
1ST ANNOUNCEMENT OF THE 1ST INTERNATIONAL CONFERENCE ON THE ECOLOGICAL IMPORTANCE OF SOLAR SALTWORKS

BACKGROUND:

It is generally accepted that the total worlds' wetland area is continually decreasing due to drainage, cultivation and urbanization, and it is therefore necessary to emphasize the importance of protecting and if possible development of the remaining wetland areas.

Solar Saltworks produce salt by solar evaporation since the dawn of human civilization. Nevertheless the development of a unique coastal ecosystem in parallel with the salt production process evolution, it is not very well known.

Hundreds of protected bird species depend on Solar Saltworks ecosystem to feed and/or nest.

The environmental uniqueness of Solar Saltworks and particularly the modern ones is based in the fact that they are integrated coastal ecosystems, where nature experiences the coexistence of regular and hyper saline environments with high significance as shelters to wildlife.

CONFERENCE MAIN SUBJECTS

The aim of the conference is to identify and promote the ecological importance of Solar Saltworks and their increasing significance of safeguarding and development of the worlds' wetland area. Additionally it aims at an analytical insight and a better understanding of the Saltworks ecosystem characteristics.

Priority will be given to following areas:

- Wetlands at risk – abandoned Saltworks etc
- Structure and function of solar Saltworks ecosystem
- Solar Saltworks Production Process
- Solar Saltworks Biological system
- Avifauna and flora of Solar Saltworks
- Low, medium and high salinity microorganisms in Solar Saltworks
- Dynamics of Solar Saltworks Ecosystem
- Geochemistry in Solar Saltworks ponds

CONFERENCE VENUE

The 1st International Conference on the Ecological Importance of Solar Saltworks will take place from 20 to 22 of October 2006 in the island of Santorini, Greece.

CONFERENCE SECRETARIAT

Aegean Str. 10

15122 Maroussi

Greece

e-mail nkor@hol.gr

Attn to Mr. N. Korovessis

NOTES ON THE DISTRIBUTION OF THE GENUS *ARTEMIA* IN THE FORMER USSR COUNTRIES (RUSSIA AND ADJACENT REGIONS)

Graziella Mura, Liubov Nagorskaya-2005

Journal of Biological Research, 4: 139-150

Abstract:

In this study we review the Russian literature on *Artemia* distribution in several saline lakes and ponds of former USSR, and report on the results of our studies for a number of populations, aiming to update available information and to identify species, often erroneously designated as *A. salina* in the existing

literature. Most of the populations recorded/examined belong to parthenogenetic *Artemia* while a number of bisexual populations were also found. The morphology of the basal part of penis, investigated by means of SEM revealed that not all of these bisexuals belong to the species *A. salina*, known to occur only in the Mediterranean area. The males of some populations are characterized by the presence of a spine-like outgrowth at the basal part of the penis, a character shared by all bisexuals but Mediterranean. More detailed SEM morphological studies of the frontal knobs and the eversible penis reinforced biomolecular and morphometrical data will certainly contribute to species identification. The need for extensive sampling of the territory is stressed to bridge the gap about *Artemia* distribution and status in the countries of former USSR.

(Dipartimento di Biologia Animale e dell'Uomo, viale dell'Universita 32, 00185 Roma, Italy; email of G. Mura: graziella.mura@uniroma1.it)

REPRODUCTIVE PERFORMANCE OF THREE *ARTEMIA FRANCISCANA* KELLOGG (CRUSTACEA, ANOSTRACA) POPULATIONS IN NORTH-EASTERN BRAZIL POND CULTURE CONDITIONS

Marcos R. Camara, Ligia G. Reis, Marcos F. Costa-2005

Journal of Biological Research 4: 173-179

Abstract:

Artemia franciscana Kellogg (Crustacea, Anostraca) is found on a year-round and permanent basis in the State of Rio Grande do Norte (RN) in north-eastern Brazil as a result of inoculations made in Macau saltworks in 1977 with cysts from San Francisco Bay (California, USA). Inoculation of *Artemia* in the saltworks of RN was initially followed by high cyst yields. However, recent data indicate that these feral brine shrimp populations reproduce predominantly ovoviviparously. In the present study, the reproductive performance of three populations from Macau (5° 06' S; 36° 38' W), Areia Branca (4° 57' S; 37° 08' W), and Grossos (4° 58' S; 37° 09' W) in RN was examined under similar pond culture conditions. A higher incidence of ovoviviparous than oviparous females for all experimental populations was found throughout ten culture cycles carried out in ponds of 0.72 ha. Furthermore, no significant variability in reproductive mode (ovoviviparity *versus* oviparity) or in fecundity (brood size) was observed ($p > 0.05$). These results presumably reflect the homogeneity of local populations and are consistent with the suspected decrease of genotypic diversity of feral *Artemia franciscana* in the saltworks of RN in north-eastern Brazil.

(Departamento de Oceanografia e Limnologia, Universidade Federal do Rio Grande do Norte, Natal, RN 59078-900 Brazil; email of Marcos R. Camara: mrcamara@ufrnet.br)

EFFECT OF *ARTEMIA* NAUPLII ENRICHED WITH VITAMIN A PALMITATE ON HYPERMELANOSIS ON THE BLIND SIDE IN JUVENILE JAPANESE FLOUNDER *PARALICHTHYS OLIVACEUS*

Fuminori Tarui, Yutaka Haga, Kengo Ohta, Yasuhiro Shima, Toshio Takeuchi-2006

Fisheries Science 72 (2), 256-262

Abstract:

The effect of *Artemia* nauplii enriched with different level of vitamin A (VA) palmitate (1 µg = 1 IU) on the occurrence of hypermelanosis on the blind side of Japanese flounder *Paralichthys olivaceus* was determined. *Artemia* were enriched with 0, 1, 2, 5 or 10 mg VA palmitate/L (control group, and 1-, 2-, 5-, and 10-mg groups). The enriched *Artemia* were fed to the larvae from 27 to 31 days post hatching (dph) corresponding to the F-G stage. VA palmitate, retinol and retinoic acid (RA) contents of *Artemia* were correlatively elevated with increasing VA palmitate in the culture medium. RA was detected in *Artemia* enriched with 5 mg and 10 mg, and a significantly high frequency of hypermelanosis on the blind side was observed in these groups at 65 dph ($P < 0.05$). These results suggest that RA synthesized from VA palmitate in *Artemia* could induce hypermelanosis on blind side of flounder when *Artemia* are enriched with more than 5 mg VA palmitate/L.

(Department of Marine Biosciences, Faculty of Marine Science, Tokyo University of Marine Science and Technology, Minato, Tokyo 108-8477, Japan; email of Toshio Takeuchi: take@s.kaiyodai.ac.jp)

MOLECULAR ATTEMPT TO IDENTIFY PREY ORGANISMS OF LOBSTER PHYLLOSOMA LARVAE

Nobuaki Suzuki, Keisuke Murakami, Haruko Takeyama, Seinen Chow-2006
Fisheries Science 72 (2), 342-349

Abstract:

A molecular approach was adopted to investigate the natural diets of palinurid and scyllarid lobster phyllosoma larvae. The central domain of the 18S rDNA gene was amplified using nested polymerase chain reaction (PCR) and genomic DNA extracted from the larval hepatopancreas. The resulting 18S rDNA clones were screened using restriction fragment length polymorphism (RFLP) analysis, and then FASTA homology search and phylogenetic analysis were performed on the nucleotide sequences to identify the source of the eukaryotic organisms. The feasibility of this method was confirmed using the laboratory-reared phyllosoma larvae of the Japanese spiny lobster *Panulirus japonicus* that were fed either with common mussel *Mytilus edulis* gonads or with *Artemia nauplii* exclusively. Among the 804 clones isolated from five wild-caught mid- to late-stage phyllosoma larvae (three palinurids and two scyllarids), 0–132 clones per sample possessed restriction profiles distinct from those of the hosts. The Cnidaria and Urochordata DNA were identified from both the palinurid and the scyllarid larvae, which were thought to be prey animals for the mid- to late-stage phyllosoma larvae.

(National Research Institute of Far Seas Fisheries, Shimizu-ku, Shizuoka 424-8633, Japan; email of Seinen Chow: chow@affrc.go.jp)

ONTOGENY OF TOLERANCE TO AND AVOIDANCE OF ULTRAVIOLET RADIATION IN RED SEA BREAM *PAGRUS MAJOR* AND BLACK SEA BREAM *ACANTHOPAGRUS SCHLEGELI*

Yuichi Fukunishi, Reiji Masuda, Yoh Yamashita-2006

Fisheries Science 72 (2), 356-363

Abstract:

Ontogenetic changes of tolerance to, and avoidance of, ultraviolet-B radiation (UV-B) were examined in red sea bream *Pagrus major* and black sea bream *Acanthopagrus schlegeli*. In the tolerance experiment, larvae and juveniles (age 13–46 days) were put in beakers, and were exposed to one of five different levels of UV-B radiation (1.8, 1.1, 0.2, 0.1, and 0 W/m²) for one hour. Their survival rates were calculated either 12 or 24 h later. In the avoidance experiment, fish (age 3–49 days) were put in a long experimental tank, half of which was covered with UV-blocking film and placed under two levels of UV-B radiation (1.1 and 0.2 W/m²), and their avoidance indices were calculated. Black sea bream had significantly better survival compared to red sea bream for most ages. Only black sea bream of ages 37 and 49 days showed significant avoidance of UV radiation under the higher level of UV-B, whereas both species did not show avoidance on any days at the lower level. The present results suggest that black sea bream are significantly better adapted to habitats with high UV-B radiation, than red sea bream, reflecting that black sea bream live in shallower waters through their early life stages.

(Fisheries Research Station, Field Science Education and Research Center, Kyoto University, Maizuru, Kyoto 625-0086, Japan; email of Yuichi Fukunishi: u1_fuku@kais.kyoto-u.ac.jp)

EFFECT OF FINE SEDIMENT INFILTRATION DURING THE INCUBATION PERIOD ON ATLANTIC SALMON (*SALMO SALAR*) EMBRYO SURVIVAL

H. P. Julien, N. E. Bergeron-2006

Hydrobiologia 563(1): 61 - 71

Abstract:

The existence of a negative relationship between fine sediment infiltration during the incubation period and salmonid embryo survival has often been discussed in the literature. However, few studies

have specifically addressed this relationship in the field. We conducted a field experiment to examine the relationship between survival of Atlantic salmon (*Salmo salar*) embryos contained in incubation baskets and the patterns of fine sediment infiltration into the baskets during the incubation period. The results indicate that survival to pre-eyed (STPE), eyed (STE) and hatched (STH) stages of development were all negatively correlated with the percentage of fine sediment entering the baskets. STPE and STE were most strongly affected by silts and clays (<0.063 mm) although this size class represented only a small fraction of the grain size distribution inside the incubation baskets (0.03–0.41%). STH was most strongly correlated with the infiltration of medium sand (0.25–0.50 mm) material. On average, 66% of the implanted embryos survived to the pre-eyed stage of development compared to 63% for the eyed and 48% for the hatched stages of development. (INRS-Eau, Terre et Environnement, 490, de la Couronne, G1K 9A9 Québec, Canada; email of N. E. Bergeron : normand_bergeron@inrs-ete.quebec.ca)

NUTRITION IN COD (*GADUS MORHUA*) LARVAE AND JUVENILES

Kristin Hamre-2006

ICES Journal of Marine Science 63(2): 267-274

Gadoid mariculture:development and future challenges

Abstract:

Over the past few years, great progress has been made in culturing cod larvae in indoor hatcheries using rotifers and *Artemia* or formulated feed as start-feed (intensive systems). However, when compared with natural systems based on copepods grown in seawater lagoons, the growth potential has not been fulfilled, and deformities of larvae and juveniles increase production costs. The deformities, which are seldom seen in natural systems, also constitute an ethical problem. The differences in growth and development of deformities in intensive and natural systems may be dependent, in part, on nutrition, but are caused by environmental conditions and early husbandry practises as well. To identify nutrients that may be deficient or in excess in live feed, we are in the process of screening the nutrient compositions of rotifers and *Artemia* grown or enriched on different feeds and comparing them with the composition of copepods and published requirements for larger fish. Replacing live food with formulated diets as early as possible is a goal of marine larval aquaculture. It is important that these diets contain protein which is available for the larvae and phospholipids that promote the absorption and transport of fat. The optimum macronutrient composition in diets for cod juveniles has been determined and can be extrapolated, with caution, to the larval stage. A problem in using formulated diets is the extensive leakage of nutrients as a result of the large surface area to volume and the short diffusion distance in the microparticles. Leakage leads to rapid loss of small, water-soluble molecules such as free amino acids, vitamins, and minerals, but extensive leakage of water-soluble protein has also been shown. The demand for protein available to the larvae, which probably will make the protein more water soluble, is therefore in conflict with the need to reduce protein leakage from the feeds. Development of feed production technology to prevent nutrient leakage is essential in order to make formulated diets a good alternative to live feed.

(National Institute of Nutrition and Seafood Research (NIFES), PO Box 2029, Nordnes, 5817 Bergen, Norway; email of Kristin Hamre: kristin.hamre@nifes.no)

GROWTH, BEHAVIOUR, AND DIGESTIVE ENZYME ACTIVITY IN LARVAL ATLANTIC COD (*GADUS MORHUA*) IN RELATION TO ROTIFER LIPID

Kelly O'Brien-MacDonald, Joseph A. Brown, Christopher C. Parrish-2006

ICES Journal of Marine Science 63(2): 275-284

Gadoid mariculture:development and future challenges

Abstract:

Atlantic cod (*Gadus morhua*) show great potential for aquaculture, but much is unknown about their digestive capacity and efficiency. An integrated experiment was performed on cod larvae to investigate the variability in digestive development in response to the quantity of lipid in the rotifer

enrichment. Survival, growth, behaviour, and digestive enzyme data from hatching to metamorphosis [0–450 dd (degree-days)] were measured. Four treatments were used in triplicate: high lipid rotifer enrichment (HLRE), low lipid rotifer enrichment (LLRE), green water, and unfed. Swimming activity and attacks (captures + misses) on prey were higher in the HLRE group at 100 dd than in other treatments, and this difference increased thereafter. There was no difference in digestive enzyme activity between the unfed and greened treatments, while the LLRE larvae had lower activity levels than larvae fed HLRE by 100–150 dd for all enzymes assayed. The larvae in the unfed and green water treatments did not survive past 100 dd. All the LLRE cod had died by 250 dd. Results suggest that a higher quantity of lipid in the rotifer enrichment will not only promote better growth and survival in Atlantic cod larvae but appears to provide more energy, allowing larvae to capture more live prey.

(Ocean Sciences Centre, Memorial University of Newfoundland, St. John's, NL, Canada A1C 5S7; email of Christopher C. Parrish: cparrish@mun.ca)

EFFECT OF ENRICHED ROTIFERS ON GROWTH, SURVIVAL, AND COMPOSITION OF LARVAL ATLANTIC COD (GADUS MORHUA)

Heum Gi Park, Velmurugu Puvanendran, Anne Kellett, Christopher C. Parrish, Joseph A. Brown-2006

ICES Journal of Marine Science 63(2): 285-295

Gadoid mariculture:development and future challenges

Abstract:

Recently, the nutritional requirements of marine finfish larvae have received considerable attention, and studies have shown that docosahexaenoic acid (DHA) affects the growth and survival of marine finfish larvae. We investigated the effects of different rotifer diets containing variable amounts of DHA on the growth and survival of larval Atlantic cod (*Gadus morhua* L.). Four different commercial rotifer enrichment formulations were used: spray-dried whole cells composed of *Cryptocodinium* sp. (ED1), spray-dried whole cells of *Schizochytrium* sp. (ED2), an oil emulsion (ED3) and ED1, and dried *Chlorella* at a 7:3 ratio by weight (ED4). The resultant rotifers contained a similar concentration of DHA (1.1–1.6% DW), but the level of DHA differed in proportion to EPA for each enrichment, and was designated ER1–4. Twelve 30-l aquaria were used with three replicates per treatment. Larvae were fed with rotifers from 3 to 43 days post-hatch (dph) at 4000 prey l⁻¹. At the end of the experiment, no significant differences were found in body length and dry weight between the larvae reared on ER1 and ER2. However, larvae reared on ER3 were significantly smaller (both in length and weight) than larvae reared on ER1 and ER2. Larval survival on the ER2 treatment at 43 dph was significantly higher than on the other three treatments. Our results showed a positive effect of rotifer DHA proportions on growth and survival of cod larvae, and demonstrated that Atlantic cod larvae require a high ratio of dietary DHA to EPA.

(Faculty of Marine Bioscience and Technology, Kangnung National University, Kangnung 210-702, South Korea; email of Velmurugu Puvanendran: puvy@mun.ca)

BACTERIA IN THE GUT OF JUVENILE COD GADUS MORHUA FED LIVE FEED ENRICHED WITH FOUR DIFFERENT COMMERCIAL DIETS

Kjetil Korsnes,, Ove Nicolaisen, Cecilie K. Skår, Audun H. Nerland, Øivind Bergh-2006

ICES Journal of Marine Science 63 (2): 296-301

Gadoid mariculture:development and future challenges

Abstract:

Atlantic cod, *Gadus morhua* L., larvae were fed rotifers, *Brachionus plicatilis* and *Artemia franciscana* enriched on four different commercial media, using the manufacturers' protocols. Pooled samples of 20 cod larvae were homogenized, diluted, and plated out on Petri dishes. The number of colony-forming units per larva was estimated, and the dominant strains subsequently sampled for sequencing of 16S rDNA. Bacteria showing high sequence similarity to a pathogen characteristic of cod and other

fish species, *Listonella anguillarum*, were present in all four groups. Other taxa present among the dominating bacterial colonies were *Pseudoalteromonas* sp., and *Vibrio* sp. However, these bacteria could be assigned to genera only. The different enrichments probably affected the number of colony-forming bacteria per millilitre in the enrichment cultures as well as in the larval gastrointestinal (GI) tract. Also, the composition of the microbiota associated with the larval GI tract was probably affected by the enrichment media.

(Institute of Marine Research, PO Box 1870, Nordnes, N-5817 Bergen, Norway; email of Øivind Bergh: ovind.bergh@imr.no)

DIET-INDUCED DIFFERENCES IN THE ESSENTIAL FATTY ACID (EFA) COMPOSITIONS OF LARVAL ATLANTIC COD (*GADUS MORHUA* L.) WITH REFERENCE TO POSSIBLE EFFECTS OF DIETARY EFAS ON LARVAL PERFORMANCE

C.J. Cutts, J. Sawanboonchun, C. Mazorra de Quero, J.G. Bell-2006

ICES Journal of Marine Science 63(2): 302-310

Gadoid mariculture: development and future challenges

Abstract:

We studied the performance of cod rearing in which live feed was given under three different essential fatty acid (EFA) enrichment regimes, using commercially available live-feed enrichments. We assessed the fatty acid profile [docosahexaenoic (DHA), eicosapentaenoic (EPA), and arachidonic acid (AA)] in larval somatic tissue, relative to its amounts in both rotifers and *Artemia* as well as to larval performance. Overall, percentage lipid level of each experimental diet for the trial was approximately 50%. Further, there were no significant differences in total fatty acid levels of larvae from each treatment at the end of the trial (mean = 444.76 µg fatty acid per mg lipid). However, during the rotifer phase, larvae from each treatment were able to incorporate comparable levels of %DHA, irrespective of levels in the diet. Despite this, the rotifer diet with more %DHA still promoted better larval growth than other treatments. Conversely, larvae from two of the treatments did not exhibit any accumulation of AA, reflecting levels found in the diet instead. However, between-tank differences in larval %AA showed improved growth during the rotifer period when larval %AA was high. Low ratios of EPA had no effect. During the *Artemia* phase, percentage levels of larval DHA decreased; there was no accumulation of DHA relative to dietary levels, which in *Artemia* were significantly lower than in rotifers (6 cf. 20–30%). However, DHA levels in larvae at the end of the experiment correlated positively with survival. *Artemia* contained lower levels of AA than rotifers (1.5 cf. 3.0%), yet comparable levels of AA were found in rotifer-fed and *Artemia*-fed larvae. This also differed significantly between treatments, and correlated positively with survival.

(Scottish Association for Marine Science, Ardtoe Marine Laboratory, Acharacle, Argyll PH36 4LD, Scotland, UK; email of C.J. Cutts: c_cutts@hotmail.com)

FOOD INGESTION IN JUVENILE COD ESTIMATED BY INERT LANTHANIDE MARKERS – EFFECTS OF FOOD PARTICLE SIZE

Oddvard Garatun-Tjeldstø, Håkon Otterå, Kåre Julshamn, Erland Austreng-2006

ICES Journal of Marine Science 63(2): 311-319

Gadoid mariculture: development and future challenges

Abstract:

Development of formulated starter diets and improvement of diets for juvenile marine fish species are major challenges in aquaculture. The ingestion rate may be regarded as a parameter for evaluating whether a diet particle is available, recognized, of adequate size, palatable, and preferred by small fish. In this study, we evaluated the effect of food particle size (150–3425 µm) on ingestion rate in juvenile cod (36–826 mg wet weight). Lanthanide oxides were used as markers. Several mixtures of lanthanide marker-labelled diets were produced by combination of the mono-labelled size classes. Each combination was fed for one, four, or seven days to groups of juvenile cod in separate tanks. After termination by anaesthetic, the fish were collected, individually weighed, and frozen until

analysis. The amount of lanthanides in the homogenized fish was measured by inductively coupled plasma-mass spectrometry (ICP-MS). There were no significant differences in ingestion of any of the markers when given in a mixture of mono-labelled particles. Thus, the markers Y₂O₃, La₂O₃, Nd₂O₃, Dy₂O₃, and Yb₂O₃ may be used as inert tools for evaluating diet ingestion. The total intake of dry diet was about 13 mg g⁻¹ body weight. The particle size that caused the highest food intake was less than 1.2 mm in all experiments.

(Department of Molecular Biology, University of Bergen, Thormøhlensgt. 55, N-5020 Bergen, Norway; email of Oddvard Garatun-Tjeldstø: oddvard.garatun-tjeldsto@mbi.uib.no)

GROWTH, SURVIVAL, AND DEVELOPMENT OF ATLANTIC COD (*GADUS MORHUA* L.) WEANED ONTO DIETS CONTAINING VARIOUS SOURCES OF MARINE PROTEIN

I. Opstad, J. Suontama, E. Langmyhr, R.E. Olsen-2006

ICES Journal of Marine Science 63(2): 320-325

Gadoid mariculture: development and future challenges

Abstract:

We studied the effects of partial or complete substitution of fishmeal with alternative sources of marine protein (amphipod or krill meal) on growth, survival, liver index, and deformities of juvenile cod (*Gadus morhua* L.). The diets contained either 100% fishmeal or fishmeal that was replaced with 25%, 50%, or 100% amphipod meal or 50% or 100% Antarctic krill meal. Cod larvae were start-fed on rotifers and weaned directly to one of the six formulated feeds at a mean wet weight of 28 mg, 40 days post first-feeding. The mean weight of fish reared on different diets at the end of the experiment ranged from 0.92 to 2.52 g. The best growth was obtained by cod fed 100% fishmeal and 50% krill meal. There was a trend in the direction of slower growth with increasing levels of amphipod meal in the diets. Survival ranged from 87% to 79%, and there was a tendency for higher mortality with increasing content of amphipod meal. The liver index varied between 11.7% and 9.9%. The composition of the diets also had a significant influence on the occurrence of skeletal deformities. The highest proportion of deformities (16% of all fish) was in fish fed 100% amphipod meal, decreasing as the proportion of amphipod meal in the diets declined. A similar effect was not seen with Antarctic krill meal. The amphipod meal had a high content of ash, fluoride, cadmium, and mercury, which may have caused the deformities.

(Institute of Marine Research, Austevoll, N-5392 Storebø, Norway; email of I. Opstad: ingegjerd.opstad@imr.no)

EFFECTS OF WATER QUALITY AND STOCKING DENSITY ON GROWTH PERFORMANCE OF JUVENILE COD (*GADUS MORHUA* L.)

Björn Björnsson, Sólveig R. Ólafsdóttir-2006

ICES Journal of Marine Science 63(2): 326-334

Gadoid mariculture: development and future challenges

Abstract:

In a 5-month experiment where groups of juvenile cod were reared in a flow-through system at low density (Group 1) and in a recirculating system at low (Group 2) and high densities (Group 3), the recirculated water had negative effects on growth rate, nutritional condition, and mortality. After the first month, mean weight was significantly larger in Group 1 than in the other two groups. The effect of stocking density on mean weight was not significant until the end of the experiment, when densities were 9.0 and 48.3 kg m⁻³ in Groups 2 and 3, respectively. Initial mean weight of fish was 37.3 g and at the termination of the experiment mean weights were 225.2, 181.8, and 167.9 g in Groups 1, 2, and 3, respectively. After 5 months, mean condition factors were 1.074, 0.965, and 0.946, mean liver indices 9.5, 9.0, and 7.6, and mean mortalities over the course of the experiment were 1.0%, 5.1%, and 2.4% in Groups 1, 2, and 3, respectively. Water temperature (10.4–10.6°C), pH (7.2–7.4) and oxygen concentration (8–10 mg l⁻¹) were similar among groups. Concentration of total ammonia nitrogen (TAN) was similar among groups for the first half of the experiment (0.3–0.4), but during the

last month it was 0.6, 1.3, and 1.5 mg l⁻¹ in Groups 1, 2, and 3, respectively. There was a negative correlation ($r^2 = 0.48$, $n = 36$) between relative growth rate and TAN, suggesting that ammonia may have been a limiting factor in the recirculating system. The apparent threshold limit of TAN for reduced growth was approximately 1 mg l⁻¹.

(Marine Research Institute, Skúlagata 4, PO Box 1390, 121 Reykjavík, Iceland; email of Björn Björnsson: bjornb@hafro.is)

METABOLIC COST OF FEEDING IN ATLANTIC COD (GADUS MORHUA) LARVAE USING MICROCALORIMETRY

Artie McCollum, Jessica Geubtner, Ione Hunt von Herbing-2006

ICES Journal of Marine Science 63(2): 335-339

Gadoid mariculture: development and future challenges

Abstract:

A microcalorimeter that measures total heat output (μW) was used to determine total metabolic rate (aerobic and anaerobic) and the cost of feeding (specific dynamic action, SDA) in larval Atlantic cod (*Gadus morhua*) from hatching to 4 weeks post-hatch at 10°C. Total heat output increased throughout development from 2.14 μW at first-feeding to 23.72 μW at 4 weeks post-hatch. SDA was determined by comparing the total heat output among unfed larvae and fed larvae simultaneously. Total heat output increased in the first 2 h after feeding with rotifers (*Brachionus* sp.) and *Artemia*, remained high for up to 10 h, was significantly higher in fed larvae than in unfed larvae, and ranged from 16.56 μW at first-feeding to 47.84 μW at 4 weeks post-hatch. The differences in total heat output between unfed and fed larvae were 14.42 μW and 24.12 μW , representing an increase in metabolic cost of feeding by a factor of 1.67 over the first 4 weeks of larval life. That the metabolic cost of feeding increased with development and remained elevated suggests that cod larvae allocate a large part of their energy budget to growth in order to meet the demands of their fast growth rates.

(School of Marine Science, University of Maine, 5741 Libby Hall, Room 214, Orono, ME 04469, USA; email of Ione Hunt von Herbing: ihuntvon@nsf.gov)

CHARACTERIZATION OF LIBYAN ARTEMIA FROM ABU KAMMASH SABKHA

Mohamed O. El-Magsodi, Hassan M. El-Ghebli, Mohammed Hamza, Gilbert Van Stappen, Patrick Sorgeloos-2005

Libyan Journal of Marine Science (2005) 10:19-8

Abstract:

Artemia cysts have been collected from -Abu Kammash sabkha at the westren part of Libya. The cyst material was processed and used for the following characterization analyses: cyst and naupliar biometrics, cyst hatching characteristics, sex ratio and mode of reproduction, survival and naupliar growth rate.

The cross - breeding tests have been performed with different other well known sibling species. These tests with cyst biometrics showed that Abu Kammash *Artemia* belonged to the *Artemia salina* (*tunisiana*) sibling species complex.

This identification of Libyan *Artemia* is of critical importance before considering any transplantation or inoculation of other *Artemia* strains to new habitats in Libya. Although quality improvements may be expected through improved harvesting and processing, Libyan *Artemia* demonstrated acceptable hatching characteristics with decapsulation treatment or cold storage and might be a good food source in aquaculture.

(Marine Biology Research Center, P.O.Box: 30830, Tajura, Tripoli, Libya; email of Mohamed O. El-Magsodi: magsodi@yahoo.co.uk)

REPRODUCTIVE AND LIFESPAN CHARACTERISTICS OF ARTEMIA FROM LIBYAN ABU

KAMMASH SABKHA

Mohamed O. El-Magsodi, Hassan M. El-Ghebli, Mohamed A. Enbaya, Mohammed Hamza, Usama A. Drebika, Patrick Sorgeloos-2005

Libyan Journal of Marine Science (2005) 10:1- 8

Abstract:

The reproductive performance of the Abu Kammash Artemia was tested in three salinities (100, 140 and 180 ppt) of Instant Ocean® solution at constant temperature of 25±1°C. Six reproductive and four lifespan characteristics were studied, they were: offspring per brood, brood per female, offspring per female per day during the reproductive period, days between broods, percent offspring encysted, total offspring per female, pre-reproductive period, reproductive period, post-reproductive period and total lifespan.

The results indicated that Abu Kammash Artemia shows a preference to high salinity. The reproductive and lifespan characteristics have no significant differences in the three salinities (100, 140 and 180 ppt). These characteristics were found to be closer to *A. tunisiana* (salina). A high level of encysted offspring was observed which suggests the possibilities of its commercial use. Also it is expected that these studies could contribute towards the more general understanding about the productivity of these animals, and prove helpful in developing this natural resource in Abu Kammash subkha. At the same time, it will provide Libya with the opportunity to explore the practical use of the Artemia population from Abu Kammash for the country needs.

(Marine Biology Research Center; P.O.Box: 30830, Tajura, Libya; email of Mohamed O. El-Magsodi: magsodi@yahoo.co.uk)

REVIEW ARTICLE

GNOTOBIOTICALLY GROWN AQUATIC ANIMALS: OPPORTUNITIES TO INVESTIGATE HOST-MICROBE INTERACTIONS

A. Marques, F. Ollevier, W. Verstraete, P. Sorgeloos, P. Bossier-2006

Journal of Applied Microbiology 100 (5): 903-918

Abstract:

The culture of aquatic organisms is still hampered by the occurrence of unpredictable diseases in their early life stages, which are responsible for massive mortalities and considerable economic losses. A better understanding of the host-microbe interactions is certainly essential to develop effective solutions of disease control for the aquaculture industry. As demonstrated in terrestrial animals, the use of gnotobiotic systems (animals cultured in axenic conditions or with a known microflora) can be an excellent tool to extend the understanding of the mechanisms involved in host-microbe interactions and to evaluate new treatments of disease control. Several aquatic animals were cultured so far in germ-free conditions, such as fish, molluscs, crustaceans, rotifers, echinoderms, cnidarians, turbellarians, ascidians and echiurans. The aim of the present review is to recapitulate the findings obtained with gnotobiotic aquatic animals over the last decades, with special emphasis to the host-microbe interactions, as well as the perspectives for future research in this field. In addition, the procedures utilized to culture axenic aquatic animals and to verify contaminations are summarized, and the standardization of these procedures is proposed.

(Laboratory of Aquaculture & Artemia Reference Center, Faculty of Bioscience Engineering, Ghent University, Gent, Belgium; email of A. Marques: marques_am@yahoo.com)

PRODUCTION OF EICOSAPENTAENOIC AND DOCOSAHEXAENOIC ACID-CONTAINING OILS IN TRANSGENIC LAND PLANTS FOR HUMAN AND AQUACULTURE NUTRITION

Stanley S. Robert-2006

Marine Biotechnology 8 (2): 103 – 109

Abstract:

A large body of evidence suggests that there is a significant underconsumption of omega-3, long-chain, polyunsaturated fatty acids (LC-PUFAs) and that this is the cause of multiple chronic diseases

and developmental aberrations. The scope for increasing omega-3 LC-PUFA consumption from seafood is limited because global wild fisheries are unable to increase their harvests, and aquaculture fisheries currently rely on wild fisheries as a source of LC-PUFAs. Agricultural production of oils is highly efficient and has the potential to be sustainable. The transfer of genes from marine microalgae and other microorganisms into oilseed crops has shown that the production of terrestrial omega-3 LC-PUFA oils is indeed possible. The specifications of these oils or whole seeds for use in human and Atlantic salmon (*Salmo salar*) aquaculture nutrition are discussed.

(Food Futures National Research Flagship Division of Marine and Atmospheric Research, Commonwealth Scientific and Industrial Research Organisation (CSIRO), Hobart, Tasmania, 7001, Australia; email of Stanley S. Robert: stan.robert@csiro.au)

UP-REGULATION OF PHOTOPROTECTION AND PSII-REPAIR GENE EXPRESSION BY IRRADIANCE IN THE UNICELLULAR GREEN ALGA DUNALIELLA SALINA

Seunghye Park, Juergen E. W. Polle, Anastasios Melis, Taek Kyun Lee, EonSeon Jin-2006

Marine Biotechnology 8 (2): 120 – 128

Abstract:

The unicellular green alga *Dunaliella salina* is an attractive model organism for studying photoacclimation responses and the photosystem II (PSII) damage and repair process in the photosynthetic apparatus. Irradiance during cell growth defines both the photoacclimation and the PSII repair status of the cells. To identify genes specific to these processes, a cDNA library was created from irradiance-stressed *D. salina*. From the cDNA library, 1112 randomly selected expressed sequence tags (ESTs) were analyzed. Because ESTs constitute the expressed part of the genome, the strategy of randomly sequencing cDNA clones at their 5'-ends allowed us to obtain information about the transcript level of numerous genes in light-stressed *D. salina*. The results of a BLASTX search performed on the obtained total set of ESTs showed that approximately 1% of the ESTs could be assigned to genes coding for proteins that are known to be up-regulated in response to high-light stress. Specifically, after 48 h of high-light exposure of the cells, an increase in the expression level of antioxidant genes, such as Fe-SOD and APX, was observed, as well as elevated levels of the Cbr transcript, a light-harvesting Chl-protein homolog. Further, the ATP-dependent Clp protease gene was also up-regulated in *D. salina* cells after 48 h of exposure to high light. The results provide initial insight into the global gene regulation process in response to irradiance.

(Department of Life Science, Hanyang University, Seoul, South Korea; email of EonSeon Jin: esjin@hanyang.ac.kr)
