

Full Length Research Paper

Effect of beach seine height and mesh size on catch characteristics in the southern part of the Caspian Sea

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In this study, the influence of height and mesh size of beach seine net on the amount of fishing, length frequency and species composition of caught fish was examined. Two beach seine nets with 20 and 24 m heights and each net with 30 and 33 mm center part mesh size were used by two fishing cooperatives during 2008 and 2009. *Rutilus frisii* kutum and *Mugil auratus* were selected as a target fish in this study. Catch and biological data were measured and recorded. Results indicated that the height and mesh sizes used in the present study had significant effect on the catch characteristics in terms of amount of species, catch rates and species composition. Amount of catch was reduced in 24 m beach seine in comparison with 20 m height net both in 2008 and 2009. There were significant differences between fish caught by 30 and 33 mm mesh size net in 2008 and 2009. With an increase in size of mesh net from 30 to 33 mm, amount of *R. frisii* kutum catches increased but amount of *M. auratus* catches decreased. There was no any especial effect of height and mesh size on fish length. Amount of bycatch also increased in relation to net height from 20 to 24 m.

Key words: Beach seine net, height, mesh size, quantity and quality of fishing, Caspian Sea.

INTRODUCTION

Half of the amount of fish consumed directly by humans is provided from the fisheries activities in small scale range (FAO, 2003). Fisheries management includes different management measures, including technical adjustments and regulation of the fishing gears that are important to achieve fisheries sustainability. These are regulations e.g. on height and mesh size to improve the selective properties of fishing gear so that bycatches of non targeted fish are reduced. There are many types of fishing gear and they all impact the marine environment in different ways and to different degrees. For example, we may see different rankings when the same fish is caught with different fishing gears. Seining is a fishing technique traditionally done in areas with large schools or groups of fish. The earliest form of seining was drag

netting (also called beach seining). There is evidence of seine nets used in artisanal fisheries several thousands of years ago and on every continent (von Brandt, 1984). This fishing method is an efficient method for scientific purposes that is widely used in the study of fish communities along a wide variety of habitats including rivers, estuarine, reservoir and marine habitats with sandy or smooth bottoms (Cailliet et al., 1986; Monteiro-Neto and Musick, 1994; Pierce et al., 1990).

The Iranian coast of the Caspian Sea contains many suitable areas for fisheries. One of the most important fishing methods in this area is fishing with one kind of beach seine net, namely Pareh (Figure 1). This is a beach seine fishing which in Gabriel classification is a beach seine net without cod end (Gabriel et al., 2005). Setting and hauling of Pareh are as follows: One of the warps of net wings is fixed in beach. Then the net is operated by a single boat to the sea and after 1 or 2 km, the second warp starts turning back towards the shore in

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Figure 1. Beach seine without cod end (Gabriel et al., 2005).

a loop shape and fixed in another point in beach about 400 or 500 m far away from the first warp. The net will stay for 2 or 4 h in the sea. Then hauling of the warps begins by two winches. This fishing method specialized for catch of bony fishes that live or move near beaches. There is no bag in this kind of fishing but center part of the net have smallest mesh size and enough hanging ration which act as a bag part and about 90% of fishing done with this part. Fishing with Pareh is started in October and closed in April every year. Pareh is made from four parts, one part in center with smallest mesh size and three parts on the left and right sides (Figure 2). The mesh sizes of the net are different from October to February and from February to April depending on the size and kind of target fishes. There is specific length for each part and total length of the net. But height of the net is different from region to another region and it is dependent on depth of water. Assessment of fish populations and species assemblages is important in managing fisheries and environmental quality in marine and freshwater systems (Murphy and Willis, 1996; Simon, 1998). There are some investigations that studied biology of caught fishes, and based on those studies, mesh size of net and time of fishing were determined (Razavi, 1990; Ghaninejad and Moghim, 1993; Abdolmaleki et al., 2005; Daryanabard et al., 2009).

Two commercially and ecologically important species were used in the present study. *Rutilus frisii kutum* and *Liza aurata* live in Caspian basin and enters many of the Iranian waters to spawn. *R. frisii kutum* is Caspian Sea endemic species. Its feeding occurs in the coastal area, and it is very important species in commercial fisheries in Iran. *Liza aurata* is not native species of the Caspian Sea and in order to increase fish productivity of this water body, 3 million individual of *L. aurata*, *Liza saliens* and *Mugil cephalus* were caught from the Black Sea and were introduced into the Caspian Sea during 1930 to 1934 (Konovalov, 1959; Kosarev and Yablonskaya, 1994). There is no research that shows effect of net height on fishing amount, length frequency and species diversity of catch fishes in Southern Caspian Sea. Therefore, the authors arranged a research to study effects of this parameter. The purpose of this study was to determine the role of height and central part mesh size

in beach seine net to evaluate differences in species composition and length frequency of *R. frisii kutum* and *L. aurata* caught in the southern area of the Caspian Sea.

MATERIALS AND METHODS

This experiment was carried out in the coastal fishing area of Mazandaran Province, southern part of the Caspian Sea. Because design and preparing of nets with different height is very expensive and not possible for authors to do that, two fishing cooperatives with two different net heights were selected for the study. Ghoreishi Fishing Cooperative used a 20 m height net in 2008. The cooperative then used a net of 24 m height in 2009. Very closed to this fishing cooperative, Islami Fishing Cooperative used a net with 20 m height in both years. The central part of the net mesh sizes used in the experiments was 30 mm from October to late January and changed to the net with 33 mm mesh size from February to April.

Therefore, studies were separated into two parts, nets with 20 and 24 m height and 30 and 33 mm mesh size in center. These are sizes that fishermen use for fishing in this area, and it is based on the size and kind of target fishes. Because two cooperatives were located much closed to each other, environmental factors were the same. Also, other parameters such as depth of the water (15 m) and length of the net were the same (1100 m). Therefore, situation of the catch will be focused on the effects of the height net.

Sampling program was arranged during October to April for two fishing years (2008 and 2009). Two target fishes, *R. frisii kutum* and *L. aurata* were selected in this study. Fork length and weight of each fish were measured and recorded. Length frequency of target fishes in two fishing cooperative was analyzed. For measuring of fish's length, a biometry table was used and fork length was estimated.

Statistics

All of the data were analyzed with Excel (Version 2007) and Minitab software (Version 15). Non-parametric, chi-square statistical test was used to compare catch data for both species, and subsequent differences were considered significant. Data are presented as Means $\pm$ SD of mean.

RESULTS

Analysis of fishing data revealed some significant differences between Islami and Ghoreishi Fishing Cooperatives that used beach seine nets (Pareh) with different height and mesh sizes. The amount of *R. frisii*

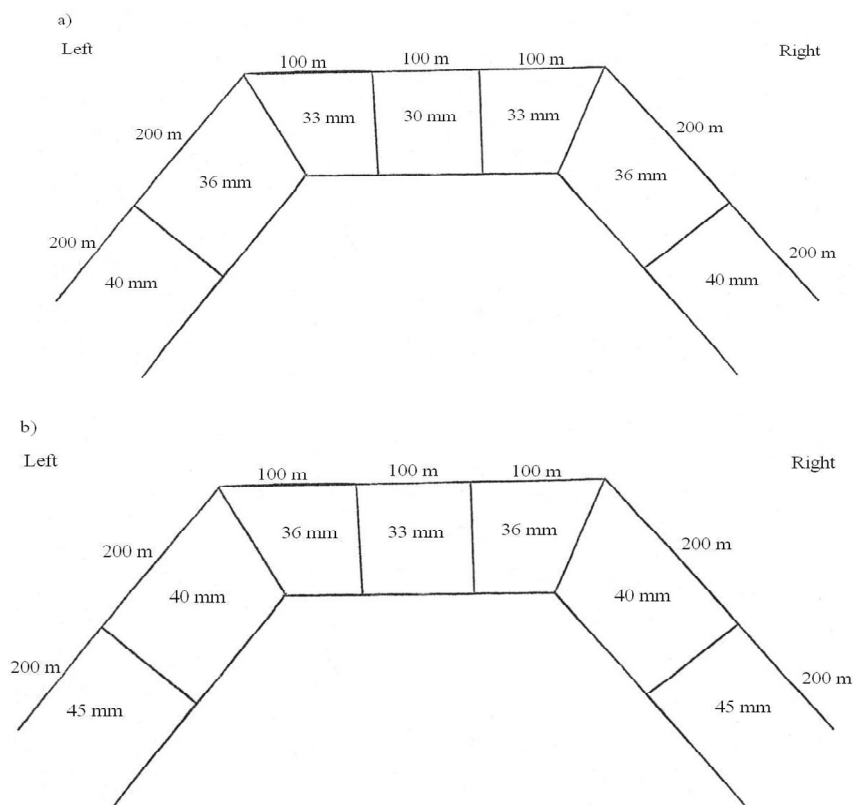


Figure 2. Shape, mesh size and length of each part of beach seine, Pareh; (a) used from October to the end of January; (b) used from February to April.

Table 1. Amount of catches (Kg) in Ghoreishi Cooperative during sampling year of 2008 and 2009 using beach seine net with 20 and 24 m height and 30 and 33 mm mesh size net.

Year (height and mesh size)	Amount per species	
	<i>R. frisii kutum</i>	<i>L. aurata</i>
2008 (20 m height and 30 mm mesh size)	1234	1508
2008 (20 m height and 33 mm mesh size)	7790	120
2009 (24 m height and 30 mm mesh size)	1028	802
2009 (24 m height and 33 mm mesh size)	3225	62

Table 2. Amount of catches (Kg) in Islami Cooperative during sampling year of 2008 and 2009 using beach seine net with 24 m height with 30 and 33 mm mesh size net.

Year (mesh size)	Amount per species	
	<i>R. frisii kutum</i>	<i>L. aurata</i>
2008 (30 mm mesh size)	1805	1170
2008 (33 mm mesh size)	11990	66
2009 (30 mm mesh size)	2350	1203
2009 (33 mm mesh size)	12538	68

kutum and *L. aurata* catches differed significantly between the two heights and mesh sizes used. The amounts of fishing for these species are given in Tables 1

and 2. In Islami Fishing Cooperative that used net with 20 m height, there were comparable differences between catch data in 2008 and 2009 the amount of catch

Table 3. Analysis of catch data in Islami Cooperative.

<i>L. aurata</i>	<i>R. frisii kutum</i>	<i>L. aurata</i>	<i>R. frisii kutum</i>
2008*	2008*	2008**	2008**
2009*	2009*	2009 **	2009**
$\chi^2 = 112.103$	$\chi^2 = 182.433$	$\chi^2 = 7.169$,	$\chi^2 = 10.498$
DF = 3	DF= 3	DF = 2	DF = 2
P-value = 0.000	P-value = 0.000		P-value = 0.005

*: 30 mm mesh size; **: 33 mm mesh size.

Table 4. Analysis of catch data in Ghoreishi Cooperative.

<i>L. aurata</i>	<i>R. frisii kutum</i>	<i>L. aurata</i>	<i>R. frisii kutum</i>
2008*	2008*	2008**	2008**
2009*	2009*	2009 **	2009 **
$\chi^2 = 331.376$	$\chi^2 = 26.092$	$\chi^2 = 18.601$	$\chi^2 = 791.076$
DF= 3	DF = 3	DF = 2	D = 2
P-Value = 0.000	P-Value = 0.000	P-Value = 0.000	P-Value = 0.000

*: 30 mm mesh size; **: 33 mm mesh size.

Table 5. Length (Mean $\pm$ Standard Deviation) of two target fishes in Islami Fishing Cooperative caught during October to January (with 30 mm mesh size net) and during February to April (with 33 mm mesh size net).

Month	Species	
	<i>R. frisii kutum</i>	<i>L. aurata</i>
October (30 mm mesh size)	41.08 $\pm$ 5.87	30.01 $\pm$ 2.68
November (30 mm mesh size)	37.49 $\pm$ 6.44	29.38 $\pm$ 3.22
December (30 mm mesh size)	38.86 $\pm$ 4.38	33.61 $\pm$ 3.33
January (30 mm mesh size)	39.52 $\pm$ 5.16	31.71 $\pm$ 3.09
February (33 mm mesh size)	43.17 $\pm$ 4.20	28.88 $\pm$ 3.51
March (33 mm mesh size)	44.57 $\pm$ 3.18	30.10 $\pm$ 3.48
April (33 mm mesh size)	45.00 $\pm$ 3.48	30.76 $\pm$ 3.49

increased using 20 m height net. In Ghorashi Fishing Cooperative which used net both with 20 and 24 m height, amount of catches decreased when this cooperative used 24 m height net (Tables 3 and 4). With an increase in size of mesh from 30 to 33 mm, amount of *R. frisii kutum* catches increased but amount of *L. aurata* catches decreased. No relationship was found between the length frequencies of two target fishes in two fishing cooperatives with height and mesh size (Table 5 and 6).

Bycatch of fish were increased with an increase in the height of net. The most amount of bycatch fishes belong to Clupeidae, Gobiidae and Acipenseridae respectively (Figure 4).

DISCUSSION

Gear selectivity is a quantification of the varying probability of capture for different sizes and/or species of

fish (Broadhurst et al., 2007; Backiel, 1980). Limited attempts were made to manage the beach activities in south coast of the Caspian Sea and involve height and mesh size regulation. Therefore, in this study, we used two beach seines (Pareh) in order to identify and quantify the effect of nets with different height and mesh sizes on the catch species composition and catch rates in the Iranian coast of the Caspian Sea. Because both cooperatives catch in same depth (15 m) and they are located very close to each other, environmental conditions for both fishing cooperative were very similar. Therefore, decrease of catches in Ghoreishi Fishing Cooperative which used 24 m height net may be depended on the height of the net. Also, this reduction in the amount of catch may be due to decrease power of winches and hauling the net.

The study of *R. frisii kutum* fish length showed that in Islami Cooperative, number of fish with high length is more than Ghoreishi Cooperative. But average of fish

Table 6. Length (Mean $\pm$ Standard Deviation) of two target fishes in Ghoreishi Fishing Cooperative caught during October to January (with 30 mm mesh size net) and during February to April (with 33 mm mesh size net).

Month	Species	
	<i>R. frisii kutum</i>	<i>L. aurata</i>
October (30 mm mesh size)	40.82 $\pm$ 5.23	30.46 $\pm$ 3.04
November (30 mm mesh size)	40.15 $\pm$ 5.17	29.32 $\pm$ 3.66
December (30 mm mesh size)	39.81 $\pm$ 6.50	29.77 $\pm$ 3.49
January (30 mm mesh size)	40.36 $\pm$ 5.01	30.05 $\pm$ 2.82
February (33 mm mesh size)	42.77 $\pm$ 4.22	29.05 $\pm$ 3.14
March (33 mm mesh size)	44.01 $\pm$ 3.89	29.76 $\pm$ 2.70
April (33 mm mesh size)	43.81 $\pm$ 3.61	31.10 $\pm$ 2.04

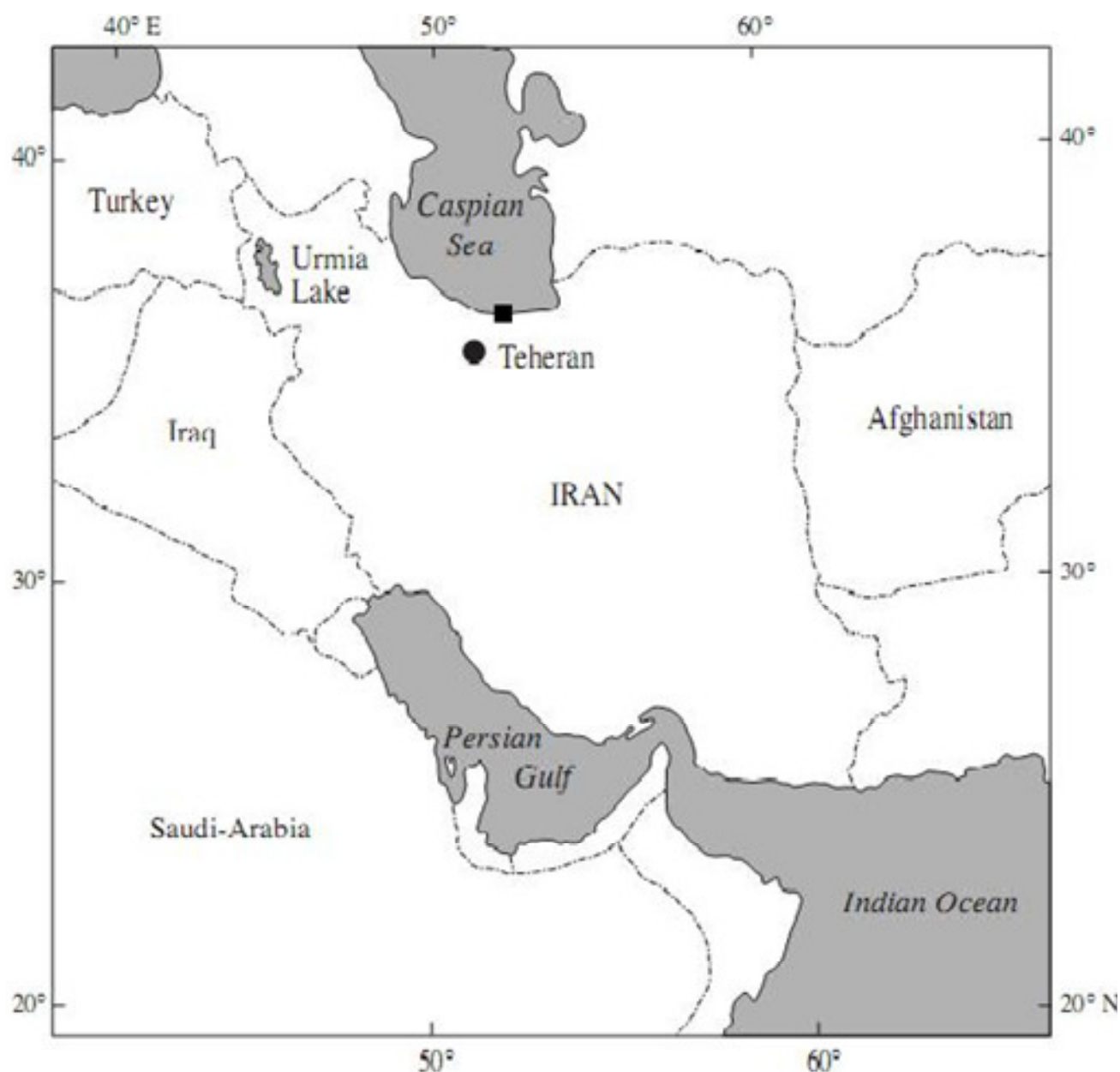


Figure 3. Location of beach seine sampling site in southern Caspian Sea (■).

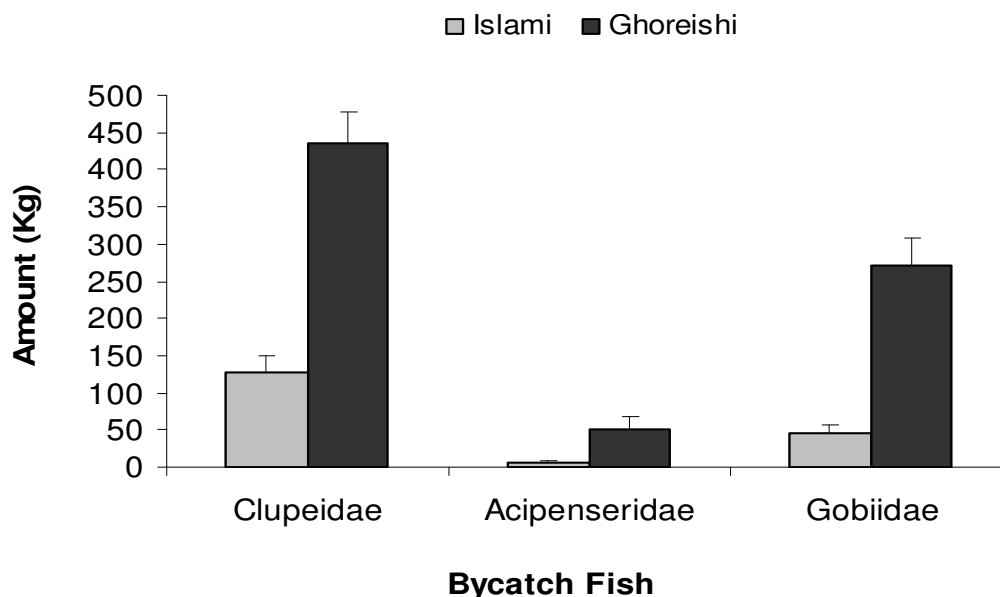


Figure 4. Number of bycatch caught by nets used in Islami and Ghoreishi Fishing Cooperatives.

catch in relation with standard deviation shows that in some months especially at the end of catching period length of fish in Islami Cooperative is higher than Ghorashi Cooperative. Anyway, analysis of length frequency showed that there is no difference between two cooperatives. In fact, there is not any significant difference between two cooperative and it shows that increase of net height does not have any effect on fish length. Furthermore, Iranian Fisheries Research Organization introduced *R. frisia* kutum more than 30 cm and *L. aurata* more than 28 cm fork length as standard fishes and fishermen must arrange their net to catch fishes bigger than standard size. In Ghoreishi cooperative with increase in net height, the size of standard fishes was increased. Although it is said that abundance generally declines exponentially with size both within- and between-species (Jennings et al., 2001). The amount of specimen (*R. frisia* kutum) caught increased significantly when mesh size increased from 30 to 33 mm, while the results showed adverse conditions for *L. aurata* as its amount declined. This was reflected in the rate of decline of the amount of individuals with mesh size being steeper for 30 mm than 33 mm, however it depends on species and the size of fish.

Previous studies have demonstrated that in some places, the bycatch from beach seines can comprise up to 60% of the total catch, and often includes large numbers of juveniles of economically-important species (Broadhurst et al., 2007). The potential mortality of these discarded individuals has raised serious concerns over the sustainability of beach seining at certain locations, and led to investigations of modifications to conventional gears designed to reduce bycatch. Also, our observations show that with increase net height, by-catch fishes were

increased. The starting point for reducing bycatch in net-based fishing gears like beach seines is to identify the strategic areas where most of the selection occurs, and then regulate mesh openings at these areas according to the sizes of the main targeted species.

Attempts to regulate the beach seine activities have met with little success. To face this situation, decision making to seek support from the Sustainable Fisheries Program would be useful. Thus, the involvement of the fisheries communities in the process of setting up regulations for the use of the beach seine is an appropriate way especially in regard to the decrease the cost of such experiments which may have some financial limitations for researchers. Proper management measures could include gear selectivity and mesh size regulation. Selective fishing methods should be encouraged, which include standardization of height and mesh sizes in beach seine nets. Based on the results from this work, we conclude that the height and mesh sizes of beach seines may have an important influence on catch properties. However, more research must be done in this regards.

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