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REGIONAL NOTES

CENTER FOR TROPICAL AND SUBTROPICAL AQUACULTURE

Regional Aquaculture Centers program surges ahead

To begin the year, Regional Notes *would like to share news from the other four regional aquaculture centers. Most of the information was provided by the directors.*

Northeastern Regional Aquaculture Center (NRAC)

NRAC is currently located at the University of Massachusetts Dartmouth (UMass Dartmouth) and represents the District of Columbia and 12 northeastern states. Principal aquaculture crops include Atlantic salmon, oysters, clams, and trout. The northeast is endowed with the largest seafood consumer market in the United States, a diversity of aquaculture species and growing conditions, and perhaps the densest concentration of the brightest minds in the world.

As demand for seafood keeps on growing, efforts are being made to develop aquaculture as a viable and environmentally benign alternative to the dwindling wild fishery. In order to speed the process, NRAC held its first "Annual Aquaculture Research, Extension, and Business Opportunities Update." Over 40 aquaculture practitioners, investors, students, researchers, and extension professionals from all over the region attended this free, one-day public forum. Abstracts of the seminar topics presented by principal investigators of ongoing and recently completed NRAC research topics will soon be made available at the NRAC Web site.

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In an effort to expedite aquaculture development in the northeast, the NRAC Board of Directors came up with a growth strategy that calls for narrowing of focus to only a few promising aquaculture enterprises that have the potential to attract serious investors and new entrants into commercial aquaculture within the next three to five years. These core products will serve as the main platform and focal point for the development of necessary support systems, extension education programs, and technology transfer materials that will make it easy for new entrants to set up, operate, and succeed in an aquafarming enterprise. Copies of the different NRAC aquabusiness feasibility studies will soon be made available at the NRAC Web site.

UMass Dartmouth will soon transfer the NRAC administrative helm to the University of Maryland (UMD). Current Executive Director Tomas Vergel Jamir agreed to stay to help Interim Executive Director Fred Wheaton and the UMD team effect a smooth and seamless transition. A small Transition Committee was also formed to map out the details.

North Central Regional Aquaculture Center (NCRAC)

NCRAC, located at Michigan State University and under the direction of Ted Batterson, serves 12 states in the heartland of America. People in the NCRAC region eat a little over 1 billion pounds of fishery products per year but produce very little (<2%) of what is being consumed. Aquaculture in the region is characterized by great diversity, with over 50 different species of aquatic animals being cultured by more than 1,000 producers of food fish, baitfish, and fish for stocking into recreational water bodies. These producers are themselves

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Regional Aquaculture Centers Mission

To support aquaculture research, development, demonstration, and extension education to enhance viable and profitable U.S. aquaculture that will benefit consumers, producers, service industries, and the American economy.

New publication available!

University of Hawaii graduate student Lotus Kam, Professor PingSun Leung, and Hawaii Sea Grant Extension Specialist Clyde Tamaru released an Aquafarmer Information Sheet titled "**Direct Marketing Hawaii's Freshwater Ornamental Aquaculture Products**."

This publication is part of the project "Economic feasibility for freshwater ornamental fish growers in Hawai to market their products directly to West Coast retailers.

To obtain a copy, please contact dsasaki@hawaii.edu or visit the CTSA Web site at www.ctsa.org.

REGIONAL NOTES

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AQUA CLIPS

Commission finalizes foreign shrimp tariffs

Honolulu Star Bulletin, Friday, January 7, 2005

The U.S. International Trade Commission yesterday cleared the way for tariffs to be imposed on shrimp imports from six Asian and South American countries, but expressed concern that tariffs on India and Thailand would burden the tsunami-ravaged countries. The commission upheld last February's preliminary finding that imports had injured, or were likely to injure, U.S. shrimp processors and fishermen. The panel reaffirmed with a 6-0 vote that frozen shrimp have hurt the U.S. industry but voted 4-2 to scrap tariffs on canned imports, which make up about 0.4 percent of imports. The ruling was the last major step before tariffs on imports from Brazil, China, Ecuador, India, Thailand, and Vietnam become final.

Hawaii shrimp exports escape tsunami's wrath

By Terrence Sing, Pacific Business News, Friday, January 14, 2005

Hawaii shrimp farms exporting broodstock into Asia say business for the most part remains unaffected by the cataclysmic tsunami that severely damaged the region's shrimp-farming industry. Kona Bay Marine Resources, Inc. and High Health Aquaculture on the Big Island both raise disease-resistant Pacific white shrimp as broodstock, which they export to Asia. They say it's remarkable their clients have not canceled orders in spite of the tragedy, which wiped out many of the region's farms. Disease-resistant Hawaii-raised shrimp exported out of state are the culmination of years of painstaking study by Hawaii researchers. Kona Bay and High Health are at the forefront of a developing new industry beginning to profit from the export of these animals, which sell for as much as $30 apiece. Kona Bay, which won the Governor's Exporter of the Year award in 2004, can ship as many as 4,000 six- to eight-inch-long Pacific white shrimp broodstock a month. More than 95 percent of the company's shrimp is exported. The United States imports about 90 percent of its shrimp from overseas, primarily from Asian countries, which fight an ongoing battle with shrimp diseases that spread easily due to many of the farms being in close proximity. Disease-resistant Hawaii shrimp are a valued commodity.

NMC OK'd to build marine, mariculture center

Saipan Tribune, Saturday, January 29, 2005

The Northern Marianas College has been granted its request to use an abandoned 2,000-square-foot government building and its surrounding properties at Pau Pau Beach, where it plans to build a new Marine/Environmental Sciences and Mariculture Demonstration Center. In a unanimous decision, the board of directors of the Marianas Public Land Authority approved NMC's request during its January 26 meeting. The goals of the proposed center are to increase awareness and appreciation of the CNMI's marine and environmental resources and to promote utilization of cultured marine life as a viable alternative to wild resource collection.

Initial funding for the first phase of the site's development will be financed by both a start-up grant of $70,000 from the U.S. Department of Education allocated to the NMC Science program and by a local government appropriation of $30,000 allocated to [NMC's] Cooperative Research, Extension, and Education Services.

Pakin pearl business development workshop

Micronesia Land Grant Update, January 2005

Another workshop, organized by the College of Micronesia Cooperative Research and Extension Department and the COM Land Grant Program, [was held on February 2] in support of the Sokehs Municipal Government's efforts [to encourage] pearl business development on Pakin Atoll. The COM Land Grant pearl project has established several long lines on Pakin Atoll, and currently over 5,000 mature and seedable oysters are growing in the demonstration farm.

Letter from the director

2005 is starting off well for CTSA. The Board of Directors approved eight proposals for CTSA's Year 18 Plan of Work, and CTSA submitted the Plan to USDA/CSREES for final approval. Year 19 development is underway, and CTSA received 22 preproposals in response to its Request. The Industry Advisory Council and Technical Committee just finished reviewing these preproposals, and I will now meet with both chairs to go over the reviews. Members followed CTSA-selected criteria to help them minimize personal interest and focus on the best interest of the industry and region as a whole. Based on these reviews, CTSA will ask submitters of selected preproposals to develop full proposals.

This year, the reviews were done entirely via e-mail to lessen the demands on members who are frequently unable to leave their farms or take time off from their busy schedules. The IAC and TC will still meet together this September, and CTSA hopes to maximize their time spent by concentrating on activities and discussions that are not able to be conducted effectively via the internet.

Looking ahead to the rest of the year, CTSA plans to hold stakeholders' meetings on special topics to better guide research. It is important to understand the big picture and to define which aspects CTSA projects can best address. We need to channel CTSA's capabilities in the right direction and ensure that its projects benefit and impact the industry.

Cheng-Sheng Lee

Regional Aquaculture continued from page 1

highly diverse, ranging from well established producers who have made a significant capital investment and are interested in ways of reducing production costs while increasing output to those who could be classified as newcomers, who need training, capital, and an awareness of the potentially high risk, high investment, and low returns that most producers encounter.

Since its inception, the Center has concentrated on funding projects for emerging species that have good potential as food fish for production in the North Central Region, such as yellow perch, walleye, and hybrid striped bass. In addition, NCRAC has supported projects on sunfish, salmonids, crayfish, baitfish, aquaculture wastes and effluents, aquaculture drugs, and tilapia. All funded projects are directed at high-priority industry needs that include development of new technologies and applications of research findings that will benefit diverse constituencies. Therefore, research and extension activities have been integrated into all funded projects to develop and implement educational outreach materials and programs.

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The Center is currently funding around a half dozen projects, which are oriented towards drug approvals, including work on 17α-methyltestosterone (MT) and AQUI-S and a project that funds the National Aquaculture New Animal Drug Approvals Coordinator position. There are also projects on yellow perch culture and extension activities as well as a nutrition project looking at diet development for yellow perch and hybrid striped bass.

Southern Regional Aquaculture Center (SRAC)

SRAC is located at Mississippi State University's Delta Research and Extension Center and represents 13 southeastern states and two territories. The SRAC region is responsible for 70% of the total U.S. aquaculture production. In addition to a large, diverse aquaculture industry, the southeast is also blessed with a deep pool of aquaculture scientists and a well-developed network of aquaculture extension specialists. Executive Director Craig Tucker also heads the National Warmwater Aquaculture Center. The following facts provide some idea of the wealth of talent available to SRAC:

- 178 scientists have participated in SRAC research projects;
- 123 authors have contributed to SRAC publications; and
- 29 institutions from all 15 states and territories have received funds from SRAC.

Since its inception, SRAC has become the centerpiece of aquaculture research and extension in the southeast. In its 17 years of operation, the Center has disbursed $10 million to fund 27 multi-state research and extension projects.

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In the past year, four research projects funded at $1.9 million were in progress. Work on those projects has been reported in 24 journal publications and 21 papers presented at meetings. The Center's "Publications" project is in its ninth year of funding and is under the editorial direction of faculty and staff at Texas A&M University. Eleven publications were printed this year, and 11 more were in various stages of production.

The most important measure of the impact of projects funded by SRAC is the extent to which the results have influenced or improved domestic aquaculture. For example, although the project is in only the second full year of funding, a discovery in the new "Fish Disease" project will have a dramatic impact on catfish farming. Research conducted as part of that project led to discovery of a safe, inexpensive method to control the intermediate host of the trematode parasite *Bolbophorus damnificus*. Over the last five years, this disease was discussed in doomsday language. In the near future, however, it may be considered no more than a manageable nuisance.

Two results of the SRAC "Harvest

Continued on page 7

AQUA TIPS

Selective breeding for improved growth performance in the Pacific threadfin, *Polydactylus sexfilis*

Charles W. Laidley and Kenneth K.M. Liu
Finfish Department, Oceanic Institute, Waimanalo, Hawaii

This article was written as part of the work for the project "Reproduction and selective breeding of the Pacific threadfin," 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

Aquaculture development of the Pacific threadfin (*Polydactylus sexfilis*), locally known as moi, is gaining substantial momentum in Hawaii with the appearance of captive farmed product in local restaurants, retail markets, and sales to both mainland and international markets. The Center for Tropical and Subtropical Aquaculture (CTSA) has fostered much of industry expansion through many years of research support and by assisting in the transfer of hatchery and grow-out technologies to the commercial sector. Recent adoption of cage culture technologies based on the joint Oceanic Institute (OI) and University of Hawaii Sea Grant collaboration under the Hawaii Offshore Aquaculture Research Project has further expanded production capability in the sector. As the industry enters into its growth phase, it is critical that we continue to invest in technological advantages to secure the competitiveness and future success of the Pacific threadfin industry.

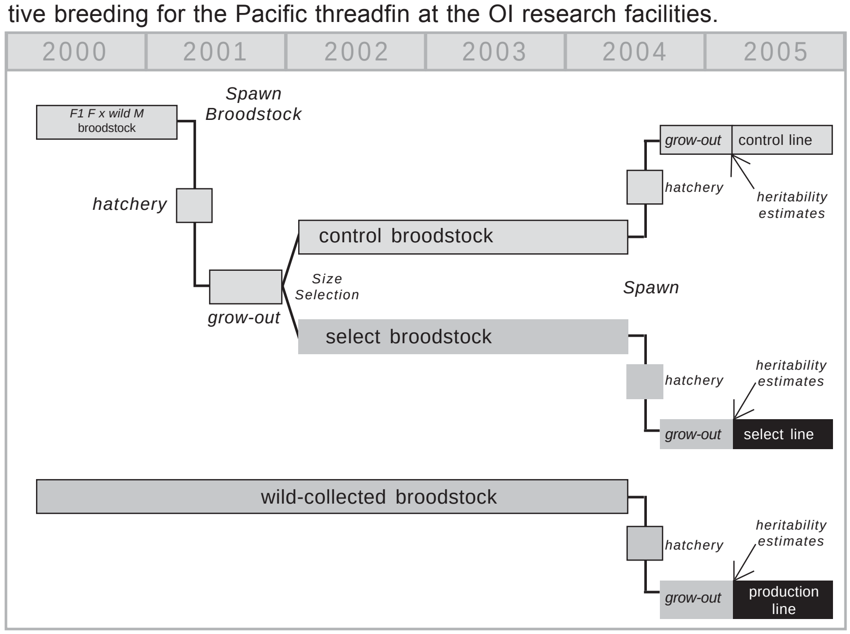
Advanced hatchery technologies are needed to ensure a continuous supply of high quality and healthy seedstock for grow-out operations. Currently, production methods for Pacific threadfin are based on egg generation from wild-collected broodstock, and methods for controlling broodstock health, reproductive development, spawning, and egg quality are all rudimentary. Fish bred to accommodate the stresses of domestication will grow and survive better under captive culture, which would improve overall production efficiencies. The development of select genetic strains will further ensure market competitiveness. Available estimates of heritable improvements in fish growth performance through genetic selection typically range from 10 to 23% per generation of selection amongst species examined to date. The majority of the costs associated with commercial operations (aside from feeds) are tied to the rates of production or growth. Thus, improvements in growth performance will reduce time to market and yield immediate gains in farm profitability.

Methodology

Project efforts began in 2000 with the establishment of a partially domesticated "founder" broodstock population composed of ten wild-collected males and ten F_1 females (Figure 1). These stocks were maintained in 25-m^3 outdoor broodstock tanks provided with a continuous supply of 26 to 27°C saltwater derived from the OI/Sea Life Park wells. Stocks were fed to satiation daily with mixed diets of raw smelt and squid occasionally supplemented with pellets (Moore Clark Marine Grower). Reproductive development of developing stocks was tracked through daily examination of tank outflow for the appearance of eggs in egg collection nets and periodic tank rotation and maturation checks by way of gonadal biopsy.

The founder broodstock population initiated spawning activity in December 2000, although initial attempts to rear eggs were unsuccessful due to poor hatch rates. In February 2001, a

Figure 1. Schematic representation of the time line for a single round selective breeding for the Pacific threadfin at the OI research facilities.



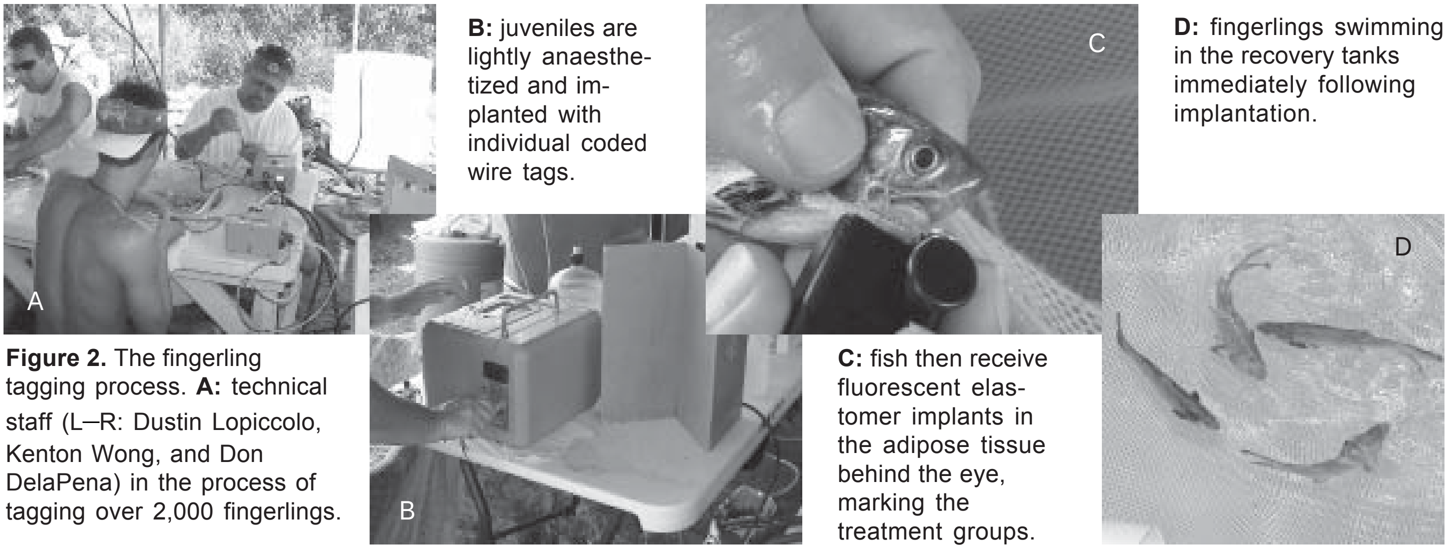


Figure 2. The fingerling tagging process. **A:** technical staff (L–R: Dustin Lopiccolo, Kenton Wong, and Don DelaPena) in the process of tagging over 2,000 fingerlings. **B:** juveniles are lightly anaesthetized and implanted with individual coded wire tags. **C:** fish then receive fluorescent elastomer implants in the adipose tissue behind the eye, marking the treatment groups. **D:** fingerlings swimming in the recovery tanks immediately following implantation.

relatively small batch of fertile eggs was successfully reared through hatchery and nursery phases to generate approximately 600 juveniles for grow-out and size selection. This domesticated line was then stocked in a single 20-m^3 outdoor grow-out tank provided with a continuous supply of OI/SLP saltwater at approximately 8 to 10 turnovers per day. Fish were grown on a marine grower diet (Moore Clark) originally developed at OI for grow-out of mahimahi. Diet was provided by way of automatic feeders for the first two months, followed by daily satiation feeding by hand until harvest in August 2001, at approximately six months of age.

At harvest all fish were weighed and measured, and 50 control fish (mean weight 377 g) were randomly selected to form the "control" line followed by selection of the 50 largest fish (mean weight 516 g) to form the "growth-selected" line. These fish were individually implanted with passive inductive transducers (PIT tags) for individual identification and stocked in separate broodstock tanks (control and growth-selected) for maturation and eventual spawning. During this maturation period stocks were periodically (approximately each half year) inspected for growth and reproductive development. The maturation of domesticated stocks proved much slower than anticipated, resulting in significant delay in obtaining viable eggs from both control and select lines.

In July 2004 both the domesticated and growth-selected broodstock populations spawned viable eggs in the same month, generating seedstock for growth performance evaluations. Although spawns were small, broodstock generated sufficient numbers of eggs to stock 1,000-L larval rearing tanks. Larvae from each of the lines were successfully reared using standard Pacific threadfin hatchery and nursery production procedures yielding 716 domesticated control fingerlings and 1,030 growth-selected fingerlings. In addition, another 722 fingerlings from wild-collected broodstock (wild controls) were recruited for comparison with the domesticated lines. Each of these fingerlings lines was kept in separate 20-m^3 grow-out tanks until three months of age, at which time they had reached sufficient size (>10 cm) to survive the stressors of the tagging process. Each fish was triple-tagged, once with coded wire tags for specific identification and twice with color-coded visible elastomer implants (Figure 2) in the adipose tissue behind each eye for easy visual identification.

After tagging, fish were split into two replicated 20-m^3 grow-out tanks with evenly mixed juveniles from each of the three treatment groups for subsequent grow-out to market size. Fish were randomly sampled monthly to monitor changes in weight and length among lines. To ensure the most accurate assessment of growth performance possible, all fish were individually weighed and measured at six, seven, and eight months of age.

Results and Discussion

Broodstock maturation. Control and fast-growth fish were selected from a post-grow-out population at approximately six months of age at a mean weight/length of 358 g/25.6 cm. From this population a 50-animal "control group" with mean weight/length of 378 g/25.6 cm and a 50-animal "select" group with mean weight/length of 516 g/28.9 cm were established (Table 1). The calculated selection differential (D) between selected and the population from which they came was 44.1%.

The control and select groups were then monitored for growth and reproductive development for another three years, at which time these broodstock finally yielded sufficient numbers of viable eggs to generate the next generation. Maturation checks at 11 months of age revealed that in addition to maintaining significant size advantage over controls (31%), the growth-selected fish also entered the primary male phase of reproductive development much quicker than smaller control animals (Table 1). At 16 months the growth-selected broodstock continued to maintain a significant size advantage (now 34%) and again showed considerable advancement in sexual maturation, with the majority of the select group having rapidly proceeded to the secondary female stage of sexual development (0 immature, 12 males, 35 females), while the control group was slower to develop reproductively (12 immature, 22 males, and 13 females). This data suggests that size, rather than environmental or behavioral conditions, appears to be more important in determining the timing of sexual development and sex change in captive stocks of Pacific threadfin.

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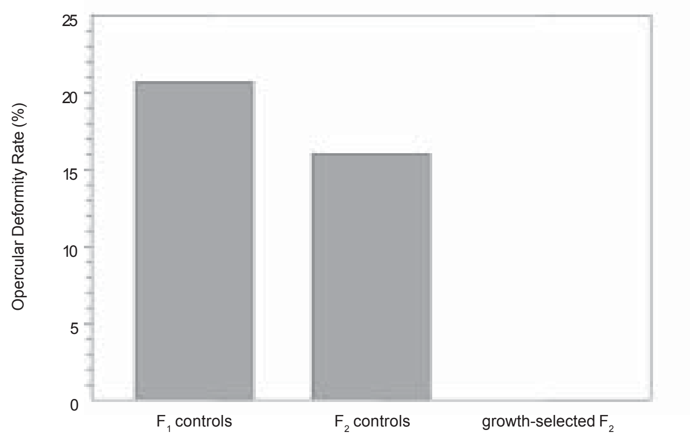
Selective breeding continued from page 5

The growth-selected group initiated sporadic spawning activity in May 2003 (27 months age), and the control group began sporadic spawning in September (31 months age). Typical of first spawning fish, spawning activity is highly sporadic and fertility rates are quite low (<15%), impairing hatchery stocking. Attempts to stimulate spawning using hormonal implants, and thus speed up project advancement, were relatively unsuccessful. In July 2004, at ~3½ years of age, both populations produced fertile spawns, allowing hatchery stocking for the final phase of the project.

Biological performance of select lines. In July 2004 both the domesticated F_1 control and growth-selected F_1 broodstock populations spawned in the same month, generating fingerlings for determination of heritability of growth performance of Pacific threadfin in captivity. In addition, a second “control” group of fingerlings (F_1 controls) was reared in parallel for reference. Larvae from all three lines were successfully reared using standard Pacific threadfin hatchery procedures. An unexpected finding was that both domesticated lines, and in particular the growth-selected line, had much lower rates of opercular deformities than fingerlings generated from wild-collected broodstock (Figure 3).

Lines were maintained in separate grow-out tanks until three months of age, when most juveniles had reached sufficient size (>10 cm) to survive the stressors associated with tagging. Note that juveniles less than 10 cm in length, known as runts, generally do not survive the tagging process and were culled from the populations. Interestingly, about 10% of the F_1 controls and F_2 controls were runts, while less than 1% of the growth-selected F_2 juveniles were runts. Although unavoidable, the culling of more runts from controls than the growth-selected line created an artificial bias for domesticated controls over the selects. Fish were then split into two replicated 20-m^3 tanks evenly mixed from each of the three treatment groups for subsequent grow-out of juvenile to market size (Figure 4). Note that this approach allows for more direct comparison of growth performance under identical conditions but prevents collection of feed conversion efficiency data.

Figure 3. Opercular deformity rates of fingerlings generated from wild-collected (F_1 controls), domesticated (F_2 controls), and growth-selected F_2 broodstock (n=25).



Despite coming out of the hatchery at slightly smaller size (0.7 g) than F_2 controls (1.1 g), the growth-selected F_2 line began to exhibit better growth performance compared to the F_2 control group by about four months of age and improved growth performance compared to F_1 controls, generated from wild-collected broodstock, by six months of age. At the end of this study the growth-selected F_2 line demonstrated a 25% increase in weight compared to the non-selected F_2 controls and a 17% increase in weight compared to F_1 controls derived from wild-collected broodstock, suggesting that growth performance is highly heritable in the Pacific threadfin. It is interesting that the relative improvement in growth performance does not manifest itself during hatchery, nursery, or early grow-out stages, suggesting the opportunity for selection at multiple stages in the production process. The poorer performance of the domesticated (F_2) controls compared to F_1 fingerlings derived from wild-collected broodstock is not unique to this study and is a common finding associated with the early stages of domestication.

Despite considerable improvement in mean and median growth performance through selection, the growth-selected line maintained considerable range in size at harvest. It appears that most of the selective growth advantage can be accounted for by a greater frequency of faster growing individuals (Figure 5). It is not clear whether further rounds of selection would help reduce the number of runts (i.e., smaller fish) or whether the lower growth rate is more related to environmental factors. We also noted that six-month harvest weights in the second phase of this study (181 to 240 g) were considerably lower than in the phase-one group from which the control and growth-selected lines were derived (377 g). The similar growth rates seen in the F_1 controls derived from wild broodstock suggests that this phenomena is not linked to domestication, but more likely related to the higher grow-out densities and frequent

Table 1. Survival, growth, and reproductive development of control and select parental stocks of Pacific threadfin. Individual fish (identified by PIT tags) were weighed, measured, and sexed at approximately 6, 12, and 16 months age. Reproductive maturation is represented as the ratio of reproductively immature (I), male (M), and female (F) fish in each group.

Age (mon.)	Date	Survival (%)		Weight (g)		Length (cm)		Reprod. Matur. (I:M:F)	
		control	select	control	select	control	select	control	select
6	Aug 01	100	100	377	516	25.6	28.9	50:0:0	50:0:0
11	Jan 02	94	100	686	896	30.9	34.2	37:10:0	9:41:0
16	Jun 02	94	98	730	980	32.4	35.9	12:22:13	0:12:35
31	Sep 03	94	84	947	1173	35.6	38.2	11:22:14	1:10:31

Figure 4. Growth (i.e., change in body weight) from hatchery at day 25 until harvest of juvenile Pacific threadfin derived from growth-selected F_2 broodstock, wild-F_1 control broodstock, and domesticated F_2 control broodstock.

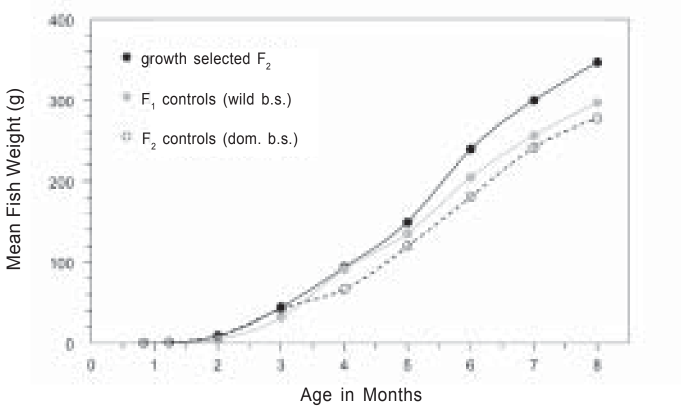
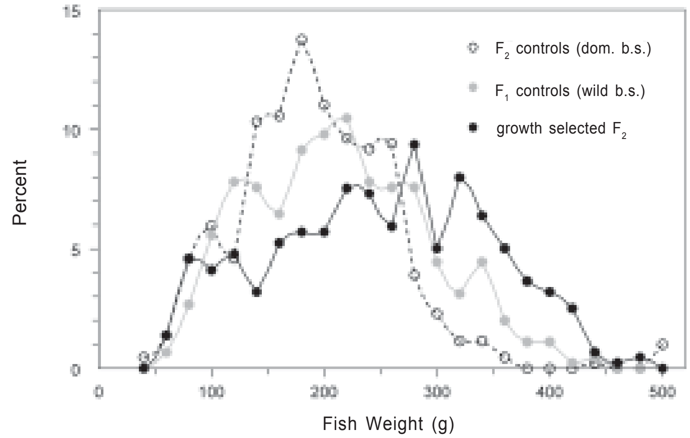


Figure 5. Relative size distribution of the three growth lines, domesticated controls, production controls, and growth-selected, of Pacific threadfin at four months grow-out.



stressing of the animals associated with the monthly handling of fish necessary to generate the required growth performance data. Fish sampled around market size at seven and eight months of age showed remarkably similar fillet ratios, with mean values ranging from 52 to 54% and clearly not significantly different between treatment growth lines.

Conclusion

This study demonstrates that genetic selection for growth offers a relatively simple (although long-term) process to improve the relative biological performance for captive stocks of Pacific threadfin. Although these studies are clearly rudimentary in scope, they demonstrate that growth performance in this species is highly heritable. Improvements in growth performance will reduce time to market and yield overall gains in farm profitability. These benefits would be further enhanced through further rounds of selection. However, a more extensive breeding program for Pacific threadfin and other marine species in Hawaii will require long-term support in terms of both resource allocation and funding. These efforts also indicate a continuing need for basic research on reproduction and growth processes in support of this growing industry and the application of modern breeding techniques, including molecular genetics, to accelerate progress.

Acknowledgments

This research was supported by the Center for Tropical and Subtropical Aquaculture through a grant from the U.S. Department of Agriculture (grant no. 00-38500-8983). The authors would like to thank the expert technical assistance provided by the hatchery, live feeds, broodstock, and grow-out teams at the Oceanic Institute with special thanks to Joe Aipa, Don DelaPena, Mindy Kaiwa, Dustin Lopiccolo, and Kenton Wong for sorting and measuring the large numbers of Pacific threadfin used in this study.

Regional Aquaculture continued from page 3

Technology" project have already been adopted by the industry. A new seine developed at Mississippi State University allows catfish ponds to be harvested faster and with greater capture efficiency than traditional seine designs. Seines based on the new design are already available from commercial netmakers. The second success is the floating platform grader developed at the University of Arkansas at Pine Bluff. The mechanical grader is so superior to conventional technologies at grading fish from mixed-sized populations that it may revolutionize catfish harvest technology, particularly for fingerling producers.

Summaries of all SRAC projects and copies of all 170 fact sheets can be found at the SRAC Web site.

Western Regional Aquaculture Center (WRAC)

WRAC is located at the University of Washington and represents 12 states. Principal farmed species include trout, oysters, salmon, and catfish. Other cultured species and products include aquatic plants, hybrid striped bass, manila clams, mussels, and tilapia. Since its inception, the Center has funded projects for trout, salmon, oysters, sturgeon, hybrid striped bass, and tilapia. Current priority areas include:

- aquaculture NGOs and the media,
- raising more fish in less water,
- economic value of recreational fish,
- expansion of therapeutant use to other species,
- development of vaccines and mass vaccination methods for warmwater fishes,
- constraints to native cutthroat trout production, and
- increase live hauling densities.

In December 2004, the Center welcomed new Executive Director Graham Young after saying farewell to Ken Chew, who retired.

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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, and 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 Palau, and the Republic of the Marshall Islands.)

In its 17 years of operation, CTSA has distributed over $9 million to fund more than 177 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. 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 telephone (808-259-3107), fax (808-259-8395) or e-mail (cslee@oceanicinstitute.org).

FAST FACT

Developing countries accounted for 90.7 percent of aquaculture production in 2002.

--UN Food and Agriculture Organization

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