# Groundfish distributions, movements and spawning potential in the NBS

Compiled by Franz Mueter (UAF)

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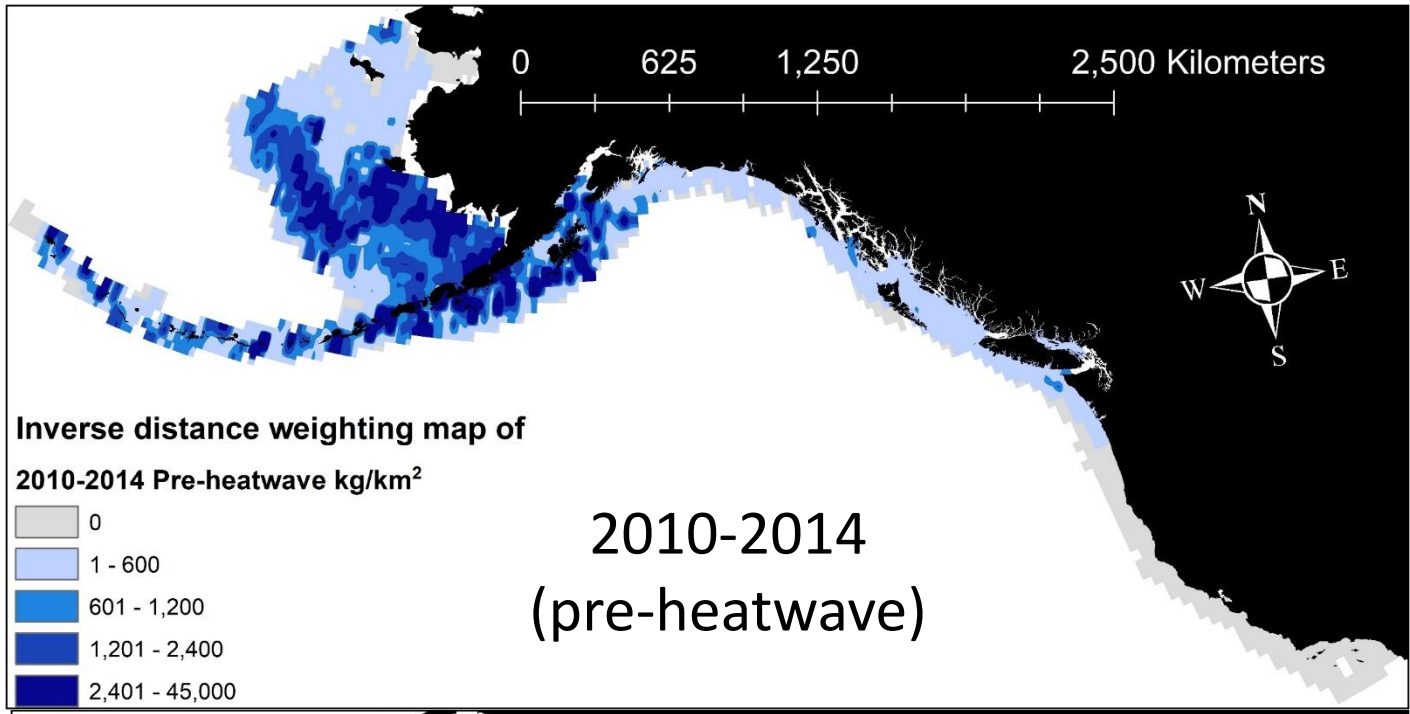
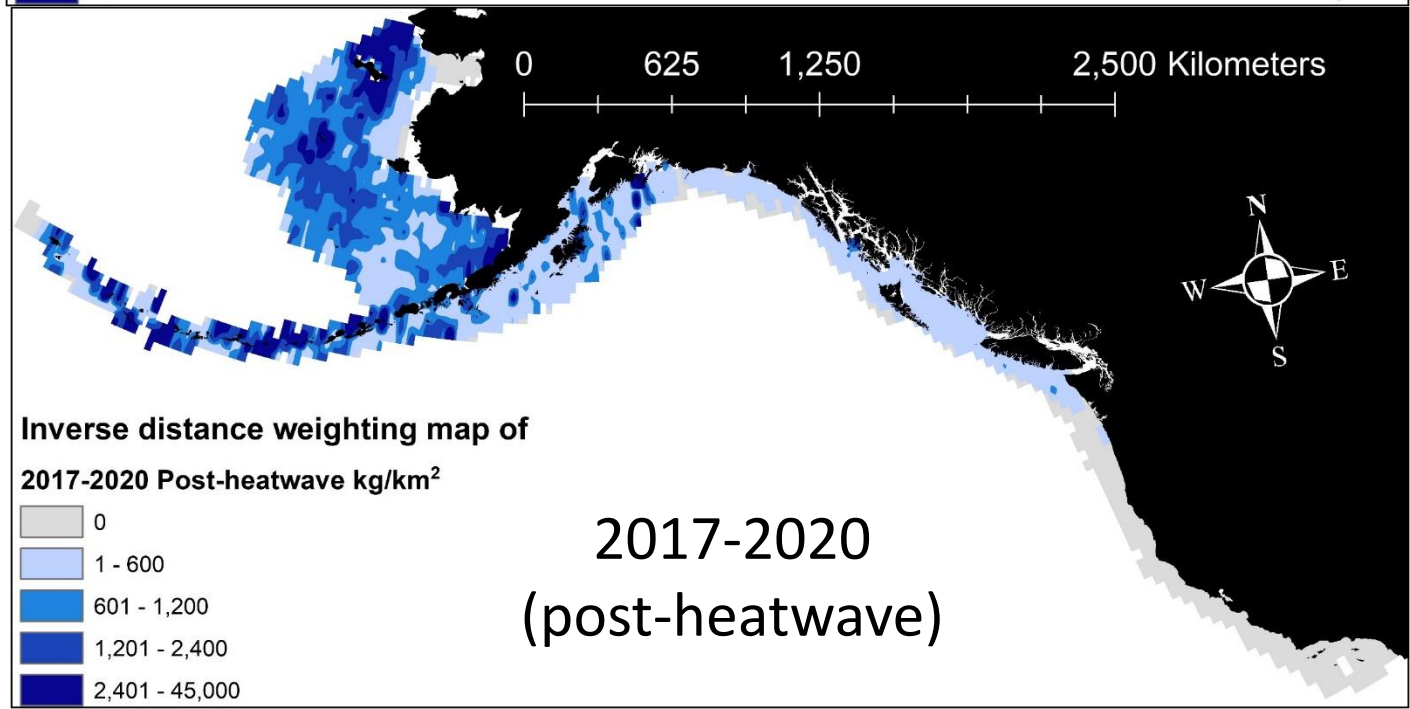
# Shifts in distribution

# Pacific cod
along the North American coast:

Distribution prior to and during a marine heatwave

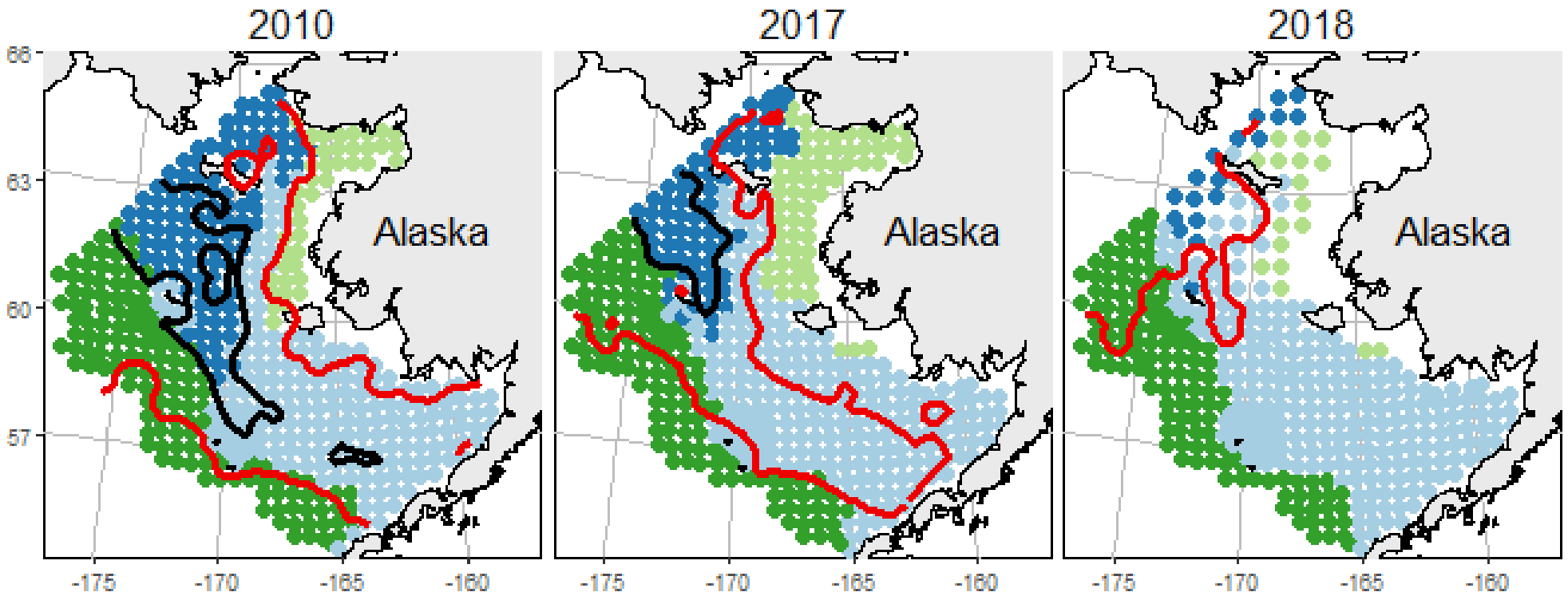
*(based on multiple surveys)*




Laurel et al. (In review; Fish and Fisheries)

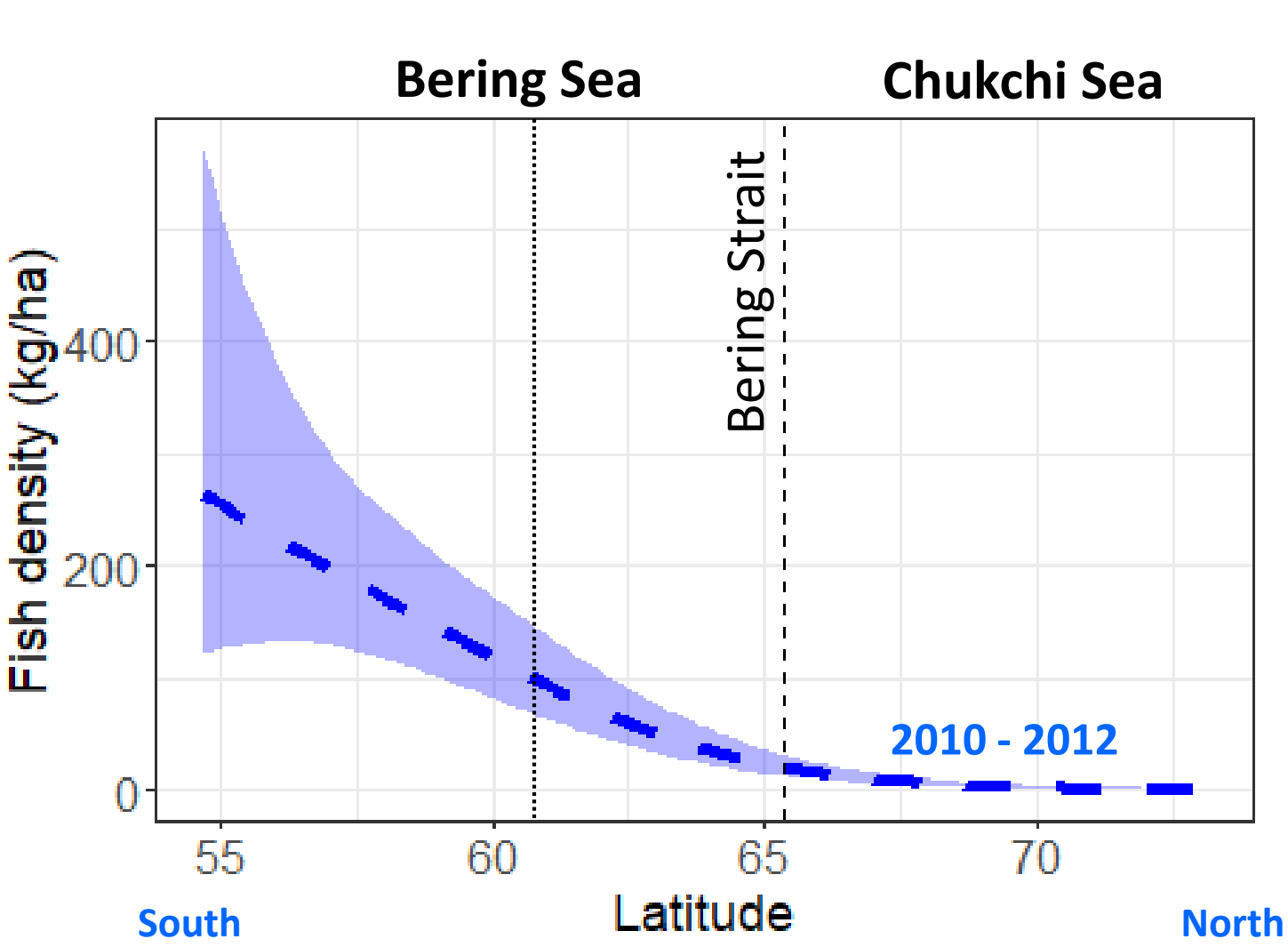
# Changing **community composition** under borealization

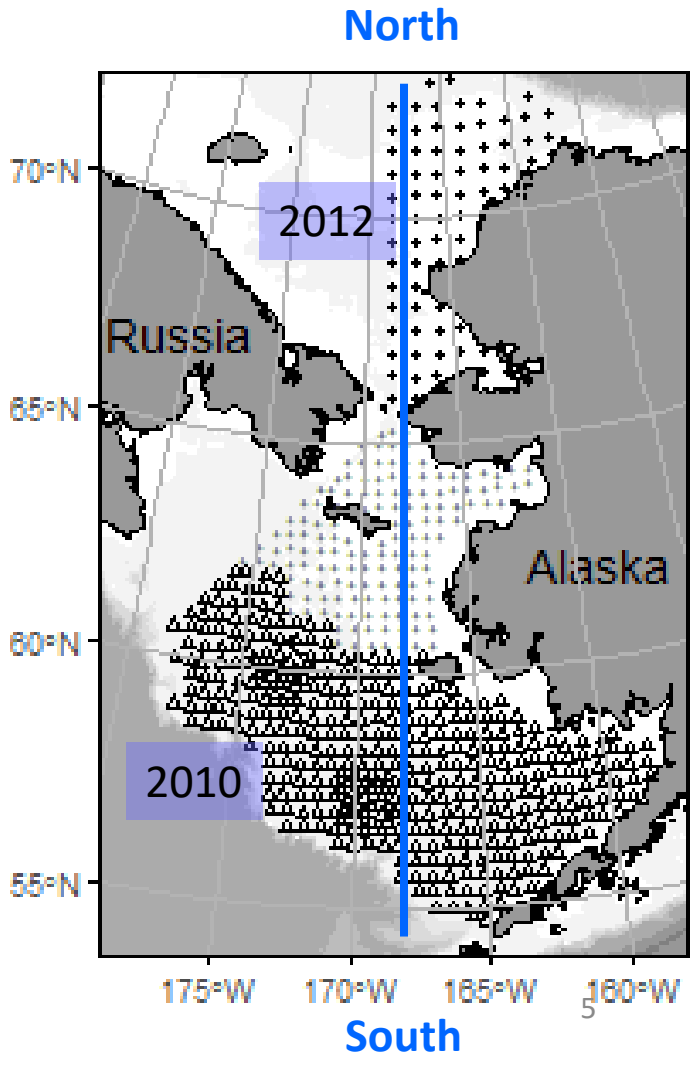



**Arctic assemblage**

Modified from Thorson et al. (2019) Arctic Report Card

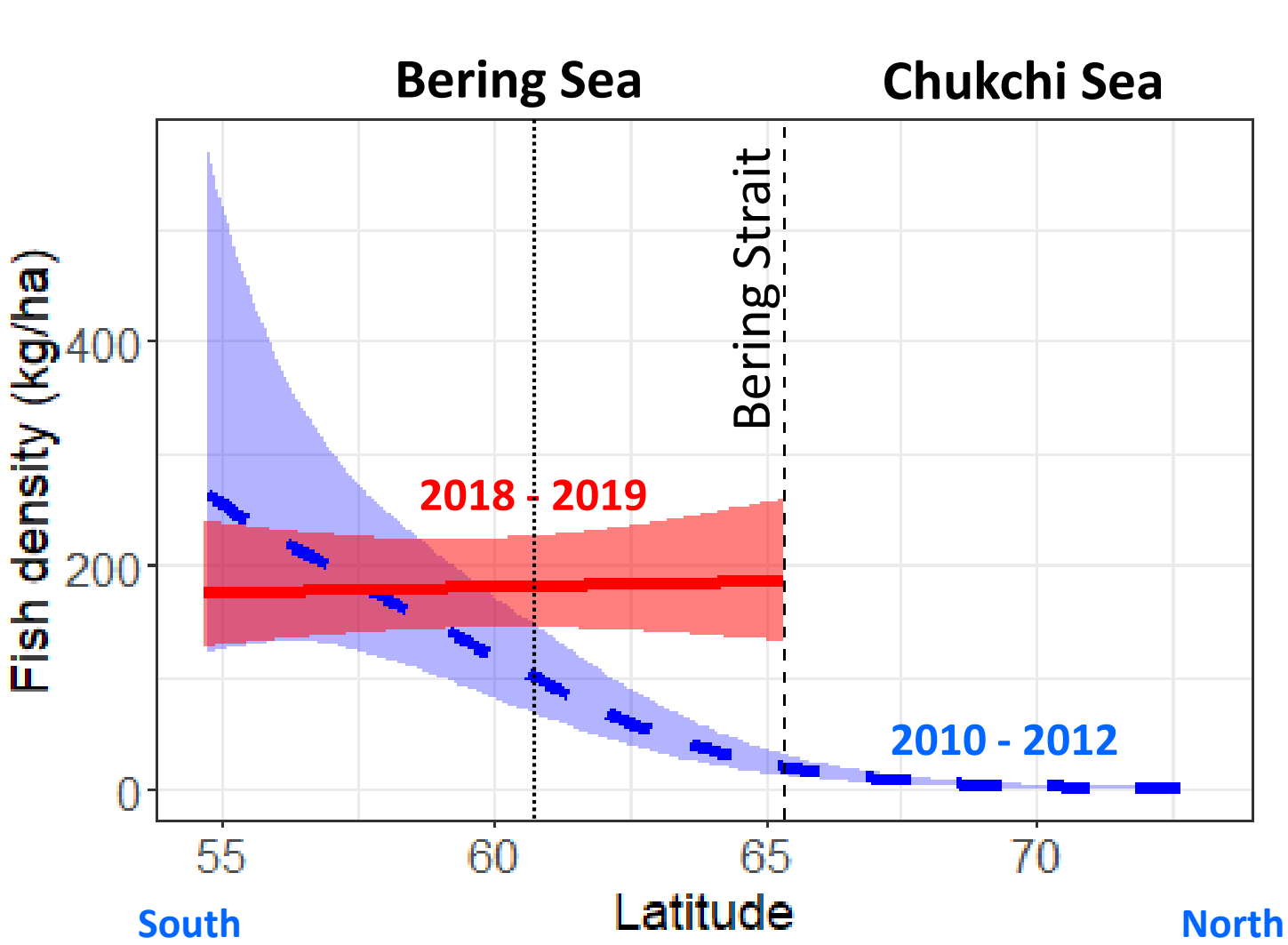
# Major re-distribution of fish biomass

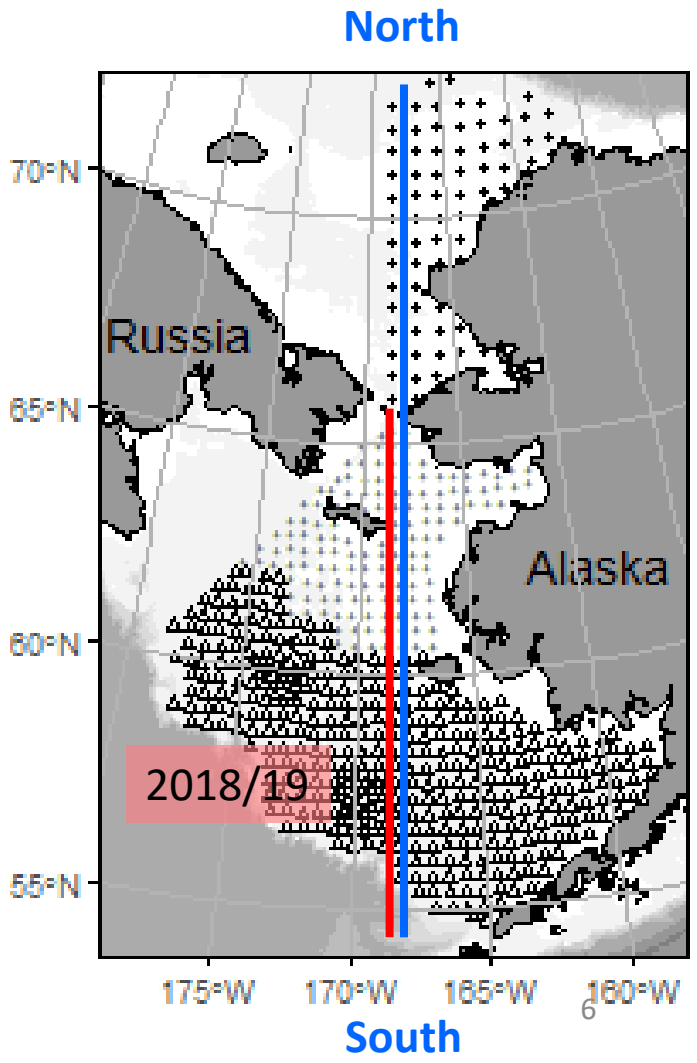



Modified from Mueter (2022)

# Major re-distribution of fish biomass



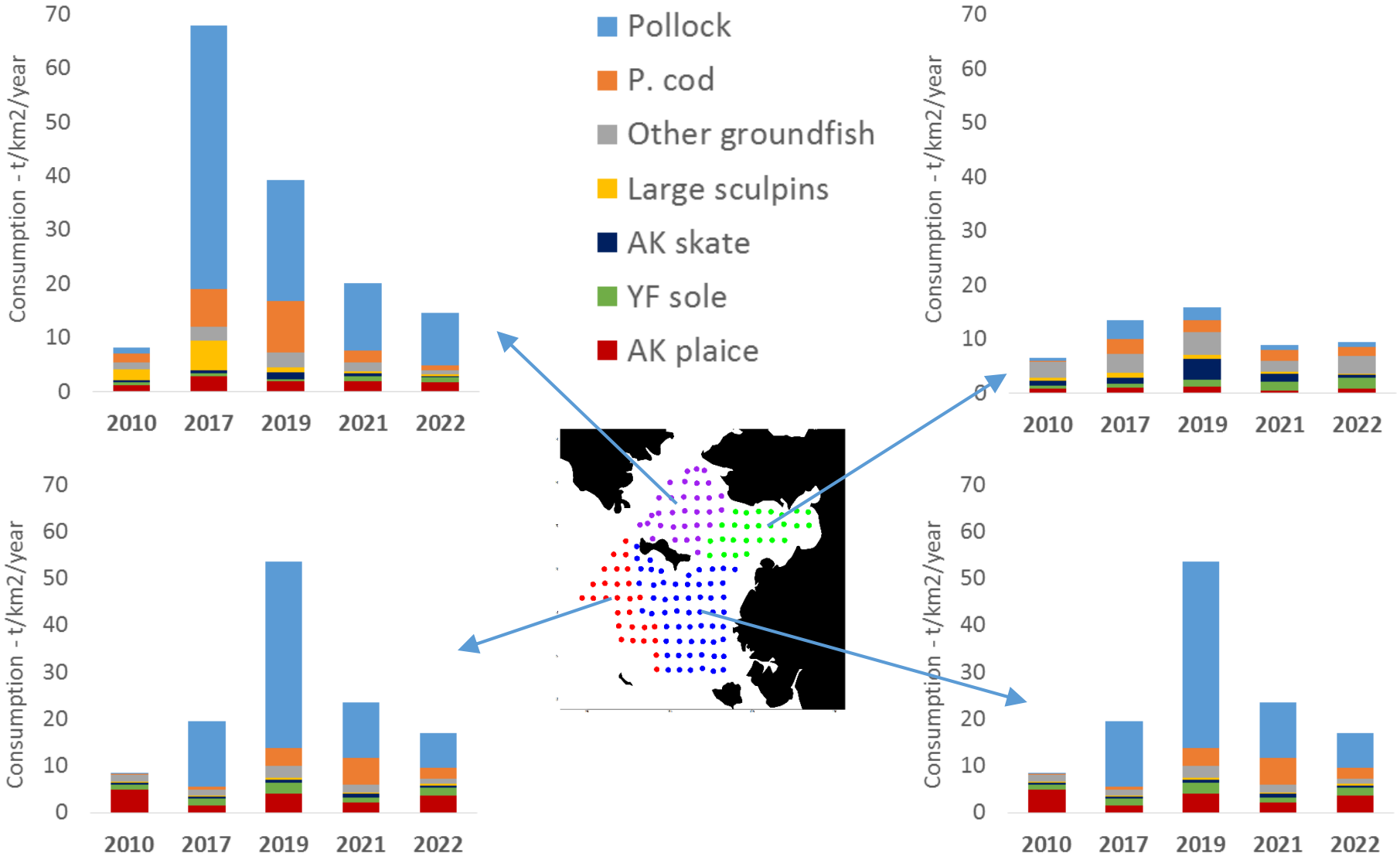




→ Gradient reverted to ~pre-heatwave pattern in 2021/22

Modified from Mueter (2022)

# Top-down impacts (predation)

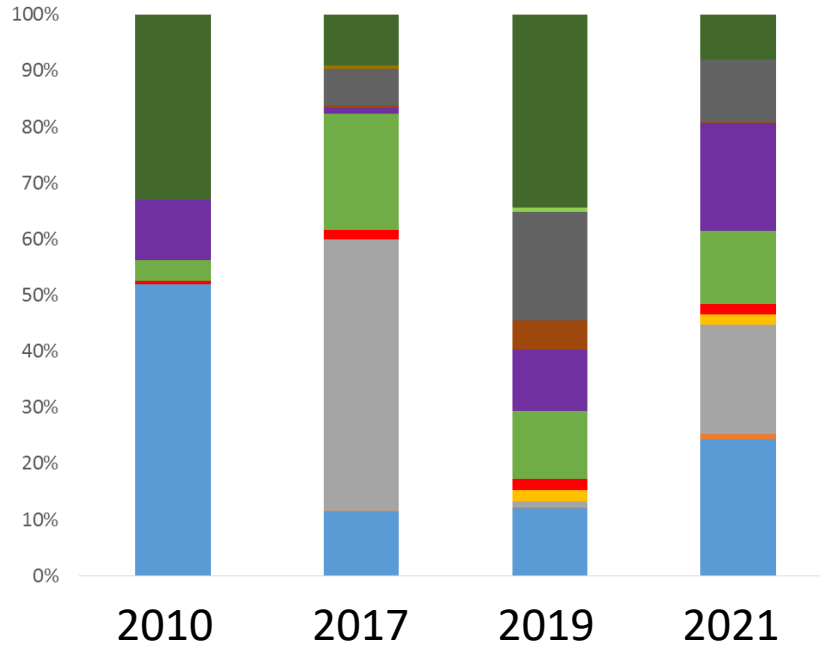
# Consumption by predator (groundfish only)

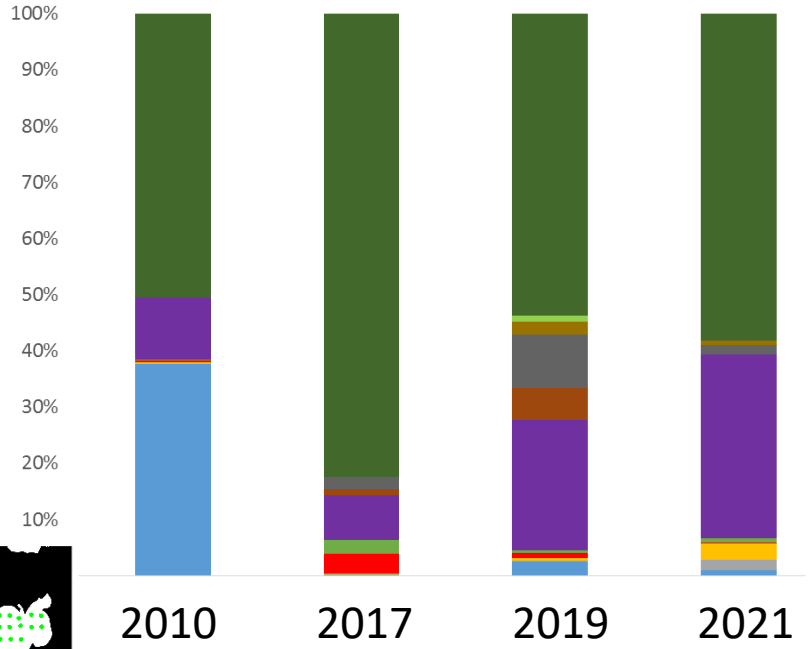


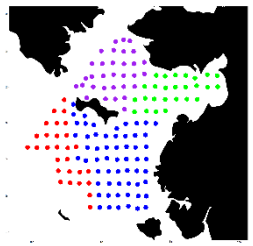

Consumption = BTS biomass (i.e. adults) * ration (from EBS life-histories, long-term means)
For comparison, EBS-wide average ~90t/km2/year for adult groundfish

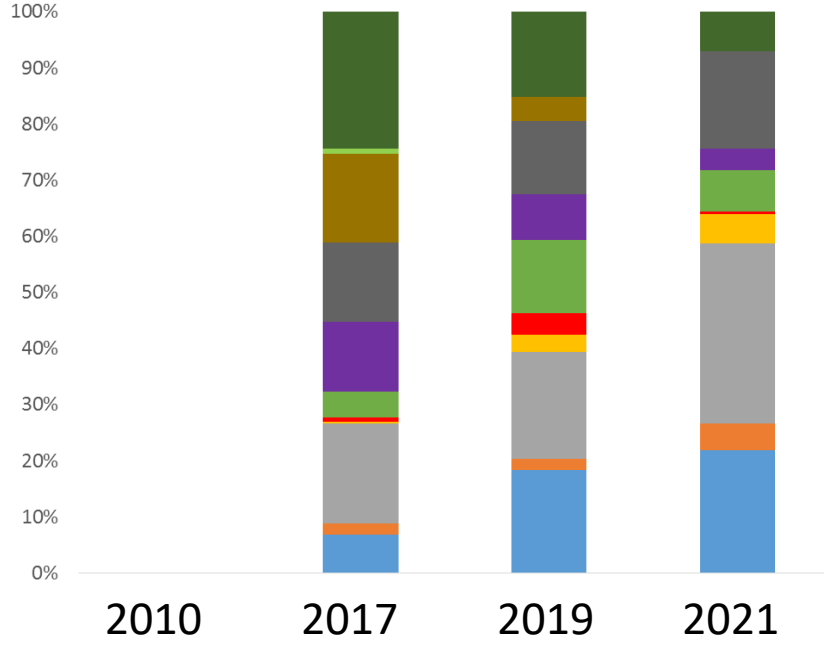
Kerim Aydin

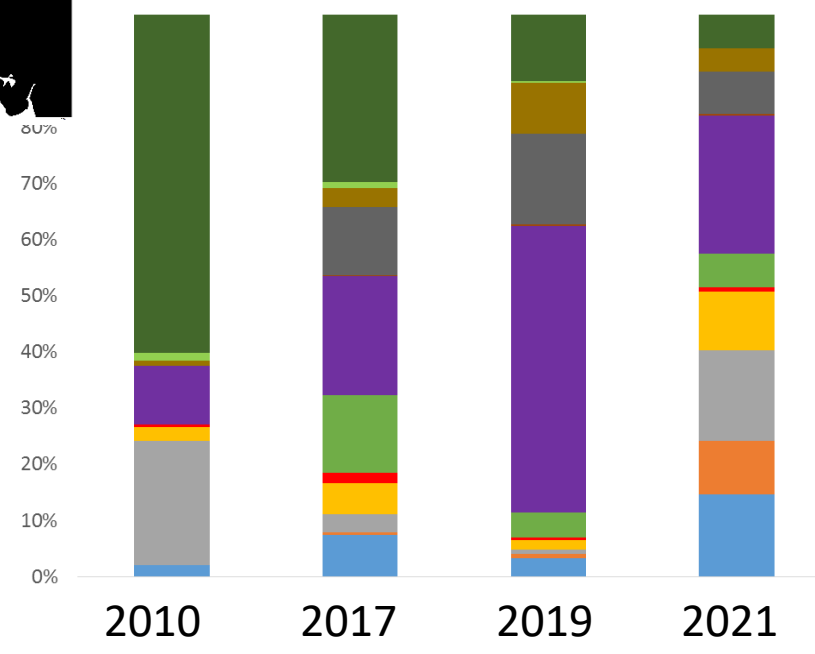
# Pollock 40+cm FL diets (% by weight)







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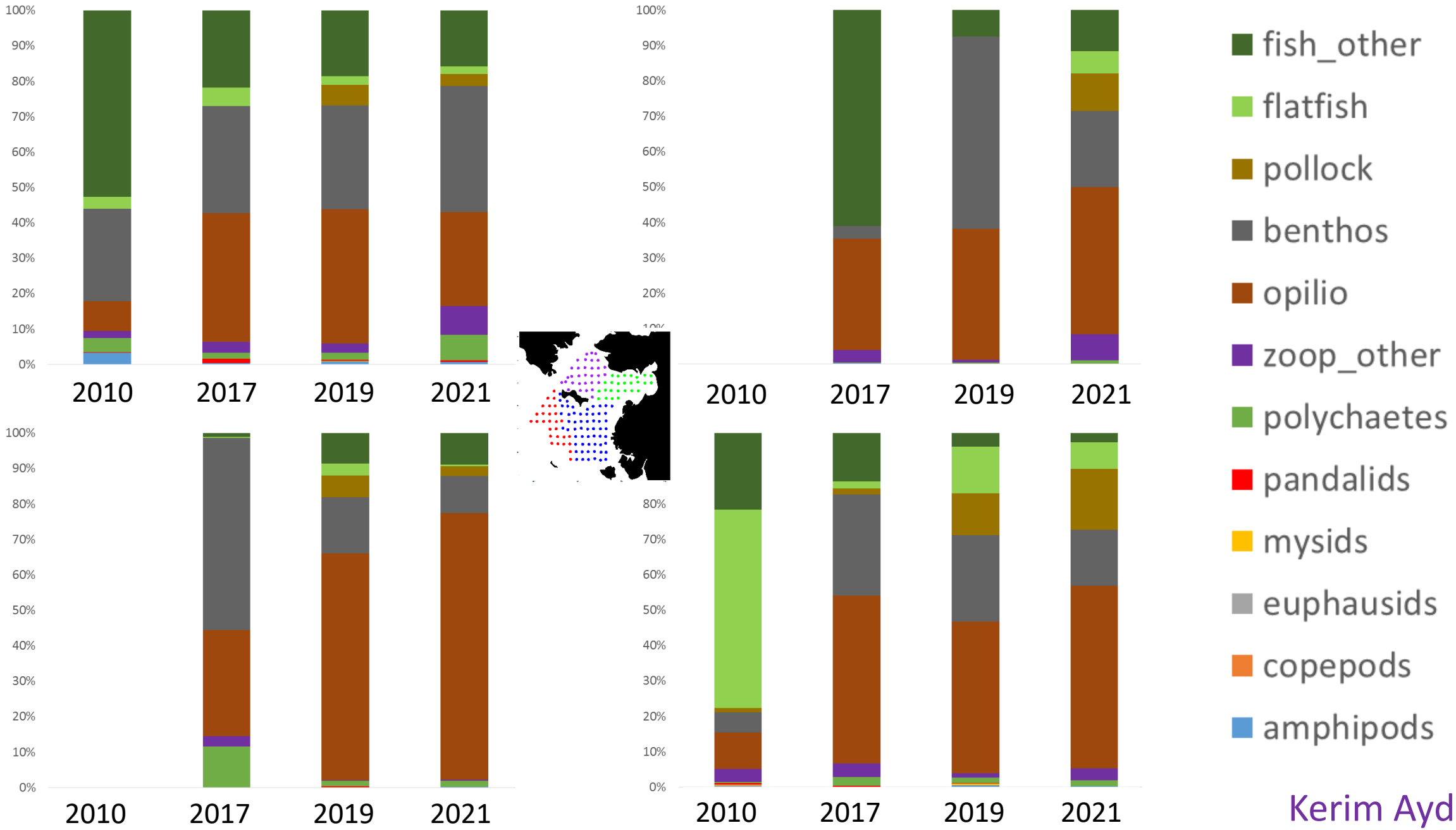
# Pacific cod 60+cm FL diets (% bv weight)

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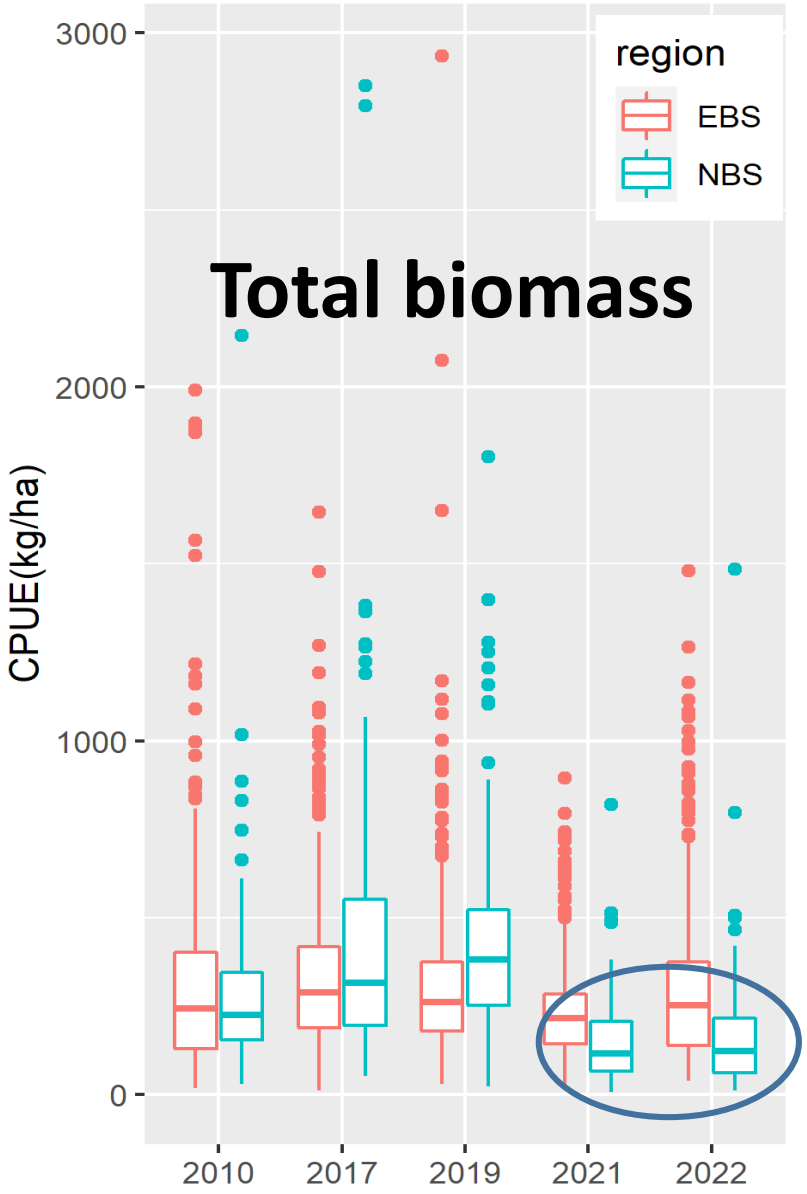
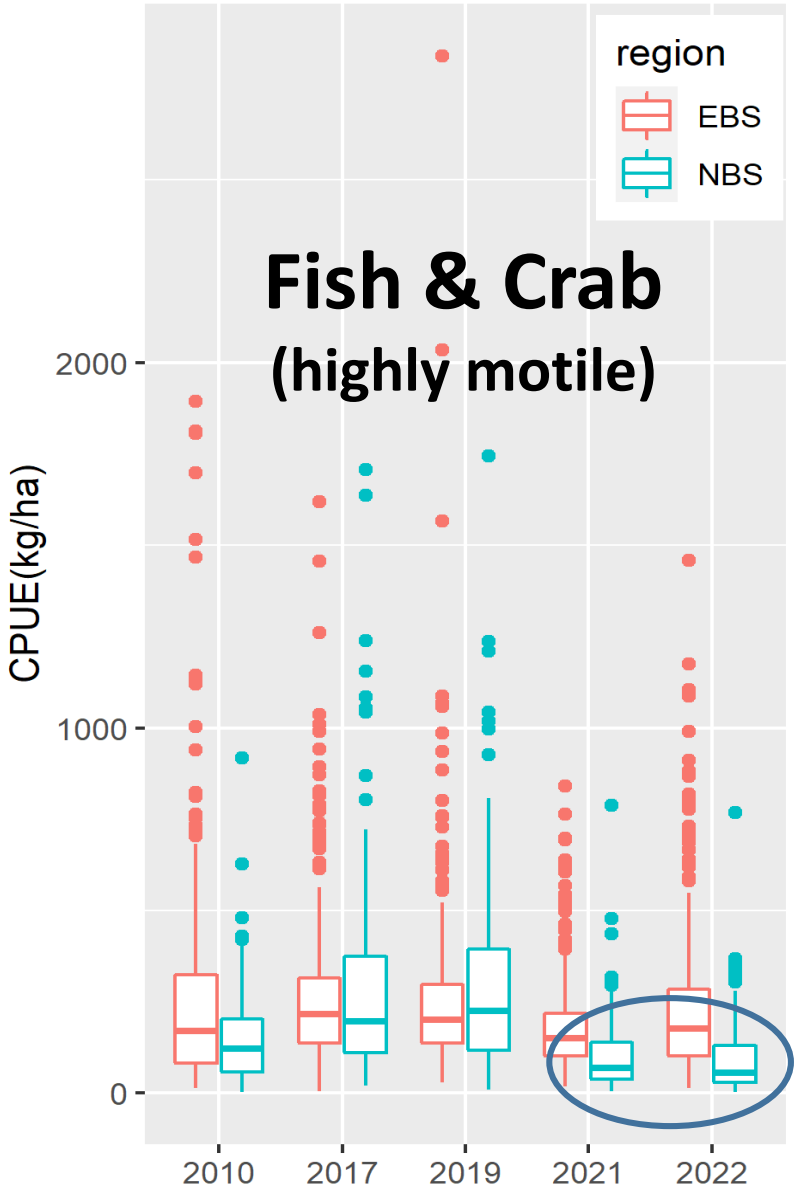
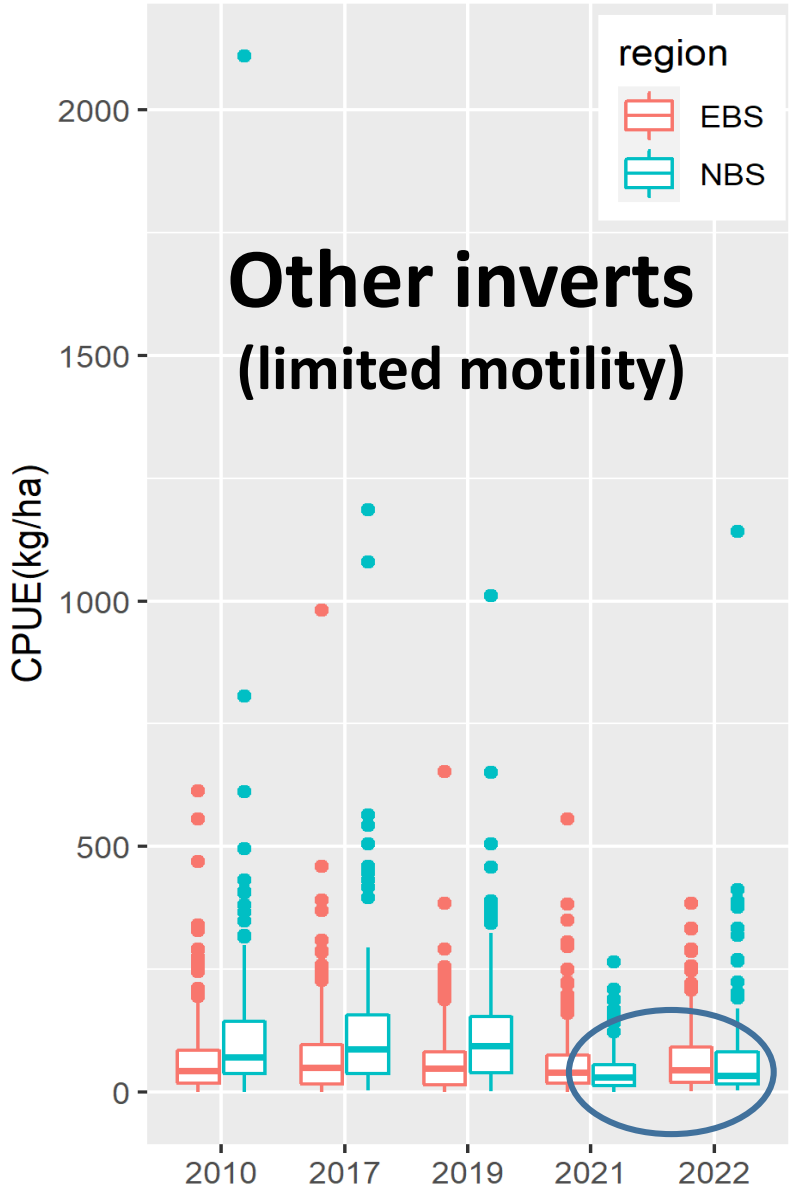
# Catch-per-unit-effort (**EBS** & **NBS** survey hauls)




AFSC (GAP) bottom trawl survey data

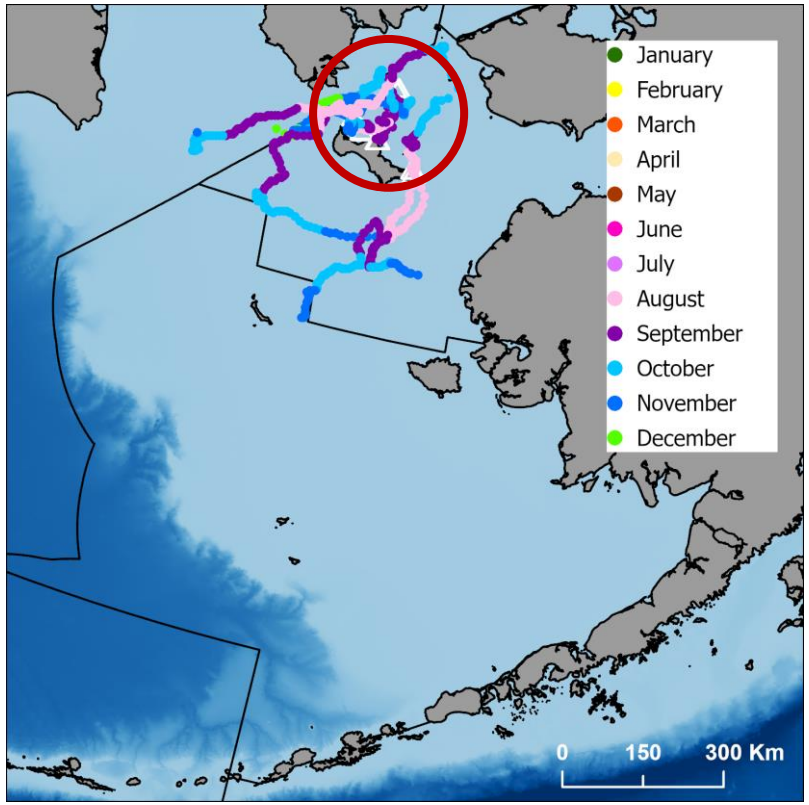
# Movement

Pacific Cod (& Pacific halibut)

# Movement of Pacific cod tagged in NBS

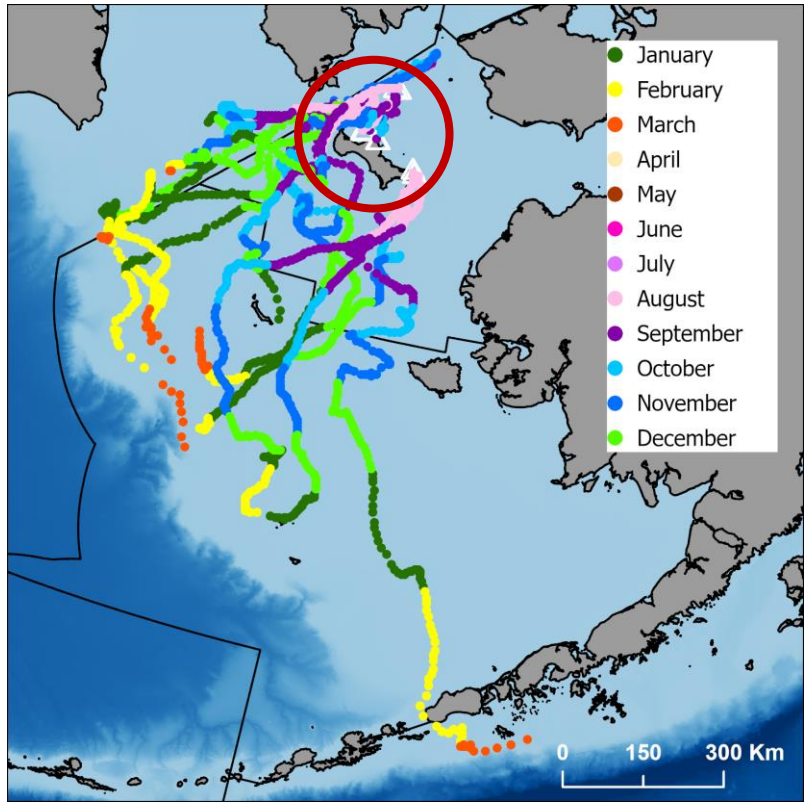
## Aug/Sep 2019 releases

Within-summer



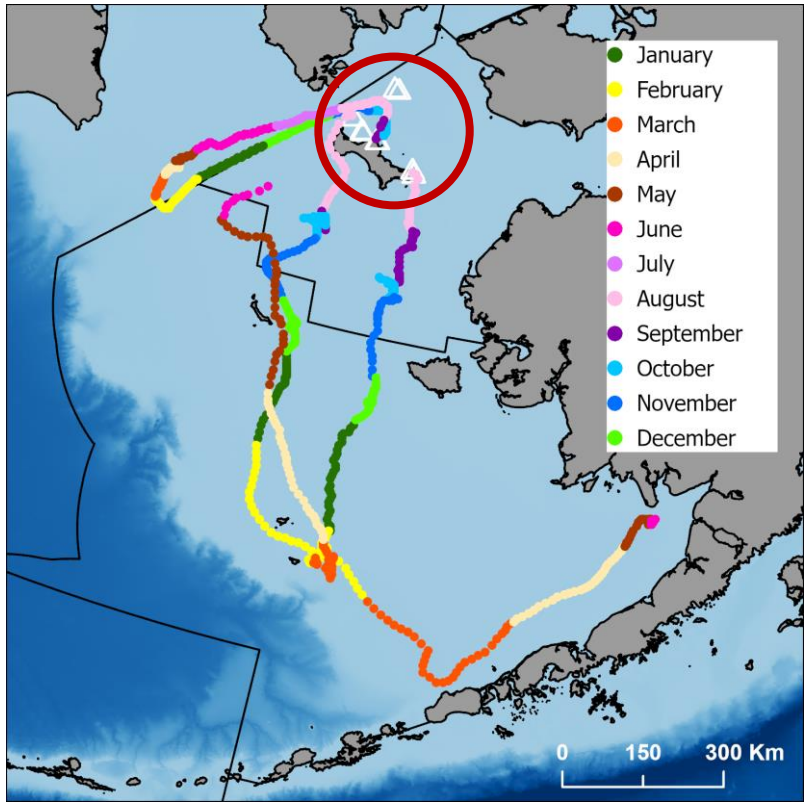

Summer/fall 2019
Pop-ups

Summer to winter




Winter 2020
Pop-ups

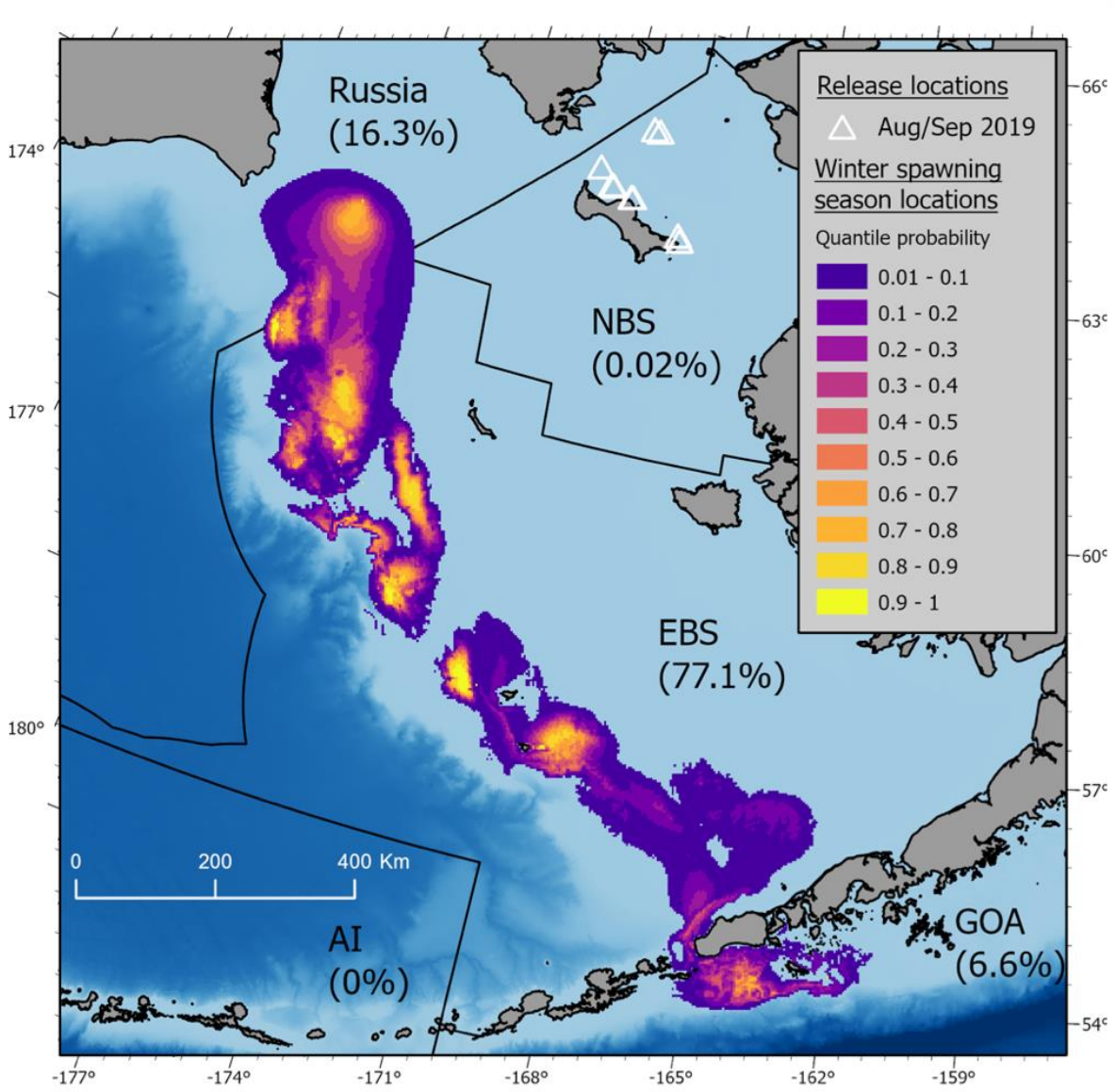
Annual




Summer 2020
Pop-ups

Julie Nielsen / Susanne McDermott

# Movement of Pacific cod tagged in NBS (2019)




Location probability during peak spawning period (mid-Feb – end of March)

- Composite for 12 fish
- tagged in NBS in Aug / Sep 2019

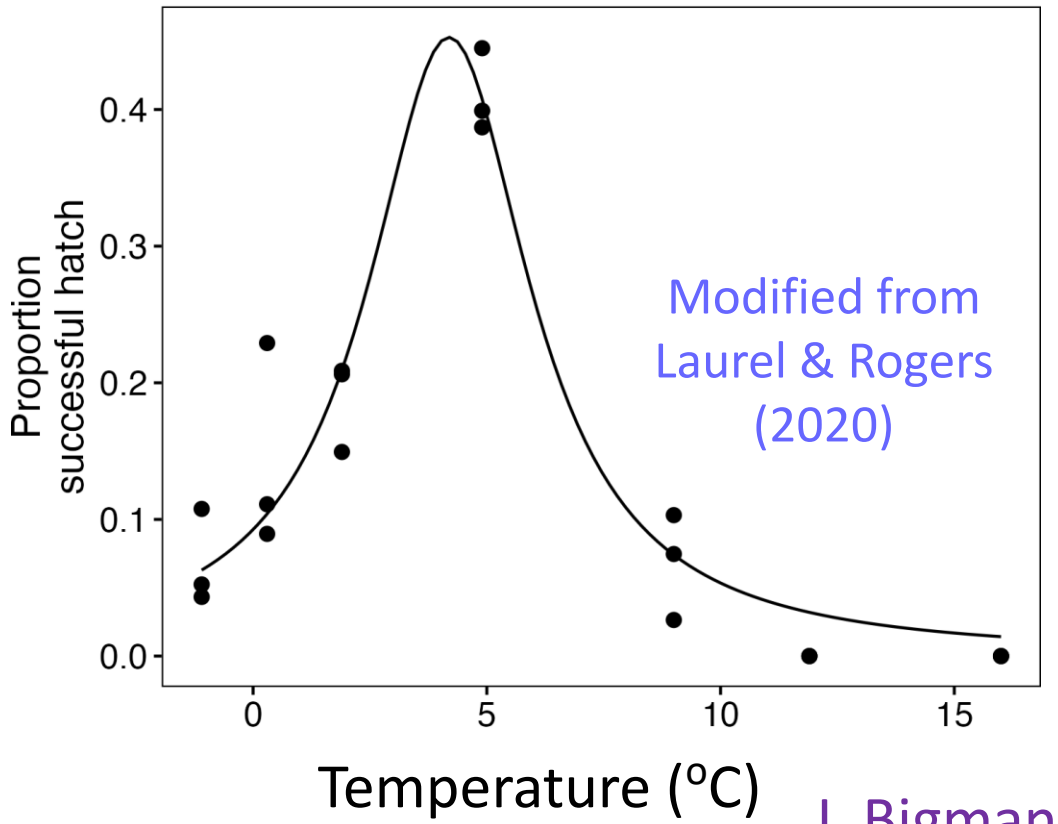
Julie Nielsen / Susanne McDermott

# Spawning habitat

# Predicting Pacific cod spawning habitat in a changing climate

We coupled an experimentally-derived relationship between temperature and hatch success with ACLIM's Bering10k ROMS hindcasts and projections to understand how spawning habitat may vary across time and space

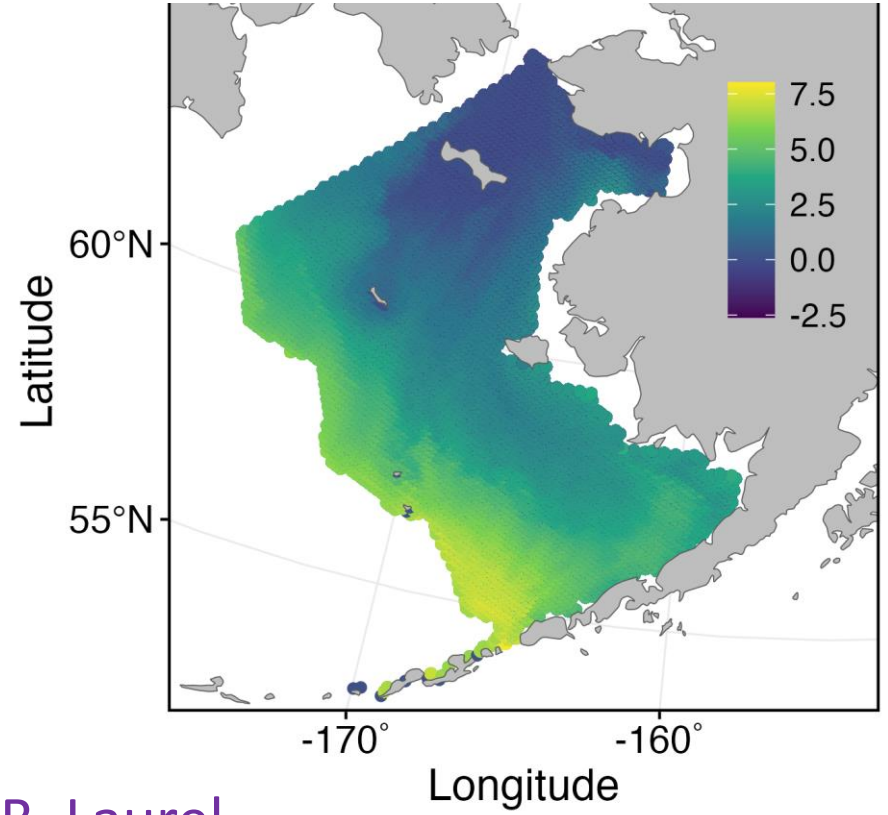
**Hatch success**




Modified from Laurel & Rogers (2020)

+

Jan-Apr bottom temperature (Bering 10k ROMS model)




J. Bigman, L. Rogers, B. Laurel

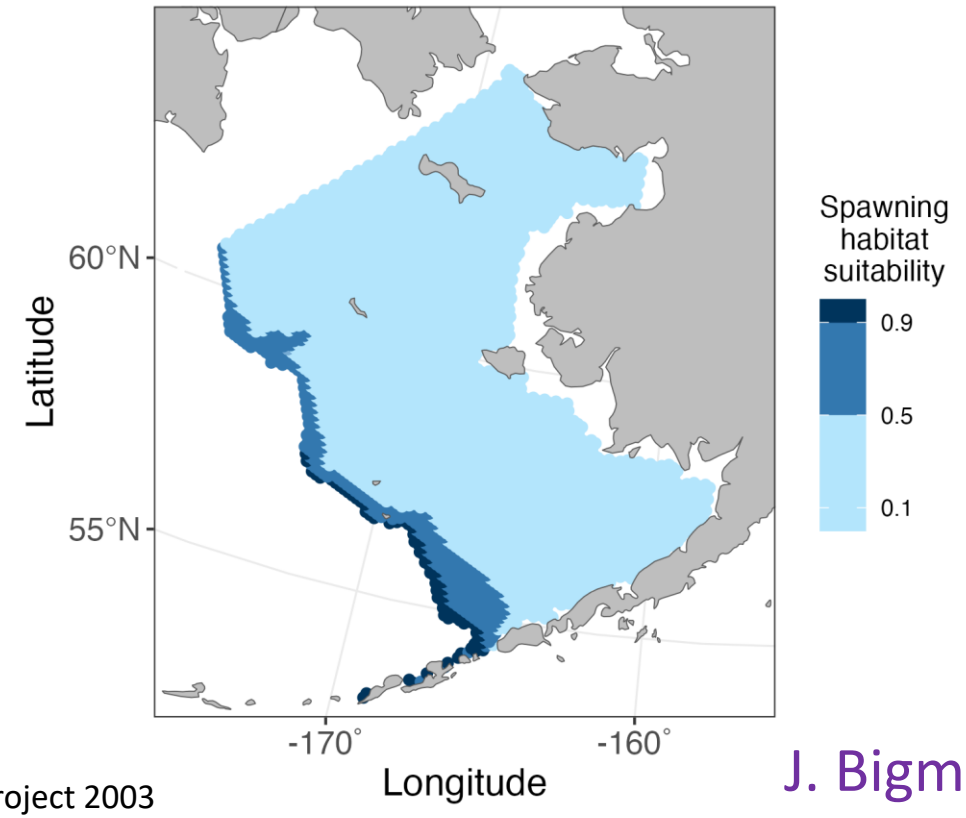
NPRB Project 2003

# Predicting Pacific cod spawning habitat in a changing climate

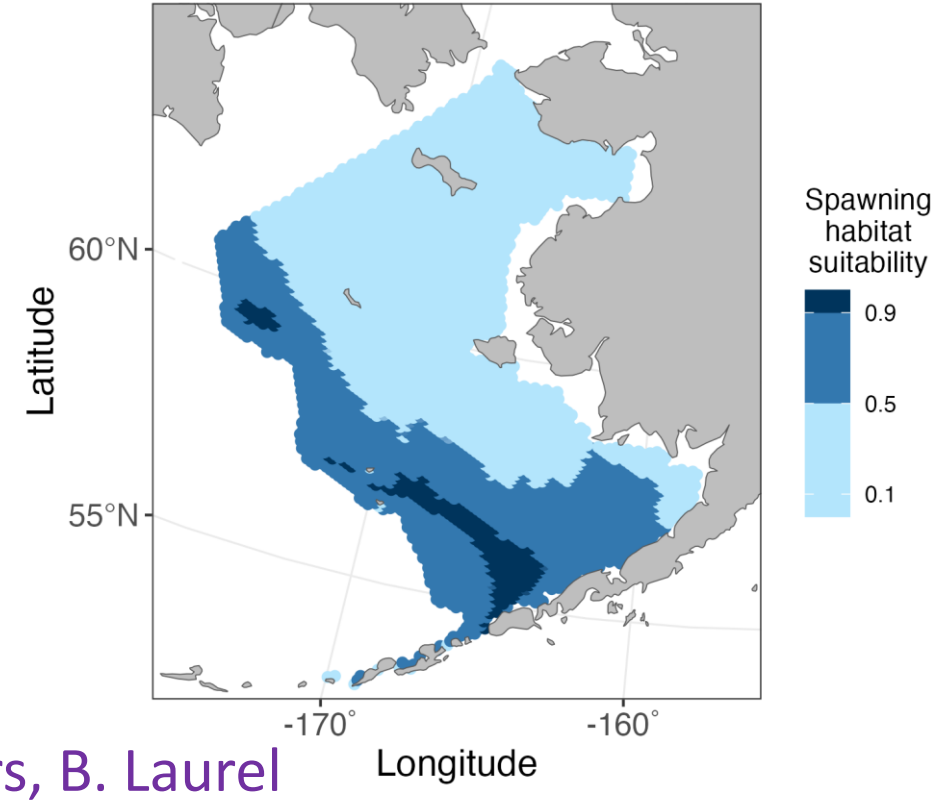
Predictions matched historical/current sites of known spawning aggregations (outer shelf edge / Aleutian Islands) & tagging results

Warm years/stanzas associated with a greater extent of thermally-suitable spawning habitat compared to cold years/stanzas

**Cold year: 2008**




**Warm year: 2016**

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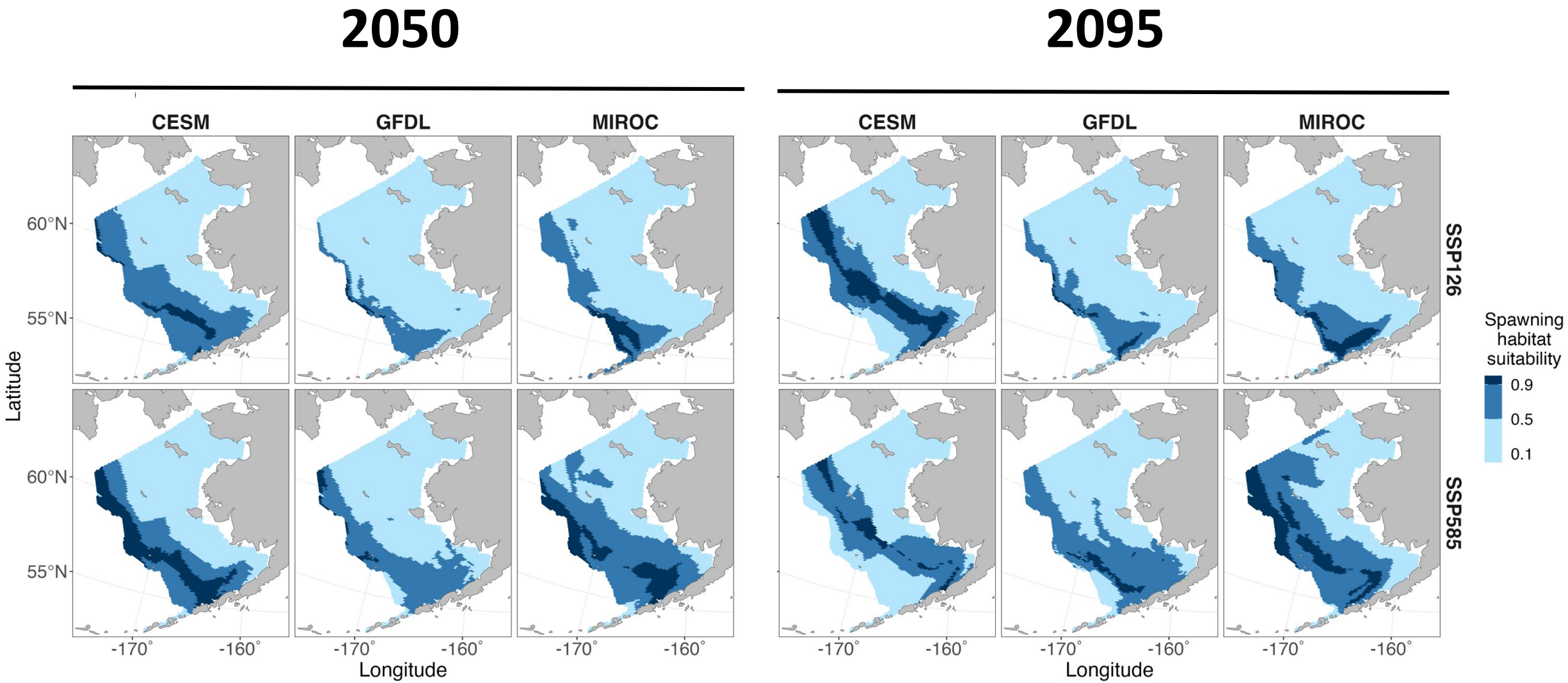
# The northern Bering Sea is not predicted to become thermally suitable for Pacific cod spawning, even by the end of the century

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# Knowledge gaps

- NBS shelf carrying capacity: Can NBS support the densities of fish observed in 2017-19?
- What are the short- and long-term effects of ‘added’ predation pressure from subarctic demersal fishes on the broader NBS ecosystem (benthos, seabirds, mammals)?
- Rates of movement between US and Russian waters?
- Role of Chukchi Sea as summer habitat (or ‘sink’?) for juvenile and adult fish?
- Potential of northern Bering Sea to provide suitable spawning habitat and juvenile nursery habitat for commercial species?
- Movement / overwintering: Temperature thresholds for juvenile and adult fish and ability to respond rapidly to cooling?