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DISTRIBUTION, ABUNDANCE AND POPULATION DENSITY OF *CELLANA RADIATA* AND *ACMAEA* SP. ON THE ROCKY COAST OF BULEJI, KARACHI, PAKISTAN

M. Humayun Atta[1], Adnan Mujahid[2] and Furqana Chugtai[1]

[1]*Centre of Excellence in Marine Biology, University of Karachi, Karachi-75270, Pakistan*
[2]*M.A.H. Qadri Biological Research Centre, University of Karachi, Karachi-75270, Pakistan*
[*]*Corresponding author e-mail: marinebiologist456@gmail.com*

ABSTRACT

The limpet, *Cellana* sp., and *Acmaea* sp., are abundantly found in Buleji coast of Karachi over clean rocks with less dense growth of algae. They are distributed over an entire intertidal area. Their maximum population density is recorded in the mid-tidal zone. The population density of *C. radiata* ranged from 7/m^2 in the month of September to 57/m^2 in summer month of April. The density of *Acmaea* sp., was recorded to be minimum in September (8/m^2) and maximum in April (24/m^2) the density was higher for *Cellana* as compared to *Acmaea* sp.

KEYWORDS: Intertidal area, Distribution, Population density, Rocky coast, Buleji.

INTRODUCTION

The ecological features of benthic marine invertebrates are not well understood (Frank, 1968; Vance, 1973). They live in readily accessible habitat, often occur in large numbers, and are easy to sample, mark and relocate. Limpets possess flattened, cone-shaped shells and majority of species are commonly found adhering strongly to rocks or other hard substrates. Limpets scrape algae with their radula, a ribbon like tongue with a row of teeth. The herbivore limpets, *Cellana* is cosmopolitan genus, which is found all over the tropical, temperate and polar rocky shores in both hemispheres (Rao & Ganapati, 1971; Underwood, 1975; Dunmore and Schiel, 2000). *Cellana* sp., is traditionally placed in the family Patellidae and *Acmaea* sp., is in family Acmaeidae. *Cellana radiata* is characterized with semi translucent shell reaching about 38mm. Apex is sub central or at least not closed to the margins (Tirmizi & Zehra, 1982). The numerous concentric striae and superficial ridges are whitish and coarse. Most species possess rough surfaces with reddish brown spots (Khan & Dastagir, 1971). *Acmaea* spp. are characterized with comparatively thick shell. Apex is sub central or at least not closed to the margins (Tirmizi & Zehra, 1982). Internally, shell is very smooth and necrous. Shell is almost non-translucent reaching 35 to 38 mm.

Many studies on rocky coasts have focused on the seasonal changes and the factors influencing the distribution and abundance of limpets (Branch, 1981). The distribution patterns are thought to be primarily caused in response to the major gradient of emersion and desiccation (Stephenson & Stephenson, 1949; Southward, 1958; Lewis, 1964). Intertidal organisms like limpets experience extreme environmental conditions during low tide associated with thermal and desiccation stresses (Christopher *et al*., 2003). Limpet distribution to various tidal zones also involves the difference in protein structures. This new research over limpets suggests that protein can be utilized to withstand the world wide common issue, the global warming (Dong & Somero, 2009).

In Pakistan extensive studies have been made on various aspects of intertidal mollusks: (Tirmizi & Zehra, 1982, 1984; Moazam & Rizvi, 1983; Shamim, 2001; Zehra & Parveen 1991; Bano, 2009; Afser 2009). But Pakistani limpets have received very little attention. The rocky coasts of Karachi offer an excellent opportunity to conduct such type of studies due to abundance of limpets in the intertidal zone.

MATERIALS AND METHODS

The Present work is based upon monthly visits and investigations of intertidal populations of limpets from the shore of: Buleji (24^o 50´, 55" N, 66^o 48 55" E DMS system) of the Karachi coast. For the study of distribution, abundance and population density each site was regularly visited, during low tide, at monthly intervals from January 2006 to December 2006. The distribution and population density of *Cellana radiata* and *Acmaea* sp., was observed by the establishment of quadrates in low, mid & high tidal zones of an intertidal area of the Buleji and Manora. The quadrates of 1 m^2 are used for the sampling of these organisms. Quadrates were taken at a distance of 5 meter. These were established from first in the low tide zone (LTZ) i.e. at seaward edge and then these are consecutively followed by the quadrates in the mid tidal zone (MTZ) and finally these are established in the high tidal zone (HTZ) which faces ultimately splash zone.

Identification of the Limpets: The limpets *Cellana radiata* and *Acmaea* sp., are identified according to Khan & Dastagir (1971) and Tirmizi & Zehra (1982).

During the present investigation all statistical computations were carried out by using MINITAB version 11.3 and MS Excel of Microsoft window XP Professional 2002 version.

RESULTS

The limpets, *Cellana radiata* and *Acmaea* sp., on the coast of Buleji are found over clean rocks or on an area where there is less dense growth of algae. They are also observed with barnacles and siphonaria over the microalgal substratum. These animals are present over the big boulders, rocks. *Cellana radiata* and are also observed in crevices, and tide pools (Fig. 1a, b). At Buleji the maximum average population density of *Cellana radiata* is recorded 57 in the month of April in the mid-tidal zone. The lowest average population density is recorded 7 in the months of January in the high-tidal zone (Fig. 2). The average maximum population density of *Acmaea* sp., is recorded as 24 in the month of April in the mid-tidal zone (MTZ). The average maximum population density in the low-tidal-zone is noted as 8 in the month of September. The lowest average population density is recorded 2 in the January in the high-tidal zone (Fig. 3).

Fig. 1a. *Cellana radiata* on a rock with *Siphonaria* and *Barnacles*.

Fig. 1b. *Acmaea* sp. over a clear rock at the coast of Buleji.

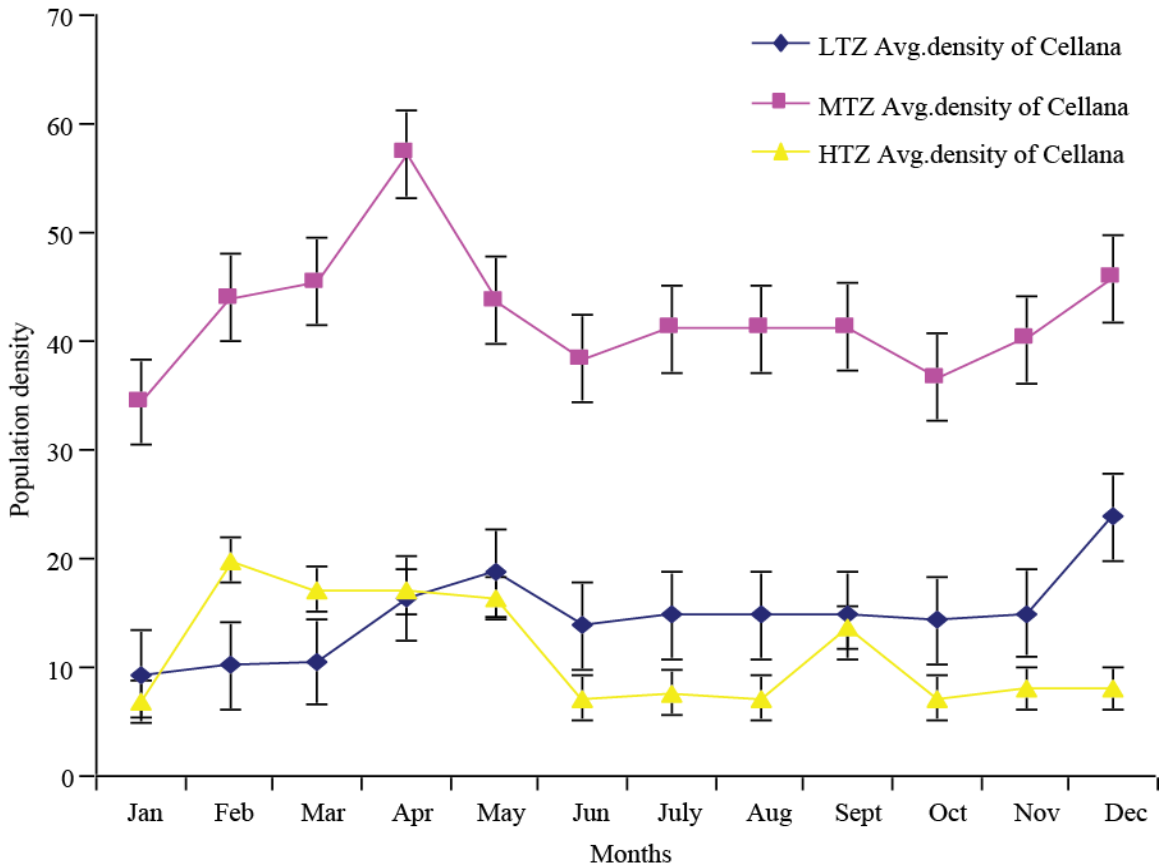

Fig. 2. Average population density per m^2 of *Cellana* sp., in various months at the shore of Buleji. LTZ low-tidal zone, MTZ, mid-tidal zone and HTZ, high-tidal zone.

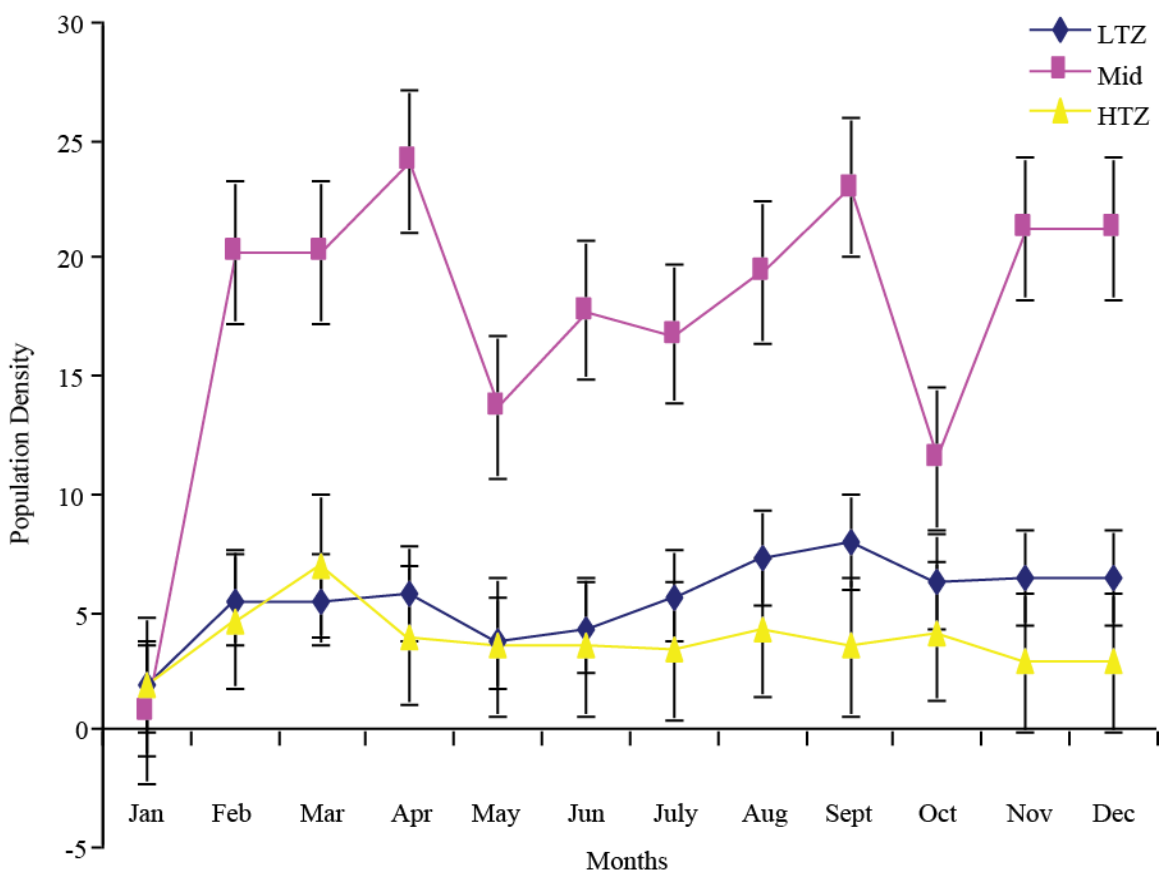

Fig. 3. Average population density per m^2 of *Acmaea* sp., at Buleji.

Population density of *Cellana radiata* and *Acmaea* sp., was highest in the mid-tidal zone. But in each zone density of *Cellana radiata* is larger as compared to *Acmaea* sp.

The total zonal population density recorded shows 730 animals of *Cellana radiata* in April and 285 animals for *Acmaea* sp., are noted in the same month. While the lowest density is recorded in the month of January i.e., 410 *Cellana radiata* and 98 of the *Acmaea* sp., (Fig. 4).

Statistical evaluation of results: One way analysis of variance (ANOVA) was used to compare population density. The population density of *Acmaea* sp., at Buleji; F = 79.03 and P = 0.000 and for *Cellana radiata*; F= 54.46 and P= 0.000 which is also <0.005 showing significant differences in the densities Tables 1-2.

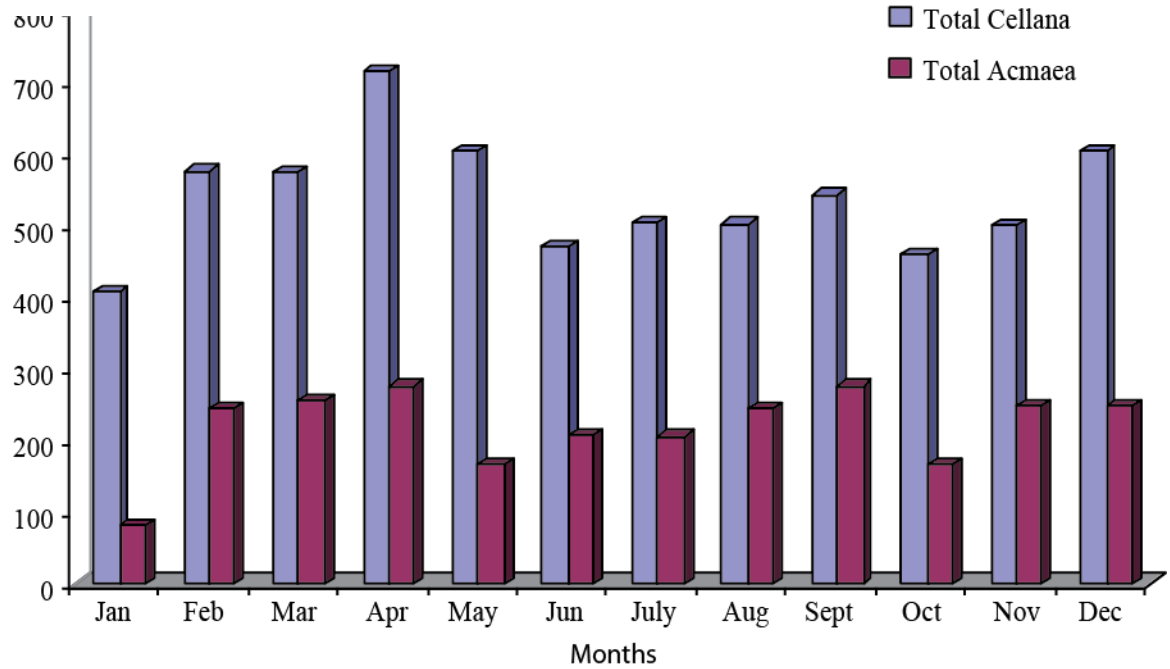

Fig. 4. Total zonal population density of *Cellana* sp., and *Acmaea* sp., at Buleji.

Table 1. One-way ANOVA: Density *Cellana* versus Zones at Buleji.

Source	df	SS	MS	F	P
Zones	2	53873	26936	54.46	0.000
Error	249	123152	495		
Total	251	177024			

Table 2. One-way ANOVA: Density *Acmaea* sp., versus Zones at Buleji.

Source	df	SS	MS	F	P
Zones	2	10992.0	5496.0	79.03	0.000
Error	249	17317.2	69.5		
Total	251	28309.2			

DISCUSSION

The comparative study of these limpets indicate that these two forms prefer to reside over clean and clear rocks not having a dense growth of seaweeds and variety of fauna (Rao & Ganapati, 1971; Dunmore & Schiel, 2003). Irrespective of their preference of habitat they are also visible over the rough rock surfaces. Monthly monitoring of these limpets at Buleji shows that both *Acmaea* sp., and *Cellana radiata* are in abundance showing high density in the mid-tidal zone as compared to the low and high-tidal zones. These results are also in agreement with the investigations of (Marcelo Tanaka *et al*., 2002) and (Dunmore & Schiel 2003) .Our results for the one way (ANOVA) for densities of two species and three zones also shows this trend. Intertidal organisms like limpets (*Cellana radiata* and *Acmaea* sp.) experience extreme environmental conditions during low tide period associated with thermal and desiccation stresses (Christopher *et al*., 2003). The distribution patterns are thought to be primarily caused in response to the major gradient of emersion and

desiccation (Stephenson and Stephenson, 1949; Southward, 1958; Lewis, 1964). So their minimum population density in high-tidal zone might be the result of thermal and desiccation stress. *Cellana radiata* and *Acmaea* sp., are associated with *Siphonaria* and Barnacles. These results are in support to that of Creese & Underwood, (1982) who investigated the association of *Cellana tramoserica* with *Siphonaria* and some other studies also reported the association of *Cellana tramoserica* and Acmaeid limpets with Barnacles (Underwood *et al*., 1983); *Acmaea digitalis* (Choat, 1977) and *Patelloida latistrigata* (Creese, 1982) with the Barnacles.

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