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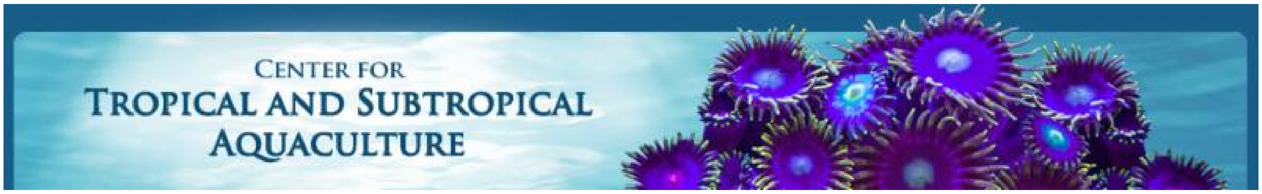

Letter from the Director

Aloha,

I just returned from a very productive trip to the mainland with my IMTA-group colleagues from Korea and the United States. We toured facilities in New England and Southern California, observing how researchers are integrating various species into multi-trophic aquaculture. In addition to yielding multiple products, IMTA systems efficiently use all of the excess nutrients from fed aquaculture, thereby diminishing the ecological footprint of production. This technology has great implications here in the U.S., and I hope to see more of it going forward.

Aside from our IMTA-specific activities, we also toured the Long Beach aquarium and discussed their upcoming plans to house an education exhibit in collaboration with NOAA. The exhibit will inform visitors of the positive impacts that aquaculture can have on our communities, the environment and the economy, and I look forward to a promising partnership with the aquarium. One of the personal highlights of the trip was a meal we enjoyed at Miya's Sushi in New Haven CT. The philosophy behind this affordable fine dining establishment is to serve creative dishes made with invasive species and other underutilized yet abundant foods. Chef Bun transforms something that most people would consider to be of little or no value into a nutritious and delicious meal. This concept prompted me to think about CTSA and our FY15 development process. Instead of focusing on the constraints of our small regional industry, I would like to encourage our industry members and researchers to consider the unique opportunities we have here, and how CTSA can utilize them to make the most effective contribution to regional aquaculture.

If you have any suggestions about research and development priorities for our FY15 development cycle, please email them to mbrooks@ctsa.org by April 10. *Click here if you would like to view last year's priority areas for reference*. As always, if you have any questions, comments, or suggestions, please do not hesitate to contact us.

Mahalo,
Cheng-Sheng Lee
Executive Director, CTSA

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CTSA Project Update: Aquaculture Potential of Hawaiian Polychaetes

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Worldwide shrimp aquaculture production has increased dramatically over the last two decades with yearly production currently >4.4 million metric tons (FAO 2013 Fisheries Statistics). The availability of domesticated and genetically improved penaeid shrimp stocks (primarily *Penaeus vannamei*) has been a primary driver of increased production. Shrimp aquaculture is almost exclusively based on captive reproduction. This requires the conditioning and maturation of broodstock shrimp to stimulate gonadal development and induce mating, spawning, and ultimately the hatching of eggs to produce viable larvae. Broodstock diet is significant in the maturation process, especially in stimulating ovarian development in females. Hatchery managers typically feed broodstock a mixed diet of raw, wet feeds with marine polychaete worms being a major component. Because penaeid shrimp have a limited ability to synthesize the n-6 and n-3 families of fatty acids *de novo* or to elongate and de-saturate these into highly unsaturated fatty acids (HUFAs), high concentrations of these important HUFAs found in the ovaries of female broodstock have been attributed to the dietary intake of HUFA-rich items, such as marine polychaete worms.

Figure 1. Marphysa sanguinea cultured at Oceanic Institute

Hawaii is a world leader in the supply of specific pathogen free, selectively bred *P. vannamei* broodstock. It is estimated that >5,000 kg of frozen marine polychaetes are imported into Hawaii annually to support shrimp breeding activities (cost > $200,000 per year). The primary sources are wild-caught *Glycera dibranchiata* from Maine, USA (~$50/kg including freight) and cultured *Nereis virens* from the Netherlands (cost ~$33/kg). Major shrimp farms in Asia and Central America typically use live wild-caught and/or cultured local polychaetes, because they are cheaper (<$10/kg) than frozen worms and female shrimp broodstock perform better (e.g. more nauplii per spawn, stronger nauplii) when feed live worms. Importing live worms from Asia (or elsewhere) is not a viable alternative to imported, frozen worms for Hawaii hatcheries due to biosecurity risks posed by viral pathogens and transportation costs. Thus, having a local source of live polychaete worms could potentially reduce worm costs, reduce/eliminate worm imports, and improve production efficiency in Hawaii hatcheries.

With funding from CTSA, Oceanic Institute of Hawaii Pacific University (OI) has begun accessing the aquaculture potential of several species of locally available polychaetes. To date, several species of polychaetes have been collected from various locations around Oahu including He'eia Kea state park, He'eia Kea boat harbor, Waiāhole beach Park, Maunalua Bay, and Pearl Harbor. Five species of polychaete were found to be of acceptable size (adults ≥5 cm in length) and in high abundance: *Marphysa sanguinea* (Fig. 1), *Lumbrineris japonica, Sabellastarte spectabilis, Malacoceros indicus*, and *Chaetopterus variopedatus*.

Collected worms were screened for the presence of White Spot Syndrome Virus, Taura Syndrome Virus, Infectious Hypodermal and Hematopoietic Necrosis Virus, and the bacterium causing Early Mortality Syndrome. Screening was accomplished by insulated, isothermal loop-mediated PCR (iiPCR) using the POCKIT pathogen screening system (GeneReach, Taiwan). Primer kits were designed for screening shrimp tissue, but we have experimented with different methods to optimize this system for screening non-shrimp species. Secondary disease screening was performed on shrimp maintained in the effluent water from the polychaete culture tanks and/or shrimp that consumed the cultured polychaetes. To date, all polychaete and shrimp samples have tested negative for the four shrimp pathogens.

All candidate species have been successfully cultured for >30 days, with a population of *M. sanguinea* being cultured for >200 days. This population currently includes more than 100 adults and 400 juveniles. At this stage, worms are housed in small baskets lined with mesh bags to retain sediment and worms. Culture baskets are placed in a tank receiving flow-through seawater and aeration from airstones to maintain water quality. Worms are fed small quantities of shrimp feed (crumble).

Figure 2. Larval M. sanguinea estimated to be four days old.

Figure 3: Juvenile M. sanguinea estimated to be two weeks old.

M. sanguinea larvae and juveniles have been collected from the culture system (Fig. 2 and 3). These collections were made >3 weeks after the last introduction of worms to the culture system, which provides strong evidence that the worms are spawning in culture. Larvae and juveniles (post-settlement) of three size classes have been collected, suggesting that there has been multiple spawning events and that larval settlement for this species will not be a major impediment to captive reproduction. A simple larvae/juvenile collection system has been setup (i.e. effluent passes thru a fine mesh filter bag), so that reproductive output and spawning trends of this species can be determined.

Due to its large size, high abundance in near-shore environments on Oahu (easy to collect founders/breeders), high survival in culture, and the apparent ease of captive reproduction, *M. sanguinea* has been selected as the primary candidate for culture. In addition, preliminary palatability screening of the collected polychaete species has revealed that shrimp responded most favorably to *M. sanguinea* with both a rapid attack time and complete consumption of the worm.

Additional studies will be performed to compare palatability of wild-caught *M. sanguinea*, cultured F1 *M. sanguinea*, and frozen, wild-caught polychaetes (from Maine). Nutrient and lipid concentrations will also be compared. Efforts will continue to further characterize reproductive output, larval development/settlement, and growth of *M. sanguinea*.

Reminder: 2015 Fish 2.0 Business Competition Now Open!

The following announcement about the launch of the 2015 Fish 2.0 Business Competition is excerpted from the Fish 2.0 newsletter. CTSA stakeholders may be eligible to participate as a competing aquaculture business, or register to serve as an advisor or online judge during the course of the competition. Participants must register and complete the Phase 1 questionnaire by April 27, 2015. Visit www.fish20.org for more information.

This year, businesses from around the world will compete for over $180,000 in cash prizes. 36 finalists will present their ideas to a broad group of investors during the competition finals at Stanford University. Fish 2.0 provides businesses with an opportunity to gain visibility, find strategic partners, and ultimately garner new investments in the range of $100,000 to over $10 million. Investors who participate as advisors or judges see a number of seafood businesses in one place and learn more about the seafood sector.

The 2015 competition will offer three tracks for businesses to compete with their peers. For details on these tracks and on specific business eligibility, click here to view the 2015 competition details on the Fish 2.0 web site . You can also register for the competition by going to the "Participate" section on the same link.

Fish 2.0 Upcoming Events and Webinars

April 14: Filling out your Fish 2.0 Entry Application Successfully
This webinar led by the Fish 2.0 Team, will guide you through the Fish 2.0 entry application for each of the three competition tracks. We will answer questions about how to complete the application and explain why each section of the application is important.

AquaClip ~ Hawaii ~ Partnership looks to make open-ocean aquaculture commercially viable

by Chelsea Jensen, West Hawaii Today. March 26, 2015

The world's largest defense contractor, Lockheed Martin, is teaming up with NELHA-based Kampachi Farms on a venture to make open-ocean aquaculture commercially viable. Forever Oceans, as the venture's termed, will take to the next level Kampachi Farms' mobile fish pen system, known as Vellela, which recently wrapped up research and development, by enhancing the means for monitoring and controlling the at-sea apparatus and creating a commercial demonstration project, Kampachi Farms co-CEO Neil Sims tells West Hawaii Today.

"We've gone and done the research. We've proven there is tremendous and phenomenal potential, and now it's time to move forward," Sims said. Kampachi Farms is a six-man outfit that uses open-ocean fish cages to raise fish reared at the company's headquarters at the Natural Energy Laboratory of Hawaii Authority in Kona.

And, moving forward means testing the company's technology on a commercial scale, which is where Lockheed Martin comes into play.

"Some of the things that are being done at Kampachi are quite novel, but really taking advantage of technology robotics, satellite communications, command and control - things that are right in Lockheed Martin's wheelhouse - could enable what you think of essentially a farming operation in the sea," Lockheed Martin Chief Technology Officer Keoki Jackson, a native of Oahu's North Shore who oversees the corporation's advanced technology strategy and the maturation of future innovations, told West Hawaii Today.

Click here to read the full article.

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 2010-38500-20948, 2012-38500-19566, and 2014-38500-22241. The regional aquaculture centers integrate individual and institutional expertise and resources in support of commercial aquaculture development. CTSA was established in 1986 and is jointly administered by the Oceanic Institute and the University of Hawaii.

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