AHM 2023 – Year 5

Coastal Margins Component

Team Leadership

LeeAnn Munk
UAA PI

Brenda Konar
PD/UAF PI

Julie Schram
UAS PI

Personnel and Organization

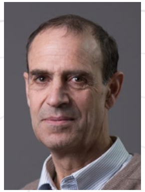
Leadership


Brenda Konar
PD/UAF PI


Julie Schram
UAS PI


LeeAnn Munk
UAA PI

Human Dimensions


Matt Berman
UAA


Jennifer Schmidt
UAA

Stream Team


Jason Fellman
UAS


Eran Hood
UAS


Eric Klein
UAA

Marine Environment


Martin Stuefer
UAF


Mark Johnson
UAF


Amanda Kelley
UAF


Claudine Hauri
UAF

Plankton


Gwenn Hennon
UAF


Alexei Pinchuk
UAF

Invertebrates/Algae


Katrin Iken
UAF


Schery Umanzor
UAF

Fish


Franz Mueter
UAF


Jessica Glass
UAF

Coastal Margins Outline

- Overview
- Research Goals and Objectives
- Sampling of Research Results by Goal – Flash Talks by Team Members and other Highlights of Results
- Summary of Research Milestones

Coastal Margins Research Goals

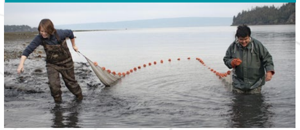
Goal CM1

Characterize the hydrological and biogeochemical dynamics of rivers along a glacial to non-glacial watershed gradient and their linkages to coastal oceanography.

Goal CM2

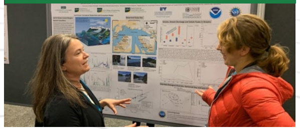
Quantify biological responses of nearshore marine organisms to varying physical and chemical conditions along the glacial to non-glacial gradient.

Goal CM3



Understand the potential responses of coastal resource users to current changes and anticipated future shifts in nearshore marine resources.

Goal CM4



Hire and train researchers and share results with academic audiences and stakeholders.

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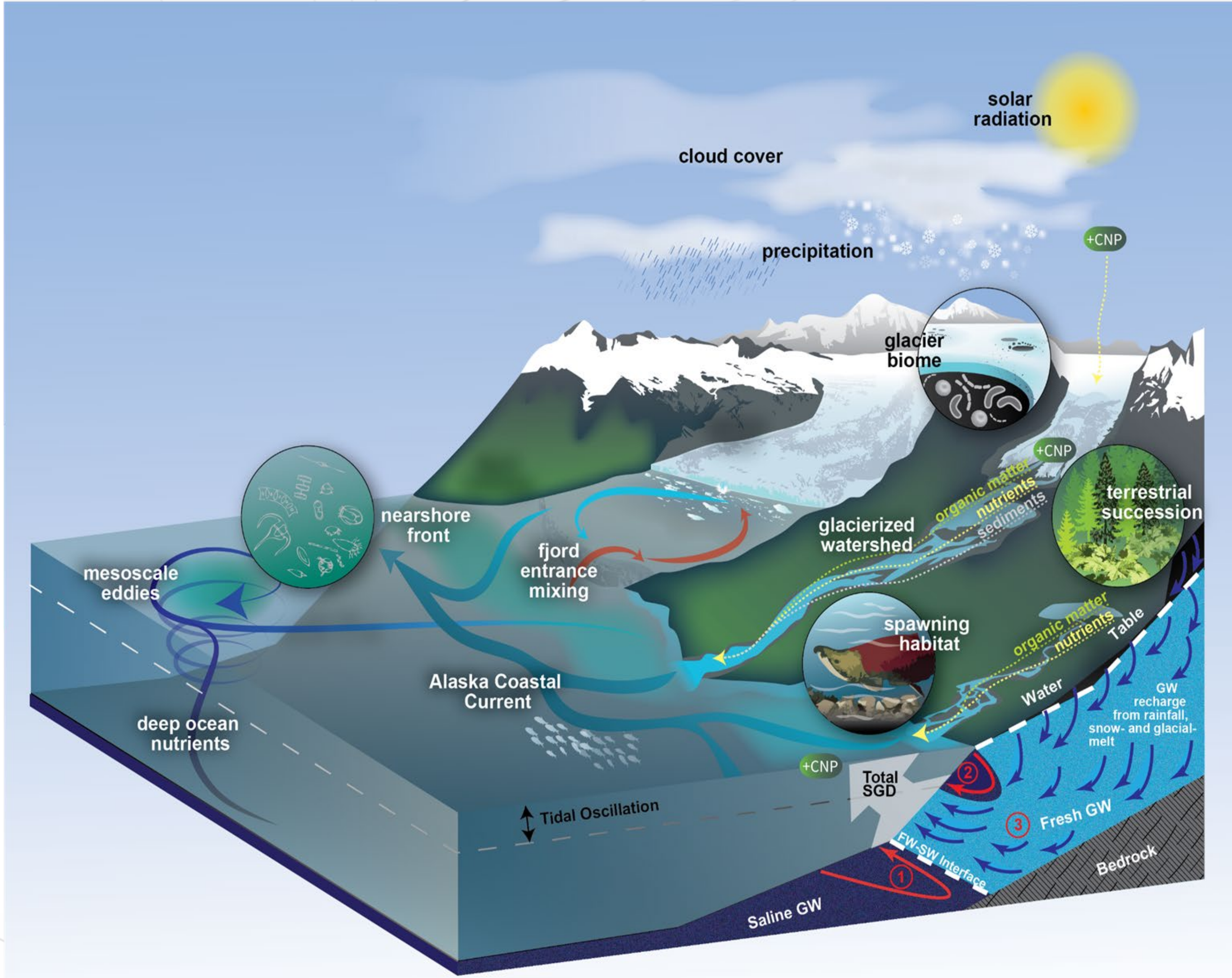
Overarching Research Goal

- Quantify biological responses in coastal waters to **climate-induced changes** in physical and chemical conditions, and
- Understand the **potential responses** of fishing communities to resulting shifts in ecosystem services.

Beach seining at the mouth of the Wosnesenski River in Kachemak Bay

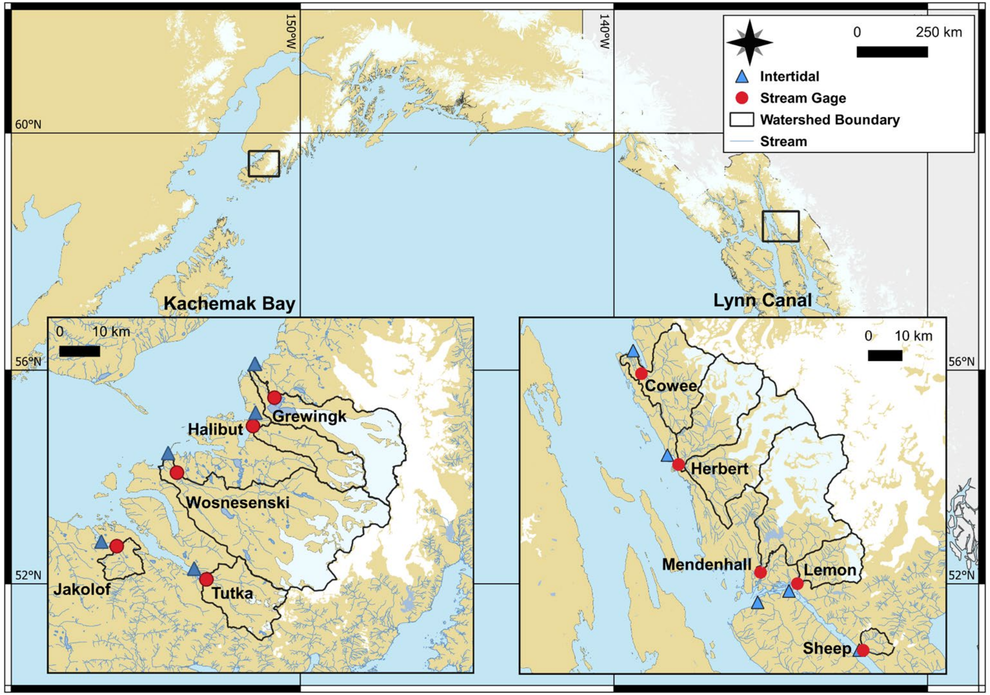
Research Focus

Conceptual Framework of The Land-Ocean System



Modified from O'Neel et al., 2015

Research Sites



Lynn Canal

Watershed	Percent Glaciated	Watershed Area (km^2)
Mendenhall	63	222
Eagle/Herbert	49	152
Lemon	29	61
Cowee	13	110
Sheep	<2	15

Climate (1981-2010)	
Average Temperature (°C)	5.6
Average Yearly Precip (cm)	158
Temperature Minimum (°C)	-30
Temperature Maximum (°C)	32

Kachemak Bay

Watershed	Percent Glaciated	Watershed Area (km^2)
Grewingk	60	112
Wosnesenski	27	256
Halibut	16	56
Tutka	8	66
Jakolof	0	18

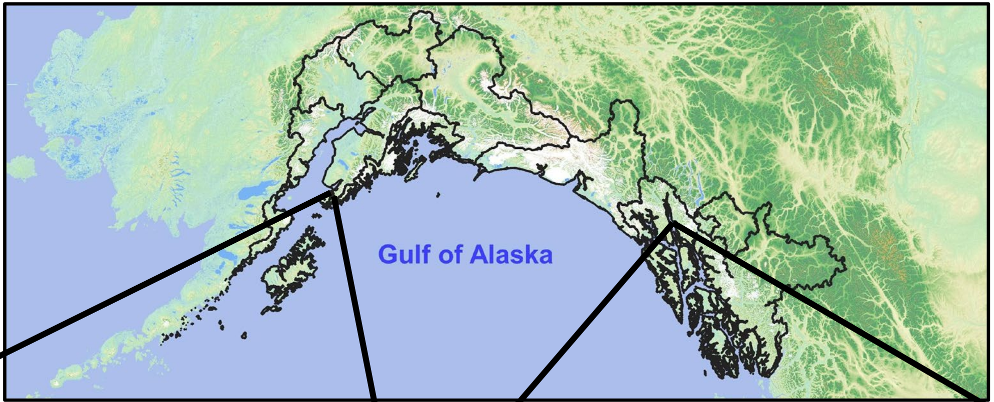
Climate (1980-2019)	
Average Temperature (°C)	3.8
Average Yearly Precip (cm)	64
Temperature Minimum (°C)	-31
Temperature Maximum (°C)	28

Regional Statistics

Gulf of Alaska watershed
~420,230 km^2

Glacier coverage
~75,000 km^2

Annual freshwater discharge
~800 km^3/yr



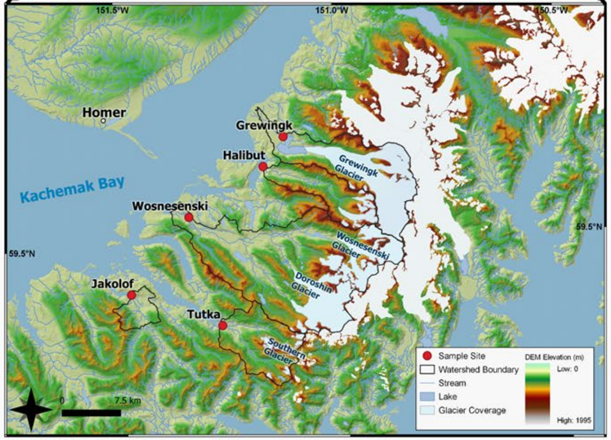
KB & LC Statistics

KB and LC watersheds
~1054 km^2

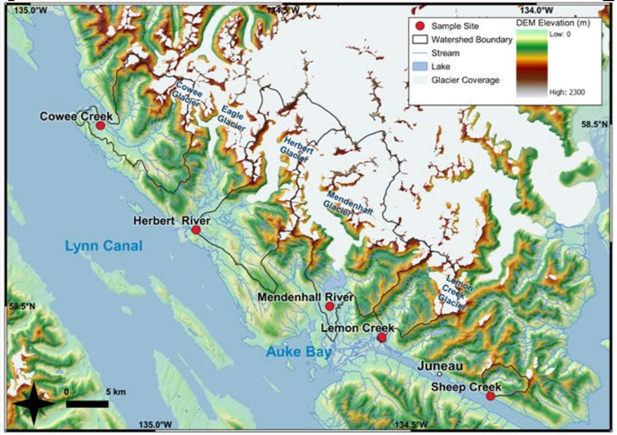
Glacier coverage
~365 km^2

Annual freshwater discharge
~4 km^3/yr

Kachemak



Lynn Canal



Research Goal 1

Characterize the hydrological and biogeochemical dynamics of rivers along a glacial to non-glacial watershed gradient and their linkages to coastal oceanography.

Speakers:

- Lee Ann Munk and Jordan Jenckes
- Flash talks: Jason Fellman, Zac Redman

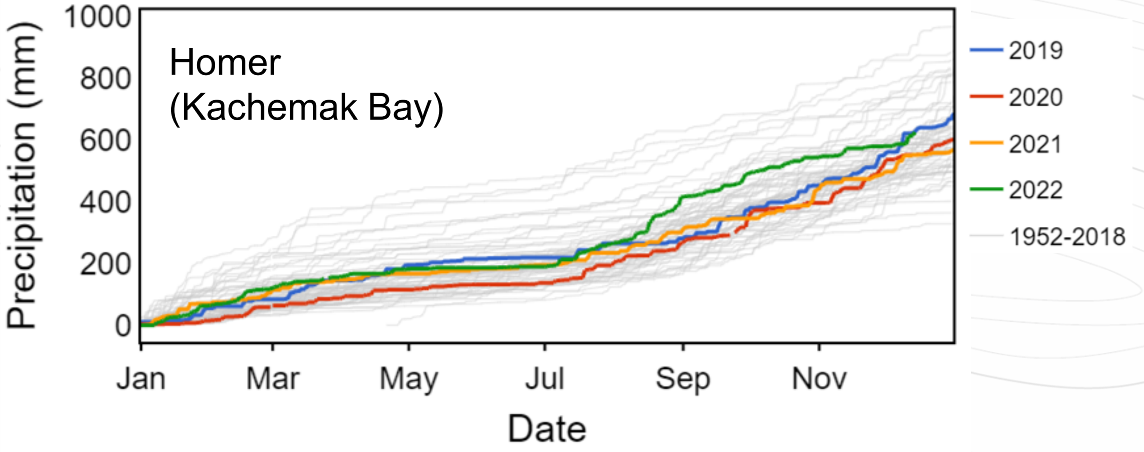
Summary of Research Results and Products: Goal 1

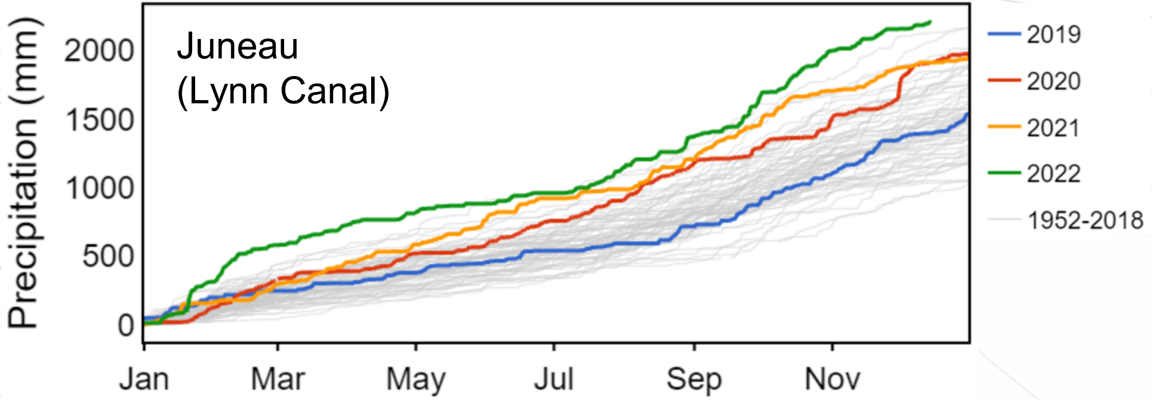
- Watershed classification predicts streamflow regime and organic carbon dynamics in the Northeast Pacific Coastal Temperate Rainforest. Global Biogeochemical Cycles, 36: e2021GB007047. https://doi.org/10.1029/2021GB007047, 2022.
- Hydroclimate drives seasonal terrestrial export across a gradient of glacierized high-latitude coastal catchments. Water Resources Research, revised and resubmitted.
- Glacier runoff influences biogeochemistry and resource availability in coastal temperate rainforest streams: Implications for juvenile salmon growth. Limnology and Oceanography, in review.
- Characterization of geochemical weathering regimes across the Gulf of Alaska Watershed. JGR Earth Surface, in prep.
- The influence of glacial-fed freshwater fluxes on the coastal waters of the Gulf of Alaska. Marine and Freshwater Research/Journal of Marine Systems, in prep.
- Contribution of fresh coastal groundwater discharge to the Gulf of Alaska. Water Resources Research, in prep.
- Proglacial lakes create a new paradigm of concentration discharge relationships. Hydrologic Processes, in prep.

Coastal Margins Stream Work Results

Precipitation: 2019-2022

- Juneau receives far greater precipitation than Homer
- Over the 4 yrs of study:
  - Homer precipitation fairly normal
  - 2022 record precipitation in Juneau





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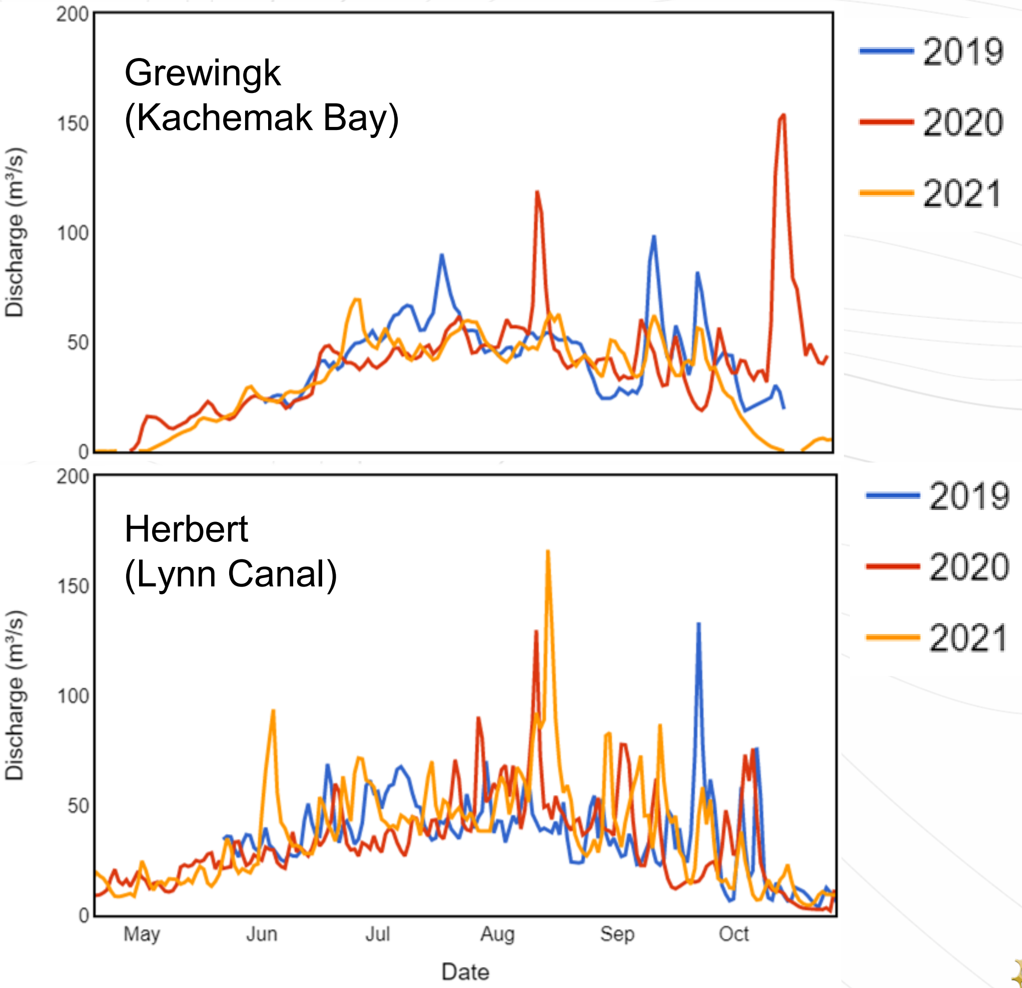
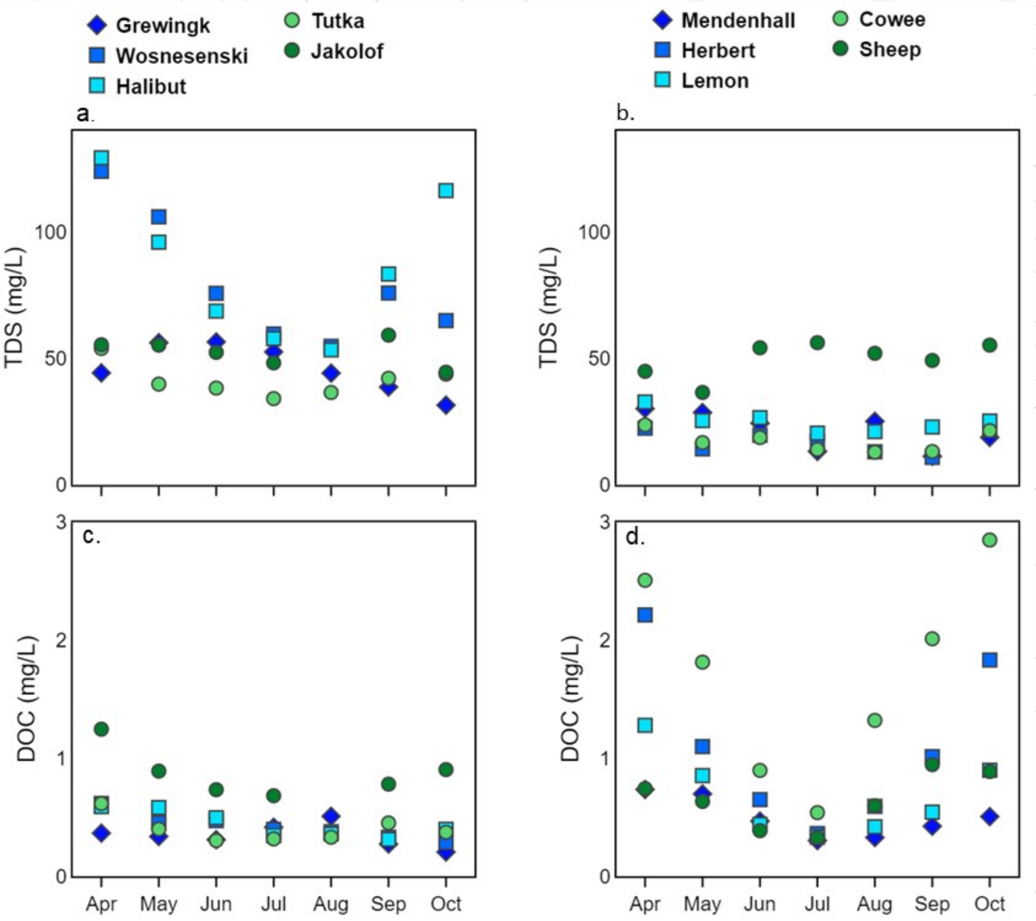
Stream Discharge

- Heavily glacierized Grewingk (Kachemak Bay) and Herbert (Lynn Canal)
- Spring and summer discharge driven by snow and glacier melt
- Rain events drive flashy stream flow
    - More common in Lynn Canal



Seasonal variability of inorganic and organic solutes

- On average inorganic solute concentrations (TDS) elevated in Kachemak Bay
- On average dissolved organic carbon (DOC) elevated in Lynn Canal
- Similar seasonal patterns in concentration variation



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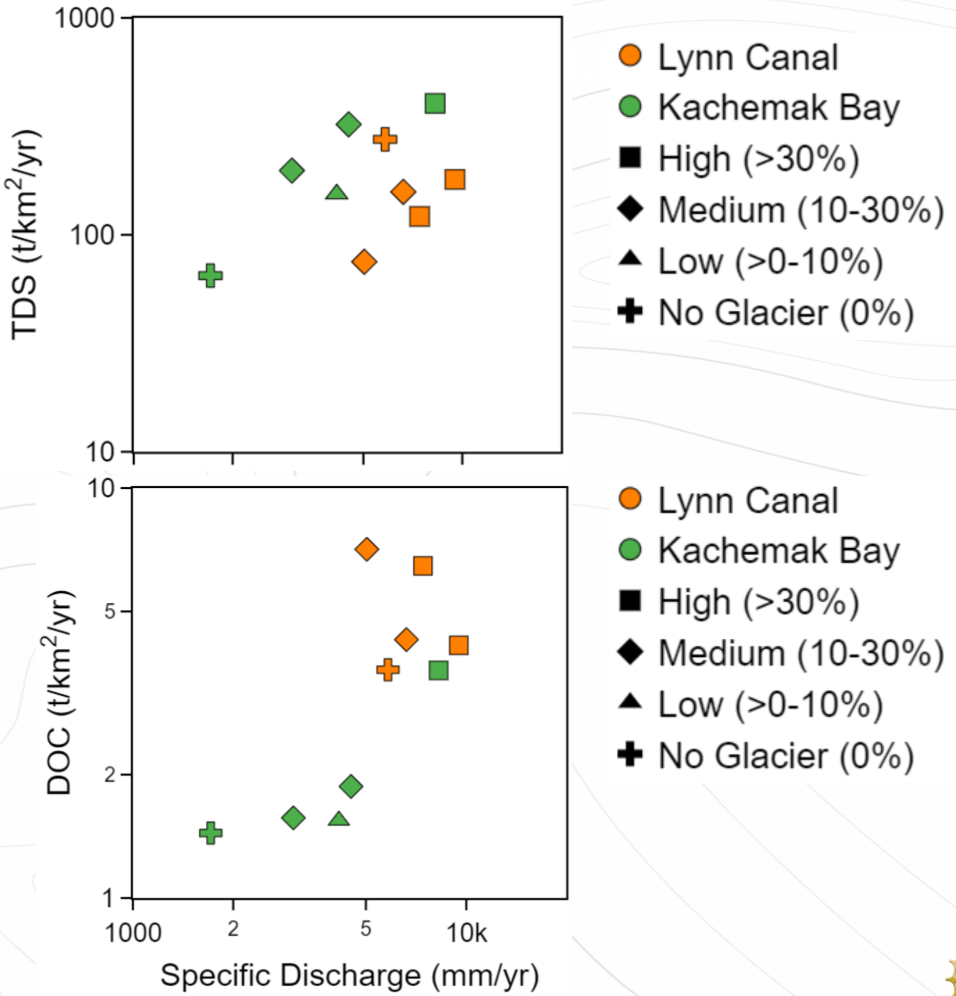
Yields of inorganic and organic solutes

- On average Kachemak Bay TDS yields are elevated compared to Lynn Canal (Sheep is the exception)
- On average Lynn Canal DOC yields are elevated compared to Kachemak Bay
- Driven by differences in climate and watershed characteristics

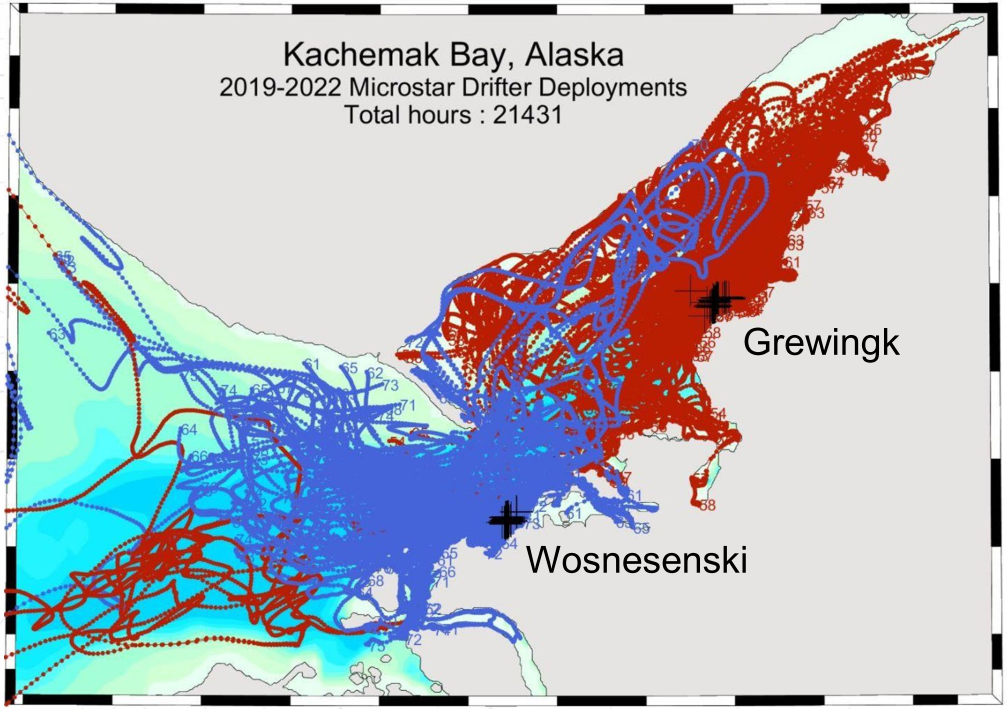


Drifter deployment results: 2019-2022 Kachemak Bay

- Data acquisition and analysis by Mark Johnson. Field work led by Brenda Konar and her crew.

- Deployments at Grewingk and Wosnesenski

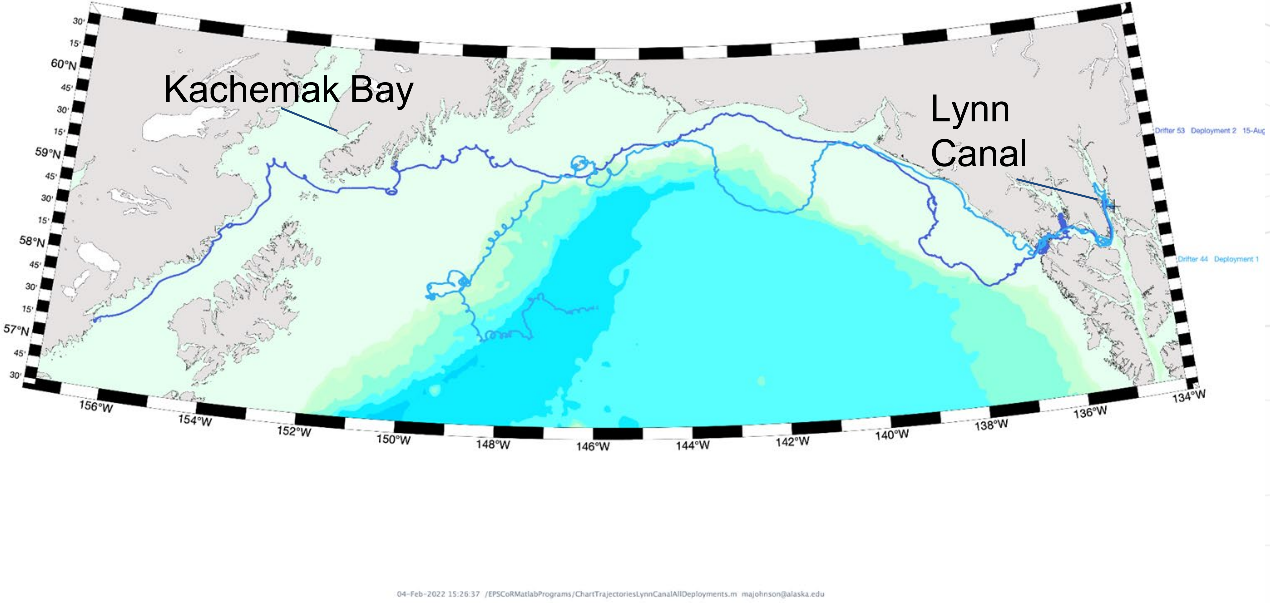
- Freshwater from Wosnesenski limited impact on freshwater budget to inner Bay



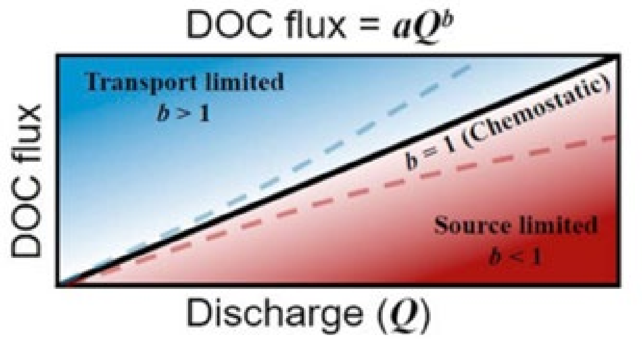
Drifter deployment results: Lynn Canal deployments

- Trajectories from deployments in Lynn Canal shows that Alaska SE is oceanographically connected to all the Gulf coast, including Cook Inlet where the pathway veers north into Lower Cook Inlet.

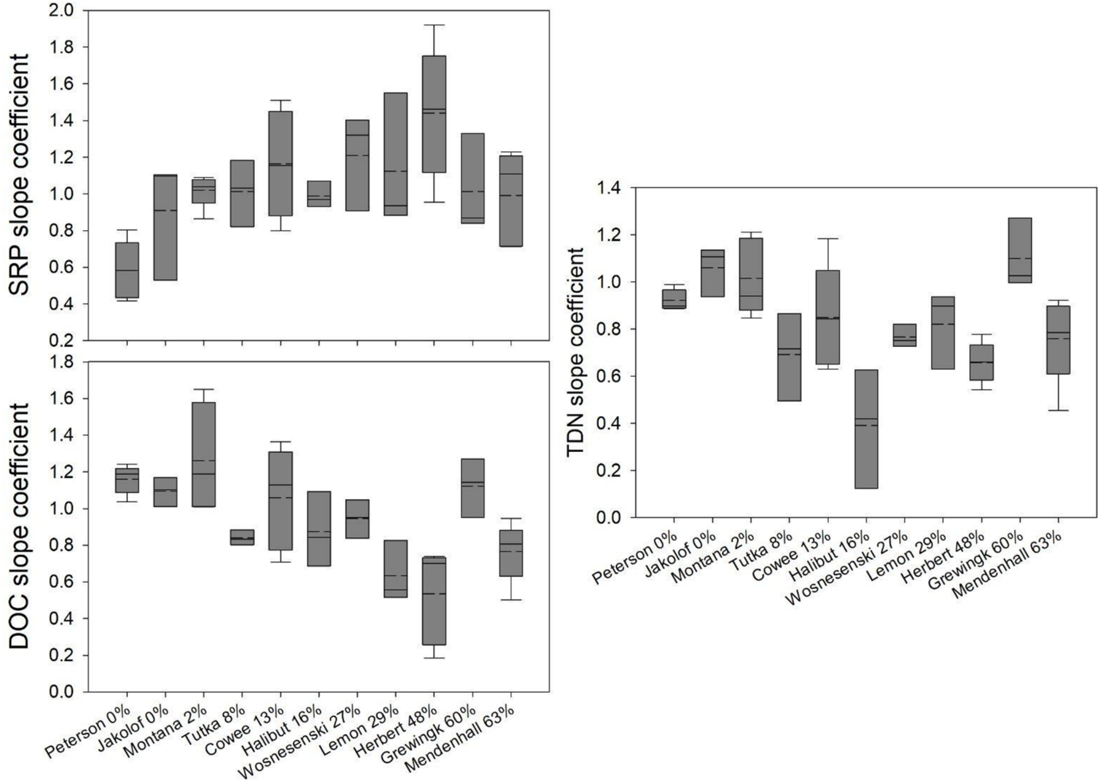
- Combined with other data, it shows that fluid parcels, or larvae for example, could be transported from Southeast to Kachemak Bay.



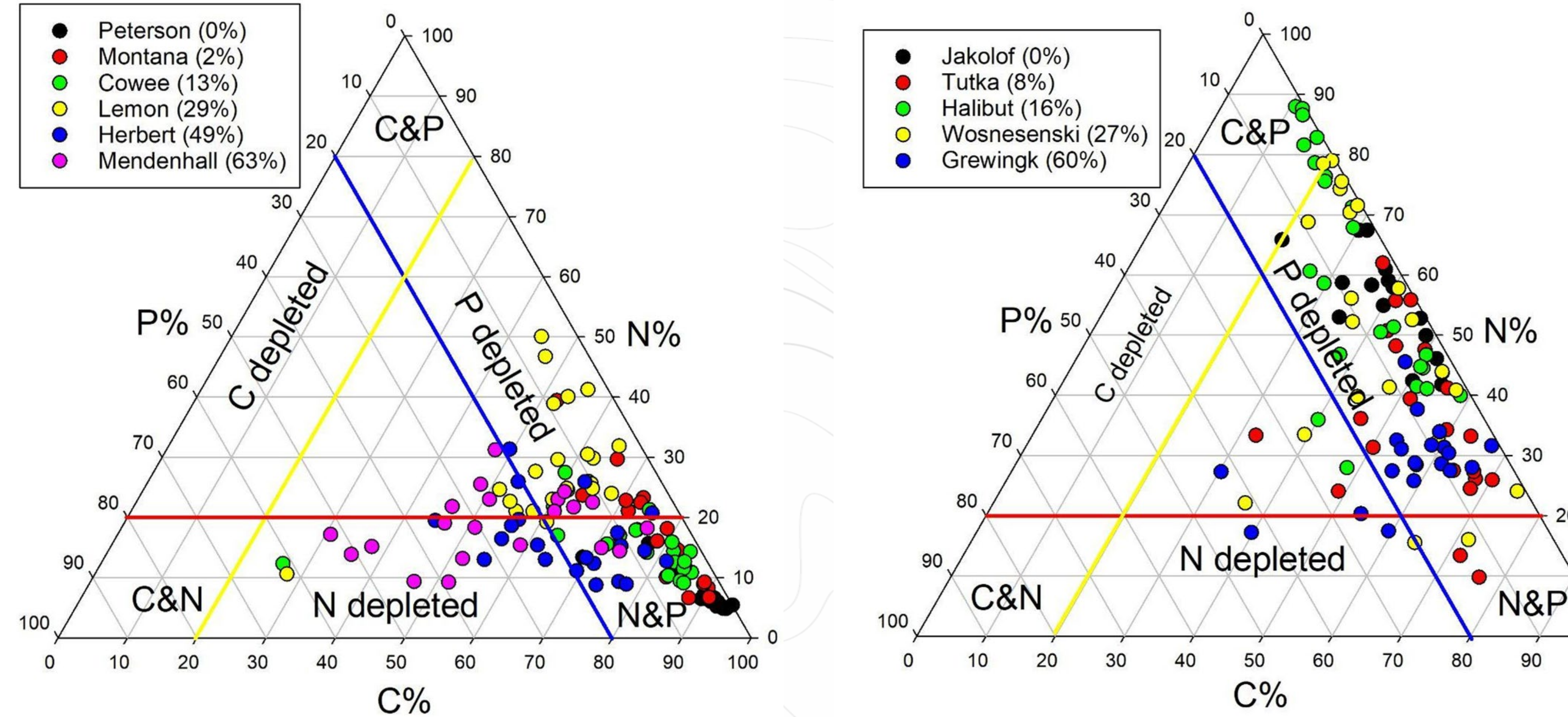
Source/runoff generating mechanisms identify generalizable patterns across regions



Conceptual model showing how an empirically derived DOC power function exponent (b) describes transport limitation, chemostasis, and source limitation of DOC production in watersheds.

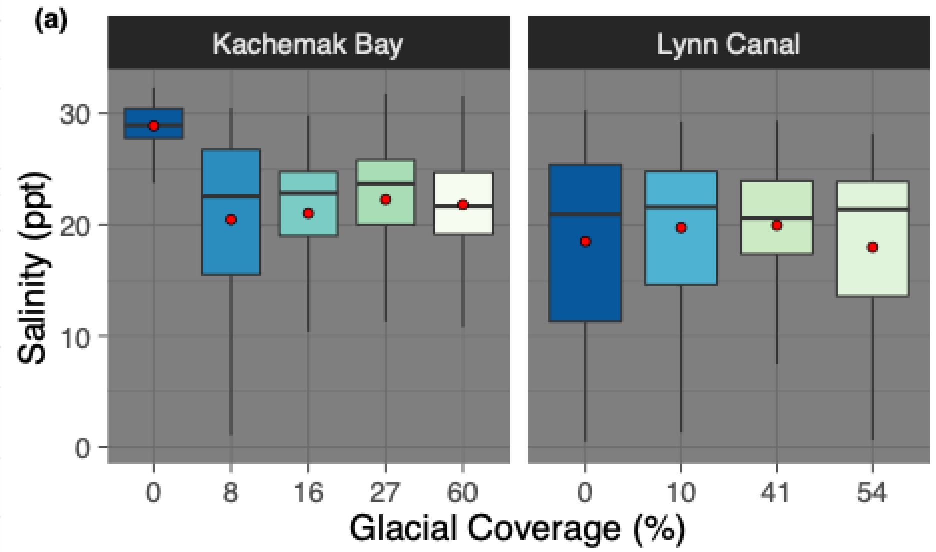


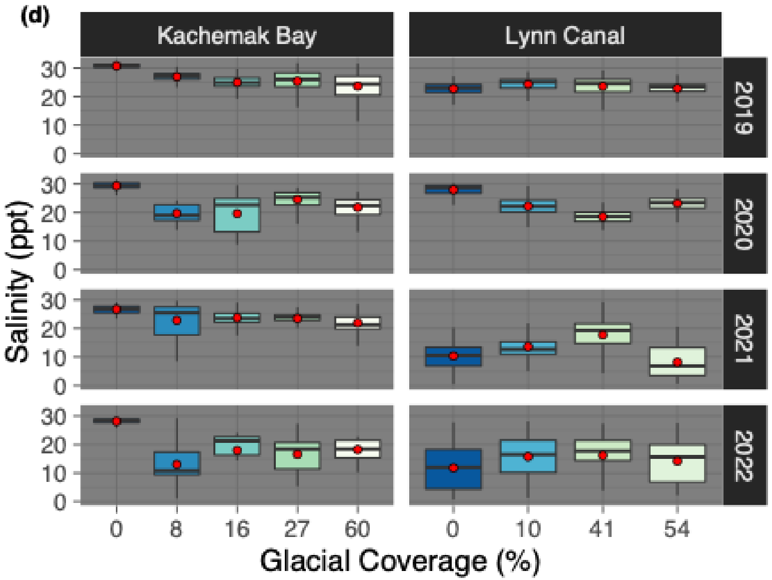
Heterotrophic nutrient assimilation using riverine stoichiometry - 68C:14N:1P

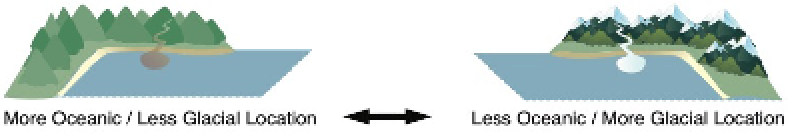


Source-runoff generating mechanisms are similar but the relative proportions are different

Freshening with increasing glacial coverage in Kachemak Bay and through time





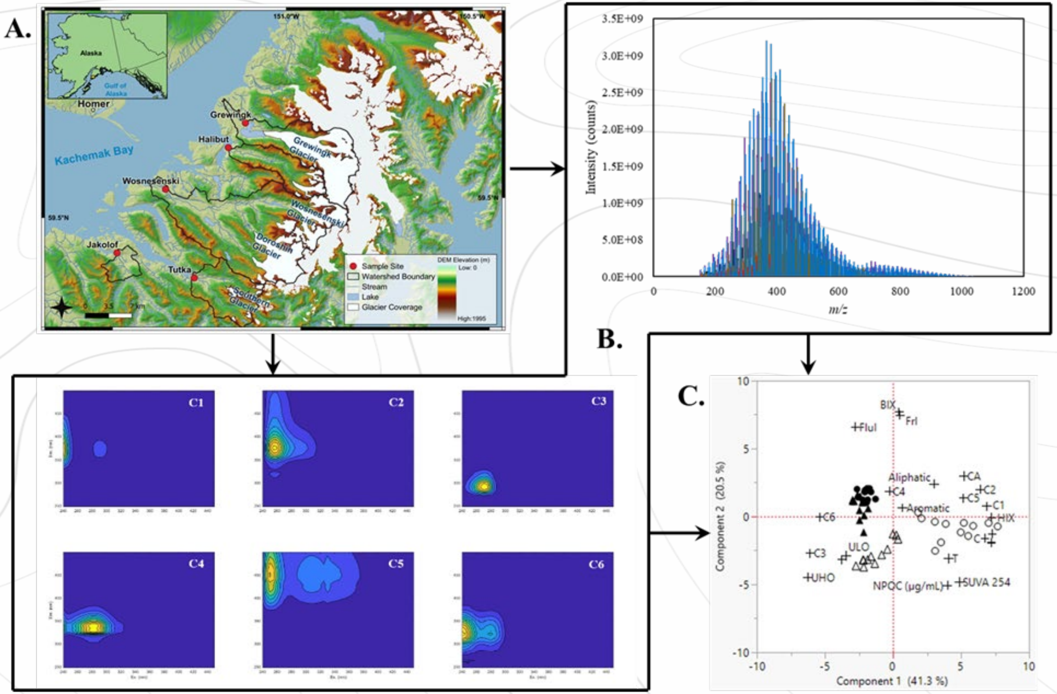


Molecular Characterization of Seasonal Dissolved Organic Matter Exports in Kachemak Bay

Objective 1. Characterize the seasonal variability of dissolved organic matter composition in waters feeding into Kachemak Bay.

Objective 2. Determine the influence of watershed glaciation on the molecular composition of dissolved organic matter in waters feeding into Kachemak Bay.

Objective 3. Identify compositional differences and similarities between dissolved organic matter in ground and surface water entering Kachemak Bay.



We will collect samples from streams and groundwater in Kachemak Bay, Alaska (A) such that DOM fluorescence and mass spectral character (B) can be used to assess the seasonal variability of carbon source and bioavailability over a gradient of watershed glaciation (C).

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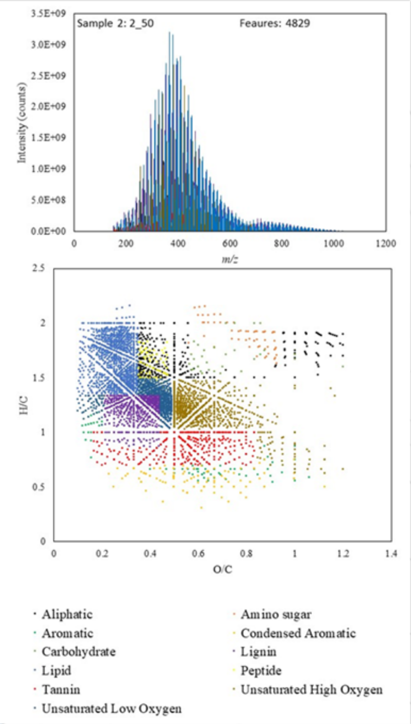
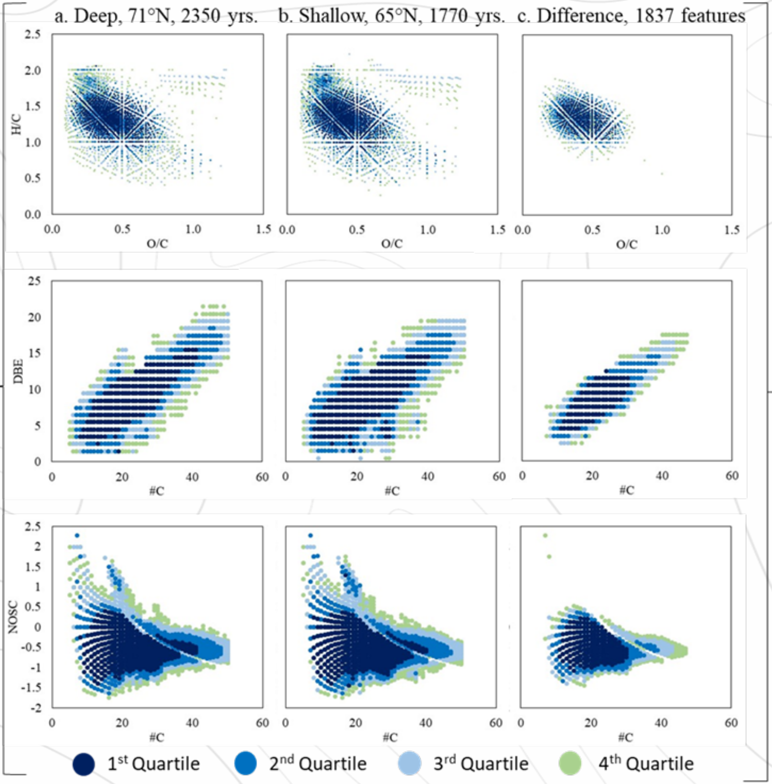
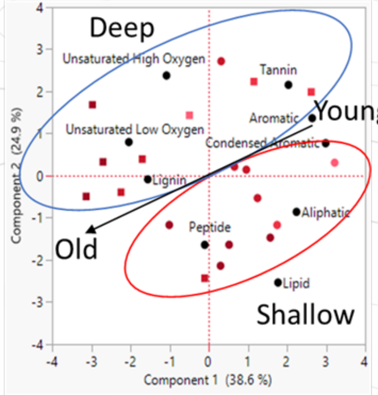
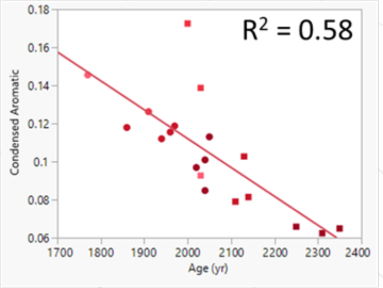
HRMS Analysis Reveals Molecular Level Trends in DOM Composition in Baffin Bay









Research Goal 2

Quantify biological responses of nearshore marine organisms to varying physical and chemical conditions along the glacial to non-glacial gradient.

- Speaker: Julie Schram
- Flash talks: Maddi McArthur, Maris Goodwin, Brian Ulaski

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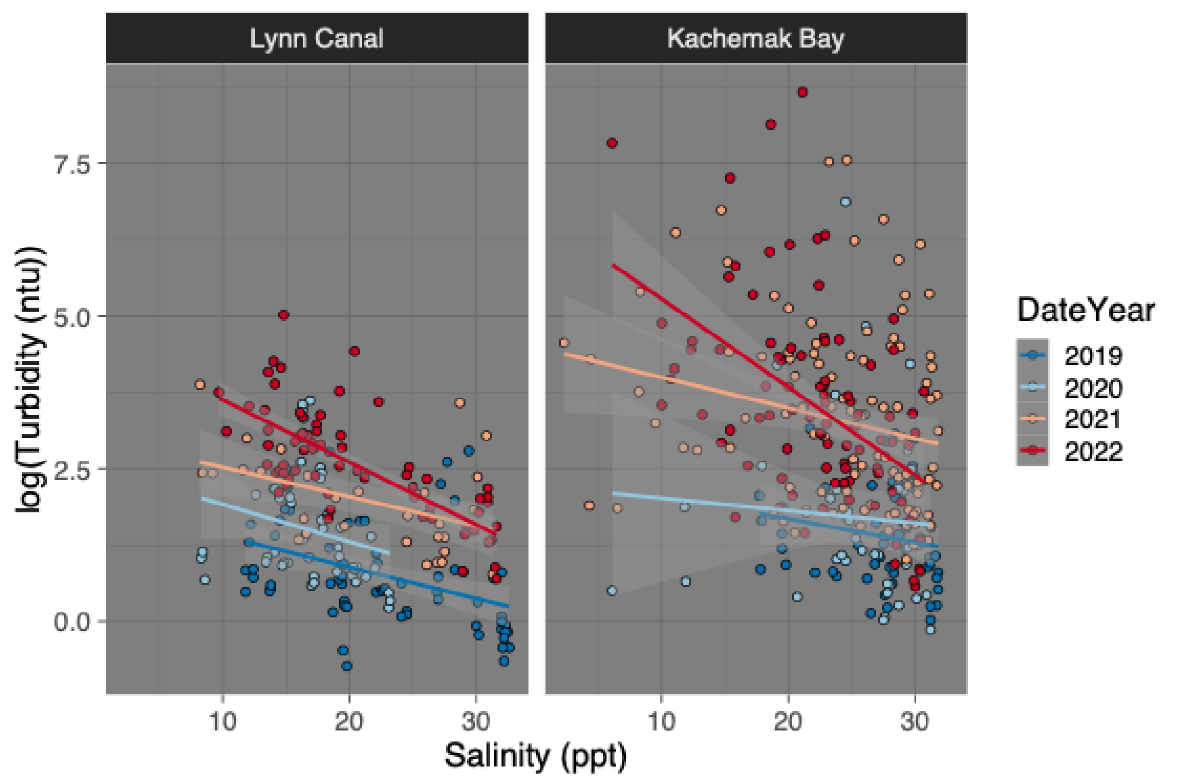
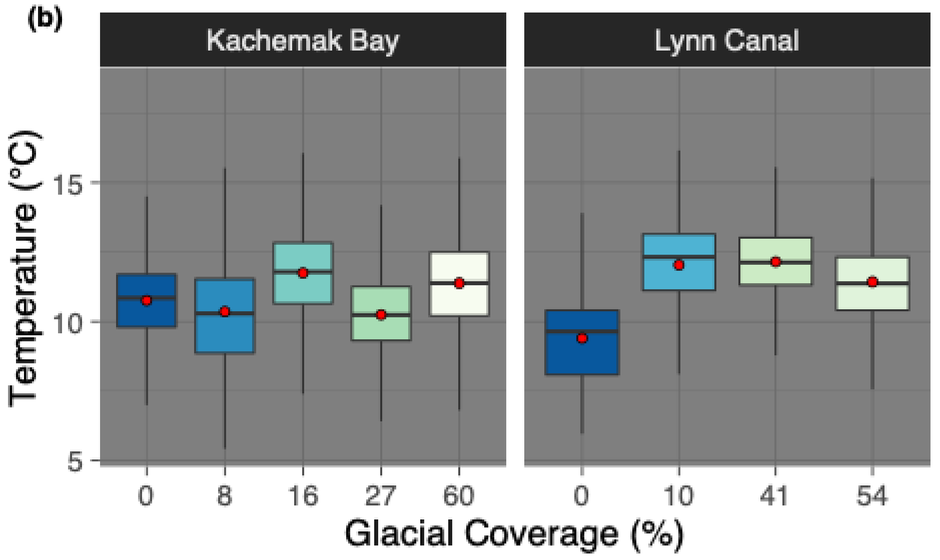
Summary of Research Results and Products: Goal 2

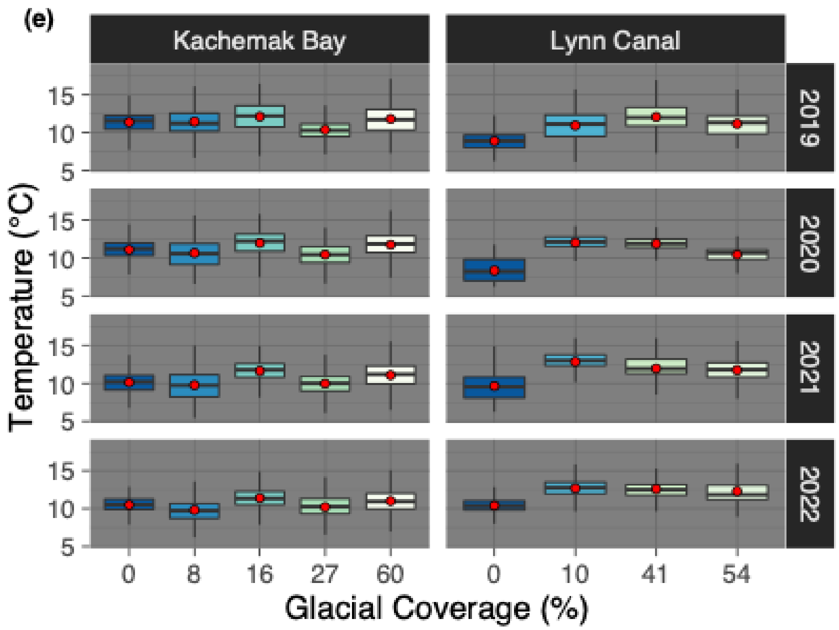
- Papers in press:
  - LaBarre, A, Konar, B. and K. Iken. *Environmental influence on size frequency distributions of the Pacific Blue Mussel (Mytilus trossulus) in two glacially influenced estuaries.* Coasts and Estuaries.
  - Hamm, G, S Gabara, P Chase, B Konar, S Umanzor. *Effects of Glacial Input on the Performance of Pacific Blue Mussel, Mytilus trossulus*
- Submitted:
  - Umanzor, Sandoval-Gil, Conitz, *Ecophysiological responses of the intertidal seaweed Fucus distichus to temperature changes and reduced light driven by tides and glacial input*.
  - Schloemer J, Munk LA, Iken K. *Marine resources, not terrestrial, support nearshore food webs in glacially influenced watersheds in the northern Gulf of Alaska.* FMARS
  - Ulaski B, Sikes, D, Konar B. *Beach-cast and drifting seaweed wrack is an important resource for marine and terrestrial macroinvertebrates in high latitudes. Marine Environmental Research*
- In prep:
  - Alcantar, M., Hetrick, J., Ramsey, J., Kelley, A.L., *Examining the impacts of elevated, variable pCO2 on larval Pacific razor clams (Siliqua patula) in Alaska*
  - Alcantar, M., Bacus, S., Kelley, A.L., *Characterizing the direct and indirect effects of ocean acidification on juvenile pink salmon (Oncorhynchus gorbuscha)*
  - Bacus, Alcantar, Kelley, Miller. *Species-specific effects of elevated pCO2 on the basket cockle and littleneck clam in the Gulf of Alaska*

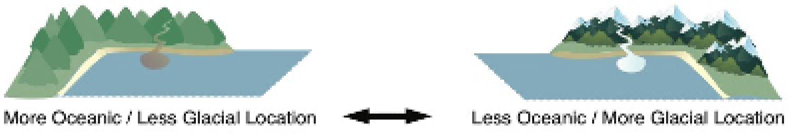
Fresher water was more turbid, higher in Kachemak Bay



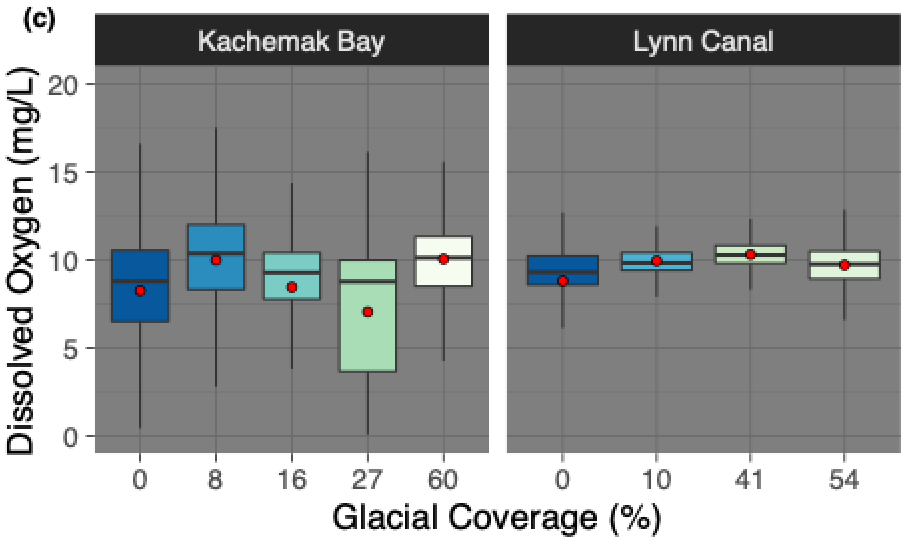
Warmer seawater with increasing glacial coverage

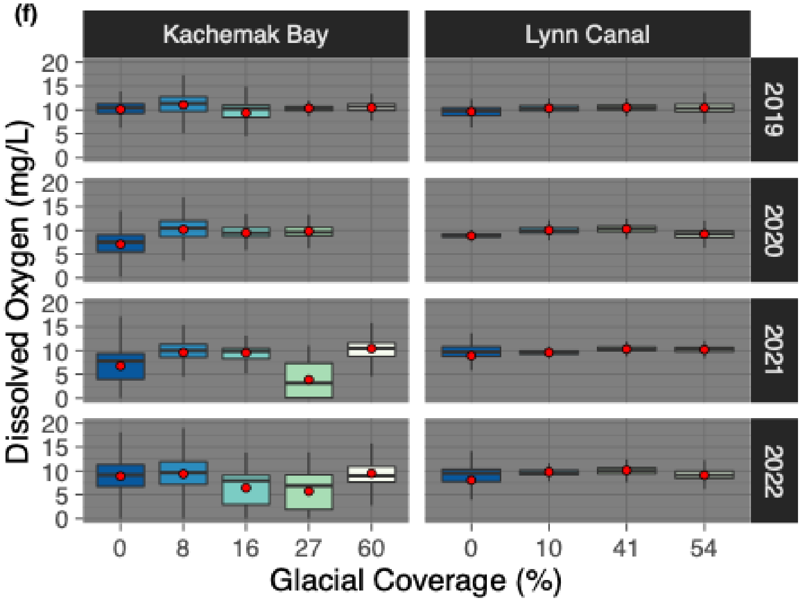


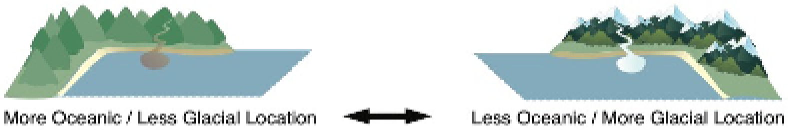




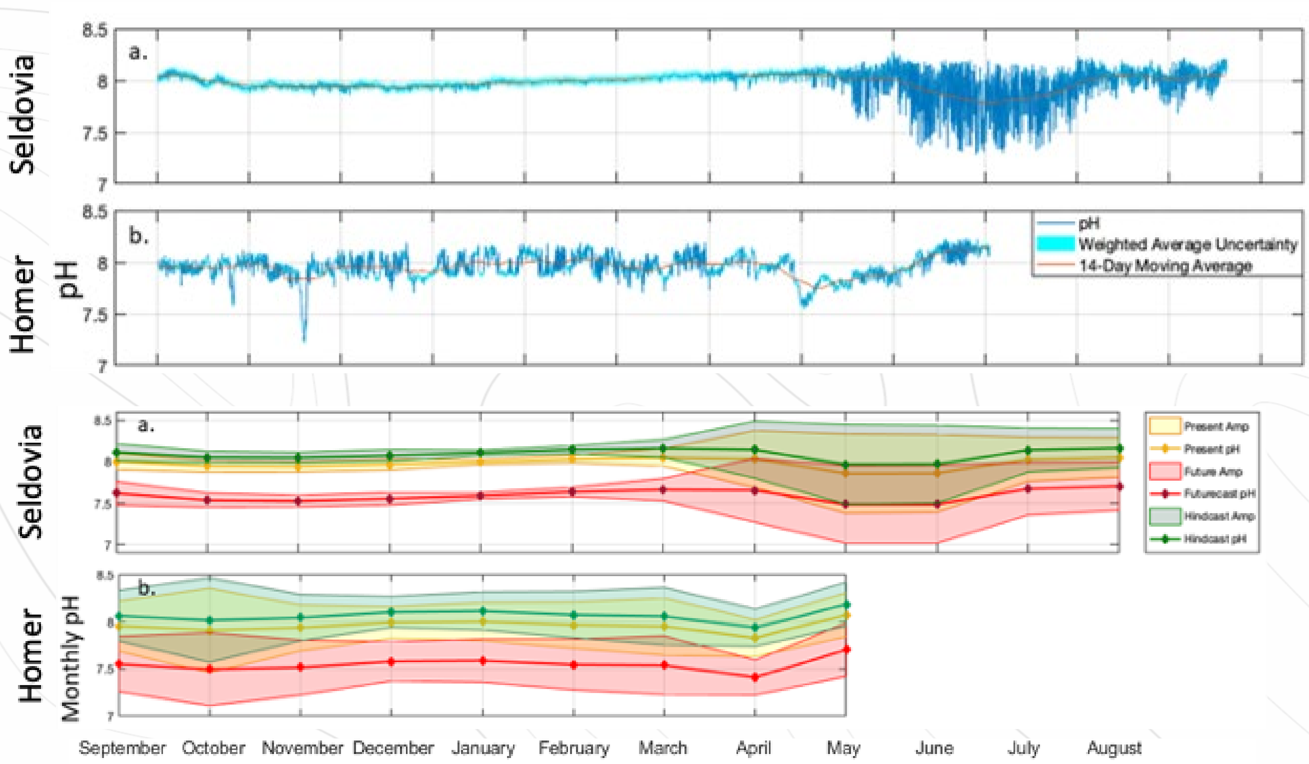
Higher dissolved oxygen with increasing glacial coverage



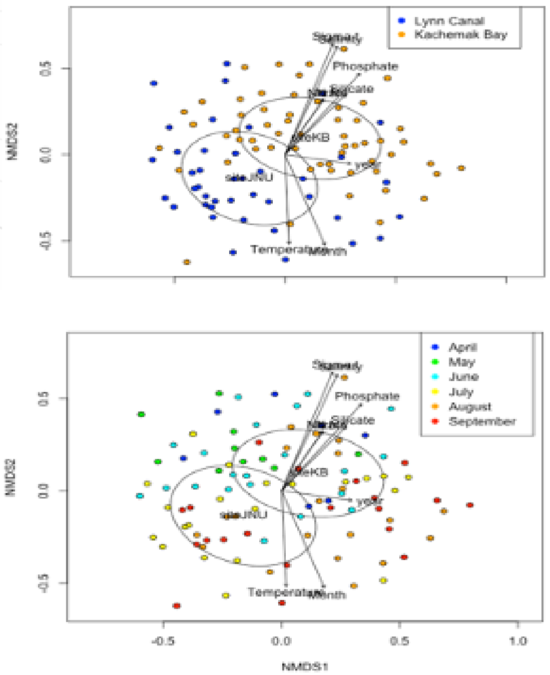


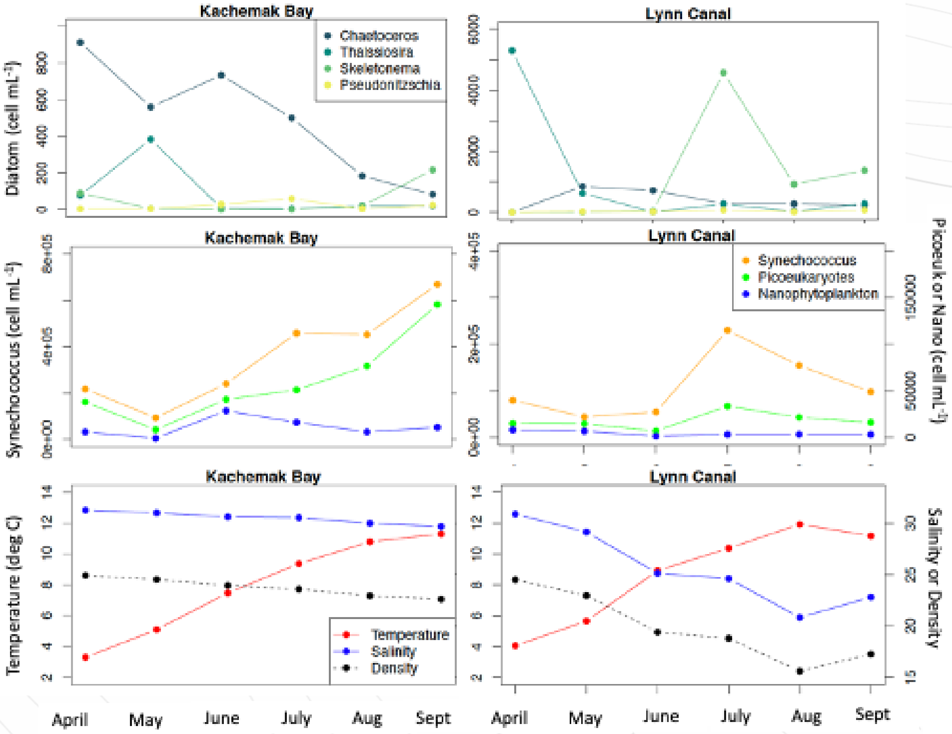


Kachemak Bay pH dynamics and hind/futurecast model RCP 8.5

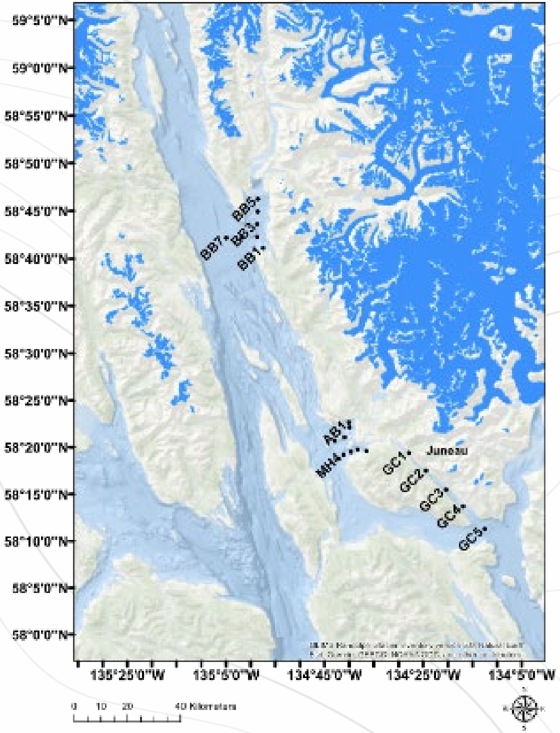


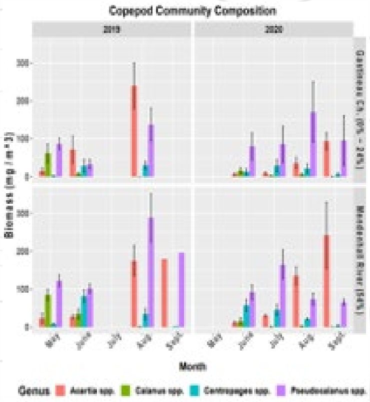
Microbial community shifts correlate with temperature, salinity and nutrients

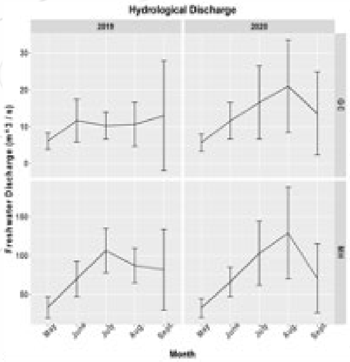


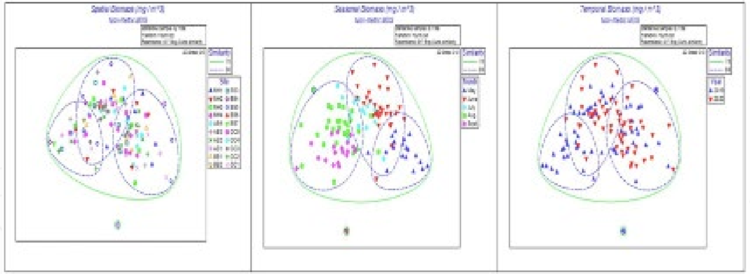


Spatial, seasonal, and interannual variability of copepod communities.









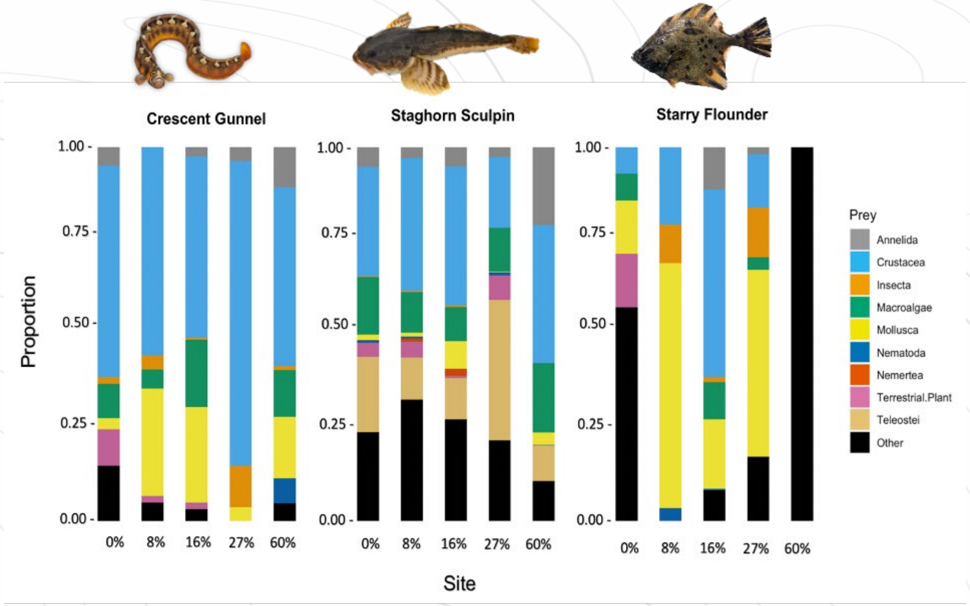
Spatial: p = 0.207

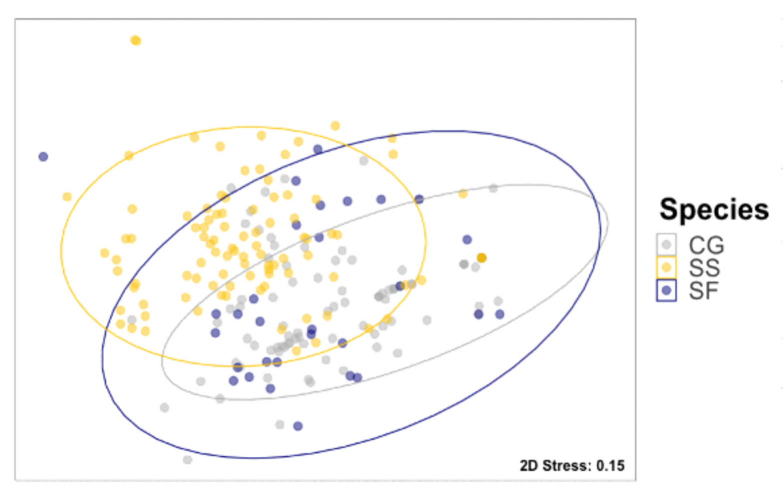
Seasonal: p = **0.001**

Interannual: p = **0.001**

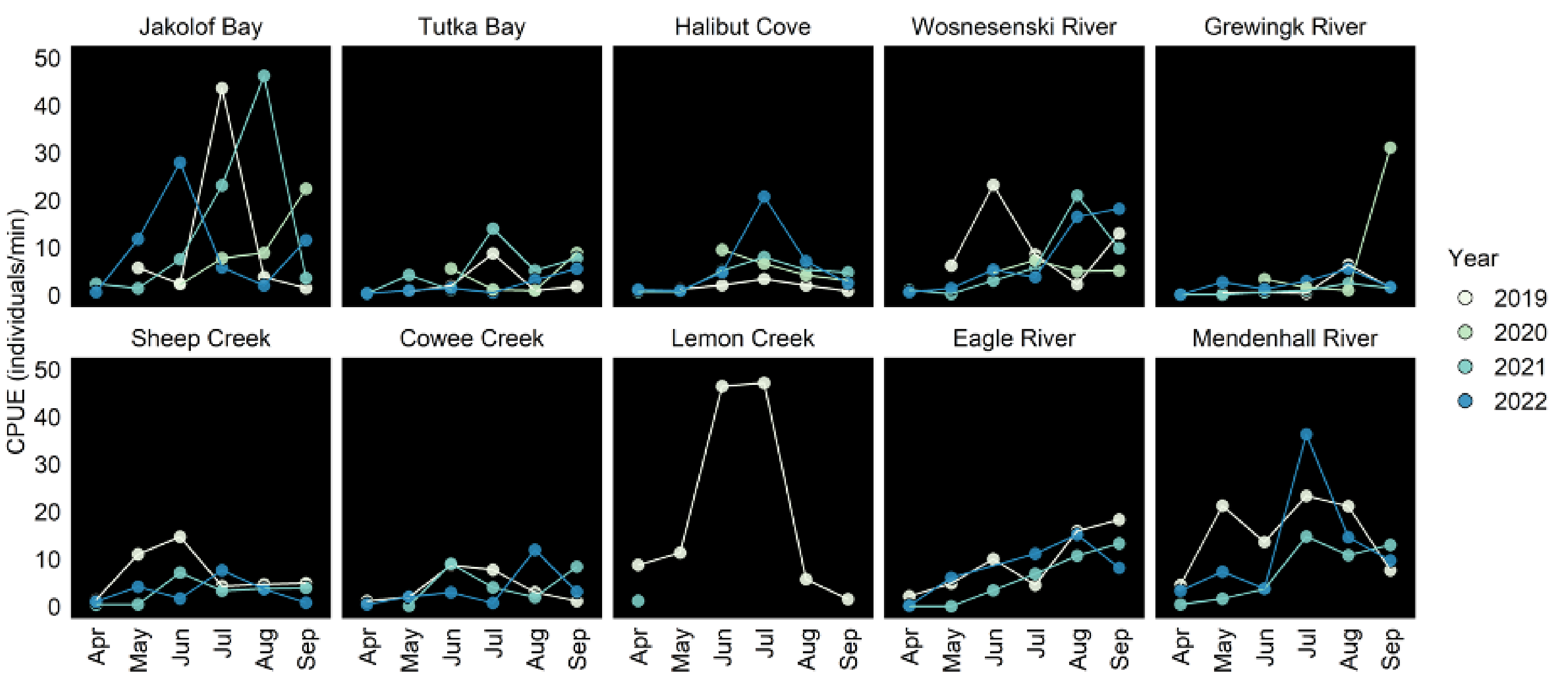
Trophic resource use of nearshore fishes in glacially influenced systems

Do various fish species have similar patterns in diet across watersheds?





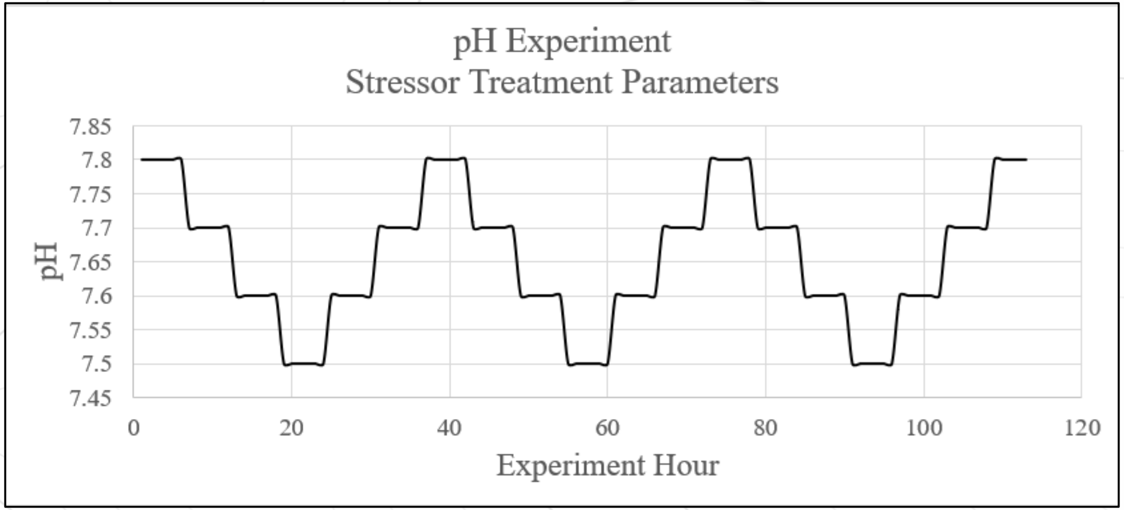
Fish catch per unit effort (CPUE) across the glacial gradient



Is mussel attachment strength impacted by intermittent exposure to low pH?

Goal:

Conduct controlled experiments to determine how mussel attachment strength is affected by detrimental pH values, while mimicking the natural variability of nearshore pH



Mussels collected from Jakolof (0%) and Grewingk (60%)

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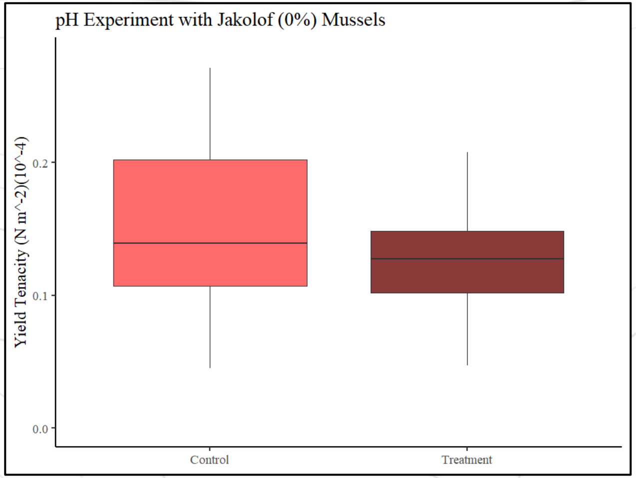
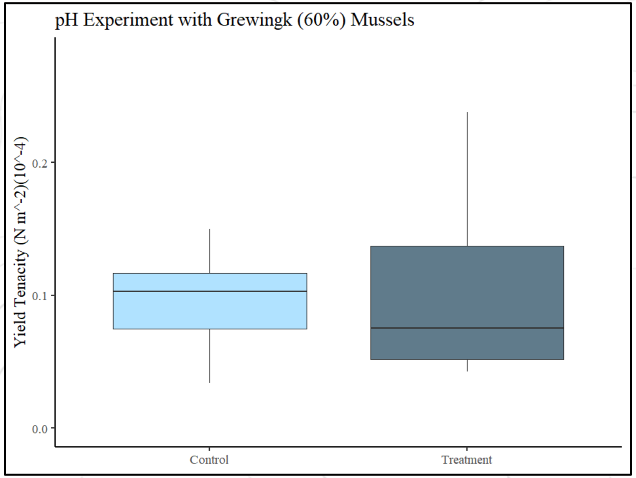
Is mussel attachment strength impacted by intermittent exposure to low pH?



Jakolof (0%) mussels: no significant difference between control and treatment (Wilcoxon, p=0.49).



Grewingk (60%) mussels: no significant difference between control and treatment (Wilcoxon, p=0.36).

It appears that mussel attachment strength is unaffected by intermittent exposure to low pH.

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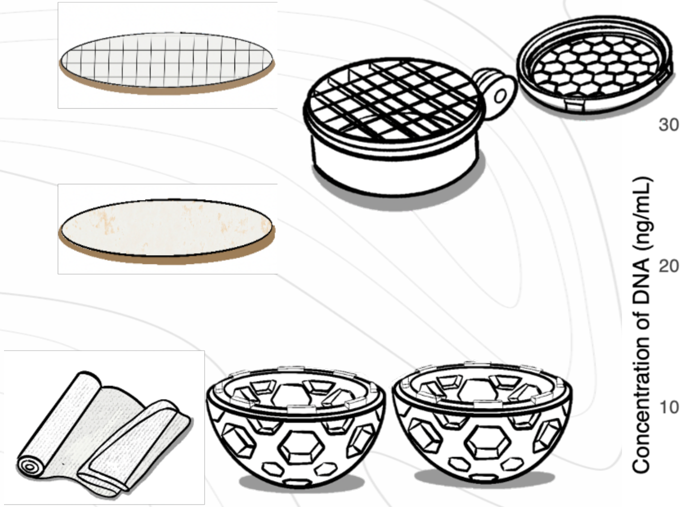
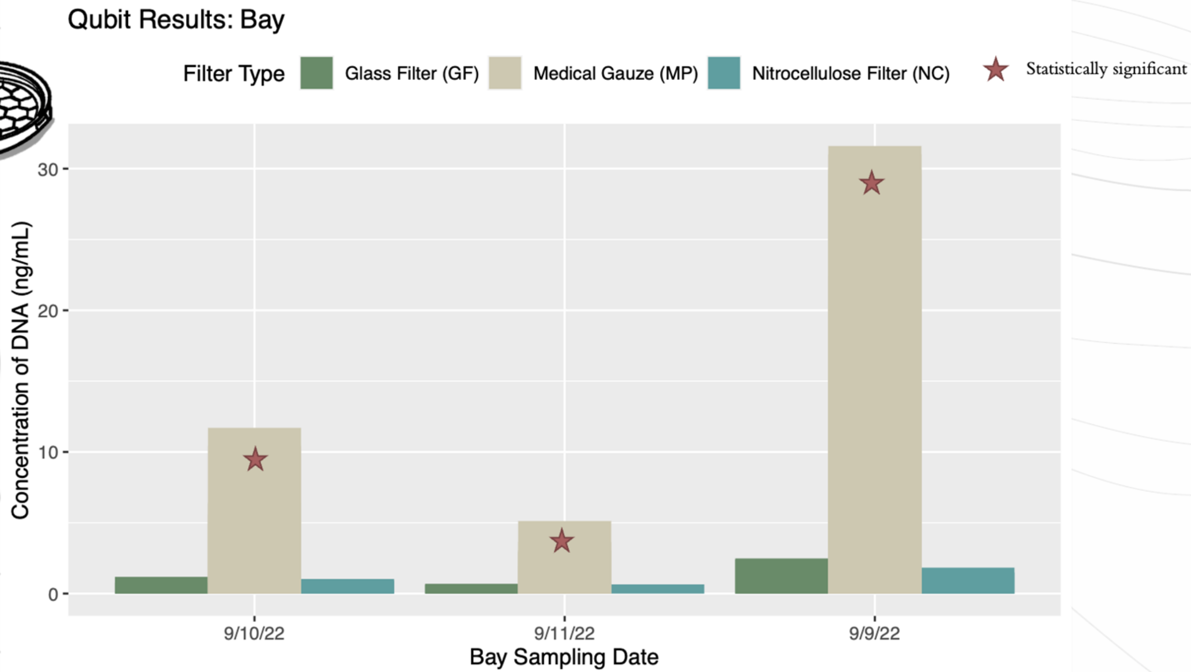
Passive eDNA sampler as a citizen science tool

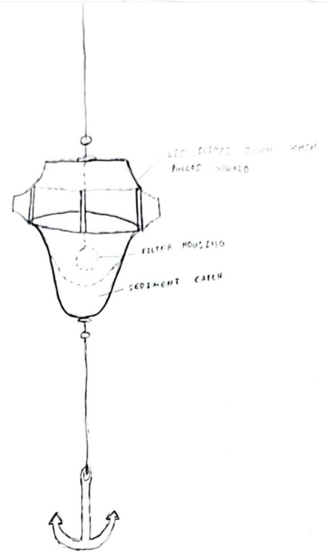


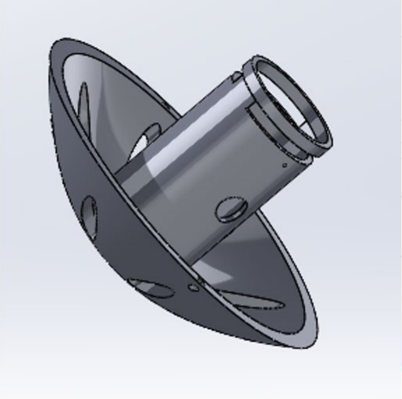


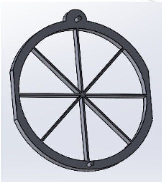
Most Recent Prototypes

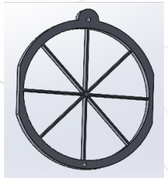
Designed By : Andrew Wilson and George Deal

Sediment Cup

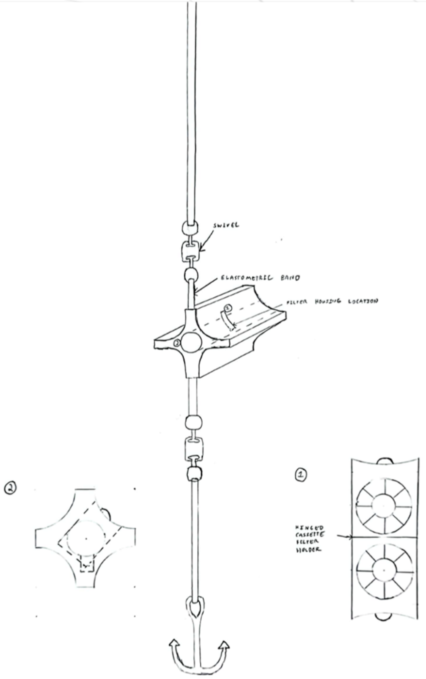


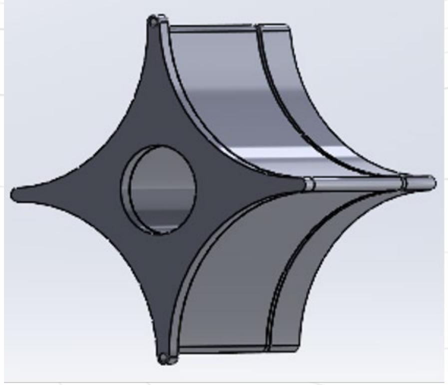


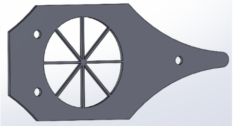


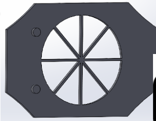


Current Alignment









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BOEM
Bureau of Ocean Energy Management

CMI
Coastal Marine Institute

NSF

Is seaweed wrack an important resource for macroinvertebrates in a glacial estuary?

Seaweeds are **foundation species**, even when cast ashore as **wrack**.

The State of Alaska sets **regulations** for aquatic plant harvesting, including wrack.

Characterize wrack-associated **invertebrate communities**.

Monthly **field surveys** and controlled **lab experiments** in Kachemak Bay.

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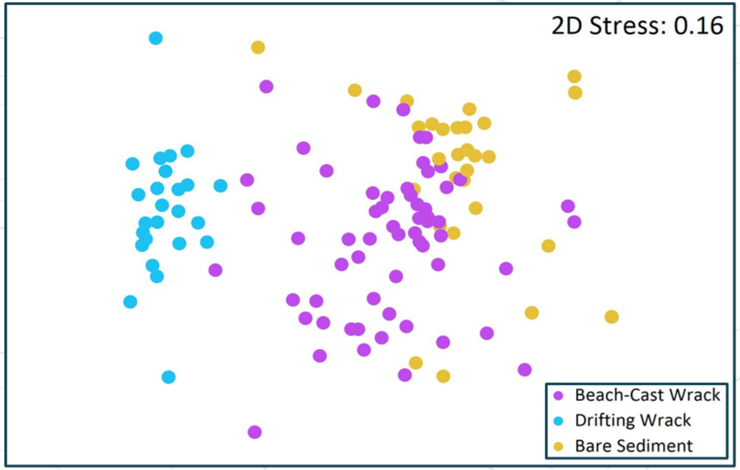
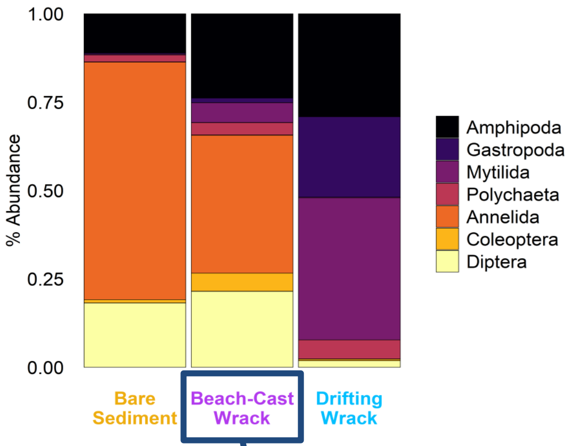
NSF

Is seaweed wrack an important resource for macroinvertebrates in a glacial estuary?



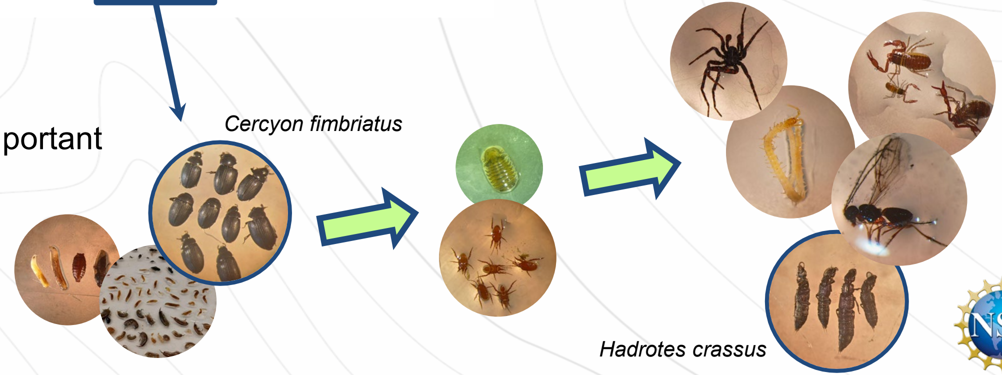


88 taxa from 40,000+ specimens.

Ecological succession.

Management implications.

Biomass and **tidal height** of the wrack line are the most important drivers of macroinvertebrate diversity and abundance.



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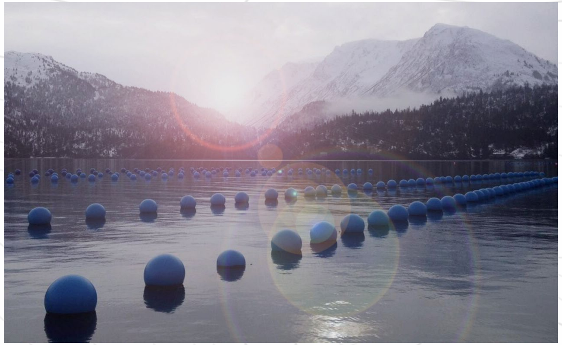
Research Goal 3



Understand potential responses of coastal resource users to current changes and anticipated future shifts in nearshore marine resources.

Speakers:

- Flash talk: Emma Kimball

FISHERS' OBSERVATIONS OF CHANGE

Changes in Salmon Stressors | Environmental Changes | Co-occurring

	Juneau	Homer
Smaller fish	x	x
Fewer fish	x	x
Straying	x	
Behavior changes		x

	Juneau	Homer
Warmer ocean	x	x
Warmer weather	x	x
Receding glaciers	x	x
Drought	x	x
More sea otters	x	x
More rain	x	
Isostatic rebound	x	
Flooding	x	
More whales	x	

	Juneau	Homer
Fish price changes	x	x
Boat and permit cost	x	x
Management changes	x	x
Management politics	x	x
User groups	x	x
1964 earthquake		x
1989 Exxon Valdez spill		x
Processor changes		x
Cruise ship pollution	x	

Interviews

- 36 fishers in Juneau and Homer
- Average 42 years fishing
- 20 institutional representatives

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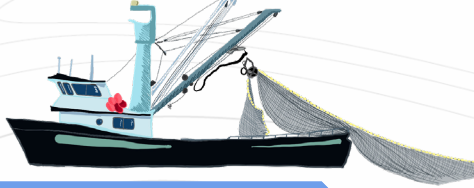
ADAPTIVE STRATEGIES



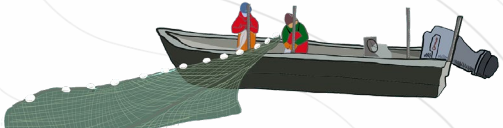
Fishers' adaptive strategies

- Change gear
- Change fishing location
- Alter fishing strategies
- Additional jobs
- Portfolio diversification
- Participate in organizations

Institutional adaptive strategies

- Habitat conservation & protection
- Flexibility in operating procedures
- Monitoring and long-term planning
- Collaboration
- Communication technology

- Fishers are noticing environmental changes, but co-occurring stressors may pose greater near-term challenges
- Salmon fishers are adaptable, taking advantage of opportunities and responding to stressors.
- Local institutions work in various capacities and are aware of stressors affecting commercial salmon fisheries



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Research Goal 4 – Update/Summary

Hire and train researchers and share results with academic audiences and stakeholders.

Speaker: Lee Ann Munk

Goal 4

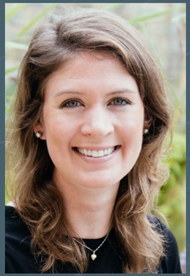
Hires and Student Participation

- All faculty and postdoc hires complete
- 25 undergraduate students and 25 graduate students employed over course of project (as of June 2021)

Faculty Hires

Julie Schram
UAS

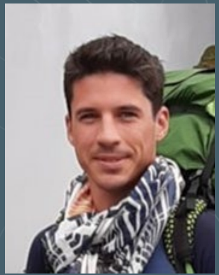
Gwenn Hennon
UAF



Jessica Glass
UAF

Postdoc Hires

Scotty Gabara
UAF



Remi Pages
UAF

Brian Ulaski
UAF

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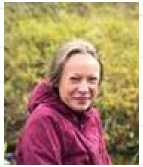
Core Students

Human Dimensions


Emma Kimball
UAA


Karen Grosskreutz
UAF

Stream Team

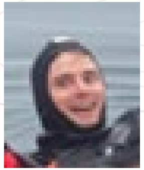

Jordan Jenckes
UAA/UAF


Croix Fylpaa
UAS

Environment


Josie Haag
UAF

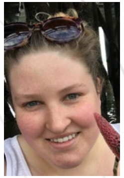

Jim Schloemer
UAF


Jamie Currie
UAF

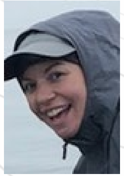
Plankton

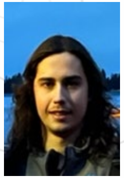

Alex Knobloch
UAF

Invertebrates/Algae


Marrina Washburn Alcanter
UAF


Shelby Bacus
UAF

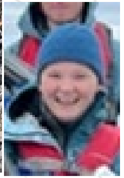

Amy Dowling LaBarre
UAF


Jonah Jossert
UAF


Grace Hamm
UAS


Maddi McArthur
UAF

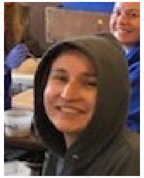

Mary McCabe
UAF


Jennifer Tustin
UAF

Fish


Maris Goodwin
UAF


Nina Lundstrom
UAF


Lindsey Stadler
UAF

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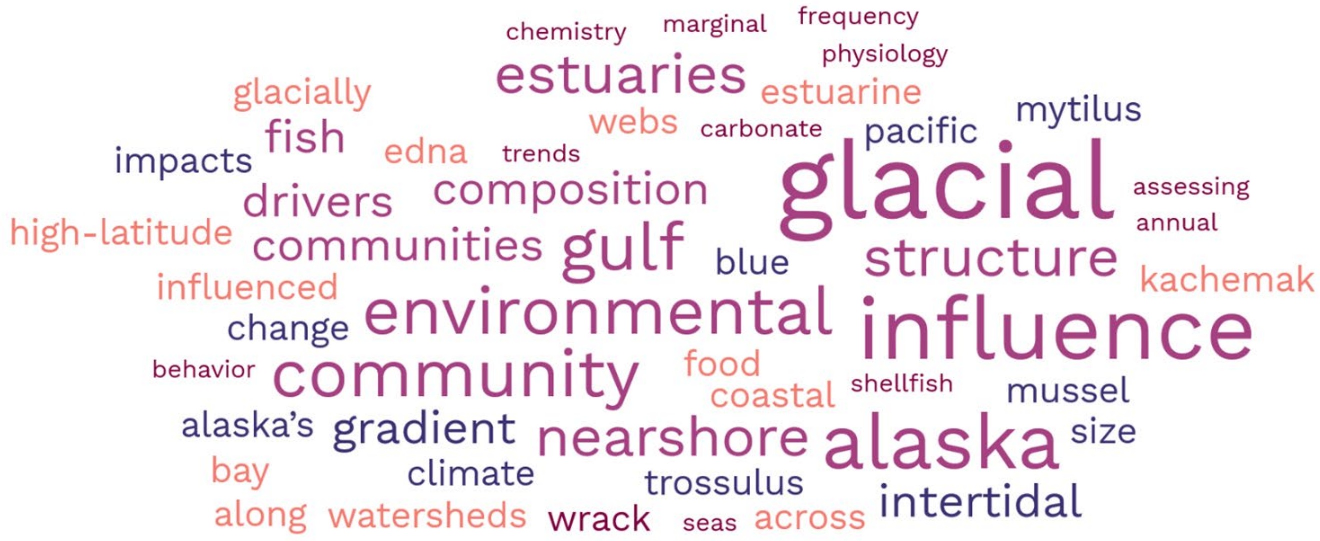
Core Student Projects



Comprehensive list of all undergrad and grad students involved in Coastal Margins

Graduate Students:

Nina Lundstrom
Lindsey Stadler
Maris Goodwin
Mary McCabe
Amy Dowling
Jordan Jenckes
Jim Schloemer
Josie Haag
James Curry
Jonah Jossert
Emma Kimball
Karen Grosskreutz
Marina Alcantar
Shelby Bacus

Alex Knobloch
Chris Guo
Rebecca Cates
Matt Calahan
Liza Hasan
Emily Reynolds
Mack Hughes
Maddi McArthur
Lauren Sutton
Katie Corliss
Sydney Wilkenson
Danielle Seigert
Brian Ulaski
Hannah Myers
Will Samuel
Drew Porter

Jesse Gordon
Carolyn Hamman
Courtney Hart
Croix Fylpaa
Cameron Kuhl

Jennifer Tustin
Grace Hamm
Tibor Dorsaz
Brian Zhang
Emily Williamson
Brianne Visaya
Andrew Scotti
Michael Kim
Preslee Chase
Amy Baxter

Undergraduate Students:

Samantha Allen
Randy Brannan
Naomi Muehleck
Spencer Gunter
Donovan Varelman
Amelia Tamone
Kenedy Williams
Sol Martinez
Caitlyn Montalto
John Seymour
Dustin Horton
Amy Jenson
Connor Johnson
Hannah Forshee
Ricardo Medina-Soler
Jon Calleja

Ezra Grey
Skye Hart
Noah Khalsa
Muriel Dittrich
Mollie Dwyer
Lucy Franklin
Kyah Mingo
Liam Bogardus
Oscar Jones
Matthew Harl
Stephanie Driscoll
Annie KinCannon
Edward Schiff
Madison Bargas
Kailey Pritzl
Alex Tugaw

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Goal 4

Sharing Results and Outreach

- Major presence at national and international conferences
- Papers published (2), in review (7) and in prep (4)
- Meetings with agencies, mariculture groups, public panels

Next Priority: Year 5 Publishing Plans

- Focus on synthesis manuscript submission
- Student project and thesis wrap-up
- Data finalization and publication
- Continue stakeholder engagement

Year 5: Stakeholder Engagement

- Alaska Forum on the Environment, holding a panel discussion
- AMSS booth at poster session for highlighting project
- Research presentations at local and national meetings

Please Visit our Posters and Story Map Tonight!

AHM - 2023