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Note

Catch efficiency of gillnets in shrimp filtration farms at Vypeen Island, Kerala, South India

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ABSTRACT

A study was conducted in a 77.6 ha perennial shrimp aquaculture farm at Vypeen island, Kerala, India to know the catch efficiency of gillnets in prawn filtration farms. Comparison of catch was made between six different mesh sizes, *viz*., 28, 32, 34, 36, 38, and 40 mm and the relative catch efficiency of twine sizes, polyamide monofilament 0.16 mm diameter and polyamide multifilament 210 x 1 x 2 and 210 x 1 x 3. Mesh size ranging from 32 to 36 mm showed better efficiency for total catch of prawn and fish together. PA multifilament gillnets caught more of *Fenneropenaeus indicus*, other shrimps and fish in terms of total weight.

Keywords: Catch efficiency, Gillnets, Mesh size, Twine size

Gillnets are widely used for harvesting shrimps in the extensive traditional shrimp culture farms. They are efficient and relatively inexpensive. Gillnets are among the most selective gears in terms of both species caught and the size range retained (Gulland, 1983).

The catch efficiency of gillnets depends on the use of right materials having least thickness without reduction in strength, lesser visibility, softness, desired elasticity and knot strength. The colour of material, mesh size and hanging ratios also influence the efficiency of gillnets. (Clark, 1960). A few studies have been carried out on the catch efficiency and selectivity of gillnets and trammel nets (Thomas *et al.,* 1993; Acosta and Appledoorn, 1995). Losanes *et al.* (1992) has worked on the catch efficiency of entangling nets. Comparative catch efficiency of nylon over cotton gillnets in reservoirs was done by Mathai and George (1972). Studies on the relative efficiency of PA monofilament and PA multifilament gillnets and trammel nets for penaeid shrimps have been carried out by Klust (1982) and Thomas *et al.* (2003). The efficiency of polyamide (PA) monofilament gillnets over PA multifilament has been reported by many authors (Shimozaki, 1964; Steinberg, 1964; Shon, 1978; Radhalakshmi and Nayar, 1985). However, Njoku (1991) reported that PA monofilament gillnets did not always perform better than multifilament gillnets.

Materials used for fabrication play a dominant role in any selective gear. Studies have been carried out on the comparative merits of synthetic nets over nets made of natural fibres in terms of catch. The commercial application of polyamide in gillnets was reported by Firth (1950). Catch efficiency of nets of different groups of synthetic fibres was studied by Carrothers (1962), Honda and Osada (1964) and Zaucha (1964). Klust (1959; 1960) suggested that PA and PES fibres are suitable for gillnet fabrication. PE gillnets were experimented along with nylon (Steinberg, 1964).

Comparative studies on different materials for gillnets were also carried out by several workers in India (George and Mathai, 1972; Khan *et al*., 1975; Radhalakshmi and Nayar, 1985; Pillai *et al*., 1989; George, 1991; Mohan Rajan *et al.,* 1991; Thomas, 2001).

The objective of this study was to investigate the catch efficiency of gillnets of different twine size and mesh size of PA monofilament and PA multifilament in prawn filtration farms

The study was carried out in a 77.6 ha perennial shrimp aquaculture farm at Vypeen Island (Ernakulam district, Kerala) for a period of 18 months from November 1999 to April 2001. The catch efficiency of monofilament gillnets versus multifilament gillnets was compared. The species composition, total length and weight of the catch caught in each net were recorded. The mean catch value was used in order to compensate for differences in sampling effort among the areas. In this study, gear efficiency is referred to the catch of a net for a given amount of effort. To study the significance of difference of total catch, total shrimp catch total fish catch, and catch of *Fenneropenaeus indicus,* the data were analyzed statistically using single factor ANOVA for mesh size and twine size.

The gillnet catch was standardized by converting the catch into catch per unit effort (CPUE) for an area of 1000 m^2 of webbing of gillnet. Polyamide monofilament nets of twine size 0.16 mm diameter having mesh size 28, 32, 34, 36, 38, 40 and 44 mm and PA multifilament nets of twine size ranging from 210 x 1 x 2 with mesh size of 28, 32, 34, 36, 38, 40 and 44 mm and 210 x 1 x 3 with mesh size of 28, 32, 34, 36, 38 and 40 mm were used for the experimental studies. All these nets were rigged with a hanging coefficient 0.50. The design details of experimental gillnets are given in Table 1. The mesh size was determined by measuring the stretched meshes from randomly selected regions of the net with a centimeter scale (FAO, 1975) and the average values were taken. The total length of the individual shrimp from rostrum to tail tip was measured to the nearest mm (Sparre *et al.,* 1989). Operations were carried out at a depth of 2-4 m from a non-motoroised wooden plank-built traditional canoe of 6 m overall length. The gillnets were operated from 5 am to 1 pm as bottom drift.

In this study, it is assumed that the gillnets placed in juxtaposition perform uniformly and the percentage composition of different length groups obtained from different mesh size, represents the different groups in the stock. As there is continuous autostocking of juveniles of shrimp species during the culture period into the filtration farms and addition of supplementary seeds of *F. indicus*, the stock in the farms represents different length groups. Table 2 shows weight (kg) of total shrimps and fish landed in gillnets. *Fenneropenaeus indicus* contributed 92.6%, *Penaeus monodon* 3.5%, and other shrimps (*Metapenaeus dobsoni* and *Metapenaeus monoceros*) 3.2% of the total shrimp catch. The fish catch comprised of mullets, milk fish, pearl spot, tilapia, catfishes, and a few other miscellaneous species like *Ambassis* sp., *Barbus* sp., C*yprinoides* sp., *Anchoviella* sp., *Terapon* sp., and crab *Sylla serrata*, together forming 13.4% of the total catch. The catch (kg h^{-1}) in 1000 m^2 of webbing in respect of *P. monodon, F. indicus* and other shrimps and total fish caught is given in Table 3.

Comparison of catch was made between 6 different mesh sizes, *viz*., 28, 32, 34, 36, 38, and 40 mm. The catch details of 44 mm mesh size was not considered for the study as this mesh size was not represented in the PA multifilament 210 x 1 x 3 gillnet. Mesh size 38 mm landed 17.9% of the total experimental shrimp catch. The shrimp catch was less in 28 mm (11.7%). The catch decreased as the mesh size increased from 34 to 40 mm. Considering the total catch of prawn and fish together, mesh size ranging from 32 to 36 mm showed better efficiency. In the case of multifilament gillnets, much variation could not be seen in the shrimp catch between various mesh size. Maximum catch (18.4% and 18.1%) was observed in the nets with 32 mm and 34 mm mesh size, respectively. In order to test the significance of the difference in the catch

Table 1. Design details of experimental gillnets

Material and twine size	Mesh size (mm)	Hanging ratio (E)	Hung length: hung depth (m)	Floats specifications (mm)	No/ unit	Sinkers specifications	No/ unit
PA monofilament 0.16 mm ø	28.0	0.50	50 x 1.8	50 x 10 PVC, cylindrical	35	25 g, lead, cylindrical	60
PA monofilament 0.16 mm ø	32.0	0.50	50 x 2.0	50 x 10 PVC, cylindrical	35	25 g, lead, cylindrical	60
PA monofilament 0.16 mm ø	34.0	0.50	50 x 2.3	50 x 10 PVC, cylindrical	35	25 g, lead, cylindrical	60
PA monofilament 0.16 mm ø	36.0	0.50	50 x 2.3	50 x 10 PVC, cylindrical	35	25 g, lead, cylindrical	60
PA monofilament 0.16 mm ø	38.0	0.50	50 x 2.4	50 x 10 PVC, cylindrical	35	25 g, lead, cylindrical	60
PA monofilament 0.16 mm ø	40.0	0.50	50 x 2.4	50 x 10 PVC, cylindrical	35	25 g, lead, cylindrical	60
PA monofilament 0.16 mm ø	44.0	0.50	50 x 2.5	50 x 10 PVC, cylindrical	35	25 g, lead, cylindrical	60
PA multifilament 210 x 1 x 2	28.0	0.50	50 x 1.8	50 x 10 PVC, cylindrical	35	25 g, lead, cylindrical	60
PA multifilament 210 x 1 x 2	32.0	0.50	50 x 2.0	50 x 10 PVC, cylindrical	35	25 g, lead, cylindrical	60
PA multifilament 210 x 1 x 2	34.0	0.50	50 x 2.3	50 x 10 PVC, cylindrical	35	25 g, lead, cylindrical	60
PA multifilament 210 x 1 x 2	36.0	0.50	50 x 2.3	50 x 10 PVC, cylindrical	35	25 g, lead, cylindrical	60
PA multifilament 210 x 1 x 2	38.0	0.50	50 x 2.4	50 x 10 PVC, cylindrical	35	25 g, lead, cylindrical	60
PA multifilament 210 x 1 x 2	40.0	0.50	50 x 2.4	50 x 10 PVC, cylindrical	35	25 g, lead, cylindrical	60
PA multifilament 210 x 1 x 2	44.0	0.50	50 x 2.5	50 x 10 PVC, cylindrical	35	25 g, lead, cylindrical	60
PA multifilament 210 x 1 x 3	28.0	0.5	50 x 1.8	50 x 10 PVC, cylindrical	35	25 g, lead, cylindrical	60
PA multifilament 210 x 1 x 3	32.0	0.5	50 x 2.0	50 x 10 PVC, cylindrical	35	25 g, lead, cylindrical	60
PA multifilament 210 x 1 x 3	34.0	0.5	50 x 2.3	50 x 10 PVC, cylindrical	35	25 g, lead, cylindrical	60
PA multifilament 210 x 1 x 3	36.0	0.5	50 x 2.3	50 x 10 PVC, cylindrical	35	25 g, lead, cylindrical	60
PA multifilament 210 x 1 x 3	38.0	0.5	50 x 2.4	50 x 10 PVC, cylindrical	35	25 g, lead, cylindrical	60
PA multifilament 210 x 1 x 3	40.0	0.5	50 x 2.4	50 x 10 PVC, cylindrical	35	25 g, lead, cylindrical	60

Table 2. Catch (kg) landed in monofilament and multifilament gillnets of different mesh and twine sizes

Catch (kg)	Mesh size (mm)						
	28.0	32.0	34.0	36.0	38.0	40.0	44.0
PA monofilament 0.16 mm ϕ							
Penaeus monodon	5.5	3.8	4.6	2.5	3.0	1.2	5.0
Fenneropenaeus indicus	58.0	76.7	104.7	93.7	88.6	80.1	68.5
Other shrimps	10.0	1.7	3.1	7.6	4.0	0.6	3.9
Total shrimps	73.5	82.2	112.4	103.8	95.6	81.9	77.4
Fish	38.0	33.3	7.6	17.2	6.9	5.6	7.0
Total catch	111.5	115.5	120.0	121.0	102.5	87.5	84.4
PA multifilament 210 x 1 x 2							
P. monodon	2.4	4.4	4.2	4.8	5.2	1.6	12.0
F. indicus	91.2	110.2	103.6	94.8	78.8	92.8	76.0
Other shrimps	2.8	5.4	2.1	5.5	5.4	0.9	1.9
Total shrimps	96.4	119.2	109.9	105.0	89.4	95.3	89.9
Fish	38.0	17.0	10.8	5.4	5.1	3.7	5.4
Total catch	134.4	136.2	120.7	110.4	94.5	99.0	95.3
PA multifilament 210 x 1 x 3							
P. monodon	2.8	3.6	4.2	3.6	3.5	1.6	-
F. indicus	96.2	95.2	103.6	87.2	88.0	91.8	-
Other shrimps	3.3	4.6	1.1	0.4	4.8	0.6	-
Total shrimps	102.3	103.4	108.9	91.2	96.3	94.0	-
Fish	36.0	32.8	10.8	15.6	8.0	4.7	-
Total catch	138.3	136.2	119.7	106.8	104.3	98.7	-

efficiency, the variance for total catch, total shrimp catch, catch of *F. indicus* and fish catch were analyzed separately.

The total catch in different mesh size shows significant difference between meshes as far as total catch is concerned ($p<0.001$). LSD at 5% level for mesh size is 0.1267. Mesh size 28, 32, and 34 mm were having significantly higher catch compared to other mesh size. This is mainly due to landing of substantial number of small sized fish and shrimps in the small mesh gillnets. The fish catch in different mesh size shows significant difference between meshes as far as fish catch is concerned ($p< 0.001$). LSD at 5% level for mesh size is 0.2302. Mesh size 28 and 30 mm were having significantly higher catch than the rest. Significantly lower catches were seen in the gillnet with mesh size 34, 36, 38 and 40 mm. There was no significant difference between the mesh and shrimp catch, mesh size and *F. indicus*.

The relative catch efficiency of the three twine size, PA monofilament 0.16 mm diameter and PA multifilament 210 x 1 x 2 and PA multifilament 210 x 1 x 3 for gill nets were compared. All the twine size of PA gill nets used in the study caught all the species recorded. Total shrimp catch for 1000 m^2 of webbing was 58.9, 82.2 and 101.5 kg h^{-1} for PA monofilament 0.16 mm ϕ, PA multifilament 210 x 1 x 2 and 210 x 1 x 3 gillnets, respectively, indicating that PA multifilament is more efficient than PA monofilament gillnets. To test whether there is significant difference in catch efficiency of the three twine size, catch in the experimental nets of different twine size, were analyzed using single factor ANOVA, separately for total shrimps, catch of *F. indicus* and fish catch.

Table 3. Catch (kg) per 1000 m^2 of webbing in monofilament and multifilament gillnets of different mesh sizes

	Catch (kg)																						
	PA monofilament 0.16 mm ϕ								PA multifilament 210 x 1 x 2								PA multifilament 210 x 1 x 3						
Mesh size (mm) / Species	28.0	32.0	34.0	36.0	38.0	40.0	44.0	Mean	28.0	32.0	34.0	36.0	38.0	40.0	44.0	Mean	28.0	32.0	34.0	36.0	38.0	40.0	Mean
P. monodon	4.5	0.2	3.1	1.8	1.6	0.5	1.7	1.9	2.0	0.0	3.6	2.6	5.7	1.8	11.1	3.8	2.4	0.0	6.4	2.2	2.5	1.9	2.6
F. indicus	45.0	60.6	73.0	63.3	58.8	33.9	41.3	53.7	77.2	90.9	89.1	72.5	70.8	70.9	55.2	75.2	82.1	115.5	123.8	103.9	64.0	86.5	96.0
Other shrimps	7.7	1.4	2.3	5.0	2.5	0.3	1.1	2.9	2.3	5.0	2.0	3.5	3.2	1.0	1.1	2.6	2.7	5.2	1.5	0.2	2.8	0.6	2.2
Total shrimps	57.2	64.9	78.4	70.2	62.9	34.7	44.0	58.9	81.5	99.9	94.7	78.6	79.7	73.8	67.3	82.2	87.3	125.2	131.7	106.4	69.3	88.9	101.5
Fish	29.4	28.7	4.9	7.3	4.7	2.4	3.9	11.6	32.2	14.0	9.4	2.8	4.3	2.8	3.9	9.9	30.6	38.2	11.8	7.4	5.7	4.5	16.4
Total catch	86.6	93.6	83.3	81.2	67.6	37.1	47.9	71.0	113.7	113.9	104.1	83.1	84.0	76.6	71.2	92.4	117.8	163.4	143.5	125.0	75.0	93.4	119.7

The total shrimp catch in different twine size showed significant difference ($p<0.01$). The twine 210 x 1 x 3 gave significantly higher shrimp catch compared to 0.16 mm PA twine size. There was no significant difference between the two multifilament twines. There was significant difference between fish catch and twine size ($p<0.01$). The twines of diameter 0.16 mm and 210 x 1 x 3 PA gave significantly higher fish catch compared to 210 x 1 x 2 twine. There was a significant difference in catch of *F. indicus* when the twine size was taken into consideration ($p<0.001$). The twine 210 x 1 x 3 gave significantly higher shrimp catch compared to 0.16 mm and 210 x 1 x 2 twines. Between 0.16 mm and 210 x 1 x 2 twines, there was no significant difference. It was observed that multifilament gill nets (210 x 1 x 2 and 210 x 1 x 3) caught more *F. indicus,* other shrimps and fish in terms of total weight. The higher catch efficiency of PA multifilament gillnets compared to monofilament is in agreement with earlier reports. Njoku (1991) observed that multifilament nets captured more fish in terms of total weight. Baranov (1914) and Klust (1982) have testified the gilling efficiency of multifilament nets. It was observed that most of the prawns were entangled in the case of multifilament gillnets and very few were gilled. The weight of shrimp was higher for multifilament gillnets (650 kg) than for monofilament gillnets (549 kg). This could be due to the fact that soft twisted PA multifilament twines usually have very fine diameters and they tend to entangle the fish. The entangling ability of the multifilament netting has been described by Baranov (1976) as a basic advantage over the monofilament material.

The shrimp catch depends on the number of shrimp which come into contact with the fishing gear and the number of shrimp captured by the net. This depends on the density of the shrimp, the area of the net, and the type of motion of shrimp, its behaviour and position of the net relative to the direction of fish motion. In the case of gillnet, the material and twine thickness plays an important role in the catch efficiency. During this study, multifilament gillnet showed better catch efficiency than monofilament gillnets. It is possible that mechanical factors play a part, PA multifilament being softer than the PA monofilament gillnets may not alert the fish much when they touch the net and thus are caught in the net easily (Baranov, 1976). Monofilament nets are often thought to be more effective than multifilament nets, principally because they are less visible in water and the difference in catch tends to be greatest when the nets are used in clear water. Because of the turbid nature of the farm, due to continuous inlet and outlet of water and operation of different fishing gears during the final harvesting, there would not be any advantage of monofilament over multifilament gillnets due to poor visibility. Potter (1983) observed that multifilament nets were more efficient than monofilament gillnets for salmon fisheries mainly due to more stretching capacity in the case of the latter. Stewart (1987), investigating the use of shallow, loosely hung gillnets (E 0.4) in Scottish inshore cod fisheries, found that more fish were caught by entangling in multifilament gillnets than in monofilament nets.

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