

REGIONAL NOTES

CENTER FOR TROPICAL AND SUBTROPICAL AQUACULTURE

Around the Pacific **Researcher sets up in Guam**

The University of Guam hired its first aquaculture research faculty member, a tenure-track position, about 10 months ago. Hui Gong, Ph.D., started her post as assistant professor on Feb. 15, so we thought it was a good time to check in to see how she was settling in and what kind of impact she wants to make.

Gong's specialties are in shrimp nutrition, health management, and molecular genetics.

She came to the University of Guam's Western Pacific Tropical Research Center (formerly the Agricultural Experiment Station) from the SyAqua subsidiary of Genius PLC, where she participated in genetic marker development, supervised biosecurity implementation and aquaculture health management efforts, and managed the breeding database for the firm's shrimp genetic program. She earned a doctorate degree in wildlife and fisheries sciences from Texas A&M University in December 1999.

"She's making a good impact. She is straightening out our PL production," says John Brown, Ph.D., professor of agricultural economics at the University of Guam and supervisor the university's Guam Aquaculture Development and Training Center (GADTC). He refers to production of specific-pathogen-free (SPF) shrimp post-larvae at the GADTC. "She's organizing production and providing a lot of oversight," he adds.

Below is an abridged version of an e-mail interview with Hui Gong by *Regional Notes* editor Kathryn Dennis in late September.

Regional Notes: What do you hope to accomplish at the University of Guam (UOG)?

Hui Gong: In the long term, I hope to develop an integrated and solid aquaculture research program at UOG. I want to conduct applied research that serves the needs of local and regional aquaculture farmers. Currently, I am establishing the foundation, setting up the right lab infrastructure and maintaining shrimp genetic



Hui Gong, Ph.D., joined the University of Guam in mid-February, taking the institution's first aquaculture research faculty position.

diversity and SPF status, as well as conducting nutrition and genetic studies.

What do you bring to your position at UOG?

My passion for applied research, my training and experience in aquaculture, molecular biology, nutrition, and health management. I also brought with me shrimp genetic materials and lab supplies, which was donated by SyAqua (my former employer) and helped initiate and speed up my research at UOG.

What challenges do you face in your efforts to achieve your goals?

As a new researcher in the Western Pacific region and at startup stage of a program, I realized that I need to work hard to face the challenges, which are as great as the potential, if not greater. Structure-wise, internally I need to establish a team and train personnel. Externally, I am working on networking and connecting with both academic and industrial groups to identify the important issues for research and to develop collaborative research efforts.

More important, I am seeking funding support for research. I must familiarize myself with the system, scope, condition, and funding opportunities from various grant sources/agencies and actively apply for grants. On top of that, time is a critical issue when dealing with live animals, which makes it more challenging

Help shape CTSA research priorities

Industry from Hawaii and the U.S.-affiliated Pacific Islands, find your voice. Tell us your problems. See Page 7.

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Letter from the director



In 2007, the CTSA Industry Advisory Council (IAC) and Technical Committee (TC) both began new, three-year terms. These groups play major roles in forming the research work plans that CTSA funds each year. Most recently, we have asked the IAC to help formulate the next Call for Pre-Proposals. If you have or see a problem or opportunity that could be solved through applied research and should be given funding priority, please contact an IAC member and ask them to report your idea to us. If you do not know an IAC member, you may contact CTSA directly.

Your opinion is key in ensuring that CTSA-funded research responds to industry needs. Tell us what production bottleneck or other obstacle to industry growth you would most like to see addressed. For more information on this chance to shape CTSA's FY08 (Year 22) Plan of Work, please see Page 7. Also, in early 2008, keep an eye on *Regional Notes* and the CTSA Web site for the Call for FY08 Pre-Proposals.

Cheng-Sheng Lee



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AQUA CLIPS

NELHA's deep-sea pipe needs repair

By Nancy Cook Lauer, Stephens Media Capitol Bureau, December 20, 2007

HONOLULU—The deep-sea pipeline that's the backbone of the Natural Energy Laboratory of Hawaii Authority's coldwater aquaculture and research projects is coming loose from its moorings, leaving it susceptible to snapping in an errant current.

The problem was discovered by inspectors earlier this month and discussed in a Dec. 11 closed-door session of the NELHA Board. The board instructed staff to immediately notify tenants and go to the Legislature for emergency funding to fix the problem before it gets worse, NELHA CEO Ron Baird said.

Baird awaits an estimate from consultant Makai Ocean Engineering, but repairs could cost more than \$1 million. Replacing the pipe if it breaks could cost more than \$10 million.

The 40-inch polyethylene pipeline, installed in 1987, extends to depths of 2,000 feet and is used by companies growing everything from abalone to oysters to seahorses.

The problem is compounded because the 18-inch backup pipeline broke during the October 2006 earthquakes. If the 40-inch pipe breaks, deep seawater will have to be rerouted from the 55-inch pipeline used by the facility's highly successful bottled water tenants.

Kona Blue moves HQ to mainland

By Jennifer Sudick, Honolulu Star-Bulletin, November 27, 2007

Aquaculture company Kona Blue Water Farms LLC is moving its Honolulu headquarters to San Francisco, even as it looks to double its capacity here.

The company, which farms sushi-grade Kona Kampachi-brand Hawaiian yellowtail in pens off the Big Island, said yesterday that it is moving all administrative offices and up to seven of the company's 45 employees, including CEO Michael Wink, to California by the end of next month to be more responsive to customer demands.

"About 80 percent of our total sales are to the mainland, and about 20 percent are here in Hawaii," said Kelly Coleman, vice president of marketing. "We felt that that would give us better oversight of our supply chain. It would also make it a bit easier to raise capital because we are going into a new period of raising funds."

The company is currently conducting a draft environmental assessment on a project that would more than double the capacity of each of its eight SeaStation cages off the coast of Kona from about 3,000 cubic meters to about 6,200 cubic meters. Coleman said the company is also looking at long-term expansion plans into Mexico's Sea of Cortez.

Big Island Abalone set to offer farm tours

By Staff, Pacific Business News, October 5, 2007

Big Island Abalone, an aquaculture company located at the state Natural Energy Laboratory of Hawaii Authority, plans to start conducting tours of its facility with a target date set in mid-October.

"We do everything by ourselves: spawning, feeding, growing, shipping," said Hiroshi Arai, general manager of Big Island Abalone. That gives products cachet with tourists.

The company also is in the middle of developing a line of packaged products that tourists can store at room temperature and take with them when they go home.

Australia's GFB Fisheries sites sea cages at the Marshall Islands

By Tony Raggatt, The Townsville Bulletin, October 3, 2007

The decision by Queensland's biggest aquaculture company, Townsville-based GFB Fisheries, to site its fish grow-out facilities at the Marshall Islands rather than in Queensland waters is a sad reflection of just how much our bureaucracy has locked up our precious Great Barrier Reef.

The company said it did not even bother applying for a license when even land-based applications take up to five years to process. The only sea-cage operation in Queensland is in the Hinchinbrook Channel.

Think seafood quality, think aquaculture

Consumer demand for seafood shows no signs of slowing down, and the world increasingly relies on aquaculture to provide a growing diversity of safe, nutritious, and affordable seafood. This outlook was the conclusion of a panel of 19 international experts in aquaculture, marine biotechnology, and human nutrition at a workshop, “Seafood Quality and Aquaculture,” organized by the Oceanic Institute and held at the East-West Center in Honolulu. For three days, Oct. 22–24, this panel examined the potential pathways of contamination “from water to waiter” in Australia, Canada, Japan, Thailand, the United Kingdom, and the United States.

Discussions covered the different regulatory and certification processes in place for seafood in various parts of the world. Speakers presented strategies used by producers to ensure seafood quality in cultured channel catfish, tilapia, trout, Atlantic salmon, yellowtail, and bivalve shellfish. The workshop concluded with summary highlights of its extended discussion sessions.

One of the first challenges was to define seafood quality, for which safety is the *minimum* requirement.

The industry does not yet have technical specifications for the varied characteristics that buyers look for in a seafood product. Inconsistent policies among regulatory agencies regarding levels of toxins that may be found in and harmful to fish could confuse and frighten the general public away from eating products that would be healthy to consume.

Short Course: Recirculating Systems

July 28–31, 2008

Virginia Polytechnic Institute and State University,
Blacksburg, Va.

This course thoroughly covers the design, operation, and management of water reuse systems for finfish, with limited coverage of systems for indoor shrimp production. This workshop is offered as either a hands-on (\$765) or a distance-learning (\$250) opportunity. **Michael B. Timmons**, Ph.D., of the Cornell Aquaculture Program and **James Ebeling**, Ph.D., of Aquaculture Systems Technology, New Orleans, La., will teach this course, which combines laboratory demonstrations with classroom presentations.

Upon completion of this workshop, individuals should be able to design their own water reuse systems and have fundamental knowledge of the principles influencing design decisions.

Hands-on enrollment is limited. Register by **July 1**. For distance learning, register by July 5. For more information, please contact Deb DeWeese at Cornell University, dwd24@cornell.edu or (607) 255-0150, or go this Web URL: <http://www.bee.cornell.edu/cals/bee/outreach/aquaculture/short-course/index.cfm>.

As an example of a useful tool for educating pregnant and nursing women about the benefits and risks of eating certain types of fish, a wallet card was distributed that listed finfish that have high levels of healthy fats (e.g., salmon and sardines), and others, which contain high levels of mercury (e.g., fresh tuna and marlin).

Aquaculture post-harvesting and processing are key components of product quality. Third-party organizations are often in charge of certifying aquaculture products, but more transparency is needed for evaluating certification programs—and fighting the corruption common to many so-called certification programs.

Because consumers ultimately define quality in seafood by the prices they are willing to pay, aquaculture producer groups should be prepared to develop standards for their products that consistently meet consumers’ expectations for nutritious seafood produced in an environmentally responsible manner. Better control over the husbandry practices that affect the quality and nutritional benefits of products is desirable.

Farmers, for example, are reducing their use of antibiotics and other chemotherapeutants by using alternatives like vaccines. Researchers, meanwhile, continue to develop alternatives to fishmeal and fish oil in aquaculture feeds that retain or enhance desirable qualities in cultured fish, a level of quality control that is not possible with wild-caught fish. In the future, aquaculture biosecurity programs will become an increasingly important part of farming practices for providing the high quality seafood that consumers demand.

The aquaculture industry needs to communicate effectively with the public about the benefits of eating the safe, nutritious, and high-quality seafood produced by aquaculture operations. Retailers play a key role in educating consumers. They can influence the seafood choices their customers make, providing information about nutritional content and suggestions and recipes for cooking products. Also, marketing seafood products to children is an approach with potential for further development.

Detailed information gathered at the “Seafood Quality and Aquaculture” workshop, including a list of research gaps and industry recommendations will be published in a proceedings next year. Look for an announcement in 2008 about the availability of this proceedings at the CTSA Web site, <http://www.ctsa.org/EventList.aspx>. —Pat O’Bryen

Gong continued from Page 1

to locate the right resources in a timely manner. Currently, I am in urgent need of locating funds to hire a research assistant to help me with daily operation and maintenance of the live animals.

What does the future hold for the aquaculture industry in Guam?

The residential population and tourism industry on Guam both have grown steadily. Growth is expected to continue, as more military personnel and their families move to Guam in the next few years. Given the territory’s increasing demand for food locally and unique geographic location, Guam’s aquaculture industry can play a more

AQUA TIPS

Vaccine development against *Cryptocaryon irritans*—standardizing the parasite challenge method

T. D. Lewis and I. Misumi

Hawai'i Institute of Marine Biology, School of Ocean & Earth Science & Technology, University of Hawai'i at Manoa

This article was written as part of the work for the project titled, "Disease Management for Pacific Aquaculture, Year 12," 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

The ciliate *C. irritans* is an obligate marine parasite responsible for "saltwater ich" or "marine white spot disease" in fish. This globally distributed parasite exhibits low host specificity. It is one of the most common and destructive protozoan parasites of marine fish. *C. irritans* has a direct lifecycle with three main developmental stages: theront, trophont, and tomont (Brown 1963, Colomi 1987, Colomi and Diamant 1993). The infective stage is the free-swimming theront, and, once this parasite has established itself on the surface of a host, it embeds itself in the epithelium of skin or gill and becomes a trophont—creating the characteristic white spot of a *Cryptocaryon* infection. Once mature, a trophont leaves the fish surface and becomes a tomont. Each tomont releases more than 200 theronts, continuing this parasite lifecycle. Amplification of parasite numbers can occur rapidly once this parasite is introduced into a culture system, and vigilance is required when culturing susceptible species.

In a previous AquaTips report (Misumi and Lewis 2005), we confirmed the utility of an immobilization assay to identify anti-*Cryptocaryon* antibodies produced by fish that immobilize the theront form of this parasite by inhibiting ciliary movement. Using standard ELISA and immunoblot analysis, we identified an individual protein that *Cryptocaryon*-immunized fish recognized and approximated this protein to be 30 kilodaltons (kDa). Tilapia are the primary fish model being used for preliminary experiments due to their availability at the Hawaii Institute of Marine Biology (HIMB) and their euryhaline physiology that allowed them to be reared entirely in freshwater and then acclimated to filtered, UV-treated seawater for vaccine trials. This approach has great utility, as it ensures that fish are naïve to any previous exposure to *C. irritans*.

Initial experiments were performed using tilapia, since commercially produced antibodies are available for this species. Ultimately, we want work with *moi*, as the Pacific threadfin (*Polydactylus sexfilis*) is known locally in Hawaii. Our efforts to develop a purified anti-*moi* IgM antibody for serological analyses are still in progress.

Vaccine development against *Cryptocaryon irritans* is an ongoing project at HIMB. This project has three main objectives to be completed over a three-year period. Briefly, these objectives include (1) identification of the life stage of *Cryptocaryon* best suited for use in a vaccine protocol and initial characterization of *moi* antibodies (IgM), (2) vaccination and challenge trials, and (3) identification and characterization of antigens in effective vaccine fractions and characterization of the anti-*Cryptocaryon* antibody response.

Here we report on studies required to standardize vaccine trials, namely identifying the infectious dose required to establish an infection in 50% of fish exposed. This "infectious dose 50" (ID₅₀) is an important parameter for vaccine development because experiments should use a standardized dose for each experiment

and should use a biologically relevant dose—not one too low to initiate infection or one so high that it overwhelms an animal's natural immune response. Other project progress presented here includes an update on identification of parasite proteins suitable for sub-unit vaccine development and the *moi* vaccine trial.

Methods

Parasite culture and challenge. Relatively large tomonts (>200 µm) were harvested from aquaria housing tilapia (*Oreochromis mossambicus*) infected with *C. irritans*. Tomonts were washed and

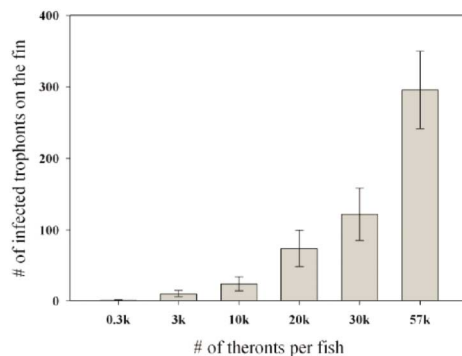


Figure 1. The average number of *Cryptocaryon* trophonts on the left pectoral fin of tilapia two days post primary exposure ($n=30$). These results use combined data of two replicates.

re-suspended in filtered seawater (FSW) and placed in a 24-well culture plate. After confirmation of encystment of the tomonts, cultures were incubated for at least four days in ambient air conditions. Newly hatched theronts in the culture were counted using a microscope.

Immersion (direct) exposure to *Cryptocaryon* theronts was conducted using six groups (n=15 each tank) of tilapia (mean weight 30.1 ± 9.3 g/length 12.3 ± 1.4 cm). Theronts were suspended in 60 L of filtered, UV-treated seawater (28 ± 0.2 °C) at concentrations of 333 (0.3K), 3,333 (3.3K), 10,000 (10K), 20,000 (20K), 30,000 (30K), and 56,667 (56K) theronts per fish (5,000, 50,000, 150,000, 300,000, 450,000, and 850,000 theronts per tank). The experiment was repeated, and the final sample size became 30 for each exposure dosage. Two days after theront exposure, the number of infected parasites on the left pectoral fin was counted under the microscope. Blood was collected from the caudal vein from MS-222 anesthetized fish after four weeks and centrifuged to extract the serum. Serum was stored in aliquots at -20°C until analyzed.

Fish were exposed to 10,000 (10K) theronts per fish at week five to boost their antibody response. Blood was collected three weeks post secondary exposure, and serum extracted and stored as described above.

ELISA. A standard protocol for ELISA was used to test for antibodies against *C. irritans* (Harlow and Lane 1988). A 96-well ELISA plate was coated overnight with a protein suspension of *C. irritans* in carbonate coating buffer (1.2 µg in 100 µl per well). The plate was blocked with phosphate buffered saline (PBS) containing 1% bovine serum albumin (BSA) (PBS-BSA) for two hours, and, then, at sequential one-hour intervals, the ELISA plate was incubated with serum from challenged or control fish (diluted 1:1,000), rabbit anti-tilapia IgM IgG (diluted 1:5,000), and 1:2,500 goat anti-rabbit

IgG (diluted 1:2,500). Between additions of each new reagent, the ELISA plate was washed five times with PBS containing 0.01% Tween 20 (PBS-T). ABTS peroxidase substrate was added to each well to allow for chromogenic (color) development. After 10 minutes, the optical density at 405 nm (OD₄₀₅) was read using a microplate reader.

Immobilization assay. Assays were carried out as described by Clark et al. (1987) with modifications. Ten µl of fish serum collected from vaccinated or control fish was diluted in 490 µl of filtered seawater (FSW) and heat inactivated at 56°C for 30 minutes. Twenty µl of this was added into each well of a 96-well plate containing 100 l of theront suspension with FSW (~30 theronts per well). After 30 minutes incubation at room temperature, the number of immobilized theronts was counted using a microscope to determine the percentage of theronts that was no longer motile.

Results

All fish dosed with theronts developed an infection evidenced by characteristic white spots. The average number of trophonts embedded in the pectoral fin resulting from each dose is provided (Figure 1, Table 1). There was no significant difference between the exposure results of the two replicates. The number of trophonts that embedded on the pectoral fin surface was dose dependent and 50% of 0.3K-infected fish did not show any trophont infection. This experiment establishes an ID₅₀ of 0.3K theronts for *C. irritans* infection, and future vaccine trials will be conducted using this dose. Previously, parasite infection in various experiments was determined by skin swab or scraping. Microscopic examination of the pectoral fin and counting trophonts (Figure 2) is much easier. This method can be used to monitor the effectiveness of future vaccine trials and is more standardized than skin swabs or scraping for enumerating infection levels.

Although the purpose of this experiment was to identify the ID₅₀ in order to standardize future challenge experiments, two additional metrics were identified. The 50% lethal dose (LD₅₀) for *Cryptocaryon* infection was 85K theronts per fish. The 100% lethal dose (LD₁₀₀) for *Cryptocaryon* required infection with more than 100K theronts per fish. When fish were challenged with a second exposure to parasites (10K theronts for all groups), few or no trophonts developed on the fish (Table 1). In fact, only three of the fish that received the lowest dose (0.3K) developed any sign of infection on the fin, and no mortalities relating to *C. irritans* infection occurred.

ELISA results indicate that fish developed specific antibodies against *C. irritans* irrespective of parasite dose administered in the study. The OD₄₀₅ for serum diluted 1:500 in PBS increased three weeks after direct exposure of parasites for every group (excluding controls), from an average background OD₄₀₅ of 0.054 to 0.180, indicating increased antibody recognition of parasite proteins coated on the ELISA plate. After the secondary challenge, titers increased almost four-fold for all groups (excluding controls) and had an average OD₄₀₅ > 0.600.

Immobilization assays were conducted to better characterize what affect, if any, parasite dose has on immobilization and antibody titers. Assays were done using serum collected four weeks post exposure (n=30) and again at week eight (post secondary exposure). Immobilization titer is the reciprocal value of the dilution at which more than 95% of the parasites are unable to move freely using ciliary motion. After four weeks, the average immobilization titers ranged from 11.4 ± 5.8 (mean ± standard deviation) for the group exposed to

Initial Exposure: Replicate One

Dose (per fish)	# of parasite per fin (avg)	STD	# of infected fish per total fish
0.3K	1	1.1	6/15
3K	10.9	4.3	15/15
10K	26.1	9.2	15/15
20K	95.3	18.2	15/15
30K	110.7	27.2	15/15
57K	301.2	60.8	15/15

Initial Exposure: Replicate Two

Dose (per fish)	# of parasite per fin (avg)	STD	# of infected fish per total fish
0.3K	0.5	0.7	8/15
3K	10.1	5.4	15/15
10K	23.5	10.5	15/15
20K	53.2	10.4	15/15
30K	133.1	43.3	15/15
57K	290.3	50.2	15/15

Second Challenge: Both Replicates Combined

Dose (per fish)	# of parasite per fin (avg)	STD	# of infected fish per total fish
0.3K	0.4	0.9	3/30
3K	0	0	0
10K	0	0	0
20K	0	0	0
30K	0	0	0
57K	0	0	0

Table 1. The average number of parasites on the left pectoral fin and standard deviation (STD) two days post exposure. Upper and middle tables provide the results of duplicated groups. After four weeks, all fish were challenged with the same amount of parasites (10K theronts per fish). After two days, parasites (trophonts) on the right pectoral fin were counted microscopically (n=30).

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0.3K theronts to 29.2 ± 17.4 for the group exposed to 56K theronts. After secondary exposure of all groups to 10K theronts, immobilization titers rose to 93.1 ± 62.3 for the 0.3K group up to 170.2 ± 52.0 for the 850K group. The group receiving 10K had the peak immobilization response after secondary challenge with a titer of 221.7 ± 43.5 . As with the antibody response measured by ELISA, secondary exposure increased the anti-*Cryptocaryon* response. The immobilization titer for the 0.3K-vaccinated group increased less than for the other groups, especially compared to the group receiving 10K theronts for the infectious dose.

Discussion

To summarize the ID₅₀ experiment, 50% of 0.3K-exposed fish did not show any parasites on a pectoral fin, and ELISA data showed all 0.3K-exposed fish had immune response against *Cryptocaryon*. These results indicate that parasites may have been infected on the skin or gill but not on the pectoral fin. Examining the pectoral fin seems a good standardized method for direct enumeration of the prevalence of trophonts on an infected fish. During this study, the method to cultures parasites *in vitro* was refined. This advancement has been very important to this study, since different cultures may possess different immobilization antigens. Current cultures at HIMB have been maintained for more than six months.

ELISA titers were examined using a single dilution (1:500 diluted in PBS) for each sample. Additional titration needs to be done to determine if antibody level is actually dose dependent. This work can be done by examining differences in titer that may be more obvious as more dilutions of antibody are tested. The immobilization observed in this study indicates immobilization

antibodies are dose dependent. We anticipate that we will see a dose response by ELISA once more serum dilutions are tested.

Moi vaccine trials using the established ID₅₀ have been initiated. Prior to this experiment, all fish were assayed for immobilization antibodies to ensure these fish were naïve to *Cryptocaryon* antigens. This step is necessary, since there is no commercial anti-moi IgM antibody currently available for use to measure moi antibody response via ELISA or immunoblot methods. Moi were injected with theronts to confirm whether they have the same response against theronts as observed for tilapia and have purified moi IgM. We are working to develop anti-moi IgM (antibodies) using funding from another grant, and we are working with *kahala*, as the longfin amberjack (*Seriola rivoliana*) is called in Hawaii. We are generating anti-kahala IgM for use in experiments during the next CTSA-funded disease research project. The anti-moi IgM will have great utility for studying moi antibody responses against various pathogens of interest in Hawaii in addition to *Cryptocaryon*. Once this vaccine trial is complete we will have a better understanding of the moi immune response at the antibody level as measured by ELISA and immobilization.

Finally, here's an update on the isolation of purified parasite proteins for use as sub-unit vaccines. The initial report of a 30-kDa immobilization antigen for *Cryptocaryon* identified in our lab has been revised. After obtaining densitometry-capable imaging software, the molecular weight for the *Cryptocaryon* immobilization antigen recognized by immunized tilapia has been identified as being only 29 kDa. This was also confirmed by sending a sample for protein sequencing at Stanford University's core protein sequencing facility. Subsequent to this analysis, a second antigenic protein has been identified and is currently being sequenced. Both proteins will be purified by electro-elution and used to inject moi in order to assess their effectiveness as a *Cryptocaryon* vaccine. Once molecular characterization of these proteins has been completed, we plan to produce a recombinant vaccine that does not have to be produced from live parasites. This activity, along with additional vaccine and challenge experiments, is the next phase of our research.

Acknowledgements

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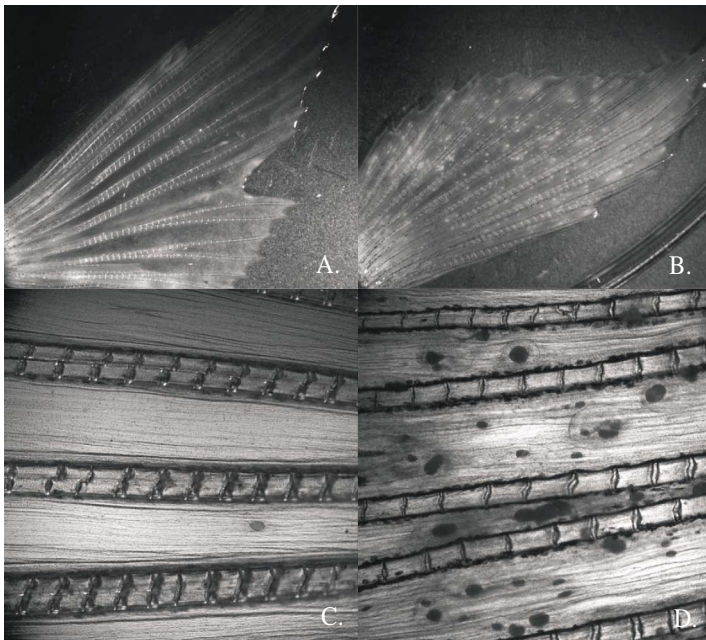


Figure 2. Images of tilapia pectoral fin used to enumerate the level of infection. Trophonts on fins visualized using a dissection stereomicroscope of (A) 0.3K and (B) 57K infected fish. Also, trophonts on fins visualized using a standard compound microscope (20X magnification) of (C) 0.3K and (D) 57K infected fish.

Got Problems? Help Shape CTSA Research Priorities

Tell us what bottlenecks and opportunities have the greatest impact on industry in the CTSA region.

We want your input to help compose the Call for Pre-Proposals for our Fiscal Year 2008 (Year 22) funding cycle. Below are the Strategic Areas and Year 21 Priorities that made up last year's call and that we expected researchers to address in their proposals. We are now updating this outline of priorities, and we need your help to make sure that the 2008 Call for Pre-Proposals reflects industry needs.

The below catalog of research priorities is just a starting point. Any feedback on how to improve it is welcome. Specifically, we want to hear about any problems or opportunities that you'd like to see addressed by CTSA-funded research. Your submission should include problems or questions to be answered, plus a justification for each. Please submit your ideas by **January 31, 2008** to Kathryn Dennis at kedennis@hawaii.edu.

A Starting Point: Strategic Areas and Priorities from the Previous Funding Cycle

❖ Offshore Aquaculture

Offshore aquaculture has the potential to greatly expand marine finfish production in Hawaii and the American Insular Pacific. Hawaii is in the national spotlight and leads the nation in industry development of open-ocean aquaculture. Yet this industry is still new and fragile. Pre-proposals focused on resolving bottlenecks or ensuring the sustainability of offshore aquaculture in the region will receive highest priority.

Year 21 Priorities

- Moi hatchery: d7–d8 mortality and other critical periods during the larval rearing cycle
- New species (tuna or snapper)
- Mass, cost-effective fry production technology

❖ Health Management

Aquaculture in the Pacific lacks a concerted effort toward health management, diagnostics, and research. Hawaii and the U.S.-affiliated Pacific Islands are uniquely isolated to ensure biosecurity yet extremely vulnerable if disease does arise. CTSA will support both targeted and strategic work toward health management of all species. Pre-proposals tackling a specific problem of industry importance or working to ensure long-term biosecurity in the region will receive highest priority.

Year 21 Priorities

- Finfish health database
- Vaccine development

❖ Ornamental Aquaculture

Hawaii is well positioned both strategically and geographically to develop robust freshwater and marine ornamental industries. However, after years of funding support from CTSA, freshwater ornamental operations in the state still need ways to improve profitability. There are unique challenges to both marine and freshwater ornamental culture. Pre-proposals addressing production bottlenecks will receive highest priority.

Year 21 Priorities

- first feeds for marine larvae
- new marine benthic egg layers
- ability to remove constraints to profitability for ornamental culture, especially for freshwater ornamental operations

❖ Innovative Aquaculture

Hawaii and the U.S.-affiliated Pacific Islands have an advantage—the existence of a variety of species that are exclusively native or endemic to their islands—upon which niche markets can be built. To succeed in the Pacific region, however, and regardless of species cultured, small aquafarmers must leverage innovative approaches that either reduce the costs of or bring added value to their production efforts. Highest priority will be given to pre-proposals targeting small farm viability through the development of niche markets (especially for endemic species), multiple markets for a single species, multiple profit centers for farms, or post-harvest value added processing.

Year 21 Priorities

- Bivalve culture (native species)
- Multi-tasking species
 - Fresh or marine species marketable as both ornamentals and food
 - Species with 2–3 markets at different life stages
- Multi-profit centers
 - Polyculture
 - Value-added (post-harvest) processing
 - Integrated agriculture

❖ Pacific Island Development

There are unique technical, social, and economic challenges to aquaculture development in the U.S.-affiliated Pacific Islands. In many cases, technology is available but expertise and training are needed to jumpstart development. Other important concerns are assessing available resources and identifying opportunities. Pre-proposals centered on technology transfer of existing technologies will receive highest priority.

Year 21 Priorities

- Aquaculture planning
- Shrimp (SPF) technology transfer
- Finfish culture technology transfer

Respond by January 31

Send an e-mail to kedennis@hawaii.edu

CENTER FOR TROPICAL AND SUBTROPICAL AQUACULTURE

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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), CTSA integrates individual and institutional expertise and resources in support of commercial aquaculture development.

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

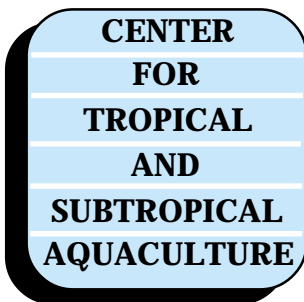
In its 20 years of operation, CTSA has

distributed nearly \$11 million to fund more than 205 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 in its region. After consultation with appropriate technical experts, CTSA responds with a program of directed research that has these pre-determined priorities as the focus of project objectives. CTSA's board of directors is responsible for overseeing programmatic functions. The center disseminates project results through its print publications, hands-on training workshops, and Web site.

CTSA is jointly administered by the Oceanic Institute and the University of Hawai'i. The main office is located at the Oceanic Institute's Makapu'u Point site on the island of O'ahu in Hawai'i.

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