Ecosystem Status Report
Gulf of Alaska
2023

Bridget Ferriss

ESR Reports
(1999-2022)

With contributions from:

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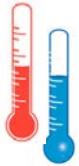
Thank you!

GOA 2023: Key Messages



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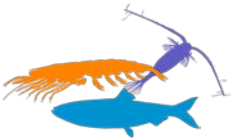
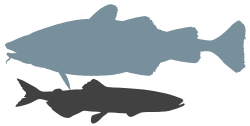
- Regional variability, average productivity, 3 La Niña's



2. Variable pelagic prey base (reduced from 2022)

- Zooplankton: below average to average
- Forage fish: below average to above average



3. Pacific cod & capelin

- Increasing populations (latest examples of MHW recovery?)

4. Looking ahead to 2024 (El Niño)*:*

- Warm surface temperatures, earlier phenology, potentially lower quality zooplankton prey, increased cross shelf transport
- Larval & age-0 groundfish most sensitive (some vulnerable, some benefit)
- Adult POP, pollock, dusky rockfish, n. rock sole

GOA Full Assessment Risk Tables: Environmental/ Ecosystem Considerations

Level 1

(No apparent environmental/ ecosystem concerns)

- Walleye pollock
- Pacific cod
- Sablefish (statewide)
- Pacific ocean perch
- Deepwater flatfish *
- Rougheye/blackspotted rockfish *
- Shortraker rockfish *
- Other rockfish *
- Skates

**Higher uncertainty due to less relevant ecosystem/prey data & fewer known mechanistic relationships*

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Physical Environment and Lower Trophic Productivity

Temperature: cool to average (surface, depth, shelf edge) *[Lemagie, Worton, O'Leary, Siwicke, Fergusson, Danielson, Axler]*

Transport: ave. to below ave. (eddy kinetic energy, relaxed winter downwelling) [*Cheng, Bond, Stockhausen*]

Shelf-edge/Slope Habitat: Reduced structural epifauna, long-term increasing acidification and decreasing oxygen (winter deep water intrusion on shelf) [*Laman, Whitehouse, Hauri, Pages*]

Phytoplankton: below average biomass, late (WGOA) to ave. (EGOA) spring bloom [*Gann, Callahan, Strom*]

Zooplankton: variable, reduced from 2022 [*Kimmel, Hopcroft, Fergusson, Drummond, Whelan*]

Larval fish: all below long-term average; low age-0 pollock and cod; ATF average; rockfish decline since 2015 [*Rogers*]

Sea jellies: cont. decline since 2019 high except high in SE [*Laman*]

Forage Fish: variable + capelin [*McGowan, Rogers, Drummon, Whelan, Laman, Pochardt, Fergusson*]

Upper Trophic Productivity & Other

Salmon: strong pink returns, other salmon mixed [*Strasburger, Whitehouse, Yasumiishi*]

Marine Mammals: SEAK humpback whales improved birth rate but not pre-2014 [*Gabriele*]

Groundfish Community: P. ocean perch relatively higher biomass, sablefish increasing; biomass of groundfish predators (P. cod, P. halibut, arrowtooth flounder) remain low in WGOA but incr. in EGOA due to arrowtooth flounder [*Whitehouse*]

Disease & Toxins: slight increase in HABs [*AOOS*]

Prince William Sound: cool temperatures, increasing herring, stable but low humpbacks, local variation in intertidal community [*Campbell, Pegau, Moran, Colletti*]

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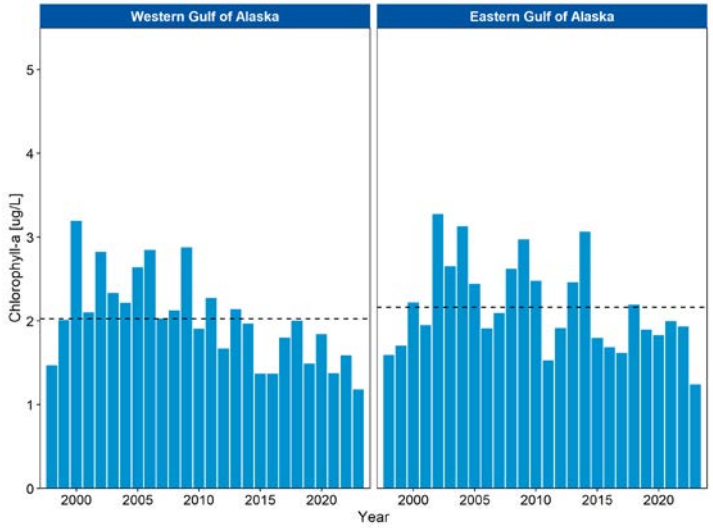
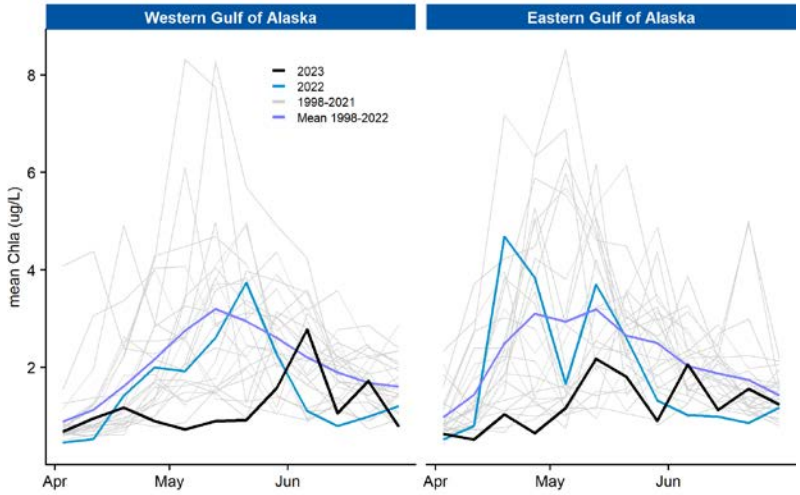
Reduced primary productivity

J. Gann, M. Callahan

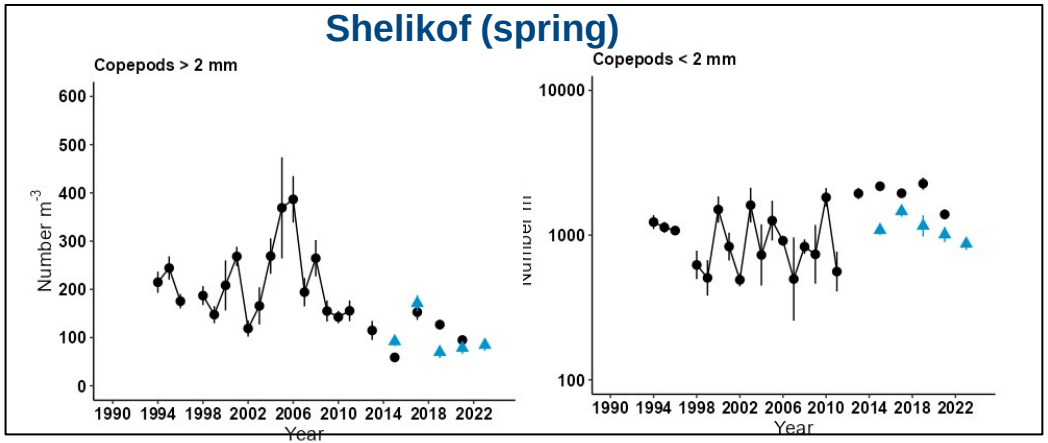


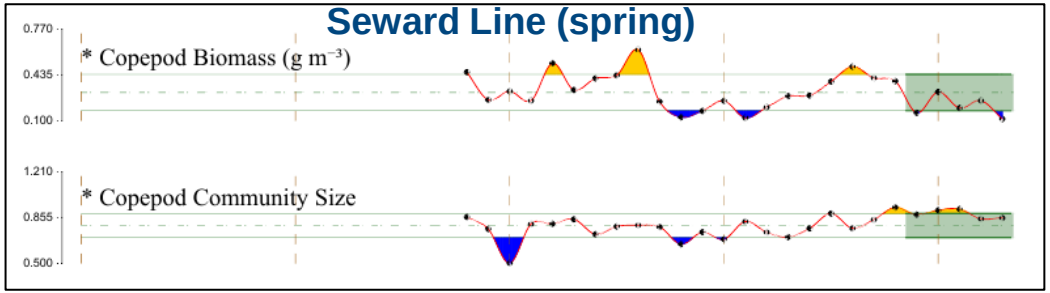


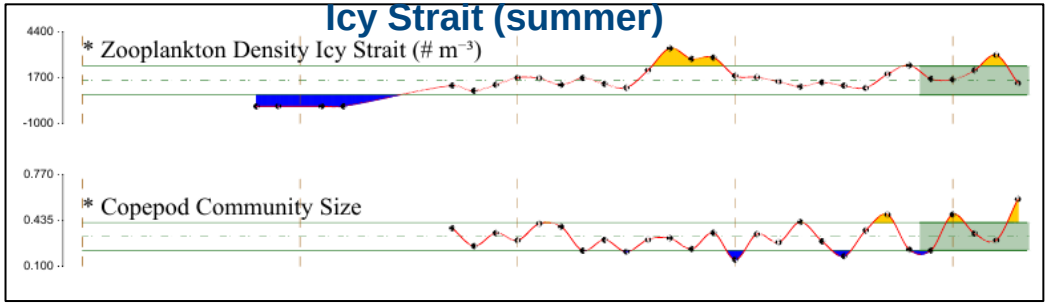
- Satellite-derived chl-a (1998-2023)
- Indicated low phytoplankton biomass
- Late timing of the chl-a spring bloom
- Unique in time series

Reduced zooplankton productivity

D. Kimmel, R. Hopcroft, E. Fergusson



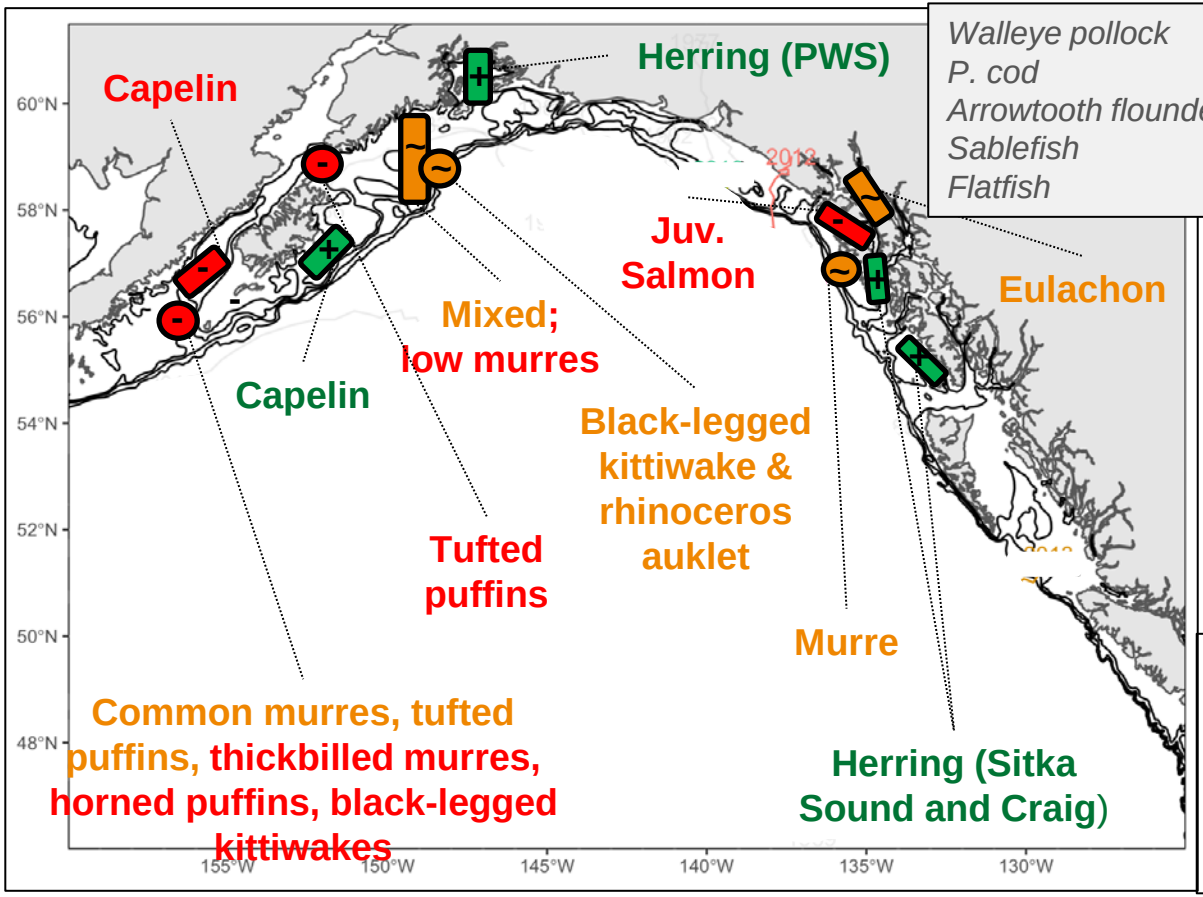




- Surveys: EcoFOCI Shelikof spring, Seward Line spring, Icy Strait (SEAK) summer
- Lower total zooplankton biomass than 2022 (below average to average)
- Higher biomass of euphausiids (Shelikof, Seward) and large copepods (Seward, Icy St.)
- Energy density (lipid content) above ave. in Icy St.

Forage Fish Prey Base: variable

B. Drummond, D. Cushing, S. Hatch, K. Hebert, S. Pegau, E. Pochardt, W. Strasburger, C. Worton



- Survey baselines from 1990's/early 2000's to present)
- Below to above average
- UP: capelin, herring
- DOWN: sandlance, juv. salmon, age-0 pollock

Legend

- *Surveys*
- *Seabird Reproductive Success*
- \+ *Above Average*
- ~ *Average*
- \- *Below Average*

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Increasing populations (MHW recovery?)

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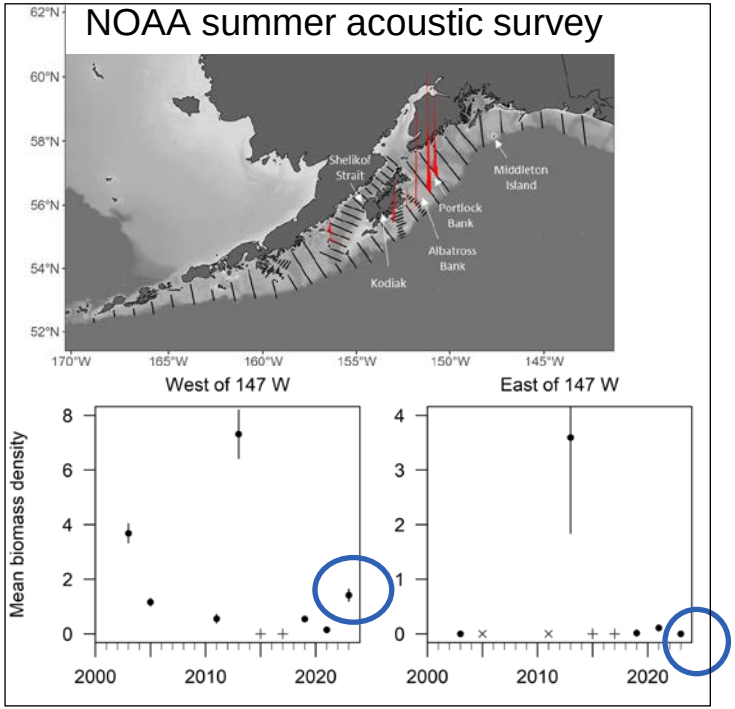
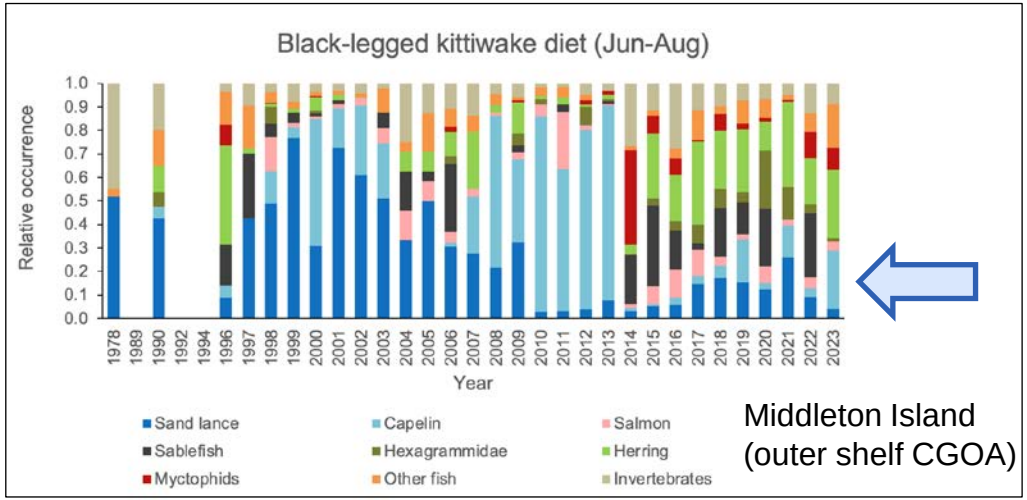
Capelin returning in core habitat

S. Whelan, D. McGowan, L. Rogers, N. Laman, Skipper Science

- Capelin are rebounding in their core habitat (at least)
- Present around Kodiak, Middleton Isl., Chowiet Isl., Sitka
- Low biomass observed around AK peninsula



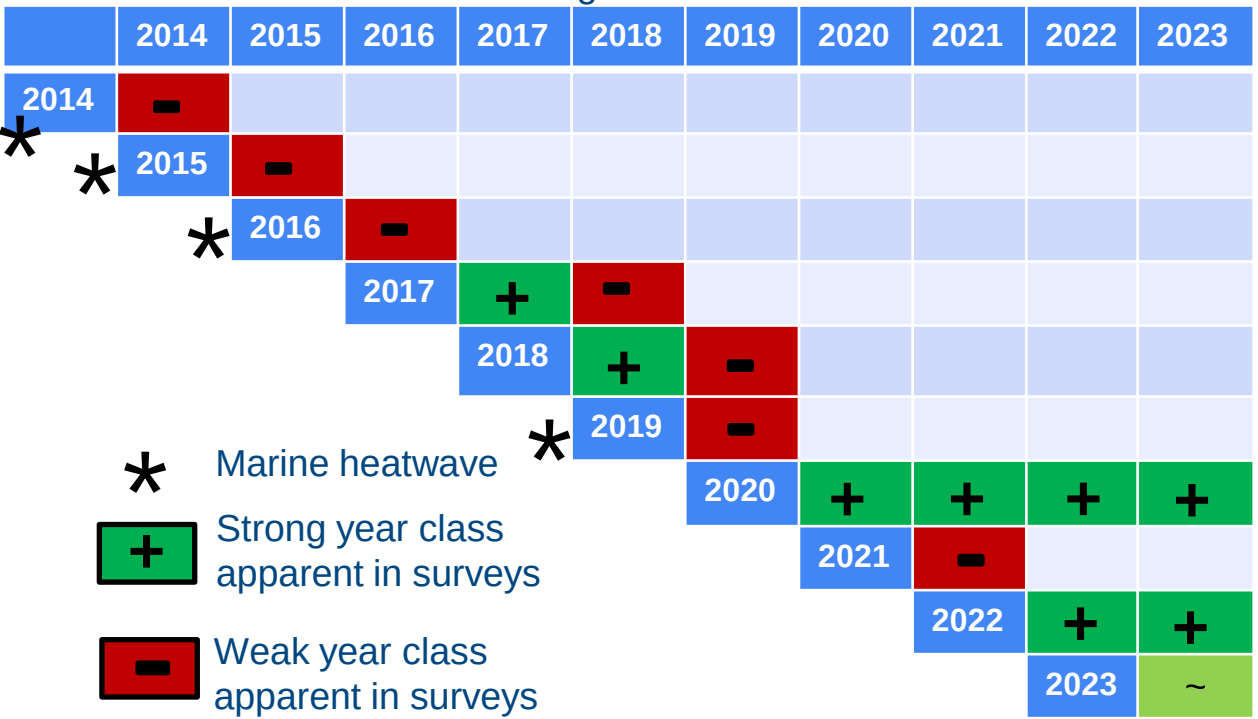
NOAA EcoFOCI summer survey (AK peninsula): low capelin biomass observed



Capelin observed around Sitka; not uncommon but hadn't seen since heatwave years; observed in chinook salmon stomachs in the area; observed large groups of seabirds (rhinoceros auklets and murrlets) feeding in these areas (unusual) (synthesized from Skipper Science)

GOA Pacific Cod 2017-2023

B. Laurel et al.



1. **Fluctuations in year class strength**

- Marine heatwave: warm SST & spawning habitat/ egg survival (2014-2016, 2019)
- Warm fall SST (2017, 2018)

2. **Larger age-0 juveniles (200% incr. in Aug**; *Laurel et al. 2023*)

- Earlier hatch times during warmer years (ave.19 days; Laurel et al., 2023)
- Faster growth rates (*Almeida et al. In Press*)

Surveys: *NOAA beach seine Kodiak (since 2006) & AK peninsula (since 2018); NOAA EcoFOCI spring (odd years) and summer (2023, 2019)*

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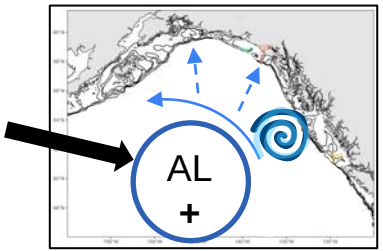
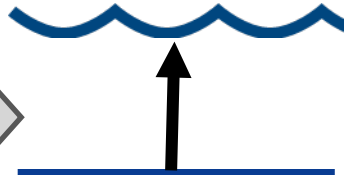
4. Looking ahead to 2024 (El Niño)
Which species are vulnerable and which might benefit?

Where are we headed (2024 +): El Niño



Aleutian Low: deeper and displaced SE

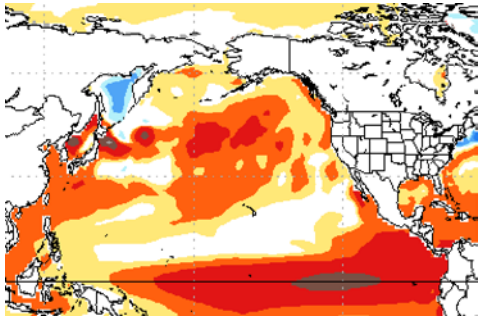
Warmer & wetter winter



Shallower mixed layer depth (earlier stratification)

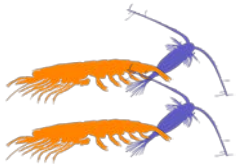
Earlier & more intense spring Bloom

?

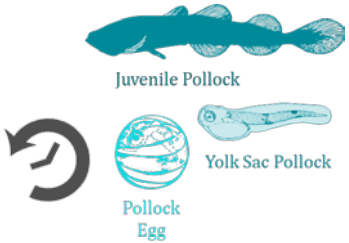


Jan, Feb Mar (2024)

Warmer sea surface temperature



Less lipid rich zooplankton community



Earlier phenology

Optimal thermal ranges for groundfish?

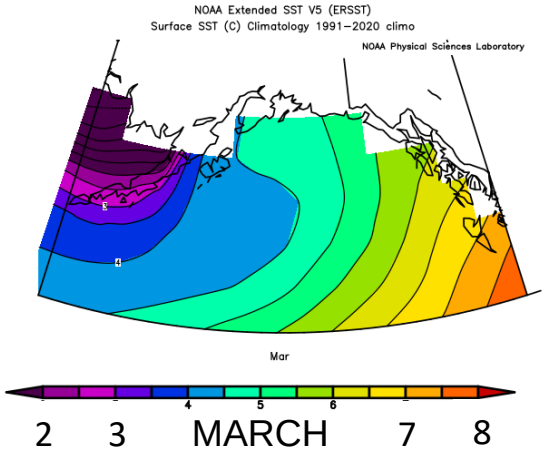
Sea Surface Temperatures in 2024

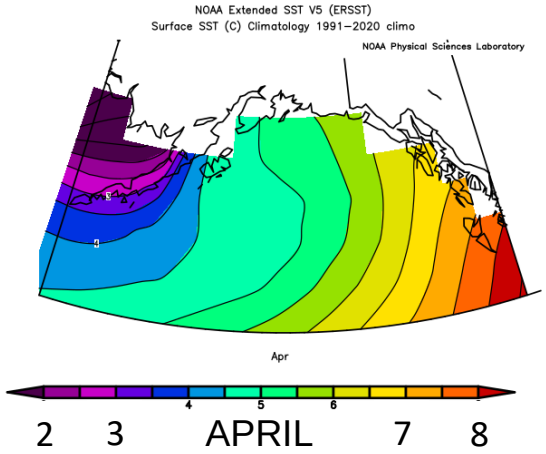
N. Bond

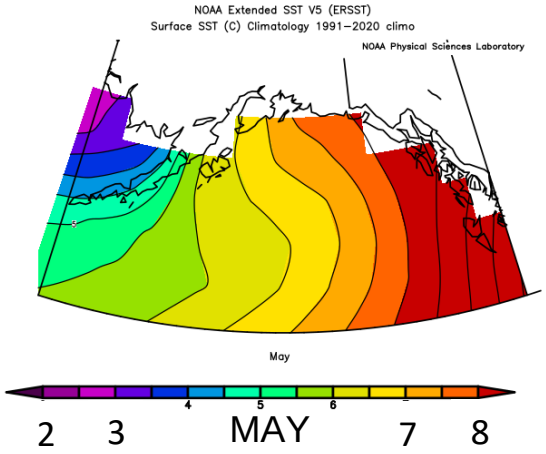
- NMME predictions of SST anomalies converted to SST (^{o}C) using ERSST average (baseline: 1991-2020) [potential underestimate of warming]

VULNERABLE (larvae favor cooler springs):
P. cod yolk-sac larvae & feeding larvae (5-6^{o}C)
W. pollock yolk-sac larvae (3-7^{o}C)
N. rock sole larvae

BENEFIT (larvae favor warm springs):
Sablefish larvae & YOY (12-16^{o}C)
S. rock sole larvae
P. ocean perch larvae
Rockfish larvae







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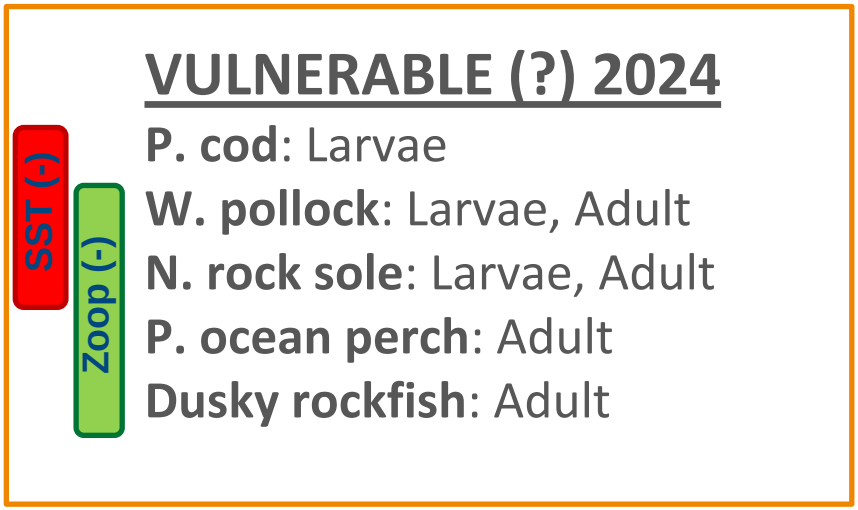
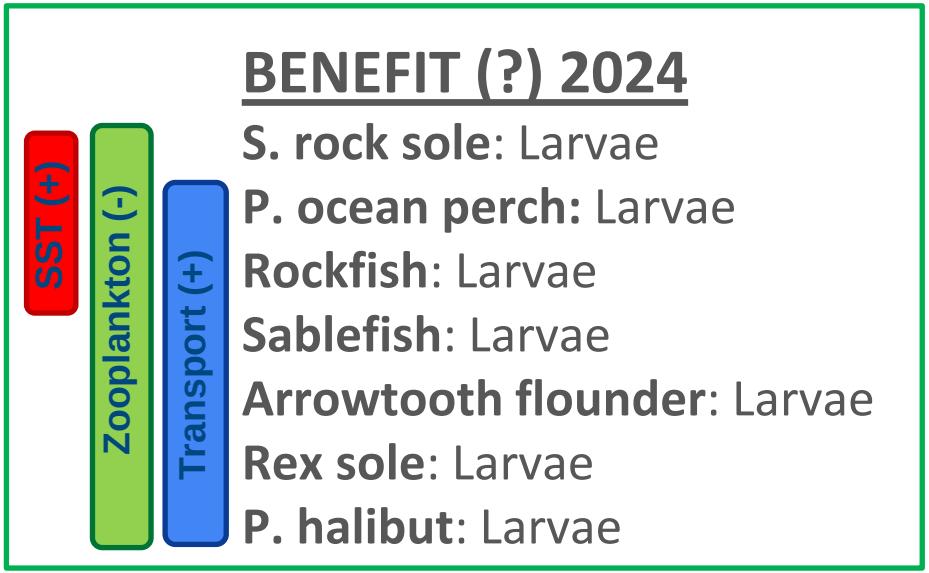
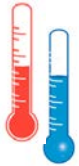




Questions:

- Can populations survive low recruitment year in 2023? 2 low recruitment years (‘23/’24)?
- If heat persists and mixes to depth (late 2024/2025): what adult populations are vulnerable?
- Do populations have a buffer for unknown ecological responses

GOA 2023: Key Messages



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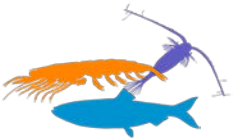

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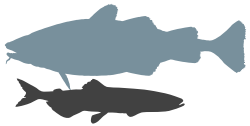

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