
MORPHOMETRIC AND PRELIMINARY GENETIC CHARACTERISTICS OF ARTEMIA POPULATIONS FROM IRAN

Naser Agh, Peter Bossier, Theodore J. Abatzopoulos, John A. Beardmore, Gilbert Van Stappen, Ali Mohammadyari, Hasan Rahimian, Patrick Sorgeloos-2009

International Review of Hydrobiology 94(2): 194 – 207

Abstract:

Six *Artemia* populations, one bisexual and five parthenogenetic, from different parts of Iran were compared using morphometric and genetic characteristics. The discriminant analysis based on 19 morphometric variables showed that there are significant differences between the studied populations based on their morphological characteristics, where 85.9% of original grouped cases were correctly classified. The bisexual *Artemia urmiana* however exhibited a 100% separation from the parthenogenetic populations. However, a 1500 bp mitochondrial rDNA fragment showed similar RFLP patterns for all Iranian populations confirming earlier reports of a close genetic relationship between *A. urmiana* and parthenogenetic *Artemia*.

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SPAWNING INDUCTION IN THE CARP: PAST EXPERIENCE AND FUTURE PROSPECTS - A REVIEW

Z. Yaron, A. Bogomolnaya, S. Drori, I. Biton, J. Aizen, Z. Kulikovskiy, B. Levavi-Sivan-2009

The Israeli Journal of Aquaculture – Bamidgah 61(1): 5-26

Abstract:

Most fish in aquaculture either fail to breed in captivity or their spawning occurs sporadically and late in the season. This is mainly due to the lack of natural cues in captivity, which leads to dysfunction of the endocrine axis regulating oocyte maturation and ovulation. Hypophysation as a remedy for this situation in fish has been employed in aquaculture since the 1930s and is still widely practiced. However, using crude pituitary homogenates in local hatcheries has frequently ended in failures that were attributed to the inconsistent potency of the injected material and the unknown ovarian stage of the recipient fish. Since the mid 1980s, hypophysation has improved through the introduction of a standardized dry carp pituitary extract in which

the luteinizing hormone (LH) content and activity have been calibrated (calibrated

carp pituitary extract = CCPE). Induction of spawning, however, is successful mainly in female cohorts in which 65% or more of the oocytes in an ovarian biopsy have migrating germinal vesicles. Further, due to decreasing quantities of industry-processed common carp and the expansion of ornamental carp production (koi and goldfish), the growing demand for CCPE could not be met, and an alternative had to be found. A hypothalamic approach, introduced into Israeli aquaculture in 1993 (called Dagin), combines a superactive analog of sGnRH (10 µg/kg), with the water-soluble dopamine (D2) receptor antagonist, metoclopramide (20 mg/kg). The progress of oocyte maturation in ovarian biopsies has been studied in parallel with changes in levels of LH, estradiol, and the maturation-inducing steroid (MIS; 17β, 20β, dihydroxy-4-pregnene-3-one). The hormone profile indicated that the gradual increases in LH and MIS following a single administration of Dagin were similar to those in fish treated with priming and resolving doses of CCPE. This would explain why Dagin is effective even when only a single injection is given, saving labor and reducing handling stress. CCPE and Dagin were tested in parallel on common

carp in a commercial hatchery. The spawning ratio and embryo viability were similar, although the latency between injection and ovulation was considerably longer and more variable in Dagin-treated than in CCPE-treated carp. It is recommended to use CCPE at the beginning and end of the spawning season when the LH content in the pituitary is low, and Dagin in mid-season and in field spawning. Future prospects raise the possibility that by employing molecular tools, a recombinant carp LH will be produced that will have the regular and expected potency of the hypophyseal approach without the

risk of spreading pathogens from donor fish to broodstock. Work along this line is currently in progress.

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EFFECTS OF LIVE FOOD ORGANISMS AND FORMULATED DIETS ON GROWTH, SURVIVAL, AND BODY PROTEIN OF ASIAN SEA BASS FRY (*LATES CALCARIFER*, BLOCH)

Vivek Rohidas Vartak, Ravendra Kumar Singh-2009

The Israeli Journal of Aquaculture – Bamidgeh 61(1): 63-67

Abstract:

The effects of the live feeds, *Artemia*, *Moina*, and *Tubifex*, and a formulated diet on the survival, growth, and body composition of fry (0.05 ± 0.001 g) of the Asian sea bass, *Lates calcarifer* (also called barramundi), were evaluated. The formulated diet was supplemented with dry Bombay duck fishmeal (10%) as an attractant. The experiment was conducted for 30 days in 40-l glass aquaria containing 30 l fresh water. The fry fed *Artemia* had the best survival (70%) and growth rate ($6.48 \pm 0.10\%$). Fry fed *Moina* and formulated diet had 60% survival, not significantly different from fry fed *Artemia*. Survival was poor (30%) in fry fed *Tubifex*. Body protein and lipid contents differed significantly among treatments. The present study suggests that *Artemia nauplii* is the better feed for Asian sea bass fry but formulated diet can be used as a substitute since growth and survival were similar.

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EMBRYONIC DEVELOPMENT OF BARBEL (*BARBUS BARBUS*)

Katarzyna Lugowska-2009

The Israeli Journal of Aquaculture – Bamidgeh 61(1): 68-72

Abstract:

Barbel (*Barbus barbus* L.) is rarely bred and reared in hatcheries, and data on the early development of this species are scarce. Thus, the aim of the study was to describe its embryonic development in detail. Eggs and sperm were obtained from artificially stimulated spawning. Fertilized eggs were incubated in ten 2000-ml aquaria filled with aerated dechlorinated tap water and maintained at a constant 18°C, the optimal temperature for embryonic development of barbel. The eggs swelled to a maximum of 18% during the first hour after fertilization. There were eight distinct stages of embryonic development: two blastomeres, eight blastomeres, small-celled blastula, embryo body formation, body segmentation, formation of brain and eye germs, change of yolk sac shape, and first movement of the embryo. Survival during development was over 81% and during hatching 74%. Of the newly hatched larvae, 88% were normal, 7% were dead, and only 5% had morphological abnormalities, the most common of which were yolk sac malformations, spinal cord curvatures, and heart edema.

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THE EFFECT OF PHOTOPERIOD ON THE REPRODUCTIVE DEVELOPMENT OF THE NORTHERN BAY SCALLOP, *ARGOPECTEN IRRADIANS*

André L. Mallet, Claire E. Carver-2009

Journal of Experimental Marine Biology and Ecology 374 (2): 28-133

Abstract:

One-year-old bay scallops, *Argopecten irradians* (58 ± 2 mm, 22 ± 1 g live weight) were exposed to four replicated photoperiod treatments (24D, 8L:16D, 16L:8D, and 24L where D = dark hours, L = light hours) in order to measure the effect on gonad weight and maturation during the conditioning process. Results indicated that day-lengths of more than 8 h are necessary to promote

gonad maturation in bay scallops. After 6 wk, the mean gonad weight for scallops in the 16-h and 24-h light regimes was similar at 0.6 ± 0.1 g dry weight compared to a mean of 0.2 ± 0.1 g dry weight for those in the 8-h and 0-h light regimes. Histological assessment indicated significantly more follicular tissue development in both the male and female portion of the gonad in the two longer photoperiod treatments. Overall, gamete maturity was highest for the scallops in the 16-h light regime; the incidence of mature eggs was 50% compared to 35% in the 24-h light regime, 20% in the 8-h light regime and 10% in the 0-h light regime. Assessment of feeding rates indicated no significant difference in algal cell consumption among treatments. Total dry tissue weight doubled over the 6-wk conditioning trial with no significant differences among treatments. One-year-old bay scallops appear to be non-responsive to conditions suitable for gonad maturation (i.e. appropriate temperature and food levels) unless they receive more than 8 h of light exposure. This finding has important implications for northern hatcheries which typically condition broodstock indoors during the early spring.

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AEROBIC SCOPE FOR ACTIVITY IN AGE 0 YEAR ATLANTIC COD GADUS MORHUA

S. L. Hansen, I. Hunt Von Herbing-2009

Journal of Fish Biology 74(7): 1355 – 1370

Abstract:

Key components of swimming metabolism: standard metabolism (R_s), active metabolism (R_a) and absolute aerobic scope for activity ($R_a - R_s$) were determined for small age 0 year Atlantic cod *Gadus morhua*. *Gadus morhua* juveniles grew from 0.50 to 2.89 g wet body mass (MWB) over the experimental period of 100 days, and growth rates (G) ranged from 1.4 to 2.9% day⁻¹, which decreased with increasing size. Metabolic rates were recorded by measuring changes in oxygen consumption over time at different activity levels using modified Brett-type respirometers designed to accommodate the small size and short swimming endurance of small fishes. Power performance relationships were established between oxygen consumption and swimming speed measurements were repeated for individual fish as each fish grew. Mass-specific standard metabolic rates ($\dot{V}O_2$) were calculated from the power performance relationships by extrapolating to zero swimming speed and decreased from 7.00 to 5.77 $\mu\text{mol O}_2 \text{ g}^{-1} \text{ h}^{-1}$, mass-specific active metabolic rates ($\dot{V}O_2$) were calculated from extrapolation to maximum swimming speed (U_{max}) and decreased from 26.18 to 14.35 $\mu\text{mol O}_2 \text{ g}^{-1} \text{ h}^{-1}$ and mass-specific absolute scope for activity was calculated as the difference between active and standard metabolism ($\dot{V}O_2$) and decreased from 26.18 to 14.35 $\mu\text{mol O}_2 \text{ g}^{-1} \text{ h}^{-1}$ as MWB increased. Small fish with low R_s had bigger aerobic scopes but, as expected, R_s was higher in smaller fish than larger fish. The measurements and results from this study are unique as R_s , R_a and absolute aerobic scopes have not been previously determined for small age 0 year *G. morhua*.

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EFFECT OF PHOTOPERIOD ADVANCEMENT OF ATLANTIC COD SPAWNING ON EGG SIZE AND BIOCHEMISTRY

Randy W. Penney, M. Jeanne Hart, P. Lynn Lush, Christopher C. Parrish-2009

North American Journal of Aquaculture 71(2): 107–115

Abstract:

We report on the proximate composition, lipid class, and fatty acid content of fertilized eggs during the course of one spawning season from two broodstocks of Atlantic cod *Gadus morhua*: one group was maintained under ambient photoperiod (PP), whereas for the second group the natural photoperiod cycle was compressed by approximately 4 months by PP advancement from ambient. We tested the hypothesis that PP compression, which reduces the time between successive spawning seasons and therefore reduces the time available for vitellogenesis and maturation, might also impair nutrient transfer to the eggs, causing reduced egg quality as measured by biochemical indices. Advanced PP eggs were significantly larger than ambient control eggs (absolute mean values for dry

weight = 109.2 and 97.9 μg , respectively). Advanced PP eggs also had significantly greater mean total protein (60.0 versus 49.4 μg), mean total lipid (15.1 versus 9.7 μg), and greater mean values for several major lipid classes (hydrocarbons, triacylglycerols, sterols, diacylglycerols, and phospholipids) than ambient controls. Proportionally (percent of dry weight), mean total lipid, ash, triacylglycerols, total saturated fatty acids, and total polyunsaturated fatty acids, including total ω -3, total ω -6, docosahexaenoic acid, eicosapentaenoic acid, and arachidonic acid, were all significantly greater in eggs of the advanced PP group than in ambient controls. The latter contained proportionally more monounsaturated fatty acids. Mean dry weight of eggs declined over time from onset of first spawning in the ambient PP group but not in the advanced PP group, and none of the measured biochemical indices varied significantly over time from onset of first spawning in either PP group. We conclude that with the PP advancement technique used here, compression of time between successive spawnings by up to 4 months in Atlantic cod does not negatively affect biochemical indices of egg quality associated with normal development or survival performance.

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EVALUATION OF WALLEYE EMBRYO SURVIVAL AND LARVAL VIABILITY AFTER IODINE TREATMENT

Konrad Dabrowski, Kyle Ware, Marta Jaroszewska, Karolina Kwasek-2009

North American Journal of Aquaculture 71(2): 122–129

Abstract:

Securing health and avoiding viral disease transmission are of paramount importance for stocking and management of walleyes *Sander vitreus*. Iodine compounds are widely used as nonselective antiviral substances; however, their adverse effects on embryo survival are less known. Our experiments investigated how maternal attributes influence the relationship between toxicity of iodine (expressed as concentrations and duration of treatment) and survival of walleyes after fertilization and during early larval growth. Eleven female and four male walleyes were collected in April 2007 from the Maumee River, Perrysburg, Ohio, and the gametes were transported unfertilized (2 h) to the laboratory. After fertilization and tannic acid treatment, embryos were exposed for 15, 30, and 180 min to iodine concentrations of 0 (control), 50, 100, 200, 400, and 800 mg/L. The calculated survival of 50% of the embryos at the eyed stage corresponded to an iodine concentration of 380 mg/L for the exposure duration of 15 min (i.e., the LD50; linear relationship). An increase in exposure time (to 30 or 180 min) significantly decreased embryo survival. Progeny from individual females varied in sensitivity to iodine treatment, particularly with respect to the high concentration (800 mg/L), but high survival in controls did not correspond to better resistance to iodine treatments. No significant differences were observed in larval walleye size or swim bladder inflation rates among various iodine exposure groups within 15 d after treatment.

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VARIABILITY OF EGG CHARACTERISTICS AMONG FEMALE WHITE BASS AND THE RELATIONSHIP BETWEEN EGG VOLUME AND LENGTH AT HATCH OF SUNSHINE BASS

S. E. Lochmann, K. J. Goodwin, C. L. Racey, C. C. Green-2009

North American Journal of Aquaculture 71(2): 147–156

Abstract:

Domesticated white bass *Morone chrysops* can be used in selective breeding programs to produce sunshine bass (female white bass \times male striped bass *M. saxatilis*). In addition to fast growth or favorable feed conversion, selection could be based on favorable egg or larval characteristics. Eggs from 12 white bass were fertilized with striped bass sperm to produce sunshine bass larvae and were individually photographed and incubated. The yolk sac larvae hatched from these eggs were also photographed within 3 h of hatching. Percent hatch ranged from 49% to 96%. Egg and larval characteristics were determined from the digital images. Total lipid and fatty acid composition were determined for eggs from each female. Average egg volume ranged from 0.32 to 0.42 mm³. Standard

lengths of yolk sac larvae ranged from 2.51 to 3.62 mm. The relation between individual egg volumes and individual standard lengths explained only 1% of the variability in length at hatch. Average egg characteristics were generally unrelated to average length at hatch, but fatty acid composition was related to percent hatch. Maternal effects explained about 11% of the variability in individual length at hatch, and time to hatch (i.e., the length of time from fertilization to hatch for an individual embryo) explained 25% of the variability in individual length at hatch. Some females produced eggs and larvae with characteristics that were more suitable to increasing survival and fingerling production. Selection for these characteristics in broodstock white bass females could lead to improved production of sunshine bass fingerlings.

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EFFECT OF TURBIDITY DURATION ON CULTURE OF WALLEYE LARVAE

Richard D. Clayton, Joseph E. Morris, Robert C. Summerfelt-2009

North American Journal of Aquaculture 71(2): 174–177

Abstract:

Although turbid water is an essential environmental requirement for intensive larviculture of walleyes *Sander vitreus* on formulated feed, research has not determined the duration of turbidity required to achieve optimal benefits for survival and growth while reducing cannibalism. We conducted a replicated, single-factor analysis to determine the effect duration of turbidity on these performance indicators at 28 d posthatch (dph). Four treatments, each with three replicate 150-L tanks, involved culture of larvae in turbid water (84–125 nephelometric turbidity units [NTU]) from 3 dph to 7, 14, 21, or 28 dph. After culture under turbid conditions for the specified period, the fish were then cultured in clear water until 28 dph (i.e., fish in the 28-dph treatment received no clear-water culture). At 28 dph, substantial differences were observed in survival and growth among treatments. Fish survival for the 7- and 14-dph treatments (1% and 2%, respectively) was significantly less than that for the 21- and 28-dph treatments (11% and 14%, respectively). There was a significant difference in total length at 28 dph among the 7-, 14-, and 21-dph treatments but not between the 21- and 28-dph treatments. Fish in the 28-dph treatment were 177% heavier than those in the 14-dph treatment. A shift in phototactic response at about 20 dph further reduced the need for turbid-water culture to prevent clinging behavior in walleye larvae. Cannibalism (2–5%) was observed in all treatments between 7 and 13 dph but not thereafter. The study substantiates benefits of turbid-water culture for larval walleyes and demonstrates that duration of turbidity should extend through 28 dph to maximize survival and growth but that it is less important for preventing cannibalism after 13 dph and clinging behavior after 20 dph.

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ALLOMETRIC GROWTH IN HATCHERY-REARED GILTHEAD SEABREAM

Deniz Çoban, H. Okan Kamaci, Cüneyt Suzer, ahin Saka, Kürat Firat-2009

North American Journal of Aquaculture 71(3): 189–196

Abstract:

Morphological development and allometric growth were investigated in the gilthead seabream *Sparus aurata* during larval development until the end of the weaning period on day 41. Fertilized eggs had a diameter of 1.01 ± 0.02 mm (mean \pm SE) and a lipid vesicle diameter of 0.227 ± 0.021 mm. Mean total length (TL) was 2.68 ± 0.04 mm for newly hatched larvae and 3.57 ± 0.09 mm at the onset of feeding (4 d after hatching [DAH]). At 10 DAH, initial swim bladder inflation occurred, mean TL was 4.19 ± 0.08 mm, and notochord length (NL) was 4.00 ± 0.07 mm. At 16 DAH, the swim bladder became more elongated, TL was 5.13 ± 0.09 mm, and NL was 4.94 ± 0.07 mm. Notochord flexion occurred at 6.46 ± 0.11 mm TL on 23 DAH, and the complement of the flexion occurred at 8.67 ± 0.109 mm TL on 35 DAH. At the end of the weaning period (at 41 DAH), larvae were 10.85 ± 0.116 mm TL. The majority of all allometric changes from the inflection point were expressed during the

larval stage and integrated with the metamorphosis stage. Inflections in body proportion changes occurred mainly at 4.19 and 7.04 mm TL, corresponding to initial swim bladder inflation and the notochord flexion period, respectively.

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SURVIVAL, GROWTH, AND FEED UTILIZATION OF PRE- AND POSTMETAMORPHIC AMERICAN SHAD EXPOSED TO INCREASING SALINITY

Yanju Jia, Qinghua Liu, Cheryl A. Goudie, Bill A. Simco-2009

North American Journal of Aquaculture 71(3): 197–205

Abstract:

The American shad *Alosa sapidissima* is currently an emerging aquaculture species in China, and establishing conditions required for optimal growth will play a key role in future development of American shad culture. We evaluated the effects of increasing salinity concentrations on survival, growth, and feed utilization of American shad in two separate 30-d experiments. In experiment 1, 25-d-old, premetamorphic fish (mean weight \pm SD = 0.07 ± 0.04 g) were exposed to 0, 10, 20, and 30-ppt salinity (26–29°C). In experiment 2, 80-d-old, postmetamorphic fish (1.46 ± 0.52 g) were exposed to 0, 5, 10, 20, and 30-ppt salinity (21–26°C). Mortality was markedly higher at salinities of 20 ppt (52% and 74%, respectively, for pre- and postmetamorphic fish) and 30 ppt (100% and 90%, respectively) than at 0 and 5 ppt (<1%). Specific growth rate (SGR) and feed conversion efficiency (FCE) were highest at 0-ppt salinity for premetamorphic fish (SGR = 8.81% per day; FCE = 1.12) and at 5-ppt salinity for postmetamorphic fish (SGR = 4.59% per day; FCE = 0.87). The SGR and FCE were lowest at 30-ppt salinity, and a significant negative relationship was demonstrated between salinity and SGR and between salinity and FCE. In both experiments, SGR and FCE were positively correlated. Our observations demonstrate that culture of young American shad may be possible at salinities up to 10 ppt, but 0–5-ppt salinity produced the best growth.

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SURVEY OF OVAPRIM USE AS A SPAWNING AID IN ORNAMENTAL FISHES IN THE UNITED STATES AS ADMINISTERED THROUGH THE UNIVERSITY OF FLORIDA TROPICAL AQUACULTURE LABORATORY Abstract View

Jeffrey E. Hill, Kathy Heym Kilgore, Deborah B. Poudier, James F. F. Powell, Craig A. Watson, Roy P. E. Yanong-2009

North American Journal of Aquaculture 71(3): 206–209

Abstract:

Ovaprim is a commercial product used as a spawning aid in fishes and contains a salmon gonadotropin-releasing hormone analog and a dopamine antagonist. Since 2005, the use of Ovaprim in commercial ornamental fish production has been through enrollment with the University of Florida Tropical Aquaculture Laboratory in an Investigational New Animal Drug (INAD) study. A database is maintained to provide information to the U.S. Food and Drug Administration on product effectiveness and target animal safety. There were 25 fish species in 17 genera and 10 families in the INAD database. Ostariophysan fishes constituted 84% of the species and 99.9% of the individuals. The goldfish *Carassius auratus* was numerically the dominant species (80% of individuals). Nearly 40,000 fish in total were injected with Ovaprim; ovulation was induced in 92% of females and spermiation was induced in 96% of males, primarily reflecting extensive use in cyprinid fishes. Conversely, average success rates across all species were moderate (50% ovulation and 54% spermiation), and some species had low success rates (range = 0–100%). Mortality after injection was 1.3% of overall individuals but varied by species (mean = 2.7%; range = 0–36%). Ovaprim was most used by producers of ornamental cyprinids.

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TANK CULTURE OF SUNSHINE BASS FINGERLINGS WITHOUT USING ROTIFERS

Gerald M. Ludwig, Steve E. Lochmann-2009

North American Journal of Aquaculture 71(3): 224–228

Abstract:

A previously reported protocol for culture of larval sunshine bass (female white bass *Morone chrysops* × male striped bass *M. saxatilis*) to fingerling size in tanks involved an initial feeding of rotifers for several days before the larvae were weaned to nauplii of brine shrimp *Artemia* spp. and prepared feed. Maintaining rotifer cultures requires space, time, equipment, supplies, and trained culturists. The rotifer cultures are often unstable, which increases risk of poor sunshine bass fingerling production in tanks. Elimination of the use of rotifers would greatly enhance the feasibility of reliable tank culture of fingerlings and should reduce production cost. This experiment compared three treatments with three replicates per treatment. In one treatment, larvae were initially fed rotifers *Brachionus plicatilis* and then were weaned to brine shrimp nauplii (0.48 × 0.19 mm). In a second treatment, larvae were fed brine shrimp nauplii throughout the experiment. In a third treatment, larvae were fed microcyst brine shrimp nauplii (0.43 × 0.18 mm) for the entire experiment. At 4 d posthatch (dph), sunshine bass larvae were stocked into 100-L tanks at 75 larvae/L. Larvae were fed according to the three treatments to 14 dph. Survival was significantly higher for larvae fed rotifers plus brine shrimp nauplii and for larvae fed microcyst brine shrimp nauplii (93.6% and 37.9%, respectively) than for larvae fed only brine shrimp nauplii (4.3%). Larvae (7.13 mm standard length [SL]) that were fed rotifers plus brine shrimp nauplii and larvae (7.26 mm SL) that were fed microcyst nauplii were significantly longer than those (6.86 mm SL) fed brine shrimp nauplii. This experiment is the first time that sunshine bass have been cultured to 14 dph on brine shrimp nauplii without rotifers at first feeding.

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TOXICITY OF COMMON AQUACULTURE DISINFECTANTS TO NEW ZEALAND MUD SNAILS AND MUD SNAIL TOXICANTS TO RAINBOW TROUT EGGS

Randall W. Oplinger, Eric J. Wagner-2009

North American Journal of Aquaculture 71(3): 229–237

Abstract:

The New Zealand mud snail (NZMS) *Potamopyrgus antipodarum* is an invasive species that threatens North American fish populations. Establishment of NZMS in fish hatcheries is a concern because fish stocking practices could expedite the spread of the species. We evaluated the potential use of chemicals to remove snails that are inadvertently collected during egg take operations involving wild broodstock from the field. We exposed green eggs of rainbow trout *Oncorhynchus mykiss* for 5 min to several chemicals that have been proven lethal to NZMS: 1,940-ppm Hyamine 1622; Clorox Commercial Solutions 409 Cleaner, Degreaser, and Disinfectant (full strength; hereafter, Clorox Commercial 409); Pine-Sol (50% dilution); household ammonia (full strength); and a 504-ppm copper solution (as copper sulfate). All of the eggs exposed to Hyamine 1622, Clorox Commercial 409, and ammonia died within 24 h. Among eggs treated with Pine-Sol and copper sulfate, hatch and cripple rates did not differ from the control (water); however, eye-up rates among eggs treated with copper sulfate were lower than those for the control. Thus, while more research is needed, it is possible that a 50% dilution of Pine-Sol could be used to kill NZMS that are inadvertently collected during egg take operations. In a second experiment, a probit analysis provided 15-min LD50 and LD90 values for several common fish therapeutic chemicals (formalin, iodine, hydrogen peroxide, and potassium permanganate). For all chemicals, we estimated that concentrations of at least 7,500 ppm are required in 15-min treatments to kill 100% of NZMS. While these chemicals could be used to remove NZMS

from hatchery facilities, concentrations required for complete mortality in 15-min exposures exceed concentrations that are considered safe for most fish species. Even though the best method for averting accidental introduction is to prevent the transportation of water from the wild into the hatchery, we feel that hydrogen peroxide may be the most effective chemical for killing NZMS that are inadvertently collected.

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USE OF HYDROGEN PEROXIDE TO IMPROVE GOLDEN SHINER EGG HATCHABILITY

Abstract View

Jamie L. Bozwell, Richard D. Clayton, Joseph E. Morris-2009

North American Journal of Aquaculture 71(3): 238–241

Abstract:

The efficacy of hydrogen peroxide (H₂O₂) in controlling fungal infections (saprolegniasis) in the eggs of golden shiner *Notemigonus crysoleucas* was assessed in two experiments. Golden shiner eggs were exposed in a 15-min static bath (21°C) to 0, 50, 100, or 200 mg H₂O₂/L in the first experiment and to 0, 200, 400, and or 800 mg/L in the second experiment. All treatments were based on the amount of active ingredient (30% active ingredient concentration of H₂O₂) in a single treatment. Three replicates of each concentration were used in each experiment. The objective was to determine the H₂O₂ concentration that would result in optimum hatching success. The hatching rate significantly increased in each treatment level until 800 mg/L. The mean ± SE percent egg hatchability was 72.3 ± 8.55% and 68.2 ± 5.03% at 400 and 800 mg/L, respectively. Regression analysis revealed the peak treatment level to be between 400 and 800 mg/L.

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EFFECT OF TEMPERATURE ON LARVAL SUNSHINE BASS GROWTH AND SURVIVAL TO THE FINGERLING STAGE

Gerald M. Ludwig, Steve E. Lochmann-2009

North American Journal of Aquaculture 71(3): 260–266

Abstract:

Determining the optimum conditions for tank culture of sunshine bass (female white bass *Morone chrysops* × male striped bass *M. saxatilis*) fingerlings will facilitate a year-round supply of seed for the production cycle of this increasingly popular food fish. This study determined the relationship between temperature and larval sunshine bass growth and survival to the time when fish were trained to accept commercial feeds. At 4 d posthatch (dph), larvae were stocked at five temperatures from 20°C to 32°C at 3°C increments. There were two replicates for each temperature. The larvae were fed rotifers through 8 dph. Conversion to a diet of brine shrimp *Artemia* spp. nauplii began at 6 dph, and training for acceptance of dry starter feed began at 20 dph. At harvest, average total length and average weight of the fish increased in a linear relationship with temperature, while relative survival and number of fish harvested decreased linearly with temperature. Tank yield had a curvilinear relationship with temperature. The temperature that provided maximum yield was 23.1°C. Although growth was faster at warmer temperatures, relative survival and yield were not. These relationships between tank culture conditions and production characteristics support optimization of tank culture to meet specific production goals. This should eliminate some of the logistical constraints to expanded tank culture of sunshine bass fingerlings.

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THE EFFECT OF HYDROGEN PEROXIDE ON THE HATCH RATE AND SAPROLEGNIA SPP. INFESTATION OF CHANNEL CATFISH EGGS

Andrew J. Mitchell, Andrew A. Radomski, David L. Straus, Ray Carter
North American Journal of Aquaculture 71(3): 276–280

Abstract:

Fungal infestations of channel catfish *Ictalurus punctatus* eggs can lower hatch rate, which requires the producer to spawn more channel catfish or risk fingerling shortages. Hydrogen peroxide (H₂O₂) treatments (0.0, 15.6, 31.3, 62.5, 125, 250, 500, 1,000, 2,000, and 4,000 mg/L) were evaluated to determine their effect on channel catfish hatch rate (number of fry/number of eggs × 100) and control of naturally occurring infestations of fungi *Saprolegnia* spp. in an experimental compartmentalized trough hatching system. Experiments were run at water temperatures of 23.2–24.0°C, dissolved oxygen concentrations of 4.5–6.8 mg/L (53–79% saturation), total alkalinity of 209–217 mg/L, and total hardness of 91–110 mg/L. Treatments were applied to hatching compartments while well water was flowing at a rate of one water exchange every 30 min and egg density was 2.5 g eggs/L of water. Observations for fungal development were made daily, and the maximum measure of fungal growth was recorded. An initial range-finding study demonstrated that H₂O₂ concentrations greater than 500 mg/L lowered the hatch rate. In later experiments, concentrations of 125, 250, and 500 mg/L applied for 6 d significantly increased the hatch rate and reduced fungal growth when compared with the controls. The 250-mg/L H₂O₂ treatment had the highest mean hatch rate (64.4% compared with 24.7% for the controls), lowest incidence of fungal infestation (27.3% compared with 100% for the control), and the lowest average fungal growth (an average measure of 0.95 cm compared with 7.23 cm for the controls).

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THE ARTIFICIAL INCUBATION OF CRAYFISH EGGS: REVIEW AND REPORT FROM AN EXPERIMENTAL STUDY CONCERNING THE EFFECTS OF OFFSPRING ORIGIN (MATERNAL OR ARTIFICIAL INCUBATION) ON THE SURVIVAL AND GROWTH OF JUVENILE SIGNAL CRAYFISH (*PACIFASTACUS LENIUSCULUS*, ASTACIDAE)

Rocío González, Jesus D. Celada, Vanesa García, Álvaro González, José M. Carral, María Sáez-Royuela-2009

Journal Reviews in Fish Biology and Fisheries 19(2):167-176

Abstract:

The development of artificial incubation techniques in astacid crayfish has attracted attention from scientists in many countries ever since the nineteenth century. It is only in the last few years that these techniques, along with studies on egg storage and transport, have provided reliable options for improving the reproductive phase in farming. The juveniles produced need to be reared until they reach a sufficient size both for restocking and for growing purposes. In view of the current level of knowledge of rearing juvenile astacids, two 80-day experiments were carried out under controlled conditions to compare the survival and growth of Stage 2 juvenile signal crayfish (*Pacifastacus leniusculus*) from two origins: maternal or artificial incubation. In the first experiment, three treatments were tested: juveniles from artificially incubated eggs with formaldehyde treatments, juveniles from maternal incubation and a mixture from both origins (50% each). Survival rates ranged from 87.8% to 93.3% with no significant differences among treatments. Crayfish from artificial incubation grew significantly faster (11.47 mm carapace length (CL), 373.80 mg weight) than crayfish from maternal incubation. In the second experiment, a bifactorial design included four treatments: the crayfish was derived from artificial or from maternal incubation and was fed once a day or twice a day. Final survival rates ranged from 68.89% to 77.78%, with no significant differences among treatments. Crayfish from artificial incubation grew significantly faster than crayfish from maternal incubation. The highest CL (14.54 mm) and weight (780.13 mg) were reached by the juveniles from artificial incubation that were fed once a day. No significant differences were found between the two feeding frequencies. Results showed that artificial incubation with

formaldehyde treatments had no harmful effects and made it feasible to get a better performance from the juveniles obtained.

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SPINY LOBSTER DEVELOPMENT: WHERE DOES SUCCESSFUL METAMORPHOSIS TO THE PUERULUS OCCUR? A REVIEW

Bruce Frank Phillips, Paulette S. McWilliam-2009

Journal Reviews in Fish Biology and Fisheries 19(2):193-215

Abstract:

This review re-addresses the question: Where does metamorphosis to the puerulus mainly take place among the shallow-water palinurids? A decade ago we reviewed this ecological question in a paper that focused on phyllosomal development of the western rock lobster, *Panulirus cygnus*. The main region of occurrence of its metamorphosis was found to be in the slope region beyond the shelf break. Because the puerulus of *P. cygnus* is a non-feeding stage, it was hypothesised that metamorphosis will not occur until the final phyllosoma has reached some critical, and specific, level of stored energy reserves. For late larval development and successful metamorphosis of *P. cygnus*, the richest food resources seem to be located in the slope waters adjoining the shelf break off Western Australia. This, like most shelf break areas, is a region of higher zooplankton and micronekton biomass than is usually found further offshore, and is dominated (in winter-spring months) by the warm south-flowing Leeuwin Current. In this new review, distribution and abundance data of final phyllosomas and pueruli are examined from, *Panulirus argus*, *Panulirus cygnus*, *Panulirus japonicus*, *Panulirus ornatus* and *Jasus edwardsii*, and where possible, related to features of the satellite imagery of the areas in which they occur. We hypothesise that metamorphosis will occur where the final stages have partaken of sufficient, appropriate nutrition to provide them with a reserve of bioenergetic resources, and this can occur where oceanographic fronts effect greater planktonic productivity and concentrations of food organisms. This may be near the shelf-break, or out to large distances offshore, because of large-scale oceanographic events such as the prevailing current system, its off-shoots, mesoscale eddy fronts, counter-currents, etc. However, we contend that, in terms of population recruitment, metamorphosis in most shallow-water palinurid species occurs mainly in the slope waters adjoining the shelf break of the region to which the species is endemic. Although some final phyllosomas may metamorphose much further offshore, it is unlikely that these pueruli will reach the shore, let alone settle and successfully moult to the juvenile stage. All of the data indicate that successful metamorphosis from the final-stage phyllosoma to the puerulus stage in all species occurs offshore but close to the continental shelf.

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GROWTH AND SURVIVAL RATE OF RUSSIAN STURGEON (*ACIPENSER GUELLENSTAEDTII*) LARVAE FROM FERTILIZED EGGS TO ARTIFICIAL FEEDING

D. Memiş, E. Ercan, M.S. Çelikkale, M. Timur, Z. Zarkua-2009

Turkish Journal of Fisheries and Aquatic Sciences 9: 47-52

Abstract:

Fertilized eggs of Russian sturgeon (*Acipenser gueldenstaedtii*) were brought from the Krasnodar Research Institute of Fisheries in 12.01.2001 to the University of Istanbul, Fisheries Faculty, Sapanca Inland Water Fish Culture Research and Applied Station on January 13 th. 5 kg fertilized eggs were put on 13 plates (size of each plate; 65 x 40 x 15 cm). Fertilized eggs were incubated in waving system (model designed according to modified Yushenko apparatus) at 14-15°C by means of water paddles continuously in action. The mass hatching was completed in 7 days after fertilization. The larvae were taken from the moving plates and were put to the fibreglass rectangular tanks (2.9 x 0.2 x 0.4 m size). From 8 to 11 days post-hatching, the larvae were fed by *Artemia nauplius* five times a day. At this period, the gill filaments were clearly red and covered by the operculum, and the anal fins were shaped. Between 12-16 days post-hatching larvae had been fed with both *Artemia* and *tubifex*.

Between 17-18 days post-hatching, the larvae fed with artemia, tubifex and artificial diets. The tubifex were minced before they were given to the larvae. 19-32 days post-hatching, tubifex and artificial diets were used. At the end of the feeding trial, sturgeon larvae had reached to 12 cm of length and 5.25 g of weight. During the 33-75 days, the larvae were fed by only commercial trout diets five times a day (containing 52% protein, 14% lipid and 13% ash; BioAqua, Turkey). The artificial granule feed size increased from 80 µm to 1200 µm parallel to the growth of the larvae size. At the end of 75 days, the survival rate of Russian sturgeon was 27%. During the first 7 days of incubation, mortality rate of fertilized eggs was approximately 69% of the total number.

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ONTOGENY OF BIOCHEMICAL PHASES OF FERTILIZED EGGS AND YOLK SAC LARVAE OF GILTHEAD SEABREAM (SPARUS AURATA L.)

Mehmet Naz-2009

Turkish Journal of Fisheries and Aquatic Sciences 9

Abstract:

Biochemical compositions of fertilized gilthead seabream (*Sparus aurata*) eggs and yolk sac larvae were determined at different periods (after hatching, 0th, 24th, 48th and 96th hours). Results showed that the yolk sac larvae and eggs contain more monounsaturated (MUFAs) and polyunsaturated (PUFAs) fatty acids than saturated fatty acids (SFAs). The changes observed in essential (EAA) and non-essential amino acid (NEAA) contents of fertilized eggs and yolk sac larvae through the experimental period were significant ($P<0.05$). Amylase and tyripsin activity was detected in fertilized eggs. Leucine alanine (LEU-ALA) peptidase activity was higher than other enzymatic activities throughout the experimental period. Aminopeptidase N(LAP) activity decreased from fertilized egg to hatching. After hatching, LAP activity increased until 24th hour and then decreased up to the beginning of exogenous feeding ($P<0.05$). The lowest alkaline phosphatase activity (AP) was taken from fertilized eggs. Then, AP activity tended to increase until the end of experimental period ($P<0.05$). In conclusion, our results can give information about the nutritional requirements of seabream larvae at the start of exogenous feeding.

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