

SHARP PHYLOGEOGRAPHIC BREAKS AND PATTERNS OF GENEALOGICAL CONCORDANCE IN THE BRINE SHRIMP ARTEMIA FRANCISCANA

S. Maniatsi, I. Kappas, A. D. Baxevanis, T. Farmaki, T.J. Abatzopoulos-2009

Int. J. Mol.Sci. 10 : 5455-5470

Abstract :

Genealogical concordance is a critical overlay of all phylogenetic analyses, irrespective of taxonomic level. To assess such patterns of congruence we have compiled and derived sequence data for two mitochondrial (16S rRNA, COI) and two nuclear (ITS1, p26) markers in 14 American populations of the hypersaline branchiopod *Artemia franciscana*. Cladistic analysis revealed three reciprocally monophyletic mitochondrial clades. For nuclear DNA, incomplete lineage sorting was evident presumably as a result of slower coalescence or male-mediated dispersal. Our findings capture the genealogical interval between gene splitting and population divergence. In this sense, strong indications are provided in favour of a superspecies status and ongoing speciation in *A. franciscana*.

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EFFECTS OF CONSTRUCTED MICROBIAL MATS ON WATER QUALITY AND PERFORMANCE OF LITOPENAEUS VANNAMEI POST-LARVAE

Carlos Lezama-Cervantes, J. Paniagua-Michel-2010

Aquacultural Engineering 42(2): 75-81

Abstract:

In this study, microbial mats were designed and constructed using microbial isolates obtained from semi-intensive shrimp culture ponds. Three microbial mats (MA, MB, and MC) were constructed on low-density polyester according to their capacity to remove inorganic nitrogen. Shrimp were stocked at three densities using twelve-day-old post-larval *Litopenaeus vannamei* (PL12). The mat cultures exhibited higher oxidation of ammonia to nitrite and nitrate nitrogen when compared with controls at higher stocking densities without water exchange. The lowest ammonia concentration was observed at the end of the experiment, 1.55 mg/l, found in mat C. However, mat C also registered the highest NO₃ level, at 5.98 mg/l; in contrast, MB registered 1.50 mg/l of NO₂-N and the lowest nitrate conversion (2.64 mg/l NO₃-N). Control cultures (without mats) exhibited an increased accumulation of ammonia and no significant increases were observed in nitrite or nitrate. Growth and survival was enhanced with mat B co-cultured with 1000 PL m⁻², which registered an average of 85.2% survival, and a yield of 423.5 g m⁻². These values were significantly higher ($P < 0.05$) than control units. Moreover, the microbial biomass in mat composite, $\sum MA + MB + MC$ evidenced active grazing and uptake of mat components by the shrimp. These findings can be used to recycle the excess N from shrimp production in a continuous and self-sufficient growth of indigenous microorganisms in the polyester support, thus providing additional food and water suitable to reuse for intensive shrimp larval rearing at low cost, particularly in closed culture systems with minimal or not water exchange.

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REVIEW ARTICLE**THE REPRODUCTIVE CONDITIONS OF MALE SHRIMPS, GENUS PENAEUS, SUB-GENUS LITOPENAEUS (OPEN THELYCA PENAEOID SHRIMPS): A REVIEW**

Jorge Alfaro-Montoya-2010

Aquaculture 300(1-4): 1-9

Abstract:

Male reproductive performance in penaeoid aquaculture is a major issue. This review evaluates the current knowledge on male reproduction of open thelyca penaeoid shrimps. This group of shrimp

belongs to the genus *Penaeus*, sub-genus *Litopenaeus*, and presents a unique reproductive model, characterized by complex spermatophores and thelyca without seminal receptacles; however, sperm seem to reach maturation and capacitation on the open thelyca. Males of this group adapt differently to captivity, being *P. (Litopenaeus) vannamei* the best adapted species. Nevertheless, three problematic conditions develop in confined environments in one or more species: male reproductive tract degenerative syndrome (MRTDS), male reproductive system melanization (MRSM), and spermatophore deterioration (SD).

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LARVAL DEVELOPMENT AND JUVENILE GROWTH OF THE SEA CUCUMBER *STICHOPUS* SP. (CURRY FISH)

Chaoqun Hu, Youhou Xu, Jing Wen, Lvping Zhang, Sigang Fan, Ting Su-2010

Aquaculture 300(1-4): 73-79

Abstract:

The global populations of Curry fish have been severely depleted over the past decade. This study describes spawning, fertilization, larval rearing, and juvenile growth in a commercially important *Stichopus* species. Data pooled from monthly trials conducted over 2 years indicate that, under optimal conditions, juveniles can be grown to a size of ca. 20 cm in length in 7 months. The survival rates are typically between 30 and 50%. Pilot research indicates that the growth of young sea cucumbers in abandoned abalone tanks has potential. Overall, this study demonstrates that Curry fish can be reared in captivity, thus providing an alternative to fisheries, or a way to maintain sustainable harvests and eventually contribute to the restoration of the natural populations.

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EFFECTS OF LARVAL STOCKING DENSITY AND FEEDING REGIME ON LARVAL REARING OF GIANT FRESHWATER PRAWN (*MACROBRACHIUM ROSENBERGII*)

Dinh The Nhan, Mathieu Wille, Le Thanh Hung, Patrick Sorgeloos-2010

Aquaculture 300(1-4): 80-86

Abstract:

A series of larval rearing experiments were conducted to investigate the effect of larval stocking density and feeding regime on larval development, survival, and larval quality of *Macrobrachium rosenbergii* (de Man). For larval density, fixed initial stocking densities (50, 100, 150 and 200 larvae \pm 1), as well as treatments where larval density changed during the rearing period (in function of the rearing volume), were tested. In the latter trial, initial densities ranged between 100 and 400 larvae \pm 1. For the factor feeding regime (based on *Artemia nauplii*), the effect of both feed ration (1.5, 2, 3 and 4 times the standard feed ration) and feeding frequency (2 or 6 times per day) on larval performance was tested. The results of the experiments showed that larval stocking density and feeding regime strongly affected larval development, survival, and duration of the rearing cycle, as well as larval quality. The best initial larval stocking density when using a constant water volume was 100–150 \pm 1, which could be increased up to 400 \pm 1 if the water volume was increased during culture. A feeding frequency of 6 times per day using first-stage *Artemia nauplii*, was more effective than feeding only twice daily. Production efficiency in terms of the number of postlarvae produced per unit rearing volume, and the number of *Artemia nauplii* used per postlarva produced in the different treatments is discussed. These optimized larval stocking densities and feeding regimes are expected to render freshwater prawn larval rearing more profitable and improve larval quality.

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DIETARY PROBIOTIC LIVE YEAST MODULATES ANTIOXIDANT ENZYME ACTIVITIES AND GENE EXPRESSION OF SEA BASS (*DICENTRARCHUS LABRAX*) LARVAE

D. Tovar-Ramírez, D. Mazurais, J.F. Gatesoupe, P. Quazuguel, C.L. Cahu, J.L. Zambonino-Infante-2010

Aquaculture 300(1-4): 142-147

Abstract:

The main goal of this work was to determine the effect of dietary live yeast *Debaryomyces hansenii* on the enzymatic antioxidative status of sea bass *Dicentrarchus labrax* larvae. Growth, activity and expression of the main antioxidative enzymes: catalase (CAT), glutathione peroxidase (GPX) and superoxide dismutase (SOD), and heat shock protein (HSP70) were measured in sea bass larvae at 23 and 48 days after hatching. Larvae were fed on two microdiets: group one, fed microdiet containing live yeast and the control group fed microdiet without yeast. Heat shock protein 70 showed the same expression levels in both fish larvae fed yeast and the control diet. The group fed *D. hansenii* showed highest growth and lower activity and expression levels of GPX and SOD compared to fish fed control diet. In our work the differences in activity and gene expression patterns could only be attributed to the presence of yeast, assuming a possible involvement of superoxide anion retention in fish larvae, which could represent importance to the host to increase cell or tissue responsiveness to growth- and/or differentiation-enhancing factors.

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HIGH DHA CONTENT IN ARTEMIA IS INEFFECTIVE TO IMPROVE OCTOPUS VULGARIS PARALARVAE REARING

Pedro Seixas, Manuel Rey-Méndez, Luísa M.P. Valente, Ana Otero-2010

Aquaculture 300(1-): 156-162

Abstract:

We analyzed the performance and biochemical composition of *Octopus vulgaris* paralarvae fed on three different diets, consisting of *Artemia* juveniles (1.5–2.8 mm) differing in their highly unsaturated fatty acid (HUFA) composition and protein/lipid (P/L) ratio. The live prey were supplied twice a day at equal proportions, with the first daily meal being common to all groups: *Artemia* enriched with a mixture of the microalgae *Rhodomonas lens* and *Isochrysis galbana* (70:30 dry-weight basis). In the second daily meal, the control group (AR+I) was supplied with the same *Artemia* enriched with microalgae; group AGOLD was fed with *Artemia* enriched with Ori-Gold (Skretting), a commercial product very rich in docosahexaenoic acid (DHA, 22:6n-3); and group AGOPEL was fed with *Artemia* enriched with a manually prepared diet rich in protein and in HUFAs. A trend for better survival was observed in group AR+I at 25 days of rearing, though no statistical differences were found among groups. The dry weight (DW) and total length (TL) of 15-day post hatch (dph) and 25-dph paralarvae from groups AR+I and AGOPEL were significantly higher than values found for paralarvae from AGOLD ($P < 0.05$). A significant and positive linear correlation was found between paralarval DW and dietary protein/lipid ratio ($P < 0.01$), while no beneficial effects of higher DHA content in *Artemia* were observed. Regarding the fatty acid (FA) composition of paralarvae, a remarkable drop in DHA was observed in all groups with respect to hatchlings. However, this decrease was more pronounced in paralarvae from AR+I ($P < 0.05$) than in those from groups AGOLD and AGOPEL. Despite this evidence, the best growth and survival rates were observed in group AR+I, which was the only one where 35-dph paralarvae were attained. These data question the nutritional “essentiality” of DHA for paralarvae, and suggest that in order to sustain a good performance of paralarvae a minimum dietary P/L ratio should be attained before the HUFA composition of the diet may play a significant role.

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SURVIVAL, DEVELOPMENT AND GROWTH OF LARVAE OF THE BLUE SWIMMER CRAB, *PORTUNUS PELAGICUS*, CULTURED UNDER DIFFERENT PHOTOPERIOD CONDITIONS

Mireia Andrés, Guiomar Rotllant, Chaoshu Zeng-2010

Aquaculture 300(1-4): 218-222

Abstract:

The blue swimmer crab is a commercially important species of the tropical Indo-Pacific regions that shows substantial potential as a candidate species for aquaculture. Optimization of larval rearing conditions, including photoperiod, is therefore important to establish a method for the intensive hatchery culture of this species. Newly hatched larvae of *Portunus pelagicus* in first zoeal stage (ZI) were reared under five photoperiod regimes 0L: 24D, 6L: 18D, 12L: 12D, 18L: 6D, and 24L: 0D (5 replicates per treatment) till they metamorphosed to megalopae (ranged from 8.5 ± 0.3 days (18L: 6D) to 10.8 ± 1.8 days (0L: 24D) at 29 ± 1 °C). Daily, larvae of each treatment were fed an identical diet of mixed rotifer and *Artemia nauplii*, and the survival and molt to successive stages was monitored.

Newly hatched ZI larvae of *P. pelagicus* could successfully develop to the megalopal stage under all tested photoperiod conditions, but we detected significant differences in survival among treatments ($p < 0.05$). The constant darkness treatment (0L: 24D) had the lowest ($19.2 \pm 7.2\%$, mean \pm S.E.) cumulative survival from ZI to the megalopal stage, while the 18L: 6D treatment achieved the highest survival ($51.2 \pm 23.6\%$). Similarly, the photoperiod significantly affected zoeal development. Constant darkness led to the longest cumulative zoeal duration (10.8 ± 1.8 days), whereas the 18L: 6D treatment rendered the shortest larval development (8.5 ± 0.3 days). In addition, larvae reared under constant darkness resulted in the smallest megalopae (carapace length = 1.44 ± 0.09 mm) and the lowest dry weight (0.536 ± 0.188 mg).

In conclusion, photoperiod significantly affected the survival, development, and growth of *P. pelagicus* zoeal larvae. Constant darkness led to the lowest larval survival and developmental rate, while a photoperiod regime of 18L: 6D appeared to be the most suitable condition for the rearing of zoeal larvae of *P. pelagicus*.

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LIPOPOLYSACCHARIDE ADMINISTRATION IN PREOVULATORY RAINBOW TROUT (ONCORHYNCHUS MYKISS) REDUCES EGG QUALITY

Diego Crespo, Josep V. Planas, Julien Bobe-2010

Aquaculture 300(1-4): 240-242

Abstract:

The effects of a simulated bacterial infection during the preovulatory period on the timing of ovulation and subsequent egg quality were investigated in rainbow trout (*Oncorhynchus mykiss*). Lipopolysaccharide (LPS) was injected intraperitoneally during the preovulatory period to mimic a bacterial infection. Eggs obtained from LPS-treated females exhibited significantly lower quality characterized by lower survival both at eyeing and yolk-sac resorption. Interestingly, the lowest embryonic survival was observed when ovulation occurred within 10 days after LPS-stimulation. Indeed, a strong correlation was observed between egg quality and the ovulatory response (in days) after LPS injection. In addition, a high incidence of abnormal alevins was observed in some LPS-treated females. Our observations also suggest that LPS administration could trigger the ovulatory process and advance the timing of ovulation. In the present study, we provide for the first time evidence that administration of bacterial LPS in preovulatory rainbow trout females causes a decrease in egg quality and embryonic survival, possibly as a result of advanced ovulation.

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USE OF AMPHIPODS AS ALTERNATIVE PREY TO CULTURE CUTTLEFISH (SEPIA OFFICINALIS) HATCHLINGS

Elena Baeza-Rojano, Sandra García, Diego Garrido, José M. Guerra-García, Pedro Domingues-2010

Aquaculture 300(1-4): 243-246

Abstract:

The effects of feeding two alternative live prey (exclusively caprellids (*Caprella equilibra*) or several species of gammarids, mainly *Erichthonius brasiliensis*, *Jassa marmorata* and *Elasmopus* sp.), to cuttlefish hatchlings were compared to feeding mysids (*Mesopodopsis slabberi*), which are normally used during the first weeks of the life cycle. Weight (g) and growth rates (GR, % BW d⁻¹) were determined. Cuttlefish hatchlings fed with mysids and gammarids grew faster (6.7 ± 0.4 and $5.7 \pm 0.9\%$ BW d⁻¹, respectively) compared to caprellids ($1.6 \pm 0.2\%$ BW d⁻¹). Survival was higher ($96.7 \pm 5.8\%$) for hatchlings fed mysids, compared to $83.3 \pm 15.3\%$ and $76.7 \pm 5.8\%$, for those fed gammarids and caprellids, respectively. According to the results obtained, gammarids could be used as an alternative prey to mysids, while *Caprella equilibra* did not deliver appropriate growth rates and should be disregarded as alternative prey for rearing early stages (hatchlings) of *Sepia officinalis*. This is the first study revealing a successful use of amphipods, mainly gammarids, as alternative prey for cuttlefish hatchlings.

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ONSET AND DEVELOPMENT OF CANNIBALISTIC AND SCHOOLING BEHAVIOR IN THE EARLY LIFE STAGES OF PACIFIC BLUEFIN TUNA THUNNUS ORIENTALIS

Francisco de la Serna Sabate, Yoshitaka Sakakura, Yousuke Tanaka, Kazunori Kumon, Hideki Nikaido, Takeshi Eba, Akefumi Nishi, Satoshi Shiozawa, Atsushi Hagiwara, Shukei Masuma-2010

Aquaculture 301(1-4): 16-21

Abstract:

Behavioral development was observed in the early life stages of Pacific bluefin tuna in order to provide fundamental information for improving seedling production techniques. Behavioral observations to quantify swimming, schooling and cannibalistic behavior were made at different developmental stages: pre-flexion (5 days after hatching, DAH), flexion (12 DAH), post-flexion (14 DAH) and juvenile (20 DAH). Video recordings of either observation containers or the rearing tank were made to observe swimming and schooling behavior, respectively. Cannibalistic behavior was estimated by frequency of chase behavior. Swimming speed maintained constant values from 6 DAH (9.2 ± 6.0 mm/s, pre-flexion stage) to 20 DAH (22.4 ± 9.0 mm/s, beginning of juvenile stage) and increased rapidly thereafter to 29 DAH (85.2 ± 32.5 mm/s). Schooling behavior was first observed on 25 DAH juveniles (SL 23.5 ± 5.0 mm). Chase behavior was first observed at 14 DAH (standard length, SL 6.1 ± 0.6 mm, transition at flexion to post-flexion stage) and increased thereafter. We propose that a practical developmental stage for size grading to reduce the mortality by cannibalism should be between post-flexion and early juvenile (SL 6–23 mm), when the cannibalistic behavior onsets and swimming speed are relatively low.

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SPERM MOTILITY IN EUROPEAN HAKE, MERLUCCIIUS MERLUCCIIUS, AND CHARACTERIZATION OF ITS SPERMATOZOA CONCENTRATION AND VOLUME, SPERMATOCRIT, OSMOLALITY AND PH

Anne-Laure Groison, Marc Suquet, Jacky Cosson, Ian Mayer, Armelle Severe, Jean-Marie Bouquet, Audrey J. Geffen, Anne Christine Utne-Palm, Olav Sigurd Kjesbu-2010

Aquaculture 301(1-4): 31-36

Abstract:

Due to stock declines there is a growing interest in farming of European hake *Merluccius merluccius*. Thus, knowledge of its sperm biology is of importance not only for purposes of broodstock management, but also for the development of sperm preservation techniques. Hake sperm were collected from mature males caught during the summer–early autumn waters off western Norway and during the winter–early spring in the Bay of Biscay (France). Sperm quality characteristics were assessed after storage at 4 °C for 25 ± 14 h. Average (\pm SD) values for Norwegian and French samples respectively were (i) sperm volume: 3.9 ± 4.0 and 2.6 ± 4.0 ml; (ii) spermatozoa concentration: $6.6 \pm$

3.2 and $13.9 \pm 5.1 \times 10^9$ spermatozoa/ml; (iii) spermatocrit: 80.2 ± 3.3 and $81.8 \pm 10.7\%$; and (iv) total number of spermatozoa: 23.5 ± 30.0 and $35.1 \pm 36.2 \times 10^9$. Average osmolality and pH (\pm SD) of French samples were 349 ± 28 mOsmol/kg and 7.6 ± 0.1 , respectively. Activation by transfer into full sea water (100 SW) or 10% ovarian fluid in sea water (10 OF) occurred synchronously for virtually all spermatozoa and the percent sperm motile decreased with post activation time. When transferred into 50% sea water diluted with distilled water (50 SW) only a few spermatozoa were activated initially but subsequently reached a maximum percentage of motility followed by a decline. Hake sperm motility declined rapidly to 50% of motility 70 s after activation with 100 SW. Sperm were motile for longer when activated with 50 SW (1570 ± 295 s) or 10 OF (718 ± 71 s) compared to 100 SW (317 ± 121 s). Undiluted hake sperm stored at 4 °C up to 10 days retained 10% motility when activated with 100 SW. When cryopreserved, the motility recovery index of the cells at thawing ranged from 0 to 76.4%. These results describe for the first time the sperm traits of European hake following successful cryopreservation, and also show the importance of activation medium on sperm motility.

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REPRODUCTIVE PERFORMANCE AND OFFSPRING QUALITY OF WILD-CAUGHT AND POND-REARED SWIMMING CRAB PORTUNUS TRITUBERCULATUS BROODSTOCK

Xugan Wu, Yongxu Cheng, Chaoshu Zeng, Chunlin Wang, Xiaozhen Yang-2010

Aquaculture 301(1-4): 78-84

Abstract:

The farming of the swimming crab, *Portunus trituberculatus*, has expanded quickly in east China over the past decade. To date, the seed production of the crab is dependent on wild-caught broodstock, which could become a constraint to the sustainable development of this crab aquaculture. The present study was conducted to compare the reproductive performance and offspring quality of wild-caught (WC) and pond-reared (PR) *P. trituberculatus*. The reproductive performance, egg and larval quality of WC and PR *P. trituberculatus* in a same size range were assessed under identical conditions. The results showed that although no significant differences on female survival, percentage spawned and female fecundity were found between WC and PR crabs ($P > 0.05$), eggs produced by WC females had significantly higher hatchability (WC = 80.72%; PR = 70.75%) as well as shorter embryonic development time ($P < 0.05$). Similarly, zoea I larvae hatched from WC females had substantially larger carapace length (WC = 624.9 μ m; PR = 603.3 μ m) ($P < 0.05$) than those from PR crabs. Furthermore, under identical culture conditions, zoea I hatched from WC females had significant higher survival rate (WC = 90.0%; PR = 72.0%) and faster development time to zoea II (WC = 3.6 days; PR = 4.3 days) than that of PR broodstock ($P < 0.05$). Biochemical analysis detected significantly lower contents of cholesterol, EPA, ARA and certain essential amino acids (e.g. Phe, His and Arg) in the eggs of PR *P. trituberculatus* than those of WC females ($P < 0.05$), indicating that these nutrients may play an important role in determining egg and larval quality of *P. trituberculatus*. In conclusion, our results demonstrated that although PR females produced similar quantity eggs, significantly lower egg hatchability and larval quality compared to WC females were evident. The differences in egg biochemical compositions between WC and PR crabs suggested that the offspring quality of the PR *P. trituberculatus* could be improved by optimizing broodstock diets.

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OOGENESIS AND FORMATION OF CORTICAL RODS IN THE BLACK TIGER SHRIMP, PENAEUS MONODON

Hathairat Kruevaisayawan, Rapeepun Vanichviriyakit, Wattana Weerachatanukul, Boonsirm Withyachumnarnkul, Jittipan Chavadej, Prasert Sobhon-2010

Aquaculture 30(1-4): 91-98

Abstract:

This study aimed to investigate morphological changes of developing oocytes during oogenesis in the black tiger shrimp *Penaeus monodon* as well as elucidate the cellular pathway for the formation of cortical rods, the egg jelly precursor. The differentiating female germ cells in the mature ovary were divided into four stages (Oc1–4) based on the changes in ultrastructural characteristics. The prominent features in the developing oocytes (Oc1 Oc2 Oc3) were the abundance of ribosomes and dilated rough endoplasmic reticulum (RER) in Oc1 and Oc2 and the presence of yolk granules and lipid droplets in Oc3 all indicating active synthesis of protein and lipid components. The main characteristic of the mature oocyte (Oc4) was the presence of cortical rods (CRs) which were composed of the tightly packed structural units each resembling a bottle-brush. Immunostaining of cortical rod proteins which were part of the structural units indicated that they were first synthesized in the RER–Golgi complex of Oc2 and transported into the extracellular crypts of the mature oocyte (Oc4) where they were assembled into CRs.

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THE IMPACT OF THE ADULT BLUE MUSSEL (*MYTILUS EDULIS*) POPULATION ON SETTLING OF CONSPECIFIC LARVAE

Per Dolmer, Ea Stenalt-2010

Aquaculture International 18(1): 3-17

Abstract:

The choice of a mussel bed as a settling locality by conspecific mussel larvae is a trade-off between reduced fitness due to an increased risk of larval predation and post-settling food competition with the filtering adults and the benefit from a reduced post-settling mortality. This reduced post-settling mortality may be due to a reduced benthic predation in habitats with high complexity. In a field experiment, the larval settling of blue mussels, *Mytilus edulis*, was recorded on an artificial substrate 0.25, 1 and 2 m above the bottom during six periods in spring 1999. The experiment was conducted at four stations with dense mussel beds located at two of these stations. Two of the four stations, one with mussel beds and one without, were located in a wind-exposed area and the two other stations in a sheltered area. It was demonstrated that the larval settling was reduced up to 1 m above the mussel beds. A size analysis of the settled mussels indicated that the reduction in settling intensity close to mussel beds was due to a pre-settling process: the larvae were predated by the filtering adult mussels. Settling was significantly affected by wind stress. During periods with a high mean wind velocity and a turbulent water column, the larvae showed a reduced settlement 1 m above a mussel bed relative to 2 m above, whereas the same patterns not could be observed outside a mussel bed. The importance of the filtration activity of the adult mussels and the behaviour of the larvae is discussed. The recruitment of blue mussels into a mussel bed was investigated. Here, significant positive correlations were observed between the density of recruits and density of adult mussels and weights of empty shells. This indicates that the filtering mussels not only increase the mortality of larvae, but also serve as an important substrate reducing post-settling predation from benthic predators.

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ADVANCES IN REARING TECHNIQUES OF *PAGRUS PAGRUS*, (LINNAEUS, 1758): COMPARISON BETWEEN INTENSIVE AND SEMI-INTENSIVE LARVAL REARING SYSTEMS

Francisco Javier Roo, Carmen María Hernández-Cruz, Juan Antonio Socorro, Hipólito Fernández-Palacios, María Soledad Izquierdo-2010

Aquaculture Research 41(3): 433 – 449

Abstract:

Red porgy, *Pagrus pagrus* L., is a potential candidate for marine finfish diversification on commercial Mediterranean and Atlantic coastal aquaculture. This paper described the development of a suitable larval rearing protocol for commercial application. Red porgy eggs were reared under Intensive and Semi-intensive systems until 50 days after hatching. In addition, two different weaning protocols were

tested for each rearing system. The effects of these treatments were evaluated on the growth, survival and whole-body biochemical and fatty acid composition of red porgy larvae. Significant differences in growth but not in survival at 50 days after hatching were detected in trial A for the semi-intensive and intensive rearing system (23.5 ± 2.7 – 18.9 ± 3.4 mm; 4.4–4.9%); however, modifications in initial prey density and illumination conditions, implemented in trials B (29.5 ± 3.0 – 25.2 ± 1.9 mm; 21.8–5.3%) and C (26.2 ± 2.6 – 24.6 ± 2.6 mm; 22.7–3.8%), significantly improved survival and growth rates in the semi-intensive rearing system. Furthermore, the results in trial C confirmed the feasibility of a partial reduction in *Artemia* use and the significant improvement in survival rates with the new weaning protocol applied (26.4 ± 2.3 – 24.1 ± 3.9 mm; 28.7–12.5%) in the intensive systems. The results of this study concluded that the best larval rearing protocol for commercial production of red porgy fingerlings should include the use of semi-intensive systems.

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SURVIVAL AND LIFE HISTORY CHARACTERISTICS AMONG WILD AND HATCHERY COHO SALMON (*ONCORHYNCHUS KISUTCH*) RETURNS: HOW DO UNFED FRY DIFFER FROM SMOLT RELEASES?

Véronique Thériault, Gregory R. Moyer, Michael A. Banks-2010

Can. J. Fish. Aquat. Sci. 67(3): 486–497

Abstract:

Survival and life history characteristics were evaluated for a coho salmon (*Oncorhynchus kisutch*) integrated hatchery program using two stocking strategies. Fish were released as unfed fry or smolts and returned as adults, and then molecular analysis was employed to pedigree the entire population. We showed that mean adult survival of individuals released as unfed fry was less than that of individuals released as smolts (0.03% vs. 2.39%). The relative reproductive success (RRS) of the fry release strategy to wild spawning was significantly greater for one of two cohorts, whereas the smolt release strategy to wild RRS was significantly greater for both cohorts. Fish released as smolts were significantly smaller upon returning as adults than either those released as unfed fry or wild returns. Mean run timing was also significantly biased towards an earlier run time for hatchery-released fish when compared with the wild component. The incidence of jacking (males maturing at age 2) was greater among fish stocked as smolts than for fish stocked as fry. Differences in survival, RRS, and life history appeared to be the result of hatchery practices and indicated that a fry stocking strategy produced fish more similar to the wild component of the population than to that of fish released as smolts.

THERMAL REACTION NORMS IN SPERM PERFORMANCE OF ATLANTIC COD (*GADUS MORHUA*)

Craig F. Purchase, Ian A.E. Butts, Alexandre Alonso-Fernández, Edward A. Trippel-2010

Can. J. Fish. Aquat. Sci. 67(3): 498–510

Abstract:

Phenotypic plasticity occurs when a genotype produces variable phenotypes under different environments; the shapes of such responses are known as norms of reaction. The genetic scale at which reaction norms can be determined is restricted by the experimental unit that can be exposed to variable environments. This has limited their description beyond the family level in higher organisms, thus hindering our understanding of differences in plasticity at the scale of the individual. Using a three-year common-garden experiment, we quantify reaction norms in sperm performance of individual genotypes within different families of Atlantic cod (*Gadus morhua*). Cod sperm showed phenotypic plasticity in swimming performance across temperatures (3, 6, 11, and 21 °C), but the pattern of the response depended upon how long sperm had been swimming (30, 60, 120, or 180 s), i.e., plasticity in plasticity. Sperm generally swam fastest at intermediate temperatures when first assessed at 30 s after activation. However, a significant genotype \times environment interaction was present, indicating inter-individual differences in phenotypic plasticity. To our knowledge, this is the first study to describe variable sperm

performance across environmental conditions as a reaction norm. The results have potential theoretical, conservation, and aquaculture implications.

COMPARATIVE SUSCEPTIBILITY OF TURBOT, HALIBUT, AND COD YOLK-SAC LARVAE TO CHALLENGE WITH VIBRIO SPP

Nina Sandlund, Odd M. Rødseth, Dag H. Knappskog, Ingrid Uglenes Fiksdal, Øivind Bergh-2010
Diseases of Aquatic Organisms 89(1):29-37

Abstract:

In intensive aquaculture systems, high mortalities are frequently observed during the early life stages of marine fish. The aim of this study was to investigate differences in the susceptibility of turbot *Scophthalmus maximus*, halibut *Hippoglossus hippoglossus* and cod *Gadus morhua* to various strains of *Vibrio anguillarum* (serotypes O1, O2 α and O2 β), *V. salmonicida* and *V. splendidus*. The bath challenge experiments were performed using a multidish system, with 1 egg well⁻¹. Unchallenged eggs and larvae were used as controls. Larvae in challenged groups that suffered high mortality rates were examined by immunohistochemistry. The overall results with respect to mortality showed that the O2 α serotype was pathogenic to all 3 species, while the O1 serotype was pathogenic to halibut and cod. The immunohistochemical examinations revealed differences in histopathology. The O1 serotype produced more severe and highly developed infections than the O2 α serotype. In larvae exposed to the O1 serotype, necrosis and bacterial cells were seen in the dermis, gastrointestinal tract, brain and eye area, while in larvae exposed to the O2 α serotype, bacteria were usually limited to the gastrointestinal tract. These results suggest either that there are undetermined species differences in host immunity or that these pathogens are host-specific even in the early life stages of fish. The O2 β strain did not cause an increased mortality to halibut and turbot.

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TRANSGENIC ZEBRAFISH EGGS CONTAINING BACTERICIDAL PEPTIDE IS A NOVEL FOOD SUPPLEMENT ENHANCING RESISTANCE TO PATHOGENIC INFECTION OF FISH

Cheng-Yung Lin, Ping-Hsi Yang, Chia-Ling Kao, Han-I. Huang, Huai-Jen Tsai-2010
Fish & Shellfish Immunology 28(3): 419-427

Abstract:

Zebrafish (*Danio rerio*) was used as a bioreactor to produce bovine lactoferricin (LFB), which has wide-ranging antimicrobial activity. We constructed an expression plasmid in which LFB was fused with green fluorescent protein (GFP) and driven by zebrafish β -actin promoter. After microinjection, six transgenic founders were screened on the basis of GFP appearance. Among them, a stable ZBL-5 line was selected by the ubiquitous and strong expression of GFP. Using PCR and Western blot analysis, we confirmed that the recombinant LFB-GFP protein was produced by the F2 progeny derived from the ZBL-5 line. The bactericidal agar plate assay proved that the functional domain of LFB was released from the LFB-GFP fusion protein, resulting in strong bactericidal activity against *Escherichia coli*, *Edwardsiella tarda* and *Aeromonas hydrophila*. Furthermore, adult zebrafish were given one feeding of fifty 72-hpf transgenic embryos. The treated fish were then immersed in freshwater containing 1×10^5 CFU ml⁻¹ *E. tarda* for 7 days. The survival rate of the treated zebrafish was significantly higher than that of fish fed with fifty wild-type embryos ($75 \pm 12.5\%$ versus $4 \pm 7.2\%$). This line of evidence suggested that pathogen resistance can be enhanced by using transgenic embryos containing LFB-GFP as a food supplement for fish, while, at the same time, reducing the demand of chemical antibiotics.

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