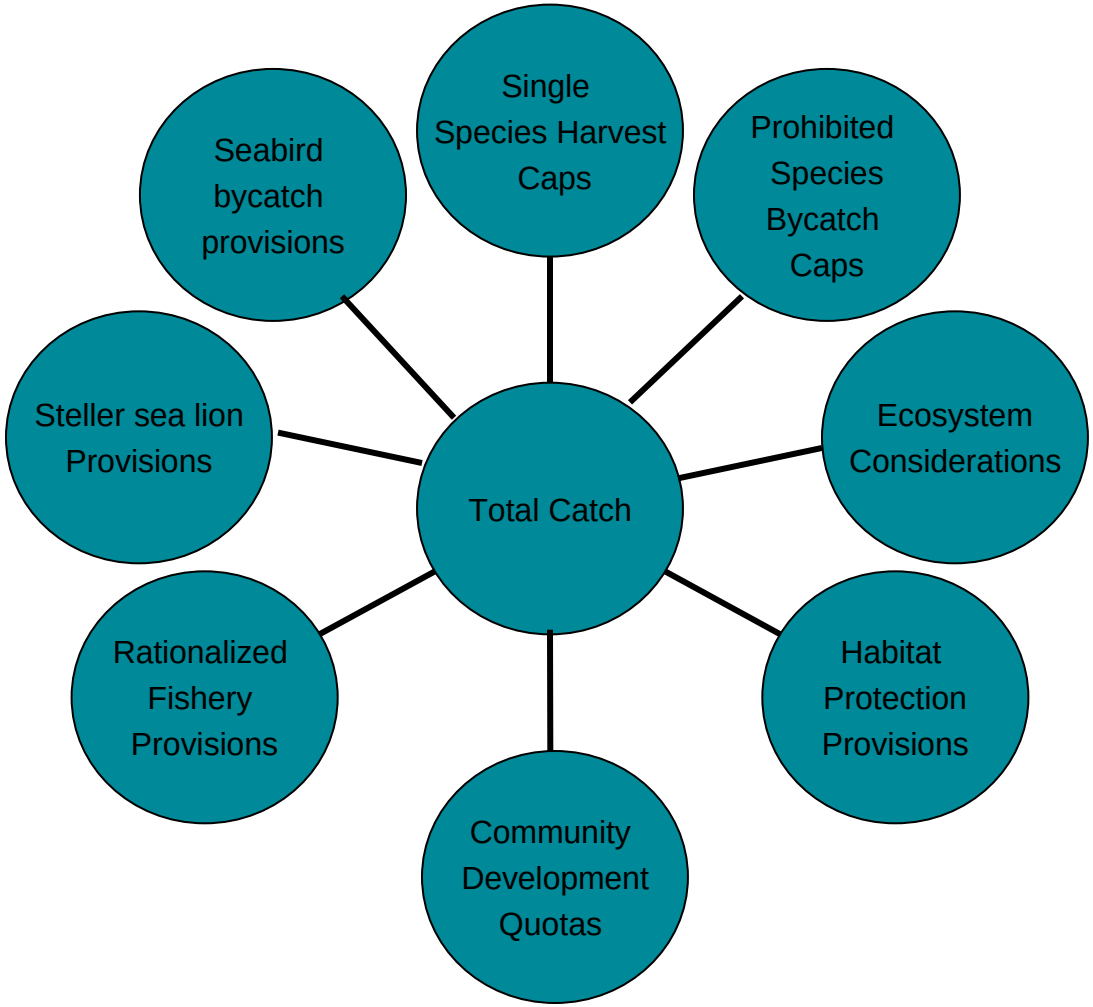
Projecting future status and trends of commercial fish and fisheries under shifting management strategies and climate change

Anne Hollowed

Alaska Fisheries Science Center

Multi-species, Multi-fishery, Multi-Sector, Multi-Objective Management



North Pacific Fishery Management Council
Ecosystem Approach to Management

- ✓*Prevent Overfishing – Annual Catch Limits*
- ✓*Promote Sustainable Fisheries and Communities – science based guidelines*
- ✓*Preserve Food Web – Weak stock management*
- ✓*Manage Incidental Catch and Reduce Bycatch and Waste*
- ✓*Avoid Impacts to Seabirds and Marine Mammals*
- ✓*Reduce and Avoid Impacts to Habitat*
- ✓*Promote Equitable and Efficient Use of Fishery Resources*
- ✓*Increase Alaska Native Consultation*
- ✓*Improve Data Quality, Monitoring and Enforcement*

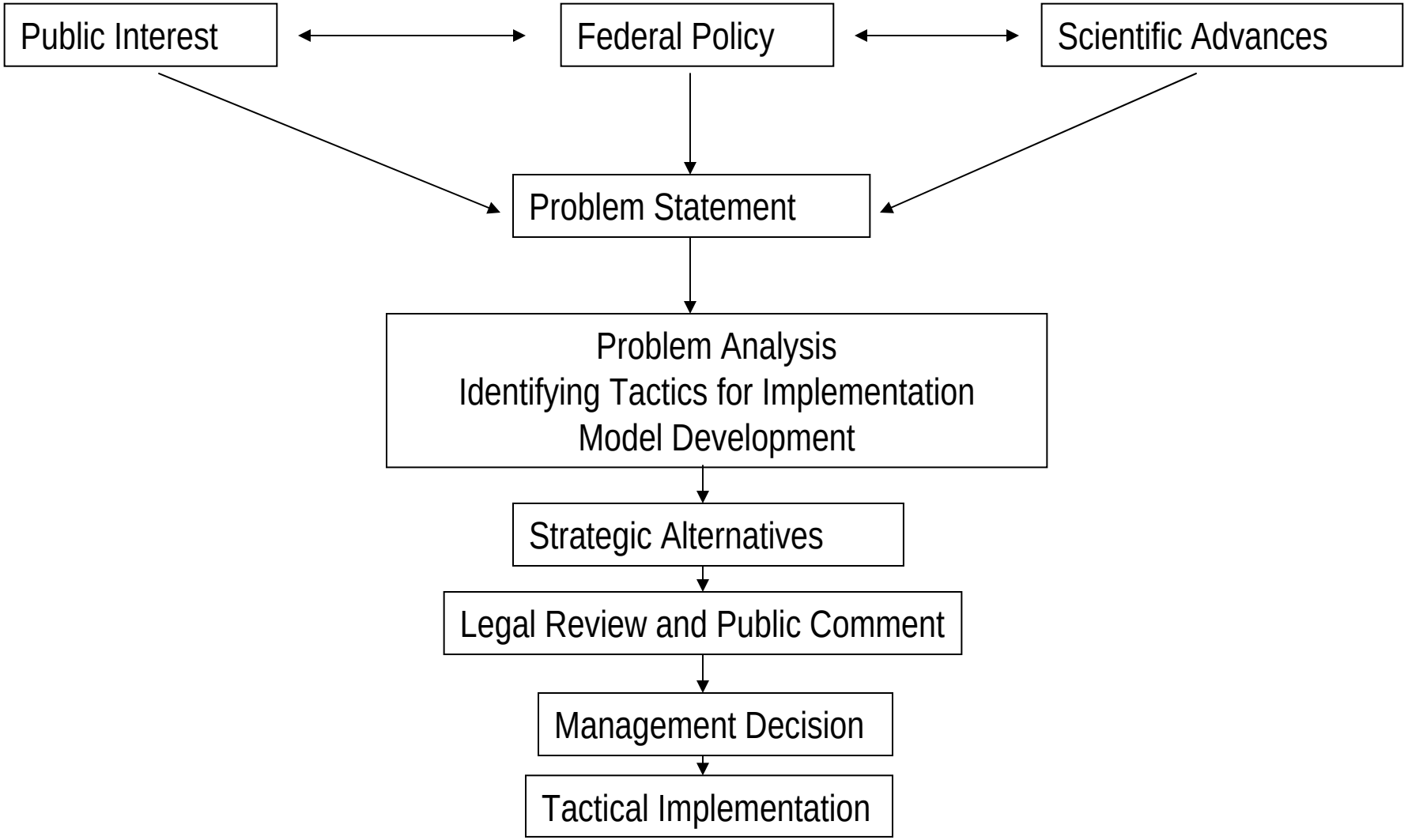
www.fakr.noaa.gov/tasking/management_FMP.pdf

Elements of Successful Co-management

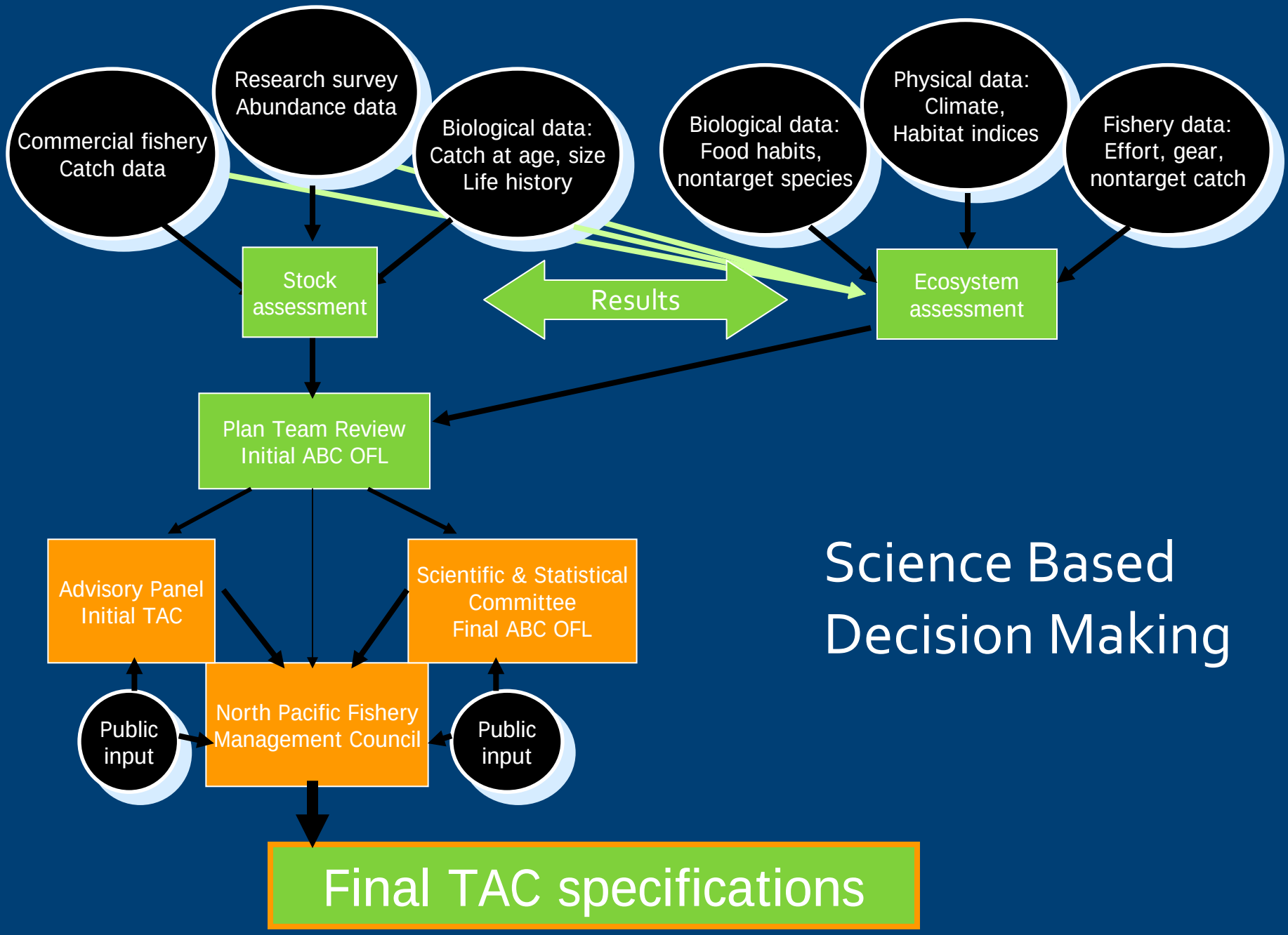
- ✓ Community involvement in decision making
- ✓ Community development quota - CDQ
- ✓ Catch shares - Cooperatives or Individual Transferable Quotas
- ✓ Marine spatial plan (protected areas)
  - ✓ prevent gear conflicts
  - ✓ limit incidental catch of unintended species,
  - ✓ mitigate species interactions

Nicolas L. Gutierrez, Ray Hilborn & Omar Defeo. 2010. Nature

Public Decision Making Process: Based on Best Available Science



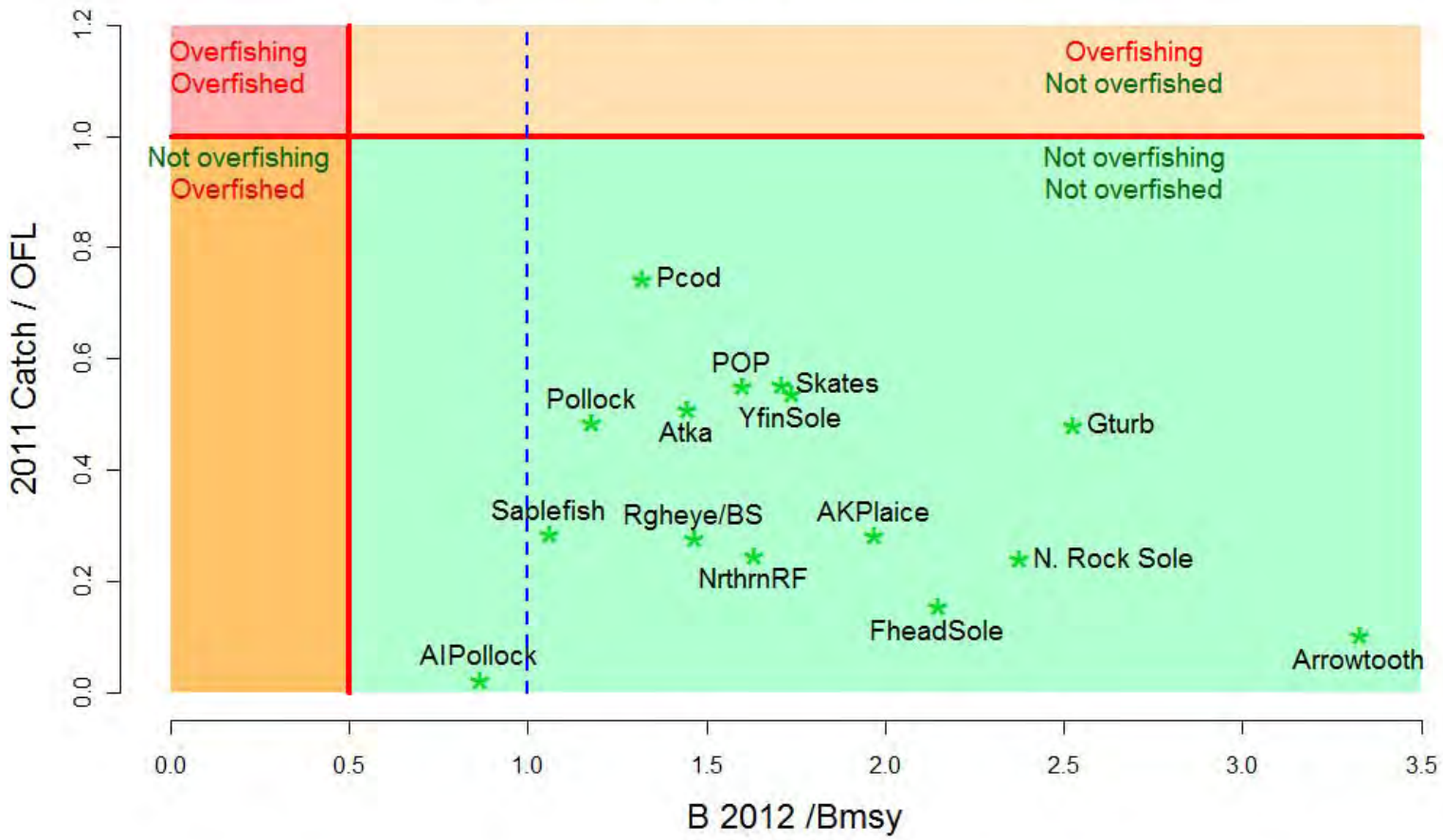
Hollowed, et al. 2011. *Fisheries and Fisheries* 12: 189-208.



Science Based Decision Making

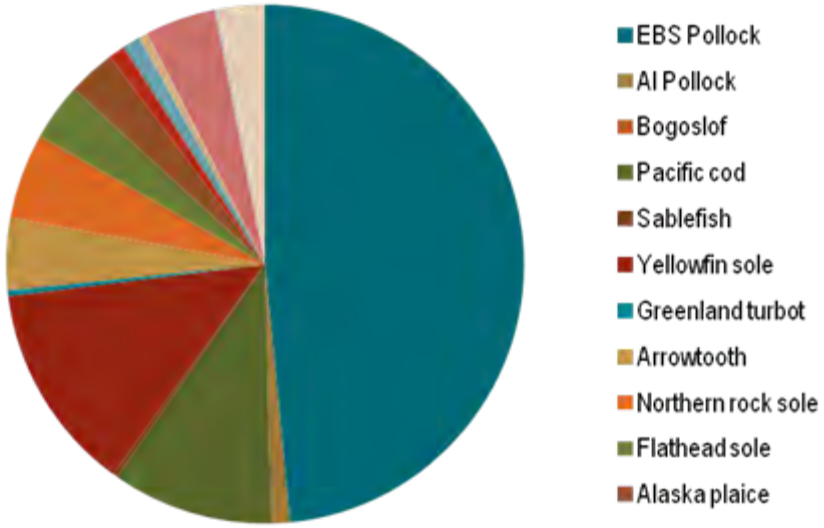
Hollowed, et al. 2011. *Fisheries and Fisheries* 12: 189-208.

Bering Sea and Aleutian Islands

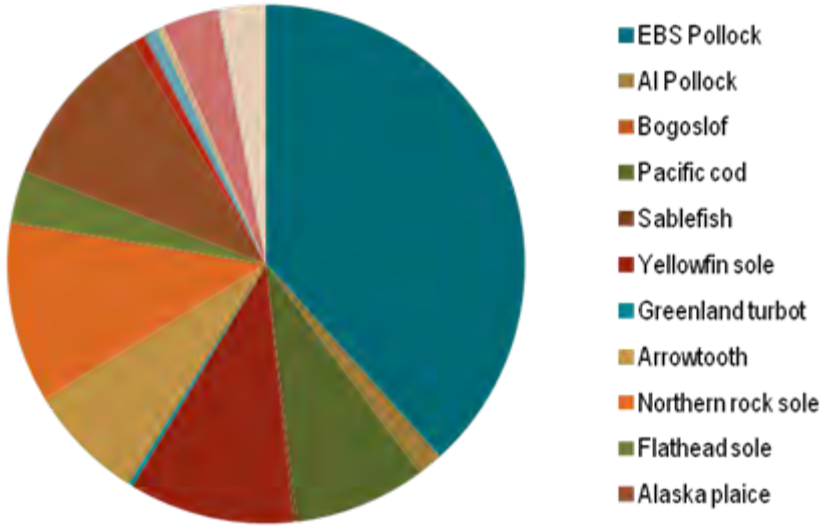


- *Catch accounting including non-targets, prohibited species, seabirds, other non-specified (e.g., forage fish)*
- *Buffer between ABC and OFL*
- *2 million ton overall cap*
- *Retention cap on forage fish*
- *Peer Review*
- *Essential Fish Habitat – 5 year assessment and review*

2010 Total Allowable Catch



2010 Acceptable Biological Catch



Prohibited species Management

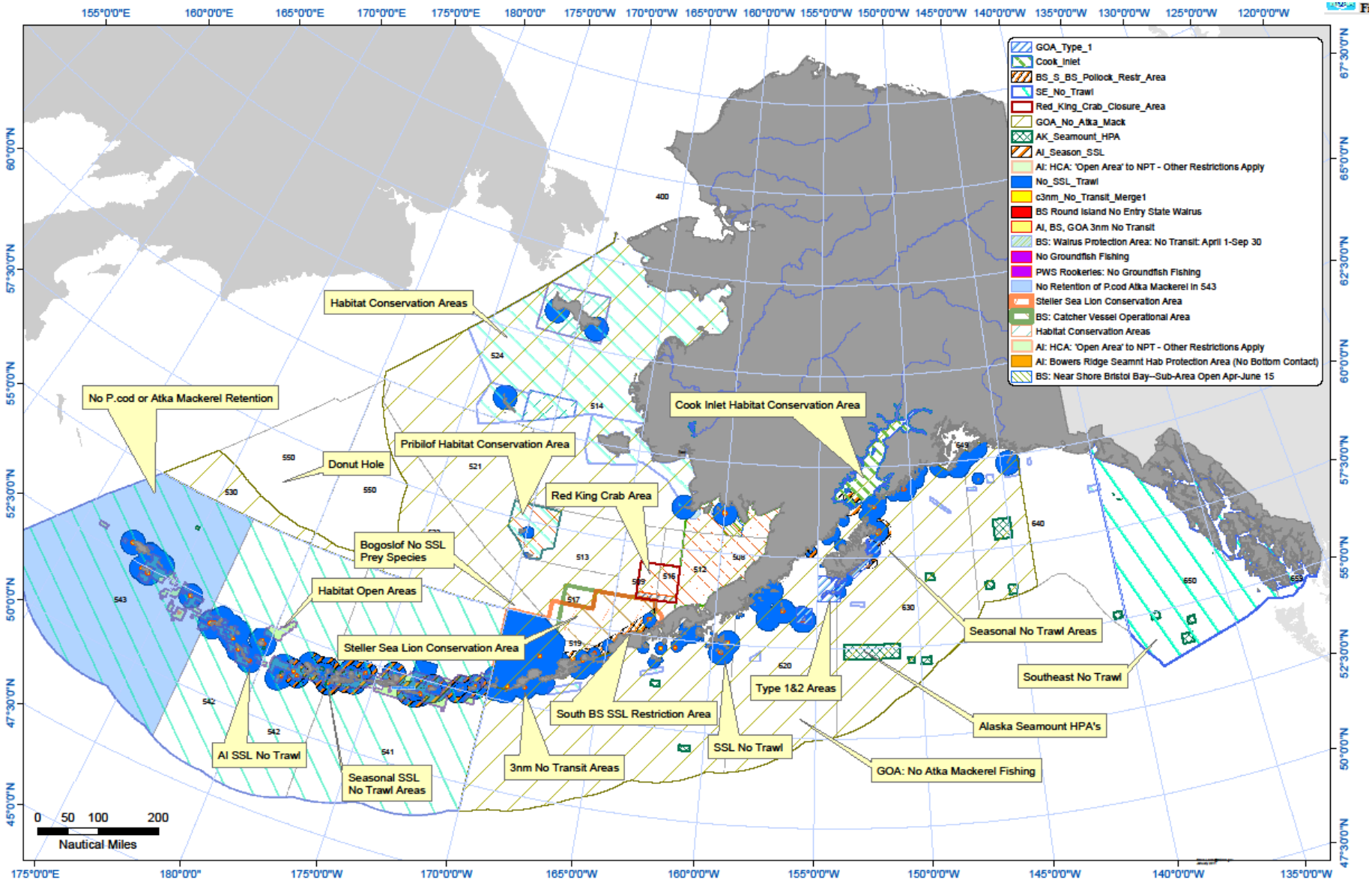
- Prohibited species caps:

P. halibut, BSAI crab, P. salmon (especially Chinook and Chum), P. herring

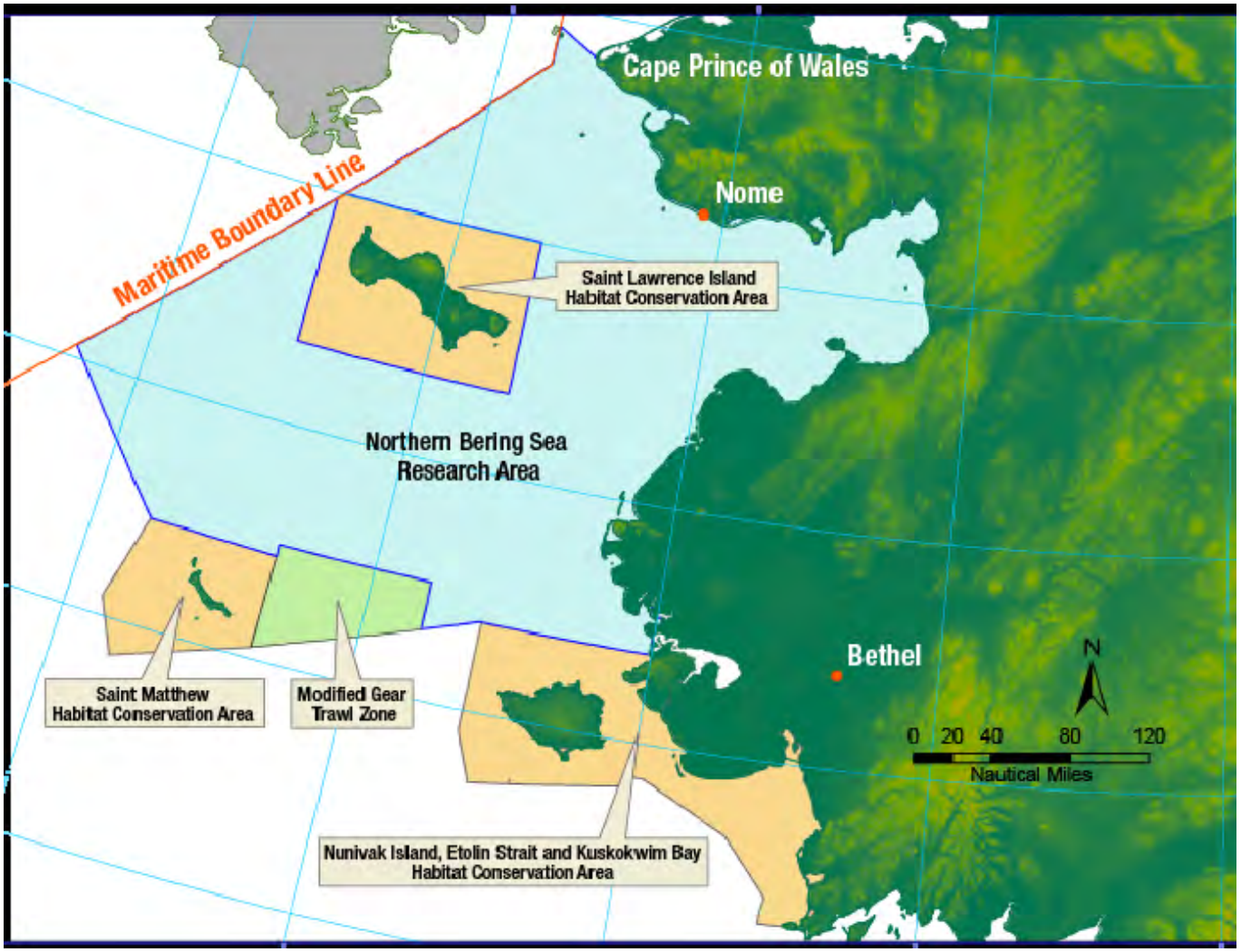
- Gear/Area closures
  - Bristol Bay Red King Crab Conservation Area
- Chinook salmon:
  - Hard cap + incentive programs
- Chum salmon: TBD

Pacific herring. Photo: JJ Vollenweider, NOAA Fisheries

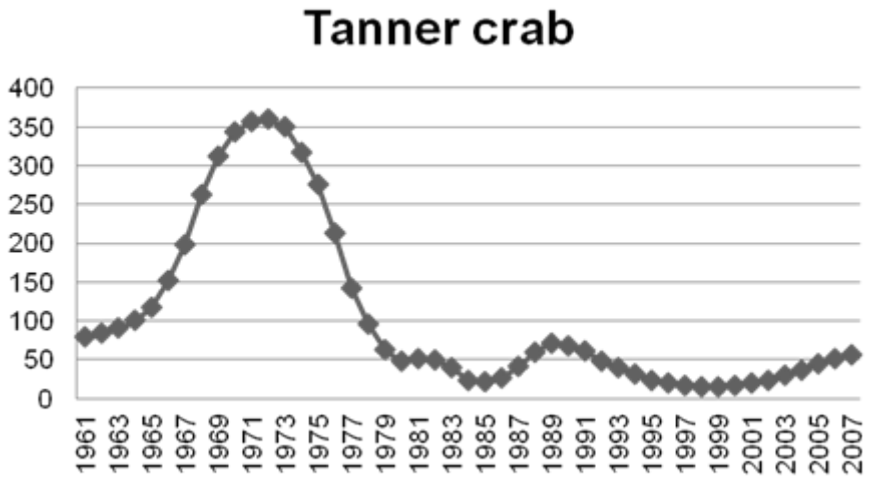
Habitat Protection

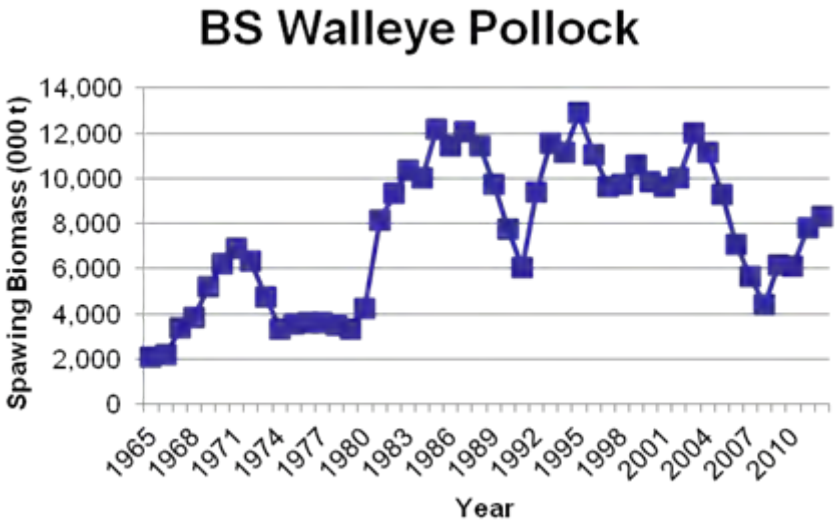


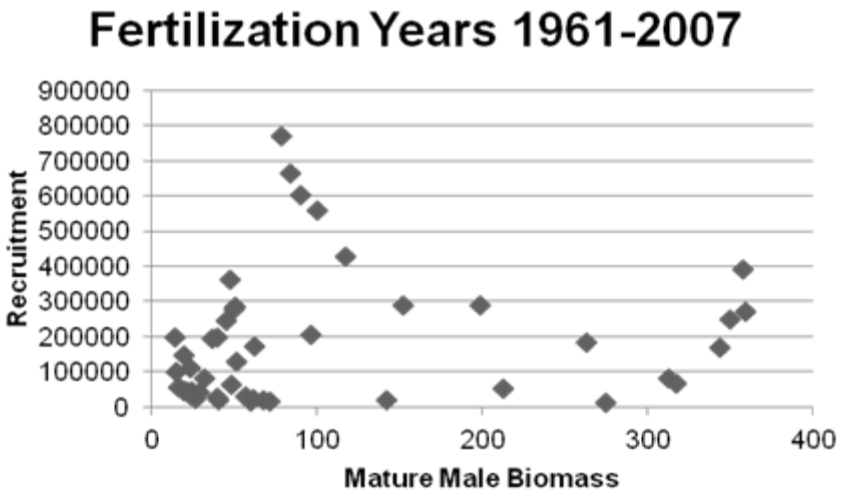
Northern Bering Sea Research Area

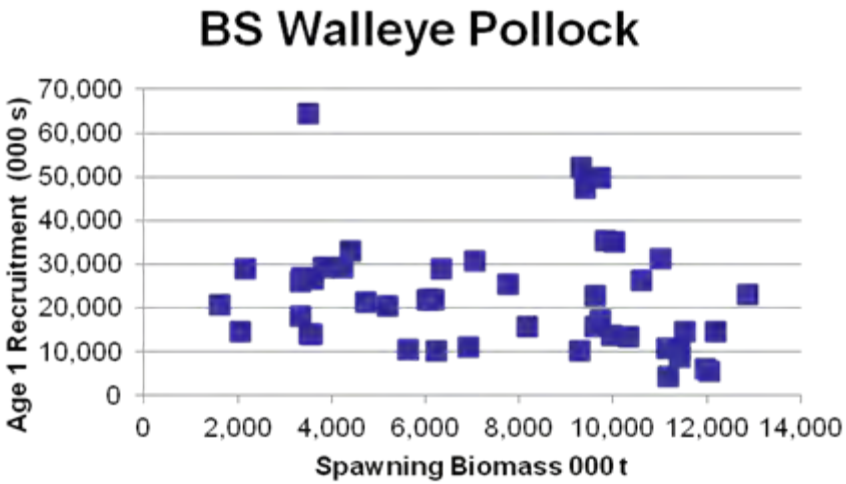


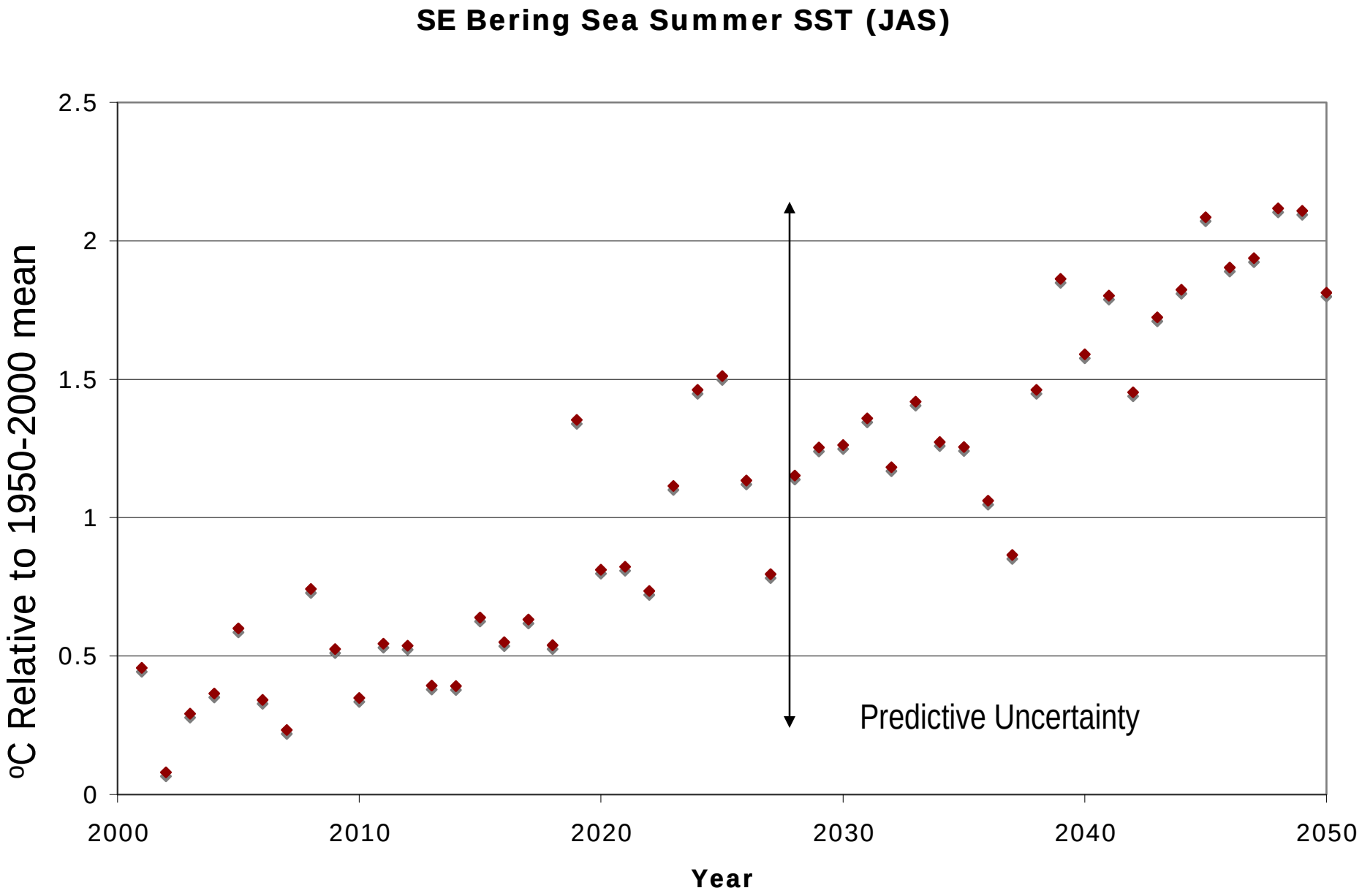
Accounting for shifts in environmental conditions: Detecting breakpoints vs risk assessment











Hollowed et al. 2009, IJMS

Possible Responses of Living Marine Resources to Climate or Fishing

Shifting zoogeographic distributions

Phenology (match-mis-match)

Changing vital rates (growth, mortality, maturity schedules)

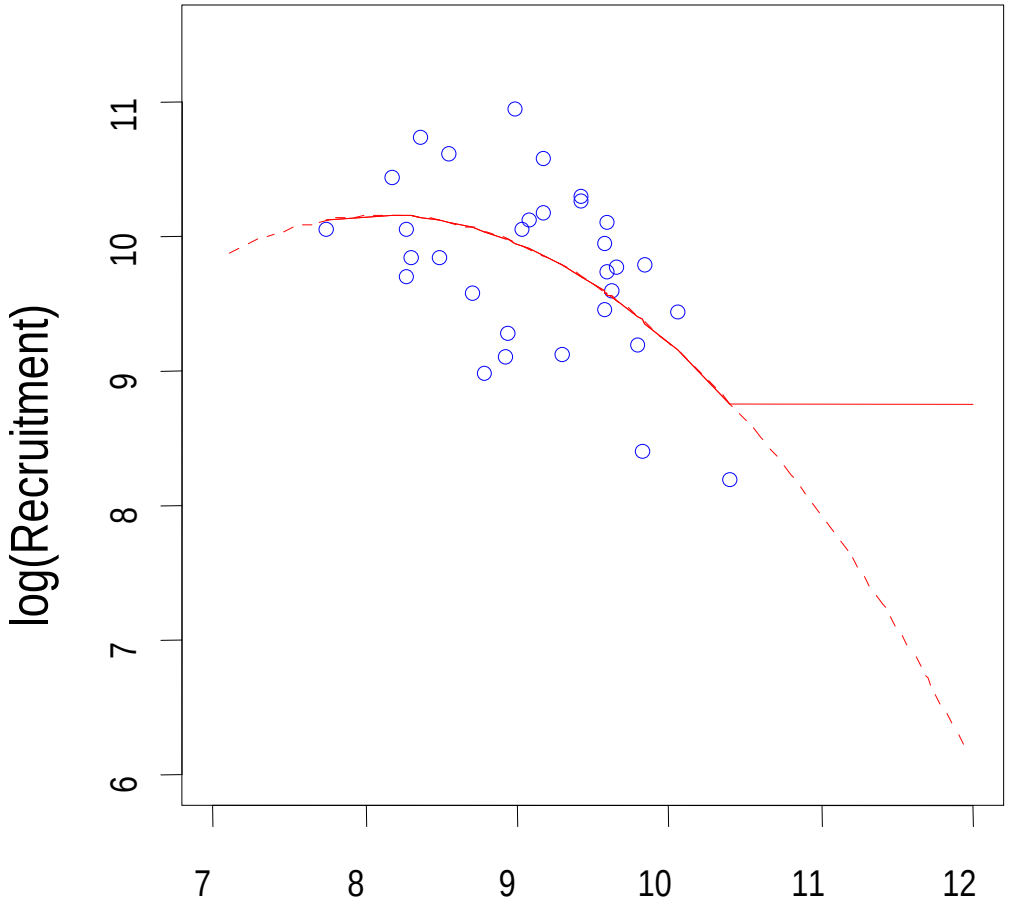
Adaptive flexibility (genetic diversity, flexibility in life history (spawning distribution, food habits)

Species interactions (predator-prey, competition)

Structural changes to foodweb

Dominance switching

EBS pollock recruitment study
Retrospective study to Identify mechanisms

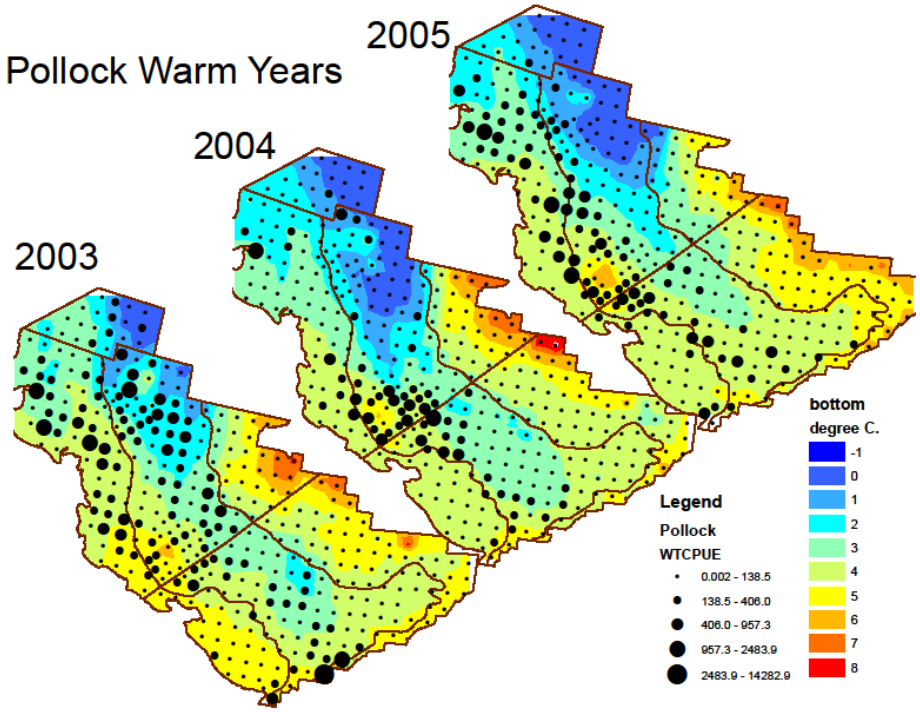


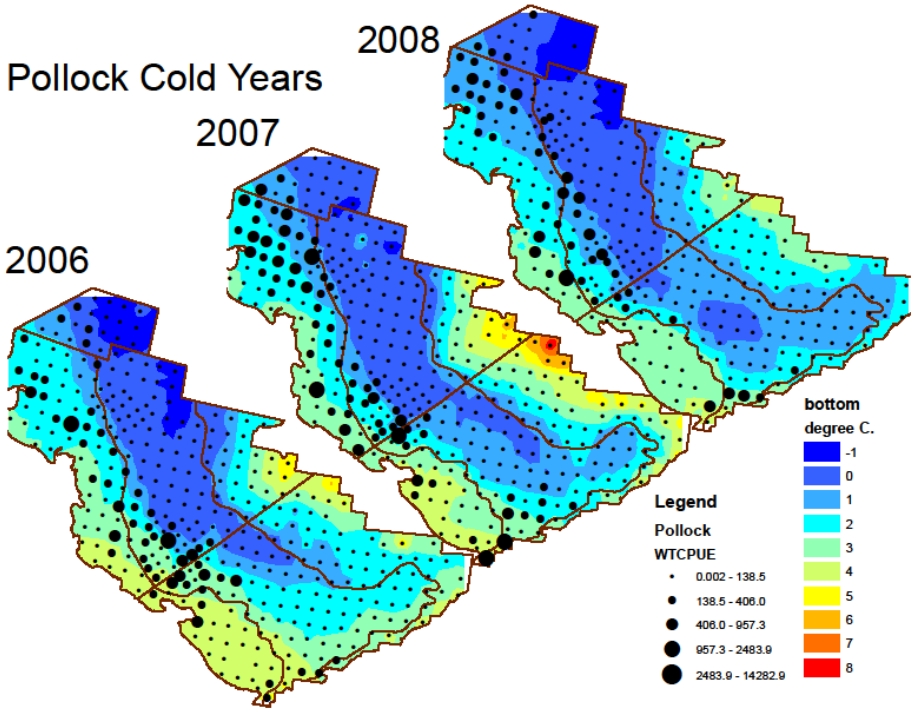
Summer SST

Mueter et al. (ICES Journal of Marine Science 68(6)

Cold pool extent affects location of zoogeographic provinces

Pollock, arrowtooth flounder, and cod all appear to be pushed to the outer shelf as the spatial extent of the cold pool expands.

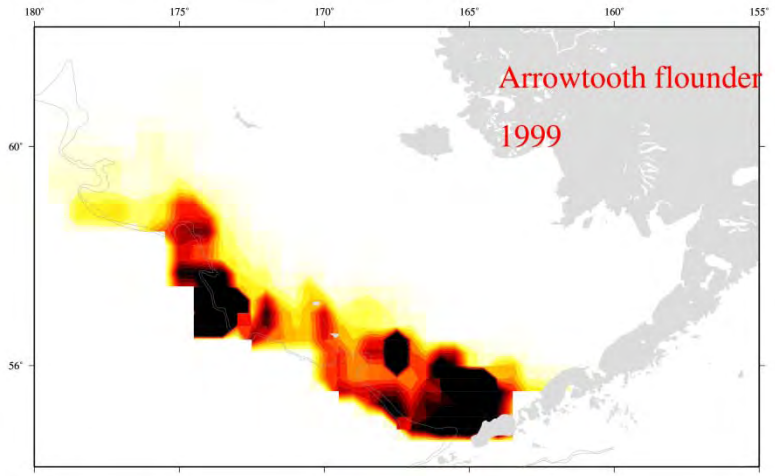


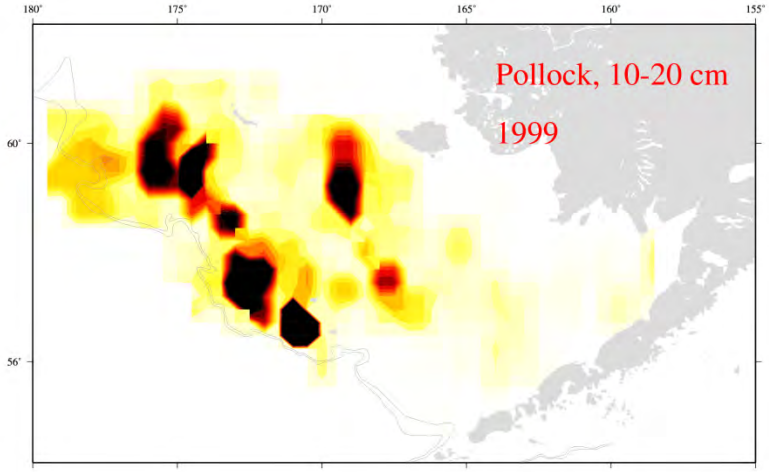


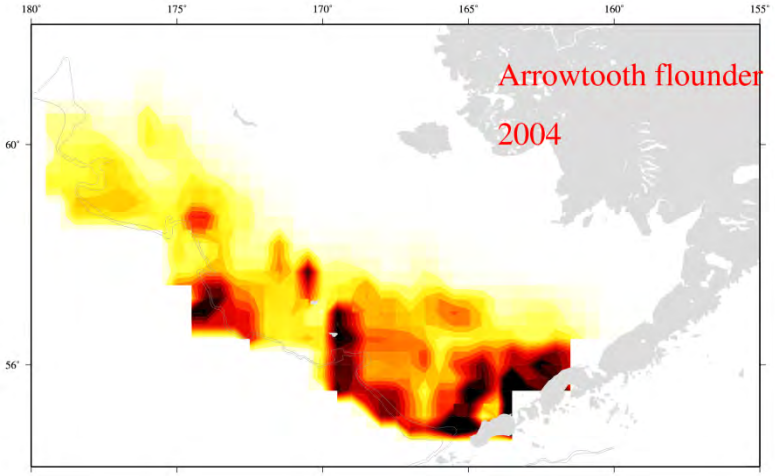
Bottom trawl survey: Lauth

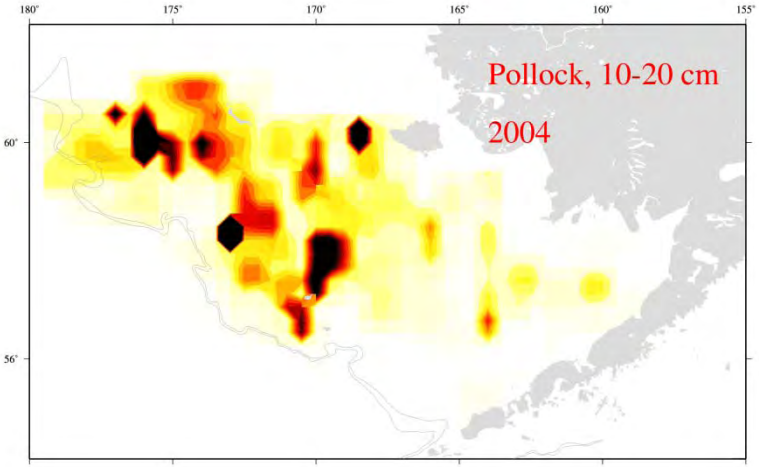
Arrowtooth flounder avoid the cold pool

Age 1 walleye pollock (mostly) do not avoid the cold pool









Hypothetical Scenario - EBS

- Reduced cold pool
- Reduced lipid rich zooplankton
- Expanded habitat for walleye pollock
- Increased overlap of predators and age 1 pollock
- Reduced abundance of pollock
- Increase flatfish TAC
- Increased bottom trawling
- Increased fuel costs

- Fishers Choice?

Challenges

NOAA FISHERIES

- Catch shares limit flexibility in re-tooling vessels to adapt to shifting species composition and abundance.
  - E.g., Halibut PSC cap may limit expansion of flatfish fisheries.
- Fixed closed areas limit flexibility to adapt to shifting fish distributions.
- Risk adverse harvest guidelines account for declining stock size but definitions of sustainable targets in a changing climate may be difficult.
- Mechanisms underlying distribution and abundance of fish in changing climate.

Future Research Needs

- Prevent overfishing and rebuilding overfished stocks.
  - Maintain and expand catch accounting, surveys, life history studies (aging, growth)
- Development of decision theoretic approaches to time frames for biological responses
- Improved ecosystem monitoring to assess response to fishing and environment. Underpins management strategy evaluations.
- Fishers response (fishers choice models), global markets.
- Interdisciplinary research teams
- Multiple model ensembles needed.