

INFORMATION OF INTEREST

EAS workshop on Reproduction of European Eel (Istanbul-Turkey, October 24, 2007):

[programme with abstracts](#), [workshop report](#), [workshop recommendation](#).

[Eat more seafood](#) to reduce mental health problems

Asian Fisheries Society - Fish Health Section [Electronic Newsletter](#) Issue 2 October 2007

Update on the WWF Pangasius Aquaculture Dialogue: [1st meeting report](#)

WWF's involvement in sustainable aquaculture practices: see [website](#)

BBC World Service One Planet programme on aquaculture with Richard Black and Patrick

Sorgeloos: [radio programme](#) and [transcript](#) "taste of wild comes home"

Intrafish Future Outlook September 2007:

[aquaculture comes of age](#)

[salmon and trout](#)

[bream, bass, cod and halibut](#)

[turbot](#)

[tilapia](#)

[Pangasius and channel catfish](#)

[shrimp](#)

Latest FAO Aquaculture [Statistics year 2005](#)

POTENTIAL EFFECT OF AQUACULTURE PROMOTION ON POVERTY REDUCTION IN SUB-SAHARAN AFRICA

Aloyce R. Kaliba, Charles C. Ngugi, John M. Mackambo, Kajitanus O. Osewe, Ephraim Senkondo, Berno V. Mnembuka, Steven Amisah-2007

Aquaculture International 15(6) : 445-459

Abstract:

There is a policy of increased support of aquaculture development in Sub-Saharan Africa. In the region, aquaculture expansion has the potential to create new jobs and improve food security among poor households. Three computable general equilibrium models were used to estimate the effects of aquaculture expansion and increased input productivity on poverty reduction in Ghana, Kenya, and Tanzania. The results suggest that there will be positive effects on per capita income for all households in Ghana and Kenya. In Tanzania some rich households will experience income loss, because of resource shift from other sectors to aquaculture. Because of reduction in poverty associated with price reductions, and increases in minimum income associated with income expansion, the poverty gap decreased in all household groups. Because of high sectoral linkages, aquaculture development is a potential candidate for sector-specific policy support to address poverty reduction in Sub-Saharan Africa.

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EFFECTS OF STOCKING DENSITY ON SURVIVAL AND GROWTH OF JUVENILE TENCH (TINCA TINCA L.)

Jesus D. Celada, Amelia Aguilera, Jose M. Carral, María Sáez-Royuela, Pedro M. Melendre, Jose R. Pérez-2007

Aquaculture International 15(6): 461-465

Abstract:

In two 120-day experiments, performed in the laboratory at 22°C, the effects of stocking density on the survival and growth of juvenile tench (*Tinca tinca* L.) were evaluated. Fish were kept in fibreglass tanks, supplied throughout with flow of artesian water, and fed a dry diet for salmonids, in excess, supplemented with restricted amounts of *Artemia* nauplii. In the first experiment four-month-old juveniles (0.31 ± 0.04 g and 32.00 ± 1.17 mm TL) were stocked at four densities—0.18, 0.88, 1.05, and 2.10 g l⁻¹. Survival was high (>89%) for all treatments. Final densities ranged between 1.10 g l⁻¹ (significantly lowest) and 10.46 g l⁻¹ (significantly highest). The density increase was significantly higher (611%) for fish stocked at the lowest initial density (0.18 g l⁻¹) than for fish stocked at 0.88, 1.05, and 2.10 g l⁻¹, for which the density increase averaged 457%. In the second experiment, 4.5-month-old juveniles (0.58 ± 0.17 g and 39.54 ± 0.83 mm TL) were stocked at three densities—1.05, 3.00, and 4.00 g l⁻¹. Survival was high (>96%) for all treatments. Final densities ranged between 4.08 and 16.53 g l⁻¹ and were significantly higher for greater initial densities. The density increase was greatest (413%) for fish stocked at the highest density (4 g l⁻¹) and was not significantly different for fish stocked at 1.05 and 3 g l⁻¹. Considering all the densities in the two experiments, for stocking at 4 g l⁻¹ the final density was 15 times higher than that reached after stocking at 0.18 g l⁻¹, without harmful effects on survival and growth. This final density (equivalent to 16.53 kg m⁻³) is in the range recommended for other fish species in this period under intensive conditions.

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EFFECT OF DIFFERENT DIETARY RAW TO PRE-GELATINIZED STARCH RATIOS ON GROWTH PERFORMANCE, FEED UTILIZATION AND BODY COMPOSITION OF JUVENILE YELLOWFIN SEABREAM (*SPARUS LATUS*)

Xiao-Yi Wu, Yong-Jian Liu, Li-Xia Tian, Kang-Sen Mai, Ran Guo, Sheng-Jie Jin-2007

Aquaculture International 15(6): 467-477

Abstract:

The effects of different ratios of dietary raw to pre-gelatinized starch on the growth performance, feed utilization and body composition of juvenile yellowfin seabream (*Sparus latus*) were evaluated during a 10-week growth trial. Five isonitrogenous, semi-purified diets containing 200 g kg⁻¹ starch comprising different ratios of raw to pre-gelatinized starch [(in g kg⁻¹)100:100 (diet 1), 150:50 (diet 2), 50:150 (diet 3), 200:0 (diet 4), 0:200 (diet 5), raw:pre-gelatinized] were prepared and fed to triplicate groups of juvenile *S. latus*. Our results showed that fish fed diet 4 (200 g kg⁻¹ raw starch) had the highest weight gain and specific growth rate, followed by those fed diet 2, diet 1, diet 3 and diet 5. Feed efficiency, protein efficiency ratio and protein productive value in the fish on diets 4 and diet 2, respectively, were significantly higher than those on diets 3 and diet 5, respectively. Body and muscle compositions were unaffected by the different dietary raw to pre-gelatinized starch ratios. Values of hepatosomatic index, intraperitoneal fat ratio, viscerosomatic index and condition factor did not vary among experimental treatments. Plasma indices showed variations, but these were not relative to dietary treatments. In conclusion, the partial or total replacement of raw starch by pre-gelatinized starch in diets for yellowfin seabream did not improve its growth performance and feed utilization.

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RESEARCH ON THE JELLYFISH (*RHOPILEMA ESCULENTUM* KISHINOUE) AND ASSOCIATED AQUACULTURE TECHNIQUES IN CHINA: CURRENT STATUS

Kui You, Caihua Ma, Huiwang Gao, Fengqi Li, Meizhao Zhang, Yantao Qiu, Bo Wang-2007

Aquaculture International 15(6): 479-488

Abstract:

The jellyfish is a popular seafood in eastern and southern Asian nations where there is a high market demand that stimulates large-scale jellyfish production. Due to its economic importance in China, many biological studies have focused on the jellyfish *Rhopilema esculentum* Kishinouye in terms of the environmental impact of aquaculture activities and culture techniques. In recent years, the commercial aquaculture of *R. esculentum* has expanded greatly in China. This paper summarizes the current status of research in China on *R. esculentum* and associated aquacultural practices, focusing on a number of related technological approaches. (Key Lab of Marine Environmental Science and Ecology, Ministry of Education, Ocean University of China, Qingdao, 266100, China; email of Kui You: ykmch@ouc.edu.cn)

TENCH (*TINCA TINCA* L.) LARVAE REARING UNDER CONTROLLED CONDITIONS: DENSITY AND BASIC SUPPLY OF ARTEMIA NAUPLII AS THE SOLE FOOD

J. D. Celada , J. M. Carral, R. Rodríguez, M. Sáez-Royuela, A. Aguilera, P. Melendre, J. Martín-2007

Aquaculture International 15(6): 489-495

Abstract:

After artificial reproduction of tench, larvae must be maintained indoors, and studies on rearing conditions are needed, focussing on the reduction of labour and costs. Three experiments on larvae (5th day post-hatch) were conducted for 25 days using *Artemia nauplii* as the sole food in order to determine basic feeding and density conditions during the first rearing period. Tench were maintained in 25 l fibreglass tanks, supplied with an artesian water flow throughout of 0.2 l min⁻¹. Water temperature was 22.5 ± 1°C, and the photoperiod was natural. Larvae fed on a restricted amount of nauplii reached high survival rates, even with the minimum of 50 nauplii larva⁻¹ day⁻¹. This amount of food may be sufficient at least for the first 25 days of exogenous feeding if fast growth is not the priority, and high densities can be maintained with good survival rates (over 90% up to 160 larvae l⁻¹ and 77% with 320 larvae l⁻¹). When food was supplied in excess once a day, high survival rates were achieved (91–97%), without differences among the densities tested. Animals at a density of 100 l⁻¹ reached the highest length (15.57 mm) and individual weight (46.8 mg). This growth is greater than those reported in studies feeding several times a day. It could be deduced that, while live food remains available for tench, it is not necessary to feed so frequently. Considering the relationship among the initial number of animals, final survival and growth and ration supplied, the new data reported here are useful to establish suitable stocking densities under both culture and experimental conditions.

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ASSESSMENT OF DIETARY LECITHIN AND CHOLESTEROL REQUIREMENTS OF MUD CRAB, *SCYLLA SERRATA*, MEGALOPA USING SEMI-PURIFIED MICROBOUND DIETS

M.-H. Holme, P.C. Southgate, C. Zeng -2007

Aquaculture Nutrition 13 (6): 413–423

Abstract:

The effects of varying dietary lecithin and cholesterol levels on growth, development and survival of mud crab, *Scylla serrata*, megalopa were evaluated using six semi-purified, microbound diets formulated to be iso-energetic and containing three levels of supplemental lecithin (0, 20 and 40 g kg⁻¹ diet dry weight) and two levels of supplemental cholesterol (0 and 7 g kg⁻¹ diet dry weight). Fifteen megalopa were reared individually in each treatment

and the nutritional value of diets was assessed on basis of mean dry weight and mean carapace width of newly settled first crab stage, as well as development time to the first crab stage and overall survival. A significant interaction between supplemental dietary lecithin and supplemental dietary cholesterol was found for final mean dry weight of newly settled crabs, and highest survival (60%) was recorded for megalopa fed diets containing the highest levels of dietary lecithin (39.7–44.1 g kg⁻¹) (diet 5 and 6) regardless of whether diets were supplemented with cholesterol; this rate of survival was identical to that of megalopa fed live *Artemia nauplii*. The results indicate that supplemental dietary cholesterol may not be essential for mud crab megalopa when fed diets containing sufficient levels of supplemental dietary phospholipids.

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ZINGIBER OFFICINALIS AN HERBAL APPETIZER IN THE TIGER SHRIMP *PENAEUS MONODON* (FABRICIUS) LARVICULTURE

K. Venkatramalingam, J. Godwin Christopher, T. Citarasu-2007

Aquaculture Nutrition 13 (6): 439–443

Abstract:

Penaeus monodon postlarvae were fed with different percentages (0%, 25%, 50%, 75% and 100%) of the herbal appetizer *Zingiber officinalis* enriched *Artemia*. After 30 days of culture (i.e. PL-1–30), a very positive result was found in *Z. officinalis*-enriched *Artemia*-fed postlarvae. The unenriched *Artemia*-fed postlarvae consumed 91.0 mg/animal/30 days of feed, whereas the *Z. officinalis*-enriched *Artemia* increased their consumption to 127.9 mg/animal/30 days. A similar pattern was noticed in feed absorbed (110.2 mg), dry weight growth (26.7 mg) and feed catabolized (83.2 mg) in *Z. officinalis*-enriched *Artemia* because of enzymatic activities. The conversion efficiency of unenriched postlarva was 17.19%, whereas in 100% *Z. officinalis*-enriched *Artemia*, the maximum conversion efficiency was 20.85%. The net production efficiency increased significantly ($P < 0.05$) to 22% from that of the unenriched *Artemia*-fed postlarvae. The administration of *Z. officinalis* in all levels produced significantly ($P < 0.05$) higher weight gain and specific growth rate. The utilization efficiency of feed increased proportionately to the percentages of *Z. officinalis*. Digestive enzyme activity (amylase, protease and lipase) increased significantly ($P < 0.05$) in the 50%, 75% and 100% enrichment. Among the different percentages of enrichment, the 100% *Z. officinalis*-enriched *Artemia*-fed postlarvae performed better in the overall status.

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OVARIAN MATURATION STAGES OF THE MUD CRAB *SCYLLA SERRATA*

Emilia T Quintio, Jennette de Pedro, Fe Dolores Parado-Esteva -2007

Aquaculture Research 38 (14): 1434–1441

Abstract:

Ovarian maturation in adult wild-sourced and pond-grown *Scylla serrata* (Forsskål) was determined based on gross morphology and histological appearance. There were no significant differences noted in the histological features of both wild and pond-reared *S. serrata* females. Ovarian maturation was classified into five stages: immature, early maturing, late maturing, fully mature and spent. The immature ovaries are thin and translucent to off white and contain oogonia, primary oocytes with large nuclei. The follicle cells were found around the periphery of the lobes and an area among groups of oogonia and oocytes. The follicle cells gradually enclosed the oocytes. The early-maturing ovaries were yellow and small yolk globules started to appear in larger oocytes. In late-maturing ovaries, the colour

became light orange and lobules were apparent. Yolk globules occurred in the cytoplasm with larger globular inclusions towards the periphery, while follicle cells were hardly recognizable. Fully mature ovaries were orange to deep orange and had swollen lobules. Large yolk globules were apparent in the entire cytoplasm. Follicle cells were hardly seen. Spent ovaries were similar to the early-maturing and late-maturing stage in partially spawned females. The ovarian development was correlated closely to the gonadosomatic index, oocyte diameter, and ovarian histology. The classification of ovarian maturation provides baseline information for further studies on reproductive biology. Likewise, the information provides a guide for broodstock management in the hatchery.

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REPRODUCTIVE PERFORMANCE, LIPIDS AND FATTY ACIDS OF MUD CRAB SCYLLA SERRATA (FORSSKÅL) FED DIETARY LIPID LEVELS

Veronica R. Alava, Emilia T. Quintio, Jennette B. de Pedro, Zenith G. A. Orosco, Mathieu Wille-2007

Aquaculture Research 38 (14): 1442–1451

Abstract:

Natural food (NF, control), artificial diets (AD) containing total lipid levels of 10%, 12% and 14% (AD10, AD12 and AD14) and their combinations (AD10+NF, AD12+NF and AD14+NF) were fed for 112 days to pond-sourced eyestalk-ablated mud crab *Scylla serrata* (625±6.4 g) in tanks in order to determine their effects on reproduction and lipid profiles in broodstock tissues and zoeae. Crabs fed NF had the highest number of spawning followed by crabs fed AD10+NF and AD14+NF. Higher offspring production (number of zoeae) was obtained from crabs fed NF and AD+NF than from AD. As dietary total lipid levels increased, total lipid of broodstock ovaries, hepatopancreas, muscle and zoeae correspondingly increased in which AD+NF promoted higher levels than AD. Increased dietary total lipid levels enhanced lipid classes such as triacylglycerols and phosphatidyl choline levels in zoeae, all higher in crabs fed AD+NF than in AD. The major fatty acids in zoeae, particularly 16:0, 18:0, 18:1n-9 and 20:4n-6, 20:5n-3 and 22:6n-3, were higher in crabs fed AD+NF than in AD, the contents corresponding to broodstock dietary total lipid levels. A 10% total lipid in AD in combination with NF was sufficient to provide the essential lipids in crabs in the improvement of larval production and quality.

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SEED PRODUCTION OF CHARYBDIS FERIATUS (LINNAEUS)

Fe D. Parado-Estapa, Emilia T. Quintio, Eduard Rodriguez-2007

Aquaculture Research 38 (14): 1452–1458

Abstract:

Some aspects of the reproductive biology of *Charybdis feriatius* (Linnaeus) were investigated to identify suitable techniques for broodstock management and seed production. Likewise, factors such as ablation, water depth and light requirements affecting survival or reproductive performance were tested. Production of megalops in tanks and juveniles in net cages installed in earthen ponds was conducted. Wild-caught berried females produced a significantly higher number of zoeae per gram body weight (BW) of the female (3300±600) than captive spawners (867±58). Ablated and unablated crabs spawned after a month and ovaries of both had oocytes in all developmental stages after spawning, indicating that ablation was not necessary. Broodstock survived higher when stocked in 1 m-deep water and kept in dark conditions compared with shallow (0.5 m depth) water or ambient lighting. There were six zoea and one megalopa stage. Megalops were produced (survival of 2–22% in 1 tonne or 23–55% in 3 L tanks) when methods for the mud crab *Scylla serrata* (Forsskål) were used, but

feeding with *Artemia* started only at the Z4 stage. Survival of megalops after 1 month was higher when stocked in net cages installed in an earthen pond (32–82%) than when reared continuously in land-based tanks (5–11%).

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BIOCHEMICAL COMPOSITION OF POND-REARED AND LAKE-STOCKED CHINESE MITTEN CRAB *ERIOCHEIR SINENSIS* (H. MILNE-EDWARDS) BROODSTOCK

Xugan Wu, Yongxu Cheng, Liying Sui, Xiaozhen Yang, Tianzuo Nan, Jinqing Wang-2007
Aquaculture Research 38 (14): 1459–1467

Abstract:

The morphological characteristics, tissue indices, proximate and fatty acid compositions of hepatopancreas, gonad and muscle of pond-reared (PR) and lake-stocked (LS) *Eriocheir sinensis* broodstock were compared. Lake-stocked crabs are characterized by a blue carapace, white abdomen, golden legs and yellow setae while PR crabs have a brown carapace, grey abdomen, black legs and similar yellow setae. The carapace length and width of PR crabs were significantly less than those of LS crabs of the same wet weight (WW). The results showed that the hepatosomatic index (HSI) of PR males was significantly higher, but the gonadosomatic index (GSI) was significantly lower for PR females when compared with LS individuals of the same sex. Regardless of their origin, the muscular index (MI) of males was higher than that of females. The hepatopancreas of LS crabs had higher protein levels and lower lipid levels compared with PR crabs. The results of proximate analysis of male gonads from two different sources were similar, while the protein level in the ovary of LS females was higher than that of PR females. The tissues of males had higher water content but lower lipid and protein levels compared with females regardless of their source. The LS crabs had higher highly unsaturated fatty acid (HUFA) levels than PR crabs in their gonad and hepatopancreas. In conclusion, our results suggest that the nutritional quality of LS crabs is better than that of PR crabs, the nutritional quality of males is poorer than that of females. The reproductive performance and larval quality of crabs from these two rearing systems should be further verified.

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LIPIDS AND FATTY ACIDS IN WILD AND POND-REARED MUD CRAB *SCYLLA SERRATA* (FORSSKÅL) DURING OVARIAN MATURATION AND SPAWNING

Veronica R Alava, Emilia T Quintio, Jennete B de Pedro, Flora Mae P Priolo, Zenith Gaye A Orozco, Mathieu Wille-2007

Aquaculture Research 38 (14): 1468–1477

Abstract:

Wild-caught and pond-reared female mud crab *Scylla serrata* at different stages of ovarian maturation were collected from Samar and Capiz, Philippines. Crabs were categorized into five stages according to the external morphological and microscopic appearance of the most advanced oocytes. The ovaries, hepatopancreas, muscle and newly spawned eggs (NSE) were analysed for lipid class components and fatty acids. Total lipid was higher in pond-reared than in wild-caught crabs but increased with ovarian maturation in both groups. Ovarian lipid peaked at the fully mature stage, coinciding with a decline in hepatopancreatic and muscle lipids. Lipid levels declined significantly in spent females. The tissues contained elevated highly unsaturated fatty acids such as arachidonic (20:4n-6), eicosapentaenoic (20:5n-3) and docosahexaenoic (22:6n-3) acids, but at higher levels in late maturing and fully mature ovaries and in NSE. The type of lipid class and fatty acid components in mature ovaries as

well as in NSE are generally considered to be indicative of their importance in reproductive physiology and embryonic and larval development.
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INDUCED OUT-OF-SEASON SPAWNING OF THE MUD CRAB, SCYLLA PARAMAMOSAIN (ESTAMPADOR) AND EFFECTS OF TEMPERATURE ON EMBRYO DEVELOPMENT

Chaoshu Zeng-2007

Abstract:

Treated with combined bilateral eyestalk ablation and maintenance of water temperature at 22.5 ± 1.5 °C, mud crab *Scylla paramamosain* females with mature ovaries were induced to produce eggs outside the natural spawning season in subtropical southern China. Newly extruded eggs from a crab were incubated in vitro at 10, 15, 20, 25, 27, 30, 35 °C, respectively, and the embryonic development was closely monitored. Abnormal cell division was observed at temperatures 10 and 35 °C. At 15 °C, development remained at the gastrula stage by day 32 post-spawn, at which time the experiment was terminated. Hatching of in vitro incubated eggs occurred between 20 and 30 °C. An increase in incubation temperature from 20 to 25 °C reduced the incubation duration by 14 days, 2.6 times of that measured for a similar 5 °C increase from 25 to 30 °C. Embryonic development of *S. paramamosain* was divided into stage 0–10, and the duration of each stage was recorded for each incubation temperature. The information obtained allows accurate prediction of hatching time of female crabs incubated under variable temperatures. Larvae hatched from in vitro incubated eggs were reared to reach first juvenile crab stage and their dry weights were similar to those of larvae hatched naturally.

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INFLUENCE OF BINDER TYPE ON LEACHING RATE AND INGESTION OF MICROBOUND DIETS BY MUD CRAB, SCYLLA SERRATA (FORSSKÅL), LARVAE

Jerome Genodepa, Chaoshu Zeng, Paul C Southgate-2007

Aquaculture Research 38 (14): 1486–1494

Abstract:

Microbound diets (MBD), composed of nutrients held within a matrix or binder, were shown to be readily ingested by larvae of the mud crab, *Scylla serrata* (Forsskål). In an effort to improve experimental MBD developed for *S. serrata* larvae, this study determined the effects of various binders on estimated larval ingestion of MBD as well as their leaching rates. Microbound diets with the same dietary compositions were bound with either agar, alginate, carrageenan, gelatin or zein. All diets contained ¹⁴C-labelled rotifers and were fed to Zoea I, III, V larvae and megalopae. The ¹⁴C content of larvae fed ¹⁴C-labelled MBD for 2 h was used to estimate the relative ingestion rates of MBD. For all larval stages tested, the estimated mean larval ingestion of MBD did not differ significantly between binder types ($P > 0.05$). Determination of the amount of ¹⁴C-labelled nutrient leaching from MBD bound with various binders after 30, 60 and 240 min of immersion showed that for all types of binders, ¹⁴C leaching occurred primarily within the first 30 min of immersion. Zein-bound MBD consistently showed the lowest numerical leaching rate among the five binders tested for all immersion periods examined, and the differences compared with other binders were often significant, particularly after 60 and 240 min of immersion. Larval feeding experiments showed that MBD prepared with binders showing higher rates of leaching were not utilized to a greater degree by *S. serrata* larvae. Furthermore, unnecessary leaching from MBD particles wastes dietary nutrients and is likely to impact on water quality. On this basis, our results

suggest that because of its consistently lower leaching rates, zein is probably a more suitable binder for MBD developed for *S. serrata* larvae.

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ACUTE TOXICITY OF NITRITE TO MUD CRAB *SCYLLA SERRATA* (FORSSKÅL) LARVAE

Mary Lynn Seneriches-Abiera, Fe Parado-Esteva, Guadosa A Gonzales-2007

Aquaculture Research 38 (14): 1495–1499

Abstract:

Early larval stages of mud crab *Scylla serrata* were exposed to different concentrations of nitrite (40, 80 and 160 mg L⁻¹ and a control, without added nitrite) and three salinity levels (25, 30 and 35 g L⁻¹) using a static renewal method. No interactive effect of nitrite and salinity was detected. Estimated LT50 in 96-h toxicity tests decreased in all stages with increasing nitrite concentrations in all salinity levels. The 96-h LC50 values of nitrite-N were 41.58, 63.04, 25.54, 29.98 and 69.93 mg L⁻¹ for zoea 1, 2, 3, 4 and 5 respectively. As the larvae grew, they showed a progressive increase in tolerance to nitrite. The toxicity of nitrite to larvae increased with exposure time. The median lethal concentration was not affected by salinity. The chloride component of salinity within 25–35 g L⁻¹ did not seem to be as effective in alleviating toxicity as has been reported in other crustacean species. Based on 96-h LC50 and an application factor of 0.1, the 'safe level' of rearing mud crab larvae was calculated to be 4.16, 6.30, 2.55, 2.99 and 6.99 mg L⁻¹ nitrite-N for zoea 1, 2, 3, 4 and 5 respectively.

(College of Fisheries, Mindanao State University, General Santos City, Philippines)

ONTOGENY OF FEEDING APPARATUS AND FOREGUT OF MUD CRAB *SCYLLA SERRATA* FORSSKÅL LARVAE

Gill J. Lumasag, Emilia T. Qunitio, Riza O. Aguilar, Rodolfo B. Baldevarona, Crispino A. Saclauso-2007

Aquaculture Research 38 (14): 1500–1511

Abstract:

The development of the feeding apparatus of the mud crab *Scylla serrata* larvae was studied using electron microscopy for mandibles and light microscopy for other paired mouthparts and the foregut. The six paired mouthparts, which consisted of the mandibles, maxillules, maxillae, first maxillipeds, second maxillipeds and third maxillipeds, were dissected from specimens representing each larval stage. The first five paired appendages were already present in newly hatched larvae while third maxillipeds appeared only at the megalopa stage. Mandibles displayed complex incisor and molar processes at early zoeal stages, which became simple in morphology at megalopa. Mandibular palp buds were observed at the zoea 5 stage and these became fully developed as three-segmented mandibular palps at the megalopa stage. Endopods of other paired mouthparts exhibited increased number of setae and size as the individual metamorphosed from zoeal stages to megalopa and crab instar. The foregut appeared as a continuous cavity at zoea 1 where the cardiopyloric valve was indistinct while the filter gland was clearly identifiable. Zoea 2 and succeeding zoeal stages exhibited a setose foregut; the gastric mill and its lateral and median teeth were prominent at zoea 3 stage. The significance of these morphological changes is discussed in terms of its implication in larval feeding management.

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INFLUENCE OF HIGHLY UNSATURATED FATTY ACIDS IN LIVE FOOD ON LARVICULTURE OF MUD CRAB SCYLLA PARAMAMOSAIN (ESTAMPADOR 1949)
Truong Trong Nghia, Mathieu Wille, Stijn Vandendriessche, Quach The Vinh, Patrick Sorgeloos-2007

Aquaculture Research 38 (14): 1512–1528

Abstract:

Two experiments were carried out to investigate the effects of docosahexaenoic acid (DHA), eicosapentaenoic acid (EPA) and arachidonic acid (ARA) levels in rotifers (*Brachionus plicatilis*) and *Artemia* on the survival, development and metamorphosis of mud crab *Scylla paramamosain* larvae. Five different lipid emulsions, varying in the level of total n-3 and n-6 highly unsaturated fatty acids (HUFA), DHA, EPA and ARA were used to manipulate the fatty acid profile of the live food. Fatty acid profiles of the live food and crab larvae at zoea one, three and five stages were analysed to study the HUFA uptake by the larvae. The fatty acid content of the live food affected the fatty acid profiles of the crab larvae. In both experiments, the survival rate in the zoeal stages was not statistically different among treatments. However, larval development rate and metamorphosis success were affected by the dietary treatments. In this respect, the DHA/EPA ratio in the live food seems to be a key factor. Enrichment emulsions with a very high (50%) total HUFA content but a low DHA/EPA ratio (0.6), or zero total HUFA content caused developmental retardation and/or metamorphosis failure. An emulsion with a moderate total HUFA (30%) and a high DHA/EPA ratio (4) was the best in terms of larval development during the zoeal stages and resulted in improved metamorphosis. Dietary ARA seemed to improve first metamorphosis, but its exact role needs further clarification. For the larval rearing of *S. paramamosain*, an enrichment medium containing about 30% total n-3 HUFA with a minimum DHA/EPA ratio of 1 is recommended. Further investigation is needed on the total HUFA and optimum DHA/EPA ratio requirements for each crab larval stage.

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EFFECTS OF TEMPERATURE AND SALINITY ON THE SURVIVAL AND DEVELOPMENT OF MUD CRAB, SCYLLA SERRATA (FORSSKÅL), LARVAE

Rahmi Nurdiani, Chaoshu Zeng-2007

Aquaculture Research 38 (14): 1529–1538

Abstract:

The combined effects of temperature and salinity on larval survival and development of the mud crab, *Scylla serrata*, were investigated in the laboratory. Newly hatched larvae were reared under 20 °C temperature and salinity combinations (i.e. combinations of four temperatures 25, 28, 31, 34 °C with five salinities 15, 20, 25, 30, 35 g L⁻¹). The results showed that temperature and salinity as well as the interaction of the two parameters significantly affected the survival of zoeal larvae. Salinity at 15 g L⁻¹ resulted in no larval survival to the first crab stage, suggesting that the lower salinity tolerance limit for mud crab larvae lies somewhere between salinity 15 and 20 g L⁻¹. However, within the salinity range of 20–35 g L⁻¹, no significant effects on survival of zoeal larvae were detected ($P > 0.05$). The combined effects of temperature and salinity on larval survival were also evident as at low salinities, both high and low temperature led to mass mortality of newly hatched larvae (e.g. 34 °C/15 g L⁻¹, 34 °C/20 g L⁻¹ and 25 °C/15 g L⁻¹ combinations). In contrast, the low temperature and high salinity combination of 25 °C/35 g L⁻¹ resulted in one of the highest survival to the megalopal stage. It was also shown that at optimal 28 °C, larvae could withstand broader salinity conditions. Temperature, salinity and their interaction also significantly affected larval development. At 34 °C, the mean larval development time to megalopa under different salinity conditions ranged from 13.5 to 18.5 days. It increased to between 20.6 and 22.6 days at 25 °C. The effects of salinity on larval development were demonstrated by the fact that for all the temperatures tested, the fastest mean development to megalopa was always recorded at the salinity of 25 g L⁻¹. However, a different trend of

salinity effects was shown for megalopae as their duration consistently increased with an increase in salinity from 20 to 35 g L⁻¹. In summary, *S. serrata* larvae tolerate a broad range of salinity and temperature conditions. Rearing temperature 25–30 °C and salinity 20–35 g L⁻¹ generally result in reasonable survival. However, from an aquaculture point of view, a higher temperature range of 28–30 °C and a salinity range of 20–30 g L⁻¹ are recommended as it shortens the culture cycle.

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IMPROVED TECHNIQUES FOR REARING MUD CRAB *SCYLLA PARAMAMOSAIN* (ESTAMPADOR 1949) LARVAE

Truong Trong Nghia, Mathieu Wille, Tran Cong Binh, Hoang Phuoc Thanh, Nguyen Van Danh, Patrick Sorgeloos-2007

Aquaculture Research 38 (14): 1539–1553

Abstract:

A series of rearing trials in small 1 L cones and large tanks of 30–100 L were carried out to develop optimal rearing techniques for mud crab (*Scylla paramamosain*) larvae. Using water exchange (discontinuous partial water renewal or continuous treatment through biofiltration) and micro-algae (*Chlorella* or *Chaetoceros*) supplementation (daily supplementation at 0.1–0.2 million cells mL⁻¹ or maintenance at 1–2 millions cells mL⁻¹), six different types of rearing systems were tried. The combination of a green-water batch system for early stages and a recirculating system with micro-algae supplementation for later stages resulted in the best overall performance of the crab larvae. No clear effects of crab stocking density (50–200 larvae L⁻¹) and rotifer (30–60 rotifers mL⁻¹) and *Artemia* density (10–20 L⁻¹) were observed. A stocking density of 100–150 zoea 1 (Z1) L⁻¹, combined with rotifer of 30–45 mL⁻¹ for early stages and *Artemia* feeding at 10–15 nauplii mL⁻¹ for Z3–Z5 seemed to produce the best performance of *S. paramamosain* larvae. Optimal rations for crab larvae should, however, be adjusted depending on the species, larval stage, larval status, prey size, rearing system and techniques. A practical feeding schedule could be to increase live food density from 30 to 45 rotifers mL⁻¹ from Z1 to Z2 and increase the number of *Artemia* nauplii mL⁻¹ from 10 to 15 from Z3 to Z5. Bacterial disease remains one of the key factors underlying the high mortality in the zoea stages. Further research to develop safe prophylactic treatments is therefore warranted. Combined with proper live food enrichment techniques, application of these findings has sustained a survival rate from Z1 to crab 1–2 stages in large rearing tanks of 10–15% (maximum 30%).

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FORMALIN AS AN ALTERNATIVE TO TRIFLURALIN AS PROPHYLAXIS AGAINST FUNGAL INFECTION IN MUD CRAB *SCYLLA SERRATA* (FORSSKÅL) LARVAE

Jennette B de Pedro, Emilia T Quinitio, Fe Dolores Parado-Esteba-2007

Aquaculture Research 38 (14) 1554–1562

Abstract:

The toxicity of formalin and trifluralin to the larval stages of the mud crab *Scylla serrata* was compared in a static bioassay. Prophylactic doses of 5, 10, 15, 20 and 25 µg L⁻¹ formalin and 0.05, 0.1, 0.2, 0.4 and 0.8 µg L⁻¹ trifluralin were used. Toxicity was assessed on the basis of survival of larvae after 24, 48, 72 and 96 h exposure to the test chemicals and metamorphosis to the next larval stage. Result shows that larval survival in all stages was significantly reduced at concentrations of 20 and 25 µg L⁻¹ formalin whereas larvae were able to tolerate all trifluralin treatments. However, larvae became more tolerant to high formalin

concentrations as the larval stage progressed. Survival was better at 5, 10 and 15 $\mu\text{g L}^{-1}$ formalin and in all trifluralin treatments than the control in almost all the larval stages. Faster metamorphosis was observed at 5 and 10 $\mu\text{g L}^{-1}$ formalin and 0.05, 0.1 and 0.2 $\mu\text{g L}^{-1}$ trifluralin concentrations. Doses of formalin and trifluralin obtained from the toxicity experiments were applied as prophylaxis to newly hatched larvae in white plastic basins. Prophylactic doses of 5 and 10 $\mu\text{g L}^{-1}$ formalin and 0.05 and 0.1 $\mu\text{g L}^{-1}$ trifluralin applied every other day were found to be effective in enhancing survival and larval development to megalopa compared with control. However, no megalopae survived to crab instar in all formalin treatments. Although the use of fungicides in rearing systems resulted in higher survival compared with controls, other strategies (i.e. maintenance of good water quality and hygienic practices in the hatchery) should be further investigated as an alternative to the use of chemicals in hatcheries.

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DEVELOPMENT OF NURSERY CULTURE TECHNIQUES FOR THE MUD CRAB SCYLLA PARAMAMOSAIN (ESTAMPADOR)

Vu Ngoc Ut, Lewis Le Vay, Truong Trong Nghia, Tran Thi Hong Hanh-2007

Aquaculture Research 38 (14) 1563–1568

Abstract:

Cannibalism is one of the main causes of mortality in the culture of the mud crab *Scylla paramamosain*, particularly in the early post-larval and juvenile stages when the densities of hatchery-reared crabs may be very high before stocking into ponds or release into the wild for stock enhancement. In a series of experiments investigating cannibalism mitigation, the influence of stocking density, the effectiveness of sand substrate, brick and shell shelters and feed type were compared in culture of crabs from instar 1 for short nursery periods of 15–30 days. Inclusion of brick and shell shelters significantly increased survival over sand substrate alone. However, inclusion of shelters did not affect growth rates. In scaled-up nursery production in lined-ponds, with shelters, live *Artemia* biomass and fresh chopped shrimp or tilapia were found to be equally effective feeds for juvenile crabs stocked at a density of 70 m^{-2} from instar 1 and grown for 30 days [52–66% survival, 21.6–24.6 mm carapace width (CW)]. In an extended nursery period for a further 30 days, crabs of 22 mm CW, stocked at 30 m^{-2} in the same ponds, attained a final size of 34.5–36.2 mm CW with a survival of 64.3–67.0% using the same feeds.

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COMPARATIVE PERFORMANCE OF HATCHERY-REARED AND WILD SCYLLA PARAMAMOSAIN (ESTAMPADOR, 1949) IN POND CULTURE

Vu Ngoc Ut, Lewis Le Vay, Truong Trong Nghia, Mark Walton-2007

Aquaculture Research 38 (14): 1593–1599

Abstract:

The performance of hatchery-reared juveniles either in aquaculture grow-out systems or stock enhancement is likely to be dependent on a range of factors during the hatchery phase of production. With recent progress in the development of hatchery systems for the mud crabs *Scylla* spp., there is growing interest in evaluation of the quality of hatchery-reared juveniles relative to wild seed crabs as currently used in aquaculture. Hatchery-reared and wild-collected *Scylla paramamosain* juveniles were stocked either together in ponds or separately. All crabs were tagged with microwire-coded tags, so that origin could be determined in the mixed groups. Preliminary validation demonstrated that tagging did not affect survival or growth, with a tag retention of 94%. After 106 days of culture, there was no significant difference in survival at harvest between the two sources of crabs. The wild juvenile crabs

had a significantly higher initial weight:carapace width (CW) ratio compared with those from the hatchery, indicating a difference in condition. However, where crabs were stocked separately, the hatchery-reared animals exhibited significantly faster growth than those collected from the wild, both in terms of specific growth rate and CW increase per month. However, in the mixed ponds, where there was competition with wild crabs, there was no significant difference in growth rate between crabs from the two sources. Overall, the results demonstrate that the growth performance of hatchery-reared *S. paramamosain* can at least equal that of wild-collected seed crabs in ponds culture.

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SHORT COMMUNICATION

ENHANCEMENT OF WHITE SPOT SYNDROME VIRUS LOAD IN HATCHERY-REARED MUD CRAB *SCYLLA SERRATA* (FORSSKÅL, 1775) JUVENILES AT A LOW TEMPERATURE

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Aquaculture Research 38 (14): 1600–1603

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