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## Design characteristics of mackerel encircling gill nets of Ratnagiri, Maharashtra

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### ABSTRACT

Gill net fishing is one of the popular fishing methods along the west coast of India. The paper deals with design and general characteristics of mackerel encircling gill nets operated from Ratnagiri, Maharashtra. Webbing of the nets were found to be fabricated with polyamide (PA) monofilament of diameter 0.23 mm, mesh size ranged between 45 to 60 mm and hanging coefficient varied from 0.40 to 0.54. The hung length and hung depth of the encircling mackerel gill net ranged in between 38.88 to 76.92 m and 8.28 to 17.62 m, respectively with the total fleet length of 410 to 960 m. For this type of net 110 to 140 number of plastic floats and oval shape lead sinkers of 50 to 140 number were used. Ten to sixteen number of units were joined together to form netting fleet. The mackerel encircling gill nets are locally known as *Phatyachi rapan* and *Bangdyachi rapan*.

**Key words :** Design, Characteristics, Mackerel, Encircling, Gill net

### INTRODUCTION

Gill nets, owing to their simplicity in design, construction, operation and the low investment needed, remain as the most popular gear in all the sectors especially in the traditional sector. Maharashtra state is one of the major marine fish landing states in India. It has 720 km coastal line spread all over the maritime districts viz. Thane, Mumbai, Raigad, Ratnagiri and Sindhudurg. The fishing fleet operating along the Maharashtra coast during the year 2006-07 comprised of 11,798 mechanized boats and 10,895 non mechanized boats. In Ratnagiri a total of 588 numbers of gill netters are in operation (Anonymous, 2007).

Design characteristics of marine gill nets of Kerala have been discussed by Thomas and Hridayanathan (2006) and Vijayan *et al.* (1993), gill nets of Gujarat by Pravin *et al.* (1998), of Andhra Pradesh by Ramarao *et al.* (2002).

Various aspects of mackerel gill nets of India were studied by Mathai *et al.* (1993), Thomas *et al.* (2005) and Meenakumari *et al.* (2009). The technical and design details of 'aila chalavala', the encircling gill nets for mackerel was reported by Satyanarayana and Sadanandan (1962). Encircling gill nets for mackerel were also recorded by Thomas *et al.* (2005) from Gujarat.

Many changes have taken place in the gillnets with

respect to the material used, net dimensions, mesh size, mode of operation (Vijayan *et al.*, 1993). The present day gill nets are mostly resource specific. The present study was undertaken with the objective of documenting the design characteristics of the mackerel encircling gill nets operated from Ratnagiri.

### MATERIALS AND METHODS

The investigation was undertaken during the period August, 2009 to May, 2010 to study the design and general characteristics of mackerel encircling gill nets of Ratnagiri, Maharashtra. Ten important fish landing centres of Ratnagiri were selected for the present study, namely Mirkarwada which is a major fish landing and distribution centre while Sakhartar, Kasarveli, Mirya Bandar, Bhagwati Bandar, Bhatkarwada, Rajiwada, Karla, Bhatye and Phansop are the small fishing and landing centres. Structured data collection schedule formulated for the present study comprised of two major sections. The first section dealt with the particulars of gill net owner and the fishing vessel used for the gill net operation. The second section dealt with the design characteristics, rigging and the mode of operation of the mackerel encircling gill nets used by the fisherman of Ratnagiri. The information included in the first section was recorded according to

Sreekrishna and Shenoy (2001) whereas, the information in the second section was physically collected and recorded according to Thomas and Hridayanathan (2006). The net designs of the mackerel encircling gill nets were presented according to Nedelec (1975).

## RESULTS AND ANALYSIS

Specification and design of a typical mackerel encircling gill net operated from Ratnagiri is given in Table 1 and Fig. 1. Encircling gill nets from Ratnagiri were operated for catching the shoals of mackerel, feeding or moving in the surface layers.

In Ratnagiri, encircling mackerel gill nets were made of material polyamide (PA) monofilament of 0.23 mm. Mathai *et al.* (1993) studied the mackerel gill nets of Goa and observed that the nets made out of nylon twine 210d×1×2 were best for the exploitation of commercially accepted size group (190-200 mm). PA monofilament of 0.28 to 0.30 mm was reported for mackerel gill nets in Gujarat by Pravin *et al.* (1998). Ramarao *et al.* (2002) recorded that the mackerel gill nets from the Andhra Pradesh coast were made up of PA of 0.23 to 0.32 mm diameter twines and PA multifilament of 210d×1×2 twine. Use of PA monofilament of 0.20 mm diameter were reported from Karnataka and Kerala and PA monofilament of 0.16 to 0.32 mm and 210d×1×2 were reported from Andhra Pradesh by Thomas *et al.* (2005). Thomas and Hridayanathan (2006) observed that in Kerala, mackerel gill nets of PA monofilament of 0.20 mm diameter were commonly used. Results of the present study indicated that the gear material used for mackerel gill net was quite similar as that of the gear material used along Indian coast.

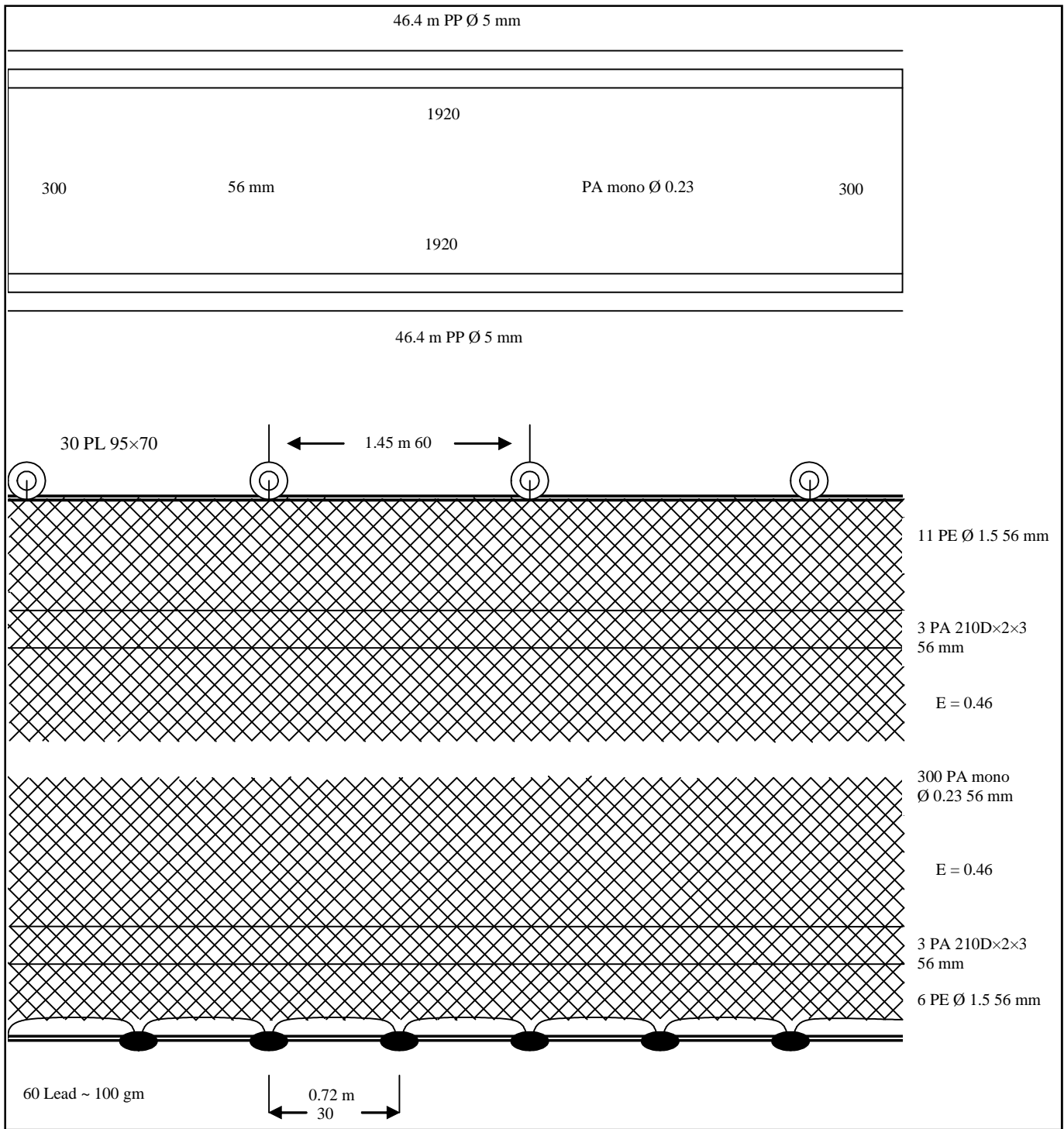
In Ratnagiri, for the encircling mackerel gill nets the mesh size ranging from 45 to 60 mm were used. Satyanarayana and Sadanandan (1962) reported almost uniform mesh size of 50.8 mm and Vijayan *et al.* (1993) reported 50 mm in 1958 and 50 to 52 mm in 1991 for mackerel. Mathai *et al.* (1993) conducted mesh selectivity studies for mackerel gill nets operated off Goa and recorded that a mesh size of 50 mm was optimum for the exploitation of commercially accepted size group of mackerel having a total length of 190 to 200 mm. Mesh size of 40 to 70 mm were used in Gujarat for mackerel fishing (Pravin *et al.*, 1998). Mesh size of 50 to 60 mm was reported by Ramarao *et al.* (2002) from Andhra Pradesh for mackerel fishery. In Karnataka for mackerel fishing encircling gill nets with mesh size of 50 to 65 mm were recorded by Thomas *et al.* (2005). They also recorded mackerel gill nets in Kerala and Andhra Pradesh with mesh size of 48 to 60 mm and 50 to 56 mm in Andaman

Islands. Thomas and Hridayanathan (2006) reported the mesh size for mackerel gill nets in the range of 38 to 52 mm with most common mesh size of 52 mm. Thirty eight to fifty mm of common mesh size and 50 mm of optimum mesh size was suggested by Meenakumari *et al.* (2009) for mackerel fishery. Mesh size recorded for the mackerel gill nets operated from Ratnagiri were in the similar size range as compared to the mesh size reported during the other studies along the Indian coast (Satyanarayana and Sadanandan, 1962; Vijayan *et al.*, 1993; Mathai *et al.*, 1993; Pravin *et al.*, 1998; Ramarao *et al.*, 2002; Thomas *et al.*, 2005; Thomas and Hridayanathan, 2006 and Meenakumari *et al.*, 2009) except for the upper range exceeding to 70 mm in Gujarat (Pravin *et al.*, 1998).

According to the study of Ramarao *et al.* (2002), hanging coefficient of 0.50 to 0.55 was used for mackerel gill nets in Andhra Pradesh. Thomas and Hridayanathan (2006) reported the mackerel gill nets with average hanging coefficient of 0.62 in Kerala. Quite similar observation regarding hanging coefficient were observed during present study. In Ratnagiri, the hanging coefficient for encircling type of mackerel gill nets ranged from 0.40 to 0.54.

It was recorded during the present study that, the hung length of each fishing unit for encircling type of mackerel gill net varied from 38.88 to 76.92 m. On the contrary, in Andhra Pradesh 70 to 800 m length of gill net units for mackerel fishing were recorded by Ramarao *et al.* (2002). In Kerala, Thomas and Hridayanathan (2006) reported the mackerel gill net units with the average hung length of 160 m which were longer than the hung length observed during the present study.

In Ratnagiri it was recorded that the hung depth for encircling mackerel gill net ranged in between 8.28 to 17.62 m. Mackerel gill nets of the late 1950s had a depth of 9 to 18.9 m used for the encircling operation (Vijayan *et al.*, 1993). Satyanarayana and Sadanandan (1962) reported the average depth of encircling mackerel gill nets of 11.48 m and had recorded 13.1 m to be the maximum fishing height and that the nets were operated in deeper waters for mackerel. Ramarao *et al.* (2002) reported the hung depth of 7.0 to 9.6 m for mackerel gill nets in Andhra Pradesh. Average of 8.48 m of fishing height or hung depth was recorded for mackerel fishing in Kerala by Thomas and Hridayanathan (2006). The hung depth for mackerel gill nets reported by the other workers (Vijayan *et al.*, 1993; Satyanarayana and Sadanandan, 1962; Ramarao *et al.*, 2002 and Thomas and Hridayanathan, 2006) along the Indian coast were observed to be within the range of the hung depth of 4.50 to 17.62 m as recorded during the present study in Ratnagiri. It was estimated that for



**Fig. 1 : Design of mackerel encircling gill net operated from Ratnagiri**

mackerel encircling gill net operated from Ratnagiri, mounted height was 87.5% of total stretched height (Graph 1).

Vijayan *et al.* (1993) recorded that the total length of mackerel gill nets operated during 1951 were in the range of 60 to 286.68 m and during 1991 were in the range of

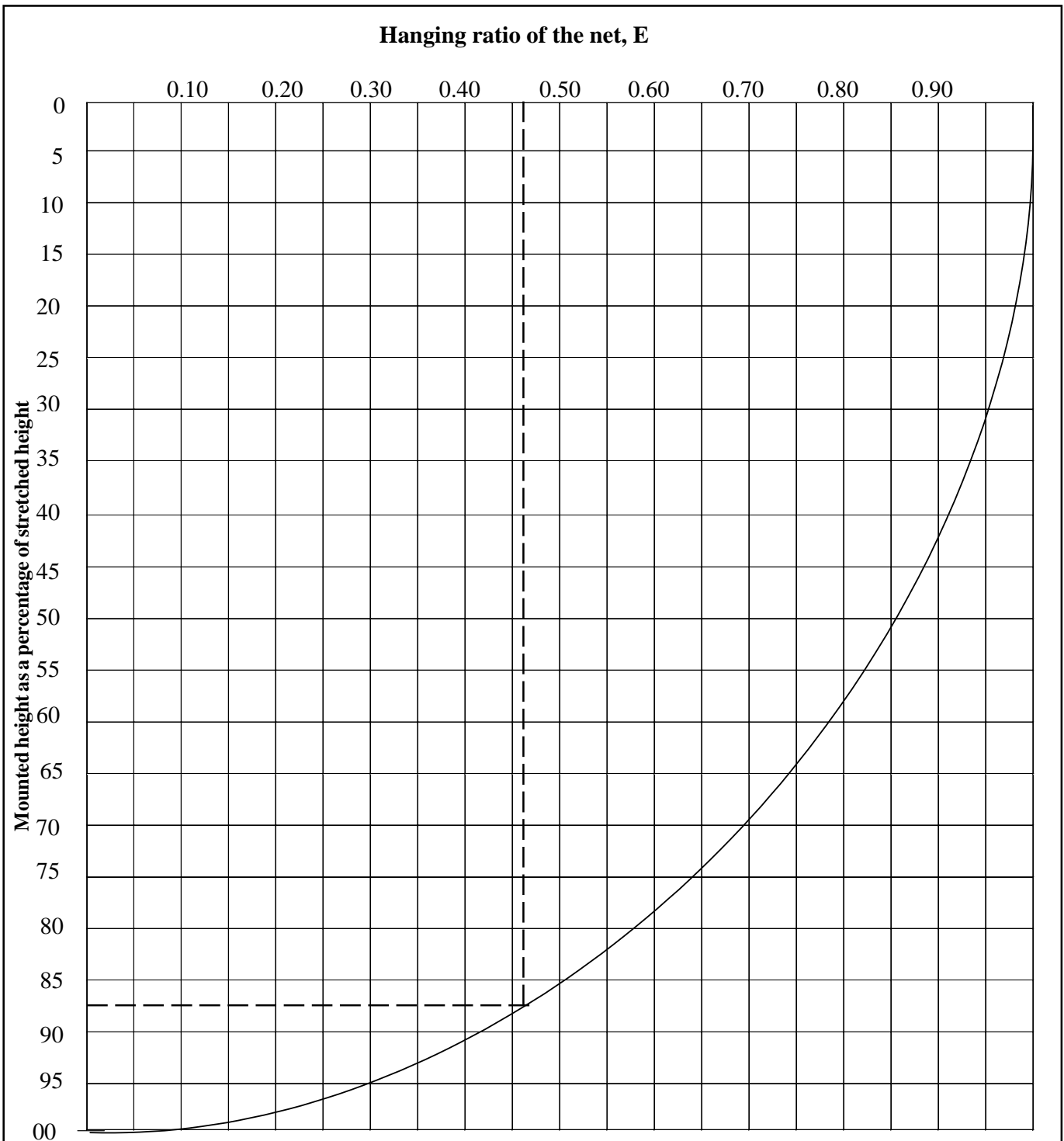
200 to 850 m. On the contrary in Ratnagiri, the total length of mackerel gill nets ranged from 320 to 960 m. Thomas and Hridayanathan (2006) reported the total fleet length for the mackerel gill nets was in the range of 800 to 1040 m which was larger than the maximum fleet length recorded during the present study.

**Table 1 : Design characteristics of mackerel encircling gill net operated from Ratnagiri**

Station	Ratnagiri			
Local name	<i>Phatyachi rapan and Bangdyachi rapan</i>			
Main webbing mesh size (mm)	45-60			
Mean main webbing mesh size (mm)	55.93 ± 0.85			
Twine type	PA mono			
Twine specification/ diameter (mm)	0.23-0.26			
Mean twine specification/ diameter (mm)	0.23			
No. of meshes in depth	200-300			
Mean no. of meshes in depth	293.33 ± 6.66			
Horizontal hanging coefficient (E)	0.40-0.54			
Mean horizontal hanging coefficient (E)	0.46			
Vertical hanging coefficient (1-E2)	0.84-0.91			
Mean vertical hang. Coefficient (1-E2)	0.87			
No. of meshes per unit	1740-2787			
Mean no. of meshes per unit	2246.2 ± 89.17			
Hung length (m)	38.88-76.92			
Mean hung length (m)	58.11 ± 2.34			
Hung depth (m)	7.83-16.38			
Colour of webbing	Colourless			
Selvedge	Top		Bottom	
Twine type	PE	PA multi	PE	PA multi
Selvedge specification-diameter (mm)	1-1.5	210×2×3	1-1.5	210×2×3
Selvedge mesh size (mm)	45-60	45-60	45-60	45-60
No. of selvedge meshes in depth	6-11	3-5	6-11	2-5
Selvedge hung depth (m)	0.19-0.60	0.14-0.24	0.19-0.60	0.07-0.24
Total hung depth (m)	8.28-17.62			
Mean total hung depth (m)	15.53 ± 0.54			
Head rope material	PP			
Head rope diameter (mm)	4-6			
Float material	Plastic			
Float dimensions (mm)	95×70/55×80			
No. of floats per unit	110-140			
Mean no. of floats per unit	123.06 ± 1.90			
Foot rope material	PP			
Foot rope diameter (mm)	4-6			
Sinker material	Lead			
Sinker weight (g)	100-200			
A) No. of sinkers per unit (100 gm)	110-140			
Mean no. of sinkers per unit (100 gm)	123.06 ± 1.90			
B) No. of sinkers per unit (200 gm)	50-70			
Mean no. of sinkers per unit (200 gm)	61.26 ± 1.32			
Total fleet length (m)	410-960			
Mean total fleet length (m)	738.33 ± 40.61			
Depth of operation (m)	18-28			
Fishing craft	Wooden and FRP boat motorized, wooden and FRP boat mechanized			
Horse power of the engine (HP)	9.9-50			

During the present investigation, for encircling type of gill net the depth of operation ranged from 18 to 28 m in Ratnagiri. For mackerel gill nets along Kerala coast Vijayan

*et al.* (1993) reported that non-motorized vessels operated at a depth of 4.7 to 6.7 m whereas motorized at 15 to 100 m. In Karnataka, 5 to 15 m of depth of operation for



**Graph 1 : Mounted height for pomfret drift gill net operated from Ratnagiri**

mackerel gill nets was recorded by Thomas *et al.* (2005). Depth of operation recorded for mackerel gill net by Thomas and Hridayanathan (2006) in Kerala was 32 to 40 m. The depth of 4.7 m and 100 m recorded by Vijayan *et al.* (1993) for operation of mackerel gill nets of Kerala coast were the minimum and maximum depths recorded along the Indian coast; were as the depth of 10 m and 28

m were the minimum and maximum depths recorded during the present study in Ratnagiri.

In Kerala, for mackerel gill net polypropylene (PP) head rope and foot rope of 4 mm diameter was used. Polyvinyl chloride (PVC) floats of 100 number per unit and concrete sinkers of 50 number each weighing 250 g were reported to be used in Kerala by Thomas and

Hridayanathan (2006). On the contrary, in Ratnagiri for encircling mackerel gill nets head rope and foot rope of PP of 4 to 6 mm diameter was used. It was observed that, 110 to 140 number of plastic floats and oval shape lead sinkers of 100 or 200 g were used in Ratnagiri. The nets with 100 g weight sinker had 110 to 140 number of sinkers per unit while nets with 200 g weight sinkers had 50 to 70 number. For this type of net, the floats were spaced at an average distance of 13.43% of the total hung depth. In Ratnagiri for encircling net, 10 to 16 number of units were joined together to form a total netting fleet during the net operation. Similar observation was recorded by Ramarao *et al.* (2002) in Andhra Pradesh that, during operation of mackerel gill net total 5 to 15 number of units were used.

In mackerel encircling gill net, the net was encircled around the mackerel shoal and after encircling, sound and vibrations were used to drive the fish towards the net so that they were gilled. Both motorized and mechanized fishing vessels were used to conduct encircling mackerel gill net operation with the number of crew members onboard the vessel varied from 4 to 8 for each vessel. Ferro cement reinforced plastic (FRP) coated wooden boats or pure FRP boats in the motorized sector fitted with outboard motors of 9.9 to 15 hp were commonly used. The mechanized sector comprised of wooden plank built or FRP boats with inboard diesel engines of 10 to 50 hp. Unlike in trawling or seining, in gill netting the motor or engine power was used for propulsion only and the entire fishing operation *viz.*, setting and hauling was carried out manually in Ratnagiri.

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