Queen Conch Stock Enhancement: The Need for Integrated Approach

A. W. STONER
Caribbean Marine Research Center
805 E. 46th Place
Vero Beach, Florida 32963, USA

KEY WORDS: *Strombus gigas*, ecology, stock enhancement, mortality, growth.

ABSTRACT

Hatchery culture and field release of juveniles has been suggested as a potentially significant mechanism for enhancing or rehabilitating rapidly declining queen conch (Strombus gigas) populations in the Caribbean region. Conch are now cultured to juvenile stage as a matter of routine in numerous laboratories and hatcheries, but test releases have resulted in unacceptably heavy loss to predation. Results of several years of field experimentation with juvenile conch at Lee Stocking Island, Bahamas, show that successful enhancement of stocks will depend upon: 1) development of hatchery animals with sufficient fitness to survive in the field, and 2) release of hatchery-reared stock in suitable habitats at optimal time. Small scale transplants can be used to screen potential outplant sites, but comprehensive understanding of habitat requirements, behavior, feeding ecology, and predator-prey relationships will be necessary for long-term management of the resource. New experiments show that differences in morphology, behavior, and habitat utilization between wild and hatchery-reared conch can have significant effects on survivorship and growth in the field. For all of these reasons, stock enhancement programs should be a strong union of hatchery science and field biology.

INTRODUCTION

Depletion of marine resources around the world has lead to the conclusion that the stocks of many fish and invertebrate species will need to be rehabilitated or enhanced through the release of hatchery-reared seed stock. Among the invertebrates, attempts to outplant hatchery stocks have been made with abalone, scallops, clams, mussels, and queen conch. The process of stock enhancement can be divided into two distinct parts - hatchery production of seed stock and field release. Development of hatchery techniques can be painstaking, and require years to optimize survivorship and growth. Many species can be cultured eventually, and hatchery output is easily quantified. However, performance of field released stock is difficult to measure and often poorly known.

Since important early work on the culture of queen conch (Berg, 1976; Brownell, 1977), release of hatchery-reared conch has been considered the logical solution to rapid depletion of the conch fishery in the Caribbean region. Hatchery production is not easy, but has become relatively routine in the Caicos

Islands, Florida, Mexico, and Venezuela. The few preliminary releases have been less successful (see review in Appeldoorn and Rodriguez, 1992).

Summarizing data from a test outplant conducted near Lee Stocking Island, Bahamas in 1990-1991 (Stoner, in press; Stoner and Davis, in review), this paper is written with the goal of promoting an integrated, ecological approach to stock enhancement with close cooperation between hatchery managers, laboratory researchers, and field biologists.

SITE SELECTION

Stoner and Waite (1990) showed that juvenile conch in the Exuma Cays, Bahamas, are associated primarily with moderate biomass (20 and 65 g dry wt/m^2) stands of turtlegrass, *Thalassia testudinum*. Despite vast expanses of moderate density seagrass in the Exuma Cays, with depth and sediment similar to conditions found in historically important conch nurseries, transplant experiments showed that areas outside the nurseries are often incapable of supporting normal survivorship and growth in transplanted juvenile conch (Stoner and Sandt, 1991). Results of these experiments suggested that variables other than seagrass biomass, sediment quality, and depth need to be considered in choosing sites for conch seeding.

New field experiments show that success in conch transplants will depend upon several dynamic variables in the field including algal productivity (Stoner *et al.*, 1992) and density-dependent mortality (Marshall and Lipcius, 1992), as well as the structure of the habitat. Two conclusions can be drawn: 1) basic research must continue to define habitat and food requirements of juvenile conch and to better understand predator-prey interactions; 2) full-scale outplanting of hatchery-reared juveniles should not be made before rigorous preliminary tests and small-scale transplants.

SEED STOCK QUALITY

In 1990, approximately 6000 hatchery-reared juvenile conch averaging 100 mm shell length were released near Lee Stocking Island and used in several different field experiments (Stoner, in press; Stoner and Davis, in review). The experiments were conducted in a natural nursery site and in a non-traditional site where preliminary transplanting had shown good survivorship and growth of juveniles. At both sites, hatchery conch survivorship was lower than that of similar sized wild conch. Patterns were parallel in groups of test animals that were free-ranging, on tethers, and in large enclosures. Higher mortality in hatchery-reared conch appeared to be related to low shell weight, short apical spines, and low frequency of burial. Growth in shell length was also lower in the hatchery-reared animals than in wild conch.

The results of these experiments show that, under certain conditions, hatchery stocks are poorly adapted to survive in the wild. It is encouraging, however, that differences in mortality became less with time over the period of study. Shell spination and weights in the hatchery-reared animals converged with those of wild animals by the end of the study, and growth rates were equivalent seven months later. This shows clearly that the morphology, the physiology, and probably the behavior of queen conch are influenced by the environment in which they are kept, and that hatchery techniques can be developed to produce juvenile conch which will perform as well as wild conch in the field. Hatcheries should be managed to produce not just large numbers of conch but stock of high quality.

CONCLUSIONS

Hatchery production of juvenile conch represents a good beginning to solving the complex problem of rehabilitating overfished stocks. Effective stock enhancement, however, will depend upon the release of stocks of high fitness and appropriate size into optimal habitats at a time of day and during a season safest for the seed stock. The development of both high quality stocks and field release procedures must be made in close cooperation between hatcheries and basic science laboratories which direct efforts toward understanding the mechanisms of habitat utilization and performance of hatchery stocks. Stock enhancement is a multidisciplinary endeavor which requires the close integration of aquaculture, genetics, ecology, and fisheries biology.

LITERATURE CITED

Appeldoorn, R.S. and B. Rodriguez Q. (eds.) 1993. *Queen conch biology, fisheries and mariculture.* Fundacion Cientifica Los Roques, Caracas Venezuela.

Berg, C.J., Jr. 1976. Growth of the queen conch, *Strombus gigas*, with a discussion of the practicality of its mariculture. *Mar. Biol.* **34**:191-199.

Brownell, W.N. 1977. Reproduction, laboratory culture, and growth of *Strombus gigas*, *S. costatus* and *S. pugilis* in Los Roques, Venezuela. *Bull. Mar. Sci.* **27**:668-680.

Marshall, L.S., Jr. and R.N. Lipcius. 1992. Density-dependent mortality of juvenile queen conch and the role of predator aggregation. *Proc. Gulf Carib. Fish. Inst.* **42**:150-151.

Stoner, A.W. Significance of habitat and stock pre-testing for enhancement of natural fisheries: experimental analyses with queen conch. *J. World Aquacul. Soc.* In press.

Stoner, A.W. and M. Davis. Experimental outplanting of juvenile queen conch (*Strombus gigas*): comparison of wild and hatchery-reared stocks. *Fish. Bull.*, U.S. In review.

Stoner, A.W., M.D. Hanisak, N.P. Smith, and R.A. Armstrong. 1992. Large-scale distribution of queen conch nursery habitats: implications for stock enhancement. in R.S. Appeldoorn and B. Rodriguez Q., (eds.) *Queen conch biology, fisheries and mariculture.* Fundacion Cientifica Los Roques, Caracas Venezuela.

Stoner, A.W. and V.J. Sandt. 1991. Experimental analysis of habitat quality for juvenile queen conch in seagrass meadows. *Fish. Bull.*, U.S. **89**:693-700.

Stoner, A.W. and J.M. Waite. 1990. Distribution and behavior of queen conch, *Strombus gigas*, relative to seagrass standing crop. *Fish. Bull.*, U.S. **88**:573-585.