Scenario-based engagement in the NE Pacific to derive community-driven guiding principles for ExOIS field trials and future ocean iron fertilization

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Project goal

Guide the creation of **community-driven guiding principles** for governance of the **proposed ExOIS field trial** and potential future, **larger-scale deployment**.

Project budget

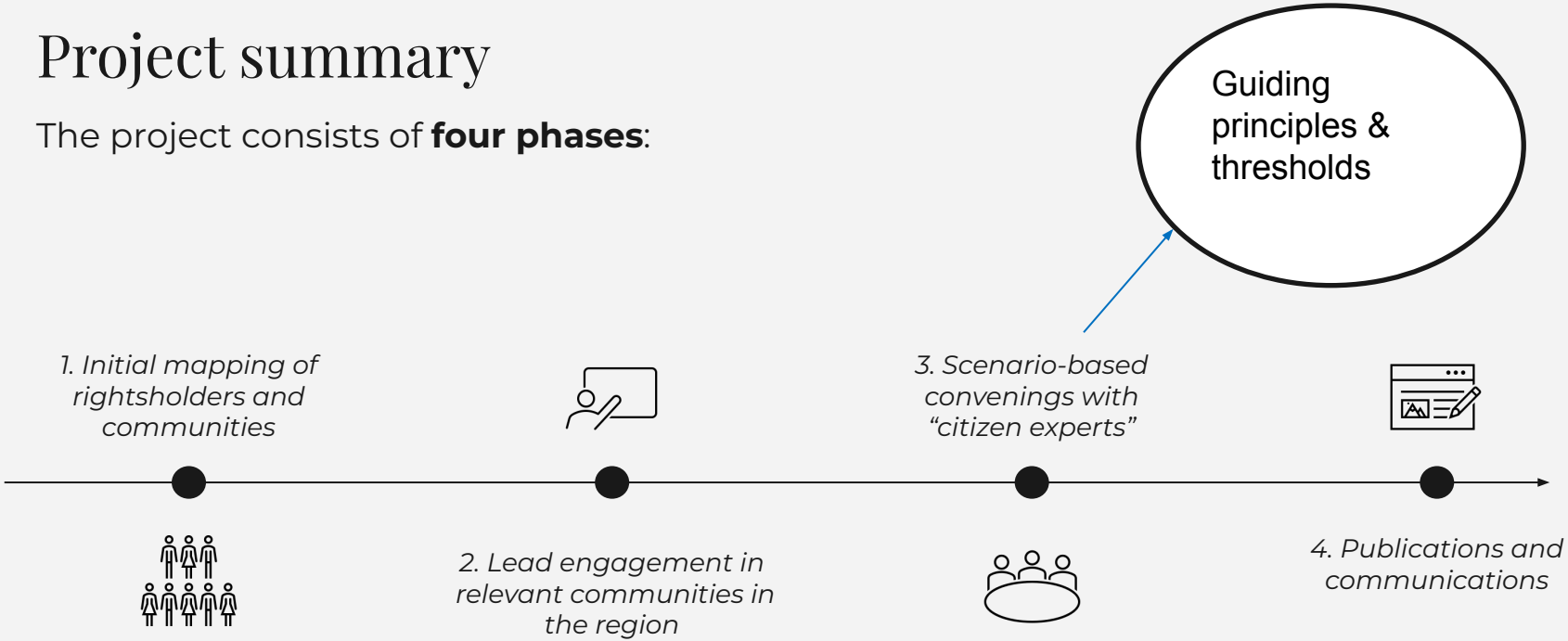
ExOIS: $33,000

CIEIF: $75,000

Total budget: $108,000

Project summary

The project consists of **four phases**:



1. Initial mapping of communities

Communities that might be affected by **or interested in learning more** about the trial include, but are not limited to:

Fishing communities

Rightsholders (Indigenous communities)

Ocean users

Communities involved in the use, management, and/or research on marine resources

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Initial data collection will include, but not be limited to:

Livelihoods, foods, and cultural practices

Trends and forces influencing public attitudes and awareness of climate impacts

Data sources for mapping:

- Peer-reviewed and grey literature
- Local and trade media reports
- Interviews with affected communities

2. Lead engagement in relevant communities

PHASE 2 GOALS

Build community understanding of ExOIS initiative and planned fieldwork

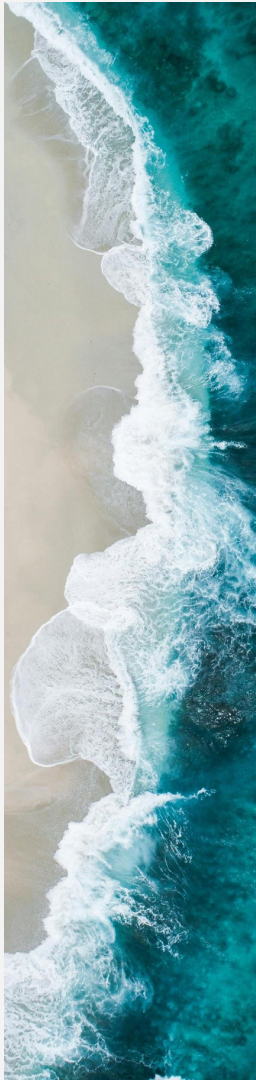
Identify and recruit respected community leaders for the “citizens experts” panel

Gather perspectives and data on community attitudes toward OIF and mCDR

Gather information on community attitudes towards climate trends and interventions

To achieve the goals of this phase, we will use:

- Interviews
- One-on-one and group discussions
- In-person meetings
- Other channels of communication



3. Scenario-based convenings

A series of **in-person and virtual convenings** will be held with a knowledgeable **panel of "citizen experts"** recruited in Phase 2.

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Through **scenario exercises** (see example), the panel will be tasked with drafting **guiding principles** for the ExOIS field trial and potential future applications at scale.

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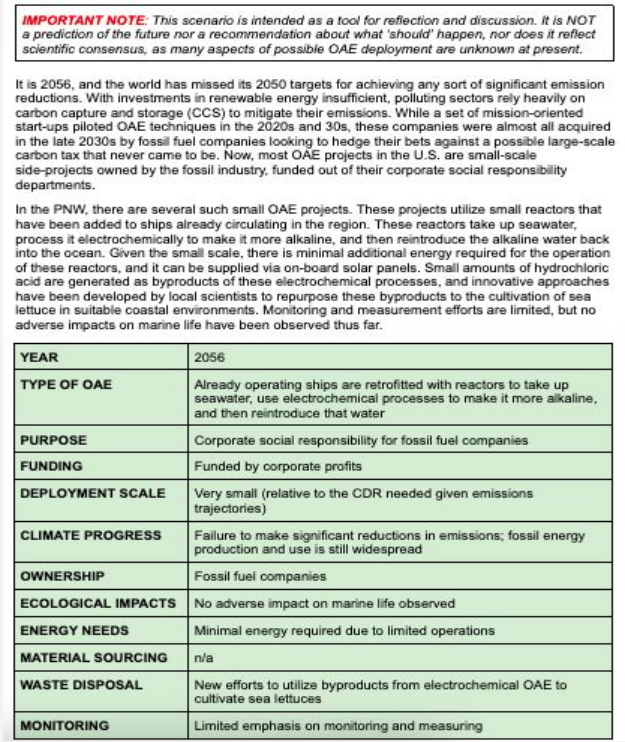
Guiding principles are **"go/no-go" conditions** reflecting **priorities and concerns** of the communities.



***IMPORTANT NOTE**: This scenario is intended as a tool for reflection and discussion. It is NOT a prediction of the future nor a recommendation about what 'should' happen, nor does it reflect scientific consensus, as many aspects of possible OAE deployment are unknown at present.*

It is 2056, and the world has missed its 2050 targets for achieving any sort of significant emission reductions. With investments in renewable energy insufficient, polluting sectors rely heavily on carbon capture and storage (CCS) to mitigate their emissions. While a set of mission-oriented start-ups piloted OAE techniques in the 2020s and 30s, these companies were almost all acquired in the late 2030s by fossil fuel companies looking to hedge their bets against a possible large-scale carbon tax that never came to be. Now, most OAE projects in the U.S. are small-scale side-projects owned by the fossil industry, funded out of their corporate social responsibility departments.

In the PNW, there are several such small OAE projects. These projects utilize small reactors that have been added to ships already circulating in the region. These reactors take up seawater, process it electrochemically to make it more alkaline, and then reintroduce the alkaline water back into the ocean. Given the small scale, there is minimal additional energy required for the operation of these reactors, and it can be supplied via on-board solar panels. Small amounts of hydrochloric acid are generated as byproducts of these electrochemical processes, and innovative approaches have been developed by local scientists to repurpose these byproducts to the cultivation of sea lettuce in suitable coastal environments. Monitoring and measurement efforts are limited, but no adverse impacts on marine life have been observed thus far.

YEAR	2056
TYPE OF OAE	Already operating ships are retrofitted with reactors to take up seawater, use electrochemical processes to make it more alkaline, and then reintroduce that water
PURPOSE	Corporate social responsibility for fossil fuel companies
FUNDING	Funded by corporate profits
DEPLOYMENT SCALE	Very small (relative to the CDR needed given emissions trajectories)
CLIMATE PROGRESS	Failure to make significant reductions in emissions; fossil energy production and use is still widespread
OWNERSHIP	Fossil fuel companies
ECOLOGICAL IMPACTS	No adverse impact on marine life observed
ENERGY NEEDS	Minimal energy required due to limited operations
MATERIAL SOURCING	n/a
WASTE DISPOSAL	New efforts to utilize byproducts from electrochemical OAE to cultivate sea lettuces
MONITORING	Limited emphasis on monitoring and measuring

Scenario exercise (from a workshop led by Nawaz and Belotti, 2024)

4. Publications and communication

In advance and during the scenario workshop process:

Educational articles and media

For online and local outlets that reach target communities in the region

At the conclusion of the scenario workshop process:

Peer-reviewed publication

Community-driven guiding principles including recommended decision thresholds and research recommendations

Mapping a path toward Sustainable mCDR Management

For ExOIS: community-recommended guiding principles & thresholds—will establish a key building block

- **Need**: rising credit sales ➡ shadow economy, undercutting transparency, sustainability.
- Overview of North Pacific fisheries
- Who: Community mapping
- What they built— summarized here: a globally respected resource management regime—
- a model for mCDR:
  —IPHC
  —Alaska statehood: origins and Article VIII
  —INPFC
  —Magnuson-Stevens Act
  —Tier System: emulated nationwide in MSA
  —Control rules: adaptive, iteratively guided by repeat surveys & assessments
  —EBFM: protecting prey for Steller sea lions set global precedent
  —Guiding principles & thresholds for field trials and future deployment: guardrails
  co-design and inclusion of people who will live with results on the water.

Why now: Nearly 800,000 tons in mCDR credit sales

Acceleration in 2024-2025

Marine carbon removal credits sold, 2020-2025

Producer	Method	Tons	Year of Sale
Vesta	Marine rock weathering	3,333.3	2000
Ebb Carbon**	Alkalinity enhancement	256	2021
Running Tide	Biomass sinking (wood waste, seaweed) + alkalinity enhancement	25,000	2023
CREW Carbon	Alkalinity enhancement	71,878	2024
Ebb Carbon*	Alkalinity enhancement	350,000	2024
Captura	Direct ocean capture	30,000	2025
Planetary Technologies	Alkalinity enhancement	115,000	2025
Gigablue	Biomass sinking (phytoplankton)	200,000	2025
Total:	Up to*	795,467.3	

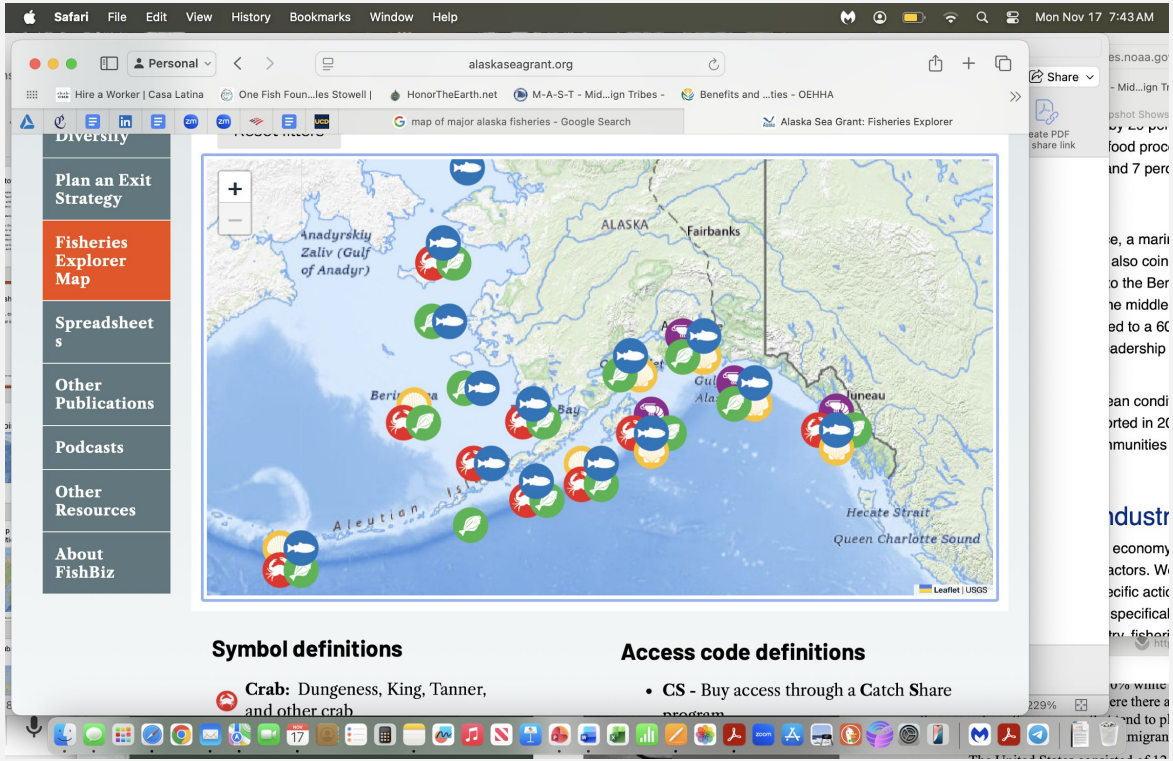
Data compiled by Brad Warren, GOH - brad@globaloceanhealth.org

Future: Managing use of ocean sequestration resources

- BGC sequestration resources are replenished thus renewable
- Spatially & temporally heterogenous
- Acceptable envelope of conditions not yet defined
- Biological pump, solubility pump, carbonate system underpin fisheries & food webs
- Public deliberation in ocean stewardship: a strong presumption in North Pacific

Alaska Fisheries

- >50% of U.S. catch
- Top employer in Alaska
- 62,200 workers at sea, ashore
- 70% of AK manufacturing jobs
- $5.7 billion in Alaska economy
- 5.7 billion pounds of seafood



DATA: NOAA, ASMI/McKinley Group
MAP: Alaska Sea Grant https://alaskaseagrant.org/fishbiz/fisheries-explorer/

Some climate impacts in North Pacific fisheries

- Bering Sea snow crab and king crab crashed 2021-2022. Snow crab collapse attributed to earlier marine heatwave (Szuwalksi et al 2023)
- Pacific cod in Gulf of Alaska shut down in 2020 after population collapse (79% drop in biomass), attributed to marine heatwave 2014-2018. (Barbeaux et al 2020)
- Collapse King salmon across Pacific Coast of North America attributed to climate change (Crozer et al)

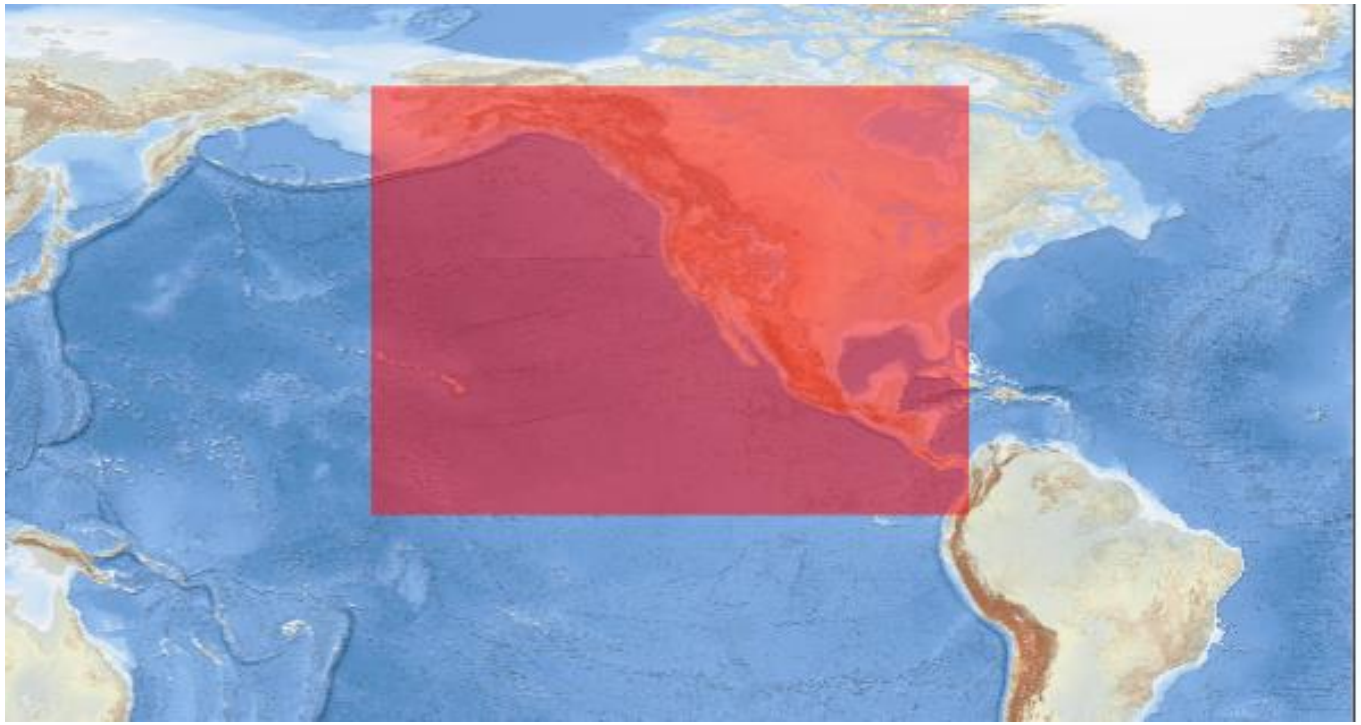
SOURCES: NOAA https://www.fisheries.noaa.gov/feature-story/economic-snapshot-shows-alaska-seafood-industry-suffered-18-billion-loss-2022-2023

Barbeaux et al. 2020. Barbeaux, S. J., Holsman, K., and Zador, S. Marine Heatwave Stress Test of Ecosystem-Based Fisheries Management in the Gulf of Alaska Pacific Cod Fishery, Front. Mar. Sci 7:703. doi: 10.3389/fmars.2020.00703

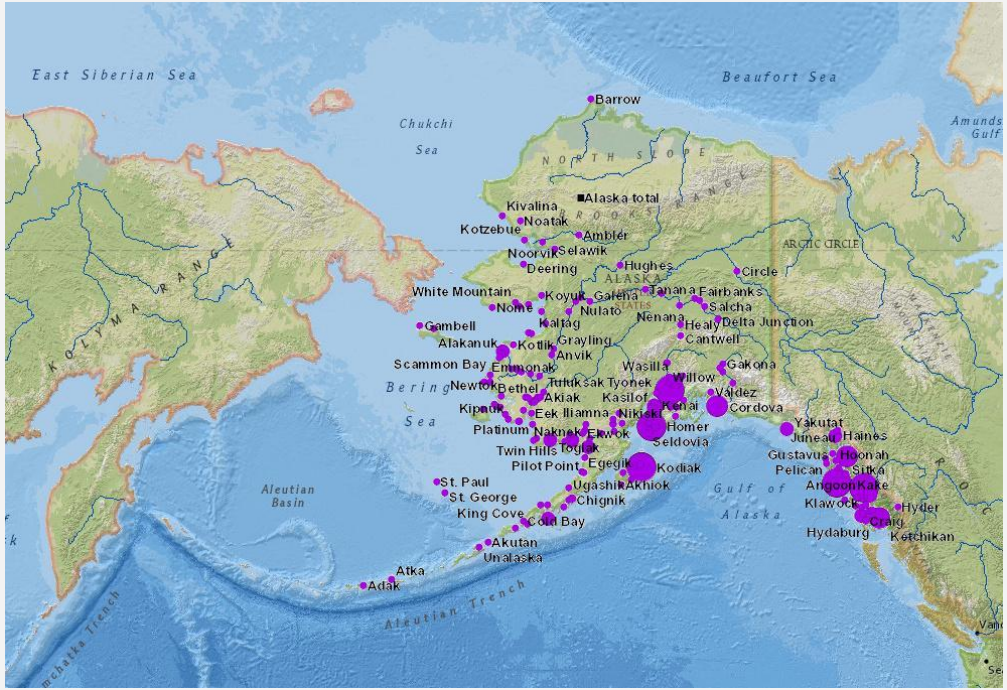
Crozier et al 2021. https://pmc.ncbi.nlm.nih.gov/articles/PMC7892847/#:~:text=Lisa%20Crozier%20et%20al.,change%20for%20this%20threatened%20species.

Szuwalski et al 2020. Szuwalski, C.S., Aydin, K, Fedewa, E. J., Garber-Yonts, B., and Litzow, M. A., The Collapse of eastern Bering Sea snow crab. Science 2023 Oct 20;382(6668):306-310. Doi: 10.1126/science.adf6035. Epub 2023 Oct 19.

Mapping the Northeast Pacific



AFSC map of Alaska commercial fishing communities

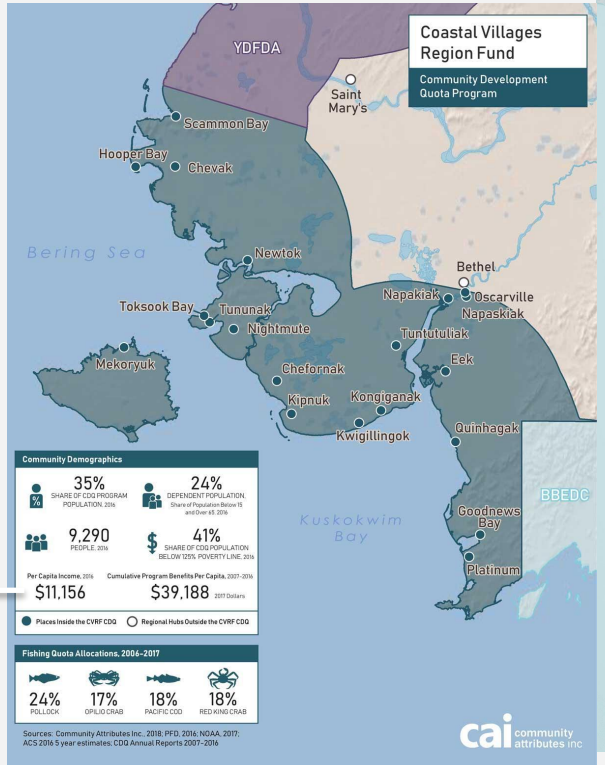


Source: https://www.fisheries.noaa.gov/resource/map/alaska-commercial-fishing-communities-interactive-map

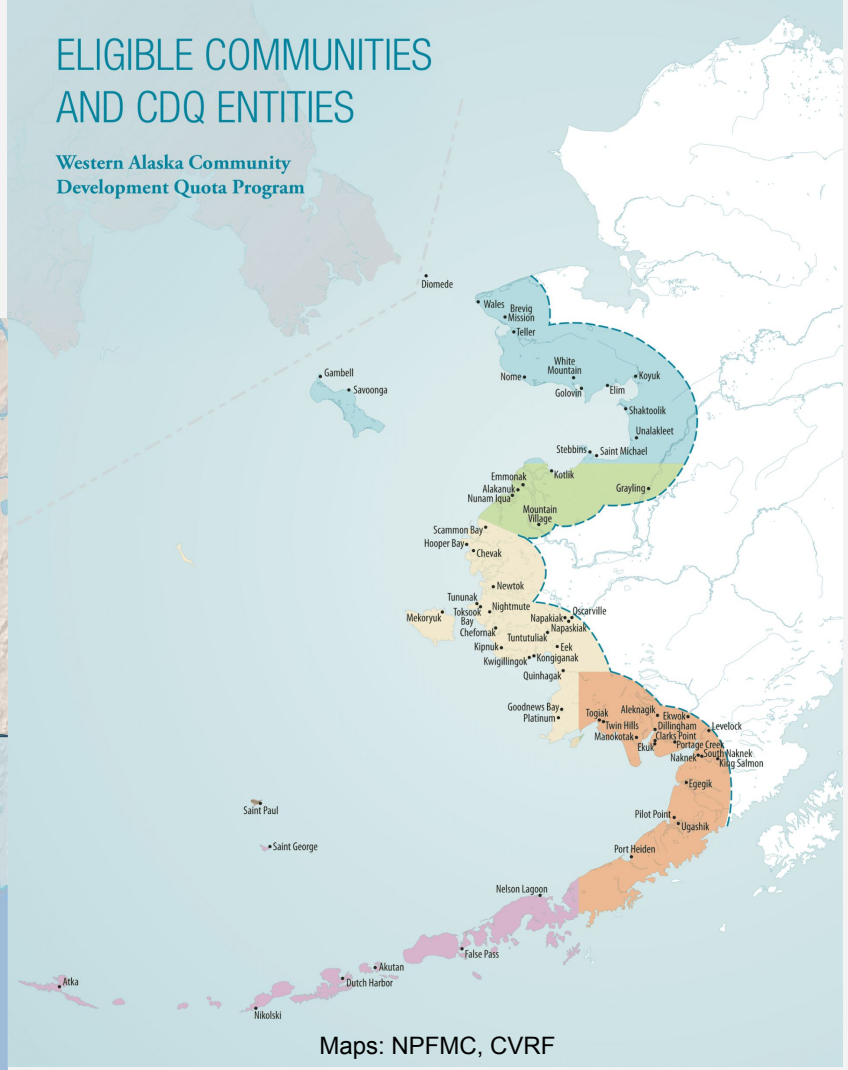
Alaska recreational fishing communities

SOURCE: https://www.fisheries.noaa.gov/resource/map/alaska-recreational-fishing-communities-interactive-map

CDQ groups in Western Alaska

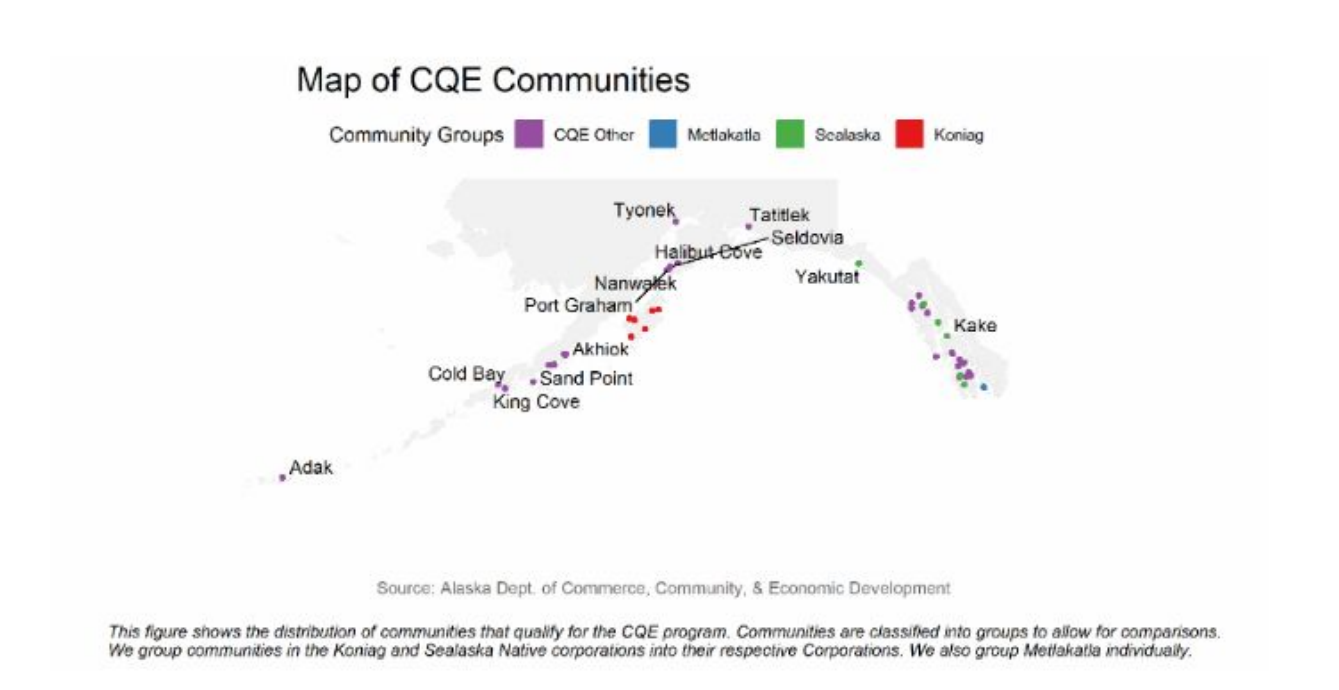


$11,156 per cap



Maps: NPFMC, CVRF

Gulf of Alaska Community Quota Progam



Sablefish, Pacific halibut, Alaska groundfish*, BSAI crab

** Includes multiple species*

North Pacific fishing communities in Pacific Northwest

SOME SIGNIFICANT PORTS
Seattle
Bellingham
Neah Bay
Newport.. and others

Makah Tribe

Reservation land: 46,892 square miles

Marine jurisdiction: 40 miles offshore (adjudicated “usual and accustomed” fishing grounds)

Active West Coast & Alaska fisheries

U&A

Inset: map of Makah U&A, from Scordino et al 2018: Availability of Pacific Coast Feeding Group gray whales during the gray whale migratory season in the Makah Usual and Accustomed Fishing Grounds, conference paper, https://www.researchgate.net/figure/Map-of-Makah-usual-and-accustomed-fishing-grounds-U-A-the-proposed-whaling-area-in-the_fig1_328626366

”The sea is our country”

Makah sealing schooner Columbia, with sealing canoes, 1894. Chestoqua Peterson (Makah) purchased this schooner October 22, 1893, and took it sealing in the Bering Sea. Photograph by Stefan Claesson, 1894. National Oceanic and Atmospheric Association/Department of Commerce.

SOURCE:
https://yalebooks.yale.edu/2015/07/16/makah-whaling-and-their-hi

ExOIS building blocks for guardrails

- Go/no-go thresholds proposed
- eMRV parameters identified:
    - HABS
    - Oxygen depletion
    - Nutrient robbing
    - Trophic effects: fisheries, protected species, benthic species
    - GHGs produced

SOURCE: ExOIS fieldwork planning workshop report, 2024

Control rules in North Pacific

—Multiple thresholds: max, target, min
—Updated via stock assessments
—Adaptive adjustments
—Extensive public deliberation

Year

Figure 1.30. Comparison of the current assessment results with past assessments of **begin-year** EBS age-3+ pollock biomass, 1978-2015.

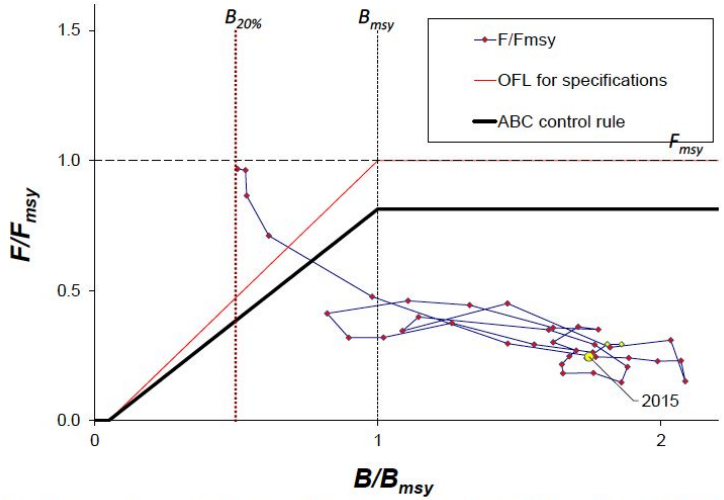


Figure 1.31. Estimated spawning biomass relative to annually estimated F_{MSY} values and fishing mortality rates for EBS pollock, 1977-2015 (plus 2016 and 2017 in highlighted dots). *Note that the control rules for OFL and ABC are designed for setting specifications in future years.*

Thank you!

Questions?

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