

EFFECTS OF SELECTED LEVELS OF WATER PH ON THE GROWTH AND SURVIVAL OF SWORDTAIL (*XIPHOPHORUS HELLERI*) LARVAE

P.H. Sapkale, R.K. Singh, A.S. Desai-2010

The Israeli Journal of Aquaculture - Bamidgeh 62(1): 38-42

Abstract:

Larvae of swordtail (*Xiphophorus helleri*) were exposed to pH levels of 5.5, 6.0, 7.0, 8.0, and 8.5 to study growth and survival under laboratory conditions for 42 days. The larvae were fed formulated dry pellets at 7% of their body weight. The growth and survival rates were highest at pH 8.0 and 8.5, while mortality was complete at pH 5.5. In all treatments, the specific growth rate was higher in the first week and decreased in subsequent weeks. Thus, for swordtail larvae, the pH of the water should be between 8.0 and 8.5.

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GROWTH AND SURVIVAL OF AFRICAN CATFISH (*CLARIAS GARIEPINUS*) LARVAE FED DECAPSULATED ARTEMIA, LIVE DAPHNIA, OR COMMERCIAL STARTER DIET

K.B. Olurin, A.B. Oluwo-2010

The Israeli Journal of Aquaculture - Bamidgeh 62(1): 50-55

Abstract:

The effects of three diets (decapsulated *Artemia*, live *Daphnia* spp., and commercial starter diet) on the growth and survival of *Clarias gariepinus* larvae were investigated in the laboratory for seven days using a completely randomized block design. Larvae were hatched by the hypophysation technique and, immediately after resorption of the yolk sac, randomly distributed into nine tanks at a stocking rate of 180 larvae per experimental plastic tank. Triplicate groups were fed treatment diets *ad libitum* twice daily, in the morning and in the evening. The highest growth values were obtained in larvae fed decapsulated *Artemia* ($p < 0.05$), while the survival rate was similar in fish fed decapsulated *Artemia* and live daphnia. It is concluded that feeds of animal origin are more suitable for first feeding of *C. gariepinus* larvae than inert diets.

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DEVELOPMENT OF PARATRANSGENIC ARTEMIA AS A PLATFORM FOR CONTROL OF INFECTIOUS DISEASES IN SHRIMP MARICULTURE

B. Subhadra, I. Hurwitz, A. Fieck, D.V.S. Rao, G. Subba Rao, R. Durvasula-2010

Journal of Applied Microbiology 108(3): 831 - 840

Abstract:

Aim: To study the accumulation and retention of recombinant proteins in *Artemia* gut for optimizing paratransgenic disease control in shrimp aquaculture.

Methods and Results: Transgenic *Escherichia coli* expressing fluorescent marker proteins and the transgenic cyanobacterium *Synechococcus bacillarus* expressing a functional murine single chain antibody, DB3, were fed to *Artemia franciscana*. Stable expression and retention of several marker molecules (e.g. GFP, DS Red and DB3) up to 10 h after of feeding with *E. coli* were evident within the gut of *Artemia*. Engineered strains of *S. bacillarus* expressing DB3 accumulated within the gut of *Artemia* with detectable antibody activity for 8–10 h of feeding via ELISA, coincident with the time period of the highest density of transgenic *S. bacillarus* in the *Artemia* gut.

Conclusions: *Artemia* fed transgenic bacteria or algae accumulated recombinant proteins for up to 10 h that retained biological activity. Co-delivery of multiple recombinant proteins simultaneously in the gut of *Artemia* was also demonstrated.

Significance and Impact of the Study: Expression of molecules that target infectious agents of mariculture in shrimp via commonly deployed feed organisms such as *Artemia* could potentially offer powerful new tools in the ongoing global effort to increase food supply.

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INBREEDING DEPRESSION AND GROWTH HETEROSIS IN LARVAE OF THE PURPLE SEA URCHIN *STRONGLYOCENTROTUS PURPURATUS* (STIMPSON)

David Anderson, Dennis Hedgecock-2010

Journal of Experimental Marine Biology and Ecology 384(1-2): 68-75

Abstract:

Effects of inbreeding and crossbreeding in the purple sea urchin *Stronglyocentrotus purpuratus* were examined by means of a controlled factorial cross of adult urchins from two full-sib families, which produced inbred ($f = 0.25$) and crossbred offspring ($f = 0$). Larvae were reared in two different culture systems: static 20-l bucket cultures and replicated 8-l buckets in a shared flow-through water system. The square root of larval area, measured by image analysis, was taken as a measure of size at one and two weeks of age. Linear models explained 60–80% of size variance in these experiments. Inbred larvae were significantly smaller and had greater coefficients of size variance than crossbred larvae, in both systems and at both time points. At week 1, the worst-performing crossbred family in the 8-l system was 33 μm greater than the best inbred family ($P = 0.001$); at week 2, the worst-performing crossbred family was 28 μm greater than the best-performing inbred cross ($P = 0.001$). The cost of inbreeding, δ/f , at week 1, was 1.0 and, at week 2, 0.8, suggesting severe inbreeding depression; the number of detrimental equivalents for larval size ranged from 0.89 to 1.32, with an average dominance of 0.06. These results, together with previous evidence for inbreeding depression of larval survival, suggest that the purple sea urchin has a large load of recessive deleterious mutations and that inbreeding and inbreeding depression could pose significant risks for hatchery-based stock enhancement or aquaculture programs, as well as for declining natural populations.

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EXTERNAL AND INTERNAL CONTROLS OF LUNAR-RELATED REPRODUCTIVE RHYTHMS IN FISHES

A. Takemura, M. S. Rahman, Y. J. Park-2010

Journal of Fish Biology 76(1): 7 – 26

Special Issue: Reproductive Physiology of Fishes

Abstract:

Reproductive activities of many fish species are, to some extent, entrained to cues from the moon. During the spawning season, synchronous spawning is repeated at intervals of c. 1 month (lunar spawning cycle) and 2 weeks (semi-lunar spawning cycle) or daily according to tidal changes (tidal spawning cycle). In species showing lunar-related spawning cycles, oocytes in the ovary develop towards and mature around a specific moon phase for lunar spawners, around spring tides for semi-lunar spawners and at daytime high tides for tidal spawners. The production of sex steroid hormones also changes in accordance with synchronous oocyte development. Since the production of the steroid hormones with lunar-related reproductive periodicity is regulated by gonadotropins, it is considered that the higher parts of the hypothalamus–pituitary–gonad axis play important roles in the perception and regulation of lunar-related periodicity. It is likely that fishes perceive cues from the moon by sensory organs; however, it is still unknown how lunar cues are transduced as an endogenous rhythm exerting lunar-related spawning rhythmicity. Recent research has revealed that melatonin fluctuated according to the brightness at night, magnetic fields and the tidal cycle. In addition, cyclic changes in hydrostatic pressure had an effect on monoamine contents in the brain. These factors may be indirectly related to the exertion of lunar-related periodicity. Molecular approaches have revealed that mRNA expressions of light-sensitive clock genes change with moonlight, suggesting that brightness at night plays a role in

phase-shifting or resetting of biological clocks. Some species may have evolved biological clocks in relation to lunar cycles, although it is still not known how lunar periodicities are endogenously regulated in fishes. This review demonstrates that lunar-related periodicity is utilized and incorporated by ecological and physiological mechanisms governing the reproductive success of fishes.

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CURRENT KNOWLEDGE ON THE PHOTONEUROENDOCRINE REGULATION OF REPRODUCTION IN TEMPERATE FISH SPECIES

H. Migaud, A. Davie, J. F. Taylor-2010

Journal of Fish Biology 76(1): 27 – 68

Special Issue: Reproductive Physiology of Fishes

Abstract:

Seasonality is an important adaptive trait in temperate fish species as it entrains or regulates most physiological events such as reproductive cycle, growth profile, locomotor activity and key life-stage transitions. Photoperiod is undoubtedly one of the most predictable environmental signals that can be used by most living organisms including fishes in temperate areas. This said, however, understanding of how such a simple signal can dictate the time of gonadal recruitment and spawning, for example, is a complex task. Over the past few decades, many scientists attempted to unravel the roots of photoperiodic signalling in teleosts by investigating the role of melatonin in reproduction, but without great success. In fact, the hormone melatonin is recognized as the biological time-keeping hormone in fishes mainly due to the fact that it reflects the seasonal variation in daylength across the whole animal kingdom rather than the existence of direct evidences of its role in the entrainment of reproduction in fishes. Recently, however, some new studies clearly suggested that melatonin interacts with the reproductive cascade at a number of key steps such as through the dopaminergic system in the brain or the synchronization of the final oocyte maturation in the gonad. Interestingly, in the past few years, additional pathways have become apparent in the search for a fish photoneuroendocrine system including the clock-gene network and kisspeptin signalling and although research on these topics are still in their infancy, it is moving at great pace. This review thus aims to bring together the current knowledge on the photic control of reproduction mainly focusing on seasonal temperate fish species and shape the current working hypotheses supported by recent findings obtained in teleosts or based on knowledge gathered in mammalian and avian species. Four of the main potential regulatory systems (light perception, melatonin, clock genes and kisspeptin) in fish reproduction are reviewed.

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TEMPERATURE AND SALMONID REPRODUCTION: IMPLICATIONS FOR AQUACULTURE

N. W. Pankhurst, H. R. King-2010

Journal of Fish Biology 76(1): 69 - 85

Special Issue: Reproductive Physiology of Fishes

Abstract:

Fish reproduction is likely to be affected by increasing water temperatures arising from climate change. Normal changes in environmental temperature have the capacity to affect endocrine function and either advance or retard gametogenesis and maturation, but above-normal temperatures have deleterious effects on reproductive processes. In Atlantic salmon *Salmo salar*, exposure to elevated temperature during gametogenesis impairs both gonadal steroid synthesis and hepatic vitellogenin production, alters hepatic oestrogen receptor dynamics and ultimately results in reduced maternal investment and gamete viability. Exposure to high temperature during the maturational phase impairs gonadal steroidogenesis, delaying or inhibiting the preovulatory shift from androgen to maturation-inducing steroid production. There are also deleterious effects on reproductive development of female broodstock of rainbow trout *Oncorhynchus mykiss* and Arctic charr *Salvelinus alpinus* when they are exposed to elevated temperature. Less is known about temperature effects on male fishes but inhibition of spermiation has been observed in *S. salar* and *O. mykiss*. Among wild stocks, the response to elevated temperature will

involve behavioural thermoregulation with consequent change in geographical ranges and the possibility of local extinctions in some regions. For domesticated stocks, containment in the culture environment precludes behavioural thermoregulation and aquaculturists will be required to develop adaptive strategies in order to maintain productivity. The most direct strategy is to manage the thermal environment using one or more of a range of developing aquaculture technologies. Alternatively, there is potential to mitigate the effects of elevated temperature on reproductive processes through endocrine therapies designed to augment or restore natural endocrine function. Studies largely on *S. salar* have demonstrated the capacity for synthetic luteinizing hormone-releasing hormone to offset the inhibitory effects of elevated temperature on maturational events in both sexes, but the potential for hormone therapy to provide protection during gametogenesis is still largely unexplored.

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TESTING THE SYNERGISTIC EFFECTS OF GnRH AND TESTOSTERONE ON THE REPRODUCTIVE PHYSIOLOGY OF PRE-ADULT PINK SALMON *ONCORHYNCHUS GORBUSCHA*

G. T. Crossin, S. G. Hinch, S. J. Cooke, D. A. Patterson, A. G. Lotto, G. Van Der Kraak, Y. Zohar, U. Klenke, A. P. Farrell-2010

Journal of Fish Biology 76(1): 112 - 128

Special Issue: Reproductive Physiology of Fishes

Abstract:

To test the hypothesis that the hypothalamic gonadotropin-releasing hormone (GnRH) and testosterone (T) co-treatment stimulates both the hypothalmo-pituitary-gonadal (HPG) and hypothalmo-pituitary-interrenal axes, the reproductive and osmoregulatory responses of pre-adult pink salmon *Oncorhynchus gorbuscha* were compared after GnRH and T administration either alone or in combination. Relative to controls, neither GnRH nor T treatment resulted in significantly greater ovarian or testicular growth, but co-treatment significantly increased ovarian growth after 5 months. Interestingly, the stimulation was undetectable after 3 months. However, once daily photoperiod began shortening after the summer solstice, c. 2 months before the natural spawning date, GnRH+T-treated females were stimulated to produce larger ovaries. Final fish body length and the size of individual eggs did not differ among treatment groups. GnRH+T eggs, however, showed signs of advanced vitellogenesis relative to GnRH-treated and control eggs, whereas T-treated eggs became atretic. Testis size increased significantly from initial values and most males were spermiating, but this growth and development were independent of hormone treatments. Final plasma ion, metabolite and cortisol concentrations did not differ among treatment groups. It is concluded that GnRH+T co-treatment was effective in stimulating female but not male maturation. GnRH and T treatment, however, presumably had little effect on the hypothalmo-pituitary-interrenal axis as observed by ionoregulatory status.

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NEUROENDOCRINE CONTROL BY DOPAMINE OF TELEOST REPRODUCTION

S. Dufour, M.-E. Sebert, F.-A. Weltzien, K. Rousseau, C. Pasqualini-2010

Journal of Fish Biology 76(1): 129 - 160

Special Issue: Reproductive Physiology of Fishes

Abstract:

While gonadotropin-releasing hormone (GnRH) is considered as the major hypothalamic factor controlling pituitary gonadotrophins in mammals and most other vertebrates, its stimulatory actions may be opposed by the potent inhibitory actions of dopamine (DA) in teleosts. This dual neuroendocrine control of reproduction by GnRH and DA has been demonstrated in various, but not all, adult teleosts, where DA participates in an inhibitory role in the neuroendocrine regulation of the last steps of gametogenesis (final oocyte maturation and ovulation in females and spermiation in males). This has major implications for inducing spawning in aquaculture. In addition, DA may also play an inhibitory role during the early steps of gametogenesis in some teleost species, and thus interact with

GnRH in the control of puberty. Various neuroanatomical investigations have shown that DA neurones responsible for the inhibitory control of reproduction originate in a specific nucleus of the preoptic area (NPOav) and project directly to the region of the pituitary where gonadotrophic cells are located. Pharmacological studies showed that the inhibitory effects of DA on pituitary gonadotrophin production are mediated by DA-D2 type receptors. DA-D2 receptors have now been sequenced in several teleosts, and the coexistence of several DA-D2 subtypes has been demonstrated in a few species. Hypophysiotropic DA activity varies with development and reproductive cycle and probably is controlled by environmental cues as well as endogenous signals. Sex steroids have been shown to regulate dopaminergic systems in several teleost species, affecting both DA synthesis and DA-D2 receptor expression. This demonstrates that sex steroid feedbacks target DA hypophysiotropic system, as well as the other components of the brain-pituitary gonadotrophic axis, GnRH and gonadotrophins. Recent studies have revealed that melatonin modulates the activity of DA systems in some teleosts, making the melatonin-DA pathway a prominent relay between environmental cues and control of reproduction. The recruitment of DA neurons for the neuroendocrine control of reproduction provides an additional brain pathway for the integration of various internal and environmental cues. The plasticity of the DA neuroendocrine role observed in teleosts may have contributed to their large diversity of reproductive cycles.

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THE ROLE OF THE MATURATION-INDUCING STEROID, 17,20B-DIHYDROXYPREGN-4-EN-3-ONE, IN MALE FISHES: A REVIEW

A. P. Scott, J. P. Sumpter, N. Stacey-2010

Journal of Fish Biology 76(1): 183 - 224

Special Issue: Reproductive Physiology of Fishes

Abstract:

The major progestin in teleosts is not progesterone, as in tetrapods, but 17,20 β -dihydroxypregn-4-en-3-one (17,20 β -P) or, in certain species, 17,20 β ,21-trihydroxy-pregn-4-en-3-one (17,20 β ,21-P). Several functions for 17,20 β -P and 17,20 β ,21-P have been proposed (and in some cases proved). These include induction of oocyte final maturation and spermiation (milt production), enhancement of sperm motility (by alteration of the pH and fluidity of the seminal fluid) and acting as a pheromone in male cyprinids. Another important function, initiation of meiosis (the first step in both spermatogenesis and oogenesis), has only very recently been proposed. This is a process that takes place at puberty in all fishes and once a year in repeat spawners. The present review critically examines the evidence to support the proposed functions of 17,20 β -P in males, including listing of the evidence for the presence of 17,20 β -P in the blood plasma of male fishes and discussion of why, in many species, it appears to be absent (or present at low and, in some cases, unvarying concentrations); consideration of the evidence, obtained mainly from in vitro studies, for this steroid being predominantly produced by the testis, for its production being under the control of luteinizing hormone (gonadotrophin II) and, at least in salmonids, for two cell types (Leydig cells and sperm cells) being involved in its synthesis; discussion of the factors involved in the regulation of the switch from androgen to 17,20 β -P production that seems to occur in many species just at the time of spermiation; discussion of the effects of in vivo injection and application of 17,20 β -P (and closely related compounds) in males; a listing of previously published evidence that supports the proposed new function of 17,20 β -P as an initiator of meiosis; finally, discussion of the evidence for environmental endocrine disruption by progestins in fishes.

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ROLES OF HEPATOCYTE NUCLEAR FACTORS (HNF) IN THE REGULATION OF REPRODUCTION IN TELEOSTS

W.-T. Huang, C.-F. Weng-2010

Journal of Fish Biology 76(1): 225 - 239

Special Issue: Reproductive Physiology of Fishes

Abstract:

Hepatocyte nuclear factor (HNF) families are composed of liver-enriched transcription factors and upstream regulators of many liver-specific genes. HNF are involved in liver-specific gene expression, metabolism, development, cell growth and many cellular functions in the body. HNF genes can be activated or influenced by several hormones and insulin-like growth factors (IGF), and different combinations of the four HNF factors form a network in controlling the expression of liver-specific or liver-enriched genes. The functions of these factors and their interactions within the gonads of bony fishes, however, are not well understood, and the related literature is scant. Recently, several members of the HNF families have been detected in teleost gonads together with their downstream genes (IGF-I and IGF-II), suggesting that these HNF could be upregulated in vitro by steroid hormones. Thus, the hormone–HNF–IGF–gonad interaction may be an alternative axis in the reproductive mechanism that acts in concert with the conventional hypothalamus–pituitary–gonad pathway. This may help the early development and maturation of the gonad or gamete, sexual maturity or reversion and spawning-regulating mechanisms among fishes to be understood.

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FRENETIC ACTIVATION OF FISH SPERMATOOZOA FLAGELLA ENTAILS SHORT-TERM MOTILITY, PORTENDING THEIR PRECOCIOUS DECADENCE

J. Cosson-2010

Journal of Fish Biology 76(1): 240 - 279

Special Issue: Reproductive Physiology of Fishes

Abstract:

In most species, fish spermatozoa activate their motility on contact with the external medium (sea or fresh water depending of their reproductive habitat). Their flagella immediately develop waves propagated at high beat frequency (up to 70 beats s^{-1}), which propel these sperm cells at high velocity (6–10 mm min^{-1}), but for a quite short period of time, usually limited to minutes. Their specific inability to restore their energy content (mostly adenosine triphosphate) fast enough relatively to their high rate of energy consumption by flagellar contributes mainly to the activity arrest of motility, as the spermatozoa need to rely on early accumulated energy prior to activation. This review of the published data explains the present understanding of physico-chemical mechanisms by which flagellar motility is activated (mostly through osmotic and ionic regulation) and then propels sperm cells at speed. It aims also to describe the gradual arrest of their motility much of which occurs within a few minutes.

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ELEVATED WATER TEMPERATURE IMPAIRS FERTILIZATION AND EMBRYONIC DEVELOPMENT OF WHITEFISH COREGONUS LAVARETUS

S. Cingi, M. Keinänen, P. J. Vuorinen-2010

Journal of Fish Biology 76(3): 502 - 521

Abstract:

The adverse effects of high temperatures on the early life stages of anadromous whitefish *Coregonus lavaretus* were experimentally examined by assessing fertilization success, the percentage of developmental abnormalities, cumulative mortality and the rate of embryogenesis across a range of temperatures. Temperatures $\geq 7^\circ C$ increased the proportion of unfertilized and abnormally dividing eggs, deformed embryos and consequent mortality. The higher the temperature, the more severe were the effects. When eggs were fertilized and constantly incubated at various temperatures, the effective level for 50% of the eggs and embryos (EL50) of temperature was $7.6^\circ C$ at the developmental stage when eye pigmentation was visible. Fewer developmental abnormalities and a lower cumulative mortality rate were observed when embryos were exposed to high temperatures from the later, gastrula stage, than from fertilization or the four-cell stage. Irrespective of retarded development in terms of day-degrees (i.e. the sum of daily mean temperatures), a high incubation temperature reduced the

development time of *C. lavaretus*, leading to earlier hatching, and hatched fry were shorter than at the reference temperature of 4–5° C. Global warming will particularly pose risks for stenothermic species such as *C. lavaretus*, with early life stages being especially susceptible. Thus, relatively small increases and fluctuations in river water temperatures during the spawning season of this anadromous species may have substantial negative impacts on its recruitment and population persistence.

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DIVERGENT TRENDS IN LIFE-HISTORY TRAITS BETWEEN ATLANTIC SALMON *SALMO SALAR* OF WILD AND HATCHERY ORIGIN IN THE BALTIC SEA

A. Vainikka, I. Kallio-Nyberg, M. Heino, M.-L. Koljonen-2010

Journal of Fish Biology 76(3): 622 - 640

Abstract:

Four Atlantic salmon *Salmo salar* stocks in the Baltic Sea, varying in their breeding history, were studied for changes in life-history traits over the years 1972–1995. Total length (LT) at age of captured (LTC) fish had increased throughout the study period, partly due to increased temperature and increased LT at release, (LTR) but also due to remaining cohort effects that could represent unaccounted environmental or genetic change. Simultaneously, maturation probabilities controlled for water temperature, LTC and LTR had increased in all stocks. The least change was observed in the River Tornionjoki *S. salar* that was subject only to supportive stockings originating from wild parents. These results suggest a long-term divergence between semi-natural and broodstock-based *S. salar* stocks. Increased LT at age explained advanced maturation only marginally, and it remains an open question to what extent the generally increased probabilities to mature at early age reflected underlying genetic changes.

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POST-RELEASE GROWTH AND DISPERSAL OF POND AND HATCHERY-REARED EUROPEAN GRAYLING *THYMALLUS THYMALLUS* COMPARED WITH THEIR WILD CONSPECIFICS IN A SMALL STREAM

J. Turek, T. Randák, P. Horký, V. Iábek, J. Velíšek, O. Slavík, R. Hanák-2010

Journal of Fish Biology 76(3): 684 - 693

Abstract:

The growth, and dispersal of stocked European grayling *Thymallus thymallus*, reared in a hatchery (fed dry food pellets) or in a pond (fed natural food), compared with their wild conspecifics was assessed from the recapture of individually tagged fish 168 days after their release into the Blanice River, Czech Republic. Recapture rates and site fidelity were higher for wild *T. thymallus* than for artificially reared fish. Specific growth rate and upstream or downstream dispersal did not significantly differ between any of the groups of fish. An influence of rearing conditions (pond v. hatchery) on the overall performance of stocked fish was not demonstrated. Initially, lower condition factors of reared *T. thymallus* were equal to wild fish after recapture, suggesting adaptation of artificially reared fish that remained in the sections studied.

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FORMATION AND STRUCTURE OF EGG ENVELOPES IN RUSSIAN STURGEON *ACIPENSER GUELLENSTAEDTII* (ACIPENSERIFORMES: ACIPENSERIDAE)

M. Želazowska-2010

Journal of Fish Biology 76(3): 694 - 706

Abstract:

The covering of the eggs in Russian sturgeon *Acipenser gueldenstaedtii* consists of three envelopes (the vitelline envelope, chorion and extrachorion) and is equipped with multiple micropyles. The most proximal to the oocyte is the vitelline envelope that consists of four layers of filamentous and trabecular material. The structural components of this envelope are synthesized by the oocyte (primary envelope). The chorion encloses the vitelline envelope. The extrachorion covers the external surface of the egg. Examination of the arrangement of layers that comprise the egg envelopes together with the ultrastructure of follicular cells revealed that the chorion and extrachorion are secondary envelopes. They are secreted by follicular cells and are built of homogeneous material. During formation of egg envelopes, the follicular cells gradually diversify into three morphologically different populations: (1) cells covering the animal oocyte region (cuboid), (2) main body cells (cylindrical) and (3) micropylar cells. The apical surfaces of follicular cells from the first two populations form processes that remain connected with the oocyte plasma membrane by means of gap junctions. Micropylar cells are located at the animal region of the oocyte. Their apical parts bear projections that form a barrier to the deposition of materials for egg envelopes, resulting in the formation of the micropylar canal.

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EFFECTS OF DIFFERENT PHOTOPERIODS AND WATER TEMPERATURES ON SURVIVAL, GROWTH, FEEDING AND INITIAL SWIM BLADDER INFLATION OF GREATER AMBERJACK *SERIOLA DUMERILI* LARVAE

Yoshiro Hirata, Katsuyuki Hamasaki, Akihiko Imai, Kazuhisa Teruya, Takashi Iwasaki, Kazuhisa Hamada, Keiichi Mushiake-2009

Nippon Suisan Gakkaishi 75 (6): 995-1003

Abstract:

To determine the appropriate rearing conditions for early stage larvae of greater amberjack *Seriola dumerili*, we investigated the survival, growth, feeding and initial swim bladder inflation of larvae reared in two or three replicates in 500 L tanks under different photoperiods (0L: 24D, 12L: 12D, 18L: 6D, 24L: 0D) and water temperatures (22, 24, 26, 28°C). In the 0L: 24D group, few larvae showed feeding incidence and growth, and total mortality occurred 8 days after hatching. Photoperiod (12-24 hours light condition) and temperature did not affect the larval feeding and swim bladder inflation, whereas larval survival and growth were improved in the 18L: 6D group and larval survival was the best at 22°C.

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EFFECT OF DIETARY N-3 HIGHLY UNSATURATED FATTY ACIDS ON SURVIVAL, MOLTING AND GROWTH OF LARVAL SNOW CRAB *CHIONOECETES OPILIO* REARED IN THE LABORATORY

Takayuki Kogane, Shigeki Dan, Katsuyuki Hamasaki-2009

Nippon Suisan Gakkaishi 75 (6):1004-1010

Abstract:

The effects of varying levels of dietary n-3 highly unsaturated fatty acids (HUFA) and the ratios of docosahexaenoic acid/eicosapentaenoic acid (DHA/EPA) on survival, molting and growth of larval snow crab *Chionoecetes opilio* were examined in two separate experiments, in which larvae were reared in small containers until reaching the first stage crab. In experiment I, zoea larvae were fed rotifers enriched with n-3 HUFA at three levels, and rotifers without n-3 HUFA enrichment. In experiment II, zoea larvae were fed rotifers enriched with n-3 HUFA at a constant level, which was considered as optimum from experiment I, but having different DHA/EPA ratios, and fed non-enriched rotifers. In both experiments, megalopa larvae were fed non-enriched *Artemia* sp. Larval survival and growth were improved by feeding rotifers enriched with n-3 HUFA. The occurrence of abnormal moltings during the metamorphosis from megalopa to the first stage crab decreased with increasing n-3 HUFA content in rotifers. The better survival rates from the first zoea stage to the first crab stage were observed when

zoeae were fed rotifers containing ~2.3 g/100 g n-3 HUFA (dry matter basis) with the DHA/EPA ratio of ~1.5.

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INFLUENCE OF LARVAL SIZE AND FEEDING ON THE RATIO OF THEIR SETTLEMENT TO SPAT COLLECTORS PRESOAKED IN SEAWATER CONTAINING ADULT PACIFIC OYSTERS CRASSOSTREA GIGAS

Yasushi Hirata, Yoshinobu Tamura, Kazuya Nagasawa-2009

Nippon Suisan Gakkaishi 75 (6): 1036-1041

Abstract:

The presoaking of spat collectors in seawater containing adult Pacific oysters *Crassostrea gigas* is known to induce their larval settlement. In this study, we examined the effect of the size and feeding condition of larvae on the ratio of their settlement. Although the presoaking of collectors increased their settlement ratios in larger larvae with a mean shell height of 344 μm , the treatment of collectors did not increase the ratios in smaller larvae with a mean shell height of 295 μm . There were no significant differences in the ratios of larval settlement among the larvae fed with a cultured diatom at a variety of concentrations (0.0~10.0 \times 10⁴ cells/mL) during the 24-hour periods of the experiments.

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EFFECT OF ENRICHED ARTEMIA URMIANA ON GROWTH, SURVIVAL AND COMPOSITION OF LARVAL PERSIAN STURGEON

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Abstract:

Recently, the nutritional requirements of marine finfish larvae have received considerable attention, and studies have been shown that docosahexaenoic acid (DHA) affects on the growth and survival of marine finfish larvae. We investigated the effects of different Artemia diets containing variable amounts of DHA on the growth and survival of larval *Acipenser persicus*. Four different commercial Artemia enrichment formulations were used: ICES30/4, Sturgeon Ovary Oil (SOO), Cod Liver Oil (CLO) and Linseed Oil (LO). The resultant Artemia contained a different 45 L concentration of DHA (0.00-5.99 mg/g DW) and eicosapentaenoic acid EPA (0.69-4.97 mg/g DW). Seventy five aquaria were used with three replicates per treatment. Larvae were fed with Artemia from 3 to 20 days after active feeding at 250 prey L⁻¹. At the end of the experiment, total length and wet weight of fish larvae showed significant differences among treatments ($P < 0.05$) but no dry weight ($P > 0.05$). However, larvae reared on LO were significantly higher dry weight than larvae reared with ICES30/4 and SOO. Survival in fish larvae fed SOO Artemia enriched (93.3 \pm 1.6%) was significantly higher than ICES30/4 and LO ($P < 0.05$) but not CLO ($P > 0.05$). Protein/ lipid ratio in larvae enriched with CLO showed significant differences with other treatments ($P > 0.05$). DHA/EPA ratio in the larvae fed ICES30/4 (1.11 \pm 0.00) was the highest among the treatments. This study resulted that the requirement of the Persian sturgeon larvae to dietary DHA and EPA is high also our results showed that there is a positive effect of Artemia DHA proportions on growth and survival rates.

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NITRIFICATION PERFORMANCE OF A SUBMERGED BIOFILTER IN A LABORATORY SCALE SIZE OF THE RECIRCULATING SHRIMP SYSTEM

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Abstract:

A submerged biofilter (SBF) with 0.1 m³ of filter medium was maintained without backwash at four different water temperatures (14°C, 18°C, 22°C and 26°C) in four different recirculating systems stocked with green tiger shrimp (*Penaeus semisulcatus*). The ammonia removal profile and nitrification performance of the SBF was evaluated at feed loading rates of 2.65 g day⁻¹ at 14°C, 5.52 g day⁻¹ at 18°C, 7.91 g day⁻¹ at 22°C and 10.94 g day⁻¹ at 26°C. In all of the experimental systems, the ammonia removal rate per unit volume of filter medium (the volumetric total ammonia nitrogen conversion rate, VTR) increased at the start of the experiment, reached and maintained a maximum value for a period of time, then decreased sharply. Statistical analysis revealed significant relationships among water temperature, total ammonia nitrogen (TAN) and the VTR. Temperature was not more important than TAN when comparing their effects on the VTR of the SBF.

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