

2023/2024 Joint Innovation Project

*Hatchery Cultivation of the Pacific Razor Clam (*Siliqua patula*)*

Lead Entity: Alutiiq Pride Marine Institute

Category: Shellfish Enhancement

Project Location: Kenai Peninsula. Seward

Project Start Date: June 2023 Postponed June 2024

Project End Date: May 2025

Award Amount: \$83,300

Project Team & Partners: Alutiiq Pride Marine Institute

PROJECT OVERVIEW

Please provide an **updated** description of your project here using the following guidelines. We understand that projects evolve to optimize impact and that there may be changes to your original proposal.

a. Problem Statement

The Pacific razor clam (*Siliqua patula*) in Alaska was once a highly valuable commercial fishery in Prince William Sound, as well as a recreational and subsistence food resource in Lower Cook Inlet. In recent years, razor clam stocks in both these regions have faced declining natural populations due to environmental changes and climate variability. This project, ***Hatchery Cultivation of the Pacific Razor Clam (*Siliqua patula*)***, focused on identifying best practices for hatchery protocols that would enable the cultivation of juvenile razor clams, eventually providing opportunities to evaluate the feasibility of restocking beaches for restoration or harvest opportunities.

b. Background/Context

Razor clam populations in Cook Inlet, Alaska, have been experiencing significant declines in recent years—of the last 10 years, nine have seen razor clam closures in the region due to low population numbers.¹ Last year, in 2024, only 84,000 adult razor clams were counted, which amounted to the lowest number of adult razor clams noted since official counts began taking place in the late 1980s.² These declines are of concern to both the local ecosystem and the

¹ Klecka, J. (2024, June 1). *State closes razor clam fisheries again for 2024*. <https://www.alaskasnewssource.com/https://www.alaskasnewssource.com/2024/06/01/state-closes-razor-clam-fisheries-again-2024/>

² Ibid.

communities that rely on razor clams for traditional subsistence harvest as well as commercial and recreational fishing. The Alaska Department of Fish and Game has noted that “the biological processes that sustain clam populations in East Cook Inlet are poorly understood.”³ Ongoing research and monitoring programs are being conducted to better understand the environmental factors affecting razor clam populations in Cook Inlet. These include studies of ocean acidification, water temperature, habitat quality, and the effects of human activities on clam populations. The aim of this project to develop hatchery protocols for successful cultivation of the Pacific razor clam could provide additional enhancement opportunities for this important species through restocking efforts. An ancillary benefit of this project was to provide insight into the reproductive life cycle of this species to help regulatory and management agencies better understand the factors influencing natural stocks on beaches in Southcentral Alaska.

c. Proposed Solution

Developing hatchery techniques to provide juvenile seed for stocking beaches may be a tool that could contribute to recovery of isolated beaches, create a population that could recruit to the location, and provide harvest opportunity. Observing species behavior in a controlled situation allows for insight into the life history of the species. Similarly, being able to observe behavior in situ for growth, mortality and migration have valuable management and enhancement implications. Once significant production of juvenile clams is reached, out planting experiments can be conducted to determine the growth and survival of hatchery-raised clams, and economic feasibility of such enhancement projects.

d. Project Objectives, Tasks and Measures of Success

The focus of this project was to build off efforts for culturing razor clams that APMI performed in 2005, 2006 and 2023. APMI has a long history of producing indigenous shellfish and has successfully developed protocols and systems for most indigenous shellfish species.

Basic culture techniques include locating, collecting, and transporting adult razor clams to APMI for production. Once received the clams need to be disinfected, acclimated, and induced to spawn. The gametes must be viable to complete successful fertilization and competent to reach the D veliger stage, the first shelled larval stage of bivalves. Subsequent successful larval rearing, settling of the larvae and metamorphosis to juvenile clams are all necessary steps in the hatchery process.

Once settled, the clams need to be placed into a system conducive to growth, monitored and maintained. Success at each stage is measured by survival and growth. There are no benchmarks for razor clam production, but APMI internally uses 60%+ for fertilization to “D veliger’s”, 30%+ for larval rearing, 50% settlement to 1mm and 1-10% loss per month for long-term rearing.

For this production cycle of razor clams we had 2.6 million released “green eggs” which resulted in 1.5 million (57%) “trochophores” (Day 1-3), 280,000 (18%) “D” hinge (Day 3) larvae, and 20,000 “setters” (Day 20). The “post-set” razor clams are transferred to an airlift system for long-term rearing (7%). During the post-set stage, a major flood event occurred in

³ Kerkvliet, C., Booz, M., Blackmon, T., & Hansen, P. (2018b, May 1). *Digging into Common Razor Clam Questions*. Alaska Fish and Wildlife News. https://www.adfg.alaska.gov/index.cfm?adfg=wildlifeneews.view_article&articles_id=865#:~:text=Since%20the%20mid%2D2000s%20we,throughout%20East%20Cook%20Inlet%20beaches.

Seward causing a water quality issue with siltation and lower salinity which significantly and negatively affected survival rates. We estimated the survival to be 7% after this vent..

e. Project Outcomes: Share overall outcome(s) as well as brief outcome summaries relevant to project objective(s). *Data collected, tables, pictures, and further descriptions will be shared below.*

The project was successful with all of its tasks. There was a major effort invested into collecting broodstock and fortunately they spawned within several days of receipt at APMI.

The induction of spawning, larval rearing, larvae settlement, and rearing protocols were successful with the resultant growth far greater than expected. APMI is continuing to culture the juveniles and preparing to evaluate the efficacy of calcein marking in the hopes of eventually outplanting hatchery-raised stocks.⁴

f. Successes, Challenges, Lessons learned: Include changes you would have made to the project or proposal.

The greatest challenge this project faced was the collection of broodstock. The scarcity of natural populations near Cordova was costly and time consuming, despite the fact that annual harvests from that region hovered around 1.7 million pounds for much of the first half of the 20th century.⁵ Adult razor clams do not transport or hold well, so developing a long-term project will require improving survival rates of broodstock and/or developing strip spawning techniques, which obviate the need to keep collected broodstock alive in the hatchery until natural-induced spawning occurs.

The only suggested changes to the project would include an outplanting component with hatchery-raised clams. This would allow staff the opportunity to evaluate survival rates of hatchery-raised clams on beaches by conducting abundance surveys to compare with historical data. An outplanting component of this project could provide some assurance as to the health and vitality of hatchery-raised clams compared to wild clams, and, if proven successful, could provide regulatory and management agencies with a path to enhancing natural populations of

⁴ From 2023-2024, APMI conducted an experiment marking cockles and butter clams with calcein, a non-toxic fluorescent dye, while rearing shellfish stocks in the hatchery. That project demonstrated that hatchery-raised shellfish species could be marked prior to outplanting on beaches, which could provide research and regulatory agencies with a mechanism to determine the efficacy of shellfish enhancement programs. This project will build off the successes of this calcein marking technique to outplant razor clams and, in partnership with Fish and Game, monitor the number of hatchery-raised clams present on beaches during typical Fish and Game clam surveys. This will provide APMI and state regulatory agencies with empirical data to measure the efficiency of clam enhancement strategies.

⁵ Bishop, Mary Anne, and Sean Powers. "Restoration of Razor Clam (*Siliqua Patula*) Populations in Southeastern Prince William Sound Alaska." Conservation & enhancement of razor clams on the Copper River Delta, March 2003. https://www.adfg.alaska.gov/static/fishing/PDFs/aquaticfarming/razor_clam_pws.pdf.

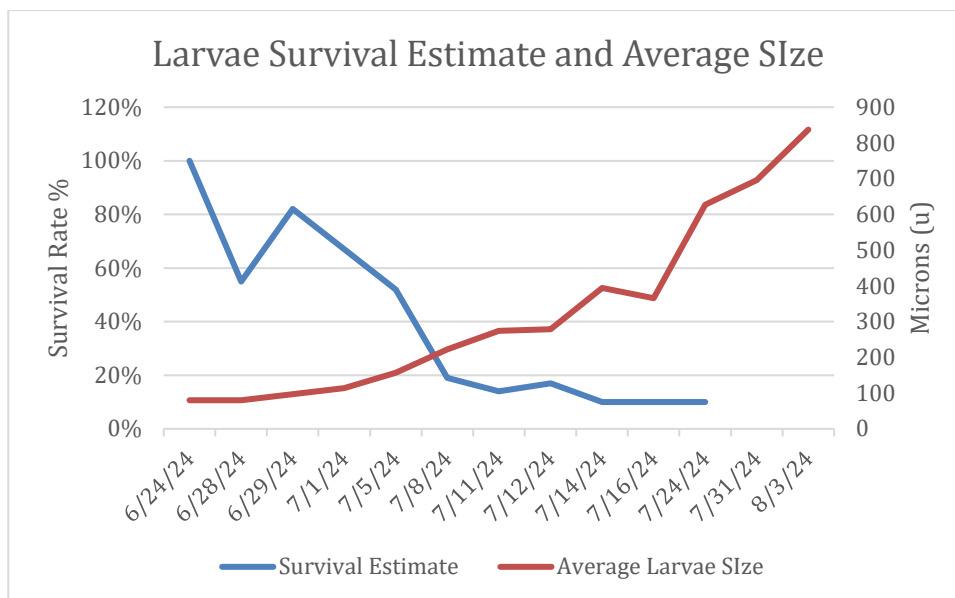
wild clams and reversing trends of declining populations on beaches in Southcentral Alaska.

g. Continuation + Dissemination of Results (If applicable)

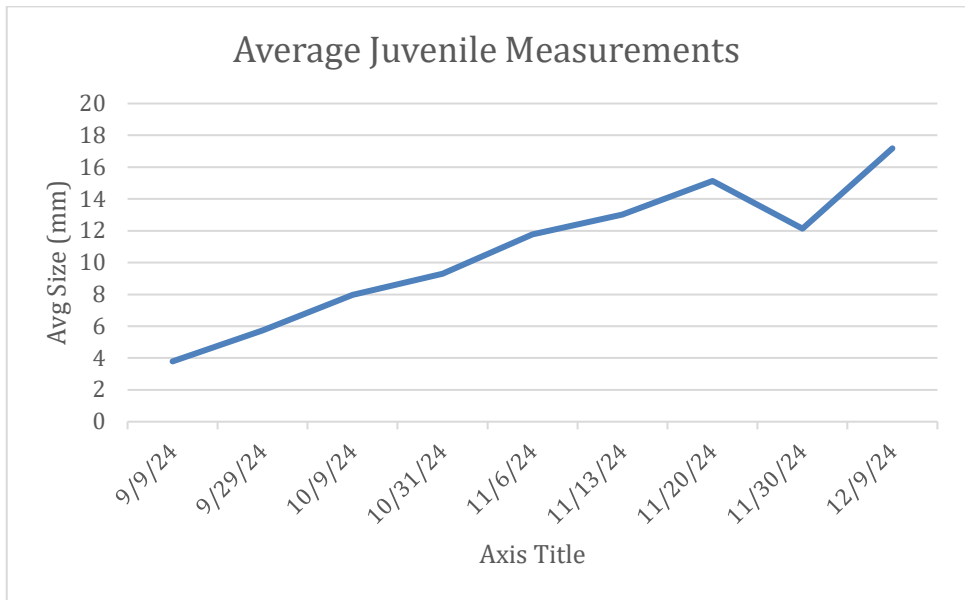
APMI/CRRC has applied for funding under the Alaska Mariculture Cluster’s Other Mariculture Species RFP to continue developing hatchery techniques for the Pacific razor clam. Objectives under this project, *Development of Sustainable Hatchery Rearing Protocols for Pacific Razor Clams (Siliqua patula) in Alaska*, include testing the ability to strip spawn broodstock with Marina Washborn, who worked at APMI to complete her PhD thesis on hatchery cultivation protocols for razor clams, and the first photographic documentation of larval development of hatchery-raised razor clams, which noted the timing of significant transitions during embryogenesis and early larval development.⁶ This project also included a partnership with ADFG’s Homer-area Management office to conduct an out-stocking project on the east side of Cook Inlet. The most promising result of APMI’s success with the project is the partnership created with the ADFG staff in Homer. Their insight into razor clam biology, willingness to help with broodstock collection and partner on this Other Mariculture Species application opens an opportunity to apply APMI’s resources towards a highly visible need. APMI intends to nurture the partnership with ADFG long term with a goal of building up razor clam stocks on beaches in Southcentral Alaska to revitalize this important recreational and subsistence fishery.

DATA & PROJECT OUTCOMES

The finalized data will be presented at the completion of the project but the attached is not likely to change. See Feeding Data below.



⁶ Alcantar, Marina & Hetrick, Jeff & Ramsay, Jacqueline & Kelley, Amanda. (2024). Embryonic and Early Larval Development of the Pacific Razor Clam (*Siliqua patula*). *The Biological Bulletin*. 245. 000-000. 10.1086/730784.



Describe the outcome(s) of the project, including a data analysis and/or description of results of the proposed solution to the stated problem to be solved.

All of the objectives of the project have been met. APMI added calcein marking to the program in the hopes of assessing the survival rates of outplanted, hatchery-raised clams, and has added ADFG as a partner to apply this technique and use their annual abundance surveys conducted on beaches in Cook Inlet as a benchmark for assessing the efficacy of outplanting efforts. APMI has been able to leverage this project’s funding to secure additional investment from the Alaska Mariculture Cluster to continue and expand on this project’s objectives and practical implications.

ADDITIONAL INFORMATION

Project Timeline: Did you complete the proposed scope of work in the intended time frame? Provide actual timeline with descriptions/reason for any changes from proposed.

The start date of the project was pushed back a year because funding was not received in time for the 2023 season. An effort was made, unsuccessfully to strip spawn razor clams in 2023. A request was made and granted to push the project back to 2024-2025 and will be completed January 2026.



BUDGET

The project has expended or obligated the budgeted amount. An invoice needs to be submitted for facility usage and travel will be utilized for the conference in Sitka. All funds should be expended by February 28, 2025.

**Statement of Activity MTD and ITD by Fund
Chugach Regional Resources Commission
For 1/05/2025**

602.3 AFDF Razor Clam

	M-T-D Actual	Y-T-D Gr Budget	I-T-D Actual	Variance
Revenues				
Non Government Grants	0.00	83,300.00	0.00	83,300.00
Total Revenues	<u>0.00</u>	<u>83,300.00</u>	<u>0.00</u>	<u>83,300.00</u>
Expenses				
Personnel	0.00	51,000.00	50,464.61	535.39
Travel	0.00	2,500.00	1,116.04	1,383.96
Supplies	0.00	850.00	1,528.94	(678.94)
Other	0.00	28,950.00	9,840.50	19,109.50
Total Expenses	<u>0.00</u>	<u>83,300.00</u>	<u>62,950.09</u>	<u>20,349.91</u>
Excess Revenue Over (Under) Expenditures	<u>0.00</u>	<u>0.00</u>	<u>(62,950.09)</u>	<u>62,950.09</u>

Expenditures to date through January 5.

PHOTOS

Please upload 2-10 photos of the project here, (as well as separate attachments).



“Bud’s Bar” Historic razor clam beach near Cordova



Razor clam harvesting crew



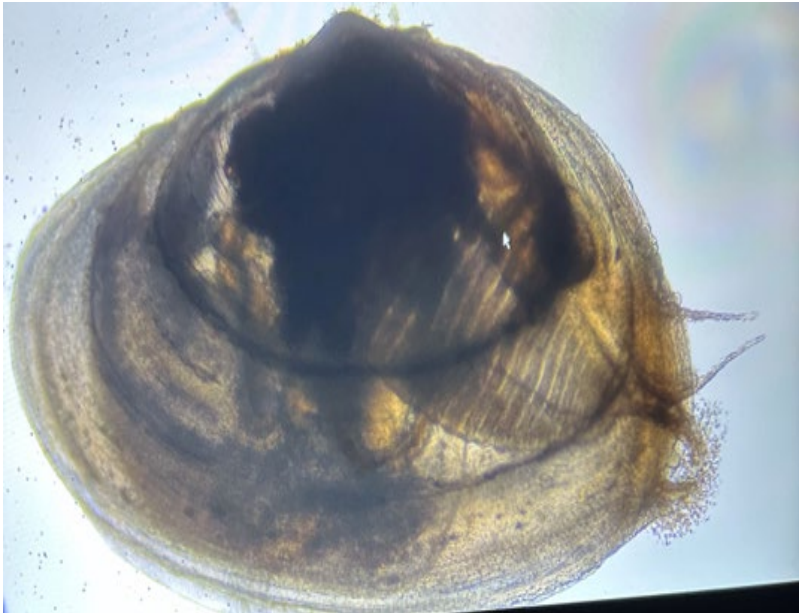
Razor Clam brood in spawning tank



Draining clam spawn (Note “milky” water)



D Hinged Larvae 200 um



Day 60 post settlement, 2mm



Culture system (Note feed and water delivery pipes)



Applying calcein mark



Razor clams seeking additional habitat.



Razor Clams January 2, 2025

Razor Clam Feeding Post set 2024

Dunaliella tertioleata

D.t.

Chaetocerus muelleri

C.m.

Tahitian isochrysis

T. iso.

		Tank	Water	Feed	Comments		Initials
	Day	Number	Temp C				
16-Jul	1	DW 9	15	Hand fed, <i>t. iso</i>	360 microns, 275,000 set		JW/JH
17-Jul	2	DW 9	16	.25 million/ml	Pump D.t. 5 min, 12 hrs., 10 liter and 5-liter T.Iso		JW
18-Jul	3	DW 9	16.6	<i>D.t., C.m.</i>	Set up pump feed line		JW
19-Jul	4	DW 9	17	<i>T. iso, D.t.</i>	a.m. and p.m. feeding		JW
20-Jul	5	DW 9	16.4	<i>T. iso, D.t.</i>	Feeding densities higher during the day		JW
21-Jul	6	DW 9	16.2	<i>T. iso, D.t.</i>	C.m. at night 5 minutes every 2 hrs.		JW
22-Jul	7	DW 9	15.9	<i>Paste</i>	10 minutes! 1 liter a minute		JH
23-Jul	8	DW 9	15.8	<i>C.m.</i>	.6 million cells/ml		JH
24-Jul	9	DW 9	14.7	<i>T. iso</i>	630 microns in length, a.m. pm. Pump 5 min./2 hrs.		JW
25-Jul	10	DW 9	14.6	<i>Paste</i>	Estimated 2 million cells per ml		JW
26-Jul	11	DW 9	14.6	<i>D.t., C.m.</i>	New feed timer 24/7, pump every 15 minutes, 1 lpm		JW
27-Jul	12	DW 9	14.6	<i>C.m.</i>	15 min./every 2 hrs.		JW
28-Jul	13	DW 9	15	<i>C.m.</i>	.9 million/cells/ml C.m.		JW
29-Jul	14	DW 9	15.8	<i>Paste</i>	Estimated 2 million cells per ml		JW
30-Jul	15	DW 9	16.4	<i>T. iso</i>	1.1 million/cells/ml		JW
31-Jul	16	DW 9	15	<i>T.iso., D.t.</i>	.7 million cells/ml T. iso, .5 m/c/ml D.t.		JH
1-Aug	17	DW 9	14.8	<i>Tiso, Dt</i>	Start of 10,000 liter AT Tank use		JH
2-Aug	18	DW 9	14.5	<i>C.m., D.t., T. iso.</i>	1.2 million/cells/ml		JW
3-Aug	19	DW 9	14.5	<i>C.m., D.t., T. iso.</i>	.85 million cells/ml T. iso		JW
4-Aug	20	DW 9	14.3	<i>T. iso</i>	.85 million/cells/ml T. iso		JH
5-Aug	21	DW 9	14.2	<i>T. iso</i>	1.2 million/cells/ml T. iso		JH
6-Aug	22	DW 9	14.1	<i>T. iso</i>	1.2 million/cells/ml D.t.		JW
7-Aug	23	DW 9	13.6	<i>D.t.</i>	.6 million/cells/ml D.t. Start of storm		JW
8-Aug	24	DW 9	13.8	<i>Paste + T.iso</i>	1.2 million/cells/ml Paste + T.iso Storm		JW
9-Aug	25	DW 9	13.6	<i>C.m., T. iso</i>	.5 million/cells/ml C.m., T. iso		JW
10-Aug	26	DW 9	15	<i>T.iso., D.t.</i>	.4 million/cells/ml T.iso., D.t.		JW
11-Aug	27	DW 9	15	<i>C.m.</i>	.6 million/cells/ml C.m.		JW
12-Aug	28	DW 9	15.7	<i>No feed</i>			JW
13-Aug	29	DW 9	16	<i>No feed</i>	Clean and purge system, Mortality		JW
14-Aug	30	DW 9	16	<i>D.t.</i>	.65 million/cells/ml D.t.		JW
15-Aug	31	DW 9	16	<i>T. iso</i>	.67 million/cells/ml T. iso		JH
16-Aug	32	DW 9	16.1	<i>T. iso</i>	.8 million/cells/ml T. iso		JW
17-Aug	33	DW 9	15.4	<i>T. iso</i>	1.3 million/cells/ml T. iso		JW
18-Aug	34	DW 9	15.4	<i>T. iso</i>	First sorting-Lots of dead shells 1 mm+		JW
19-Aug	35	DW 9	15.6	<i>T. iso</i>	1.3 million/cells/ml T. iso		JH
20-Aug	36	DW 5	15.7	<i>D.t., C.m</i>	Sifted 2 silos only, saw 2.5 alive, combined into 1 silo		JW
21-Aug	37	DW 5	16	<i>D.t.</i>	1.3 million/cells/ml D.t.		JW
22-Aug	38	DW 5	16.6	<i>D.t.</i>	1mm to 1.7 mm		JW
23-Aug	39	DW 5	15.2	<i>C.m.</i>	1.3 million/cells/ml C.m.		JW
24-Aug	40	DW 5	11		Boiler down, temporary drop		JW
25-Aug	41	DW 5	9.9	<i>ad libitum</i>			JW
26-Aug	42	DW 5	NA	<i>ad libitum</i>			JW
27-Aug	43	DW 5	11	<i>ad libitum</i>			JW
28-Aug	44	DW 5	12.2	<i>ad libitum</i>			JW
29-Aug	45	DW 5	15.2	<i>ad libitum</i>			JW
30-Aug	46	DW 5	15.2	<i>ad libitum</i>			JW
31-Aug	47	DW 5	15.2	<i>ad libitum</i>			JW
Sept 1-30	48-78	DW 5	15	<i>ad libitum</i>	Long-term holding		JW/JH
Oct. 1-31	79-100	DW 5	14	<i>ad libitum</i>	Long-term holding		JW/JH