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To: Southeast Conference

From: McKinley Research Group and Pacific Shellfish Institute

Date: November 7, 2024

Re: Alaska Mariculture Industry Overview, Fall 2024

The Alaska Mariculture Cluster (AMC) contracted with McKinley Research Group and the Pacific Shellfish Institute to provide AMC and the broader mariculture industry with current information about topics including oyster and seaweed harvest, farm utilization, seed supply and quality, and growing techniques. This is the first of three annual memos produced as part of AMC's Mariculture Industry Tracking project.

Key Findings

- Seaweed harvest likely fell in 2024, while oyster harvest rose.
- A lack of markets and poor seed quality negatively impacted the seaweed sector in 2024. Demand for frozen Alaska kelp for food products contracted in 2024, but greater access to kelp drying in 2025 may open new markets.
- While oyster markets seem to have softened nationwide in 2024, at least slightly, Alaskan oyster farmers did not have this experience with in-state sales.
- Both seaweed and oyster harvests are expected to increase in 2025.
- On average, much of the space on currently permitted oyster farms was used in 2024, while a small fraction of space on seaweed farms was used.

Methods

The findings in this memo are based on primary research and review of available data.

Primary research completed for this analysis included questionnaires sent to aquatic farm and seaweed hatchery operators, fielded in August 2024. A total of 21 completed questionnaires were returned. Interview research with 15 farms, hatcheries, and other industry experts were conducted in September 2024 to supplement questionnaire responses.

The project team reviewed harvest data (through 2023) from the Alaska Department of Fish and Game, as well as aquatic farm lease information from the Alaska Department of Natural

Resources. Most of Alaska's aquatic farming takes place in state waters leased through the Alaska Department of Natural Resources aquatic farm leasing program.[1]

TERMINOLOGY

Seaweed harvest – Estimates for "harvested" seaweed weight do not necessarily refer to seaweed that is removed from the water. Harvested seaweed (in both this report and Alaska Department of Fish and Game records) includes both landed seaweed and estimates for the weight of some seaweed that is grown and discarded without being removed from the water. This year's memo does not track seaweed that is sold because of limited data for current year because some seaweed is in inventory and may or may not be sold this year. In 2023, about two-thirds of the seaweed harvested on commercial farms was sold, according to the Alaska Department of Fish and Game, up from less than half in 2022.

Growing seasons – Oyster harvests are described by calendar year, while seaweed harvest are described by both the out-planting and harvest season (for example, for the 2024/2025 season, farmers out-plant in 2024 and harvest in 2025). This two-year description is a generalization: Some farmers out-planted in early 2024 and harvested the same year, and multiple farmers plan to experiment with year-round growing for giant kelp this year.

2025 forecasts – Harvest forecasts for 2025 are based on farmer estimates for the year ahead based on seed orders. These forecasts are likely over-estimates given the many unknowns associated with ocean farming.

Commercial Harvest Estimates

Alaska's oyster harvest is forecast to triple between 2023 and 2025, while seaweed harvest is expected to fall in 2024 and recover to 2023 levels in 2025.

OYSTER HARVEST

Alaska Department of Fish and Game data show oyster harvests fell to 1.3 million oysters in 2023, following two years of about 2 million oysters.

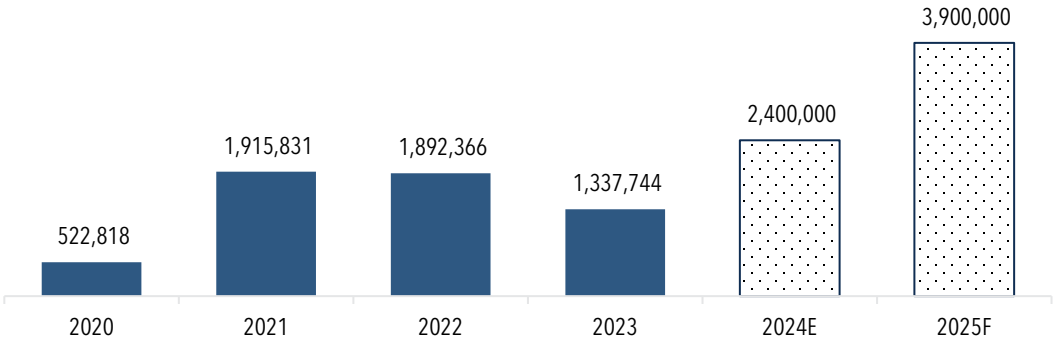
Alaska oyster harvest volumes increased by about 80% in 2024 to a record 2.4 million individual oysters, based on estimates developed in this analysis. Oyster harvests are forecasted to grow another 60% between 2024 and 2025.

The estimated increase in 2024 and 2025 is largely from reports of increased production at established farms as well as one large new oyster farm in Southeast Alaska. As in other recent

[1] In 2023 there were five aquatic farms not on state waters, which do not require leases but do require a permit from the Alaska Department of Fish and Game, according to summary annual report data from permit holders.

years, most oysters harvested in the state in 2024 were grown in Southcentral. However, Southeast may have the largest oyster harvest in 2025 if regional activity increases as expected.

Figure 1. Alaska Oyster Harvest, (count of oysters sold*) 2020 – 2025 Forecast



Sources: Alaska Department of Fish & Game (2020-2023), MRG/PSI estimate/forecast (2024-2024)
*Excludes sale of oysters between farms.

Alaska's pre-2020 oyster sales data can be difficult to interpret and are not displayed above because oyster sales between farms (juvenile oysters sold from nurseries to larger grow out farms) were previously not separated from final sales in state statistics, causing some individual oysters to be counted multiple times in statewide totals.

Inter-farm oyster transfers (now counted separately in state records) increased in 2023, which is another indicator that oyster numbers are increasing on Alaska's farms and harvests will be larger in 2024 and 2025.

SEAWEED HARVEST

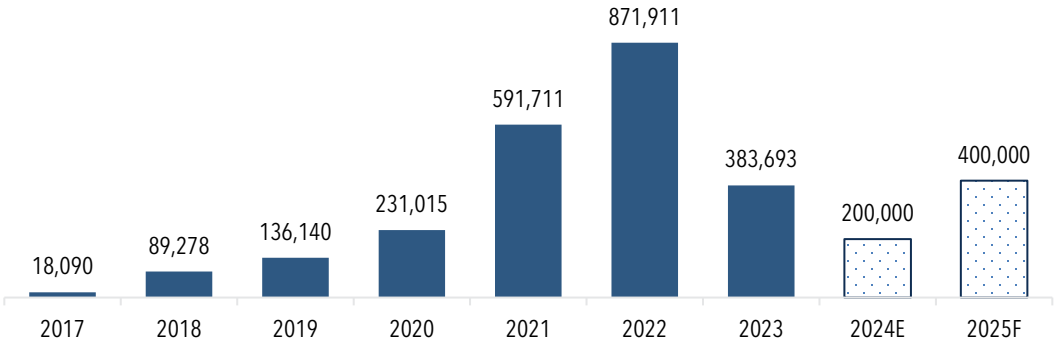
Alaska seaweed harvest fell on the order of 50% between 2023 and 2024 to an estimated 200,000 pounds, based on questionnaire and interview responses. This estimated decline in harvest follows a decline of a similar magnitude in 2023 compared to the record high harvest in 2022. Alaska's farmers cited poor markets and poor yields as reasons for the decreased harvest.

A lack of buyers likely caused farmers to pull back and out-plant less seeded line in fall 2023. Sales of seeded line declined by about 25% between the 2022/2023 and 2023/2024 seasons, which is another indicator of decreased out-planting.

Farmers attributed poor yields in the 2023/2024 season to both poor-performing seaweed seed and in some cases their own limited farming experience, as described in the "seed supply" section below.

The two-year trend of declining harvests is expected to reverse in 2025, with harvests returning to around 2023 levels. The expected increase is due to farmers feeling more confident about their seed quality in 2024 as well as at least three new farms coming online.

Figure 2. Alaska Seaweed Harvest, 2017-2023 Actual and 2024-2025 Estimate/Projection (wet pounds)



Source: Alaska Department of Fish and Game, Alaska Department of Natural Resources, industry interviews, and McKinley Research Group/Pacific Shellfish Institute estimates

Seaweed Species Trends

Sugar kelp and ribbon kelp continue to be the most grown seaweeds on Alaska farms, along with bull kelp to a lesser extent. The 2025 season is expected to be a breakout year for wider commercial farm tests of at least three additional species: split kelp (Saccharina groenlandica), dragon kelp (Eualaria fistulosa), and three-ribbed kelp (Cymathaere triplicate).

Part of the interest in new species comes from Alaska Mariculture Cluster research funding this year to expand Alaska's harvest beyond Pacific oysters and the three dominant seaweed species. Additionally, farmers reported there may be more interest from existing food markets for non-sugar kelp seaweeds.

As one interview participant stated:

> ***"Sugar kelp is the pink salmon of the seaweed world. Fast to grow, but not necessarily the most interesting."***

Seaweed Yield

Comparing seaweed harvest to the previous year's seeded line sales provides a rough measure of average productivity across all farms. This measure is described here as an "implied" yield because of several factors:

- Not all seeded line sold is necessarily used, resulting in actual yield of out-planted seed above this estimate of implied yield.

- Yields vary by species, and yield variation may be a reflection of changing species mix.
- While most seeded line is sold one year before the harvest year, some line is sold late, in the same calendar year as the harvest.

The implied yield values described in the following table align with interview findings of particularly low 2024 yields. The estimated 2024 implied yield is less than one pound per foot. For context, directly measured yield in a 16-farm study in Maine averaged 4.2 pounds per foot of line in 2022, up from 3.7 in 2017.[2]

Table 1. Alaska Seeded Line Sales, Seaweed Harvests and Implied Yields (2021-Estimated 2024)

Year	Feet of Seeded Line Sold in Previous Year	Pounds of Seaweed Harvested	Implied Yield: Pounds Harvested per Foot of Seeded Line Sold in Previous Year
2021	260,350	591,711	2.3
2022	247,200	871,911	3.5
2023	321,600	383,693	1.2
2024 estimate	237,100	200,000*	0.8

Source: Alaska Department of Fish and Game (seaweed and line production), McKinley Research Group calculations

Mariculture Markets

OYSTER MARKETS

Alaska's oyster production is dwarfed by states like Washington and Virginia, which lead the nation in oyster production by volume. [3] As of 2022, Washington state continues to lead national shellfish sales ($166.4 million in 2022 sales), followed by Virginia ($93.6 million) and Florida ($53.3 million).[4] Alaska was not among the top 10 oyster producing states.

According to the last nationwide assessment of U.S. aquaculture, national oyster production totaled over 19 million metric tons.[5] The report describes "Thriving shellfish industries… in all coastal regions of the United States, however the Atlantic and Pacific Coast states produce more oysters, clams, and mussels by value ($134.1 and $131.0 million, respectively), while the Gulf states produce more by volume (24.3 million pounds)."

[2] Maine Aquaculture Association, 2023. "Maine Seaweed Benchmarking Report." Note that Maine's farms grow sugar
[3] USDA Census of Aquaculture
[4] USDA National Agricultural Statistics Service
[5] Based on 2020 NOAA Fisheries of the United States and 2019 USDA Census data

Nationwide, oyster prices seem to have softened slightly in 2024.[6] To date in 2024, interviews indicate Alaska oyster farmers did not experience this with in-state sales.

Researchers and economists watching oyster markets speculate that the price point for half-shell oysters (e.g. raw consumption, served on the half shell) may be hitting a ceiling of what U.S. consumers are willing to pay, especially given recent inflation trends and consumer reluctance to eat out as frequently. Efforts are under way by Pacific Shellfish Institute (PSI) and collaborators on the East Coast to better understand oyster markets and recent trends in U.S. oyster production and supply chains.

Table 2. Top Ten Mollusk Producing States by Value, 2022 ($ Millions)

State	Annual Mollusk Sales
Washington	$166.4
Virginia	$93.6
Florida	$53.3
Massachusetts	$35.1
California	$31.4
South Carolina	$29.6
Maine	$23.1
Oregon	$19.7
Louisiana	$19.0
Connecticut	$17.4

Source: United States Department of Agriculture

SEAWEED MARKETS

Farmers reported declining demand from seaweed buyers in food markets last year, including from consumer-packaged goods products and the ingredient market. In general, 2024 was a challenging year for kelp-based food products: with closures of seaweed businesses including chips company 12 Tides and kelp burger maker AKUA.[7]

Global seaweed consultant and author of the Phyconomy seaweed newsletter Steven Hermans described the closures in seaweed packaged goods companies this year as the natural result of the explosion of new products that launched a few years ago and a limited niche for seaweed food products.

> ***"I'm surprised we haven't seen more bankruptcies," he said. Not everyone was meant to survive. In 2020 and 2021 everyone was sitting in their kitchen saying. 'Let's make some seaweed products.'"***

While food markets were never envisioned as the largest markets of Alaska kelp, this market has been the primary buyers of Alaska kelp as the industry works to establish itself.[8] Diminishing demand has led growers to out-plant decreasing volumes of seeded line for the two years following the peak Alaska harvest of more than 800,000 pounds in 2022.

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[6] CNN Business. *Inflation Comes for Your Oysters.* August, 2024.
[7] See Green Queen, "Akua: Kelp Burger Startup Winds Down Amid Wider Plant-Based Industry Headwinds," August, 2024 for a discussion of the closure of New York-based kelp-burger producer Akua in August 2024. While Akua used Maine kelp rather than Alaska kelp, it faced many of the same market headwinds as companies that use Alaska kelp.

While existing markets have contracted in 2024, the industry has long been faced with limited markets for Alaska kelp. In 2022, the year of the peak Alaska seaweed harvest, more than half of the farmed kelp harvested in Alaska was not sold. Kelp that is not sold includes product kept for personal use, dumped, used in testing, and donated. About a third was not sold in 2023.[8] Interview participants expressed some optimism that seaweed drying equipment that will be available in 2025 may increase demand because of interest from current buyers in dried seaweed.

Several companies have piloted technologies that promise to create a larger market by extracting chemical compounds from kelp, making it possible to create higher value products near the farm site without having to dry kelp or ship it long distances from Alaska to markets. These companies include Cascadia Seaweed, Kelp Blue, Macro Oceans, Ocean Rainforest, and Oceanium. While these companies have the potential to be future large volume buyers, this sector is still developing and is not expected to significantly change seed out-planting volumes until fall 2025 or later.

Grant-funded research was also a significant source of income for seaweed farms in 2024. In particular, farmers mentioned receiving support from the Alaska Mariculture Cluster (the funder of this research) and GreenWave's Kelp Climate Fund, a subsidy for kelp farms that pays farmers based on how much seeded line they outplant (up to $25,000 per year for up to three years) and estimates cumulative environmental benefits of supported kelp farms.

Regional Trends (Seaweed, Oysters, and Non-Oyster Shellfish)

SOUTHCENTRAL ALASKA (PRINCE WILLIAM SOUND AND KENAI PENINSULA)

Most oyster and kelp farming takes place in different areas of Southcentral Alaska. Oyster farming is well-established in Kachemak Bay, near Homer on the Kenai Peninsula. Farms in this region have produced most of Alaska's oysters in recent years and produce mussels and wild "natural set" kelp that grows on shellfish farming equipment. Alaska Shellfish Farms in Kachemak Bay is the largest oyster farm in the state (by production volume). There are also a couple active kelp farms in Kechemak Bay and additional proposed.

Most kelp farming takes place near Cordova in Prince William Sound. Kelp farming has not taken place in this region as long as in Kodiak or Prince of Wales Island in Southeast Alaska, but at least three kelp farms were active in 2023/2024, with a fourth expected to out-plant in 2024/2025. Prince William Sound also has multiple oyster farms, but not as many as Kachemak Bay.

[8] Alaska Department of Fish & Game statistics

SOUTHEAST

Southeast Alaska is a significant location for both oyster and seaweed production. Southeast Alaska is also the state's hub for geoduck clam aquatic farm leases, although harvest data for farmed geoducks are unavailable. Both oyster and seaweed farming is concentrated in southern Southeast around Prince of Wales Island and Ketchikan, although there are active farms in other parts of the region including around Juneau and Wrangell.

Southeast Alaska oyster production expanded in 2024, helped by oysters at a new 27-acre oyster farm, Seagrove Oysters, near Craig, starting to reach maturity. The region produced about half of the state's adult oysters. If conditions and markets allow, Southeast oyster production is expected to continue growing in 2025. Increased harvest is expected at established farms in southern Southeast (home to Hump Island near Ketchikan, Canoe Lagoon near Coffman Cove, and several farms around Naukati Bay) as well as larger parts of Seagrove's farm reaching maturity.

Southeast Alaska's seaweed harvest fell in 2024 and will likely fall again in 2025 as the Seagrove farm pauses their kelp farming operation. Two potential new seaweed growers include Kelp Blue and Pacific Kelp Co., two companies with large seaweed farms in the permitting pipeline, which plan to grow giant kelp (Macrocystis pyrifera) in southern Southeast.

SOUTHWEST (KODIAK ARCHIPELAGO AND ALEUTIANS)

The Southwest region has been the center of seaweed growing in Alaska and produced the bulk of the state's seaweed harvest in 2024. However, along with the state in general, seaweed harvest declined in 2024.

Kelp farming in western Alaska is primarily clustered around the Kodiak road system, with some activity and several inactive leases in more remote parts of the Kodiak archipelago. Farther west of Kodiak, aquatic farm leases have been approved (although not used) as far west as Sand Point in the Eastern Aleutian Borough and proposed as far west as Adak in far southwestern Alaska.

On a statewide scale, Western Alaska is not a significant producer of Pacific oysters for the commercial market, but there is one established farm in Larsen Bay and interest is growing from some of the region's kelp farmers.

Aquatic Farm Capacity and Utilization

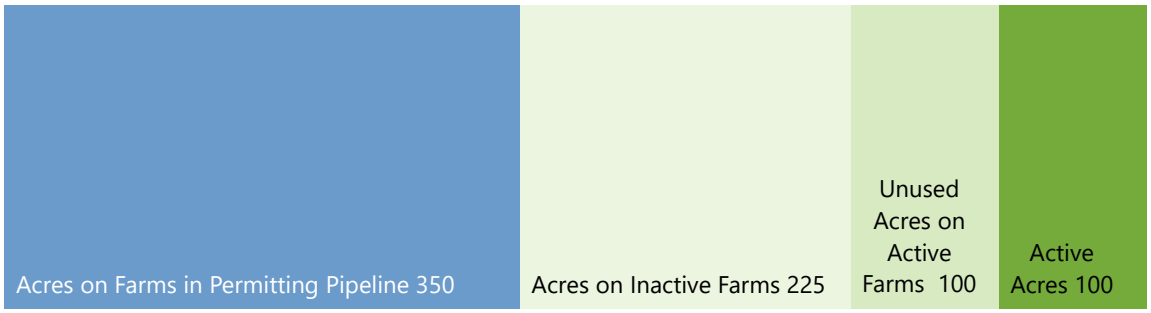
OYSTER FARM UTILIZATION

Alaska's oyster farming industry has room to quadruple production within existing aquatic farm footprints; however, little of the room to grow is on the most active existing farms.

There were an estimated 425 acres available for oyster farming at Alaska's authorized aquatic farms in 2024. Of these, there were 225 acres on farms that did not harvest oysters in 2024, most of which are in the unused 182-acre Silver Bay Seafoods oyster farm site near Sitka.

Among the estimated 200 acres on active oyster farms, an estimated 50 percent of available space was used across the state on average. However, the statewide average is skewed by a few large farm sites with fewer than 50% of acres active in 2024. The majority of farms used far more of their available space, with many small 1-3 acre farms using all of their available space.

Figure 1. Estimated Utilization of 785 Acres Proposed or Authorized for Alaska Commercial Oyster Harvest, 2024



Sources: Alaska Department of Natural Resources, industry interviews ,and McKinley Research Group estimates
Note: Parts to not sum to total due to rounding. Acreage includes farms permitted for both seaweed and shellfish (some farm statistics were excluded or modified where interviews show farm is exclusively or predominantly seaweed focused).

OYSTER PERMITTING PIPELINE

Most of the currently proposed oyster farms would be owned by Chenega Regional Development Group, which is the Alaska Native Claims Settlement Act village corporation for the community of Chenega, in the southwest side of Prince William Sound. In 2024, the corporation applied for six aquatic oyster farm leases covering about 200 acres in total. These aquatic farms are still in the early stages of the permitting process.

Existing oyster farmers Markos Scheer (Seagrove) and Trevor Sande (Hump Island) also have aquatic farm leases in the permitting process, totaling about 100 and 50 acres respectively.

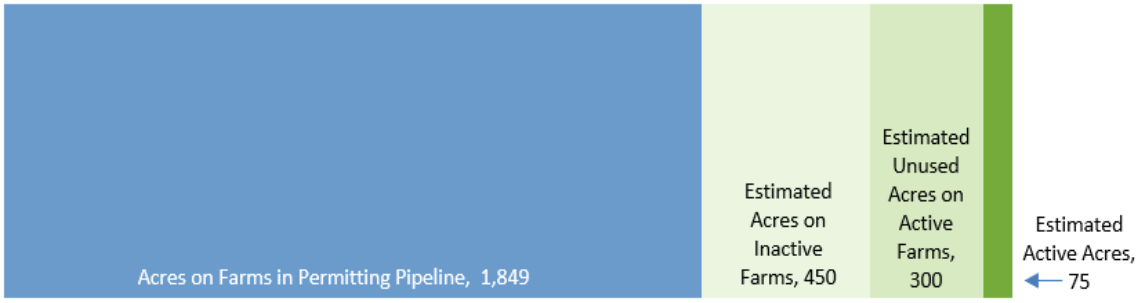
SEAWEED FARM UTILIZATION

Seaweed farm utilization was low in the 2023/2024 season because of the market conditions and limited processing options described earlier in this document. Of about 750 acres permitted and available for seaweed farming, an estimated 75 acres were actively used.

Several large farm sites were not used, including a 101-acre farm site in Sand Point owned by Trident Seafoods and several 10-40 acres sites outside Cordova and around Kodiak Island.

Among active farm sites, interviews and questionnaire responses indicate about 20% of available space was used, on average.

Figure 2. Estimated Utilization of 2,723 Acres of Proposed or Authorized for Alaska Commercial Seaweed Farming in the 2023/2024 Growing Season



Sources: Alaska Department of Natural Resources, industry interviews and McKinley Research Group estimates
Note: Parts to not sum to total due to rounding. Acreage includes farms permitted for both seaweed and shellfish (some farm statistics were excluded or modified where interviews show farm is exclusively or predominantly shellfish focused).

SEAWEED PERMITTING PIPELINE

More than 1,800 acres of proposed seaweed farm sites are in the permitting process, including seven proposed farms that are 100 acres or larger. The largest pending farm is a 400-acre site off Prince of Wales Island proposed by Dutch startup Kelp Blue. The company also has a 121-acre farm further along in the permitting process.

Seed Supply

OYSTER SEED SUPPLY

Interviews indicated that many Alaska farms are relying on relatively small (3-5mm) oyster seed, which they are importing into the state and raising to grow-out size with systems such as mesh bags. More widespread use of nurseried seed grown to a larger size in a Floating Upwelling System (FLUPSY) could potentially boost the output of Alaska farms, but availability from Alaska FLUPSYs is limited and farmers report that importing nurseried seed is expensive when available.

Increased FLUPSY capacity in Alaska has long been identified as important to Alaska's oyster mariculture industry.[9] FLUPSYs, which pump water to increase the flow and available supply of nutrients to juvenile oysters, have the potential to make Alaska's oyster industry more competitive by increasing juvenile oyster growth rates and decreasing mortality.

Although some farmers expressed interest in more Alaska Mariculture Cluster investment in the state's oyster seed infrastructure, others expressed concerns about unintended consequences. As one oyster farm operator stated when asked "Do you have any concerns about the quality or availability of oyster seed for your operations?"

"Yes, [I'm] concerned that grant funded seed operations [will] outcompete commercial operations, reducing the number of vendors willing to sell in Alaska, and reducing seed quality and availability."

Larvae and seed imports to Alaska

All oysters imported in Alaska at the larvae stage currently come from Hawaiian Shellfish, LLC of Hilo, Hawaii.[12] Hawaiian Shellfish is the only shellfish hatchery certified to import oyster larvae into Alaska. Interview research conducted for this analysis, although limited to a small number of farmers, indicates that Hawaiian Shellfish/Nisbett Oyster Co. is the largest importer of oysters at the larger seed

OYSTER SEED TERMINOLOGY

Pacific oysters are not native to Alaska and do not typically reproduce in the state's cold waters. All oyster seed purchased by Alaska farmers initially comes as larvae from outside of the state. Various terms are used for oysters as they move from hatchery to final market.

Larvae are less than two weeks old and less than 3 mm long, about the height of two stacked pennies. Some Alaska oysters are grown from imported larvae grown by Alaska hatcheries, while other Alaska oysters are grown from larvae grown into larger "seed" in out-of-state hatcheries.

Seed is a general term for immature oysters less than about 25mm. "Seed" and "spat" are sometimes used interchangeably, but "spat" typically refers to seed for cluster-grown oysters.[10]

Nurseried seed is a subcategory of larger seed that have spent time in a FLUPSY or other nursery, growing to 12 mm or larger. Seed brought into Alaska from outside the state must be smaller than 20mm under regulations to prevent disease.[11]

Grow out size – Oysters are ready to me moved to farm grow out systems such as flip bags or trays (see "Trends in Culture and Techniques" below) when they are about 25mm. In Alaska, oysters spend between one and three years at the grow out stage, depending on conditions, starting size and desired market size.

Market size – Oysters are ready to sell at the "cocktail" size at about 50mm, and more than twice that size if sold as "large" oysters.

[9] See the Alaska Mariculture Cluster proposal "Equipment and Technology Component Narrative," 2022.

[10] Cluster-grown oysters are almost always destined for the shucked meat market. To our knowledge, no Alaska oyster farmers are growing cluster oysters, and in-state sales of shucked oyster meat (packaged raw) is currently not occurring. However, three facilities: Craig Fisheries, EC Phillips in Ketchikan, and Jakolof Bay Oyster Co LLC in Homer are permitted "Shucker Packers" on the FDA Interstate Certified Shellfish Shippers List. Notably, these "Shucker Packers" can process oysters for value-added items like smoked and tinned products or sell shucked oyster meat to other facilities making these products.

[11] Within Alaska oyster seed sales and transfers are not restricted to less than 20mm, but many other states require juvenile oysters to be less than market sized, typically 2 inches (about 50mm), to be considered seed.

[12] Hawaiian Shellfish is a subsidiary of Nisbet Oyster Co., which also owns Goose Point Oyster Co. an oyster farm in Willapa Bay, Washington.

stage of development in addition to being the only larvae provider. Other out-of-state providers of oyster seed for Alaska farms include the Jamestown S'Klallam Tribe (which has facilities in both Hawaii and Washington), and the USDA Pacific Shellfish Research Unit in Newport, Oregon.

The Jamestown S'Kallam Tribe recently began providing larger nurseried seed grown in FLUPSYs to Alaska farmers. While this is a new source of larger seed for Alaska, farmers indicated that it comes with a significantly higher shipping cost compared to importing smaller seed and has not been widely used.

Alaska FLUPSY Usage

While official statistics about FLUPSY use in Alaska are limited, interviews indicate that there were at least five active FLUPSYs in the state in 2024. Of these, two are authorized to sell nurseried seed to other farms (Blue Starr and the Kachemak Shellfish Mariculture Association) while the other three grew seed for their own farms.

The table below shows one measure of existing and potential new FLUPSY operators in Alaska: the 10 operators below all had parcels identified for a FLUPSY in their Alaska Department of Fish and Game aquatic farm permit application. This is not necessarily a comprehensive list, and as noted, most farms on the list did not have an active FLUPSY in 2024.

Table 3. Alaska Department of Aquatic Farm Permits Which Include "FLUPSY" in Parcel Descriptions, 2024

Permit Holder Name	Region	Nearest Community	Active FLUPSY in 2024?	Permitted to sell seed to other farms
Safety Cove Shellfish Co.	Southcentral	Cordova		
Alaska Shellfish Farms LLC	Southcentral	Homer	√	
KSMA*	Southcentral	Homer	√	√
Aquabionics Inc.	Southcentral	Whittier		
Salty Lady Seafood Co.	Southeast	Juneau	√	
Marble Seafoods, LLC	Southeast	Ketchikan	√	
Shinaku Shellfish Company	Southeast	Klawock		
Alaska Oyster Cooperative	Southeast	Naukati		
Blue Starr Oyster Co.	Southeast	Naukati	√	√
Silver Bay Seafoods**	Southeast	Sitka		

Sources: Alaska Department of Fish and Game (list of permits), Alaska Department of Natural Resources (additional permit holder information), and industry interviews (FLUPSY operational status). *Kachemak Shellfish Mariculture Association **This farm site is not currently used.

Multiple farmers are looking to add FLUPSYs to their operations, but no new systems came online in Alaska in 2024. One FLUPSY operation not associated with an oyster farm was permitted in 2024 – in Kodiak – but is not yet operational.

SEAWEED SEED SUPPLY

Poor-performing seaweed seed and low yield (ratio of volume harvested to seed out-planted) was a persistent theme in this year's interviews and questionnaire responses. Some farmers reported particularly low yields of well below one pound of seaweed per foot of seeded line in 2024. Farmers attribute this year's low yields to both poor seed quality and in some cases their own inexperience in seaweed farming. Some of the 2024 harvest problems were particular to changes in hatchery capacity that took place in the 2023 out-planting season, while other issues highlight weaknesses of Alaska's seaweed supply system that remain.

A last-minute scramble for seeded line in fall 2023 was likely a key factor in the low 2024 seaweed yields. Both the Alutiiq Pride Shellfish Hatchery in Seward and the University of Alaska Fairbanks' Lena Point Fisheries Facility in Juneau reported receiving an influx of late-season requests for seed because of capacity limitations at the other active seaweed hatcheries in the state. Operators at both hatcheries reported that seaweed harvest yields were poor from seed provided late in the season, either because of late season sori (reproductive tissue) gathering or because of late season out-planting, in some cases in mid-winter.

The hatchery capacity challenges are expected to improve somewhat in the 2024/2025 season due to expanded capacity at the Alaska Ocean Farms hatchery in Kodiak. Most farmers contacted for this research who had poor harvests in 2024 reported they were more confident in the quality of their seed going into the 2024 out-planting season.

Nonetheless, the number of facilities producing seaweed seed likely fell in 2024. Interviews indicate seven Alaska hatcheries produced seaweed seed in 2023. In 2024 the number fell to four, with most of the state's seed produced by Alaska Ocean Farms in Kodiak and Alutiiq Pride in Seward. OceansAlaska in Ketchikan, one of the state's largest hatcheries, did not produce seed in 2024, because the hatchery is a collaboration with Seagrove, which pivoted operations from seaweed to oysters this year. The PWS Science Center in Cordova did not produce seaweed seed in 2024 because the hatchery was focusing on expanding its capacity for future years.

Table 4 Hatcheries Authorized to Produce Seaweed Seed and Operational Status, 2023-2024

Hatchery Operator	Region	Community	Produced Seaweed Seed in:	
			2023	2024
PWS Science Center	Southcentral	Cordova	√	
Native Conservancy	Southcentral	Cordova	√	√
Alutiiq Pride Marine Institute	Southcentral	Seward	√	√
Mothers of Millions LLC	Southcentral	Seward (mobile)	√	
University of Alaska Fairbanks	Southeast	Juneau	√	√
OceansAlaska	Southeast	Ketchikan	√	
Malaspina Sea Farms	Southeast	Yakutat		
Blue Evolution	Southwest	Kodiak		
Alaska Ocean Farms LLC	Southwest	Kodiak	√	√

Sources: Alaska Department of Fish and Game (hatchery permits) and industry interviews (operational status)

Several, long-term challenges with Alaska's seaweed supply remain. Seed availability at different hatcheries fluctuates between years, and the state's network of hatcheries includes nonprofit institutions that, while available to help the industry develop, were not designed to serve as a large-scale hatcheries for commercial farms.

Tiff Stephens, a University of Alaska Fairbanks College of Fisheries and Ocean Sciences seaweed researcher interviewed for this report, identified a lack of qualified hatchery workers, or even candidates as a key challenge.

> ***"It's a demanding job and takes training," she said. "It's a seasonal job. Times have changed and people don't want a job, they want a career."***

Alaska's geography and regulations can also limit the ability of the state's hatcheries to provide reliable access to seed. To protect biodiversity, Alaska's seaweed farms must use genetic material from wild seaweed found within 50 miles of the farm site. Farmers have to gather sorus tissue, ship it to a hatchery and then ship the seeded line back.

Seed availability limitations can affect not only crop yield, but also participation. As one interview subject noted, uncertainty about seed availability adds to the complexity of farming seaweed and makes it harder for off season-fishermen to participate.

> ***"This industry is so new and young you have to closely follow hatcheries and go to lots of meetings and research markets to be successful. I just want to be a farmer and grow things."***

Trends in Culture and Techniques

OYSTER TRENDS

Since publication of PSI's "Shellfish and Seaweed Species and Gear Thresholds for Alaska Mariculture" report to NOAA in late 2023, oyster farmers are continuing to try new methods via new gear types. In many cases new methods are deployed in addition to existing grow-out techniques, primarily adding new containers such as FlipFarm alongside suspended stacked tray systems and other, often self-designed, floating containers. This trend is expected to continue, especially if farmers continue to have access to capital through loans, grants, and matching grant programs.

Interest and willingness to try new oyster gear types has been generated as word-of-mouth spreads awareness about new gear types, particularly when use is successful. FlipFarm and OysterGrow systems are two key examples in Southeast Alaska in 2024. Domestic and international attention to Alaska's growing mariculture industry is also seemingly attracting suppliers and vendors, making more diverse grow-out gear and processing equipment available to Alaskan farmers. Suppliers are contacting individuals and groups, and participating in conferences and meetings, raising awareness of their products and services among Alaskan oyster farmers and their networks.

SEAWEED TRENDS

Alaska seaweed farm architecture is growing more complex. Alaska commercial seaweed farms, especially larger farms, have moved away from simple suspended longline setups and towards catenary arrays, according to interview research performed for this analysis, as well as the 2023 Pacific Shellfish Institute report to NOAA "Shellfish and Seaweed Species and Gear Thresholds for Alaska Mariculture." The latter cited that commercial farmers have limited access to nutrient and current data, which are important factors to successful growth.

Arrays differ from longline setups that were more common in the first years of farming because they are secured both lengthwise and widthwise, as opposed to a single dimension. Arrays promise to reduce the risk of grow lines tangling and can reduce grow line sagging, potentially increasing yield by keeping lines at consistent depths.

While added farm layout complexity can improve results, it can also add cost. PSI's Gear Thresholds Report observed that one farmer overspent on anchoring equipment, building a system that was four times more robust than needed because a hydrodynamic modeler did not have access to ocean current data:

> ***"This cost was magnified by the size of ships/barges and personnel needed for deployment; costs for deployment were non-linear to cost of gear. However, as the industry matures, this will become less of a concern."***