

**NSA Industry Committee  
Selected Papers**

***Journal of Shellfish Research*, Volume 29(4), December 2010**

**Evaluating the Effects of Formulated Moist Diets on Juveniles of Patagonian Octopus *Enteroctopus megalocyathus* (Gould 1852)**

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The aim of this study was to evaluate the performance of Patagonian octopus fed with moist diets formulated with several local feed ingredients. All formulated diets were based on crab paste (70%) and the experimental feed ingredient (30%). Experiment 1 assayed salmon meal, prime sardine meal, and wheat gluten, using fresh fish as a control; experiment 2 assayed prime fish meal and macroalgal meal against crab paste alone as a control. The ingestion rate was lower than expected for all diets except those of fresh fish, crab paste alone, and crab paste plus prime sardine meal. No significant differences were found in the observed digestibility of the diets, indicating, in general, low digestibility, even for fresh fish. The highest protease values were observed for crab paste plus prime sardine meal in both experiments. The better growth of *Enteroctopus megalocyathus* was obtained when these were fed fresh fish, which was associated with the greater consumption observed in this diet, as neither the digestibility nor the enzymatic activities of the hepatopancreas were related to this greater growth.

**Settlement of Queen Scallop *Aequipecten opercularis* on Artificial Substrates in Aldán, Ría De Pontevedra, Galicia, Northwest Spain**

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Artificial collectors deployed in May and early June obtained higher numbers of *Aequipecten opercularis* spat than when collectors were deployed in late June and July in both 2007 and 2008. Different recruitment patterns were found in the 2 y studied. Four successive cohorts settled in both 2007 and 2008; however, in 2007 the 4 cohorts settled over short periods of time, whereas in 2008 a single cohort settled for an extended period of time and produced most of the spat of the year. The effectiveness of collectors for spat settlement decreased after 2 mo. Spat showed a fast growth rate that was density dependent. In general, the survival rate was high, mainly because there were very few predators.

**Summer Mortality of Selected Juvenile Pacific Oyster *Crassostrea gigas* Under Laboratory Conditions and in Comparison with Field Performance**

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This study reports mortality under laboratory conditions in unselected controls and 2 lines of juvenile Pacific oysters *Crassostrea gigas* previously selected for their high or low survival in the field during the summer period. Oysters were also deployed in field conditions, and mortality between both conditions was then compared. In the laboratory, mortality was observed in all experiments and it always lasted for a week, indicating that mortality under laboratory conditions was a short-term event. It was also shown that mortality could be repeated for a batch in several experiments using oysters that never experienced any abnormal mortality. This approach could facilitate further studies to investigate the causes of mortality by allowing repeated trials during a summer. Differences in mortality between the resistant and the susceptible selected lines confirmed the positive response to selection under laboratory conditions. Batches that performed well in the laboratory also showed high survival in the field, and the results of those exhibiting low survival in the laboratory trials were also mirrored in the field. Finally, challenging oysters with heat stress is proposed as a useful method for estimating the survival capacity of hatchery-produced and wild-caught spat used by the oyster industry.

### **Management of the Piankatank River, Virginia, in Support of Oyster (*Crassostrea virginica*, Gmelin 1791) Fishery Repletion**

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The Piankatank River is a trap-type estuary on the western shore of Chesapeake Bay that has been managed for seed oyster production since 1963. Market oyster production in the river is minimal. Repletion efforts include shell planting and seed removal. We describe sequential changes in population demographics and habitat in relation to repletion activities on eight Piankatank River public oyster reefs from 1998 through 2009. Two reef groups (northern and southern) may be distinguished by density (oysters/m<sup>2</sup>), biomass (g dry tissue weight), and shell volume (L/m<sup>2</sup>) data. Age-at-length relationships were estimated from demographic data using a quadratic model. Observed mortality rates were high, and age 3+ oysters were essentially absent. A strong recruitment signal was observed in 1999 and 2002. Between 1998 and 2009, about 30% of the live oysters in the river were harvested as seed, corresponding to ≈7.5% of the total shell base in an average year. Typically, for every 5 bushels of shell planted, 1 bushel of seed was harvested (20% return). Even with shell planting (≈10 L/m<sup>2</sup>/y), the river shell budget showed a deficit with respect to the accretion rate required to balance sea level rise and natural degradation processes. During the study period, the mean river recruit-to-stock ratio was ≈4. The unusual and consistently high recruit-to-stock ratios suggest that management for modest continuous seed removal may be accomplished without shell planting. Annual stock assessment to identify low recruitment years is recommended as a method to adjust annual seed harvest quotas.

### **Floating Oyster, *Crassostrea virginica* Gmelin 1791, Aquaculture as Habitat for Fishes and Macroinvertebrates in Delaware Inland Bays: The Comparative Value of Oyster Clusters and Loose Shell**

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The substantial decline of eastern oyster (*Crassostrea virginica*) stocks along the east coast of the United States has prompted the growth of many types of restoration and enhancement efforts. One of the most recent types is oyster gardening. Oysters grown in floating structures are subsequently planted in bays, where they continue to live, grow, and spawn; filter the water; contribute to the larval pool; and provide habitat. Our study is one of the first evaluations of habitat value provided by floating oyster gardens in a degraded mid-Atlantic estuary. Oyster growth and survival within the floats was monitored in a eutrophic, turbid, periodically hypoxic, soft-bottom coastal lagoon system. We examined the abundance and diversity of fishes and invertebrates with respect to 3 replicated treatments: live oyster clusters, disarticulated oyster shell, and a float with no shells or oysters. We also studied the effects of 2 cleaning frequencies (biweekly and monthly) on species assemblages, and the growth and survival of oysters, and monitored basic water quality parameters. The species assemblages in floats with oyster clusters were very similar to those with loose shell but considerably different than that of empty floats. Cleaning frequency (biweekly and monthly) did not affect the growth or survival of oysters. Location of floats within the canal system, however, was a large determinant of oyster vital rates as well as community structure. Forty-nine species of fishes and invertebrates, and 8 species of macroalgae were collected from floating oyster gardens, including 9 commercial or recreational fishery species, many of which are likely habitat limited in the Inland Bays because of the loss of tidal wetlands, oyster reefs, and seagrass beds. Newly settled juvenile oysters have been found for the first time within the floating oyster gear in the manmade, residential canal systems. Our results will be used to gauge the success of enhancement efforts and to improve our understanding of the effects oyster gardens on the Inland Bays ecosystem.

### **Infection of Cultured Eastern Oysters *Crassostrea virginica* by the Boring Sponge *Cliona celata*, with Emphasis on Sponge Life History and Mitigation Strategies**

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The boring sponge *Cliona celata* poses an ongoing threat to the quality of eastern oysters *Crassostrea virginica* cultured in Baie St-Simon, Shippagan, New Brunswick, Canada. Although grown primarily off-bottom, 25–30% of cultured oysters develop severe sponge infections, leading to the culling of otherwise marketable individuals. The main objectives of the current study were to identify the areas with the highest prevalence of infected oysters, determine the primary mode of sponge infection, document the rate of shell bioerosion, and develop an effective treatment for eliminating the sponge without harming the oysters. A bottom survey of wild oysters throughout the bay indicated a high prevalence of sponge infection in certain areas, possibly related to seasonal salinity patterns. No evidence of sponge infection via shell-to-shell contact, or proximity to wild oysters, was detected during the winter months when oyster shells were deployed in bags lying on the bottom. Histological sectioning of sponge tissues in severely infected wild oysters revealed the presence of developing gametes in early June, mature eggs and sperm from mid June to mid July, and empty follicles in late July. Larvae were never successfully identified in plankton tows, but the sequential deployment and retrieval of experimental shells corroborated that June/July was the peak infection period. By the end of October, single infections measured approximately 0.05–0.10 cm<sup>2</sup>, with evidence of shell bioerosion and papillae development. Monitoring of sponge growth in 70–90-mm shells (upper valve) indicated that a 5-cm<sup>2</sup> infection will grow at a rate of approximately 15 cm<sup>2</sup>/y, rapidly occupying the 21-cm<sup>2</sup> valve of a marketable oyster (64-mm shell length). Comparison of various treatment strategies indicated that a 6-min brine dip (>90% NaCl saturation) was completely effective at eliminating

the boring sponge without harming the oysters. A program of brine dipping every second year appears to be sufficient to control the development of this pest organism in cultured oysters.

### **Reproduction, Fecundity, and Growth of Abalone (*Haliotis Tuberculata Coccinea*, Reeve 1846) in the Canary Islands**

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The abalone, *Haliotis tuberculata coccinea* has been considered in the Canary Islands as a potential candidate species for aquaculture to restock its natural ecosystem. Because the study and development of artificial culture techniques require as much information as possible on natural populations, 20 monthly *H. tuberculata coccinea* samples were collected in the island of Gran Canaria between June 2005 and May 2007. Reproductive biology was assessed by histological techniques, and von Bertalanffy growth parameters were also estimated. Ovarian morphology of *H. tuberculata coccinea* showed 6 sexual cell stages during the oogenetic process and a group synchronous ovarian development. Its reproductive cycle is characterized by an annual spawning period throughout the entire year, although the maximum reproductive activity of this population was observed between August and February. Batch fecundity ranged from 85,749 (shell length (SL), 39 mm)-691,456 (SL, 62 mm), and a significantly higher fecundity rate was observed in individuals with an SL larger than 55 mm, suggesting that, to optimize egg production, this is the minimum broodstock size to be used in hatcheries. With regard to the population structure, the overall male-to-female ratio was 1:1.02 and the data of the size class analysis did not show any tendency. The von Bertalanffy growth parameters estimated for females and males were 72.5 and 78.8 mm in SL of asymptotic length, and 0.43 year<sup>-1</sup> and 0.37 year<sup>-1</sup> of growth rate.

### **Validation of a Noninvasive Technique for Estimating Fecundity in the American Lobster *Homarus americanus***

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We investigated a noninvasive sampling technique that estimates fecundity for ovigerous American lobster based on field measurement and live release. These estimates were compared with fecundity estimates obtained from the widely used traditional invasive technique involving the removal, drying, and weighing of the entire egg mass. The noninvasive technique, which requires the removal of only 10 eggs per female, produced fecundity estimates that were within 4% of those obtained using the traditional invasive method. Applications of this technique may be carried out in an experimental setting where the effects of conservation measures such as v-notching or the establishment of closed areas, aimed at increasing egg production, can be quantified without the use of destructive sampling techniques.

**Gamete Maturation and Gonad Growth in Fed and Starved Sea Urchin *Paracentrotus lividus* (Lamarck, 1816)**

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A 4-wk rearing trial of the sea urchin *Paracentrotus lividus* was carried out in a closed-circuit system in the presence and absence of food supply to evaluate the short-term response of gametogenesis to different feeding conditions. At the end of the trial, the gonad index (GI) was calculated, histological analyses of the gonads were performed, gamete fertilization ability was evaluated, and sperm motility was assessed by computerized motility analysis. Starvation significantly affected gametogenesis, whereas developing gametes were always observed in fed animals, whose GI had doubled by the end of the 4-wk trial. No differences were recorded between gametes from reared (fed) urchins and wild-collected ones. Although spent gonads frequently contained unspawned motile spermatozoa or morphologically intact eggs, the fertilization ability of gametes from starved urchins was significantly lower. It may be concluded that, although they were at the end of the reproductive season, the specimens fed *ad libitum* were able to reactivate the gamete maturation process immediately. This ability can be used in short-term procedures for roe enhancement and gamete production, particularly for specimens from areas in which environmental conditions determine slow gametogenesis and a consequently short reproductive season.