CENTER FOR
TROPICAL AND SUBTROPICAL
AQUACULTURE

Letter from the Director

Talofa and Happy Earth Month!

As part of the ongoing project "Adaptation of Aquaponics Systems for Use in the Pacific Islands," CTSA conducted a two-day workshop "Food Security and Self-Sufficiency in American Samoa" in collaboration with the American Samoa Department of Agriculture, Department of Marine and Wildlife Resources, and AS Community College. Over 40 enthusiastic farmers and community members attended the free event last week; I would like to take this opportunity to thank our partners for their hard work to make it a success.

CTSA workshop participants visit Apela Afoa's aquaponics farm in Taputimu, American Samoa

The workshop coincided with Earth Day and as such, an important theme was good stewardship of our natural resources. As good stewards of our planet, it is our responsibility to innovate and incorporate sustainable technology and development in our communities. Aquaponics is an energy-efficient method of farming that conserves water and recaptures and utilizes nutrients that are lost in traditional aquaculture. It also appeals to wide range of people, and is thus a potential catalyst for tangible change in the region. I am very pleased with the positive feedback we received at the workshop, and I am hopeful that more farms and farming-related initiatives will develop in American Samoa as a result of the outreach.

An article in the May issue of e-Notes and a forthcoming video will summarize the event in detail. In the meantime, do not hesitate to let us know if you have any suggestions, questions, or concerns. Also,

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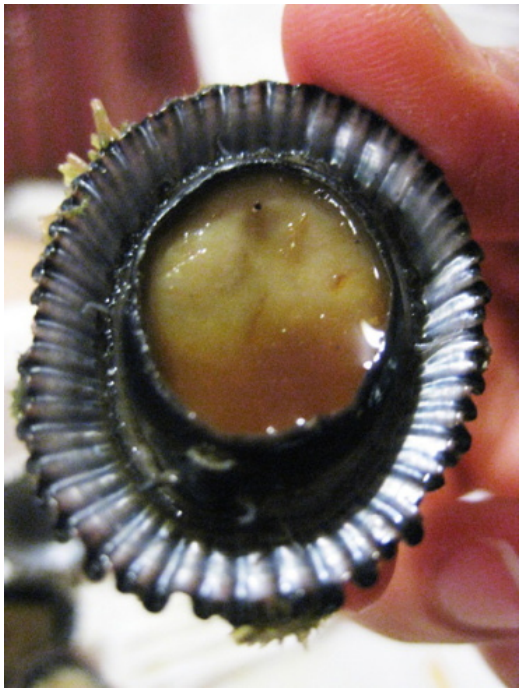
keep an eye out for our video highlighting the ongoing CTSA Bivalves project (to be released prior to May e-notes).

Mahalo,
Cheng-Sheng Lee
Executive Director, CTSA

Project Summary: Aquaculture of Opihi

Project Co-PI's: Dong-Feng Deng and Harry Ako. Graduate Assistant: Nhan Hua



Opihi are a cultural icon and a seafood of very high market value and potential. However, increases in human population and subsequent intensive harvesting have led to scarcity of the limpets in many areas of the Hawaiian Islands. The major annual commercial catch decreased significantly from 68,000 kg in the 1900s to about 4,500 kg in 1978 (Iacchei 2011). The scarcity has driven prices up to about $150/gallon shell on.

Therefore, this project aimed to develop aquaculture of the opihi as a means to alleviate pressure on wild stocks and increase the market supply. The objectives were to capture and culture the animals, and introduce them in the Hawaiian market. Although the initial goal of closing the life cycle has yet to be attained, the project achieved success in capture, spawning, and larval rearing to Day 9.

The first objective of the project was to collect broodstock and develop a holding facility. It was originally thought that the holding facility for opihi would be limiting. Previous work used vertical hemispheres onto which seawater was sprayed or huge ebb and flow tanks. In the present work, opihi were held in containers with limited water circulation. However, removing opihi from surfaces turned out to be the greatest challenge. They clung to rocks or tanks so strongly that collecting them or moving them from tank to tank without killing them was difficult. Removing them from rocks during collection initially led to 58% mortality, while removing them from aquaria or tanks to transfer to another aquarium or tank initially resulted in 42% mortality. To address this issue, our team adjusted collection methods to be more careful and use smoother instruments. In addition, we changed the holding tanks to soft plastic containers with holes in the plastic (so the animals could not stick strongly). Upon this revision of collection and holding techniques, we were able to achieve 83% survival during collection and little mortality during transfer between tanks.

The next objective of the project was to confirm the feeding habits of opihi and subsequently develop an artificial feed. An issue that arose immediately after capturing the opihi was starvation leading to mortality within a week of capture. Thus, feeding preference of opihi in the wild was determined by stomach content analysis. Ten giant opihi that died immediately after collection were frozen to interrupt gut content digestion. Each animal was carefully dissected and gut contents were fixed in 5 mL of 4% formalin. Stomach contents contained benthic diatoms (about 30% of the material seen), bacterial clumps and other un-identifiable particles. Twenty diatom species were seen; the most frequently seen were the benthic diatoms Bacillariasp., Fragilariasp., Melosirasp., Navicula sp., and Rabdonema sp. To develop

Opihi stomach samples were analyzed to determine natural diet

Navicula sp.; and Rabdonema sp. To develop appropriate conditions to support life, aquaria were covered with the plastic sheets and supplied with open running seawater (approximately 15 Lmin-1) that had been filtered with a sand filter, and placed outdoors where they were also exposed to ocean spray and the sun. Biofilm grew spontaneously, and was analyzed to determine that it contained many of the diatoms required to sustain opihi. Thus, biofilm was used for holding animals between feeding trials, and played a key role in the development of artificial feeds.

Artificial feed development was an essential step of this project. Initial feed trials were conducted with sea urchin feeds, but results were questionable due to low survival rates. The subsequent trials were conducted with diets containing a fish meal and soybean meal base to represent marine carnivore sensory cues, while another diet contained herbivore sensory cues. Potential feeding stimulants such as GABA, DMPT and Spirulina did not improve feed consumption or raise feeding frequency. However, a diet incorporating biofilm was significantly preferred and the animals ate relatively frequently, while diets containing Spirulina instead of biofilm were not as well eaten. Also, optimal protein and carbohydrate levels were found to be 27% and 32%, respectively; these requirements might be typical for other herbivores. An artificial diet of Porphyra, fish meal, soy meal and krill proved to support good growth rates (0.44% per day) as a consequence of good feed consumption (0.73% dry matter/bodyweight/day); krill meal was an added palatability factor. The diet tested well and one animal survived more than 45 days and increased in size as a result of regular consumption. It was determined that this diet was the most effective and would yield commercial growout times of about a year for opihi. Animals have been held in the laboratory for this period of time.

Towards the end of the project, final maturation was studied and diets containing arachidonic acid to eicosapentaenoic acid ratios of 0.7 were found to have potential for final maturation during the spawning photoperiod. Traditional spawning methods using hydrogen peroxide were studied and found to be lethal to broodstock at levels that were effective in inducing spawning. GnRH was better at inducing spawning. Finally, larval rearing met limited success up to Day 9 of life using pelagic and benthic microalgae. Additional research on final maturation, spawning, and larval rearing is required to successfully culture the limpet.

The primary impact of the project is providing critical first steps in the development of aquaculture of opihi. The project has paved the way for researchers to close the life cycle of the species and work on commercial aquaculture of the species. In addition, aspects of the feed research might be applicable to abalone as well, and optimization of protein and carbohydrate levels may relate to other aquatic herbivores.

Aquaculture Announcements

CTSA In the News
CTSA's American Samoa aquaponics workshop was featured in a recent news article in the Samoa News. Click here to view the original article.

samoa news

2014 Farm Bill Fact Sheet Available Now
The 2014 Farm Bill, signed by President Obama on February 7, 2014, updates certain requirements and modifies several loan programs administered by the Farm Service Agency (FSA). Click here to download a fact sheet containing details on these updates and modifications

AquaClip ~ Monterey Bay Aquarium Seafood Watch Recognises BAP Farmed Shrimp Standards

By The Fish Site Staff www.thefishsite.com. April 23, 2014

Two-star Best Aquaculture Practices (BAP) shrimp standards of the Global Aquaculture Alliance (GAA) are equivalent to a yellow "Good Alternative" rating from the Monterey Bay Aquarium Seafood Watch® programme. Seafood Watch will recommend that consumers, chefs and businesses consider farmed shrimp assessed under the BAP standards as a "buy" option.

The determination came after an extensive evaluation of BAP farm standards for finfish and crustaceans conducted by the Seafood Watch science staff. The process of benchmarking existing eco-certification programs against Seafood Watch criteria began more than two years ago when Seafood Watch business partners sought guidance in navigating a marketplace of proliferating global eco-certification programmes.

In order to meet the Seafood Watch "Good Alternative" recommendation bar, the GAA strengthened its certification requirements for habitat mitigation, water discharge and escapes.

"This is a landmark recognition for the BAP certification programme," said Peter Redmond, BAP vice president of market development. "We have strived for years to deliver high-quality seafood to the marketplace that is farmed in a responsible way."

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 grants 2008-38500-19435, 2010-38500-20948, and 2012-38500-19566. 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.