2 REVIEW OF LITERATURE

Currently the biological diversity is expected at 1.75 million species globally, without microbial species (Heywood and Watson, 1996) but as per researcher Reaka-Kudla (1997) assessment says species is available in the range from 5 to 120 million. Around 300000 species in marine environment are identified (Reaka-Kudla, 1997; Gray, 1997) and the number of defined species on Earth is undecided, estimates range from 1.2-1.8 million, (Mora et al., 2011; Hammond, 1992) and 1.3 million has been classified (Bisby et al., 2012). Total number of species take place in the coastal zone is approximately 80 % of all marine species (Ray, et al., 1999: Arjunan, et al., 2010) and this amount is appropriately conservative (Reaka-Kudla, 1997).

All Ecologists from the earth are attracted by the work on the ecology of the intertidal zones of coastal area and well acknowledged that inter actions and inter relationships among the living organisms and their habitat related research works are a very dynamic discipline of science. (Reid, 1967)

The coastal zone is constant and repeated movement by the major surface currents, upwelling and seasonal turnover in the upper waters, waves and tidal action. High waves and tides can dislocate the organisms in marine environment, which are not attached confidently to the substratum and throw them away. Coral reefs are formed and changed by the wave action. The shoreline between open sea and land is subject to the physical violence of waves and tides fluctuations, and also for instabilities in light intensity, temperature and moisture. Along rocky shores, find more sessile organisms (algae, barnacles, etc.) with compare to in any other type of ecosystem (Sebens, 1991). Organisms on sandy shores are adjusted by burrowing in or adhering

to sand (e.g. ghost crabs, polychaetes). Coral reefs formed by colonial coelenterates around islands and it may be also regarded as littoral ecosystems. Coral reefs are highly fruitful part of all marine ecosystems due to their habitually higher temperatures, penetration of light and rich nutrient levels (Dubinsky, 1990). Salt marshes, which are also attractive ecosystems as wetlands as they are known heavens of biological diversity (Burkett and Kusler, 2000)

Intertidal zone is the most important and interesting zone from all of the other zones of marine environment. Changing environment, extreme physiological pressure at the time of low tide, flora and fauna which live in this zone are needed to deal with this changes. Especially those flora and fauna, which living in the upper intertidal zone are habitually more accepting the stress of warm air and dryness with compare to those which are available in other zones of intertidal zone (Sokolova and Berger, 2000). This area is an amazing indication for food chains, interactive life cycles and many other countless and extraordinary adaptations to this challenging habitat and also considered as a most useful with maximum variety of life of any ecological zone of the earth. In all over the intertidal zone, vertical banding of the organisms occurs, which is known as a Zonation. The zonation of organisms is a mirror image of their reaction to biological and physical feature (Mettam, 1994). Ecological factors like waves and temperature stress are the main reason to the creation of this zonation. This phenomenon is not exclusively the outcome of adaptation of physical conditions. Scattering of intertidal flora and fauna is generally arranged into strata along with the littoral zone (Underwood, 1979). The population of invertebrate on Intertidal zone clearly show vertical zonation patterns, which is one other apparent of zonation on rocky intertidal zone (Raffaelli and Hawkins, 1996).

The most active environment of marine environment is Intertidal zone. Tropical rocky intertidal zones are the topic of talk and interest for all marine researchers and studied intensively since a few decades (Little and Kitching, 1996). This area provides a good roof to diverse fauna and flora from invertebrates to vertebrates. There is an extreme difference available in the ecology of benthos and for that reason a constant monitoring is necessary to judge the variations disturbing the local community.

Habitats of intertidal zones are mostly studied due to very diverse habitats of a shore and also for the fall and rise of tides. So, investigators can move within 10 to 100 meters and do their research from one habitation to another. Intertidal area is crisscrossed with countless biological diversity, floristic composition and complex community categories between habitat of land and marine, and also one of the areas, which is easily disturbed by some human activity (Sheng and Shi, 2008).

Macro benthos (body size < 1 mm) are an important part of the intertidal zone among the marine biological entities, and it plays an very significant role in the aquatic habitat in view of its involvement in mineralization, mixing of sediments, flux of oxygen into sediments, and cycling of organic matter (Snelgrove, 1998).

Abundance of benthic flora and fauna would be more valuable for the demersal fishery resources assessment as benthos is a very significant source of food for demersal fishes (Prabhu and Reddy, 1987). Also for understanding of changes in biological diversity, benthos is useful (Gray et al., 1992).

The use of benthos in marine ecological research and mostly in assessing marine pollution is effective to evaluate long term dissimilarity. The benthos reflects the effect of pollutants or organic enrichment by responding through visible changes in

population dynamics and time scale from weeks to years. Mollusca are used (Linse et al, 2006) for investigation of marine biodiversity because they are the bio-indicators (Daka et al.,2006) for environment, population dynamics and also the second most diverse group. In this group most eye catching members of the macro benthic fauna (Brown and Mclachlan, 1990) of intertidal area are gastropods and bivalves.

More than 65,000 Species of gastropod are recorded. Amongst them 30,000 species are from marine, 5000 species from fresh water and 30,000 species live on land. Overall, marine gastropods are most varied in total number of species and in variety of shell structures in tropical waters. (https://www.britannica.com/animal/gastropod). Appukuttan (1996) pointed out that total of 3271 species of mollusca with 220 families and 591 genera, including almost 1900 species of gastropods are recorded in India, which are found in the water with more calcium concentration (Tonapi, 1980)

These molluscs exhibit their role in marine food web as well as in marine population assembly. Additionally they are the major class of fauna that exist in the ecology of intertidal habitat with the ability to accumulate secretions (which may be some times toxic) used as bio-indicators for the condition of the intertidal zone (Daka et al., 2006).

Gastropod is the largest group in the Mollusca, which become successful in all three major habitats such as the ocean, fresh water and land. (https://www.britannica.com/animal/gastropod) Furthermore, they are variable morphologically in relation to their environments. On the same rocky shore, individuals of the same species may have different morphologies as a result of different microhabitats (Britton, 1995). They also help to control macro algae growth and also important part of the diet of many mollusca and some other carnivorous

organisms (Castell and Sweatman, 1997). Most gastropods are useful to humans as they help decompose dead flora and fauna into substances that can be used by plants to production of new organic compounds. In both field and forest; in ponds, rivers, and oceans, gastropods are a vital part of the decomposer community, and some are significant predators also (https://www.britannica.com/animal/gastropod/Importance-to-humans). Because of all above interesting causes gastropods are the well-studied fauna for ecologist in rocky intertidal habitats.

In India, detailed studies on the bottom fauna off Madras, Malabar and Travancore were the first to conduct by Seshappa (1953) and Kurian (1953). Since then, a number of studies have been conducted at both the east and west coasts (Ganapati and Lakshmana, 1959; Radhakrishna and Ganapati, 1969; Kurian, 1971; Damodaran, 1973; Ansari et al., 1977; Harkantra et al., 1980; Harkantra et al., 1982; Parulekar et al., 1982; Raut et al., 2005).

In addition benthos of the Indian seas was also studied by Parulekar *et al.* (1982) However, Varshney *et al.* (1988) was also also studied the macro-flora and fauna of very-near-shore depths (5–20 m) off Versova, west coast of India and Kundu *et al.* (2009) was worked at Bay of Bengal. Wide seasonal and regional dissimilarities are the one of the most significant features of benthic fauna along the coast of India (Achuthankutty *et al.*, 1978; Divakaran *et al.*, 1981; Murugan *et al.*, 1980)

Intertidal zone of Gujarat state is still silent and less explored, but some investigations were made for diversity and distribution by ecologist and research scholars' viz., Apte recorded 188 molluscan species at Gujarat coast line. Different areas of Saurashtra coast of Gujarat was investigated by number of researchers. (Pandya, 2015; Gohel,

2016; Desai,1987; Joshi, 2010; Prasad, 1984; Malli,1983; Patel,1984; Misra, 2004; Bhadja,2010; Vaghela, 2010).

Bhadja (2010) and Vaghela (2010) recorded total seven diverse phyla of macrofaunal such as annelida, arthropoda, coelenterata, echinodermata, mollusca, platyhelminthes and porifera at Saurashtra coast line. As per Bhadja (2010) arthropoda, coelenterate and mollusca were the most prominent groups. Vaghela(2010) recorded total 120 intertidal macrofaunal species during the course of study, which include 65 species of mollusca, 17 species of Coelenterate, 15 species of Arthropoda, 8 species of Annelida 6 species of Porifera, 6 species of Echinodermata and 3 species of Platyhelminthes.

Earlier Chorwad coast was explored by Vadher et al (2014) and recorded 69 molluscan species. Diversity and distribution of Anthozoan class was also documented from selected sites of Saurashtra coast by Pandya et al (2013, 2014) and Dave et al (2016)

Plentiful research have been done on the ecological studies and benthic diversity studies in Veraval, Sutrapada, Mangrol of Saurashtra region (Prasad,1984; Malli,1983; Desai,1987; Patel, 1984; Misra, 2004; Bhadja, 2010; Vaghela, 2010; Joshi, 2010; Gohel, 2016; Pandya, 2015) as compared to meagrely studied areas of Navapara, Aadri, Vadodra dodiya, Chorwad etc. of south Saurashtra coastline. These areas were scrutinized and reporting systematically to get a clear picture of habitat characteristics and create a database of macro benthos assemblage and to estimate various attributes of its Key species, which will be helpful for future references.

We can view Coastal zones as the border amongst three different habitat media viz. sea, air and earth. Coastlines have been continuously the theme of curiosity and study

with natural historians (Raffaelli and Hawkins, 1996), first identifying areas controlled by certain species as early as 1832. This zone includes the land where terrestrial actions are reflected on the marine environment and life developments influenced by the marine and the water areas where marine activities and life forms are significantly influenced by the resources of and activities on terrestrial (Schaefer, Milner, 1969)

Numerous literature available on the diversity including the worldwide diversity assessment (Huston, 1994) however there is meagre summarizing separation of marine biological diversity available in relation to protection requirements, only specific assessments are there as coastal zone biodiversity (Ray, 1991).

The strata of environmental situations spreads over the intertidal zone, mostly due to the diverse periods of submergence of intertidal zone at every tidal level hence we can see unpredictable variations in temperature and salinity of sea shore(Newell, 1970). The habitats at intertidal zone are very different but compacted into a small part, where upper and lower limits of distribution are typically determined by physical conditions and biological communication respectively (Branch, 1976). In biological populations, spatial and temporal variability in the abundance of species are due to the interaction between biotic and abiotic factors (Danielson, 1991). Understanding of the role of these processes is easy by documented identification of spatial and temporal scales of dissimilarity (Underwood and Chapman, 1996). Assessing this variation at different scales is a necessity to the suggestion and test of clarifying models of experimental distributional patterns (Underwood, 2000). From intertidal substrates the spatial forms in the arrangement of groupings on stiff substrates have been widely reported (Benedetti-Cecchi L, 2001). For sub tidal, literature is still not so ample,

normally limited to sessile (Boero and Fresi, 1986). Relatively limited efforts have been carried out worldwide to study marine populations; so that, it is challenging for researcher to measure the habitat loss impact and other humanoid stresses on marine resources (Culotta, 1994). As marine macro benthos is a part of definite ecosystems, evaluating the condition of coastal environment is a valuable indicator of pressures to species-level diversity.