

REGIONAL NOTES

CENTER FOR TROPICAL AND SUBTROPICAL AQUACULTURE

Micronesian pearls attract international attention at region's first pearl auction

By Ramsey Reimers, Jessica Reimers, Maria Haws and Simon Ellis
Robert Reimers Enterprises, Inc. and University of Hawaii Hilo

MAJURO – Cultured black pearls from Marshallese company Robert Reimers Enterprises, Inc. (RRE) shone brightly at the Micronesian region's first pearl auction on November 20, 2003. This gala event, organized by RRE, Outrigger Hotels, and Aloha Airlines, strengthened the growing global reputation of Micronesian pearls as a high quality product. At the auction, RRE sold 100 of its best pearls selected from its November 2003 harvest. These pearls, distinguished by their large size, high luster, and silvery blue-green colors, sold at an average of 25 percent over estimated values. Buyers snatched up all the pearls within just two hours of frenzied bidding. The largest pearl harvested had a whopping 14 mm diameter. One of the most impressive pieces sold was a necklace consisting of 38 matched circle pearls with a stunningly bright green center pearl. Final lot prices ranged from \$175 to \$1,550.

The pearls sold at the auction came from two RRE pearl farms located on the outer islands of Arno and Jaluit. This was the fourth harvest from the Arno farm and the first from the newer Jaluit farm. The farms did not disappoint, and the high quality results pleased everyone, buyers and sellers alike. The pearls were typical of the "Marshallese" black pearl, being lustrous and possessing rather unusual, but highly desirable blue-green overtones on a dark black- or gray-colored body. The harvests were completed just days before the auction. This necessitated long days and nights of grading, pricing, and setting the pearls in preparation for the sale.

RRE personnel completed the work through a series of hands-on training events conducted by University of Hawaii Hilo's (UHH) Maria Haws and Simon Ellis and the College of the Marshall Islands' (CMI) Don Hess and Matang Ueanimatang. The training was funded under the UHH USDA Initiative for Future Agriculture and Food Systems (IFAFS) program and the Sea Grant Minority Serving Institution Grant awarded to CMI. The RRE personnel doing the work were familiar with the tasks and had already taken courses from the Gemological Institute of America, After Midnight Jewelers, and Lucoral Pearls.

Several prominent members of the pearl industry attended the auction, which

Continued on page 6



Photos courtesy of Maria Haws

Top: Pearl auctioneers, Anne Bailey (Common Heritage Foundation) and Robert "Bo" Torry (Editor, Pearl World) conduct the pearl auction at the Outrigger Hotel.

Bottom: UH Hilo's Simon Ellis (far right) and other potential bidders view RMI pearls on pre-auction display.

Don't miss CTSA's Call for Concepts!

January 30, 2004

See page 7 for details.

Letter from the director



On behalf of CTSA, I would like to wish you Merry Christmas and Happy New Year. May 2004 bring you much prosperity in your business and research.

As 2003 comes to a close, I am pleased to report that our Year 17 Plan of Work will soon be ready for Board approval. As we continue to strive to meet the needs of the regional aquaculture industry, I invite everyone to work together as a group. A fundamental principle of the Regional Aquaculture Centers is to use the team approach to address industry problems. Every institution excels in different areas, and combining the expertise of each institution in a united, well-thought-out, and focused effort will have a powerful impact.

The first step of our Year 18 project development process is now underway, and I look forward to the new year and the progression of all of our current and future projects.

Cheng-Sheng Lee



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AQUACLIPS

Governor's Exporter of the Year talks tons of abalone

By Jerome Tabar, Pacific Business News, Friday, October 3, 2003

In 2002, the Big Island Abalone Corp. set a goal of exporting 100 tons of abalone internationally. Rocketing toward that goal, among other achievements, earned Big Island Abalone the 2003 Governor's Exporter of the Year award. The annual award is granted to acknowledge outstanding contributions to exporting from Hawaii. The nomination and judging process is managed by the Department of Business, Economic Development and Tourism with support of other state and federal agencies as well as businesses. Hawaii is quickly becoming the abalone capital of the world, outpacing competitors in California, Australia and Japan, thanks in whole to Big Island Abalone and its cutting-edge production and marketing techniques. Big Island Abalone is an aquaculture business operating in the Hawaii Ocean Sciences and Technology park at Keahole Point on the Big Island. When it reaches full capacity, the abalone company will produce upward of 100 tons of abalone annually. A majority of its product is consumed in Japan, to which 90 percent of the product is shipped live.

The New Exporter award was given to Cates International Inc. It leased the first open-ocean space from the US government and grew moi, a popular Hawaiian fish, in submerged cages. It has a customer base in Hawaii and is moving to export moi to the continental United States.

High-end Japan shrimp makes Hawaii debut

By Terrence Sing, Pacific Business News, Friday, November 21, 2003

It's a good day for the country's shrimp lovers: The "King of Seafood" has entered the building – alive and kicking – in the form of *Penaeus japonicus* – aka Kuruma shrimp. This native Japanese shrimp has achieved great status in its homeland, where superior taste, texture and looks earned it the "King of Seafood" title. Among its one-of-a-kind attributes is its unique ability to be transported live – packed in sawdust without water – for 48 to 72 hours, allowing the shrimp to be delivered fresh to distant locales, much to the delight of sushi bar patrons. Until very recently, Hawaii and mainland US restaurants could not get live Kuruma shrimp delivered from overseas due to federal import regulations. That's changed since Yasuhiko Akamine, who has more than 40 years of shrimp farming under his belt, began growing the shrimp in ponds out at Kahuku over the past two years. But it wasn't easy. Akamine had his broodstock quarantined by the state Department of Agriculture for 18 months before he was allowed to begin his research. Four generations of successfully reared Kuruma shrimp later, Akamine is ready to take operations to the next level.... The project's first stage will require a hatching facility, 20 acres of land and the development of 12 one-acre ponds, which could yield 8,000 pounds of shrimp every nine months.... For more information, contact Yasuhiko Akamine via e-mail, akamine@aloha.com, or by phone at (808) 258-2403.

Hilo company plans ahi pens

West Hawaii Today, Friday, December 5, 2003

HILO (AP) – A Hilo company plans to raise tuna in pens floating off the South Kohala coast, with an eye toward selling them to sushi and sashimi markets in Japan. Ahi Nui Tuna Farming LLC plans to take ahi (young yellowfin tuna) and bigeye tuna caught with barbless hooks in Hawaiian waters and raise them in the pens for up to eight months, during which the fish will double or triple their weight. The company plans to develop its fish farm 2 ½ miles southwest of Kawaihae in water 800 feet deep, said spokesman Robert Cabos. The company had previously requested a state lease and a permit to build the floating net cages in 170-foot-deep water in a conservation area about a quarter mile offshore four miles north of Kawaihae Harbor, but changed plans because of community opposition.

The Oceanic Institute dedicates new training facility



The Oceanic Institute (OI) dedicated its Information Technology and Training Facility (ITTF) on December 9, 2003, enhancing its education and training programs. Gary Karr, OI's Communications, Training, and Education Manager, said the facility "enables us to broaden our training programs for aquaculture farmers, our professional forums for US and foreign industry leaders, and our marine science educational programs for secondary school students."



Entryway to the Information Technology and Training Facility



Outdoor Viewing Pond

Funding for the \$1.9 million ITTF was provided by grants from the US Department of Commerce Economic Development Administration, contributions from several Hawaii-based charitable foundations, and the pivotal support of Senator Daniel K. Inouye.

The dedication of the ITTF is a significant milestone in the completion of the \$24.4 million Center for Applied Aquaculture and Marine Biotechnology (CAAMB). Future CAAMB expansion will

include a feeds research laboratory near Hilo and a marine shrimp and finfish research facility at the Natural Energy Laboratory of Hawaii Authority (NELHA) in Kailua-Kona on the Big Island. A marine finfish hatchery will also be constructed on Molokai.

OI's President and CEO Thomas Farewell described the CAAMB as "one of the largest aquaculture research centers in the US, providing commercially scaled laboratories for responsible and innovative development of science-based technologies designed to meet local, national, and worldwide seafood needs."

photos courtesy of OI



Interactive Exhibit



In celebration of our diverse region, we present the:

CTSA Holiday Greeting Quiz



We wish you, "Merry Christmas and Happy New Year" in some of the native languages of the CTSA region. Match the greeting on the left with the language on the right.

- | | |
|--|-------------|
| 1. Felis Pascua yan Annu Nuebo | Samoan |
| 2. Meri Kihristmas ac Acpi Nuhyā | Hawaiian |
| 3. Mele Kalikimaka a Hau'oli Makahiki Hou | Chamorro |
| 4. Peren en Kristmas oh Parakapw Mwahu | Marshallese |
| 5. Felfelan' ko Baynag nge Bi'eche Duw | Pohnpeian |
| 6. Ia manuia le Kilisimas ma le tausaga fou | Yapese |
| 7. Mere Krijmaj im Jeramman ilo iio in ekaal | Kosraen |

Answers are on page 7.



AQUA TIPS

Creating the homozygous genotype for the lyretail trait in swordtails

Kathleen McGovern-Hopkins, Glenn Takeshita and Clyde S. Tamaru

University of Hawaii Sea Grant College Program, Hawaii State Department of Agriculture
Aquaculture Development Program and Honolulu Aquarium Society

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.

As part of our research activities in Hawaii, we are interested in finding ways to increase the percentage of lyretail individuals per brood because the lyretail variety of swordtail is approximately two to three times higher in value than the common varieties. Lyretail swordtails are swordtails with caudal fins that have elongated upper and lower rays, hence the name "lyretail." In a previous Aqua Tips article (McGovern-Hopkins et al. 2002), we described the results of lyretail swordtail artificial insemination, demonstrating that the numbers of lyretail individuals can be immediately realized. The method of artificially inseminating live-bearers has been described in detail in a recently published manual by McGovern-Hopkins et al. (2003), the results of which form the basis for this article. The insemination technique caught our attention because it represented a way in which we could mate lyretail males with lyretail females and circumvent the problem of male lyretails being unable to breed naturally. In this fashion, we would be able to make selected crosses and thereby document that the lyretail trait is a dominant characteristic as was reported by Norton (1991). The ultimate goal, however, would be to create a population of swordtails that were genotypically homozygous for the lyretail trait. Production of these individuals would be conclusive evidence of the nature of the trait as well as of its mode of inheritance. In addition, the creation of these individuals is of significant economic value because theoretically, 100 percent of their offspring should be lyretails.

Using the artificial insemination technique, we proceeded to construct several lyretail male to lyretail female crosses. Using the Punnet square, all of the possible genotypic combinations can be constructed by this particular cross, and we can predict the genotypic and thereby phenotypic ratios (number of lyretail to common individuals) from these crosses (Figure 1). For a lyretail male to lyretail female cross, we would expect a ratio of three lyretail individuals to every one common swordtail. A summary of five



	Genotype		L	I	
	L	LL	LI		
	I	IL	II		
Genotype = 1LL 2LI 1II					
Phenotype = 3 Lyretail:1Common					

FIGURE 1. Punnet Square summarizing all possible genotypic and phenotypic combinations resulting from a cross between a lyretail male and a lyretail female.



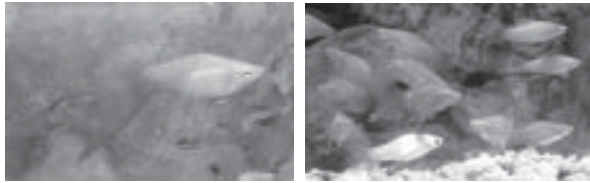
	Genotype		L	L	
	I	LI	LI		
	I	LI	LI		
Genotype = 4LI					
Phenotype = 4 Lyretail:0Common					

FIGURE 2. Punnet Square summarizing all possible genotypic and phenotypic combinations resulting from a cross between a homozygous lyretail female and a common male swordtail

successful crosses resulting from artificial insemination is provided in Table 1. We did find one cross that did not result in the expected 3:1 ratio, but more closely resembled a 2 lyretail:1 common ratio instead. The reasons for this observation are not known at present, but clearly, from the other four crosses, it can be concluded that the lyretail trait is being inherited in Mendelian fashion.

Of major interest is that 25 percent of the progeny produced should be homozygous for the lyretail trait. One main issue was determining how to identify these individuals because there are no known external features that distinguish a homozygous lyretail swordtail from a heterozygous lyretail individual. A method called progeny testing was employed where all of the females resulting from a lyretail male to lyretail female cross were mated with common males. Each female was then reared separately, and their individual clutches were also reared separately from other broods until they reached a size at which the number of lyretail and common swordtails could be scored

RESULTS OF PROGENY TESTING



Female #9

Clutch born: 8/17/02
52 Lyretail:0 Common

FIGURE 3. Example of a homozygous female and the results of her progeny test.

confidently. If a female's progeny were 100 percent lyretail, then we would know that we had identified a homozygous female as summarized in Figure 2. This was accomplished with our first group of 13 females, and we found three females who produced broods that were 100 percent lyretails. An example of using progeny testing on one of the females is presented in Figure 3. One in four of the females tested was expected to be homozygous for the lyretail trait, and therefore, the expected number of homozygous females out of the 13 females examined was three. Using females from a completely separate lyretail male to lyretail female cross, the entire process of mating those females with common males followed by progeny testing was repeated. In this instance, a total of 22 females from a single brood went through progeny testing. Out of those females, five homozygous lyretail females were identified. The expected number of homozygous females was six (25% of 22 = 6), which did not differ significantly (Chi Square Test, $P > 0.10$) from the number that was observed. All of these results clearly demonstrate that the lyretail trait is a dominant characteristic and is being inherited according to the Principle of Mendelian Segregation.

To our knowledge, although the characteristics and mode of inheritance of the lyretail trait was postulated many years ago, this was the first time that homozygous lyretail swordtails had actually been documented. This advancement in knowledge allows us to draw other conclusions that were previously not possible. For example, the lyretail trait appears to differ from that reported to exist for the hi-fin trait in swordtails and platies. It has been reported that the homozygous individual for the hi-fin trait also results in a lethal condition, and all homozygous individuals die before being born (Norton, 1967). This apparently is not the case with the homozygous individuals with the lyretail trait.

Although the results of the investigations have clearly established how the lyretail trait is being inherited, it remains to be determined whether this information will benefit farmers. What is most intriguing, however, is that when the homozygous lyretail female is crossed with a common male, it results in a population of 100 percent lyretail individuals. Production of homozygous lyretail female broodstock would eliminate the need for culling out common swordtails and significantly improve the current methods used in the commercial production of the lyretail swordtail. Clearly, development of techniques for the production of such broodstock would have an immediate and significant impact on the production output of a live-bearer enterprise and is the focus of future investigations. 🐟

Acknowledgments

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3. the State of Hawaii Department of Agriculture Aquaculture Development Program (ADP) as part of the Aquaculture Extension Project with the University of Hawaii Sea Grant Extension Service, Contracts No. 48499 and 49855.

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- Norton, J. 1991. Fancy live-bearers, Part Two. *Freshwater and Marine Aquarium* 14(7):48-51.

TABLE 1. Summary of observed and expected ratios of lyretail and common swordtails resulting from the insemination of lyretail males and virgin lyretail females. Values with a ** are significantly different $P < 0.05$.

Clutch Number	Lyretails	Common
D9 Born January 15, 2002		
Observed	22	7
Expected	22	7
Chi Square = 0.00, $P > 0.05$		
D23 Born January 22, 2002		
Observed	79	44
Expected	92	31
Chi Square = 5.69, $P < 0.05^{**}$		
D6 Born February 4, 2002		
Observed	53	19
Expected	54	18
Chi Square = 0.07, $P > 0.05$		
D10 Born February 18, 2002		
Observed	43	22
Expected	49	16
Chi Square = 2.06, $P > 0.05$		
D7 Born March 28, 2002		
Observed	32	13
Expected	34	11
Chi Square = 0.30, $P > 0.05$		

Pearls cont'd from page 1

was held at the Outrigger Hotel. Aloha Airlines provided transportation for a dozen international pearl buyers and experts to attend the special event, which was largely organized by Outrigger's Public Relations Representative Mary Lou Foley and Majuro Outrigger Hotel Manager Grant James. Among the pearl celebrities present were Mr. Robert "Bo" Torrey, editor of the leading industry journal *Pearl World* who also served as auctioneer, and Ann Bailey of the Common Heritage Foundation. RRE's Chief Operating Officer Jessica Reimers was among the many Marshallese ladies notably displaying their pearl jewelry that evening. On her head, Reimers wore a unique and spectacular *wut*, a hair wreath similar to the Hawaiian *haku lei*, made from woven white pandanus fibers embedded with large keshi pearls. Full coverage of the Micronesian pearling industry, including the auction, will be featured in the January edition of *Pearl World*.

The remaining 2,000 pearls from the November RRE harvest flew off the tables at a public sale held the following day. Hundreds of local and international buyers inundated the event hoping to grab one of the beautiful pearls. Within five hours, the entire stock was nearly sold out. Total sales for the day were over 150 percent more than those of previous public sales. Additionally, 200 pieces of pearl jewelry set by local trainees through a UHH value-added initiative were offered for sale for the first time, and these also sold rapidly. Unique designer jewelry created by Flora Lu of Lucoral in Waikiki, Hawaii, were also offered for sale. Lu used RRE pearls in her pieces. Strong support from a variety of institutions including the Marshall Islands Marine Resources Authority (MIMRA), UHH, CMI, and the Marshall Islands Visitors Authority (MIVA) contributed to the success of the auction and public sale. The success of the industry, however, is primarily dependent on the development of productive pearl oyster hatcheries. With support from the Center for Tropical and Subtropical Aquaculture (CTSA), CMI started a project earlier this year to focus on hatchery research and development. Stakeholders hope that this project will help build the strong foundation necessary for industry expansion.

Another first time event was the major purchase of pearls by the Kwajalein Military base procurement agency. These pearls are destined for subsequent sale on base. The military base is home to 3,000 expatriate workers, and the base store serves 10,000 Marshallese customers. Transactions like these open up new opportunities for "internal" export within the Micronesian region where there is a high demand for locally produced products. This spirit of cooperation extends beyond pearls to include specialty products like sponges. RRE has been helping the Pohnpein sponge farmers by selling cultured Pohnpein sponges in its retail store in Majuro.

RRE was not the only Micronesian company enjoying record pre-Christmas sales of pearls. The Nukuoro pearl farm in the Federated States of Micronesia completed its second harvest of the large, extra fine, second implant pearls in November, and these were sold at a Thanksgiving weekend sale in Pohnpei. Nukuoro Chief Magistrate George Steven, who also manages the farm's business operations, confirmed that this year's sale produced their highest revenues yet. Thanks to the IFAFS training initiatives, the

UPDATE

USDA CSREES project directors meet to coordinate efforts:

On November 12-14, 2003, project directors gathered together in Washington, DC for the US Department of Agriculture Cooperative State Research, Education, and Extension Service (USDA/CSREES) Post-Award Management and Peer Review Workshop for Aquaculture Non-competitive Grants. The workshop served as a forum for directors to come together and discuss all of the aquaculture projects funded by CSREES, thereby finding ways to avoid duplication of efforts and initiate collaboration. It gave everyone an opportunity to meet each other and to learn more about the different kinds of projects everyone was working on. The workshop will likely take place every two to three years.

CTSA director Cheng-Sheng Lee was also able to receive clarification on whether research results should be patented, a topic of increasing interest to CTSA researchers. The government encourages researchers to patent their findings. This is not in conflict with the Regional Aquaculture Centers' mission to support industry development and technology transfer. RAC projects are directed by the industry, and it is the industry's prerogative to determine what information from RAC-funded projects should be proprietary, what should be part of the public domain, and what should have limited access.

CTSA's Year 17 proposals in the process of being revised:

On November 25, 2003, CTSA's Technical Committee (TC) met to review and discuss the proposals submitted for the Year 17 Plan of Work. The TC took the proposals' external reviews into consideration as they decided which proposals to recommend to the Board of Directors. The TC also requested that some of the proposals be revised before being submitted to the Board. The Board will meet on Thursday, January 15, 2004.

Concepts for CTSA's Year 18 are being accepted:

On December 8, 2003, CTSA sent out a Call for Concepts for its Year 18 funding cycle. Concepts are due on January 30, 2004. Please see page 7 for details. CTSA's Industry Advisory Council will meet on February 17 and 18, 2004 to select the Year 18 priority areas from the submitted concepts.

Nukuoro community has also been adding value to their products by setting over 150 pearls in high quality pendants, earrings, and necklaces. The Nukuoro farm expects to harvest 8,000 pearls in August 2004, which will be its largest harvest to date.

RRE sees these events as setting the trend for what will hopefully become annual events to promote Marshallese pearls and tourism. These recent successful harvests are helping to establish Micronesia as a producer of upscale, limited-production, high quality black pearls. These pearls can only be purchased by the lucky few who travel to Majuro, but a few limited pieces can be ordered from Ramsey or Jessica Reimers at readmin@ntamar.net.

Surfing
the Net for
aquaculture
information?
Save time and
seek PRAISE.

Pacific
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Aquaculture
Information
Service for
Education

<http://library.kcc.hawaii.edu/praise/index.html>

CALL FOR

CONCEPTS

The Industry Advisory Council of the Center for Tropical and Subtropical Aquaculture (CTSA) will meet on February 17 & 18 2004, to determine the funding priorities for CTSA's Year 18. (Projects approved for Year 18 will likely begin in Summer/Fall 2005). Your suggestion(s) must be received by **Friday, January 30, 2004** at 5 pm Hawaii Standard Time.

www.ctsa.org

CTSA's mission is to support aquaculture research, development, and demonstration and extension education to enhance viable and profitable US aquaculture. CTSA is funded by an annual grant from the US Department of Agriculture Cooperative State Research Education and Extension Service. **CTSA's priority is to fund research that will benefit the aquaculture industry in our region** (American Samoa, Commonwealth of the Northern Mariana Islands, Federated States of Micronesia, Guam, Hawaii, Republic of Palau, and the Republic of the Marshall Islands).

We prefer your submission to include:

1. Title or Subject
2. Justification
3. Desirable outputs

CTSA is also open to a simple statement of a problem or currently unexploited opportunity. Please limit submissions to two pages. Send concepts to:

CTSA's IAC Priorities Year 18
University of Hawaii at Manoa
3050 Maile Way, Gilmore Hall 213A
Honolulu, Hawaii 96822
Fax: (808)956-5966
E-mail: dsasaki@hawaii.edu

JANUARY 30

The Fifth International Conference on

Recirculating Aquaculture

July 22-25, 2004 - Roanoke VA



Call for Papers
February 1, 2004

Dr. George J. Flick

5th Int. Conference on Recirculating Aquaculture
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e-mail: aqua@vt.edu



www.conted.vt.edu/aquaculture/r-aqua

CTSA Holiday
Greeting Quiz
Answers:

1. Chamorro
2. Kosraen
3. Hawaiian
4. Pohnpeian
5. Yapese
6. Samoan
7. Marshallese

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 US aquaculture. Funded by an annual grant from the US 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 US-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 fifteen years of operation, CTSA has distributed over \$7

million to fund more than 161 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 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 email at cslee@oceanicinstitute.org.

FAST FACT

"The value of Hawaii grown aquaculture totaled \$25.2 million in 2002, up 13 percent from 2001."

--Hawaii Agricultural Statistics Service

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