
AGE: AGE GENETIC CORRELATIONS FOR WEIGHT OF PENAEUS MONODON REARED IN BROODSTOCK TANK SYSTEMS

Gregory John Coman, Stuart John Arnold, Andrew Thomas Wood, Peter Denis Kube-2010

Aquaculture 307(1-2): 1-5

Abstract:

Fourth generation domesticated *Penaeus monodon* stocks from 21 experimental families were reared in controlled-temperature, sand-based tank systems from tagging age (approximately 16 weeks from nauplii) for 28 weeks. Weights of individual shrimp were measured at tank stocking (i.e. nominally 16 weeks) and at fixed intervals after this date, corresponding to nominal ages of 24 weeks, 32 weeks and 44 weeks. Due to low numbers at tank stocking and poor survivals, two of the families were excluded from subsequent analyses leaving 19 families for genetic evaluation. Averaged (mean \pm SD) for shrimp from 19 families, weights of shrimp at week 24, which is a typical age at which shrimp would be 'harvested' from commercial ponds and sold at market, was 19.7 ± 7.7 g for females and 17.1 ± 5.8 g for males. At the final measure at week 44 females averaged 80.2 ± 18.8 g and males 51.8 ± 9.0 g. Growth was highly variable between families with mean observed female and male growth rates over the whole experiment of 2.17 and 1.32 g week⁻¹ for the lightest family and 3.20 and 2.10 g week⁻¹ for the heaviest family. Heritabilities for weight at weeks 24, 32 and 44 were moderate, ranging from 0.23 to 0.39. The genetic correlation between weight at weeks 16 and 24 was 0.63 ± 0.19 ; and correlations between week 16 and later measures were low (0.05 to -0.15). The genetic correlation between weight at weeks 24 and 32 was 0.62 ± 0.19 , and the correlation between weeks 24 and 44 was low at 0.38 ± 0.26 . The genetic correlation between weight at weeks 32 and 44 were high with low standard errors (0.95 ± 0.04). As a moderate correlation with week 24 weight was found at week 32, and as potential early life rearing effects likely dissipate with increasing age, our results suggest that week 32 is likely the most appropriate alternative age, of those evaluated, at which to select to increase harvest weight.

(CSIRO Food Futures National Research Flagship, Australia; email of Gregory John Coman: Greg.Coman@csiro.au)

HATCHERY METHODS AND NATURAL, HORMONE-IMPLANT-INDUCED, AND SYNCHRONIZED SPAWNING OF CAPTIVE ATLANTIC CROAKER (MICROPOGONIAS UNDULATUS) LINNAEUS 1766

Todd D. Sink, Richard J. Strange, Rebecca T. Lochmann-2010

Aquaculture 307(1-2): 35-43

Abstract:

The Atlantic croaker *Micropogonias undulatus* Linnaeus 1766 is a candidate for multiple purpose aquaculture production including use as a baitfish and foodfish. Controlled production of Atlantic croaker could alleviate seasonal availability, establish a steady supply, provide size-specific grades of bait, alleviate pressure on wild stocks, diversify aquaculture businesses, and contribute to foodfish sales. To achieve these potential benefits, development of commercial-scale spawning protocols must occur. Therefore, a study was conducted to determine: 1) if Atlantic croaker could be passively spawned in a captive environment; 2) if hormone implants could be used to actively spawn Atlantic croaker or improve fecundity; 3) if environmental control and hormone implants could be used to synchronize spawning of Atlantic croaker. Wild broodfish (mean \pm SE; 329 ± 11 g; 28.7 ± 0.3 cm TL) were captured from Trinity Bay, Texas, pellet trained, and held under controlled photoperiod and temperature conditions. The treatments used were: 1) natural spawning (no hormone treatments); 2) pre-optimal temperature hormone implant (implant injected at 25 °C; 75 μ g salmon gonadotropin-releasing hormone analogue; sGnRH α); 3) optimal temperature hormone implant (implant injected at 23 °C; 75 μ g sGnRH α); or 4) post-optimal temperature hormone implant (implant injected at 21 °C; 75 μ g sGnRH α). The total production from all treatments (N = 36 females; 24 males) included 30 total spawning events during the 120 day study, which yielded 2,922,510 eggs (3064 mL eggs). The mean water temperature and photoperiod at time of spawning were 19.9 °C and 10.1 h of daylight, respectively. The post-

optimal implant treatment resulted in a greater number of spawning events per tank (5.0 ± 0.0), the shortest period of latency (3 ± 0 days), larger volume of eggs-spawning event (170 ± 40 mL), greater quantity of eggs-spawning event ($160,203 \pm 37,943$), and greater fertilization rate ($51.9 \pm 5.6\%$) than the other hormone implant treatments. The fish allowed to spawn naturally or in the post-optimal treatment often produced similar results, but fish in the post-optimal treatment produced more spawns per tank (5.0 ± 0.0 compared to 1.7 ± 0.3), had greater fecundity ($267,004 \pm 33,191$ eggs·female compared to $49,090 \pm 22,061$ eggs·female), and spawning was highly synchronized (5 days compared to 33 days). The results of this study demonstrate that Atlantic croaker can be spawned passively in a captive environment, but hormone implants used to actively induce spawning can improve fecundity and synchronize spawning for commercial production.

(Department of Aquaculture and Fisheries, University of Arkansas at Pine Bluff, Pine Bluff, Arkansas 71601, USA; email of Todd D. Sink: tsink@uaex.edu)

SPERMATOPHORE QUALITY OF THE PINK SHRIMP FARFANTEPENAEUS PAULENSIS (DECAPODA, DENDROBRANCHIATA) BROODSTOCK FED WITH DIFFERENT MATURATION DIETS

André L. Braga, Cintia L. Nakayama, Juscilaine G. Martins, Elton P. Colares, Wilson Wasielesky Jr.-2010

Aquaculture 307(1-2): 44-48

Abstract:

The objective of the present work was to evaluate the effects of different diets on spermatophore quality and tissue biochemical composition in male pink shrimp *Farfantepenaeus paulensis*. The experiment was carried out with the three following treatments: fresh food, commercial diet and a mix of fresh food and commercial diet. Spermatophore quality was evaluated by spermatophore weight, sperm count, melanization and spermatophore absence rates. Biochemical analyses of glucose, triacylglycerides and protein were completed for hemolymph, hepatopancreas and muscle. Spermatophore weight and sperm count were not significantly different among treatments ($P > 0.05$). At the end of the experiment, shrimp fed only with commercial diet showed highest melanization rate and spermatophore absence, 42.85% and 42.85%, respectively. To shrimp fed only with fresh food the values melanization and spermatophore absence were 15.38% and 0%, respectively and the mix 12.51% and 37.50%, respectively. Hemolymph glucose concentration was significantly higher in commercial diet treatment (31.19 mg/dL) than fresh food (12.24 mg/dL) and mix treatments (10.97 mg/dL). *Farfantepenaeus paulensis* broodstocks fed only the commercial diet may present decrease spermatophore quality.

(Marine Station of Aquaculture, Oceanography Institute, Federal University of Rio Grande, C.P. 474, Rio Grande (RS), 96 201-900, Brazil; email: manow@mikrus.com.br)

LIPID DYNAMICS DURING EARLY DEVELOPMENT OF HIPPOCAMPUS GUTTULATUS SEAHORSES: SEARCHING FOR CLUES ON FATTY ACID REQUIREMENTS

Filipa Faleiro, Luís Narciso-2010

Aquaculture 307(1-2): 56-64

Abstract:

The biochemical composition of eggs and the nutrient dynamics during early ontogeny can provide better understanding on the nutritional requirements of both broodstock and first-feeding fish, thus constituting a valuable tool for improvement of aquaculture procedures. This study constitutes the first record of lipid composition and fatty acid dynamics during early development of seahorses. Lipid content and fatty acid profile were determined for *Hippocampus guttulatus* eggs and newborn juveniles, and their patterns of consumption were analyzed during embryonic development. *H. guttulatus* produced small broods (426 ± 128 juveniles) but invested in the production of large eggs (2.44 ± 0.37 mm) that resulted in large fingerlings (15.53 ± 1.28 mm), which may have a high survival capacity. The total lipid content of seahorse eggs (17.6% DW) was within the typical range of marine fish eggs. Eggs were dominated by PUFA (43.9%), mainly by HUFA (17.4% of DHA and 13.2% of EPA), and showed a lower MUFA content (22.5%). Extremely low AA levels (0.6%) and particularly high EPA concentrations resulted in a low DHA:EPA ratio (1.3) and high EPA:AA (22.3) and β -m-6 (12.2)

ratios. Fatty acid consumption during embryonic development was considerably high (67.8%), reflecting the high requirements of seahorse embryos. Fatty acids were depleted at different rates, with PUFA being preferentially consumed (75.2%), while SFA were selectively retained (59.2%). PUFA constituted the major source of metabolic energy and the fatty acids 16:0, EPA and DHA were the main fatty acids to fulfill the energetic demands of seahorse embryos. Essential fatty acids (AA, EPA and DHA) were not preferentially retained, with EPA being catabolized at a particularly high rate (88.0%). These patterns of embryonic consumption resulted in newborn juveniles with an exceptionally low lipid content (5.0% DW), a predominance of SFA (41.0%) and extremely low EPA levels (5.0%). Fatty acid composition of *H. guttulatus* eggs and juveniles provided important clues to determine seahorse requirements, so that suitable feeding protocols could be developed. The use of broodstock and juvenile diets that reflect the lipid profile of eggs will allow the accomplishment of nutritional requirements and improvement of seahorse production.

(Centro de Oceanografia, Laboratório Marítimo da Guia, Faculdade de Ciências da Universidade de Lisboa, Avenida Nossa Senhora do Cabo 939, 2750-374 Cascais, Portugal ; email of Filipa Faleiro:

filipafaleiro@gmail.com)

EFFECTS OF DIETARY ARACHIDONIC ACID ON GROWTH PERFORMANCE, SURVIVAL, IMMUNE RESPONSE AND TISSUE FATTY ACID COMPOSITION OF JUVENILE JAPANESE SEABASS, *LATEOLABRAX JAPONICUS*

Houguo Xu, Qinghui Ai, Kangsen Mai, Wei Xu, Jun Wang, Hongming Ma, Wenbing Zhang, Xiaojie Wang, Zhiguo Liufu-2010

Aquaculture 307(1-2): 75-82

Abstract:

A 12-week feeding experiment was conducted to investigate the effects of dietary arachidonic acid (ARA) on growth, survival, immune response and tissue fatty acid composition of juvenile Japanese seabass (*Lateolabrax japonicus*) (mean initial weight 9.48 ± 0.09 g) in seawater floating net cages ($1.5 \times 1.5 \times 2.0$ m). An ARA-enriched oil was supplemented into the basal diet to formulate six isonitrogenous and isoenergetic practical diets containing 0.08% (the control group), 0.22%, 0.36%, 0.56%, 1.33% and 2.12% ARA of dry weight, respectively. All diets had the same total n-3 long chain polyunsaturated fatty acid (LC-PUFA) level and 22:6n-3/20:5n-3 ratio. Triplicate groups of 30 fish were fed to apparent satiation twice daily for 12 weeks. The water temperature ranged from 22.5 to 31.5 °C, the salinity from 28‰ to 33‰ and the dissolved oxygen content was approximately 6 mg l^{-1} during the experimental period. The results showed that final weight (FW) and specific growth rate (SGR) significantly increased with increasing dietary ARA from 0.08% to 0.36% ($P < 0.01$) and thereafter declined. The feed efficiency ratio (FER) had the similar pattern with SGR, and fish fed the diet with 0.36% ARA showed significantly higher FER than the control ($P < 0.05$). No significant differences were found in survival rate among dietary treatments ($P > 0.05$). The hepatosomatic index (HSI) decreased significantly with the increase of dietary ARA, and HSI in fish fed the diets with more than 0.22% ARA content were significantly lower than the control group ($P < 0.01$). The serum lysozyme (LYZ), alternative complement pathway (ACP) and superoxide dismutase (SOD) activity were significantly enhanced by the supplementation of ARA, especially in moderate supplementation (0.36–0.56%). However, there were no differences in both respiratory burst activity of head kidney macrophage and serum catalase (CAT) activity among dietary treatments. The body composition analysis showed that whole-body protein first increased, then decreased with increasing dietary ARA, while whole-body lipid content followed the opposite pattern. The fatty acid composition of whole body and liver reflected closely those of the diets, while liver EPA levels were inversely related to dietary ARA. These results suggested that dietary ARA, especially moderate ARA level (0.22–0.56% d.w.), significantly enhanced growth and immune response and modified the chemical composition of whole body and liver of Japanese seabass juvenile.

(The Key Laboratory of Mariculture (Ministry Education of China), Ocean University of China, 5 Yushan Road, Qingdao, Shandong 266003, PR China; email of Qinghui Ai: qhahai@ouc.edu.cn)

PEDIOCOCCUS ACIDILACTICI IN THE CULTURE OF TURBOT (*PSETTA MAXIMA*) LARVAE: ADMINISTRATION PATHWAYS

Luisa Villamila, Antonio Figueras, Miguel Planas, Beatriz Novoa-2010

Aquaculture 307(1-2): 83-88

Abstract:

Probiotic administration to marine fish larvae and live prey has been shown to be a useful means to prevent bacterial infection and mass mortalities. Here, several experiments were carried out in order to determine the optimum protocol for *Pediococcus acidilactici* delivery to the turbot (*Psetta maxima*) gastrointestinal tract by its administration via rotifers supplemented for 1 or 24 h with the bacteria or directly via the water. The survival capacity of *P. acidilactici* in sterile seawater, in microalgae (*Isochrysis galbana*) culture and in rotifers (*Brachionus plicatilis*) was determined, with best results in rotifer culture.

The incorporation of *P. acidilactici* into the rotifer's gut was time-dependant, with *P. acidilactici* recovery from rotifer cultures supplemented with the lactic acid bacteria suspension for 24 h being significantly lower than from cultures supplemented for 1 h. Similarly, *P. acidilactici* recovery from the gastrointestinal tract of turbot larvae was higher when larvae were fed with 1-h supplemented rotifer cultures. However, significantly higher *P. acidilactici* recovery from turbot larvae gastrointestinal tract was observed when the probiotic was directly administered in the rearing water.

Lastly, the bactericidal activity of the extracellular products (ECPs) of *P. acidilactici* against a pathogenic bacterium for turbot, *Vibrio splendidus* (Hm 112) was assessed. The ECPs of *P. acidilactici* significantly inhibited the growth of the pathogenic bacteria in vitro. However, during in vivo experiments, the bacterial community, dominated mainly by *Vibrio* and *Pseudomonas*, was not apparently affected by *P. acidilactici* supplementation in rotifers or turbot larvae.

(Universidad Jorge Tadeo Lozano, Programa de Biología Marina, Carrera 2#11-62, Edificio Mundo Marino, El Rodadero, Santa Marta, Colombia ; email of Luisa Villamila: luisa.villamil@utadeo.edu.co)

DEVELOPMENT OF FORMULATED DIET FOR POST-LARVAL ABALONE, *HALIOTIS DIVERSICOLOR SUPERTEXTA*

Wen-Rong Chao, Chi-Yang Huang, Shyn-Shin Sheen-2010

Aquaculture 307(1-2): 89-94

Abstract:

This study examined the effects of formulated diets with/without emulsified fish oil on the survival and growth of post-larval *Haliotis diversicolor supertexta*. Agar was used as a binding agent and served as a carbohydrate source to make formulated diets. Post-larval abalone were settled on plastic plates and cultured in fiberglass reinforced plastics (FRP) tanks treated with 0.2 ppm ozone. Two experimental conditions, one with shading (90% light shading) and the other without shading were provided. The post-larval abalone were fed with (a) natural diatom biofilm (without diet supplementation), (b) formulated diet containing only agar, (c) formulated diet containing agar and *Chlorella* powder and (d) formulated diets containing 0.5, 1.0 or 2.0% emulsified fish oil and agar. Experimental duration was 35 days and survival, growth rate, daily growth rate, the amount of bacteria and attached diatoms were identified every 7 days. In the shading condition, post-larval abalone fed a formulated diet supplemented with 0.5% emulsified fish oil and a diet supplemented with *Chlorella* powder had a significantly higher daily growth rate than those fed other diets. Their daily growth rate in shell length was 78.5 $\mu\text{m}/\text{day}$ and 77.5 $\mu\text{m}/\text{day}$, respectively. Post-larval abalone fed the diet with 0.5% emulsified fish oil had a significantly higher survival (35.1%) than those fed diets supplemented with only agar, *Chlorella* powder or natural diatom biofilm. For the treatment groups without shading, post-larval abalone fed a diet with 2% emulsified fish oil had significantly higher final size (3708 μm) and daily growth rate (98.8 $\mu\text{m}/\text{day}$ shell length) than those fed diets supplemented with only agar or natural diatom biofilm.

(Department of Aquaculture, National Taiwan Ocean University, Keelung, 202, Taiwan; email of Shyn-Shin Sheen: shin@mail.ntou.edu.tw)

DEVELOPMENT AND GROWTH OF THE EARLY JUVENILES OF THE SPIDER CRAB MAJA SQUINADO (BRACHYURA: MAJOIDEA) IN AN INDIVIDUAL CULTURE SYSTEM

Guillermo Guerao, Guiomar Rotllant-2010

Aquaculture 307(1-2): 105-110

Abstract:

The spider crab *Maja squinado* is an endangered Mediterranean species; therefore, culturing it successfully is essential for developing restocking programs. The survival, growth and development of post-larval stages (juvenile crabs, C1–C8) were studied using larvae obtained from adult individuals collected in the Catalan Sea. The juvenile crab stages were cultured individually from a megalopal stage using a semi-open recirculation system to obtain the precise growth data of each juvenile crab stage until C8. Development up to C8 at 20 °C lasted 154 ± 10 days. Survival from C1 to C8 was 5.8%. Moulting increment values in cephalothoracic length were similar in all the crab stages (21–35%). Intermoult duration (9 ± 1 in C1–C2 to 51 ± 8 days in C7–C8) increased sharply from juvenile stage 5. Males and females can be distinguished from C4 based on sexual dimorphism in the pleopods and the presence of gonopores. The allometric growth of the pleon is sex-dependent from C4, with females showing positive allometry and males isometric growth. The juvenile growth rate was lower compared with that of the previously studied Atlantic species *Maja brachydactyla*.

(IRTA, Unitat de Cultius Experimentals, Ctra. Poble Nou, Km 5.5, 43540 Sant Carles de la Ràpita, Tarragona, Spain ; email of Guillermo Guerao : guillermo.guerao@irta.cat)

ANTIOXIDANT DEFENCES IN THE FIRST LIFE PHASES OF THE STURGEON ACIPENSER NACCARI

M. Elena Díaz, Miriam Furné, Cristina E. Trenzado, Manuel García-Gallego, Alberto Domezain, Ana Sanz-2010

Aquaculture 307(1-2): 123-129

Abstract:

A study has been made of the activity of the antioxidant enzymes superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPX), and glutathione reductase (GR), as well as of lipid peroxidation and of glutathione, during the first stages of ontogenic development of the sturgeon *Acipenser naccarii*: the embryo within the egg, the free embryo (with vitellin reserves), and the juvenile. Also, the same determinations were made in *Artemia nauplii* to determine the possible influence of the presence of live food in the quantification of the antioxidant-enzyme pool of the sturgeon. Activity was found for the antioxidant enzymes SOD, CAT, and GPX in all the stages of ontogenic development corresponding to the first month of life of the sturgeon *A. naccarii*. Notable activity of these enzymes was found during the embryonic phase. On the contrary, the GR activity was not detected in this phase, coinciding with a greater proportion of oxidized glutathione. In the sturgeon *A. naccarii*, after the embryo phase of free life, the activity of all the antioxidant enzymes tended to increase with age as did the glutathione levels. The results are compared with those previously determined in the different organs of the adult. The marked activity of the antioxidant enzymes found in the sturgeon *A. naccarii* during the first month of life provides the sturgeon effective protection against oxidative damage.

(Dp. Biología Animal, Facultad de Ciencias, Universidad de Granada, Campus Fuentenueva, 18071 Granada, Spain; email of Ana Sanz: anasanz@ugr.es)

A COMPARATIVE STUDY ON ANTIOXIDANT SYSTEMS IN SEMEN OF SPECIES OF THE PERCIDAE, SALMONIDAE, CYPRINIDAE, AND LOTIDAE FOR IMPROVING SEMEN STORAGE TECHNIQUES

Franz Lahnsteiner, Nabil Mansour-2010

Aquaculture 307(1-2): 130-140

Abstract:

The present study investigated the antioxidant systems in semen of different teleost fish species (burbot — *Lota lota*, perch — *Perca fluviatilis*, bleak — *Alburnus alburnus*, brown trout — *Salmo trutta*) with

the intention to define types and effective concentrations of antioxidants suitable for supplementation of sperm storage solutions and cryopreservation extenders.

Biochemical analysis revealed that in semen of *L. lota*, *P. fluviatilis*, *A. alburnus*, and *S. trutta* antioxidants (ascorbic acid, carnitine, glutathione, methionine, tocopherol, and uric acid) and oxidant defensive enzymes (catalase, glutathione reductase, peroxidase, and superoxide dismutase) occurred in an almost similar qualitative and quantitative pattern whereby uric acid concentrations and superoxide dismutase activities were high while activities/concentrations of other enzymes and metabolites were low and/or fluctuating. Species-specific differences existed in the occurrence of catalase and carnitine.

Important antioxidants and oxidant defensive enzymes were tested on their sperm protective effect in *in vitro* experiments. Spermatozoa were incubated in sperm motility-inhibiting saline solutions containing the antioxidants or enzymes and thereafter motility was activated with distilled water and measured and membrane integrity and sperm lipid peroxidation were determined. The experiments demonstrated that uric acid is the major antioxidant of semen of the investigated species, as it improves the sperm motility and membrane integrity and decreases the sperm lipid peroxidation. Therefore, supplementation of sperm diluents with uric acid can be recommended to increase the quality of semen whereby the effective concentration was 0.5 mmol/l for all investigated species. Also methionine has importance as antioxidant in teleost fish semen whereby the oxidized form (methionine sulfoxide) was most effective to increase sperm motility and membrane integrity. The effective concentration was 1.5–3 mmol/l. Finally, catalase improved sperm motility and membrane integrity in all species with exception of *A. alburnus* and therefore it can be useful to protect spermatozoa from reactive oxygen species, too. The optimal activity was 2 kU/l for *P. fluviatilis* and *L. lota*, and 0.1 kU/l for *S. trutta*.

(Department of Organismic Biology, University of Salzburg, Hellbrunnerstr. 34, A-5020 Salzburg, Austria; email of Franz Lahnsteiner : Franz.Lahnsteiner@sbg.ac.at)

COMPARATIVE STUDY ON THERMOTOLERANCE OF ARTEMIA RESTING EGGS FROM QINGHAI–XIZANG PLATEAU, CHINA

Su-Feng Wang, Shi-Chun Sun, Robert K. Okazaki-2010

Aquaculture 307(1-2): 141-149

Abstract:

Artemia resting eggs are well-known to be extremely tolerant to harsh conditions. However, eggs from some hypersaline waters in Qinghai–Xizang Plateau (Q-XP) have recently been reported to be very sensitive to high temperatures. Thus, the thermotolerant capacity of Artemia eggs from four hypersaline waters [(Gai Hai (GH), Aqqikkol Hu (AQK), Xizang (XZ), Jingyu Hu (JYH)] in Q-XP were studied by comparing their structure, biochemical composition and physiology. Thermotolerance was markedly different among eggs of the four sites. GH eggs were found to be more thermotolerant than AQK eggs. Both eggs were much more tolerant than those from JYH and XZ. Water content had significant effect on heat resistance of “dry” eggs. Rate of water loss of GH eggs was markedly slower than that of AQK eggs; the latter slower than XZ and JYH eggs. The water loss from inner embryo (and the first embryonic cuticle) appeared not to be related to the nature of the tertiary envelope. Volatile factor(s) releasing from (or/and entering into) the eggs might play crucial role on the viability of encysted embryos under thermal stress. The thermotolerant capacity of Artemia eggs is likely to be negatively related to the permeability of egg shell/underlying membranes. The hypoplastic outer cuticular membrane (OCM) found in some eggs from Q-XP might be responsible for their thermal sensitivity.

(Marine Culture Research Laboratory, Ocean University of China, 5 Yushan Road, Qingdao 266003, China; email of Shi-Chun Sun: sunsc@ouc.edu.cn)

EFFECTS OF SALINITY ON REPRODUCTION AND SURVIVAL OF THE CALANOID COPEPOD PSEUDODIAPTOMUS PELAGICUS

Cortney L. Ohs, Andrew L. Rhyne, Scott W. Grabe, Matthew A. DiMaggio, Erik Stenn-2010

Aquaculture 307(3-4) : 219-224

Abstract:

Four experiments were conducted on the calanoid copepod, *Pseudodiaptomus pelagicus*, to determine the effects of salinity on survival, development time, reproductive output, and population growth in

order to define the optimal salinity for culture. To determine the appropriate experimental salinity range we exposed nauplii and adults to abrupt salinity changes from 35 g/L to 5, 10, 15, 35, 42, and 48 g/L at 30 °C and determined survival after 24 hours. The second experiment stocked early stage nauplii into 1 L beakers after which they were cultured using standard procedures for 10 days at six salinities (10, 15, 20, 25, 30, 35 g/L); from this survival, sex ratio, time to maturation, and fecundity were measured. The third experiment evaluated the effects of salinity on brood size, brood interval, and nauplii production by stocking individual adult pairs and monitoring nauplii production daily for 10 days. The fourth experiment determined the effects of salinity on population growth and composition of the population produced by stocking 10 adult pairs and culturing them until five days after the first mature adults were observed. Results from the abrupt salinity change experiment showed nauplii survival decreased following abrupt changes in salinity from 35 g/L to < 15 g/L and > 35 g/L. Additionally, adults do not tolerate rapid changes in salinity from 35 g/L to < 15 g/L but are rather tolerant of changes in salinity up to 48 g/L. Survival from early nauplii to adult was not significantly affected by salinity but survival declined at 35 g/L. Time to first maturation and maturation of the entire population was significantly influenced by salinity and took from 6.3 to 9.5 days. In the individual paired adults experiment, salinity significantly affected nauplii production by affecting brood interval and brood size. The percentage of ovigerous females peaked at 20 g/L and declined at salinities above and below this value. When developing production objectives, aquaculturists must consider salinity because of its numerous effects on the culture of *P. pelagicus*. The optimal salinity range to achieve high survival and the greatest nauplii production is 15–25 g/L.

(University of Florida, Institute of Food and Agricultural Sciences, School of Forest Resources and Conservation, Program in Fisheries and Aquatic Sciences, 7922 NW 71st St., Gainesville, FL 32653, United States; email of Cortney L. Ohs: cohs@ufl.edu)

EVALUATION OF DIETARY MICROALGAE FOR CULTURE OF THE CALANOID COPEPOD PSEUDODIAPTOMUS PELAGICUS

Cortney L. Ohs, Kelly L. Chang, Scott W. Grabe, Matthew A. DiMaggio, Erik Stenn-2010

Aquaculture 307(3-4): 225-232

Abstract:

A series of five experiments were conducted to evaluate the effects of various dietary microalgae on survival, reproduction, sex ratio, fecundity, time to first maturation, brood interval, brood size, total nauplii production, and population development of the calanoid copepod *Pseudodiaptomus pelagicus*. Three experiments utilized 10 reproductive pairs of adults cultured in 1 L beakers. In the first experiment, the microalga *Isochrysis galbana* (T-iso) was fed at five densities to determine the optimal density for production. In the second experiment, five microalgae, T-iso, *Thalassiosira weissfloggi* (Tw), *Chaetoceros gracilis* (Ch), *Rhodomonas lens* (Rh), and *Tetraselmis suecica* (Tet), were each fed at a carbon equivalency of 80,000 cells/mL of T-iso. In the third experiment, the same five microalgae were fed along with four mixed microalgae diets, consisting of T-iso/Tw and T-iso/Ch at two ratios, 50:50 and 75:25, all were fed at a carbon equivalency of 160,000 cells/mL of T-iso. The fourth experiment cultured individual pairs in 30 mL beakers to determine the effects of dietary microalgae on nauplii production, brood size, and brood interval. The fifth experiment cultured 100 early stage nauplii (N1–N3) until the population reached sexual maturity. The optimal density of T-iso was 160,000 cells/mL. At 80,000 cells/mL, Tw produced a significantly greater number of copepods than the other microalgal diets. In the 160,000 cells/mL experiment, total production with T-iso/Tw at 50:50 ratio was the highest and was significantly higher than all monoalgal diets except Rh. In general, the total number of copepods produced was greater with mixed algal diets than those attained with the monoalgal diets. Results of the nauplii growout experiment showed that the survival of nauplii to adult was highest with Rh and lowest with T-iso. Time to first maturity was significantly affected by dietary microalgae with T-iso being the slowest. The percentage of ovigerous females was significantly different among dietary microalgae, with T-iso and Ch exhibiting the lowest percentage. *P. pelagicus* can be successfully cultured with various monoalgal diets but results suggest that a mixed algae ration of T-iso and Tw will produce the greatest population growth.

(Program in Fisheries and Aquatic Sciences, School of Forest Resources and Conservation, Institute of Food and Agricultural Sciences, University of Florida, 7922 NW 71st St, Gainesville, FL 32653, United States; email of Cortney L. Ohs: cohs@ufl.edu)

LACK OF ESSENTIAL FATTY ACIDS IN LIVE FEED DURING LARVAL AND POST-LARVAL REARING: EFFECT ON THE PERFORMANCE OF JUVENILE SOLEA SENEGALENSIS

Maria Luísa Dâmaso-Rodrigues, Pedro Pousão-Ferreira, Laura Ribeiro, Joana Coutinho, Narcisa M. Bandarra, Paulo J. Gavaia, Luís Narciso, Sofia Morais-2010

Aquaculture International 18(5): 741-757

Abstract :

Despite the large progress obtained in recent years, Senegalese sole (*Solea senegalensis*) production of high quality juveniles is still a bottleneck. This paper examines the effect of larval and post-larval lipid nutrition on juvenile performance and quality. Four dietary treatments were tested: A—enriched *Artemia* spp. (EA); B—non-enriched *Artemia* spp. (NEA); C—EA during the pelagic larval period and NEA after larval settlement; D—50% EA and 50% NEA. Juvenile fatty acid profile at 60 days after hatching (DAH) clearly reflected the larval and post-larval diet composition. Feeding sole larvae on NEA (poor in lipids and essential fatty acids-EFA) had a negative effect, reducing growth (total length and dry weight) after 30 DAH and decreasing digestive enzyme activity at the end of the rearing period (60 DAH). However, relatively good performance compared to the EFA-richest treatment (A) was obtained when larvae were fed 50% EA and 50% NEA (D) or even EA only during the pelagic larval period followed by NEA after larval settlement (C). Malpigmentation was not affected by the dietary regimes and its incidence was very low. However, skeletal deformities were prevalent, particularly in the caudal complex, independently of diet. The results confirm that Senegalese sole appear to have lower larval EFA requirements than most cultured marine species and potentially even lower requirements during the post-larval stage. The importance of studying the impact of early nutrition on later juvenile stages was clearly highlighted in this study.

(Aquaculture Research Centre, IPIMAR/INRB, Av. 5 Outubro s/n, 8700-305 Olhão, Portugal; email of Maria Luísa Dâmaso-Rodrigues: ldamaso@cripsul.ipimar.pt)

MANAGEMENT STRATEGIES TO REDUCE OPERATING COSTS IN A COMMERCIAL SHRIMP HATCHERY IN NW MEXICO

Ludwig C. A. Naegel-2010

Aquaculture International 18(5) : 759-770

Abstract

Strategies to reduce operating costs at an expanding shrimp hatchery in NW Mexico are presented for a period covering 3 years (2004–2006). The hatchery increased its greenhouse-type larval rearing halls from three (50 tanks, total water volume 996 m³) in 2004, to five (70 tanks, water volume 1,396 m³) in 2005, and to seven (94 tanks, total water volume 1,876 m³) in 2006. Production increased from 400 million postlarvae in 2004 to 579 million in 2005 to 760 million in 2006, but operating costs increased only 6% during this period and the unit cost for postlarvae was 44% lower. Administration expenses were the highest variable cost, but restructuring the company reduced them from 35% in 2004, to 29% in 2005 and to 21% in 2006. Feed was the second largest variable cost, reduced from 44 to 36 to 31 through improved feeding practices, changes in feed composition, and bulk purchases of commercial feeds. Costs for propane and the workforce increased, in part from higher consumption and additional staff and higher salaries to retain the trained workforce. Competition will continue to lower the market price for shrimp postlarvae, forcing hatcheries into a permanent improvement process. Increasing costs for energy will require investments in energy-saving technologies. Improved sanitation and strict bio-security procedures will increase the survival rate, thereby reducing unit costs still further.

(Centro Interdisciplinario de Ciencias Marinas-Instituto Politécnico Nacional (CICIMAR-IPN), Apdo. Postal 592, 23000 La Paz, B.C.S., Mexico ; email of Ludwig C. A. Naegel : naegel@ipn.mx)

SPERM OF FERAL CARP CYPRINUS CARPIO: OPTIMIZATION OF ACTIVATION SOLUTION

Kazem Darvish Bastami, Mohammad Reza Imanpour, Seyed Hossein Hoseinifar-2010
Aquaculture International 18(5): 771-776

Abstract:

The spermatozoa of oviparous fish, such as feral carp (*Cyprinus carpio*), are immotile in the presence of semen plasma or isotonic solutions, and to obtain good motility, they must be diluted with suitable medium. The objective of this study was to identify the best activating solution for feral carp sperm. Sperm motilities were compared in the new activating solution (a): (50 mM NaCl, 30 mM KCl, 30 mM Tris, pH = 8.5) and activating solution (b): (50 mM NaCl, 40 mM KCl, 30 mM Tris, pH = 8.5) based on effect of pH with everyone of Na⁺ and K⁺ ions versus four other activating solutions Billard's saline solution, Poupard's saline solution, distilled water and hatchery water that is routinely used for extending carp semen. Our results showed that maximum total motility period and percentage of motile sperm were seen in selected saline solution (a). The present study describes an activating solution that prolongs feral carp sperm motility.

(Fisheries Faculty, Gorgan University of Agricultural Sciences and Natural Resources, 45165-386 Gorgan, Iran; email of

(2) Department of Fisheries and Environmental Sciences, Faculty of Natural Resource, University of Tehran, 31585-4314 Karaj, Iran; email of Kazem Darvish Bastami: darvish_60@yahoo.com)

ELIMINATION OF ANIMALS WITH BEST GROWTH POTENTIAL AS A POSSIBLE EFFECT OF THE CULLING OF *MERCENARIA MERCENARIA NOTATA* (L.) LARVAE IN HATCHERY PROCEDURE

Chantal Gionet, Elise Mayrand, Thomas Landry-2010

Aquaculture International 18: 801-812

Abstract:

The *Mercenaria mercenaria notata* line was introduced into the Canadian Atlantic provinces in the late 1990s because of its fast growth rate when compared with that of the current native line. The purpose of this study was to compare the development of two groups of *M. mercenaria notata*, according to the initial size of the individuals, in order to check whether the current hatchery practice of keeping only the largest larvae may ultimately eliminate the best performing animals. The larvae were raised and sorted by size according to standard hatchery practices. On the tenth day post-fertilization, the two larval size groups were formed. The "initially smaller" (IS) and the "initially larger" (IL) animals were grown separately. Mortality, shell length and energy reserves were measured for both groups at three stages: veliger, post-settling and juvenile. The observed mortality in the two groups was low varying from 8.1 to 19.6%. The IS animals had a higher shell growth rate (18.2 lm/day) when compared to the IL group (12.7 lm/day) with the result that at the end of the experiment, the IS animals were larger than the IL. In both groups, the lipid and protein concentrations diminished rapidly during the veliger stage but faster in the IL group. The glycogen level remained at the limit of detection for all the three stages. The use of energy reserves followed a different pattern according to the group size. This study indicates that culling would have led us to discard the animals which in fact have the best growth potential in that their rate of shell growth is the highest.

Coastal Zones Research Institute, Inc., 100 rue de l'Aquarium, Shippagan, NB E8S 1H9, Canada; email of C. Gionet: gionetc@umcs.ca)

APPLICATION OF SYNTHETIC HORMONE LHRH-A2 ON THE ARTIFICIAL PROPAGATION OF PERSIAN STURGEON *ACIPENSER PERSICUS*

Rajab Mohammad Nazari, Maryam Modanloo, Mohammad Reza Ghomi, Mahmoud Reza Ovissipor-2010

Aquaculture International: 18: 837-841

Abstract:

For studying the effect of LHRH-A2 hormone on the induction of final maturation and ovulation of Persian sturgeon, 71 matured females and 20 matured males were used. Five groups of breeders were injected with sturgeon pituitary gland hormone (50 mg per fish) and LHRH-A2 in dosages of 3.5, 7, 8 and 10 lg kg⁻¹ for females and 3 and 5 lg kg⁻¹ for males. Results showed that LHRH-A2 successfully

induced final maturation and ovulation in females, and there was no significant difference between five groups of breeders in ovulation proportion, fertilization rate, survival rate of incubation, survival of yolk-sac absorption period and active feeding period of larvae. It can be concluded that the LHRH-A2 is a proper alternative for pituitary gland hormone in artificial propagation of Persian sturgeon.

(Rajaei Sturgeon Fish Farm, P.O. Box 833, Sari, Iran; email of M. R. Ghomi: mghomi@tonekabon.iau.ac.ir)

THE EFFECT OF DARKNESS ON MATING AND PLEOPODAL EGG PRODUCTION TIME IN A FRESHWATER CRAYFISH, *ASTACUS LEPTODACTYLUS* ESCHSCHOLTZ

Muzaffer Mustafa Harlioğlu, Tuba Çakmak Duran-2010

Aquaculture International 18(5): 843-849

Abstract:

In the present study, the effect of darkness on the timing of mating and pleopodal egg production in *Astacus leptodactylus* was investigated. Crayfish were exposed to three different light regimes: natural day light regime (control, mean 10.04-h light/13.96-h dark); 24-h dark (24 h D); 8-h light/16-h dark (8 L:16 D). Experiments were carried out between November 2006 and January 2007 with 36 males and 144 females. The results showed that darkness did not have an effect on the onset of mating and pleopodal egg production in the groups, but it did affect significantly the timing of individual matings; the higher percentage of ovigerous females in the darkness group at the first observation means that on average females under this condition mated and spawned earlier than in the other groups ($P < 0.01$). The percentage of ovigerous females exposed to constant darkness in the first observation in which crayfish started to mate and spawn was 62.50. These figures for those exposed to 16 D:8 L and control were 43.75 and 37.50%, respectively. Therefore, it can be concluded that the reproduction efficiency (i.e., rate of ovigerous females) of *A. leptodactylus* can be enhanced under controlled conditions by exposing broodstock to constant darkness in their mating and spawning season.

(Firat University, 23119 Elazığ, Turkey; email of Muzaffer Mustafa Harlioğlu: mharlioglu@firat.edu.tr)

EFFECT OF STOCKING DENSITY AND JOURNEY LENGTH ON THE WELFARE OF ROHU (*LABEO ROHITA* HAMILTON) FRY

N. Chatterjee, A. K. Pal, T. Das, R. Dalvi, M. S. Mohammad, K. Sarma, S. C. Mukherjee, K. Baruah-2010

Aquaculture International 18(5): 859-868

Abstract :

The effect of higher packing density and increased duration of transport on the survival and key metabolic enzymes of *Labeo rohita* fry was investigated. *L. rohita* fry (length 40 ± 5 mm, weight 0.60 ± 0.13 g) were packed in two different densities 40 and 80 g/l and sampled at 0, 12, 24, and 36 h after packing. Results showed that packing density and length of confinement severely affected the survival of the fry. The whole-body glucose level and the activities of the enzymes, lactate dehydrogenase (LDH), malate dehydrogenase (MDH), glucose-6-phosphatase (G6Pase), fructose-1, 6-bisphosphatase (FBPase), aspartate amino transferase (AST), alanine amino transferase (ALT), and adenosine triphosphatase (ATPase) assayed from the fish whole-body significantly ($P < 0.05$) increased due to increase in the length of the confinement. However, acetylcholine esterase (AChE) activity decreased significantly ($P < 0.05$) with increase in the length of confinement. Similarly, higher packing density also significantly ($P < 0.05$) increased the glucose level and activities of all these enzymes (except AChE). The results revealed that both higher packing density and increased transportation duration mobilize protein resources for glucose production via gluconeogenesis and subsequently activate the glycolysis pathway for energy. The rise in the ATPase activity indicates disruption of the osmoregulatory function and the role of this enzyme in ameliorating it. Overall results suggest that normally practiced packing density of 40 g/l is optimum up to 24-h duration for seed transportation.

(Division of Fish Nutrition and Biochemistry, Central Institute of Fisheries Education, Mumbai, 400061, India; email of K. Baruah: baruahkartik4@rediffmail.com)
