

POPULATION DENSITY OF *CELLANA* AND *ACMAEA* (MOLLUSCA: GASTROPODA) AT VARIOUS TIDAL ZONES ON THE ROCKY COAST OF MANORA, KARACHI, PAKISTAN

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ABSTRACT

The limpets *Cellana* and *Acmaea* are well known gastropods of the rocky intertidal zones of Manora, Karachi coast. They are conspicuous at each tidal zone along with dense algal mats. Their maximum population density was recorded in the mid-tidal zone. Yearlong field studies of these limpets for twelve consecutive months displayed higher population density for *Cellana* as compared to *Acmaea*. The maximum average population density per m² of *Cellana* was recorded to be 43 in September in the mid-tidal zone. Average maximum density per m² of *Acmaea* was noted to be 17 in mid-tidal zone in January. The minimum density was recorded to be 7 for these animals in the month of February in high tidal zone.

Keywords: Inter-tidal zone, Mid-tidal zone, Population density, Manora (Karachi), *Cellana* and *Acmaea*.

INTRODUCTION

Limpets constitute a conspicuous and well known group of the gastropod molluscs which are worldwide in distribution. They can be used as best contender for environmental monitoring (Davies *et al.*, 2005). The storms and desiccation may direct their occurrence over the coast. The limpets also play important role in the ecosystem, being herbivores (Humayun and Chaghtai, 2012) at both temperate and tropical latitudes (Liu, 1994; Dunmore and Schiel, 2000).

The population dynamics of various limpets has been studied in various parts of the world (Lewis and Bowman, 1975; Thompson, 1980; Fletcher, 1987; Bosman and Hockey, 1988; Misra and Kundu, 2005). The population dynamics and growth of limpets have been reported to vary among different habitats (Thompson, 1980; Creese, 1980; Bosman and Hockey, 1988). Factors which influence the population structure of limpets include associations with some other species (Johnson *et al.*, 1997), discharge of the sewage waste (Hindell and Quinn, 2000), limpet density (Boaventura *et al.*, 2002) and predation (Lewis and Bowman, 1975). Marine intertidal organisms, like limpets have to cope with severe environmental conditions during low tide period associated with thermal and desiccation stresses (Christopher, 2003). The selection of particular habitats like pits, crevices, cracks play a vital role in reduction of thermal and other physical stresses. These places are cooler, more humid, and support more micro algae and provide them more shelter from water flow than open areas. Topographic features of the environment and distribution of organisms are thought to be directly related with each other. Crevices are often conspicuous feature of the rocky coasts which are cooler and humid. However, other factors such as seasons, height on the shore and tidal conditions also seem to alter the conditions.

Population density of limpets remains relatively uniform on various sizes of the rocks. The results of studies of 1500km coastline of South African coast showed that no significant difference of population densities was found on larger and smaller rock patches (Victoria *et al.*, 2012). In Pakistan, mollusks have been a subject of investigations by many researchers like (Tirmizi and Zehra, 1982, Moazzam and Rizvi, 1983; Zehra and Parveen, 1991; Ahmad and Siddique, 1997; Shamim, 2001; Afser, 2009; Bano, 2009; Humayun and Chaghtai, 2012; Atta *et al.*, 2013) on different aspects of mollusks but Population density of these two coexisting limpets (*Cellana* and *Acmaea*) at the commercially and biologically important on rocky shore of Manora which is still un-described. The study of population density of limpets over such populated coast like Manora is undertaken which is the first of its type and hopefully will help us in future to compare their densities in other rocky coasts of Pakistan.

MATERIALS AND METHODS

The aim of present work was to ascertain the population density of the two limpets (*Cellana* and *Acmaea*) inhabiting rocky shore of Manora (24^o. 48, 67^o 5E) of the Karachi coast. These study area is located along Northern Arabian Sea (Fig. 1). Observations were made in the field from January 2008 to December 2008 by the establishment of quadrates in the intertidal zone of Manora. The quadrates of 1 m² each were placed at an interval of about 5m apart from each other (Fig. 2). These were established in low, mid and high tidal zones. The site was visited twice in a month. For sampling a fixed route was followed throughout the study period and samples were collected from low to high tidal zone. Sampling was done by hand picking. Limpets were identified according to Khan and Dastagir (1971) and Tirmizi and Zehra (1982).



Fig. 1. *Cellana* and *Acmaea* in their natural habitat.



Fig. 2. A quadrat placed in the study area of Manora.

RESULTS

The population of both organisms varied in low-, mid and high tidal zones significantly (Fig. 3) as given by the ANOVA (Table 1). Both limpets showed higher density on the clear rocks of the coast whereas lesser density over rocks with dense algal encrustation. Maximum average population density of *Cellana* per m² was recorded to be 43 in September in the mid-tidal zone and minimum density per m² was noted to be 7 in high-tidal zone in the month of February. Average maximum density of *Acmaea* was noted to be 17 in mid-tidal zone in January and minimum density was recorded to be 7 in the February in high tidal zone.

The comparative study of *Cellana* and *Acmaea* revealed that both species possess maximum densities at the mid-tidal zones (MTZ). The density of *Cellana* was greater than *Acmaea* in this zone. Both species exhibited minimum densities in the high-tidal zone (Fig. 3). The maximum total zonal population density was recorded in September to be 620 individual for the *Cellana* and 240 animals were recorded for the *Acmaea*. In intertidal area the lowest density of *Cellana* at Manora was 360 and 150 individual for *Acmaea* in the month of October.

DISCUSSION

Cellana sp. and *Acmaea* sp. are the commonest limpets of the rocky shores of Manora (Karachi), Pakistan coast. The studies which are carried out in different parts of the world have shown that these two limpets prefer to dwell over clean and clear rocks which are devoid of dense growth of any of seaweeds (Rao and Ganapati, 1971; Dunmore and Schiel, 2003). They are also visible over the rough rock surfaces. They are also found in crevices and tide pools. The limpets residential preferences match with the topographic conditions of Manora where bare rocks and less dense growth of algae over the rock was observed. So, reasonable population density of *Cellana* and *Acmaea* was observed in such rocky habitats. Moreover, they are abundant in crevices which are humid cooler places and promote more micro algal growth (Jackson, 2010), where desiccation stress is low which also prevents them from heat in summer and ultimately decreases their mortality (Liu, 1994). Moreover plenty of micro algal food is in easy access of the species which could be the major factor for high population density of limpets in much habitat. Monthly monitoring of these limpets at Manora showed that both *Acmaea* and *Cellana* are in abundance in the mid-tidal zone as compared to the low and high-tidal zones. Similar results are also documented by the Brazilian investigators (Marcelo Tanaka *et al.*, 2002) and Kiwi researchers (Dunmore and Schiel, 2003).

Table 1. One-way ANOVA: Density per m² of *Cellana* versus intertidal Zones at Manora.

Source	df	SS	MS	F	P
Zones	2	22354	11177	42.16	0.000
Error	249	66013	265		
Total	251	88367			

One-way ANOVA: Density per m² of *Acmaea* versus intertidal Zones at Manora

Source	df	SS	MS	F	P
Zones	2	5832.2	2916.1	78.75	0.000
Error	249	9220.8	37.0		
Total	251	15053.0			

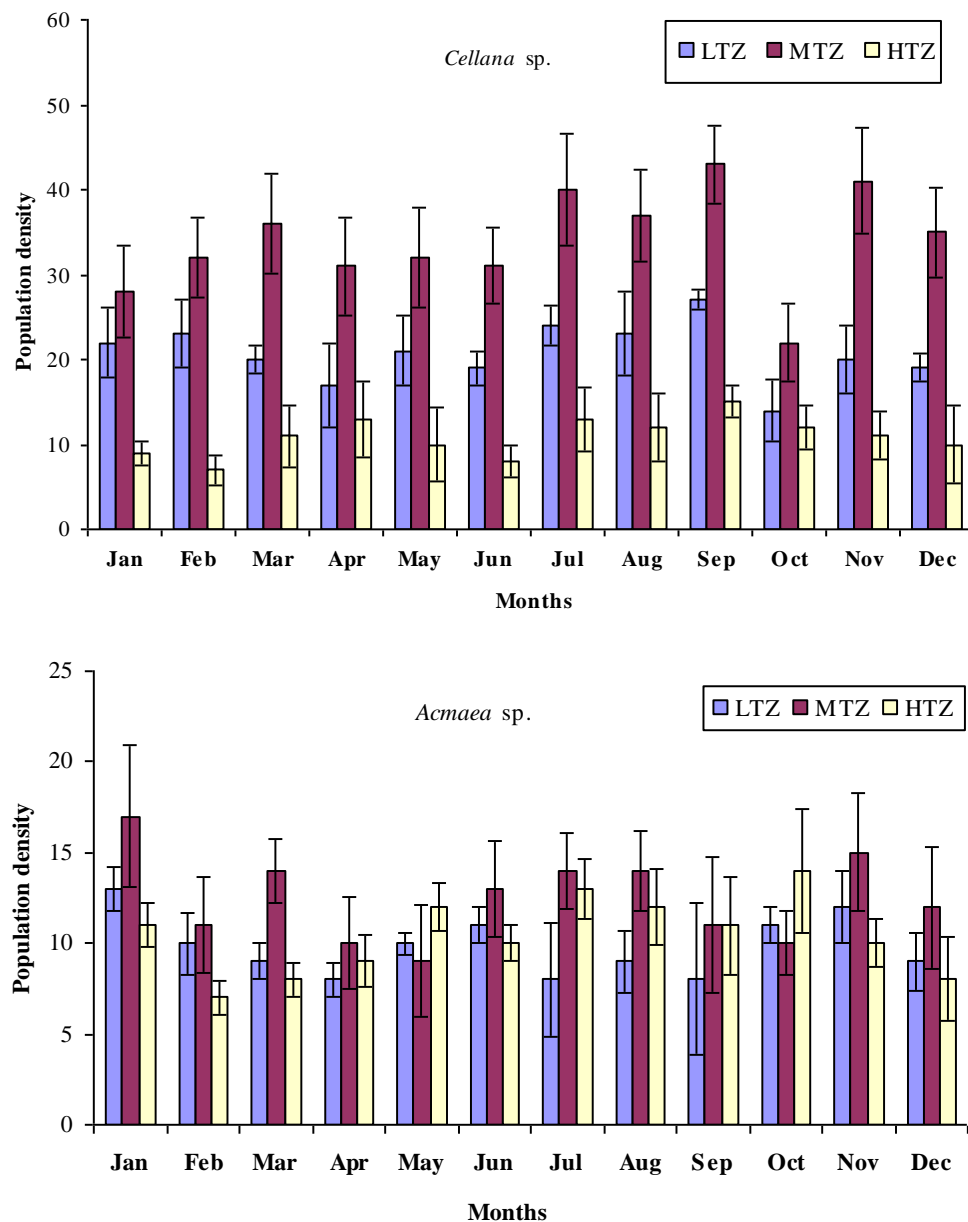
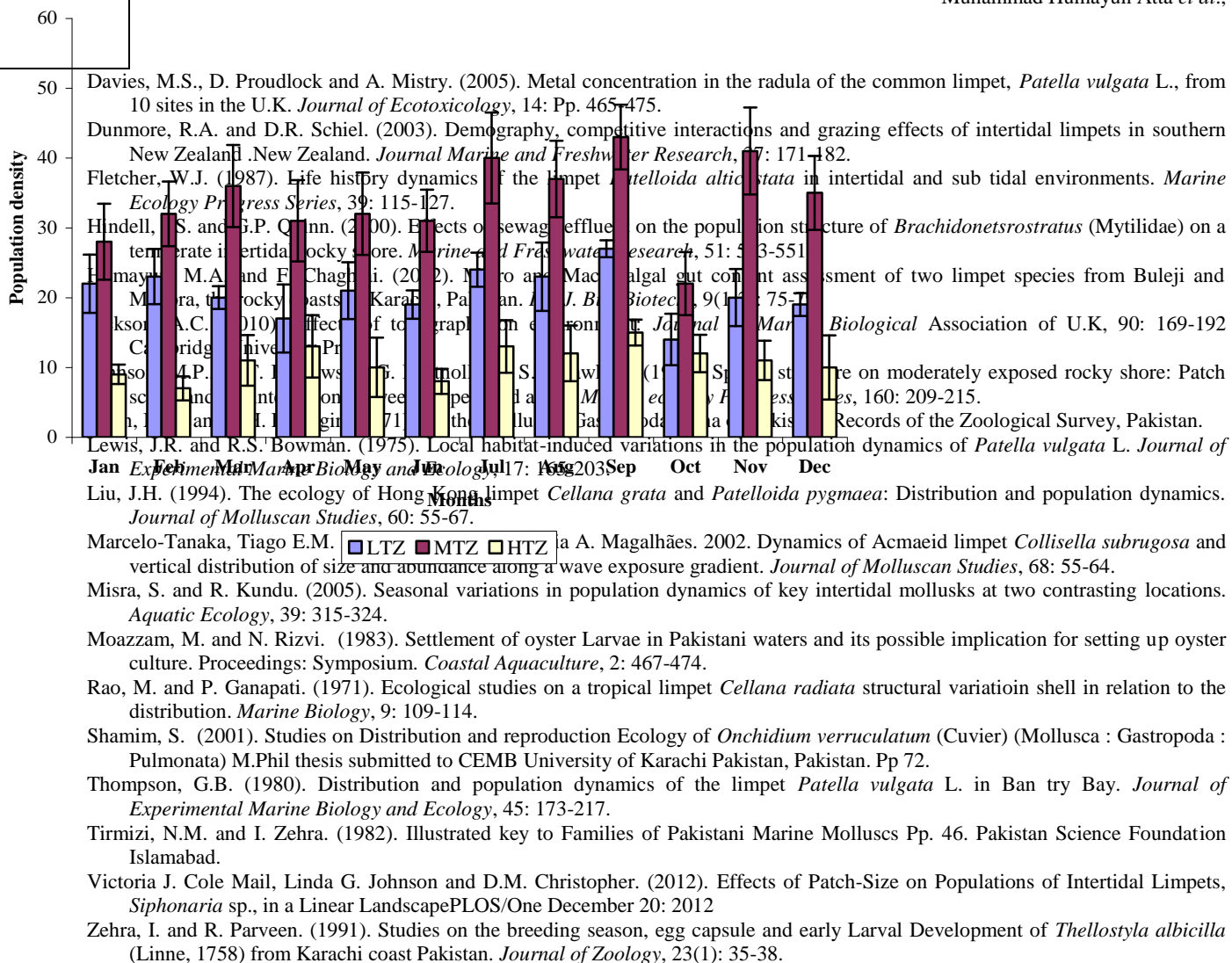


Fig. 3. Population density per m² of *Cellana* sp. and *Acmaea* sp. in a coastal rocky outcrop of Manora, Karachi. LTZ, Low tidal zone; MTZ, mid tidal zone and HTZ, High tidal zone.

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