Climate Change and Marine Protected Areas: A Fisheries Perspective from Alaska

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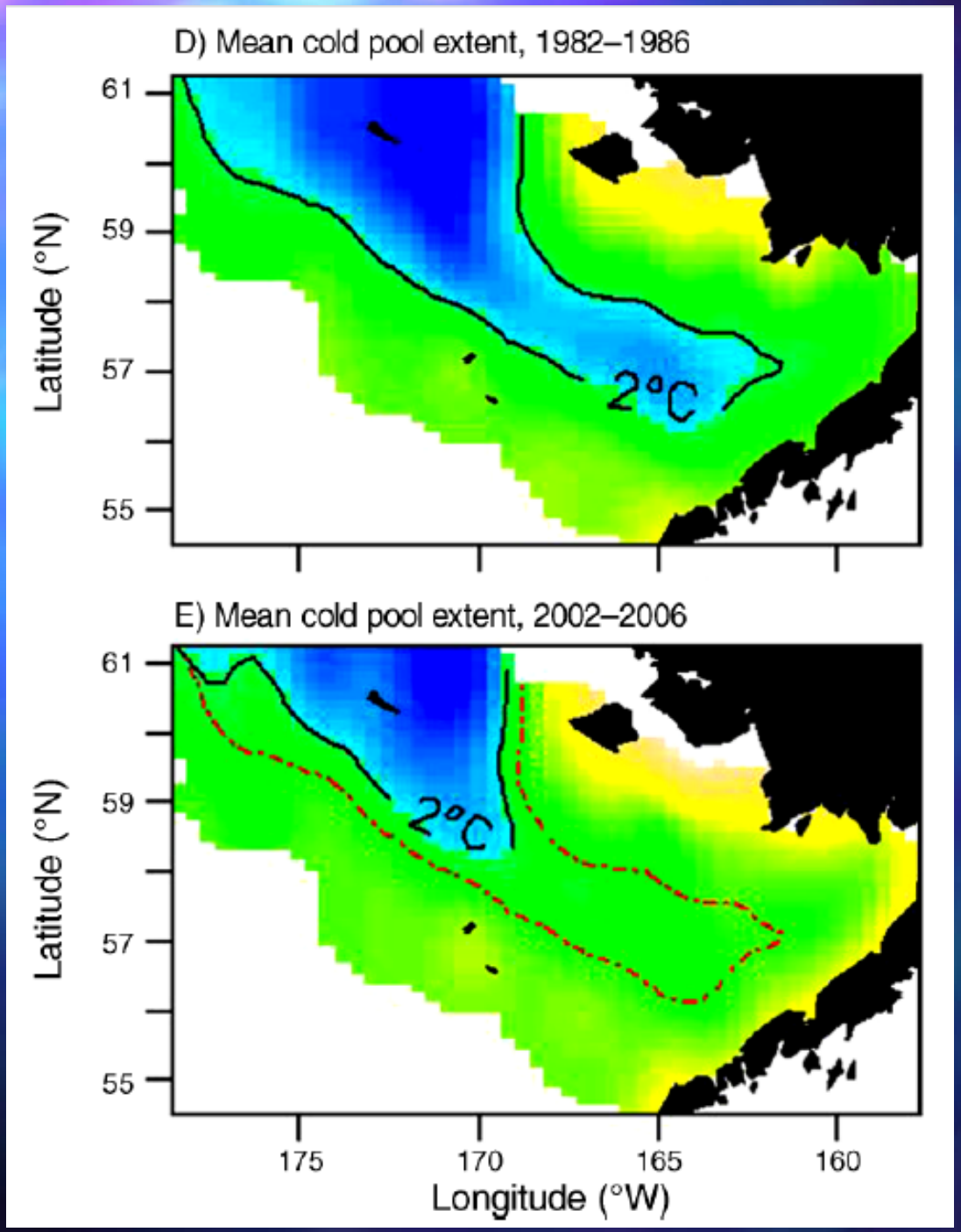
Impacts of Climate Change on Species & Habitats Managed by MPAs

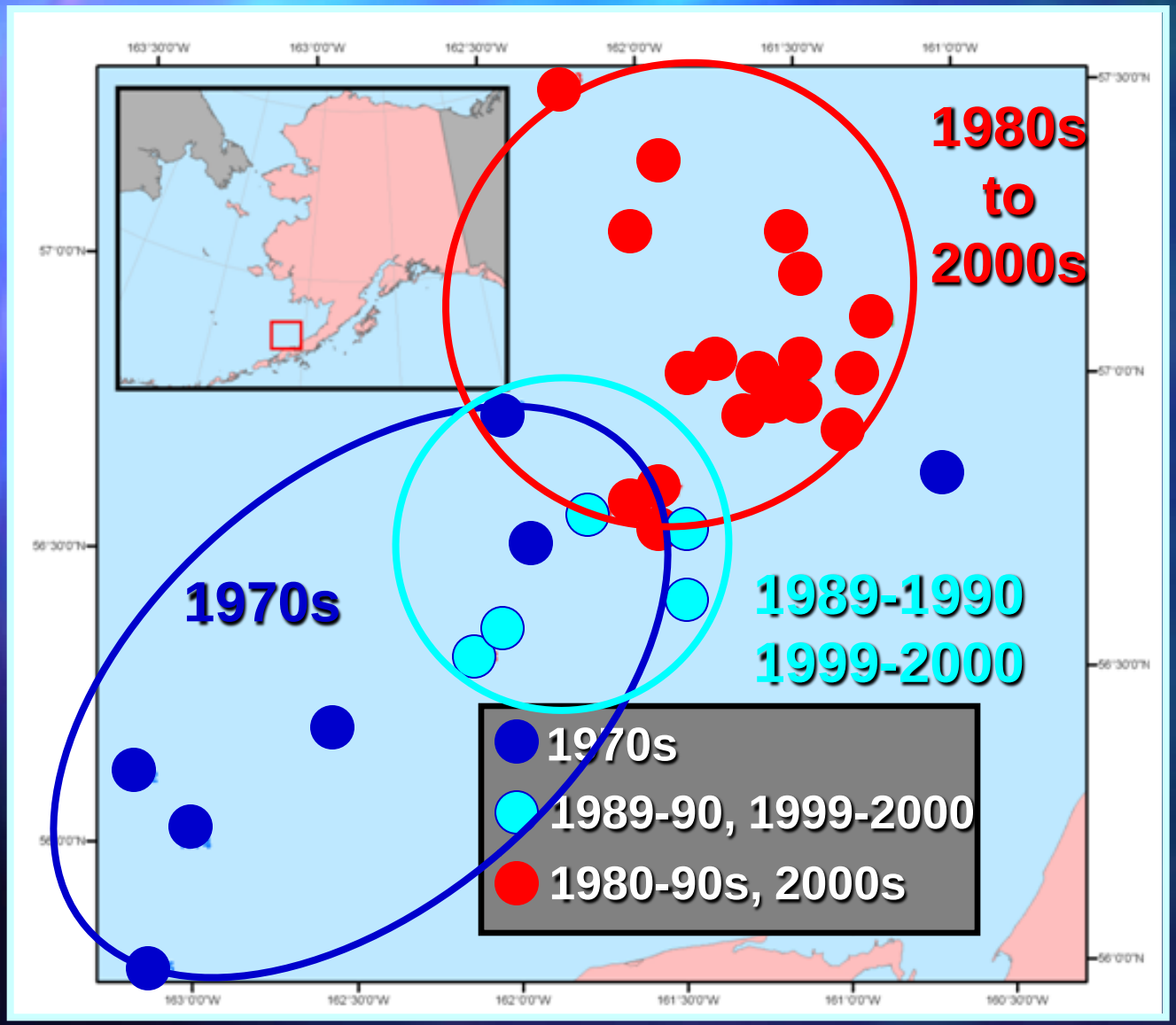
Shifts in Geographic Distributions

- Species unlikely to shift much – Arctic species (e.g., Arctic cod, polar bears), species limited by geomorphology (e.g., Aleutian Islands deep-sea corals, Cook Inlet beluga whales)
- Species likely to shift a lot – Pelagic species (e.g., Pacific salmon, Pacific herring, albacore tuna, mackerel), benthic species on broad continental shelf (e.g., Bering Sea groundfish)
- Southern edge of EBS cold pool (<2 C) shifted 230 km since 1980s – defines ecotone between arctic and subarctic communities



Mueter & Litzow (2008)

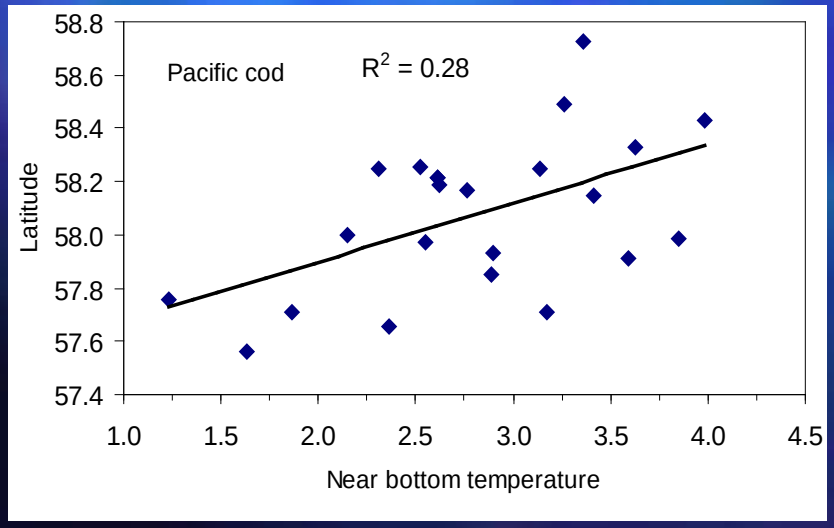
Annual Centers of Distribution: Red King Crab

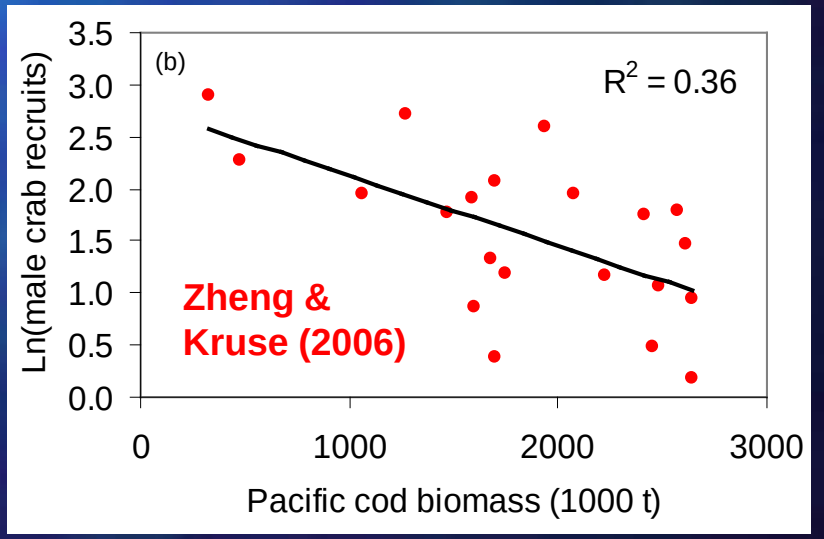


Centers of Distribution of mature female red king crabs in Bristol Bay (after Zheng & Kruse 2006)

Ecological Effects: Predators & Prey

- Mackerel extend further north to BC in warm years
- Reduced survival of WCVI sockeye salmon correlated with abundance and early arrival of Pacific mackerel
- Pacific cod latitudinal distribution & biomass related to red king crab recruitment

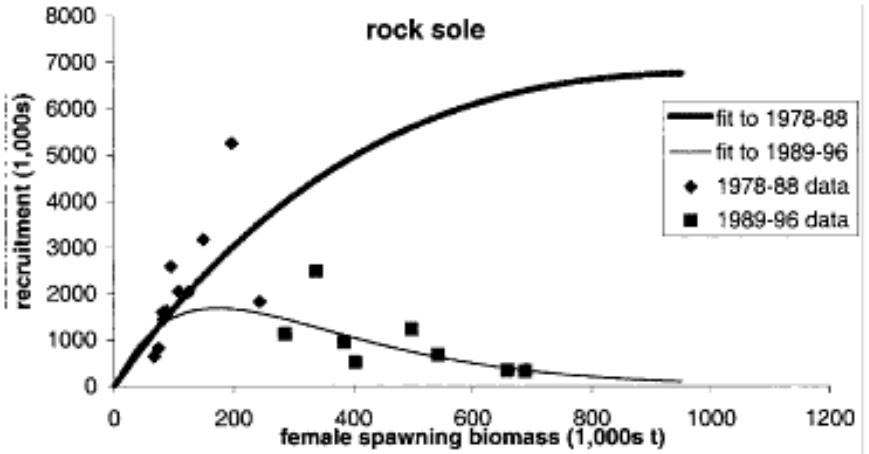


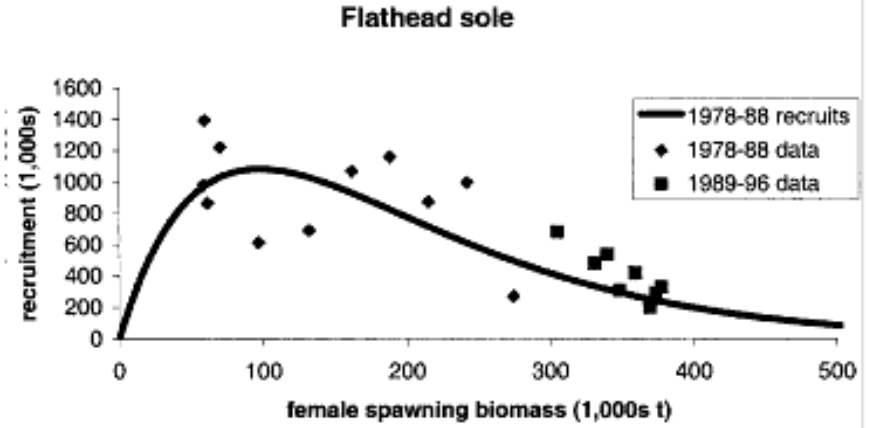


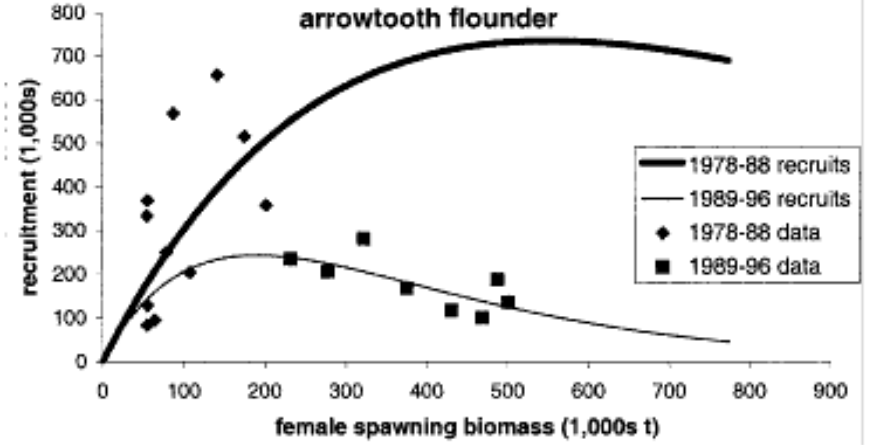
Changes in Mean Productivity

- Rock sole and arrowtooth flounder more productive in late 1970s to late 1980s than late 1980s to late 1990s
- No change for flathead sole

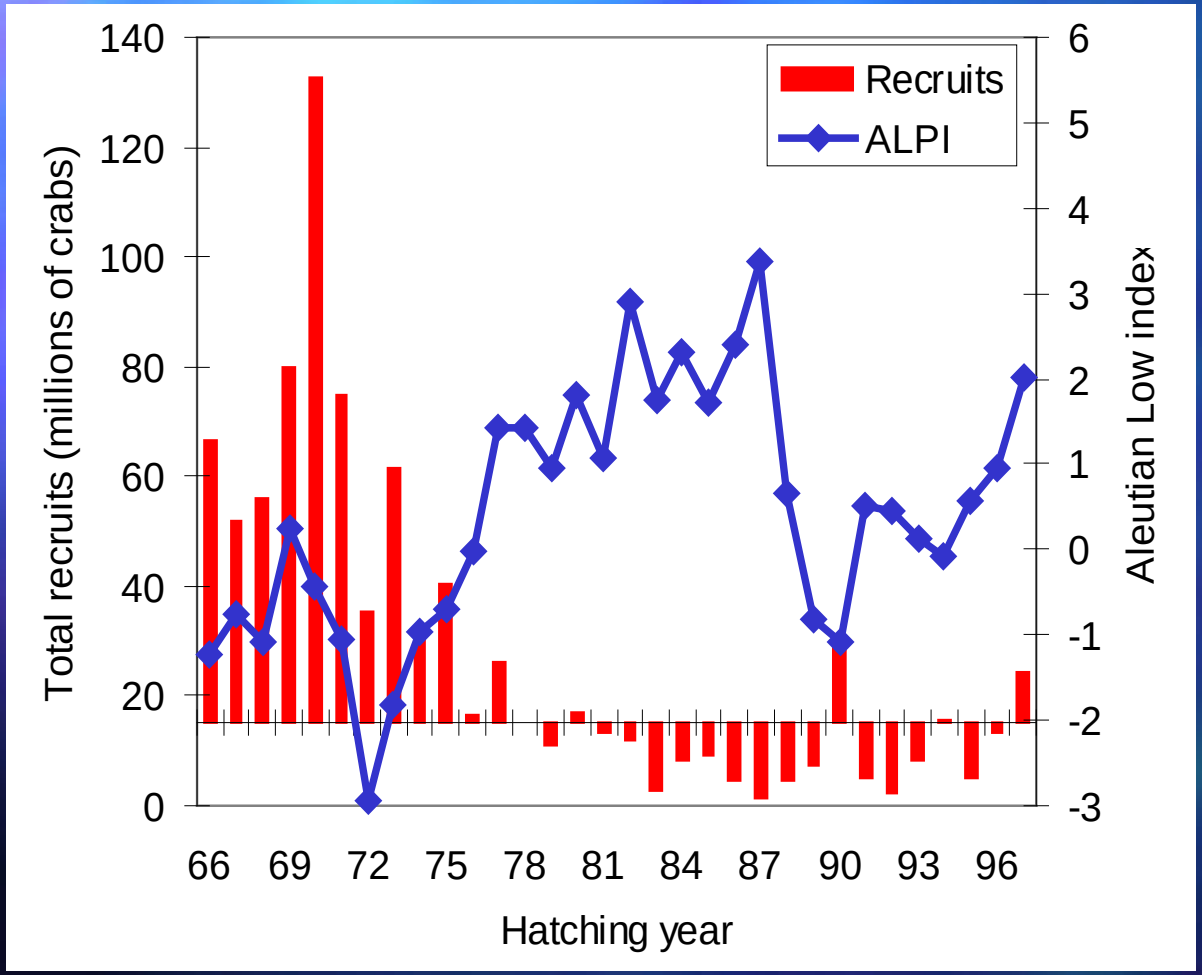
Wilderbuer et al. (2002)







Changes in Variability: Red King Crab Recruitment

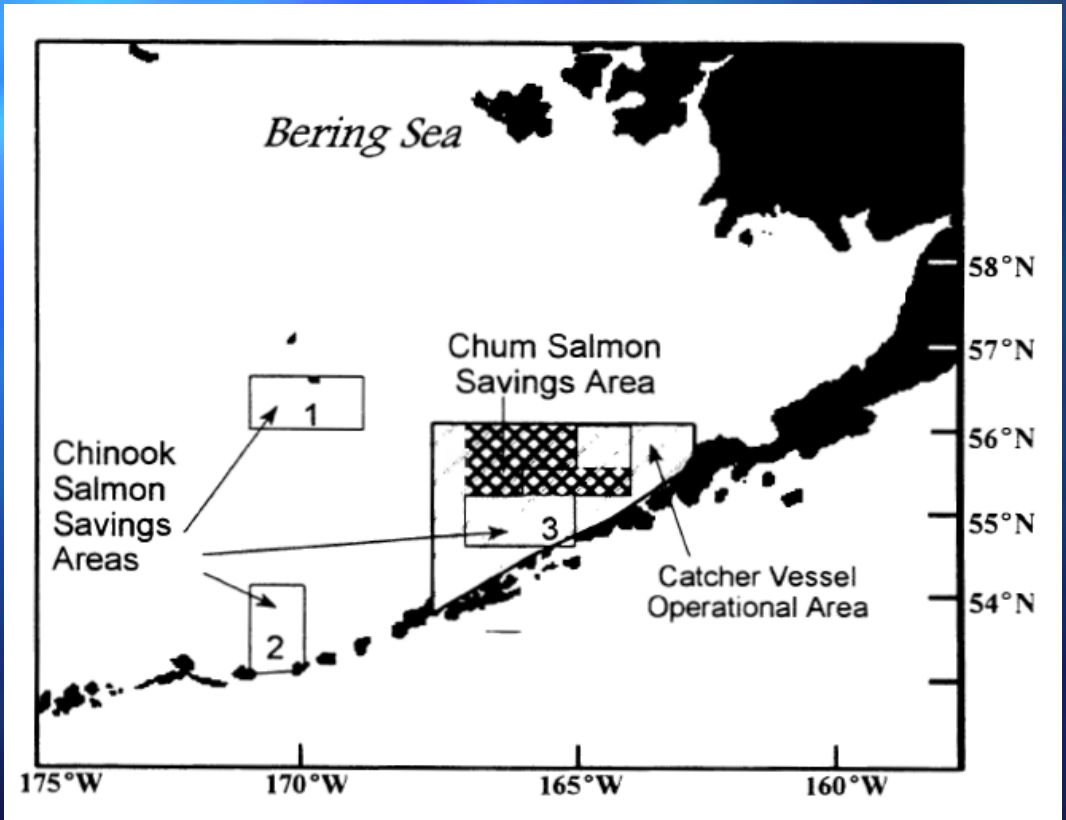


- Many strong year classes occurred before 1977
- Even moderate year classes are rare after 1977

Issues to Address by Marine Protected Areas

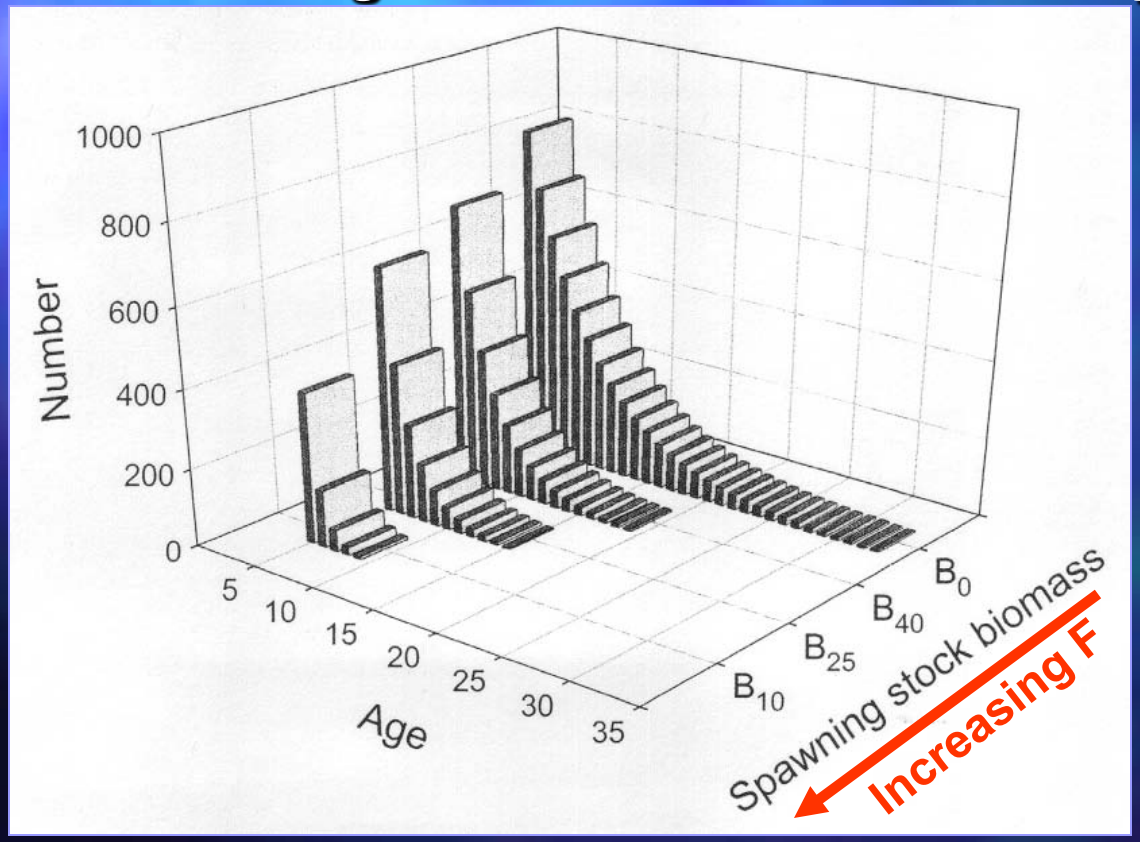
Impacts of Climate Change on Existing MPAs

- **Need to adapt** – Chinook and chum salmon savings areas established in the early 1990s had to be abandoned in the late 2000s



Role of MPAs in Addressing Climate Change Impacts & Fostering Resilience

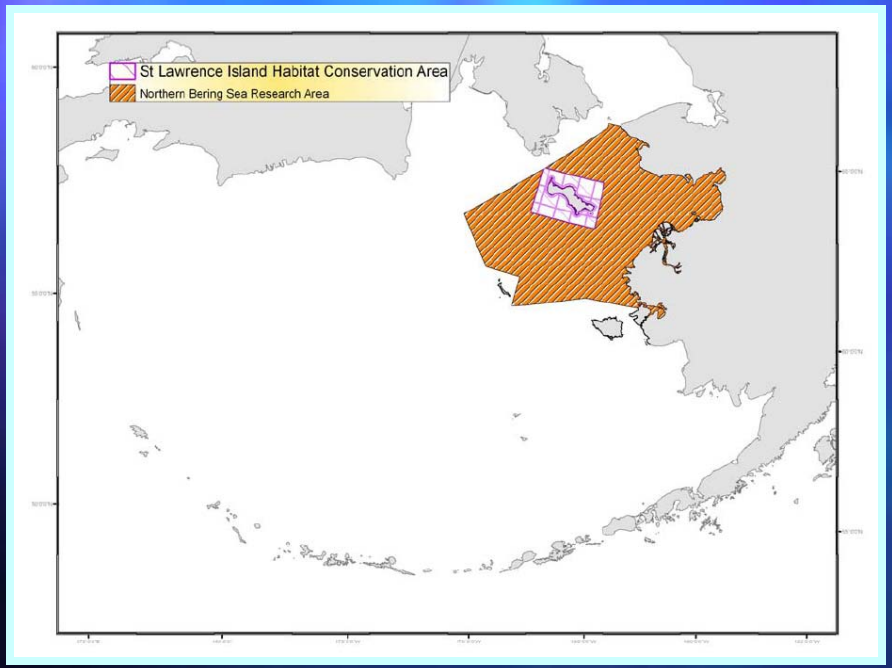
- **Buffer against increased variability – Fishery closures serve to maintain full age and size structure as buffer against increased variability in recruitment**

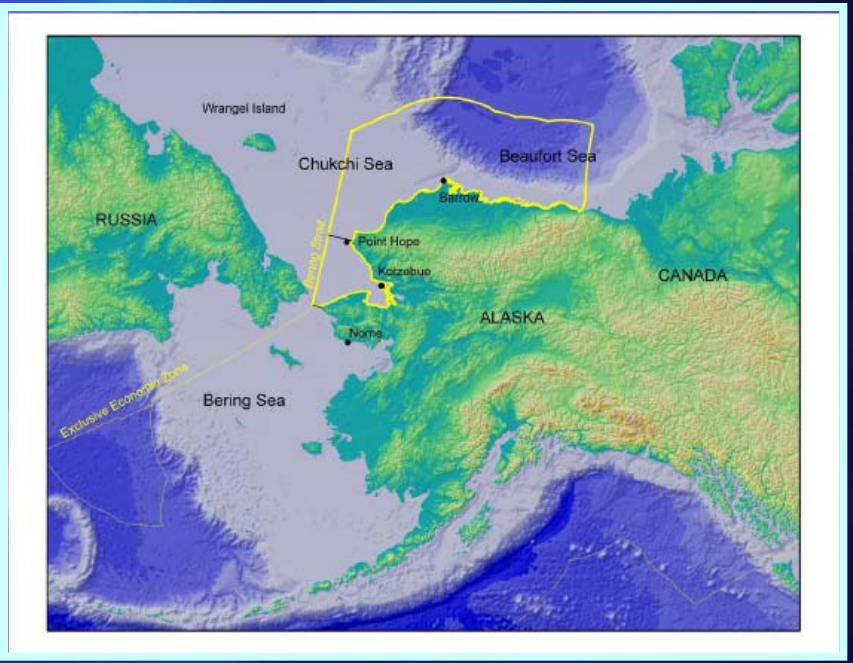


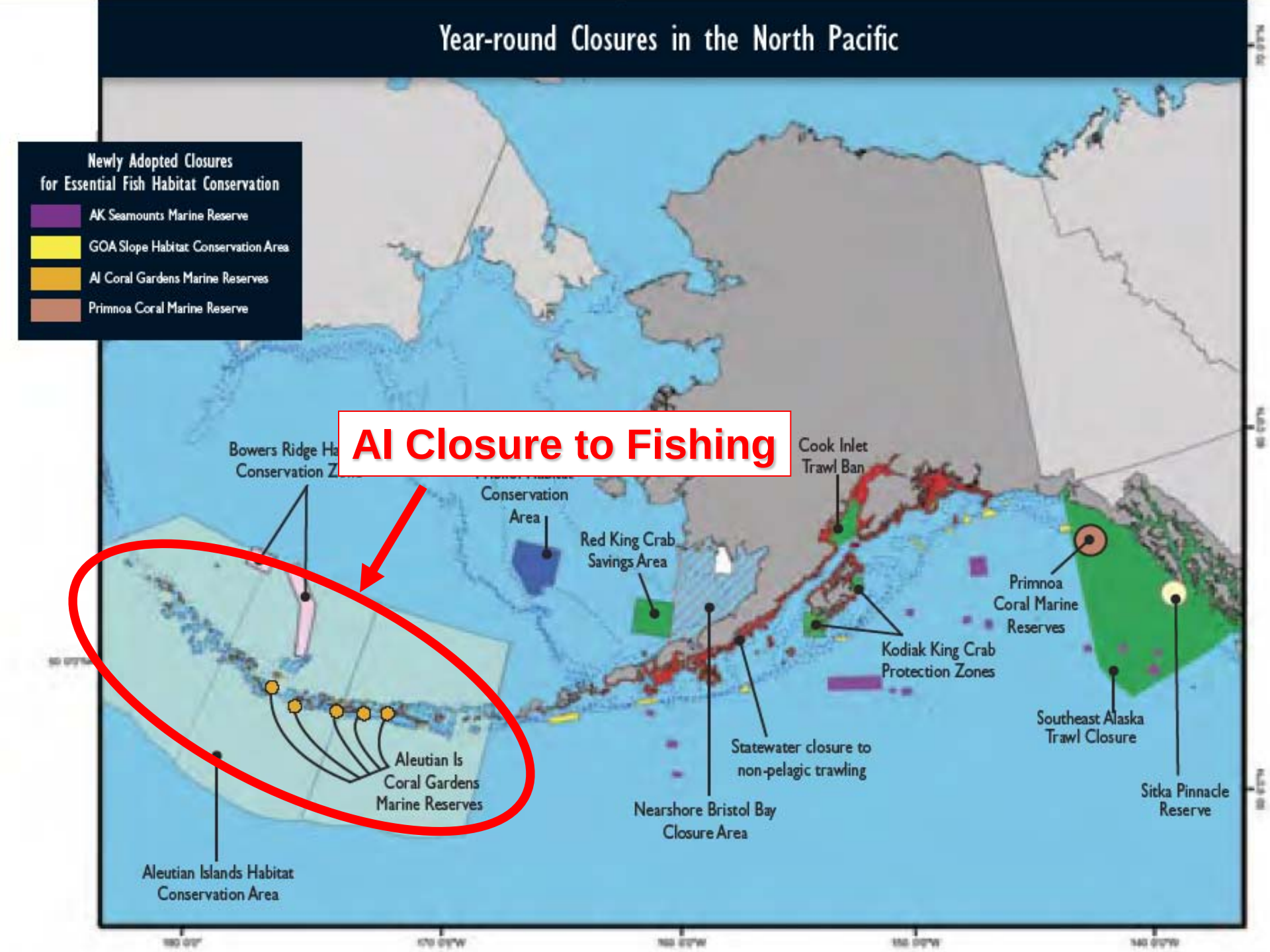
- **Fishing removes the largest (oldest) fish from a population**

Role of MPAs in Addressing Climate Change Impacts & Fostering Resilience

- **Provide resilience by reducing other stressors – Area closures protect non-mobile species and habitats from other stressors (e.g., fishing)**






Year-round Closures in the North Pacific
Newly Adopted Closures for Essential Fish Habitat Conservation
AK Seamounts Marine Reserve
GOA Slope Habitat Conservation Area
AI Coral Gardens Marine Reserves
Primnoa Coral Marine Reserve
AI Closure to Fishing
Bowers Ridge Ha
Conservation Z
Conservation Area
Red King Crab Savings Area
Cook Inlet Trawl Ban
Primnoa Coral Marine Reserves
Kodiak King Crab Protection Zones
Southeast Alaska Trawl Closure
Sitka Pinnacle Reserve
Statewater closure to non-pelagic trawling
Nearshore Bristol Bay Closure Area
Aleutian Is Coral Gardens Marine Reserves
Aleutian Islands Habitat Conservation Area

How should MPAs be Integrated with other Measures to Build Resilience?

- Ecosystem approach to management (EAM) – strives to balance diverse societal objectives by applying an integrated approach within ecologically meaningful boundaries. MPAs are just one tool.
- Need to define policy goals & operational objectives
- Need to monitor performance relative to objectives