

Population of *Modiolus* spp. in the Intertidal Rocky Coastline of Pudhumadam, Gulf of Mannar

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ABSTRACT

The Gulf of Mannar falls in the Indo-Pacific region, considered to be one of world's richest marine biological resource regions. This is considered a hyper fragile environment, inhabiting all types of flora and fauna. Intertidal rocky coastlines are heterogeneous environments that support a wide variety of living forms. In these systems, organisms are distributed in a particular way, occurring at specific levels along the vertical axis, from the lower to the upper shore. Pudhumadam are the distinguished area of intertidal rocky shorelines in the Gulf of Mannar. Horse mussel *Modiolus* spp. belongs to the family *Mytilidae*. Studies on the distribution of individual numbers of *Modiolus* spp. in the intertidal rocky shore regions of Pudhumadam coast (Lat 09°16.26' N and Lon 94°12.88' E) near the Ramanathapuram district were carried out from August to October period in 2009 and 2010. Sampling plots were laid in 5 sites at an interval of 200 meters in 1 kilometer stretch of the coast using 1m² quadrat method and mean (\pm SD) number of *Modiolus* spp. was estimated at 1356.45 and 1368.63 in 2009 and 2010 respectively. 0.12% increase was noted during 2010 when compared from 2009.

Key Words: *Modiolus* spp., Gulf of Mannar, intertidal rocky shore, Pudhumadam and quadrat.

INTRODUCTION

Ecological boundary on planet Earth is more definitive or profound than the interface between land and sea. Sea cliffs of one kind or another are estimated to back 80% of the modern global coastline (Emery and Kuhn 1982), but perhaps only 33% of the present coastline entails rocky shores that are in direct contact with sea water on a regular basis (Johnson 1988). Hard substrates exposed to intertidal and shallow-subtidal waters provide varied habitats for colonization by marine algae and invertebrates. Many studies have shown that one of the most important characteristics of rocky shore communities is their great spatial and temporal variability which arises from a combination of biotic and physical factors (Dye 1998). The Gulf of Mannar falls in the Indo-Pacific region, considered to be one of world's richest marine biological resource regions. This is considered a hyper fragile environment, inhabiting all types of flora and fauna. Horse mussels (*Modiolus* spp.) (family: *Mytilidae*) are one of the most popular benthic species in the vicinity of the Southeast coast of India. In spite of the widespread distribution, studies on population pattern of *Modiolus* spp. are sparse due to lack of commercial value and colonization depth. In order to know about the colonization depth, present study investigates the population and settlement pattern of bivalve mussel *Modiolus* spp. of Pudhumadam rocky shoreline in Gulf of Mannar.

MATERIALS AND METHODS

Study area

Pudhumadam (Lat 09°16.26' N and Lon 94°12.88' E) located in Ramanathapuram district, Tamilnadu, India is one among distinguished rocky shoreline of Gulf of Mannar (Fig.1). The rocky outcrop at Pudhumadam is mostly covered with mussels, year-round.

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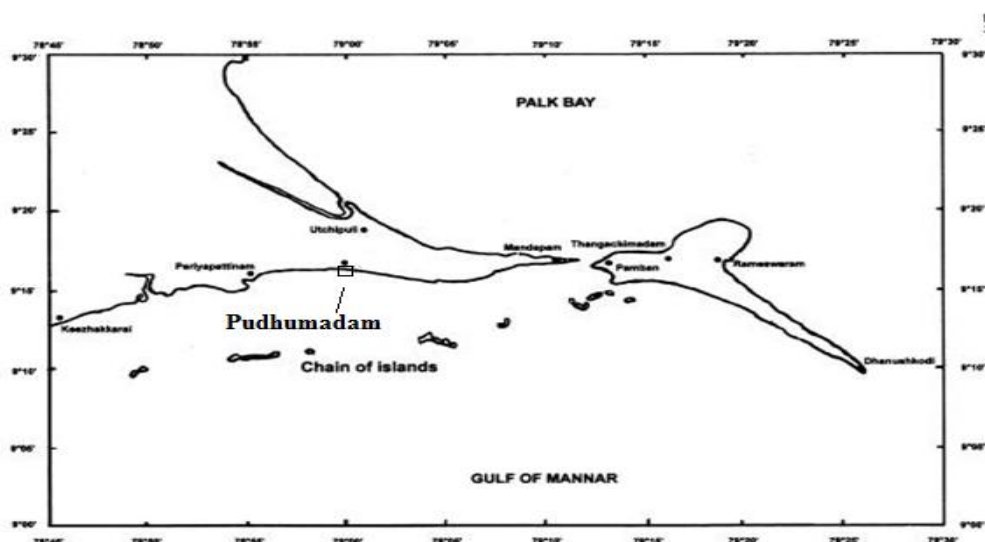


Figure 1. Study site – Pudhumadam coast, Gulf of Mannar.

Population and settlement pattern

Abundance and frequency of mussel distribution in mussel beds at the intertidal rocky coastline were studied. Five 1m² quadrates were placed in at an interval of 200 meters. Each time individual number of horse mussel *Modiolus* spp. was counted using visible methods. Mussel settlement patterns within quadrats of rocky substrates were examined during five day intervals at rocky intertidal sites from August to September 2009 and 2010. Within each of the five sites, two habitats (mussel bed and algal band) were examined in a factorial design. Random samples of 50 *Modiolus* spp. from each plots were collected and size was recorded. All mussels were classified into two size classes (< 10 and > 10 mm in shell length).

Data analysis

Analyses of variance were used to significant differences between plots and number of mussels assemblages located on different heights along quadrates - vertical gradient. Linear regression plot for mussel population and months were carried out using Excel in MS office 2003.

RESULTS AND DISCUSSION

Settlement and distribution pattern

Intertidal rocky coastlines are heterogeneous environments that support a wide variety of living forms. In these systems organisms are distributed in a particular way, occurring at specific levels along a height axis, from the lower to the upper shore (Araujo *et al.* 2005). The observation of these distribution patterns led to the development of several models of vertical zonation of organisms on rocky shores. The distribution patterns of organisms in intertidal rocky systems have been approached by many authors (Underwood 1981, Jenkins *et al.* 1999, Bockelmann *et al.* 2002, Alfaro *et al.* 2004 and 2006).

The Pudhumadam rocky intertidal ecosystems are divided into three major zones, as described in general zonation schemes by Seoane-Camba (1969). Sessile filter feeders *Modiolus* spp. is the most common organisms at mid levels on the shore of exposed zones. Algae are the most predominant organisms at mid levels of the shore. Large quantities of algae with associated mussel juveniles, or spat, accumulate rocky shore. The algae serve as primary settlement sites for 0.25mm to 5mm sized spat. In this study, 1356.45 ± 45.21 and 1368.63 ± 52.96 number of *Modiolus* spp. were recorded in 2009 and 2010 with length of 4.80 ± 1.54 mm L during August, 7.20 ± 0.78mm L in September and 9.50 ± 0.97 mm L during October in both the years. Similarly, Alfarao *et al.* (2004) reported that large quantities (>170 tonnes/year) of drift algae with associated mussel juveniles, or spat, accumulate near shore. The drift algae serve as primary settlement sites for 0.25mm to 5mm sized spat and can transport spat along shore for several kilometers before being washed ashore onto the beach in New Zealand.

Concerning the variability between samples taken at the same sites on different occasions, no significant differences were found between each quadrate (Table 1) or between vertical axes. Similarly, Alfaro (2006)

reported the Settlement patterns of green lipped mussel *Perna canaliculus* in three sites of New Zealand and reported that mussel abundance was generally higher at Scott Point than Tonatona Beach and that the lowest settlement rates were observed at The Bluff. The study reported the no significant differences were observed in settlement rates of mussels >1.5mm among the three study sites. These results, in conjunction with the fact that quadrates in the mussel beds were never recorded to have 100% mussel cover, indicate that secondary settlement rates in the adult mussel beds within the three sites were not limited by space. This coincides with the present study with no significant changes within five sites. Significant difference in number of mussels from August – September were estimated and R² value of linear regression plot for population of mussels versus month was 0.902 and 0.887 in 2009 and 2010 (Fig. 2).

Table 1. Statistical analysis of population of mussel *Modiolus* spp.

| Source | df | < 10mm | | > 10mm | |
|--------|--|--------|------|--------|------|
| | | F | P | F | P |
| Site | 3 (column factor) 5 (row factor) 15 (residual error) | 14.35 | 0.05 | 17.33 | 0.05 |

Tukeys test (q); Significant? P < 0.05

| | | | |
|------------|----------|------------|----------|
| Site 1 x 2 | 2.039 ns | Site 1 x 3 | 3.053 ns |
| Site 1 x 4 | 1.544 ns | Site 1 x 5 | 3.582 ns |
| Site 2 x 3 | 1.509 ns | Site 2 x 4 | 3.057 ns |
| Site 2 x 5 | 1.567 ns | | |

ns- not significant; df – degrees of freedom; F – column factor.

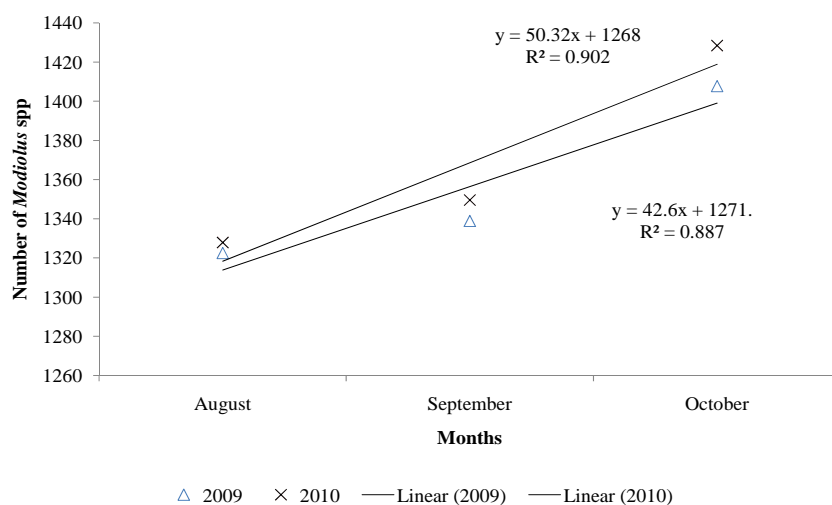


Figure 2. Population of *Modiolus* spp. versus period of study.

The populations themselves also may be regulated by biological and physical factors that affect adult mussels, such as competition, predation, hydrodynamic forces, temperature and salinity. The sum total of these biological and physical factors is likely to be reflected in the growth and mortality rates of mussels within various populations. Further studies on comparisons among mussel populations must take into account a combination of interacting factors that affect mussels at various life-history stages. This study is a preliminary and addressed the population abundance and settlement patterns, that reflects the population dynamics of the major intertidal rocky coastline.

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