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Effects of Hanging Ratio on the Catch Rate and Catch per Unit Effort (CPUE) of Tuna Drifting Gillnets in Bushehr Coastal Waters, Persian Gulf (Iran)

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Abstract: The aim of this study was to compare the effect of different hanging ratios (E=0.5 and 0.6) of drift gillnets on catch rates and CPUE (Catch per Unit Effort) in Bushehr coastal waters. The study was carried out between late September 2010 to late March 2011. A total of 55889 kg of various large pelagic species were caught during 6 cruises in six months that 26409 and 29480 kg were related to gillnets with 0.5 and 0.6 hanging ratios, respectively. The CPUE did not differ significantly between two gillnets (P>0.05). The catch composition of gillnet with 0.5 hanging ratio was included: *Thunnus tonggol* 48.8%, *Euthynnus affinis* 25.4%, *Scomberoides commersonnianus* 17%, *Carcharhinus pleurotaenia* 3.9%, *Scomberomorus commerson* 3.4%, *Rachycentron canadum* 1.2%, *Sphyraena jello cuvier* 0.3% and species composition of gill net with 0.6 hanging ratio was included: *Thunnus tonggol* 52.1%, *Euthynnus affinis* 24.1%, *Scomberoides commersonnianus* 16.6%, *Scomberomorus commerson* 3.3%, *Carcharhinus pleurotaenia* 2.9%, *Rachycentron canadum* 0.6%, *Sphyraena jello cuvier* 0.2%. The ANOVA did not provide strong evidence for an effect of hanging ratio on catch rates.

Key words: Bushehr · CPUE · Gillnet · Hanging Ratio

INTRODUCTION

The waters of the Persian Gulf and Oman Sea are environmentally unique with an unusual faunal assemblage. The Persian Gulf is a semi-enclosed water body connected to the Oman Sea through the Strait of Hormuz, which is 56 km wide at its narrowest point. The maximum width of the Gulf is 640 km and average depth is 35 m. Among the fishing tools, gillnet is one of the most important fishing gears used in the Coastal Waters of Bushehre [1].

Usually gillnets consist of a single or double wall made of polyamide monofilament or multifilament [2]. The amount of fish caught with gill nets changes with the mesh size, mesh shape; twine thickness of material, colour and hanging ratio [3]. Gillnets are the most frequently used fishing gear because of ease of their use, their low costs and high selectivity [4-7]. It has been reported that the net mesh size, body shape, fish size, hanging ratio, the thickness, the flexibility of the netting twine, the visibility of the twine and fish behavior affect the selectivity of gill nets [8]. However, it has been stated expressly that the major factor affecting the selectivity is the mesh size [9]. The hanging ratio of a gill net is one of the most important factors affecting catches. Hanging ratio (E) is defined as the length of a rope on which a net panel is mounted divided by the actual length of stretched netting on the rope.

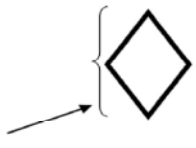
The hanging ratio was estimated using the formula: [10]

$$Hanging\ ratio = \frac{Lr}{Ln}$$

Lr= Length of rope

Ln= Length of net

STR= Stretched mesh size (mm)



$$Ln = n \times STR$$

n= Number of meshes in length of the net

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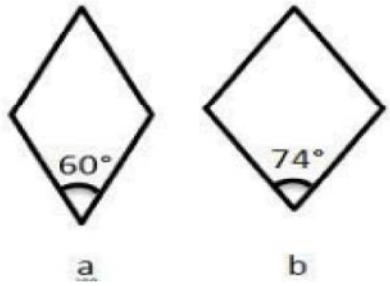

Fig 1: Effect of different hanging ratios on the mesh size (a= 0.5 and b= 0.6 hanging ratio)

At low hanging ratios, meshes have narrow openings that can easily entangle fish across a wide range of sizes. In contrast, at large hanging ratios, the mesh height is lowered and the lateral opening increased, effectively increasing the probability of fish being gilled across a defined size range (Figure 1) [10].

Catch-per-unit-effort (CPUE) data from commercial fishing operations have traditionally been used as a relative index of fish stock abundance [11-12].

In the present study, we aimed to explore the catch rate of multifilament drifting gillnets in Bushehr Coastal Waters (Persian Gulf, Iran). This paper also describes the results of comparative fishing trials using nets with hanging ratios of E= 0.5 and E= 0.6 and the effect of these hanging ratios on CPUE in gill nets located in the Coastal Waters of Bushehr.

MATERIALS AND METHODS

This study was conducted in the coastal waters of Bushehr from late September 2010 to late March 2011 (Figure 2). Two fishing vessels were used for the fishing trials. The nets were shoted around sunset, vertically to the direction of the wind and water current and the end rope of the fleet was tied to the vessel. The fleet of nets and the vessel were allowed to drift for about 6-8 h and the nets were hauled in the opposite order of shooting. Overally, 72 fishing operations were performed (36 fishing operations for each hanging ratio).

The nets were collected around 6-8 hours after setting. The caught fish were collected from the nets that have been taken out of the water onto the vessels. The number of fish collected from each net was recorded. The total weight was recorded in prepared forms. The number and the weight of the fish caught in the nets were then recorded in Microsoft Excel depending on the hanging ratios.

The CPUE were estimated using the formula: [13].

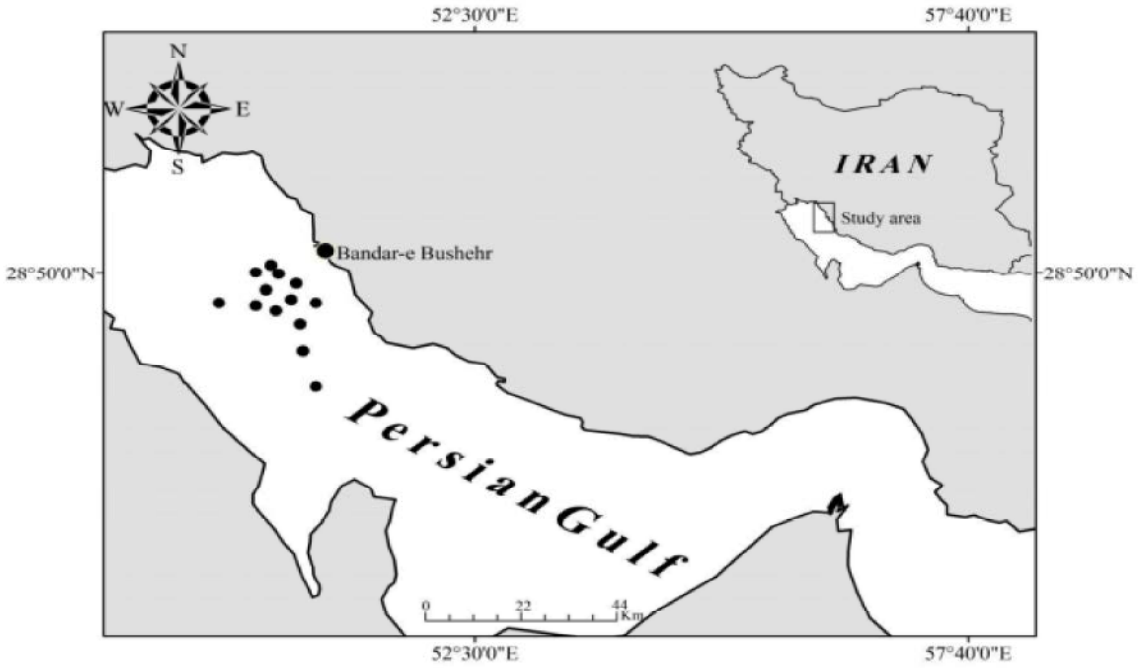

Fig. 2: The fishing area, where the comparative fishing trials were carried out.

Table 1: Gear specifications for the experimental nets

	Hanging ratio	
Parameter	0.5	0.6
Netting type	Polyamid multifilament	Polyamid multifilament
Netting colour	Gray	Gray
Mesh size	145mm	145mm
Twine thickness	210D/30	210D/30
Length	200 yard	200 yard
Depth	200 meshes (25 m)	200 meshes (25 m)
Float line	Polypropylen	Polypropylen
Sinker line	Polyetylen 10 mm	Polyetylen 10 mm
Pendent line	Polyetylen 10 mm	Polyetylen 10 mm
Sinkers	Concrete 500 g	Concrete 500 g

$$CPUE = \frac{Cw}{N1 * N2}$$

Where:

CPUE = Amount of catch in each operation on fishing effort (kg/each net)
Cw = Total weight of catch in each netting, N1= Number of nets in each netting
N2 = Number of netting in each operation

The fleet of nets consisted of two equal parts, each of two nets with a hanging ratio of either 0.5 or 0.6 and all nets were identical except for hanging ratio (Table 1).

Analysis of variance (ANOVA) was used to test effects of 0.5 and 0.6 hanging ratios on the catch rates, species composition and Catch Per Unit Effort.

RESULTS

Table 2 shows the species caught, Table 3 shows catch data for the fishing trials and Table 4 shows catch per unit effort for the fishing trials. The caught species were *Scomberomorus commerson*, *Thunnus tonggol*, *Euthynnus affinis*, *Scomberoides commersonnianus*, *Rachycentron canadum*, *Carcharhinus pleurotaenia* and *Sphyraena jello cuvier*. All species belonged to the pelagic fishes. The most common and numerous fish caught in both hanging ratios was *Thunnus tonggol* (48.8% in net with 0.5 hanging ratio and 52.3% in net with 0.6 hanging ratio). As may be expected for *Thunnus tonggol* is dominant species in Coastal waters of Bushehr. A total of 16358 individuals representing 7 fish species were caught during the study period. The most numerous fish in net with 0.5 hanging ratio were *Thunnus tonggol* 48.8%, *Euthynnus affinis* 25.4%, *Scomberoides commersonnianus* 17%. The remaining of the total numerical catch consisted of *Carcharhinus pleurotaenia* 3.9%, *Scomberomorus commerson* 3.4%, *Rachycentron canadum* 1.2% and *Sphyraena jello cuvier* 0.3%. The most numerous fish in net with 0.6 hanging ratio were *Thunnus tonggol* 52.1%, *Euthynnus affinis* 24.3%, *Scomberoides commersonnianus* 16.6%, *Scomberomorus commerson* 3.3%, *Carcharhinus pleurotaenia* 2.9%, *Rachycentron canadum* 0.6% and *Sphyraena jello cuvier* 0.2%.

The surface area of each net in 0.6 hanging ratio was approximately 10% higher than with 0.5 hanging ratio. Catch rates in number and weight for caught species were

Table 2: Fish species caught during the fishing trials.

Taxonomic Grouping	Common Name	Family Name
Scomberomorus commerson	Spanish Mackerel	Scombridae
Thunnus tonggol	Long tail tuna	Scombridae
Euthynnus affinis	Kawa kawa	Scombridae
Scomberoides commersonnianus	Talang queenfish	Carangidae
Rachycentron canadum	Cobia	Rachycentridae
Carcharhinus pleurotaenia	Shark	Carcharhinidae
Sphyraena jello cuvier	Barracudas	Sphyraenidae

Table 3: Overview of the catch data for the fishing trial

	Hanging ratio			Hanging ratio	
Total catch (number)	0.5	0.6	Total catch (kg)	0.5	0.6
Spanish Mackerel	164	178	Spanish Mackerel	894	986
Long tail tuna	2918	3762	Long tail tuna	12890	15349
Kawa kawa	1612	1805	Kawa kawa	6710	7177
Talang queenfish	2331	2997	Talang queenfish	4498	4891
Cobia	47	29	Cobia	310	177
Shark	242	184	Shark	1021	843
Barracudas	59	30	Barracudas	86	57
All species	7373	8985	All species	26409	29480

Table 4: Overview of the catch per unit of effort for the fishing trials

	Hanging ratio		
Catch per net (number)	0.5	0.6	P
Spanish Mackerel	0.065	0.066	0.9
Long tail tuna	1.166	1.739	0.5
Kawa kawa	0.719	0.693	0.9
Talang queenfish	0.997	1.185	0.9
Cobia	0.018	0.01	0.2
Shark	0.093	0.063	0.6
Barracudas	0.024	0.011	0.8
All species	3.082	3.767	-
Catch per net (kg)			
Spanish Mackerel	0.369	0.363	0.9
Long tail tuna	5.188	7.117	0.6
Kawa kawa	2.99	2.747	0.9
Talang queenfish	1.943	2.036	0.9
Cobia	0.124	0.061	0.2
Shark	0.398	0.292	0.7
Barracudas	0.035	0.021	0.6
All species	11.074	12.637	-

9.22% and 5.49% higher with 0.6 nets than with E=0.5 nets, respectively. The ANOVA did not provide strong evidence for an effect of hanging ratio on catch rates (Table 3). The analysis also provided no strong evidence for a difference in 0.5 and 0.6 hanging ratios on CPUE (Table 4).

DISCUSSION

According to the catch rate of nets with 0.5 and 0.6 hanging ratios, *Thunnus tonggol* and *Euthynnus affinis* were considered the most abundant species. Although, *Scomberomorus commerson* had been regarded the most target species, this species obviously had smaller populations in the study area than other species. The existence of a wide variety of resources in the study area is of great importance to this fishery.

In study of species composition of caught fishes in entire period, it was found that contrary to what was expected *Scomberomorus commerson* is being caught more, but this species that is one of the most valuable commercial fish species, had a very small percentage of the catch. In the whole research period and in the total 72 trials in two nets with the 0.5 and 0.6 hanging ratios, *Scomberomorus commerson* had only 3.36% of catch rate. In each of the two nets, *Thunnus tonggol* with 50.6% had the most catch rate in the entire period of the research, which represents the high amount of its reserve than other species of tuna fishes in the region.

About the incidental catches of fishes in this study, if we consider *Scomberomorus commerson* as the target catch, other species like *Thunnus tonggol*, *Euthynnus affinis*, *Scomberoides commersonnianus*, *Carcharhinus pleurotaenia* and *Sphyraena jello cuvier* are consider as incidental catches that the pattern of their catch rate changes in different months is similar to the changes of their species composition. There were no significant interactions between 0.5 and 0.6 hanging ratios and their effects on the species composition.

According to table 4, in relation to the catch per unit effort, there was no significant difference between the two nets with the 0.5 and 0.6 hanging ratios (P>0.5). The interesting point about the parameter of catch per unit effort of different species, despite the design of drift gill nets to catch *Scomberomorus commerson* as the main target species, the catch per unit effort of this species was less than the other species, which represents decline in the stock of *Scomberomorus commerson* in the study region.

In this study, the surface area in net with 0.6 hanging ratio was approximately 10% higher than with 0.5 hanging ratio. This may be explained by the fact that the E = 0.6 nets are already loosely hung by the way the nets are rigged.

Nomura [14] has reported that the most suitable hanging ratios for gill nets ranged between 0.30 and 0.50. In the study, we concluded that the nets with hanging ratios between 0.5 and 0.6 have similar effect in fishery.

Backiel and Welcomme [15] have previously stated that the gill nets with 0.50 hanging ratio was more effective than the gill nets with 0.67 hanging ratio. Karslen and Bjarnason [16] have reported that the most suitable hanging ratios are between 0.50 and 0.80. Machiels *et al*. [17], have identified that the nets with 0.50 hanging ratio to be more efficient than the nets with 0.25 hanging ratio.

Fish body shapes and even different sizes of one species make limitations in design the fishing gears that do fishing by selectivity. Practically, the study of fishing gears that their purpose is migrant fishes like tuna fishes is more difficult than the fishing gears that design to catch benthic or demersal fishes. Because in addition to scientific reasons such as more and faster reaction of pelagic fishes toward changes of environmental parameters like water temperature or marine flows, herds of pelagic fishes make restrictions in marine studies. In general, in tropical and subt-tropical regions like Persian Gulf and Oman Sea, because of great variety of

fishes, using methods that catch fishes by selectivity is difficult. However, the only appropriate management practice in relation to multi- species reserves like tuna fishes is making the fishing tools selective.

Given that the stocks of pelagic fishes in Persian Gulf have high potential ability and, in the other hand, in comparison to the fishing tools of demersal fishes, the fishing tools of these species will do little damage to the ecosystem, at the present time it is necessary to pay more attention to these stocks; and while encouraging the fishermen to catch these fishes, these pelagic fishes should study biologically to control their reserves and that can be programmed to catch and manage them.

In Bushehr Province, catching pelagic fishes starts from the second half of each year, namely from the October and with migration of pelagic species to Bushehr waters and will continue until June next year. Spawning season of tuna fishes is from spring until summer. With an overview to catch composition of the most important species, it can be stated that 90 -95% of caught fishes in this study belong to pelagic fishes which are the main target of gill nets. If these nets use in proper locations, not only will not harm the stocks of pelagic fishes, but also are one of the best methods to catch pelagic fishes.

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