Vol. 15 No. 2 June 2004
ISSN: 1053-590X

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REGIONAL NOTES
CENTER FOR TROPICAL AND SUBTROPICAL AQUACULTURE

CTSA holds first semiannual Board of Directors meeting in Guam

CTSA's Board of Directors held its first semiannual meeting on Friday, June 25, 2004 in Mangilao, Guam. At its previous meeting on January 15, the Board approved the establishment of semiannual meetings. This would allow them to more readily address issues and have better access to information.

The main purpose of the Board meeting was to appoint members to the newly reorganized Industry Advisory Council (IAC). The Board appointed 20 members to the council. The members' names will be posted on the CTSA Web site and announced in the next issue of the *Regional Notes*.

CTSA's Board of Directors and staff visit with aquaculture industry members in Guam. L–R: Reza Kamarei, Harry Ako, Jo-Ann Leong, Bennie San Nicolas, John Bernardo, Michael Wang, Cheng-Sheng Lee (center), Debra Sasaki, John Brown, Rick Spencer, Frank Toves, Brian Mizusawa and Peter San Nicolas.

Meeting highlights included the creation of a new initiative to formally gather regional aquaculture information for program planning and development, the change of the IAC Chair's status from non-voting to voting member of the Board and the reinforcement of the position that CTSA projects should not use research by-products to compete with commercial companies.

The meeting took place at the University of Guam's College of Natural and Applied Sciences in the morning and the Ladera Tower condominium and hotel in the afternoon. A day-long power outage meant the Board conducted its meeting without overhead lighting and full air conditioning. However, enough sunlight filtered through the windows, particularly the floor-to-ceiling windows at the Ladera Tower, to aid visibility and produce a soothing atmosphere.

Eight of the eleven Board members attended the meeting in Guam. They included Board Chair Jo-Ann Leong of the Hawaii Institute of Marine Biology, Andrew Hashimoto of the University of Hawaii, Reza Kamarei of the Oceanic Institute, Singeru Singeo of the College of Micronesia, Lee Yudin of the University of Guam, IAC Co-Chair Rick Spencer, Technical Committee Chair Harry Ako and Executive Director Cheng-Sheng Lee.

CTSA selected Guam as the meeting site to coincide with the 2004 Western Regional Joint Summer Meeting of Land Grant Colleges and the Agricultural Development in the American Pacific (ADAP) project's Board of Directors meeting. Three of CTSA's Board members, Hashimoto, Singeo and Yudin, participated in all three meetings.

To take advantage of being in Guam, the Board spent the day before the meeting touring aquaculture research facilities and commercial farms. John Brown, a professor at the University of Guam (UOG) and a member of CTSA's Technical Committee, led the tour. Stops included Brown's integrated farm demonstration site,

Continued on page 6

CTSA implements new procedures.

See page 3 for details.

Letter from the director

At this year's Industry Advisory Council (IAC) meeting in February, members indicated that they wanted to be better informed about the progress of CTSA's funded projects. As a result, the IAC encouraged its liaisons to monitor progress through quarterly project updates and other reports from the projects' principal investigators (PIs). Every year, the IAC assigns one of its members to each project to serve as an industry liaison. It is a way for the industry to learn more about the projects that CTSA supports on its behalf.

The role of the liaison is also to assist CTSA in ensuring that PIs are: (1) on the right course, (2) producing results that will benefit the industry and (3) promptly disseminating information. Liaisons received the first quarterly status report in May, and CTSA would like to encourage everyone to continue working together to make this good idea help support industry development.

Cheng-Sheng Lee

REGIONAL NOTES

REGIONAL NOTES is published four times per year by the Center for Tropical and Subtropical Aquaculture under a grant from the U.S. Department of Agriculture Cooperative State Research, Education and Extension Service.

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Printed on recycled paper

AQUA CLIPS

Jumbo news about shrimp comes from the Oceanic Institute

Pacific Business News, Monday, April 26, 2004

Researchers at the Oceanic Institute say they are achieving record-breaking shrimp production using a new method, funded by the National Institute of Standards and Technology. It's called the Biosecure Zero-Exchange Shrimp Technology, a closed system that recirculates water and keeps disease agents out. Traditional shrimp farming methods use thousands of times more water. The five-year, $16.6 million project aims to develop an economically viable, environmentally responsible, and sustainable system for the production of disease-free shrimp in the United States. A joint-venture team comprised of the Oceanic Institute, the bioengineering company SyAqua Inc., the specialty feed company Zeigler Bros. Inc., and the Kahuku Shrimp Co. have been working on this. SyAqua engineers shrimp for commercially-attractive qualities. Zeigler developed feed that's good both for shrimp and also for microorganisms beneficial to shrimp. Shrimp farming usually yields half a kilo of shrimp per square meter, stocked at a density of 25 shrimp per square meter. The Oceanic Institute has previously gotten as much as 6 kilos of shrimp, stocking 350 shrimp in the same space. The 18-week research trial yielded 6.8 kilos from stocking 10-day old postlarvae at 600 shrimp per square meter. "We are pushing the envelope of shrimp production," said Shaun Moss, Oceanic Institute Director of Shrimp Technology and principal investigator of the project. Moss is aiming for 10 kilos of shrimp per square meter in a system that allows for production of three crops per year.

Ceatech expects rebound from virus

By Janis L. Magin, Honolulu Star-Bulletin, Saturday, May 8, 2004

A Kauai aquaculture farm that had to kill 20 million shrimp after the discovery of a devastating virus last month expects to restock its pond this summer. The outbreak of the white spot syndrome virus at Ceatech USA Inc. has been contained, and no evidence of it has been found outside the company's West Kauai farm, state officials said. The virus is harmless to humans but highly contagious and deadly for shrimp. Paul Bienfang, senior vice president at Ceatech, said the company expects its ponds to be ready for new shrimp by July, but harvesting won't happen until March or April of next year, at the earliest.

DLNR, Waikiki Aquarium to release moi in waters off Waikiki Beach

DLNR news release – Thursday, May 20, 2004

HONOLULU – About 200 hatchery-reared and tagged Pacific threadfin, or moi, were released today into the waters off the Waikiki Aquarium, as part of the State of Hawaii's ongoing marine finfish stock enhancement program. The Department of Land and Natural Resources (DLNR) Division of Aquatic Resources is leading the project in an effort to track valuable biological and behavioral information for fishery scientists, such as growth estimates and migration patterns. Today's moi release into the Waikiki-Diamond Head Marine Life Conservation District—where fishing is prohibited—has been timed to coincide with the statewide closing of the moi fishing season from June through August.

In recent years, over-fishing has greatly reduced wild populations of moi. Season, size and bag restrictions are helping to protect this species from overharvest, as are the research efforts by DLNR's Anuenue Fisheries Research Center (AFRC). Over the past nine years, AFRC has been investigating the spawning and mass culturing of moi as a potential aquaculture species. About four years ago, the research focus shifted toward coastal fish stock enhancement activities utilizing technology that was developed in conjunction with a number of institutions. The project is funded in large part by federal programs, including the Dingell-Johnson Sport Fish Restoration Program.

For more information on the fish release or to report tagged moi, please call the Oahu Moi Hotline at (808) 832-5003.

CTSA implements new procedures

The Center for Tropical and Subtropical Aquaculture (CTSA) revised its December 2000 *Procedures of CTSA* manual to improve its project development and implementation processes. CTSA published the new version in April 2004. The Board of Directors initiated the revision at its February 11, 2003 meeting and formed a subcommittee to complete the task.

The initial issue the Board wanted to address was the development of a conflict-of-interest policy to remove any real or perceived conflicts of interest regarding proposed or ongoing research. The policy was completed and included in the manual. One important new guideline is that Technical Committee (TC) members are no longer eligible for funding support from CTSA.

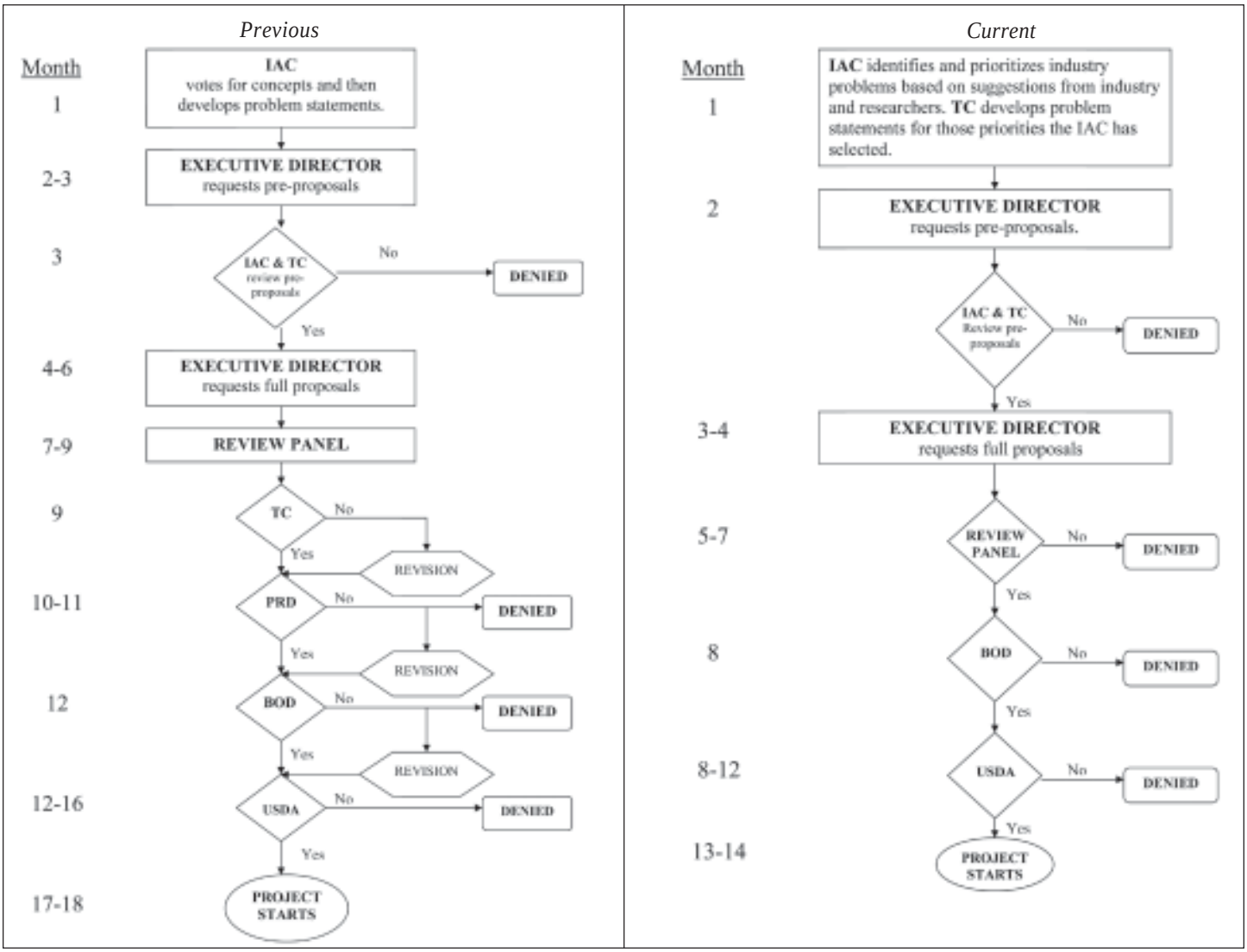
The revision streamlined the proposal development process. It used to take 18 months, but it will now take 12 months (Figure 1). Previously, a panel of independent experts, the TC, a Program Review Delegation (PRD), the Board and the USDA were all involved in the review process. Now, only a review panel, the Board and the USDA will review the proposals.

The roles and responsibilities of each group in CTSA's organizational structure are clearly defined in the revised manual. The Industry Advisory Council's role is primarily to report the status and needs of aquaculture development in the region and to recommend and rank research and development needs. The TC's role is to develop problem statements, assess the scientific merit of preproposals and evaluate the annual progress of funded projects. A description of the Executive Director's role and responsibilities is also included in the revised manual, which was absent in the previous one.

The Board made additional changes to improve clarity and aid the Executive Director's ability to effectively manage the program.

CTSA implemented the new procedures in February 2004 when it called the first joint meeting of the IAC and TC.

FIGURE 1. *Project development flow charts.*



AQUA TIPS

Growth of *Moina macrocopa* (Straus) for use in freshwater ornamental fish culture

Clyde S. Tamaru, Harry Ako, Lena Asano and Kathleen McGovern-Hopkins

**University of Hawaii Sea Grant Extension Service and
Hawaii Department of Agriculture Aquaculture Development Program**

This article was written as part of the work for the project "Transitioning Hawaii's Freshwater Ornamental Fish Industry" which was funded in part by the Center for Tropical and Subtropical Aquaculture under a grant from the US Department of Agriculture Cooperative State Research, Education and Extension Service.

Introduction

Freshwater cladocerans of the genus *Moina*, more commonly known as water fleas, have a worldwide distribution. They are considered to be one of the most valuable live foods, because they result in higher larval survival and growth than artificial feeds. It has been reported that because of their nutritional profile they are also used as a maturation feed for a variety of freshwater ornamentals. Their small size (males 0.6–0.9 mm, females 1.0–1.6 mm) and ability to be produced in relatively large quantities are additional reasons for their popularity. *M. brachiata* and *M. macrocopa* (Figure 1) have been reported to reach densities of over 10,000 individuals/L under favorable conditions in the wild.

Investigations conducted under the auspices of the Center for Tropical and Subtropical Aquaculture supported freshwater ornamental fish projects focused on two objectives, one of which forms the basis for this report. Results achieved under the second objective will be reported in a separate article. The first objective was to document the level of *M. macrocopa* production using a variety of feeding regimens. One was the use of natural phytoplankton, or "green water," and the second was using a commercially produced freshwater alga, *Chlorella vulgaris* (*Chlorella* V-12, Pacific Trading Company, Ltd., Fukuoka, Japan), in its fresh and frozen forms.

Materials and Methods

Green water production

For the culture of *M. macrocopa*, green water was produced from four 60-L glass aquaria stocked with approximately 25 adult guppies (3F:1M sex ratio) with no aeration. Fish were fed a diet of commercial salmon fry feed *ad libitum* on a daily basis with no water changes. Within four days the green water cultures were suitable for use as a food source for the culture of *M. macrocopa*. Approximately 40–50 L of green water was available each day from at least one of the culture tanks, representing a batch culture system where individual aquaria are being rotated through a four-day interval.

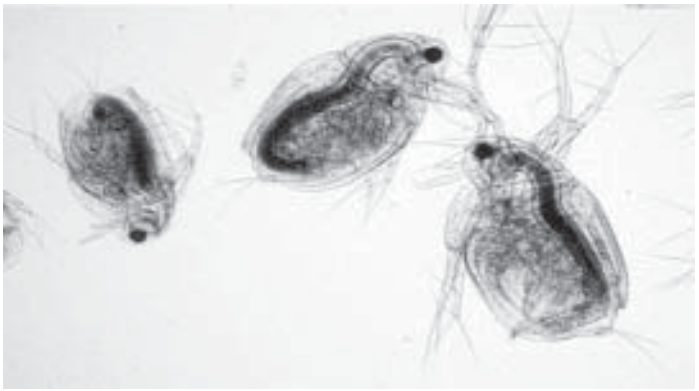


FIGURE 1. Photomicrograph of *Moina macrocopa*.

Culture method for *M. macrocopa* and determining rate of growth

Cultures were conducted in two 20-L polycarbonate tanks that were filled with green water. Each tank was stocked with enough *M. macrocopa* to result in an initial density of one individual/ml. For this experiment, the culture was provided with aeration and allowed to incubate for 24 hours. Observed water temperatures during the culture period ranged between 20.2 and 26.2°C. On a daily basis, the density of *M. macrocopa* was estimated volumetrically using a 10-ml pipette and an 8x ocular tube. A minimum of two determinations for each tank was made each day. After determining the density, all of the *M. macrocopa* were harvested using 55-micron Nytex netting and restocked into 20 L of fresh green water. Culture densities above five individuals/ml required complete replacement with fresh green water at least two or three times per day to maintain the observed rate of growth. The cultures were maintained until the green water production capability was exhausted, which was approximately seven days after inoculation and at an average density of 10 individuals/ml.

Use of *Chlorella vulgaris* as food

The fresh *Chlorella* V-12 used in the investigation was purchased from the Pacific Trading Company, Ltd., Fukuoka, Japan. A single

order consists of a 20-L slurry of alga from cultured stock apparently free from epiphytic algae and invertebrates. Algal densities range between 5 x 10^9 and 8 x 10^9 cells/ml. Upon arrival in Hawaii half of the slurry was placed into plastic bags and frozen at -20°C until used. Culture trials using the fresh *Chlorella* V-12 were conducted in two 20-L polycarbonate tanks filled with tap water and stocked with sufficient *M. macrocopa* to result in a density of one individual/ml. In each of the culture tanks, 10 ml of slurry was added to the tank and allowed to incubate overnight. The densities of *M. macrocopa* were determined volumetrically as described previously after which all of the *M. macrocopa* were harvested using 55-micron Nytex netting and restocked into fresh water and fed with 10 ml of fresh *Chlorella* V-12. When densities exceeded 10 individuals/ml all of the alga had been consumed within a 12-hour period and another 10 ml of fresh *Chlorella* V-12 was provided to insure that there would be sufficient food throughout the culture period. The same protocol was also used to test the suitability of using the frozen *Chlorella* V-12.

Results

The rate of population growth of *M. Macrocopa* cultured in green water is summarized in Figure 2. The data were subjected to regression analysis and a statistical model, density = (0.113 x hours) + 0.497, where *density* is equivalent to individuals/ml and *hour* represents the number of hours in culture, was found to provide the best fit of the data (R^2 = 0.959, P < 0.01). From the slope of the regression line, it is clear that the population being grown in green water is at least doubling every 24 hours. When culture densities reached five individuals or more (2–3 days in culture), the green water in the tank would be completely cleared within 10–12 hours. When this occurred, all of the *Moina* had to be harvested, and a fresh batch of green water was provided. In essence the cultures were being fed twice a day. When densities approached 10 individuals/ml (approximately 72 hours), the cultures needed to be fed three times a day. The end result was that the green water consumption was great enough to overtake the rate of green water production and exhaust the production system that was being employed.

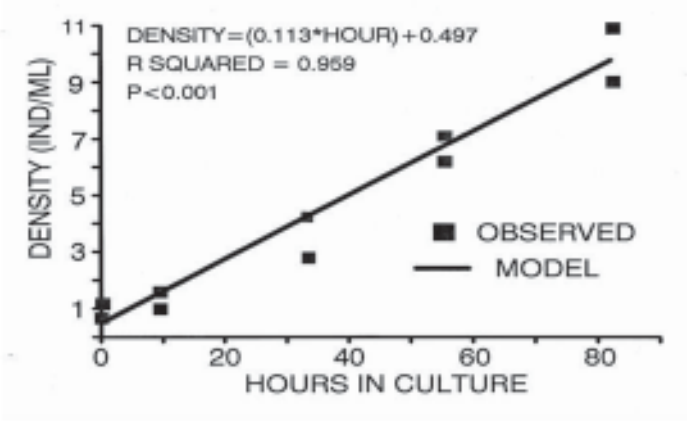


FIGURE 2. Statistical model describing population growth of *M. macrocopa* fed with "green water."

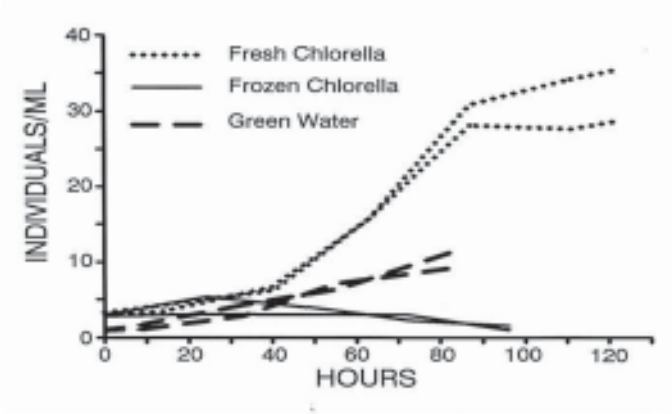


FIGURE 3. Comparison of population growth of *M. macrocopa* provided various feeds.

Temporal changes in density when using fresh *Chlorella* V-12, frozen *Chlorella* V-12, and green water are summarized in Figure 3. The results demonstrate that the frozen *Chlorella* V-12 does not support any growth of the *Moina* in culture, and the population crashes after 24 hours. In contrast, the population increases significantly (P < 0.01) over those cultures using green water, to the point where an average of 30 individuals/ml is obtained after 80 hours in culture. At this stage, between 20 and 30 ml/day of *Chlorella* V-12 was being provided to the cultures to sustain its rate of growth. However, after the cultures attained this density, the population would plateau. Linear regression analyses using the observed rate of growth from both tanks resulted in the statistical model, density = (0.273 x hour) + 0.267 (R^2 = 0.858, P < 0.001), where *density* is individuals/ml and *hour* is the number of hours in culture. The slope of the statistical model indicates that within a 24-hour period the density will have increased approximately 6.5 times until it reaches 30 individuals/ml. It is shortly after this period in the culture process that the observed dissolved oxygen and pH values reach their lowest levels. During the early portion of the culture period, 0–70 hours, the dissolved oxygen level ranged between 6 and 7 ppm, but during the latter stages (> 80 hours), it was observed to fall to 4 ppm. The same trend was observed for pH, where in the early stages it ranged between 7.2 and 7.5, and during the later stages, it was observed to fall to a low of 6.7. The water temperatures observed during these trials ranged between 20 and 22°C.

Discussion

Results of the green water culture trials indicate that densities of 10 individuals/ml (10,000 individuals/L) of *M. macrocopa* can be achieved using natural phytoplankton. It does not appear to matter whether phytoplankton occurs naturally or as a result of fertilization using inorganic fertilizers or from fish culture systems (as in the current investigation). These observations are consistent with the life history of *M. macrocopa*. As do most cladocerans, *M. macrocopa* reproduces by cyclic parthenogenesis, with the ability to switch to a sexual mode of reproduction in response to adverse conditions. *M. macrocopa* belongs to a group of cladocerans characterized as "puddle species" that are tolerant to large variations in temperature and dissolved substances. This tolerance allows them to colonize bodies of water that go through a sequence of events

Continued on page 7

Guam cont'd from page 1

the Guam Aquaculture Development and Training Center (GADTC), UOG's Marine Laboratory, a freshwater food fish farm and two of the largest shrimp farms on the island. One of these shrimp farms was recovering from an outbreak of white spot syndrome virus, and its ponds were completely empty. The source of contamination is still under investigation, and the devastating incident underlined the importance for farms to implement biosecurity protocols.

The tour enabled the Board to see one of CTSA's projects firsthand. The CTSA project, "Evaluation of Tilapia Species and Varieties for Establishment of a Tilapia Hatchery in Guam," is primarily situated at GADTC. Project work group member Victor Camacho showed the Board the facility and the project fish. The Board also visited Bernardo's Farm, which is one of the project's commercial participants. The owners, John Bernardo and his wife Frances, grow tilapia, catfish and other products such as cucumbers.

Left: Biologist Victor Camacho
Above: Guam Aquaculture Development and Training Center (GADTC)
Above Right: Research Assistant Josh Golder

Above: John Bernardo, Bernardo's Farm

Right: John Brown, University of Guam

The Board spent the remainder of the afternoon visiting both sites of shrimp farmer Peter San Nicolas' operation. San Nicolas also took the Board to a nearby beach for a time of fellowship with his family and various other farmers, many of whom are part of the Guam Aquaculture Growers Association. The San Nicolas family graciously provided refreshments for everyone. The Board sampled generous portions of shrimp, eel, papayas, coconut juice, coconut meat and *tuba* (coconut wine).

The date of the Board meeting was a propitious choice. Earlier in the week, beginning on Father's Day, heavy rainfall drenched Guam and flooded parts of the island. The weather cleared up briefly for the duration of the Board's stay from June 23 to 26. On Monday, June 28, Tropical Storm Tingting hit Guam with torrential rain, flash flooding, high winds and mudslides.

The Board would like to thank Lee Yudin and his staff for making the meeting arrangements and John Brown for coordinating the tour.

Project What's new? Highlights

Aquaculture Extension & Training Support for the U.S.-Affiliated Pacific Islands

Principal investigators Rand Dybdahl and Manoj Nair reported that they conducted a second successful pearl oyster spawning trial on May 5, 2004 at the College of the Marshall Islands' Arrak hatchery using broodstock from the Arrak demonstration farm and Robert Reimers Enterprises' site on Arno Atoll.

At least 21 oysters spawned, and tens of millions of fertilized eggs were placed into three 750-L larval tanks. This large number is beyond the carrying capacity of the facility, and the excess larvae will be progressively culled while still ensuring that enough settled spat remain by Day 42, when they will be ready for delivery to the industry.

Improving Sturgeon Farming in Hawaii

The project's industry liaison Jeff Koch reported that because the broodstock fish in Hilo did not spawn, principal investigator Kevin Hopkins continued his efforts to purchase fish from overseas. In early June he was finally successful in obtaining viable fry. After stabilizing them and rearing them up to the first feeding stage, the fish were sent to project participants on June 17.

Disease Management

The project is conducting a **free** workshop:

Fish Disease Prevention and Management: Preliminary Examination

Date: Saturday, July 24
Time: 9:00 a.m - 12:00 p.m.
Place: Komohana Agricultural Complex in Hilo, Hawaii
Contact: Jim Szyper at (808) 981-5199 or jszyper@hawaii.edu

Following a brief introduction to fish health, the session will focus on how to look at a fish when disease is suspected. The workshop will be presented by Dee Montgomery-Brock of the Hawaii Aquaculture Development Program and Jim Szyper of the Hawaii/Pacific Sea Grant Extension Service.

Moina cont'd from page 5

characteristic of life in temporary pools. By providing a continuous source of phytoplankton, the population is prevented from switching to the sexual mode of reproduction and maintains the parthenogenic mode of reproducing, resulting in at least a doubling of the population each day. This would imply that if the availability of food were removed as a limiting factor, the population would attain even higher densities than the 10 individuals/ml previously reported. The green water system can provide a continuous source of phytoplankton; however, there is a practical consideration in that the algal densities in such systems only reach 1–5 x 10^6 cells/ml. There is a point where the continual addition of green water is no longer practical because of the volume of water that must be transferred from the green water culture facility to the *Moina* grow-out tanks as experienced in the current investigation.

The results of using the freshwater *Chlorella* V-12 support the hypothesis that if the amount of food is no longer a limiting factor, population densities could increase to even higher levels than the 10 individuals/ml. The population growth of *M. macrocopa* fed the *Chlorella* V-12 had an overall change in density of 6.5 times per day and attained an average density of 30 individuals/ml, apparently the highest reported to date. That high density was achieved in a relatively short time, as well as in a small culture container. The implications of these results may have far-reaching effects on the future development of a live food culture system for this species.

Acknowledgments

This project was supported in part by the Center for Tropical and Subtropical Aquaculture through a grant from the U.S. Department of Agriculture (USDA Grants No. 00-38500-8983 and 2001-38500-10480). Support was also provided by a grant/cooperative agreement from the National Oceanic and Atmospheric Administration (NOAA), project A/S-1, which is sponsored by the University of Hawaii Sea Grant Program, SOEST, under Institutional Grant No. NA86RG0041 from the NOAA office of Sea Grant, Department of Commerce. The views expressed herein are those of the authors and do not necessarily reflect the views of NOAA or any of its subagencies. Additional support was also provided by the Hawaii Department of Agriculture Aquaculture Development Program.

UPDATE

CTSA requested selected proposals for Year 18:

CTSA received 13 pre-proposals in response to the Request for Pre-proposals. The Technical Committee reviewed the research approach of the pre-proposals, and the Industry Advisory Council reviewed the responsiveness of the pre-proposals to the problem statements. Based on these reviews and in accordance with procedures, CTSA requested eight full proposals from the submitters of the following pre-proposals:

1. Sturgeon Culture in Hawaii, Year 3
2. Low-Cost Intensive Microalgae Production
3. Evaluation and Propagation of Tilapia Strains for a Self-Sufficient Tilapia Industry on Guam, Year 3 / Improved Stocks and Management Practices for Commercial Tilapia Culture in Hawaii and the Pacific Region
4. Disease Management in Pacific Aquaculture, Year 12
5. Aquaculture Extension and Training Support for the U.S.-Affiliated Pacific Islands with a Special Emphasis on Hatchery Propagation of the Black-lip Pearl Oyster (*Pinctada margaritifera*)
6. Amberjack Fingerling Production, Year 3
7. Analysis of Shrimp Waste Processing Alternatives
8. Determining the Optimal Nutritional Requirements for the Chinese Catfish *Clarias fuscus*

Proposals are due on Friday, July 16.

Pray for our nation

Support our Troops

CENTER FOR TROPICAL AND SUBTROPICAL AQUACULTURE

The Center for Tropical and Subtropical Aquaculture (CTSA) is one of five regional aquaculture centers in the United States established by Congress in 1986 to support research, development, demonstration and extension education to enhance viable and profitable U.S. aquaculture. Funded by an annual grant from the U.S. Department of Agriculture's Cooperative State Research, Education and Extension Service (USDA/CSREES), the centers integrate individual and institutional expertise and resources in support of commercial aquaculture development.

CTSA currently assists aquaculture development in the region that includes Hawaii and the U.S.-affiliated Pacific islands (American Samoa, Commonwealth of the Northern Mariana Islands, Federated States of Micronesia, Guam, Republic of Belau [Palau] and the Republic of the Marshall Islands.)

In its sixteen years of operation, CTSA has distributed over $7 million to fund more than 165 projects addressing a variety of national aquaculture priorities.

FAST FACT

In 2000, reported total world aquaculture production (including aquatic plants) was US$56.5 billion by value.

--UN Food and Agriculture Organization

Each year, the Center works closely with industry representatives to identify priorities that reflect the needs of the aquaculture industry. After consultation with appropriate technical experts, CTSA responds with a program of directed research with objectives that focus on these industry priorities. A Board of Directors is responsible for overseeing the programmatic functions of CTSA. Results of CTSA projects are disseminated through its print publications, hands-on training workshops, and Web site.

CTSA is jointly administered by The Oceanic Institute and the University of Hawaii. Its main office is located at The Oceanic Institute's Makapuu Point site on the island of Oahu in Hawaii.

For further information, contact Cheng-Sheng Lee, Ph.D., Director, by phone (808-259-3107), fax (808-259-8395) or e-mail (cslee@oceanicinstitute.org).

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