HATCHERY BROODSTOCK CONDITIONING OF THE BLUE MUSSEL MYTILUS EDULIS (LINNAEUS 1758). PART I. IMPACT OF DIFFERENT MICRO-ALGAE MIXTURES ON BROODSTOCK PERFORMANCE

Anna Elisabeth Pronker, Nancy Marie Nevejan, Frank Peene, Pieter Geijsen, Patrick Sorgeloos-2007

Aquaculture International 16(4): 297-307

Abstract:
Blue mussel (Mytilus edulis) broodstock collected from the Irish Sea during wintertime (November) was conditioned with three different microalgae diets. Positive flagellates (PF) treatment consisted of Pavlova lutherii, Isochrysis galbana (T-Iso), and Chaetoceros calcitrans (1:1:1). Positive diatoms (PD) treatment consisted of Pavlova lutherii, Chaetoceros calcitrans, and Skeletonema costatum (1:1:1). Broodstock animals in the PF and PD treatments were fed a total of 2.4 × 1011 algae cells per day. Animals in the negative flagellates (NF) treatment received only 1/8th of the total amount of algae of the PF diet. The conditioning diets had an impact on spawning success and broodstock fecundity but not on hatching rate, which was similar in all three groups. The best results were obtained with the PD diet where 84% of the conditioned animals spawned and females released 5.0 × 106 eggs on average. Animals belonging to the PF and NF treatments released, on average, only 3.6 × 106 and 1.6 × 106 eggs, respectively. Although the amounts of algae provided to the broodstock animals had no effect on the hatching rate, the D-larvae resulting from the NF treatment were smaller in size than the larvae from the other treatments. Biochemical analysis of the different broodstock groups at the end of the experiment revealed higher carbohydrate levels in group NF than in PF and PD, supporting the theory that gametogenesis is mainly supported by the energy from the glycogen reserves. As far as we are aware this is the first study describing hatchery broodstock conditioning of blue mussels under fully controlled conditions.

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EFFECTS OF DAPHNIA (MOINA MICRURA) PLUS CHLORELLA (CHLORELLA PYRENOIDOSA) OR MICROPARTICLE DIETS ON GROWTH AND SURVIVAL OF LARVAL LOACH (MISGURNUS ANGUILLICAUDATUS)

Youji Wang, Menghong Hu, Ling Cao, Yi Yang, Weimin Wang-2008

Aquaculture International 16(4): 361-368

Abstract:
Culture performance beyond metamorphosis of larval loach (Misgurnus anguillicaudatus) was examined in a feeding experiment of the early development stage (20 days after hatch; DAH). Total length, dry weight, length- and weight-specific growth rate (SGR) and survival were monitored in different diet regimes. During 20 days, diet treatments included: microparticle diets (A); live daphnia (Moina micrura) (B); live daphnia plus live chlorella (Chlorella pyrenoidosa) (C); and live daphnia plus microparticle diets (D). Fish survival rates during 20 days were 21.23 ± 4.2% (A), 73.19 ± 2.8% (B), 90.76 ± 3% (C) and 91.46 ± 3.1% (D), respectively. Length- and weight-specific growth rate after 20 DAH (final mean SGR; % day−1) were 5.36 ± 0.44 and 15.75 ± 1.52 (A), 9.29 ± 1.25 and 23.47 ± 2.23 (B), 9.42 ± 1.55 and 24.88 ± 2.9 (C) and 9.55 ± 1.23 and 24.40 ± 2.75 (D), respectively. Fish in treatments B, C and D displayed higher growth rates and were significantly longer and heavier than fish in treatment A by the end of the experiment ($P < 0.05$). Fish in treatment A had highly significant greater ($P < 0.001$) mortalities than in treatments B, C and D. There were no significant differences in any growth parameter between fish in treatments B, C and D, but the survivals in treatments C and D (90.76% and 91.46%) were significantly higher than in treatment B (73.19%, $P < 0.05$). The results demonstrated that enriched prey and co-feeding may serve as a potential feeding strategy for loach larvae, and the form of co-feeding reduces the costs and dependence on live foods to a certain extent. We concluded that larval loach should be reared over metamorphosis using either of the following methods: feed with live daphnia supplemented with microparticle diets or with live

chlorella. However, a prolonged rearing period of loach larvae is needed to detect nutritional problems and observe remote effects of co-feeding on weaning in the future.
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REPRODUCTION OF CHUB, LEUCISCUS CEPHALUS L., UNDER CONTROLLED CONDITIONS

Sławomir Krejszeff, Dariusz Kucharczyk, Krzysztof Kupren, Katarzyna Targońska, Andrzej Mamcarz , Roman Kujawa, Zbigniew Kaczkowski, Sebastian Ratajski-2008
Aquaculture Research 39(9): 907-912
Abstract:
Research into artificial reproduction of chub was studied during three subsequent reproductive seasons. Chub reproduction was conducted in two different variations. In the first experiment different hormonal agents were given to fish, such as CPE, hCG, or an analogue of GnRH with dopamine antagonist (ovopel). In the second one, the optimum moment of applying of artificial reproduction was sought and the fish were only obtained an analogue of GnRH in different periods. The results obtained in two first seasons indicated that ovopel is the most effective agent for the artificial reproduction of chub. Consequently, it was decided that the fish would obtain only this agent in the final year of research. In last year (experiment II), chub spawners were taken to the hatchery under controlled conditions every few weeks from February to the beginning of June. Periodically, the maturity of oocytes was checked. As soon as the oocytes had achieved stage 2–3 of maturity, fish were obtained ovopel. It was noted that there was no problem with collecting semen. Obtaining oocytes was much more difficult. Most frequently, they were not obtained at all or obtained in very small amounts. It was also observed that the administration of hormones caused a very quick maturation of gonads and their over-maturation.
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EFFECTS OF DIET, STOCKING DENSITY AND ENVIRONMENTAL FACTORS ON GROWTH, SURVIVAL AND METAMORPHOSIS OF CLAM, PAPHIA MALABARICA (CHEMNITZ) LARVAE

Gireesh Raghavan, Cherukara Purushothaman Gopinathan-2008
Abstract:
Aquaculture Research 39(9): 928-933
A series of experiments were conducted to evaluate the effects of diet, stocking density and environmental factors on the growth, survival and metamorphosis of short neck clam Paphia malabarica larvae. These experiments examined the following factors: diet [Isochrysis galbana, Nannochloropsis salina and a mixture of I. galbana and N. salina (1:1 w/w)], stocking density (1, 3, 5 and 7 larvae mL−1), light intensity (unshaded, partially shaded and fully shaded) and water filtration (unfiltered and sand filtered). Results indicated that N. salina could replace 50% of I. galbana as a food source for the clam larvae with an increase in growth, survival (47.2%), metamorphosis (33.5%) and early settlement. Larval growth decreased significantly with increasing stocking density. A density of 1–3 larvae mL−1 appeared to be optimal for normal growth of clam larvae. Neither diet nor stocking density used in the study had a significant effect on larval survival. Under partially shaded (light intensity=1000–5000 lx) and fully shaded (light intensity <1000 lx) conditions, larval growth was significantly faster than under direct sunlight (unshaded). Larvae grew significantly faster in the unfiltered water than in the filtered water.
(Central Marine Fisheries Research Institute, Ernakulam North P.O., Kochi, Kerala 682018, India; email of G. Raghavan: girmsr@gmail.com)

SHORT COMMUNICATION

USEFULNESS OF FLAT BOTTOM TANKS ON THE SETTLEMENT OF SPIDER CRAB (MAJA SQUINADO, HERBST) LARVAE

Jorge Palma, Miguel Correia, José P Andrade-2008

Aquaculture Research 39(9):1005-1008

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DEVELOPMENT OF SURVIVORSHIP MODEL FOR UV-B IRRADIATED CATLA CATLA LARVAE

Jai Gopal Sharma Prabhat Mitta, Rina Chakrabarti-2008

Aquatic Ecology 42(1): 17-23

Abstract:
A survivorship model was developed for UV-B irradiated Catla catla (17 days) larvae with the help of Kaplan and Meier Product-Limit (PL) method. Larvae were exposed to UV-B radiation (145 μW cm−2) for three different exposure times: 5, 10 and 15 min on every other day. The mean survival time of fish was calculated for each treatment using uncensored and censored survival data during 74 days study period. The mean uncensored and censored survival data for the 5-min exposed fish were 7 and 43, respectively. In 10-min exposure period, the uncensored and censored survival data were 19 and 31, respectively. During maximum exposure of 15 min, the uncensored survival data was 20 and censored data was 30. The mean survival time of fish calculated using PL estimate in 5, 10 and 15-min exposure treatments were 69.61 ± 0.50, 65.25 ± 0.96 and 60.60 ± 1.55 days, respectively. The mean survival time showed a decreasing trend with the increase of exposure period. The survival time was significantly ($P < 0.001$) higher in 5-min exposure treatment than others. This is clear from the present study that the exposure of UV-B radiation affects the survival rate of surface feeder catla larvae.

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IMMUNOHISTOCHEMISTRY OF ATLANTIC COD LARVAE GADUS MORHUA EXPERIMENTALLY CHALLENGED WITH VIBRIO ANGUILLARUM

Ane Rebecca Engelsen, Nina Sandlund, Ingrid Uglenes Fiksdal, Øivind Bergh-2008

Diseases of Aquatic Organisms 80(1): 13-20

Abstract:
Farming of Atlantic cod Gadus morhua is one of the most rapidly growing sectors of Norwegian aquaculture. Classical vibriosis caused by Vibrio anguillarum is a problem in cod aquaculture. To prevent disease outbreaks, a thorough understanding of the infection route and the impact of the bacteria on the host is important. The intestinal tract, skin and gills have all been proposed as routes of entry for bacterial infections such as vibriosis. We aimed to further develop understanding of V. anguillarum serotype O2α infections in cod larvae by elucidation of a possible route of entry, the pattern of infection and its histopathology. Cod eggs were transferred to a 24-well polystyrene multi-dish with 2 ml of sterile aerated 80% (28‰ salinity) seawater. Challenge doses were 104 and 106 CFU ml–1. Unchallenged larvae were used as controls. Larvae for immunohistochemical examination were sampled daily from each group. In most of the larvae, either no or very few bacteria were observed. Typical findings were clusters of bacteria in the spaces between the primary gill lamellae. None of these bacteria seemed to have adhered to the gills. Intestines of 3 out of 161 larvae examined contained positively immunostained bacteria. Some bacteria appeared attached to the microvilli, but none was observed inside epithelial cells. Only 2 larvae from the low-challenge dose group showed clear signs of histopathology, which occurred in the intestine. It is not possible to draw any conclusions regarding the portal of entry.

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ESSENTIAL FATTY ACIDS INFLUENCE METABOLIC RATE AND TOLERANCE OF HYPOXIA IN DOVER SOLE (SOLEA SOLEA) LARVAE AND JUVENILES

D. J. McKenzie, I. Lund, P. B. Pedersen-2008

Marine Biology 154(6): 1041-1051

Abstract: Dover sole (Solea solea, Linneaus 1758) were raised from first feeding on brine shrimp (Artemia sp.) with different contents and compositions of the essential fatty acids (EFA) arachidonic acid (ARA, 20:4n − 6); eicosapentaenoic acid (EPA, 20:5n − 3), and docosahexaenoic acid (DHA, 22:6n − 3), and their metabolic rate and tolerance to hypoxia measured prior to and following metamorphosis and settlement. Four dietary Artemia preparations were compared: (1) un-enriched; (2) enriched with a commercial EFA mixture (Easy DHA SELCO Emulsion); (3) enriched with a marine fish oil combination (VEVODAR and Incromega DHA) to provide a high ratio of ARA to DHA, and (4) enriched with these fish oils to provide a low ratio of ARA to DHA. Sole fed un-enriched Artemia were significantly less tolerant to hypoxia than the other dietary groups. Larvae from this group had significantly higher routine metabolic rate (RMR) in normoxia, and significantly higher O2 partial pressure (PO2) thresholds in progressive hypoxia for their regulation of RMR (P crit) and for the onset of agitation, respiratory distress and loss of equilibrium. Metamorphosis was associated with an overall decline in RMR and increase in P crit, but juveniles fed on un-enriched Artemia still exhibited higher P crit and agitation thresholds than the other groups. Sole fed un-enriched Artemia had significantly lower contents of EFA in their tissues, both before and after settlement. Thus, enriching live feeds with EFA has significant effects on the respiratory physiology of sole early life stages and improves their in vivo tolerance to hypoxia. We found no evidence, however, for any effect of the ratio of ARA to DHA.

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FEEDING SELECTIVITY OF MARINE FISH LARVAE, VERASPER VARIEGATUS, SERIOLA QUINQUERADIATA AND PLATYCEPHALUS SP. ON DIFFERENT SIZES AND SHAPE OF THREE ROTIFER STRAINS

Atsushi Akazawa, Yoshitaka Sakakura, Atsushi Hagiwara-2008

Nippon Suisan Gakkaishi 74 (3):380-388

Abstract:

We compared the feeding selectivity of three marine fish larvae, spotted halibut, yellowtail and flathead, according to their growth by using two strains of L-type rotifer and one strain of S-type rotifer. In the experiment on the selectivity to shape of rotifer lorica (L and S-type), the larvae of the three species showed similar selectivity though the shape of the lorica and the anterior spines were different. In terms of rotifer size selection, the larvae of the three species positively selected smaller rotifer at the onset of feeding. However, the selection shifted to larger rotifers on 10 DAH for spotted halibut and 16 DAH for yellowtail and flathead larvae. By comparing the selectivity based on mouth size, flathead larvae showed strong selectivity to larger rotifers than spotted halibut and yellowtail larvae.

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REPRODUCTIVE ECOLOGY AND SPAWNING SUBSTRATE PREFERENCE OF THE NORTHERN LEATHERSIDE CHUB

Eric J. Billman, Eric J. Wagner, Ronney E. Arndt-2008

North American Journal of Aquaculture 70 (3):273–280

Abstract.:

Conservation of rare fishes is often hindered by a lack of understanding of their basic life history characteristics. We used captive-breeding studies to determine the preferred spawning habitat and early life history characteristics of the northern leatherside chub Lepidomeda copei, a small cyprinid native to the upper Snake River basin and the Bear River drainage in the Bonneville Basin (Idaho, Utah, and Wyoming). In the first study, wild adult northern leatherside chub were given a choice of

four habitats (two shallow riffle habitats and two deeper pool habitats), each with four spawning substrates (large cobble, small cobble, pebble, and a coarse artificial spawning mat) in a large rectangular tank. In the second study, adults were given a choice of three locations with different water velocities (9.5, 12.9, or 19.0 cm/s) but the same substrate size (small cobble). Successful spawning occurred in both studies. Northern leatherside chub spawned almost exclusively over the small cobble substrate (99.6% of total young). Habitat selection was significant, but the patterns were not consistent across tanks; uncovered pool habitat was selected in two tanks and the upper riffle habitat was primarily selected in the third tank. In addition, northern leatherside chub preferentially chose the site with the highest flow (19 cm/s) for spawning. Early life history characteristics (embryo size, time to hatch, larvae size, eggs per spawn, time to swim-up, and fry growth) were estimated from the reproductive output of the spawning studies. Small cobble is needed for northern leatherside chub reproduction, and its availability may be among the limiting factors for northern leatherside chub populations.
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EFFECTS OF DISSOLVED OXYGEN CONCENTRATION ON OXYGEN CONSUMPTION AND DEVELOPMENT OF CHANNEL CATFISH EGGS AND FRY: IMPLICATIONS FOR HATCHERY MANAGEMENT

Les Torrans, Jim Steeby-2008

North American Journal of Aquaculture 70 (3):286–295

Abstract.:
Eight channel catfish Ictalurus punctatus spawns were split into two similar portions and incubated under controlled conditions to determine the effect of dissolved oxygen (DO) concentration on the development and survival of eggs and fry. The DO concentration was 7.42 ± 0.03 mg/L (mean ± SD; 92.5% saturation) and 18.40 ± 0.28 mg/L (230% saturation) through hatching in the low- and high-oxygen treatments, respectively. Eggs hatched 6 h earlier in the low-oxygen treatment, but fry reached swim-up stage 31 h later. Survival to the swim-up stage in the low-oxygen treatment was 16.4 percentage points lower than in the high-oxygen treatment (72.5% versus 88.9%, respectively). The routine metabolic rate and limiting oxygen concentration were also determined for eggs, sac fry, and swim-up fry. Oxygen consumption increased through swim-up stage, as expected. However, the limiting oxygen concentration peaked during the last day of incubation at 88.1 ± 2.9% saturation and decreased to 40.1 ± 2.0% saturation upon hatching. Premature hatching observed in the low-oxygen treatment was apparently initiated when the limiting oxygen concentration approached the ambient oxygen saturation on the last day of incubation. A survey of DO management in 26 commercial catfish hatcheries in the Mississippi Delta revealed that DO saturation in the hatching troughs ranged from 45.2% to 100.2%, with only nine hatcheries (35% of the hatcheries sampled) having a DO saturation greater than 95%. Seventeen hatcheries (65%) had a DO saturation less than that maintained in the low-oxygen treatment in our hatching experiment and could experience greater mortality through swim-up than we observed. We recommend that hatcheries initially run well water through a packed column and use blowers or liquid oxygen to maintain the DO concentration in hatching troughs at or above air saturation as eggs near the time of hatching.
(U.S. Department of Agriculture, Agricultural Research Service, Thad Cochran National Warmwater Aquaculture Center, Catfish Genetics Research Unit, Post Office Box 38, Stoneville, Mississippi 38776, USA; email of Les Torrans: les.torrans@ars.usda.gov)

TOLERANCE OF CHANNEL CATFISH FRY TO ABRUPT PH CHANGES

Charles C. Mischke, David J. Wise-2008

North American Journal of Aquaculture70(3): 305–307

Abstract.:
Fry survival in the catfish industry is variable, and failure to survive cannot be completely attributable to diseases, fertilization practices, or lack of zooplankton abundance. The variability in fry survival may be related to current handling and stocking methods. When stocked, fry are transferred relatively

quickly from hatchery water to pond water. Generally, temperature differences are monitored between hatchery water and pond water, but little attention is paid to pH differences. We conducted studies to determine the tolerance of channel catfish Ictalurus punctatus fry to pH changes. Catfish fry showed a high tolerance for decreasing pH values but a relatively low tolerance for increasing pH values. We estimate that an increase in pH of 0.7 units will cause 10% mortality in 8-d-posthatch catfish fry, and an increase of 1.4 pH units will cause 50% mortality. We recommend that farmers monitor pH before stocking fry and stock ponds that tend to increase in pH throughout the day early in the morning.
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COPPER SULFATE TOXICITY TO CHANNEL CATFISH FRY: YOLK SAC VERSUS SWIM-UP FRY

David L. Straus-2008

North American Journal of Aquaculture 70(3): 323–327

Abstract:
Yolk sac and swim-up fry from five separate spawns of channel catfish Ictalurus punctatus were exposed to dissolved copper sulfate (CuSO4) in a series of static toxicity bioassays to observe age sensitivity at 24 and 48 h in waters with two different chemistries at a temperature of 23.1 ± 0.47°C (mean ± SD). The two waters were (1) well water with a total alkalinity (as CaCO3) of 217 mg/L and a total hardness of 126 mg/L and (2) a 1:1 mixture of well water and deionized (WDI) water with a total alkalinity of 112 mg/L and a total hardness of 66 mg/L. Probit median lethal concentration (LC50) values were estimated with PoloPlus using the nominal CuSO4 concentrations. The mean 24-h LC50 values for the yolk sac fry were 62.8 ± 37.1 mg of CuSO4/L in the well water and 10.2 ± 3.4 mg/L in the WDI water; the 24-h LC50 values for the swim-up fry were 13.5 ± 11.5 mg/L in well water and 4.3 ± 4.4 mg/L in WDI water. The mean 48-h LC50 values for the yolk sac fry were 14.9 ± 5.0 mg/L in well water and 3.9 ± 1.6 mg/L in WDI water; the 48-h LC50 values for the swim-up fry were 3.5 ± 1.8 mg/L in well water and 1.5 ± 0.3 mg/L in WDI water. The yolk sac fry were about 4.6 times more tolerant of CuSO4 than the swim-up fry at 24 h and 4.3 times more tolerant at 48 h. Fry were about 4.7 times (at 24 h) and 3.3 times (at 48 h) more sensitive to CuSO4 in water with low alkalinity and hardness (WDI water) than in water with high alkalinity and hardness (well water). The differences in LC50 values between the different spawns of each fry type and time within a water type are attributed to natural variation and channel catfish strain.
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FIELD COLLECTION, HANDLING, AND REFRIGERATED STORAGE OF SPERM OF RED SNAPPER AND GRAY SNAPPER

Kenneth L. Riley, Edward J. Chesney, Terrence R. Tiersch-2008

North American Journal of Aquaculture 70(3): 356–364

Abstract.:
Red snapper Lutjanus campechanus and gray snapper L. griseus support valuable sport and commercial fisheries. Because of their high market value and limited commercial harvests, these species are prime candidates for aquaculture and stock enhancement. Development of culture techniques for snapper species has been attempted over the past 30 years, but use of gonadotropic hormones with mature, wild-caught red snapper remains the most reliable method for inducing ovulation and producing eggs that can be fertilized. In this study, procedures for sperm collection, handling, and refrigerated storage were developed to improve strip-spawning techniques for these snapper species. Use of refrigerated sperm allows efforts to be focused on maintaining female broodstock, monitoring of ovarian development, and increasing efficiency during the strip-spawning process. Sperm were collected from male red snapper (n = 199) and gray snapper (n = 83) captured in the recreational fishery during the summers of 2000 and 2001. Sperm were diluted 1:4 with calcium-free Hanks' balanced salt solution (HBSS), placed in 4-L plastic bags, and transported to the

laboratory on ice. Osmotic pressure (mean ± SE) of seminal plasma was 428 ± 15 milliosmoles (mOsm) per kilogram for red snapper (n = 19) and 411 ± 5 mOsm/kg for gray snapper (n = 13). Blood plasma osmolality was 440 ± 7 mOsm/kg for red snapper and 421 ± 7 mOsm/kg for gray snapper. Activation studies of red and gray snapper sperm indicated that sperm motility was suppressed by decreasing the osmotic pressure of artificial seawater to a level less than 400 mOsm/kg. Refrigerated storage experiments demonstrated that sperm samples suspended in 200-mOsm/kg HBSS retained motility for 10 d when refrigerated at 4°C. These results show that red snapper and gray snapper sperm can be stored for short-term repeated use in a hatchery.

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EARLY INDUCTION OF SPAWNING OF TAUTOGS AND COMPARISON OF GROWTH RATES OF LARVAE FROM EARLY AND NORMALLY SPAWNED BROODSTOCKS

Dean M. Perry, Grace Klein-MacPhee, Aimee Keller-2008

North American Journal of Aquaculture 70(3): 365–369

Abstract.:

A reliable broodstock of spawning fish must be available year-round for finfish aquaculture to be a commercially viable venture. Two independent laboratory trials were conducted at Milford, Connecticut, and Narragansett, Rhode Island, to investigate spawning adult tautogs Tautoga onitis outside their normal spawning season by manipulating temperature and photoperiod. The spawning date for adult tautogs was successfully advanced by 2 months in each trial. Egg production rates were similar between the two trials, the peak numbers of eggs produced per day occurring between 5 and 8 d after spawning began. Although the methods used were slightly different at each laboratory, the results were similar, viable embryos being successfully hatched and cultured in each trial. Larval growth from the Rhode Island early-spawned fish was similar to that of larvae from fish spawned during the normal spawning season. The results of both trials indicate the possibility of maintaining multiple broodstocks and inducing them to breed at different times throughout the year.

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