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REGIONAL NOTES

CENTER FOR TROPICAL AND SUBTROPICAL AQUACULTURE

Stocking the fish for fishing

When thinking about a vacation of freshwater sport fishing, the average person might envision going to places in the deep South, like Louisiana, but go a bit more south and lot more west and that's where they intend to revitalize the sport. Twenty years ago large-mouth bass were caught in abundance in Lake Wilson in a little town called Wahiawa on the island of Oahu. Today although little is known about what is actually living in the 500-acre reservoir, fishermen like Jason "Brock" Brockington, Hawaii Freshwater Fishing Association Vice President, can tell by their catches that there are very few game fish left. It was Brock, along with the 40 other members of their association that originally came up with the concept of restocking the lake. And now every day he, as just one of many volunteers committed to help the reservoir get back to the way it used to be, drives from his home in Waikiki to a fruit of their labor – a brand new hatchery facility in Wahiawa.

Working with the Department of the Land and Natural Resources (DLNR), James Chow, a science teacher at Wahiawa Middle School, and a coordinator of this state- and federally-funded initiative, feels the future of Wahiawa could lie in the success of this project. Its focus is to raise large-mouth bass to be released into Lake Wilson. Restocking the lake could introduce the increasingly popular eco-tourism industry into the stagnant economy of Wahiawa. With the scaling back of the military bases there, the halting of Dole field operations in 1992, and the closing of the sugar mill in Waialua in 1996, Wahiawa residents have suffered a tremendous economic downturn.

In addition to the economic benefits the project may create, tremendous educational gains are also anticipated. Science classes at Wahiawa Middle School may not currently be integrating the project into its curriculum, but once definite protocols are established, Chow feels that many of the daily tasks can be taken on by the students like similar programs have done at other schools. The hope is for the students to become acquainted with the program while in intermediate school and then to be able to fuel their interest with vocational education programs they look forward to implementing at Leilehua High School. If students go through the whole program, they will have seven years of hands-on training by the time they graduate from high school. For now, the middle school students volunteer to clean tanks and are helping with a population study of the reservoir. And, although the bass project may not be a part of their curriculum at this point, students have been using extra space in the hatchery facility to experiment with hydroponics and raising chickens and quails.

For the past five years, Chow kept several of the bass in 15-ft round swimming pools in his backyard in anticipation of approval and funding of their initiative. And now with the state and federal funding, Wahiawa Middle School finally has its own hatchery facility. As part of DLNR's participation, it has made the staff and

Continued on page 6

Letter from the director

Efficiently addressing the problems industries in the region face requires a strong commitment from both the industry itself and the CTSA administration. To guarantee this happening, the industry must voice its needs to us and we will work to find the most appropriate project working group to address each issue. This year, the Industry Advisory Council (IAC) met on February 26th and 27th to discuss what will go into the 16th Annual Plan of Work. This is the second IAC meeting we have had since we implemented our new prioritizing process and this year was definitely an improvement from years passed. I would like to thank everyone who attended the meeting and helped to make it a successful and productive two days. Of course, the process still has room for improvement. It seems that we must evaluate our concept selection process to ensure that good concepts are not overlooked because of lack of knowledge or understanding of the concept. We will use the time before the next cycle begins to continue to work with those concerned in the region. As always, please contact me if you have any comments or suggestions.

Cheng-Sheng Lee

REGIONAL NOTES

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AQUACLIPS

MISS sees sea cuke potential

In The Marshall Islands Journal - Friday, November 23, 2001

The Marshall Islands Science Station -- the College of the Marshall Island's research [center] -- has produced substantial research during the past year on sea cucumber growth that can be used to support re-stocking and future commercial development in the RMI. [Marine scientists Jean-Francois Hamel and Annie Mercer] believe the key for the [RMI], if it wants to pursue what for other countries has been a bery lucrative trade in sea cucumber exports, is to set in motion a system of sustainable use of the cucumbers. Generally speaking, it takes 12-18 months to grow a sea cucumber in the wild. Millions can be produced annually "if there is dedication and interest from local people to do it," Hamel said.

NELHA abalone farm is poised for success

By Paula Helfrich, West Hawaii Today - Sunday, December 23, 2001

Abalone is raised on Hawaii Island at Big Island Abalone Corp, (BIAC), located at [NELHA]. The company specializes in commercial aquaculture and research of California red abalone and Japanese northern (Ezo) abalone. In April, BIAC completed construction of a 10-acre, state-of-the-art abalone aquafarm at NELHA, the largest single abalone production facility in the world outside of China, designed to produce up to 100 tons of abalone per year. At the site the company has been raising Ezo abalone. It currently has more than 1 million growing, with the first shipment planned in first quarter 2002. Red abalone drives the company's sales and is currently shipped to Asian and U.S. markets as well as sold to local clientele. This nursery boasts one of the highest abalone yields in the world.

Surviving saltless streams

By Jan TenBruggencate, The Honolulu Advertiser - Monday, December 24, 2001

The tasty saltwater Pacific white shrimp, [can] survive quite well in fresh water. While the shrimp requires salinity in the water in which it reproduces, it can grow up and apparently thrive in fresh water, according to new research conducted in Hawaii. Kathleen McGovern-Hopkins, the Windward Oahu extension agent with the Sea Grant program, said it was known that the shrimp could survive in low salinity and that they grew in hard water. McGovern-Hopkins found they grow just fine in fresh water, even when it's soft water. Among issues [in her investigation] is whether they grow faster or slower in fresh water, whether their flavor and appearance changes, and whether freshwater growth affects the keeping quality of the shrimp when they go to market.

Biologist score breakthrough in raising reef fish

By Jan TenBruggencate, The Honolulu Advertiser - Wednesday, January 23, 2002

Researchers working with Charles Laidley and Robin Shields at the Oceanic Institute have raised angelfish entirely in captivity, overoming a major barrier by developing a food source for its tiny larvae. At the same time, biologist Karen Brittain at the Waikiki Aquarium has reared Hawaiian masked angelfish for the first time, also by finding a food source for its larval form. And Andrew Baensch at the Hawaii Institute of Marine Biology has raised Fisher's angelfish.

Caviar farming starts to hatch here

By Timothy Hurley, The Honolulu Advertiser - Sunday, January 26, 2002

Kevin Hopkins, a professor of aquaculture at the University of Hawaii-Hilo, and retired UH extension agent Howard Takata are proving that Russian sturgeon can be raised here and grow much bigger than in the Caspia Sea. [Russian] sturgeon caviar eggs [sell] for about $1,300 a pound, and the meat of the fish for more than $50 a pound. What [Hopkins and Takata] found was that the local sturgeon not only grow three times as fast as the Caspian fish but mature twice as fast, after only five years. [At] least five Hawaii fish farms are raising sturgeon and another is posed to start up in Ukumehame, Maui.

The Industry Advisory Council (IAC) met on February 26th and 27th and put forth the following areas as priorities for funding. They are listed as they were prioritized by the IAC. The level of funding corresponds to the following:

Low = $0-$35k **Medium =** $35k-$75k **High =** $75k-$100k

Please contact the project working group leader if you would like to be included in the project working group or would like to participate in the meeting. Pre-proposals will be due to the CTSA administrative office on April 12, 2002, so please plan accordingly.

Disease – Medium Funding ***Project Working Group Leader:*** Dr. Robert Bullis, rbullis@oceanicinstitute.org

1. What are the effective dosages of formalin & hydrogen peroxide needed to treat the ecto parasites *Gyrodactylus* sp. and *Trichodina* sp. infecting fishes of different life stages in the region?
2. Can cell lines be developed for two marine fish species that are growing in demand; the Kahala and the Yellow tang?
3. Provide diagnostic support and remediation for the aquaculture sector in the region.
4. Can a health certification process for ornamentals (freshwater) be established?

Web/Library Resources – Low Funding ***Project Working Group Leader:*** Ms. Kristen Anderson, krisa@hawaii.edu

1. Can we develop web page(s) for aquaculture (e.g. linking producers, market info, ongoing research bulletin board and existing resources)?
2. Can we devise and develop a single source search engine to allow users to "pull" research resources through PRAISE system?
3. How do we provide outreach and extension of these products?

Marine Ornamentals – High Funding ***Project Working Group Leader:*** Dr. Anthony Ostrowski, aostrowski@oceanicinstitute.org

1. What are the best ways of applying lab scale first feeding results to production at a commercial scale be determined?

Black Pearls – Medium Funding ***Project Working Group Leader:*** Dr. Maria Haws, haws@aol.com

1. Can we use selective breeding to improve spat quality/survivability?
2. What are the quality and survival differences between using land-based versus lagoon-based nursery systems?

Extension Agent – Medium Funding ***Project Working Group Leader:*** Mr. Simon Ellis, sellis@mail.fm

1. How can we support the development of new aquaculture industries at existing facilities with knowledgeable professionals within the Pacific Region?
2. How can we develop training and better communication between the island extension agents?

Freshwater Ornamentals – Low Funding ***Project Working Group Leader:*** Dr. PingSun Leung, psleung@hawaii.edu

1. Is it economically viable for producers to directly market their product(s)? Singly? Cooperatively?
2. Why do published research results differ greatly from those experienced in the commercial sector? (ie. Survival rates, stocking density, profit)

Ogo – Low Funding ***Project Working Group Leader:*** TBD. Contact Kai Lee Awaya, kawaya@oceanicinstitute.org

1. How can the shelf life of seaweed be extended so that growers can expand to export markets industry growth of current shelf-life 3-7 days? Initial goal is 2 + weeks.

Marine Food Fish – High Funding ***Project Working Group Leader:*** Mr. Tom Iwai, tomi@hawaii.rr.com

1. Develop culture techniques for a target species. Suggested target species are kahala, opakapaka or omilu.
   Criteria for selecting target fish: a) Captive spawning, b) Favorable growth rate, c) Rapid commercialization potential, d) Suit able for mass culture, e) Marketability, f) Suitable for culture both on-shore and off-shore

Freshwater Food Fish – Medium Funding ***Project Working Group Leader:*** TBD. Contact Kai Lee Awaya, kawaya@oceanicinstitute.org

1. How can species for development be determined?
2. Provide culturing data.

Sturgeon – Low Funding ***Project Working Group Leader:*** TBD. Contact Kai Lee Awaya, kawaya@oceanicinstitute.org

1. How can mortality be lowered during the first feeding stage for sturgeon (other than white)?
2. How can we lower losses during the transition to dry pellets?
3. What are the temperature requirements for sac fry and larvae?
4. How can we lower differential growth rates within a single cohort during growout?
5. What is a less invasive method for determining sex?

This project will need to expand on Year 1 results.

Featherdusters –- Low Funding ***Project Working Group Leader:*** Dr. Clyde Tamaru, ctamaru@hawaii.edu

1. Diversify marine ornamental invertebrates of those species that are conducive to low-tech production systems.

This project will need to expand on Year 1 results.

Fish Transport – Low Funding ***Project Working Group Leader:*** TBD. Contact Kai Lee Awaya, kawaya@oceanicinstitute.org

1. How can fry larval fish be transported economically? The initial goal is 200 miles.

AQUA TIPS

The Reduced Impact of Taura Syndrome Virus on *Litopenaeus vannamei* Held Under Hyperthermic Conditions

Dee Montgomery-Brock, Hawaii State Aquaculture Development Program
Ron Y. Shimojo, Hawaii State Aquaculture Development Program
Robert A. Bullis, The Oceanic Institute

This article was written as part of the work for the project titled "Disease Management for Hawaiian Aquaculture, Year 8," which was funded in part 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.

Introduction

Taura Syndrome (TS) was first noted in shrimp populations that were farmed near the mouth of the Taura River in the Gulf of Guyaquil, Ecuador (Jiminez 1992 as cited in Hasson et al. 1999). Initially thought to be caused by toxicity, TS was eventually shown to be a result of a virus, which was thereafter named Taura Syndrome Virus (TSV) (Hasson et al. 1995). This virus has since been classified in the family Pocornaviridae (Hasson et al. 1995, Lightner 1996a, Bonami et al. 1997). Over the next five years, TSV caused catastrophic crop losses of *Litopenaeus vannamei* in South, Central and North America and in Hawaii (Lightner 1996b). In late 1998 TSV was also found to be the cause for shrimp mortalities in Taiwan (Tu et al. 1999).

There are three distinct disease phases associated with TSV infection. The first is the peracute/acute phase, where the shrimp are moribund. The shell is soft with a reddish coloration. The red coloration is caused by expanded chromatophores (Nunan et al. 1998). Shrimp mortality from TSV usually occurs in the acute phase. The survivors of this first stage of the disease then progress into the second, or recovery, phase. Shrimp in this phase are characterized by multifocal, melanized cuticular lesions (Lightner 1996). Mortalities are generally not high during this phase. The third phase is the chronic phase. Shrimp in this stage of the infection appear normal, but are often asymptomatic carriers of TSV (Brock et al. 1995). Mortalities from TSV during the chronic phase are extremely rare.

Once TSV is found to be the cause of mortalities on a shrimp farm, the most frequently used management tool is to stock with a species of shrimp that is less susceptible to disease, such as *Litopenaeus stylirostris.* Another option is to acquire post-larval *L. vannamei* that have been selected for TSV-resistance. (Poulos et al. 1999). Other less attractive alternatives are to destroy all the shrimp, clean up and re-stock after an extended dry-out or without initiating a cleanup, continue to stock *L. vannamei* in the presence of the virus and hope that mortalities are not excessive.

This paper documents a trial where the use of higher water temperature was applied in an attempt to control shrimp mortalities from exposure to TSV. Researchers at the CENIACUA group in Colombia recently discovered that *L. vannamei* shrimp held in warmer water (32.0° C) did not die when exposed to the otherwise lethal White Spot Syndrome Virus (WSSV) (Vidal et al. 2001). The purpose of this trial was to compare the survival of *L. vannamei* held in warm (32.0° C) and ambient (27.0-28.0° C) water when exposed to TSV.

Materials and Methods

Seven, 10-gallon aquariums were set up with seawater, which was adjusted with tap water to a reduced salinity of 11 ppt. Each aquarium was stocked with 10 *L. vannamei*. The shrimp ranged in size from 1 to 1½ g. The seven aquariums were set up in the following manner:

- Two aquariums with no heaters and the shrimp were fed approximately 1 g of TSV-infected tissue for 2 days, and commercial shrimp feed for the next 15 days (exposed, non-heated group). The temperature in these aquaria ranged 27.0 ± 0.9° C.
- Two other aquaria were set up, with heaters to maintain an elevated water temperature. The temperatures in these aquaria ranged 32.0 ± 0.7° C. Shrimp in this heated group were fed approximately 1 g of TSV-infected tissue for 2 days, then commercial shrimp feed for the next 15 days (exposed, heated group).
- Three control aquaria were set up.
  - √ One aquaria was set up with a heater to maintain an elevated water temperature (non -exposed, heated group). The temperature in this aquaria ranged 32.0 ± 0.7° C.

√ The other two aquaria did not have heaters and were maintained at room temperature (27.0 ± 0.8° C). Shrimp in the three non-TSV-exposed aquaria were fed only commercial shrimp feed for the duration of the trial.

Temperatures were recorded once daily and any dead shrimp were removed daily from the aquaria. The trial was terminated 16 days after the first feeding. Surviving shrimp were injected with R-F (RNA friendly) fixative. After 48 hours in R-F fixative, the samples were processed for histology, using the methods recommended by Bell and Lightner (1988 as cited in Hasson et al. 1999).

Results and Discussion

Shrimp survival was 20% and 40% in the non-heated, TSV-exposed aquaria, 80% and 90% in the two heated, TSV-exposed aquaria, 90% and 100% in the two control aquaria held at room temperature, and 90% in the one heated control aquarium. (Table 1).

Histopathology changes, suggestive of TSV-infection were found in the surviving shrimp examined from the TSV exposed, non-heated group. These changes included multi focal areas of necrosis in the cuticle epithelium and spheroid formation (severity grade 2.5–3) in the lymphoid organ (Figure 1). Lymphoid spheroids are proliferative nodules of pale staining vacuolated cells. As stated in Hasson et al. 1995, shrimp in both the recovery and chronic phase will usually have spheroid formation in the lymphoid organ. The reduced survival and the histology changes are indicative that the shrimp in the TSV exposed, non-heated group were infected and undergoing disease caused by TSV.

The surviving shrimp examined from the exposed/heated group and from the three control aquaria were free of areas of necrosis in the cuticle epithelium, cuticular melanization and spheroid formation in the lymphoid organ. These histology results suggest the shrimp in these groups had not been infected with TSV.

Tank Description	% Survival
Non-heated, Exposed	20
Non-heated, Exposed	40
Heated, Exposed	80
Heated, Exposed	90
Non-heated, Control	90
Non-heated, Control	100
Heated, Control	90

Table 1

Conclusion

It appears that maintaining shrimp in higher temperatures may offer a large degree of protection against TSV infection. The exact reason for this is unknown. Further studies are being carried out to better determine how warmer water protects *L. vannamei* from TSV.

Regardless of the mechanism for the protection, it would appear that shrimp farmers would want to raise their shrimp in warmer water temperatures if at all possible. While it is not feasible to heat an entire pond in the same manner that aquariums are heated, there are ways to optimize the use of warmer water when raising shrimp. The use of dark liners in the ponds, along with reduced water depth might help to increase the water temperature in the pond. The use of enclosed growout raceways instead of ponds, would give the shrimp producers more control over water temperature. Also, it would be advisable to seed the ponds or raceways during the months of the year that coincide with the warmer growing season.

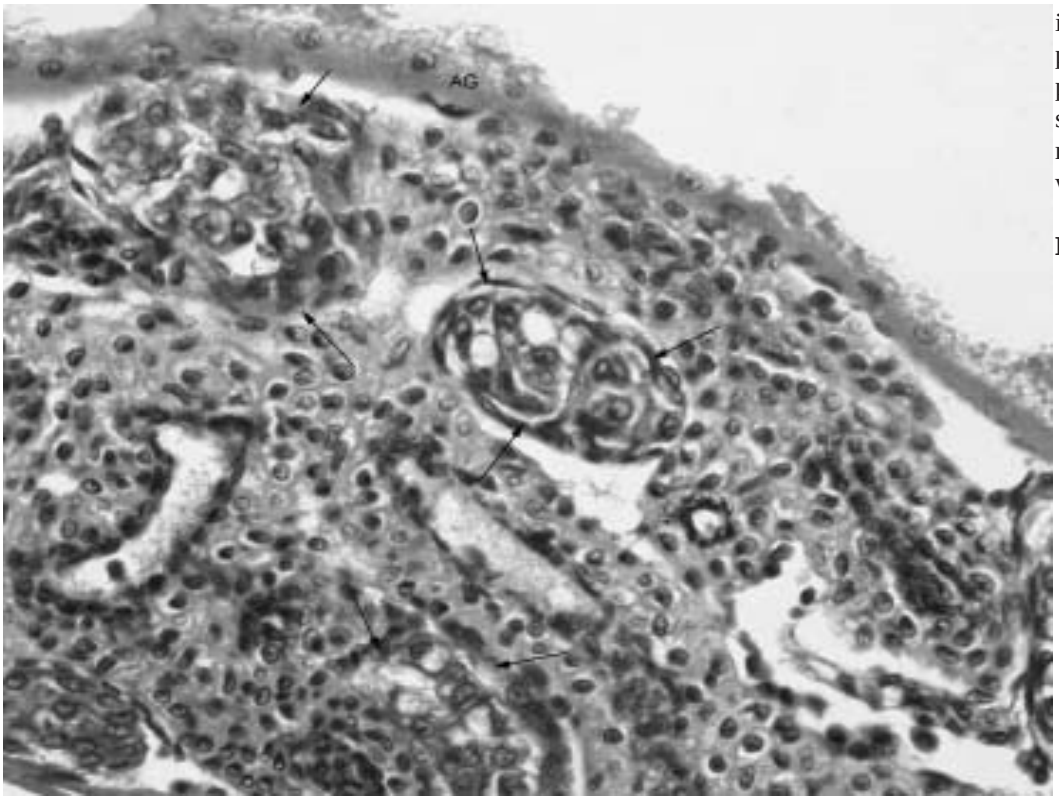


Figure 1.

Literature Cited

Bell, T.A. and D.V. Lightner. 1988. A handbook of normal penaeid shrimp histology. World Aquaculture Society, Baton Rouge.

Bonami, J.R., K.W. Hasson, J. Mari, B.T. Poulos and D.V. Lightner. 1997. Taura syndrome of marine penaeid shrimp: Characterization of the viral agent. Journal of General Virology 72:313-319.

Brock, J.A., R.B. Gose, D.V. Lightner and K.W. Hasson. 1995. An overview on Taura syndrome, an important disease of farmed *Penaeus vannamei*. IN: Brody, C.L. and J.S. Hopkins (editors) Swimming through troubled water. Proceedings of the spe-

Continued on page 7

CTSA welcomes new Board of Directors Chair

Dr. Jo-Ann Leong, Director of the Hawaii Institute of Marine Biology, was recently appointed by UH President, Evan Dobelle, as the representative of the University to the CTSA Board of Directors. Dr. Leong will take on the role of Chair of the Board immediately.

Dr. Leong recently returned home to Hawaii. As a native of Kapahulu, she went to the University of Hawaii for two years before transferring to the University of California at Berkeley for her B.A. She completed her doctoral thesis work at the University of California School of Medicine in San Francisco where she worked on retroviruses and reverse transcriptase.

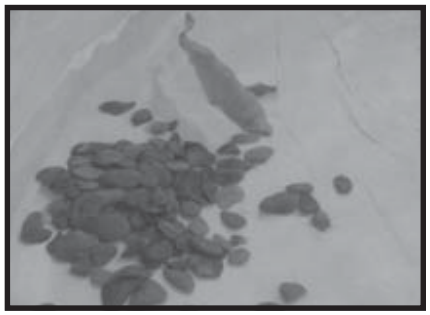
After completing her postdoctoral training in Biochemistry and Cancer Research at UCSF, Dr. Leong took a position as Assistant Professor in the Department of Microbiology at Oregon State University (OSU). When she started there, 6 million steelhead trout fry had just died from infection by Infectious Hematopoietic Necrosis virus. No molecular studies had been conducted on the virus and she devoted much of her career to studying it, developing vaccines for salmon, and using molecular tools to understand the immune response in fish. She and her team developed the first recombinant vaccine and DNA vaccine for fish. They are now in the process of testing the technology as a general transient expression system in fish. Dr. Leong also serves on the Board for the Western Regional Aquaculture Center as part of her joint appointment with OSU, so she is no stranger to the way the Regional Aquaculture Centers work. We are excited to have her become a part of CTSA.

As we welcome Dr. Leong, we would also like to thank Dr. Dean Smith for his past dedication to CTSA and bid him a kind farewell. Dr. Smith served as Chair since 1995 and has always been an asset to CTSA. Best of luck to him in the future.

Bass cont'd

from page 1

resources of Anuenue Fisheries Research Center available for the project. Since they get all of their feed and supplies directly from Anuenue, operation expenses are very low. However, by the time this article is published, all monetary funding will have run out. Chow is unsure of what this will mean for the project and is currently looking for other funding, but feels that things should proceed as planned for now.



All funding issues aside, Chow feels that one of the most important issues the project faces is that they do not know what currently lives in Lake Wilson. A preliminary study has shown that the reservoir is filled with approximately 32 species of aquarium fish. The lack of information on large-mouth bass in tropical environments has also been a hindrance for Chow. He found it to be even more daunting to actually track down and glean information from the authors of the publications he did find especially since they were all outside of Hawaii. Fortunately for Chow, the old adage that if you ask enough you'll get an answer was right. Chow recently met someone that has given him great encouragement. He has worked with large-mouth bass in the past, has agreed to take part in the effort and he is not far away – Dustin Moss, a researcher at The Oceanic Institute, a freshwater fisherman from Georgia and most importantly, a resident of Oahu did his master's thesis on population dynamics of large-mouth bass at Auburn University. Moss has agreed to help Chow determine the populations that presently exist in Lake Wilson, which will help ascertain the size of the bass that can be released into the lake. Currently the State has asked that 1,500 1-lb or 8-10-in fish be released per year, but if the pond's populations can feed the bass at a smaller size, they can be released at a smaller size, which would cut down on labor and feed costs and likely increase production levels. The population study will also determine if the physical changes to Lake Wilson will make the existence of a thriving population of large-mouth bass feasible. The sugar fields used to be irrigated with water from the reservoir every summer creating a flooded plain, a situation similar to the Amazon Basin. This would cause all the small ornamental fish hiding in the reeds along the lake to be flushed out into the mouths of the hungry game fish. Chow remembers that the river running under the bridges in Wahiawa would be dry six months of the year. For the other six months, the large fish would essentially starve while the fish they fed on hid in waters too shallow or overrun with foliage for the larger fish to swim through. With irrigation no longer occurring since the sugar mill closed in 1996, the reservoir creates perpetually flooded banks and may make it nearly uninhabitable for large fish. Chow contends that in fact, this may be the reason that they are no longer found there in abundance.

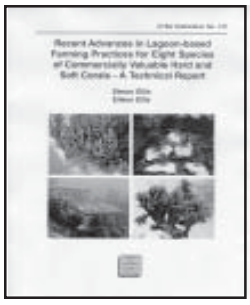
The project hit a wall last year when all but 4 of 5,000 1 ½-in fingerlings died last year. The death toll spanned over two months, during which tank by tank all of the fingerlings would die within 15 minutes to a maximum of two hours from each other. With no indication prior to death of disease or weakness, Chow was stumped. Dr. Jim Brock, the State veterinarian at the time, could not understand the phenomenon either. He performed some pathology work and took some water samples and still was not able to offer any clues. So, with many of the females in the tank gravid now, Chow is hoping that a fertile spawn will happen any day now. And so he waits with his fingers crossed and the town of Wahiawa behind him.

All photos were provided courtesy of Wahiawa Middle School.

New publications available!

The arrival of *A Manual for Commercial Production of the Swordtail, Xiphophorus helleri*, has long been awaited and it has finally come! The manual, written by several contributors from the University of Hawaii Sea Grant Extension Service (UHSGES), discusses all aspects of culturing the *Xiphophorus helleri* for commercial production, from breeding to bagging and shipping. Methods described in the manual are also applicable to other livebearers such as mollies, guppies and platies.

Through extensive field research and a literature review, Bob Howerton of UHSGES, was able to compile a manual for *Best Management Practices or Hawaiian Aquaculture*. By utilizing the suggestions put forth by Bob, farmers may be able to "manage their facilities more efficiently and more profitably [and at the same time] help to alter the negative perception of aquaculture and mitigate the potential for impact on an already delicate aquatic environment."



Our second coral manual put out in recent years, written by regional extension specialist, Simon Ellis and Eileen Ellis, reports on research conducted in Pohnpei on the culture of eight species of commercially valuable hard and soft corals. By examining growth and attachment rates, *Recent Advance in Lagoon-based Farming Practices for Eight Species of Commercially Valuable Hard and Soft Corals - A Technical Report*, helps the interested culturist determine which species is the most economically viable. The manual also includes a survey conducted with a few retailers in the U.S. on customer interest and expected retail prices.

If you are interested in receiving one or more of these manuals please contact Kai Lee Awaya at kawaya@oceanicinstitute.org or (808) 259-3167 or you can download it off our website at http://library.kcc.hawaii.edu/CTSA.

On the web . . .

For information and updates on the activities of the Joint Subcommittee for Aquaculture's Effluent Task Force (AETF), visit

http://ag.ansc.purdue.edu/aquanic/jsa/index.htm

The AETF is assisting the EPA develop science-based aquaculture effluents limitations guidelines for aquaculture facilities nationwide. The site also provides information on EPA presentations, announcements for meeting and the members and participants on the AETF.

Taura Syndrome cont'd from page 5

cial session on shrimp farming. Aquaculture '95. World Aquaculture Society, Baton Rouge, p 84-94.

Hasson, K.W., D.V. Lightner, B.T. Poulos, R.M. Redman, B.L.White, J.A. Brock and J.R. Bonami. 1995. Taura Syndrome in *Penaeus vannamei*: Demonstration of a viral etiology. Dis Aquat Org 23:115-126

Hasson, K.W., D.V. Lightner, L.L. Mohney, R.M. Redman, B.T. Poulos and B.M. White. 1999. Taura syndrome virus (TSV) lesion development and the disease cycle in the Pacific white shrimp *Penaeus vannamei*. Dis Aquat Org 36: 81-93.

Jimenez, R. 1992. Sindrome de Taura (Resumen) Acuaculturael Ecuador. *Rev Especial Camara Nac. Acuacult*1, 1-16.

Lightner, D.V. 1996a. A handbook of shrimp pathology and diagnostic procedures for disease of cultured penaeid shrimp. World Aquaculture Society, Baton Rouge.

Lightner, D.V. 1996b. The penaeid shrimp viruses IHHNV and TSV epizootiology, production impacts, and role of international trade in the Americas. Rev Sci Tech OIE (Offi Int Epizoot) 15(2) 579-601.

Nunan, L.M., B.T. Poulos, D.V. Lightner. 1998. Reverse transcription polymerase chain reaction (RT-PCR) used for the detection of Taura Syndrome Virus (TSV) in experimentally infected shrimp. Dis Aquat Org 34:87-91.

Poulos, B.T., R. Kibler, D. Bradley-Dunlop, L.L. Mohney and D.V. Lightner. 1999. Production and use of anti-bodies for the detection of Taura Syndrome virus in penaeid shrimp. Dis Aquat Org 37: 99-106.

Tu, C., H.T. Huang, S.H. Chuang, J.P. Hsu, S.T. Kuo, N.J. Li, T.L. Hsu, M.C. Li and S.Y. Lin. 1999. Taura Syndrome in Pacific white shrimp *Penaeus vannamei* cultured in Taiwan. Dis Aquat Org 38: 159-161.

Vidal, O.M., C.B. Granja, F. Aranguren, J.A. Brock and M. Salazar. 2001. A profound effect of hyperthermia on survival of *Litopenaeus vannamei* juveniles infected with White Spot Syndrome Virus. Journal of WAS 32:364-372.

In an effort to develop aquaculture education programs, the Massachusetts Department of Food and Agriculture and the New England Board of Higher Education (NEBHE) announce the release of the *Aquaculture Curricula Resource Guide: A Resource Tool for the Aquaculture Educator.* The guide describes instructional materials for educators interested in integrating aquaculture into existing programs or in establishing new aquaculture programs. Hard copies of the *Aquaculture Curricula Resource Guide* are available free of charge. Electronic copies can be downloaded from the Massachusetts Department of Food and Agriculture's Aquaculture Program webpage at (http:www.state.ma.us/dfa/aquaculture/education_curricula.pdf). For more information or a hard copy of the publication, please contact Fenna Hanes at the NEBHE at (617) 357-9620 or email fhanes@nebhe.org.

The *Aquaculture Curricula Resource Guide* was funded by the Northeastern Regional Aquaculture Center.

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 thirteen years of operation, CTSA has distributed $7 million to fund more than 130 projects addressing a variety of national aquaculture priorities.

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 and is located at The Oceanic Institute's Makapuu Point site on the island of Oahu in Hawaii.

For further information on the CTSA program, contact Cheng-Sheng Lee, Ph.D., Director, by phone (808-259-3107), fax (808-259-8395) or by email at cslee@oceanicinstitute.org.

FAST FACT

Between 1990 and 2000, per capita shrimp consumption in the U.S. rose from 2.2 to 3.2 pounds, which is slightly over 20 percent of total seafood consumption.

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CENTER FOR TROPICAL AND SUBTROPICAL AQUACULTURE

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