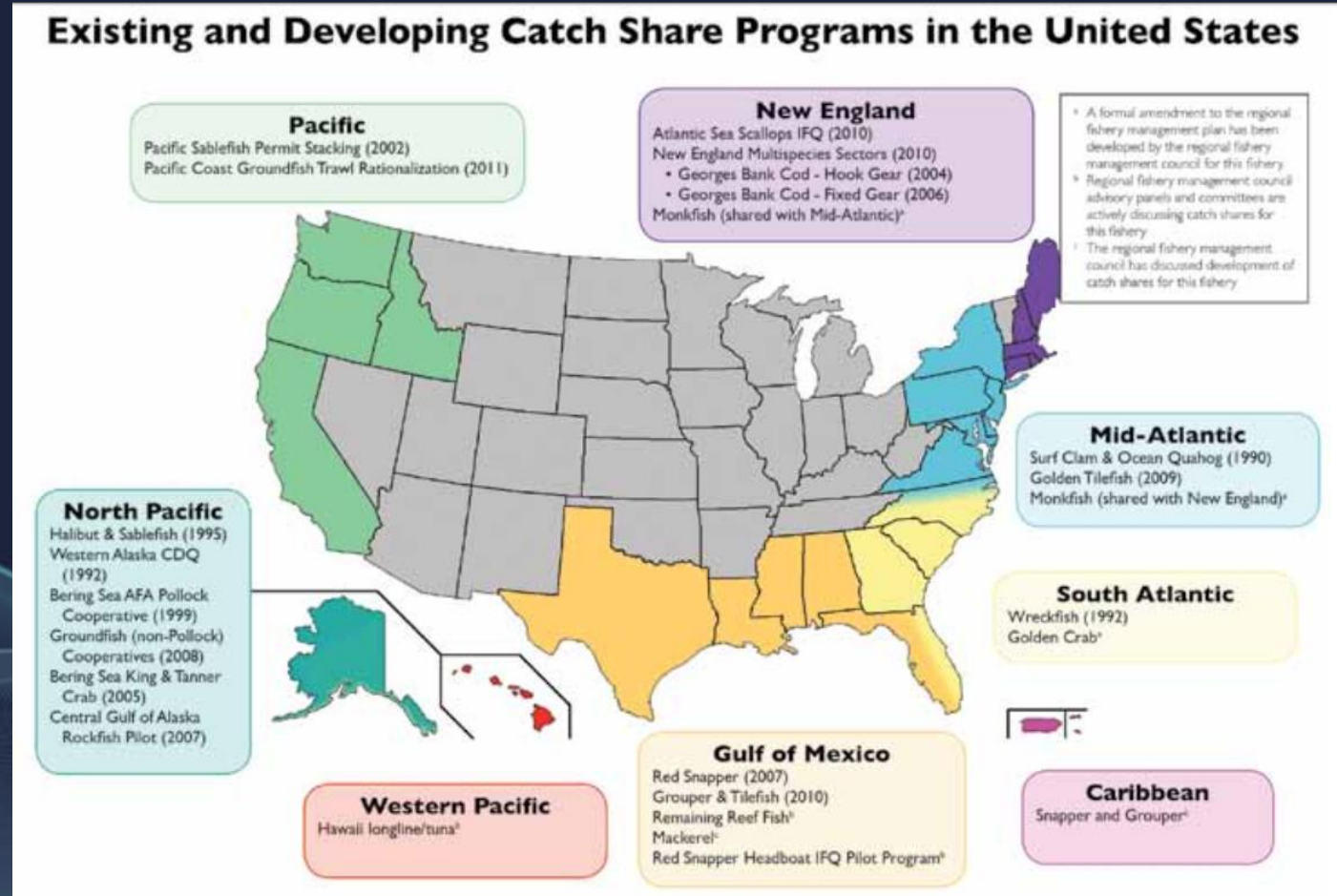
Gulf of Mexico Grouper & Tilefish IFQ (2010)

Atlantic Sea Scallop General Category IFQ (2010)

Northeast Multispecies Sector Program (2010)

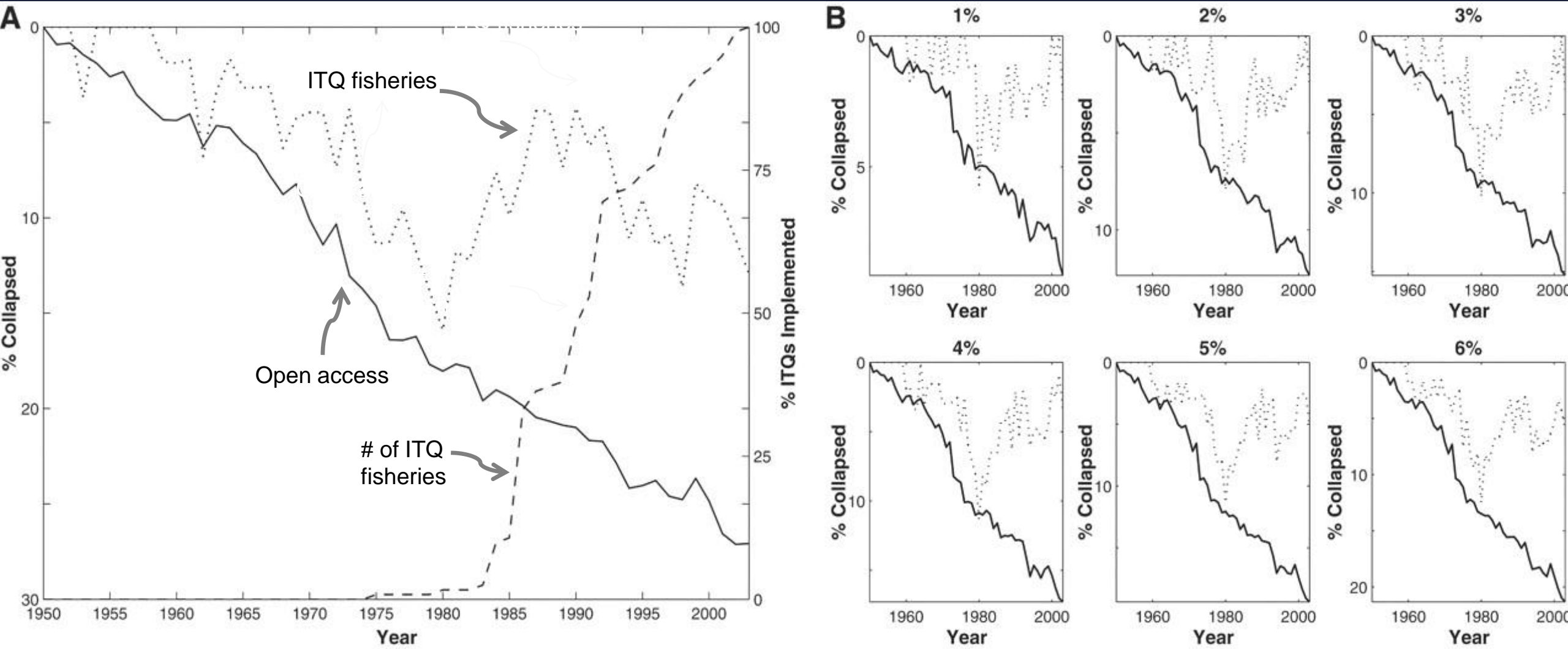
Pacific Coast Groundfish Trawl Rationalization (2011)

Central Gulf of Alaska Rockfish Program (2011)



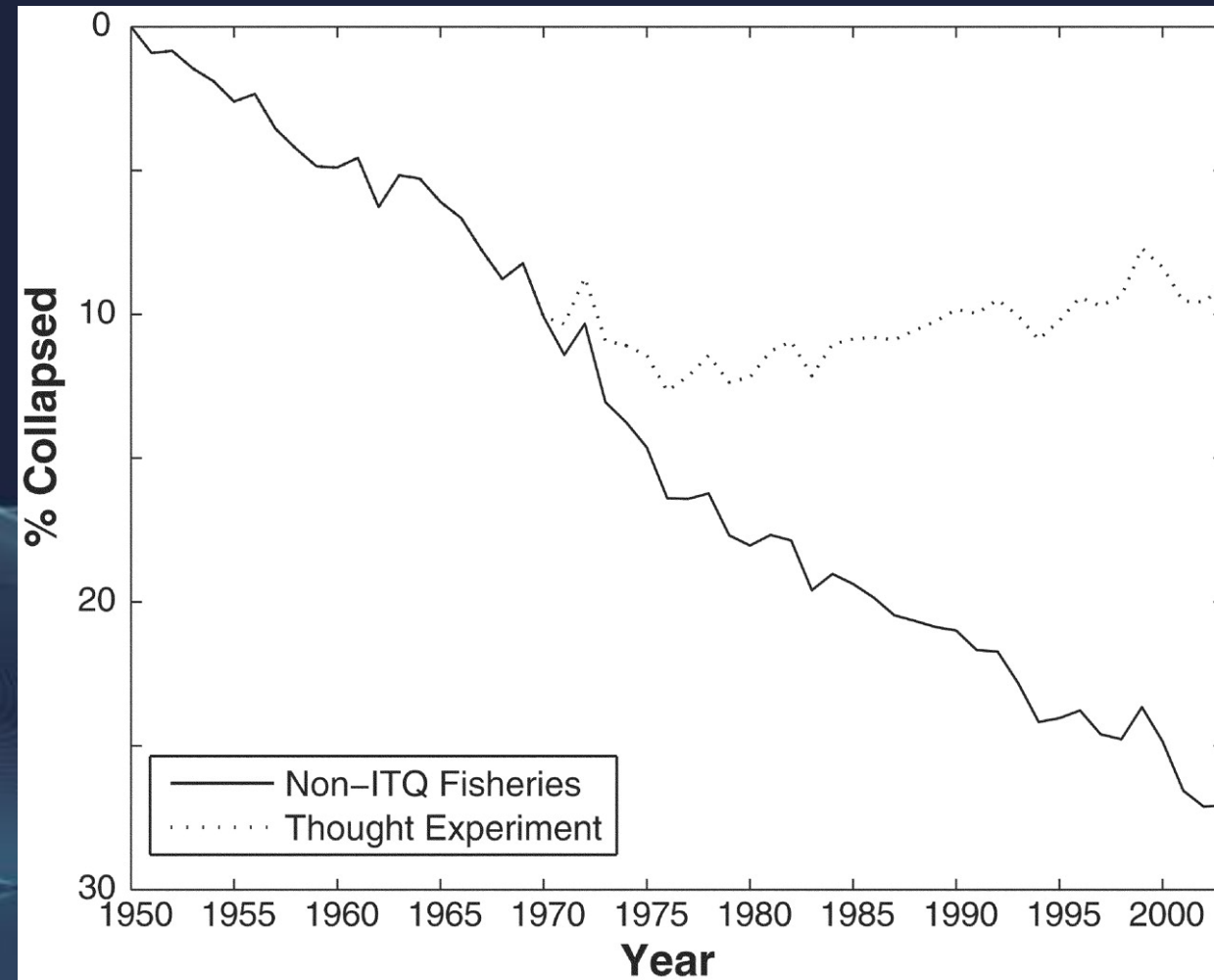
Catch Share Management

- Percent of fisheries collapsed with and without



Switched to Catch Share in 1970?

- Predicted fisheries collapse if all non Catch Share fisheries switched in 1970 (dotted line) compared to the actual trend (solid line).



Catch Share Programs

Crab Rationalization

Season length, Bristol Bay Red King Crab (BBR):

- Before Program (2004): ~ 3 Days;
- After Program (2007-8): ~ 93 Days

Season length, Bering Sea Snow Crab (BSS):

- Before Program (2004): ~ 5 Days
- After Program (2007-8): ~ 230 Days

Ex-vessel value

- Before Program (2004): ~ \$125M
- After Program (2007-8): ~ \$202M (worth \$177 M in 2004 dollars)

Consolidation

- Red King Crab: (2004) 251 vessels; (2007-8): 74 vessels (71% reduction)
- Snow Crab: (2004): 189 vessels; (2007-8): 78 vessels (59% reduction)

Stock status

- Of the 8 crab stocks managed under the Program, none have experienced overfishing.

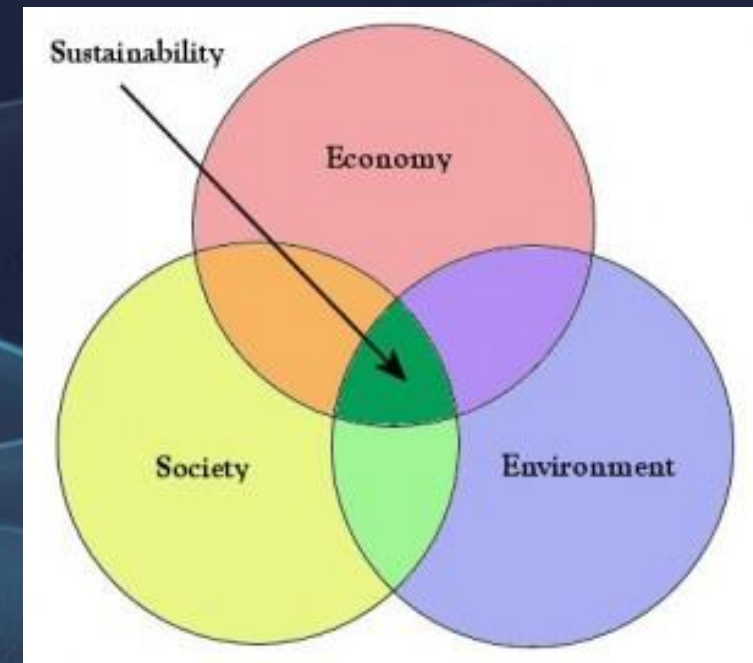


Self Check

- Catch share programs are seen as overwhelmingly beneficial and are being implemented in as many fisheries as possible
 - True
 - False
- Alaska Sein Salmon is an example of a catch share program
 - True
 - False

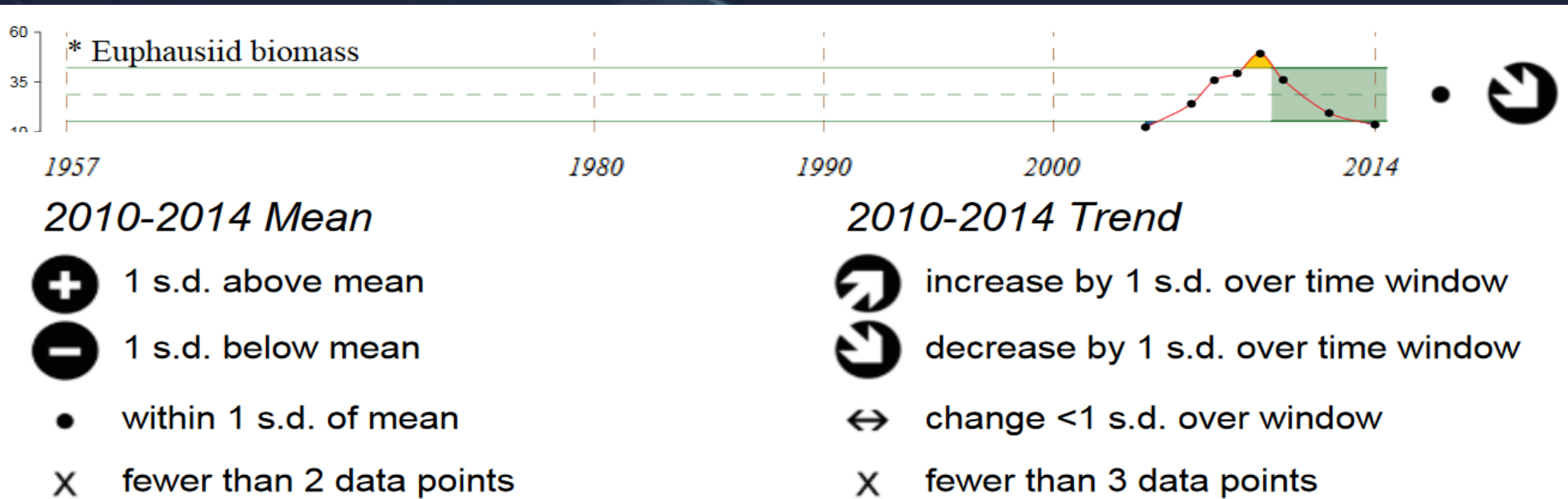
Ecologically Sustainable Yield (ESY)

- Allows a sustainable harvest that does not shift the marine ecosystem to an undesirable state
- Requires long-term monitoring of all trophic levels
- Requires more complete knowledge of the biology of individual species



Ecosystem Considerations

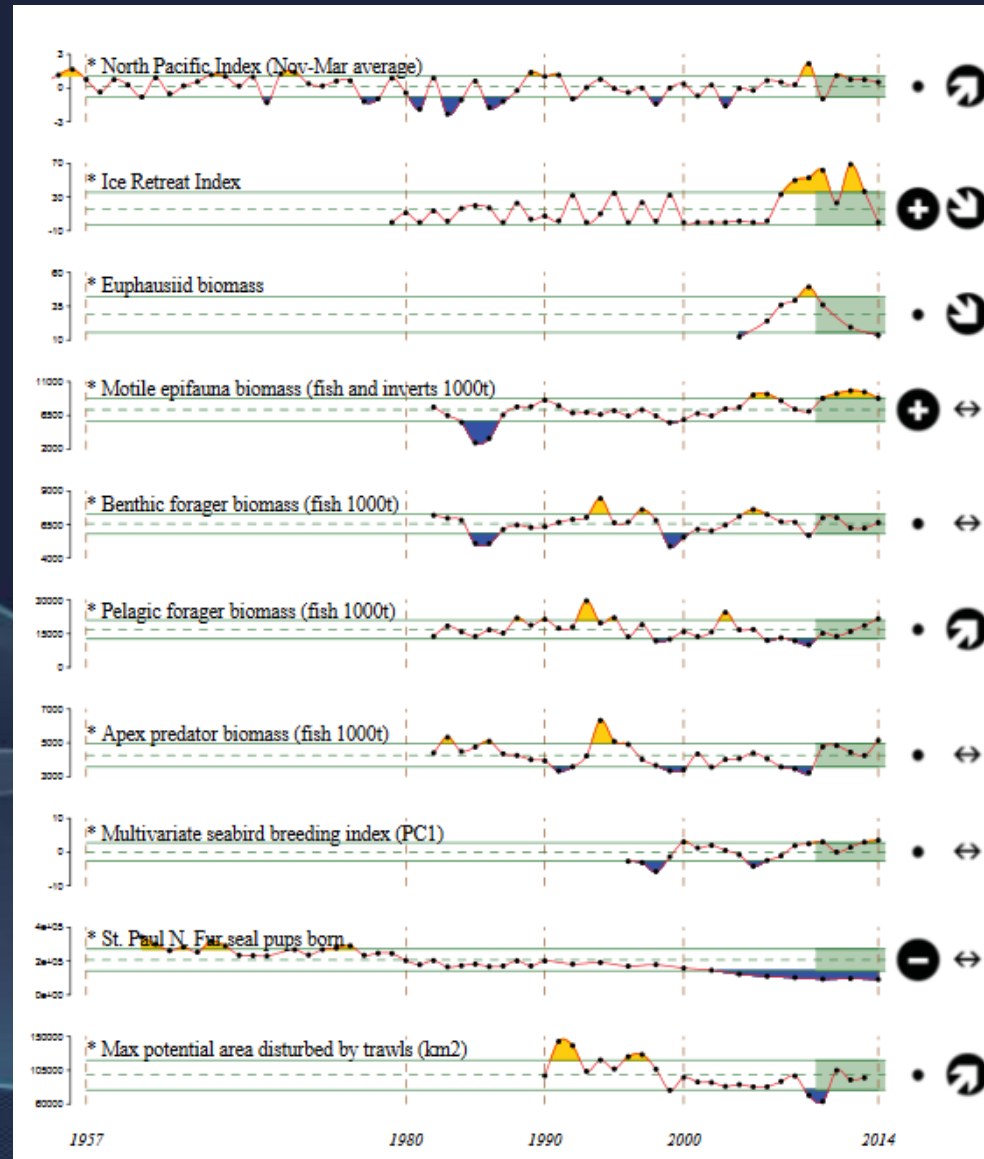
- Federal FMP's are required to include ecosystem chapter
 - Looks at various ecosystem components when making stock assessments and setting catch limits
 - Report Card tracks trends in easy to interpret manner



Ecosystem Considerations

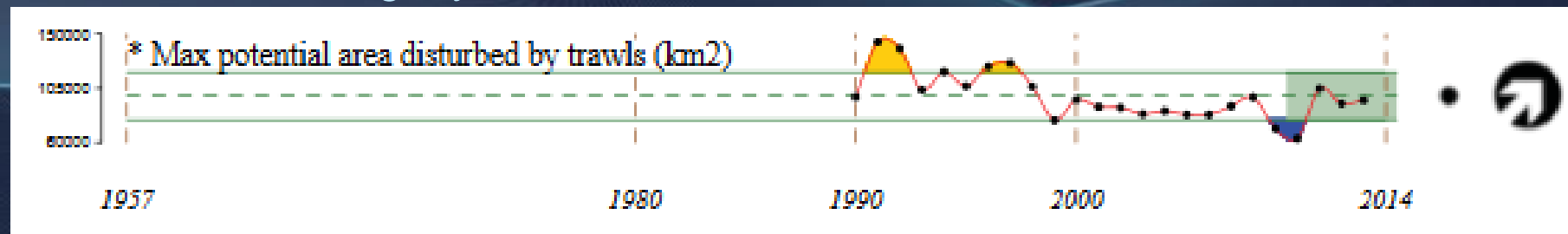
Groundfish Fisheries

- Temperature Index
- Ice retreat Index
- Euphausiid biomass
- Mobile epifaunal biomass
- Benthic forager biomass
- Pelagic forager biomass
- Apex Predator biomass
- Seabird breeding
- Fur seal pups born
- Area disturbed by trawls

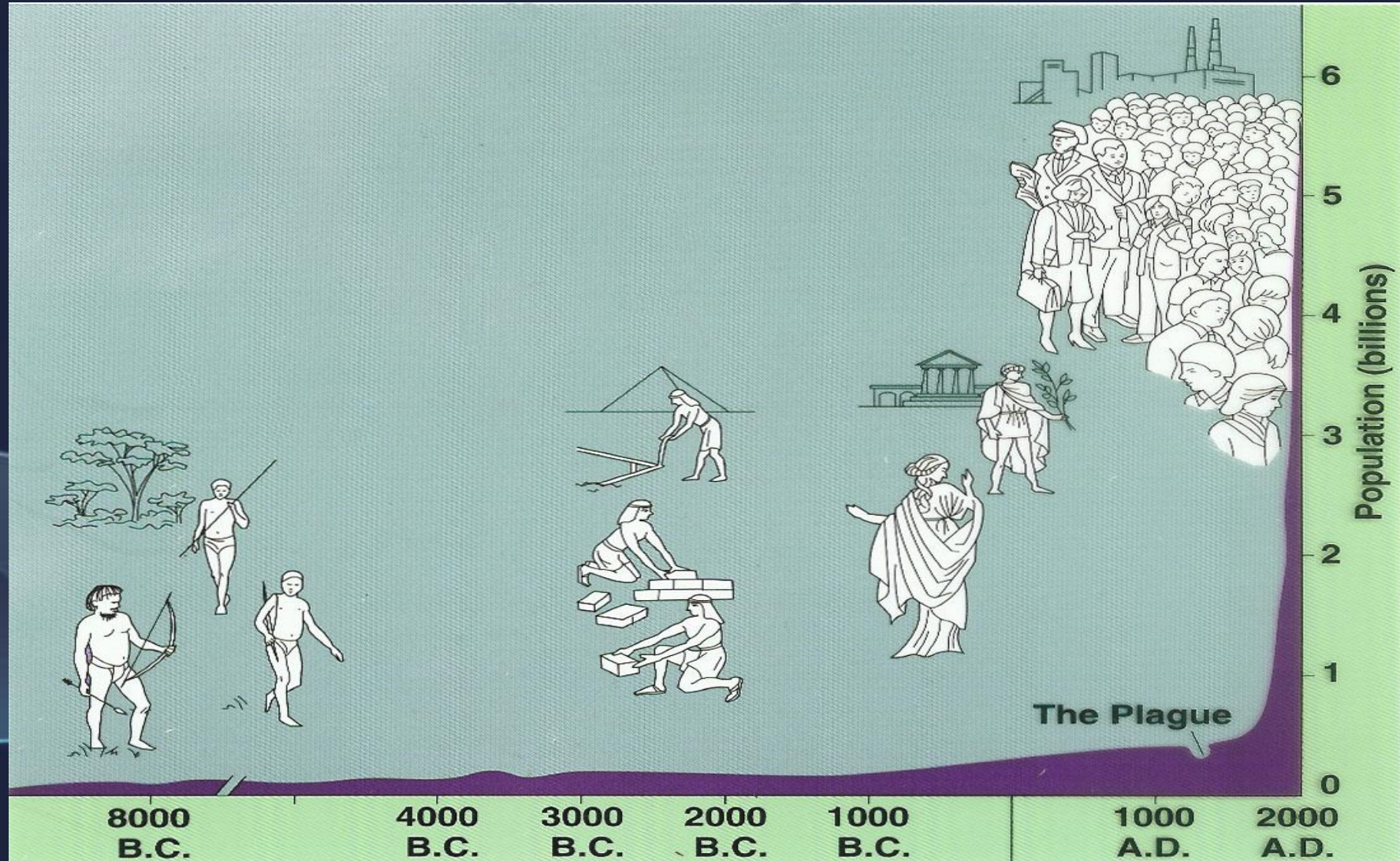


Self Check

- Ecosystem wide metrics are being taken into account more and more when making fishery decisions and setting catch limits
 - True
 - False
- In the below image what is the ecosystem report card telling us about area disturbed by trawls
 - The area Trawled has decreased dramatically
 - The area Trawled has Increased dramatically
 - The area Trawled has increased slightly
 - The area Trawled has decreased slightly



Can fish continue to feed the world?



The Future of Marine Fisheries

“An ecosystem-based approach is founded on the notion that robust fisheries depend on healthy marine ecosystems..... Ideally, ecosystem-based fishery management would shift the burden of proof that fishing would not take place unless it could be shown not to harm key components of the ecosystem.”

Pikitch, et al. 2004

- Nuclear plant testing
- FDS Drug testing
- Crash Safety

Ecosystem-based Fishery Management

- Reduce bycatch
- Marine reserves
- Monitoring of population characteristics
- Catch share programs
- Ecologically sustainable yield

Stock Assessment Homework

- Identify a Fishery (local or not)
- Examine how it is assessed (Stock assessment)
- Examine the types of information that the assessment collects
- Look at how the assessment informs management of the fishery
- Make a 3 minute presentation (4 slides max)
- To be presented (or recorded before next class)

Good Night

The background of the image is a dark blue gradient. It features several overlapping, semi-transparent, wavy lines in shades of light blue and cyan. These lines flow across the frame, creating a sense of movement and depth. The lines are most prominent in the lower half of the image, where they appear to be layered and intersect, creating a complex, organic pattern. The overall effect is a calm and modern aesthetic.