CENTER FOR TROPICAL AND SUBTROPICAL AQUACULTURE

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Letter from the Director

Aloha and Happy New Year!

The year began with a dramatic example of just how much the world values seafood. At Tokyo's annual New Year auction, a single bluefin tuna sold for approximately $3.2 million. At 243 kilograms (about 536 pounds), that translates to nearly $6,000 per pound, making headlines while also highlighting an important truth: seafood may be prized, but it is not always accessible. At the same time, the USDA's latest dietary guidelines continue to encourage Americans to eat more seafood for its nutritional benefits. For most consumers, however, premium prices are out of reach. That's why affordable seafood matters, and why aquaculture plays such a critical role. By increasing production, aquaculture can help lower costs for consumers while also enabling the development of new, value-added products. Think of the growing demand for convenient, high-protein snacks for TV nights or game days; some companies are already producing seafood-based snack products to meet this market.

The Pacific Islands have tremendous natural resources, and with innovation, we can create a wider range of products derived from seafood. Doing so not only increases access and affordability, but also strengthens local and regional economies. With this goal in mind, our FY25 Plan of Work is coming together. We have recently received revised final proposals, which will be forwarded to the Board of Directors for a vote prior to final submission to the USDA. Several of these projects feature highly innovative approaches to aquaculture and strong potential for high returns on investment. I'm especially pleased that one of the projects we are involved in was highlighted in a recent UH newsletter; Dr. Du's work on "green gold" (culturing green algae) is already generating significant interest across the industry.

Looking ahead, demand continues to grow. U.S. retail seafood sales are projected to reach approximately $245.8 billion by 2026, with annual growth estimated at around 12%. This surge underscores the urgency of expanding domestic aquaculture production, rather than continuing to rely on imports. The global picture is telling. In 2025, Norway's aquaculture exports reached roughly $18 billion, while Vietnam's exceeded $11 billion. Not long ago, Vietnam looked to the United States for guidance on aquaculture development; today, its innovation has delivered substantial returns on investment. Aquaculture clearly presents enormous potential to increase revenue and GDP. If Hawaii and the Pacific Islands can capture even a small share of this opportunity, the economic impact would be significant.

Making this vision a reality will require collaboration, innovation, and sustained effort. The opportunity is there; let's work together to seize it.

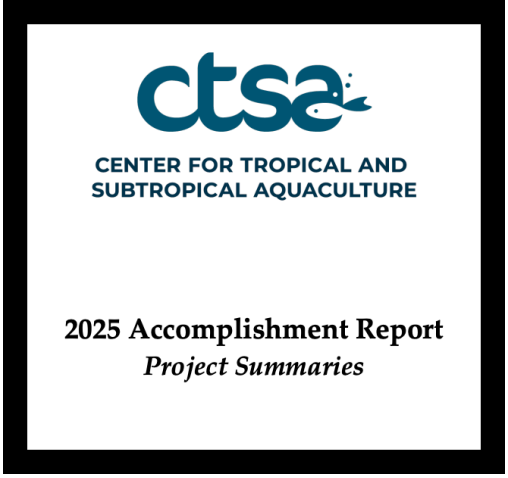
Mahalo,
Dr. Cheng-Sheng Lee
Executive Director, CTSA

NEW: CTSA 2025 Annual Progress Report 'Project Summaries'

As part of our NIFA reporting requirements, CTSA must submit a comprehensive Annual Accomplishment Report to the USDA. This 100+ page report features full progress reports of ongoing CTSA-supported projects, as well as final reports of projects that were completed during the calendar year.

In an effort to consolidate information for our stakeholders, CTSA has prepared a 2-page summary of each project that was active during 2025. These summaries are included as one part of the AAR that is being

sent to NIFA. Each summary provides a brief description of the project, as well as the anticipated benefits, impacts, and current progress of the work being done. **Click here to read the Summaries**.



CTSA Project Results: Developing Solutions for Larval Mass Mortality and Stunted Growth at the HOST Park

By Melissa DellaTorre
Pacific Hybreed

Pacific Hybreed and Hedros Bio collect samples for bacterial analyses.

Increasing frequencies of larval mortality events have resulted in major production losses and supply instability for some of the hatcheries at HOST (Hawaii Ocean Science and Technology) Park. Because larvae are a vulnerable early life history stage for most marine animals, water quality is critical to the success of the industry. In response to their own challenges with water quality, shellfish breeding and genetics company, Pacific Hybreed, conducted a 4-mo project, in collaboration with Hedros Bio, to identify causes of larval mortality and to develop practical mitigation strategies. Hedros Bio's specialization in microbiological technology and the development of bacteriophage-based solutions in aquaculture was pivotal in reaching the projects goals.

Mortality events in shellfish hatcheries have been often associated with elevated loads of bacterial pathogens, particularly *Vibrio* species, that persist in seawater. To identify the pathogenic bacteria present at HOST Park, the group conducted a thorough sampling across multiple points of the seawater system and a range of biological materials. By culturing samples on selective media, several bacterial genera were identified including *Vibrio, Pseudomonas, Aeromonas,* and *Shewanella*. Further efforts to differentiate species and strains isolated 27 bacterial strains, with 18 isolates identified as *Vibrio alginolyticus* and three as *Vibrio vulnificus*. To assess the virulence of these specific strains, laboratory challenge experiments were conducted to infect larvae, in which two isolates caused significant larval mortality (>60%) within 48–96 hours. These mortality rates were comparable to a known pathogenic reference strain. These results identified these two *Vibrio* strains as the likely contributors to larval losses observed at the hatchery, causing significant mortality within 48 hours, even at concentrations lower than those detected during larval rearing operations.

Following the identification of the virulent strains, three mitigation strategies were employed to control the presence of pathogenic bacteria; an ultrafiltration system, bacteriophage cocktails, and probiotic treatments (see tables below). Ultrafiltration is designed to remove particles much smaller than those removed from standard filtration systems used in most shellfish hatcheries. Typical mechanical filtration removes particles larger than 200 to 1000 nanometers (in diameter or shortest axis). In contrast, the ultrafiltration system is designed to remove particles larger than 10 nanometers, which in principle will remove bacteria before seawater is added to larval tanks. This test showed that the system, after iterative refinements, with continuous seawater flow-through and frequent cleaning, increased larval survival in some cases by over 60%.

The second approach entailed the use of bacteriophages - a promising solution in aquaculture to specifically target pathogenic bacteria. In this project, each pathogenic bacterial isolate was screened against a library of known bacteriophages. Different phage cocktails were formulated and tested based on

laboratory efficacy. These cocktails showed lytic activities against the highly pathogenic *V. alginolyticus* and *V. vulnificus*.

The third method used probiotic supplementation in algal and larval cultures. The addition of *Pseudoalteromonas* increased larval survival by 2-fold across multiple trials compared to larval cultures not receiving the probiotic, with the greatest benefit observed during early larval stages. Probiotics are a commonly used mitigation strategy against *Vibrio*, and the data collected support the beneficial effects.

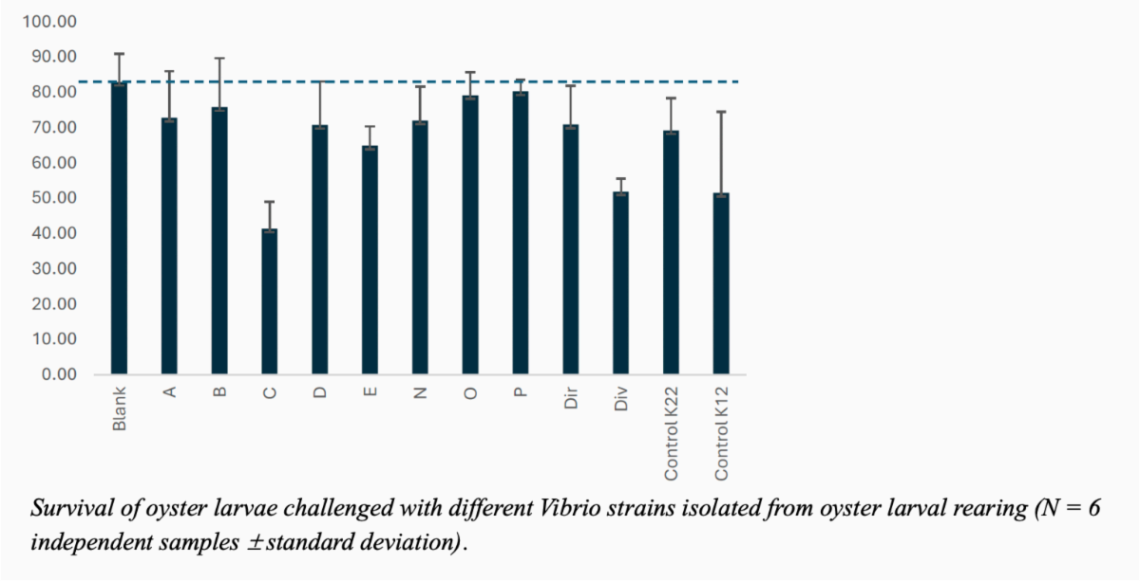
Implications for Hatchery Management

Standard-filtered seawater characterizations consistently show bacterial loads orders of magnitude higher than shellfish hatcheries in other regions, indicating that this high bacterial load is likely a key factor in water quality issues.

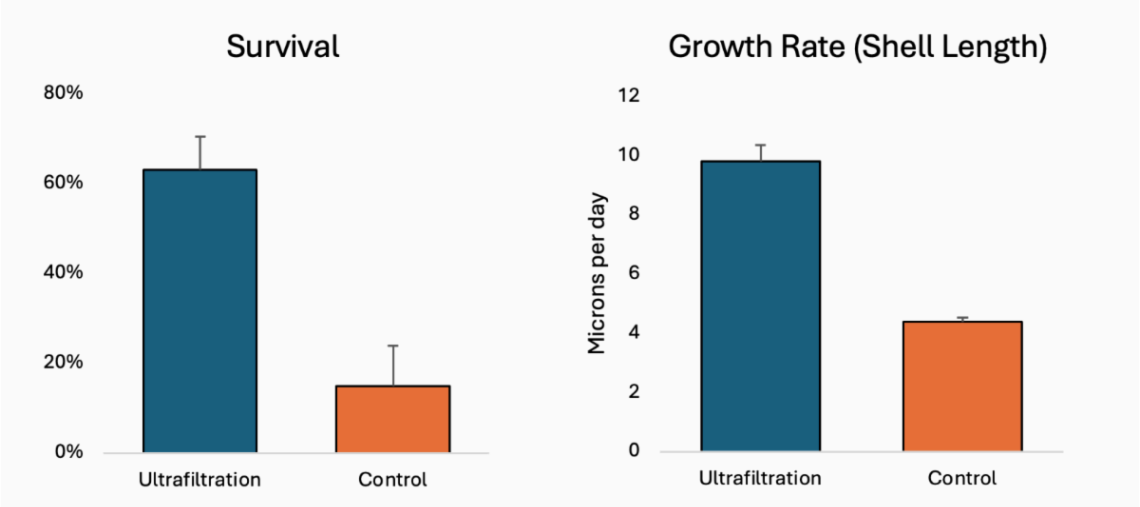
Mechanical filtration combined with the addition of beneficial biological materials showed significant improvements in larval rearing growth and survival. The study improved the understanding of pathogen dynamics in the HOST Park seawater by identifying key bacterial species and their sources at different seasonal time points. Effective mechanical filtration to remove harmful bacteria, combined with beneficial biological inputs, significantly increased larval growth and survival.

Ultrafiltration and probiotic supplementation emerged as reliable, scalable, and cost-effective solutions against the identified pathogens linked to larval mortality. Bacteriophage therapy shows promise as a targeted, environmentally responsible approach to pathogen control and may complement existing hatchery practices.

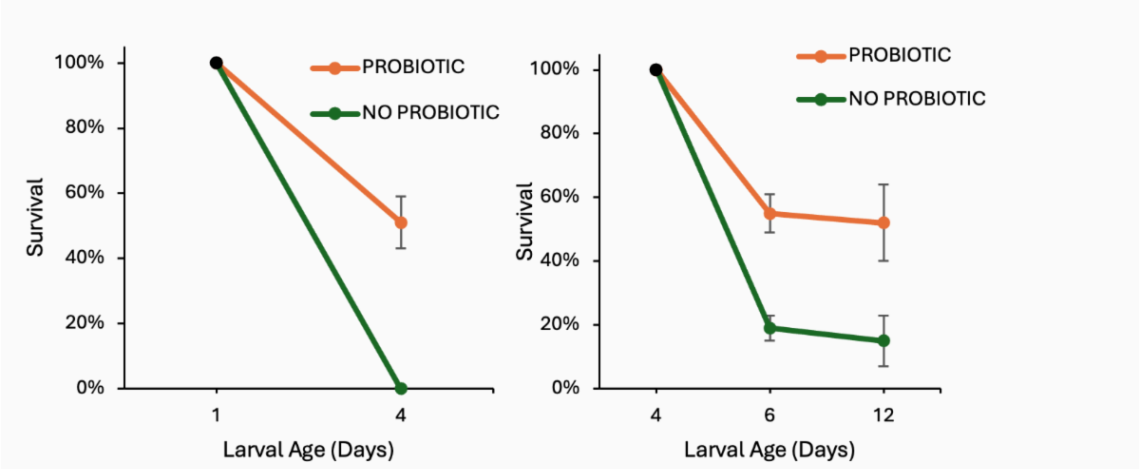
Overall, integrating pathogen monitoring with targeted microbial management strategies can increase hatchery resilience, reduce larval mortality, and improve production reliability. These findings support the development of sustainable, antibiotic-free approaches for shellfish aquaculture.



Survival of oyster larvae challenged with different Vibrio strains isolated from oyster larval rearing (N = 6 independent samples ± standard deviation).



Larvae had on average 4-fold greater survival and 2-fold higher growth rates from 7 to 21 days of age, when reared in the ultrafiltered seawater (100kDa) compared to standard control (0.35µm) filtered seawater. (Data shown from one cohort trial of three replicate tanks each).



Probiotic, Pseudoalteromonas, consistently demonstrated improved survival across controlled trials compared to no probiotic supplementation.

AquaClip: New Journal Article Highlights Aquaculture and Indigenous Knowledge Systems in Hawaii and the Pacific

Article Title: Reawakening Ancestral Ocean Technologies, Healing Communities, and Ensuring Intergenerational Food Sovereignty: Lessons from Indigenous Aquaculture
By Olivia Horwedel et al

Across the Pacific, coastal Indigenous Nations have been stewards of their environments for thousands of years, creating unique, geographically specific technologies and tending practices that increase abundance of diverse seafood, all while strengthening access to nutrient-rich food for generations. Indigenous technologies that increase food system productivity in coastal areas – known as Indigenous aquaculture – are rooted in intergenerational place-based knowledge and systems of governance. Indigenous aquaculture illustrates the deep relationality maintained between Indigenous Peoples and their environments for millennia. It is this knowledge and love for the land, water, and each other that inspires commitment to caretaking through a sense of responsibility and kinship. In the Hawaiian language, this can be reflected in the concept of aloha ʻāina and is aligned with the Haida principles, ʹlaa guu ga kanhllns (responsibility) and gina ʹwaadluxan gud ad kwaagid (everything is interconnected). In all our places, our cultures tie us to the ecosystems we manage...

Hawaiʻi Fishponds
Loko iʻa are ancestral ocean technologies designed to sustain substantial human populations through supporting and modifying natural ecosystems to increase seafood availability. Hawaiian oral tradition attributes the invention of the first loko iʻa to Kūʻula, a fisherman with skills so great that they were considered supernatural. Loko iʻa are diverse systems that draw upon the natural features of specific nearshore ecosystems. Many loko iʻa are built along coastlines with freshwater inputs, often with rock walls that encircle a nearshore area to create a contained water body (Figure 1). Interspersed among the rock walls are mākāhā, or sluice gates, which control the flow of water, nutrients, and fish into the loko iʻa. The slats of the mākāhā allow for size selection of small, young fish to enter the system while preventing more mature fish from escaping the pond – creating a sustainable harvest within the loko iʻa. Additionally, the gates allow for oxygen to continue flowing into the pond and ensure water circulation. While loko iʻa are self-sustaining, stewardship is integral to managing the fishponds and ensuring consistent stock to feed the community. Researchers have estimated that prior to the arrival of James Cook in 1778, the Hawaiian archipelago was home to at least 488 loko iʻa that could produce about 136 kg of herbivorous fish per acre per year. The targeted species for many loko iʻa systems include various herbivorous fish such as moi, awa, amaʻama, and ʻāholehole...**click here to read full article**.

Source: The Journal of Ocean Technology, V20N4 - Indigenous Ocean Technology: Priorities and Practices [2025] // Full Article

This newsletter is written and prepared by the CTSA Information Specialist Meredith Brooks.
The Center for Tropical and Subtropical Aquaculture (CTSA) is one of five regional aquaculture centers in the United States established and funded by the U.S. Department of Agriculture's National Institute of Food and Agriculture (NIFA) under active grants 2020-38500-32559, 2022-38500-38099, 2023-38500-40707, and 2024-38500-42306. The regional aquaculture centers integrate individual and institutional expertise and resources in support of commercial aquaculture development.

CTSA was established in 1986 and is administered by the University of Hawaii.

Center for Tropical and Subtropical Aquaculture
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