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Original Article

Estimation of gillnets selectivity for greater lizardfish, *Saurida tumbil* (Bloch, 1795) in coastal waters of the Oman Sea

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Abstract: The selectivity of greater lizardfish (*Saurida tumbil*), which is one of the most abundant economic species caught by gillnets in the northeast of the Oman Sea, Iranian waters, was studied. Sampling was conducted from February to March 2021. Four types of gillnets with mesh sizes of 4.8, 6.3, 10.0, and 15.3 cm were used and 857 fish specimens were collected. The catch patterns, including (snagged, gilled, wedged, and entangled) for *S. tumbil* were observed in gillnets. For 4.8 and 6.3 cm mesh sizes, more than 70% of the catch was mainly obtained by gilled, followed by wedged, and no found of entanglement. For 10.0 and 15.3 cm mesh sizes, the catch of 10.0 mesh size included 16% of fish caught from wedging, though most of the fish was caught by entanglement. In particular, all catches at 15.3 cm were due to entanglement. Estimation of gillnets selectivity for *S. tumbil* was performed using the SELECT method. The SELECT method was used to fit three various gillnet selectivity models (log-normal, skew-normal, and bi-normal). Gillnets selectivity was best estimated by a bi-modal Selection curve. The mean lengths ±SE were estimated as 31.48±0.71, 40.3±0.97, 40.1±0.75 and 43.9±1.05 cm for 4.8, 6.3, 10.0 and 15.3 cm mesh sizes, respectively. Mean lengths increased with increasing the mesh size. Most of the fish caught in the 4.8 and 6.3 cm mesh sizes were below the first maturity length (Lm_{50}). Considering the relative efficiency set as 0.5, that was L50 (50% retention length), the optimal mesh size was determined to be 10.0 cm. Therefore, to protect *S. tumbil* stock and the sustainability of the fishing resource, the gillnet mesh size should be at 10.0 cm to manage *S. tumbil* in this area.

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Introduction

Saurida tumbil is the most abundant Lizardfish species (Synodontidae) in the Persian Gulf and Oman Sea. Its distribution is widely spread in the Red Sea and the eastern coast of Africa to the Arabian Sea, the Oman Sea, and the Persian Gulf to Southeast Asia and Australia (Fisher and Bianchi, 1984; Russell and Houston, 1989; Jaiswar et al., 2003; Eagderi et al., 2019). *Saurida tumbil* can be found at a depth up to 700 m (Goldshmidt et al., 1996), and their maximum fork length was reported to be 60 cm (Shindo, 1972). The size of *S. tumbil* at first maturity is 29.5 cm, which provides essential information for suitable management during reproduction to protect the stocks of this fish (Taghavi Motlagh et al., 2012). In the northeastern Oman Sea, the *S. tumbil* is caught by various methods such as bottom trawl and gillnet (Abaszadeh et al., 2013). After the ban on trawl fishing in Iran in 2020, most of the species are caught by gillnets.

According to the fishing data of the Iranian Fisheries Organization, the catch volume of this fish species is 6682 tons in 2021 which has increased by 4.6% compared to two years ago (Iranian Fisheries Statistics Yearbook, 2021). Although most of the catch of this fish is done with gillnet, but in the region, there is no special gillnet to catch it. Generally, four types of monofilament drift gillnet with mesh sizes of 4.8, 6.3, 10.0, and 15.3 cm are used to catch the species by fishermen. These gillnets consist of 6 to 10

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panels with a length of 182.88 m and a height of 4-6 m which are connected to each other with a hanging ratio of 0.5. The fishing operation included setting the gillnets before sunset and hauling them after 10-12 hours. Most of the fishermen targeted for *S. tumbil* are native and local fishermen who catch fish with their small boats. Small-scale fisheries in the northeastern Oman Sea use small vessels with crews usually of three persons or less. These small vessels performed fishing operations using various fishing gears such as bottom longlines, drift gillnets, or bottom gillnets (Bizzarro et al., 2009).

Small-scale fisheries are widely effective in catching scattered fish populations and include almost half of the world's fisheries production (Chuenpagdee and Jentoft, 2018). In general, there is a concern for improving resource management in these small-scale fisheries, especially, in the case of the *S. tumbil*, which contributes the most to global wastage and disposal (Zeller et al., 2018; Stevens et al., 2000). In the last two decades, the rapid expansion of the fishing of greater lizardfish has increased the fishing pressure on most of the population of lizardfish, especially in the Persian Gulf and the Oman Sea. As the number of small-scale fisheries increases, fishermen who commonly use gillnets in seas and coastal areas, it is imperative that this activity is properly managed to reduce global waste (Alves et al., 2009). Proper fishing management should use fishing gear that catches mature fish and allows immature fish to escape (Armstrong et al., 1990), which results in reproduction and increased stocks. Therefore, it is indispensable to understand the selectivity of the fishing gear used.

Various studies have been done on gillnets selectivity in different countries (Millar, 1992; Millar and Holst, 1997; Millar and Fryer, 1999). And in Iran, Hosseini et al. (2017) studied drift gillnets selectivity for *Scomberomorus guttatus* using the Sechin (1969) method, and optimum selection length was estimated as 33, 37, 42, 44, 50, and 59 cm (FL) for the nominal stretched mesh size of 70, 76, 79, 90, 101 and 114 mm respectively. Sadough Niri et al. (2020) also studied gillnets selectivity of *Thunnus tonggol* (Bleeker, 1851) in the northeastern Oman Sea with the Sechin method. In their study, optimum catch sizes of 100, 110, 130, and 165 mm gillnet mesh sizes were estimated as 35, 38, 46, and 57 cm, respectively. Pouladi et al. (2020) studied the case estimation of gillnet selectivity for *Scomberomorus commerson* (Lacepède, 1800) in the Persian Gulf using the SELECT method. In this study, optimum catch sizes of 130, 140, and 150 mm gillnets mesh sizes were determined as 74.5, 80.5, and 86 cm, respectively. However, there are no studies of gillnet selectivity for *S. tumbil* species in Iranian waters. Not only one of the goals of this study is to increase the knowledge of the selectivity of gillnets in the northeastern Oman Sea but also to improve the stock of an economically important species. On the other hand, most of the selectivity studies have been using old methods and new methods have been used less in Iran. Therefore, we conducted the fishing experiment in the northeastern Oman Sea using gillnet with different mesh sizes which are commonly used by fishermen to estimate the selectivity of *S. tumbil* species by the SELECT method.

Materials and method

Fishing experiment: The study was performed using commercial drift gillnets in the Konarak fishing port, northeastern Oman Sea (25°20’N, 60°30’E) from February to March 2021 (Fig. 1). Konarak fishing port is one of the most important fishing ports in southeastern Iran and on the other hand, it was easy and accessible to the research team. In the area, fishermen use a variety of monofilament and polyfilament drift gillnets to catch fish. Although most of the catch of *S. tumbil* is done with gillnet, there is not any special gillnet to catch *S. tumbil* in this region. Therefore, in some of the gillnets, the species is mainly caught, and in others, it is seen as bycatch.

Samples were collected from four types of monofilament (PA) drift gillnets that are used by local fishermen with stretched mesh sizes of 4.8, 6.3, 10.0, and 15.3 cm (STR) and Twine No. 210D/30 with 0.8 mm diameter. The mesh size was measured as the internal mesh sizes in opposite knots for the mean of

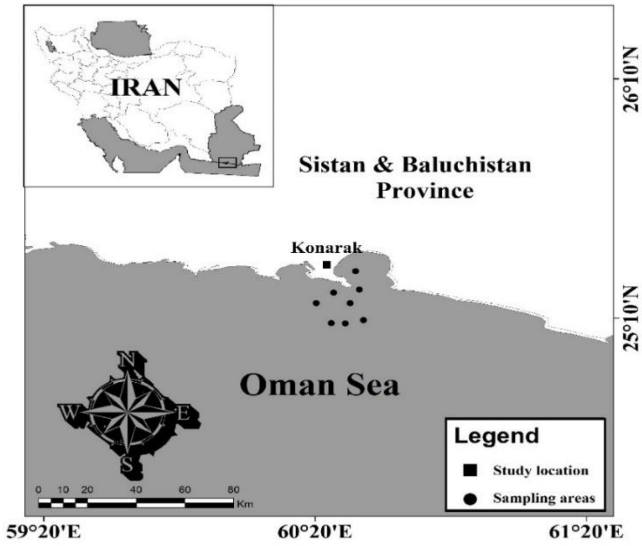


Figure 1. The location of the fishing experiment in this study.

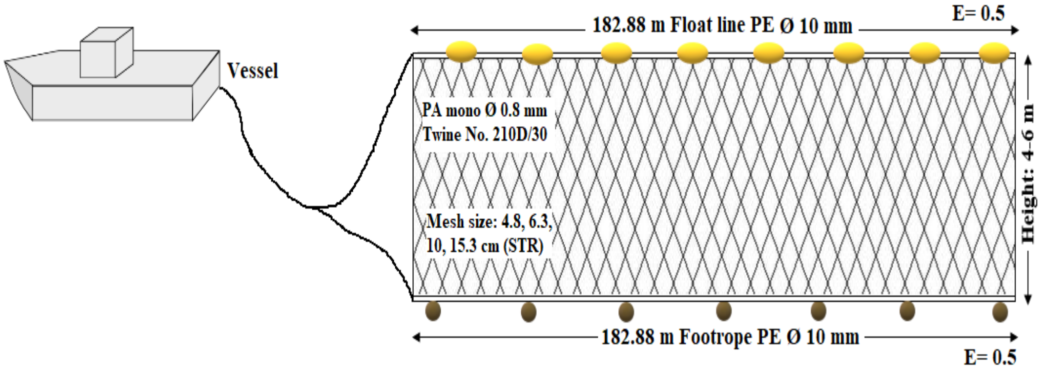


Figure 2. The drift gillnets used in this experiment.

20 randomly selected meshes by inserting a steel ruler with an accuracy of 0.1 cm. These gillnets used by fishermen consist of 6 to 10 panels with a length of 182.88 m and a height of 4-6 m which are connected with a hanging ratio of 0.5 and two 10 mm diameter Polyethylene (PE) ropes as the headline and bottom line (Fig. 2).

In each trial, four mesh sizes were placed in water randomly and separately. The fishing operation consisted of setting the drift gillnets for 1 hour before sunset and hauling them after 10-12 hours. All samples of the *S. tumbil* were measured for their fork length using a measuring board with an accuracy of 0.1 cm. The length classes were classified at intervals of 3 cm according to Sturges' rule. In addition, when fish were removed from the net, the catch pattern (snagged, gilled, and wedged) was recorded based on the net mark on the fish body to investigate the capture condition. If a mark could not be found or if there were multiple marks and the captured position could not be determined, it was assumed to be entangled.

Selectivity calculation: The gillnet selectivity was estimated using the SELECT method. The catch of the j-th length class by i-th mesh size is expressed by the following equation (Fujimori and Tokai, 2001).

$$C_{ij} = p_i \lambda\, s\,(R_{ij})\ (1)$$

Where p_i is the relative fishing intensity ($\sum_{i=1}^{k} p_i = 1$), λ_j is the expected number of fish of length l_j that are in contact with the net, and $s(R_{ij})$ is the selectivity function of the ratio of fish length to mesh size, the relative length $R_{ij} = (l_j/m_i)$. The relative fishing intensity is an index of gear efficiency of any mesh size. In the present study, three kinds of functional models (log-normal, skew-normal, and bi-

Table 1. The mean length (cm) and size ranges (cm) of species caught in the experiment.

Species	Mean length±SE (cm)	Size range (cm)
Saurida tumbil	38.75±0.26	24.5-57.5
Plicofollis dussumieri	36±0.22	24.5-56.5
Cynoglossus arel	32.23±0.81	19.8-37.2
Trichiurus lepturus	85.1±4.18	51.4-110.7
Otolithes ruber	26.67±0.46	23.1-29.7
Pomadasys kaakan	31.3±1.77	19.8-39.2
Parastromateus niger	33.94±1.25	25.4-39.4
Rastrelliger kanagurta	23.32±0.95	17.3-29.3
Sphyraena jello	48.7±1.37	43.2-59.3

normal models) were compared as the selection curve. Each model is as follows (Fujimori and Tokai, 2001):

$$s(R_{ij}) = exp - \left[\frac{(lnR_{ij} - lnR_0)^2}{2\sigma^2}\right] \text{ Log-normal (2)}$$

$$s(R_{ij}) = exp\left[-\frac{(R_{ij}-R_0)^2}{2\sigma^2}\right].1 - 1/ 2\eta\sigma^{3/2}.\left[\frac{(R_{ij}-R_0)}{\sigma} - \frac{(R_{ij}-R_0)^3}{3\sigma^3}\right] \text{ Skew-normal (3)}$$

$$s(R_{ij}) = \frac{1}{\delta}\left[exp\left(-\frac{(R_{ij}-R_a)^2}{2\sigma_a^2}\right) + \omega exp\left(-\frac{(R_{ij}-R_b)^2}{2\sigma_b^2}\right)\right]$$

Bi-normal (4)

Where R_0 is the relative length at the peak of the selection curve and the parameter σ denotes the curve width. η is the skewness constant in the skewness model R_a and R_b in the bi-normal model are the relative length with the maximum value (=1.0) of each constituent normal curve and σ_a and σ_b denote the width of each curve. The weighting factor ω decides the height of the second curve, and δ the scaling constant to make the maximum value of the selectivity 1.0. Relative fishing intensity is composed of fishing power and fishing effort in gillnet (Millar, 1992).

Additionally, the two kinds of models were compared, one in which the relative fishing intensity was fixed by relative catch effort the rate of the number of nets in each mesh size to the number of total nets, and the second, which has the relative fishing intensity was regarded a parameter to be estimated. The parameters of each model are estimated by maximizing the log-likelihood function using the Solver program in Microsoft Excel was used for the calculation.

$$log_e L = \sum_{j=1}^{n}\sum_{i=1}^{k} \left(c_{ij}\, log_e(p_i s(R_{ij}) / \sum_{i=1}^{k} p_i s(R_{ij})\right) \quad (5)$$

The fitness of models was confirmed using the model deviance based on the residual differences between both proportions to determine the optimum model and the residual plot (Millar and Fryer, 1999).

$$d_{ij} = \pm\left[2C_j\left(\phi_{ij} log_e\left(\frac{\phi_{ij}}{\phi_{(R_{ij})}}\right) + (1 - \phi_{ij}) log_e\left(\frac{1-\phi_{ij}}{1-\phi(R_{ij})}\right)\right)\right]^{1/2} \quad (6)$$

Results

Catch results: Table 1 shows the mean and length range of *S. tumbil* and various species caught by gillnet during the experiment. Table 2 shows the catch distribution by fork length in each mesh size. A total of 224, 228, 198, and 207 of *S. tumbil* were caught with 4.8, 6.3, 10.0, and 15.3 cm mesh sizes, respectively. Fish with shorter lengths were caught in smaller mesh sizes, and fish with longer lengths were caught in larger mesh sizes. The fork length of the most abundant fish caught are 27.5 cm in 4.8 cm mesh size, 36.5 cm in 6.3 cm, 36.5 cm in 10.0 cm, and 48.5 cm in 15.3 cm, respectively. The length of fish caught increases with the increase in the mesh size. The results also indicate the relative catch effort based on the number of nets used.

Figure 3 shows the catch pattern for *S. tumbil* recorded by mesh size. For 4.8 and 6.3 cm mesh sizes,

Table 2. Fork length frequency of fish caught in different mesh-size of gillnets.

Length class (cm)	Mesh size (cm)				Total
	4.8	6.3	10.0	15.3	
24.5	24	1	0	1	26
27.5	60	9	1	0	70
30.5	57	9	3	1	70
33.5	35	27	21	21	104
36.5	26	54	59	34	173
39.5	10	37	57	30	134
42.5	9	26	17	20	72
45.5	1	24	23	22	70
48.5	2	19	4	35	60
51.5	0	12	9	19	40
54.5	0	7	2	11	20
57.5	0	3	2	13	18
Total	224	228	198	207	857
Mean length ±SE	31.48±0.71	40.3±0.97	40.1±0.75	43.9±1.05	-
No. net used, *xi*	149	48	18	11	226
Relative catch effort (*xi*/Σ*ixi*)	0.659	0.212	0.079	0.049	1

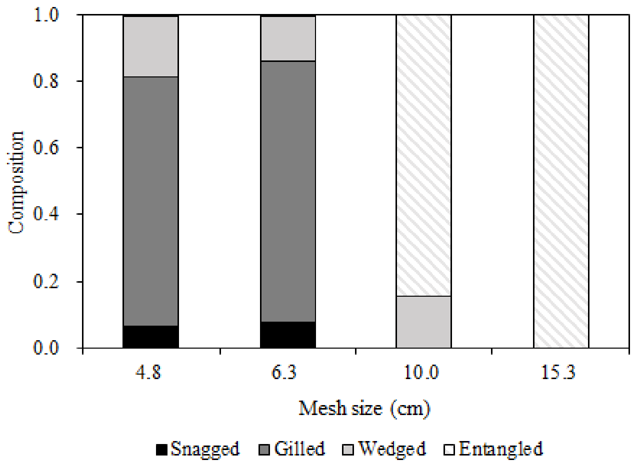


Figure 3. The catch pattern of *Saurida tumbil* in each mesh size.

more than 70% of the catch was mainly obtained by gilled, followed by wedged, and no found of entanglement. For 10.0 and 15.3 cm mesh sizes, the catch of 10.0 mesh size included 16% of fish caught from wedging, though most of the fish was caught by entanglement. In particular, all catches at 15.3 cm were due to entanglement. In this mesh size, most of the catches by entanglement were determined by multiple net marks, not by unmarked conditions (Fig. 4). This means that the catch was not due to unadulterated entanglement, but originated from gilled or wedged in net.

Figure 5 indicated the relative catch position (the ratio of the distance between the snout and catch position to the fork length). The range of relative catch position is narrow in the case of snagged and wider in the case of wedged. This range indicates the range of distances on the fish body where the girth does not change significantly.

Selection curve and fitting model: Estimation of the selection curve was done using the catch data of all mesh sizes. The catch pattern of 10.0 and 15.3 mesh size was mainly entanglement. The estimated parameters, the model deviance and the other results in all models of the selection curve were summarised in Table 3. Model deviance was clearly small when p_i was estimated in any models. In the comparison of the models, the model deviance of the bi-normal and log-

Figure 4. Example of entangled catch for *Saurida tumbil* in the experiment.

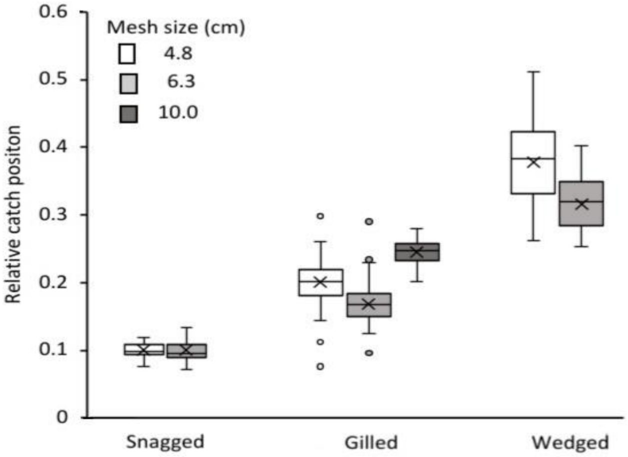


Figure 5. Relative catch position (the ratio of the distance between snout and catch position to the fork length) in *Saurida tumbil*.

Table 3. The SELECT model parameter estimates for gillnet selectivity and the values of model deviance.

Model	**Parameters**								**MLL**	**Model deviance**
	$R_0(R_a, R_b)$	$\eta.\omega$	σ	δ	p_1	p_2	p_3	p_4		
Lognormal										
P_i estimated	4.600		0.3491		0.3273	0.1659	0.1259	0.3809	-1047.9437	296.23
P_i fixed	4.5974		0.3111		0.6592	0.2123	0.0796	0.0486	-1307.2036	911.84
Skew-normal										
P_i estimated	4.0000	1.0000	0.9000		0.4000	0.3000	0.3000	0.2000	-2199.6382	2936.06
P_i fixed	4.3653	1.1767	0.5240		0.6592	0.2123	0.0796	0.0486	-3920.4716	8466.57
Bi-normal										
P_i estimated	3.2656 5.4096	0.7357	0.7887 1.5029	1.2813	0.5818	0.2114	0.0929	0.1140	-1034.5386	264.78
P_i fixed	3.0102 5.3921	0.4119	0.8147 1.4335	1.1082	0.6592	0.2123	0.0796	0.0486	-1038.3442	274.44

normal models was much smaller than that skew-normal model. Then, the value in the bi-normal model was slightly smaller than that of the log-normal model. Comparing the values of p_i on estimated and fixed value by the relative catch effort in the bi-normal model, the tendency on both was generally similar, but the value of p_4 was larger in the p_i estimated model.

The estimated selection curves by SELECT model

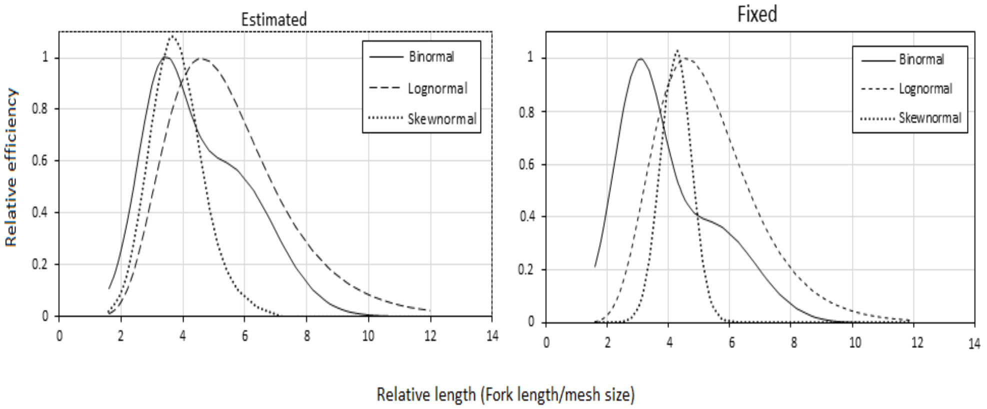


Figure 6. Estimated selection curves with the relative length *R*ij= (*lj/mi*) for *Saurida tumbil*.

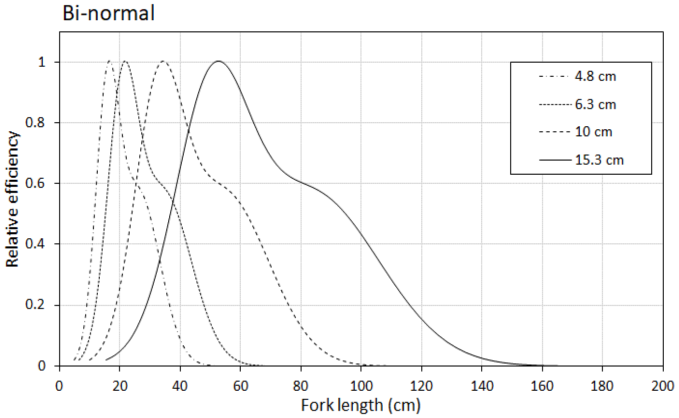


Figure 7. The gillnet selection curve with fork length from the bi-normal model for *Saurida tumbil*.

in various functional models, when p_i is estimated and fixed, are given in Figure 6. The relative lengths at the peak of the curve (the optimum relative length) in each model, when p_i was estimated as 4.84 for the log-normal, 3.65 for the Skew-normal, and 3.37 for the bi-normal model. Also, the optimum relative lengths in each model, when p_i was fixed were estimated as 4.55 for the log-normal, 4.37 for the Skew-normal, and 3.05 for the bi-normal model, respectively. The modal relative length of the log-normal model was larger than other models when p_i was estimated, while the modal relative length of the bi-normal model was smaller than the others when p_i was fixed.

The gillnet selection curve with fork length based on the bi-normal model, which was appropriate to represent the selectivity for *S. tumbil*, was estimated for all mesh sizes (Fig. 7). The width of the selection curve was remarkably wider in 15.3 cm mesh size. The upper limits of the selection in 10.0 and 15.3 cm mesh sizes were well above the upper limit of fork lengths caught in the experiment.

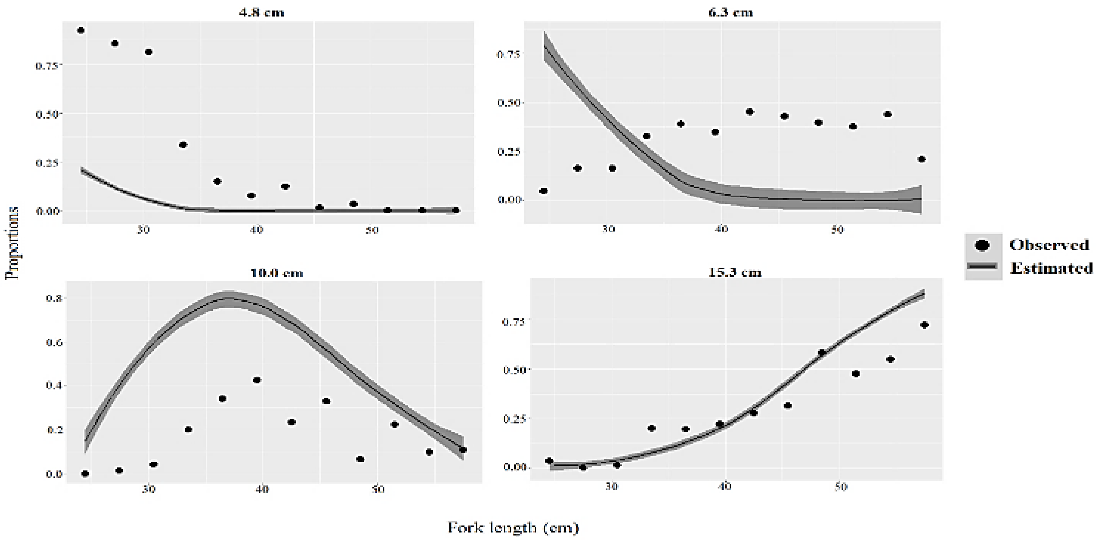
The observed and estimated catch proportion from the log-normal, skew-normal, and bi-normal model, αvδ $\phi_{\iota\varphi}$ and $\phi(R_{ij})$, are compared in Figure 8. The log-normal model provides a better fit than the skew-normal model and has smaller model deviance. However, the bi-normal model is the best fit and more suitable because has smaller model deviance and gives a large reduction in model deviance compared with the log-normal model. Also, it is generally inferred that the modal length will be large as the mesh size expands in the bi-normal model.

Discussion

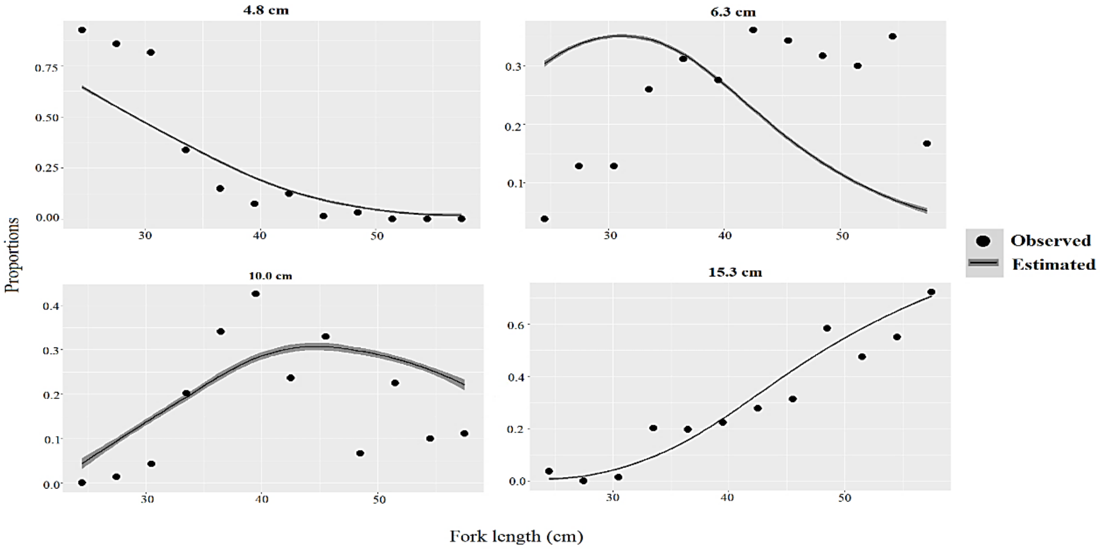
The size-selectivity of fishing gear provides the most important information on fisheries management and optimal use of fisheries stocks (Carol and Garcıa-Berthou, 2007).

Thus, in the present study, we estimated the size selectivity for *S. tumbil*, which is one of the important

Skew-normal



Log-normal



Bi-normal

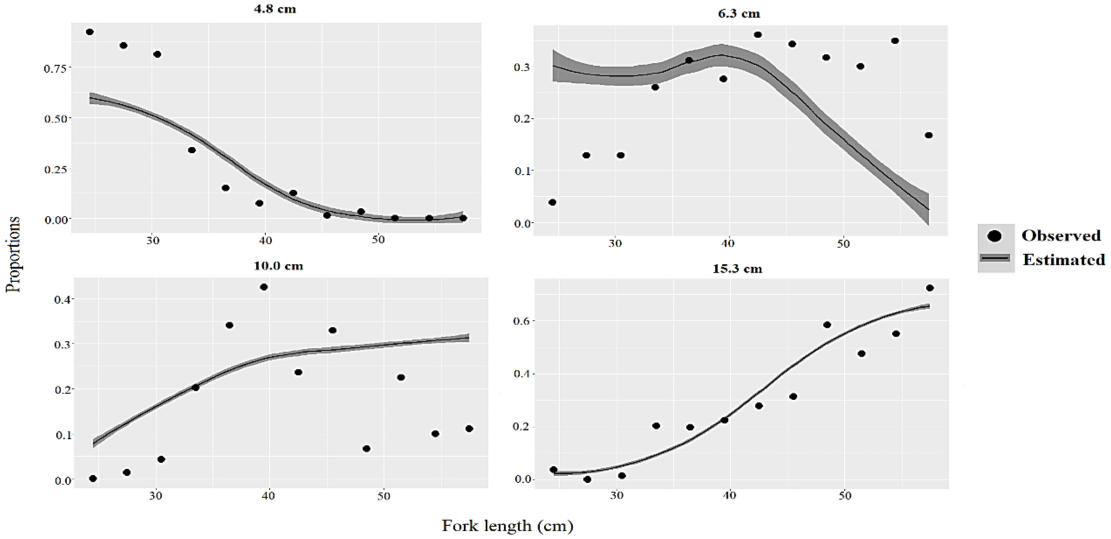


Figure 8. Observed and estimated catch proportion from the log-normal, skew-normal and bi-normal model.

species taken in gillnet fisheries in the northeastern Oman Sea by applying the SELECT method and three various models (log-normal, skew-normal, and bi-normal).

The catch pattern of fish in gillnets could offer precious information about how the fish was caught in the netting (Grati et al., 2015; Savina et al., 2021). Therefore, the following catch patterns for *S. tumbil* have been observed in gillnets: snagged (caught in nets by the mouth, teeth, or maxillae), gilled (caught behind the gill cover by the netting), wedged (caught in the net by the largest part of the body) and entangled (caught by the spine, fins, or other parts of the body). In 4.8 and 6.3 cm mesh sizes, most of the catch is caught by gilled and these nets did not catch any fish due to entanglement. The proportion of gilled high and the proportion of wedged low suggests that the 4.8 and 6.3 cm mesh size may have been small relative to the target individual and the large fish are so athletic that they become entangled when trying to navigate the net. For those fish that are captured, gilled, or wedged, Reis and Pawson (1993) noted the variance of girth measurements for a given length is normally higher than that of the length for the same girth. Differences in the degree of maturity or in the stomach content of fish captured can account for these effects, as well as differences in body compressibility. However, in 10.0 cm or more mesh size, most of the catch is caught by entanglement. It could mean that there are few large individuals that can be properly wedged in nets with a mesh size of 10.0 or 15.3 cm. Also, given that the body shape of *S. tumbil* caught at 10.0 and 15.3 cm mesh sizes narrow and nets with a larger mesh size are less stretched than nets with a smaller mesh size, therefore, most of the fish is caught by entanglement. Sparre and Venema m(1998) and Millar and Fryer (1999) noted that entangled happens mainly when the net is loosely rigged. Hamley (1975) reported entangled is less size-dependent and may affect both large and smaller individuals. Grati et al. (2015) and Savina et al. (2021) noted the catch patterns can also affect whether the fish are retained or released, as some patterns of catch are more effective at retaining fish than others (e.g. fish caught by the mouth/ maxillae have a greater chance of escaping the netting).

According to the results of the deviance residual, the binomial model was recognized as a suitable Selection curve for *S. tumbil*, because most of the catch was entangled due to the complicated meshing (Losanes et al., 1992; Madsen et al., 1999). This means that larger individuals are more likely to be caught by the trunk in the net than the wedge. Pope et al. (1975) mentioned that if there is more than one way to be caught, the Selection curve may show two or more modes. The studies in several fish species have shown that the bimodal curve (bi-normal) may yield a better fit than unimodal models (log-normal and skew-normal). Hovgård (1996) indicated that the bi-normal model was suitable for the Selection curve for cod. Fujimori and Tokai (2001) also estimated the selection curve for pink salmon using the bi-normal model. Poulsen et al. (2000) indicated that the bi-normal model was suitable to the selection curve for Atlantic herring. They noted this as being due to the situation of enmeshment on the fish body was not continued due to the presence of the operculum or the fins, which causes the retention of the fish in the net, and offered that such multiple-part selection causes bi-normal selectivity.

Determining the optimum mesh size depends on the length-frequency distribution of fish in fishing areas (Millner, 1985). In this experiment, the length-frequency distribution of *S. tumbil* increased with an increase in mesh size. Generally, as the gillnet mesh size increases, fishes with larger girth and length are caught, and conversely, as the mesh size decreases, smaller sizes are caught (Gray et al., 2005; Kalaycı and Yeşilçiçek, 2014; Ago et al., 2014). The length ranges of *S. tumbil* specimens were variable from 24.5 to 57.5 cm. The mean lengths for 4.8, 6.3, 10.0, and 15.3 cm mesh size were 31.48±0.71, 40.3±0.97, 40.1±0.75 and 43.9±1.05 cm, respectively. The average lengths of *S. tumbil* were noted as 38.7 and 39 cm by Soofiani et al. (2006) and Taghavi Motlagh et al. (2012), respectively. Rahimi Bashar et al. (2012) reported the mean fork length *S. tumbil* of 30.54±6.84 cm in the North of the Persian Gulf. Vahab Nezhad et al. (2021) noted the mean fork length *S. tumbil* of

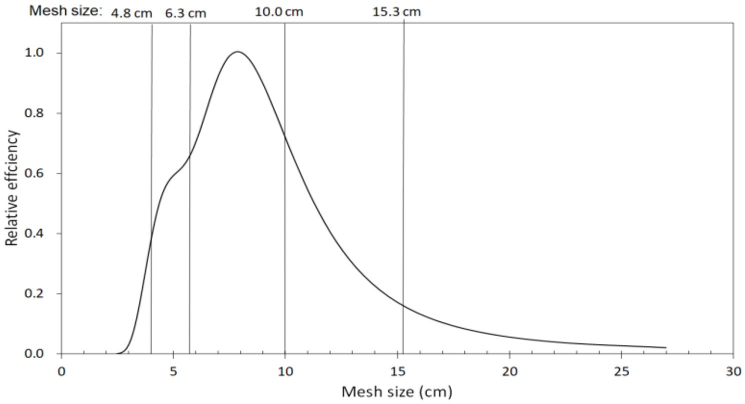


Figure 9. The selection curves with mesh size to a maturity length, Lm50 = 27.0 cm, for *Saurida tumbil*, which based on the bi-normal model estimated in this study.

33.12±0.32 cm on the northern coasts of the Oman Sea. The differences in lengths might be due to fishing season, species size, stock status, and depths (Genc, 2002). Factors such as the behavior and reaction of fish around the net, net structure, hanging ratio, elongation of the mesh, and fish visibility influence the length distribution of fish caught in the gillnet (Holst et al., 1998).

The size at first maturity (Lm_{50}) provides essential information for correct management during the reproductive cycle to maintain a healthy stock of this fish. Several studies were reported on the size at first sexual maturity of the *S. tumbil*. Abbaszadeh et al. (2010) reported a length of 27 cm in the coastal waters of the Persian Gulf. Latife and Shenoda (1973) recorded 16-18 cm in the Gulf of Suez. Taghavi Motlagh et al. (2012) noted the size at first maturity of *S. tumbil* is 29.5 cm on the Iranian coast of the Persian Gulf. Given the distance between the areas, these differences might be due to the effects of temperature or other environmental factors that could be leading to the differences (Taghavi Motlagh et al., 2010).

The selection curve with mesh size (type-B selection curve, Regier and Robson (1966) to a maturity length (lm_{50}) was estimated based on the bi-normal model in this study to consider the impact of mesh size used to the stock of *S. tumbil* (Fig. 9). As can be seen, the length of the fish caught was increased with the increase in the mesh size of the gillnets. In this study, the size of *S. tumbil* at first maturity was determined 27 cm. Most of the fish caught in the 4.8 and 6.3 cm mesh sizes were small and their body length was below the first maturity length (lm_{50}). Thus, the use of gillnets with mesh sizes of 4.8 cm and 6.3 cm may cause increased fishing pressure and decrease the number of fish in stocks of *S. tumbil*. Although the fish caught in the mesh sizes of 10.0 and 15.3 cm were mature and suitable for fishing, considering the relative efficiency set as 0.5, that was L_{50} (50% retention length), the optimal mesh size was determined to be 10.0 cm. Therefore, the use of 10.0 cm is appropriate for the conservation of small individuals under 27 cm. Therefore, for the protection of *S. tumbil* stock, sustainability of the fishing resource, and local gillnet fishery, the gillnet mesh size should be at 10.0 cm. However, in some areas, the expansion of the size range may cause a significant decrease in the catch. Therefore, it is necessary to compare the selectivity of lizardfish with that of non-lizardfish and to study the adjustment of selective pressure among species in the future.

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