



# Justification Report: Deploying AnchorBot™ Helical Anchors for Alaska Mariculture

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## Executive Summary

Alaska's Kelp farming sector is at an inflection point. Farms are scaling from pilot plots to commercial-scale operations, but their ability to optimize growth area is limited by anchoring methods. Traditional anchors, such as concrete blocks, railroad wheels, drag embedment and mushroom anchors require long catenary scopes which consume valuable leased acreage while also being costly and disruptive to install. Farmers report that of a 22-acre lease, roughly a quarter to a third may actually be growing kelp as the rest is consumed by anchor spread and scope requirements.

AnchorBot™ presents a new solution: a remotely operated vehicle (ROV) designed to install helical anchors from vessels with as little as 20 feet of deck space. Helical anchors provide high lateral and vertical holding power, disturb only a small patch of seabed, and can be installed and removed within +/- 3 ft of their designed locations. By reducing scope requirements from 4+ : 1 down to 2:1 or less, helical anchors unlock two to four times more usable acreage within existing leases. This means a farm that currently harvests 40,000 pounds of kelp annually could scale to 135,000–270,000 pounds without expanding its lease.

The economics are equally compelling. AnchorBot eliminates the need for barges and cranes while installing 10+ anchors per day thereby reducing installation costs by 50–70 percent.

Farmers interviewed during site visits in Kodiak and Southeast Alaska expressed strong interest in adopting helicals, not only for kelp but also for oyster operations. Their priorities include year-round farm structures, near-benthic arrays that improve yield consistency, and potentially elastic mooring systems to reduce storm-related losses. AnchorBot's combination of speed, safety, and reliability makes these priorities achievable.

This report provides the technical basis, logistical considerations, economic modeling, and farmer perspectives supporting the case for AnchorBot deployment in Alaska. It concludes with recommendations for pilot programs, business models, and scaling strategies to establish helicals as the standard anchoring method for Alaska mariculture.



## 1. Industry Context

Anchoring is not a side detail in mariculture, it is the foundation that determines how farms are laid out, how much lease area can actually be used, and oceanographic & meteorological resiliency of the farm. In Alaska, most leases are large on paper, but their usable acreage is often as little as 25% of the total because anchor line scope occupies the majority of the lease.

Common anchoring methods, such as concrete blocks/ railroad wheels, Danforths and drag embedment anchors are reliable in shallow, calm conditions but become logistically prohibitive in deeper, tidal waters. These anchors require barges or A-Frames to install, divers for placement, and often end up 20 feet or more from the designated location. Misplaced anchors can require rework of the farm structural lines which are typically constructed on land prior to deployment. The anchor's large footprint and scope requirements further reduce the productive space available within a lease.

Farmers are innovating within these constraints. Some are moving from 6-foot to 4-foot line spacing, which increases the density of kelp lines and reduces entanglement. Others are experimenting with benthic arrays, anchoring lines closer to the seabed, which early trials suggest may increase growth by up to 50 percent compared to near surface catenary systems. The desire to leave gear year-round is strong, but regulators require evidence that permanent structures will not harm benthic habitats. All of these trends point to the need for a more precise, less intrusive anchoring system that supports innovation rather than constrains it.

## 2. Market Context and Farmer Momentum

The mariculture sector in Alaska is poised for significant growth, but the realities of anchoring and logistics continue to constrain production. Discussions with farmers in Kodiak, Cordova and Juneau reveal the same pattern: lease sizes on paper appear large, but the acreage that actually produces kelp is a fraction of the total. Anchoring inefficiencies, compounded by downstream hurdles in shipping and processing, keep harvest volumes well below potential.

On Kodiak, a 17-acre lease produced 16,000 pounds of kelp last season, harvested from 1.2 acres of growing area. Prices vary: about \$0.50 per pound for fresh kelp and \$1 per pound for stabilized product (treated with citric acid and stored in IBC containers). For the upcoming season, the target is 100,000 pounds grown over 28,000 feet of line, a nearly tenfold increase. The primary obstacles are not biological, but logistical: shipping and processing costs threaten to erode margins and constrain expansion.

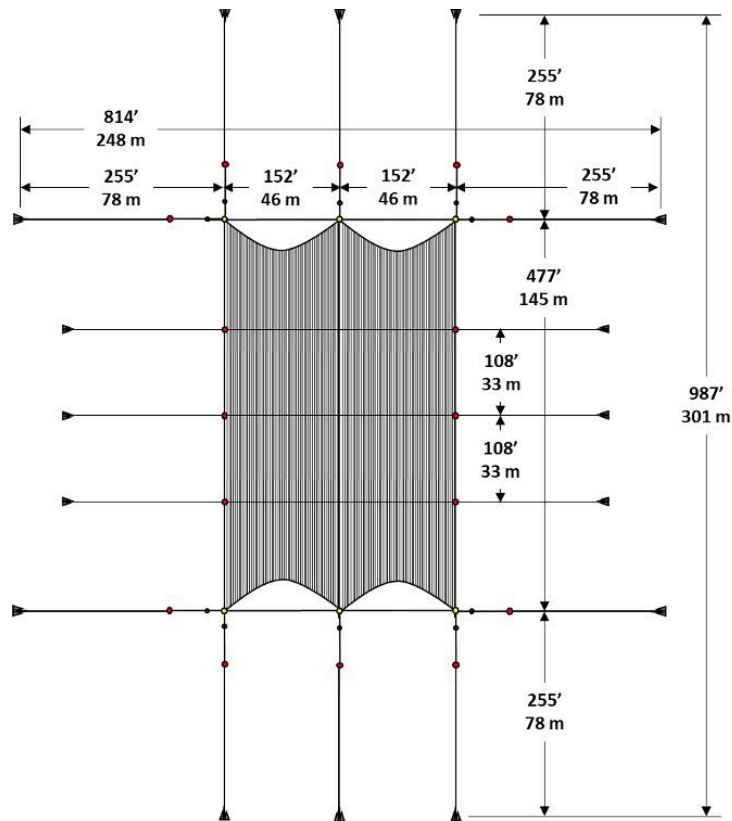


Figure 1. Typical catenary growth system illustrating total growth area in the middle with lines extending out to show the anchor points (image Courtesy and Property of Tend Ocean, Inc).

A similar dynamic is illustrated in Cordova on a 22-acre lease. In the 2024 season, 4–5 acres were actively used of which a single array measuring 75 by 400 feet (~1 acre) produced kelp. This generated 40,000 pounds of harvest, sold at approximately \$1 per pound (stabilized), yielding \$40,000 in revenue. For 2025, Cordova based farms are targeting 75,000–100,000 pounds per lease, but they estimate that with more efficient anchoring they forecast increasing each farm's harvest up to 135,000–270,000 pounds annually. Their biggest hurdles are expanding processing capacity and managing transportation costs as production scales.

A third case in Juneau highlights how even larger leases remain underutilized. On a 25-acre lease, only 0.6 acres were actually harvested last season, yielding 38,000 pounds of kelp. The average sales price achieved was about \$0.75 per pound, and the farm is targeting 80,000–100,000 pounds for the next season. Here the limiting factors are farm design (anchoring and line layouts), harvesting capacity, and processing bottlenecks. Despite strong biological performance, 38,000 pounds from barely half an acre is evidence of kelp's potential productivity, infrastructure challenges prevent scaling to the full 25-acre lease.



Taken together, these three farms illustrate the same structural issue: Alaska’s mariculture leases are substantially underutilized because of anchoring inefficiencies. Farmers pay for 17–25 acres but are often only able to farm a fraction effectively, leading to lower harvests, higher costs per pound, and weaker economics for downstream processing.

AnchorBot™ directly eliminates the anchoring bottleneck. By reducing scope ratios from 4:1 down to just 2:1 at high tide, helical anchors unlock two to four times more usable acreage within existing leases. Instead of leaving large portions of leased water idle, farmers can convert underutilized areas into productive growing space, transforming harvests from tens of thousands of pounds into hundreds of thousands. This scale of growth not only boosts farm-level revenues but also justifies the critical downstream investments in processing and transportation infrastructure that make Alaska’s mariculture industry truly sustainable.

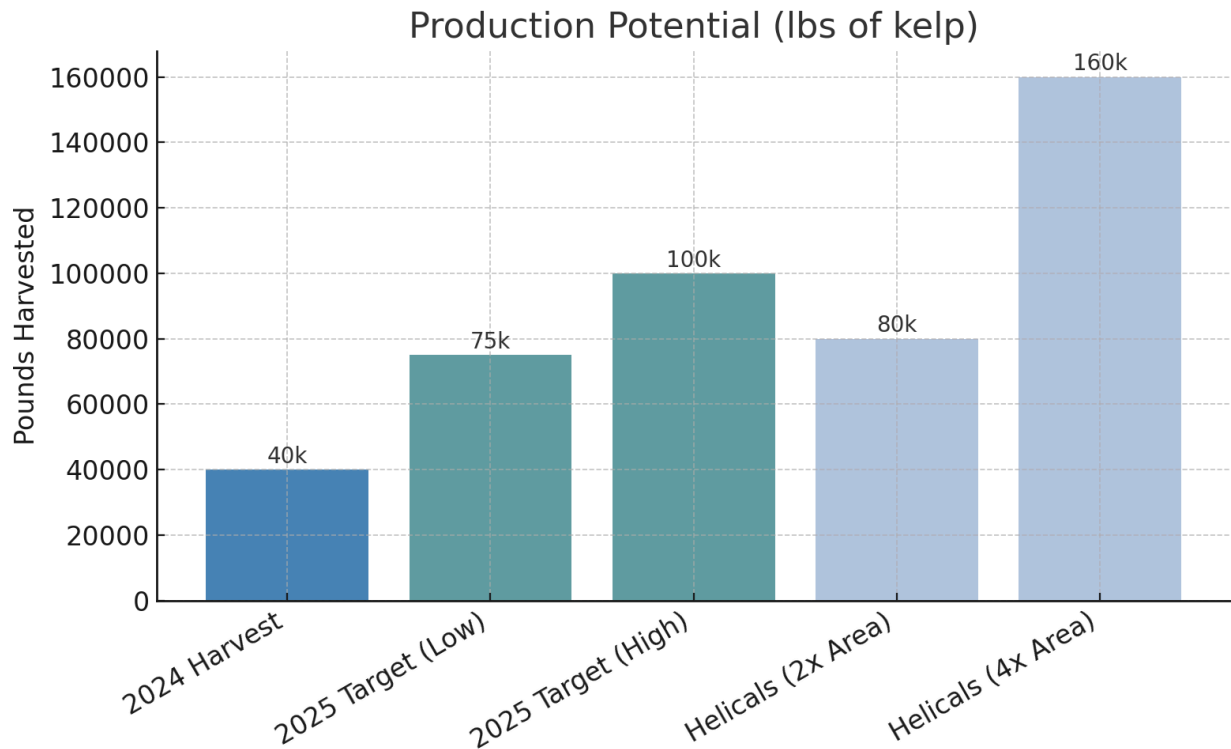


Figure 2: Potential revenue increase as a function of increased farmed area within a lease. With a typical catenary system, 4x of current farmed area is feasible



### **3. Technical Basis for Helical Anchors and AnchorBot**

#### **Helical Anchors**

Helical anchors have been used for decades in terrestrial and offshore industries because of their high holding power, minimal footprint, and ease of installation. Unlike blocks, which rely on sheer mass, helicals derive strength from embedment. Installed to a specified torque, they lock into mud, sand, or volcanic ash substrates, which in Alaska often “cement” the anchor in place.

Helicals resist both vertical and lateral loads. They do not “walk” across the seabed under tension like drag anchors, and they can be bridled in groups of two to four to achieve higher holding power. Because installation is verified by real-time torque readings, all stakeholders can have confidence that each anchor meets its design load.

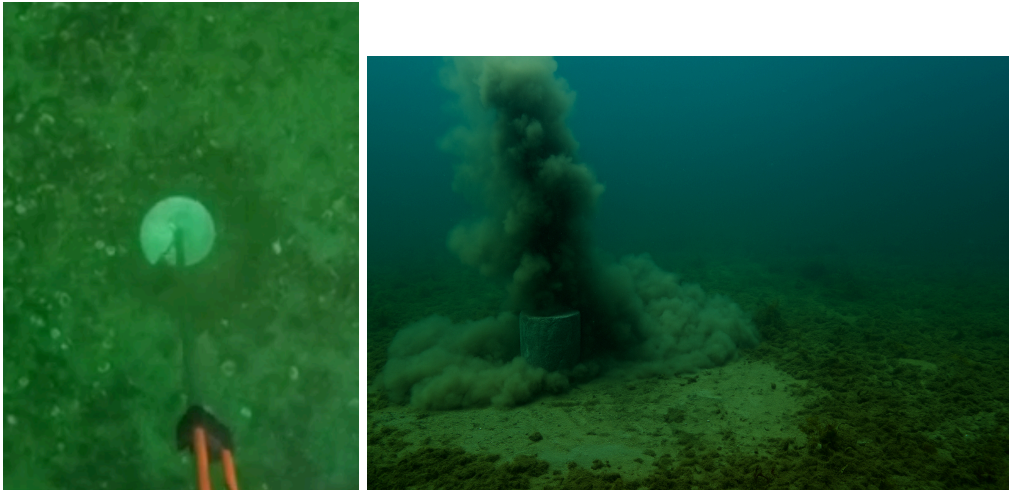
#### **The AnchorBot Solution**

AnchorBot is a compact, remotely operated system designed to install helical anchors from small vessels to a maximum depth of 330 ft. Any boat with a davit is sufficient for deployment; no barges or cranes are required. Mobilization takes three to four hours, and the system is portable by a two-person crew.

AnchorBot installs more than ten anchors per day under typical conditions. Each anchor can be placed with acoustic positioning for increased accuracy, while real-time video and torque feedback confirm proper installation. Anchors can also be reversed for farm relocation or decommissioning, avoiding the “orphaned blocks” that litter many existing sites.

#### **Environmental Benefits**

The environmental case for helicals is strong. Unlike blocks or wheels, which crush benthic habitat and leach materials over time, helicals disturb only a narrow column of seabed as they screw into place. They avoid cement leaching, corroded steel, and the broad drag scars of traditional anchors. Helicals do not require bottom chain in the mooring line, and therefore can have a line depart the anchor head at a steep angle upward, preventing benthic damage from mooring line dragging. Their smaller footprint means benthic communities outside the immediate anchor site are left intact. For regulators evaluating year-round farm proposals, the low-impact footprint of helicals is a critical advantage.



*Figure 3: Total impacted area for AnchorBot is contained within the diameter of the helical itself (left). However disruption is significant as shown when a concrete anchor impacts the seafloor (right).*

### **Risk Reduction**

AnchorBot's design eliminates many of the risks associated with traditional installs. Divers are not required, improving safety. Weights of the installer and anchor are significantly lower, reducing likelihood of injury during deployment and transport. Anchors do not drag, reducing line failures and insurance claims. Decommissioning is safer and cleaner, with no abandoned debris left behind. Together, these factors reduce both operational risk for farmers and environmental risk for regulators.



## 4. Logistics of Deployment

### Vessel and Crew Requirements

One of the defining strengths of AnchorBot is its low logistical footprint. The system can be deployed from a vessel with as little as 20 feet of deck space, with only a two-person crew required. Mobilization takes three to four hours, and no divers are needed. The system and anchors can be delivered to the departure dock in a single pickup truck. By comparison, traditional anchors often require barges, cranes, and diver teams, which drive costs up significantly.

### Installation Rate

AnchorBot consistently installs 1 to 2 anchors per hour under normal conditions. Each installation is verified in real time through torque and video feedback, providing assurance that the anchor has reached its target holding capacity.

### Depth and Substrate

Most Alaska mariculture sites visited fall between 50 and 140 feet deep, with substrates of mud, sand, and volcanic ash covered by a thin layer of silt. These conditions are ideal for helicals, which embed securely and often “cement” in place. In denser sand, AnchorBot has installed helicals as deep as 14 feet, with torque readings confirming holding capacity.

### Scope and Lease Utilization

As mentioned, traditional anchors require a scope of three to four times water depth, which dramatically expands their footprint. A farm with a 22-acre lease may only use four acres for kelp because the rest is consumed by anchor scope. Helicals, by contrast, allow scope ratios of one to two times depth at high tide, reducing mooring spread and freeing up two to four times more farmable area within the same lease.

### Mooring Systems

AnchorBot is compatible with the mooring systems farmers already use. High-modulus polyethylene (HMPE/Spectra) lines are common for their neutral buoyancy and low stretch, though they require UV protection. AnchorBot also supports elastic mooring elements, such as bungees or snubbers, which absorb peak loads and allow smaller anchors to achieve the same performance. Farmers already using block-and-tackle systems for line tensioning can continue to do so; AnchorBot provides more consistent anchor placement and predictable load distribution.



## Shipping and Regional Support

Helical anchors are lightweight until installed, making them far easier to ship and handle than typical anchors. Regional caches in Anchorage, Kodiak, and Juneau/Ketchikan would allow farms to access anchors and battery packs without long-distance shipping for every install. Farms already maintain staging areas for line assembly; helicals require only modest additional space.

One major hurdle is the shipping of batteries to and across Alaska. AnchorBot operates off 8.5 kW of DC power sourced from two lithium ion battery packs. All airline carriers no longer allow for li-ion batteries greater than 130 kW to be transported via cabin or cargo. Further, many ferries that operate throughout Alaska have restrictions on battery capacity aboard their vessels to the point where they only allow two (2) electric vehicles aboard at a time. While there are options for batteries in Alaska, it has become clear that utilizing a topside powered solution via a heavy tether would be the best solution for AnchorBot in Alaska. Such a modification would allow for standard air transport thereby providing much greater reach in logistically difficult regions to access through Alaska while also lowering the overall shipping costs.

## 5. Economics

The economics of Alaska's kelp farming industry are currently constrained less by biology than by infrastructure. The three case studies in Cordova, Kodiak and Juneau, illustrate the structural mismatch between lease size, usable acreage, and actual harvests.

Near Cordova, a 22-acre lease produced only 40,000 pounds of kelp in 2024, harvested from approximately one acre of effective growing area. With kelp selling for about \$1 per pound, this equated to \$40,000 in gross revenue. While the farm is targeting 75,000–100,000 pounds for 2025, analysis suggests that with improved anchoring and more efficient lease utilization, the true capacity could be 135,000–270,000 pounds annually. The bottleneck is not kelp growth rates, but the ability to bring more of the lease into production while ensuring that downstream processing and transportation capacity keep pace.

In Kodiak, a 17-acre lease yielded 16,000 pounds last season, harvested from just 1.2 acres. This equates to a productivity rate of over 13,000 pounds per acre, which demonstrates the biological potential of kelp farming when conditions are right. Pricing here is split: \$0.50 per pound for fresh product and \$1 per pound for stabilized product preserved in citric acid. With a target of 100,000 pounds for the upcoming season, Kodiak is preparing for a nearly tenfold scale-up. But without lower-cost anchoring solutions and more efficient logistics, his growth is constrained by the high costs of shipping and processing.

Finally in Juneau, they demonstrate another variation on the same problem. On a 25-acre lease, 0.6 acres were harvested in 2024, yielding 38,000 pounds of kelp. This indicates a productivity



rate of more than 60,000 pounds per acre but the total harvest was capped by anchoring and farm layout limitations. With an average sales price of \$0.75 per pound, the farm generated about \$28,500 in revenue despite operating on a 25-acre lease. For the coming year, the target is 80,000–100,000 pounds, but they highlight the farms rearrangement, harvesting capacity, and processing bottlenecks as the primary hurdles.

When these three case studies are viewed together, a consistent picture emerges:

- Farmers are paying for 17–25 acre leases but using only 0.6–1.2 acres effectively.
- Harvest volumes range from 16,000–40,000 pounds annually, far below what the leases could support.
- Productivity per acre is strong, ranging from 13,000 to 60,000 pounds per acre but this potential is not realized at scale because anchoring systems consume most of the lease footprint.
- Pricing varies depending on stabilization and market access, but averages \$0.50–\$1.00 per pound, which provides attractive gross margins if volume can scale.
- The most consistent hurdles are anchoring inefficiency, processing costs, and shipping logistics.

AnchorBot™ and helical anchors directly change this economic equation. The scope reduction alone would allow farmers to free up to four times more usable acreage within their existing leases. Depending on growth density, this means the difference between harvesting 16,000–40,000 pounds annually and harvesting 100,000–270,000 pounds annually. At current pricing, this would shift revenue potential from tens of thousands of dollars into the hundreds of thousands, fundamentally changing the viability of their operations.

Equally important, installation costs decline. AnchorBot eliminates the need for barges, cranes, and divers, cutting installation expenses by approximately 50–70 percent. Anchors can be placed and verified with precision, reducing failures and insurance risks. Over time, these savings compound, providing a more predictable and scalable cost structure for Alaska's mariculture industry.

In summary, the economic case for AnchorBot is twofold: it both expands revenue potential by unlocking underutilized lease acreage and reduces costs through safer, more efficient installations. This combination creates the margin space for farmers to invest in processing and logistics, which are the other critical bottlenecks to scaling Alaska's kelp industry.



Table 1: Typical installation costs for different anchor types

| Cost Component             | AnchorBot (Helicals) | Helicals (Barge + Divers) | Gravity Anchors (Blocks/Wheels) | Drag Embedment Anchors |
|----------------------------|----------------------|---------------------------|---------------------------------|------------------------|
| Small Vessel Day Rate      | \$2,000.00           | \$0.00                    | \$0.00                          | \$0.00                 |
| Barge Day Rate             | \$0.00               | \$5,000.00                | \$5,000.00                      | \$0.00                 |
| Large Boat with A-frame    | \$0.00               | \$0.00                    | \$0.00                          | \$3,000.00             |
| Commercial Diver (per day) | \$0.00               | \$1,000.00                | \$1,000.00                      | \$0.00                 |
| Fuel & Logistics           | \$300.00             | \$2,000.00                | \$3,000.00                      | \$300.00               |
| Support Equipment          | \$0.00               | \$2,000.00                | \$1,000.00                      | \$1,500.00             |
| <b>TOTAL</b>               | <b>\$2,300.00</b>    | <b>\$10,000.00</b>        | <b>\$10,000.00</b>              | <b>\$4,800.00</b>      |

## 6. Business Models

Several models are viable for deploying AnchorBot in Alaska. A regional hub-and-spoke approach would place units and anchor caches in Anchorage, Kodiak, and Juneau/Ketchikan, allowing multiple farms to share access. Pricing could be set on a day-rate basis, with equipment at approximately \$1,000 per day and operators at \$1,500 per day, bringing turnkey anchor installation between \$650 to \$1,000 per anchor.

For smaller farms or those seeking predictability, an anchor-as-a-service model could offer per-anchor pricing, including installation, torque and video proof, and light site survey. A subscription model could cover seasonal installations and maintenance visits. Direct sales of Anchorbot ROVs are also viable, with a capital cost of approximately \$158,500 per unit, plus training and support. Finally, grant or consortium models through organizations like Alaska Sea Grant or AFDF, could seed initial units with shared access and standardized data reporting.

## 7. Implementation Roadmap

The immediate next step is to conduct pilot deployments at three farms with varied substrates, farm designs and growth conditions. Each site should undergo a pre-survey with side-scan sonar and two to three core samples to determine anchor size and torque targets.

AnchorBot can then conduct installation campaigns, placing more than ten anchors per day with torque and video logs for each. Three to five local operators should be trained at each hub to



reduce mobilization costs. Farms should document productivity gains, lease utilization, and ecological outcomes, providing data for regulators and grant funders.

## 8. Why Helicals and AnchorBot Are the Right Solution

Helical anchors align with the needs of Alaska mariculture. They embed securely in mud, sand, and volcanic ash substrates, which are common across farm sites. By reducing scope, they unlock two to four times more usable lease area, allowing farmers to expand production without expanding leases. Their installation is faster, safer, and cheaper than traditional methods, requiring only small vessels and no divers.

Environmental regulators benefit from their minimal footprint and removability, while insurers benefit from their predictable performance and reduced failure rates. Farmers benefit from lower costs, higher yields, and the ability to innovate with benthic and year-round arrays.

AnchorBot Helical Anchors: Key Benefits

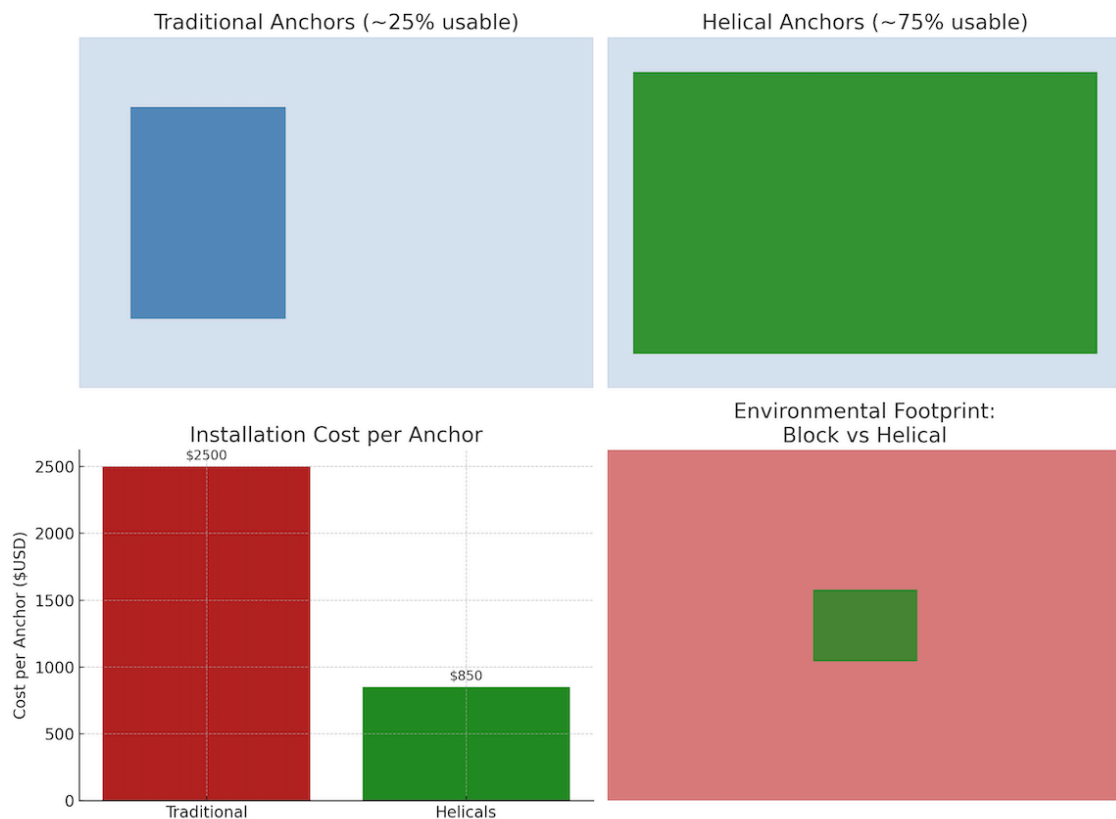


Figure 4: Key Benefits of Helicals as compared to existing anchoring solutions



## 9. Next Steps

AnchorBot is ready for immediate pilot deployment. The first priorities should be to secure grant funding for three pilot sites, establish regional anchor caches, and train local operators. Data collected from these pilots will demonstrate the economic and ecological benefits of helicals, supporting broader adoption across Alaska.

## Recommendations

1. Re-engineer AnchorBot to run off of topside power to remove any logistical concerns with regards to batteries. Such a modification would reduce the long term cost of ownership while increasing the reach to the less accessible regions of Alaska
2. Launch Pilot Program: Deploy AnchorBot at three farms to measure yield improvements and ecological outcomes. Site selection should be done in such a manner that edge cases can be discovered and documented.
3. Establish Regional Hubs: Position AnchorBot units, spares and anchor caches in Anchorage, Kodiak, and Juneau/Ketchikan.
4. Adopt Benthic and Year-Round Arrays: Transition farms to lower scope ratios, freeing more lease space for production.
5. Standardize Mooring Packages: Offer turnkey kits with helicals, elastic moorings, and block-and-tackle tensioning systems.
6. Address Processing and Markets: Partner with organizations like Spruce Root to strengthen downstream capacity.
7. Plan for Scale-Up: Move from pilots to regional access models, then to direct sales for large farms.

## Conclusion

Alaska's kelp and oyster farming sectors are at a pivotal stage, moving from small-scale demonstration projects to commercial operations that can anchor a new blue economy for the state. Yet across every farm examined in this report, the same pattern emerges: large leases on paper are being used at a fraction of their potential, not because of biology or market demand, but because of anchoring inefficiencies. Farmers with 17–25 acre leases are often harvesting from less than one acre, leaving both economic and ecological value unrealized.

AnchorBot™ and helical anchoring systems offer a direct and scalable solution. By reducing scope requirements from 4:1 to 2:1 or less, helicals can free up two to four times more usable space within existing leases. This not only unlocks production potential — shifting harvests from tens of thousands to hundreds of thousands of pounds per farm — but also transforms the



economics of Alaska’s mariculture industry by lowering installation costs, reducing risk, and providing regulators with a low-impact, reversible anchoring option.

The implications go beyond individual farms. A shift to helicals would make it possible for processors to operate at scale, for shipping logistics to be rationalized, and for the broader mariculture ecosystem to mature into a reliable, high-volume industry. AnchorBot’s ROV installation capability eliminates the need for heavy equipment, divers, or barges, allowing farms of all sizes to access advanced anchoring technology at a fraction of the cost.

Taken together, the evidence presented in this report, from farmer case studies, technical validation, economic modeling, and logistical analysis, demonstrates that helical anchors installed by AnchorBot are not simply an incremental improvement, but a foundational enabler for the next phase of mariculture growth in Alaska.

The path forward is clear. By launching targeted pilot deployments, establishing regional hubs, and re-engineering AnchorBot for topside power to overcome logistical hurdles, Alaska can position itself as a global leader in sustainable mariculture. With support from farmers, regulators, and investors, AnchorBot can transform underutilized leases into productive water, strengthen local economies, and help build the resilient ocean farming systems needed for the decades ahead.

## **10. Acknowledgments**

We extend our sincere gratitude to Schmidt Marine Technology Partners for their generous funding, which has made this work possible. We also thank the Alaska Fisheries Development Foundation (AFDF) for their leadership in coordinating meetings with farmers and stakeholders, and for providing invaluable feedback and guidance throughout this process. Their support has been essential in shaping this effort into a collaborative path forward for Alaska’s mariculture industry.