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Research Article

Comparative Study of Population Dynamics and Seasonal Variation of Mysid *Mesopodopsis orientalis* (Crustacea: Mysida) in Coastal, Estuarine and Saltpan Waters of Mumbai Area

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ABSTRACT

The comparative study of population dynamics and seasonal variation mysid was carried out twice in monthly basis (once in Waning period and once in Waxing period) from Coastal, estuarine and Saltpan waters during May 2016 to December 2017. Total mysids found in Coastal waters were 35.59% followed by 35.67% in Estuarine waters and 28.72% in Saltpan waters. In Coastal waters mysids were present year-round and exhibited marked monthly variations in abundance, with modal peaks during summer period. In estuarine waters as also in saltpans waters maximum quantity was found during summer period. Females predominated over males in the entire population, and brooding females were present at every monthly sample, indicating that reproduction is continuous year round. Females found much more in coastal waters than estuarine as also salt pan waters. Brooding females occurred together with Immature mysids Male & Female juveniles) in all monthly samples, indicating that reproduction was year round. Mesopodopsis orientalis breed throughout the year but there is a seasonal variation in the intensity of breeding. The species produced more than one generation per year and the number of embryos carried by a single female ranged from 5 – 25. All developmental stages were observed. Mature but unfertilized females with empty brood pouch as also fertilised but Spent females with no embryos in brood pouch from which the youngs have emerged were also found during the collection period. As a result of its abundance, this mysid is regarded as one of the most important species of the shallow-water crustacean community. Moreover, mysids or opossum shrimps are component of zooplankton composition which is used for human consumption.

Key words: *Opossum shrimps, Brooding females, Sex ratio, Seasonal variation, Continuous reproduction.*

INTRODUCTION

Mysids or opossum shrimps are component of zooplankton composition which is used for human consumption. *Mesopodopsis orientalis* is a common mysid of the shallow coastal waters of India.

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It is a small, shrimp like arthropod belonging to the Order *Mysidacea* of the class *Crustacea*. This is locally called as "Lepa" or "Banda Kolim" which is smaller than "Acetes" i.e. "Jawla". Due to their high nutritive quality, this species is suitable for aquaculture as a live feed[3]. Bhattacharya and Kewalramani[4] observed that *M. orientalis* could survive even in fresh water for considerable time after gradual acclimatization. *Mesopodopsis orientalis* breed throughout the year but there is a seasonal variation in the intensity of breeding. It occurs in large shoals during September to November in coastal waters of Mumbai. The animal also occurs in January but less abundantly. Considering the ecological and economical importance, the present study on comparative population structure, breeding season and fecundity of *Mesopodopsis orientalis* was undertaken in coastal waters, estuaries/mangroves and saltpans.

MATERIAL AND METHODS

Description of study area

A plankton collection net was used for the collection of samples during low tide period at surface water in every month manually during May 2016 to December 2017 from:

1.0 One site from Coastal area (Girgaon Chaoupati).

2.0 Three sites from Mangrove estuarine area (Juchandra, Thane and "Kandalvan" at Mauze – Mulund/Bhandup). This study area is a vast expanse of mangrove habitat and 3.0 Three sites from Saltpan (Airoli, Vasai and Naigaon) from different parts viz., reservoirs, condensers and crystallizers.

Sampling procedure and data analysis

The collections were made at least twice a month viz., once in Waxing period (New Moon to Full Moon) and once in Waning period (Full Moon to New Moon) to study the population dynamics of *Mesopodopsis orientalis*. Samples were preserved in 5% buffered formalin. Mysids are counted under a stereomicroscope in the laboratory. Mysids classified into different groups based on the degree of development of secondary sexual characteristics. Sexes can be distinguished by the presence of an extended fourth pleopod in males and the brood pouch in females[8]. The number of individuals within the population has been studied under various categories, such as 1.0 Mature males: the secondary sexual characters are fully developed and the animals are provided with penes and Exopods of fourth pleopod are specially modified. 2.0 Mature/Gravid Mature females with "eggs" present in the brood pouch. 3.0 Mature/Gravid Mature females with "eyeless embryos" present in the brood pouch. 4.0 Mature/Gravid Mature females with "eyed embryos" present in the brood pouch. 5.0 Mature/Spent females: females with empty brood pouches from which the youngs have emerged. 6.0 Mature/Empty females: Mature but Unfertilized females with empty brood pouch; more than 4 mm in size. 7.0 Immature Male (juveniles): less than 4 mm in size provided with large and slender annular peduncle with hirsute lobe but secondary sexual characters absent. 8.0 Immature Female: less than 4 mm in size and brood pouch is not developed. The developmental stages of eggs/embryos were classified according to Hanuamura *et al*., *viz.*, egg like embryo, eyeless embryo and eyed embryo.

Abundance and population structure

In Waxing period 56.32% of Total mysids density was found whereas 43.67% was found in Wanning period. In Estuarine waters 69.55% of Total mysids density obtained in Waxing period followed by 51% in Coastal waters and 45.96% in Salt waters. Whereas in Wanning period, 54.03% obtained from Saltpan waters followed by 49% mysids obtained in oceanic waters and 30.44% from Estuarine waters (Fig:1). The number of individuals in the population was found fluctuating seasonally. In Coastal waters mysids were present year-round and exhibited marked monthly variations in abundance, with modal peaks during summer period. In estuarine waters as also in saltpans waters maximum quantity was found during summer period but, during late monsoon period surprised presence of animals was also obtained in estuarine waters of Thane creek.

The total population densities of *Mesopodopsis orientalis* in the study areas was 140682 Nos which was ranged from 2841-50080 Nos. with an average of 20097.43 Nos. The variation in densities significantly differed among sampling stations. Maximum population was recorded in Estuarine waters at 35.67% followed by 35.59% in Coastal waters and 28.72% in Saltpan waters.

The mysid formed dense aggregations at the estuarine edge close to the mangrove but very few were captured elsewhere in the estuarine system. Compared with other seasons, the high abundance of *M. orientalis* occurred in the pre-monsoon period. In Coastal waters of Girgaon Chowpati, from the end of monsoon period till the complete winter period animals shown the presence with good quantity as also during winter period, but maximum quantity was found during summer period. Out of total collection of animals (No: 50080) during the entire period of collection, the maximum number of animals i.e. Total Males and Females obtained in the month of October (No: 7662, 15.30%) and November (No: 10437, 20.84%), 2016 & in October (No: 5582, 11.15%) and in November (5114, 10.21%) 2017 respectively. In Estuarine waters of Juchandra, out of total collection of animals (No: 2843) maximum animals found in the month of February (No: 1101, 38.73%) and March, 2017 (No: 670, 23.57%). Whereas in Thane creek waters out of total collection of animals (No: 29129) maximum animals found in the month of September, 2016 (No: 6400, 21.97%) and September, 2017 (No: 8253, 28.33%). Surprisingly, good quantity of animals were also found in October (No: 2100, 7.21%) and November, 2016 (No: 1600, 5.48%) but in October, 2017 there was nil animals in the collection. In December, 2016 there was no animals in the collection but in December, 2017 good quantity of animals were found (No: 7791, 26.75%). In Mulund estuarine waters in the months of May to July of both the years i.e. in 2016 and 2017 good collection was found ranging from No:1700 (9.33%) to No: 3454 (18.96%). In the months of November and December, 2016 little quantity of animals were obtained (No: 150, 0.82%) and (No: 170, 0.93%) respectively, but on the contrary, did not found any animals in November and December, 2017. In Aairoli Saltpan waters, out of total collection of animals (No: 14480) maximum animals obtained in the month of June, 2017 (No: 2910, 20.10%). In the month of November and December, 2016) there was good collection of animals found (No: 150, 1.04% and No: 200, 1.38% respectively, but surprisingly there was nil collection in the same period i.e. November and December, 2017. In the waters of Salt pans of Vasai, out of total collection of animals (No: 19600) maximum animals found in the month of July, 2017 (No: 7392, 37.71%) in continuous satisfactory collection from January to August, 2017. May to August, 2016 the months were found good collection period (No: 33, 0.17% to No: 225, 1.15% respectively) and September to December, 2016 was the period was found for little collection (No: 10, 0.05% to No: 3, 0.02% respectively). But in the same period i.e. October to December, 2017 was found to be completely dry period for collection of animals. In Naigaon Saltpan waters, out of total collection of animals (No : 6335), March and April, 2017 was the peak period found when maximum animals found in the collection ranging from No:1535, 24.23% to No:3645, 57.54% respectively in relation to the total period of collection i.e. from May,2016 to December, 2017. During September to December, 2016 and 2017 completely dry period was found for collection of animals. The cause of this sudden depopulation is still not very clear. Whereas in estuarine waters as also in saltpans waters maximum quantity was found during summer period. (Fig: 2).

Females predominated over males in the entire population and brooding females were present at every monthly sample, indicating that reproduction is continuous year round. In Coastal waters mature females obtained frequently more than that of mature males during entire period of collection except January when males (7.34%) found more than

females (0.25%) and February (males 3.50% & females 0.21%) where as in Estuarine waters as also in the Saltpans waters matured males (1826 no.69.06% and 1078No.54.42% respectively with the average 608.67 no. & 59.33 no. and range of which was 330-1117no.& 5752-8584no respectively) are obtained more than that of mature females (818 no., 30.94% and 903no, 45.58% respectively with the average 272.67no.& 301 no. and range of which was 166-411 no.& 227-373). The greatest imbalance was found in the sex ratio during July and September, 2016 in Coastal waters when no females found in the sample where as in Estuarine waters of Juchandra, no males found in August, 2017. In Estuarine waters of Thane creek, no males found in the month of December, 2016, June, August, and October, 2017 whereas in the month of September & October, 2016, and March, 2017&September, 2017 no females was found. However, no such visible imbalance was found throughout during the collection period in Estuarine waters of Mulund. But in the Saltpans waters of Vasai, such visible imbalance was found throughout the collection period. In the waters of Salt pans of Aairoli, in the month of July, 2016, no females found in the collection. Whereas, in the waters of Salt pans of Naigaon, no such imbalance was found in throughout the culture period. It may be therefore presumed that males may live in different habitats from that of females. Similar observations were made by Wigley and Burns[20] when they observed a ratio 59: 1 in favour of females in their collections of *Mysis mixta*. (Fig: 3). Sex ratio within the population was found to be variable. The average sex ratio of number of mature male and female was calculated for complete data (male: female). In coastal waters, estuarine waters and salt pan waters, number of male and female ratio was noticed as 1: 20.69, 1: 0.44 and 1: 0.83 respectively. This result of calculation indicates that numbers of females are much more found in coastal waters than estuarine as also salt pan waters. (Fig: 4). The same case observed in immature male and female ratio viz., In coastal waters, estuarine waters and salt pan waters, number of immature male and female ratio was noticed as 1: 129, 1: 3.78 and 1: 34 respectively. This indicates that numbers of females are much more found in coastal waters than estuarine as also salt pan waters (Fig: 5).

Population of all developmental stages of gravid females were observed. In Coastal waters, maximum number of females with "eggs" was found in October, 2016 (16 no., 21.33%) out of Total No.75. Whereas maximum number of females with developing embryos i.e. "eyeless embryos" were found in January, 2017 (57no., 28.07%) out of Total No.203 and maximum number of females with fully developed "eyed embryos" were obtained in October, 2017 (18 no., 18%) out of Total No.100. In Estuarine waters, maximum number of females with "eggs" was found in June, 2017 (7no, 21.87%) out of Total No.32. Whereas maximum number of females with developing embryos i.e. "eyeless embryos" were found in May, 2017 (33 No., 15.34%) out of Total No. 215 and maximum number of females with fully developed "eyed embryos" were obtained in February, 2017 (25no., 24.27) out of Total No.103). In Saltpan waters, maximum number of females with "eggs" was found in February, 2017 (17 no., 2394%) out of Total No. 71. Whereas maximum number of females with developing embryos i.e. "eyeless embryos" were found in May 2017 (32 No., 23.80) out of Total No.135 and maximum number of females with fully developed "eyed embryos" were obtained in May, 2016 & 2017 (12 No., 19.04% and 12 No., 25.53% respectively) (Fig: 6). This evidence indicates that the Coastal waters population would differ to some degree from those of the Estuarine and also Saltpan waters counterparts.

Brooding females occurred together with all immature mysids (Male & Female) in all monthly samples, indicating that reproduction was year round. In coastal waters, maximum abundance of Immature male mysids (juveniles) in January, 2017 (30 no, 43.48%) and Immature female mysids (juveniles) in October, 2017 (900no, 20.73%) was established. In Estuarine waters, during

March, 2017 (257no, 62.23%) maximum Immature male mysids and maximum Immature female mysids during January to April, 2017 (23 No. 38.98%) were obtained. Whereas in Saltpan waters, Immature male mysids were found in the month of March, 2017 (15 No., 21.13%) and Immature female mysids found in March, 2017 (24 No., 42.86%) (Fig: 7). Mature but unfertilized females with empty brood pouch as also fertilised but Spent females with no embryos in brood pouch from which the youngs have emerged were also found during the collection period. In coastal waters, maximum Empty females were found in June, 2017 (401 no., 26.43%) and Spent females obtained in August, 2017 (778 No., 38.75%). In Estuarine waters, maximum Empty females were found in February, 2017 (20 No., 32.79%) and Spent females were obtained in March, 2017 (16 No., 41.03). Whereas in Saltpan waters, maximum Empty females were found in June, 2016 & 2017 (18 No., 18.56%) Spent females were obtained in June, 2016 (12 No., 21.05%). (Fig: 8).

RESULTS AND DISCUSSION

The number of individuals in the population was found fluctuating seasonally. 35.59% of Total mysids found in Ocenanic waters followed by 35.67% in Estuarine waters and 28.72% in Saltpan waters. In Waxing period 56.32% collection was found whereas 43.67% found in Wanning period. In Estuarine waters 69.55% specimen obtained in Waxing period followed by 51% in Oceanic waters and 45.96% in Saltwaters. Whereas in Wanning period, 54.03% obtained from Saltpan waters followed by 49% mysids obtained in oceanic waters and 30.44% from Esuarine waters. Total number of males and females in the population was found fluctuating seasonally. Females predominated over males in the entire population, and brooding females were present at every monthly sample, indicating that reproduction is continuous year round. Sex ratio within the population was found to be variable. In coastal waters, estuarine waters and salt pan waters, number of male and female ratio was noticed as 1: 20.69, 1: 0.44 and 1: 0.83 respectively. The same case observed in immature male and female ratio viz., in coastal waters, estuarine waters and salt pan waters, number of immature male and female ratio was noticed as 1: 129, 1: 3.78 and 1: 34 respectively. This result indicates that numbers of females are much more than males found in coastal waters than estuarine as also salt pan waters. *Mesopodopsis orientalis* breed throughout the year but there is a seasonal variation in the intensity of breeding. The species produced more than one generation per year and the number of embryos carried by a single female ranged from 5 – 25. In Coastal waters, maximum number of females with "eggs" was found in October, 2016. Whereas maximum number of females with developing embryos i.e. "eyeless embryos" were found in January, 2017 and maximum number of females with fully developed "eyed embryos" were obtained in October, 2017. In Estuarine waters, maximum number of females with "eggs" was found in October, 2016. Whereas maximum number of females with developing embryos i.e. "eyeless embryos" were found in January, 2017 and maximum number of females with fully developed "eyed embryos" were obtained in October, 2017. In Saltpan waters, maximum number of females with "eggs" was found in February, May & June, 2017. Whereas maximum number of females with developing embryos i.e. "eyeless embryos" were found in March, May & June 2017 and maximum number of females with fully developed "eyed embryos" were obtained in May, 2017. During monsoon completely dry period was found for collection of animals. This sudden disappearance may be due to severe wave action in the littoral region due to heavy monsoon. Borodith and Havlena[5] and Brown and Talbot[5] also support this view. According to them, the wave action in the littoral region affects the distribution of many intertidal species. It is possible that the animals during this period perform horizontal migration and may occur in the sub tidal zone. During other periods these animals mostly occur in the intertidal zone and migrate

horizontally according to the movement of tidal waters[4]. Moreover, Bhattacharya and Kewalramani[4] observed that, *M.orientalis* could survive in fresh water for considerable time after gradual acclimatisation. The study area in the Coastal, Estuarine and Saltpan waters ecosystem does have a moderate potential for mysids. The culture of mysids would therefore, become an important pre-requisite for Aquaculture.

Fig: 1 Population of *M. orientalis* in different fortnights (Waning and Waxing) from May, 2016 to December, 2017

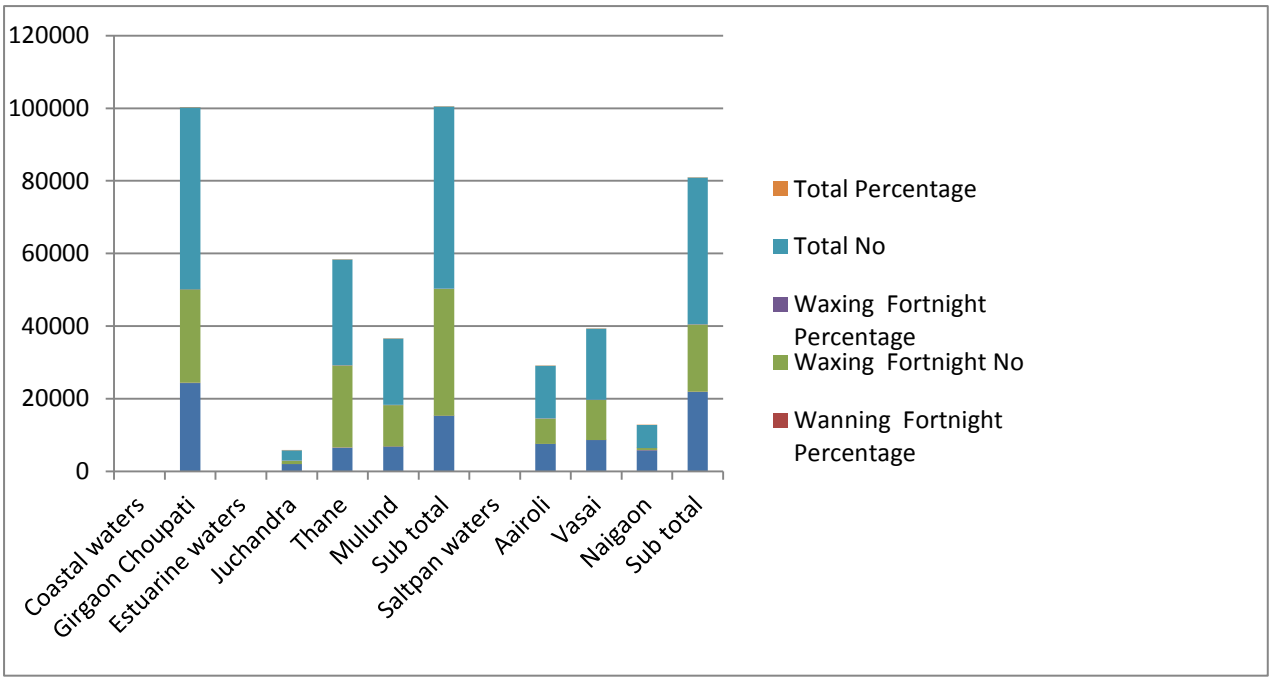


Fig: 2 Month wise population of Total Mysids from May, 2016 to December, 2017.

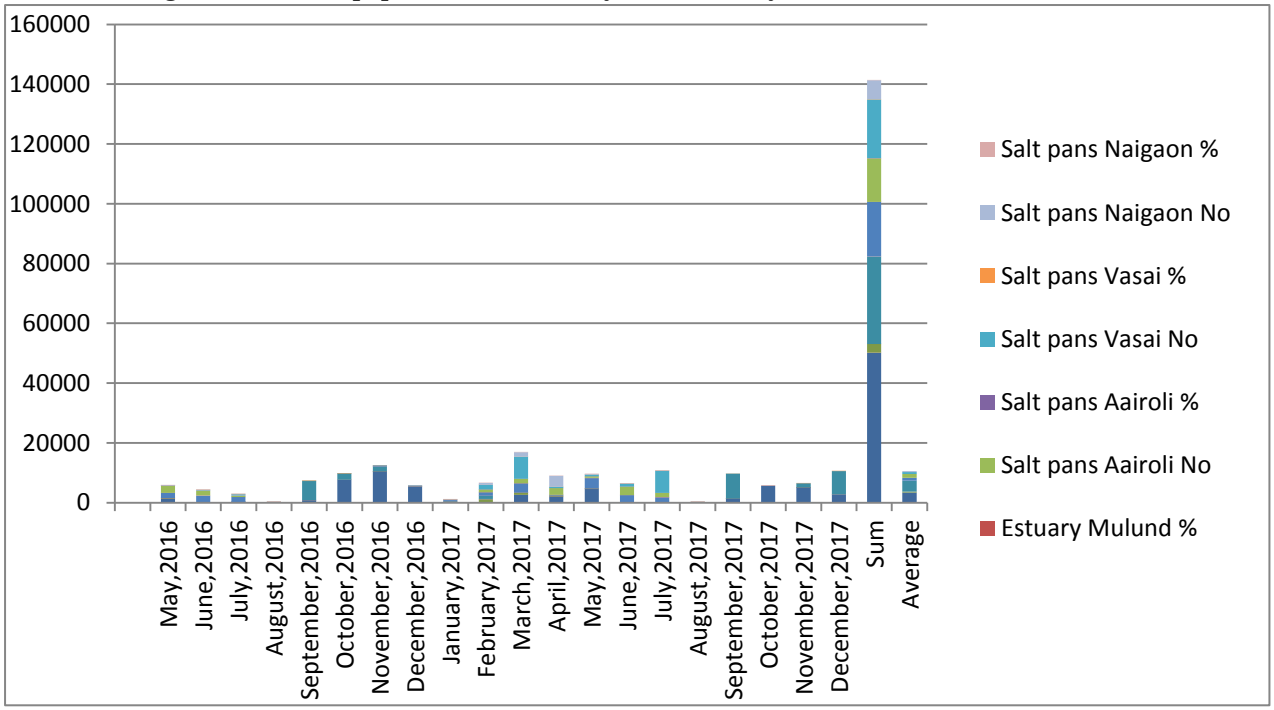


Fig: 3 Month wise population *M.orientalis* Mature Male and Females from May, 2016 to December, 2017

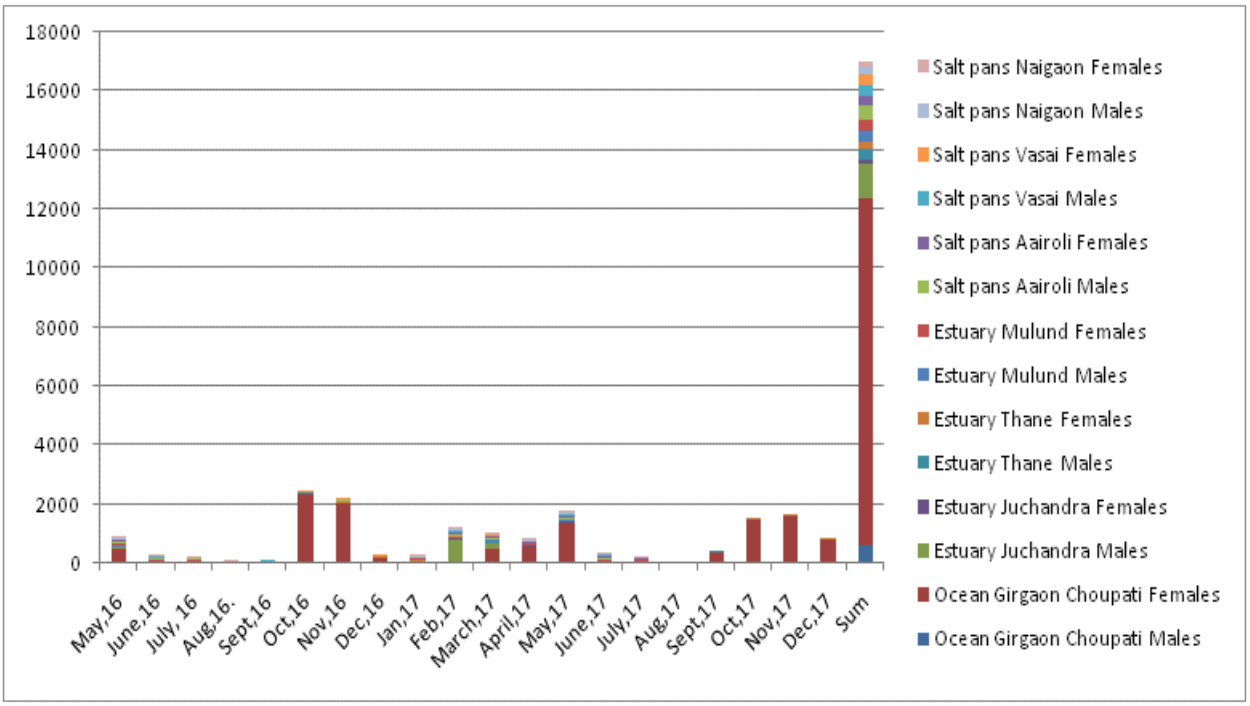


Fig: 4 Average sex ratio of number of mature male and female mysids from May, 2016 to December, 2017

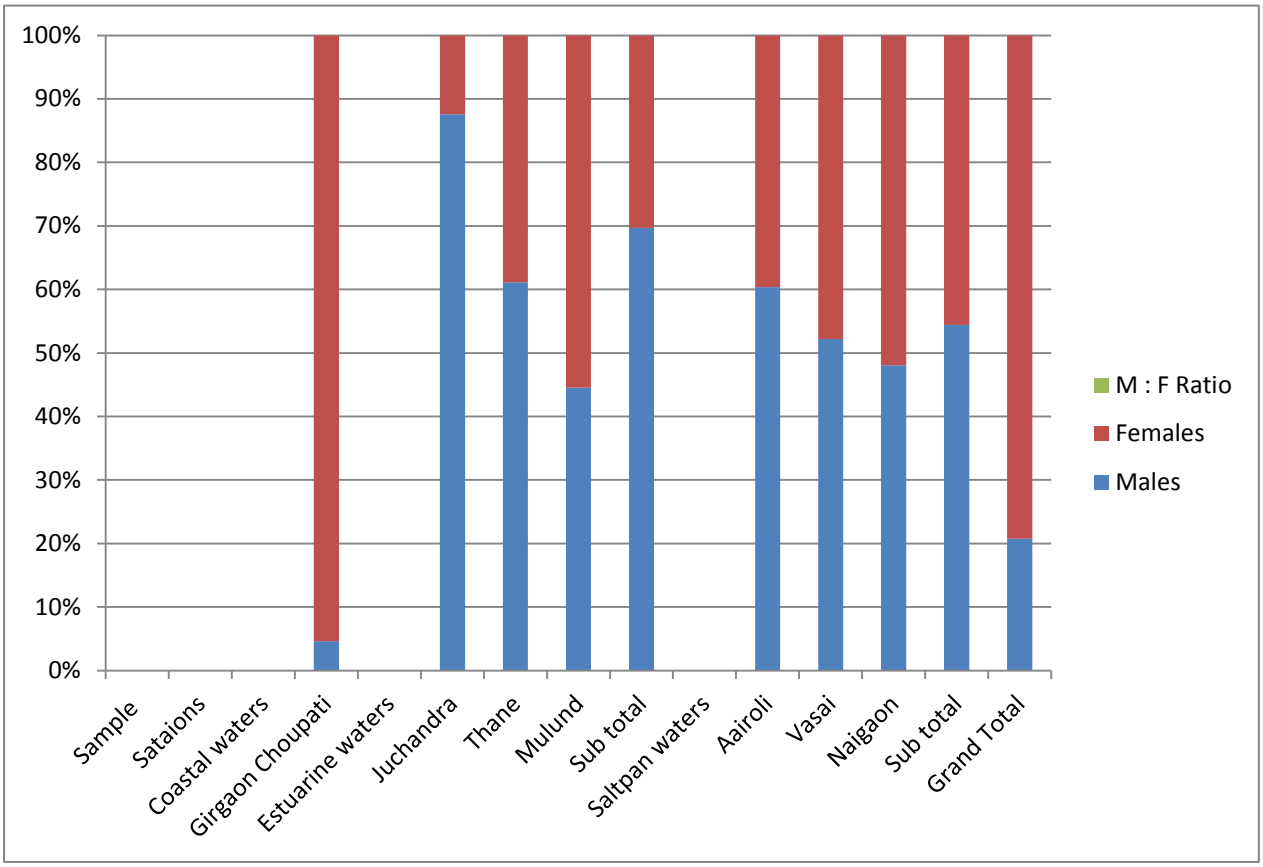


Fig: 5 Average sex ratio of number of immature male and female mysids from May, 2016 to December, 2017

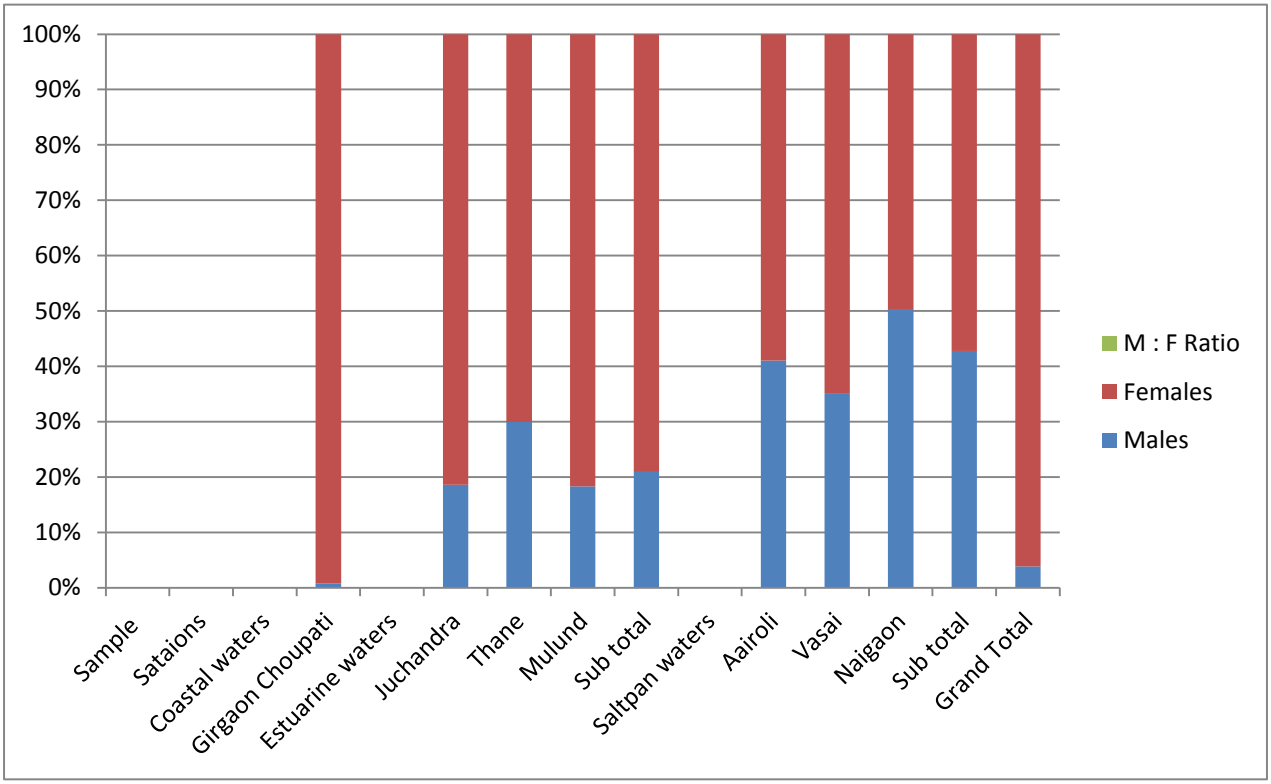


Fig : 6 Month wise population of ALL Gravid mysids females Nos.in relation with Total No. of Gravid Females with "Eggs", "Eyeless embryos" &"Eyed embryos" from May,2016 to December, 2017

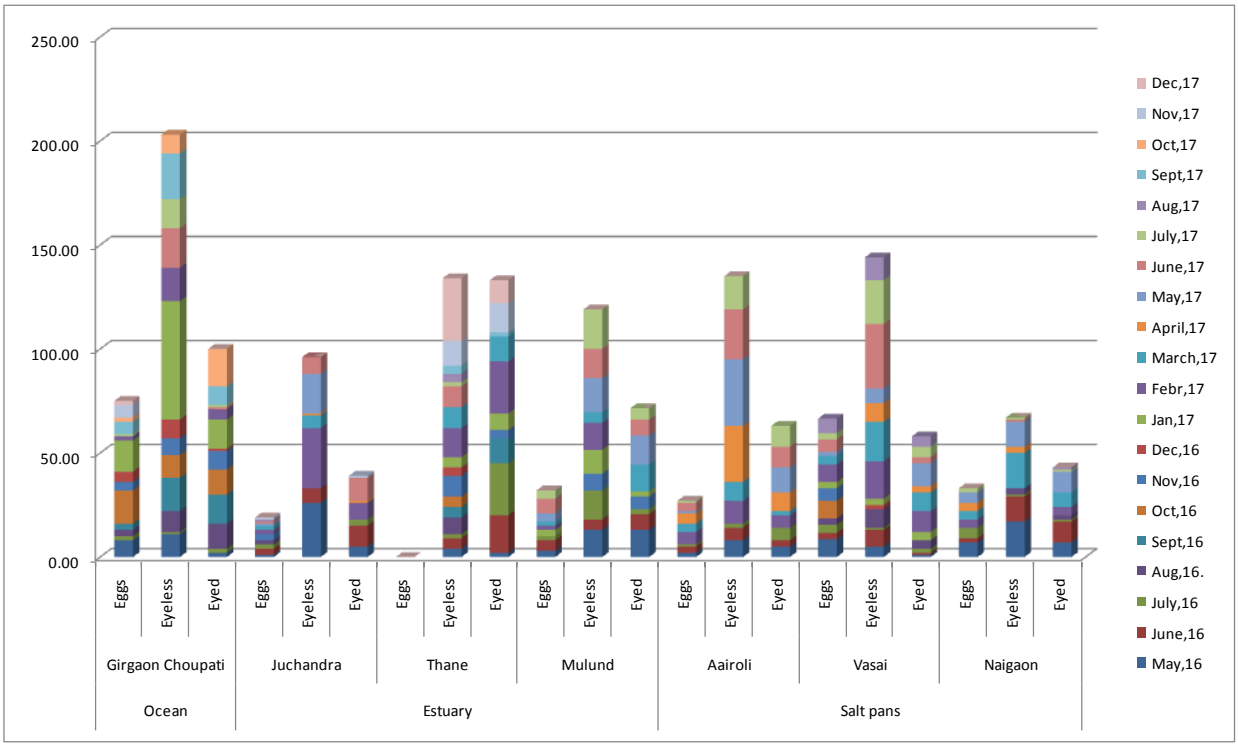


Fig: 7 Month wise population *M.orientalis* Immature Male and Females from May, 2016 to December, 2017

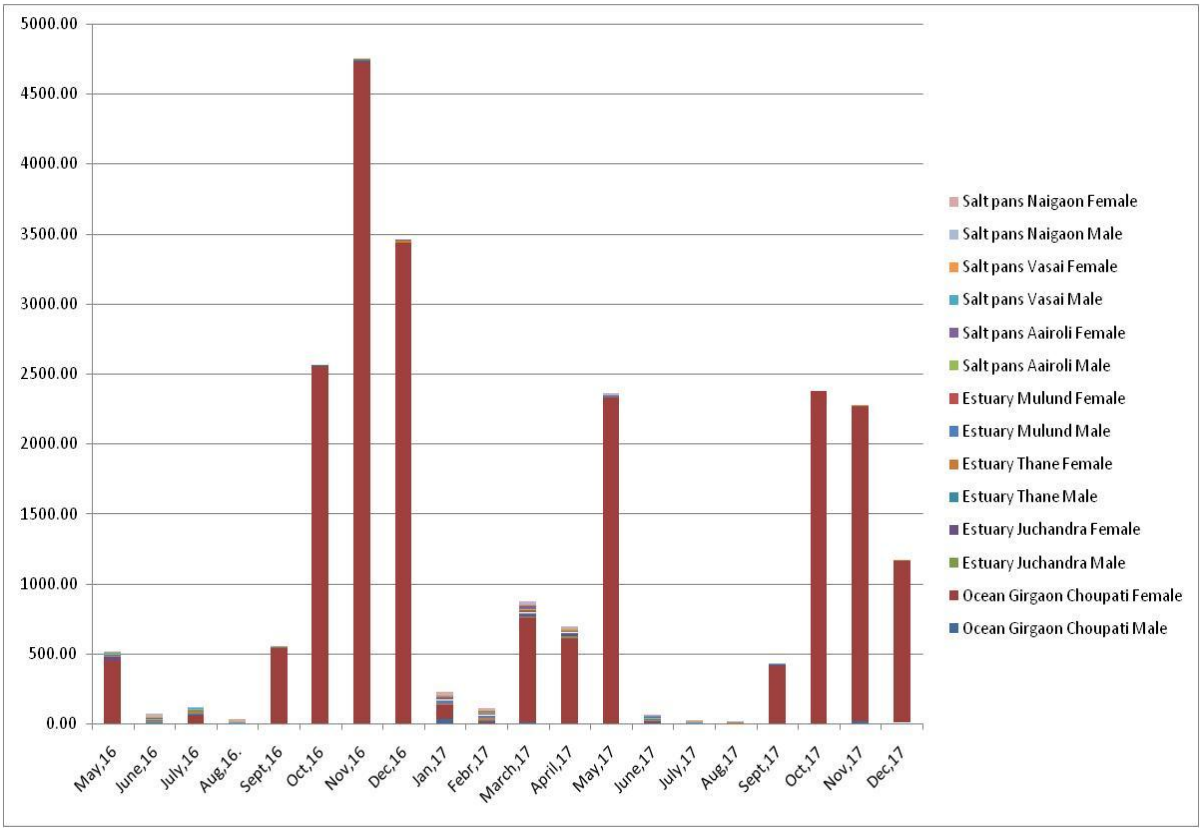
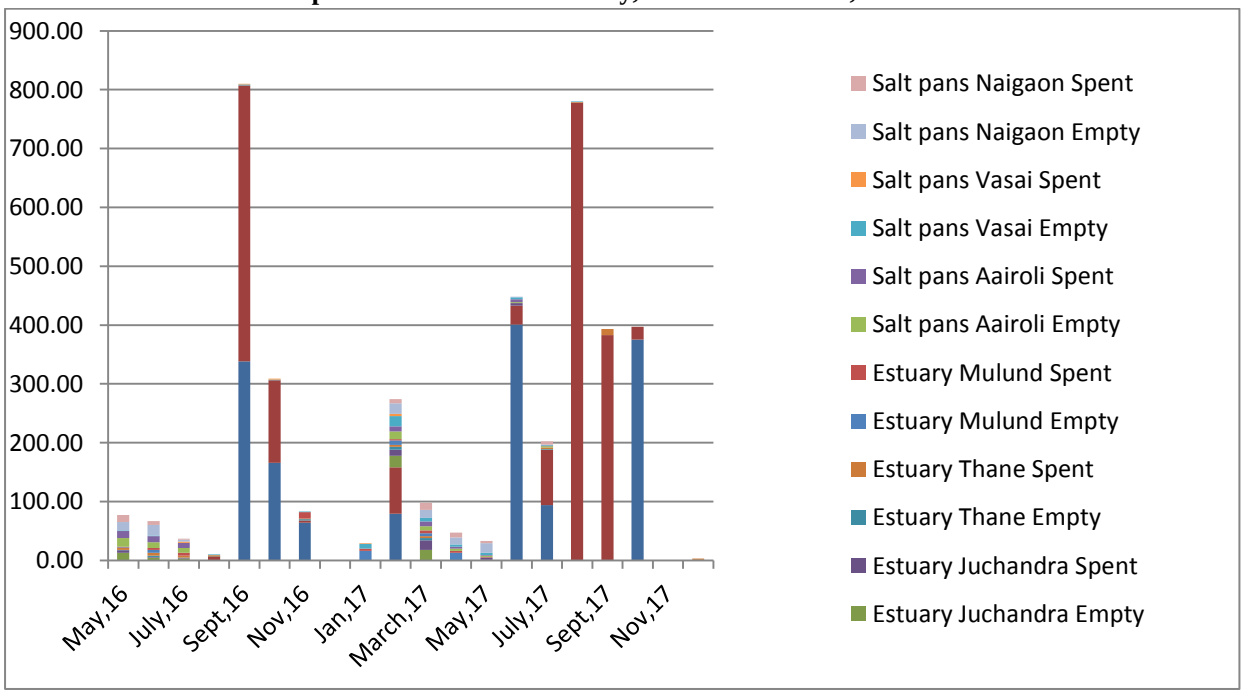


Fig: 8 Population of Total No. of All Mysids Unfertilized (empty brood pouch) Females and Fertilized Spent females Nos. from May, 2016 to December, 2017



CONCULSION

Bhattacharya studied salinity tolerance in the laboratory and reveal that *M. orientalis* of Indian coastal waters could survive under an extremely wide range of salinity conditions, even though it tends towards a low salinity preference, particularly in the early life stages; this ability ensures its wide distribution from sea water to near fresh water conditions. There was a seasonal variation found in the

distribution of *M. orientalis* during the present study. Compared with other seasons, the high abundance of *M. orientalis* occurred in the pre-monsoon period (February-May) in coastal waters. In estuarine waters as also in saltpans waters maximum quantity was found during summer period. This evidence indicates that the Coastal waters population would differ to some degree from those of the Estuarine and also Saltpan waters counterparts.

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