

DETECTION OF NODAVIRUS IN SEAWATER FROM REARING FACILITIES FOR ATLANTIC HALIBUT HIPPOGLOSSUS HIPPOGLOSSUS LARVAE

Audun H. Nerland, Cecilie Skaar, Tove Boge Eriksen, Hogne Bleie-2007

Diseases of Aquatic Organisms 73(3):201-205

Abstract:

We used (1) ultracentrifugation followed by RT-PCR and (2) real-time RT-PCR to detect and quantify nodaviruses in seawater in which Atlantic halibut *Hippoglossus hippoglossus* larvae/fry had been held at rearing facilities. Evaluated against in vitro propagated viruses, the viral concentration corresponded to 1.6×10^4 TCID₅₀ (50% tissue culture infectious dose) ml⁻¹. Evaluated against in vitro transcribed RNA, the concentration was estimated at 2×10^7 virus particles ml⁻¹ seawater.

(Institute of Marine Research, PO Box 1870 Nordnes, 5817 Bergen, Norway; email of Audun Nerland: audun.nerland@imr.no)

VERTICAL MOVEMENT OF MUD CRAB MEGALOPAE (*SCYLLA SERRATA*) IN RESPONSE TO LIGHT: DOING IT DIFFERENTLY DOWN UNDER

James A.C. Webley, Rod M. Connolly-2007

Journal of Experimental Marine Biology and Ecology Volume 341(2): 196-203

Abstract:

Selective tidal-streaming is a model frequently used to explain how planktonic larvae invade estuaries. The ability of larvae to move vertically in the water column to selectively ride favourable currents and maintain ground gained is critical to this process. The mud crab (*Scylla serrata*) is a widely distributed, commercially and recreationally important portunid crab but little is known about its estuarine recruitment mechanisms or the vertical migration behaviour of its megalopae. In studies of the blue crab (*Callinectes sapidus*), important factors identified in the recruitment mechanism include altered vertical swimming behaviours in estuarine and offshore water and an endogenous circadian rhythm. Using laboratory experiments we examined the vertical displacement response of mud crab megalopae to illumination in estuarine and offshore water during the day and the night. Mud crab megalopae released into 1 m high towers swam higher when illuminated than when in darkness. This behaviour was repeated during the day and the night and in offshore and estuarine water. Given the apparent indifference to water type and the fact that mud crab megalopae are rarely caught in estuaries, we propose the model that these crabs do not invade estuaries as megalopae, but settle and metamorphose into small crabs on the coastal shelf before moving along the sea bed into estuarine habitats.

(Australian Rivers Institute - Coasts and Estuaries Griffith University, PMB 50 Gold Coast Mail Centre QLD 9726, Australia; email of James A.C. Webley: j.webley@griffith.edu.au)

FATTY ACID COMPOSITION OF 12 MICROALGAE FOR POSSIBLE USE IN AQUACULTURE FEED

Vishwanath Patil, Torsten Källqvist, Elisabeth Olsen, Gjermund Vogt, Hans R. Gislørød-2007

Aquaculture International 15(1): 1-9

Abstract:

Twelve algal strains representing the classes Cyanophyceae, Prymnesiophyceae, Bacillariophyceae, Rhodophyceae, Cryptophyceae, Chlorophyceae, Xantophyceae and Eustigmatophyceae were selected mainly from the culture collection of the Norwegian Institute for Water Research (NIVA). The algae were grown as continuous cultures in a 1.8 l. reactor, internally illuminated with an 11 W fluorescent tube. The retention time was adjusted in the range 2–4 days to fit the growth rate of the algae. The growth responses and fatty acid composition were analysed. The maximum production rate was obtained with *Pseudokirchneriella subcapitata* (0.63 g l⁻¹ day⁻¹) and the lowest with *Porphyridium cruentum* 0.13 g l⁻¹ day⁻¹. Arachidonic acid (AA) and eicosapentaenoic acid (EPA) were the

dominating polyunsaturated fatty acids (PUFAs) in *P. cruentum*, while only EPA accumulated in *Phaeodactylum tricornutum*. Docosahexaenoic acid (DHA) was the major PUFA in *Isochrysis galbana*, while *Pavlova* sp. had both EPA and DHA. This is the first report on the fatty acid profiles of *Nannochloropsis oceanica*, *Chroococcus* sp., *Synechococcus* sp. and *Tribonema* sp.

(Department of Plant and Environmental Sciences, Norwegian University of Life Sciences, P.O. Box 5003, N-1432 Ås Blindern, Norway; email of Vishwanath Patil: vishwanath.patil@umb.no)

EFFECTS OF BREEDER REUSE ON THE REPRODUCTIVE POTENTIAL OF THE SIGNAL CRAYFISH (*PACIFASTACUS LENIUSCULUS* DANA, ASTACIDAE) IN CULTURE

J. D. Celada, J. I. Antolín, J. M. Carral, J. R. Pérez, M. Sáez-Royuela-2007

Aquaculture International 15(1): 37-42

Abstract:

The aim of this work was to evaluate the reproductive potential of the signal crayfish (*Pacifastacus leniusculus* Dana) in the second cycle under culture conditions. The experiment was carried out using 5,653 animals placed in six earthen ponds in August. Three treatments were performed, each in two ponds: breeder reuse (males and females used in the former reproductive cycle), female reuse (new males from the wild and females used in the former reproductive cycle) and new breeders (males and females from the wild). In April, close to hatching, egg-bearing females were transferred to the hatchery. Mortality of the reused breeders (around 30% of females and 41.4% of males) was significantly higher than that of the new breeders (11.4% of females and around 19.5% of males). The proportion of berried females close to hatching was significantly higher for the new ones (77.4% of the initial number), and the percentage of new females with a large quantity of eggs (63.6%) was higher than that of the reused females (25.6 and 20.9%). Differences among the percentages of females without eggs in the new breeders (11.2%) and the rest of the treatments (30.7 and 39.6%) were significant. The reproductive capacity of reused females was not improved by providing new males. Considering the number of females initially stocked into ponds, mean yield per new female was greater than that of the reused females, mainly due to the higher mortality recorded in the reused broodstock. Although the yield that can be obtained using the same breeders in two reproductive cycles drops in the second one, the production was not negligible.

(Department of Animal Production II, Universidad de León, Campus de Vegazana s/n, León, 24071, Spain; dp2jcv@unileon.es)

EFFECT OF STOCKING DENSITY ON SURVIVAL AND GROWTH PERFORMANCE OF PIKEPERCH, SANDER LUCIOPERCA (L.), LARVAE UNDER CONTROLLED CONDITIONS

Maciej Szkudlarek, Zdzisław Zakeś-2007

Aquaculture International 15(1): 67-81

Abstract:

The effect of stocking density on the survival and growth of pikeperch, *Sander lucioperca* (L.), larvae was examined in two consecutive experiments. In experiment I, 4-day-old larvae [body wet weight (BW): 0.5 mg; total body length (TL): 5.6 mm] were reared in 200-l cylindro-conical tanks in a closed, recirculating system ($20 \pm 0.5^\circ\text{C}$) at three stocking densities (25, 50 and 100 larvae l⁻¹) and fed a mixed feed (*Artemia nauplii* and Lansy A2 artificial feed) for 14 consecutive days. At densities of 25 and 100 larvae l⁻¹, growth rate and survival ranged from 2.7 to 1.9 mg day⁻¹ and from 79.2 to 72.3%, and fish biomass gain ranged from 0.6 to 2.0 g l⁻¹, respectively. There were two periods of increased larval mortality: the first was at beginning of exogenous feeding and the second during swim bladder inflation. In experiment II, 18-day-old larvae (BW: 35 mg; TL: 15.6 mm) obtained from experiment I were reared under culture conditions similar to those of experiment I, but at lower stocking densities (6, 10 and 15 larvae l⁻¹). The fish were fed exclusively with artificial feed (trout starter) for 21 consecutive days. At densities of 6 and 15 larvae l⁻¹, the growth rate and fish biomass gain ranged from 28.8 to 23.1 mg day⁻¹ and from 2.0 to 3.3 g l⁻¹, respectively. The highest survival (56.5%) was achieved at a density of 6 larvae l⁻¹. Mortality at all densities was mainly caused by cannibalism II type behaviour (27–35% of total). In both experiments, growth and survival were

negatively correlated and fish biomass gain positively correlated with stocking densities. The present study suggests that the initial stocking density of pikeperch larvae reared in a recirculating system can be 100 individuals l⁻¹ for the 4- to 18-day period post-hatch and 15 individuals l⁻¹ for the post-19-day period.

(Department of Aquaculture Research, The Stanisław Sakowicz Inland Fisheries Institute, Oczapowskiego 10, 10-719 Olsztyn, Poland; email of Maciej Szkudlarek: szkudlarek@infish.com.pl)

THE EFFECT OF DIFFERENT DIETS ON THE GROWTH AND MORTALITY OF JUVENILE PIKEPERCH (SANDER LUCIOPERCA) IN THE TRANSITION FROM LIVE FOOD TO FORMULATED FEED

M. Bódis, B. Kucska, M. Bercsényi-2007

Aquaculture International 15(1): 83-90

Abstract:

The efficiencies of four feeding methods were compared in the transition period from live food to dry feed in pikeperch (*Sander lucioperca*). Pond-nursed fry were trained to artificial feed without a transition (Group P) and with a transition, using a combination of dry feed and different kinds of live food—*Chironomus* larvae (Group C), *Tubifex* (Group T) and *Daphnia* (Group D)—during a 12-day-long trial. The ratio of dry feed for the transition groups was increased from 0 to 100% in 3-day intervals. The highest specific growth rates and condition factors were detected for Group C (4.2%, 1.46 ± 0.5) and Group T (4.2%, 1.48 ± 0.6), respectively. The survival percentages of the groups were as follows: $86.7 \pm 9\%$ (Group C), $78 \pm 4\%$ (Group T), $52 \pm 1.4\%$ (Group D) and $41 \pm 9\%$ (Group P). The rate of cannibalism ranged between 6.3 and 13.7% during the transition period. Larger-sized fish seemed to learn more rapidly to accept dry feed than their smaller counterparts.

(Georgikon Faculty of Agriculture, University of Pannon, Deák F. st. 16., Keszthely, 8360, Hungary; email of M. Bódis: bodis-m@georgikon.hu)

DIETARY MICROBIAL PHYTASE AND CITRIC ACID SYNERGISTICALLY ENHANCES NUTRIENT DIGESTIBILITY AND GROWTH PERFORMANCE OF LABEO ROHITA (HAMILTON) JUVENILES AT SUB-OPTIMAL PROTEIN LEVEL

Kartik Baruah, Narottam P. Sahu, Asim K. Pal, Kamal K. Jain, Dipesh Debnath, Subhas C. Mukherjee-2007

Aquaculture Research 38(2): 109–120.

Abstract:

A $2 \times 2 \times 2$ factorial experiment was designed to study the main effect of dietary microbial phytase, citric acid, crude protein (CP) level and their interactions on growth performance, nutrient digestibility and body composition of *Labeo rohita* juveniles. Two basal diets were formulated using plant-based ingredients containing either sub-optimum (25%) or normal (35%) CP levels. Both the diets were supplemented with microbial phytase (U kg⁻¹) and citric acid (%) at the level of 0, 0; 500, 0; 0, 3; and 500, 3 respectively. One hundred and twenty *L. rohita* juveniles (average weight 12.61–13.72 g) were randomly distributed in eight treatments, each with three replicates. Dietary microbial phytase alone had no significant effect on whole-body ash content but addition of citric acid (3%) in the diet activated the phytase as evidenced by their significant interaction. A significant interaction between citric acid and microbial phytase was also found on weight gain%, specific growth rate, protein efficiency ratio. Increasing the dietary CP level from 25% to 35% significantly ($P < 0.01$) decreased phosphorus and dry matter digestibility. Thus, these results showed that the growth-promoting effect was higher in groups fed a sub-optimum protein (25%) diet containing both 3% citric acid and 500 U kg⁻¹ of microbial phytase than those fed 35% CP diets. This suggests that microbial phytase and citric acid in sub-optimum CP diet had a synergistic effect on nutrient digestibility and growth performance of *L. rohita* juveniles.

(Laboratory for Aquaculture and Artemia Reference Center, Faculty of Bioscience Engineering, Department of Animal Production, Ghent University, Ghent, Belgium; email of N P Sahu: npsahu1@rediffmail.com)

SKELETAL DEVELOPMENT AND DEFORMITIES IN CULTURED LARVAL AND JUVENILE SEVEN-BAND GROUPEL, EPINEPHELUS SEPTEMFASCIATUS (THUNBERG)

N. Nagano, Akiko Hozawa, Wataru Fujiki, Toshiyuki Yamada, Kadoo Miyaki, Yoshitaka Sakakura, Atsushi Hagiwara-2007

Aquaculture Research 38(2): 121–130.

Abstract:

The seven-band grouper, *Epinephelus septemfasciatus* (Thunberg), is currently recognized as a potential new species for aquaculture in Japan. This study describes normal and abnormal skeletal development of the jaw and vertebrae in cultured larvae and early juveniles of *E. septemfasciatus*. The ontogenetic stages at which skeletal deformities of jaw and vertebra developed were also described for this species. Osteological observations were made using a clearing and staining method for larvae and soft X-ray photographs for juveniles. A high incidence of skeletal deformities was observed in the jaws and vertebral column during the larval and juvenile stages. Most of the jaw deformities were explained by an abnormal maxilla curvature. Jaw deformities were visually evident from flexion stage after ossification of the deformed elements. Deformities in the vertebral column (mostly lordosis) were observed from the post-larval stage and became more evident as growth proceeded. The lordosis generally occurred on the positions of the 8–11th vertebra. These types of deformities are compared with those of other species, and possible causative factors of the skeletal deformities are discussed.

(Nagasaki Industrial Promotion Foundation, Nagasaki Prefectural Institute of Fisheries, Nagasaki, Japan; email of N. Nagano: n-nagano@cc.miyazaki-u.ac.jp)

FIRST RESULTS ON A RELATION BETWEEN OVARIAN FLUID AND EGG PROTEINS OF SALMO TRUTTA AND EGG QUALITY Aquaculture Research

Franz Lahnsteiner-2007

Aquaculture Research 38 (2): 131–139

Abstract:

By use of sodium dodecyl sulfate polyacrylamide gel electrophoresis, ovarian fluid proteins and main proteins of unfertilized eggs were qualitatively and quantitatively investigated in the brown trout, *Salmo trutta*, to see whether some of them were correlated with the rate of embryos reaching the eyed embryo stage. In the ovarian fluid, 12 types of proteins in the range of 39–166 kDa were detected whereby three proteins were lipoproteins and two were glycoproteins. Ovarian fluid proteins with a molecular weight of 85, 68, 62 and 39 kDa were negatively correlated with the percentage of eyed stage embryos. The statistical significance of the relations was low in simple and multiple regression models ($R^2 \leq 0.534$) indicating that the relations were influenced and superposed by other factors. Therefore, ovarian fluid proteins give only poor information about maturity and quality of eggs. In the eggs, nine major types of proteins in the range of 95–15 kDa were identified. The 95 kDa protein was a lipoprotein, the 85 and the 62 kDa protein were glycoproteins, and the 15 kDa protein was a phosphoprotein. The 95, 85, 77 and 39 kDa protein were positively correlated with embryo survival to the eyed embryo stage. The explanatory effect of the multiple regression model was very high ($R^2 = 0.961$) indicating that distinct egg proteins are closely related with egg quality.

(Department for Organismic Biology, University of Salzburg, Hellbrunnerstrasse 34, 5020 Salzburg, Austria; Franz.Lahnsteiner@sbg.ac.at)

IMPROVED PERFORMANCE OF GILTHEAD SEA BREAM, SPARUS AURATA, LARVAE AFTER OZONE DISINFECTION OF THE EGGS

Isashar Ben-Atia, Sigal Lutzky, Yoav Barr, Kutsal Gamsiz, Yariv Shtupler, Amos Tandler, William Koven-2007

Aquaculture Research 38 (2): 166–173.

Abstract:

Ozone (O₃) dissolved in seawater (ODS) was evaluated, as an egg disinfectant, on the spawn of captive gilthead sea bream, *Sparus aurata*, brood stock. Four contact times (CT) were tested (0.6, 1.2, 2.4 and 4.8 mg min L⁻¹) where CT was calculated by multiplying the dissolved O₃ concentration (0.3 mg L⁻¹) by different exposure periods (2, 4, 8, 16 min). There was also a disinfected seawater treatment that contained no O₃ or derived compounds (CT 0) and an untreated seawater control. All ODS treatments reduced egg surface bacterial counts to zero, which was significantly ($P < 0.05$) lower than the CT 0 and the control groups (194 and 1320 plate⁻¹ respectively). Nevertheless, the hatching rate was high in the control and the CT treatments 0, 0.6 and 1.2 (88.7%, 87.3%, 89.5% and 83.7% respectively) while eggs exposed to a CT 2.4 and 4.8 hatched poorly (36.5% and 20.4% respectively), which was likely due, at least in part, to larvae unable to break the egg chorion successfully. Swim-bladder inflation was significantly higher in the ODS groups (>97%) compared with the control and CT 0 treatments (ca. 70%). The results suggest that a 2-min exposure of eggs to 0.3 mg O₃ L⁻¹ of ODS (CT 0.6) would improve current protocols in marine larviculture.

(Israel Oceanographic and Limnological Research, The National Center for Mariculture, Eilat; email of W. Koven: Koven@ocean.org.il)

EFFECT OF TANK PROPORTIONS ON SURVIVAL OF SEVEN-BAND GROUPEPINEPHELUS SEPTEMFASCIATUS (THUNBERG) AND DEVIL STINGER INIMICUS JAPONICUS (CUVIER) LARVAE

Yaowalux Ruttanapornvareesakul, Yoshitaka Sakakura, Atsushi Hagiwara-2007

Aquaculture Research 38 (2): 193–200

Abstract:

We examined the effects of rearing-tank proportions on early survival, surface death and growth of the seven-band grouper *Epinephelus septemfasciatus* (Thunberg) and the devil stinger *Inimicus japonicus* (Cuvier). Fertilized eggs were introduced into three differently shaped 100 L rearing tanks. The three tanks had different water surface areas, and included a shallow tank (S; 71 × 26 cm in diameter and depth, respectively), an intermediate tank (I; 57 × 39 cm) and a deep tank (D; 44 × 70 cm). Both species showed their highest survival rate and the lowest numbers of surface death in the D tank ($P < 0.05$). There were no significant differences between fish reared in the three tank shapes in notochord length, total length, growth rate and dry weight. Rearing-tank shape affected larval movement in the water column, with the duration of larval movement under the water surface being the shortest in the D tank. These results suggest that using a rearing tank of a suitable shape could significantly reduce the surface death of marine fish larvae.

(Nagasaki Industrial Promotion Foundation, Nagasaki, Japan; email of Y. Sakakura: sakakura@nagasaki-u.ac.jp)

PHYSICAL, BIOCHEMICAL AND FUNCTIONAL CHARACTERIZATION OF HAEMOGLOBIN FROM THREE STRAINS OF ARTEMIA

Vasudevan Sugumar, Natesan Munuswamy-2007

Comparative Biochemistry and Physiology - Part A: Molecular & Integrative Physiology 146(2): 291-298

Abstract:

The brine shrimp, *Artemia*, an inhabitant of coastal and inland salterns, encounter fluctuations in the salinity which in turn influences the oxygen availability of their habitat. Hence, experiments were performed to analyze variations in haemoglobin structure and patterns of three strains of *Artemia* from South India and also to reflect the effect of varying oxygen levels in their habitat. Haemoglobins were purified on a DEAE–Sephadex column and haemoglobin types were analyzed by comparing their relative mobility on a non-denaturing medium. Furthermore, their molecular masses were determined by gel filtration in Sepharose column and by dodecylsulfate polyacrylamide gel electrophoresis. Results clearly reveal the presence of three distinct extracellular haemoglobins Hb I, Hb II and Hb III in Tuticorin strain while the other strains displayed only trails or the complete absence of Hb III and Hb II. Estimated molecular masses of these haemoglobins are 235,000–250,000

Da. Denaturation of the reduced and alkylated haemoglobins revealed apparently one polypeptide chain with a molecular mass of 124,000 Da. Upon denaturing gel electrophoresis of native haemoglobin Hb II, it was found that the 124,000 Da, polypeptide was cleaved specifically into two unequally-sized fragments of 50,400 and 79,800 Da. With regard to oxygen affinity, Hb III has a very high affinity for oxygen, an almost negligible Bohr effect and a good physiological adaptation to temperature changes. By combining the three haemoglobins in different proportions *Artemia* strains must be able to withstand diverging environmental conditions. In particular, the absence of Hb III in Puthalam and its occurrence as a faint band in Thamaraiikulam could be correlated to the oxygen levels of their habitats.

(Department of Zoology, University of Madras, Guindy Campus, Chennai 600025, Tamil Nadu, India; email of Vasudevan Sugumar: vasu_sugumar@yahoo.co.in)

LIPID AND FATTY ACID CONTENT IN WILD WHITE SEABREAM (*DIPLODUS SARGUS*) BROODSTOCK AT DIFFERENT STAGES OF THE REPRODUCTIVE CYCLE

M.J. Pérez, C. Rodríguez, J.R. Cejas, M.V. Martín, S. Jerez, A. Lorenzo-2007

Comparative Biochemistry and Physiology Part B: Biochemistry and Molecular Biology 146(2): 187-196

Abstract:

The lipid and fatty acid content of the gonads, liver and muscle of wild white seabream males and females was studied at different stages of the reproductive cycle. Samples were taken from mature white seabream at pre-spawning (November), mid-spawning (March) and post-spawning (June) stages. The results showed that lipid accumulates in gonads and muscle from November to March. The gonadosomatic index (GSI) was also increased during this period. Male gonads showed a greater increase in polar lipid (PL) than neutral (NL), while female gonads displayed the reverse. The increase in both neutral and polar lipid was higher in the muscle of males than in females. In the same period, male livers showed no changes either in lipid content or the hepatosomatic index (HSI), while female livers registered an increase in both lipid content and HSI. Between March and June, in both males and females, total, neutral and polar lipid decreased sharply in the gonads and muscle. Muscular lipid content reduction was more pronounced in males than females. On the other hand, the lipid content of the liver in males and females remained relatively constant. In general terms, the amounts of major fatty acids (16:0, 18:1n-9, 20:5n-3 and 22:6n-3) in gonadal and muscular polar and neutral lipid in both males and females increased from November to March and declined thereafter. Variations of the liver fatty acid content were less extreme. In the period from mid-spawning to post-spawning, the presence of 20:4n-6 in polar and neutral lipid increased to a notable extent in all organs studied.

(Dpto. de Biología Animal (U.D.I. Fisiología), Fac. de Biología, Univ. de La Laguna, 38206 S/C de Tenerife, Spain ; email of A. Lorenzo: alorenhe@ull.es)
