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CENTER FOR TROPICAL AND SUBTROPICAL AQUACULTURE

Regional e-Notes

Letter from the Director

Aloha!

Summer is officially here and CTSA's 2011 development process is moving forward at full speed. This year, we received 18 pre-proposals. Of those, five have been selected by our Industry Advisory Council (IAC) and Technical Committee (TC) to submit full proposals for our 2011 Plan of Work.

As with every year, the process this cycle was competitive. CTSA's funding selections are dictated by the IAC; the proposals that are most often successful are those that will be of most impact to regional and local aquaculture operations. We were happy to see innovative research suggestions in this year's pre-proposals, and we urge those researchers that were not successful to try again next year.

In this month's issue of e-notes, we review the new features and sections of our redesigned website! There is also an article about the CTSA Pacu project, and a reminder about two upcoming workshops in Hawaii. As always, if you have any suggestions, concerns, or comments, please do not hesitate to let us know.

Mahalo,

Cheng-Sheng Lee
Executive Director, CTSA

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www.ctsa.org
www.oceanicinstitute.org

CENTER FOR TROPICAL AND SUBTROPICAL AQUACULTURE

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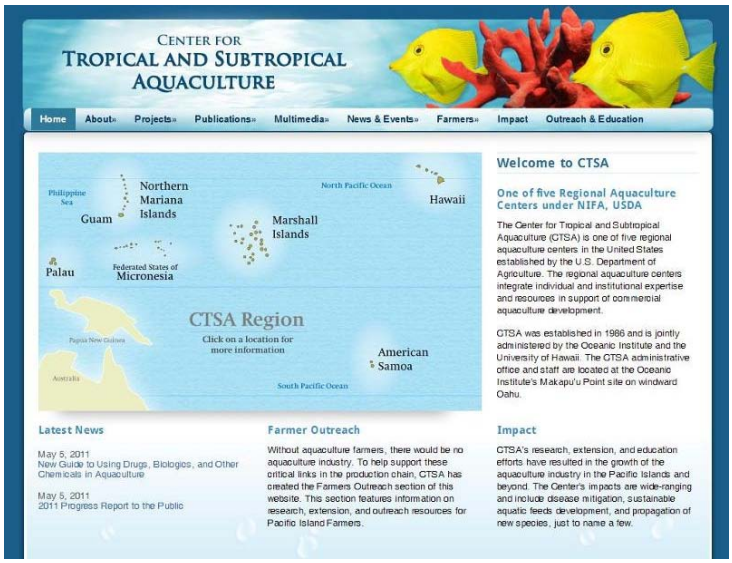
Redesigned CTSA Website Features Several New Sections

In an effort to improve our services and information dissemination objectives, CTSA has redesigned our website www.ctsa.org!

The first change you will most likely notice on our remodeled homepage (aside from the brand new design) is a large map of the CTSA region. You can click on any location on the map to see information on the aquaculture production and extension support in that location. Our homepage also now features the latest news, and is the starting point for exploring all the expanded website



has to offer.

In addition to organizing the
information from our old site in a more user-friendly manner, we created several new sections aimed at providing industry members with easy access to the information and resources they need:

Multimedia

CTSA has recently begun taking an active role in creating high quality imagery and video about aquaculture and aquaculture farmers in the U.S. Affiliated Pacific Islands. In this section, you can find the videos we have created to highlight CTSA projects, Pacific Island Aquafarmers, and pertinent industry issues, as well as photos from industry events, aquaculture operations, and more. We are just starting, so please check this section often for new videos and photos. If you have any photo galleries you would like to add, please email them to mbrooks@oceanicinstitute.org.

News & Events

Whether news from the U.S. government or an upcoming aquaculture event in the region, this section is designed to keep you abreast of the latest aquaculture industry happenings in the CTSA region. Check back often for updates. If you have any announcements to add, please email them to the address provided above. ALSO: the latest news posted in this section is also posted on the homepage of the website.

Farmers Outreach

This section provides a guideline to the plethora of information available for farmers on the CTSA website. In addition to highlighting the resources available on the CTSA website, this section is consistently updated to include announcements on upcoming farmer workshops and publications due to be released shortly. If you have any announcements to add, please email them to the address provided above.

Impact

CTSA has been heavily involved in Pacific aquaculture for the past 25 years. During this time, the Center has sponsored research, extension, and education efforts that have resulted in milestones for the industry, regionally and beyond. Please visit this section of our website to see some of our more notable impacts.

Outreach & Education

This portion of our new site explains CTSA's efforts in outreach and education, and will serve as a portal to the AQUA (A Quest to Understand Aquaculture) program's website (currently under construction).

Diversifying Freshwater Aquaculture Products for Hawaii with the Red Pacu (Piaractus brachypomus)

Robert Howerton [1], Clyde Tamaru [2], RuthEllen Klinger-Bowen [2], Bradley Kai Fox [2] and Kathleen McGovern-Hopkins

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[1]University of Hawaii Sea Grant College Program, [2] College of Tropical Agriculture and Human Resources, Department of Molecular Biosciences and Bioengineering

The number of freshwater finfish that are grown commercially in Hawaii is limited to primarily two species, tilapia (*Oreochromis* sp.) and Chinese catfish (*Clarias fuscus*). The overall goal of the Center for Tropical and Subtropical Aquaculture supported project is to increase food and ornamental fish production by importing, spawning, culturing and test marketing two crossover species commonly known as pacu, *Colosomma macropomum,* (black pacu or black-finned pacu, Tambaqui) and *Piaractus brachypomus* or the red pacu. The first year's work focused on the red pacu and the specific objectives included characterizing growth of juvenile red pacu under monoculture conditions, comparing growth and survival in monoculture and polyculture with Chinese catfish, test marketing and initiating the establishment of broodstock populations of red pacu and locate sources of the black pacu that meet import requirements. The data obtained would allow stakeholders to make an informed decision regarding the culture of this species in Hawaii.

Figure 1. RuthEllen Klinger-Bowen acclimates the first arrival of red pacu at Windward Community College.

The first shipment (n=400 individuals) of red pacu arrived on August 30, 2010 and was distributed into five quarantine tanks located at Windward Community College Aquaculture/Aquaponic Facility (Figure 1). The fish were obtained from Aqua Nautic Specialist, PTE, Ltd., located in Inglewood California and only two mortalities were recorded after arrival. This is quite remarkable as the source of the hatchery produced fish is in Indonesia. While a source and shipping to Hawaii was successful, the first challenge encountered was with an outbreak of *Ichthyophthirius multifiliis*, and a flagellated protozoan, *Ichthyobodo* sp. which resulted in severe mortalities. Since the red pacu was being cultured as a food fish this restricted the choice of treatments[1] and despite use of a low dose (25 ppm) of formalin mortalities amounted to 98.5%. It should also be noted that as a food fish when treating with formalin only properly labeled formalin products (e.g., Paracide-F, NADA 140-831, approved by the Food and Drug Administration[2]) are allowed for treatment. A second shipment of 200 pacu from the same source was received on October 6, 2010. Despite a preliminary survey conducted the same day of receiving the pacu revealed no signs of parasites an outbreak of *I. multifiliis* occurred again and a high dose (100ppm formalin) repeated every other day was initiated in combination with raising the salinity to 2 ppt with Hawaiian salt. While FDA has not approved the use of salt in aquatic organisms FDA considers the use of salt in aquaculture as a low regulatory priority and does not regulate the use of salt to control salinity[3]. The combination of a high dose of formalin and raising salinity proved to be effective and halted the mortalities and no parasites were observed with biweekly inspections.

The 150 survivors were used to initiate the polyculture experiment with Chinese catfish and the experimental design consisted of the following:

Treatment 1: 14 pacu + 0 Chinese catfish
Treatment 2: 14 pacu + 50 Chinese catfish
Treatment 3: 14 pacu + 100 Chinese catfish
Treatment 4: 14 pacu + 200 Chinese catfish
Treatment 5: 14 pacu + 300 Chinese catfish

Initial body weight of Chinese catfish and pacu averaged 23.1g and 88.1g respectively. Fish were stocked in 300 gallons and provided a continuous flow of water and aeration. Fish were fed a diet of Nelson's Silver Cup trout feed to satiation and their growth and survival were monitored at monthly intervals. The last sample date was completed on March 10, 2011 and the data on their average percent survival, body weight, total length and condition factor index is summarized in Table 1.

Survival over the course of the 113 day grow-out period was high (>82%) for both Chinese catfish and pacu amongst all of the treatments. Interestingly, significantly ($P<0.05$) lower average body weights were detected as was total length amongst the Chinese catfish stocked at the lowest density (e.g., 50 individuals) along with 14 pacu. This trend was also detected with the condition factor index (CFI) which is a measure of robustness. Food conversion ratios (FCR) obtained for the various treatments are summarized in Table 2. Interestingly the FCR improves when pacu are grown together with Chinese catfish as opposed to being cultured alone. Based on these results there appears to be some merit for a polyculture of pacu and Chinese catfish but using low densities of Chinese catfish.

By the end of the 113 day grow-out period the pacu stocked with 300 Chinese catfish showed the lowest growth and while not statistically significant, the lowest average survival (Table 1). This trend is repeated for both average total length and CFI. When the biomass (kg body weight/m^3 , Figure 2) of pacu are viewed in relation to the stocking density of Chinese catfish there is a noticeable drop in Pacu biomass when Chinese catfish are co-cultured beginning with 50 individuals, although the difference was not statistically significant.. Biomass of pacu drops significantly when the Chinese catfish are stocked at 200 and 300 individuals, accompanied by an increase in mortalities particularly in the 300 Chinese catfish treatment. Interestingly the biomass for Chinese catfish continues to increase in a linear fashion with increasing number of fish indicating that their limits have yet to be reached. Based on these results pacu alone maybe a more suitable growout strategy or at best with a very low density of Chinese catfish to induce an improved FCR.

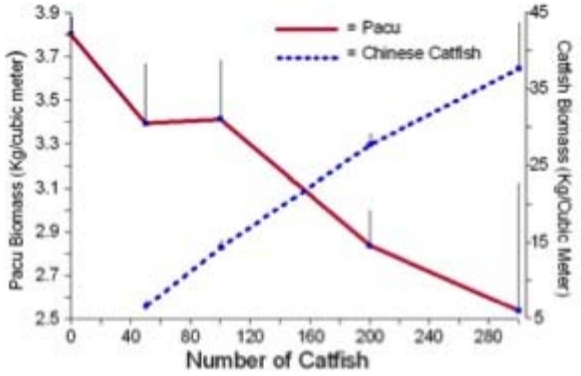

Figure 2 Biomass of pacu and Chinese catfish in relation to number of Chinese catfish stocked.

The growout trial employed a flow through system that resulted in a daily turnover of each tank at a rate of approximately 4.4 times per day per tank. For all ten tanks this equates to a water consumption of approximately 8,360 gallons per day or 31,768 liters per day. Because the trends in growth were clearly detectable the experiment was terminated on the 113th day and the estimated water consumed till that date was approximately 944,680 gallons. Using today's Board of Water Supply agricultural rate of $2.79/1,000 gallons the cost in just water is estimated at $2,636. One can argue that the amount of water used would be unsustainable particularly if the culture was extrapolated out to commercial scale. This resulted in examining the use of closed recirculating systems as a more sustainable alternative.

All ten tanks were re-equipped with two 26 gallon ebb and flow biofilters filled with cinder and operated using a bell siphon. Water from the tanks was airlifted through ½ inch PVC pipe using the aeration already being provided to the tanks. Fish were restocked on March 28, 2011using the following treatments 1) 20 pacu only, 2) 20 pacu + 100 Chinese catfish, 3) 50, 4) 100 and 5) 200 Chinese catfish only. All treatments are being conducted in duplicate and because the biofilter is a reciprocating ebb and flow design it can also support plant growth and all beds were planted with a variety of plants (e.g., bak choi, manoa lettuce, green onions, basil, chiso). Growth and water quality were monitored as before and the trial would be terminated when the target harvest body weight of 450 grams for pacu and Chinese catfish were achieved. Due to inclement weather resulting in a power surge and also an accident with standpipe aeration was lost during the night of April 26 resulting in heavy mortalities with the Pacu. No mortalities were observed for the Chinese catfish and the experiment had to be terminated albeit with approximately one month of data as an aquaponic trial. Data on growth was summarized for both Chinese catfish and pacu and is presented in Table 3. The average body weight of pacu that were raised alone (456.4 ± 116.5g) was not quite significantly larger than the pacu grown with 100 Chinese catfish (392.2 ± 69.2 g) two tailed $P = 0.080$, $t = 1.807$. The data is consistent with previous results that indicate the pacu fair better when cultured alone or with low densities of Chinese catfish. Although the trial had to be terminated prematurely, the pacu raised alone had attained the target harvest size of one pound

(450 g). As the original stocking of the fish was in November of 2010, the pacu had attained the target body weight of one pound within seven months, albeit already being at the average body weight of 88 grams. The data clearly shows that the red pacu does exhibit a relatively fast rate of growth as predicted from the literature.

In conclusion, the red pacu does live up to its reputation of being a relatively fast growing species in captivity when cultured alone or can be co-cultured with low densities of Chinese catfish. How it performs being cultured with other species (e.g., tilapia, grass carp, etc.) remains to be determined. Survivorship is also high indicating it is a moderately robust species. However, it should be pointed out that it cannot tolerate low DO levels as well as Chinese catfish or tilapia. Importing stock from outside of Hawaii does pose a threat in the form of accompanying diseases. In both cases where red pacu were imported disease outbreaks were encountered and it is being recommended that once fish are received they immediately be placed in quarantine and undergo the high dose formalin increased salinity treatment, that was devised during the current project, be implemented as a prophylactic measure to prevent catastrophic losses. Developing hatchery technologies for this species would bypass this constraint and is a future prospect of the ongoing work being conducted under the auspices of the current project.

Table 1. Summary of body weight, total length and CFI for pacu and Chinese catfish being cultured alone or in combination.

Species	Treat	Number	Average Survival (%)	Body Weight (g)	Total Length (mm)	CFI (%)	Biomass Kg/m^3
Chinese Catfish	Pacu + 50 CF	40	100.0	125.8 ± 48.7^{a}	239.2 ± 28.7^{a}	0.88 ± 0.10^{a}	6.6
Chinese Catfish	Pacu + 100 CF	40	86.0	158.7 ± 54.0^{b}	252.7 ± 25.5^{b}	0.95 ± 0.14^{b}	14.4
Chinese Catfish	Pacu + 200 CF	40	90.6	146.2 ± 42.6^{b}	247.3 ± 28.1^{ab}	0.96 ± 0.14^{b}	28.0
Chinese Catfish	Pacu + 300 CF	40	86.0	139.7 ± 53.1^{b}	240.0 ± 30.0^{ab}	0.97 ± 0.13^{b}	37.9
Pacu	Pacu Only	14	100.0	258.0 ± 49.2^{a}	225.9 ± 17.4^{a}	2.23 ± 0.21^{a}	3.8
Pacu	Pacu + 50 CF	14	88.0	267.4 ± 40.5^{a}	242.2 ± 17.0^{b}	1.90 ± 0.41^{b}	3.5
Pacu	Pacu + 100 CF	14	89.3	256.6 ± 56.5^{a}	237.7 ± 18.8^{ab}	1.89 ± 0.19^{b}	3.4
Pacu	Pacu + 200	14	96.5	225.8 ± 42.4^{a}	226.8 ± 16.5^{a}	1.93 ± 0.20^{b}	3.2

	CF						
Pacu	Pacu + 300 CF	14	82.2	190.7 ± 39.3[b]	219.5 ± 19.5[a]	1.79 ± 0.18[b]	2.3

Table 2. FCR values for the various growout treatments.

Treatment	FCR	Cost of Production
Pacu Only	2.45 ± 0.08	$ 1.59/lb
Pacu + 50 Chinese catfish	1.46 ± 0.03	$ 0.95/lb
Pacu + 100 Chinese catfish	1.34 ± 0.09	$ 0.87/lb
Pacu + 200 Chinese catfish	0.99 ± 0.28	$0.64/lb
Pacu + 300 Chinese catfish	1.25 ± 0.19	$0.81/lb

Table 3. Summary of Chinese catfish and pacu growth in an aquaponic setting.

Species	Treatment	Weight (g)	Length (mm)	CFI
Chinese Catfish	Catfish 50	244.5 ± 75.3	295.7 ± 25.4	0.92 ± 0.14
Chinese Catfish	Catfish 100	240.6 ± 70.1	288.5 ± 25.6	0.93 ± 0.12
Chinese Catfish	Catfish 200	201.8 ± 50.5	282.6 ± 21.1	1.99 ± 0.18
Chinese Catfish	Cat + Pacu	222.2 ± 65.5	285.6 ± 29.3	2.04 ± 0.13
Pacu	Cat + Pacu	392.2 ± 69.2	269.5 ±16.5	0.88 ± 0.09
Pacu	Pacu only	456.4 ± 116.5	279.4 ±23.5	0.97 ± 0.11

[1] http://www.fda.gov/downloads/AnimalVeterinary/ResourcesforYou/AnimalHealthLiteracy/ucm109808.pdf
[2] http://www.drugs.com/vet/paracide-f.html
[3] http://edis.ifas.ufl.edu/pdffiles/VM/VM00700.pdf

Aquaponics Workshop Reminder

"Challenges and Opportunities of Soil-less Farming in Hawaii" Workshop

On Saturday, July 23, the College of Tropical Agriculture and Human Resources (CTAHR) will hold a workshop on theChallenges and Opportunities of Soil-less Farming in Hawaii. The workshop, which is a part of the CTSA Aquaponics project, will be held at Windward Community College, Hale Akoakoa Room 105 from 9am - 12pm *(refreshments served from 8:30am)*. The cost is $10 per person.

The workshop will be facilitated by Clyde Tamaru, Aquaculture Specialist CTAHR. Workshop participants will be asked "What kind of technical assistance is most needed from faculty at the

University of Hawaii?". Admission charge for the workshop is $10.00 per person and parking is free. Refreshments will be served.

There are a limited number of seats available. To reserve a seat, please contact:
Harry Ako. Phone: 956-2012 ~ email: hako@hawaii.edu
Clyde Tamaru. Phone: 342-1063 ~ email: ctamaru@hawaii.edu

Please make checks payable to Research Cooperation of the University of Hawaii or (RCUH) and send to the following address: Department of Molecular Biosciences and Bioengineering, University of Hawaii-Manoa, 1955 East-West Road, Ag. Science 218, Honolulu, HI 96822.

Workshop sponsors:
College of Tropical Agriculture and Human Resources
Aquaculture and Livestock Support Services, Department of Agriculture
Center For Tropical and SubTropical Aquaculture
Hawaii Aquaculture and Aquaponics Association

Pacific Island Spotlight: Sustainability Education in the Pacific

CTSA strongly believes in the importance of education for the future of the aquaculture industry, so much so that we are supporting our own education efforts in Hawaii and the U.S. Affiliated Pacific Islands. We are also happy to work alongside other programs that educate students about food science and production in a captivating, hands-on manner. Please enjoy this article from the Samoa Observer highlighting one such program:

www.samoaobserver.ws, June 17, 2011.

Pacific News Centre - Students from Samoa, Virgin Islands, the Marshall Islands, CNMI, Guam, Palau and the FSM are gathering at the University of Guam (UOG) this week. They are participating in a three and a half week internship to share information about agricultural innovation, research and applications.

"Students will participate in a variety of field observations and hands-on laboratories where they can observe and learn about the agricultural businesses and activities that are found on Guam," says Dr. Prem Singh, UOG faculty member and CariPac Internship Programme Coordinator.

While in Guam, the students will visit a variety of farms. These include the Department of Agriculture organic farm; the Triton Farm's aquaponics facility; the Watson vegetable/fruit farm which uses a drip irrigation and fertigation system on a farm scale, and utilizes many innovations in its operation; the Ernie Wusting Corn Farm which utilizes a no-till corn production method and which has reduced soil erosion and increased soil depth; Quan's Coconut Farm which supplies fresh coconut drinks to the tourism industry; and the Hydroponic Living Lettuce farm and local plant nurseries to learn about the business and production aspects of modern agribusinesses.

They will also visit the ecotourism to observe how to combine tourism, ecology, vegetable and fruit production, and post harvesting and processing to develop a business enterprise.

In the UOG labs, they will learn about plant propagation and grafting and agricultural engineering technologies for Sustainable Tropical Agriculture.

The students will learn how to setup an automated micro-irrigation system, irrigation controllers, and learn about water harvesting canopies among other activities.
They will also learn about biotechnology in agriculture and observe juvenile shrimp production facilities at UOG's aquaculture facility and how Guam is fighting the invasion of Rhino beetle that threatens the existence of coconut trees on Guam.

"This is an all encompassing three and a half weeks where these students get the opportunity to absorb information that they can take back to their home islands to enhance their own agricultural economies," says Lee Yudin, Dean of the College of Natural and Applied Sciences and Principal Investigator for the consortium grant.

AquaClip: Industry Reaction to NOAA Aquaculture Policy

By SeafoodSource.com staff. June 15, 2011.

Reaction to the National Oceanic and Atmospheric Administration's (NOAA) new national marine aquaculture policy is beginning to trickle in. Released on Thursday, the policy will guide agency's fish farming-related activities and provide a national approach to supporting sustainable aquaculture.

The Ocean Stewards Institute (OSI), an industry group that advocates for sustainable aquaculture, applauded the policy, calling it "a positive step forward" for both aquaculture and oceans conservation.

"This is a positive step forward, not only for sustainable domestic aquaculture but also for the protection of our ocean resources," said Neil Anthony Sims, OSI president and co-CEO of Hawaii's Kona Blue Water Farms. "We look forward to working with NOAA to now implement this plan."

Sims commended NOAA for its emphasis on a timely, science-based process for issuing fish farm permits.

"Given that the increasing demand for healthful seafood is already outstripping supply, NOAA needs to move forward without additional delays," said Sims. "We believe that a responsible, environmentally sound open-ocean mariculture industry is an integral part of a national ocean policy that should also include sustainable fisheries management and extensive marine protected areas. NOAA should now move forward expediently in setting up the implementing regulations."

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 2005-38500-15720, 2006-38500-16901, 2007-38500-18471, and 2008-38500-19435. 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.