# Mariculture Prospects for the West Indian Topshell, *Cittarium Pica*

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ABSTRACT

Spawning and larval development of *Cittarium pica* are summarized. Growth of laboratory-reared *C. pica* up to 90 days of age is described, and size of two and one-half year topshells is estimated using growth data from other studies. The feasibility of mariculture is discussed, and areas needing further study are suggested.

KEY WORDS: Larval development, mariculture, reproductive cycle, spawning, topshell.

## INTRODUCTION

The West Indian topshell, *Cittarium pica* (Trochidae), is an intertidal marine gastropod found along the rocky shores in the Bahamas and West Indies (Abbott, 1974). It is eaten throughout much of this area, and is second only to the queen conch, *Strombus gigas*, in value among Caribbean gastropods (Randall, 1964; Flores and Talarico, 1981). It has been overexploited in some islands of the West Indies, and was eliminated in South Florida and Bermuda (Clench and Abbott, 1943). Mariculture of *C. pica* is feasible and could be used for supplementing and maintaining local populations throughout the West Indies. This paper describes aspects of the biology of *C. pica*, such as spawning, larval development and growth, as related to its mariculture.

## MATERIALS AND METHODS

Adult *C. pica*, between 30-70 mm shell width, were maintained in outdoor water tables at the Caribbean Marine Research Center, Lee Stocking Island, Exumas, Bahamas. Fecundity was estimated for females of 40-55 mm shell width (SW) by estimating ovary and mean oocyte volumes. Spontaneous spawning of *C. pica* occurred in water tables, and gametes or larvae were collected using 125 µm mesh nets and transferred to 1 µm-filtered seawater in the laboratory. Larvae were reared at 26.5-27.5°C in 1-2 1 liter glass beakers, with daily water changes. Metamorphosis was induced by providing larvae with an algal/bacterial film substratum in a plastic petri dish. *C. pica* juveniles were then reared in plastic petri dishes that had been seawater for two to three weeks and contained both micro and macroalgae. Growth was monitored for 90 days post spawning.

## RESULTS AND DISCUSSION

Spawning and larval development of *C. pica* has been described by Colin (1991) and Bell (MS). In summary, spontaneous spawning occured in water tables on an unpredictable basis between June and October 1991, possibly in response to simulated low tides in the water tables. Spawning never occurred when topshells were held in continuously-running seawater. *C. pica* could not be induced to spawn using hydrogen peroxide (Morse *et al.*, 1978) or by injecting serotin directly into the gonad (Braley, 1985). Fecundity was estimated at 5 to 10 x $10^5$ eggs for females of a moderate size (40-55 SW). Fecundity appears to increase with shell width.

*C. pica* have planktonic, lecithotrophic (non-feeding) larvae. Larval survey was low through the veliger stage, where the highest mortality occurred, but improved after metamorphosis. Metamorphosis occurred as early as three and one-half to four and one-half days post-spawning, when given a bacterial/algal film substratum. At the onset of metamorphosis, the shell of *C. pica* at its widest distance measured 270-280 µm, the same size as the larval shell of the post-torsional veliger, indicating that further shell growth did not occur until after metamorphosis (Colin, 1991). The first growth of the juvenile shell occurred atsix and one-half days post-spawning.

Growth of newly-metamorphosed *C. pica*, from six and one-half to 90 days age, is shown in Figure 1. Using the growth equation given in Figure 1, at 90 days age juvenile *C. pica* measure 1.24 mm shell width. Randall (1964) monitored growth of juvenile *C. pica* on a rocky shore at St. John, Virgin Islands, beginning at a mean size of 1.5 mm shell width, and followed the cohort for six months. Mean size at this time was 8.2 mm shell width, which corresponds to an age of nine months in this study. Randall also monitored growth of *C. pica* between 5.8 and 35.7 mm mean shell width. From her results, and ages estimated above, an individual 22.5 mm in shell width would be about eighteen months old. Debrot (1990) showed an inverse relationship between growth rates of *C. pica* and wave exposure, that is growth rates were lower at sites with high wave exposure. He estimated growth rates for small (x = 22.8 mm) *C. pica* from 7.9-22.4 mm/year, and for large (x = 80.0 mm) *C. pica* from 2.6-5.1 mm/year, corresponding to high-low wave exposure sites, for each mean size, respectively. Using the above growth rates, size at age two and one-half years can be estimated at 44.9 mm, 40.9 mm and 30.4 mm shell width, for sites with low, intermediate and high wave exposure, respectively.

The data above indicate favorable qualifications for the mariculture of this species. The larval phase is short and lecithotrophic, metamorphosis is induced with a non-specific bacterial/algal film, and small juveniles can be grown on the same type of substratum. *C. pica* is a generalist herbivore feeding on a wide variety of soft algae and detrital material (Randall, 1964). Once they reach a size which they are easy to see and handle, growth on algal mats in tanks or cages

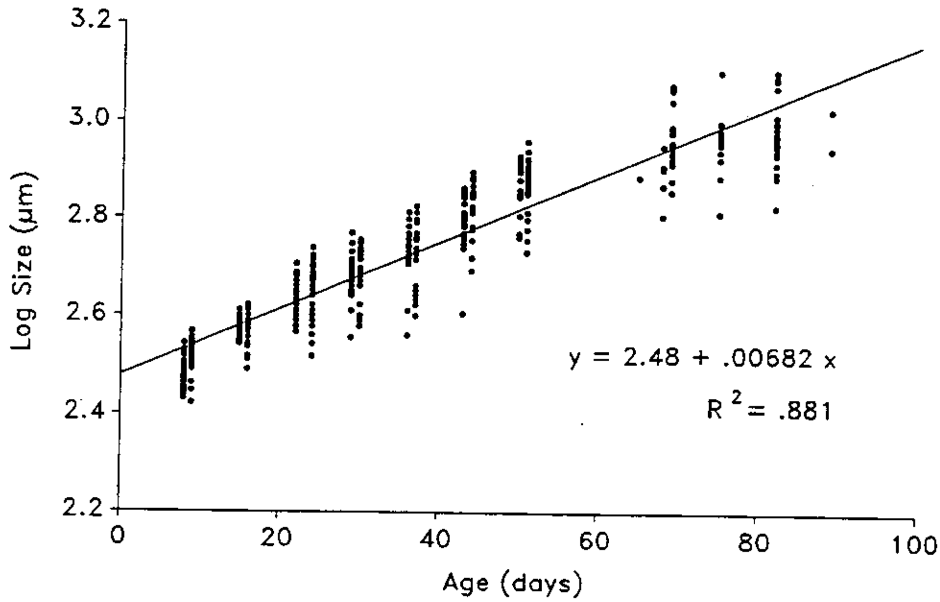


**Figure 1.** Regression of size (log µm) on age (days) of laboratory-reared *Cittarium pica* at 26.5-27.5°C in the Bahamas (n = 492).

appears highly feasible.

Present constraints to successful mariculture are spawning induction and larval survival. More natural conditions in tanks, with a well-simulated tidal cycle, might produce regular, spontaneous spawnings. Further studies on induction methods might yield promising procedures. While hydrogen peroxide was unsuccessfully used in the present study, it is used to induce spawning in abalone (Morse *et al.*, 1978). Since abalones are phylogenetically closely related to topshells, further work with this method might result in successful individual spawning for *C. pica*. Another possibility is to use a cerebral ganglion homogenate, such as that used by Clare (1986; 1987) to induce spawning of the temperate trochid, *Gibbula umbilicalis*, this suggests hormonally regulated spawning. This possibility has yet to be studied for spawning induction in *C. pica*.

The reproductive seasonality of *C. pica* must be taken into consideration when considering production of gametes for mariculture. Colin (1991) suggested that in the Bahamas *C. pica* has a single spawning period in early October, possibly requiring the entire summer to become sufficiently gravid to spawn. It seems likely that adult *C. pica* could be conditioned year-round at summer seawater temperatures and day lengths, which might then result in year-round spawning. Castell (1987) reported probable year-round spawning of *C. pica* in the Los Roques Archipelago, Venezuela, where warmer water temperatures continue through the winter months.

Many techniques exist to increase larval survival. Conditioning adults may enhance yolk content and egg viability resulting in increased larval survival. In addition, use of antibiotics in larval culture of gastropod and bivalve molluscs has been practiced for many years. It is likely that larval survival can be significantly increased with further studies.

Mariculture of the Indo-Pacific trochid, *Trochus niloticus*, has been a successful practice for a number of years now (Heslinga and Hillman, 1981; G. Heslinga, Pers Comm.). There appears no reason why the same cannot be achieved for its Caribbean counterpart, *C. pica*.

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