Biodiversity, the genetic library maintained by natural ecosystems, is the basic biotic resource that sustains all human life-support systems (Kim and Byrne, 2006; Costanza *et al*, 2007; Hooper *et al*, 2005; Diaz *et al*, 2006; Hiddink *et al*, 2008). It is necessary to protect biodiversity in all ecosystems and is essential (whether for agriculture, fishery, forestry systems or evolutionary processes) for stabilization of ecosystems, protection of overall environmental quality for understanding intrinsic worth of all species on the earth (Ehrlich, 1991). Among different ecosystems, freshwater ecosystems are the richest and more diverse ecosystems on earth (Revenga and Mock, 2000). Yet 6% of all species, and more than 10% of all animal species, occur in freshwater, including 25% of all vertebrates and 40% of all fish (Balian *et al*., 2008). Moreover, freshwater ecosystems contain 41% of the world's known fish species (Daily, 1997).

India is one of the 17 mega biodiversity hot spots contributing with 60-70 % of the world’s total biological resources. It has third rank in the world in total fish production with the contribution of 11.72% of total global fish biodiversity. And fishes are the fifth largest agricultural resource and are the primary source of protein to over one billion people.

However despite the enormous taxonomic, biological and fishery literature, many species and genera of clupeoids (Cushing, 1975; Whitehead, 1985) are still unknown in subtropics and tropics. The species diversity of clupeoids constitutes the largest component of estuarine and coastal waters and subsistence fishery (Longhurst and Pauly, 1987; Blaber, 1997).

The Clupeidae is the most valuable family of food fishes in the world. It is the principal family of the order Clupeiformes, the group of fish with a form most like the original form of the bony fishes (Teleostei), from which all other bony fishes have evolved. Other families of the order include the Megalopidae (tarpons), Albulidae (bonefishes), and Engraulidae (anchovies). The catch of herrings in 1978 was about 11 million tons, or 15% of the world total. A majority of it was used directly for human food; thus, the herrings comprise one of the most valuable families of fishes (Royce, 1996).

The Clupeidae are characteristically small (<50 cm), schooling fish with silvery bellies and sides and greenish gray backs. They have no spines in the fins, one short dorsal fin, deeply forked tails, ventral fins on their abdomens far behind the pectorals, deep bodies, and large scales that slip off at a touch. Their flesh is oily, a feature that adds greatly to their flavor and furnishes a valuable oil for industry. They have intramuscular bones in abundance. The family is considered now to have about 160 species in about 50 genera, most of which are marine and tropical and of little importance. Some live in fresh water; others are anadromous—living in the sea and ascending rivers to spawn. The genera that are of most importance as food are widely distributed around the world and may be extremely abundant in many places (Fischer and Bianchi, 1984; Berry, 1964; Nelson, 1967).

Clupea, the sea herring is the major herring of the temperate and subarctic waters of the Northern Hemisphere. It is found in the Atlantic from Cape Hatteras north to Greenland, east to Spitsbergen, and south to the Bay of Biscay. In the Pacific it is found from Korea to the Arctic Ocean and south to California. The genus is

divided into a number of species and subspecies that are not easily distinguishable, but more importantly it comprises dozens of

different races, each with distinctive life habits. Some migrate thousands of kilometers annually; others remain in the same bay. Most races spawn in spring; others spawn in summer or fall. Some grow rapidly and rarely exceed 5 years of age; others may live to be 25 years old. Some races may spawn in the intertidal zone; others spawn in 200 m of water. The eggs are adhesive and are laid on the bottom (Blaxter and Holliday, 1963). In some small races the females each produce fewer than 10,000 eggs at every spawning; in others they produce more than 100,000. The sea herrings eat zooplankton with an extraordinary efficiency. They are found where the zooplankton is abundant, whether the plankton is composed predominantly of copepods, euphausids, crab larvae, molluscan larvae, worm larvae, or fish larvae. The estuarine areas of the rivers and the brackish water lakes are characterized by strong tidal action, high turbidity and heavy silting. The salinity fluctuates considerably and in areas far inland the water may become entirely fresh during monsoon months There is a fairly rich growth of plankton except during the rainy season. A greater abundance of zooplankton than phytoplankton (mainly copepods) is usually noticed (Bapat and Bal, 1950). The water level in the freshwater areas of never falls very appreciably during the dry months, very often exposing large areas of the river bed and converting long stretches into a chain of pools which the fish fauna takes refuge. During the rainy season the rivers swell, often suddenly and result in heavy floods The turbidity which is usually low, tends to be high during the rainy months and during this

period, plankton crop is also comparatively low. In none of the habitats of Hilsa does the water temperature decreases very much, even during the winter months.

One of the most nutritive rich and commercially important fishes found in the Indian waters is Hilsa, *Tenualosa ilisha* (Family: Clupeidae) previously known as *Hilsa ilisha*. It was classified for the first time by Russel (1803) in the coastal waters of Visakhapatnam and was given the name 'Palash'. He gave the first description and drawing of the fish (though his nomenclature was faulty), and remarked that the Hilsa is a '...rich and luscious fish with much of herring flavour'. It was then classified as *Clupanodon ilisha* by Hamilton in the year 1822. It is basically an anadromus fish which means a fish inhabiting the marine waters in its entire life span but for spawning and breeding purposes it moves to fresh waters. It is known to ascend rivers through its area of distribution. In the marine environment they are distributed from Iran and Iraq in the Persian Gulf to the west coast of India in the Arabian Sea and the Bay of Bengal. The observations made in the states of Tamil Nadu, Andhra Pradesh, Orissa, West Bengal and Gujarat has proved that Hilsa breeds in the upper stretches of estuaries or rivers where the water is fresh (Raj, 1917; Hora nad Nair, 1940; Chacko and Ganapati, 1949; Jones and Sujansinghani, 1951; Jones and Menon, 1951; Kulkarni, 1950; Motwani *et al*., 1957; Pillay, 1958; Jhingaran and Nararajan, 1966)

The interest in Hilsa aroused after the preliminary investigations by Francis Day (1873) for his book, Fishes of India and the recommendation by K. G. Gupta (1908). Later on, the Fisheries Departments of West Bengal, Bihar and Orissa

started up further investigations of the fish including artificial breeding of Hilsa. Further, Chaudhari (1916) observed the presence of Hilsa in the Chilka Lake, Orissa throughout the year. Jhingran et al. (1963) have given a brief account on age and growth of the fish.

The Indian shad is one important members of the Clupeidae family. The adult Hilsa is of silvery colour shot with gold and purple. The young ones are usually of a bronze colour along the back, with silvery sides and a burnished silvery band going from above the eye to the upper half of the caudal fin, and the caudal fin is often deeply edged with black in its entire circumference. With absence of teeth and presence of scales in regular rows all over the body and many even over the caudal fin.

The body of Hilsa is fusiform, fairly deep and compressed, its depth 31 to 37 times in standard length, belly with 30-33 scutes, head length 33 to 36 times in standard length. Head is remarkably large, top of head covered with thick skin Eyes at anterior half of the head and covered with broad adipose eyelids Mouth terminal, cleft large Lower jaw not prominent but upper jaw with a distinct median notch when seen from above, maxilla reaching to or a little beyond posterior border of eye front parietal edges narrow and without striae. Teeth are absent on the jaws. Gill rakers fine and numerous, about 100-250 on lower part of first arch psuedobranch rather attenuated, a groove present below border of psuedobranch. Scales cycloid, thin and smooth, arranged in regular rows and extended up to the basal part of the caudal fin Caudal fin moderate, 3 2 to 4 times in standard length, equal to length of head, and deeply forked Caudal peduncle as

long as deep Dorsal fin with soft rays originated in the anterior half of the body without caudal and located slightly anterior to pelvic fin Pectoral reaches to above the origin of the pelvic Pectoral and pelvic fins with auxiliary scales. Anal fin short Hilsa is shvery shot with gold and purple

colored, a dark blotch behind gill openings, followed by a series of small spots along flanks in the immature, fins are hyaline (Talwar and Jhingran, 1991).

Hilsa is a heterosexual species in which female grows faster than male and the body of female is broader than the male with larger girth. Urinogenital opening of the gravid female is flat but narrow in the case of male where papillae are comparatively prominent (Quddus, 1982; Shafi *et al*, 1977; Hora, 1954, Moses, 1942; Ahmed *et al*, 2008). It approaches maturity during the monsoon when the inland rivers are flooded. Southwell and Prashad (1918) expressed the opinion that there are no fixed breeding grounds for the fish in the generally accepted sense of the term and that they probably breed during the rainy season, when conditions such as weather, temperature and other undetermined factors are suitable.

Hilsa is considered to be a major food source in India, Bangladesh, Pakistan and the countries around Persian Gulf occurring in rivers and estuaries s an essential part of fisheries. This fish enter estuaries and rivers for spawning in different dates and duration in different regions. Raj (1937) stated that the fish spends the first year of its life in the lower reaches of the rivers and goes to the sea in the third year. It was observed that after leaving the rivers they do not go far into the sea, but move about in shoals in the estuaries and foreshores.

All the riverine and estuarine loads of Hilsa seem to breed in the upper ranges, where eggs, hatchlings and adolescents are found during the bringing forth seasons. During the southwest storm which structures the fundamental rearing season, all the beginning times can be found in the producing grounds. In the succeeding a long time till the finish of November adolescents and youthful ones are found in the lower comes to and estuarine regions Young fishes of around 15 cm to 22 cm happen along the foreshore regions throughout the winter months (Ahmed, 2002; Panhwar et al., 2013). During winter, from January to March every beginning period of hilsa are found. The typical living space of the estuarine loads of Hilsa is the lower districts of the estuary and the foreshore zones. During reproducing season they climb the streams and in the wake of generating, come back to the first environment where they stay till the following rearing season (Bala et al., 2014). The riverine stocks, similar to those of Ganga and Brahmaputra, seem to stay in the freshwater regions consistently, yet there is a more prominent fixation in the lower comes to during the period between the rearing seasons. During reproducing season the developing fish relocate upstream and in the wake of generating come back to the lower comes to (Salini, 2004; Pillay and Rosa, 1963)

The migration of Hilsa (shad) is of two types:

1. Monsoon migration: The anadromous character of Hilsa is one of the main factors behind such migratory pattern. During consequent flooding of the rivers, the Hilsa swims against the tide and goes to the river for spawning and breeding.

2. Winter migration: Not only in monsoon, the Hilsa migration is limited to winter season too for a short period of time. The period is from February to March.

The Hilsa, being anadromous in nature follows a life cycle that follows the pattern of breeding upstream and the larvae hatching from the free floating eggs. The immature young stages grow in river channels and descend to the sea for the period up to growth to a mature male/female stage before returning to the rivers for breeding to complete the cycle.

According to Chopra (1933) as quoted by (Hora, 1954), the medicinal qualities of Hilsa are: flesh demulcent (soothing), stomachic (promoting functional activity of the stomach), phlegmatic (characterized by excess of phlegm), and carminative (relieving flatulence).

In Gujarat, the Narmada River is one of the rivers where Hilsa ascends about 80 miles from the sea. Besides that, rivers like Mahi, Tapi, Purna, Ambika and Par are also believed to have niches for the Hilsa though no major fishing practices are done. In Narmada, observations were made along the course of the river showed that there is hardly any large scale Hilsa fishing beyond the village of Zanor (40 miles from the sea) as shoals do not seem to ascend beyond this area (Bhaumik, 2013; Naskar, 2015). But it seems to ascend to the village of Garudeshwar. Beyond this village, the river bed is rocky and steep and consequently the current is much stronger. The high velocity of the river current may be the main factor for restricting the migration of the Hilsa beyond this area (Bhaumik *et al.,* 2017). Moses (1942) have recorded that in the river Narmada

(formerly called as Narbada), Hilsa are found in its lower reaches during the monsoon months with no detailed reports on spawning.

Primary investigations were done in the same river but at villages of Nikora and Zanor, 40 miles upstream from the sea along the course of the river and about 12 to 15 miles from the town of Bharuch (formerly known as Broach). This area is slightly under tidal effect though the water at this part of the area remains fresh or salt free (Kulkarni, 1950; Naskar, 2015). There is a slight increase in water height during monsoons or high spring tide which affects the in migration of Hilsa.

Formerly it was known that Hilsa also ascends about 20 miles into the Purna River on the Gujarat coast. But suitable information on any such catch is unknown as of now. Thus it's very important to note that in rivers like Ganges and Indus this fish travels very much inside the fresh waters but on the western coast of India it is having very much limited migration in the rivers.

From preliminary survey, it has been known that in the waters of Narmada, two species of Hilsa are found: *Tenualosa ilisha* and *Hilsa keele*. *Hilsa keele,* fairly deep and compressed, belly with distinct keel of scutes compared to *Tenualos ailisha* having no scutes. Besides that, there also may be the presence of *Hilsa toli* which is also one of the main species of the Hilsa – shad.

At present, Hilsa has been recording a rapid decrease in its population in the past 10 years. The migratory pattern followed by the fish has changed to some extent. It used the travel to a very extensive part in the fresh waters but currently it is

found up to the estuarine waters of Bhadbhut, a place near Bharuch though no such work or proof have been conducted in this part of the country for Hilsa.