



AQD conducts training-workshop in Zamboanga for BIMP-EAGA

WG Yap and TD Mallare

SEAFDEC/AQD conducted the second Training-Workshop on Responsible Aquaculture in Zamboanga City, Philippines from 17 to 20 January under the ASEAN Human Resources Development Project on Sustainable Fisheries in the Brunei Indonesia Malaysia Philippines East Asia Growth Area (BIMP-EAGA). The Bureau of Fisheries and Aquatic Resources (particularly Region 9 Director Virgilio Alforque and Evelyn Vargas of the Plans and Policy Division) and the National Fisheries Research and Development Institute (Noel Barut) made all the arrangements for the workshop from the selection of the venue to the selection of participants.

The 24 participants were all from the Mindanao-Sulu-Palawan area and consisted of 19 BFAR personnel and five from the local government units.

Director Alforque gave a welcome dinner on the evening of January 16. Held outdoor under a starry sky at the grounds of the seaside office of BFAR Region 9, it was a pleasant informal affair with lots of food. The full view of the sea and the lights from the fishing boats and the nice sea breeze added to a very nice welcome to Zamboanga Hermosa.

The training-workshop was opened by Director Alforque with a message. Then began a series of lectures on responsible aquaculture and various aquaculture technologies. The AQD team consisted of WG Yap (who lectured on responsible aquaculture, and project planning and development), NM Franco (farming of crabs, farming of marine fish in cages), CM Ganancial (mangrove-friendly shrimp culture), and Training Officer TD Mallare (farming of seaweeds, oysters, and mussels). The lectures were followed by presentations by the participants of the aquaculture status and potentials of their respective regions. The participants were then grouped into four teams and selected appropriate aquaculture projects to plan for and make proposals for, as follows:

- Team 1 – Western Mindanao – Seaweeds
- Team 2 – Northern Mindanao and Caraga – Milkfish in cage
- Team 3 – Central Mindanao, Southern Mindanao – Seaweeds
- Team 4 – Palawan and Autonomous Region of Muslim Mindanao – Mud crab

Teams 1, 2, and 3 planned at the farm level. Seaweed was a clear favorite with two teams selecting it. Teams 1 and 3 found seaweed farming to be viable although the actual returns differed according to harvest schedules and cost of materials. Team 2 found that milkfish farming in cages was profitable in Caraga (Agusan-Surigao) but not in Region 10 due to differences in the cost of feeds and the market price of milkfish.

Team 4 led by Mr. Sukarno B. Anayatin planned at the regional level. They determined the financial viability of raising mud crabs in mangrove pens, then proceeded to plan for doubling the present mud crab production from ARMM from only 10 tons in 2005 to 20 tons by 2010.

After the presentations, Certificates of Training were awarded to the participants. Representing BFAR in the awarding of certificates was Mr. Abdulkadil Manick, OIC of the Administration and Finance Division.

The fourth day was devoted to a field trip. First stop was the seaweed processing plant of Polysaccharide Company, which is owned by the Cebu-based Shemberg Corporation, one of the Philippines' major seaweed processors. Next stop was the Zamboanga Economic Zone in San Ramon. Lunch was at La Vista del Mar, a beach resort within the city. After lunch, many participants opted to go shopping. After all, a trip to Zamboanga City is not complete without stopping by the barter-trade market, incidentally stocked with goods from Sandakan, the other half of the barter-trade route. Natural pearls were among the best buys.



Participants in the BIMP-EAGA Workshop in Zamboanga City, 17-20 Jan 2006



Team 4 discusses their project proposal

FishWorld joins EE conference

SEAFDEC FishWorld was built to deliver informal public education *para sa Sambayanang Pilipino*. Ellen Flor Doyola participated in the Second Philippine Environment Educators Conference held at the Bureau of Soils and Water Management in Quezon City on 10-13 December 2005. The conference was organized by the Center for Environmental Education and Awareness (CEAE) and the Bureau of Fisheries and Aquatic Resources — Fisheries Resources Management Project (BFAR-FRMP) and was sponsored by Metrobank, Manila Bulletin, Unilever Philippines, Philstar.com, Philippine Information Agency, and Marine Environment Resources Foundation. *Challenges, Innovations and Models in Environmental Education* was the theme of the conference, which was attended by more than 300 school teachers (from elementary to college), BFAR technicians, environment officers of local government units, members of conservation groups, and leaders of peoples' organizations.

The Center for Environment Education and Awareness is a non-stock non-profit organization dedicated to making environment education available to every educator and student in the Philippines. The two-day conference included concurrent lectures, documentary videos, and workshops on a wide range of topics from biodiversity conservation to delivering environment education in various communities and schools.

I attended several lectures:

- WWF-Philippines program on environmental education
- Biopiracy issues in the country
- Ethnic groups in Palawan managing natural resources
- The beauty of marine life in the Philippines waters
- The recreational Wild Bird Club of the Philippines promoting wildlife conservation

Niño Jacinto, an industrial engineer and scuba diver showed pictures from his diving escapades and a compilation of pictures which included the photograph taken by TU Bagarinao of the megamouth shark stranded in Namoon, Tigbauan and now in the collection of SEAFDEC FishWorld.

Michael Lu, the President of the Wild Bird Club took those of us who attended his lecture to a bird show at Ninoy Aquino Wildlife Park. Hawks, eagles, and several other kinds of birds flew overhead and colorful parrots performed amazing tricks.

The conference proper was followed by several workshops. One workshop was conducted by artist Joey Ayala on values education in coastal resource management delivered through songs, dances, or other artistic means. Several participants like me attended separate one-day workshops and became certified educators for Project Water Education for Teachers (Project WET) and Project Learning Tree (PLT).

Project WET is a multi-awarded environment education program for teachers and young people. It is implemented by CEAE to facilitate and promote awareness, appreciation, and stewardship of water resources through the development and dissemination of classroom-ready teaching aids. Workshop participants acted out several of 90 water-related exercises out of a book. Teachers became students amused with the different properties of water demonstrated in the different exercises. Copies of the book were given to those who completed the workshop.

AQD takes SPC on mud crab study tour

Upon the request of the Secretariat of the Pacific Community (formerly the South Pacific Commission), AQD arranged a study tour for a party of five officials and researchers headed by Dr. Satya Nandlal to visit AQD's facilities and some private mud crab farms in Panay from 5 to 10 December 2005. The SPC visitors discussed their interests with AQD researchers and aquaculturists, including JH Primavera, ET Quintio, FP Estepa, ME Rodriguez, TU Bagarinao, CM Ganancial, NR Jamon, and RF Bombeo.



Dr. Satya Nandlal and company from the SPC take the AQD tour



Ellen Flor meets several environment educators including artist Joey Ayala

Project Learning Tree is widely recognized as one of the premier environment education programs in the world. It was formulated by the American Forest Foundation and is implemented in the country by CEAE. A PLT guide was issued to workshop participants and Integrating biodiversity with mathematics, ecology with values education, life science with physical education was so simple using hands-on, interdisciplinary activities and lesson plans tested and found in It was pleasurable seeing the talents and loose sides of our educators revealed in skits, dances and presentations at the workshops.

EF Doyola

AQD turns over grouper cages and income to MACABATA-ARM

The project *Poverty Alleviation through Aquaculture* was initiated in Carles, Iloilo in March 2004 by AQD Scientists FG Ayson, EG de Jesus, and SV Siar with funds from the Australian Agency for International Development. The beneficiary organization was a federation of barangays (Manlot, Cabilao, Bangkal, and Tarong Association for Rehabilitation of Mangroves, or MACABATA-ARM). Initial attempts to grow rabbitfish proved costly with poor survival (10%), slow growth rate, and absence of viable market, against a very large investment. When the three scientists left AQD, the Technology Verification and Commercialization Division took over the project and held consultations with the beneficiaries. It was decided that the project will shift to grouper farming in cages.

In September 2004, TVCD personnel were assigned at the project site and 20 floating cages (5 m x 5 m x 3 m) were built in a cove off Manlot Island. In December, juvenile groupers (*Epinephelus* spp., 5-10 grams) from Cagay, Capiz were stocked in the cages. In March 2005, mid-way through the first cropping, AusAID decided to end the Grant Agreement upon advice of the AusAID Counselor and AQD returned the remaining grant money. Since the project was in progress, AQD continued the project under a new Memorandum of Agreement with MACABATA-ARM. AQD agreed to shoulder all expenses for grow-out until harvest of all fish.

The fish were harvested on a staggered basis as soon as they reached desired market sizes. After nine months of grow-out, the total biomass harvested was 1,278.3 kg, for gross sales of P 378,905. Survival rate was 47% and food conversion rate was 5.4 kg 'trash' fish for 1 kg grouper. The success of MACABATA-ARM in grouper farming can be attributed to:

- *Good cage site:* The cove in Manlot had good water quality and was protected from strong winds and wave action.
- *Technology and materials:* AQD provided the grow-out technology, the services of a resident technician, as well as seeds, feeds, and other materials. The methods laid out by TVCD was strictly followed.
- *Training of the beneficiaries:* The beneficiaries were successfully trained in the grow-out technology, including sourcing of quality seedstock and efficient marketing.

After harvest, the 20 fish cages were turned over to MACABATA-ARM in good condition, complete with mooring system and caretaker's hut.

In January 2006, MACABATA-ARM received from AQD a check for P221,707.38 representing the proceeds from the grouper farming project less all the expenses advanced by AQD. This amount is sufficient to finance succeeding grow-out operations.

In a written communication addressed to TVCD Head Dan Baliao, MACABATA-ARM thanked SEAFDEC/ AQD for the "hardships and dedication that you and your team have provided in teaching our trainees for almost 11 months in Brgy Manlot, Carles, Iloilo. We are convinced that the environment-friendly grouper in cages aquaculture technology can generate additional incomes for our members."

NM Franco

VetMed seniors train in fish health at AQD

Eleven 6th year students from the School of Veterinary Medicine of the Aklan State University underwent hands-on training in fish health from 30 January to 10 February 2006. The training course fulfilled part of the requirements for clinical experience. The lectures and laboratory practicals were conducted by the staff of the Fish Health Section of SEAFDEC/ AQD headed by Dr. Celia Lavilla-Pitogo. The course was offered *gratis* as part of AQD's effort to facilitate the inclusion of aquatic animal health in the VetMed curriculum in the Philippines. Veterinarians are needed in aquaculture to prevent, diagnose, and treat diseases in farmed animals and plants.

The VetMed students learned about bacterial, viral, and fungal diseases as well as parasites in farmed fishes, shrimps, and crabs. The laboratory demonstrations and practicals included PCR-based methods of disease diagnosis, slide preparation, fungal isolation, electron microscopy, fish vaccination methods, and monitoring of shrimp larval quality and health status. The class discussed disease prevention and control and studied several modules of AquaHealth Online. The students were graded for the lectures and practicals.

CM Genzola



The 11 seniors from the School of Veterinary Medicine, Aklan State University, who completed the fish health training course at AQD



Some of the laboratory practicals

AQD's young ones start families

Marriages and births of children are important and happy events in our lives. At AQD over the years, many researchers and research assistants have met and fallen in love and have raised families. Josefa and Armando Fermin, Nieves and Joebert Toledo, Rowena and Ruel Eguia, Evelyn and Felix Ayson, to mention just four couples. During the past few years, several young couples have livened up the AQD social scene again. Three finally took the plunge.

AQD's beautiful Miss Abalone, Shelah Mae Buen married Lope Ursua in civil rites on 15 March 2005. The private affair was celebrated with friends at the AQD dormitory with videoke singing, dancing, and fireworks. While Lope was on the high seas, Shelah produced lots of abalone juveniles throughout 2005. Finally, she herself produced a baby girl, Loushelle Leonida, on 5 January 2006. Congratulations, She and Lope!



**Shelah and Lope
and Loushelle**

Josette Bangcaya (Miss IGF?) came back to AQD with a MSc degree from Queensland University of Technology and immediately proceeded to marry Gerald Gonzaga first in civil rites, then on 30 October 2005 at the Saint John de Sahagun Parish Church in Tigbauan. Gerald and Josette walked down the aisle in their finest barong, watched by their former supervisors and co-workers at the Feed Development Section. Principal sponsors included Esteban Garibay and Margarita Arnaiz. The banquet was held at the South Park Grill near AQD.



**Josette and
Gerald**

*All smiles on their
wedding day, 30
October 2005*



Jennette and Rex Jr

*The handsomest couple on the
SEAFDEC/AQD campus for a
long time finally walked down
the aisle and said I do at
Leganes Church on 8 January
2006*



AQD's Miss Mudcrab, Jennette de Pedro married Rex Tillo Jr., former AQD Network and Systems Administrator, now working in Australia. Sunday, the 8th of January 2006 was the feast of the Three Kings, and a good date for a wedding, we were told. Jennette was a-gaga with the wedding preparations, with Rex away. Luckily, she had supportive supervisors and colleagues and nearly a dormful of lady friends she could get exhausted with, or buoyed by. Bride's maids Gwen Anuevo and Fiona Pedroso agreed to wear turquoise-blue tube gowns (bare shoulders, mind you!) without much persuasion. There were many *Ninongs* and *Ninangs* including the couple's supervisors at AQD: ET Qunitio, FDP Estepa, ME Rodriguez, RV Cuevas, VT Sulit, TU Bagarinao, and PH Garibay Reception was at the Sarabia Manor, where the couple got a litany of advice from Aunt Fely Yu, herself an accomplished wife and mother.

Some more weddings are in the horizon, the couples carefully weighing their chances, given the present economic situation and their employment status at AQD.

EF Doyola

Betsie sparkles at 60

What do Bill Clinton, Sylvester Stallone, Diane Keaton, and Dolly Parton have in common with Betsie Platon? They all belong to the first generation of baby boomers! Betsie, the vibrant lady who sparkles like a diamond in the AQD Chief's home, embraces the big SIX OH, the sexygenarian years, with excitement! "I am excited about the 20% discounts on airfare, medicines, and other products with my senior citizen's card!" Betsie had a birthday party, her 'second debut', at her family beach house in Villa Arevalo, Iloilo City on 13 February.

Betsie taught political science for nine years at Mindanao State University in Marawi before she became housewife and executive home manager of Dr. Rolando Platon when he joined SEAFDEC/AQD, then industry, and back again at AQD. In a recent reunion with her college peers who boast of corporate achievements, Betsie vindicated herself for being a housewife all these years! "I am happy! I realized that I did not miss out on anything. As lady of the house, I feel good about myself!"

Betsie now looks forward to the end of Dr. Platon's term at AQD. She wants him all to herself and Roel's.

JMA Ferriols-Pavico



AQD Chief RR Platon presents AQD's programs to PTAC, 14 Feb 2006

PTAC endorses AQD programs

The Philippine Technical and Administrative Committee for SEAFDEC/AQD met on 14 February 2006 and endorsed the Restructured Program for AQD including the staffing pattern for the present organizational structure and AQD's Departmental and Regional R&D Programs for 2006-2010. PTAC is currently chaired by Secretary Domingo F. Panganiban of the Department of Agriculture. AQD Chief RR Platon formally presented the AQD Programs, which had earlier been discussed by PTAC's technical arm, the Research and Development Advisory Committee during its meeting on 22 November 2005.

PTAC noted the financial difficulties that SEAFDEC is currently facing because of the drastic reduction of the contribution of the Government of Japan. Regarding the R&D programs for 2006-2010, PTAC asked AQD to consider the following suggestions:

- Establish benchmark information on AQD-developed technologies adopted by the SEAFDEC Member Countries and by the private sector in the Philippines
- Strengthen coordination and collaboration with the Bureau of Fisheries and Aquatic Resources, especially in the use of BFAR's idle ponds around the country
- Rationalize AQD programs to complement those of the National Fisheries Research and Development Institute
- Optimize the use of the Laboratory Facilities for Advanced Aquaculture Technologies
- Intensify collaboration with the University of the Philippines-Visayas in fisheries and aquaculture extension
- Develop strategies to increase aquaculture production and livelihood for fisherfolk

VT Sulit

Happy Birthday, Chief!
28 February 2006



K Okuzawa and RJ Maliao at Carbin Reef with the staff of Sagay Marine Reserve



*AQD signs an MOA with Sagay Marine Reserve
(from left): AG Maranon Jr., K Okuzawa, AD
Maranon III, LRM Cueva, and RRPlaton*

AQD's stock enhancement program starts in Sagay

During the Regional Technical Consultation held in Iloilo City, Philippines on 13-15 July 2005, the Country Representatives identified the threatened species for which stock enhancement may be a feasible and effective intervention. Sea horses, giant clams, abalone, and sea cucumbers were of common interest to several countries, and AQD's Stock Enhancement Program will do research and development for these species.

Abalones are not formally listed as threatened species, but they are heavily fished because of high demand in the export market. A project has been started to refine the seeding strategies used for stock enhancement of the donkey-ear abalone *Haliotis asinina*. Release of tagged abalone was done in 2002-2003 at the Sagay Marine Reserve (SMR: 32,000 ha of coral reefs, seagrass beds, and mangrove forests) in Negros Occidental, but the methods and strategies for restocking and monitoring are still in the making.

Sagay Marine Reserve was selected as the main site for the stock enhancement program (for abalone, sea horses, and giant clams) because of the excellent track record of the City of Sagay in resource management. SMR won the *Galing Pook* Award in 1997 as one of the top ten innovative programs in the area of marine conservation and protection.

A planning workshop for a new AQD-SMR collaboration was conducted in October 2005. On 19 January 2006, a new Memorandum of Agreement was signed at the Kauswagan Hotel in Sagay. AQD was represented by Chief RR Platon, Deputy Chief and Program Leader K Okuzawa, and researchers RJ Maliao and SM Ursua. Sagay officials in attendance included City Environment and Natural Resources Officer and SMR Supervisor MA Cueva, Negros 2nd District Congressman AD Maranon III, Sagay City Mayor LRM Cueva, President AG Maranon Jr. of the Organization for Industrial, Spiritual and Cultural Advancement, and SMR Biologist TM Dacles of the Northern Negros Resources Management Council.

During the MOA signing, both Dr. Platon and Mayor Cueva expressed the hope that stock enhancement in the SMR can alleviate the intense fishing pressure around the reserve. Dr. Okuzawa expressed optimism that the stock enhancement project will be successful through the close collaboration of AQD and SMR.

The day before, Dr. Okuzawa visited Molocaboc Island and Carbin Reef; he considers Carbin Reef the best he has visited in the Philippines so far.

From Sagay, the AQD team proceeded to Escalante, Negros Occidental to visit a private abalone farm, whose seedstock had come from the AQD hatchery.

RJ Maliao



AQD visits a cooperators abalone farm in Escalante, 19 January 2006



K Okuzawa checks out the giant clams in cages

AQD forges ties with UP-MSI to work on giant clams

AQD has also forged ties with the University of the Philippines Marine Science Institute to work on the stock enhancement of giant clams. The collaboration was formulated last year by UP Professors EM Gomez and SM Licuanan and AQD Chief RR Platon, K Okuzawa, JH Primavera, and RJ Maliao. Gomez and Licuanan have been engaged to write the extension manual on giant clam hatchery, nursery, and stock enhancement.

Dr. Okuzawa and RJ Maliao visited the Bolinao Marine Laboratory in Pangasinan on 25-26 January 2006. The Silaki Island station houses the giant clam hatchery and maintains a broodstock of about 100,000 *Tridacna gigas*, *T. derasa*, *T. maxima*, *T. squamosa*, *T. crocea* and *Hippopus hippopus*. AQD purchased juvenile *Tridacna gigas* from Bolinao for restocking at the Sagay Marine Reserve, which has several species of giant clams except *T. gigas*.

RJ Maliao



The giant clam hatchery of the Bolinao Marine Laboratory



The phycoogy lab at BML



RJ Maliao checks out a harvest of farmed sea urchins at BML



JIRCAS scientists conclude research at AQD

AQD hosted a despedida party on 13 February for JIRCAS Scientists Dr. Hiroshi Ogata and Dr. Ikonari Kiryu, whose tours of duty ended 2-3 days later. AQD Chief RR Platon and Research Division Head WG Yap thanked Dr. Ogata for research to improve the survival of tropical marine fish larvae through addition of essential fatty acids in the diets of broodstocks or larvae, and Dr. Kiryu for a better understanding of the pathogenesis of viral nervous necrosis in groupers.

AQD Deputy Chief Koichi Okuzawa informed everyone Dr. Ogata was his superior and Dr. Kiryu his colleague (and tennis partner) at the National Research Institute of Agriculture in Mei, Japan. He was pleased to meet them again at AQD.

Dr. Ikonari Kiryu thanked the AQD staff for their cooperation and kindness not only to him but also to his wife and son. He said at first he was hesitant to mingle with the staff but later began to socialize and found some of his best friends here. He said he cannot forget the people he worked with and who made their stay here a memorable one. The most memorable of all was raising his son Motofumi at the AQD staff house in Tigbauan.

Dr. Hiroshi Ogata thanked his AQD counterparts in the JIRCAS project and the rest of the Tigbauan staff for making his stay here with wife Reico unforgettable. He said he loved the people here (he became emotional when he said this). Reico became quite popular among the locals because she regularly went to market in a tricycle and spent some time with the teachers and pupils at the Kinaadman Elementary School. She is a writer-artist and left behind at FishWorld her handmade book, *Hand in Hand*.

Denny Chavez thanked Dr. Ogata for giving him the opportunity to be his counterpart in the project such that he was also able to visit Japan. Denny hopes that more experts from Japan will come to have collaborative projects with SEAFDEC/AQD. Other AQD staff also gave testimonials about the research experiences and social encounters with the two JIRCAS scientists and their families.

Dr. Ogata, 55, is an expert in fish nutrition and breeding. His project at AQD from February 2002 to February 2006 was on egg and larval quality of the mangrove red snapper fed improved broodstock diets. Dr. Kiryu, 38, worked at AQD from July 2003 to February 2006 on the development of control methods for diseases suppressing sustainable production of aquaculture Species. From AQD, they both will move on to the Fisheries Research Agency of Japan.

NC Bantillo

Coming back to SEAFDEC after 18 years

Hello! I am Joy Ferriols-Pavico and beginning with the February 2006 issue of *AQD Matters*, I will be assisting Dr. Doris Bagarinao with lay-out and editing of the newsletter *AQD Matters*. Many of you may not know me but I am not new to AQD. I was a chemist at the Binangonan Freshwater Station from 1977 to 1988. Any stories you have of AQD concern (research, admin, social, even personal) write them up, attach jpeg photo files and send them as soon as possible to my AQD email address: jpavico@aqd.seafdec.org.ph



It's great to be back! It has been 18 long years since I left SEAFDEC to be a stay-at-home mom to three growing boys. Today, those boys are grown up with the youngest graduating from College in a year's time. My resume has blossomed from a one-page simple resume that I submitted to Binangonan in 1977 to a six-page resume I sent to Tigbauan in 2005.

Going over my resume I cannot help but look back to my days at SEAFDEC. Yes, many of the skills I so proudly claim to have, had their roots in SEAFDEC. I know I have come a long way, just as SEAFDEC has come a long way. I share with you snippets of the impact of SEAFDEC on my professional life. Because of SEAFDEC, I can claim to be a researcher, a seminar leader, a trainer, a writer, an innovative packager of information and so much more. I see SEAFDEC as a crucible for emerging researchers fired with a myriad of skills. In the chemistry lab, a crucible is a pot made of material that is not easily damaged by fire.

Coming back to SEAFDEC feels like the scene from a futuristic science fiction movie wherein one returns to Earth only to realize that many of the people you once knew are no longer here. Domiciano Villaluz, Quiterio Miravite, Andres Mane, Benjamin Cer Gabriel, Julia B. Pantastico - they are my rainbow of wows, as they all taught me a thing or two. To SEAFDEC AQD I say "Thank You!" I grow well wherever I am planted. I will enjoy keeping the world informed of the latest news and events at SEAFDEC-AQD.

Sayonara and arigato, Dr. Ogata and Dr. Kiryu!!!

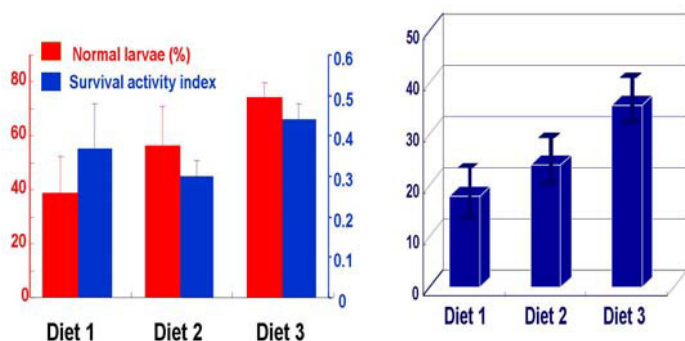


Arachidonic acid improves survival of larvae of tropical marine fishes in the hatchery

Feeding broodstocks ArA-enriched diets

From March to October 2003, mangrove red snapper broodstock were fed one of three diets supplemented with either 6% soybean oil (diet 1), 2% soybean oil + 4% squid oil (diet 2), or 2% soybean oil + 3.5% tuna oil + 0.5% ArA (diet 3). Total egg production (9.3 million) and total number of spawns (11) were highest in broodstock fed diet 3. Diet 1 produced 2.4 million eggs in six spawns, whereas diet 2 resulted in 3.6 million eggs in eight spawns. Mean egg viability, hatching rate, egg diameter, total length of newly hatched larvae, and survival were similar among the diets. However, diet 3 increased the percentage of normal larvae and the cumulative survival to more than twice those in diets 1 and 2. The results clearly showed the importance of dietary ArA to reproduction of mangrove red snapper.

From July to December 2004, rabbitfish broodstock were given diets supplemented with 0.75%, 1.5% or no ArA. The diet with 0.75% ArA increased the egg production and normal larvae, but that with 1.5% ArA aborted embryo development. From March 2005 to January 2006, another feeding test was conducted using diets with fish meal, soybean meal, *Acetes*, and squid meal as the protein sources and wheat flour and corn starch as the carbohydrate sources. The basal diet had 1% soybean oil + 6% squid oil + 4% cod oil (diet 1). The soybean oil was replaced with 0.3% ArA in diet 2 or 0.6% ArA in diet 3. The broodstock (six pairs) spawned 13 times on diet 1, five pairs spawned 14 times on diet 2, and six pairs spawned 17 times on diet 3. The total hatched larvae were 3.8 million on diet 1, 4.4 million on diet 2, and 4.6 million on diet 3. The percentage normal larvae did not differ among diets. Given the results for both snapper and rabbitfish, the optimum ArA level appears to be between 0.5% and 0.7% of the dry broodstock diet.



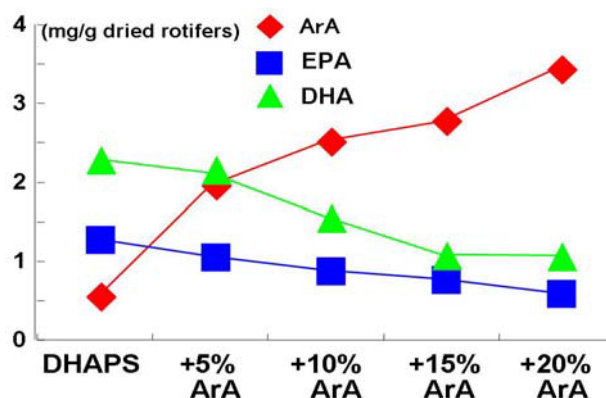
Percent normal larvae, survival index, and cumulative % survival of larvae from broodstock of mangrove red snapper fed three diets (diet 3 had 0.5% ArA)

Feeding larvae ArA-enriched rotifers and brine shrimp

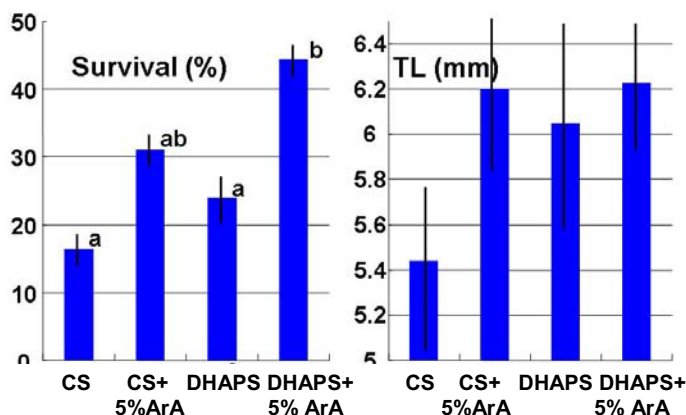
Rotifers *Brachionus sp.* were fed the diet DHAPS (Protein Selco high in DHA) with graded levels of ArA (0–20%). ArA levels increased in both rotifers and culture media. Surprisingly, EPA and DHA levels in the rotifers decreased as the amount of ArA increased—this result suggests that ArA depresses the absorption or accumulation of EPA and DHA in rotifers. Thus, the optimum level of ArA supplementation is 5% in DHAPS.

Larval rearing tests were conducted to investigate the effects of ArA-enriched rotifers (3 trials) and *Artemia* (2 trials) on survival and growth of rabbitfish larvae. Enrichment was done for four treatments: Culture Selco (CS, which is low in DHA), CS + 5% ArA, DHAPS, and DHAPS + 5% ArA. Larvae fed rotifers or *Artemia* enriched with DHAPS+5% ArA always showed the best survival. Growth was not different among the enrichment treatments.

Fatty acid analysis indicated that DHA and ArA must be added to larval diets at the same time to make the DHA/ArA ratio optimum for the larvae.



Levels of ArA, EPA, and DHA (mg/g dry basis) in rotifers grown in DHA Protein Selco (DHAPS) with ArA added at 5-20%



DHAPS + 5% ArA improves survival of rabbitfish larvae to day 17

Arachidonic acid improves survival of larvae of tropical marine fishes in the hatchery

HY Ogata, DR Chavez, ES Garibay, A Suloma, H Furuita, AC Emata

Aquaculture contributes significantly to food production, incomes, and jobs in coastal communities in Southeast Asia. A persistent constraint in aquaculture development is the supply of good-quality seed (called ‘fry’ in the industry) in quantity at the right time. The fry of tropical marine fishes used in aquaculture still come mostly from the wild. Hatcheries are expected to provide a stable fry supply for farmers, but seed production is often highly variable due to poor fecundity and low survival.

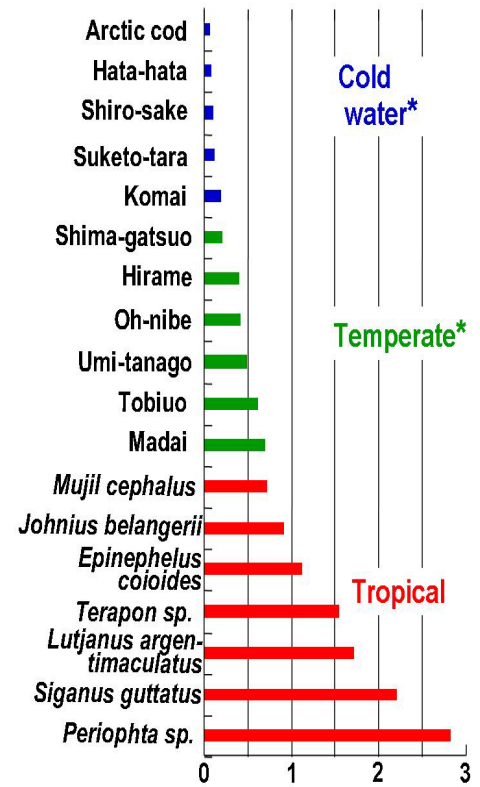
During the period 2002– 2005, SEAFDEC/AOD and JIRCAS (Japan International Research Center for Agricultural Sciences) Fisheries Division have collaborated on studies aimed at developing advanced diets to improve the quality and production of eggs, larvae, and seedstock for tropical marine fishes. These studies were part of JIRCAS’ international project, **Studies on Sustainable Production Systems of Aquatic Animals in Brackish Mangrove Areas** and were conducted mostly at the Tigbauan Main Station of SEAFDEC/AOD.

ArA is a major fatty acid in tropical marine fishes

The mass production of marine fish fry used in aquaculture and aquaranching has progressed remarkably due to the discovery of the dietary importance to marine fish of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) and the establishment of technologies for EPA/DHA-enriched feeds. Most studies on essential fatty acids in relation to fry production have been focused on EPA and DHA and little attention has been paid to arachidonic acid (ArA). ArA is found in only small quantities in cold-water and temperate-water fish and has been presumed to be unimportant

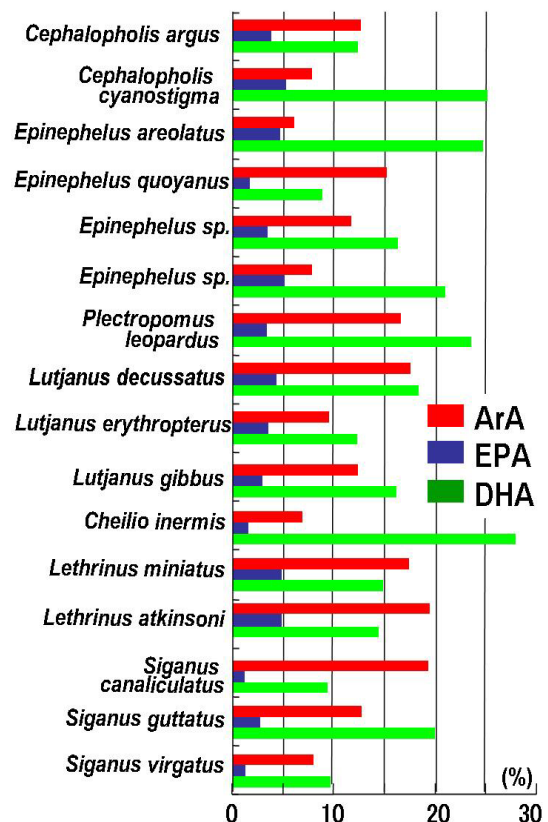
It was a pleasant surprise to find intermediate or high ArA and relatively low EPA in the ovaries, eggs, and fry of mangrove red snapper *Lutjanus argentimaculatus*. Later sampling showed similarly high levels of ArA in muscle, liver, ovary, and testes of other tropical marine fishes from mangrove areas or coral reefs in the Philippines, Malaysia, and Ishigaki, Japan. Thus, ArA is a major fatty acid widely distributed in tropical marine fishes and likely important to reproduction and larval survival and growth.

The potential value of ArA has not been applied to fry production technologies for tropical and subtropical fishes. We studied the effects of dietary ArA on reproductive and larval performance in mangrove red snapper (a carnivore) and in the orange-spotted rabbitfish *Siganus guttatus* (a herbivore). We conclude that adding arachidonic acid to broodstock diets or larval feeds improves seed production tremendously. Improved hatchery production of seedstock can help aquaculture take off in the developing tropical countries.



*Takama et al., 1994 Fish. Sci., 60:177-184

ArA/EPA ratios in the muscle of coldwater, temperate, and tropical fishes



ArA, EPA, and DHA (as % total fatty acids) in the ovaries of coral reef fishes