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Application of a Controlled Aquarium Experiment to Assess the Effect of Mesh Sizes and Mesh Opening Angles on the Netting Selectivity of Antarctic Krill (*Euphausia superba*)

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Abstract: Understanding the interactions between target species and netting is paramount for increasing the sustainability of trawling activities. The selectivity of the utilized netting depends on the sizes and opening angles of the mesh. The effects of the mesh size and mesh opening angle on the fishing selectivity of Antarctic krill (*Euphausia superba*) were assessed via micro-cosmos experiments. The results show that both the absolute abundance and the incidence of larger krill individuals passing through experimental panels are proportional to the utilized mesh size. Krill individuals larger than 35 mm passed through experimental panels at mesh opening angles larger than 50° for a 15 mm mesh size, 35° for a 20 mm mesh size and 20° for a 30 mm mesh size. Additionally, all *L*50 values increased with an increasing mesh size and an increasing mesh opening angle at the same mesh size. Furthermore, the selection range increased with an increasing mesh size and with an increasing mesh opening angle at the same mesh size. This paper provides scientific guidance for the choice of liner mesh sizes of krill trawl with the aim to improve fishing efficiency while minimizing fishing losses and potential negative ecosystem impacts from fisheries.

Keywords: trawling fisheries; fishing gear; zooplankton; liner netting; size selection

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1. Introduction

Antarctic krill (*Euphausia superba*), hereafter abbreviated as krill, is a key species in the ecosystem of the Southern Ocean. Krill is a food source for fish, seabirds, seals, whales and other organisms and the biomass of krill has been estimated at 100 million tons [1–4]. Krill is also the main target species of trawl fisheries with recent yields of about 300,000 tons from the Southern Ocean [5,6].

Commercial krill trawls are usually low tapered constructions where liners with a small mesh size are fitted inside the trawl body and the cod end to reduce the catch being lost through the mesh [7,8]. The length and mesh size of the liner netting differ between different fishing trawlers. For example, "Krill trawl 300" used by the trawler "Longteng" of China Fisheries Co., Ltd., was fitted with a 16 mm mesh size liner starting from the second section of the trawl body and a 11 mm mesh size liner at the cod end [9]. Other trawls such as that used by the trawler "Furonghai" of Liaoning Ocean Fishery Co., Ltd., of China used liners that started from the sixth section of the trawl, utilizing a liner mesh size that gradually decreased from 30 mm (6th–7th sections) to 25 mm (8th–9th sections), then to 20 mm (10th–11th sections) and finally to a 15 mm mesh size at the cod end [10].

These different arrangements and mesh sizes of liners may result in different fishing performances with regard to krill escaping through the mesh at the front sections and retention at the cod end. Additionally, these different arrangements and mesh sizes can affect trawl net selectivity and result in a sampling bias of krill in the catches collected by scientific observers from different commercial trawls in spatiotemporally-overlapping fishing grounds [11,12]. Understanding the effects of mesh sizes and opening angles on the size selection of krill is critical to identifying technical measures for targeting this species.

Size selectivity represents the ability of a given trawl to catch different sizes of a targeted species and it is a key parameter for the development of sustainable fishery management [13]. The selectivity of the trawling net not only relies on the size and shape of the mesh but also on the morphology and behavior of a given target species [14,15]. However, smaller invertebrates such as krill tend to display a more limited response to the visual stimuli of the trawling net. Size selection resembles a sieving process in which individuals may contact the netting multiple times following a random angle trajectory for each of the contacts [16–18].

The Commission of Antarctic Marine Living Resources (CCAMLR) strongly recommends investigating the escape dynamics of krill for different fishing gears to better assess the fishing mortality of species [19,20]. Therefore, and based on the potential differences in length composition of krill captured by the specific netting designs used by different trawlers, the interactions of krill and trawling netting should be thoroughly investigated. Thus, the goal of the current study was to determine the influence of the trawl netting characteristics (i.e., mesh size and netting orientation) on the size selection of krill.

2. Materials and Methods

2.1. Experiment Set Up

The test aquarium was 70 cm long, 52 cm wide and 42 cm deep and contained ~150 L of water. It was located in the processing room of the commercial krill trawler "Longteng". The experiment was conducted from 9 April 2019 to 12 April 2019 for netting with mesh sizes of 10, 15, 20 and 30 mm. The krill used for experiments were collected from the hauls before tests at 63°01′ S–6°05′ S, 58°26′ W–58°49′ W.

To quantify the krill size selection of netting with different mesh sizes and mesh opening angles, a 20 × 20 cm square steel frame was used. Polyethylene (PE) knotted netting with a twine diameter of 0.77 ± 0.043 mm was attached to the front of the frame. Four mesh sizes of 10, 15, 20 and 30 mm were used in the experiment as the mesh size used for trawl liners mostly ranges between 10 and 20 mm but can reach up to 30 mm. The mean lengths of 20 consecutive meshes measured by a digital caliper were 9.21 ± 0.13 mm, 14.65 ± 0.11 mm, 19.69 ± 0.10 mm and 28.96 ± 0.31 mm, respectively. Based on previous studies, the frequency of mesh units with a given opening angle in a given panel resulted in 39.90% (25°), 45.33% (30°), 14.74% (35°) and 0.02% (>40°) [13]. Therefore, eight mesh opening angles of 20°, 25°, 30°, 35°, 40°, 45°, 50° and T45 (i.e., a square-shaped mesh) were set up for each mesh size of the netting. Thus, a total of 32 trails were scheduled (i.e., 4 mesh sizes × 8 mesh opening angles). The horizontal (N_t) and vertical (N_n) mesh numbers of the experimental panel associated with opening angle θ and mesh size (2a) were calculated as follows:

$$N_t = \frac{L}{2a \times \sin\frac{\theta}{2}},\ N_n = \frac{L}{2a \times (1 - \left(\sin\frac{\theta}{2}\right)^2)} \tag{1}$$

where L represents the length of the frame, *2a* represents the mesh size and θ represents the opening angle (Figure 1).

Every netting unit was sewn to a given squared frame taking the specific N_t and N_n for each of the 32 trials into account. The netting was then evenly sewn in front of the square frame according to the calculated horizontal and vertical mesh numbers (Figure 2). A handle was welded to the top side of the frame to control the frame movement during the experiment. Furthermore, a fine mesh ($2a$ = 5 mm) collection bag was arranged behind the frame to collect krill individuals passing through the netting meshes of a given experimental panel (Figure 1).

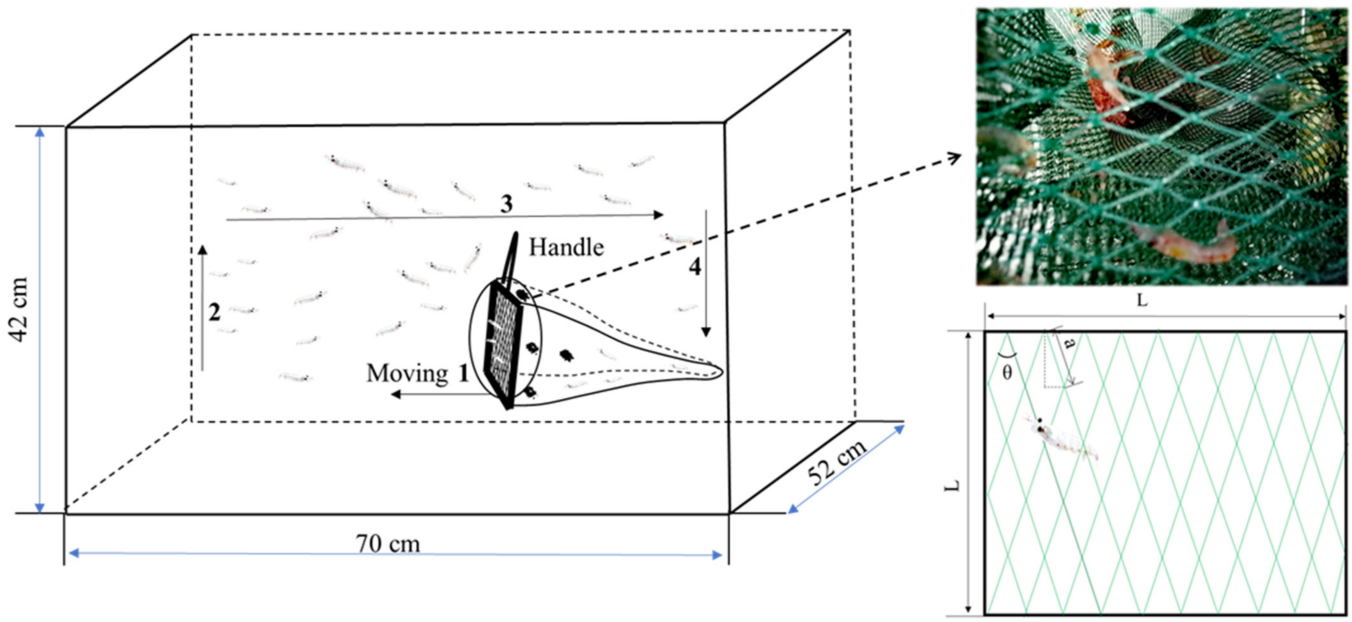

Figure 1. Schematic representation of an experimental trial, water tank and the experimental panel. The action simulating the krill trawling in the micro-cosmos experiment is decomposed into movement 1 and 2 arrows. The movement 1 arrow depicts the horizontal trajectory of the experimental panel ("trawling") whereas the movement 2 arrow shows when the experimental panel was taken out of the water to continue with the 5-min reciprocating movement simulating trawling for krill.

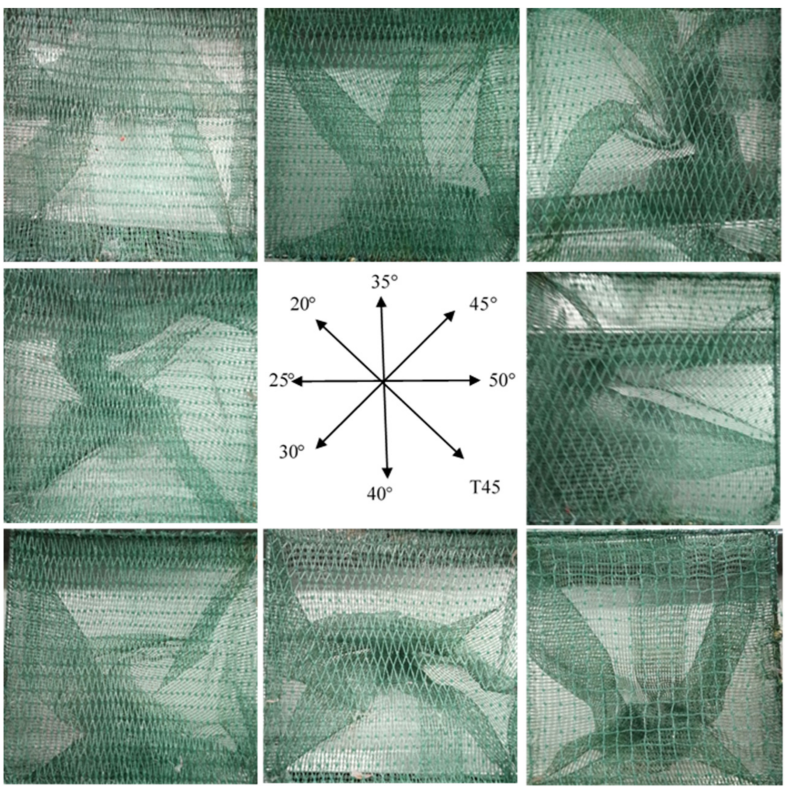

Figure 2. Experimental panels of 20 mm mesh size showing increasing opening angles from top to bottom and left to right.

A 5 min period was sufficient for all krill to come into contact with the experimental panel in all different orientations. A krill stock obtained from the trawl was used to obtain the krill individuals used for each of the 32 experimental trials. Prior to each trial and always with the same dip-net, a new set of individuals (n = 200–300) was randomly collected from the krill stock and introduced into the water tank. A total of 200 individual krill from the same haul were randomly sampled and the individual lengths were measured from the front of the eye to the tip of the telson using a digital caliper (range = 300 mm, resolution = 0.01 mm) based on CCAMLR standard protocols. Five replicates per opening angle were carried out. A one-way ANOVA (Analysis of Variance) with a multiple comparison (LSD) was used in SPSS (V 20.0, International Business Machines Corporation, New York, US) to analyze the length composition between replicates. Both the non-collected and the collected krill fraction (i.e., those that passed through the experimental panel) were then separately preserved in ethanol (75%) until a further length analysis. The length variable was pooled in 5 mm groups (i.e., 17.5 (<20 mm), 22.5 (20–24 mm), 27.5 (25–29 mm), 32.5 (30–34 mm), 37.5 (35–39 mm), 42.5 (40–44 mm), 47.5 (45–49 mm) and 52.5 (≥50 mm). The median of each group was taken as the reference value for analyses. The Kruskal–Wallis test was used to analyze the number of each size class of krill in the collection bag between replicates.

2.2. Analysis of Selectivity

In studies of the selectivity of small shrimp trawls, the logistic model is sufficiently flexible to describe the selection process [8,13]. Therefore, the selectivity data collected for different mesh sizes and mesh opening angles were modeled by the traditional logistic model (Equation (2)) using the parameters of 50% selection length ($L50$: the length of the krill at which 50% of the individuals were not captured) and the selection range (SR: the difference between $L75$ and $L25$). The equation for the logistic curve is as follows:

$$r(l, L50, SR) = \frac{\exp\ (2\ln(3) \times (l - L50)/SR)}{1 + \exp(2\ln(3) \times (l - L50)/SR)} \quad (2)$$

where l represents the length of the krill.

$$N_{tl} = N_l - N_{cl} \quad (3)$$

In Equation (3), N_{tl} represents the number of krill in length class l, which did not pass through the mesh; N_l represents the total number of krill used for the test of length class l and N_{cl} represents the number of krill in length class l, which was obtained from the collection bag of the experimental panel unit.

The selective process is similar to the cover net method whereby N_{cl} is equivalent to the krill in the cover net and N_{tl} is equivalent to the krill captured by trawl. N_{tl} and N_{cl} can thus be used to estimate the selection parameters $L50$ and SR by maximizing the likelihood for the observed data (Equation (4)).

$$\sum_l \{N_{tl} \times ln(r(l, L50, SR)) + N_{cl} \times ln(1 - r(l, L50, SR))\}. \quad (4)$$

Based on the estimated selection parameters $L50$ and SR, the length L_i (the retention likelihood is given in %) can be calculated by Equation (5):

$$Li = L50 + \frac{SR}{Ln(9)} \times ln\left(\frac{0.01 \times i}{1 - 0.01 \times i}\right). \quad (5)$$

The selectivity data were analyzed using the analysis tool SELNET [21]. The ability of the model to describe the observed data was evaluated by inspecting the fit statistics, i.e., the p-value and the model deviance versus the degrees of freedom (DOF). This evaluation followed the procedures described by Wileman et al. [22].

3. Results

3.1. Validation of the Experimental Krill: Inter-Replicate Differences of Size Class Frequencies

As only a few small individuals (~25 mm) went through the 10 mm T45 experimental panel, all 10 mm data were excluded from the analysis. The lengths of the krill used for tests ranged from 25.05 mm to 54.37 mm. There was a significant difference among the 20 mm and 30 mm mesh size replicates ($p < 0.05$), but not for the group of 15 mm (Table 1). Figure 3 shows the krill length frequency between replicates of each mesh size.

Table 1. SPSS multiple comparison (least significant difference (LSD)) results of a one-way ANOVA between replicates of a given mesh size (i.e., 15 mm, 20 mm and 30 mm). The significance level threshold (*p*-value) was set to 0.05. The symbol * indicates significant inter-replicate differences among length compositions of krill.

Mesh Size	(I) Replicates	(J) Replicates	Mean Difference (I–J)	Std. Error	*p*-Value	95% Confidence Interval	
15 mm	1	2	1.60	0.86	0.48	−0.82	4.02
		3	0.95	0.94	0.98	−1.70	3.60
		4	0.10	0.94	1.00	−2.57	2.77
		5	−0.70	0.91	1.00	−3.28	1.88
	2	3	−0.65	0.90	1.00	−3.19	1.89
		4	−1.50	0.90	0.64	−4.06	1.06
		5	−2.30	0.87	0.08	−4.76	0.16
	3	4	−0.85	0.98	0.99	−3.63	1.93
		5	−1.65	0.95	0.58	−4.34	1.04
	4	5	−0.80	0.95	0.99	−3.50	1.90
20 mm	1	2	4.95 *	0.93	0.00	2.30	7.60
		3	3.35 *	1.00	0.01	0.51	6.19
		4	3.00 *	0.98	0.03	0.21	5.79
		5	1.70	1.02	0.64	−1.19	4.59
	2	3	−1.60	0.78	0.35	−3.81	0.61
		4	−1.95	0.76	0.10	−4.09	0.19
		5	−3.25 *	0.80	0.00	−5.53	−0.97
	3	4	−0.35	0.84	1.00	−2.73	2.03
		5	−1.65	0.88	0.48	−4.15	0.85
	4	5	−1.30	0.86	0.76	−3.74	1.14
30 mm	1	2	−1.63 *	0.48	0.01	−2.99	−0.26
		3	−1.08	0.51	0.30	−2.51	0.36
		4	−0.32	0.49	1.00	−1.70	1.05
		5	−0.97	0.49	0.39	−2.36	0.41
	2	3	0.55	0.51	0.96	−0.89	1.99
		4	1.30	0.49	0.08	−0.08	2.68
		5	0.65	0.49	0.88	−0.74	2.04
	3	4	0.75	0.52	0.80	−0.70	2.20
		5	0.10	0.52	1.00	−1.36	1.56
	4	5	−0.65	0.50	0.88	−2.05	0.75

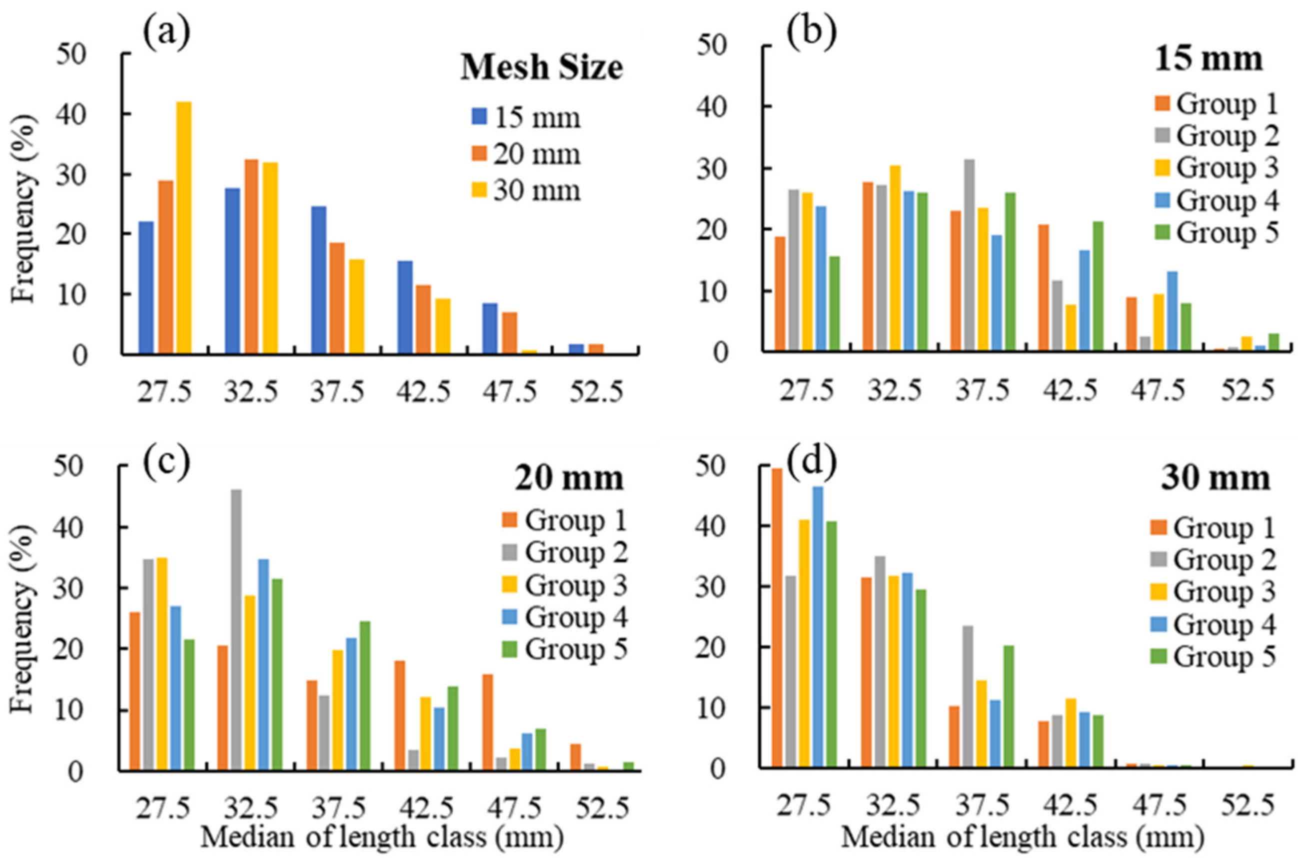

Figure 3. Histogram of the frequencies for each of the length classes obtained per replicate. The median was used as a length descriptor for each of the replicates. (**a**) A plot of aggregated values for each panel mesh size; (**b**–**d**): A plot of values for mesh sizes 15 mm, 20 mm, and 30 mm, respectively.

3.2. Effect of Panel Mesh Size and Opening Angle on the Catchability of Experimental Krill

The number of experimentally captured krill did not significantly differ within the five replicates per panel size (*p*-values provided in Table 2). Within the krill captures, both the absolute abundance and the incidence of larger krill individuals were proportional to the mesh size (Figure 4a). For the mesh size of 15 mm, no krill leakage was observed at opening angles of 20°, 25° and 30°. Only a few small krill individuals shorter than 30 mm passed through the meshes at an opening angle of 35° and the dominant krill length remained below 30 mm at opening angles of 40° and 45°. The maximum length of krill that passed through the T45 meshes exceeded 40 mm (Figure 4b). For the mesh size of 20 mm, a few krill shorter than 30 mm passed through meshes at an opening angle of 20° and the dominant krill length remained below 30 mm at opening angles of 25° and 30°. Escaped individuals were mainly shorter than 40 mm at opening angles of 35°, 40° and 45°. The maximum length of krill that passed through the mesh at an opening angle of 50° and the T45 mesh exceeded 40 mm (Figure 4c). For the mesh size of 30 mm, the dominant krill length in the collection bag remained below 40 mm at opening angles of 20° and 25°. The maximum krill length that passed through the meshes exceeded 40 mm at the opening angles of 30° and reached even up to 45 mm at opening angles of 40°, 45°, 50° and the T45 mesh (Figure 4d).

Table 2. Kruskal–Wallis results on the differences of the abundances of captured krill within replicates. N represents the total number of the respective size class of krill with a different angle given per mesh size (i.e., 15 mm, 20 mm and 30 mm).

Mesh Size	Replicates	N	Rank Mean	Test Statistic	
15 mm	1	48	122.92		
	2	48	118.30	χ2	0.201
	3	48	120.31	df	4
	4	48	120.83	*p*-value	0.995
	5	48	120.14		
20 mm	1	48	119.69		
	2	48	119.49	χ2	0.084
	3	48	122.42	df	4
	4	48	121.28	*p*-value	0.999
	5	48	119.63		
30 mm	1	48	119.28		
	2	48	117.85	χ2	0.162
	3	48	122.73	df	4
	4	48	121.90	*p*-value	0.997
	5	48	120.74		

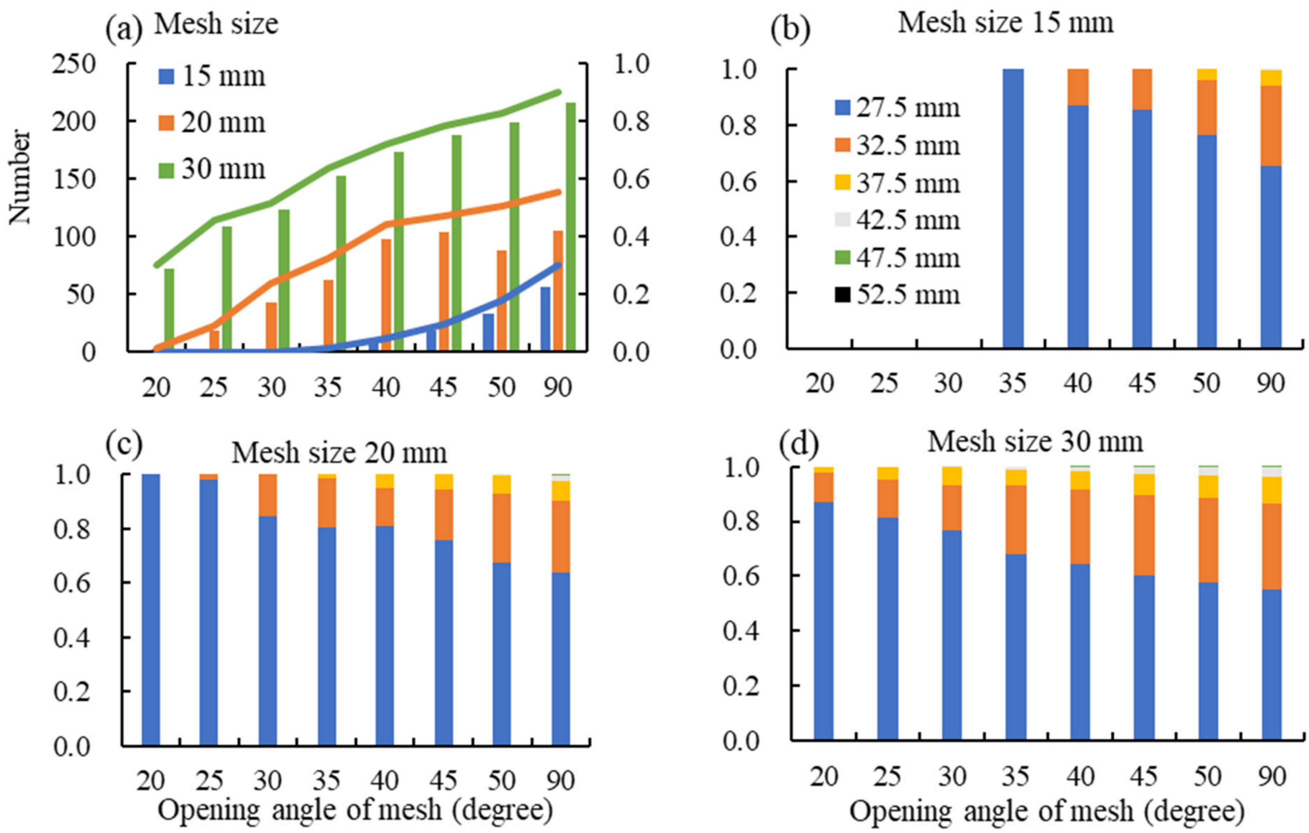

Figure 4. Dynamics of the abundance of captured krill (y-axis) as a function of the mesh opening angle (x-axis). (**a**): Number of krill in the collection bag (Columnar) and the proportion of total number of krill for the test (line); (**b**–**d**): Length frequencies of krill in the collection bag associated with different mesh opening angles for mesh sizes 15 mm, 20 mm, and 30 mm, respectively.

3.3. Parameter Estimation to Model the Effect of Mesh Size and Opening Angle on the Catchability of Experimental Krill

Specific groups (20°, 25°, 30° and 35° at a mesh size of 15 mm as well as 20° and 25° at a mesh size of 20 mm) did not collect any or only a few krill. Therefore, these were excluded from the selectivity analysis. Significant differences were not found for *L*50 ($p > 0.05$) and *SR* ($p > 0.05$) between the five replicates (Table 3).

Table 3. One-way ANOVA results of *L*50 (lengths of krill at which 50% of the individuals are not captured) and *SR* (selective range: difference between *L*75 and *L*25) between replicates.

	Source of Difference	Sum of Squares	df	Mean Square	F	*p*-Value
*L*50 (mm)	Between Groups	1.26	4	0.31	0.01	0.99
	Within Groups	2319.83	85	27.29		
	Total	2321.08	89			
SR (mm)	Between Groups	7.79	4	1.95	0.86	0.49
	Within Groups	191.64	85	2.25		
	Total	199.43	89			

At an opening angle of 40° for a mesh size of 15 mm, the mean values of the selectivity parameters of the *L*50s, *SR*s and *L*95s were 23.95 ± 1.07 mm, 4.71 ± 0.97 mm and 30.27 ± 0.58 mm, respectively. For a mesh size of 20 mm, the *L*50s, *SR*s and *L*95s were 30.97 ± 0.39 mm, 5.58 ± 1.02 mm and 38.45 ± 1.07 mm, respectively. For a mesh size of 30 mm, the *L*50s, *SR*s and *L*95s were 36.35 ± 0.75 mm, 6.73 ± 0.86 mm and 45.36 ± 1.35 mm, respectively (Table 4). All *L*50 values followed an increasing trend with an increasing mesh size and with an increasing mesh opening angle at a constant size. Furthermore, the *SR* increased with an increasing mesh size and with an increasing mesh opening angle at the same size (Figure 5).

Table 4. Selectivity parameters associated with different mesh sizes and mesh opening angles.

Mesh Sizes	Opening Angles	*L*50 (mm) Mean ± SD	*SR* (mm) Mean ± SD	*L*95 (mm) Mean ± SD	*p*-Value	Deviance	DOF
15 mm	40°	23.95 ± 1.07	4.71 ± 0.97	30.27 ± 0.58	0.99	0.21	4
	45°	25.17 ± 0.76	4.74 ± 1.03	32.06 ± 0.64	0.98	0.41	4
	50°	26.99 ± 0.71	6.23 ± 1.32	35.34 ± 1.15	0.92	0.89	4
	90°	29.76 ± 0.63	6.72 ± 0.62	38.77 ± 0.61	0.74	2.33	4
20 mm	30°	28.44 ± 0.63	4.17 ± 0.64	34.03 ± 0.68	0.98	0.21	3.6
	35°	29.58 ± 0.85	4.62 ± 0.78	35.76 ± 0.93	0.73	4.58	3.8
	40°	30.97 ± 0.39	5.58 ± 1.02	38.45 ± 1.07	0.63	2.70	4
	45°	31.44 ± 0.32	6.02 ± 1.11	39.51 ± 1.08	0.53	3.35	3.8
	50°	32.48 ± 0.45	6.52 ± 0.57	41.03 ± 0.90	0.54	4.18	3.8
	90°	33.41 ± 0.92	7.59 ± 1.62	43.58 ± 2.20	0.16	10.74	4
30 mm	20°	28.23 ± 0.33	5.00 ± 0.77	34.94 ± 0.82	0.59	3.45	3.2
	25°	29.80 ± 0.19	6.09 ± 0.57	37.97 ± 0.65	0.40	3.31	3.2
	30°	31.50 ± 0.27	6.29 ± 0.19	39.92 ± 0.30	0.51	5.52	3.2
	35°	34.44 ± 0.32	6.52 ± 0.91	43.17 ± 0.92	0.83	0.92	3.2
	40°	36.35 ± 0.75	6.73 ± 0.86	45.36 ± 1.35	0.73	2.97	3.2
	45°	38.29 ± 0.27	7.48 ± 0.51	48.32 ± 0.61	0.56	2.31	3.2
	50°	40.20 ± 0.75	8.14 ± 0.80	51.11 ± 1.24	0.52	2.62	3.2
	90°	44.33 ± 1.56	9.57 ± 0.99	57.16 ± 2.03	0.32	4.99	3.2

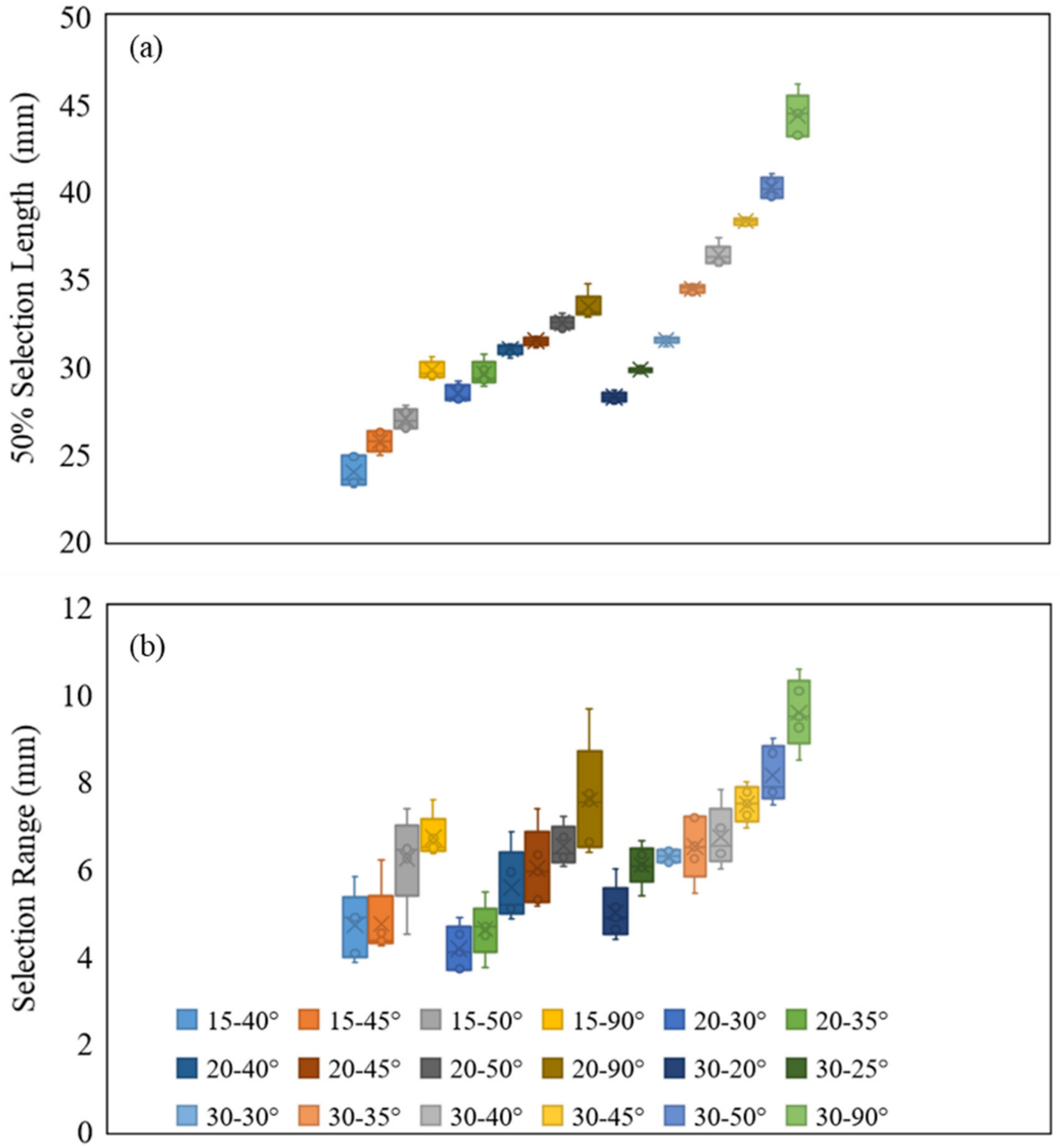

Figure 5. (**a**) Values of *L*50 (lengths of krill at which 50% of the individuals are not captured) associated with different mesh sizes and mesh opening angles; (**b**) *SR* (selective range: difference between *L*75 and *L*25) associated with different mesh sizes and mesh opening angles. The figures before and after the hyphen in the legend are the mesh size and mesh opening angle.

4. Discussion

4.1. Size Selection of Krill Associated with Different Mesh Sizes and Opening Angles

The present study showed that both the absolute abundance and the incidence of larger krill individuals passing through the experimental panels were proportional to the utilized mesh size. Krill of sizes larger than 35 mm passed through experimental panels at mesh opening angles larger than 50° for the 15 mm mesh size, 35° for the 20 mm mesh size and 20° for the 30 mm mesh size. The logistic model described the observed data sufficiently well based on inspecting the fit statistics and the similarity of the model deviance with regard to the degrees of freedom. All *L*50 values showed an increasing trend with an increasing mesh size and an increasing mesh opening angle at the same size. Furthermore, the *SR* increased with an increasing mesh size and an increasing mesh opening angle at the same size.

The computed selectivity parameters *L*50 and *SR* from this experiment were slightly different than the results of Krag et al. [8]. They reported that the *L*50 of the experimental panels associated with a mesh size of 15.4 mm at an opening angle of 90° was 31.64 mm (total range: 28.00–37.93 mm). Additionally, the wide confidence bands of *L*50 and *SR* from Krag et al. [8] were probably a result of the uncertainty of sea trials and the relatively low number of individuals that passed the experimental panels and ended in the collection bag. In the present study, the confidence bands of *L*50 remained relatively stable because the number, density and length composition of the krill could be controlled. Almost all krill could contact the netting by random orientations because of the use of a continuous 5 min reciprocating motion.

4.2. Potential Application of the Results for Determining Reasonable Mesh Size of Liners for Sustainable Krill Fisheries

Commercial krill trawls are typically equipped with small mesh liners inside the trawl body and at the cod end to reduce catch loss. The arrangement and mesh sizes of liners are different between different commercial fishing trawlers [9,10]. Czubek [23] reported that the intensity of escape (i.e., weight per m^2 of netting per 10 tons of catches) was 1.1 kg for the front part of a trawl body with a 90 mm mesh size while the intensity of escape was only 0.23 kg for a trawl body equipped with 12 mm liners. The dominant individual length of krill was 22–26 mm. Therefore, the liners inside the trawl body effectively reduce catch losses and should be equipped from the front part of the trawl body. However, as a small mesh size of liners reduces the possibility that krill can escape through the meshes, based on CCAMLR standard protocols, a large number of juvenile krill with lengths within 35 mm will be caught. Additionally, small mesh sizes will also cause a decrease in water drainage and may adversely affect the trawl performance. Thus, the mesh size of liners should be 30 mm for the front part of the trawl body related to the minimum mature size of the krill (i.e., 35 mm) as the *L*50 value.

Along the path from the mouth area of the trawl to the cod end, the krill density constantly increases compared with the krill concentration outside the trawl [24]. The probability of krill contacting the netting increases because of the low tapered structure of commercial krill trawls [7,8]. Thus, a segmented degraded mesh size of the liner netting is a better strategy to release krill juveniles before these enter the cod end. The liner mesh size of the extension part of the trawl body should not exceed 20 mm. This will retain more than 95% of krill larger than 34.03 mm, 35.76 mm and 38.45 mm for opening angles of 30°, 35° and 40°, respectively.

When the krill enters the cod end, a number of small krill individuals may escape as a result of catch stacking and squeezing. The intensity of escape through the same mesh size liners was 0.23 kg for the trawl body versus 3.2 kg for the trawl cod end [23]. Additionally, Krafft et al. [25] reported that krill tolerates the process of capture and disposal in trawls quite well. Mortality was only 4.4 ± 4.4% of krill escaping from the cod end of a 16 mm mesh size. Therefore, the mesh size of the liner inside the cod end should be no less than 15 mm, which only slightly reduces the fishing yields while considerably reducing the number of caught juvenile krill.

5. Conclusions

The present study assessed the effects of the mesh size and mesh opening angle on the krill fishing selectivity via micro-cosmos experiments. Both the absolute abundance and the incidence of larger krill individuals passing through experimental panels were found to be proportional to the mesh size. Additionally, all *L*50 values showed an increasing trend with an increasing mesh size and an increasing mesh opening angle at the same size. Furthermore, the *SR* increased with an increasing mesh size and an increasing mesh opening angle at the same size. These data help to better understand the size selection of krill obtained by sea trials and provide a scientific basis for the size selection of krill associated with different mesh sizes and mesh opening angles. Furthermore, this study provides scientific advice for the selection of a reasonable liner mesh size for krill trawl to improve fishing efficiency, minimize fishing losses and reduce potential negative impacts of fishing on the ecosystem.

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