Literature Review of Management Approaches in a Changing Climate

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Need

Climate Change is a long-term change in part of the land-atmosphere-ocean system

Already observing impacts of climate change on variety fish stocks.

Expected Changes:

- Changes in stock *productivity*
- Changes in *distribution*
- Changes in species *interactions*
- Changes in species *habitats*

Question and Goal

Question:

Climate is changing. What does this mean for fisheries management?

Goal:

Review the literature and compile alternatives for managing fisheries in a changing climate

Disclaimer

The ideas presented here are from the literature and do not represent the views of NMFS.

NMFS does not necessarily endorse the ideas and in some cases, NMFS may not have the authority to implement them.

Outline of Literature Review

- Reactive Management-
  - Adapt Current Management to Account for Observed Changes:

- Proactive Management- Manage to:
  - Increase Resilience of Individual Stocks or Species:
  - Increase Resilience of Individual Stocks or Species:
  - Increase Ecosystem Resilience:
  - Increase Resilience of Fishing Businesses:

- Underlying Practices that Could Improve Management-

What is Resilience?

Resilience is defined as the “capacity of an ecosystem [species, or industry] to absorb recurrent disturbances or shocks and adapt to change while retaining essentially the same function and structure” (McClanahan et al. 2012).

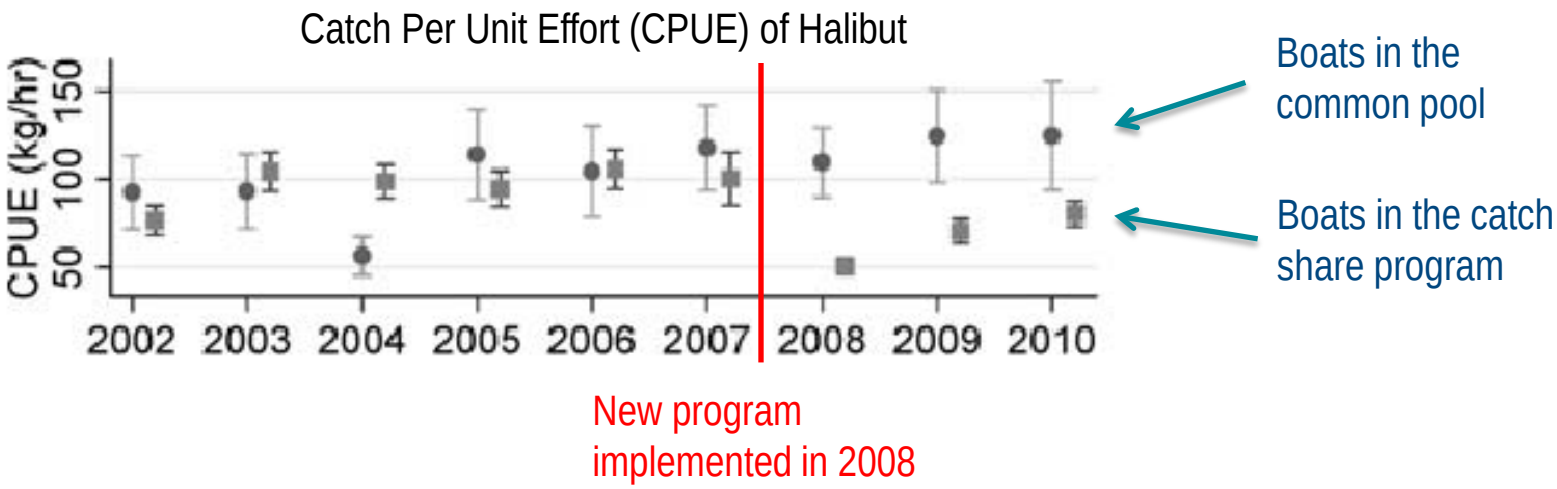
For this project, resilience includes both resistance to the change and recovery back to the original form after the removal of the disturbance.

Lit Review Approach 1-- Adapt Current Management to Account for Observed Changes:

- Adjust reference points to changes in species productivity
- Adjust allocations to new species distributions
- Adjust practices or gears as fish community composition changes:
- Create flexible, nimble management systems:

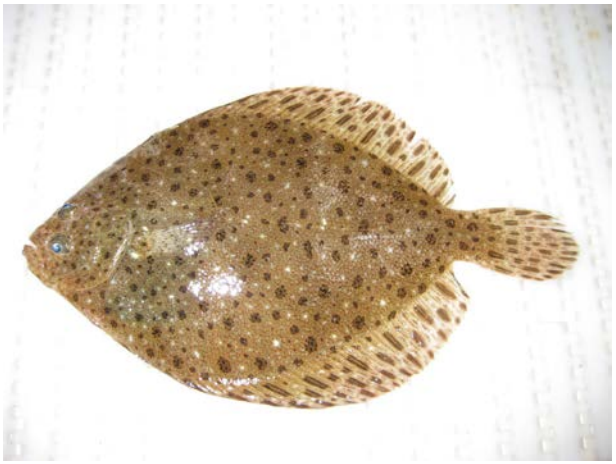
Example- Adjust Fishing Practices as Community Composition Changes:

Fishermen changed location, behavior, and timing of fishing to reduce the bycatch of halibut, a limiting species.



Abbott et al. 2015. Land Economics

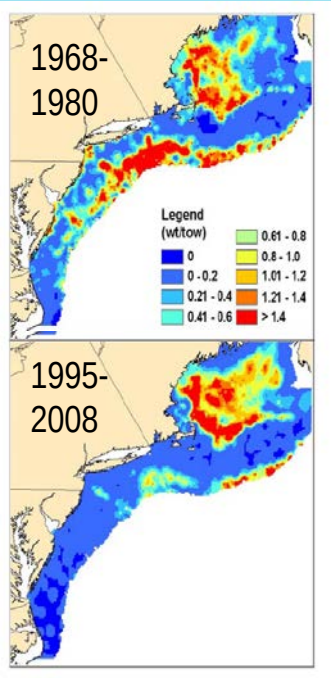
Lit Review Approach 2-- Manage to Increase Resilience of Stocks/Species



- Incorporate environmental parameters into stock assessments:
- Manage for uncertainty-- scenario planning:
- Protect age structure and old females:
- Decrease existing stressors:
- Enhance or translocating stocks:
- Manage to promote adaptive capacity:

Example- Manage to Promote Adaptive Capacity

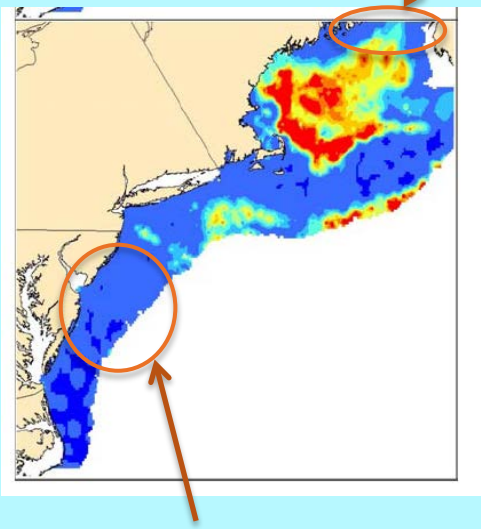
Distributional shift of Red Hake



Nye et al. (2009)

Impacts on genetic diversity

The leading edge often has lower diversity, but it can contain the alleles best adapted to the new conditions– these animals are the "source for most of the surviving lineages".

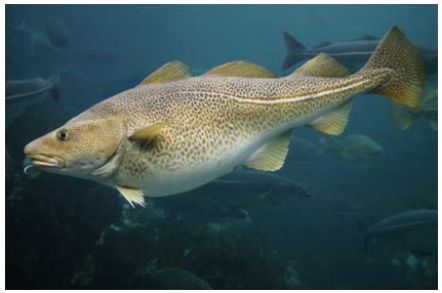


The rear edge often has high genetic diversity as it preserves historical alleles.

Source: Pauls et al. 2013

Lit Review Approach 3-- Manage to Increase Resilience of Ecosystem

- Design appropriate marine reserves:
- Modify gears to increase habitat health:
- Recover or enhance degraded habitats:
- Protect key functional groups:
- Increase use of Ecosystem Based Fisheries Management (EBFM):



Example- Design Appropriate Marine Reserves

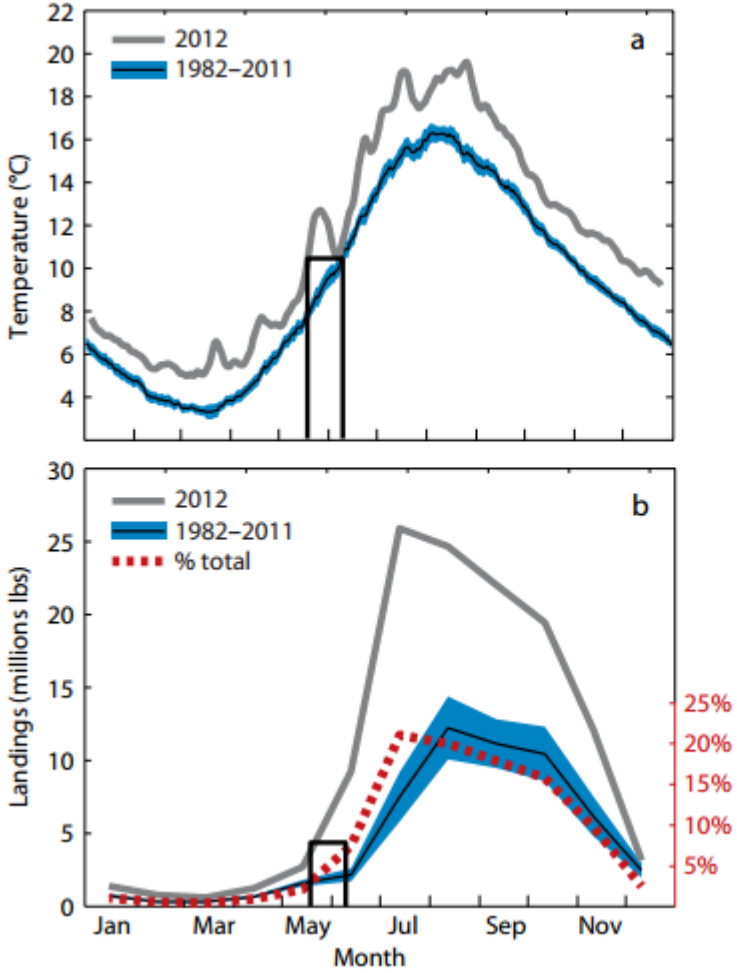
The literature suggests three options for creating marine reserves that are effective even through a changing climate:

1) Locate reserves to include the habitat/species we want to protect in addition to the areas where we expect them to move (Hobday 2011).
2) Periodically reexamine and modify reserves to ensure they remain centered on core areas of stock distribution (Campbell 2013) and are maintaining their goals.
3) Create reserves to be dynamic, where boundaries are tied to environmental conditions (Hobday et al. 2010; Cambell 2013).

Lit Review Approach 4-- Manage to Increase Resilience of Fishing Businesses/Communities

- Provide insurance for fishermen to cover years with poor catch:
- Expand flexibility in fisheries permitting:
- Improve flexibility in the supply chain:
- Consider community fishing associations:

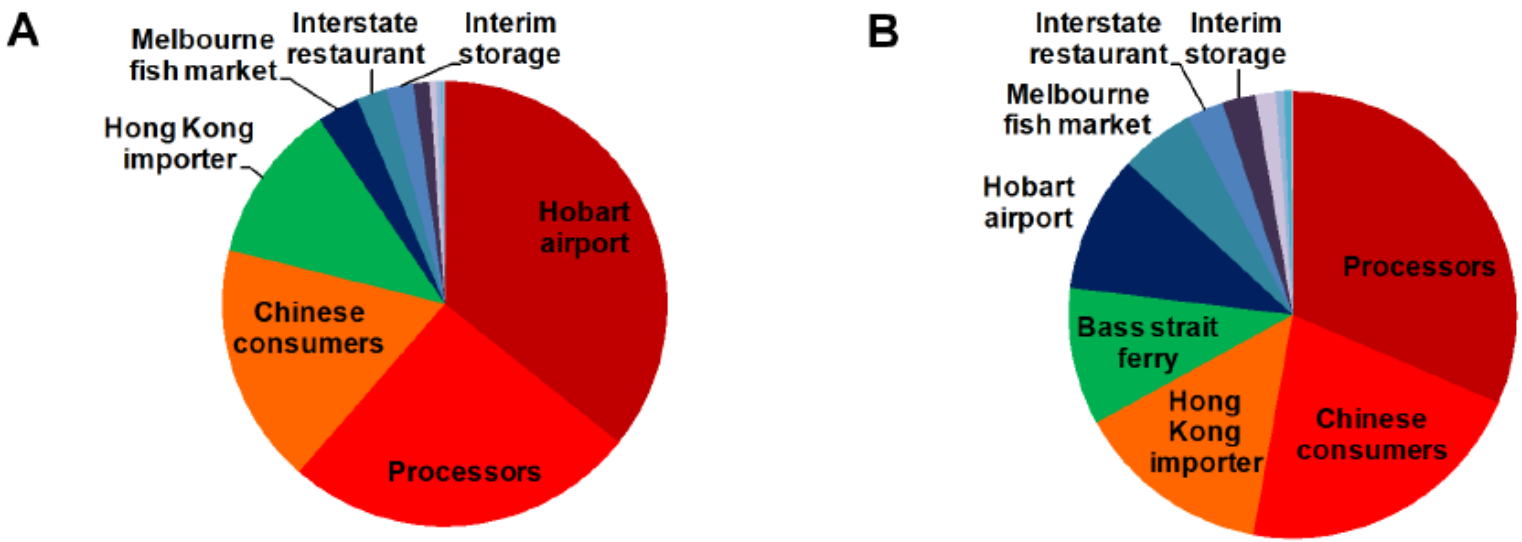
Example- Flexibility in the Supply Chain



Maine lobstermen reeling from low prices, seeking cooperation from dealers

Source Mills et al. 2013; Presentation by Pershing 2013

Example- Flexibility in the Supply Chain



In the Australian southern rock lobster fishery, researchers created a "supply chain index" to identify the critical elements of a supply chain that impact its resilience both today and to changing climate conditions (Plagyani et al. 2014)

Literature Review-- Underlying Practices that Could Improve Management

- Update and Clarify Management Goals:
- Apply Ecosystem Models to Predict Possible Changes:
- Monitor for Climate Change:
- Use Regional Planning to Address Local Needs:

Literature Review Conclusions

- Climate change will continue to affect the abundance and distribution of fisheries resources.
- Since fisheries management has historically occurred in a changing environment; the foundation for adaptation already exists.
- The management alternatives provided here is not comprehensive, and there is no one “right” answer.
- Suitable approaches will differ depending on local conditions.
- Management actions that seek to increase management flexibility and provide incentives to the fishing industry to try new approaches should prove to be beneficial.