

Meeting announcement: update

INTERNATIONAL CONFERENCE ON SALT LAKE RESEARCH & MANAGEMENT  
SALT LAKE CITY, UTAH, USA, MAY 12-16, 2008

The *International Society of Salt Lake Research* (ISSLR) will hold its 10th International Conference on Salt Lake Research in Salt Lake City, Utah, USA, May 12-16, 2008 at the University of Utah which overlooks the Great Salt Lake, one of the largest and most ecologically important salt lakes in the world. The conference will showcase recent microbial research in saline environments, bird use of salt lakes, and an array of other topics. The biennial Great Salt Lake Issues Forum sponsored by the *FRIENDS of Great Salt Lake* will be held jointly with the ISSLR conference, providing a stimulating mix of scientists, environmental groups and managers with a common interest in the conservation and scientific management of saline lake ecosystems. The conference will include interesting mid-conference field trips in the local area and an optional post-conference exploration of saline lakes and national parks in the southwestern U.S. Co-sponsors of the meeting include Utah State University, The University of Utah, and U.S. Geological Survey. Proposals for Special Sessions will be considered until *October 15, 2007* and can be sent to Wayne Wurtsbaugh (wurts@cc.usu.edu). For more information see <http://www.isslr.org/>

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UPDATED INFORMATION ON AQUACULTURE EUROPE, ISTANBUL, October 24-27, 2007

From October 24 to 27, 2007, Istanbul will be the scene for a major aquaculture event consisting of Aquaculture Europe 2007, an international conference, under the theme Competing Claims, an international exhibition (Future Fish Eurasia 2007), an industry forum, and several workshops. The event is being organised by the European Aquaculture Society

(EAS) and Eurasia Trade Fairs and hosted by the Turkish Federation of Aquaculture and Fisheries (SUFED).

The conference theme "Competing claims" addresses the various levels of competition that aquaculture faces, and upon which its future development will depend.

The conference will consist of plenary morning sessions with invited speakers presenting the main issues related to aquaculture competing claims.

-Øystein Dahle, chairman of the World Watch Institute, will address the future as a challenge to us all in terms of world resources, especially focusing on food supply and water shortage; - Patrick White, Akvaplan Niva, will present his ideas on what is acceptable, in terms of the interactions of aquaculture and the environment; -Doris Soto, FAO Aquaculture Management and Conservation Service, will explore the relations between sustainable aquaculture and biodiversity; -Karl Alms, President of SINTEF Fisheries and Aquaculture, asks the key question How will aquaculture find the space to develop?; and -Karen Bruns, University of Aarhus, Denmark and SEAFOODplus, will provide her insights into how to address consumer expectations and concerns.

The issues raised during the plenary sessions will be expanded in the parallel sessions of the conference. In addition there will be poster presentations and poster sessions, a special session (especially for Turkish academics) focussing on new knowledge on the culture of trout, sea bream and sea bass, offshore aquaculture, marketing, fish health and seafood quality, a Student Seminar and several social occasions to meet with people from around the world. Presentations have been submitted from some 41 countries.

In addition to the conference there will also be The Industry Forum - Farmers Day and workshops including:

1. a special Turkish Farmers Day on Friday, October 26, chaired by Atilla Ozdemir, Tolga Uruk and Kursat Firat addressing: sustainable aquaculture, coastal management, aquaculture & environment, new trends in marketing, new species/alternative species. It is being prepared by SUFED (The Turkish Federation of Aquaculture and Fisheries).;
2. the 6th Practical Short course Aquafeed EurAsia 2007 - Aquaculture Feed Extrusion, Nutrition, & Feed Management. Tuesday, October 23 and Wednesday, October 24;
3. AquaMax EU-funded Integrated Project on aquaculture feeds. Wednesday, October 24
4. EAS Thematic workshop on Controlled reproduction and larval rearing of the European Eel and focussing on the creation of a network for all interested in European eel reproduction. Wednesday, October 24
5. A meeting of the European Aquaculture Technology Platform (EATP). Thursday, October 25
6. EUROFISH workshop on Marketing and Quality Insurance. Thursday, October 25

An overview of the conference sessions and workshops is provided on the EAS web site at [http://www.easonline.org/index.php?option=com\\_content&task=view&id=28&Itemid=38](http://www.easonline.org/index.php?option=com_content&task=view&id=28&Itemid=38)

Book early and save on registration. The deadline for the next registration is September 10. After this date registration fees will increase.

For more information and registration, please visit:

Website:

[http://www.easonline.org/index.php?option=com\\_content&task=view&id=28&Itemid=38](http://www.easonline.org/index.php?option=com_content&task=view&id=28&Itemid=38)

Or contact: for Conference: [ae2007@aquaculture.cc](mailto:ae2007@aquaculture.cc); Registration: [worldaqua@aol.com](mailto:worldaqua@aol.com);  
Exhibition: [mario.stael@scarlet.be](mailto:mario.stael@scarlet.be)

Laszlo Varadi  
EAS President

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<http://www.easonline.org>

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#### BIOLIPIDS FROM ALGAE

From: Boriah Suryakumar [suryakumarus@yahoo.com](mailto:suryakumarus@yahoo.com)

To: [shrimp@yahoogroups.com](mailto:shrimp@yahoogroups.com)

Date: 15 August 2007

Is it economically viable to produce biolipids from algae in some of the empty shrimp ponds?

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#### COMMENTS 1:

There is an entire Yahoo discussion group on the topic of biolipids from algae. It is [\\_oil\\_from\\_algae@yahoogroups.com](mailto:_oil_from_algae@yahoogroups.com) ([mailto:\\_oil\\_from\\_algae@yahoogroups.com](mailto:_oil_from_algae@yahoogroups.com))

Neal Van Milligen  
Kentucky Enrichment Inc  
[\\_cavm@aol.com](mailto:_cavm@aol.com) (<mailto:cavm@aol.com>)

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#### COMMENTS 2:

How do you propose to economically harvest any biolipids from algae? If you could cheaply remove algae from water, imagine what aquaculture could do in managing pond dynamics with that tool.

Dallas Weaver [deweaver@scientifichatcheries.com](mailto:deweaver@scientifichatcheries.com)

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#### COMMENTS 3:

Please try this link and also the email at the end. The company may be able to provide you the information.

<http://www.aquafeed.com/read-article.php?id=1876>

Udaya Ram Jothy [jothy\\_ur@yahoo.com](mailto:jothy_ur@yahoo.com)

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#### COMMENTS 4:

What about feeding the algae to rotifer or copepod or Artemia or fish larvae and processing it from there? What could the expenses related to culture of the larvae, freeze drying, processing, packing and/or encapsulation be? It may be cheaper than direct extraction of the biolipids from the algal water. I'm sure this pathway beats trying to collect algae cells using the industrial centrifuges.

Ramon Macaraig  
Alsons Aquaculture Corporation  
[monmac52@yahoo.com](mailto:monmac52@yahoo.com)

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COMMENTS 5:

I can visualize a niche market for frozen zooplankton as a shrimp/ fish larval feed. From an energetic viewpoint, you lose a lot going up the food chain, but the harvesting energy decreases. Maintaining the species you desire will be tricky, but it can in theory be a money maker. Copepods are of very high value to the larval fish business for most of the marine species.

Dallas Weaver [deweaver@scientific hatcheries.com](mailto:deweaver@scientific hatcheries.com)

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COMMENTS 6:

In the mid-south region of China, (aka Fujian Province northern Guangdong Province) very few hatcheries (finfish or otherwise) will use rotifers since there is a sub-industry of gathering off-shore zooplankton as an industry in and of itself and the cost base for this is much lower than rotifer culture. In the north, this option is not available and with shorter light hours during the off season, makes algae culture for rotifer or other copepod culture a more expensive deal. This limits traditional culture to the annual seasons as it has been done for ages. Marine fish culture is rapidly catching up with shrimp production since it maintains a higher market value.

Leland Lai – ABM  
[lelandlai@aquafauna.com](mailto:lelandlai@aquafauna.com)

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COMMENTS 7:

What will be a real moneymaker is if we can mass produce the copepods, the rotifers and the artemia using the heterotrophic system technology. Then you can harvest the biolipids from the algae for songs. I wonder, though, what the influence of the biolipids from the bacteria will be. Maybe in a generation or two of the zooplankton, the biolipids from the algae will mask those from the bacteria already. BTW, will there be any value from the biolipids from the bacteria? What profile can they have?

Ramon M. Macaraig  
Alsons Aquaculture Corporation  
[monmac52@yahoo.com](mailto:monmac52@yahoo.com)

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REVIEW ARTICLE  
NITROGEN REMOVAL TECHNIQUES IN AQUACULTURE FOR A SUSTAINABLE  
PRODUCTION

Roselien Crab, Yoram Avnimelech, Tom Defoirdt, Peter Bossier, Willy Verstraete-2007  
Aquaculture 270(1-4): 1-14

Abstract:

As the aquaculture industry intensively develops, its environmental impact increases. Discharges from aquaculture deteriorate the receiving environment and the need for fishmeal and fish oil for fish feed production increases. Rotating biological contactors, trickling filters, bead filters and fluidized sand biofilters are conventionally used in intensive aquaculture systems to remove nitrogen from culture water. Besides these conventional water treatment systems, there are other possible modi operandi to recycle aquaculture water and simultaneously produce fish feed. These double-purpose techniques are the periphyton treatment technique, which is applicable to extensive systems, and the proteinaceous bio-flocs technology, which can be used in extensive as well as in intensive systems. In addition to maintenance of good water quality, both techniques provide an inexpensive feed source and a higher efficiency of nutrient conversion of feed. The bio-flocs technology has the advantage over the other techniques that it is relatively inexpensive; this makes it an economically viable approach for sustainable aquaculture.

aLaboratory of Microbial Ecology and Technology (LabMET), Ghent University, Coupure Links 653, 9000 Gent, Belgium

(Laboratory of Microbial Ecology and Technology (LabMET), Ghent University, Coupure Links 653, 9000 Gent, Belgium; email of Willy Verstraete: [Willy.Verstraete@UGent.be](mailto:Willy.Verstraete@UGent.be))

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#### AN ASSESSMENT OF THE AQUACULTURE POTENTIAL OF THE TROPICAL SPONGES RHOPALOEIDES ODORABILE AND COSCINODERMA SP.

D. Loudon, S. Whalan, E. Evans-Illidge, C. Wolff, R. de Nys-2007

Aquaculture 270(1-4): 57-67

Abstract:

Sponge aquaculture offers the opportunity to provide a sustainable supply of bath and industrial sponges and mitigate the environmental effects of over-harvesting. The potential to develop sponge aquaculture is diverse given the variety of sponge species. However, amenability to culture and the selection of appropriate culture methods are species specific and need to be determined to provide the platform for commercial success. In this study the survival (in situ and ex situ), growth rates (in situ), and recovery processes (ex situ) were measured for explants of two sponge aquaculture candidates, *Rhopaloeides odorabile* Thompson et al. and *Coscinoderma* sp. [Phylum Porifera: Order Dictyoceratida: Family Spongiidae], cultured in the Palm Islands Group of the central Great Barrier Reef. Sponge survival was dependent on the species, experiment duration, and method of culture. For both species the highest mortality occurred within days of excision of sponge material from parent stock, and mortalities were negligible after 78 days. After 78 days, *R. odorabile* had highest survival ex situ (75%) and lowest in situ (60%). In contrast, *Coscinoderma* sp. had the lowest survival ex situ (30%) and highest in situ (90%). The total growth of *R. odorabile* ( $146.0 \pm 40.3\%$ ) and *Coscinoderma* sp. ( $195.9 \pm 39.8\%$ ) was not significantly different over the 21 month experimental period, but was highly variable between explants from the same individual. Both species demonstrated initial size dependent growth rates with smaller explants growing fastest over the first 78 days. Explant recovery rates were rapid for both species with a protective layer of collagen forming over the surface within 24 h. This layer was replaced by pinacoderm between 3 and 41 days after excision as the subsurface tissue reorganised to recreate a functional surface for each species, including redevelopment of the aquiferous system within 41 days for *R. odorabile*. *R. odorabile* and *Coscinoderma* sp. both show potential for commercial aquaculture, however, further research is required to reduce initial mortality rates and the high variability in growth rates between explants.

(School of Marine and Tropical Biology, James Cook University, QLD, 4811, Australia; email of R. de Nys: [rocky.denys@jcu.edu.au](mailto:rocky.denys@jcu.edu.au))

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DIURNAL VARIATION OF TRYPTIC ACTIVITY IN LARVAL STAGE AND DEVELOPMENT OF PROTEOLYTIC ENZYME ACTIVITIES OF MALABAR GROUPE (EPINEPHELUS MALABARICUS) AFTER HATCHING

Aya Fujii, Yuko Kurokawa, Shin'ichiro Kawai, Kenzo Yosedo, Shigeki Dan, Aya Kai, Masaru Tanaka-2007

Aquaculture 270(1-4): 68-76

Abstract:

Diurnal variation in tryptic activity and developmental changes in proteolytic enzyme activities of malabar grouper larvae (*Epinephelus malabaricus*) were examined. Five different groups were prepared for the experiment of diurnal variation of tryptic activity in larvae: larvae were fed Thai-type rotifers *Brachionus rotundiformis* from the time of mouth opening, fed rotifers from 6 h after mouth opening, 12 h, 24 h and not fed rotifers (starved control). The experimental tanks were placed in temperature-controlled baths at 28 °C under 24 h light. Developmental changes in proteolytic activity of trypsin and pepsin-like enzyme were measured from hatching to 57 days after hatching (DAH).

The tryptic activity of all fed groups showed the same pattern, and the diurnal variation of tryptic activity was clearly observed from 3 to 6 DAH. The highest tryptic activities were found at 19:00, and the activities were lowest from 01:00 to 07:00. In contrast, that of non-fed larvae was low compared to the fed groups, however the diurnal variation of tryptic activity was shown same tendency to the fed groups. Interestingly, both groups (fed and non-fed) were exhibited a circadian rhythm under the 24 h light conditions and delaying of first-feeding. Tryptic activity of larvae notably increased from 40 to 45 DAH and markedly decreased at 52 DAH. In contrast to the tryptic activity, that of pepsin-like enzyme clearly increased from 47 to 51 DAH. The results suggest that a functional change of protein digestion occurs from 40 to 50 DAH related with metamorphosis in malabar grouper. These results could contribute to determining appropriate feeding schedules, such as feeding time, frequency and optimal time to change food items, in mass-scale production of the present species.

(Kobe College, Faculty of Human Sciences, Nishinomiya, 662-8505, Japan; email of Aya Fuji: [fujiiaya@adm.kais.kyoto-u.ac.jp](mailto:fujiiaya@adm.kais.kyoto-u.ac.jp))

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OPTIMAL CONDITIONS FOR EGG STORAGE, INCUBATION AND POST-HATCHING GROWTH FOR THE FRESHWATER TURTLE, CHELODINA RUGOSA: SCIENCE IN SUPPORT OF AN INDIGENOUS ENTERPRISE

Damien A. Fordhama, Arthur Georges, Ben Corey-2007

Aquaculture 270(1-4): 105-114

Abstract:

Incubation of northern snake-necked turtle (*Chelodina rugosa*) eggs and subsequent sale of hatchlings for the pet industry has the potential to provide culturally suitable employment for indigenous communities in northern Australia. Developmental arrest in response to egg inundation is unique to *C. rugosa*. Eggs can be stored under water for up to 10 weeks without appreciable impact on egg or embryo survival, allowing the transport and sale of eggs into niche markets without high levels of mortality, and permitting eggs to accumulate in diapause until there are sufficient numbers to incubate as batches. Eggs that are not inundated or inundated for short periods experience similar survival rates to eggs inundated for lengthy periods. Incubation temperature influences embryo survival and development period in *C. rugosa*. Embryonic survival is greatest at 26 °C, steadily declining as temperature increases to 32 °C. A similar increase in incubation temperature decreases incubation period by approximately 40 days, however almost half of this variation is attributed to the increase in incubation temperature from 26 to 28 °C. Hatchling growth in *C. rugosa* is characterized by two phases. There is an initial phase of relatively slow growth under the partial influence of initial egg size and incubation duration, followed by a second phase of relatively rapid growth under the partial influence of water temperature and mass at hatching. Post-hatching survival

is negatively correlated with duration of egg inundation and water temperature. Evidence suggests that inundation of *C. rugosa* eggs for 6 weeks, incubation of embryos at 28 °C and raising hatchlings in 28 °C water will yield the best overall outcomes.

(Institute for Applied Ecology, University of Canberra, ACT 2601, Australia; email of A. Georges: [georges@aerg.canberra.edu.au](mailto:georges@aerg.canberra.edu.au))

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#### SPAWNING, EARLY DEVELOPMENT AND FIRST FEEDING IN THE GOBIID FISH PRIOLEPIS NOCTURNA

Matthew L. Wittenrich, Ralph G. Turingan, R. LeRoy Creswell-2007

Aquaculture 270(1-4): 132-141

Abstract:

The reproductive behavior, embryonic development and early larvae of *Priolepis nocturna* are described. Three pairs of *P. nocturna* began spawning 41 days after acquisition and maintained a 5–10 day spawning cycle lasting beyond several months. Spawning was initiated by the female who signaled her readiness to spawn by displaying to the male. Egg clutch size averaged  $1578 \pm 51.23$  eggs and ranged from 268 to 3121. Egg length averaged  $0.82 \pm 0.01$  mm total length (TL) and ranged from 0.75 to 0.90 mm. Egg width averaged  $0.51 \pm 0.51$  mm total width (TW) and ranged from 0.49 to 0.52 mm. Fertilized eggs were ovoid in shape and attached to the ceiling of provided shelters via adhesive filaments at the proximal end. Hatching rates averaged  $97.3 \pm 0.51\%$  and ranged from 91.9 to 99.8%. Larvae measuring  $1.89 \pm 0.04$  mm TL hatched  $121 \pm 0.5$  h post fertilization and did not rotate position prior to hatching. Skeletal elements of the chondrocranium were simplistic and dominated by the hyoid, hyomandibulosymplectic cartilage, ethmoid and Meckel's cartilage in first feeding larvae. No elements were added to the cranial architecture by 5 days post hatch (DPH) when larvae measured  $2.05 \pm 0.04$  mm TL. First feeding larvae consumed only dinoflagellates and tintinnids suggesting that feeding was constrained by a poorly developed feeding mechanism. Embryology and larval development are described to 5 DPH.

(Department of Biological Science, Florida Institute of Technology, 150 W. University Boulevard, Melbourne, Florida, 32901, USA; email of M. L. Wittenrich: [mwittenr@fit.edu](mailto:mwittenr@fit.edu))

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#### GROWTH AND SURVIVAL OF LARVAL AND JUVENILE COBIA RACHYCENTRON CANADUM IN A RECIRCULATING RACEWAY SYSTEM

Cynthia K. Faulk, Jeffrey B. Kaiser, G. Joan Holt-2007

Aquaculture 270(1-4): 149-157

Abstract:

*Cobia* *Rachycentron canadum* is a fast-growing, pelagic marine species that has recently attracted aquaculturists in both the research and commercial sectors. The typical method of grow-out for this species is in outdoor systems where production is limited to locations and seasons conducive for adequate growth and survival. Expanding the culture of cobia to indoor recirculating aquaculture systems (RAS) would allow for the production of fingerlings throughout the year and extend production to cooler regions. Two rearing trials were conducted to examine the growth and survival of cobia from hatching through 4 (trial 1, T1) or 35 (trial 2, T2) g in RAS. *Cobia* larvae were reared in circular tanks placed in a raceway to control water temperature and quality. During early juvenile grow-out, fish were transferred without grading to a second raceway on 29 dph (T1) or over a period of grading from 29–43 dph (T2). Larval growth (1–22 dph) measured as standard length was similar for both trials ranging from 3.9 to 14.7 mm. However, larval growth measured as wet weight (0.033 g, T1; 0.026 g, T2) or dry weight (5.7 mg, T1; 3.9 mg, T2) was significantly greater on 22 dph during T1 as was the ratio between myotome height and standard length. These differences may have resulted from an increase in initial densities from 8.7 larvae l<sup>-1</sup> (T1) to 14.7 larvae l<sup>-1</sup> (T2) which apparently caused an increase in food competition and overall aggression. During juvenile grow-out, cobia reached 4.0 g on 43 dph in T1 and 35.4 g on 71 dph in T2



matching weights achieved during grow-out in outdoor ponds. Over the course of both trials, survival was similar to that reported in outdoor ponds. Mean survival ( $\pm$  S.D.) during the early rearing phase (hatching through 29 or 43 dph) averaged  $13.2 \pm 3.2$  % and  $10.4 \pm 3.2$  % corresponding to final densities of  $0.9 \pm 0.2$  and  $1.2 \pm 0.4$  fish/l for T1 and T2, respectively. During the first grow-out phase (29–43 dph), survival of fish moved into the open raceway was 64.5% in T1 and 88.7 % in T2. Survival of cobia during the second grow-out phase (43–71 dph) for T2 was 92.5%. The results of this study indicate that cobia can be successfully cultured in indoor systems from hatching through at least 35 g without negatively affecting growth or survival.

(University of Texas at Austin Marine Science Institute, Fisheries and Mariculture Laboratory, 750 Channel View Drive, Port Aransas, TX 78373, United States; email of Cynthia K. Faulk: [cfaulk@utmsi.utexas.edu](mailto:cfaulk@utmsi.utexas.edu))

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#### TWO MICROALGAE CRYPTHECODINIUM COHNII AND PHAEODACTYLUM TRICORNUTUM AS ALTERNATIVE SOURCE OF ESSENTIAL FATTY ACIDS IN STARTER FEEDS FOR SEABREAM (SPARUS AURATA)

E. Atalah, C.M. Hernández Cruz, M.S. Izquierdo, G. Rosenlund, M.J. Caballero, A. Valencia, L. Robaina-2007

Aquaculture 270(1-4): 178-185

Abstract:

Despite oils extracted from algae and other microorganisms that may constitute excellent sources of HUFAs, few studies have determined the nutritional value of different microalgal species for young marine fish. Six thousand gilthead seabream (*Sparus aurata*) postlarvae (73 mg body weight) were fed for 57 days diets containing either fish oil as a single lipid source or 2 and 4% of *Cryptecodinium cohnii* or 5% *Phaeodactylum tricorutum*. Fish oil substitution by *C. cohnii* resulted in improved fish survival and a very good growth performance, in agreement with a higher proportion of DHA in diets and in total lipids of fish. Incorporation of DHA and other fatty acids was proportional to their contents in diet suggesting the good nutritional utilization of homogenized *C. cohnii*. Lower survival rates were found in fish fed *P. tricorutum* and could be related to an epithelial degeneration observed in the anterior intestine. This degeneration could be related to a higher lipid content in these fish or to the strong hornlike cornutate processes found in the valves of the diatom *P. tricorutum*.

(Grupo de Investigación en Acuicultura (ICCM and IUSA), P.O. Box 56, 35200, Telde, Las Palmas de Gran Canaria, Spain; email of E. Atalah: [eyadatalah@gmail.com](mailto:eyadatalah@gmail.com))

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#### EFFECT OF DOCOSAHEXAENOIC ACID ENRICHMENT IN ARTEMIA ON GROWTH OF PACIFIC BLUEFIN TUNA THUNNUS ORIENTALIS LARVAE

Manabu Seoka, Michio Kurata, Hidemi Kumai-2007

Aquaculture 270(1-4): 193-199

Abstract:

Feeding enriched *Artemia* induces growth failure in Pacific bluefin tuna (PBT) *Thunnus orientalis* larvae; however, feeding of yolk-sac larvae of marine fish promotes larval growth. It is considered that this growth failure partly results from dietary docosahexaenoic acid (22:6n-3, DHA) deficiency. Therefore, we examined the effect of DHA contents in enriched *Artemia* on the growth of PBT larvae. *Artemia* nauplii were enriched with graded levels of DHA ethyl ester, and fed to PBT larvae for 9 days. Yolk-sac larvae of Japanese parrotfish *Oplegnathus fasciatus* were used as a reference diet. The DHA contents in *Artemia* increased with the enrichment from 0 mg g<sup>-1</sup> dry weight basis (DW) to 25 mg g<sup>-1</sup> DW, while the content in the reference diet was 21 mg g<sup>-1</sup> DW. Feeding of enriched *Artemia* significantly improved the growth of PBT larvae. However, this improvement was negligible when compared with the excellent growth of the larvae that were fed the reference diet. PBT larvae



that were fed the reference diet accumulated approximately twice or much higher levels of DHA in the neutral and polar lipids in the body when compared with the larvae that were fed enriched Artemia. These results show that PBT larval growth cannot be promoted by feeding enriched Artemia even if the DHA contents in Artemia are elevated to the same levels as those of yolk-sac larvae. The incorporation of dietary DHA into phospholipids in the fish body may be desirable for the normal growth of PBT larvae.

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COMPARATIVE PERFORMANCE OF GAMMA AMINO BUTYRIC ACID (GABA) AND 5-HYDROXYTRYPTAMINE (5-HT) IN THE DIET OF LARVAE AND POST LARVAE OF GIANT FRESHWATER PRAWN, MACROBRACHIUM ROSENBERGII: EFFECT OF DOSE AND ROUTE OF ADMINISTRATION ON GROWTH AND SURVIVAL

Jiwan Kumar Chettri, N.P. Sahu, A.K. Pal, A.K. Reddy, Shivendra Kumar, and Vikas Kumar-2007

Aquaculture 270(1-4): 240-248

Abstract:

Three experiments were conducted to evaluate the effect of different dose and route of administration of 5-Hydroxytryptamine (5-HT) and Gamma Amino Butyric Acid (GABA) on growth, survival and pigmentation of giant freshwater prawn, *Macrobrachium rosenbergii*, larvae (experiment 1) and post larvae (experiment 2 and 3). In experiment 1 larvae were stocked at 100 /L in seven different treatments with each of three replicates. The treatments were T1 (control), T2 (100 µg/ml of 5-HT bath exposure for 2 days), T3 (1 µM of GABA bath exposure for 2 days), T4 (0.5% 5-HT in feed), T5 (0.25% 5-HT in feed), T6 (0.5% GABA in feed) and T7 (0.25% GABA in feed). Highest growth, transformation rate, pigmentation and survival of larvae were recorded in T2 group in experiment 1. In experiment 2, post larvae were stocked at 70 per tank with 200 L of water for 45 days. This experiment consisted of 5 treatment groups with each of 3 replication viz. T1 (control), T2 (0.5% 5-HT in feed), T3 (0.25% 5-HT in feed), T4 (0.5% GABA in feed) and T5 (0.25% GABA in feed). At the end of this experiment growth was found to be higher in the control than the other treatment group showing inhibitory effect of 5-HT and GABA on growth of post larvae. To confirm the result, a third experiment was conducted for 30 days. Thirty numbers of post larvae having similar size were segregated from the previous experimental tanks (experiment 2) and stocked in the tanks of 100 L of water for experiment 3. All treatments were fed with control diet. There was similar growth pattern in all the treatments, which were higher ( $P < 0.05$ ) than control, confirms the inhibitory effect of neurotransmitter in the diet of PL. Therefore, the overall results of the present study suggest that the bath treatment of neurotransmitter is superior to the dietary addition with regard to the growth, survival and pigmentation of *M. rosenbergii* larvae. 5-HT is more effective than the GABA for larvae of *M. rosenbergii*.

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CLASSIFICATION OF DIFFERENTIATING OOCYTES DURING OVARIAN CYCLE IN THE GIANT FRESHWATER PRAWN, MACROBRACHIUM ROSENBERGII DE MAN  
Prasert Meeratana, Prasert Sobhon-2007

Aquaculture 270(1-4): 249-258

Abstract:

Based on the light microscopic observations of cells' sizes, chromatin patterns, amount of lipid droplets and yolk granules, the female germ cells could be classified into four different phases, which include 1) oogonia (Oog), 2) primary oocytes (pOc), 3) secondary oocytes (sOc), and 4) mature oocyte (mOc). Oog are small oval-shaped cells with irregular-shaped

nuclei sizing 4–6 µm in diameter. They rest on the connective tissue germinal cord at the tip of each ovarian pouch (lobule). Oogonia increase their number through mitotic division, and the daughter cells move into ovarian pouch where they undergo first meiotic division to become primary oocytes, which have various steps of 1st meiotic prophase accumulating at the innermost zone of the ovarian pouch. The primary oocytes are small oval-shaped cells (8.5–10 µm in diameter) with large nuclei containing chromatin in various states of condensation that finally transform into chromatids. Their nuclei are surrounded by thin rim of faint blue-stained cytoplasm. The secondary oocytes derived from 2nd meiosis and comprise five steps: Oc1 and Oc2, classified as previtellogenic oocytes, Oc3 and Oc4, classified as vitellogenic oocytes, and mature oocyte (mOc) The zones of ovarian pouch are defined based on the accumulation of various steps of developing oocytes, namely, oogenic, previtellogenic, vitellogenic and mature zones, respectively. The ovarian cycle is divided into five stages based on the number and types of oocytes present in each stage. Stage 0 and I are spawn and spent stages. Stage II and III are proliferative and premature stages, while stage IV is mature stage. During ovarian stage I, each ovarian pouch contains primarily oogonia, primary oocytes, Oc1 and a few Oc2. In stage II, the pouch contains mainly Oc2 and Oc3, while in stage III the predominant cells are Oc4. Mature oocytes appear synchronously, in stage IV. The ovulating mature oocytes pass through the thin disrupted wall of ovarian pouch into subcapsular space, that leads into the oviduct situated on the ventro-lateral side of the ovarian lobe. At spawning, the ovarian pouches break down and only connective sheaths and hemolymph sinuses remain. The germinal cords and islets of oogonia remain in the central area of stage 0 ovary. The ovarian capsule, including the muscular layer, becomes attenuated as the ovary progresses from stage 0 to IV. The hemolymph vessels become highly convoluted in the central area of the ovary, and they branch radially into smaller hemolymph sinuses around each oogenic pouch.

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#### OVARIAN FLUID PH ENHANCES MOTILITY PARAMETERS OF RAINBOW TROUT (ONCORHYNCHUS MYKISS) SPERMATOZOA

Mariola Wojtczak, Grzegorz J. Dietrich, Mariola Słowińska, Stefan Dobosz, Henryk Kuźmiński, Andrzej Ciereszko-2007

Aquaculture 270(1-4): 259-264

Abstract:

All evidence to date suggest that sperm motility is the primary determinant of fertilization success in externally fertilizing fish species. Ovarian fluid, which comprises 10–30% of the total egg volume in salmonids, enhances sperm motility with respect to swimming speed, trajectory and the duration of movement. It was recently demonstrated that there is individual variability in sperm motility enhancing potential of ovarian fluid of particular females. In the present study we examined the effect of particular ovarian fluids collected from 31 females on the sperm motility parameters of one male of rainbow trout (*Oncorhynchus mykiss*) using computer-assisted sperm analysis (CASA). During our experiment we also monitored the pH of ovarian fluid. We found that particular fluids differed in the ability to activate spermatozoa; sperm remained immotile in four fluids and exhibited 50–100% motility in 27 samples. The percentage of motile sperm, velocity and duration of movement positively correlated with ovarian fluid pH ( $r^2 = 0.34–0.62$ ). These data strongly suggest that the pH of the ovarian fluid is the primary determinant of sperm motility in rainbow trout under natural conditions of fertilization.

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## OOGENESIS AND RELEVANT CHANGES IN EGG QUALITY OF ABALONE HALIOTIS DISCUS HANNAI DURING A SINGLE SPAWNING SEASON

Hirotsu Fukazawa, Tomohiko Kawamura, Hideki Takami, Yoshiro Watanabe-2007

Aquaculture 270(1-4): 265-275

### Abstract:

Oogenesis of abalone *Haliotis discus hannai* was examined histologically during a single spawning season using broodstock of various maturation conditions, which were controlled by effective accumulative temperature (EAT). The quality of eggs spawned was determined in relation to oogenesis. For histological examinations, three to five females were sacrificed at 300, 600, 850, 1050, and 1150 °C days EAT, without induction of artificial spawning. Other females were successfully induced to spawn at 700 °C days EAT and were reared following spawning. Three of these females were then sacrificed every 200 °C days EAT until 1300 °C days EAT. Gonad histology showed that two oocyte cohorts matured in *H. discus hannai* ovaries during a single spawning season. One mature oocyte cohort could be spawned in multiple times. The second oocyte cohort started developing after the first oocyte cohort had been spawned or reabsorbed, and became fully mature 400 °C days EAT after the first cohort was depleted. For egg quality measurements, three to five females were successfully induced to spawn at 850, 1050, 1150, 1900, and 2350 °C days EAT (Experiment 1). Three females were induced to spawn twice, at 700 and 1500 °C days EAT, resulting in two batches of eggs from the same individuals (Experiment 2). Total lipid and protein content of eggs were measured and were greater in eggs from the second cohort than in eggs from the first cohort. No carbohydrates were detected in eggs and there was no difference in cytoplasm volume between the two cohorts. In hatcheries producing *H. discus hannai*, it is important to increase post-larval starvation tolerance by increasing the quality of eggs, to yield higher and more consistent survival. The results of this study suggest that *H. discus hannai* hatcheries should use eggs from the second oocyte cohort, which are of higher quality, rather than eggs from the first oocyte cohort.

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## SWIMMING STIMULATES OOCYTE DEVELOPMENT IN EUROPEAN EEL

Arjan Palstra, Danilo Curiel, Madelon Fekkes, Merijn de Bakker, Csaba Székely, Vincent van Ginneken, Guido van den Thillart-2007

Aquaculture 270(1-4): 321-332

### Abstract:

In this study, we subjected eels from Lake Balaton (Hungary) to a swimming period of 1 week and 2 or 6 weeks. Most eels were silver and were 13–21 years old. Time dependent changes in morphometrical parameters and developmental characteristics of the oocytes were determined. Already after 1 week of swimming, the gonadal mass increased and oocytes became larger, filled with large numbers of lipid droplets. After 2 and 6 weeks of swimming we found in addition a significant enlargement of the eyes, which is a sign of sexual maturation. In contrast to the resting eels, that had oocytes in the primary growth phase (stage 1–2); the swimming eels had oocytes in stage 3; the cortical alveolus or lipid droplet stage. The results indicate that lipid mobilisation induced by swimming is a requirement for the natural incorporation of lipid droplets in the oocytes, a crucial step in oocyte maturation. As the Balaton eels responded stronger to swimming than young farmed eels, it is suggested that older eels are more sensitive for maturation triggers.

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## ONTOGENY OF PEPSINOGEN AND GASTRIC PROTON PUMP EXPRESSION IN RED PORGY (PAGRUS PAGRUS): DETERMINATION OF STOMACH FUNCTIONALITY

María J. Darias, Harry M. Murray, Jeffrey W. Gallant, Susan E. Douglas, Manuel Yúfera, Gonzalo Martínez-Rodríguez-2007

Aquaculture 270(1-4): 369-378

Abstract :

The appearance of functionally developed gastric glands is commonly considered as the transition from the larval to the juvenile stage in fish, since it means the switch from the less efficient alkaline digestion to a more efficient acid digestion characteristic of adult specimens. From that moment, fish are supposedly able to better assimilate nutrients from inert diets. Acid digestion takes place by the action of pepsin activity and hydrochloric acid, both secreted by the gastric glands of the stomach. Pepsinogen is the precursor of pepsin which is converted into active enzyme by the action of hydrochloric acid secreted by the proton pump. The goal of this work was to assess the ontogeny of pepsinogen and gastric proton pump expression along larval development of red porgy using RT-PCR and in situ hybridization techniques. Firstly, red porgy specific pepsinogen and proton pump partial sequences were isolated. Amplification products presented 615 and 591 bp and were identified as pepsinogen IIb and the  $\alpha$ -subunit of the proton pump (H<sup>+</sup>/K<sup>+</sup>-ATPase) by sequencing, respectively. Both sequences were aligned to several predicted pepsinogen and proton pump polypeptides from different vertebrate species showing elevated homologies with them, especially in the case of the proton pump, the identity of which was never less than 90%. Pepsinogen and proton pump expressions were detected from 30 days post-hatching (dph), increasing with development. Proton pump expression was localized in the gastric glands of red porgy larvae as revealed by in situ hybridization, showing increasing signal intensity along the digestive system development. Such results indicated that at 30 dph red porgy starts to acquire the adult digestive capacity and therefore inert diets should be better utilized from that time onwards.

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## TECHNICAL NOTE

### THE IMPACT OF REPEAT SPAWNING OF MALES ON EFFECTIVE NUMBER OF BREEDERS IN HATCHERY OPERATIONS

Craig Busack-2007

Aquaculture 270(1-4) : 523-528

Abstract:

In conservation hatcheries, typically a great emphasis is placed on maximizing the effective number of breeders through spawning an appropriate number of spawners, spawning equal numbers of males and females when possible, and by mating either in a single-pair or factorial fashion. A commonly encountered problem, especially in small operations with anadromous salmonids, is a shortage of males at some point during the season, so that some males need to be spawned multiple times. This has an impact on the genetically effective number of breeders, and the commonly used equations for effective number are not applicable. In this paper I derive a relatively simple equation for effective number of breeders when some males are multiply spawned but reproductive contribution within spawning classes are equal:  $N_e = \frac{N_m}{\mu} \left( \frac{1}{i} \right)$ , where  $i$  is the number of times a male is spawned,  $N_m$  the number of males spawned  $i$  times, and  $\mu$  the mean gametic contribution. I also derive an equation that allows relaxation of the assumption of equal contribution within classes. I then develop a number of simple and accurate approximations for the effective number of breeders. The equations can be applied to any situation in which there are discrete spawning classes in which the average reproductive contribution of any one class can be expressed as a multiple of that of another class.

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EFFECTS OF TEMPERATURE AND LIPID DROPLET ADHERENCE ON MORTALITY OF HATCHERY-REARED SOUTHERN HAKE MERLUCCIUS AUSTRALIS LARVAE

Claudia A. Bustosa, Mauricio F. Landaeta, Enrique Bay-Schmith, Rodrigo Lewis, Ximena Moraga-2007

Aquaculture 270(1-4): 535-540

Abstract:

Effects of exogenous (water temperature) and endogenous (lipid droplet adherence) factors were experimentally tested on early survival of southern hake *Merluccius australis* reared under controlled conditions. Experiments to determine the effect of temperature (10, 12 and 14 °C) on larval growth rates and yolk-sac absorption rates of unfed southern hake were carried out under laboratory conditions. There was no significant differences in growth rates at the temperature range tested (ANCOVA,  $F = 0.164$ ,  $p > 0.25$ ), but yolk-sac absorption rates and mortality increased with temperature (ANCOVA,  $F = 53.84$ ,  $p < 0.001$ ). A high percentage (between 31 and 81%) of hake eggs showed a lipid droplet not adhered (i.e., freely moving in the yolk, and not located in the posteriormost portion of the yolk-sac). In a second experiment, fed southern hake larvae with the lipid droplet not adhered during embryonic development did not survive after yolk-sac absorption. This study provides the first data on the influence of the lipid droplet absorption on larval survival of cultured hake, and can be used as an early indication of the quality of the batch.

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