Progress Report, May 30, 2026

Title: Advancing Pinto Abalone Farming in Alaska: Developing Protocols for an Efficient Transition from Laboratory Nurseries to Ocean-Farmed Growth Systems.

PI: Dr. Alexei Pinchuk, College of Fisheries and Ocean Sciences, University of Alaska.

The project focuses on efficiency of pinto abalone spat transfer from laboratory-based nursery to ocean-based rearing arrays depending on animal's age/size and cage system used. Our overarching goal is to provide prospective abalone farmers with clear protocols for setting up and maintaining pinto abalone spat rearing systems to help plan and manage their mariculture efforts.

The work is being conducted at three different location: UAF Fisheries Department (wet lab) in Juneau, Sea Quester Farms site in Lynn Canal near Juneau, and Metlakatla Indian Community at Annette Island near Ketchikan (Fig. 1).

The following work has been done **from the start of the project through April 7, 2025** towards achieving the ultimate project goals:

- We obtained all necessary supplies and Alaska State permissions to start outgrowing efforts in Lynn Canal in collaboration with Sea Quester Farms. The latter include Aquatic Resource Permit (for scientific/collection/holding purposes) and Over-The-Counter Storage Permit. We decided to work with Sea Quester Farms instead of the originally proposed Shikat Oysters Farm because of two reasons: (1) logistics is a lot easier because of close vicinity of the Lynn Canal site to the UAF wet lab; and (2) the deployment in Lynn Canal will test the possibility of pinto abalone farming within the Inside Passage where many farms are located. It will also help to investigate why wild pinto abalone tend to avoid inshore environment.
- We expanded our abalone hatching facility in UAF wet lab, to maintain abalone spat hatched in March 2024 and to accommodate new spat produced in the fall 2024. Both cohorts will be transferred to outgrow cages once spring weather sets and marine production season starts in mid-April or early May. The developing spat has recently transformed to mainly kelp-feeding stage which makes them ready for outplanting.

- We designed and built abalone cage prototypes for the outplanting efforts. The materials were obtained from Ketcham Supply, a leading aquatic farming gear manufacturer and distributor located in Main, as well as sourced locally. The prototype contained 2 plastic baskets secured by removable stainless rods inside the protective cage and lined with 1000 µm Nitex mesh. Rectangular plastic inserts were attached to the upper and lower sides of the baskets to provide smooth surface for attachment of the abalone. The assembled cage was equipped with four stainless cables attached to the cage corners on one end and a stainless swivel on the other end (Figure 2). The prototype successfully underwent a month-long initial sea trial (empty, no live abalone) at the Sea Quester Farms site. The cages for the experiments are built and ready.
- We visited Metlakatla Indian Community (MIC) to identify a suitable site near Annette Island. The main site is in the direct view from the MIC office among an extensive kelp forest which will be harvested to feed abalone. During discussions with MIC members, we finalized deployment and maintenance protocols, including handling live abalone. We provided members of the MIC with printed and video materials on abalone culturing.

This work concludes Deliverable 1.

The following work has been done **from April 7, 2025 through October 30, 2025** towards achieving the ultimate project goals:

At UAF CFOS labs in Junea:

- We continued to maintain abalone spat produced in our lab in March and October 2024.
- We delivered 30 individual abalone spat to ADF&G Pathology Lab to establish a disease history prior to transport to the Metlakatla Indian Community for culture purposes. The spat spawned and cultured in our lab was completely healthy with no parasites or infectious agents in their tissues. A copy of the pathology report is attached.

At SeaQuester Farm Site (Lynn Canal):

- Experimental Cage #1 with 20 (10 per basket) juvenile abalone ~10 mm long was deployed on May 2, 2025. After a two-week initial assessment, Experimental Cage # 2 with 20 (10 per basket) juvenile abalone was deployed on May 24. Each cage was equipped with a temperature logger and the initial mix of fresh dulse kelp (cultured in the UAF laboratory) and kelp harvested at the farm site were placed into each basket as ad libitum food source for the abalone spat.
- The site was visited bi-weekly (weather permitting). During each visit, cages and spat were visually checked and food was replaced with fresh kelp from the site.
- On July 8, 2025, a census accompanied with individual length measurement was done on all experimental animals. Intensive coverage of newly settled barnacle was observed on the cages and animals. In over 50% of the abalone, barnacles covered over half of the shell surface area blocking abalone respiration pores, so the animals suffocated (Figure 3). Only 4 individuals did not have any barnacle growth. While all individuals were still alive, they barely moved and could not easily attach themselves to the surface. It was clear the future barnacle growth would not leave them any chances of survival. We decided to terminate the experiment at that point.

At Metlakatla Site (Annette Island):

- Two Experimental Cages with 40 (10 per basket) juvenile abalone ~15 mm long were deployed in a protected cove of Annette Island. The cove has naturally growing bull kelp field which is used to harvest food for the experimental abalone. Similarly to previous deployments, each cage was equipped with a temperature logger and the initial mix of fresh dulse kelp (cultured in the UAF laboratory) to provide initial ad libitum food source for the abalone spat.
- The site was visited bi-weekly (weather permitting). During each visit, cages and spat were visually checked and food was replaced with fresh kelp from the site (Figure 4).
- So far, abalone appears to be in good health and increase in size. Minimal barnacle settlement has been observed on the cages, and no spat was infested.

Preliminary Results and Conclusions: Water temperature at the Seaquester Farms Site in Lynn Canal site continually increased from ~6°C to ~12°C through the duration of the experiment (Figure 5), indicating that most favorable conditions for abalone growth were set by the middle of June. For the period of 45 days starting on May 24, the abalone increased in length by 56% from the initial mean 10.95±0.65(95% CI) mm to the final 17.13±1(95% CI) mm length, which corresponds to 0.137 mm day^{-1} at the average temperature of ~9°C. Larger pinto abalone (40-50 mm of total length) experienced considerably lower increase in length of 8-10% over observation period of 65 days (Paul and Paul, 1981). This indicates that summer conditions for abalone spat growth in Lynn Canal are quite favorable, if damage from barnacle settlement could be avoided.

Our oceanographic observations in Lynn Canal fjords conducted in summer 2019-2021 show that a well-developed peak in barnacle planktonic larvae abundance consistently occurs in late May and continues through late June (Figure 6). This might explain why abalone natural range does not extend into the Inside Passage and lays within coastal North Pacific waters. Despite otherwise favorable conditions, the lethal effect of barnacle settlement on juvenile abalone shells would prevent the establishment of a self-supporting abalone population in inshore waters.

Large concentrations of ready-to-settle larvae directly threaten abalone farming. One way to counter this threat in the future would be to outplant abalone spat later in the season (July) after most of the planktonic barnacle larvae settled and disappeared from the water column. Alternatively, outplanting older animals with larger respiration pores might decrease detrimental effect of the barnacles on abalone growth.

This work concluded Deliverables 2.

The following work has been done at Metlakatla Site (Annette Island)
from October 30, 2025 through May 5, 2026 towards achieving the ultimate project goals:

- We continued the experiment through the winter to determine how spat responds to decreased water temperatures and light levels. Winter is a critical time in northern ecosystems and the data we obtain improve our knowledge on pinto abalone and feasibility of their farming in Alaskan waters.
- The spat was examined at least once a month (and bi-weekly when weather permitted safe work). During each checkup, the spat was removed from the cages, counted, measured and its general state recorded. Then, it was placed back into the holding baskets and fed with fresh kelp collected at the site.
- The PI visited the site on May 4-5 to make final measurements and discuss prospective abalone culturing with MIC representatives (Fig. 8).
- The PI delivered mariculture supplies (holding baskets, custom-designed cages and other materials) to facilitate future mariculture efforts in MIC.
- Information about the project was submitted to Alaska Mariculture Research and Training Center web-site (https://amrtc.org/), as the most appropriate web resource for sharing the results.
- A presentation "***Investigating abalone farming in Southeast Alaska: comparison of spat development and survival from open-ocean growth systems in the Inside Passage and coastal Gulf of Alaska***" by A. Pinchuk, S. Umanzor, M. Montiel, K. Booth, J. Antoni and O. Duner was delivered at Alaska Mariculture Conference held in Anchorage on February 9-13, 2026.

Preliminary Results and Conclusions: The abalone spat outplanted at the Metlakatla Site near Annette Island was observed for 295 days. The water temperature continually decreased from mean 13.5±0.03°C in summer (July through September) to 7.9±0.02°C in winter and spring (October through May) (Figure 9), indicating that most favorable conditions for abalone growth occurred in the summer and early fall. In the summer, the site experienced substantial fluctuations in daily temperatures caused by diurnal insolation cycle. In contrast to the Seaquester Farms site in Lynn Canal, the diurnal thermal amplitude at the Metlakatla site was amplified by the shallower depth and substantial protection from wind mixing.

The spat survival through the duration of the experiment was relatively high averaging 75% and ranging between 100% and 60% among the baskets. However, according to the site manager, most of the mortality was probably due to human operation errors, e.g. occasional crashing of abalone shells during measurements and missing them while inspecting and replacing old kelp thalli with fresh under inclement weather. In any case, all mortality (n=10) occurred from October 11, 2025 through January 3, 2026, during the period preceding the coldest and darkest time of the year, suggesting that winter conditions have little impact on abalone spat survival.

For the period of 295 days starting on July 10, the abalone increased in length by 63% from the initial mean 14.95±0.47(95% CI) mm to the final 24.43±1.53(95% CI) mm length, which corresponds to 0.032 mm day^{-1} at the average temperature of ~9°C. However, the growth pattern was highly seasonal with elevated rate of ~0.056 mm d^{-1} in July-September followed by retardation to ~0.02 mm d^{-1} in October-December. The growth almost completely stopped from January through March and picked up again in April to ~0.04 mm d^{-1} (Figure 10). There was substantial individual variability in abalone growth marked by increasing 95% confidence intervals as the experiment progressed. At the end of observations, 13% of the abalone population were under 20 mm length, 10% were over 30 mm, and 77% fell within 20-30 mm range.

Abalone spat undergo relatively low mortality during winter time and demonstrated intense growth through late summer, fall and spring with little growth during mid-winter. However, the initial growth was substantially slower than that of abalone outplanted in Lynn Canal earlier in the summer. The observed growth retardation might have resulted from the large amplitude (between 14-16°C) of diurnal fluctuations in water temperature at the Metlakatla site during summer. In contrast, the diurnal thermal variation in Lynn Canal was typically within 1-2°C through the observation period. Temperature instabilities were detrimental for small (3-5 mm length) pinto abalone spat dramatically reducing their survival (Stapelton, 2023). While we did not record any mortality during summer, it is possible that growth rates were affected. Another reason might be the difference in diet. Abalone at the Metlakatla site were fed primarily wild bull and giant kelp, while spat in Lynn Canal consumed commercially grown split kelp. Further studies are needed to evaluate nutritional benefits of these kelp species and their effect on pinto abalone growth.

This work concludes Deliverable 3.

References:

Paul AJ, Paul JM. 1981. Temperature and growth of maturing *Haliotis kamtschatkana* Jonas. The Veliger, 23(4): 321-324.

Stapleton J. 2023. Impact of fluctuating temperature and elevated CO_2 on the growth, survival, and metabolic rate of the endangered pinto abalone (*Haliotis kamtschatkana*) in the Salish Sea. WWU Graduate School Collection. 1180. https://cedar.wwu.edu/wwuet/1180

Figure 1. Locations of experimental sites for outplanting experiments.

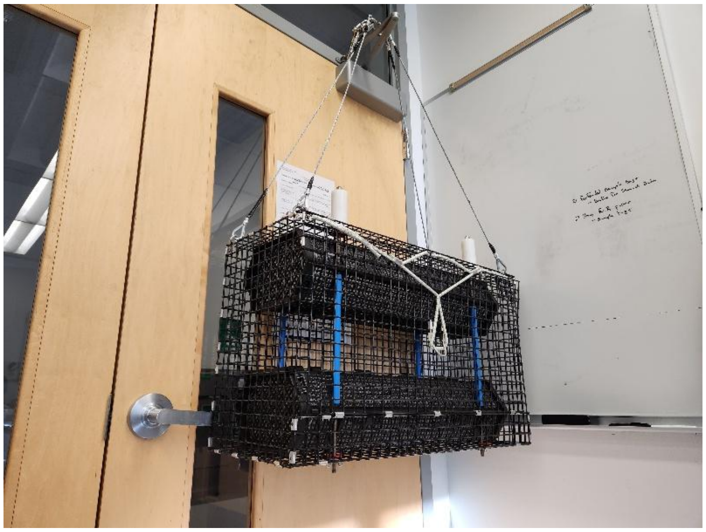

Figure 2. Outplanting abalone cage prototype before deployment.

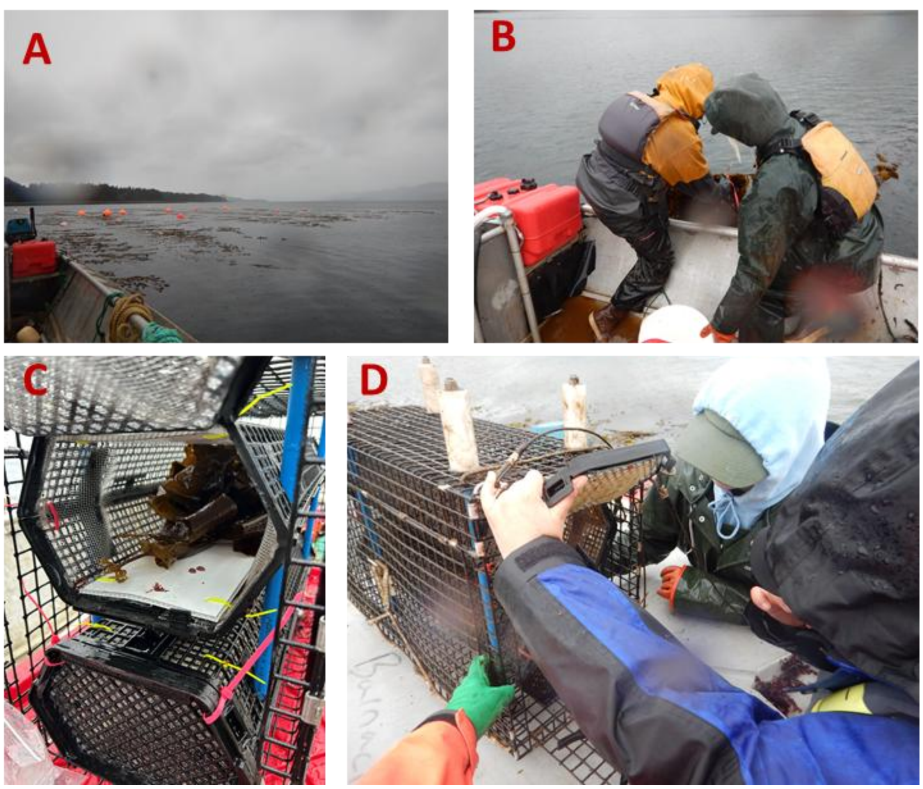

Figure 3. Operations at SeaQuester Farms site (Lynn Canal): A – farm site, B – deployment of the cages, C and D – inspection and feeding of abalone spat.

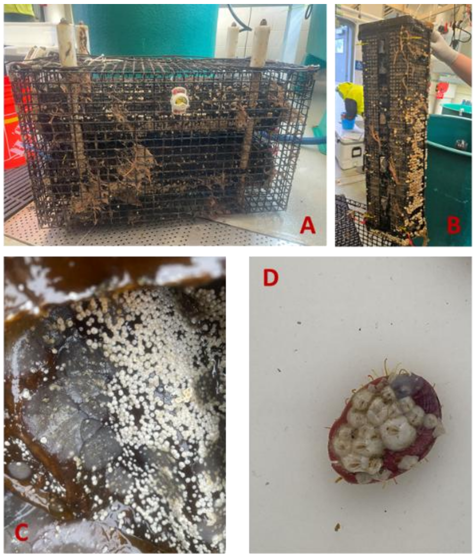

Figure 4. Barnacle colonization of the cages, kelp and abalone spat at SeaQuester Farms site (Lynn Canal): A – Cage #1 after ~65 days exposure, B – individual basket after ~65 days exposure, C – kelp food, D - abalone shell.

Figure 5. Operations at Metlakatla Site (Annette Island): A – choosing healthy kelp to feed abalone spat, B – abalone spat after ~30 days of exposure, C – harvesting wild kelp at the site

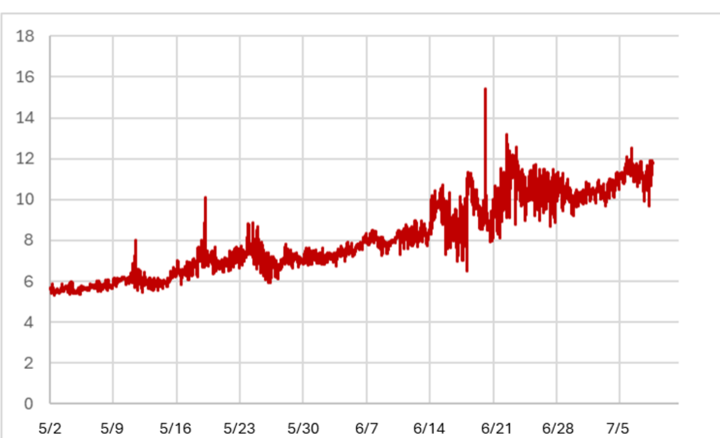

Figure 6. Water temperature (°C) at the Seaquester Farms site.

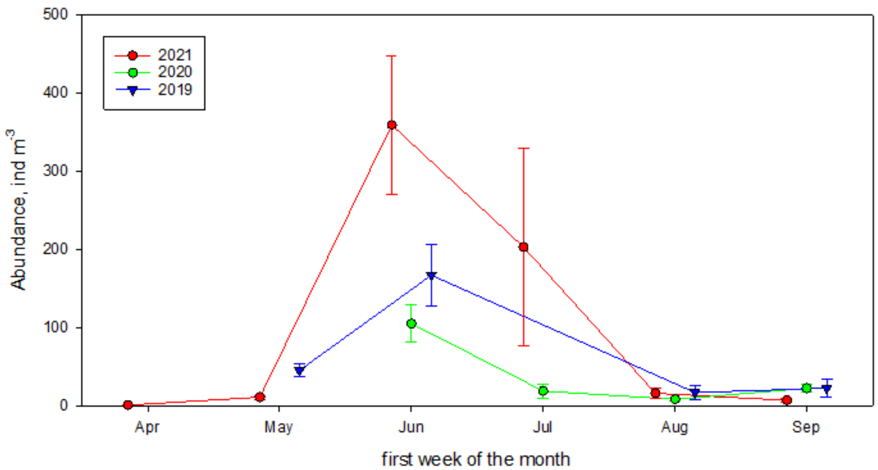

Figure 7. Interannual variability in abundance of barnacle cyprid larvae in Lynn Canal fjords (Auke Bay, Gastineau Channel, Berners Bay combined) in 2019-2021. Data from the EPSCOR Fire and Ice Project provided by A. Pinchuk and A. Knobloch (UAF).

Figure 8. Operations at the Metlakatla site on May 5, 2026. A – site location; B and C – inspecting baskets in the cages; D – experimental abalone spat.

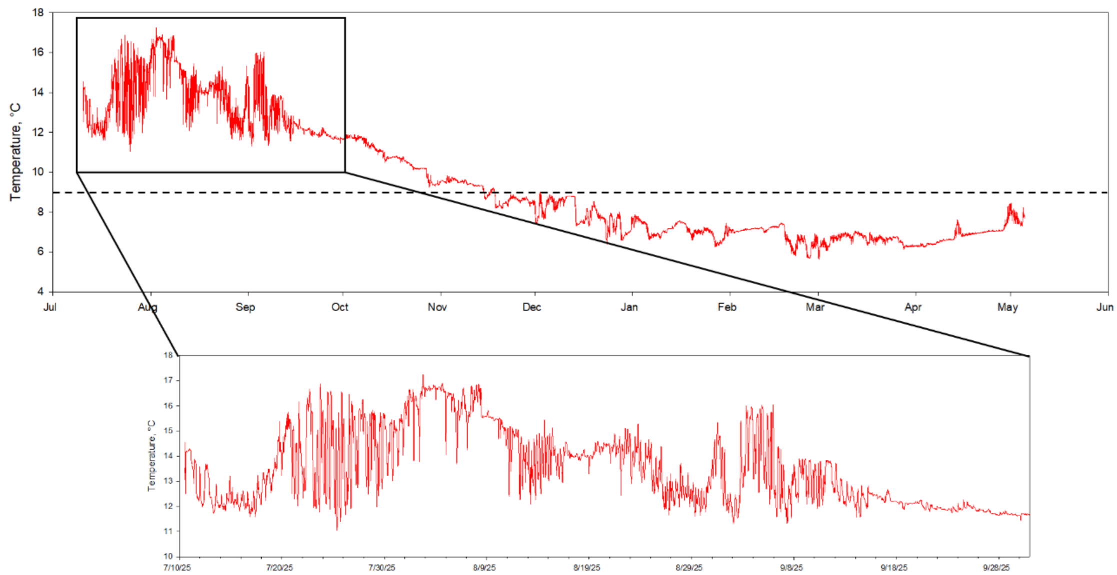

Figure 9. Water temperature (°C) at the Metlakatla site during the entire period of observations (the upper graph). The reference line indicates the temperature below which pinto abalone growth dramatically slows down (according to Paul and Paul (1981)). The lower graph shows daily temperature fluctuations during summer.

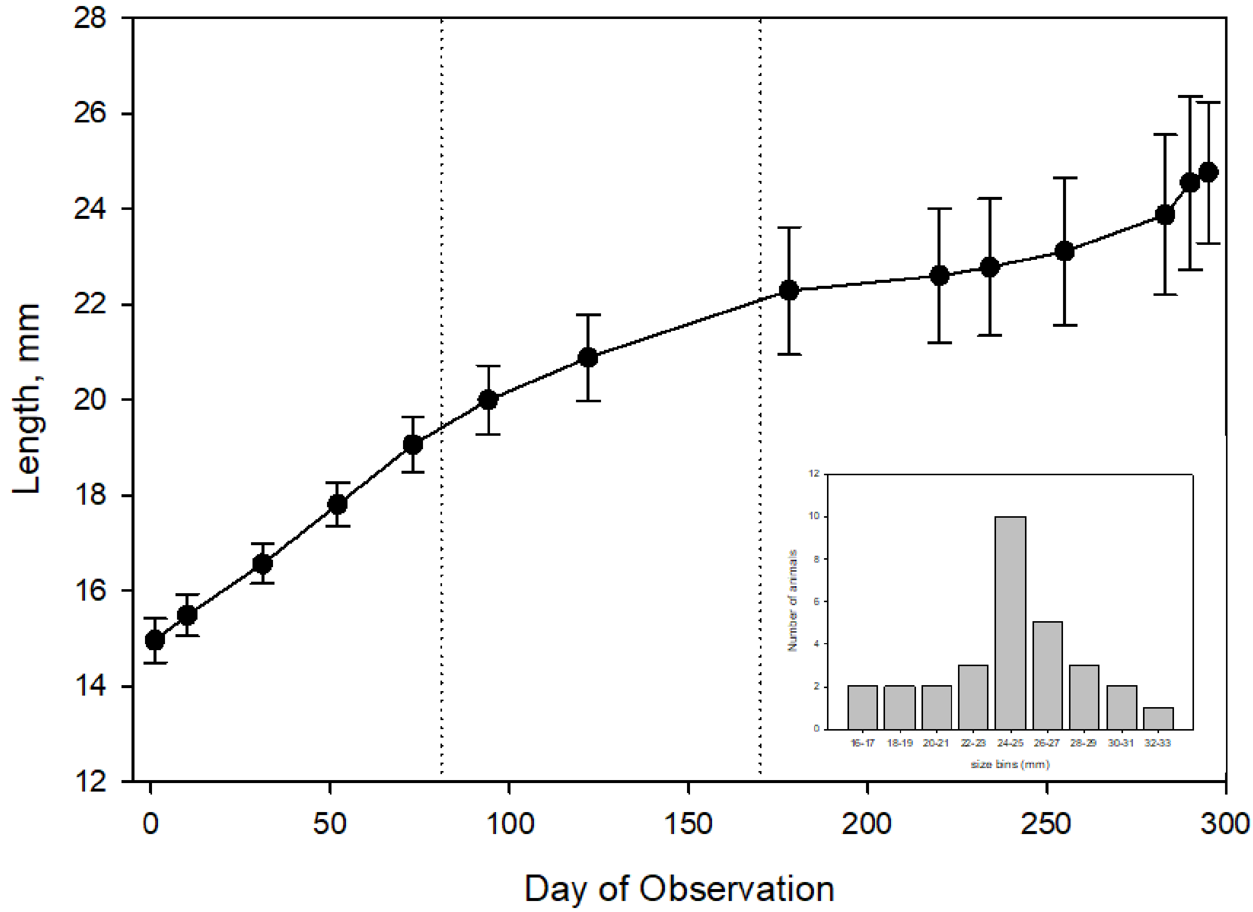

Figure 10. Growth in length of spat abalone at Metlakatla Site during the period of observations starting on July 10, 2025 and ending on May 5, 2026. Inserted plot shows length distribution of the experimental abalone population at the end of the experiment.