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INTRODUCTION:

Biodiversity refers to a variety and abundance of life in given area. Among the types of diversity, species diversity is the most common usage of diversity, which pertains to the number of species found in given areas (Gray 1997). The species diversity comprises many levels of variation, which are ranged from genus to ecosystems level. The oceans cover more than 71 percent of the earth, which provides up to more than 99 percent of the space available for life in the ecosystem. Marine ecosystems are extraordinarily diverse in all aspects; it varied from genetic to taxonomic to ecological level (Ray & Grassle 1991). According to Dulvy *et al.* (2003) within the fish population there is a high genetic diversity was present and that may be helpful them to protect them against various environmental stresses and the spread of diseases. There are 31,362 distinct fish species reported globally (William *et al.* 2010). According to the IUCN (2008) there were about 1,275 species of fishes reported as threatened fishes on earth i.e. Red list species. In India total 2,358 number of finfishes were recorded and among them 877 species are fresh water, while 113 species are brackish water and 2,358 are marine species (Ayyappan *et al.* 2011).

The taxonomy of the fish fauna of India has been described by Day (1878), Jordhan (1895), Axelord and Schultz (1905), Jinghran (1975) and Whiteland and Talwar (1976). It is estimated that the fish fauna of India comprises 2546 species belonging to 969 genera and 254 families (ZSI, 1991). Some isolated studies were carried out by few workers in post independence era in Gujarat. Ranade in 1952 published a checklist of freshwater fishes of Baroda district. In 1973, Ramachandran published a list of marine and freshwater fishes of Gujarat. Later on identification and description of marine and freshwater fishes have been carried out by the Gujarat Fisheries Aquatic Science Research Institute. In 1979 Patel and Chhaya published a field key to the identification of fishes in Gujarat.

Fish were the earliest vertebrates and presumably evolved from a group of aquatic lower chordates, the terrestrial vertebrates evolved from fishes. Fish are the largest group of vertebrates, which exhibit a remarkable diversity of morphological attributes and biological adaptations. Species identification is challenging for taxonomists when facing new biota. There are over 20,000 living species of fishes (Allendorf, 1988). Most are confined either to marine water or to freshwater. Many fishes stay in tightly organized groups, called schools; others are solitary and congregate only for feeding and spawning. Fish may be carnivorous, herbivorous, or omnivorous. Some fish are scavengers on lake or ocean bottoms. Fish are a major source of human diet (Sarwade & Khillare, 2010) as well as of oil, fertilizer, and feed for domestic animals.

DNA barcoding, advocated by Hebert *et. al.,* (2003), seeks to facilitate identifying the increasing number of unfamiliar taxa in biological conservation and biodiversity surveys, based on sequence diversity within a short and standardized gene region. So far, scientists from over 30 different countries have participated in this large international plan, which will cost about 1.5 billion for build up species tags for each eukaryote. However, DNA barcoding has proven powerful in some cases where the morphological taxonomy is little to the purpose of species identification. Herein, 229 sequences from 158 marine fishes of Japan were employed to test the efficacy of species identification by DNA barcoding. High efficiency in species identification by DNA barcoding was demonstrated in this study.

The overall development of marine fisheries in India depends on the rational exploitation of the potential yield in the Indian Exclusive Economic Zone (2.02 million sq. km) (Vyshnavi, P.V. & P Venkata Rao, Prof. 2016).Besides increasing fish production to the maximum, the fisheries development should aim at raising nutritional level of the people and improving the socio-

economic condition of the fishermen. The marine fishermen in India, in general, are socially and economically backward. Hence, any innovation in marine fisheries including new technologies besides increasing the yield from capture and culture sector, should be economically and technically efficient and socially acceptable. Any sort of technological innovation, financial scheme or management practice needs to be analyzed to assess its socio-economic, environmental and ecological impact. The study of socio-economic parameters such as family size, age structure, employment potentials, education and living standards of fishermen will help to identify the constraints obstructing the realization of full potential of development schemes and adoption of new technologies.

The importance of fisheries in a country cannot only be measured by the contribution to the GDP, but one must also take into consideration that fisheries resources and products are fundamental components of human feeding and employment. Another aspect that makes fisheries resources important is the self renewable. Unlike mineral resources, if the fishery resources or any other biological resources are well managed; their duration is practically unlimited. An important conclusion is that the fundamental basis for the conservation and management of fisheries resources stems from the biological characteristics.

Marine contribution of Saurashtra is the major portion in Gujarat state, with coastline contribution 33% of Gujarat area; it has around 50% of coastline and accounts more than 90% of the fish production in Gujarat State (Barad, 2012). During the year 2012-13, total fish production in the Gujarat State has been estimated at 7.88 lakh tones worth Rs.5130.68 crore. The marine fish production constitutes about 87.96 percent of total fish production of the State. There were 36770 fishing boats registered in the State, out of which 24612 were mechanized boats and

12158 were non-mechanized boats. During the year 2012-13, export of 242057 tonnes of fish and fish products of the State.

Sutrapada is one of the fishing villages, a municipality in Gir-Somnath district in the state of Gujarat. Sutrapada is located 92 km distance from its district main city Junagadh and 14 km from Somnath. This place is known for GHCL plant, largest "Soda ash" producing company in the world. However, fishing is one of the major occupations for local people; about 350 families are engaged in fishing as well as fishery activities. The fishing is the occupation of “Koli Kharawa” a backward Hindu community. All the fishermen have settled near landing centre and the village is known as Sutrapada Bunder which is about 1 km away from main Sutrapada village. About 272 families are engaged in fishing and fishery allied activities. Fishermen population totaled 2,094 comprising 580 adult males, 579 adult females and 935 children. Members per family averaged 7.7. Percentages of families with less than 5, 5-9 and 10 or more members were 21.7, 57 and 21.3 respectively. About 47% was working population. Among the working population, 51.5% was active fishermen, 45.1% engaged in fishery allied activities and 3.4% in non-fishery activities. Of active fishermen, 87.8% was found operating OBM boats and 12.2% non-mechanized boats. Occupation analysis showed that 90.5% of the respondents had fishery as the only occupation, 5.4% fishery main and non-fishery as subsidiary occupation and 4.1% non-fishery main and fishery as subsidiary occupation They have very limited information and infrastructure (Sehara et. al., 1986).

REVIEW OF LITERATURE

Ichthyofaunal diversity refers to variety of fish species. India is one of the 17 mega biodiversity countries of the world, with only 2.5% of the land area. The variety of fishes includes the variation among the genotype and so species diversity within species population (Johnson et al.,

2016). Of the 33,059 total fish species from the world, India contributes of about 2492 marine fishes owing to 7.4% of the total marine fish resources. Of the total fish diversity known from India, the marine fishes constitute 76 percent, comprising of 2492 species belonging to 941 orders 240 families. The marine fishes were varies in their size from smallest Goby fish (up to 8 mm) to that of *Rhincodon typus*, Whale Shark (may be reach up to 12 m) (Joshi, *et al*., 2018). Among the fish diversity-rich areas in the marine waters of India, the Andaman and Nicobar archipelago shows the highest number of species, 1431, followed by the east coast of India with 1121 species and the west coast with 1071. As many as 91 species of endemic marine fishes are known to occur in the coastal waters of India. As of today, about 50 marine fishes known from India fall into the Threatened category as per the IUCN Red List, and about 45 species are Near-Threatened and already on the path to vulnerability (Joshi, K. K., Thobias, P. A., & Varsha, M. S. 2017).). The categories of fishes occurring in India includes groups such as damsel fish (52 species), Butterfly fishes (32 species), sweet lips (16 species), angel fishes (16 species), parrot fishes (14 species), snappers (42 species), wrasses (53 species), groupers (43 species), surgeon fish (18 species) .

DNA barcoding is a taxonomic method that uses a short genetic marker in an organism's DNA to identify it as belonging to a particular species. It differs from molecular phylogeny in that the main goal is not to determine patterns of relationship but to identify an unknown sample in terms of a preexisting classification. Although barcodes are sometimes used in an effort to identify unknown species or assess whether species should be combined or separated, the utility of DNA barcoding for these purposes is subject to debate. The most commonly used barcode region, for animals, at least, is a segment of approximately 600 base pairs of the mitochondrial gene cytochrome oxidase I (COI). Globally as of late-July 2008, a total of 29 112 specimens

representing 5334 fish species had been barcoded representing a mean of 5.46 individuals per species (FISH-BOL). A major national programme on DNA barcoding of fish and marine life was initiated in India by the authors during 2006 and 115 species of marine fish covering Carangids, Clupeids, Scombrids, Groupers, Sciaenids, Silverbellies, Mullids, Polynemids and Silurids representing 79 Genera and 37 Families from the Indian Ocean have been barcoded for the first time using cytochrome c oxidase I gene (COI) of the mtDNA. The species were represented by multiple specimens and a total of 397 sequences were generated.

Marine fisheries are very important to the economy and well-being of coastal communities, providing food security, job opportunities, income and livelihoods as well as traditional cultural identity. They produced 80 million tonnes of fish in 2009 and directly employed 34 million people in fishing operations in 2008 (FAO, 2010). Fish and fishery products are a vital and affordable source of high-quality protein, especially in the world's poorest nations – in 2008, fish supplied more than 3 billion people with at least 15 percent of their average animal protein intake (FAO, 2010). Therefore, maintaining the long-term prosperity and sustainability of marine fisheries is not only of political and social significance but also of economic and ecological importance. The United Nations Convention on the Law of the Sea (UNCLOS), the United Nations Fish Stocks Agreement (UNFSA [UN, 1995]) and the FAO Code of Conduct for Responsible Fisheries (FAO, 1995a) all require maintaining or restoring fish stocks at levels that are capable of producing their maximum sustainable yield (MSY).To fulfil the objectives of these international treaties, fishery management authorities need to undertake assessment of the state of fish stocks and develop effective policies and management strategies. As the United Nations (UN) Agency with a mandate for fisheries, FAO has an obligation to provide the international community with the best information on the state of marine fishery resources. West

Africa is one of the most diverse, and economically important, fishing zones in the world. Fisheries in the West African marine region, where total landings of fish have risen from 600,000 tons in 1960 to 4.5 million by 2000 have made it one of the most important sources of foreign exchange in the region. Fish is also a highly traded commodity and it is one of the leading export commodities for Africa, with an annual export value of nearly USD 3 billion. Exploitation of Africa's marine fishery resources has followed an increasing general trend observed in recent years.

During 1983, the economic condition of the fishermen in some selected villages of Maharashtra and Gujarat were evaluated. The illiteracy rate ranged from 48 to 75% and among the literates majority had primary education only. The size of the family was 7-8 and the earning members in different categories were 40-59%. The number of annual fishing days ranged from 200 to 244. The average annual net fishery income for mechanised group, non-mechanised group, gear owners, fishery and allied group was Rs. 10000, Rs. 4500, Rs. 3800 and Rs. 3500 respectively in Maharashtra and Rs. 12000, Rs. 5600, Rs. 4400 and Rs. 3500 respectively in Gujarat. Significant difference in annual Income was observed between categories and between villages. For different categories 53-91% of the total Income in Maharashtra and 57-91% in Gujarat were obtained from fishery. The proportion of total income spent on household items ranged from 60 to 94% in Maharashtra and 57 to 93% in Gujarat. In Maharashtra, 62-84% and in Gujrat 58-78% of the total number of families in different categories were indebted. The average outstanding loan per family was about Rs. 4000 in Maharashtra and Rs. 3000 in Gujarat. The regression analysis showed that one rupee increase in operational fishing expenditure was responsible for Rs. 0.15 and Rs. 0.13 increase in net fishery Income in Maharashtra and Gujarat respectively (Narayanakumar et. al, 2000).

The importance of fisheries in a country cannot only be measured by the contribution of the GDP, but one must also take into consideration that fisheries resources and products are the fundamental components of human feeding and employment (Cadima, 2003). As per the Central Marine Fisheries Research Institute report Gujarat is top fish producing state in the India, this highest landing rank was maintained by Gujarat since from last 4 years constantly (CMFRI, 2017). They reported that in the year of 2016 landings of Gujarat state was 0.77 mt, which contributed around 21.32% to the total fish landings of India. In Gujarat, the Gir-Somnath district contributes the maximum landings of marine fishes, i.e., 0.34 lakh tones approx. The number of estimated living fish species might be close to 28,000 in the world. Day has described 1418 species of fish under 342 genera from the British India. Talwar193 has described 2546 species of fish belonging to 969 genera, 254 families and 40 orders. The distribution of marine fishes is rather wide and some genera are common to the Indo-Pacific and the Atlantic regions. 57 percent of the Indian marine fish genera are common to the Indian Ocean and to the Atlantic and Mediterranean. The exact number of species associated with coral reefs of India is still to be found, however the number of fishes in Indian Ocean is 1367 species. The Lakshadweep Islands have a total of 603 species of fishes191. Over 1000 species are found in the Andaman and Nicobar Islands and about 538 in the Gulf of Mannar Biosphere Reserve. The categories of fishes occurring in coral reef ecosystem of India includes groups such as the damselfishes (52 species), butterfly fishes (32 species), sweet lips (16 species), angelfishes (16 species), parrot fishes (14 species), snappers (42 species) and most of the wrasses (53species), groupers (43 species) and surgeonfish (18species)194. Another 20% are composed of cryptic and nocturnal species that are confined primarily to caverns and reef crevices during daylight periods. (Venkataraman & Raghunathan, 2015).

In the marine fisheries sector of India, there are 194,490 numbers crafts. Out of these 72,559 numbers (37.3%) are mechanized,71,313 numbers (36.7%) are motorized and 50, 618 numbers (26.0%) are non-motorized. It is also observed that 167,957 numbers of crafts are owned by fisherfolk. 52.6% of them are non-motorized, 24.2% are motorized and 23.1% are mechanized. From the mechanized crafts owned by fishermen, 28.9% are trawlers, 42.8% gillnetters and 19.1% dol-netters (Kumar & Shivani, 2014).

OBJECTIVES:

1. Species and genetic diversity of fishes
2. Status of fisheries of Sutrapada
3. Socio-economic status of fisherman

METHODOLOGY:

Regular surveys of landing centers for fish diversity and occasional survey of fishing ground with fisherman during fishing has been done. Fish sample have been collected and identified through morphology and morphometry. The collected specimens have been cleaned properly. Informative photographic documentation has been done prior to preservation. Identification of the species has been carried out using morphological features and morphometry. The standard keys and monographs have been used for identification. Confirmations of species have been done through FAO and ZSI links. Proper preservation has been done to retain specimen in museum. For status evaluation of the existing fisheries of Sutrapada, assessment of fishing unit encompassing details of crafts, gears etc. catch composition and yield have been recorded and CPUE will be calculated. For fishing activity various fishing ground have been visited and sample fishing have been carried out. Relation between PFZs and non-PFZs will be established. The fishing and fishery seasons will be determined. Interviews with fisherman and fishery

officers of veraval and sutrapada have been made to collect the secondary information available to acquire recent primary data for socio-economic status of the fishermen community of Sutrapada. The DNA bar-coding secondary data for establishment of Phylogenetic studies have been collected form Junagadh Agricultural University, Veraval- Junagadh. DNA-barcoding of some highly commercial fishes of Sutrapada will be done after monsoon season.

RESULTS AND DISCUSSION:

The actual fishing days and time varied from time and seasons depending on climatic and weather condition of Sutrapada. The presentented data is from June2015 to June 2019, on observation it was found that the fisherman usually go for fishing either in morning and come within four hours and some are going for 2-3 days fishing. The data collected is from various fisherman on random basis. In Sutrapada the population of fisherman is 4368, total family – 703 and of active fisherman is about 873.There are 62 Kacha Makan, 482 Pakka Makan and 159 without any Ghar. In Sutrapada village about 251 OBM, gillnets, 03 Trawlers 03 Non mechanized boat are operating among which most are active in fishing. These OBM gillnetters were fitted with 2 cylinders, 8 horse power engine which operates on kerosene. The length of OBM gillnetters varied from 9.6 to 11.4 m and their breadth varied from 1.21 to 1.80 m. The tonnage of these gillnetters ranged from 1.58 to 4.16 t. These OBM gillnetters are owned by the local fisherman.

Table 1. Specification of gill net operated by OBM at Sutrapada Coast: (Barad,2012)

Types of net	Mesh size (mm)	Length of net (m)	Height of net (m)	Total No. of net	Species caught
Chokla	66-81	60	5	80-100	Chinese herring, croakers, mackerel, shark, Bombay duck, big eye ilisha etc.
Patira	43-53	55	4	80-90	Chinese herring, croakers, pomfret, ribbon fish etc.
Jada Jaal	177-190	70	7	70-85	Shark, jew fish, tunas, croakers, seerfish etc.
Pakha Jaal	195-203	75	8	70-80	Tunas, seerfish. crokers, jew fish etc.
Ghaghra	254-266	75	18	70-75	Bronze croaker, jew fish, Indian thread fin, tuna etc.
Maoul na jaal	152-165	70	6	100-120	Tunas, seerfish, mackerel etc.
Point na jaal	127-152	55	5	80-90	Pomfret, big eye ilisha, mackerel, Chinese herring, shark etc..

The vessels used are Fiber Reinforced Plastic (FRP). Multifilament and Monofilament nylon nets are operated by FRP cannones fitted with outboard machine for fishing purposes. Types of nets are Chokla, Jada Jaal, Ghaghra, Maoul na Jaal, Paitra, Pakha Jaal, Point na Jaal.On and average fishing days varies between 55-62 days in a year, that include Pre-monsoon (March-April), Post monsoon (September -November) and Winter (December -January).

The marine fishery recourses of sutrapada consisted exclusively of capture fishery. During this study period, 66 fish species belonging to 46 families were identified. The most dominant family

found was Carangidae (S=7), followed by Nempitheridae (s=3), Engraulidae (S=3), Sciaendae (S=3), Clupidae (S=3), followed by Acanthuridae (S=2), Aridae(S=2), Synodontidae (S=2) and Torpendinidide (S=2), and rest families constituted of single species. Out of 66 fishes 13 has been found new in Sutrapada - Gujarat having no records in other part of India.

Table 2. Annotated list of fishes with current distributional status

	Family	**Species**	**Record**	**IUCN**	**Sutrapada-Gujarat**	**Other part of India**
1	Chaetodontie	*Chaetodon collare*	F	LC	✓	✓
2	Haemulidae	*Pomadasys maculate*	F	LC	✓	✓
3	Kyphosidae	*Kyphosus vaigienis*	F	LC	✓	✓
4	Mullidae	*Upeneus moluccenis*	F	LC	✓	✓
5	Pomacanthidae	*Pomacanthus annularis*	F	LC	✓	✓
6	Priacanthadae	*Priacanthus hamrur*	F	LC	✓	
7	Serranidae	*Cephalopholis sonnerati*	F	LC	✓	✓
8	Carangidae	*Atropus atropus*	F	LC	✓	✓
9		*Dacapterus russelli*	F	LC	✓	✓
10	Serranidae	*Epinephelus dicanthus*	F	LC	✓	✓
11	Menidae	*Mene maculate*	F	NE	✓	✓

12	Polynemidae	*Polynemus indicus*	F	NE	✓	✓
13	Sillaginidae	*Sillago sihama*	F	LC	✓	✓
14	Terapontidae	*Terapon jarubua*	F	LC	✓	✓
15	Trichiuridae	*Trichiurus lepturus*	F	LC	✓	✓
16	Carangidae	*Alectis indica*	F	LC	✓	✓
17		*Alepes kleinii*	F	LC	✓	✓
18		*Elagatis bipinnulata*	F	LC	✓	✓
19		*Parastromateus niger*	F	LC	✓	✓
20		*Scomberoides tol*	F	LC	✓	✓
21	Coryphaenidae	*Coryphaena hippurus*	F	LC	✓	✓
22	Echeneidae	*Echeneis naucrates*	F	LC	✓	✓
23	Rachycentridae	*Rachycentron canadum*	F	LC	✓	✓
24	Lethrinidae	*Lethrinus nebulosus*	F	LC	✓	✓
25	Nempitheridae	*Nemipterus japonicus*	F	NE	✓	✓
26		*Scolopsis vosmeri*	F	NE	✓	✓
27		*Parascolopsis eriomma*	F	NE	✓	
28	Sparidae	*Acanthopagrus lactus*	F	DD	✓	✓

29		*Argyrops spinifer*	F	LC	✓	✓
30		*Diplodus sargus*	F	NE	✓	
31	Acanthuridae	*Acanthurus mata*	F	NE	✓	✓
32		*Zebrasoma desjardinii*	F	LC	✓	
33	Sciaendae	*Otolithoides biauritus*	F	NE	✓	✓
34		*Otolithes ruber*	F	NE	✓	✓
35		*Roncador stearnsii*	F	LC	✓	
36	Clupidae	*Sardinella gibbosa*	F	LC	✓	✓
37		*Sardinella maderensis*	F	VU	✓	
38	Engraulidae	*Coilia mystus*	F	EN	✓	
39	Chirocentridae	*Chirocentrus dorab*	F	LC	✓	✓
40	Dussumieriidae	*Dussumiera acuta*	F	LC	✓	✓
41	Engraulidae	*Thryssa setriostris*	F	LC	✓	✓
42	Clupeidae	*Sardinella longiceps*	F	LC	✓	✓
43	Engraulidae	*Thryssa dussumieri*	F	LC	✓	✓
44	Engraulidae	*Thryssa malabarica*	F	DD	✓	✓
45	Gobidae	*Bathyobius curacao*	F	LC	✓	✓
46	Platycephalidae	*Platycephalus*	F	DD	✓	✓

		indicus				
47	Scorpinediae	*Pterois miles*	F	LC	✓	
48	Scombridae	*Auxis rochei rochei*	F	LC	✓	✓
49	Stromatediae	*Pampus argenteus*	F	NE	✓	✓
50	Trichiuridae	*Lepturacanthus savala*	F	NE	✓	✓
51	Aridae	*Plicofollis tenuispinis*	F	NE	✓	✓
52		*Osteogeneious militaris*	F	NE	✓	✓
53	Balistadae	*Odonus niger*	F	NE	✓	✓
54	Tetraodontidae	*Takifuga oblongus*	F	LC	✓	✓
55	Tricanthidae	*Triacanthus biaculeatus*	F	NE	✓	✓
56	Synodontidae	*Saurida tumbil*	F	LC	✓	✓
57		*Trachinocephalus myops*	F	LC	✓	✓
58	Caracharhinidae	*Caracharhinus limbatus*	F	VU	✓	✓
59	Triakidae	*Mustelus mosis*	F	DD	✓	✓
60	Torpedinidae	*Torpedo fuscomaculata*	F	DD	✓	
61		*Torpedo sinuspersici*	F	DD	✓	
62	Ephippidae	*Platax teira*	F	NE	✓	✓

63	Mugilidae	*Mugil cephalus*	F	LC	✓	✓
64	Dasyatidae	*Himantura gerrardi*	F	VU	✓	
65	Rhinobatos	*Rhinobatus punctifer*	F	NT	✓	
66	Uranoscopidae	*Uranoscopus archionema*	F	NE	✓	

CONCLUSION:

In the period of 2015-2019, the total number of fishes caught form Sutrapada coast belongs to 66 species and 46 families. All of them have been identified through different standard available identification keys and the labelled species has been kept in departmental museum. For confirmation of morphological identification, DNA barcoding approach was employed and till now 75% of species were confirmed through DNA barcoding. The total population of fisherman in Sutrapada are 4368 out of which active fisherman are about 873 and others are busy in some other activities like net making or doing work in some other sector like daily wages worker in GHCL company during the off-season (monsoon). In Sutrapada village about 251 OBM, gillnets, 03 trawlers 03 non-mechanized boat are operating among which most are active in fishing.

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