Clam populations in coastal Alaska

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Outline

- The importance of clams
- Clam populations in Alaska
- Changes in those populations
- Changes in coastal environment
- My research focus
- Citizen science help

Photo: Marina Washburn

Clams throughout history


Photo: Marina Washburn

- Used as subsistence food source to native populations for thousands of years
- Used as decorations, jewelry, tools, or money in some cultures
- Social event
- Now clamming is a recreational pastime as well as a subsistence food source

http://traditionalanimalfoods.org/marine-invertebrates/bivalves/page.aspx?id=6504

Clam middens/gardens

- Ancient marine enhancement and management
- Reduce coastal erosion
- Stabilize sediment
- Increase recruitment

Groesbeck et al 2014

Total Landings & Landings of Key Species/Species Groups (thousands of pounds)

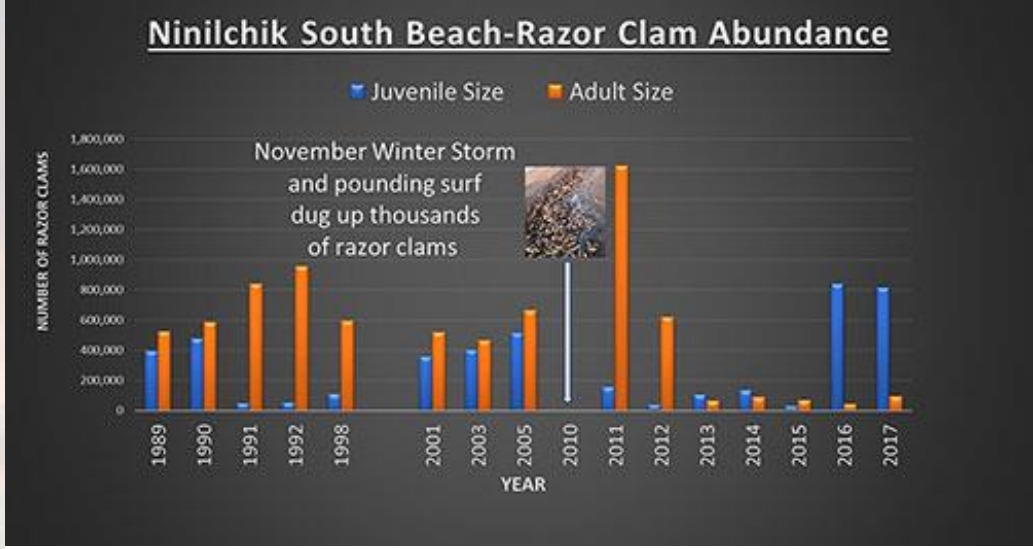
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Total Landings	5,430,208	5,323,296	4,538,906	4,069,788	4,348,788	5,354,950	5,345,454	5,791,752	5,671,323	6,038,170
Finfish & Other	5,351,184	5,244,927	4,431,960	3,973,816	4,262,927	5,269,122	5,229,228	5,700,699	5,580,283	5,908,919
Shellfish	79,023	78,369	106,946	95,972	85,861	85,828	116,226	91,053	91,040	129,251

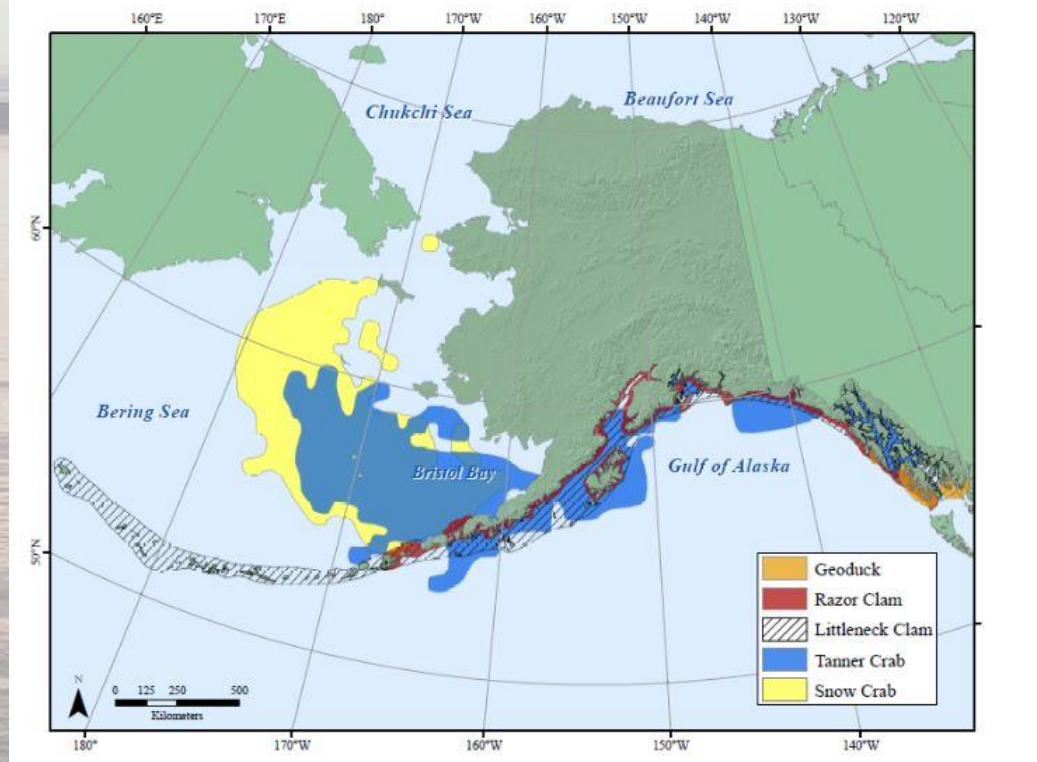
Total Landings Revenue & Landings Revenue of Key Species/Species Groups (thousands of dollars)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Total Revenue	1,314,856	1,485,703	1,759,670	1,259,446	1,592,775	1,930,551	1,839,324	1,926,853	1,730,807	1,732,545
Finfish & Other	1,190,460	1,304,790	1,507,952	1,063,867	1,386,142	1,663,708	1,553,063	1,686,719	1,482,338	1,438,799
Shellfish	124,396	180,912	251,718	195,579	206,633	266,843	286,261	240,134	248,469	293,746
Key Species										
Atka mackerel	14,816	17,506	21,688	29,734	30,535	30,031	30,638	16,647	24,803	30,582
Crab	110,572	168,195	240,747	180,264	189,553	248,693	275,745	230,139	237,813	284,283
Flatfish	68,200	74,507	96,326	69,233	79,518	109,661	123,319	103,456	89,553	68,932
Pacific cod	144,678	181,325	241,933	98,507	145,907	163,424	171,192	190,015	155,150	174,380
Pacific halibut	192,905	217,399	208,983	134,603	200,454	205,211	144,801	111,483	106,674	110,709
Pacific herring	7,455	14,817	22,912	29,294	23,026	12,305	19,430	16,280	11,492	7,040
Rockfish	18,003	17,422	16,755	14,446	21,576	33,628	33,240	27,157	31,590	29,125
Sablefish	85,023	88,500	92,205	87,236	97,262	139,741	120,163	82,291	87,373	86,436
Salmon	276,512	347,625	368,219	344,655	505,695	564,788	441,284	679,528	546,022	413,199
Walleye pollock	380,510	344,170	436,074	254,295	279,999	401,912	453,172	446,558	421,087	508,560

Recreational clamming

- No-limit clamming on razor clams until 2011
- Razor clam, average per year of 843,136 clams between 1969-2003 to 391,186 clams between 2004-2013
  - From 2006-2015 declined 92%
  - From 2014-2015 declined 58%
- Similar declines in butter clam and littleneck clam

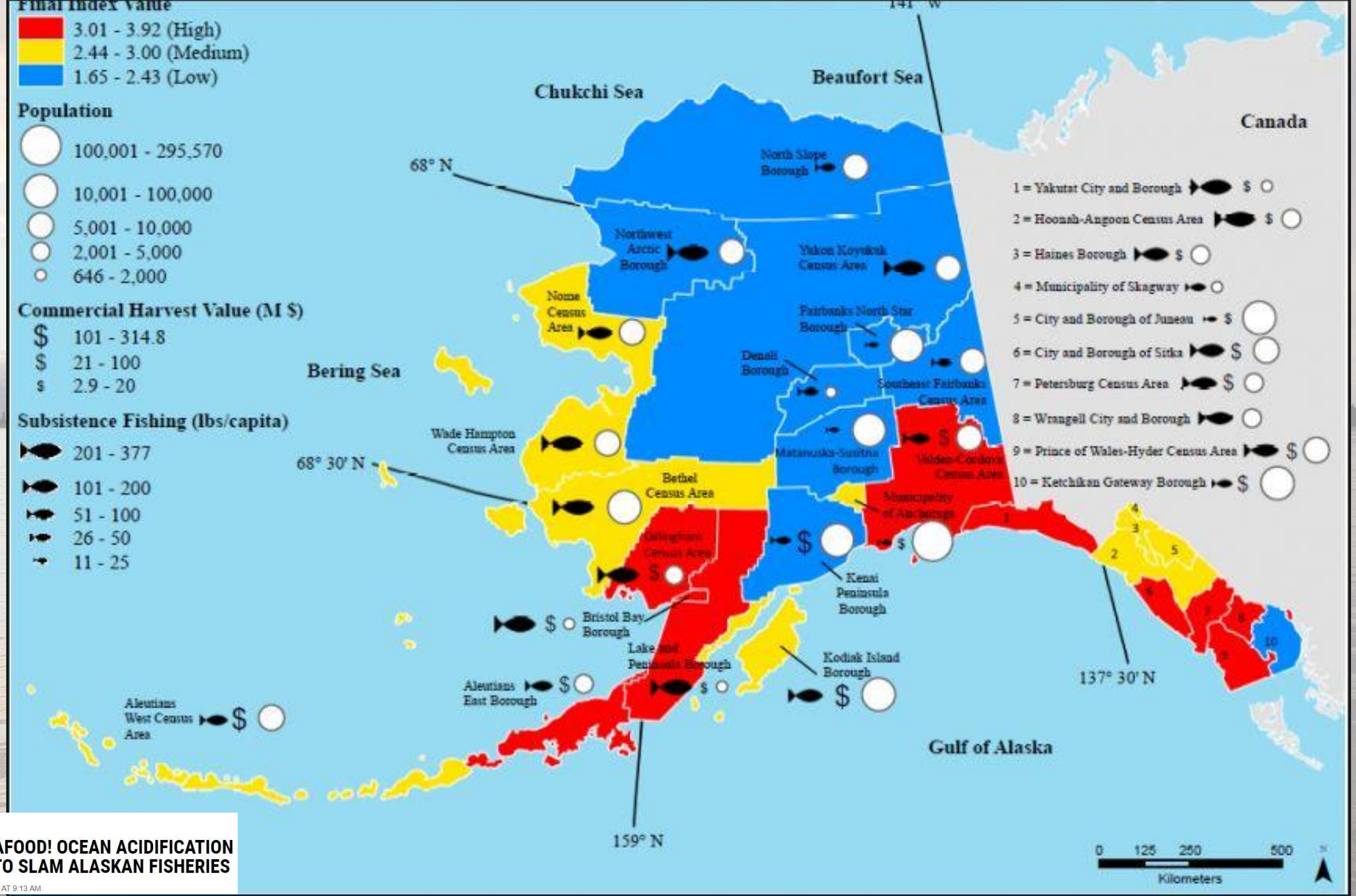




Habitat ranges of vulnerable species studied in the report: Tanner and snow crabs, geoduck, littleneck, and razor clams (adapted from Alaska Department of Fish & Game).

NOAA

Alaska Department of Fish and Game



TECH & SCIENCE

SO LONG, SEAFOOD! OCEAN ACIDIFICATION PROJECTED TO SLAM ALASKAN FISHERIES

BY ZOË SCHLANGER ON 7/29/14 AT 9:13 AM

NOAA

Causes

- Fall 2010 storm
- Predators
- Disease
- Overfishing
- Changes in habitat
- Shift in environment

Alaska Department of Fish and Game

ANCHORAGE DAILY NEWS

Outdoors/Adventure

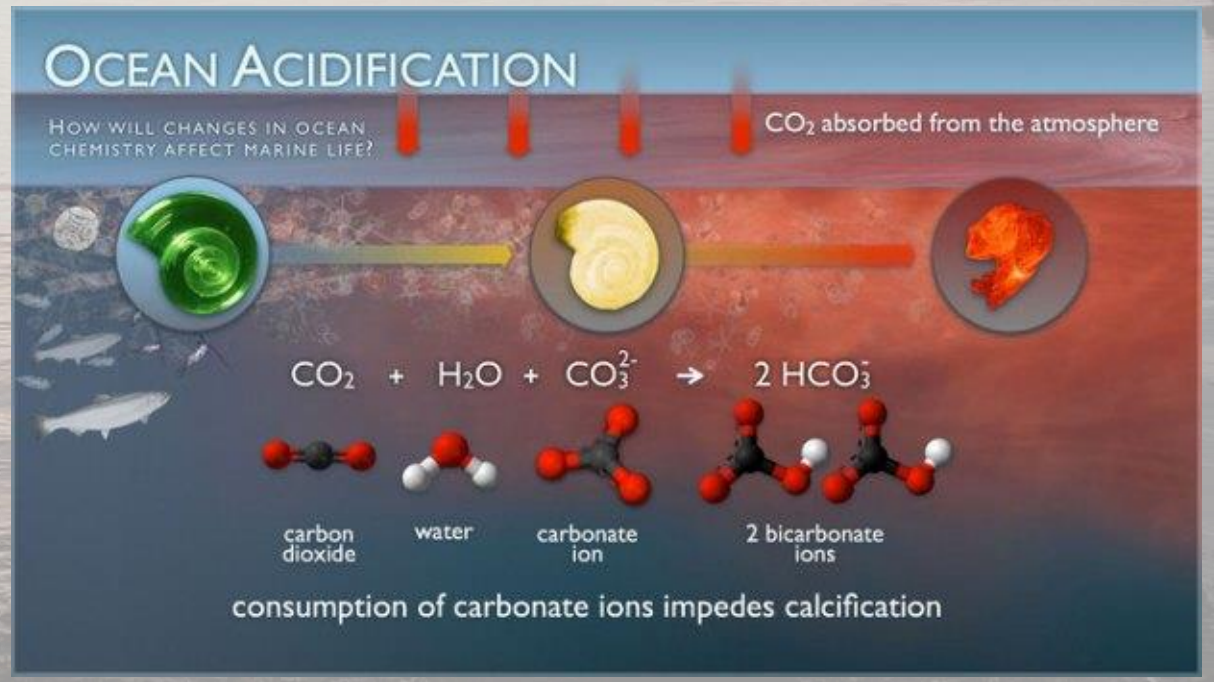
Clamming shut down again on Kenai Peninsula beaches

Author: Mike Campbell Updated: December 2, 2017 Published December 29, 2016

Stacy Michael of Wasilla holds some of her catch while clamming for razor clams at Clam Gulch on the Kenai Peninsula in 2010.

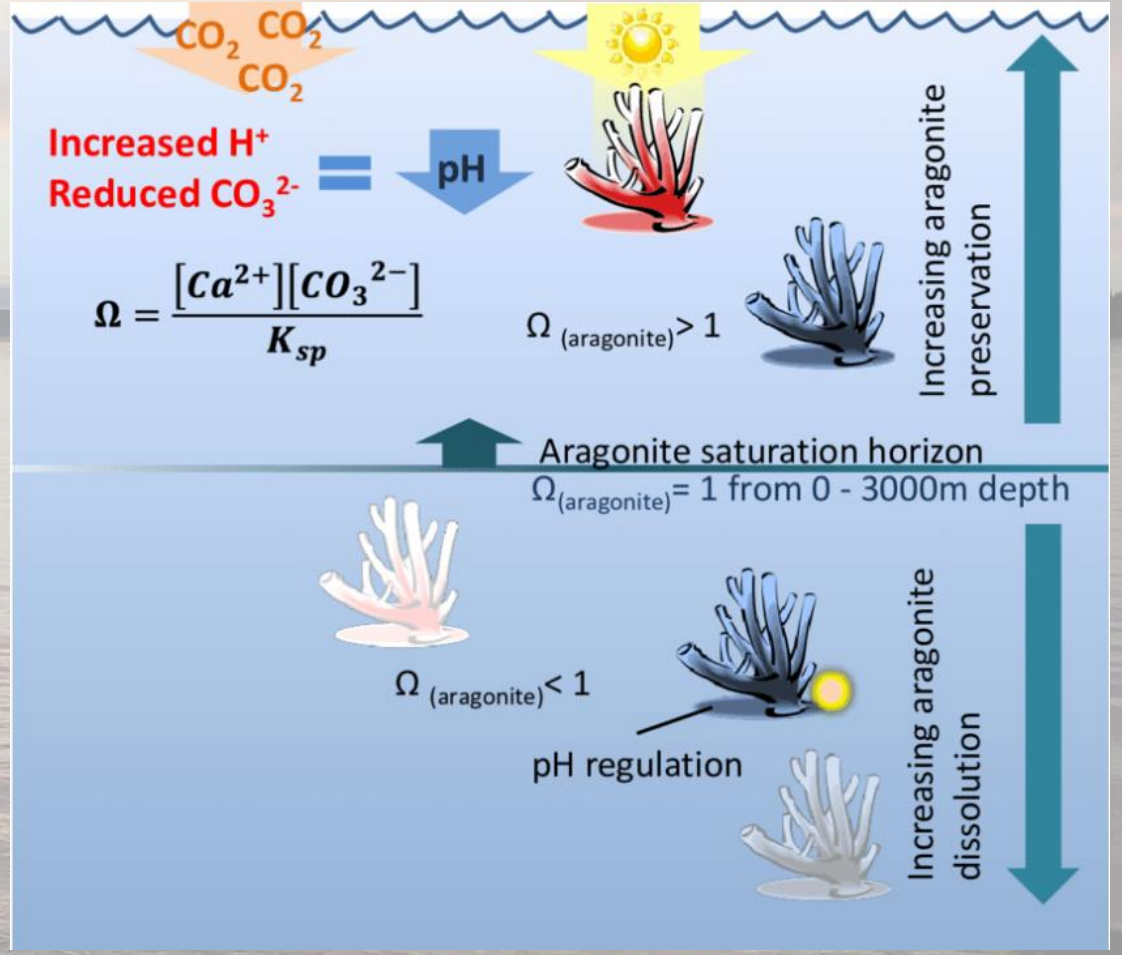
Changes in Alaskan coastal waters

- Increase in atmospheric carbon dioxide since the Industrial Revolution
- Ocean takes up atmospheric carbon dioxide, which lowers ocean pH
- Alaska is one of the fastest changing environments in the world
  - Cold water takes up more CO_2
  - Lowered buffering capacity
  - Less carbonate in system

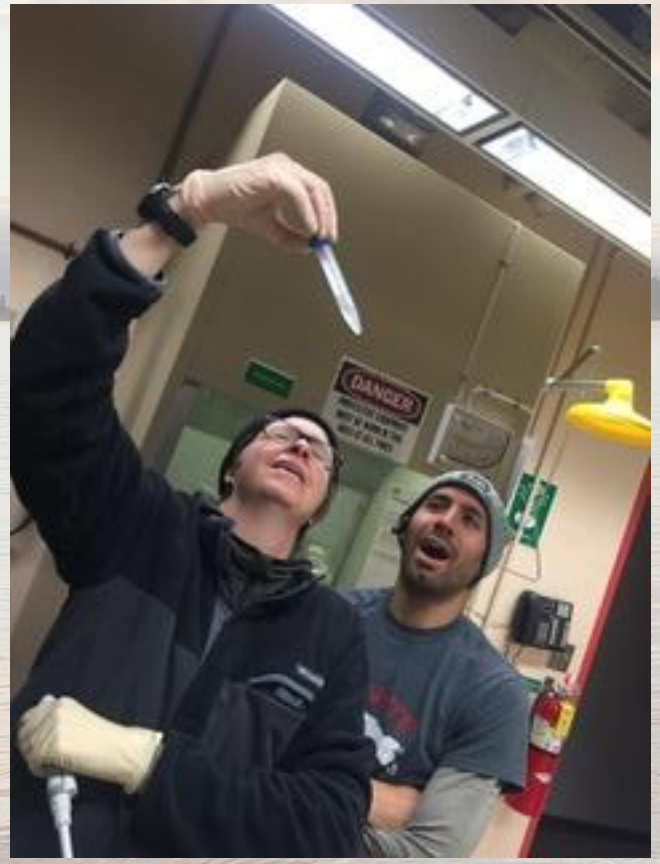


Impacts for calcifying organisms

- Living in under saturated conditions may lead to corrosion
- Increase in energy towards stabilizing internal pH
- Possible shift from growth to dissolution
- Balancing act between physiological, metabolic, and reproductive processes



Purpose



- To understand how two clam species respond to acidified conditions on a cellular- and organismal-level
- To better understand the environmental conditions they currently inhabit
- To identify habitats where clam populations are today, and how those change over time
- To engage with the community to conserve natural resources that are essential to Alaskan culture

Photo: Marina Washburn

Leukoma staminea

- Slow-growing species, 2-5 mm/year
- Max shell length of ~50mm
- Sexual maturity at 2-8 years
- Larvae settle onto cobble, sand, silt, and clay
- Juveniles inhabit 1.5-2 mm of top 2 cm of substrate

***Protothaca staminea* – Steamer or littleneck clam**
The equally-sized concentric and radial lines identify this species from juveniles of *Saxidomus*.

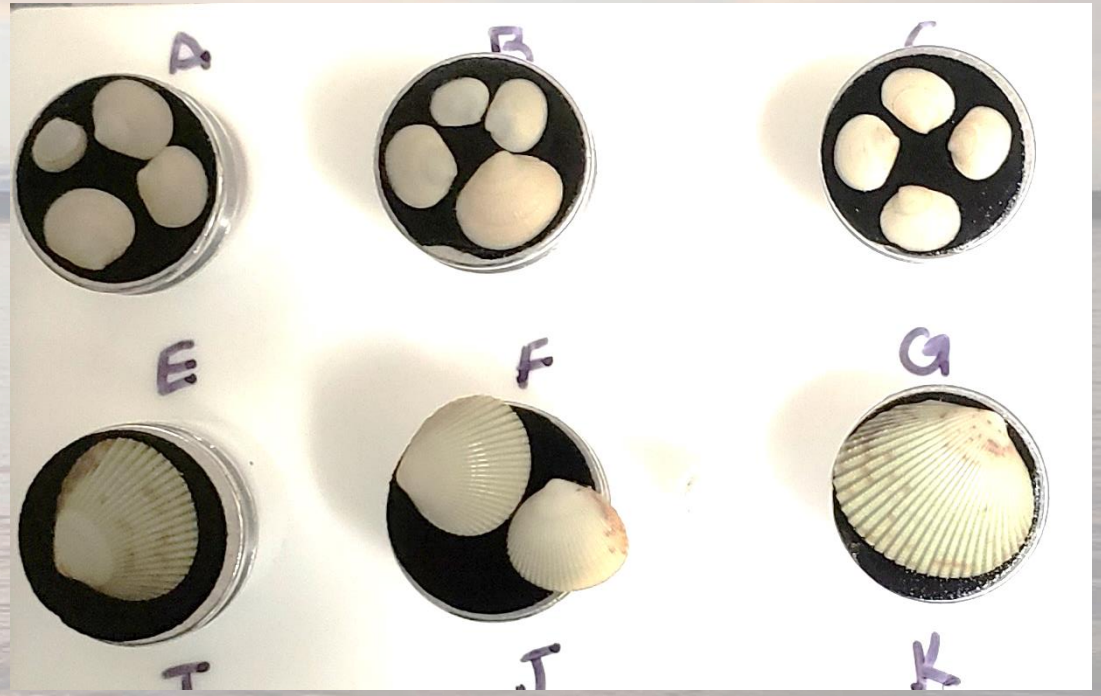
Clinocardium nuttallii

- Relatively fast-growing, ~15 mm/year
- Max shell length ~100 mm
- Sexual maturity at 1-2 years
- Larvae settle in course sand to silt and clay
- Just below sediment surface

***Clinocardium nuttallii* – Heart cockle**
Common low intertidal species, often not buried. Commonly exceeds 10 cm in length. Displays escape response to sea stars.

Our study species

- Occupy same niche
- Employ different life history strategies



Experimental procedure

- Clams were collected from Kasistsna Bay, AK
- Conducted at Alutiiq Pride Shellfish hatchery in Seward, AK
- 60 male-female pairs spawned on May 30, 2016.

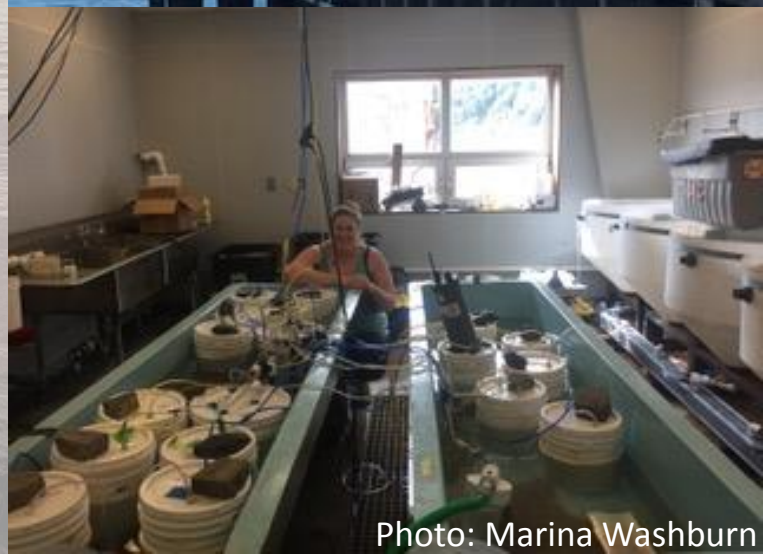
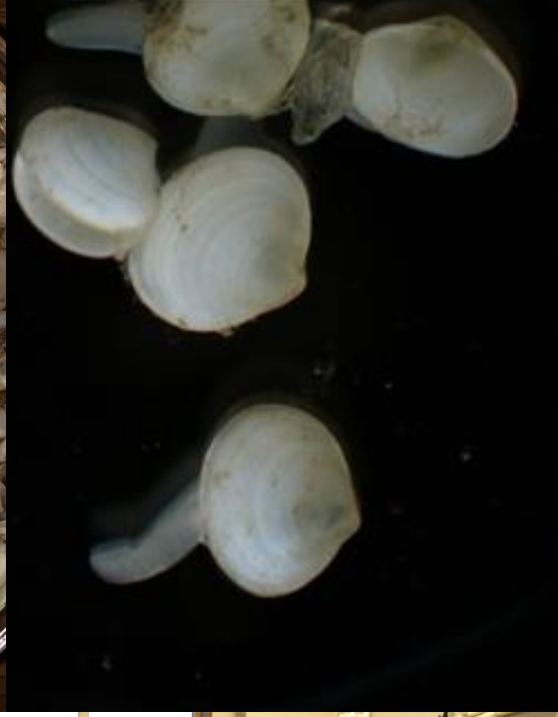


Photo: Marina Washburn

Experiment

- February 24, 2017 – March 22, 2017
- 24-day long experiment with two treatments
  - pH of 7.99 pH units (Ambient)
  - pH of 7.67 pH units (Acidified)
- Collected at 8 time points
  - Fast and slow response



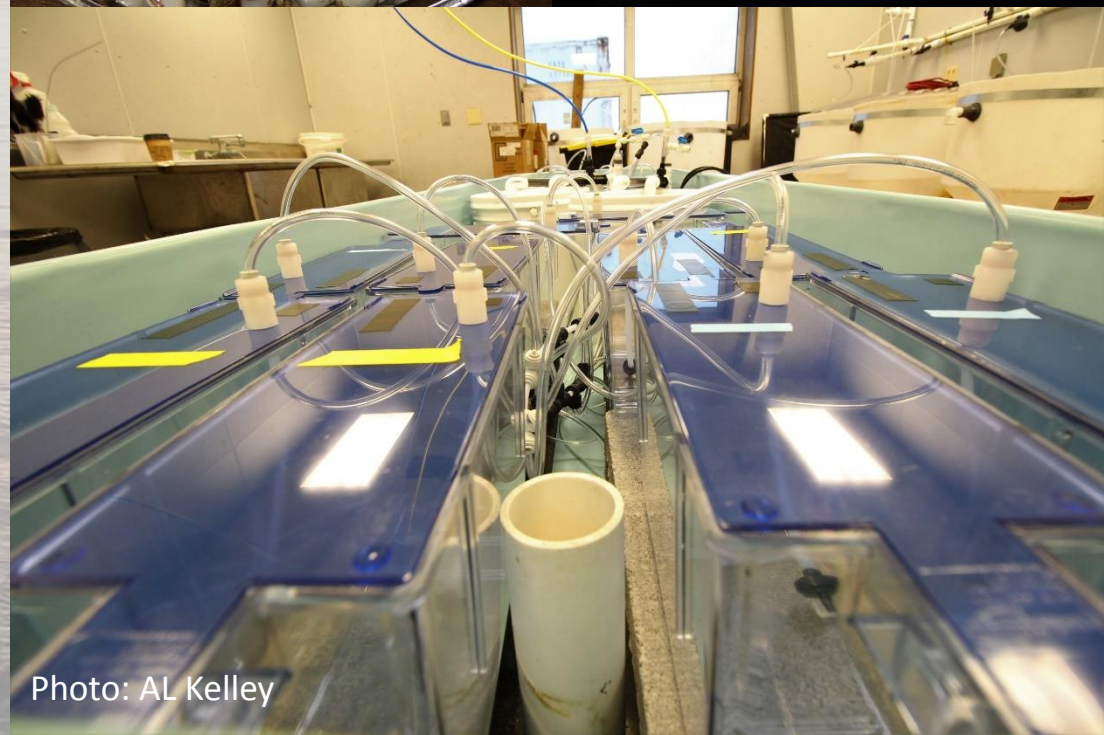


Photo: AL Kelley

Variables

- Ocean acidification can impact :
  - Calcification
  - Metabolism
  - Reproduction
  - Internal pH regulation
  - Homeostasis
  - Survival
  - Growth
  - Abundance
  - Feeding strategies
  - Shell composition
  - Energy reserves

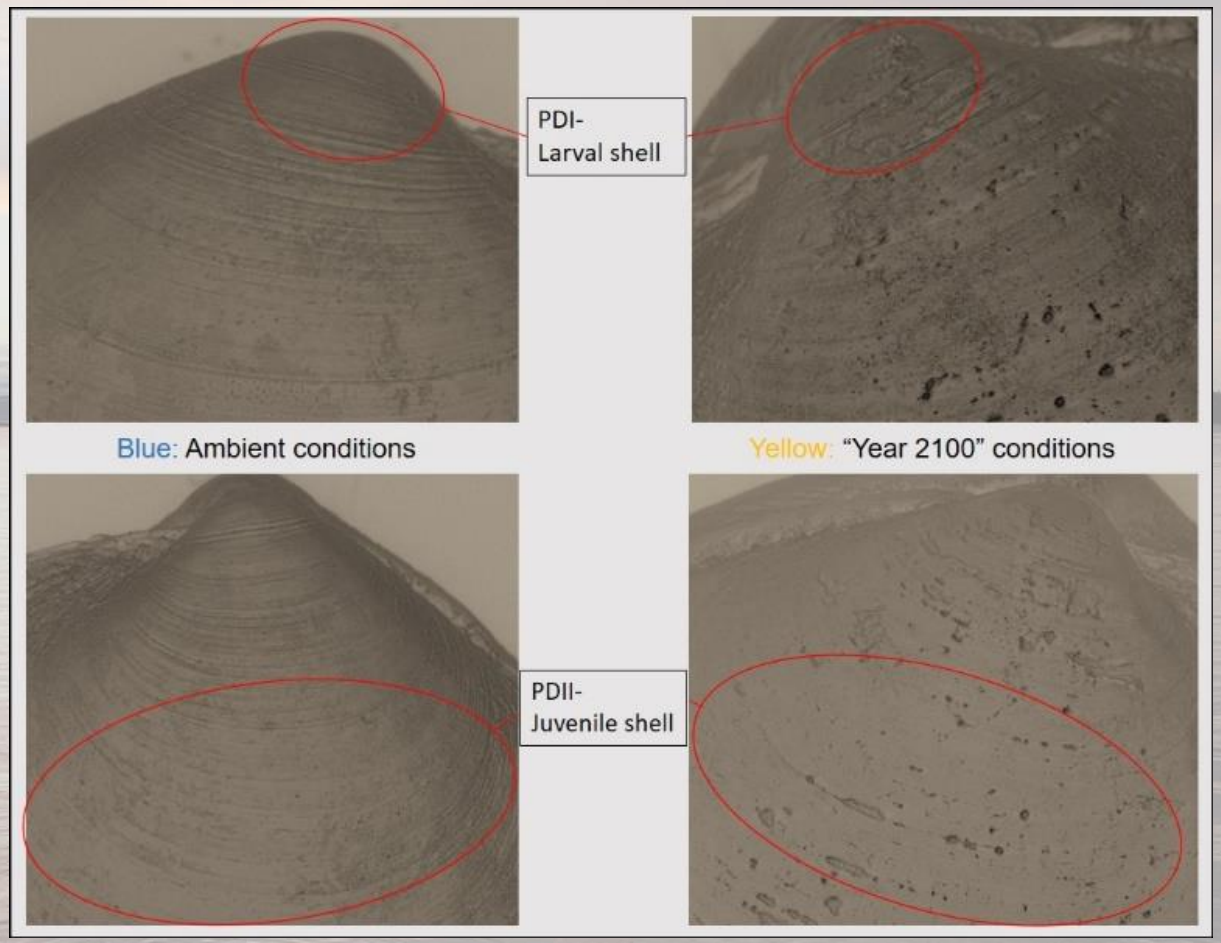
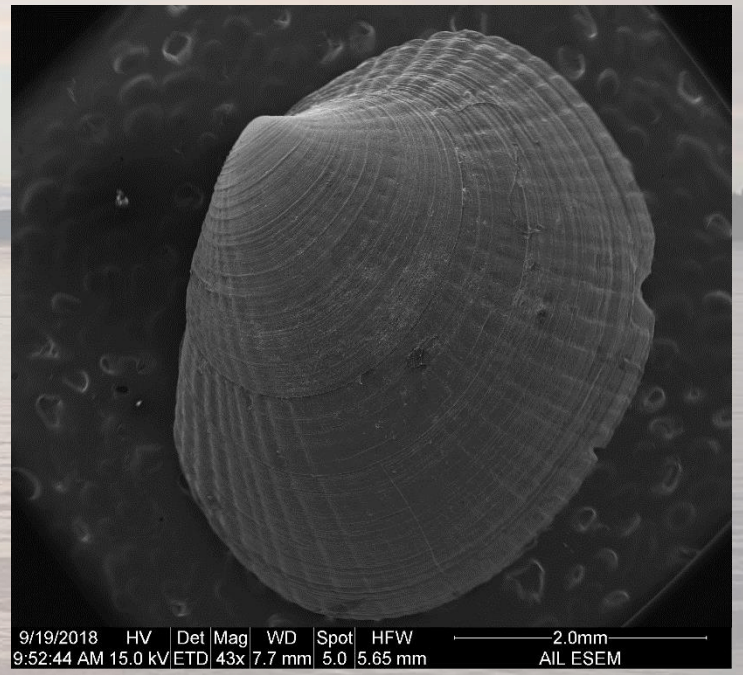


Photo: AL Kelley

My research

- Investigating the stress responses, maintenance of homeostasis, energy reserves, programmed cell death
  - qPCR
- Investigating shell dissolution, and shell composition, to be compared with ability of a shell to withstand “predation”
- Comparing between time points, treatments, and species
- Understand their response and resilience to the environmental changes



Environmental research

- Clams live within the first few cm of sediment
- The water in these sediments are generally more acidic than surrounding water
- Collecting pore-water samples from 3 different beaches to better understand the conditions the clams inhabit
  - Dissolved Inorganic Carbon, alkalinity, pH

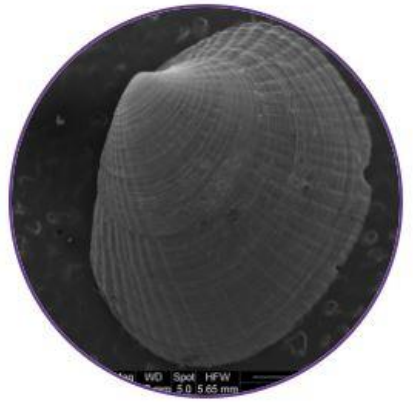
Where does that leave us?

- 2017 experiment
  - Cellular-level response to stress
  - External response (shells)
    - Insights to predation
- Pore-water sampling for carbonate conditions
  - Insight to habitat conditions
- Connecting to the local community

Photo: Marina Washburn

Citizen science

- Utilize local observations to help us better understand clam population dynamics across Alaska
- Combining technology with local knowledge and experiences



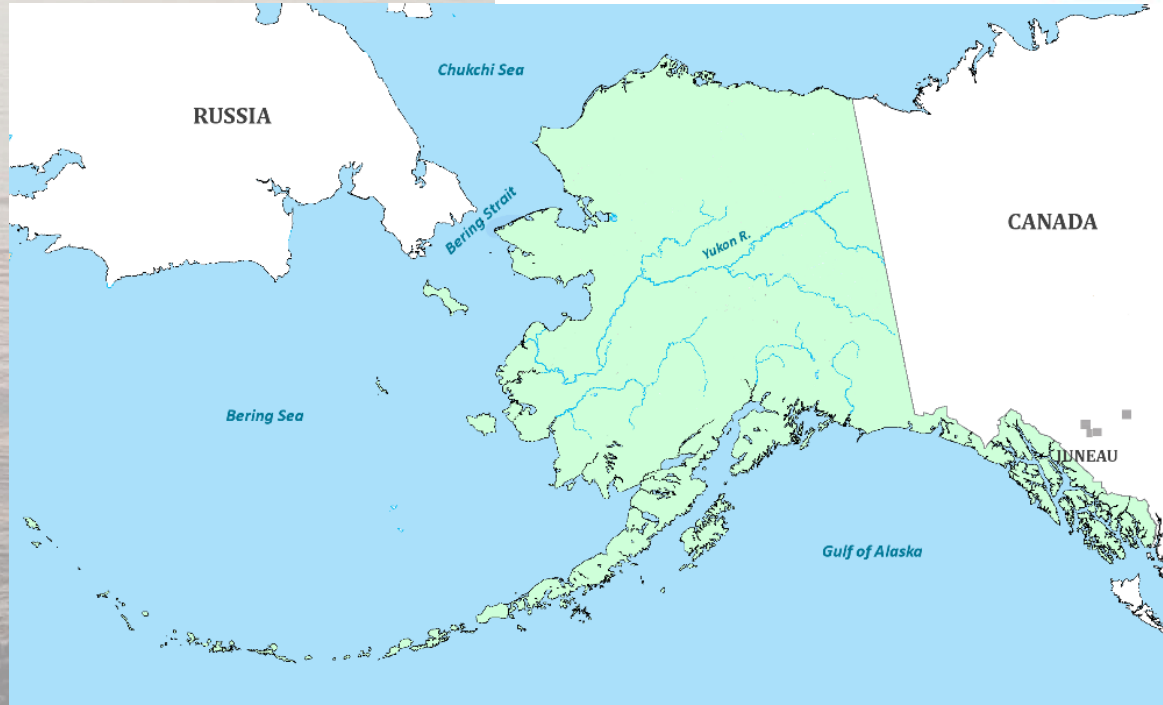
CLAM SURVEY

Observations of clams throughout the state of Alaska t...

Created: **15 Sep 2018**

Entries: **0**

VIEW



Using the apps

- Using both LEONetwork and Epicollect5
- Available to anyone!
- Easy to use, works in both online and offline mode
- Can go back later and add more

Photo: Marina Washburn

How to be a part of the project

- What day did you make the observations?
- What time was it?
- Where did you observe the clams?
- Any photos of the clams you saw!
- What type of substrate?
- What species did you find?
- How many of each species did you find?
- How does this clamming season compare to previous...
- How often per clamming season do you go clamming ...
- How long have you or your family been coming here...
- Do you clam for recreation or subsistence?

- Acila castrensis (Tent nut shell)
- Angulus carpenteri (Carpenter's tellin)
- Angulus modesta (Plain tellin)
- Angulus nuculoides (Salmon tellin)
- Antalis pretiosum (Indian tuskshell)

Clam survey

- Results from across the state
- Current habitats, species composition, size and age if photos collected
- Both local ecological knowledge, and tourist engagement
- Connect the organism level to the community

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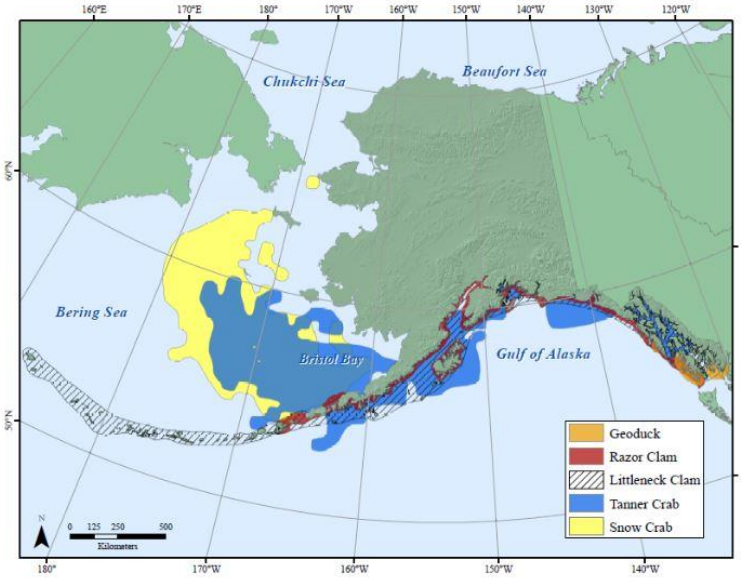

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NOAA

Questions?

- https://five.epicollect.net/project/clam-survey
- Contact with additional questions! arossin@alaska.edu