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 INFORMATION OF INTEREST

- The Aquaculturists, a blog published by AquaFeed magazine: website
- American Fisheries Society: Journal of Aquatic Animal Health Volume: 22, Number: 4 (December) is now available online
- Website of the American Fisheries Society - Early Life History Section <http://www.elhs.cmast.ncsu.edu/>
- Global Aquaculture Alliance 2010 conference: presentations
- Aquaculture planning: policy formulation and implementation for sustainable development. FAO Fisheries and Aquaculture Technical Paper No. 542
- 200 Years In 4 Minutes - the correlation between income growth and life expectancy: plotting life expectancy against income for 200 countries since 1810, Hans Rosling shows how the world we live in is radically different from the world most of us imagine: see video clip
- EU project AQUAMAX "Sustainable Aquafeeds to Maximise the Health Benefits of Farmed Fish for Consumers" – newsletters, technical leaflets, final meeting presentations: see website

## VLIZ Library Acquisitions no

- 489 December 10, 2010
- 490 December 17, 2010
- 491 December 24, 2010

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 EDITORIAL

## DISEASES OF COMMERCIALY EXPLOITED CRUSTACEANS: CROSS-CUTTING ISSUES FOR GLOBAL FISHERIES AND AQUACULTURE

G.D. Stentiford-2011

Journal of Invertebrate Pathology 106(1): 3-5  
 Diseases of Edible Crustaceans

(European Community Reference Laboratory for Crustacean Diseases, Centre for Environment, Fisheries and Aquaculture Science (Cefas), Barrack Road, Weymouth, Dorset DT4 8UB, United Kingdom; email: [grant.stentiford@cefas.co.uk](mailto:grant.stentiford@cefas.co.uk))

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 VIRAL DISEASES IN COMMERCIALY EXPLOITED CRABS: A REVIEW

Jean-Robert Bonami, Shuyong Zhang-2011

Journal of Invertebrate Pathology 106(1): 6-17

Diseases of Edible Crustaceans

## Abstract:

Viruses and viral diseases of crabs were observed and investigated earlier than the first observation of viruses in shrimp. In fact, crabs were used as biological models to investigate crustacean virology at the beginning of shrimp aquaculture development. More than 30 viruses have been reported in crabs, including those related to the known virus families Reoviridae, Bunyaviridae, Roniviridae and a group of Bacilliform enveloped nuclear viruses. This review reports data on several important viral diseases of crabs, particularly those associated with pathology of organs and tissues of commercially and ecologically significant host species.

(Pathogens and Environment, UMR 5119 EcoLag cc 093, CNRS/UM2, Place E.Bataillon, 34095 Montpellier Cedex 5, France ; email of Jean-Robert Bonami : [bonami@crit.univ-montp2.fr](mailto:bonami@crit.univ-montp2.fr))

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 BACTERIAL DISEASES OF CRABS: A REVIEW

W. Wang-2011

Journal of Invertebrate Pathology 106(1): 18-26

Abstract:

Bacterial diseases of crabs are manifested as bacteremias caused by organisms such as *Vibrio*, *Aeromonas*, and a Rhodobacterales-like organism or tissue and organ tropic organisms such as chitinoclastic bacteria, *Rickettsia* intracellular organisms, Chlamydia-like organism, and *Spiroplasma*. This paper provides general information about bacterial diseases of both marine and freshwater crabs. Some bacteria pathogens such as *Vibrio cholerae* and *Vibrio vulnificus* occur commonly in blue crab haemolymph and should be paid much attention to because they may represent potential health hazards to human beings because they can cause serious diseases when the crab is consumed as raw sea food. With the development of aquaculture, new diseases associated with novel pathogens such as spiroplasmas and Rhodobacterales-like organisms have appeared in commercially exploited crab species in recent years. Many potential approaches to control bacterial diseases of crab will be helpful and practicable in aquaculture.

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#### PROTISTAN DISEASES OF COMMERCIALY IMPORTANT CRABS: A REVIEW

J.F. Morado-2011

Journal of Invertebrate Pathology 106(1): 27-53

Diseases of Edible Crustaceans

Abstract:

Protists are a diverse group of eukaryotes that possess a unicellular level of organization. As unicellular organisms, the differentiation of cells into tissues does not occur, although when cell differentiation does occur, it is limited to sexual reproduction, alternate vegetative morphologies or quiescent life history stages. Protistan parasites may possess simple or complex life histories that are important factors to consider when investigating protistan diseases of decapods. Unfortunately, the life histories of many protistan parasites of decapods are insufficiently described, resulting in the fact that modes of infection and transmission are often unidentified. This is surprising considering the economic importance of many marine decapods and the ability of protistan parasites to produce significant, but generally transient and area limited mortalities. However, the marine disease landscape is changing and will continue to change as climate change and ocean acidification will play important roles in disease occurrence and distribution. As a result, the following discussion attempts to summarize current knowledge on several crab diseases, their protistan etiological agents, the impact of disease on economically important crab populations and draw attention to areas of needed research. The discussion is not complete as only selected diseases are addressed, or perfect as the Microsporidia are included in the discussion (a traditional error continued in this summary) despite the recent, but controversial placement of the taxon with the fungi.

(National Oceanic & Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center, Resource Assessment & Conservation Engineering Division, 7600 Sand Point Way NE, Seattle, WA 98115, United States; email: frank.morado@noaa.gov)

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#### DISEASES OF CRAYFISH: A REVIEW

Matt Longshaw-2011

Journal of Invertebrate Pathology 106(1): 54-70

Diseases of Edible Crustaceans

Abstract:

A systematic review of parasites, pathogens and commensals of freshwater crayfish has been conducted. All major groups of disease causing agents have been covered including viruses, bacteria, fungi, protistans and metazoans. Most agents tend to cause limited problems for crayfish. Exceptions to this include fungi, bacteria and viruses. However, in many cases, these tend to be isolated reports in either a specific geographical location or in individual animals. The apparent absence of pathology

associated with these agents in crayfish should not be taken to suggest that movements of crayfish to new geographical areas is necessarily acceptable. Several examples are given where seemingly healthy animals have been moved to new areas leading to mortality of other crayfish within the same area as a direct result of transmission of pathogens to naïve hosts. Some future research needs are proposed, including the need for pathogen characterisation and production of disease-free crayfish for aquaculture. (Cefas Weymouth Laboratory, Barrack Road, The Nothe, Weymouth, Dorset DT4 8UB, UK; email: matt.longshaw@cefass.co.uk)

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#### DISEASES OF AMERICAN LOBSTERS (HOMARUS AMERICANUS): A REVIEW

Richard J. Cawthorn-2011

Journal of Invertebrate Pathology 106(1): 71-78

Diseases of Edible Crustaceans

Abstract:

The American lobster fishery is a significant economic driver in coastal communities of North America. Increasingly, the impacts of infectious disease are recognized as important components and factors in the population ecology and subsequent management of the lobster fishery. Both environmental and anthropogenic factors impact marine diseases. The review herein highlights aspects of several important bacterial, fungal and protistan diseases, including gaffkemia, shell disease, vibriosis, disease caused by species of *Lagenidium*, *Haliphthoros* and *Fusarium*, paramoebiasis and Bumper Car disease. As the global environment continues to change, these diseases could more severely affect both wild caught and impounded lobsters.

(Department of Pathology and Microbiology & AVC Lobster Science Centre, University of Prince Edward Island, Charlottetown, PE, Canada C1A 4P3; email: Cawthorn@upei.ca)

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#### DISEASES OF SPINY LOBSTERS: A REVIEW

J.D. Shields-2011

Journal of Invertebrate Pathology 106(1): 79-91

Diseases of Edible Crustaceans

Abstract:

Spiny lobsters have few reported pathogens, parasites and symbionts. However, they do have a diverse fauna comprised of a pathogenic virus, several bacteria, protozoans, helminths and even symbiotic crustaceans. A few idiopathic syndromes have also been reported, but these appear correlated with lobsters held in poor conditions. Fungal and bacterial pathogens present significant threats for rearing spiny lobsters in aquaculture settings, but only one pathogen, *Panulirus argus* virus 1, is thought to have damaged a fishery for a spiny lobster. No doubt others will emerge as lobsters are brought into aquaculture setting and as fishing pressure intensifies with stocks become more susceptible to anthropogenic stressors.

(Department of Environmental and Aquatic Animal Health, Virginia Institute of Marine Science, The College of William & Mary, Gloucester Point, VA 23062, USA; email : jeff@vims.edu)

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#### DISEASES OF NEPHROPS AND METANEPHROPS: A REVIEW

Grant D. Stentiford, Douglas M. Neil-2011

Journal of Invertebrate Pathology 106(1): 92-109

Diseases of Edible Crustaceans

Abstract:

Nephrops and Metanephrops are commercially exploited genera within the family Nephropidae (clawed lobsters). Commercial fisheries for each genus exist in the Northern and Southern Hemispheres and utilise trawling or trapping for capture. Despite a relative lack of dedicated disease surveys on lobsters from these fisheries, several important symbionts and pathogens have been described. The most significant known pathogen of *Metanephrops* (*challengeri*) is a microsporidian parasite (*Myospora metanephrops*) which causes destruction of the skeletal and heart muscles of infected lobsters while the most significant known pathogen of *Nephrops* (*norvegicus*) is a dinoflagellate parasite assigned to the

genus *Hematodinium*. This parasite has been responsible for an ongoing epidemic in fished populations of *N. norvegicus* in Northern Europe since at least the early 1980s and since then extensive studies on its life history and pathogenesis have occurred. Despite these research efforts significant gaps exist in our knowledge of the effects of parasites such as *Hematodinium* on the fished and non-fished portions of *Nephrops* populations and on the effect of fishery practices on the spread of infection. Furthermore, little is known about the effect of this (and other) pathogens on cohort survivability and the likelihood that early life stages will be effectively recruited to the fishery. This review summarises the available literature on diseases of these two lobster genera and provides an assessment of future research needs in this discipline.

(European Community Reference Laboratory for Crustacean Diseases, Centre for Environment, Fisheries and Aquaculture Science (Cefas), Barrack Road, Weymouth, Dorset DT4 8UB, United Kingdom; email of Grant D. Stentiford: grant.stentiford@cefas.co.uk)

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#### VIRUS DISEASES OF FARMED SHRIMP IN THE WESTERN HEMISPHERE (THE AMERICAS): A REVIEW

D.V. Lightner-2011

Journal of Invertebrate Pathology 106(1): 110-130

Diseases of Edible Crustaceans

Abstract:

Penaeid shrimp aquaculture is an important industry in the Americas, and the industry is based almost entirely on the culture of the Pacific White Shrimp, *Litopenaeus vannamei*. Western Hemisphere shrimp farmers in 14 countries in 2004 produced more than 200,000 metric tons of shrimp, generated more than \$2 billion in revenue, and employed more than 500,000 people. Disease has had a major impact on shrimp aquaculture in the Americas since it became a significant commercial entity in the 1970s. Diseases due to viruses, rickettsial-like bacteria, true bacteria, protozoa, and fungi have emerged as major diseases of farmed shrimp in the region. Many of the bacterial, fungal and protozoan caused diseases are managed using improved culture practices, routine sanitation, and the use of chemotherapeutics. However, the virus diseases have been far more problematic to manage and they have been responsible for the most costly epizootics. Examples include the Taura syndrome pandemic that began in 1991–1992 when the disease emerged in Ecuador, and the subsequent White Spot Disease pandemic that followed its introduction to Central America from Asia in 1999. Because of their socioeconomic significance to shrimp farming, seven of the nine crustacean diseases listed by the World Animal Organization (OIE) are virus diseases of shrimp. Of the seven virus diseases of penaeid shrimp, five are native to the Americas or have become enzootic following their introduction. The shrimp virus diseases in the Americas are increasingly being managed by exclusion using a combination of biosecurity and the practice of culturing domesticated specific pathogen-free (SPF) stocks or specific pathogen-resistant (SPR) stocks. Despite the significant challenges posed by disease, the shrimp farming industry of the Americas has responded to the challenges posed by disease and it has developed methods to manage its diseases and mature into a sustainable industry.

(Aquaculture Pathology Laboratory, Department of Veterinary Science and Microbiology, University of Arizona, Tucson, AZ 85721, USA: email: dvl@u.arizona.edu)

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#### VIRAL DISEASES OF THE GIANT FRESH WATER PRAWN *MACROBRACHIUM ROSENBERGII*: A REVIEW

Jean-Robert Bonami, Joannes Sri Widada-2011

Journal of Invertebrate Pathology 106(1): 131-142

Diseases of Edible Crustaceans

Abstract:

The giant freshwater prawn *Macrobrachium rosenbergii* is cultivated essentially in Southern and South-eastern Asian countries such as continental China, India, Thailand and Taiwan. To date, only two viral agents have been reported from this prawn. The first (HPV-type virus) was observed by chance 25 years ago in hypertrophied nuclei of hepatopancreatic epithelial cells and is closely related to members of the Parvoviridae family. The second, a nodavirus named MrNV, is always associated with a non-

autonomous satellite-like virus (XSV), and is the origin of so-called white tail disease (WTD) responsible for mass mortalities and important economic losses in hatcheries and farms for over a decade. After isolation and purification of these two particles, they were physico-chemically characterized and their genome sequenced. The MrNV genome is formed with two single linear ss-RNA molecules, 3202 and 1250 nucleotides long, respectively. Each RNA segment contains only one ORF, ORF1 coding for the RNA-dependant RNA polymerase located on the long segment and ORF2 coding for the structural protein CP-43 located on the small one. The XSV genome (linear ss-RNA), 796 nucleotides long, contains a single ORF coding for the XSV coat protein CP-17. The XSV does not contain any RdRp gene and consequently needs the MrNV polymerase to replicate.  
(Pathogens and Environment, UMR 5119, EcoLag cc 093, CNRS/UM2, Place E. Bataillon, 34095 Montpellier Cedex 5, France ; email of Jean-Robert Bonami : bonami@crit.univ-montp2.fr)

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#### HEALTH MANAGEMENT DURING HANDLING AND LIVE TRANSPORT OF CRUSTACEANS: A REVIEW

S. Fotedar, L. Evans-2011

Journal of Invertebrate Pathology 106(1): 143-152

Diseases of Edible Crustaceans

Abstract:

Best practice approaches used in the live transport of commercial crustacean species groups are reviewed and the physiological responses to handling practices are described. Codes of practice aimed at providing technological guidelines in handling and transportation of live prawns, lobsters, crabs and freshwater crayfish are examined. While some handling and transport practices are common across species groups, for example purging and chilling, recommended practices vary with species group. The influence of stress responses on health and survival during live transport is discussed and research investigations on the effect of stressors, in particular air exposure, handling and physical disturbances and temperature fluctuations on physiological processes are reviewed for the six species groups, crabs, freshwater crayfish, clawed and spiny lobsters, freshwater prawns and marine prawns. Investigations on the assessment of immune responses to live transport stressors using haemograms, clotting times, phenoloxidase activity, phagocytic activity, bacteremia and antibacterial activity and haemolymph protein concentration are described. A combination of physiological parameters is desirable in the assessment of stress response or health status in crustacean species transported live to seafood markets.

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#### RESERVOIRS AND ALTERNATE HOSTS FOR PATHOGENS OF COMMERCIALY IMPORTANT CRUSTACEANS: A REVIEW

Hamish J. Small, Katrina M. Pagenkopp-2011

Journal of Invertebrate Pathology 106(1): 153-164

Diseases of Edible Crustaceans

Abstract:

There is a considerable body of literature describing the causative agents of many diseases of crustaceans. Given that many of these crustaceans support commercially important fisheries, it is somewhat surprising that comparatively little information is available regarding the natural transmission pathways and reservoirs of many of the disease-causing agents. In this paper we review what is known about reservoirs and alternate hosts for several important diseases of commercially important crustaceans and provide recommendations on future areas of research.

(Virginia Institute of Marine Science (VIMS), College of William & Mary, P.O. Box 1346, Gloucester Point, VA 23062, USA; email of Hamish J. Small: hamish@vims.edu)

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#### RECONSTRUCTED 3D MODELS OF DIGESTIVE ORGANS OF DEVELOPING ATLANTIC COD (GADUS MORHUA) LARVAE

Yuko Kamisaka, Ivar Rønnestad-2011

Marine Biology 158(1): 233-243

Abstract :

Six 3D models of the digestive system during ontogeny were reconstructed from histological sections of Atlantic cod larvae. The 3D models clearly visualize the following features: folding of the gut rotation; subdivision of digestive tract into foregut, midgut, and hindgut by sphincters; development of stomach and pyloric caeca from 39 dph; location of entrances of bile and pancreatic ducts in the medial plane of the anterior midgut; ontogeny of pancreas from a compact organ to an elongated and branched (but not diffuse) organ along the posterior midgut; one dominant islet of Langerhans until 39 dph and several smaller satellite islets also visible from 53 dph; the relatively large volume of the anterior midgut that probably increases residence time of ingested food mixing with secretions from pancreas and bile. Calculated volumes of each digestive organ demonstrate allometric changes during ontogeny. Interactive 3D models are available as QuickTime format downloadable files.

(Department of Biology, University of Bergen, P.O. Box 7800, 5020 Bergen, Norway; email of Yuko Kamisaka: [yuko.kamisaka@bio.uib.no](mailto:yuko.kamisaka@bio.uib.no))

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#### OFF-SEASON MATURATION AND SPAWNING OF THE PACIFIC WHITE SHRIMP LITOPENAEUS VANNAMEI IN SUB-TROPICAL CONDITIONS

Metin Kumlu, Serhat Türkmen, Mehmet Kumlu, O. Tufan Eroldoğan-2011

Turkish Journal of Fisheries and Aquatic Sciences 11: 15-23

Abstract:

This study deals with investigations on how to control off-season maturation and spawning of the Pacific white shrimp *Litopenaeus vannamei* by using various maturation techniques. For the experiment, the broodstock were separated into five groups (Group 1: Control, Group 2: Serotonin-injected, Group 3: Ablated, Group 4: Temperature-fluctuated, and Group 5: Another ablated groups). Each of the first four groups were stocked into a 2-m diameter round tank at density of 9.44 shrimps per m<sup>2</sup> (2:1, female/male), while Group 5 were stocked into a 3-m diameter tank at density of 5.67 shrimps per m<sup>2</sup> (1:1, female/male). The experiment continued for 2 months until maturation in a recirculation system. Each female was tagged and any ripe female carrying a spermatophore was removed to spawn individually in a spawning tank. The first spawnings occurred on 25-28th days of the experiment in all the groups. The highest female spawning rate (55-90%) and fecundity (79,778-125,015 eggs) were obtained in the eyestalk-ablated groups ( $P < 0.05$ ). Serotonin (Group 2) induced ovarium development in 35% of the females, generating 60,277 eggs per female. Cyclic temperature fluctuation (Group 4) stimulated ovarium maturation in 39% of the females with a mean fecundity of 28,500 eggs per female ( $P < 0.05$ ). Mean egg fertility rates ranged from 63.08% to 96%, and hatching rates from 8.53% to 31%. Spawning, fecundity and hatching rates were found to be different between the two eyestalk-ablated groups (Group 3 and 5), and the reasons were thought to be due to tank size and/or shrimp stocking density. Our broodstock displayed poor reproductive performance with abnormal egg morphology and low egg hatching rates. The stress caused by off-season reproduction and low genetic variation due to past selective breeding programs might have seriously hampered the reproductive performance of our broodstock. The results of this study has demonstrated that, under Mediterranean climatic conditions, the broodstock of this non-indigenous shrimp species can be readily matured and spawned out of season in recirculating systems.

(Çukurova University, Faculty of Fisheries, 01330 Balcalı, Adana, Turkey; email of Metin Kumlu: [mkumlu@cu.edu.tr](mailto:mkumlu@cu.edu.tr) Received 26 March 2010)

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#### DEVELOPMENT OF TRANSGENIC ZOOPLANKTON ARTEMIA AS A BIOREACTOR TO PRODUCE EXOGENOUS PROTEIN

Chang S.H., Lee B.C., Chen Y.D., Lee Y.C., Tsai H.J.-2011

Transgenic Res. 2011 [Epub ahead of print]

Abstract:

Although the crustacean *Artemia* has been commonly used as an experimental organism and served as a live bait feed for aquaculture, gene transfer system on *Artemia* sp. to generate stable lines is not well developed. In this study, we optimized a condition for cyst-eleporation and generated stable lines of

transgenic *A. sinica*. Two expression plasmids directed by the hybrid promoters of cytomegalovirus (CMV) and medaka  $\beta$ -actin ( $M\beta$ ) were co-electroporated on decapsulated cysts: pCMV- $M\beta$ -GFP contained GFP reporter gene and pCMV- $M\beta$ -ypGH contained yellowfin porgy GH (ypGH) cDNA. We examined the GFP shown in the *Artemia* larvae and found that the expression rate was 13.3% (3,219 out of 24,054 examined). We then chose 200 G0 founders which strongly expressed GFP to generate transgenic lines. Homozygotic strains derived from F4 generation of each transgenic line, A3 and A8, were obtained. We proved that transgenic lines A3 and A8 also harbored pCMV- $M\beta$ -ypGH and produced recombinant ypGH with a concentration of 0.089 and 0.032  $\mu$ g per 50 homozygotic nauplii, respectively. Ten live *Artemia* nauplii were fed daily to zebrafish larvae during 25 to 35 days of post-fertilization. The average body length gain rates of zebrafish larvae fed transgenic *Artemia* were 16-20% greater than those of control group, indicating the exogenous ypGH produced by transgenic *Artemia* is functional. Therefore, we concluded that the transgenesis on *Artemia* is developed, and transgenic *Artemia* might be highly potentially useful as a new bioreactor material for application in aquaculture and biological researches.

(Institute of Molecular and Cellular Biology, National Taiwan University, Taipei, Taiwan)

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#### COMPARATIVE STUDY ON GROWTH AND SURVIVAL OF LARVAL AND JUVENILE DICENTRARCHUS LABRAX REARING ON ROTIFER AND ARTEMIA ENRICHED WITH FOUR DIFFERENT MICROALGAE SPECIES

M. I. Zaki, H. Saad-2010

African Journal of Biotechnology 9(24): 3676-3688

In the present study, two experiments were carried out, the first one at age from 4th to 24th days post hatching (dph) which include *Dicentrarchus labrax* larvae rearing on rotifer and *Artemia* enriched with four types of algae as follows: *Chlorella salina*, *Dunaleilla salina*, *Nannochloropsis salina* and *Tetraselmis chuii* (ch1, D1, N1 and T1). At the end of the experiment, mean body length of 5.4, 11.9, 11.0 and 10.01 mm and a survival rate of 79.4, 73.8, 63.5 and 30.0% were achieved. Larvae fed with algae cultured in basal medium of chcont, Dcont, Ncont and Tcont reached 9.1, 9.5, 8.0 and 8.0 mm with survival rate of 31.7, 40.4, 30.5 and 22.4% by 25 (dph), respectively. In the second trial, juvenile *D. labrax* (25 – 60 dph) fed with *Artemia* metanauplii, enriched by ch1 (the best result recommended from 1st experiment) increased their mean total length to 35.5 $\pm$ 1.4 mm at age 60 dph. The total carbohydrate and total protein in the algae species used to enrich rotifer and *Artemia* significantly increased for ch1, D1, N1 and T1. Also total amino acid significantly increased at  $P < 0.001$ . The total fatty acid and total unsaturated fatty acid in the algae significantly increased ( $P < 0.001$ ) for ch1, D1, N1 and T1 taking into consideration that the state of C22:6 significantly increased. The ch1 gave better growth and survival percentage followed by D1 for enriched *Brachionus plicatilis* and newly hatched *Artemia*.

(National Institute of Oceanography and Fisheries, Kayed Bay, Alexandria, Egypt)

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#### SUSCEPTIBILITY OF HATCHERY-REARED SNUBNOSE POMPANO TRACHINOTUS BLOCHII TO NATURAL BETANODAVIRUS INFECTION AND THEIR IMMUNE RESPONSES TO THE INACTIVATED CAUSATIVE VIRUS

Rolando Pakingking Jr., Koh-Ichiro Mori, Norwell Brian Bautista, Evelyn Grace de Jesus-Ayson, Ofelia Reyes-2011

Aquaculture 311(1-4): 80-86

Abstract:

Mass mortality of snubnose pompano *Trachinotus blochii* fry exhibiting dark coloration, anorexia, and abnormal swimming behavior was recently documented at the hatchery of the Aquaculture Department of the Southeast Asian Fisheries Development Center, Philippines. Samples of brain tissues were collected from affected fish and processed for RT-PCR amplification and virus isolation in cell culture. Infected E-11 cells exhibited cytopathic effect characteristic of betanodavirus. Histopathology of moribund fish showed pronounced vacuolations in the brain, spinal cord, and retina. An RT-PCR product of approximately 430 bp was amplified from the culture supernatant of betanodavirus-infected E-11 cells and sequenced. Sequencing of the T4 region of the coat protein gene (RNA 2) revealed

clustering of the isolated virus within the red-spotted grouper nervous necrosis virus type. The pathogenicity of the isolated betanodavirus in healthy pompano juveniles and fry was determined via intramuscular injection and immersion challenges, respectively. Higher mortality rates were obtained in challenged fish compared with the controls. An inactivated vaccine was subsequently prepared by treating the clarified betanodavirus with formalin. Pompano juveniles intraperitoneally injected with the inactivated vaccine exhibited neutralizing antibodies from days 15 (mean titer 1:240) to 125 (1:560) with the highest titer noted at day 64 (1:2240) post-vaccination. Additionally, pompano fry bath-vaccinated and consequently bath-challenged with betanodavirus at day 35 post-vaccination showed higher survival rate compared with the control, indicating the potential of the inactivated betanodavirus vaccine against VNN in pompano fry and juveniles.

(Aquaculture Department, Southeast Asian Fisheries Development Center, Tigbauan 5021, Iloilo, Philippines; email of Rolando Pakingking Jr: rpakingking@seafdec.org.ph)

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#### THE OPTIMAL FEEDING FREQUENCY OF LARGE YELLOW CROAKER (*PSEUDOSCIAENA CROCEA*, RICHARDSON) LARVAE

Fengjun Xie, Qinghui Ai, Kangsen Mai, Wei Xu, Hongming Ma-2011

Aquaculture 311(1-4): 162-167

Abstract:

A 30-day feeding experiment was conducted to determine the effects of feeding frequency on the growth, survival and specific activity of digestive enzymes in large yellow croaker larvae (13 days after hatch) with an initial weight of  $4.08 \pm 0.1$  mg. Feeding frequency of 2, 4, 8 and 12 times daily as four treatments were evaluated against a control without feeding in triplicate tanks. The fish were fed to satiation each time. The results showed that treatment of 8 meals per day (meals d<sup>-1</sup>) had significantly higher survival ( $P < 0.05$ ) compared with other treatments. Specific growth rate (SGR) in 8 meals d<sup>-1</sup> treatment was significantly higher than those in 2 meals d<sup>-1</sup> or 4 meals d<sup>-1</sup> treatments ( $P < 0.05$ ), but was not significantly different from that in 12 meals d<sup>-1</sup> treatment ( $P > 0.05$ ). No significant differences in coefficient variations (CV%,  $P > 0.05$ ) of fish larvae body length were observed among the treatments, but there was a significant negative dependency between CV and feeding frequency ( $CV = -0.1476 \times \text{feeding frequency} + 17.55$ ,  $R^2 = 0.9352$ ). Both crude protein and crude lipid in fish larvae significantly increased with increasing feeding frequency. There were no significant differences in fatty acid composition of fish larvae. The specific activity of trypsin, both in pancreatic and intestinal segments, first significantly increased (from 2 meals d<sup>-1</sup> to 8 meals d<sup>-1</sup>) and then kept at a constant level (from 8 meals d<sup>-1</sup> to 12 meals d<sup>-1</sup>). There were no significant differences in specific activities of amylase among dietary treatments. Results of this study suggest that the optimal feeding frequency was 8 meals d<sup>-1</sup> in the culture of large yellow croaker larvae.

(Key Laboratory of Mariculture, Education Ministry of China, Ocean University of China Qingdao 266003, P.R. China; email of Qinghui Ai: qinghui.ai@yahoo.com)

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#### THE RELATIONSHIP BETWEEN ENRICHMENT, FATTY ACID PROFILES AND BACTERIAL LOAD IN CULTURED ROTIFERS (*BRACHIONUS PLICATILIS* L-STRAIN) AND ARTEMIA (*ARTEMIA SALINA* STRAIN FRANCISCANA)

Rémy Haché, Sébastien Plante-2011

Aquaculture 311(1-4): 201-208

Abstract:

Rotifers and Artemia are generally used as first foods in marine finfish aquaculture. Because of their poor nutritional value and the incapacity of marine fish to elongate or desaturate 18-carbon of longer polyunsaturated fatty acids (PUFA), it is a common practice to enrich live foods with commercial products. Since live foods represent a significant vector for transmitting bacterial contaminants, this study describes the impact of using different enrichment strategies for rotifers and Artemia on bacterial load, in addition to fatty acid profiles. Rotifers were reared in continuous culture while Artemia were obtained from cysts; both were enriched for 24 h. Total bacterial counts were obtained after a 7-d incubation on marine agar. Docosahexaenoic acid (DHA) levels varied from 9.8 to 34.4% and from 8.3 to 23.2% respectively, for rotifers and Artemia. Eicosapentaenoic acid (EPA) levels ranged from 3.2 to



7.3% for rotifers and from 5.1 to 9.0% for Artemia, while arachidonic acid (ARA) levels varied, respectively, from 0.7 to 2.9 and from 1.4 to 3.7. Total bacterial counts varied from  $0.9 \times 10^8$  to  $56.6 \times 10^8$  for rotifers and from  $0.2 \times 10^9$  to  $11.7 \times 10^9$  for Artemia. These results demonstrate the importance of the enrichment strategy on the fatty acid composition and the bacterial contamination of live food. (Institut de Recherche sur les Zones Côtières, 232B rue de l'Église, Shippagan, NB, Canada, E8S 1J2 ; email of Rémy Haché : remy.hache@irzc.umcs.ca)

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#### SHORT COMMUNICATION

#### CHARACTERISATION OF 4A-METHYL STEROLS IN PAVLOVA SPP. AND POSTLARVAL SEA SCALLOPS, PLACOPECTEN MAGELLANICUS

Christopher C. Parrish, Lisa M. Milke, V. Monica Bricelj-2011

Aquaculture 311(1-4): 261-262

#### Abstract:

Dietary sterols are necessary to ensure the growth of bivalves such as the commercially important sea scallop, *Placopecten magellanicus*. 4 $\alpha$ -methyl sterols are large C<sub>30</sub>–C<sub>34</sub> sterols present in dinoflagellates and prymnesiophytes, and are thus encountered by scallops in both hatchery and natural environments. Those present in the two classes are very similar with the same number of carbon atoms, the same number of double bonds and the same ions in a mass spectrum. There is, however, a subtle but perhaps biochemically important difference in the side chain in that one group of compounds has an ethyl group (CH<sub>3</sub>CH<sub>2</sub>) while the other has two methyl groups (CH<sub>3</sub>). The ethyl group produces a small difference in retention times on a gas chromatography (GC) column and a small difference in the intensity of key ions in certain mass spectrometers. The ethyl group may also be responsible for discrimination against this compound by the sea scallop.

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#### PARASITIC INFECTION AMONG LARVAE AND FINGERLINGS OF THE PERSIAN STURGEON (*ACIPENSER PERSICUS*) IN VNIRO TANKS AND EARTHEN PONDS

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#### Abstract:

This study was conducted in two phases on sturgeon larvae and fingerlings produced from artificial breeding of five pairs of the Persian sturgeon (*Acipenser persicus*) broodstocks in Shahid Beheshti Hatchery in spring and summer 2006. Initially, 600 larvae were collected on 3 post days hatching (pdh) and 5 days after the onset of exogenous feeding. The second phase was conducted with 450 specimens collected from five earthen ponds, which included 150 larvae collected one week after stocking, 150 fingerlings collected 20 days after stocking and 150 fingerlings collected at the time of their release into rivers. No parasite was observed in the sturgeon larvae on day 3 pdh and 5 days after the onset of exogenous feeding. However, *Trichodina reticulata* were observed in the larvae in the first week (prevalence = 10-20 %) and also in fingerlings (prevalence = 10-46.67 %) 20 days after they were transferred to the earthen ponds. At the time of their release into the river, in addition to *T. reticulata* (prevalence = 13.33-100 %) a digenean trematode, *Diplostomum spathaceum* (prevalence = 6.67-30%) was also observed in the sturgeon fingerlings. It is evident from the present study that *Trichodina* and *Diplostomum* infection occurs after fingerlings were released into the earthen ponds and gradually increases with the progress in the rearing period. Increase in prevalence of *Trichodina* infection through the rearing period can be explained by the increase in water temperature and increase in dissolved organic matter in the ponds which provide the desirable conditions for the propagation of this unicellular ciliate. Significant differences were observed in the mean intensity of *T. reticulata* infection in sturgeon fingerlings during different stages of rearing into earthen ponds ( $P < 0.05$ ).

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