CHAPTER V

DISCUSSION & CONCLUSION
5.1. FISHING GEAR STRUCTURE

The conventional behundi jal (CBJ) is basically estuarine set bag net (ESBN) with equal head rope, breast rope and foot rope length i.e., 12.5 m (Fig. 5). The forward part of the upper and lower panels has mesh size of 140 mm. The mesh sizes of the following parts gradually decrease and terminate into the codend with mesh size of 18 mm. The head rope and footrope are directly interlaced into the main body and wings through 6.0-mm \( \phi \) pp ropes.

The Eco-behundi jal (EBJ) is also basically estuary set bag net (ESBN) operated during winter season. The dimensions and characteristics of this jal are identical to Conventional behundi jal (CBJ), except the second section of upper panel and codend. The second section of upper panels and codend has square mesh with mesh size of 65 mm and 20 mm respectively. The mesh sizes of the following parts gradually decreases and terminates into the codend with the mesh size of 20 mm. Other details of jals are presented in Data Sheet 1 and 2 and are described in chapter III.
These two jals designed and fabricated were used throughout two winter fishing season. Comparative fishing trials were conducted in lower zone of Sunderban delta. In order to study catching efficiency of both jals and with a view to minimize the catch of juveniles and under sized fish resources.

5.2. TOTAL CATCH

The present investigation shows that, the catch rates of Conventional behundi jal (CBJ) was 1.36 times more than Eco-behundi jal (EBJ) with average catch rates of 96.90 kg/haul in year of 2001–02 and 99.50 kg/haul in 2002–03. In other words, total catch per haul was apparently found to be poorer in Eco-behundi jal in both the year of investigation with average catch rates of 71.76 kg/haul in year 2001–02 and 72.58 kg/haul in 2002–03, respectively.

This indicates that, the Eco-behundi jal has less catch rate when compared to Conventional behundi jal. This could be due to the fact that, the mesh opening of the square mesh panels in codend and in second section of upper belly have more area of opening and stable. Hence, the possibilities for escape of juveniles, undersized finfishes and shellfishes through these openings are greater whereas the diamond mesh in
Conventional behundi jal has lesser opening and not stable. Hence, retaining of fishes from escapement is more. Similar results have been reported by Thorsteinsson (1989) during Icelandic investigations on the selectivity of square mesh codend. This result is also corroborated by many workers viz., results of Kunjipalu et al. (1989, 2001), Pillai et al. (1996) and Talwar (1997).

Results of Mann Whitney ‘U’ test to compare the average total catch per haul by the two jals (Table 6 and 6.1) show that, there is no significant difference between the average catch obtained between Eco-behundi jal and Conventional behundi jal. Since the rank total for Eco-behundi jal is less than that of Conventional behundi jal, it can be concluded that, the former has less catching efficiency than the latter. This is a clear indication that, the Eco-behundi jal facilitates easy escape of catch of juveniles through its square mesh opening during operation. Kunjipalu et al. (1988, 1994 and 2001) have found that 30 mm square mesh is sufficiently large enough to provide escapement for certain percentage of commercial size groups.

Average catch rates (Table 2 and 2.1) of different species and their percentage contribution indicate that, the catch rates
of commercial species constituted a higher percentage of total catch of 87.24% in Eco-behundi jal when compared to Conventional behundi jal (71.99%) during 2001–02. During the second year of study (2002–03) also, the Eco-behundi jal is found to contain higher percentage of the total catch with catch rate of 87.77% when compared to Conventional behundi jal (72.17%).

In both years of investigation there is higher percentage of commercial species in Eco-behundi jal to the tune of 121% compared to that of Conventional Behundi jal. This is mainly due to the reduction of by-catch. Talwar (1997) has reported in his selectivity studies that, the contribution of commercial groups towards total catch was higher (84.53%) in square mesh codend experimental gear when compared to the conventional one (49.58%). Similar results also have been reported by Kathavarayan et. al., (2002) also.

5.3 CATCH COMPOSITION

The catch obtained in Eco-behundi jal (EBJ) and in Conventional behundi jal (CBJ) during period of study was grouped into finfishes, shellfishes and by-catches for the purpose of analysis.
As the lower zone of Sunderban delta is a positive estuary of maxiohaline type (according to Pantulu and Bhimachar, 1964), the catches of both jals have comprised 12 and 4 species of commercially important finfishes and shellfishes respectively.

Among finfishes, twelve species of finfishes namely, *Herphodon neherus, Pama pama, Polynemus paradiseus, Ilisha megaloptera, Silago panijius, Trichiurus spp., Pampus argenteus, Chirocentrus dorab, Setipinna phasa, Coilia spp., Tachysurus jella* and *Osteogenious militoris* are marine species and *Pangasius pangasius* is freshwater species.

In shellfish group, 2 shrimps namely *Metapenaeus* spp. and *Peneaus* spp. are marine forms and other 2 species namely *Macrobrachium lamerrri* and *M. mirable* are freshwater prawns.

Many workers have reported similar species-wise catch composition during their exploitation in lower zone of estuary by winter migrating bag net (Pillay and Ghosh, 1962; Datta et. al., 1975 and Mitra et. al., 1997).
The percentage composition of different types in each group during entire period of study (i.e., 2001–2003) as tabulated in Table 2 and 2.1, with respective figures 12 and 12.1. It can be seen that, percentage composition of finfish was higher in Eco-behundi jal (61.31%) than that of Conventional behundi jal (54.06%) during 2001–02.

During the second year of study, the percentage composition of finfish appeared to be higher in Eco-behundi jal with 63.37% to that of the Conventional behundi jal with 54.21%. Hence, the percentage composition of finfish catch in Eco-behundi jal was almost 1.13 to 1.16 times more than that of Conventional behundi jal. By-catch percentage composition was only 12.75% in Eco-behundi jal when compared to 28% in Conventional behundi jal during first year of study. In second year, it was noticed again to be less in Eco-behundi jal (12.23%) than in Conventional behundi jal (27.83%).

The higher percentage of finfish composition could be mainly due to reduction of by-catch in Eco-behundi jal. Among the finfish group, the percentage composition of Bombay duck (*H. neherus*) was maximum followed by *Setepinna phasa,*
*Trichiurus* spp. and *Pama pama* in Eco-behundi jal during entire period of study.

Eco-behundi jal had higher percentage composition of shellfish group (25.98% in 2001–02 and 24.40% in 2002–03) than the Conventional behundi jal (17.90% in 2001–02 and 2002–03), even though the average catch rate of Eco-behundi jal was less than that of Conventional behundi jal. This could be due to the reduction of by-catch in Eco-behundi jal.

The catch rate of finfish and shellfish group clearly indicates that, the difference between the Eco-behundi jal and Conventional behundi jal are marginal. This is corroborated by statistical analysis, where there is no significant difference in average catch obtained from both Eco-behundi jal as well as Conventional behundi at 5% level (Table 8).

**5.3.1 Month-wise catch composition**

Month wise catch composition was obtained during the entire period of investigation (i.e., from 2001 to 2003). The month wise catch in kg per unit haul for finfishes, shellfishes and by-catches are tabulated in Table 3 and 3.1 and represented in Fig. 13 and 13.1.
Table 3 depicts the overall view of catches obtained during 2001–02 that, both jals had maximum catch in the month of December with 586.53 kg in Conventional behundi jal, while, it was 459.93 kg in Eco-behundi jal followed by January and February. Minimum catch was recorded in the month of October with 284.75 kg in Conventional behundi jal, while it was 170.75 kg in Eco-behundi jal.

The contribution of commercially valuable finfish and shellfish group was higher in Conventional behundi jal when compared to Eco-behundi jal in December. In January and February the contribution of finfish group was at higher rate in Conventional behundi jal when compared to Eco-behundi jal. In case of shellfish group, the catch rate was more in Eco-behundi jal when compared to Conventional behundi jal. The higher rate of by-catch was recorded in Conventional behundi jal throughout the winter fishing season when compared to Eco-behundi jal.

During the second year of fishing, Conventional behundi jal had a higher catch in the month of December with 469.76 kg while, it was 375.47 kg in Eco-behundi jal followed by January, February and November. Minimum catch was landed in the
month of October with 219.59 kg in Conventional behundi jal, while, it was 135.96 kg in Eco-behundi jal (Table 3.1).

The contribution of commercially valuable finfish group was at higher rate in Conventional behundi jal when compared to Eco-behundi jal in December followed by January, February and November.

The shellfish group showed higher quantity in Eco-behundi jal in December, followed by January and November, when compared to that of conventional behundi jal. In October and February Conventional behundi jal had a higher catch of finfish group, when compared to Eco-behundi jal.

The by-catch contribution was at higher rate in Conventional behundi jal throughout the season when compared to Eco-behundi jal.

The lower zone of this estuary contained large amount of organic matters, detritus and other washed-off materials, that is rich in nutrients and this is deposited below the mouth of the estuary during monsoon by heavy inflow in the streams (Datta et. al., 1975). This brings about major change in the food chain
by inducing a rich growth of phytoplankton, which reaches a peak in winter months (Shetty et al., 1961; Saha et al., 1975). Such conditions are highly prevalent in the shallow sea surface regions of this bay where the winter migratory bag net fishery operates (Mitra et al., 1997).

Based on these reports, we could interpret that, increased abundance of catch from November to February with peak in December month in both jals could be mainly due to the winter bloom of plankton causing a feeding and breeding migration of finfishes and shellfishes in the estuary. This may induces migration of their predators as well.

5.3.2 Haul-wise catch composition

A observation of catch composition of finfish during first year of fishing for every haul showed variation from 25.4 to 70.0 kg/haul in Conventional behundi jal, while, it varied from 20.54 to 58.98 kg/haul in Eco-behundi jal (Table 4 and 4a). The higher catch composition of finfish group i.e., 70.0 kg/haul was landed in fourteenth haul in Conventional behundi jal, while it was 58.98 kg/haul in Eco-behundi jal. This is mainly due to the catch of Bombay duck and Setepinna phasa, Ribbonfishes and Pama pama, which were represented in minimum quantity in
first haul of both jals. For the entire number of samples, the contribution of catch to the total catch by finfish group was higher in Eco-behundi jal when compared to Conventional behundi jal contribution to the total catch.

Catch composition of shellfish group during this period of sampling for every haul varied from 10 to 21.13 kg/haul in Conventional behundi jal, while it varied from 6.96 to 30 kg/haul in Eco-behundi jal. The share of shellfish group to the total catch was quite high in Eco-behundi jal for the entire number of hauls, when compared with the share of this group to the total catch in Conventional behundi jal.

By-catch composition during the period of fishing for every haul ranged from 15.35 to 34.76 kg/haul in Conventional behundi jal, while it varied from with minimum quantity of 4.58 to 11.75 kg/haul in Eco-behundi jal. The landings of by-catch during every haul are found to be minimum in Eco-behundi jal when compared to Conventional behundi jal.

During second year of fishing, the catch composition of finfishes group, shellfishes group and by-catch landed in both jals prevailed in similar pattern as landed in the first year of
sampling in Conventional behundi jal and Eco-behundi jal. The contributions of finfish and shellfish group to the total catch were more in Eco-behundi jal, when compared to Conventional behundi jal. The landings of by-catch during every haul found to be maximum in Conventional behundi jal when compared to Eco-behundi jal (Table 4.1 and 4a.1).

5.4 BY-CATCH ANALYSIS

The Conventional behundi jal (CBJ) landed higher quantities of by-catch than Eco-behundi jal (EBJ) during entire period of study (i.e., 2001–2003) (Table 5 and 5.1). The average catch rate of Conventional behundi jal was found to be 27.13 kg per haul which is almost 2.89 times higher than the Eco-behundi jal which has by-catch rate of only 9.37 kg per haul during the first year of sampling.

During the second year of sampling, the average catch rate of Eco-behundi jal was found to be 8.87 kg per haul, which is almost 3.12 times lesser than the Conventional behundi jal, which has by-catch rate of 27.68 kg per haul.

The by-catch contribution is found to be more (28%) in Conventional behundi jal, than (12.5%) percentage in Eco-
behundi jal. This indicates filtration of juveniles, undersized finfishes and shellfishes through square meshes at codend and second section of upper belly. Reductions of by-catch through square mesh panels have been opined by several authors and workers (Robertson, 1982; Robertson et al., 1986a; Robertson and Stewart, 1986b; Casey J et al., 1987; Talwar, 1997; Kunjipalu et al., 2001 and Kathavarayan et al., 2002).

The statistical analysis in Table 7 and 7.1 shows that, the rank total of by-catches obtained from Eco-behundi jal is lower than that of Conventional behundi jal. Hence, it may be concluded that Eco-behundi jal lands comparatively lower quantities of by-catch than the Conventional behundi jal, in the both years of investigation.

5.5 LENGTH FREQUENCY ANALYSIS

Present investigation was conducted to know the size composition and size selectivity of various types of fishes caught in Eco-behundi jal (EBJ) when compared to that of Conventional behundi jal (CBJ). Eco-behundi jal, had the codend mesh size of 20 mm bar and second section of upper belly mesh size of 65 mm bar with square mesh opening and Conventional behundi jal mesh codend had 18 mm mesh size. L50% (i.e., 50% of
retention length) value was determined for the Eco-behundi jal and Conventional behundi jal.

The selectivity of square mesh codend has been tested in a series of comparative fishing experiments by Robertson (1982). Robertson and Stewart (1986a&b) have found that the 50% retention lengths ($L_{50\%}$ value) for haddock and whittings were increased in square mesh codend when compared with diamond mesh codend of the same mesh size.

In the length frequency analysis, the median lengths of the species were considered instead of mean lengths because any chances of occurrence of a few large size fish in the catch will not affect the median length.

5.5.1 Finfish Group

Figures 15 to 24.3.1 represent the percentage cumulative frequency curves for some species obtained during period of 2001–02 and 2002–03, from which the median lengths ($L_{50\%}$) are measured. All these curves are of sigmoid or S-shaped indicating the normal distribution of finfishes in the length range.
5.5.1.1 Bombay duck \textit{(Herphodon neherus)}:

The length range of Bombay duck caught in Eco-behundi jal was from 8 cm to 22 cm and in Conventional behundi jal was from 6 cm to 18 cm (Table 9). The ogive curve (Fig.15-15.1) indicates that, the median length of Bombay duck caught in Eco-behundi jal was higher (13.9 cm) than that of Conventional behundi jal (9.7 cm) during 2001–02. While, in second year of sampling (2002–03), the sigmoid shaped curves indicates that, the median length of same fish caught in Eco-behundi jal was 14 cm (higher again) than that of Conventional behundi jal was 10.2 cm.

Bal and Rao (1990) have reported that, the size of Bombay duck \textit{(H. neherus)} at first maturity is fixed at 200 mm \textit{(i.e.,} 20 cm) and all fishes below that size are to be regarded as juveniles. From this it is evident that, the Eco-behundi jal and Conventional behundi jal catch has only juveniles of Bombay duck. However, the sizes of this fish caught in Eco-behundi jal were larger than those caught in Conventional behundi jal.

5.5.1.2 Croakers \textit{(Pama pama)}:

The length ranges of croakers caught in Eco-behundi jal and Conventional behundi jal during 2002–03 are 8 cm to 22
cm and 8 cm to 18 cm respectively. The median length of croakers caught in Eco-behundi jal is 15.5 cm whereas in Conventional behundi jal it is 12.1 cm in during 2001–02 (Fig.16). While, in 2002–03 median lengths of this fish caught in Conventional behundi jal is 12.3 cm whereas 16 cm in Eco-behundi jal. i.e., 50% retention lengths are larger in Eco-behundi jal as compared to that of Conventional behundi jal.

Somashekharan Nair (1977) has reported that, the minimum size at first maturity of croakers has been found to be at an average size of 11.5 cm for females and 12.5 cm for males. Hence, it is evident that Eco-behundi jal catches matured croakers while Conventional behundi jal has the tendency to catch juveniles. Hence, it may be concluded that Eco-behundi jal is ideal for catching mature croakers, which may helps in conservation of this species.

5.5.1.3 Threadfins (*Polynemus paradiseus*):

The length ranges of Threadfins caught during both years in Eco-behundi jal (EBJ) and Conventional behundi jal (CBJ) are 10 cm to 24 cm and 8 cm to 18 cm respectively (Table 9). The median length of *Polynemus paradiseus* caught during 2001–02 in Eco-behundi jal is found to be 14.2 cm whereas in
Conventional behundi jal is 10.3 cm. During second year, the median length of this species caught in Eco-behundi jal is 15.6 cm whereas that in Conventional behundi jal is 11.3 cm i.e., 50% retention length are larger in Eco-behundi jal as compared to that of Conventional behundi jal.

Gupta (1968) has reported that, the size at maturity of males of *P. paradiseus* at 135 mm (13.5 cm) and females at 160 mm (16.0 cm). Hence, it is evident that Eco-behundi jal catch matured threadfins, while Conventional behundi jal has the tendency to catch immature ones (i.e., juveniles). Hence, it may be concluded that, Eco-behundi jal is ideal for catching mature threadfins that helps in conservation of this species.

5.5.1.4 Shads (*Msha megaloptera*):

The length range of Shads caught in Eco-behundi jal was from 12 cm to 26 cm and in Conventional behundi jal from 10 cm to 22 cm (Table 9). The ogive curves (Fig.18–18.1) indicate that the median length of shads caught in Eco-behundi jal was higher (17.3 cm) than that of Conventional behundi jal (14 cm) during 2001–02. While, in second year (i.e., 2002–03), the median length of shads caught in Eco-behundi jal is 17.8 cm whereas it is 14.7 in Conventional behundi jal.
The mature and spawning individual of clupeids are of the size range of 10–10.9 cm in length (Nair, 1951). Based on this report, we can conclude that, both jals are catching matured ones of clupeid species, but size ranges caught in Eco-behundi jal was larger than in Conventional behundi jal.

5.5.1.5 Indian Whitings (*Silago panijius*):

More number of smaller sizes of Indian whitings were caught in Conventional behundi jal when compared to Eco-behundi jal. Table 9 shows the length range of Indian whitings caught in Eco-behundi jal and in Conventional behundi jal and the range is 6 cm to 12 cm and 4 cm to 10 cm respectively during 2002–03. The median length of this species calculated for both years of study were found to be 8.7– 8.8 cm in Eco-behundi jal and 7.3 cm in Conventional behundi jal.

Bal and Rao (1990) reported that, the size of *S. panijius* at first maturity is 120 mm (12 cm) and also reported that this species in this estuary is known to spawn during November to February and during August to September (i.e., twice a year). Based on this report, we can conclude that both Eco-behundi jal and Conventional behundi jal catch mainly catch premature ones. Moreover, Eco-behundi jal catches larger size of this
species of fish when compared to Conventional behundi jal. Thus, spent and premature ones during this period of fishing season mostly support this fishery.

5.5.1.6 Ribbon fishes (Trichiurus spp):

The length range of Ribbon fishes (i.e., Trichiurus spp) remains same in both Eco-behundi jal and Conventional behundi jal ranging from 14 cm to 40 cm during entire period of study (Table 9). The median length of Trichiurus spp. caught during 2001-02 in Eco-behundi jal is 32.8 cm whereas that in Conventional behundi jal is 32.2 cm. In the second year of investigation, the median length of the species caught in Conventional behundi jal is found to be 31.2 cm whereas in Eco-behundi jal, it is 32.4 cm.

Bal and Rao (1990) reported that the minimum size at maturity is 47-48 cm for Trichiurus lepturus and 43 cm in E. muticus and further mentioned that, L. savala, T. lepturus and E. muticus are common ribbon fishes available in West Bengal, and juveniles, immature and maturing fishes support fishery.

Based on this report, we could interpret that ribbonfishes caught in both jals were not of maturation size. Hence, 20 mm
square mesh in Eco-behundi jal and 18 mm in diamond mesh in Conventional behundi jal is not selective for *Trichiurus* spp. However, this fishery is supported in this region by mainly immature ones.

5.5.1.7 Pomfrets (*Pampus argenteus*):

Length range of Pomfrets caught in Eco-behundi jal (10–26 cm) were higher than those in Conventional behundi jal (10–24 cm) during the entire period of study (Table 9). The median length of this species caught in Eco-behundi jal during 2001–02 is found to be 14.9 cm where as that in Conventional behundi jal is 14.6 cm. While, during 2002–03, the median value for the median length of these fishes in Eco-behundi jal is 15 cm and that in Conventional behundi jal is 14.4 cm.

Bal and Rao (1990) have reported that, the occurrences of small juveniles of this species are from September to December. Based on this report, we can conclude that, the fishing trials were carried throughout the winter season tallies with the period of occurrence of juveniles. So, it is obivious, that, both jal catches constitute only juveniles of this species with variation in sizes, but comparatively larger size of this species were caught in more number in developed Eco-behundi jal.
5.5.1.8 Wolf herrings (*Chirocentrus dorab*):

Length ranges of wolf herrings caught in Eco-behundi jal (18–32 cm) were higher than those in Conventional behundi jal (Table 9). The median length of *Chirocentrus dorab* in Eco-behundi jal is 25.4 cm whereas that in Conventional behundi jal is 24 cm during first year of fishing season. During second year of fishing the median length ranges of this species caught in Eco-behundi jal and Conventional behundi jal are 25.5 cm and 24.4 cm respectively. However, larger ones of *Chirocentrus dorab* are caught in Eco-behundi jal than those in Conventional behundi jal.

5.5.1.9 Anchovies

5.5.1.9.1 *Setipinna phasa*:

Comparatively less number of smaller ones of this species were caught in Eco-behundi jal. The length ranges of *Setipinna phasa* caught in Conventional and Eco-behundi jals are from 4 to 26 cm and 8 to 30 cm respectively (Table 9). The median length of *Setipinna phasa* caught during 2001–02 in Eco-behundi jal is 13.4 cm whereas in Conventional behundi jal, it is 11.7 cm. Similarly, during 2002–03 the L₅₀ value of this species of Eco-behundi jal and Conventional behundi jal are 13 cm and 11.7 cm respectively. Hence, the Eco-behundi jal caught
more number of larger sizes of *Setipinna phasa* when compared to catch size of Conventional behundi jal throughout entire period of experiment.

5.5.1.9.2 *Coilia* spp.:  

The length range of *Coilia spp* caught during 2001–02 and 2002–03 in Eco-behundi jal and Conventional behundi jal is 8 to 22 cm and 4 to 16 cm respectively (Table 9). The median length for this species caught during 2001–02 in Eco-behundi jal is 12.1 cm, while, it is 9.5 cm in Conventional behundi jal. Similar median length for the same species was calculated during second year of study and is found to be 12.2 cm in Eco-behundi jal and 9.4 cm in Conventional behundi jal. Based on this result, we can conclude that, Eco-behundi jal catches more number of larger size group of anchovies, when compared to conventional behundi jal.

5.5.1.10 Catfishes

5.5.1.10.1 *Tachysurus jella*:

Table 9 depicts the length range of *Tachysurus jella* caught during the entire period of investigation in Conventional behundi jal and Eco-behundi jal (6 to 12 cm and 8 to 16 cm respectively).
The median length of this species caught during first year of study in Eco-behundi jal is 10.3 cm and in Conventional behundi jal is 8 cm. While, in the period, 2002-03 this is 10.1 cm in Eco-behundi jal and 7.8 cm in Conventional behundi jal. From this we can conclude that, Eco-behundi jal catches larger sizes at higher rate of this species of catfish than the Conventional behundi jal.

5.5.1.10.2 *Pangasius pangasius*:

The length ranges of *Pangasius pangasius* caught throughout the study period from 2001 to 2003 in Conventional and Eco-behundi jals were 4 to 10 cm and 4 to 14 cm respectively (Table 9).

The median length of this species caught during 2001-02 in Eco-behundi jal are 7.6 cm and it is 6.4 cm in Conventional behundi jal. During the period, 2002-03, the median length of the same species caught in Eco-behundi jal is 6.7 cm, while it is 5.6 cm in Conventional behundi jal. Hence, Eco-behundi jal catches comparatively larger fishes of this species than that of Conventional behundi jal.
5.5.1.10.3 *Osteogenious militoris*:

The length ranges of *O. militoris* is 4 to 14 cm and 4 to 12 cm respectively in Eco-behundi jal and Conventional behundi jal during the entire period of study. The median length calculated for *O. militoris*, caught in Eco-behundi jal is 7.7 cm and in Conventional behundi jal is 6.7 cm. Based on median length calculation, we can conclude that Eco-behundi jal catches more number of larger size of *O. militoris* when compared to Conventional behundi jal.

5.5.2 Shellfish Group

Two species each of penaeid and non-penaeid shrimps are recorded in catch of Conventional and Eco-behundi jals throughout the study. The length frequencies and percentage cumulative frequencies of these shrimp species are presented in Table 9, 20 and 20.1 and discussed below.

5.5.2.1 *Metapenaeus* Spp.:

Comparatively more numbers of larger shrimps of this species are caught in Eco-behundi jal than in Conventional behundi jal (Table 20). Length range of *Metapenaeus* spp. caught during entire period of study in Eco-behundi jal were in
the range of 2 to 16 cm, while for Conventional behundi jal it was 2 to 14 cm (Table 9).

The median length of this species caught in Eco-behundi jal is 6.9 cm, while it is 4.6 cm in Conventional behundi jal, during 2001–02. During 2002–03, similar median length ranges found for same species was 6.6 cm in Eco-behundi jal, whereas in Conventional behundi jal is 4.8 cm.

Bal and Rao (1990) have reported that the minimum size at sexual maturity is 88.6 mm (8.86 cm) for the ‘O’ year class. Hence, it is evident that, both jals catch belongs to ‘O’ year class. In other words, we can conclude that Eco-behundi jal catch contains the nearer to maturity size of this species in more number when compared to Conventional behundi jal catch.

5.5.2.2 Peneaus Spp.:

Larger size groups of this shrimp species were caught in more number by Eco-behundi jal than the Conventional behundi jal throughout study period (Table 20). The median length of this species of shrimp caught during 2001–02 in Eco-
behundi jal are 7 cm whereas in Conventional behundi jal it is only 3.7 cm (Fig 26.2).

The median lengths are also calculated for this species of shrimp caught in the period of 2002–03 and are found to be similar in Eco-behundi jal and in Conventional behundi jal to that in the period of 2001–02 (Fig 26.2.1).

George (1962) who observed that the recruitment of these species of shrimp takes place in all months except during June to September with the peak of occurrence in November – December and February - April. It is known that juveniles spend their life in the estuaries or backwaters till they attain about 120-140mm length and return to the sea where sexual maturity takes place.

Based on this report, we can interpret that catch from both jals contain juveniles of this species of shrimp, but size ranges of this species caught in Eco-behundi jal were quite larger than those caught in Conventional behundi jal.
5.5.2.3 *Macrobrachium lamerrii* :

Length frequency data for the period of 2001-02 and 2002-03 for *M. lamerrri* given in Table 20.1 show that the number of smaller size caught in Conventional behundi jal is higher than that in Eco-behundi jal.

The median length of *M. lamerrri* caught in period of 2001-02 by Eco-behundi jal as obtained from graph (Fig 26.3) is found to be 8.0 cm and that in Conventional behundi jal is 5.6 cm. The length range of this species of shrimp caught during the entire period of study is 4-14 cm in Eco-behundi jal and 2-10 cm in Conventional behundi jal (Table 9).

During the period of 2002-03, the median lengths calculated for *M. lamerrri* caught in Eco-behundi jal is found to be 7.2 cm whereas it is 5 cm in Conventional behundi jal (Fig 26.3.1).

Bal and Rao (1990) have reported that, the *Macrobrachium* spp. grows to its maximum size of 230mm and 200mm for the male and female respectively. Hence, it is evident that catch content of both jals are not of maximum size of this
species of shrimp, but developed Eco-behundi jal catches larger sizes of this species when compared to Conventional one.

5.5.2.4 *Macrobrachium mirable* :

Number of small size *M. mirable* caught throughout the period of study is higher in Conventional behundi jal than that in Eco-behundi jal. Median length of *M. mirable* caught during 2001-02 in Eco-behundi jal (Fig 26.4) is found to be 6.6 cm whereas in Conventional behundi jal it is 4.3 cm.

The length ranges of *M. mirable* caught throughout the study period in Eco-behundi jal is 4-14 cm and that in Conventional behundi jal is 2-10 cm (Table 9). Fig 26.4.1 shows the median values of this species obtained during 2002-03 periods in Eco-behundi jal and Conventional behundi jal. These are found to be 7.2 cm in Eco-behundi jal and 3.7 cm in Conventional behundi jal. Bal and Rao (1990) have reported that, the *Macrobrachium* spp. grows with its maximum size of 230mm and 200mm for the male and female respectively. We can conclude that, even though catch content in two jals are not of maximum size of this species, the developed Eco-behundi jal catches larger sizes of this species when compared to Conventional one.
CONCLUSION:

The present investigation shows that, the catch rate of Eco-behundi jal (EBJ) was 1.36 times less than Conventional behundi jal (CBJ), but the percentage of commercial species recorded is at higher rate in Eco-behundi jal to the tune of 121% compared to that of Conventional behundi jal. This means that the Eco-behundi jal has less catch rate when compared to Conventional behundi jal, which is due to the mesh opening of the square mesh panels in codend and in second section of upper belly have more area of opening and stable. Whereas the diamond meshes in conventional behundi jal have lesser opening and not stable. Hence, the possibilities for escape of juveniles, undersized finfishes and shellfishes through these openings are greater in developed Eco-behundi jal.

The Conventional behundi jal landed higher quantities of by-catch than the Eco-behundi jal during the entire period of study. The by-catch contribution is found to be more (28%) in Conventional behundi jal, than (12.5%) percentage in Eco-behundi jal. This indicates the filtration of juveniles (fry),
undersized finfishes and shellfishes through square mesh openings at codend and second section of upper belly.

Length of individuals of different species groups recorded were analyzed and found that, the Eco-behundi jal catches invariably less number of juveniles, undersized finfishes and shellfishes when compared to Conventional behundi jal. The L₅₀% (i.e., 50% retention lengths) was found to be better in Eco-behundi jal than Conventional behundi jal for finfishes and shellfishes. Thus, Eco-behundi jal had better selection properties for finfishes and shellfishes with respect to releasing the juveniles (fry) and smaller ones.

Based on this investigation, I suggest that, further mesh size standardization studies may be carriedout for the conservation of migratory fishes. The peak periods of abundance of young fry of finfishes and shellfishes in this region may be studied to regulate and restrict the fishing with small meshed nets like Conventional Behundi jal (Winter Migratory Bag Net).