Ecosystem Status Report: Gulf of Alaska 2023

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With contributions from:

1. 2023 Average productivity; Spatially variable; 4-year consistent environmental drivers

2. Variable pelagic prey base (zooplankton, forage fish); Reduced from 2022

3. Pacific cod & capelin show signs of increase (first since marine heatwave years)

4. Looking ahead to 2024 (El Niño): which groundfish are vulnerable & which might benefit?
### GOA Full & Update Assessment Risk Tables: Environmental/ Ecosystem Considerations

#### Level 1
*(No apparent environmental/ ecosystem concerns)*

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

#### Environment:
- Ocean temperatures cool to average

#### Prey:
- Pelagic: (Zooplankton & forage fish) reduced/variable
- Benthic & infauna: variable /unknown

#### Predation:
- Relatively low (P. cod, P. halibut, arrowtooth flounder) except sablefish; no major changes in seabirds & marine mammal populations

#### Competition:
- Potentially higher for zooplankton-eating groundfish due to pink salmon, P. ocean perch, pollock

#### 2024:
- El Niño primarily impact larval survival & prey base for juveniles and zooplankton—eating adults
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

2024 early, larger phytoplankton spring bloom
Zooplankton
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 large copepods & euphausiids (Shelikof, Seward)
• Energy density (lipid content) above average in Icy St.

2024 community shift to smaller copepods
Forage Fish Prey Base: variable

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

- Common murres, tufted puffins, thick-billed murres, horned puffins, black-legged kittiwakes
- Mixed; low murres
- Herring (Sitka Sound and Craig)
- Eulachon
- Juv. salmon
- Mixed; low murres
- Tufted puffins
- Black-legged kittiwake & rhinoceros auklet
- Murre
- Herring (PWS)

Legend

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

- Survey baselines from 1990’s/early 2000’s to present
- Below to above average
- Incr: capelin, herring
- Decr.: sandlance, juv. salmon, age-0 pollock

Prey for:
- W. pollock
- P. cod
- Arrowtooth fl.
- Sablefish
- Flatfish
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 around AK peninsula (NOAA EcoFOCI summer survey) & eastern GOA (NOAA summer acoustic survey & Bottom trawl survey)

• 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 murrelets) feeding in these areas
• (synthesized from Skipper Science)
Surveys: NOAA beach seine Kodiak (since 2006) & AK peninsula (since 2018); NOAA EcoFOCI spring (odd years) and summer (2023, 2019)
Looking ahead to 2024 (El Niño): warming SST


**VULNERABLE?** (larvae favor cooler springs):
- P. cod yolk-sac larvae & feeding larvae (5-6°C)
- W. pollock yolk-sac larvae (3-7°C)
- N. rock sole larvae

**BENEFIT?** (larvae favor warm springs):
- Sablefish larvae & YOY (12-16°C)
- S. rock sole larvae
- P. ocean perch larvae
- Rockfish larvae
Looking ahead to 2024 (El Niño)

**VULNERABLE (?) 2024**
- **P. cod**: Larvae
- **W. pollock**: Larvae, Adult
- **N. rock sole**: Larvae, Adult
- **P. ocean perch**: Adult
- **Dusky rockfish**: Adult

**BENEFIT (?) 2024**
- **S. rock sole**: Larvae
- **P. ocean perch**: Larvae
- **Rockfish**: Larvae
- **Sablefish**: Larvae
- **Arrowtooth flounder**: Larvae
- **Rex sole**: Larvae
- **P. halibut**: Larvae
Looking ahead to 2024 (El Niño)

**VULNERABLE (?) 2024**
- P. cod: Larvae
- W. pollock: Larvae, Adult
- N. rock sole: Larvae, Adult
- P. ocean perch: Adult
- Dusky rockfish: Adult

**BENEFIT (?) 2024**
- S. rock sole: Larvae
- P. ocean perch: Larvae
- Rockfish: Larvae
- Sablefish: Larvae
- Arrowtooth flounder: Larvae
- Rex sole: Larvae
- P. halibut: Larvae
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- Rockfish: Larvae
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- Arrowtooth flounder: Larvae
- Rex sole: Larvae
- P. halibut: Larvae

Questions:
- How would a low recruitment year in 2023 affect populations? 2 low recruitment years (‘23/’24)?
- If heat persists and mixes to depth (late 2024/2025?): which adult populations are vulnerable?
- Do populations have a buffer for unknown/indirect/cumulative ecological responses?
GOA 2023: Key Messages

1. 2023 Average productivity; Spatially variable; 4-year consistent environmental drivers
   • 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 show signs of increase (first since marine heatwave years)

4. Looking ahead to 2024 (El Niño):
   • Warm surface temperatures, potentially lower quality zooplankton prey, increased cross shelf transport
   • Larval & juvenile groundfish most sensitive (some vulnerable, some benefit)
   • Adult POP, pollock, dusky rockfish, n. rock sole are more vulnerable
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?

- Juvenile Pollock
- Yolk Sac Pollock
- Pollock Egg