

Original Research Article

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Contribution of Bycatch in Gillnet Fishery of Saroda Reservoir, Kabeerdham District, Chhattisgarh (India)

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ABSTRACT

A comparative study was conducted on different types of gillnets operated in a medium type Saroda reservoir along the *Uttari* river in Kabeerdham district. Gillnets mesh size operated in the reservoir varied from 20 mm to 210 mm. CPUE varied from 3.70 kg to 5.70 kg for total catch, 1.90 kg to 5.40 kg for main catch and 0.02 kg to 1.80 kg for bycatch. Hanging coefficient of gillnets operated in this reservoir was 0.7. The bycatch from gillnets was 48.648, 5.263, 2.277 and 0.534 % for various types of gillnets N1, N2, N3 and N4 respectively. Undersized *Catla catla* was the major constituent 20.270% of bycatch from the gillnet N1 and minor constituent 0.213% from gillnet N4. The bycatch of *Labeo rohita* 12.126, 0.877, 0.474 and 0.106 %, *Cirrhinus mrigala* 6.756, 1.754, 0.189 and 0.106 % and undersized *Ctenopharyngodon idella* 0.054, 0.877, 0.474 and 0.106 % was respectively contributed by gillnet N1, N2, N3 and N4. The bycatch of *Cyprinus carpio* 0.054% and 0.189%, *Hypophthalmichthys molitrix* 1.351% and 0.474% was respectively contributed by gillnets only N1 and N3. One-way ANOVA was carried out and significant difference was found in bycatch of different gillnets. Gillnet N1 with very small mesh size had more bycatch in comparison to main catch. Hence, it may be concluded that bycatch is inversely proportional to mesh size of gillnets. Therefore, it is recommended that smaller mesh size gillnets shall not be permitted in the reservoir.

Keywords

Saroda Reservoir,
Gillnet, Main catch,
Bycatch.

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Introduction

Bycatch is the incidental capture of non-targeted organisms in commercial fisheries, is a growing concern and an important conservation issue (Alverson *et al.*, 1994; Hall and Mainprize, 2005; Harrington *et al.*, 2005; Kelleher, 2005). It is also referred to an incidental catch causing mortality and injuries to the non-target species, is an issue affecting the ecosystem and survival of marine population (Read, 2013). The awareness of bycatch issue attracted a global interest as it is urged to develop international guideline on

bycatch management and reduction of discards (FAO, 2014). In general, there are three types of bycatch; normal, cryptic and ghost fishing. Normal bycatch is a non-target species trapped in nets, alive or dead, during hauling process. Cryptic bycatch constitutes of organisms entangled in fishing gears and develops injury and die after trying to escape from the gears (Leland, *et al.*, 2013).

Offlate fisheries are now not only concerned with the sustainability of targeted organisms,

but also beginning to consider sustainability of catches of non-targeted fauna (Hall, *et al.*, 2000). A number of studies examining bycatch issues have increased exponentially in recent decades (Soykan *et al.*, 2008). However these studies, however, focus primarily on marine systems, leaving freshwater bycatch issues relatively unstudied (Raby *et al.*, 2011).

This is disconcerting given that biodiversity in highly diverse freshwater ecosystems which is declining with overexploitation identified as one of the leading causes (Dudgeon *et al.*, 2006). Gillnets are commonly used in reservoirs. In India several commercial gill net fishery operates in almost all lakes and reservoir systems.

Gillnet is a passive fishing gear with species selectivity and are set for long durations (Hubert, 1996). Bycatch has contributed to the degradation of marine ecosystems (Crowder and Murawski, 1998; Hall *et al.*, 2000; Lewison *et al.*, 2004) and very likely have similar impact on freshwater ecosystems. Therefore, there is a need to determine the extent and consequences of bycatch in freshwater commercial fisheries.

The vast and varied inland water resources contribute immensely to the fisheries in the State of Chhattisgarh. This state has mainly three types of water resource viz. pond/tank (74,300 ha), reservoirs (88700 ha) and river (3570 km). Fish production from inland water body is of Chhattisgarh is 2.56 lakh tones (2014). Nearly 56% fish is produced from reservoirs. The total fish production from Kabeerdham district is 9.039 thousand tones. The productivity of this reservoir is 154.76 kg/ha (CGSIRD, 2010). The main objectives of this study were to document the total catch, main catch and bycatch from different types of gillnet and comparing the bycatch among different gillnets.

Materials and Methods

Study area

The present study was carried out at Saroda reservoir, Kabeerdham, Chhattisgarh, India. It is a small type of dam having area 232 ha. and is located at 21°58'38"N. The gillnetting is a year round activity in Saroda reservoir. Gillnet operated in this reservoir have different mesh sizes such as 20 – 60 mm (N1), 70 - 110 mm (N2), 120 – 160 mm (N3) and 170 - 210 mm (N4). Gillnets of different mesh size group were randomly selected for the collection of catches. Technical details and design features of different gillnets being operated in the Saroda reservoir were documented. The design features includes total length, depth (M), color of twine, size of twine (mm), mesh size (mm), diameter of rope (mm), types and sizes of floats and sinkers, inter distance between two consecutive floats and sinkers (cm). Sampling and identification of species were done during present investigation for quantitative assessment of bycatch. Main catch and bycatch for gillnets were segregated and species identification was done using FAO identification sheets (Fischer and Bianchi, 1981, De Bruin *et al.*, 1994).

Catch effort

Catch per unit effort (CPUE) was generated for main catch, bycatch and total catch for the landing centers of Saroda reservoir. The CPUE was calculated by using the formula: Catch = CPUE x Effort (Banarjee, 1980). Catch efforts data were collected from the landing centers of Saroda reservoir for gillnets. The catch per unit effort (CPUE) was taken as catches from the net of 1000 m long, for a soaking duration of 20 hours and the catch was expressed as weight in kg. Estimation of Bycatch, Mean quantity of bycatch and proportion of bycatch to main

catch were estimated for different gillnets. Mean of bycatch was also calculated (Biradar, 2002). Proportion of bycatch to the main catch was expressed as percentage in terms of weight.

Data analysis

Analysis of Variance (ANOVA) was carried out for bycatch and main catch for selected gillnets operated in Saroda reservoir to test for variability at 5% level of significance. Duncan Multiple Range Test was used to separate means. Statistical Package for Social Science (Version 16.0) was used.

Results and Discussion

Gillnet was found to be a major gear used for harvesting of fishes from Saroda reservoir. A wide variation in design features of gillnets was found (Table 1). The gillnets operated in Saroda reservoir varied in length from 200 m to 300 m head rope.

The hanging co-efficient (0.7) and gap between two consecutive sinkers and floats was almost uniform for all the nets operated in Saroda reservoir. The largest mesh size of the net was 210 mm and the smallest was 20 mm with operational depth ranging from 8 - 10 m.

In Saroda reservoir maximum total catch was contributed by Gillnet N2 whereas least total catch was contributed by gillnet N4. The maximum bycatch 36 kg (48.648%) of total catch get contributed by gillnet N1 whereas the minimum contribution of bycatch was from gillnet N4, 0.5kg (0.534%) of total catch (Table 2).

This variation in main catch and bycatch from the gillnet operated in Saroda reservoir occurred only due to the use of unregulated mesh size of the net. The less mesh size of

gillnets results into reduced selectivity and increased bycatch. Presence of undersize fishes such as *Labeo rohita*, *Catla catla*, *Cirrhinus mrigala*, *Cyprinus carpio*, *Hypophthalmichthys molitx* and *Ctenopharyngodon idella* as bycatch in gillnet showed least selectivity of the gillnets. Only three fish species, *Labeo rohita*, *Catla catla* and *Ctenopharyngodon idella* was found as bycatch from the gillnet N2 and N4. All the five fish species *Labeo rohita*, *Catla catla*, *Cirrhinus mrigala*, *Cyprinus carpio*, *Hypophthalmichthys molitx* and *Ctenopharyngodon idella* was found as bycatch from the gillnet N1 and N3. The gillnet N3 have less bycatch 2.4 kg of total catch 105.4 kg whereas gillnet N1 have highest bycatch 36 kg of total catch 74 kg. The gillnet N1 have least mesh size followed by N2, N3 and N4. The gillnet N4 have highest mesh size and contributed least bycatch. So, the mesh size of the gill net N1 has to be regulated to reduce proportion of bycatch.

The details on catch per unit effort (CPUE) was estimated for each shot of 100 m long of different gillnets for a soaking duration of 20 hrs are given in Table 3. The maximum CPUE of bycatch was recorded as 1.80 kg from the gillnet N1 and minimum was 0.02 kg from the gillnet N4. A catch per unit effort (CPUE) was generated for main catch, bycatch and total catch for all the gillnets (Table 3).

The statistical analysis of data obtained in this study indicate the significant differences among the main catch and bycatch from all the gillnets (Table 4). Table 4 presents results of one-way ANOVA with Duncan test, comparing the difference in main catch and bycatch at different coasts. The effects of both factors were highly significant with the p value <0.05 as found in earlier studies (Anirudh *et al.*, 2014 and 2015).

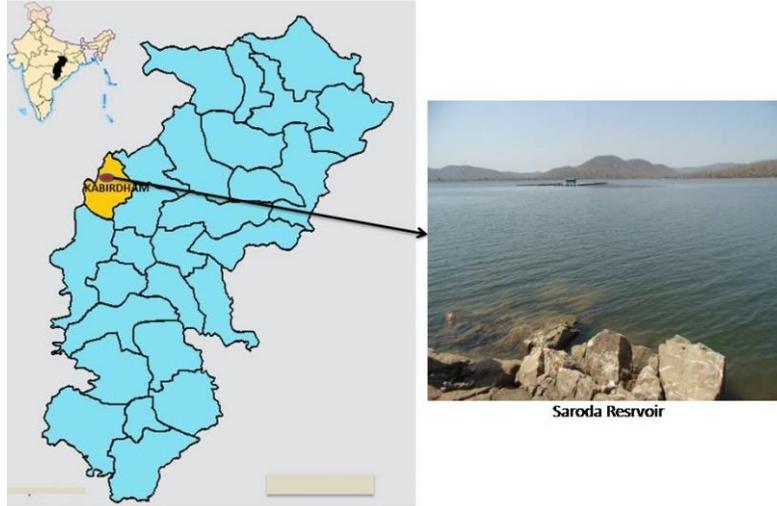


Fig. 1. Study Area (Saroda Reservoir)

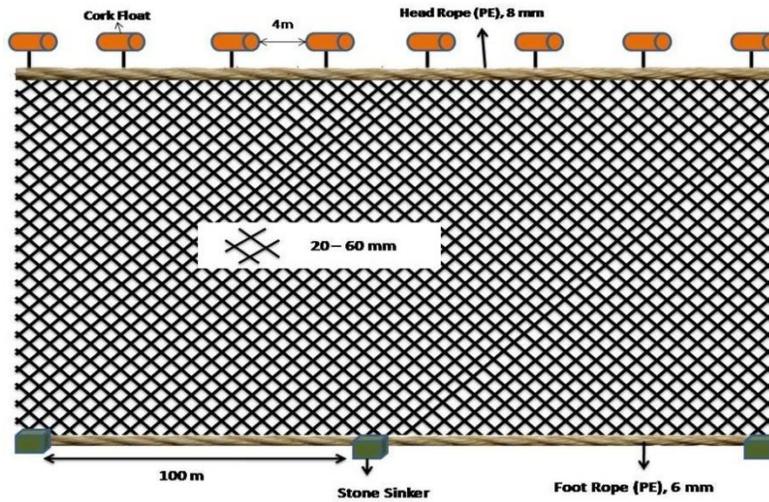


Fig. 2 Gillnet 1 (N1)

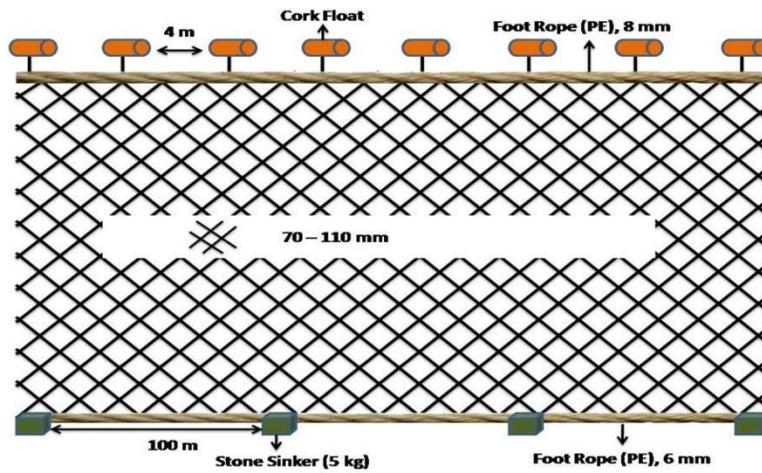


Fig. 3 Gillnet 2 (N2)

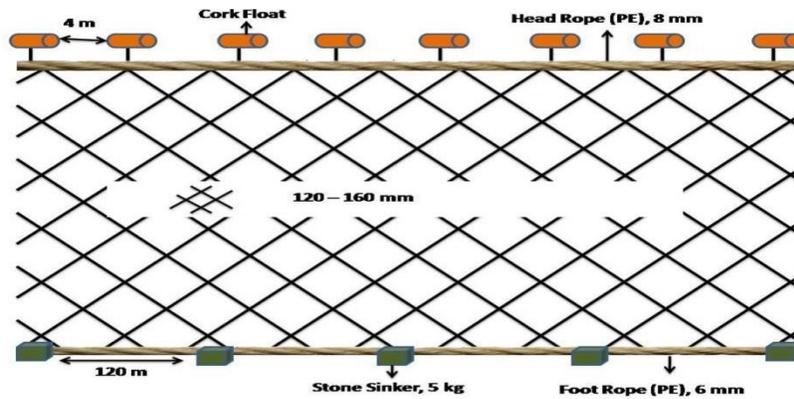


Fig. 4 Gillnet 3 (N3)

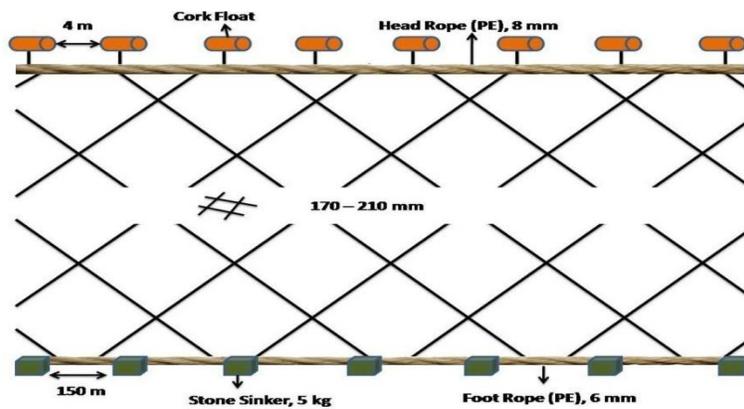


Fig. 5 Gillnet 4 (N4)

Table.1 Design and operational parameters of Gillnets used in Saroda Reservoir, Kabeerdham

Design Features	Gillnets			
	Gillnet 1 (N1)	Gillnet 2 (N2)	Gillnet 3 (N3)	Gillnet 4 (N4)
Mesh size (mm)	20- 60	70-110	120-160	170 - 210
No. of meshes in length	1600	1300	900	700
No of meshes in depth	65	60	52	40
Twine diameter (mm)	1.0	1.0	1.0	1.0
Hanging co-efficient(inner)	0.7	0.7	0.7	0.7
Netting material	PA	PA	PA	PA
Colour of webbing	Light green	white	white	White
Head rope and foot rope length (m)	200	200	300	300
Diameter of head rope (mm)	8.0	8.0	8.0	8.0
Diameter of foot rope (mm)	5.0	5.0	5.0	5.0
Rope material	PE	PE	PE	PE
Type of float	Thermocol	Thermocol	Thermocol	Thermocol
Gap between two consecutive floats(m)	4.0	4.0	4.0	4.0
Type of sinker (Weight)	Stone (5kg)	Stone (5kg)	Stone (5kg)	Stone (5kg)
Gap between two consecutive sinkers (m)	100	100	150	150
Depth of operation (m)	8 - 10	8 - 10	8 - 10	8 - 10
Time of fishing	5pm – 8am & 10 am – 3 pm	5pm – 8am & 10 am – 3 pm	5pm – 8am & 10 am – 3 pm	5pm – 8am & 10 am – 3 pm
Duration of fishing (Hours)	20	20	20	20

Table.2 Mean quantity and proportion of catch and bycatch from Gill nets operated in Saroda Reservoir, Kabeerdham

Species	Mean Length (cm)	Mean catch (kg) and Contribution (%) from Gillnets			
		Gillnet 1 (N1) (20 – 60 mm)	Gillnet 2 (N2) (70 – 110 mm)	Gillnet 3 (N3) (120 – 260 mm)	Gillnet 4 (N4) (170 – 210 mm)
Main Catch					
<i>Catla catla</i>	40	5 (6.756%)	15 (13.157%)	25 (23.719%)	70 (75.268%)
<i>Labeo rohita</i>	35	7 (9.459%)	35 (30.701%)	60 (56.925%)	20 (21.505%)
<i>Cirrhinus mrigala</i>	28	12 (16.216%)	45 (39.473%)	7 (6.641%)	2 (2.150%)
<i>Cyprinus carpio</i>	30	3 (4.054%)	8 (7.017%)	2 (1.897%)	-
<i>Hypophthalmichthys molitxix</i>	30	1 (1.351%)	2 (1.754%)	1 (0.948%)	-
<i>Ctenopharyngodon idella</i>	35	2 (2.702%)	3 (2.631%)	8 (7.590%)	1 (1.075%)
<i>Puntius sp.</i>	12	8 (10.810%)	-	-	-
Total Main Catch		38 (51.351%)	108 (94.736%)	103 (97.620%)	93 (99.465%)
Bycatch					
<i>Catla catla</i>	24	15 (20.270%)	2 (1.754%)	0.5 (0.474%)	0.2 (0.213%)
<i>Labeo rohita</i>	20	9 (12.162%)	1 (0.877%)	0.5 (0.474%)	0.1 (0.106%)
<i>Cirrhinus mrigala</i>	22	5 (6.756%)	2 (1.754%)	0.2 (0.189%)	0.1 (0.106%)
<i>Cyprinus carpio</i>	18	3 (4.054%)	-	0.2 (0.189%)	-
<i>Hypophthalmichthys molitxix</i>	20	1 (1.351%)	-	0.5 (0.474%)	-
<i>Ctenopharyngodon idella</i>	22	3 (4.054%)	1 (0.877%)	0.5 (0.474%)	0.1 (0.106%)
<i>Puntius sp.</i>	10	-	-	-	-
Total Bycatch		36 (48.648%)	6 (5.263%)	2.4 (2.277%)	0.5 (0.534%)
Total Catch		74	114	105.4	93.5

Table.3 Catch per Unit Effort (CPUE) of Gillnets of Saroda Reservoir, Kabeerdham

Gill Net	Main Catch (Kg)	Effort (Hrs.)	CPUE For Main catch	Bycatch (Kg)	Effort (Hrs.)	CPUE for Bycatch	Total Catch (kg)	Effort (Hrs.)	CPUE for total catch
N1	38	20	1.90	36	20	1.80	74	20	3.70
N2	108	20	5.40	06	20	0.30	114	20	5.70
N3	103	20	5.15	2.4	20	0.12	105.4	20	5.27
N4	93	20	4.65	0.5	20	0.02	93.5	20	4.67

Table.4 Result of one way ANOVA for main catch, by-catch and total catch for all four types of gillnets operated in Saroda reservoir

Gillnets	Main catch Mean ± SD	Bycatch Mean ± SD	Total catch Mean ± SD
N1	1.8667 ± 0.35119	1.7333 ± 0.30551	3.7000 ± 0.40000
N2	5.3667 ± 0.45092	0.3000 ± 0.20000	5.7000 ± 0.30000
N3	5.1533 ± 0.41501	0.1233 ± 0.02517	5.2900 ± 0.45033
N4	4.6333 ± 0.47522	0.0200 ± 0.01000	4.5900 ± 0.30790

All values were mean standard deviation (SD) of triplicate analysis. Differ superscripts in the same row indicate significant differences (P< 0.05).

Table.5 Results of one way analysis of variance (ANOVA) comparing the main catch, bycatch and total catch from different five gillnets operated in Saroda reservoir

		Sum of Squares	df	Mean Square	F	Sig.
Main Catch	Between Groups	23.670	3	7.890	43.547	.000
	Within Groups	1.449	8	0.181		
	Total	25.120	11			
By Catch	Between Groups	5.777	3	1.926	57.452	.000
	Within Groups	.268	8	0.034		
	Total	6.045	11			
Total catch	Between Groups	6.908	3	2.303	16.820	.001
	Within Groups	1.095	8	0.137		
	Total	8.003	11			

Significance level of the factors (Source of variation): $p \leq 0.05$

The statistical analysis of data obtained in this study indicate the significant differences among the main catch, bycatch and total catch from all the gillnets operated in Saroda reservoir (Table 5).

From this study, author suggests that mesh size of gillnet N1 should be regulated in between 80 mm to 200 mm to reduce bycatch by enhancing selectivity. The increase in mesh size will help to increase main catch and reduce energy utilization and time consumption during operation of gillnet in Saroda reservoir. Such studies however, need to be done in other reservoirs too but till then mesh regulation may be extended to all reservoirs uniformly.

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