
PARENTAL EFFECTS ON EMBRYONIC VIABILITY AND GROWTH IN ARCTIC CHARR SALVELINUS ALPINUS AT TWO INCUBATION TEMPERATURES

M. Janhunen, J. Piironen, N. Peuhkuri-2010

Journal of Fish Biology 76(10): 2558 – 2570

Abstract:

The parental influences on three progeny traits (survival to eyed-embryo stage, post-hatching body length and yolk-sac volume) of Arctic charr *Salvelinus alpinus* were studied under two thermal conditions (2 and 7° C) using a factorial mating design. The higher temperature resulted in elevated mortality rates and less advanced development at hatching. Survival was mostly attributable to maternal effects at both temperatures, but the variation among families was dependent on egg size only at the low temperature. No additive genetic variation (or pure sire effect) could be observed, whereas the non-additive genetic effects (parental combination) contributed to offspring viability at 2° C. In contrast, any observable genetic variance in survival was lost at 7° C, most likely due to the increased environmental variance. Irrespective of temperature, dam and sire–dam interaction contributed significantly to the phenotypic variation in both larval length and yolk size. A significant proportion of the variation in larval length was also due to the sire effect at 2° C. Maternal effects were mediated partly through egg size, but as a whole, they decreased in importance at the high temperature, enabling a concomitant increase in non-additive genetic effects. For larval length, however, the additive component, like maternal effects, decreased at 7° C. The present results suggest that an exposure to thermal stress during incubation can modify the genetic architecture of early developmental traits in *S. alpinus* and presumably constrain their short-term adaptive potential and evolvability by increasing the amount of environmentally induced variation.

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EXOCRINE PANCREAS DEVELOPMENT AND TRYPSIN EXPRESSION IN CULTURED EUROPEAN SEA BASS (DICENTRARCHUS LABRAX) LARVAE

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Turkish Journal of Fisheries and Aquatic Sciences 10: 123-130 (2010)

Abstract:

The ontogenesis and formation stages of exocrine pancreas in European sea bass (*D. labrax*) larvae were investigated from hatching to 40 days after hatching (DAH). Histological and enzymatical techniques were used to explain the functional development of the pancreas in *D. labrax* with the expression of trypsinogen activity. The incipient pancreas appeared as a lamination of the dorsal wall of the digestive tract. It was observed that the primary visible indication of exocrine cell differentiation was polarization. The first zymogen granules and pancreas with exocrine polyhedral cells appeared on 6 DAH and became abundant as a compact structure located dorsal and slightly posterior to the liver. At the same time, firstly, anus and then mouth were opened, and total lengths of larvae were determined as 3.47±0.26 mm. Until larval metamorphosis, the pancreas became diffuse, spreading throughout the mesentery enclosure, the stomach, the upper intestine and the pyloric caeca. On the other hand, zymogen granules were more numerous and larger, and a greater quantity of material was carried by the ducts, indicating an increased cellular activity. The specific activity of trypsin was determined as early as after hatching (42.54±6.8 mU/mg protein-1) at 4.28±0.2 mm total length of larvae and increased immediately during the following days especially after exogenous feeding. The highest tryptic activity was detected on 30 DAH as 122.45±11.76 mU/mg protein-1. It is concluded that exocrine pancreas organogenesis is the main critical step of the zymogen granules and trypsin activity is present as early as after hatching and continuously increasing with larval period of *D. labrax*.

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AUTOMATIC CONTROL OF GROWTH AND DENSITY IN ROTIFER CULTURES

Morten Omholt Alver, Jo Arve Alfredsen, Gunvor Øie, Werner Storøy, Yngvar Olsen-2010

Aquacultural Engineering 43(1): 6-13

Abstract:

A system for automatic control of the growth and density of rotifer cultures is presented and tested. The system computes feeding rates based on a setpoint for rotifer density, and provides a fast growth period followed by rapid stabilization of the rotifer density. At the same time, overfeeding is prevented, thereby reducing the risk of culture crashes. Feeding rates are automatically computed based on measurements of the culture's density and egg rate, and internal setpoints for growth rate and egg rate. The controller is tested and tuned against a mathematical model of a rotifer culture before being applied to four experimental cultures.

The experimental results show densities in all tanks increasing from 60 to 901 m^{-1} to the setpoint densities of 500 and 1000 m^{-1} in 5–7 days, after insignificant growth on the first day. Gross growth rates slowed down considerably towards the end of the experiment, as the controller reduced feed rations in order to stabilize densities. The cultures were stabilizing at higher densities compared to their setpoints, while there was no such bias in the observed egg rates. This indicates that a part of the controller algorithm needs further tuning. The approach to the setpoint densities was fast, and within the experimental period there were no indications of oscillations beyond those caused by daily dilution.

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LOW AND VARIABLE PRODUCTIVITY AND LOW EFFICIENCY OF MASS CULTURES OF THE HAPTOPHYTE ISOCHRYSIS AFF. GALBANA (T-ISO) IN OUTDOOR TUBULAR PHOTOBIOREACTORS

S.A. van Bergeijk, E. Salas-Leiton, J.P. Cañavate-2010

Aquacultural Engineering 43(1): 14-23

Abstract:

The haptophyte *Isochrysis aff. galbana* (T-iso) was cultured during 2 consecutive years (from spring to autumn) in outdoor horizontal tubular photobioreactors (PBRs) that had a size compatible with that recommended for hatchery service. Around one-third of the cultures carried out in these PBRs showed immediate growth after inoculation up to a maximum biomass. In all other instances a lag phase or a culture collapse were found. In the cultures that showed productivity, average growth rate, μ (d^{-1}), productivity ($\text{g L}^{-1} \text{d}^{-1}$) and photosynthetic efficiency, PE (%), were $0.39 \pm 0.085 \text{ d}^{-1}$, $0.075 \pm 0.038 \text{ g L}^{-1} \text{d}^{-1}$ and $2.51 \pm 0.85\%$, respectively. These values were low compared to values for cultures routinely incubated indoors, which were used as inocula for the outdoor cultures, and were studied as a reference. In these 50-L acrylic columns (19.4 cm internal diameter) growth, productivity and PE were $0.91 \pm 0.087 \text{ d}^{-1}$, $0.076 \pm 0.012 \text{ g L}^{-1} \text{d}^{-1}$ and $13.72 \pm 2.23\%$, respectively. Outdoor productivity of T-iso was limited to average temperatures above $15 \text{ }^{\circ}\text{C}$, while below an average temperature of $21 \text{ }^{\circ}\text{C}$ growth rate and productivity were lower than above $21 \text{ }^{\circ}\text{C}$. Above this temperature, solar irradiance and biomass density had a more important effect on growth rate and productivity than temperature. Analysis of our data revealed a critical value of the ratio between incident solar irradiance ($\text{MJ m}^{-2} \text{d}^{-1}$) and cell density ($10^6 \text{ cells mL}^{-1}$) at the moment when the protective black netting was removed from the cultures. Cultures that had a ratio above 1.5 suffered an initial lag phase or collapsed, while cultures that showed direct growth had a value below 1.5. This seemed to be independent of absolute initial cell density. However, we recommend using cell densities higher than the ca. $5 \times 10^6 \text{ cells mL}^{-1}$ used in the present study. In the South of Spain this seems to be especially relevant in spring, when temperatures are relatively low in relation to incident solar irradiance. T-iso seems to be particularly sensitive to the variable conditions outdoors and we suggest that new designs of closed PBRs, specifically developed for outdoor cultivation of T-iso, try to achieve more stable and homogeneous conditions throughout the system and over the daily cycle.

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AN ALTERNATIVE OUTDOOR PRODUCTION SYSTEM FOR THE MICROALGAE CHAETOCEROS MUELLERI AND DUNALIELLA SP. DURING WINTER AND SPRING IN NORTHWEST MEXICO

Manuel Becerra-Dórame, José Antonio López-Elías, Luis R. Martínez-Córdova-2010
Aquacultural Engineering 43(1): 24-28

Abstract:

Shrimp hatcheries have faced problems related to microalgae production: a wide variability on final densities, and marked differences in nutritional composition. An alternative system for the outdoor culture of *Chaetoceros muelleri* and *Dunaliella* sp. during winter and spring in Northwest Mexico was evaluated. The new system increases the exposure of microalgae to light by introducing a recirculation cascade. Higher growth rates and final densities of both species were found in the alternative system independently of the season. In the winter trial, cell density of *C. muelleri* at 92 h was 0.85×10^6 cells mL^{-1} in the alternative system, compared to 0.57×10^6 cells mL^{-1} in the traditional. *Dunaliella* sp. reached a density of 0.26×10^6 and 0.23×10^6 cells mL^{-1} in the alternative and traditional systems, respectively. In spring, density of *C. muelleri* in the alternative system was 2.8×10^6 cells mL^{-1} , in the traditional 2.08×10^6 cells mL^{-1} . For *Dunaliella* sp. 0.83×10^6 and 0.78×10^6 cells mL^{-1} were respectively obtained. No differences in dry matter biomass were observed among systems in any trial for the two species. We concluded that the alternative system is a good option to improve the production of microalgae especially during spring. Better results were achieved for *C. muelleri*.

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CARBON DIOXIDE DEGASSING IN FRESH AND SALINE WATER. I: DEGASSING PERFORMANCE OF A CASCADE COLUMN

Damian Moran-2010

Aquacultural Engineering 43(1): 29-36

Abstract:

A study was undertaken to measure carbon dioxide degassing in a cascade column operating with both fresh (0‰) and saline water (35‰ NaCl) at 15 °C. The cascade column contained bio-block type packing material, was 1.7 m long in each dimension, and was tested both with and without countercurrent air exchange. The CO₂ concentration of the influent and effluent water was measured using submersible infrared CO₂ probes over an influent range of 10–60 mg L⁻¹ CO₂. Carbon dioxide degassing was quantified in terms of the mass transfer coefficient (kLa, log concentration driving force divided by packing height) and the CO₂ stripping efficiency (the difference in CO₂ concentration between the influent water and the effluent water that has re-established chemical equilibria approximately 1 min after exiting the column). Mass transfer coefficients were similar between fresh and saline water. Countercurrent air flow did not improve stripping efficiency, probably because the column was already operating at a high mass transfer rate with no active ventilation and there was sufficient passive, concurrent air flow to overcome the accumulation of CO₂ inside the column. There was a positive relationship between influent CO₂ concentration and CO₂ stripping efficiency, which ranged from 67% to 89% CO₂ stripped in a single pass. The CO₂ stripping efficiency was lower in saline water compared to freshwater at equivalent influent CO₂ concentrations. The dependence of CO₂ stripping efficiency on salinity was attributed to differences in the ionization fractions of inorganic carbon species in the effluent water. The results indicate that CO₂ removal will be more problematic for saline or seawater recirculating systems compared to freshwater systems.

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APPLICATION OF MULTI-SPECIES OF BACILLUS IN SEA BREAM LARVICULTURE

Matteo Alessandro Avella, Giorgia Gioacchini, Olivier Decamp, Pavlos Makridis, Claudia Bracciatelli, Oliana Carnevali-2010

Aquaculture 305(1-4): 12-19

Abstract:

To date, probiotics can be considered a valid alternative to the use of antibiotics in aquaculture and in particular, in fish larviculture, to prevent high mortality and to improve welfare and promote growth. In the two last decades, many studies reported promising results using a single beneficial bacterial strain in the culture of many finfish species. Looking for innovative ways to improve fish larviculture, we tested a mixture of Bacillus probiotic bacteria in the gilthead sea bream (*Sparus aurata*) larviculture focusing on their effects on survival, growth and general welfare. The mixture, composed of three Bacillus strains, *Bacillus subtilis*, *Bacillus licheniformis* and *Bacillus pumilus* was provided via rotifers and *Artemia nauplia* and added to the water (group 1) or supplied exclusively via live prey (group 2).

The Bacillus mixture significantly increased growth in terms of standard length and body weight in both experimental groups, at larval and juvenile stages, 47 and 75 days after hatching, respectively, with the highest values obtained from Group 2 treatment.

In addition, the expression of genes involved in growth metabolism (Insulin-like Growth Factors I and Myostatin) and animal welfare (70 KDa-Heat Shock Protein and Glucocorticoid Receptor) were analysed. The morphometric analysis was supported by molecular results which clearly evidenced higher expression of IGFI and lower levels of myostatin in groups fed on probiotics. In addition, a better tolerance to farming conditions was also found as evidenced by the lower expression of HSP70 and Glucocorticoid Receptor, suggesting beneficial effects of the supplied Bacillus mixture on fish welfare.

The data generated in this study provide scientific and technical support for the implementation of sustainable development of sea bream aquaculture.

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WARMER TEMPERATURES REDUCE RATES OF GAMETOGENESIS IN TEMPERATE MUSSELS, MYTILUS GALLOPROVINCIALIS

J. Fearman, N.A. Moltschaniwskyj-2010

Aquaculture 305(1-4): 20-25

Abstract:

Temperature is known to have a substantial effect on the rate of reproductive maturation in many marine organisms, yet the effect of a range of temperatures on the rate of gametogenesis in *Mytilus galloprovincialis* has not been thoroughly investigated. Temperature influences natural reproduction and population dynamics in bivalves, and is often used in hatcheries to regulate broodstock conditioning. In this study mussels were held at, 7 °C, 10 °C, 13 °C, 16 °C, and 19 °C, which includes temperatures within the natural range. Feeding ration was 10% of the dry weight of the mussels, and samples were collected regularly throughout the nine week conditioning period. Gametogenesis occurred at varying rates according to conditioning temperature. Glycogen concentration decreased in all temperatures at the same rate. At 7 °C larger oocytes were significantly more frequent and space in the mantle tissue was greater than at 16 °C. A greater proportion of vitellogenic oocytes were produced in mussels at 10 °C and 13 °C compared to other temperatures. Glycogen storage tissue, as a percentage of the mantle tissue, was greatest at 19 °C, and lowest at 7 °C and 10 °C. Fecundity and D-veliger larvae production were not influenced by temperature. These results suggest that the effect of temperature on the rate of gametogenesis is strongly influenced by energy balance. At low temperatures gametogenesis is more rapid, while at high temperatures gametogenesis is slowed by the increased demands of metabolism and potentially decreased assimilation efficiency, limiting surplus energy for reproduction. This information can be applied within a hatchery setting to optimise broodstock conditioning.

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OPTIMIZATION OF FEEDING FREQUENCY OF ASIAN SEABASS (*LATES CALCARIFER*) FRY REARED IN NET CAGES UNDER BRACKISHWATER ENVIRONMENT

G. Biswas, A.R. Thirunavukkarasu, J.K. Sundaray, M. Kailasam-2010

Aquaculture 305(1-4): 26-31

Abstract:

An experiment was conducted in brackishwater environment to determine the optimal feeding frequency for growth, effective feed conversion, survival, shooters emergence and size variation in Asian seabass fry reared in the net cages. Four feeding frequencies of one (T1), two (T2), three (T3) and four (T4) times a day were evaluated as treatments in triplicate for a period of 5 weeks. Hatchery produced weaned seabass fry (25.9 ± 0.3 mm/ 203.8 ± 4.6 mg size) stocked at 120 numbers per cage were fed with a commercial marine fish larval diet containing 55% crude protein at 10% of the biomass daily for the first 3 weeks, followed by 8% for the remaining 2 weeks. Although, the highest growth was recorded in T3, the final length (45.9 ± 0.3 mm) and weight (1203.8 ± 4.6 mg) did not differ significantly ($P > 0.05$) from that of T4. Whereas, fish with one or two times feeding exhibited significantly lower growth ($P < 0.05$). Daily weight gain, percentage weight gain and specific growth rate were significantly higher in T3 ($P < 0.05$), while there was no significant variation ($P > 0.05$) between T3 and T4. Significantly higher survival of $75.89 \pm 4.17\%$ was recorded in T3 than those of one and two times fed fish ($P < 0.05$). The fish in T3 had significantly improved feed conversion ratio ($P < 0.05$). No significant differences were recorded among treatments for the cumulative number of shooters separated and coefficient of variation in the harvest weight, which were ranging from 9.67 to 12.00 and 0.113 to 0.124, respectively. This study infers that the Asian seabass fry can achieve maximum growth, survival and better feed conversion when they are fed a given ration with three times feeding daily in brackishwater net cage rearing. The findings also have practical significance towards establishing Asian seabass seed rearing package and will directly benefit the nursery operators.

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SCREENING OF MARINE STREPTOMYCES SPP. FOR POTENTIAL USE AS PROBIOTICS IN AQUACULTURE

Surajit Das, Louise R. Ward, Chris Burke-2010

Aquaculture 305(1-4): 32-41

Abstract:

Marine Streptomyces strains (CLS-28, CLS-39 and CLS-45) were used to colonise *Artemia* nauplii (Instar I) and 15 d old adult *Artemia* prior to challenge with *Vibrio harveyi* and *V. proteolyticus*. The LC₅₀ of *V. harveyi* and *V. proteolyticus* was found to be 106 CFU ml⁻¹. *V. proteolyticus* was more pathogenic than *V. harveyi* at 106 CFU ml⁻¹. A significant reduction in mortality ($P < 0.001$) was found by addition of 1% wet cell mass of Streptomyces strains in nauplii and adult *Artemia* against both the pathogens. The best protective responses were shown by CLS-39 in both nauplii and adults against *V. harveyi* and by CLS-39 in nauplii and CLS-28 in adults against *V. proteolyticus*. Shrimp feeds were supplemented with Streptomyces cell mass at 1% dosage and fed to black tiger shrimp *Penaeus monodon* postlarvae for 15 d in three treatments with two treatments of commercial probiotic (T1: feed + CLS-28; T2: feed + CLS-39; T3: feed + CLS-45; T4: feed + Sanolife® commercial probiotic and T5: Sanolife® commercial probiotic in water). During this time, ammonia was in the range of 1 to 2 ppm in all the treatments with significant differences between treatments ($P < 0.05$). Significant differences ($P < 0.05$) were also found in survival, total length and wet weight of the shrimp postlarvae during the 15 d trial. T5 showed the best gains in terms of length and weight followed by T1, T2, T3 and T4. Streptomyces treatments T1, T2 and T3 showed better survival and higher length and weight than the control and T4. Total heterotrophic bacteria and *Vibrio* counts were in the range of 108 and 106 CFU ml⁻¹ respectively in all the treatments. The *Vibrio* population differed significantly in the treatments ($P < 0.05$) and the total bacterial counts showed no significant differences in the treatments ($P > 0.05$). After challenge with *V. harveyi* at 107 CFU ml⁻¹, highest survival was found in T1 and T5. Among the Streptomyces treatments, T1 showed significantly higher survival compared to the control, followed by T2 and T3. Thus Streptomyces strains show promise as probiotic agents in mariculture.

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WHY IS CANNIBALISM SO RARE AMONG CULTURED LARVAE AND JUVENILES OF PANGASIUS DJAMBAL? MORPHOLOGICAL, BEHAVIOURAL AND ENERGETIC ANSWERS

E. Baras, R. Hafsaridewi, J. Slembrouck, A. Priyadi, Y. Moreau, L. Pouyaud, M. Legendre-2010
Aquaculture 305(1-4): 42-51

Abstract:

The ontogenetic trajectory of *Pangasius djambal* resembles that of *Pangasianodon hypophthalmus*. At the start of exogenous feeding (48 h after hatching), larvae of *P. djambal* (8.5 mm TL, 4.5 mg WM) exhibit a large gape (17.5% TL), they possess long oral spines (100 μ m) but no pectoral fins. However, the spines do not overhang from the mouth, and gape height never exceeds body depth, contrary to the situation in *P. hypophthalmus*. These differences account for why encounters between larvae of *P. djambal* never lead to the deadly clashes observed in *P. hypophthalmus*. The rarity of cannibalism in older larvae and juveniles of *P. djambal* originates from the combination of morphological, behavioural and energetic factors (studied during predation experiments with cannibals from 20 to 70 mm TL): (1) the negative allometry of mouth parts and positive allometry of body depth restrict the logistics of cannibalism from 84.9% TL at 10 mm TL to 56.5% TL at 40 mm TL; (2) cannibals of increasing size prefer prey that are increasingly smaller relative to the logistics of cannibalism (pref:max TL ratios of 99 and 48.5% at 10 and 40 mm TL, respectively); and (3) cannibals need high maintenance food rations (14.9% DM at 6–10 mg DM), they exhibit a rather low gross conversion efficiency (0.36 DM:DM at 6 mg DM), and gain no growth advantage over siblings fed brine shrimp nauplii ad libitum. No single factor suffices to account for the rarity of cannibalism in *P. djambal*, but their combination almost makes it impossible, even among fish fed submaximally.

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EFFECT OF EARLY CO-FEEDING AND DIFFERENT WEANING DIETS ON THE PERFORMANCE OF COBIA (*RACHYCENTRON CANADUM*) LARVAE AND JUVENILES

Van Can Nhu, Kristof Dierckens, Hong T. Nguyen, Tuyet Minh T. Hoang, Thanh Luu Le, Mai Thien Tran, Christel Nys, Patrick Sorgeloos-2010

Aquaculture 305(1-4): 52-58

Abstract:

Cobia (*Rachycentron canadum*) is a very fast growing species. This can only be achieved if sufficient amounts of feed are provided from early larval development onwards. In this study, we examined the effects of early co-feeding and different co-feeding formulated diets on growth, survival and vitality of cobia larvae and juveniles. Two experiments were conducted to test the possibility of early co-feeding of the two formulated diets for cobia larvae (8–18 dph) and one experiment was conducted to compare the effect of three formulated diets for cobia juveniles (20–38 dph).

During the larval stage, two formulated diets: Proton® and an experimental diet (INVE, Belgium) were used along with live food from eight days post hatch (dph) and 13 dph compared to 18 dph as the control. Results from the study indicated that early co-feeding of Proton® from eight dph had a significantly positive effect on growth ($P < 0.05$), but not on survival and stress resistance in a salinity stress test ($P > 0.05$) of cobia larvae. In the second trial, no significant difference ($P > 0.05$) was detected between all treatments in terms of growth, vitality and survival. However, high mortality occurred in the treatment with the experimental diet as of 12 dph. The study suggested that early co-feeding of Proton® to cobia larvae from eight dph is possible and research on the appropriate nutritional composition of weaning diets needs to be addressed.

In the juvenile stage, three formulated diets, i.e. the experimental diet, Proton® and NRD® (INVE Aquaculture NV) were evaluated for growth performance and survival of early cobia juveniles (20–38

dph). The diets were manually introduced from 22 dph at a feeding frequency of every 2 h until satiation, while feeding of enriched EG Artemia was maintained until 30 dph. Average length and weight of the 38-dph juveniles fed the experimental diet were significantly higher ($P < 0.05$) compared to larvae fed Proton® and NRD®. However, the coefficient of size variation as well as the cumulative stress index in a salinity challenge test was not significantly different ($P > 0.05$). Survival in the Proton® treatment was the lowest, while no significant difference was evident between the experimental diet and NRD® treatments. The mortality rate of all three treatments had two peaks: one at the beginning of the experiment and one when live food feeding was discontinued. This result indicates that the nutritional requirements of cobia are age-dependent and prolongation of live food co-feeding during weaning may be necessary. The higher DHA/EPA ratio in the experimental diet can be a clue for the improvement of growth and survival of cobia during the weaning stage.

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DEVELOPMENTAL CHANGES IN BEHAVIORAL AND RETINOMOTOR RESPONSES OF PACIFIC BLUEFIN TUNA ON EXPOSURE TO SUDDEN CHANGES IN ILLUMINATION

Hiromu Fukuda, Shinsuke Torisawa, Yoshifumi Sawada, Tsutomu Takagi-2010

Aquaculture 305(1-4): 73-78

Abstract:

Schooling behavior traits during the process of retinomotor response from scotopic to photopic vision were examined in cultivated juvenile Pacific bluefin tuna (PBT) at 3 different ages. After a sudden change in illumination from darkness to 300 lx, retinal adaptations changed from scotopic to photopic vision. Retinomotor and schooling indices showed strong agreement, with juvenile PBTs forming polarized schools upon complete retinal adaptation to photopic vision. The behavioral and retinal adaptation to sudden illumination took 20, 15, and 10 min after illumination in PBT 25, 40, and 55 days after hatching (dah). At 40 dah, PBT took a longer time to adapt than fish aged 55 dah and showed the highest swimming speed, including momentary bursts of swimming immediately after illumination. This suggested that these fish were swimming at high speed under poor visibility conditions. In contrast, PBT at 55 dah showed a gradual increase in swimming speed that correlated with their retinal adaptation. Therefore, behavioral and retinal adaptation traits changed during growth, suggesting that the high mortality in PBT around 40 dah, due to collisions with the tank and net walls at dawn, may be because these adapt more slowly than fish at 55 dah and were swimming at a relatively high speed under conditions of poor visibility.

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THE EFFECT OF TEMPERATURE ON THE INCUBATION OF EGGS OF THE TROPICAL ROCK LOBSTER PANULIRUS ORNATUS

N.G. Sachlikidis, C.M Jones, J.E. Seymour-2010

Aquaculture 305(1-4): 79-83

Abstract:

The period over which spiny lobster eggs develop varies widely and is related to incubation temperature. For the tropical rock lobster (*Panulirus ornatus*), this relationship is found to be: Incubation period (days) = $95.444 - 2.482 \times \text{Temperature } (^{\circ}\text{C})$ for incubation temperatures between 24 and 30 °C. Incubation temperatures ≥ 32 °C are unsuitable for this species and result in the termination of egg clutches. Additionally, egg clutches incubated at lower temperatures hatched over more nights than those at higher temperatures. These findings mean that lead times to larval hatch can now be predicted for this species, allowing for preparation time prior to larval culture.

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A DYNAMIC ENERGY BUDGET (DEB) GROWTH MODEL FOR PACIFIC OYSTER LARVAE, CRASSOSTREA GIGAS

B. Rico-Villa, I. Bernard, R. Robert, S. Pouvreau-2010

Aquaculture 305(1-4): 84-94

Abstract:

Dynamic Energy Budget (DEB) theory aims to quantify the energetic framework of an individual organism as a dynamic model, from the uptake of food to its utilisation in metabolic processes (maintenance, growth, development and reproduction). The purpose of the present paper is to extend the existing DEB model for adult Pacific oyster *Crassostrea gigas* to the larval life stage of this species. We present the application of generic DEB theory to oyster larvae, with the formulation of the specific assumptions based on the characteristics of this stage. The model depends on seawater temperature and food density, as forcing variables, followed throughout the whole larval development. We calculated DEB parameter values for larvae by means of laboratory experiments specifically designed to collect datasets on ingestion and growth at different levels of phytoplankton density and temperature. The DEB model developed here showed good growth simulations and provided an extensive description of the energetic needs of *C. gigas* during its larval stage. It was demonstrated that, at 27 °C, a food density of 1400 µm³ µl⁻¹ must be maintained throughout larval development to maximise growth and metamorphosis success. Timing of metamorphosis decreases exponentially with increasing temperature. (Ifremer, Département de Physiologie Fonctionnelle des Organismes Marins, Station Expérimentale d'Argenton, Presqu'île du Vivier, 29840 Argenton, France ; email of R. Robert rrobert@ifremer.fr)

EFFECTS OF TEMPERATURE REGIME ON GROWTH AND DEVELOPMENT OF POST-LARVAL STRIPED TRUMPETER (LATRIS LINEATA)

Bryan Y. Choa, Chris G. Carter, Stephen C. Battaglene-2010

Aquaculture 305(1-4): 95-101

Abstract:

The striped trumpeter (*Latris lineata*) is a promising new candidate for diversification of aquaculture in temperate regions of Australasia. Striped trumpeter is also of scientific interest due to an unusually prolonged post-larval phase. The research aimed to identify the optimal temperature for rearing post-larval striped trumpeter approaching metamorphosis. Three-hundred-day-old post-hatch post-larvae (12.1 ± 0.2 g, 114.0 ± 0.5 mm, mean ± SE) were reared at 12, 14, 16 and 18 °C, over 84 days. Survival, growth and metamorphosis into juveniles were recorded every 21 days. Fish were fed to apparent satiation and reared in oxygen saturated water (95.9 ± 2.6%). At 14 °C, fish exhibited the best growth, had significantly higher lipid content and the majority (> 90%) of the population metamorphosed into juveniles. The performance of fish reared at 16 °C was similar to those at 14 °C but the carcass had a significantly higher protein content and a significantly smaller proportion of the population (66.2 ± 3.0%) metamorphosed into juveniles. A specific growth rate model showed that growth was highest at 14.4 °C. At 12 °C, fish showed the highest food conversion efficiency and all of the fish metamorphosed into juveniles. At 18 °C, fish showed the lowest growth, metamorphosis, and protein and energy retention. This is the first study on the effects of temperature on growth and development of striped trumpeter post-larvae. The results have important implications for aquaculture and fisheries management of striped trumpeter, in particular the rearing of post-larvae in hatcheries, timing of stocking into sea cages especially prior to metamorphosis, and for wild stock recruitment models. (Marine Research Laboratories, Tasmanian Aquaculture and Fisheries Institute and Aquafin Cooperative Research Centre, University of Tasmania, Private Bag 49, Hobart, Tasmania, 7001, Australia; email of Bryan Y. Choa: bhchoa@utas.edu.au)

RESPONSE OF COMMON CARP FRY FED DIETS CONTAINING A PEA SEED MEAL (PISUM SATIVUM) SUBJECTED TO DIFFERENT THERMAL PROCESSING METHODS

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Abstract:

Three forms of pea seed meal (native - NAT Diet, autoclaved - AC Diet and dry cooked - DC Diet) were evaluated in balanced diets for common carp fry (*Cyprinus carpio* L.) replacing solvent extracted soybean meal protein in a fish meal / soybean meal based control diet (CTR Diet).

After a 49- day growth trial, weight gain, feed conversion ratio, protein efficiency ratio and apparent net nitrogen utilization of fish fed the fish meal / soybean meal diet (CTR Diet) and of that fed the pea seed meal subjected to different thermal treatments were determined. Significant differences ($P < 0.05$) were found in the mean final weight (MFW) and specific growth rates (SGR) between fish fed the CTR and NAT Diets (i.e., mean final weight: 30.69 and 25.70 g, respectively; SGR: 2.84 and 2.51 g, respectively). The mean final weight of carp fed the autoclaved pea seed meal diet (MFW 28.40 g, AC Diet) and the group fed the dry cooked pea seed meal diet (MFW 29.34 g, DC Diet) were not deemed significantly ($P > 0.05$) different to those of carp fed the fish meal / soybean meal control diet.

A sequential digestibility study was also undertaken to complement the growth trial. Apparent nutrient and energy digestibility coefficients (ADCs) reflected a similar trend as results in the first trial. Apparent nutrient and energy digestibility coefficients were found to be highest when fish were fed the CTR Diet. Apparent digestibility coefficients of carp fed the AC and DC Diets were generally higher than that of the NAT Diet. Overall, ADC's of fish fed the DC Diet were generally higher than that of the AC Diet.

It can be concluded that thermal treatment can nutritionally modify pea seed meal to some extent: the dry heating treatment proved to be slightly more effective than the moist heat treatment in terms of growth performance, feed utilization efficiency and apparent digestibility in common carp.

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EFFECT OF NUTRITION ON CRASSOSTREA GIGAS LARVAL DEVELOPMENT AND THE EVOLUTION OF PHYSIOLOGICAL INDICES. PART A: QUANTITATIVE AND QUALITATIVE DIET EFFECTS

R. Ben Kheder, C. Quéré, J. Moal, R. Robert-2010

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Abstract:

Several quality indices have been defined for marine bivalve larvae, including the coloration of whole larvae and the Triacylglycerols/Sterols ratio (TAG/ST), putting emphasis on the role of lipids in larval development. Using an image analysis system, epifluorescence microscopy and Nile Red, to specifically colour the reserves, we improved and quantified the overall physiological index based on the ratio of the lipid surface to the total larval surface. This Overall Lipid Index (OLI) was then tested in two experiments on the influence of nutritional parameters on larval development and metamorphosis in *Crassostrea gigas*, following the parallel evolution of the indices. The higher the input of microalgae, the quicker larvae developed, leading to a maximum development rate of 16.5 $\mu\text{m}\cdot\text{d}^{-1}$. This rate was accompanied by the highest lipid reserves. At the end of rearing, the lipid reserves occupied 30% of the larval surface in the batches with the highest food ration, while they only covered 12% in the larvae on the lowest ration. In the same way, the TAG/ST ratio increased over the rearing period and reached its highest levels in larvae with the highest food ration. We also noted that the decrease in lipids over the first week of rearing was higher when the nutritional input was lower. Finally, deficient reserves and poor performances were recorded in larvae fed only the flagellates *Pavlova lutheri* (P), *Isochrysis affinis galbana* (T) or a mixture of these species (PT). In contrast, a high lipid accumulation and better performances were shown when the diet was based on the diatom *C. calcitrans* f. *pumilum* (Cp), whether alone or in combination with other species.

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