CENTER FOR TROPICAL AND SUBTROPICAL AQUACULTURE

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Letter from the Director

Aloha,

Photo of Guam hatchery by Dr. DH Jiang

I hope your new year is off to a productive start! CTSA is preparing to close out our FY24 development process and begin FY25 development later this spring. We are happy to see the FY24 Plan of Work coming together nicely --having received revised proposals last week-- and are preparing for the final steps where our Board of Directors will meet to discuss and approve the package of proposals to then send on to the USDA for final review. I am looking forward to the good work that will be done under this PoW. However, I would like to see more projects coming out of the Western Pacific islands in our next development cycle.

On that note, I traveled to Guam earlier this month to engage our partners in the region. Turnover in aquaculture personnel is common throughout the Western Pacific islands, and the goal of my trip was to meet with newly-assigned colleagues to learn more about the current status and potential for realistic industry development on these remote islands. It is important for our region to produce seafood to meet growing demands for animal protein. The Dutch financial services firm Rabobank anticipates that seafood will soon overtake poultry as the top contributor to global animal protein needs; we should utilize our abundant and unique regional marine resources to take a more active role in farming fish and other species.

Over the past four decades, CTSA has supported efforts in aquaculture research, development, and extension across the Western Pacific region. Long running projects to farm locally important species such as giant clam, pearl oysters, sea cucumbers, rabbitfish, and mangrove crab have seen great initial success, only to fall by the wayside when priorities shift with personnel changes. This is a unique regional challenge that we have discussed for decades. CTSA is looking forward to partnering with other entities in the region to overcome this and other challenges.

If we truly want aquaculture to be successful as an industry in the region --and I believe we do, as aquaculture provides food security, economic growth, and environmental benefits-- we must work together to develop a realistic path forward that both builds on previous work and efficiently utilizes our regional assets. These assets include the technical expertise of Hawaii's aquaculture researchers and industry, who have participated in many CTSA projects to transfer valuable technologies to remote islands.

I am optimistic about building this pathway together with communities, researchers, and decision makers across the Western Pacific region. It is evident now more than ever that we must work together to see the industry progression we all desire. I look forward to joining with you to carry out this important mission.

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

CTSA 2024 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 2024. These summaries are included as one part of the AAR that was 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. The following are brief highlights from some of the ongoing projects:

Developing Affordable and Efficient Photobioreactor and Biofiltration Systems with Fungal Filters to Grow and Harvest Microalgae
P.I. Zhi Yan (Rock) Du, University of Hawaii at Manoa CTAHR
Microalgae and their naturally occurring derivatives are an increasingly promising source for sustainable materials and marketable bioproducts. Microalgae has a particular utility as a food, feed resource, and nutraceutical supplement with regard to the provision of fatty acids, β-carotene, and astaxanthin, to name a few. An economical and environmentally friendly method to harvest microalgae is needed to meet the demand for the booming algae market. Inspired by the observation of algae aggregates in fungi-contaminated culture, researchers have developed a high efficient flocculation method using fungal mycelium. In this project, with the algal culture from the newly designed PBR, researchers are developing a BioCube system using natural fungal filters (mycelium incubated with optimized media for best performance). The combination of PBR and BioCube will provide an affordable, efficient, sustainable, and environment-friendly solution for aquaculture and algal industries. During Year 1 and into Year 2, the research group has focused on designing and developing prototypes of Smart PBR with controls of various growth conditions, including light, temperature, CO2/oxygen, pH, nutrients, and monitoring modules. They have finished the essential modules such as lights, and have made good progress in testing and optimization. They are working on other control modules like sensors to continue improving the prototypes, including sensors to help monitor nutrients, which is challenging. They have developed an automatic cell counting app to monitor the cell concentration of the PBR cultures. The project also achieved a major improvement in fungi cultivation to further develop the fungal filters. The group aims to develop even more affordable prototypes with increased durability that can be used for additional applications; they are working with solar panels and other new technologies to improve the systems. One of their prototypes uses a 5 gallon water bottle and costs less than $100.

Next Steps in Culture of Native Hawaiian Macroalgae: Scale-up and Market Analysis
P.I. Karla McDermid, University of Hawaii at Hilo PACRC
Although Native Hawaiians are believed to have used over 60 species of macroalgae (limu), only three species are routinely consumed in Hawaii today. Developing aquaculture methods for native macroalgal species will provide opportunities for industry development, provide nutritious food sources, and maintain unique local traditions. Additionally, many seaweeds can be used as ornamentals, fish foods, nutraceuticals, and for cultural purposes. The purpose of this project is to build on previous CTSA-funded work to develop reliable culture methods for *Caulerpa lentillifera*, *Codium edule*, and *Asparagopsis taxiformis*, and do so in a manner to protect Hawai`i's interests. In addition, the research group is working to scale-up production of *Halymenia hawaiiana* (red sea lettuce), and assessing market demands for limu in Hawaii. During Year 3, the project work group completed the first market study for non-*Gracilaria* species in Hawaii, providing statistically analyzed data about the demand and market size of *Caulerpa lentillifera, Halymenia hawaiiana*, and dried *Halymenia*. Among the species surveyed, *Halymenia h*. is the highest in purchase intention, and *Caulerpa l*. is relatively lower in purchase intention. All products are considered “high-quality” products. Dried *Halymenia* was perceived as the product with the highest price, while *Caulerpa l.* was perceived as the product with the lowest price. Cultivation of both species has been successful in 400 L and 560 L tanks. During Year 4, the research group has been focused on scaling up but have had to mitigate an issue with their tanks (described in the Challenges Encountered section). They have resolved the issue and started scale-up experiments in three 3500 L conical tanks in the oyster hatchery barn. Stocking density was 3.8 kg/ 3500 L tank. Thus far, they have determined that conical and tubular tanks are better for growth rates, which may be light-related.

CTSA Nanobubble Project Outputs: Video and Conference Abstracts

The recently completed CTSA project "Development of a State-of-the-art Aquaculture and Aquaponic System: Integrating Biochar Filtration and Nanobubble Technology" developed a state-of-the-art aquaponic system marrying two innovative strategies: nanobubble technology and biochar. The

research team hypothesized this combination could significantly increase plant and fish yields, and stocking densities through amelioration of aqueous phase DO and improvement in water quality.

The integration of these novel technologies holds the potential to enable a highly efficient and climate-smart aquaponic/aquaculture system, which may have significant beneficial effects on both the industry and the wider community including farmers and stakeholders.

Over the course of the project, the work group built and operated four floating raft aquaponic systems with multilayered biofilters. Through a series of trials, the group monitored key parameters such as plant and fish yield, as well as water quality indicators such as pH, DO levels, nitrate, nitrite, TAN, and COD. The trials found that integration of biochar and NB technology enhanced plant yield; these results will serve as a useful dataset for comparative analysis, enabling the establishment of benchmarks for previous research efforts and local commercial aquaculture/aquaponic systems. Furthermore, leveraging the baseline data obtained from this CTSA-funded study, the research team has successfully submitted other research proposals aiming to optimize NB technology applications, while exploring fundamental underlying mechanisms, for maximizing the performance of aquaponic systems.

As part of their outputs, the project published research papers and review articles, presented findings at national and international conferences, and created a video to share the state-of-the-art technology within the local aquaponic and aquaculture industries. Student participants presented the project results at NANOBUBBLE 2024, held in Japan. The conference focused on nanobubbles, nanodroplets and their applications, and the student presentations were on the following subjects:

- Nanobubble technology can improve mass transfer of CO2 for algal cultivation
- Application of Nanobubbles and Biochar in Aquaponics: Effects on Plant Yield and Water Quality
- Biochar as an Alternative to Plastic-Based Biofilter Media in Aquaponics

Click here to read / download the presentation abstracts

2026-2028 Hawai‘i Sea Grant Requests for Proposals

The University of Hawai‘i Sea Grant College Program (Hawai‘i Sea Grant) is requesting preliminary proposals for funding available beginning February 1, 2026 and ending January 31, 2028. Click here for more information. For this competitive research cycle there are four research tracks for which Investigators can submit a proposal. Please note that the Indigenous Science research track has *different eligibility, evaluation, and selection criteria* from the other research tracks.

- Island Sustainability and Resilience (pre-proposals due Feb. 21, 2025)
- Aquaculture (pre-proposals due Feb. 21, 2025)
- Contaminants of Emerging Concern (pre-proposals due Feb. 21, 2025)
- Indigenous Science (statement of interest due Mar. 7, 2025)

AquaClip: Seeking blue futures: Can aquaculture take a leading role on island nations?

On the islands and atolls of French Polynesia, black pearls have been cultivated from the black-lipped oyster (Pinctada margaritifera) since the 1960s. These pearls, renowned for their beauty and uniqueness, are French Polynesia’s second-largest source of income, creating jobs and generating national wealth.

However, pearl oyster production has been exposed to several environmental changes and mortality events over the years. At the same time, French Polynesian food is heavily influenced by the natural abundance of seafood, and the Polynesians are particularly fond of oysters.

Against this backdrop, scientists in the town of Vairao in Tahiti have been investigating the possibility of farming other species of oysters, namely the tropical rock oysters Saccostrea echinata and Saccostrea cucullata. In the 1960s, the first attempts to do this were made by collecting spat from the wild and growing

them to maturity. A series of hatchery trials and grow-out tests followed in the 1970s and 1980s but were unsuccessful as farms were hit hard by the parasitic worm Polydora sp., which burrowed into the oyster shells, making them unfit for sale. As a result, all farming trials were abandoned in the mid-1980s.

The French Polynesian environment is also a challenge. “It’s oligotrophic and poor in nutrients, so species like the tropical rock oyster grow slowly,” Guillaume Mitta, professor and researcher at the French national institute for ocean science and technology (IFREMER), told the Advocate. “This species also tends to reproduce very early, so its growth can be compromised.”

Mitta and his team are part of a group of scientists from Australia, New Zealand and New Caledonia who are working on two research programs – the Ostreapol and Ostreapac projects – to establish land-based tropical rock oyster farming in Tahiti. Working with two species from the Saccostrea genus, the team is also looking at the use of a technique called triploidization, which, if successful, would be a world-first for tropical rock oysters. The work stems from the World Aquaculture Congress, which was held in Darwin in May 2023, and included a workshop on tropical rock oyster farming.

“Triploidization takes place in the first hour of development, just after fertilization,” said Dr. Julien Vignier, aquaculture researcher at the Cawthron Institute in New Zealand. “It is widely used in agriculture to produce higher quality, seedless crops, such as bananas, watermelon or grapes. In oysters, early sexual maturity hinders their growth and makes them milky, but if they can no longer produce gametes, this milky phase can be avoided and they can channel their energy into growing faster instead. The result is that they will arrive on tables more quickly and be good to eat year round. So far, we have had very promising results, which is encouraging for the development of Tahitian oyster farming.”

One challenge faced by French Polynesia, as well as other tropical regions and islands across the South Pacific, is the difficulty of acquiring economic and food independence. Each year, French Polynesia imports around 120 metric tons of Pacific oysters (Crassostrea gigas) from France and New Zealand, said Vignier, but this generates a significant carbon footprint. The Ostreapol and Ostreapac projects are aiming to establish oyster farming for local consumption, to provide communities with a steady food supply. Climate change impacts and unemployment are other hurdles, but hopes are high that oyster farming can address these and improve community resilience.

Farming oysters also has other benefits, said Mitta. “They have a low environmental footprint and are full of nutrients compared to other food sources,” he said. “The demand for oyster farming is also rising around the world. But despite good potential for development in more tropical areas, it is almost exclusively carried out in temperate latitudes. Efforts to produce oysters locally in Tahiti are particularly welcome, because they are a popular delicacy and the island needs to reduce air transport from France or New Zealand, because that has huge knock-on environmental effects.”

“Oysters have bioremediation capacities, while farming them brings other possibilities,” added Cristián Monaco, a researcher at IFREMER. “For example, by co-culturing oysters and shrimp in land-based systems, we can prevent organic waste from leaking into the environment. We can also use the effluents from shrimp aquaculture to generate blooms of single-celled algae that can feed the oysters. This limits the escape of large quantities of nutrients that can destabilize tropical-reef ecosystems and environments like lagoons.”...

Source: Global Seafood Alliance // Read 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 and 2022-38500-38099. 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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