Marine finfish section

The Grouper Section has taken on a new and broader name: It has become the Marine Finfish Section to take account of other species. This Section is almost wholly based on the Grouper Electronic Network which is prepared by Sih Yang Sim (Editor), Michael Phillips (NACA Environment Specialist) and Mike Rimmer (Principal Fisheries Biologist of the Queensland Department of Primary Industries). Visit www.enaca.org/grouper for more information on the network.

Marine Finfish Aquaculture Network meets in Vietnam

The farming of marine fish is contributing increasingly to national economic development and livelihoods of people. There is a growing demand for marine finfish, including high value coral reef species such as groupers. For example, in 2001, Hong Kong, destination of most of the live fish traded in the region, imported an estimated 15-19,000 tons of live reef fish (caught and farmed) valued at more than US$ 315 million. The trade in fry, fingerling and juveniles is also flourishing. Marine fish farming, experts say, has become a promising area of aquaculture. The problem, among others, is that supply of seed from wild fishery sources is either dwindling or getting more expensive to obtain. There is also a growing concern over damage to the environment and resources from over-fishing or destructive collection of seed or adults from the wild. A special concern is incorporating into research planning and technology development the priorities of farmers and then translating their results into socio-economic benefits to the industry, especially to the small farmers and their communities.

It is these concerns that are being addressed in a regional technical and policy workshop being held from 30 September to 4 October at the picturesque and rapidly developing coastal city of Halong in Vietnam. The meeting – attended by some 100 participants from government, scientific organizations, industry, NGO's and regional and international organizations, from Vietnam, and 11 other countries in Asia-Pacific – is on Sustainable Marine Finfish Aquaculture in the Asia-Pacific Region. The participants are reviewing the status, research and development needs for marine finfish aquaculture in the Asia-Pacific region. From the review will come recommendations for collaborative actions to assist the sustainable development of marine finfish aquaculture in the region. In practical terms, the workshop looked at effective substitutes for trash fish in feed, more economical feed, better feeding systems and better culture systems and techniques for hatchery and grow-out, and good management practices. The workshop includes a special session on the development of a set of standards for farming of coral reef fish as part of a wider Asia-Pacific initiative to develop industry standards for the live reef fish trade, a joint project of the International Marinelife Alliance (IMA), Marine Aquarium Council (MAC), and The Nature Conservancy (TNC), with the support of the APEC Fisheries Working Group.

The scientific gathering is sponsored by the Ministry of Fisheries, Vietnam, the Australian Centre for International Agricultural Research (ACIAR), the Australian Academy of Technological Sciences and Engineering (ATS)E, the Network of Aquaculture Centres in Asia-Pacific (NACA) and the Asia-Pacific Economic Cooperation (APEC).

Results of the regional collaborative grouper research and development network supported by the Asia-Pacific Economic Cooperation (APEC) and NACA and the findings of an Australian Centre for International Agricultural Research (ACIAR) project "Improved hatchery and grow-out technology for grouper aquaculture in the Asia-Pacific region" are being reported and will suggest further steps for research, development and policy This ACIAR project involves the collaboration of scientists and technologists from several institutions in Australia, Indonesia, Thailand, Vietnam, and the SEAFDEC Aquaculture Department in the Philippines.

The development of sustainable hatchery systems and farming systems for groupers and other coral reef fish species, environmental management and planning for aquaculture, extension of research findings to farmers, and ways in which sustainable development of marine aquaculture can be best used to create employment and alleviate poverty among coastal communities will be addressed by the workshop.

An additional value from the workshop is the opportunity it is giving to many young researchers in marine fish culture working in different laboratories in various countries in Asia-Pacific to share their results with each other.

Speaking at the opening, Dr Nguyen Xuan Ly, head of science and technology of the Ministry of Fisheries of Vietnam, emphasized the high level of government support for marine aquaculture in Vietnam, as a means of earning income and creating employment in coastal communities. He urged further collaboration in Asia, and support from international and regional agencies such as ACIAR and APEC for sustainable development of marine aquaculture in Vietnam.

Mr Barney Smith, Fisheries Program Manager of ACIAR, said he was pleased to see the participation of so many young scientists in the workshop. He praised the marine finfish research and development network — coordinated since 1998 by the Network of Aquaculture Centres in Asia-Pacific, and recently adopted by its member

governments into NACA's regular work program -as an excellent example of institutional, donor and government cooperation in support of sustainable aquaculture development in Asia.

As such, governments have committed to provide the resources, through NACA's regular program, to support the needed additional technology development work and information exchange activities, and to take up the results of the regional program into their fishery extension programs and development policies.

Dr Rachel Peitsch from the US Department of State, representing the Fisheries Working Group of APEC emphasized the importance APEC gives on sustainable aquaculture. APEC has given support to the activities of the Asia-Pacific marine fish R and D network. It has also recently approved a project addressing alternative livelihood strategies for communities in stressed coral reef areas. The project concept was presented at the workshop. It is being implemented by the NACA-hosted initiative on Support to Regional Aquatic Resources Management (STREAM).

Former Deputy Prime Minister of Vietnam, Mr Nguyen Cong Than emphasized the high priority the Government of Vietnam gives on sustainable development of marine fish aquaculture. In his keynote address, Mr Than identified the importance of building skills for managing environmental impacts, the need to develop hatchery technology to avoid use of wild resources, the importance of using manufactured feed, rather than wild "fish by-catch" resources, for development of marine fish culture, building skills in health management and market diversification as key issues to address for sustainable development of marine fish farming in Vietnam. He requested APEC, NACA and ACIAR and other agencies to provide further support for transfer of technology on seed production and advanced, environmentally friendly farming systems, to assist in building human resources, especially in technical, environmental and socio-economic skills, so that Vietnam could develop its aquaculture, and economy in general, in a sustainable manner.

The same sentiments would apply to the greater Asia-Pacific region.

For more information on cooperation in marine fish aquaculture in Asia and NACA, APEC and ACIAR projects, and to find out about the outcomes of the workshop, contact grouper@enaca.org or visit the grouper web site www.enaca.org/grouper.

New APEC Project: Improving Coastal Livelihoods Through Sustainable Aquaculture Practices

In recent years significant technological advancements have taken place in sustainable grouper and reef fish aquaculture. Now, APEC member economies wish to find out how best to implement these advances in coastal communities. It is hoped that this can improve community livelihoods and prevent unsustainable and destructive fishing practices. In order to take this forward APEC have selected the STREAM Initiative to undertake a short Sub-project of the APEC Grouper Research and Development Network aimed at "Improving coastal livelihoods through sustainable aquaculture practices". The project will begin by identifying four reef fisheries in APEC economies that are most at risk from unsustainable fishing and sea-farming practices. The overall objective is to develop a strategy for encouraging sustainable aquaculture in communities that are dependent upon each of the identified reef fisheries - addressing social, economic and ecologically sustainable issues. The project will be in three phases:

i) identifying at-risk reef fisheries,
ii) conducting four case studies of the identified reef fisheries and developing an understanding of socio-economic constraints and opportunities and factors that might influence the ability of the community to adopt sustainable sea farming,
iii) attempting to identify strategies for coastal communities in regions that are most at risk, that can be taken and applied by APEC economies in their own communities as required.

A number of current activities have already been identified, which attempt to address unsustainable fishing and sea farming practices and which are well placed to both learn from and contribute to case studies, these include the Nature Conservancy Aquaculture Project in the Komodo Island Marine Park, Indonesia, the IUCN Na Trang Marine Protected Area Project in Vietnam, and the Bureau of Aquatic Resources

and Fisheries alternative livelihoods approaches to unsustainable reef exploitation on Panay Island, Philippines. The project will begin shortly and will report its findings in January 2003. For further information contact Graham Haylor, STREAM Director, email: ghaylor@loxinfo.co.th.

New Network Publications

Marine Finfish Aquaculture Network Website available on CD

The entire Collaborative APEC Grouper R&D Network website has been put on a CD, featuring two newly-released technical proceeding from previous network meetings and other associated publications including a complete set of network e-newsletters. (Note: Since this is a 'hard copy' version of the information freely available on the website a nominal production/postage charge applies). To order, contact publications@enaca.org.

Regional Workshop on Sustainable Seafarming and Grouper Aquaculture

The Report of the Regional Workshop on Sustainable Seafarming and Grouper Aquaculture held in Medan, Indonesia, 17-20 April 2000 is now available. This was the second workshop hosted by APEC and NACA under the project 'Collaborative APEC-NACA Grouper Aquaculture Network' (APEC Project FWG 01/99). The workshop was held to further develop a sustainable seafarming and grouper aquaculture industry in the Asia-Pacific region through collaborative networking among researchers. The report is available online and is free for download, click the title for an electronic version in pdf format (2.15 MB). The hard copy is available for a cost of US$25 (including postage), if you are interested please contact: Mr Sih Yang SIM, Asia-Pacific Marine Finfish Aquaculture Network, c/o: Network Of Aquaculture Centres in Asia-Pacific (NACA), P.O. Box 1040, Kasetsart Post Office, Bangkok 10903, Thailand, Tel: (66-2) 561-1728 to 9
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Report on the Formalization of an Asia-Pacific Marine Finfish Aquaculture Network

This is the report of a sub-section of 'Collaborative APEC-NACA Grouper Aquaculture Network' (APEC Project FWG 01/99) project on "Formalization of an Asia-Pacific Marine Finfish Aquaculture Network" (formally known as Asia-Pacific Grouper Network). One of the recommendations from the Medan Seafarming Workshop held in April 2000, Medan, Indonesia was to formalize the grouper network participation, which should included all regional institutes which are actively involve in R & D on grouper and other marine finfish. As a result of the recommendation, a project proposal was submitted and approved by APEC FWG in 2000, and was being carried out in 2001. The aim of the formalization are to create a strong network of research institutes and experts that are actively involve in grouper and other marine finfish R & D in the region; resources sharing through cooperation in order to make maximum use of limited resources; and improve information exchange and dissemination. The final report is available for free download from http://www.enaca.org/grouper

Technical developments

Breakthrough in Bluefin Tuna Breeding Cycle

Japanese researchers have achieved the first full-cycle breeding of the endangered bluefin tuna. Scientists at the Fisheries Laboratory of Kinki University in Wakayama made the breakthrough in late June. It is the first time the species has achieved a full breeding cycle, with matured fish spawning their own eggs. Researchers said the breakthrough meant there was potential not only to satisfy the demand for the prized fish without depleting wild stocks, but also for future ocean restocking. The matured tuna spawned around one million eggs, and Fisheries Laboratory officials said they expected around 800,000 to hatch. The research center began bluefin tuna breeding experiments in 1970, with the capture of wild fish to raise to sexual maturity, as its experiment station in Kushimoto, 450 km from Tokyo. It was successfully achieved spawning in 1979.

Attempts to breed bluefin are also taking place in Australia and the Mediterranean, where captured bluefin are being raised in captivity. South Australian company the Stehr Group is one company aiming to propogate southern bluefin tuna to sell to Japan and other lucrative markets. The Japanese government granted the programme at Kinki University funding of 100 m yen (US$832,000) over the next five years, in recognition of its increasing success. A CNN report claimed lack of funding had meant researchers had previously bred fish such as sea bream to raise funds for the bluefin experiments. Environmentalists have been calling for some time for restrictions on Japanese catches of the endangered southern bluefin tuna. A conservation report by WWF and IUCN in 1997 called for the total annual catch to be reduced by 35%, and claimed that "the status of the southern bluefin tuna parental population is now less than 9% of that in 1960". *Source: Fish Farming International, August 2002, Volume 29, No. 8*

Breakthrough in Yellowfin Breading

The Achotines Laboratory of the Inter American Tropical Tuna Commission (IATTC) in Panama is successfully spawning the yellowfin tuna in land-based tanks. The IATTC believes that this is the only successful example of yellowfin tuna breeding in the world. Senior scientist Dan Margulies says the tuna has been spawning almost daily since 1996.

Juveniles have been cultured for up to 100 days, and are routinely reared up to six weeks after hatching. The lab was established as part of the IATTC's Tuna Billfish Programme,

and has two main responsibilities. One is to study the biology of the tunas and tuna-like species of the Eastern Pacific Ocean to estimate the effects that fishing and natural factors have on their abundance. The other is to recommend appropriate conservation measures so that stocks of fish can be maintained at levels that will afford maximum sustainable catches. *Source: INFOFISH International 4/2002*

Resistance of Cobia *Rachycentron canadum* Juveniles to Low Salinity and Low Temperatures

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To determine the lower salinity tolerance of cobia fingerlings, seven circular tanks (61 cn in diameter) were each stocked with 10 fish (31.5 ±9.64g, mean ±SD). Each tank contained approximately 75 L of 20 g/L-salinity, constantly-aerated water and was equipped with its own biofilter. Fish were allowed to acclimate to the tanks overnight, and then the salinity was reduced in five of the tanks by 2 g/L per day (27.3 ±1.36 °C). All fish survived exposure to salinities down to and including 10 g/L. First mortality occurred after the salinity was lowered to 8 g/L. Survival then declined steadily until stabilizing at 20% in 2 g/L. All fish in four of the tanks were dead after 24h of exposure to 2 g/L salinity. Surprisingly, all fish in one tank survived in 2 g/L salinity for six days, at which time the experiment was terminated. Repeated analyses of the water (including determining calcium concentrations) containing the surviving fish did not indicate anything unique. All control fish survived.

To determine the tolerance of cobia to low temperature, 10 fish (30.5 ±10.88 g, mean ±SD) were stocked into each of five temperature-controlled and aerated recirculating systems containing 375 L of 20.5 ±0.28 g/L-salinity, 22.6 ±0.59 °C water. Fish were acclimated to the systems for 3 days and then the water temperature was reduced an average of 0.53 ±0.03 °C/d (r = 0.95) until all fish died. Fish were offered feed daily during the experiment, until they ceased feeding. By the time the water reached 16 °C, most fish had ceased feeding. The first mortality occurred at 12.9 °C, the median-lethal tenperature was 11.9 °C, and all fish were dead by the time the temperature reached 10.4 °C.

The results of this study indicate that cobia juveniles require at least 10 g/L salinity and water temperatures above 12.9 °C for survival. Future studies will define the salinity and temperature requirements for growth.

Production and Characterization of Monoclonal Antibodies against *Lutjanus argentimaculatus* Immunoglobulins

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The serum immunoglobulins (Ig) of four fish species, mangrove red snapper *Lutjanus argentimaculatus* (Forsskal), banded grouper *Epinephelus awoara* (Temminck et Schlegel), white seabass *Lates calcarifer* (Bloch) and Japanese flounder *Paralichthys olivaceus* (Temminck et Schlegel) were purified by affinity chromatography on protein A- sepharose. Using SDS-PAGE, the molecular weight of heavy chains of serum immunoglobulins were, respectively, 79.5 kDa and 75.0 kDa for *L. argentimaculatus*, 77.2 kDa for *E. awoara*, and 81.8 kDa and 75.7 kDa for *L. calcarifer*, 73.5 kDa for *P. olivaceus*. The light chains were, respectively, 30.1 kDa, 31.1 kDa, 29.7 kDa and 15.0 kDa. The groin lymph nodes of Balb/c mice in six-week old immunized by intraperitoneally at foot pads with purified Ig of *Lujanus argentimaculatus*, were taken out sterilely and fused with mouse myeloma cells (SP2/0) at a ratio of 1:4 at 37¡æ, using PEG 4000. After selected by HAT medium and ELISA, and cloned, six monoclonal antibodies (McAbs) against *Lutjanus argentimaculatus* Ig were produced and characterized. All of the McAbs are functional for use in enzyme-linked immunosorbent assays (ELISAs) and immunoblotting applications. Characterization of the MAbs for mouse Ig class and subclass indicate that one was IgG 1, three were *Lutjanus argentimaculatus* Ig indicated that all six McAbs were heavy chain specific. ELISAs indicated that one of six MAbs hasa weak reaction with grouper Epinephelus awoara Ig, another one has a weak reaction with Lates calcarifer, and no McAb reacted with *Paralichthys olivaceus*.

Molecular Cloning, Expression on the Goose-Type Lysozyme cDNA from Orange-Spotted Grouper (*Epinephelus coioides*), and the Lytic Activity of its Recombinant Protein

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Lysozyme acts as a non-specific innate immunity molecule against the invasion of bacteria pathogens. In this study, the molecular cloning, sequencing, and recombinant protein's lytic activity of the goose-type (g-type) lysozyme cDNA from the orange-spotted grouper (*Epinephelus coioides*) were described. A cDNA library was constructed in +EtripIEx2 by using total RNA extracted from orange-spotted grouper leukocytes 72h after stimulation with Polyribonucleotide Poly(I) Poly(C). By random sequencing of the library inserts, cDNA for g-type lysozyme was isolated. The complete cDNA is 788 bp with a 585 bp open reading frame (ORF) encoding a protein of 194 amino acids. The sequence predicts a molecular weight of 21178 Dalton and PI of 6.18. The cDNA shows 73.2% amino acid identity with the g-type lysozyme of Japanese flounder. Three catalytic residues, as well as their neighboring amino acids are conserved between the orange-spotted grouper, Japanese flounder and four avian g-type lysozymes (black swan, goose, ostrich and chicken). Not like avian g-type lysozymes which have four conserved Cysteine residues, grouper and Japanese flounder lysozymes have none. RT-PCR analysis told us that the g-type lysozyme gene was transcriped in all the tissues examined. Northern blot analysis indicated that it was expressed in the intestine liver, spleen, head kidney, posterial kidney, heart, brain, and leukocytes. When grouper was experimentally infected with *Vibrio alginolyticus* quantities of the g-type lysozyme mRNA increased in the stomach, spleen, head kidney, posterial kidney, heart, brain and leukocytes. The

g-type lysozyme ORF was cloned into the pRSETA vector and expressed in *E.coli* BL21. The recombinant enzyme was with molecular weight of 21.4 kDa, and possessed lytic activity against *Micrococus lysodeikticus*, and four examined aquaculture pathogenic bacteria (*Vibro alginolykicus*, *Vibrio vulnificus*, *Aeromonas hydrophila* infecting soft-shell turtle, *Aeromonas hydrophila* infecting gold fish), but no lytic activity against *E. coli* DH5+A.

Optimum Dietary Protein to Energy Ratios in Juvenile Parrot Fish, *Oplegnathus fasciatus*

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This study was conducted to determine the optimum dietary protein to energy (P/E) ratio in juvenile parrot fish, *Oplegnathus fasciatus*, fed the white fish meal and casein based diets for 8 weeks.

Ten experimental diets were formulated with two energy levels and five protein levels at each energy level. Two energy levels of 12.5 and 16.7 kJ/kg diets contained at crude protein (CP) levels of 35, 40, 45, 50 and 55%, respectively. The energy value of each diet was estimated based in standard physiological fuel values (16.7 J/g protein or carbohydrate and 37.6 J/g lipid). After two week of the conditioning period, triplicate groups of 20 fish initially averaging 7.1 ±0.06 g (mean ±SD) were randomly distributed into the aquarium.

After 8 weeks of the feeding trial, the optimum dietary protein level from fish fed 12.5 kJ/kg diets could be 40% for the maximum weight gain and feed efficiency, and this from fish fed 16.7 kJ/kg diets could be 50%. Diets containing 50% crude protein and 16.7 kJ/kg diet appeared to be utilized more efficiently in terms of percent weight gain than diets containing the other crude protein and energy levels.

Therefore, based on weight gain, feed efficiency and specific growth rate, diets containing energy levels between 12.5 and 16.7 kJ/kg diet had an optimum P/E ratio of approximately 125-133 mg protein/kcal.

Offshore Culture of the Pacific Threadfin *Polydactylus sexfilis* in Hawaii: Results of the Hawaii Offshore Aquaculture Research Project (HOARP) Phase II

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NOAA and the National Sea Grant Office have identified demonstration of the feasibility of offshore aquaculture in the United States as a top priority to address issues of sustainability of U.S. fisheries. HOARP is a joint research effort between the Oceanic Institute (OI) and the University of Hawaii Sea Grant College Program, in partnership with state governmental agencies, commercial farmers, and seafood processors. The ultimate goal of HOARP is to provide a scientific basis for evaluation of the biological, environmental, and economic feasibility of offshore aquaculture in the Pacific region. HOARP Phase I sought to combine newly developed sea cage designs from Ocean Spar Technologies, Inc. of Washington with technologies of Pacific threadfin mass culture and fish management developed by OI. Phase I successfully demonstrated the technical feasibility of raising and harvesting large numbers of fish in an offshore containment structure under completely submerged conditions. Phase II addressed issues to increase final harvest density, improve feed utilization, lower harvest size variability, and expand environmental monitoring efforts. Phase II also addressed the economics of production.

Monthly growth of fish raised in a single 2,600 m^3 Sea Station offshore during Phase II paralleled that of siblings raised in triplicate, onshore reference tanks at similar biomass densities. Peak biomass before harvest at 235 days of age offshore (mean wt. = 417.7 ±33.0g) was 12.1 kg/m^3, double that achieved during Phase I. The overall feed conversion ratio offshore (2.4) was higher than that achieved in onshore tanks (1.3 ±0.1) at the end of the trial. Overall recovery of fish offshore (57.5%) was lower than that achieved onshore (90.2 ±0.5%) owing largely to unaccounted losses. Harvested fish fell into a normal bell-shaped distribution with 66.9% of the fish falling into size classes ranging from 400-899 g.

Total ammonia levels measured near peak biomass and directly downstream from the cage four hours after the initial feeding of the day tended to increase slightly from upstream levels and began to dilute 15 m from the cage edge. There were no discernable trends in total phosphorous, chlorophyll A, turbidity, and total dissolved solids in weekly or quarterly samples. The polychaete, *Ophryotrocha*, became more abundant in the benthos directly underneath the cage than at control sites indicating a community response to increased organic load. The cage also acted as a fish aggregation device sustaining approximately 800 kg of resident species near the end of the trial. Improved economic outlook of Pacific threadfin culture offshore requires increasing offshore nursery survival and final harvest density, and lowered feeding costs.

Induction of Sex Reversal n Juvenile Sevenband Grouper, *Epinephelus septemfasciatus* by Injection of 17a-Methyltestosterone

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Grouper a high potential fish species for aquaculture because of their high economic values in fisheries. There are active efforts in seed production and breeding in hatcheries of many countries including Korea, Japan, China and ASEAN. There are also several ongoing research efforts in grouper aquaculture. However, seed production of groupers has not always achieved great success. This difficulty may be partially due to inadequate sex ratio in breeding of adult groupers for the obtaining of fertilized eggs. The sevenband grouper, *Epinephelus septemfasciatus* is a common species in coastal of Juju Island. It is protogynous hermaphrodite; sex reversal to male occurs at the age of 7-9 years. In this study, we attempted sex reversal by injection of 17a-methyltestosteron (MT)

with juvenile sevenband grouper for obtaining of functional male.

Juvenile sevenband groupers were collected at the coastal area of Jeju Island, Korea. At the beginning of the experiment, body weight ranged from 578 to 1,168 g. Fish were divided into four experimental groups of 2 to 4 individuals; control, MT 0.5 mg/kg fish, MT 1.0 mg/kg fish and MT 2.0 mg/kg fish. MT was dissolved in 1ml of 70% ethanol and added with 9 ml of dissolved coconut oil and the resulting mixture was emulsified by mixing. MT mixture was injected weekly for 5 weeks and gonad of fish was prepared with histological procedures at the beginning of the experiment and at 10th weeks after MT injection.

At the beginning of the experiment, gonads of fish were occupied by oocytes of the perinucleolus stage and bundles of gonial cells in the area of germinal epithelium. After 10 weeks, fish from all treatment groups except control group were appeared spermatogenesis in gonads and several fish observed that the remnant of the oocytes are scattered through the testicular tissue.

International Certification for the Quality and Sustainability of Marine Aquarium Organisms

A new certification system for the marine aquarium trade has been launched by Marine Aquarium Council (MAC). The certification system which was developed through an international consultation process involving conservation groups, the industry, hobbyists, public aquaria and government agencies, enables customers and the marine industry to identify certified facilities and organisms of the marine trade. The goal is to put an end to unsustainable harvesting practices and enhance the conservation of the marine environment. This will also ensure economic stability of collectors and is considered to be a win-win solution for the entire supply chain, including coastal communities and the marine industry. The new certification system also provides consumers access to healthy products. The goals are to:

- Established independent standards and certification of "best practices"
- Raise public awareness of the industry role in conservation
- Provide objective, accurate data on the marine ornamental trade
- Ensure the health and quality of marine life through responsible collection, handling and transporting practices
- Encourage responsible husbandry through education and training

For update information on this please visit the Marine Aquarium Council website at http://www.aquariumcouncil.org/.

Low Cost Light Traps for Coral Reef Fishery Research and Sustainable Ornamental Fisheries

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Source: NAGA, The ICLARM Quarterly (Vol. 25, No 2) April-June 2002

Light traps are generally considered as expensive research equipment with practical applications. They can provide a more sustainable alternative method for collecting reef fish to the destructive fishing practices used in the marine aquarium fisheries. In this article, the authors described one low cost and one minimal cost light trap modified from published designs. The design of light source and light traps are provided in details with additional construction diagrams used for illustration. The design of these light traps are based on ease of construction and cost effectiveness, these will allow the light traps to be deployed, and applications can extend beyond scientific research.

Temporal Growth Patterns of Farmed Juvenile Southern Bluefin Tuna, *Thunnus maccoyii* (Castelnau) Fed Moist Pellets

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Journal of the World Aquaculture Society, 33(2): 138-145 (from Current Contents)

The growth, condition, and feed utilization patterns of juvenile southern bluefin tuna (SBT) fed moist-pellets were examined over a 19-wk period from March to July 1999. The SBT had significant weight gain over the course of the study, increasing on average from about 27 to 34 kg (dependent on size class). No significant weight gain by the SBT occurred in the first 5 wk of the study. Following this initial period of slow growth, the rate of weight gain increased, ranging between 40 to 90 g/d. Weight gain peaked after 11 week, with no further gain occurring after this time point. Weight gain was strongly related to average daily feed intake (AFI) which was predominantly influenced by water temperature. Weight gain was minimal following the decrease of water temperatures below 15 C, consistent with a decrease in feed intake from peak values at the beginning of the study to basal levels by week 13. Basal feeding levels were maintained for the remainder of the study through to week 19. Although water temperature and AFI were strongly related, other time related effects also appeared to be significant. A relationship between condition index and feed intake was also identified. Condition index of the SBT increased from about 19 kg/m (3) to 22 kg/m (3) over the 19-week period. Similar to the patterns observed in growth, there was also an initial delay in increases of condition index. The results from this study support that the majority of weight gain by juvenile SBT occurs during the early part of the production season and that this is most likely influenced indirectly through responses to water temperature. The results of this study also suggest that there is little value in conducting growth trials beyond the point where water temperatures decrease below 15 C. Although there was minimal weight gain or improvement in condition beyond the 11-wk time point, these parameters would need to be considered in conjunction with flesh quality characteristics to identify optimum harvesting regimes.

Effects of Salinity, Aeration and Light Intensity on Oil Globule Absorption, Feeding Incidence, Growth and Survival of Early-stage Grouper *Epinephelus coioides* Larvae

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Fisheries Science, 68(3): 478-483

A series of experiments were conducted to examine the effects of salinity, aeration and light intensity on oil globule absorption, feeding incidence, and growth and survival of early-stage Epinephelus coioides larvae. Newly hatched larvae were transferred to 40-L aquaria at a density of 1500 individuals/ aquarium. Larvae were exposed to different levels of aeration (0 mL/min per L, 0.62 mL/min per L, 1.25 mL/min per L, 2.50 mL/min per L, or 3.75 mL/ min per L); salinity (8ppt, 16 ppt, 24 ppt, 32 ppt, or 40 ppt); and light intensity (0lx, 120lx, 230lx, 500lx, or 700lx) for 4-6 days. Twenty larvae were sampled daily at 11:00 hours to measure for total length (TL), oil globule volume, and feeding incidence. Survival rates were determined by counting the total number of larvae remaining in each aquarium at the end of the experiment. Significantly higher survival rates ($P<0.05$) were observed at aeration levels of 0.62mL/min per L and 1.25mL/min per L, at salinity levels of 16 ppt and 24 ppt, and at light intensities of 500lx and 700lx. The influence of aeration level, salinity and light intensity on oil globule absorption, feeding incidence, and growth and survival of early-stage grouper larvae are discussed.

Proteolytic Enzyme Activity of Juvenile Asian Sea bass, *Lates calcarifer* (Bloch), is increased with Protein Intake

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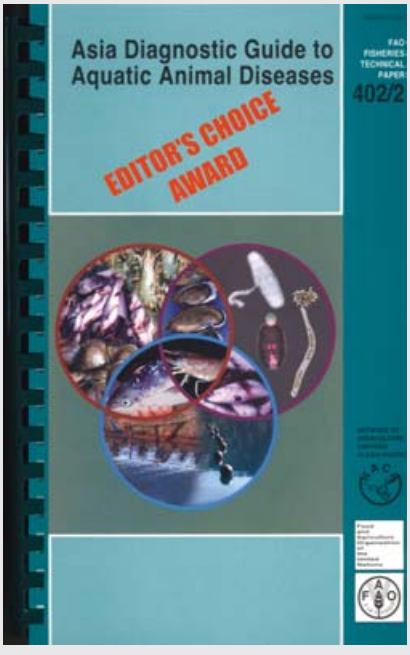
Aquaculture Research, 33(8): 569-574

The effect of high dietary protein intake on proteolytic enzyme activity of feeding juvenile Asian sea bass, Lates calcarifer (Bloch) was studied. Ninety fish [mean body weight±standard error (SE) 304.62±34.84g] were randomly assigned to two dietary treatments, each with three replicates. In treatment 1, fish were fed by-catch (Thunnus albacares) and in treatment 2, a formulated diet containing 50% protein. Proteolytic enzyme activity was determined in pyloric caecae and intestine at day 0, 7, 15, and 30. Initial proteolytic enzyme activity in sea bass ranged from 174 to 232 azocasein units (U^{AC}) per mg of protein. After 7days there was no significant difference in proteolytic enzyme activity of fish fed the two diets. However, a marked increase was observed in fish fed the formulated diet at day 15. After 30days, the proteolytic enzyme activity in fish fed the formulated diet was threefold higher than that in fish fed the by-catch diet. Fish fed the formulated diet had significantly higher total protein intake at day 7 than did fish fed by-catch. Thereafter, a twofold weekly increase in the total protein intake was observed in both fish fed the by-catch and formulated diets until day 30. These results suggest that a high dietary protein intake induces increased proteolytic enzyme activity in Asian sea bass.



Asia Diagnostic Guide to Aquatic Animal Diseases

The Asia Diagnostic Guide is a comprehensive, up-datable diagnostic guide for the pathogens and diseases listed in the NACA/FAO and OIE Quarterly Aquatic Animal Disease (QAAD) Reporting System including a number of other diseases which are significant in the Asia region. It jointly published by FAO and NACA under the Asia-Pacific Regional Programme on Aquatic Health Management.

This 240 page volume contains a general introduction on health and aquatic animals and the roles and levels of diagnostics. Section 2 to 4 cover Finfish Diseases, Molluscan Diseases and Crustacean Diseases. Each host section commences with a chapter on "General techniques" which covers essential starting points that will enable prompt and effective response(s) to disease situations in aquatic animal production. These chapters are not disease specific and emphasize the importance of gross observations and how and when they should be made, including information on environmental parameters worth recording, general procedures for sampling and fixation and the importance of record-keeping. The guide is illustrated with more than 160 colour photos. Limited hard copies and a CD version are available for cost of postage. A free electronic (PDF) version is available from the NACA website (http://www.enaca.org/aapqis/ - visit the publications link).