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Seasonal variations of invertebrates diversity & environmental health in intertidal area at Tak Bay, (Kalatoo) Hingol National Park Balochistan Pakistan

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ABSTRACT

This study was initiated to discover the distribution & diversity of invertebrate communities on a rocky intertidal shore at Tak Bay, Ormara along the Balochistan coast of Pakistan. Quadrat techniques were used to establish abundance of species. Overall, 49 species of invertebrates were recorded. Two of these species were annelids, 35 molluscs (Polyplacophora 1, gastropods 30, bivalves 4), 9 arthropods (cirripediae 2, malacostraca 7) & 3 echinoderms (stelleroids 3). The Highest diversity was found during the mid & high tidal zones. Diversity & distribution configurations were found to be linked with topography & prevailing environmental conditions.
Keywords: Ormara, Tak Bay, tidal levels, biodiversity, intertidal area

INTRODUCTION

Intertidal areas are ideal locations for many communities such as fishes, birds & crustaceans. The distribution patterns of organisms in coastal habitats is effected by many factors. Among these, composition of sedement & stabality, length & frequency of low tidal exposure, arial extension of tidal flats, & origion, evolution of topography & oceanographic factors are important determinant (Menge, 2000; Reise, 1985). The spatial distribution of macrofauna in intertidal areas is mostly controlled by predation & competetion for space, food & settlement of larva in the sediment (Peterson, 1991). In addition, consumer plays an important role in cotrolling distribution patterns from top to down in rocky intertidal areas through establishing a food chain (Menge, 2000).

Taq Bay is a part of Hingol National Park, located 250 km towards west from Karachi. The park has an area of approximately 6000 km^2 & spread in Lasbella, Gwadar & Awaran districts of Balochistan province (Ghalib *et al.,* 2008; Qureshi, 2012). Arabian Sea is located on the southern part of the park. Numerous sandy & rocky beaches & intertidal rocky habitats are hot marine biodiversity spots & also provide breeding & nursey grounds for different turtle species. Tak or Kalatoo Bay is located about 15 km towards west of Ormara. Rocky, sandy & rocky beaches & tidal pools are the main features of the bay. The bay serves as an ideal place for the residence of many marine & terrestrial communities (seaweeds, molluscs, polychetes, crustaceans, echinoderms, snakes & birds etc.). The s&y beaches at the bay serve as an important nesting sites for *Chelonia mydas* & *Lepidochelys olivacea.* (Groombridge *et al.,* 1988; Khan *et al.,* 2010).

The coastline of Pakistan is distributed between Sindh & Balochistan provinces. Both coasts have numerous rocky cum s&y beaches, mud flats & creeks system. A wealth of information on faunal diversity from intertidal & mangrove swamps is available along Sindh coast (Habib & Mustaquim, 1988; Ahmed & Hameed, 1999; Mustaquim, 2000; Barkati & Rahman, 2005; Qureshi & Saher, 2012; Rahman & Barkati, 2012; Imran *et al.,* 2014; Naz *et al.,* 2015; Ullah *et al.,* 2015), & Balochistan (Ahmed *et al.,* 1982; Gondal *et al.,* 2012; Afsar *et al.,* 2016; Ghani *et al.,* 2017) coasts, however, no significant studies were conducted regarding diversity of invertebrate communities from intertidal rocky habitat at Taq Bay. The present study aimed to record the distribution & diversity patterns of invertebrate communities at three tidal levels with prevailing physical conditions.

MATERIALS & METHODS

Study Site

The site was located approximately 15 km towards west from main city of Ormara (Balochistan) at $25^0$15′ 980″ N, 64^0 29′ 905″ E. Habitat at the site was rocky with numerous pools & occasional boulders (Fig. 1).

Author's Contribution: A.R.K, Collected data, noted environmental parameters, identified marine organisms, reviewed literature, statically analyzed & wrote up technical research paper ; **P.J.S.,** Helped & supervised in collection of data, provided Lab facility, helped in literature review & checked plagiarism
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Sample Collection

Surveys were made on monthly basis from January 2010 to December 2010. The samples were collected from 3 tidal levels (low, mid & high). General observations were also noted round the year. Samples were collected by h&s, using chisel & hammer. Samples were stored in pre labeled polythene bags & plastic bottles. Relative abundance of species was determined using quadrat (1 m^2) method. Nine quadrats were deployed, 3 each in low, mid & high tidal zone with a distance of 10 m on both horizontal & vertical directions (Fig. 2). Overall, 108 quadrats were deployed throughout the year. Species within each quadrat were counted throughout the research period. Literature quoted for identification comprises Dance (1974) & Bosch *et al.,* (1995) for molluscs, Mustaqeem & Rabbani (1976) for crabs, Mustaquim (1997, 2000) for polychaetes, Southward (1976) & Jones (1986) for barnacles, Gosliner *et al.* (2008) for nudibranchs & Clark & Downey (1992) for Starfishes. Samples were preserved in 70 % alcohol. Crabs, polychaetes worms & nudibranchs were narcotized using solution made up of marine water & $MgCl_2$ for a period of 2 to 8 hours. Samples were stored at Center of Excellence in Marine Biology, University of Karachi for future reference.

Physico-chemical Parameters Measurement

Environmental health was checked by determining physical parameters such as temperature (water & air), salinity & pH were also recorded during each sampling. Temperature was recorded using thermometer (HI98501), salinity was determined using refractometer (Atago, Japan) & pH meter (Hanna HI98107) was used to record pH.

Statistical Data Calculation

Diversity indices, for example Shannon, Simpson, Pielou's evenness & equitability were determined by using PAST software.

RESULTS & DISCUSSIONS

In the present study, overall 49 species were recorded. Among them, 2 were Annelids, 35 Molluscs, 9 Arthropods & 3 Echinoderm. List of the species with relative total number in each tidal level is given in Table (1). Molluscs were recorded as the most abundant group followed by Arthropods, Echinoderms & Annelids. Bivalves & Gastropods were mostly found in mid & high tidal zones. High water & air temperatures were recorded during April & lowest during December. High salinities were recorded during September while minimum during December. High pH (8.0±0.1) value was recorded while minimum Physical parameters (7.0±0.1) are displayed in Fig. 3. High value of Shannon index was noted while minimum as in Pielou's evenness (Fig. 4).

Fig. 1: Map of Pakistan coast showing study site

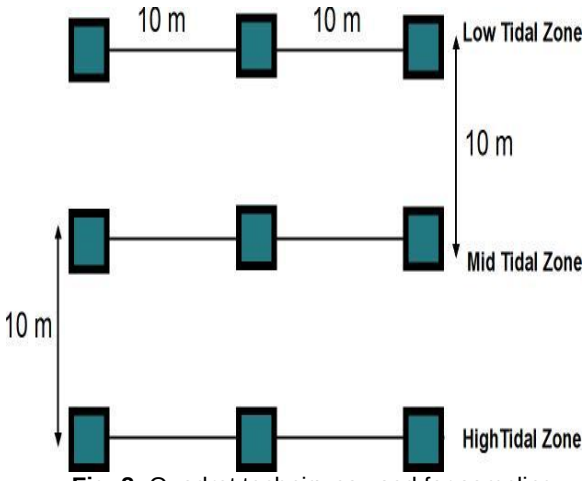

Fig. 2: Quadrat techniques used for sampling

Existing of different communities (molluscs, arthropods, echinoderms etc.) at different tidal levels (low, mid & high) might be due to different tidal conditions. High diversity at mid & high tides might be due to frequently coverage of these areas by tides. The other possible reasons for variations in diversity at different tidal levels might be due to variations in physical conditions as fauna in intertidal areas is strongly affected by environmental conditions (Reise, 1985; Rios, 1985; Wilson, 1991). A physical regime forced by the tides, decline the species in various tidal marks (Mc Intyre & Elefitherious, 1968; Johnson, 1970).

The change in spatial distribution of Molluscs might be due to their feeding habitats. The preferential distribution of gastropods at mid tidal zone was mainly due to their feeding habitat i.e. carnivores, predators or herbivores &
the availability of high food. Restriction of herbivores (feed on algae) & carnivores species in lower zone was mainly due the presence of detritus & algae in this zone (Rhoads & Young, 1970). On the other h&, the presence of bivalves on a larger area was due to being filter feeders whereas the presence of sluggish bivalves in lower belt was due to their food dependency on small molluscs such as recruits (Peterson, 1991). Moreover, the role of physical factors & topography of the area were also responsible for variations in community structure during different months of study period as the community structure in intertidal areas is effected by temperature & topography (Bustamante *et al.,* 1997).

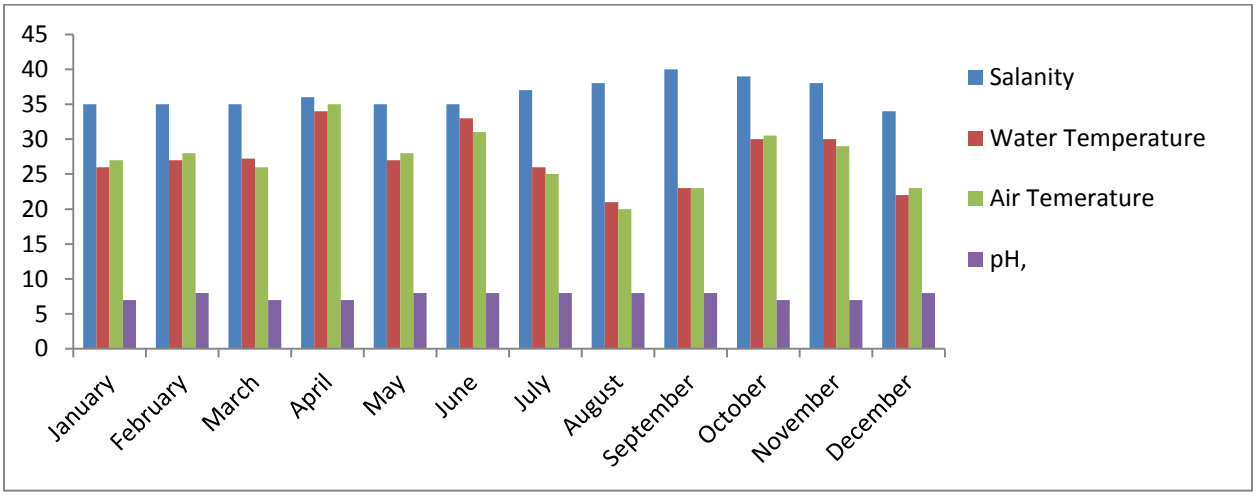

Fig. 3: Physico-chemical parameters recorded during the sampling period

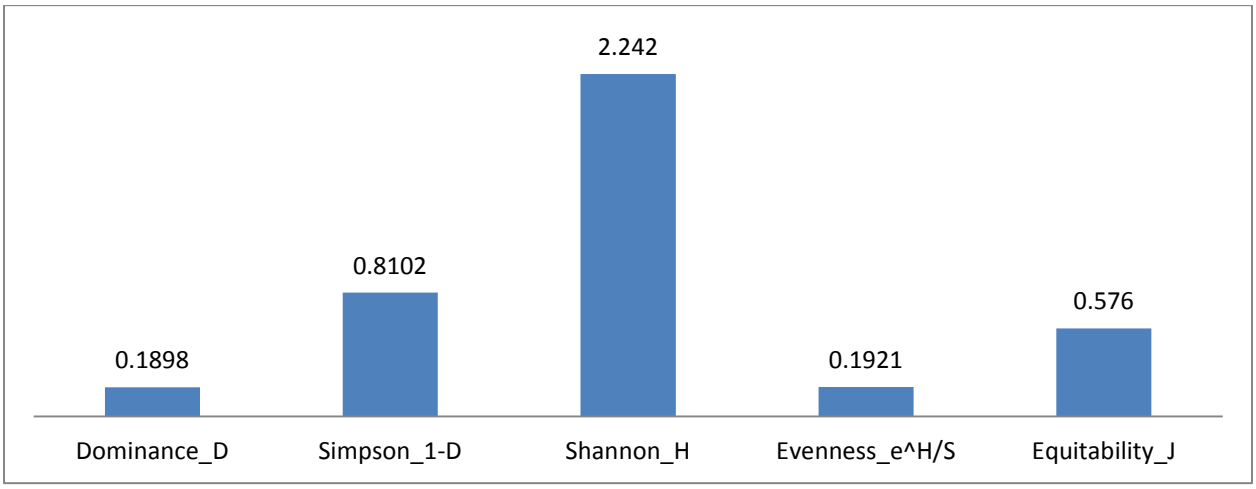

Fig. 4: Different diversity indices used for species diversity

CONCLUSION

Though 49 species were recorded in this studies, however further surveys in the area will explore more species. Also a detailed physico-chemical studies is also recommended for future research.

Table 1: List of species recorded & their total number at different tidal levels

Phylum	Class	Texa	Low tide	Mid tide	High tide
Annelida	Polychaeta	*Neries* sp.	+	+	_
		Sabella sp.	_	+	_
		Total	**1**	**2**	_
Mollusca	Polyplacophora	*Acanthochiton* sp.	+	+	+
		Total	**1**	**1**	**1**
	Gastropoda	*Aplysia* sp.	_	+	+
		Clanculas sp.	+	+	+
		Cellana toreuma	+	+	+
		Cellana radiata	_	+	+
		Cellana sp.1	_	+	+
		Cellana sp.2	+	+	+
		Cellana sp.3	_	+	+
		Cellana sp.4	_	_	+
		Clypeomorus sp.1	_	_	+
		Clypeomorus sp.2	_	_	+
		Morula sp.	+	+	+
		Monodanta canalifera	_	+	_
		Natica tigrina	_	+	+
		Nerita albecella	_	+	+
		Nerita textilis	_	+	+
		Nerita sp.	_	_	+
		Nodilittorina sp.	_	+	+
		Planaxis sp.	_	+	+
		Patella granularis	_	+	_
		Patella sp.	_	-	+
		Siphonaria sp.1	_	+	_
		Siphonaria sp.2	_	+	_
		Siphonaria sp.3	_	+	_
		Siphonaria sp.4	_	+	_
		Thais hippocastanum	+	+	+
		Thais tissoti	+	+	+
		Thais carinifera	-	+	_
		Thais sp.1	+	+	_

		Thais sp.2	-	+	+
		Turbo sp.	+	+	+
		Total	**8**	**25**	**22**
	Bivalvia	*Lithophaga* sp.	+	+	_
		Barbatia obliquata	+	+	_
		Perna viridus	+	+	+
		Perna sp.	+	+	+
		Total	**4**	**4**	**2**
Arthropoda	Cirripedia	*Chthamalus* sp.	+	+	+
		Balanus sp.	+	+	+
		Total	**2**	**2**	**2**
	Malacostraca	*Charybids* sp.	+	+	-
		Eriphira sp.	+	-	+
		Grapsis sp.	+	+	_
		Petrolisthes boscii	+	+	+
		Petrolisthes sp.	+	+	+
		Portunas sp.	+	_	+
		Paranthura sp.	+	-	-
		Total	**7**	**4**	**4**
Echinodermata	Stelleroidea	*Asterina* sp.	+	+	_
		Ophineries sp.	+	+	_
		Echinometra sp.	+	_	_
		Total	**3**	**2**	_
Grand Total			**26**	**40**	**31**

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