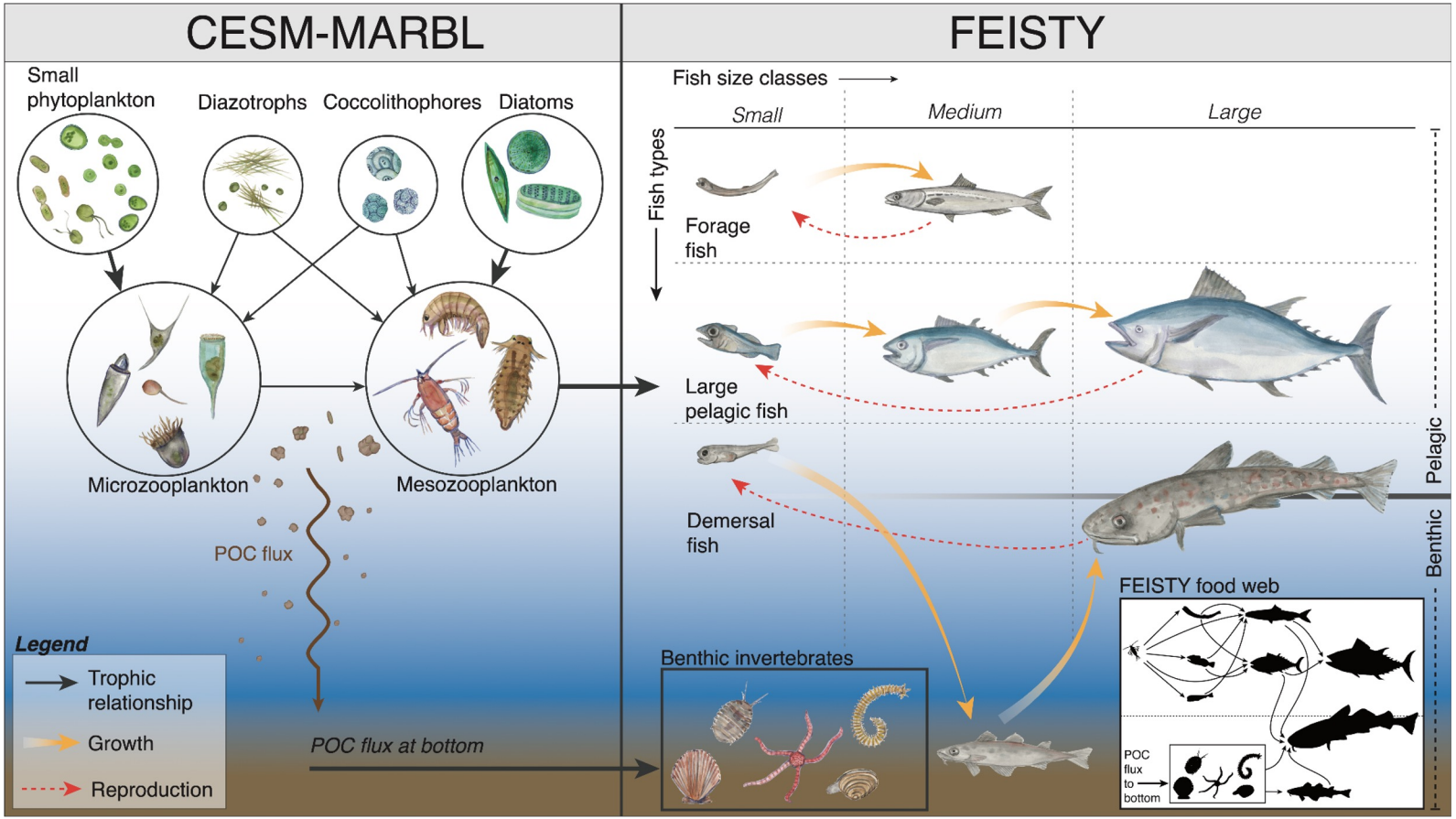
Potential applications of CESM linked to a fisheries model

Kristen Krumhardt,
Actionable and Convergent Research Cross Working group
CESM Workshop 2023

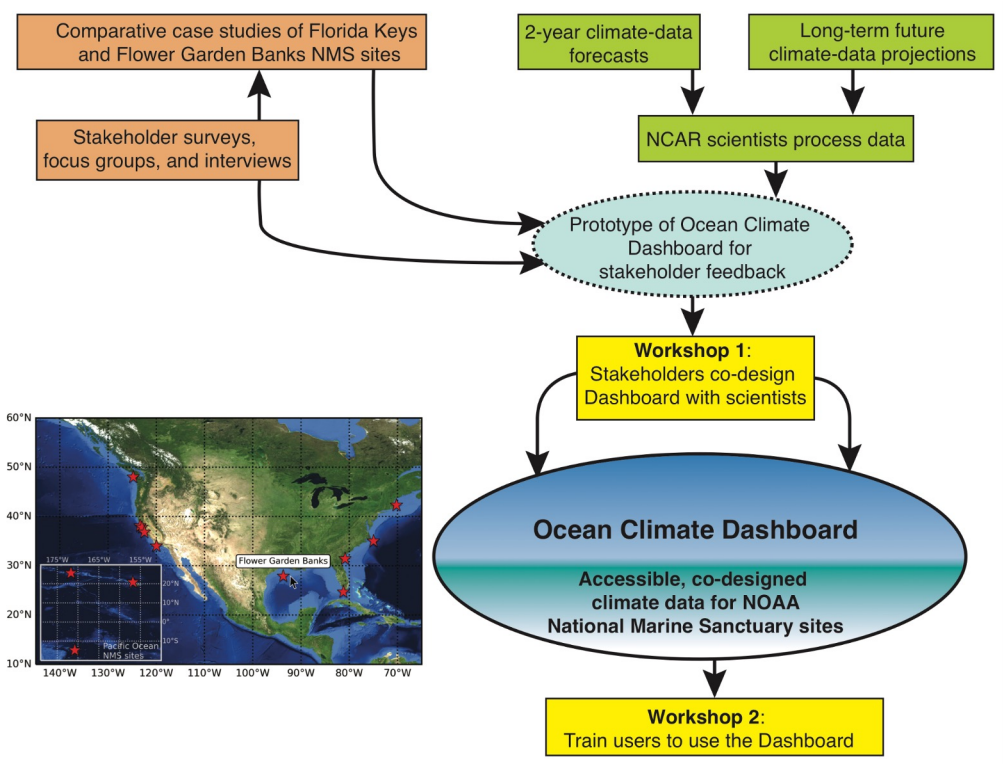
Collaborators:

Matt Long, Mike Levy, Colleen Petrik, Keith Lindsay, Elena Romashkova, Rémy Denechere, Kelly Dunning, Gretchen Luchauer, Fred Castruccio, Melissa Moulton, Deepak Cherian, Kaare Sikuaq Erikson



- New marine ecosystem in CESM.
- Inputs for pelagic and benthic realms.
- 3 fish types, 3 size classes.
- Includes growth and reproduction.
- Presenting on 2 case studies using FEISTY.

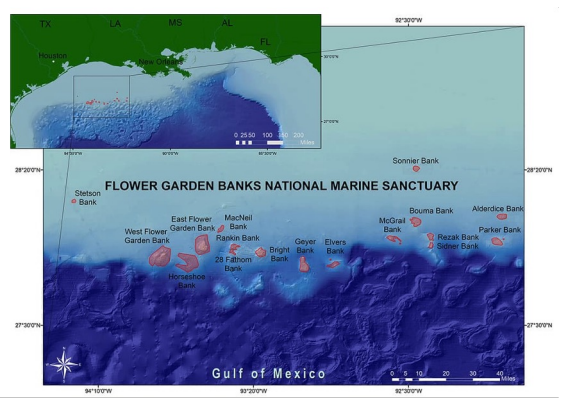
A ocean climate data dashboard for National Marine Sanctuaries



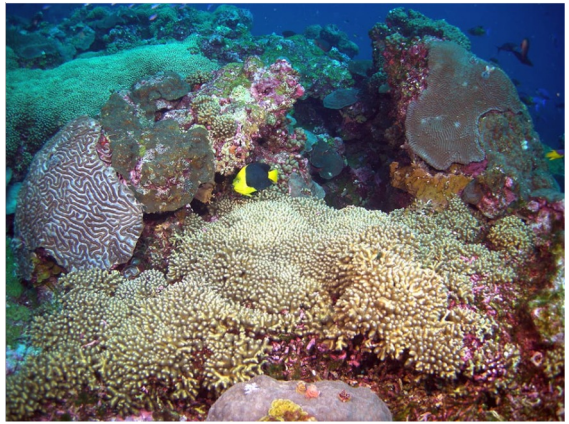
- Planning in NMSs requires knowledge on climate-driven changes
- Diverse stakeholders
- Co-design dashboard with NMS managers + stakeholders
- Includes surveys and workshops
- Flower Garden Banks and Florida Keys NMS sites as case studies

Collaborators: Kelly Dunning, Gretchen Luchauer, Melissa Moulton, Deepak Cherian, Fred Castruccio

Flower Garden Banks National Marine Sanctuary



- Medium depth coral reefs growing on underwater salt domes, banks
- Extremely diverse, many fish and other species
- Established marine sanctuary in 1992, with more reefs added in subsequent years; protection from increasing human activities (oil and gas extraction, anchoring on the reefs, commercial fishing)
- Reef managed by National Marine Sanctuary, advised by Sanctuary Advisory Council
- Adaptive governance framework



All images: https://flowergarden.noaa.gov/

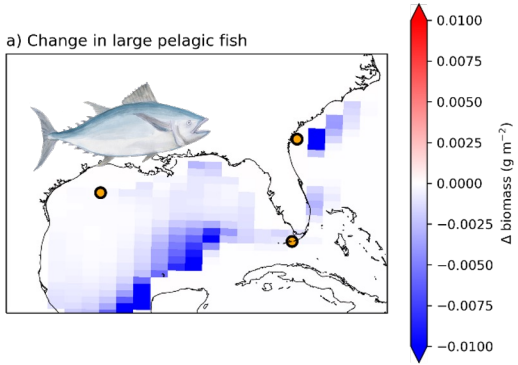
Sanctuary advisory council meetings

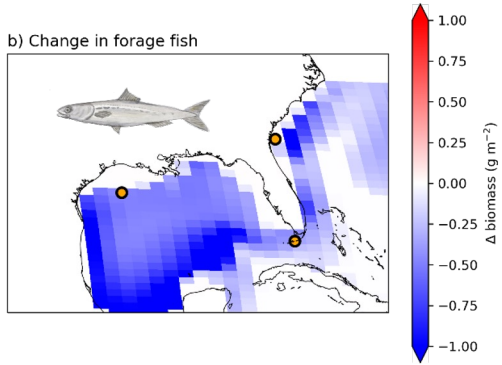
- Fishermen, divers, researchers, sanctuary managers, oil & gas, educators
- Public welcome at all meetings

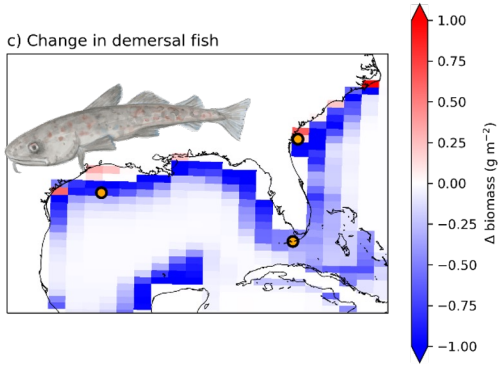
Climate data dashboard: Interested in climate-driven impacts on fish populations, ocean acidification, water temperature (coral bleaching), and storm activity

Images: https://flowergarden.noaa.gov/advisorycouncil/meetinginfo.html

FEISTY run on one CESM2-LE ensemble member

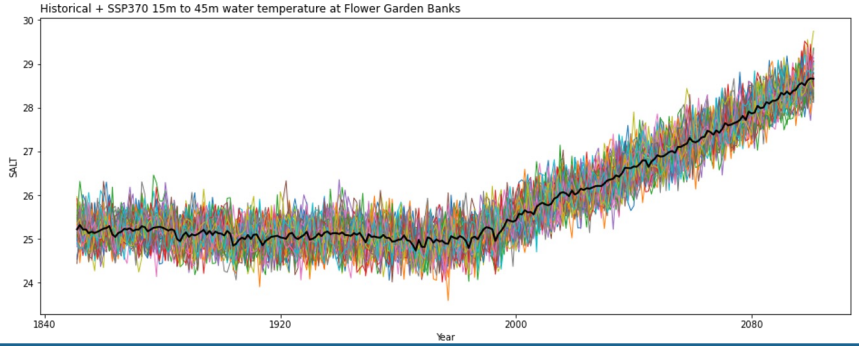






Changes in fish from 1950s to 2090s

Increasing temperature → coral bleaching → habitat loss



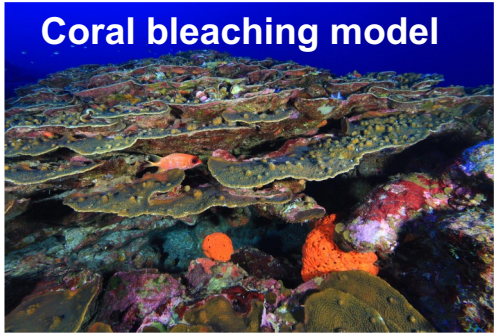
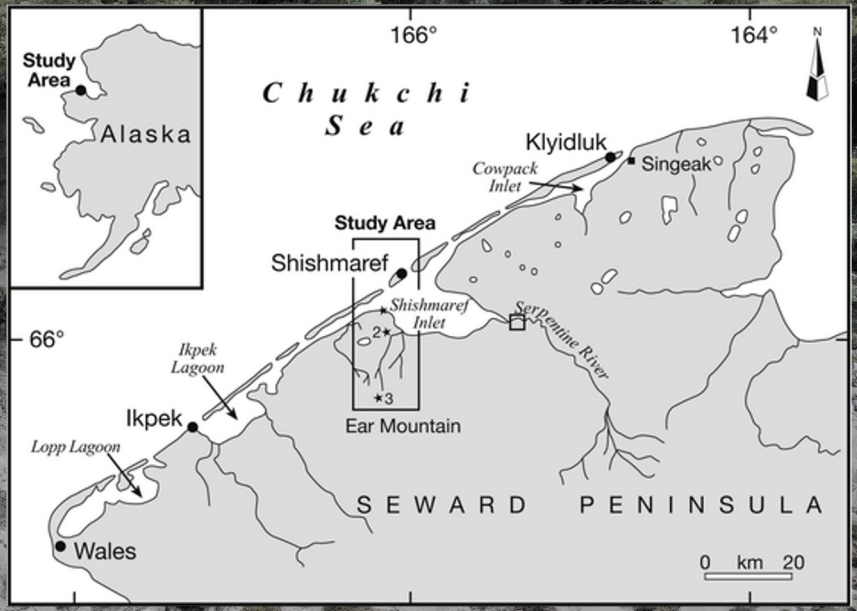


Photo:https://marinesantuary.org/blog/top-five-things-to-spot-in-flower-garden-banks-national-marine-sanctuary/

Rising Voices, Changing Coasts: Alaska regional hub

- RVCC is a NSF funded project with 4 regional hubs
- Focusing on community of Shishmaref (photo exhibit at Mesa Lab)
- Native communities rely on marine and terrestrial ecosystems for subsistence
- Concerned about many climate change-related things:
  - coastal erosion
  - sea ice loss
  - harmful algal blooms
  - ocean acidification
  - **changes in fish abundance**
- Idea to create a “Convergence Research Atlas” for community that combines Earth system science with local elder knowledge on environmental changes.



Narratives of Shoreline Erosion and Protection at Shishmaref, Alaska: The Anecdotal and the Analytical (Mason, et. al., 2012)

Background photo: Kaare Erikson

10)

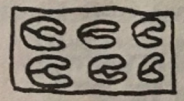
White Fish (dried)

lace white fish in pan. Sprinkle with salt.
ry in the oven. When fish are cooked, they
ill have oil on the bottom of the pan.

Agnes
Kiyutelluk

Salmon (fried)

ash the pieces of salmon, cover with flour.
prinkle with salt. Add onion around the
almon. Place on a greased pan and fry in
he oven.



Agnes
Kiyutelluk.

Flounders (fried)

prinkle the herring with salt. Fry them in
he oven. Not too long.

Morris and Marion.

Herring (fried)

prinkle the herring with salt. Fry them in
he oven. Not too long.

Morris and Marion.

Salted Herring Fish (11)
(Eloc-pa-id)

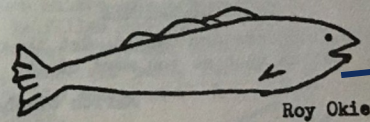
Cut off the heads of the fish, wash the fish, and put a layer on the bottom of the barrel. Cover with rock salt, then put more herring fish and more rock salt in until the barrel is filled. Cover tightly. Use in winter-time. Take out as many herring as needed, rinse in water until herring loses the salty taste.

Nellie Okpowruk.

Shee Fish (fried)

Sprinkle shee fish with flour, salt and pepper. Put in pan with lard. Cook for thirty minutes.

Nellie Kigrook.



Roy Okie

Dried White Fish

Hang white fish on drying racks. After they are dry put into pokes with seal oil, and keep them for winter use.

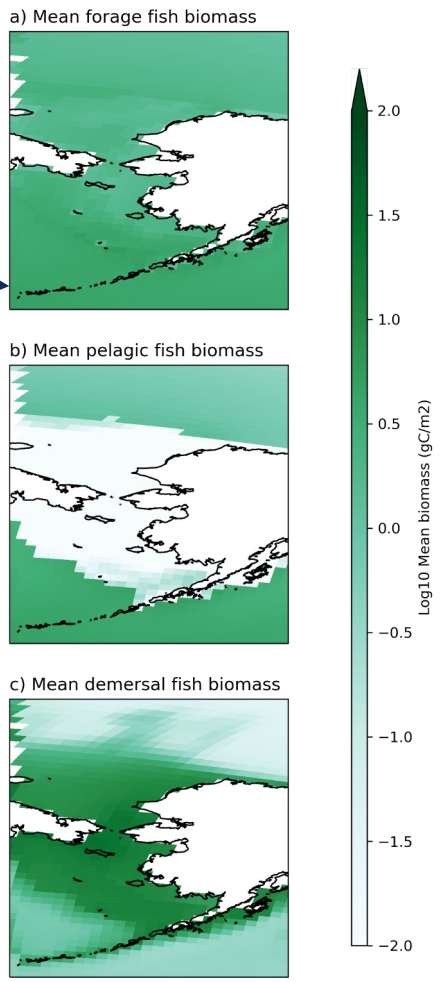
Stephen Kiyutelluk

Students of Shishmaref Day School

Eskimo Cook Book

Anchorage: Alaska Crippled Children's Association, [1952]
https://eartharchives.psu.edu/2020/04/19/living-with-climate-change/

Mean fish biomass (FEISTY) from forced ocean sea ice CESM simulation (1958 - 2021)



- Will combine changes in fish with other environmental changes

Summary: Actionable Science using CESM with FEISTY fish model

- Linking CESM-MARBL planktonic ecosystem with FEISTY fish model
- Combine with other environmental changes simulated in CESM (sea ice loss, OA)
- Two actionable science research projects
  - Flower Garden Banks NMS
  - RVCC Alaska region
- Other potential uses:
  - Fish prediction in coastal areas (LMEs)
  - Other RVCC hubs (e.g., Hawaii)
  - Food resources for Antarctic marine predators (e.g., penguins; Alice's talk)