

WHAT ROLE FOR GENOMICS IN FISHERIES MANAGEMENT AND AQUACULTURE?

Roman Wenne, Pierre Boudry, Jakob Hemmer-Hansen, Krzysztof P. Lubieniecki, Anna Was, Antti Kaase-2007

Aquatic Living Resources 20: 241-255

Abstract :

The development and application of genomics has been facilitated in a number of fields by the availability of new methodologies and tools, such as high throughput DNA sequencing and complementary DNA (cDNA) microarrays. Genomic tools are already used in research on commercially important fish and shellfish species. Thousands of expressed sequence tags (EST) are now available for some of these species, and the sequencing of complete genomes of tilapia, cod, salmonids, flatfishes, sea bass and Pacific oyster has been proposed. Microarray technology through simultaneous analysis of the expression of thousands of genes allows the identification of candidate genes involved in the function of multiple physiological, morphological and behavioural traits of interests in organisms and populations from different environments. This paper reviews the current development of genomic technologies, and pinpoints their potential beneficial applications as well as implications for fisheries management and aquaculture.

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OCCURRENCE OF ALLOCHTHONOUS ARTEMIA SPECIES IN THE BOHAI BAY AREA, PR CHINA, AS CONFIRMED BY RFLP ANALYSIS AND LABORATORY CULTURE TESTS

Van Stappen Gilbert, Yu Haiying, Wang Xiaomei, Hoffman Stefan, Cooreman Kris, Bossier Peter, Sorgeloos Patrick-2007

Fundamental and Applied Limnology / Archiv für Hydrobiologie, 170(1): 21-28

Abstract:

Nauplii of the brine shrimp *Artemia*, predominantly *Artemia franciscana* Kellogg 1906, are the most common live food used in marine larviculture. Through aquaculture activities, this species may get dispersed into nearby saltworks, resulting in competition with, and sometimes extinction of the local *Artemia* populations. This work assesses, how the *Artemia* species composition in the Bohai Bay, China, an area with intensive aquaculture activities, has changed over recent years. Seventeen *Artemia* cyst samples, harvested in Bohai Bay saltworks from 1989 onwards, were used for HpaII analysis of a 1500 bp mitochondrial rDNA fragment in the individual cysts. The results were compared with a database consisting of 133 different populations belonging to all known *Artemia* species. The sex ratio of the populations was determined through laboratory culture tests. Four different genotypes represented by RFLP patterns typical for parthenogenetic populations, *Artemia sinica* Cai 1989 and *A. franciscana*, and one new pattern, very similar to the *A. franciscana* pattern, were observed. Nearly all samples consisted of varying mixtures of parthenogenetic and *A. franciscana* and/or *A. sinica* individuals. The results of the laboratory culture tests were less conclusive due to limited hatching and/or survival in several samples. The fact that the HpaII *franciscana* genotype shows up in 11 out of 17 samples, demonstrates that *A. franciscana* has become a competitor - and in view of its competitive advantage, probably a threat - for the autochthonous parthenogenetic Bohai Bay populations. The presence of *A. sinica* in a coastal environment is a new observation. This expansion of the exotic *A. franciscana* is discussed in the light of similar observations elsewhere in the world.

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STOCKING SUCCESS OF LOCAL-ORIGIN FRY AND IMPACT OF HATCHERY ANCESTRY: MONITORING A NEW STEELHEAD (*ONCORHYNCHUS MYKISS*) STOCKING PROGRAM IN A MINNESOTA TRIBUTARY TO LAKE SUPERIOR

David C. Caroffino, Loren M. Miller, Anne R. Kapuscinski, Joseph J. Ostazeski-2008

Can. J. Fish. Aquat. Sci. 65(2): 309–318

Abstract:

The inception of a hatchery program to rebuild a naturalized steelhead (*Oncorhynchus mykiss*) population in Minnesota waters of Lake Superior gave us the rare opportunity to monitor the success of fry stocking and determine if hatchery ancestry can reduce fitness of stocked fish in the early generations of a stocking program. Through genetic monitoring of two year classes, we determined that hatchery adults produced 1.3-6.2 times as many age-2 juveniles per female than naturally spawning fish. Survival of stocked fry of parents born in a hatchery relative to those of parents born in the wild was 70% in paired-stocking comparisons. These results suggest that stocking local-origin fry can increase the short-term abundance of depleted populations and that fish with no hatchery history are a better source for supplemental stocking. Additionally, sampling small numbers of adults for broodstock created genetically distinct groups, which could potentially cause long-term genetic change in the population. Genetic monitoring of adults will be essential to determining whether differences observed persist through the life cycle of the stocked fish.

HATCHERY-INDUCED MORPHOLOGICAL VARIATION IN AN ENDANGERED FISH: A CHALLENGE FOR HATCHERY-BASED RECOVERY EFFORTS

Mark C. Belk, Lisa J. Benson, Josh Rasmussen, Steven L. Peck-2008

Can. J. Fish. Aquat. Sci. 65(3): 401–408

Abstract:

Recovery plans for many endangered fishes include production of large numbers of individuals in hatcheries to augment wild populations. However, effects of hatchery culture on phenotypic development are poorly documented for most species. June sucker (*Chasmistes liorus*) is an endangered lake sucker endemic to Utah Lake (Utah, USA), and recovery plans include raising thousands of juveniles to stock in the lake. To determine effects of hatchery culture on morphology of young June sucker, we raised individuals from four different families in both lake and hatchery environments and compared shape variation among families and between environments. We compared shape from three perspectives: lateral body, ventral mouth, and lateral head views. Mean shape varied between hatchery-reared and lake-reared individuals in each of the three views. In addition, hatchery-reared individuals exhibited higher variance in shape both within and among families compared with shape variance in lake-reared individuals. Hatchery-reared individuals exhibited divergent phenotypes compared with lake-reared individuals. These results suggest that exposure to the native environment during early life stages may be important for phenotypic development suitable to native habitats. Hatcheries should incorporate designs and practices to minimize divergent phenotypic development of individuals.

SEXUAL DIMORPHISM IN *ARTEMIA URMIANA* GÜNTHER 1899 (ANOSTRACA: ARTEMIIDAE) FROM THE URMIA LAKE, WEST AZERBAIJAN, IRAN

Alireza Asem, Nasrullah Rastegar-Pouyani-2007

Journal of Animal and Veterinary Advances 6(12): 1409-1415

Abstract:

Sexual dimorphism is an important subject in biosystematic and evolutionary studies of the animal kingdom. In this survey, 4 geographical stations have been chosen from the Urmia Lake (west Azerbaijan, Iran). Males and females of *Artemia urmiana* were examined in order to study sexual dimorphism. The t-test was used to find out significant differences between means. For classified the male and female samples in each station, Principal Components Analysis (PCA) and Discriminant Function Analysis (DA) were used. PCA analysis let us to separate male and female groups in each station. Also by using DA we can find out that %100 of original groups were correctly classified. This research shows that *A. urmiana* in each 4 different stations is a sexually dimorphic. Also size differences between male and female can be interpreted as mating advantage; according to *Artemia* breeding mechanism, the female carries male during copulation process then large size of female is necessary for this breeding system and can prove mating process.

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DIFFERENT SALINITIES EFFECT ON BIOMETRY OF NAUPLII AND META-NAUPLII OF TWO ARTEMIA (CRUSTACEA; ANOSTRACA) POPULATIONS FROM URMIA LAKE BASIN

Informal communication by:

Alireza Asem, Ramin Manaffar, Nasrullah Rastegar-Pouyani-2008

Abstract:

The brine shrimp, *Artemia* is a cosmopolitan genus, distributed in all over temperate and tropical areas of the world. In these days, the nauplii and meta-nauplii are undoubtedly the most widely used from adult *Artemia* in aquaculture, especially as live food. In this survey the effect of different salinities were studied on larvae size of *Artemia urmiana* and commercial parthenogenetic *Artemia* populations from the vicinity of the Urmia Lake, northwestern Iran. The result shows that different salinities can affect biometry of nauplii and meta-nauplii. This is the first record which shows the effect of salinity on the nauplii size. This character can be used for description of different populations of *Artemia* aside other parameters. Also the larvae size, especially, the nauplii size is a very important character for feeding marine fish larvae because they can't ingest large nauplii. Therefore, with regard to our findings, the suitable size of nauplii can be obtained for the aquaculture systems.

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MODULATION OF DIGESTIVE ENZYME ACTIVITIES DURING ONTOGENY OF LABEO ROHITA LARVAE FED ASCORBIC ACID ENRICHED ZOOPLANKTON

Gopa Mitra, P.K. Mukhopadhyaya, S. Ayyappan-2008

Comparative Biochemistry and Physiology - Part A: Molecular & Integrative Physiology 149 (4): 341-350

Abstract:

The effect of supplementation of ascorbic acid through enriched zooplankton [10%, 20% and 30% ascorbyl palmitate (AP) inclusion in diet of zooplankton] on different digestive enzyme activities during ontogeny of *Labeo rohita* larvae was studied from 4 day to 15 day post hatch. Ascorbic acid (AA) content in different groups of unenriched (8.6 ± 0.71) and enriched zooplankton were, 750 ± 29.3 , 1409.1 ± 45.5 , 2009.21 ± 199.2 $\mu\text{g/g}$ respectively on dry matter basis with differences ($P < 0.05$) between the treatments. A difference ($P < 0.05$) was found in tissue AA level in different dietary groups. Low amylase, protease, lipase and alkaline phosphatase activities were present in rohu larvae from the mouth opening stage which showed increasing trend with the age of larvae and increasing dietary AA content. A clear dose-dependent modulation of digestive enzyme activities in response to 10%, 20% and 30% AP enriched zooplankton feeding was evidenced from positive correlations between dietary

AA content with magnitude of elevation of enzyme activity in different groups. There were 57, 55, 29.2 and 2 fold increases in amylase activity; 7.35, 7.02, 4.43 and 2.73 fold increases in protease activity; 45.636, 41.50, 19.83 and 13.69 fold increases in lipase activity and 6, 5, 3, and 2 fold increases in alkaline phosphatase activity observed in the 15th day post hatch larvae fed 20%, 30%, 10%AP enriched and normal zooplankton respectively, than 4-day post hatch larvae of the respective groups. Enzyme activities were also positively correlated with specific growth rates of wet weight of rohu larvae at the 15th day post hatch. Increased AA might have played an important role in advancing morphological transformation of the digestive tract, protecting gastric mucosa and accelerating growth by the process of tissue formation, which necessitated the requirement of more nutrient thereby, increasing digestive enzyme activity. The regulatory role of AA in the modulation of different digestive enzymes activity and its physiological consequences of nutrient digestibility and utilization during ontogenesis could be extrapolated for better nutrient management of the larvae.

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EFFECT OF REARING TEMPERATURE ON SEX RATIO IN JUVENILE ATLANTIC HALIBUT, HIPPOGLOSSUS HIPPOGLOSSUS

Victoria Hughes, Tillmann J. Benfey, Deborah J. Martin-Robichaud-2008

Environmental Biology of Fishes 81(4): 415-419

Abstract:

Several flatfish species exhibit temperature-dependent sex determination. This research investigated the effects of rearing temperature on sex ratio in Atlantic halibut, *Hippoglossus hippoglossus*, a species in which females grow larger and faster than males under culture conditions. Previous research has shown that ovarian differentiation occurs in Atlantic halibut in the size interval of 38–50 mm, and precedes the differentiation of testes. In the current study, triplicate groups of juvenile Atlantic halibut were reared at each of three temperatures (7, 12 and 15°C) from an initial mean size of 21 mm to a final mean size of 80 mm (total length). The sex of each fish was then determined by macroscopic and histological examination of the gonads. Sex ratios were not significantly different from 1:1 in any group, suggesting that sex in this species is not influenced by temperature.

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AQUACULTURE PRACTICES IN NORTHEAST INDIA: CURRENT STATUS AND FUTURE DIRECTIONS

S. Munilkumar, M. C. Nandeeshha-2007

Fish Physiology and Biochemistry 33(4): 399-412

Abstract:

The northeast region of India, comprised of the states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura, is blessed with rich biodiversity and fisheries resources. With more than 90% of population being fish eaters, there is heavy demand for fish but a wide gap exists between supply and demand. The region produces over 0.214 million tons of fish annually, with almost 50% coming from aquaculture. Aquaculture development in the region is taking place at a rapid rate. However, efforts are necessary to increase the present level of production through both horizontal and vertical expansion. The region has rivers, coldwater streams, floodplain wet lands, reservoirs, lakes, ponds, paddy fields, and mini-barrages to support large-scale aquaculture activities, which can not only produce fish to meet regional requirements, but also export the surplus. This paper describes and discusses the current status of aquaculture, production level, constraints, and future directions towards achieving “fish for all” in the region.

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THE ISOELECTRIC POINT, A KEY TO UNDERSTANDING A VARIETY OF BIOCHEMICAL PROBLEMS: A MINIREVIEW

F. M. A. H. Schuurmans Stekhoven, M. H. A. G. Gorissen, G. Flik-2007

Fish Physiology and Biochemistry 34(1) : 1-8

Abstract: We address the importance of the isoelectric point (IEP) of proteins and membrane components such as phospholipids for our understanding and interpretation of isoforms and opposite charge interactions in the formation of complexes. Five examples drawn from the literature are newly approached from the IEP point of view to clarify general principles.

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EFFECTS OF DIETARY PHOSPHOLIPID LEVEL IN COBIA (RACHYCENTRON CANADUM) LARVAE: GROWTH, SURVIVAL, PLASMA LIPIDS AND ENZYMES OF LIPID METABOLISM

J. Niu, Y. J. Liu, L. X. Tian, K. S. Mai, H. J. Yang, C. X. Ye, Y. Zhu-2007

Fish Physiology and Biochemistry 34(1) : 9-17

Abstract:

A study was conducted to determine the effects of dietary phospholipid (PL) levels in cobia (*Rachycentron canadum*) larvae with regard to growth, survival, plasma lipids and enzymes of lipid metabolism. Fish with an average weight of 0.4 g were fed diets containing four levels of PL (0, 20, 40 and 80 g kg⁻¹ dry matter: purity 97%) for 42 days. Final body weight (FBW), weight gain (WG) and survival ratio were highest in the 8% PL diet group and mortality was highest in PL-free diet group. We examined the activities of lipoprotein lipase (LPL) and hepatic lipase (HL) in liver, lecithin-cholesterolacyltransferase (LCAT) in plasma as well as plasma lipids and lipoprotein. LCAT activity showed a decrease of more than two-fold in PL-supplemented diet groups compared with the PL-free diet group. HL activity was highest in the 8% PL diet group and the other three groups showed no difference. LPL activity was significantly higher in the PL-supplemented diet groups than in the PL-free diet group. The dietary intervention significantly increased plasma phospholipids and total cholesterol (TC) levels, and the higher free cholesterol (FC) level contributed to the TC level. However, the fish fed PL exhibited a significantly decreased plasma triglyceride (TG) level. The lipoprotein fractions were also affected significantly by the PL. The PL-supplemented diet groups had significantly higher high-density lipoprotein (HDL) compared with the PL-free diet group, but showed a marked decrease in very low-density lipoprotein (VLDL). The results suggested that PL could modify plasma lipoprotein metabolism and lipid profile, and that the optimal dietary PL level may well exceed 80 g kg⁻¹ for cobia larvae according to growth and survival.

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GROWTH AND LIPID COMPOSITION OF ATLANTIC COD (GADUS MORHUA) LARVAE IN RESPONSE TO DIFFERENTLY ENRICHED ARTEMIA FRANCISCANA

Alexandre Sachsa Garcia, Christopher C. Parrish, Joseph A. Brown-2007

Fish Physiology and Biochemistry 34(1) : 77-94

Abstract:

Considerable progress has been achieved in the intensive culture of Atlantic cod (*Gadus morhua*). However, there is little information concerning optimum live-feed enrichments for cod larvae, since many of the techniques used during the larviculture have been borrowed from other fish species and adapted for the production of Atlantic cod. The present study compared four different protocols for the enrichment of *Artemia* to be used as live feed for cod larvae. The protocols tested were: (1) AlgaMac 2000, (2) AquaGrow Advantage, (3) Pavlova sp. + AlgaMac 2000, and (4) DC DHA Selco + AlgaMac 2000. Larvae were fed differently enriched *Artemia* between 37 and 59 days post hatch. At the end of the experiment, larvae from treatment 1 [specific growth rate (SGR) = $10.4 \pm 0.4\%$ day⁻¹] grew faster than larvae from treatments 3 (SGR = $6.9 \pm 0.2\%$ day⁻¹) and 4 (SGR = $4.9 \pm 0.4\%$ day⁻¹, $P < 0.0001$). However, treatments 3 and 4 resulted in better larval survival at the end of the experimental period, estimated to be 3 on a scale from 1 to 5, whereas the survival estimates for the two other groups were 2. The treatments affected the fatty-acid composition of *Artemia* and of cod larvae. Larvae from treatment 1 had a higher percentage of AA (20:4 ω 6, $P < 0.0001$) and ω 6DPA (22:5 ω 6, $P < 0.0001$) than the other larvae. Levels of DHA (22:6 ω 3) were similar in larvae from treatments 1 and 4, and higher than in the other larvae ($P < 0.0001$). Our results suggest that *Artemia* containing a DHA/EPA/AA ratio of 7/2/1 result in good larval performance.

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DNA INTEGRITY OF POLYODON SPATHULA CRYOPRESERVED SPERM

P. Li, Q. Wei, L. Liu-2008

Journal of Applied Ichthyology 24(2): 121-125

Abstract:

Comet assay was used to detect DNA integrity of paddlefish (*Polyodon spathula*) sperm following cryopreservation. At the same time, sperm velocities prior to freezing and post-thawing were also assessed by the computer-assisted sperm analysis (CASA) system. Significant differences ($P < 0.05$) were detected in the degree of DNA damage in cryopreserved sperm using different extenders. According to osmolality of the extenders, DNA damages of Sb (20 mm Tris, 75 mm sucrose, 0.5 mm KCl, pH 8.5) sperm was the least, which showed that the percentage of tail DNA of Sb (17.87–35.28%) was lower than those of Sa (20 mm Tris, 50 mm sucrose, 0.5 mm KCl, pH 8.5) and Sc (20 mm Tris, 100 mm sucrose, 0.5 mm KCl, pH 8.5). Moreover, A and B class sperm cells provided most of the Sb sperm (>50%). However, in light of the concentration of methanol, DNA damages of M8 (8% methanol concentration) sperm were the least, including a lower percentage of the tail DNA (21.56–30.86%), and C and D class sperm cells (<30%), regardless of the osmolality of the extenders. In conclusion, when the dilution was 20 mm Tris, 75 mm sucrose, 0.5 mm KCl, pH 8.5 and the concentration of methanol was 8%, the extenders were the best for cryopreservation of paddlefish sperm. In addition, the results indicated that the extent of damage to sperm motility caused by freeze-thawing (VCL, VSL) was correlated with DNA breakage ($|r| > 0.8$). This implied that cryopreservation could damage sperm DNA of paddlefish and affect the sperm velocities when the osmolality and the concentrations of the cryoprotectants of the extender were inappropriate.

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MEASUREMENTS OF LARVAL ATLANTIC COD (GADUS MORHUA) ROUTINE METABOLISM: TEMPERATURE EFFECTS, DIEL DIFFERENCES AND INDIVIDUAL-BASED MODELING

M. A. Peck, L. J. Buckley-2008

Journal of Applied Ichthyology 24 (2): 144–149

Summary:

In the present study, dry mass (MD, μg) and routine respiration rate (RR) ($\mu\text{l O}_2 \text{ ind}^{-1} \text{ h}^{-1}$) were measured for larval cod, *Gadus morhua* (L.) that were reared and tested at 5.0, 7.5, and 10.0°C. Bi-hourly measurements of RR were made on groups of larvae using a closed-circuit respirometer over a 24-h period (14L : 10D light regime) to test temperature and body size effects and whether unfed larvae exhibited diel differences in metabolism. At 10°C, the relationship between mean RR and mean MD was: $\ln \text{RR} = 1.16 \cdot \ln \text{MD} - 6.57$ ($n = 31$, $r^2 = 0.883$, $P < 0.001$). The exponential increase in RR with temperature was described by a Q10 of 3.00. Diel differences in unfed larvae were only apparent in groups of the largest larvae. A comparison of Q10 estimates from this and other studies suggest a linear decrease in the effect of temperature on cod RR with increasing log MD for sizes encompassing larvae to large juveniles. The trend may explain, in part, observations of cod juveniles exploiting a wider range of in situ temperatures than larvae. Finally, the two most comprehensive data sets on larval cod RR compare poorly (approximately five-fold differences) and our results support the assertion that daily metabolic energy loss in many larval cod individual-based models were based upon measurements that over-estimated hourly metabolic rates by a factor of approximately four.

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EARLY DEVELOPMENT OF THE AFRICAN CATFISH CLARIAS GARIOPINUS (BURCHELL, 1822), FOCUSING ON THE ONTOGENY OF SELECTED ORGANS

A. G. M. Osman, S. Wuertz, I. A. Mekki, J. Verreth, F. Kirschbaum-2008

Journal of Applied Ichthyology 24 (2): 187–195

Summary:

Embryonic development of *Clarias gariepinus* was studied from oocyte activation to the end of endogenous feeding (164 h post-fertilization, 164 h-PF). The ontogeny of the eyes, the ear, the heart, the digestive tract and the notochord were described histologically: (i) eyes were not pigmented at hatching (40 h-PF) and the anlage of the retina was observed at 96 h-PF. At 164 h-PF, the pigmented epithelium was distinguished as a single layer of cubical cells and the outer nuclear layer was composed of cones; (ii) the inner ear was oval-shaped and two otoliths and a sensory epithelium were differentiated at hatching. Three semicircular canals with rudimentary cristae developed until 96 h-PF, leading to a fully developed auditory vesicle at 120 h-PF; (iii) at 40 h-PF, a beating heart appeared as a thin-walled tube and at 72 h-PF no blood elements were recorded in the two-chambered heart. The four compartments (bulbus arteriosus, ventricle, atrium, sinus venosus) and mature blood elements were found only at 144 h-PF; (iv) the hatchlings possessed an undifferentiated digestive system, and differentiation of a buccal cavity, oesophagus and intestine was only recorded 96 h-PF. The connection between the oesophagus and the intestine and the anus opened at 144 h-PF; (v) the notochord in newly hatched embryos was composed of vacuolated cells and a peripheral layer of notochordal epithelium inside a fibrous sheath. Subsequently, vacuolated cells proliferated and notochordal epithelium changed from cubical to squamous cells. Eye differentiation was concomitant with first feeding, thus suggesting a key role of visual senses in feeding behaviour.

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PHYTOPLANKTON BLOOM IN COMMERCIAL SHRIMP PONDS USING GREEN-WATER TECHNOLOGY

M. C. M. Cremen, M. R. Martinez-Goss, V. L. Corre Jr., R. V. Azanza-2008

Journal of Applied Phycology 19(6): 615-624

Abstract:

Phytoplankton community composition, density, and succession were studied in tropical commercial ponds with euryhaline tiger shrimp (*Penaeus monodon* Fabricius) using green-water technology at two different stocking densities [T1 10 post-larvae (PL) m⁻² and T2 15 PL m⁻²] in one grow-out season (May–October 2005) in Leganes, Iloilo, Philippines. Weekly qualitative and quantitative analyses of phytoplankton were done along with physicochemical analyses of the pond waters. A total of 103 taxa belonging to nine different algal classes were observed. Of these classes, the Chlorophyceae, Cyanophyceae and Bacillariophyceae constituted the great bulk of the phytoplankton population. The two treatments did not show any significant differences in the growth pattern of phytoplankton over time and in their diversity indices. Although T2 had higher values than T1 for algal density and species diversity index, the differences were not significant. The mean Shannon-Wiener diversity index for T2 (1.56) was higher than T1 (1.39) but not significantly different. Both treatment ponds had Chlorophyceae as the dominant algae during the initial culture phase [0–35 days of culture (DOC)], which coincided with high salinity (average = 35.67 ppt) and relatively high N:P ratios (average = 1.95). The chlorophycean bloom was made up mostly of *Nannochloropsis* sp. The cyanophycean bloom occurred towards the final culture phase (84–112/126 DOC) when there was low salinity (average = 19.5 ppt) and relatively high N:P ratios (average 2.01). A short diatom bloom occurred in T2 at the same time that the N:P ratios rose dramatically to 4.2 at 42 DOC. Among the eight physicochemical parameters examined, positive correlations were noted among alkalinity, ammonium-nitrogen, nitrite-nitrogen and phytoplankton community. High species diversity index and species richness could have enhanced the stability of favorable *Nannochloropsis* blooms, especially in T2. No differences were noted between the two treatments in terms of the shrimp's biomass at harvest time (T1 = 28.9 and T2 = 29.4 g fresh wt per shrimp), although a significantly higher survival rate ($P < 0.05$) was observed in T1 (97%) than in T2 (56%). Both treatments were able to control the occurrence of the luminous bacterium *Vibrio harveyi*.

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ONE-STEP METHOD FOR QUANTITATIVE AND QUALITATIVE ANALYSIS OF FATTY ACIDS IN MARINE ANIMAL SAMPLES

Sakdullah Abdulkadir, Makoto Tsuchiya-2008

Journal of Experimental Marine Biology and Ecology 354(1): 1-8

Abstract:

In the one-step method, fatty acid methyl esters (FAMES) have been prepared without prior lipid extraction. Each oyster, clam, and squid sample was esterified with 14% boron-trifluoride (BF₃) in methanol at 100 °C for 120 min, and hexane was used to help dissolve the lipids. This method gave a higher recovery of fatty acids as compared to the conventional method. Using an internal standard, the fatty acid content of the sample can be determined quantitatively and qualitatively. Due to its simplicity, speed, and reduced organic solvent usage, the one-step method should be useful for the determination of fatty acid composition in marine biological samples.

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A COMPARATIVE STUDY OF THE FATTY ACID PROFILE OF ARTEMIA FRANCISCANA AND A. PERSIMILIS CULTURED AT MESOCOSM SCALE

O. Ruiz, F. Amat, J.C. Navarro-2008

Journal of Experimental Marine Biology and Ecology 354(1): 9-16

Abstract:

The goal of this study was to examine the fatty acid (FA) profile of two Artemia species, *A. persimilis* (Argentina) and *A. franciscana* (Great Salt Lake, Utah; USA) in coexistence at mesocosm scale. The experiment was carried out to 1) evaluate putative differences in the fatty acid composition of both species while they share resources and 2) to investigate the causes of such differences. Although the coexistence of these species in nature has not yet been observed, it remains possible that this situation may arise in the future mainly due to the invasive ability of *A. franciscana*. FA analyses were performed on individuals as well as on pooled biomasses of each species, and integrated in multivariate principal components analysis (PCA). Comparison of the relative abundance of FA between the two species revealed that interspecific differences in FA composition are greater than intraspecific variability. Higher percentages of unsaturation were found in the fatty acids of *A. persimilis* compared to *A. franciscana*, demonstrating that aside from a high phenotypic effect of diet on the FA composition of the animals, a species-specific genotypic effect should not be discarded.

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ASSESSMENT OF THE NUTRITIONAL STATUS OF FIELD-CAUGHT LARVAL PACIFIC BLUEFIN TUNA BY RNA/DNA RATIO BASED ON A STARVATION EXPERIMENT OF HATCHERY-REARED FISH

Yosuke Tanaka, Keisuke Satoh, Harumi Yamada, Takayuki Takebe, Hideki Nikaido, Satoshi Shiozawa-2008

Journal of Experimental Marine Biology and Ecology 354(1): 56-64

Abstract:

RNA/DNA ratio is a useful and reliable indicator of the nutritional status of fish larvae and juveniles. In order to assess the nutritional status of field-caught larval Pacific bluefin tuna *Thunnus orientalis* (Temminck et Schlegel), starvation experiments of hatchery-reared larvae were conducted and changes in the RNA/DNA ratio of fed and starved larvae were analyzed. Starvation experiments were conducted every 3 days after first feeding. The survival rate of Pacific bluefin tuna larvae ranged 10–50% after 1 day of starved conditions and growth retardation was observed immediately. These results suggest that Pacific bluefin tuna larvae have a very low tolerance to starvation. The RNA/DNA ratios of fed larvae were approximately 2.0–4.0. On the other hand, the value of starved larvae significantly decreased to 1.0–3.0. The nutritional status of 3 cohorts of field-caught tuna larvae collected in the northwestern Pacific Ocean was examined based on the value of the RNA/DNA ratio of the 1 day starved larvae. 4.35–25.77% of the cohorts were regarded as the “starving condition”, which was negatively correlated to the ambient prey densities. These findings suggest that the nutritional condition of larval Pacific bluefin tuna was influenced by the ambient prey density, and starvation itself and starvation-induced predation could greatly contribute to mortality in the larval period of Pacific bluefin tuna.

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FATTY ACID AS MARKERS TO DEMONSTRATING TROPHIC RELATIONSHIPS AMONG DIATOMS, ROTIFERS AND GREEN-LIPPED MUSSELS

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Abstract:

Green-lipped mussels *Perna viridis*, collected from Peng Chau, Hong Kong were allotted into two treatment groups, each containing three experimental tanks. The first treatment group comprised of mussels fed with the diatom *Thalassiosira pseudonana* only, whereas the second treatment group contained mussels fed with the marine rotifer *Brachionus plicatilis*, which was in turn fed with diatom *T. pseudonana*. The mussels were fed two times each day over the experimental period of 14 days. On Days 4, 7 and 14, three mussels were collected from each tank of each treatment group and treated as a single replicate. Fatty acid profiles of diatoms, marine rotifers and the three organs (digestive gland, mantle margin and adductor muscle) of the two mussel groups were analyzed. Results showed that monosaturated fatty acid (MUFA) 16:1n7 was conserved along the food chain among diatoms, marine rotifers and green-lipped mussels. This suggested that 16:1n7 or the ratio of 16:1n7 to saturated fatty acid (SFA) 16:0 can be a trophic marker for diatom *T. pseudonana* and elevated amounts of 16:1n7 in mussels can reflect the dominance of diatoms in its diet. The present results also showed that rotifers could accumulate MUFA 18:1n7 and PUFA 20:4n6 which were transferred up to mussels, especially 18:1n7, as zooplankton have the ability to synthesize or actively accumulate certain fatty acids that they need for growth or reproduction. There was an increase in the amount of 18:1n7 in the digestive gland of mussels fed with rotifers but the level of this fatty acid remained unchanged in those fed with diatoms, further confirming that 18:1n7 can be used as a marker for the presence of rotifers in trophic relationship studies. The relatively faster responses in the digestive gland of mussels to acquire the fatty acid signatures from their food suggested that the fatty acid profiles in the digestive gland can be a good marker to show a short-term fluctuation of food conditions in the marine environment.

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NEW BOOK TITLES FROM FAO

Assessment of freshwater fish seed resources for sustainable aquaculture

By: Bondad-Reantaso Melba G.

FAO Fisheries Technical Paper No. 501. Rome, 2007, 666 pp., color plates.

ISBN 978-92-5-105895-4, GBP£80.00

Four of the most important resources to aquaculture, outside human and technological resources, are land, water, seed and feed. Efficient use of these resources are necessary to guarantee optimum production from aquaculture. A project Study and Analysis of Seed Production in Small-scale Rural Aquaculture was implemented through a desk study and expert workshop (held in Wuxi, China from 23-26 March 2006) to assess the status of freshwater fish seed resources and supply and its contribution to sustainable aquatic production. This publication is presented in two parts.

Part 1 contains the proceedings and major recommendations of the expert workshop which tackled three major themes:

(a) seed quality, genetics, technology and certification;

(b) seed networking, distribution, entrepreneurship and certification and (c) how rural fish farmers can benefit from the freshwater aquaculture sector. Part 2 contains the detailed outcomes of the desk study consisting of three regional syntheses (Africa, Asia and Latin America) based on 21 country case studies, five thematic reviews (quality, genetics and breeding, seed networks and entrepreneurship, seed supply in rural aquaculture, farmer innovations and women involvement) and three invited papers (self-recruiting species, decentralized seed networking in Bangladesh and establishment of national broodstock centres in Viet Nam).

Pearl oyster health management. A manual

By: Bondad-Reantaso Melba G., McGladdery, S.E., Berthe F.C.J.

FAO Fisheries Technical Paper No. 503. Rome, 2007, 132 pp., color plates.

ISBN 978-92-5-105896-1, GBP£19.99

The pearl oyster industry is a growing multibillion dollar sector of molluscan aquaculture. The end product of pearl farming, the pearl, is unique to this sector. Pearl production is entirely based upon health.

The pearl itself is a product of the oyster's immune defences as a response to soft-tissue irritation.

Today, most disease problems are caused by opportunistic pathogens taking advantage of oysters weakened by the stress of handling, including pearl surgery and sub-optimal growing conditions. Further development of the industry will inevitably lead to increased risk of disease introduction, spread or emergence. Against such an unwanted future, health management is the critical line of defence. This publication provides guidance on the management of pearl oyster health and reviews pearl oyster mortalities and disease problems that will be useful for designing programmes aimed at reducing the risks from diseases. Part 1 consists of pearl oyster health - the current interest in it and an overview of the cultured marine pearl industry. Part 2 examines pearl oyster health

management: husbandry and handling, hatchery production, diseases, field collections of samples, laboratory protocols, national strategies...

Certain countries in the pearl oyster producing regions have acquired a great deal of experience in health management of cultured species.

Experiences from Australia, the Cook Islands, Japan, French Polynesia, the Philippines, China, the Persian Gulf and the Red Sea are included in Part 3 which also contains a general review of pearl oyster mortalities and disease problems.

Sharks, Rays and Chimaeras. International plan of action for the conservation and management of sharks.

FAO Species Identifications publications excerpts on CD-ROM Rome, 2007 ISBN 978-92-5-105905-0, GBP£15.00

This CD-ROM is a compilation of several FAO species identification publications dealing with Elasmobranchs (Sharks, Rays and Chimaeras). It includes complete publications such as the Catalogue of sharks of the world, the Field guide of sharks and rays of the Mediterranean and Black Seas and the Field guide of sharks and rays of the Red Sea and Gulf of Aden. It also includes excerpts dealing with elasmobranchs from several regional guides: Eastern Central Atlantic, Western Indian Ocean, Southern Ocean, Mediterranean and Black Seas, Eastern Central Pacific, Western Central Pacific and Western Central Atlantic.

Disaster response and risk management in the fisheries sector

By: Westlund, L., Poulain, F., Bage, H., van Anrooy, R.

FAO Fisheries Technical Paper No. 479 Rome, 2007, 70 pp.

ISBN 978-92-5-105765-0 GBP£13.50

Over the last few decades, natural and human-induced disasters have become more frequent and increasingly destructive. Populations depending on fisheries and aquaculture for their livelihoods have become more and more vulnerable and have been seriously affected by loss of life and property.

This document gives an overview of FAO's work with regard to such disasters in the fisheries and aquaculture sectors, together with the lessons learned and experience gained on how to improve disaster response, preparedness and prevention in these sectors. One of the main purposes of this document is to support policy- and decision-makers involved in disaster

response and disaster risk management by increasing their effectiveness in addressing the needs of fishers and coastal communities in relation to disasters.

Report of the Workshop on the age estimation of sardine and sardinella in Northwest Africa. Casablanca, Morocco, 4-9 December 2006 FAO Fisheries Report No. 848 Rome, 2007, 114 pp., Bilingual (En/Fr) ISBN 978-92-5-005868-9, GBP£15.50 The workshop reviewed and discussed the results of an otolith exchange that had been carried out in 2006 and which included both sardine and sardinella otoliths from different locations. The final outcome of the meeting consisted in revised agreed guidelines for the preparation and interpretation of sardine and sardinella otoliths.

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