Ecosystem Status Report
Gulf of Alaska
2023
Bridget Ferriss
With contributions from:

GOA 2023: Key Messages

1. 2023 Spatially variable, average productivity, 4 year period
   • 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*
2023 Gulf of Alaska

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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]
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

Common murres, tufted puffins, thickbilled murres, horned puffins, black-legged kittiwakes

Mixed; low murres

Herring (Sitka Sound and Craig)

Herring (PWS)

Capelin

Eulachon

Walleye pollock
P. cod
Arrowtooth flounder
Sablefish
Flatfish

Legend

Surveys

Seabird Reproductive Success

+ Above Average

~ Average

- Below Average

• Survey baselines from 1990’s/early 2000’s to present)

• Below to above average

• UP: capelin, herring

• DOWN: sandlance, juv. salmon, age-0 pollock
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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)

Middleton Island (outer shelf CGOA)
**GOA Pacific Cod 2017-2023**

*B. Laurel et al.*

### Year Class Strength of GOA Pacific Cod

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1. **Fluctuations in year class strength**
   - 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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   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)

Warmer sea surface temperature

Less lipid rich zooplankton community

Jan, Feb Mar (2024)

Earlier & more intense spring Bloom

Optimal thermal ranges for groundfish?

Earlier phenology
Sea Surface Temperatures in 2024

- NMME predictions of SST anomalies converted to SST (°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°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
Where are we headed (2024 +)?

**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

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
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