

A stylized map of the Aleutian Islands region in the North Pacific Ocean. The islands are shown in dark teal, with a lighter teal area highlighting the island chain. The map includes latitude and longitude lines.

Aleutian Islands Ecosystem Status Report

North Pacific Fishery
Management Council
December 14, 2021



Ivonne Ortiz &
Stephani Zador



Thank you!

Contributors & Partners

Sonia Batten, Nick Bond, Peter Boveng, Mathew W. Callahan, Jenipher Cate, Wei Cheng, Cynthia Christman, Shaun Dahle, Jane Dolliver, Darcy Dugan, Thomas Farrugia, Anne Marie Eich, Sarah Gaichas, Suzi Golodoff, Tyler Hennon, Cate Jenipher, Timothy Jones, Mandy Keogh, Joseph Krieger, Kathy Kuletz, Carol Ladd, Ned Laman, Jean Lee, Jackie Lindsey, Josh London, Calvin Mordy, John Olson, Ivonne Ortiz, Clare Ostle, Noel Pelland, Chandra Poe, Lorrie Rea, Heather Renner, Sean Rohan, Nora Rojek, Natalie Rouse, Greg Ruggerone, Kate Savage, Sarah Schoen, Kevin Siwicke, Lisa Spitler, Phyllis Stabeno, Jay Ver Hoef, Jordan Watson, George Whitehouse, Bruce Wright, Stephani Zador, and Heather Ziel



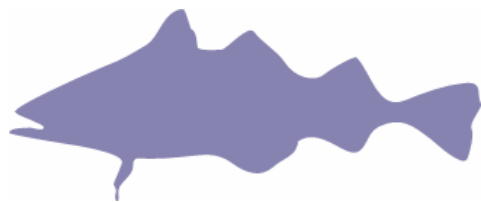
photos: photolib.noaa.gov



2021 BSAI Risk Tables

7 full assessments for BSAI (+ Alaska-wide Sablefish):

- 4 recommended an ecosystem risk level of 1.
- 4 recommended an ecosystem risk level 2 (details below).



EBS Pollock



Prolonged warm phase, lack of cold pool, and carrying capacity concerns in the NBS.



EBS Pacific cod



Prolonged warm phase, reduced prey availability combined with increased metabolic demands, and die-offs in the NBS.



AI Pacific cod



Persistent warm conditions and lower prey quality resulting in reduced fish condition.



Yellowfin sole



Bottom temps may exceed thermal tolerance, carrying capacity concerns in the NBS, declines in fish condition from 2019

Noteworthy

Mercury in AI food webs (Rea) & Plastics in Seabirds (Ortiz)



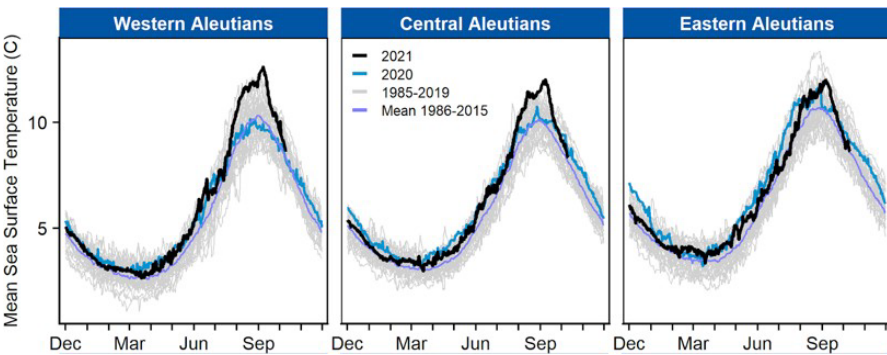
Mercury study (p. 26): <https://ine.uaf.edu/werc/werc-projects/aleutian-mercury/>

- Relatively high total mercury concentration (THg) in 25% pups sampled to date in WAI and CAI. Exposure highest in utero.
- Decreased immune function, muscle, organ tissue damage during active breath-hold diving
- Pups with THg > 20 $\mu\text{g/g}$ doubled at Agattu: 20.6% (2011) to 46.4% (2019)
- Higher THg in WAI than CAI also in several groundfish and seabirds
- Differences originate at base of food chain and amplified by feeding ecology.

Plastics (p. 28)

- in AI, highest concentration of phthalates (plastic derived contaminant) in diving plankton- feeders (crested auklets)
- Healthy looking seabirds affected by weight loss, higher blood calcium levels, positive correlation with concentration of uric acid, cholesterol.
- 32% - 71% of seabirds ingest plastics depending on location (NZ, New England)
- ingesting one item has a 20.4% chance of lifetime mortality, balloons 32 times more likely to result in death.
- high proportion of plastic ingested is recyclable.

This year - 2021



Climate: La Niña year (p. 33)

- Winter: Stormier than average, unfavorable environmental conditions for foraging seabirds
- Spring: suppressed transport through eastern passes
- Summer: slightly unfavorable foraging conditions for seabirds, may explain delayed hatching of seabirds

Temperature (p. 37)

- Record high SST in WAI and CAI causing moderate MHW in Aug & Sep. Atka mackerel nests in shallower waters, potentially reaching upper limits of observed spawning temperatures

Prey availability (p. 62)

High reproductive success in seabirds signals wide prey availability for piscivorous & planktivorous groundfish

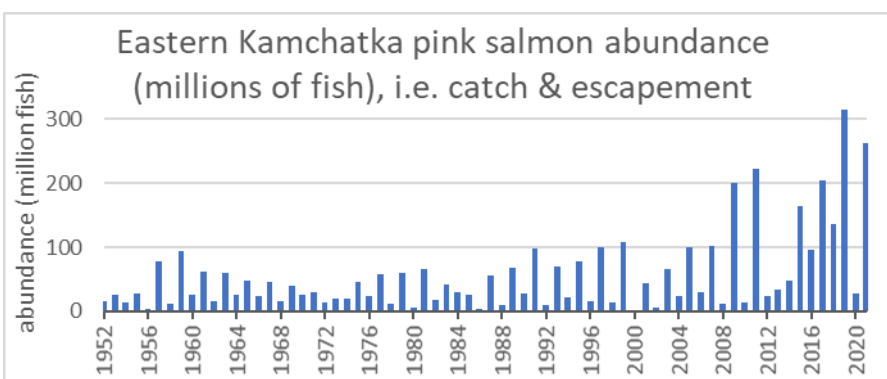
Eastern Kamchatka Wild Pink Salmon (p. 57)

- Second highest abundance on record; increased competition for prey expected in high abundance years

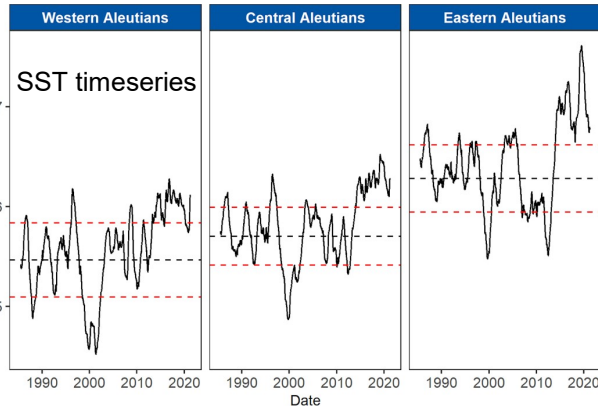
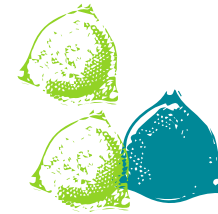
Paralytic Shellfish Toxin, blue mussels, Unalaska (p. 78)

- 75x above regulatory limit, risk to human health & food webs. West of Unalaska, levels under regulatory limits), current samples in lab

Site	Species														
	Primarily fish eaters						Primarily zooplankton eaters								
	red-faced cormorant	glaucous winged gull	common murre	thick billed murre	horned puffin	tufted puffin	red-legged kittiwake	black-legged kittiwake	fork-tailed storm-petrel	Leach's storm-petrel	ancient murrelet	parakeet auklet	least auklet	whiskered auklet	crested auklet
Aiktak	-	😊	😊	😊	😊	😊	-	-	😊	😊	-	-	-	-	-
Buldir	-	😊	😊	😊	😊	😊	😊	😊	😊	😊	-		😊	😊	😊

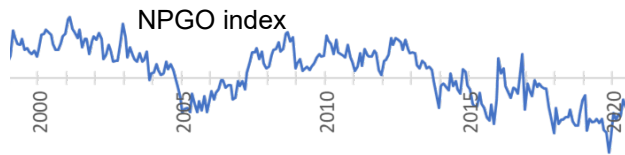


Multi-year Patterns

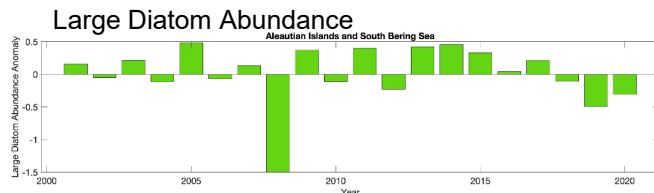
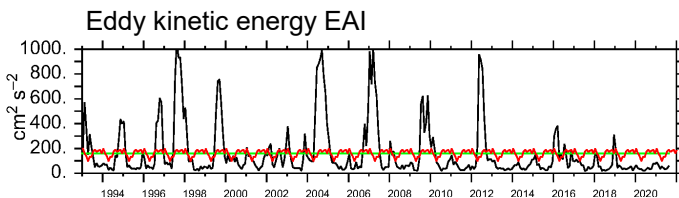


Three drivers (since ~ 2013):

Continued unfavorable environmental conditions
 Eastern Kamchatka Pink Salmon Abundance
 Rockfish dominating pelagic foragers

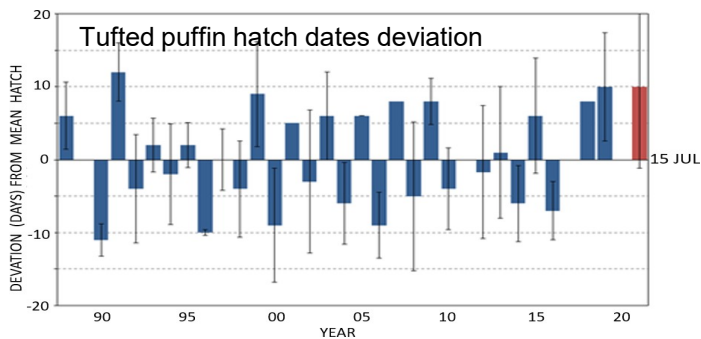
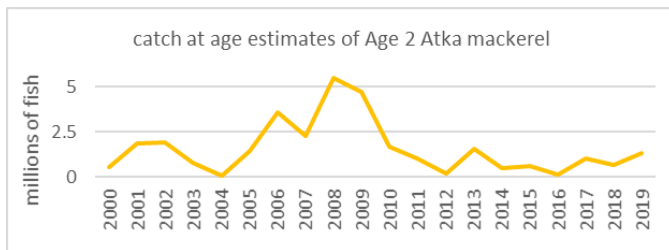
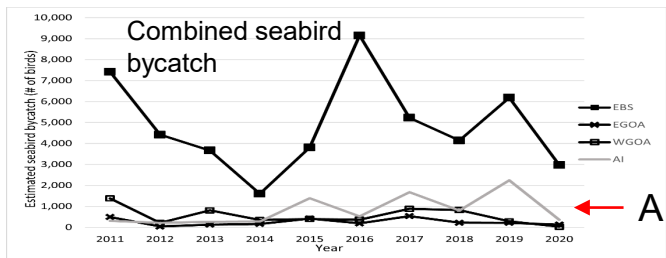
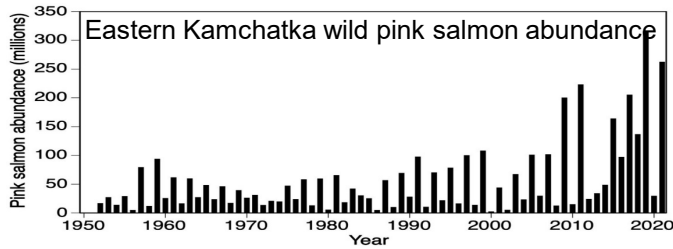


- SST above long-term average (p. 38)
- NPGO negative (p. 32)
- EKE in eastern Aleutians below long-term average (p. 48)
- Large diatom abundance decreasing trend (p. 54)



NPGO, Bond; SST, Watson & Callahan; EKE, Cheng; CPR Diatom Ostle and Batten

Multi-year Patterns



Three drivers (since ~ 2013):

Continued unfavorable environmental conditions
 Eastern Kamchatka Pink Salmon Abundance
 Rockfish dominating pelagic foragers

- Biennial pattern in combined seabird bycatch, p. 88
- Catch age 2 Atka mackerel (SAFE 2021), also otolith growth, Matta 2020.
- Tufted puffin hatch dates (from Springer & Van Vliet 2014) extended to 2021, p. 61.
- Not shown: Batten et al. 2018 – trophic cascade copepods and large diatom abundance.

Pink salmon, Ruggerone; Bycatch all seabird, Krieger and Eich, Catch age-2 Atka Mackerel, Atka Mackerel SAFE Lowe; Tufted puffin yearly hatch date deviation, Rojek

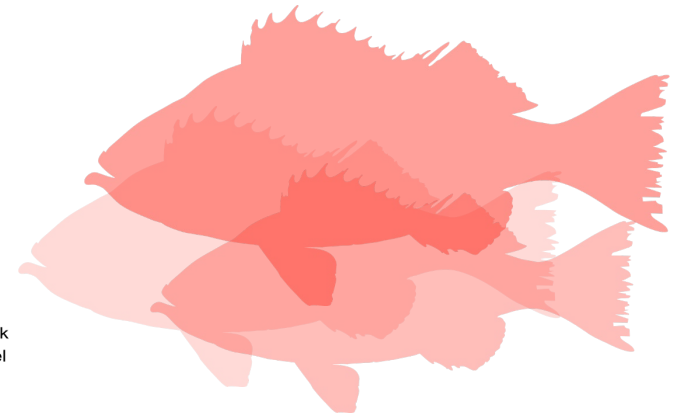
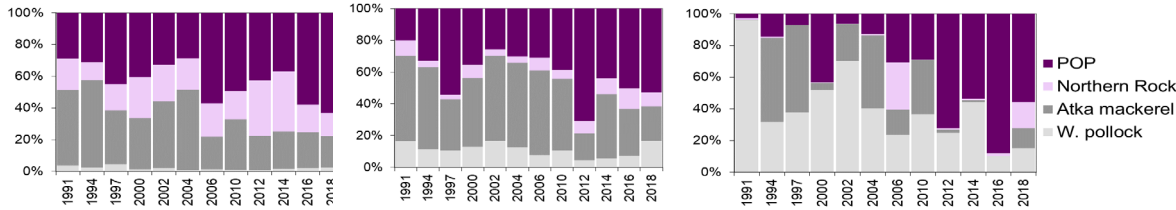
Multi-year Patterns

Biomass proportion of pelagic foragers

Pelagic Foragers: Western AI

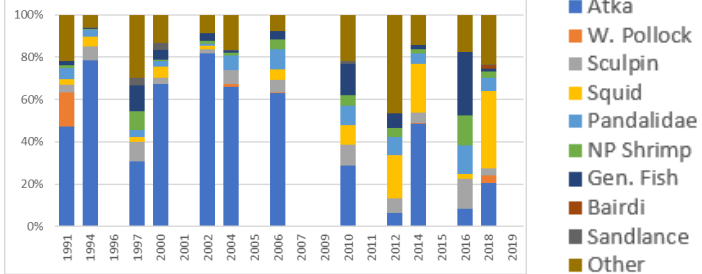
Central AI

Eastern AI

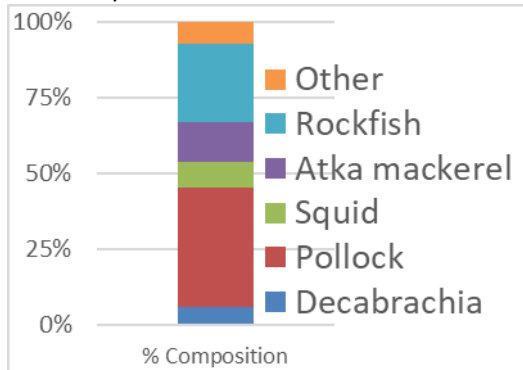


Pacific cod >20cm diets in Central Aleutians

Area 542 P. Cod > 20 cm fork length



Tufted puffin diet at Buldir



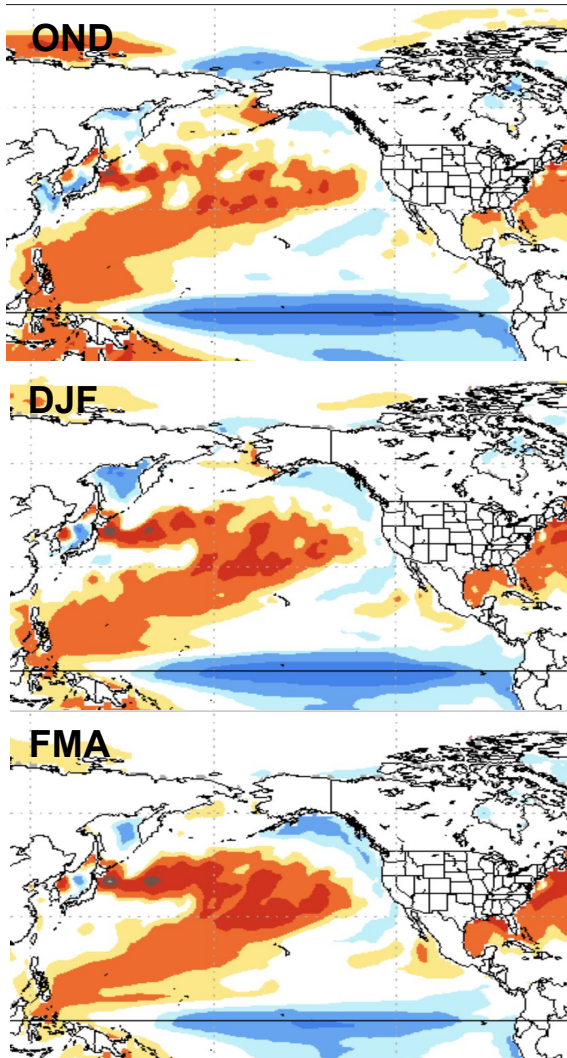
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- Change in ratio of pollock & Atka mackerel to Pacific ocean perch & northern rockfish (AI ESR 2018)
- Area occupied by POP has also increased (Spencer et. al., POP SAFE)
- POP, Northern rockfish, stable at high abundance, Atka mackerel decreasing (SAFE 2021)
- Less Atka mackerel in P. cod diets in CAI
- Rockfish in Tufted puffin diet at Buldir

Multi-year Pattern Implications

- Conditions since ~2013 suggest **lower productivity in the ecosystem**. Higher temperatures increase bioenergetic costs, which may have **increased prey consumption**. They also increase growth rates of zooplankton. Low EKE in the eastern Aleutians suggests **reduced flows through the eastern passes** of heat, salt and nutrients. Continued decrease in diatom abundance suggest **potential lower productivity or may reflect increased consumption by zooplankton**.
- Increases in **pink salmon abundance may have crossed a threshold in 2013-2014** with competition impacts more evident and cascading through the system. Although biennial patterns are observed in other species, **other processes may offset competition**.
- **Rockfish dominance may be unfavorable for pinnipeds** as it may decrease availability of Atka mackerel and pollock to pinnipeds (both Steller sea lions and harbor seals are decreasing), while **mercury and plastics may have sublethal adverse effects** which would make recovery more difficult.
- Cumulatively, these trends may be adversely impacting predators, 2012-2018 **lower than average fish condition** in Pacific cod, northern rockfish and Pacific ocean perch (but not detected in stock assessments) may indicate a detrimental effect of temperature as well **as increased competition for prey, changes in prey field timing, availability and composition**. This may have contributed to the decrease in Atka mackerel biomass and lower groundfish condition; **lower prey availability and quality** would also cascade to apex predators.

NMME Projections 2022 (p. 39)



- Moderate La Niña, decrease in temperature in the southeast Bering Sea and Gulf of Alaska
- late winter and early spring of 2022 will bring near-normal temperatures to most of the Bering Sea and Aleutian Islands, and quite cold temperatures to the central GOA
- February - April 2022 Near-normal temperatures in the Bering Sea and Aleutian Islands with neutral La Niña conditions

AI Summary

Risk Table **Environmental/Ecosystem** **Considerations**

Level 2

(Some indicators showing adverse signals relevant to the stock but the pattern is not consistent across all indicators.)

- AI Pacific cod

Level 1

(No apparent environmental/ecosystem concerns)

- Northern Rockfish
- Atka mackerel
- Sablefish (statewide)

Noteworthy

- Mercury in food webs
- Plastics in seabirds

• In both, frequency and intensity of sublethal effects is linked to feeding ecology

Assessment 2021

- Record high SST in WAI, CAI, moderate MHW
- Most seabirds above average reproduction
- Pink salmon - 2nd highest abundance on record

Multi-year since ~2013

- Warmer temperatures, low EKE in EAI, lower to average productivity
- Pinks impact? Biennial pattern in combined all seabird bycatch
- Pelagic foragers dominated by rockfish

2022 Forecast

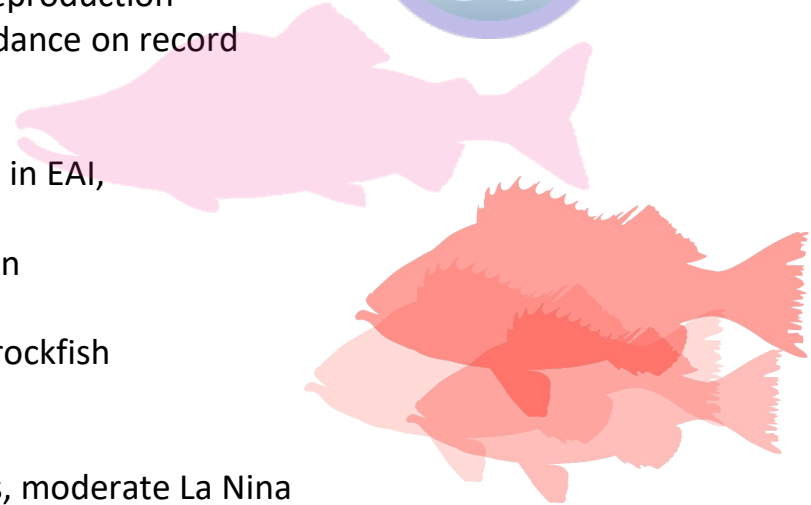
- Cooler near average conditions, moderate La Nina

Implications for this year

- SST reaching upper limit of Atka mackerel spawning temperatures
 - wide prey availability expected for planktivorous and piscivorous predators

Cumulative effects

- bioenergetic costs
- lower productivity
- zooplankton grows faster
- changes in prey field timing, composition and location
- competition exacerbated by pink salmon
- combined effects of mercury and plastics may affect recovery of pinnipeds



Full presentations to SSC available at:

Aleutian Islands: Full SSC presentation [AI powerpoint](#), [AI audio](#) (@11:30), [AI inBrief draft](#)

Eastern Bering Sea: Full SSC presentation [EBS powerpoint](#), [EBS audio](#) (@1:28:56) [EBS inBrief draft](#)

Gulf of Alaska: Full SSC presentation: [GOA powerpoint](#), [GOA audio](#) (@54:50), [GOA inBrief draft](#), [GOA ESR 2020 Outreach Video](#)

Full reports, pdf: https://apps-afsc.fisheries.noaa.gov/Plan_Team/2021/assessments.htm

Question to Council members: *For future presentations, would you like to hear the same presentation as SSC or abbreviated version?*

Full presentation as presented to the SSC (Dec 3, 2021)

Aleutian Islands Ecosystem Status Report

BSAI

SSC, December 3, 2021



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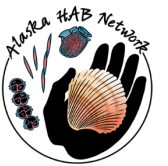
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Thank you!

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photos: photolib.noaa.gov



Outline

2021 not a survey year in AI

Index Category		2020-2021
Physical Oceanography		2021
Primary producers		2020-2021
Zooplankton		2020
Salmon		2021
Groundfish		---
Seabirds		2021
Marine Mammals		2020-21
Ecosystem Indicators		2020-21
Fishing and Human Dimensions		2020

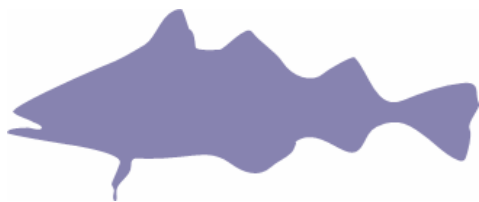
- Summary of risk tables
- SSC comments
- Noteworthy updated
- This Year
 - climate
 - expected prey availability
 - HABs
- Multi-year Patterns
- Implications
- Questions and/or Comments?

Note: Contributions for Human Dimensions were paused due to ongoing conversations with AFSC and SSC)

2021 BSAI Risk Tables

7 full assessments for BSAI (+ Alaska-wide Sablefish):

- 4 recommended an ecosystem risk level of 1.
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EBS Pollock



Prolonged warm phase, lack of cold pool, and carrying capacity concerns in the NBS.



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Prolonged warm phase, reduced prey availability combined with increased metabolic demands, and die-offs in the NBS.



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Persistent warm conditions and lower prey quality resulting in reduced fish condition.



Yellowfin sole



Bottom temps may exceed thermal tolerance, carrying capacity concerns in the NBS, declines in fish condition from 2019

SSC Comments

New contributions

- i. Mid water temperature from longline survey
- ii. Satellite chl_a
- iii. Harbor seals
- iv. Seabird bycatch evaluation
- v. Christmas Bird Count at Unalaska



•There have been suggestions that fluctuations in seabird bycatch possibly reflect prey availability; however, patterns differ among species or species groups. This may be an interesting area to investigate as the time series get longer and the methods of bycatch reduction stabilize. It may also be possible to relate seabird bycatch to die-off events, which also likely reflect a lack of available prey.

We looked for patterns in seabird bycatch and found potential links to pink salmon. We will continue to work on that.

•The addition of new data on HABs is excellent. Should there be an effort to report on other pollutants and heavy metals?

Unfortunately, there is no regular monitoring of pollutants or heavy metals. However, we included mercury and plastics in the noteworthy section this year.

•In reference to multi-year trends, declines in some populations, among other, The SSC suggests a holistic approach may be needed to understand and manage the region given its remoteness.

We have tried to increase contributions and find linkages across indicators. However, there has been no integrated ecosystem study for the AI, the AI Fisheries Ecosystem Plan is past its review time, there is no Regional Plan specific to the AI, there has been no survey since 2018. Other than the ESR, the most comprehensive study at the ecosystem level was a special issue in 2005, and the FEP in 2007.

Noteworthy

Mercury in AI food webs (Rea) & Plastics in Seabirds (Ortiz)



Mercury study: <https://ine.uaf.edu/werc/werc-projects/aleutian-mercury/>

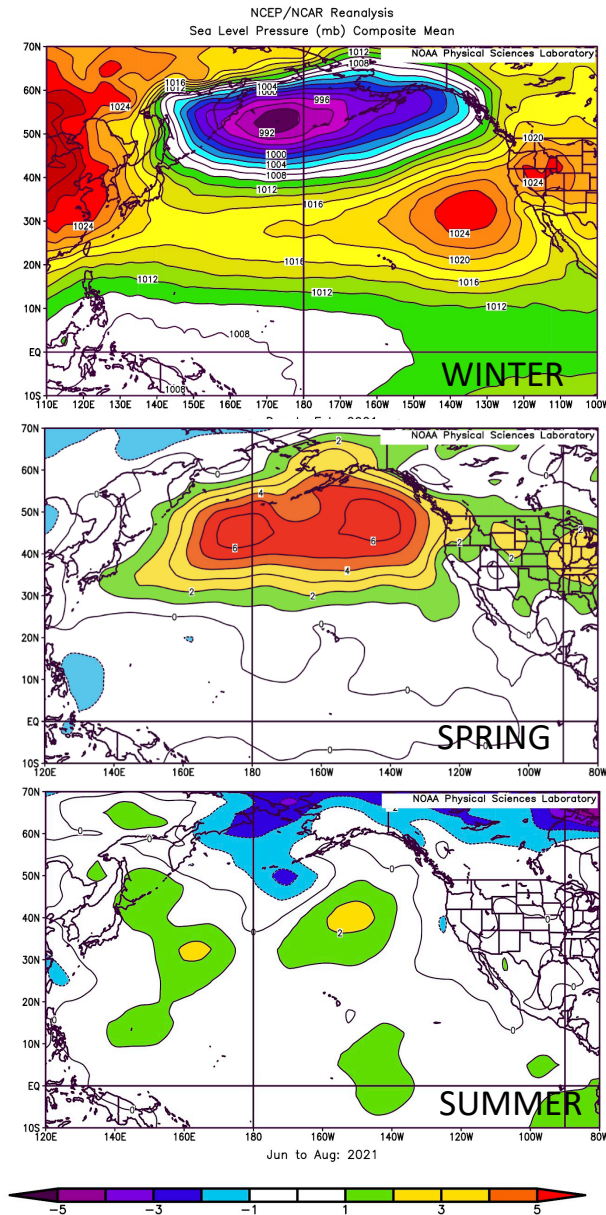
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- Higher THg in WAI than CAI also in several fish and seabirds
- Differences originate at base of food chain and amplified by feeding ecology.

Plastics

- in AI, highest concentration of phthalates (plastic derived contaminant) in diving plankton- feeders (crested auklets)
- Studies show healthy looking seabirds affected by weight loss, higher blood calcium levels, positive correlation with concentration of uric acid, cholesterol.
- 32% - 71% of seabirds ingest plastics depending on location (NZ, New England)
- ingesting one item has a 20.4% chance of lifetime mortality, balloons 32 times more likely to result in death.
- high proportion of plastic ingested is recyclable.

This year - 2021

Winds and Sea Level Pressure (SLP) Bond

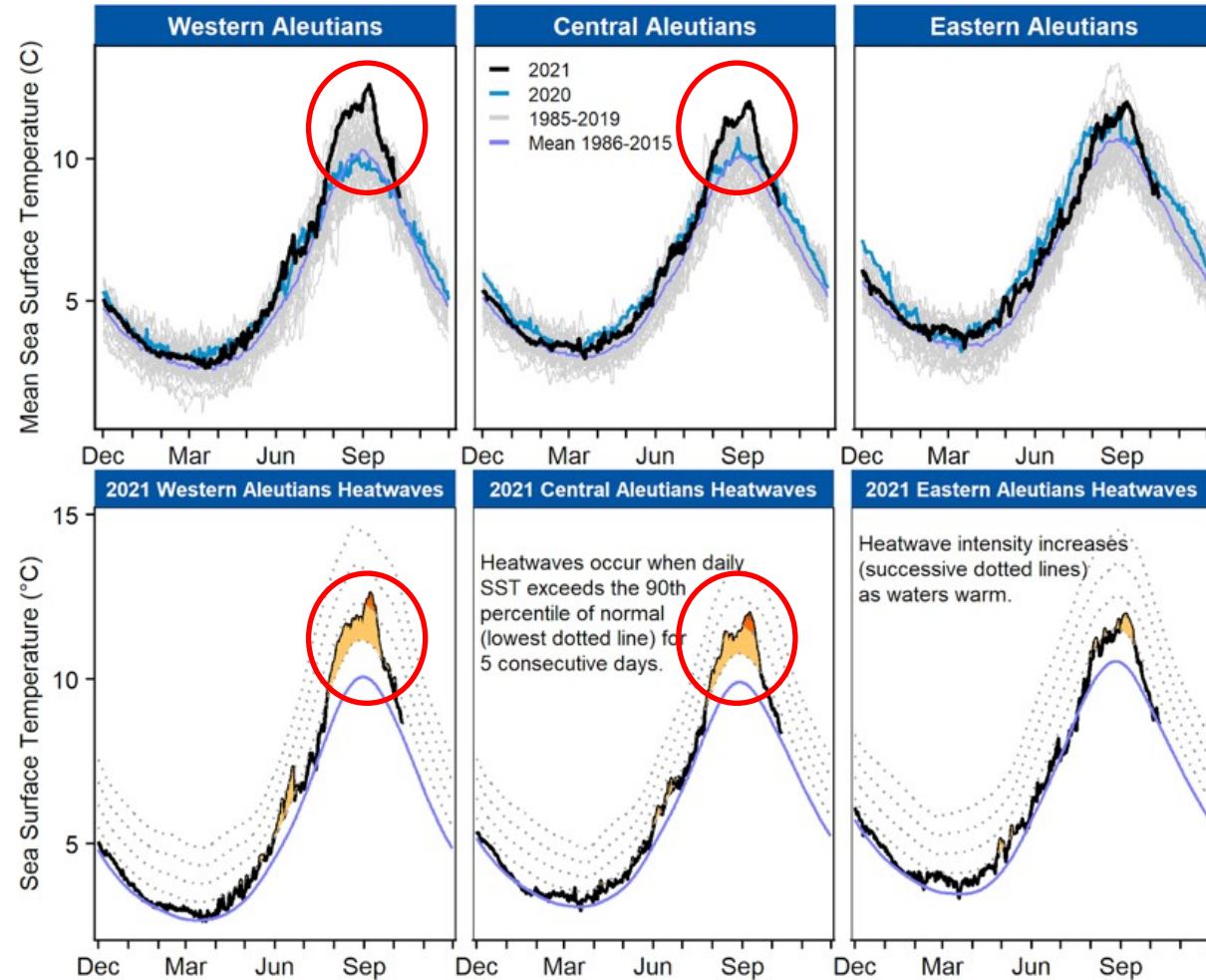


La Niña year

- Winter: Negative anomalies in SLP
 - Stormier conditions
 - Hi SLP over Western Bering Sea resulted in decreased warmth over SEBS, consistent with La Nina years
 - Spring: Westerly winds
 - Summer: slightly stormier conditions again in WAI and CAI
-
- Implications
 - Winter: Potentially unfavorable foraging conditions for seabirds
 - Spring: suppressed transport through eastern passes
 - Summer: slightly unfavorable foraging conditions for seabirds, may explain delayed hatching for piscivorous seabirds

This year - 2021

Sea surface temperature (SST), Marine heat wave (MHW)
Watson & Callahan



- record high SST in WAI and CAI
- moderate MHW in Aug & Sep
- short lived strong MHW
- temperatures now close to average

Implications

- Atka mackerel nests in shallower waters, at 4-11°C
- SST reaching upper limits of Atka mackerel spawning temperatures

This year - 2021

Seabirds
Rojek, Renner,

Reproductive success		Species														
Primarily fish eaters		-----							Primarily zooplankton eaters							
Site		red-faced cormorant	glaucous winged gull	common murre	thick billed murre	horned puffin	tufted puffin	red-legged kittiwake	black-legged kittiwake	fork-tailed storm-petrel	Leach's storm-petrel	ancient murrelet	parakeet auklet	least auklet	whiskered auklet	crested auklet
<u>Aiktak</u>	-	☺	☺	☺	☺	☺	-	-	☺	☹	-	-	-	-	-	-
<u>Buldir</u>	-	☺	☺	☺	☺	☺	☺	☺	☹	☺	-	-	☺	☺	☺	-

- **WEST and EAST Above average reproductive success** ☺ for most seabirds, both fish and plankton eaters
- **AVERAGE** 🕒 to **LATE** 🕒 hatching chronology of plankton and fish-eating seabirds, and larger copepod size, may signal early spring bloom.

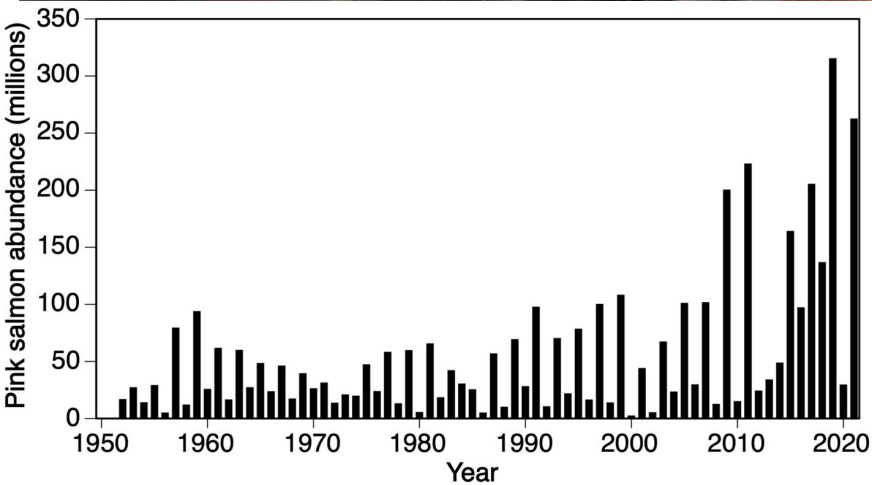
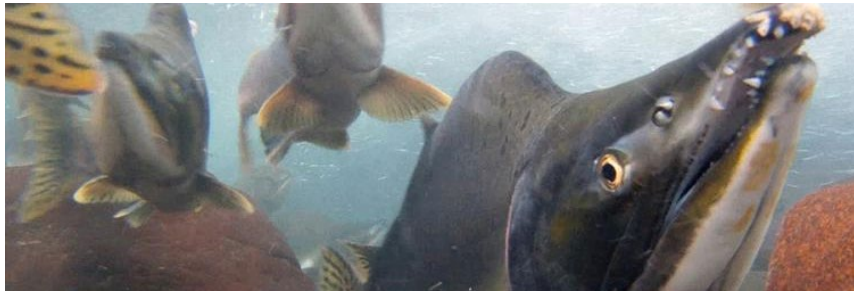
Implications

- environmental conditions for foraging might not have been ideal, however good availability and wide type of prey.

Hatching chronology		Species											
primarily fish eaters		-----									primarily zooplankton eaters		
Site		glaucous winged gull	thick billed murre	horned puffin	tufted puffin	black-legged kittiwake	fork-tailed storm-petrel	Leach's storm-petrel	ancient murrelet	parakeet auklet	least auklet	whiskered auklet	crested auklet
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<u>Buldir</u>	🕒	🕒	🕒	🕒	🕒	🕒	🕒	🕒	-	🕒	🕒	🕒	🕒



This year - 2021



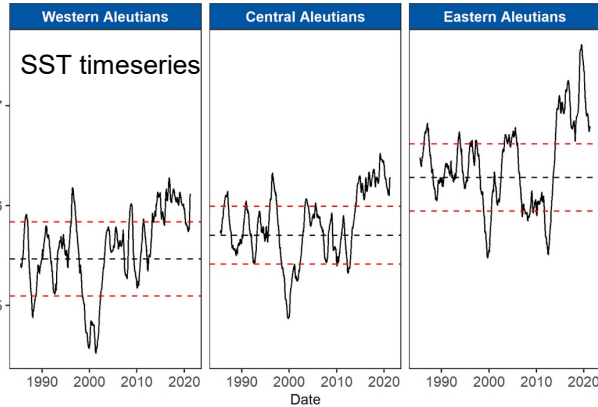
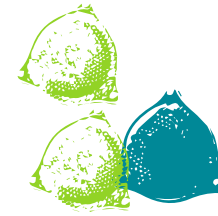
Eastern Kamchatka Pink Salmon

- Second highest abundance on record
- Increased competition for prey expected in high abundance years

Paralytic Shellfish Toxins in blue mussels, Unalaska

- 76x the regulatory limit
- continued risk to human health and local food webs
- west of Unalaska, under regulatory limit (past records), current samples in lab

Multi-year Patterns

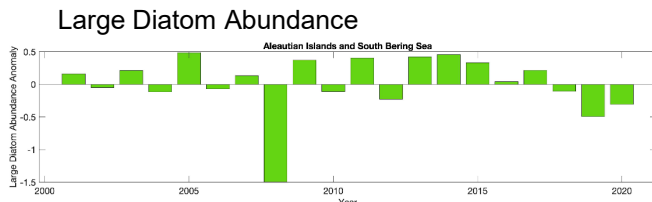
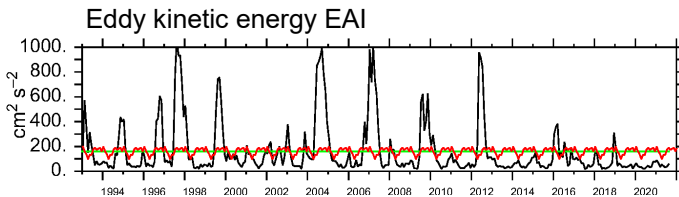


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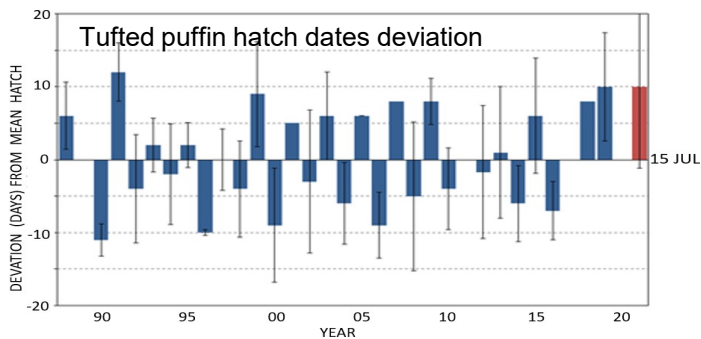
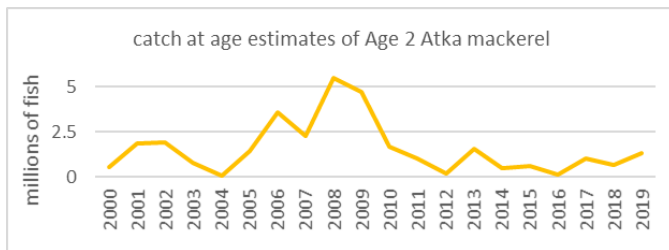
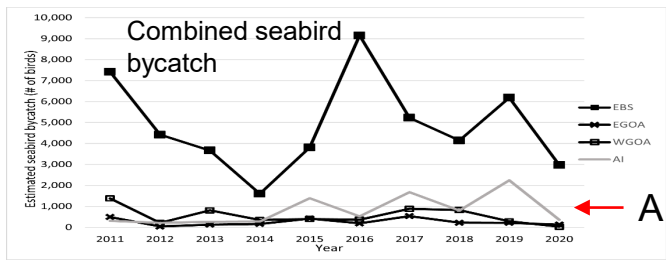
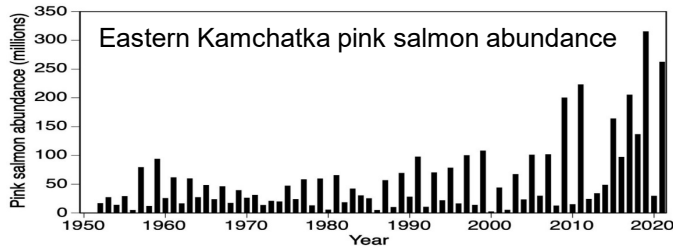


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- Not shown: Batten et al – trophic cascade copepods and large diatom abundance

Pink salmon, Ruggerone; Bycatch all seabird, Krieger and Eich, Catch age-2 Atka Mackerel, Atka Mackerel SAFE Lowe; Tufted puffin yearly hatch date deviation, Rojek

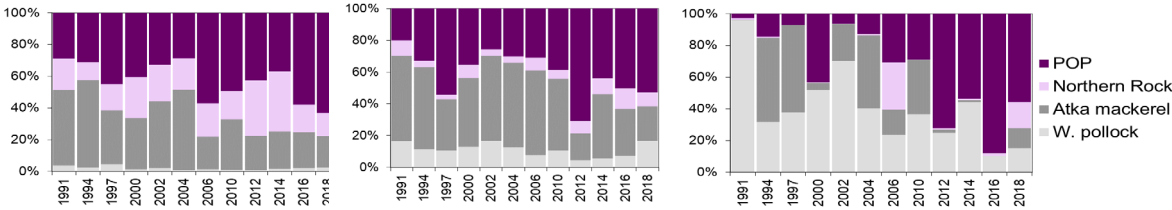
Multi-year Patterns

Biomass proportion of pelagic foragers

Pelagic Foragers: Western AI

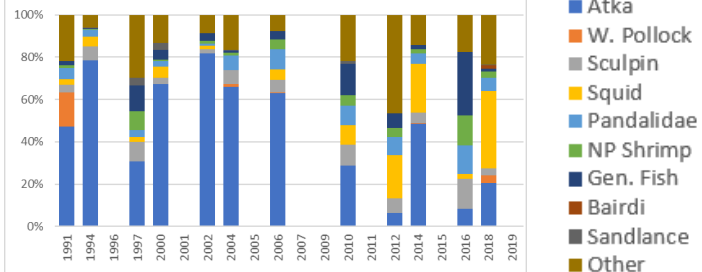
Central AI

Eastern AI

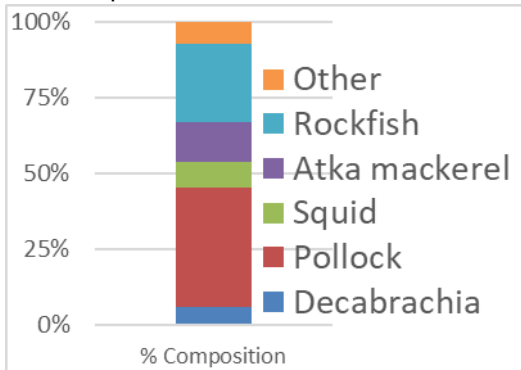


Pacific cod >20cm diets in Central Aleutians

Area 542 P. Cod > 20 cm fork length



Tufted puffin diet at Buldir



Continued unfavorable environmental conditions
 Eastern Kamchatka Pink Salmon Abundance
 Rockfish dominating pelagic foragers

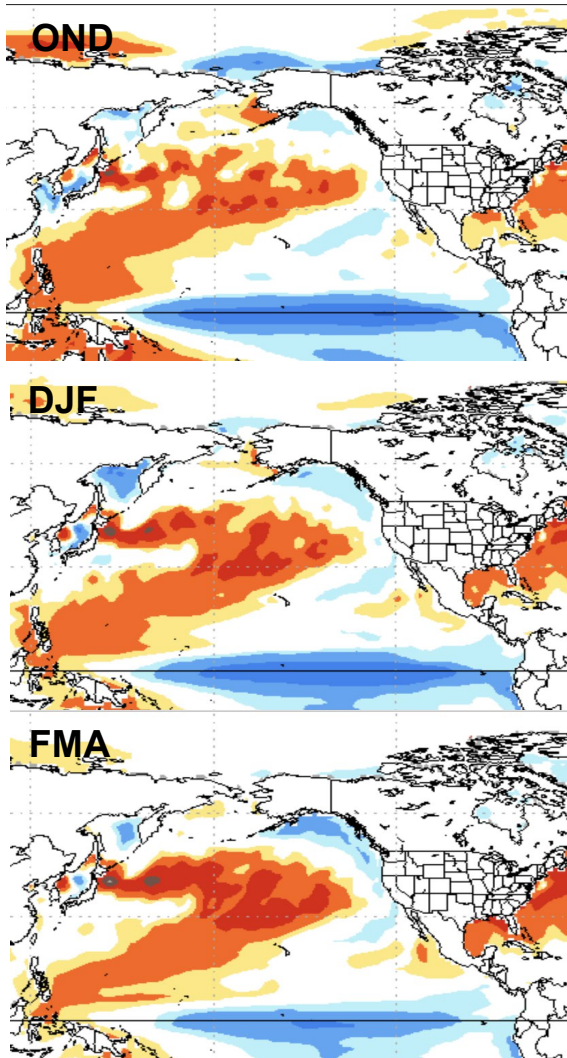
- Change in ratio of pollock & Atka mackerel to Pacific ocean perch & northern rockfish
- Area occupied by POP has also increased (Spencer et. al., POP SAFE)
- POP, Northern rockfish, stable at high abundance, Atka mackerel decreasing
- Less Atka mackerel in P. cod diets in CAI
- Rockfish in Tufted puffin diet at Buldir

Pelagic Foragers, Pacific cod diets, Tufted puffin diets, Ortiz

Multi-year Pattern Implications

- Conditions since ~2013 suggest **lower productivity in the ecosystem**. Higher temperatures increase bioenergetic costs, which may have **increased prey consumption**. They also increase growth rates of zooplankton. Low EKE in the eastern Aleutians suggests **reduced flows through the eastern passes** of heat, salt and nutrients. Continued decrease in diatom abundance suggest **potential lower productivity or may reflect increased consumption by zooplankton**.
- Increases in **pink salmon abundance may have crossed a threshold in 2013-2014** with competition impacts more evident and cascading through the system. Although biennial patterns are observed in other species, **other processes may offset competition**.
- **Rockfish dominance may be unfavorable for pinnipeds** as it may decrease availability of Atka mackerel and pollock to pinnipeds (both Steller sea lions and harbor seals are decreasing), while **mercury and plastics may have sublethal adverse effects** which would make recovery more difficult.
- Cumulatively, these trends may be adversely impacting predators, 2012-2018 **lower than average fish condition** in Pacific cod, northern rockfish and Pacific ocean perch (but not detected in stock assessments) may indicate a detrimental effect of temperature as well **as increased competition for prey, changes in prey field timing, availability and composition**. This may have contributed to the decrease in Atka mackerel biomass and lower groundfish condition; **lower prey availability and quality** would also cascade to apex predators.

NMME Projections 2022



- Moderate La Niña, decrease in temperature in the southeast Bering Sea and Gulf of Alaska
- late winter and early spring of 2022 will bring near-normal temperatures to most of the Bering Sea and Aleutian Islands, and quite cold temperatures to the central GOA
- February - April 2022 Near-normal temperatures in the Bering Sea and Aleutian Islands with neutral La Niña conditions

AI Summary

Risk Table **Environmental/Ecosystem** **Considerations**

Level 2

(Some indicators showing adverse signals relevant to the stock but the pattern is not consistent across all indicators.)

- AI Pacific cod

Level 1

(No apparent environmental/ecosystem concerns)

- Northern Rockfish
- Atka mackerel
- Sablefish (statewide)

Noteworthy

- Mercury in food webs
- Plastics in seabirds

• In both, frequency and intensity of sublethal effects is linked to feeding ecology

Assessment 2021

- Record high SST in WAI, CAI, moderate MHW
- Most seabirds above average reproduction
- Pink salmon - 2nd highest abundance on record

Multi-year since ~2013

- Warmer temperatures, low EKE in EAI, lower to average productivity
- Pinks impact? Biennial pattern in combined all seabird bycatch
- Pelagic foragers dominated by rockfish

Implications for this year

- SST reaching upper limit of Atka mackerel spawning temperatures
 - wide prey availability expected for planktivorous and piscivorous predators

Cumulative effects

- bioenergetic costs
- lower productivity
- zooplankton grows faster
- changes in prey field timing, composition and location
- competition exacerbated by pink salmon
- combined effects of mercury and plastics may affect recovery of pinnipeds

