SCALLOP DREDGE SELECTIVITY STUDY: COMPARISON OF DIFFERENT RING WASHERS AND DREDGE CONFIGURATIONS

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ABSTRACT

Parsons, G.J. and L.-A. Davidson. 2004. Scallop Dredge Selectivity Study: Comparison of Different Ring Washers and Dredge Configurations. Can. Tech. Rep. Fish. Aquat. Sci. 2547: iv +20 p.

A study to assess the scallop catch and size selectivity of a dredge with buckets made using 76 mm (3 inch) rings fastened with different types of washers was conducted in the southern Gulf of St. Lawrence. Buckets with rings joined with only steel washers caught less small, undersized (≤76 mm) scallops compared to buckets with other configurations. The buckets with rings joined with steel washers and chaffing pads were the second most efficient at releasing the undersize scallops while buckets with steel and rubber washers were third. The buckets with rings joined with two rubber washers were the least efficient. This was because the effective ring size was larger for the steel washers. The buckets with rings fastened with steel washers had a slightly lower mean number of scallops per tow but a slightly higher mean shell height of scallops >76 mm compared to buckets with other configurations. The net result, for type of buckets, was no difference in catches, based on meat weight of scallops >76 mm in size.

RÉSUMÉ

Parsons, G.J. et L.-A. Davidson. 2004. Etude de sélectivité pour des fins de comparer les différents anneaux et configurations de la drague. Rapp. Tech. Can. Sci. Halieut. Aquat. 2547 iv+ 20 p.

Une étude pour des fins d'évaluation des prises de pétoncle et de sélectivité de taille en se servant de différents types de rondelles sur une drague à pétoncle avec des paniers fabriqués avec des anneaux de 76 mm (3 pouces) fut effectuée dans le sud du golfe du Saint-Laurent. Des paniers munis d'anneaux rejoints avec seulement deux rondelles d'acier ont capturé moins de pétoncles de petite taille (≤76 mm) à comparer aux paniers avec autres configurations. Les paniers munis d'anneaux rejoint avec des rondelles d'acier munis de tapis de caoutchouc qui prévient l'usure, sont les deuxième plus efficace à laisser passer les pétoncles de plus petite taille. Les paniers munis d'anneaux rejoints avec des rondelles d'aciers et de caoutchouc étaient les troisièmes. Les paniers munis d'anneaux rejoints avec deux rondelles de caoutchouc étaient les moins efficaces. L'espace effectif des anneaux est plus grand lorsque les anneaux sont reliés avec les rondelles d'acier. Les paniers munis d'anneaux rejoints avec les rondelles d'aciers retenaient un peu moins de pétoncles par trait mais il y avait plus de pétoncles >76 mm à comparer aux paniers avec autres configurations. Dans l'ensemble, pour chaque type de paniers, il n'y avait pas de différence dans la prise (poids de chaise) des pétoncles >76 mm.

1.0. INTRODUCTION

Several studies have examined the selectivity and efficiency of different scallop dredge types over at least the last thirty years (Bourne 1964, 1966, Rolfe 1969, Caddy 1971, 1972, Mason and Chapman 1979, Worms and Lanteigne 1986). More recently, a few studies have examined the effect of ring size and different gear configurations on catch rates (Howell 1983, Robert and Lundy 1988, DuPaul *et al.* 1989, Anon. 1996).

In the southern Gulf of St. Lawrence some fishers are using rubber washers instead of steel washers or along with steel washers to link the rings. They claim that this technique reduces the wear and tear of the rings. Some fishers have kept using only steel washers, but have added rubber pads under the buckets to prevent chaffing.

With a number of scallop populations experiencing low recruitment rates and declining stocks, the need for conservation measures to protect undersize, nonmature (juvenile) scallops is an important objective for the management of the scallop fishery. One approach to protecting undersized scallops is to develop gear that is more selective, retaining larger scallops and leaving the smaller ones on the bottom. With scallop dredges, this could possibly be achieved through the use of a large ring or through the use of washers that do not reduce the effective ring size.

With the interest of all participants in the southern Gulf of St. Lawrence scallop fishing industry (fishers, managers, biologists) in seeking new conservation measures and with the use of many different ring and washers combinations, an experimental study was undertaken to assess scallop catch and size selectivity by using different bucket configurations.

2.0. MATERIALS AND METHODS

The study was conducted on commercial scallop beds in the southern Gulf of St. Lawrence (Figure 1). In general, the scallop beds in the study area have gravel/sand bottoms. The study was conducted in four locations with four different fishing vessels. All trials were conducted between October 13, 1995 and November 28, 1995 (Table 1). There were a total of 99, 111, and 41 tows, respectively, conducted with vessels from P.E.I., N.B., and N.S. for a total of 251 tows.

For this experimental study, a ten bucket Digby dredge was used. Each bucket was a standard width of 0.6 m (2 feet) with teeth and the metal mesh bag was constructed with 76 mm metal rings (3 inches, internal diameter). A configuration of five different types of buckets was used. The first type had rings linked with two steel washers (steel); the second had rings linked with one steel and one rubber washer (rubber and steel); the third had rings with two rubber washers (rubber); the fourth had rings linked with two steel washers and was lined with 13 mm (0.5 inch) black plastic mesh, Vexar™ (steel-lined); and the fifth had rings linked with two steel washers and had external rubber pads (steel-pad) (Annex 1). For the trials, there were two buckets of each type. The order of the buckets were steel, steel and rubber, rubber, steel-lined, steel-pad, steel, steel and rubber, rubber, steel-lined, and steel-pad. Using this design,

each bucket type was represented on each half of the tow bar and one of each bucket type was generally on the outside and one on the inside of the tow bar. The initial placement of the buckets was randomly assigned.

For each tow, the fishermen towed the dredges for eight minutes at a speed of about two knots. There was approximately a 3:1 scope on the warp. For each tow, the starting and finishing position (Loran), start and finish time, direction, speed, depth, scope, and bottom type were recorded.

For all tows, the number of scallops per bucket was recorded. Further, for 17, 3, 91 and 7 tows from Cape Bear Reef, P.E.I., Howard's Cove, P.E.I., Cape Tormentine, N.B., and Pictou Island, N.S., respectively, (Table 1) the catch was measured for shell height (hinge to ventral margin) to the nearest mm using Vernier calipers. Field assistants were on board at all times to record the scallop catch information.

The scallop catch data and shell height information were entered into a database and summarized and analyzed for statistical differences among different buckets types with an one-way ANOVA using the SPSS statistical software package. Where there were significant differences among factors, differences among treatments were examined using the *post hoc* Tukey B test.

3.0. RESULTS

Data from Cape Bear Reef, P.E.I. could not be considered in the analysis because fishers did not use all ten buckets on one tow bar.

The highest mean number of scallops per tow was found in buckets with two rubber washers followed by the steel-pad and steel and rubber. The lowest count was in the buckets with only steel washers and steel-lined buckets (Figure 2 and Table 2). However, there was no statistical difference between the mean number of scallops per tow and the different bucket types (Table 2).

In order to compare the mean number of small scallops (≤76 mm) and large scallops (>76 mm) among the different bucket types, the data obtained from the tows in which the scallops were measured were used. The mean total number of scallops per tow (i.e., all sizes) from the measured tows was compared (one-way ANOVA) and presented no significant difference among the buckets (Table 2, Figure 2). However, when the data for scallops >76 mm was compared among the different bucket types, there was a significant difference (Table 2). The bucket with the rubber washers had the highest mean number of large scallops followed by the steel and rubber and steel-pad (Figure 3, Table 2). The steel ring and liner bucket caught significantly fewer scallops than the other buckets ($p<0.05$).

The analysis examining scallops ≤76 mm, revealed that the steel only buckets retained the lowest number of small scallops while the steel-pad bucket retained the second lowest followed by the rubber and steel (Figure 3). As expected the steel-lined bucket retained the largest numbers of small scallops, followed by buckets with rubber washers. These differences, however, were not significant (Table 2).

The mean size of scallops (shell height) was compared for all scallops from the measured tows and there was a significant difference among the buckets (Table 2).

There were also significant differences in the mean shell height of large scallops (>76 mm) among the buckets and significant differences in the mean shell height of the small scallops (≤76 mm) among the bucket types (Table 2). Of the large scallops, the buckets with steel-only washers retained the largest scallops (Figure 4). The second largest were retained by the steel-pad followed by the rubber and steel, and rubber. The steel-lined buckets had the significantly smallest scallops ($P<0.05$). The small scallops, the steel-lined bucket had the significantly smallest mean size scallops ($P<0.05$; Figure 4).

Scallop size frequency distributions showed that the majority of the scallops caught were >76 mm and were primarily in the 77 to 101 mm size range (Figure 5). Overall, 19.4% of the total catch was scallops ≤76 mm (Table 3). A greater proportion of smaller scallops were in the steel-lined and rubber washer buckets (Table 3).

A comparison of the potential catch, in terms of meat weight (total yield of scallops >76 mm) was estimated for each of the different bucket types. A weight-length relationship was derived from data for the Northumberland Strait (Figure 6; Davidson, unpublished data). This catch analysis used the mean shell height and mean number of scallops from tows with scallops >76 mm only and compared the catch (meat yield) for 100 tows (Table 4). The difference in yield was negligible and ranged from 6.8 to 7 kg (15.1 to 15.6 lbs) of meats for the steel, steel-pad, steel and rubber and rubber buckets (Table 4).

4.0. DISCUSSION

The analysis of the total potential catch of scallops for the different bucket configurations resulted in negligible differences among the buckets with steel, steel and rubber, and rubber washers and steel washers with rubber pad. This analysis was based on a weight-length relationship of scallops from the Northumberland Strait. While differences in growth rates can vary throughout the Gulf (Chouinard and Mladenov 1991), the meat weight-length relationship should not have changed during the course of this study.

The findings that the buckets with rubber washers caught more small scallops than the bucket with steel washers is consistent with the finding of Robert and Lundy (1988) who conducted a study in the Bay of Fundy. Robert and Lundy (1988) also found differences in catch rates on different bottom types but they found the same general pattern. For the same ring diameter, buckets linked with rubber washers reduce the inter-ring space compared to buckets with steel washers. This selects scallops of a relatively small size at 70-80 mm shell height. Steel washers buckets retain scallops of a larger size at 100 mm shell height.

Since scallops caught in buckets linked with steel washers had a slightly higher mean shell height, the overall meat yield was the same as buckets with other configurations. Buckets with rubber washers do have lower catch efficiencies however (Robert and Lundy 1988). This suggests that if only steel washers were used, catches of undersize scallops would decline, without impacting the overall yield of harvestable scallops.

A couple of studies have examined the effect of increased ring size on the efficiency and selectivity of scallop dredges on Georges Bank (DuPaul *et al.* 1989,

Anon. 1996). These reports conclude that the larger ring size caught fewer small scallops, as would be expected, and that using the large ring size resulted in a net benefit due to increased meat weight yield. Increased ring size could be an additional or alternative conservation measure to be considered for the Gulf of St. Lawrence and a study examining the selectivity of increased ring size using Gulf fishing gear is warranted.

5.0. CONCLUSION

Buckets with steel washers caught less small, undersized (≤76 mm) scallops compared to buckets with other configurations. The steel-pad was the second most efficient at releasing the small scallops followed by the steel and rubber. The buckets with steel washers had a slightly lower mean number of scallops per tow, but a slightly higher mean shell height of scallops >76 mm compared to buckets with other configurations. The net result was no difference in the catch, based on meat weight of scallops >76 mm in size.

6.0. SUMMARY OF FINDINGS

1. Steels washers (two) could be used to link the rings on the scallop buckets as a conservation measure for scallop fishery. These buckets caught less small scallops compared to other bucket configurations and there was no net reduction in catch (as measured in total weight of meats for scallops >76 mm).

2. If for economic reasons, chaffing gear is required, steel washers with rubbers pads or buckets with steel and one rubber washer could be allowed as a second option. However two rubber washers should be avoided.

3. Increasing ring size could be another alternative, but would require further investigation.

7.0. ACKNOWLEDGEMENTS

Thanks to the fishermen (Captains Roger Cormier, Joe Papp, Barry Cooke, and Jack Martin) and field assistants (Bill Cook, Thorold Fitzpatrick, Donna Waltman, John MacIntyre, Robert L. Mackay) who carried out the sampling and to Maurice Maillet (DFO), Dave Gillis (PEI - DAFF), Greg Roach (NS - DF) and François Mondo and Claude Williams (NB - DFA) for their assistance in setting up the study.

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Table 1. Summary of scallop tow locations, dates, and numbers.

Location	Date	Number of Tows	Number of Tows Measured
Cape Bear Reef, P.E.I.	Oct. 13, 1995	21	5
Cape Bear Reef, P.E.I.	Oct. 18, 1995	22	4
Cape Bear Reef, P.E.I.	Oct. 19, 1995	34	5
Cape Bear Reef, P.E.I.	Oct. 20, 1995	15	3
Total Cape Bear Reef, P.E.I.		92	17
Howard's Cove	Oct. 25, 1995	7	3
Total Howard's Cove, P.E.I.		7	3
Cape Tormentine, N.B.	Nov. 7, 1995	25	17
Cape Tormentine N.B.	Nov. 9, 1995	29	25
Cape Tormentine N.B.	Nov. 11, 1995	27	25
Cape Tormentine, N.B.	Nov. 13, 1995	11	10
Cape Tormentine, N.B.	Nov. 14, 1995	19	14
Total Cape Tormentine, N.B.		111	91
Pictou Island, N.S.	Nov. 24, 1995	27	5
Pictou Island, N.S.	Nov. 28, 1995	14	2
Total Pictou Island, N.S.		41	7
Total Study		251	118

Table 2. Summary of mean numbers per tow and mean shell height per tow and results of one-way ANOVAs for each category.

Category	Steel	Steel and Rubber	Rubber	Steel - lined	Steel - pad	F value	P value
			Numbers per Tow				
Mean	7.71	8.28	8.70	7.68	8.46	2.29	0.057
SE	0.29	0.30	0.33	0.28	0.30		
			Numbers per Measured Tows (all sizes)				
Mean	7.73	8.24	8.38	7.19	7.99	1.62	0.17
SE	0.35	0.38	0.42	0.37	0.32		
			Numbers per Measured Tows (>76 mm)				
Mean	6.59	6.84	6.93	5.59	6.77	3.36	0.01
SE	0.30	0.30	0.33	0.30	0.27		
			Numbers per Measured Tows (≤76 mm)				
Mean	1.14	1.40	1.45	1.58	1.21	1.54	0.19
SE	0.11	0.15	0.15	0.17	0.13		
			Shell Heights (mm) - All sizes				
Mean	88.51	87.60	87.17	85.38	88.42	14.48	0.001
SE	0.31	0.30	0.32	0.37	0.31		
			Shell Height (mm) - >76 mm				
Mean	92.53	91.92	91.79	91.42	92.46	3.21	0.01
SE	0.24	0.25	0.25	0.28	0.25		
			Shell Height (mm) - ≤76 mm				
Mean	68.88	69.44	68.49	66.31	69.09	7.89	0.001
SE	0.47	0.37	0.44	0.53	0.45		

Table 3. Overall number of scallops and percent ≤76 mm shell height for the different bucket types.

Bucket Type	No. <76 mm	No. >76 mm	Total No.	% <76 mm
Steel	266	1298	1564	17.0
Steel-pad	279	1334	1613	17.3
Steel and Rubber	320	1345	1664	19.2
Rubber	336	1357	1693	19.8
Steel-liner	349	1102	1451	24.1
Total	1550	6436	7986	19.4

Table 4. Estimated catch (meat weight) for 100 tows by different bucket types.

Bucket Type	Mean Shell Height (mm)	Ave. Meat Wt. (g)[1]	Mean number per tow	Meat Wt. per Tow (g)	Meat Wt. per 100 Tows (kg)	Meat Wt. per 100 Tows (lb.)
Steel	92.53	10.39	6.59	68.47	6.85	15.1
Steel-pad	92.46	10.37	6.77	70.22	7.02	15.5
Steel and Rubber	91.92	10.24	6.84	70.04	7.04	15.4
Rubber	91.79	10.20	6.93	70.67	7.07	15.6
Steel-liner	91.42	10.11	5.59	56.52	5.77	12.5

1. From weight length relationship Ln Weight = 2.2604 Ln Shell Height - 7.8932 (Davidson, unpub. data) (Figure 6).

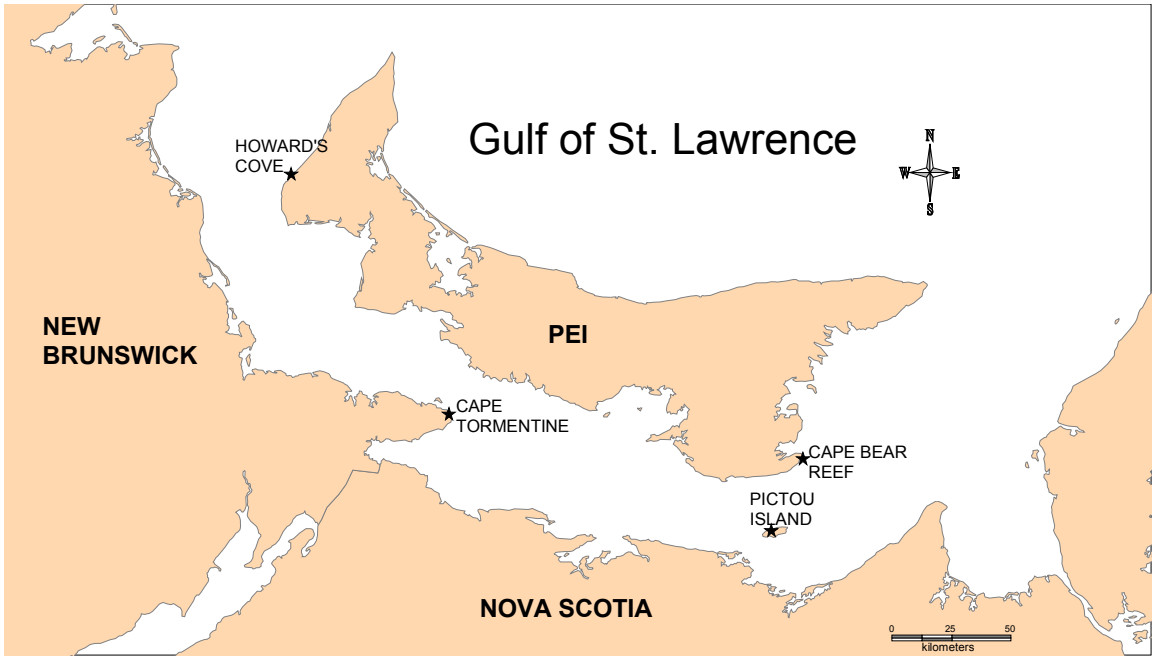


Figure 1. Map of study site.

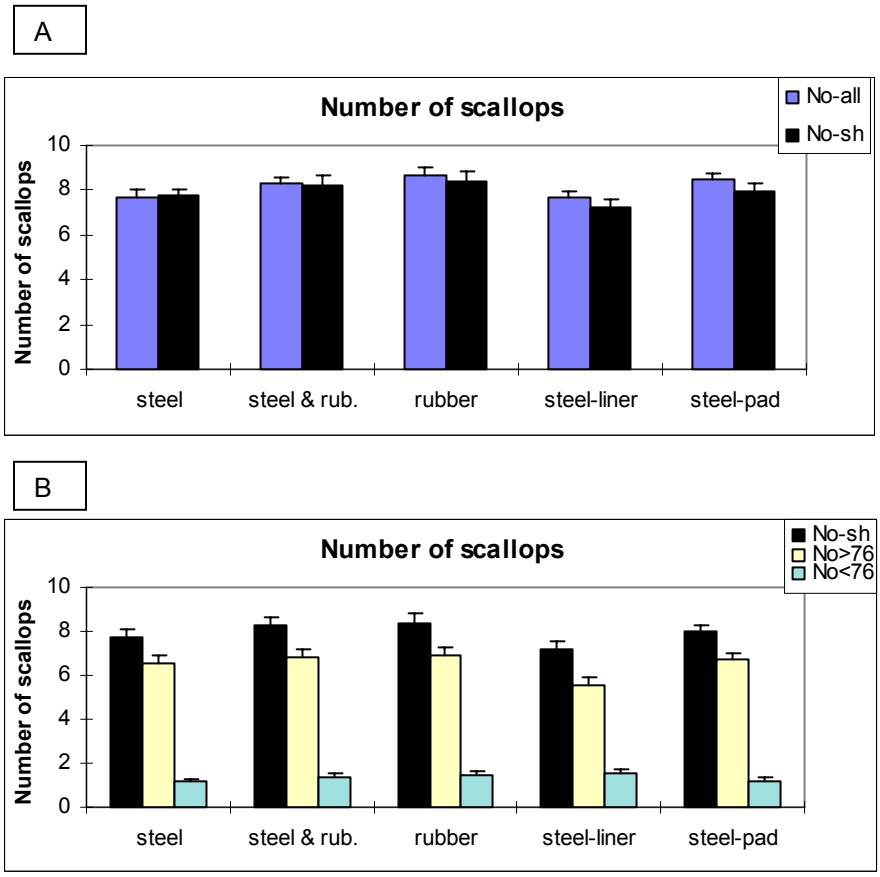


Figure 2. Number of scallops for (A) all tows and for all measured tows and (B) numbers of scallops for measured tows by size.

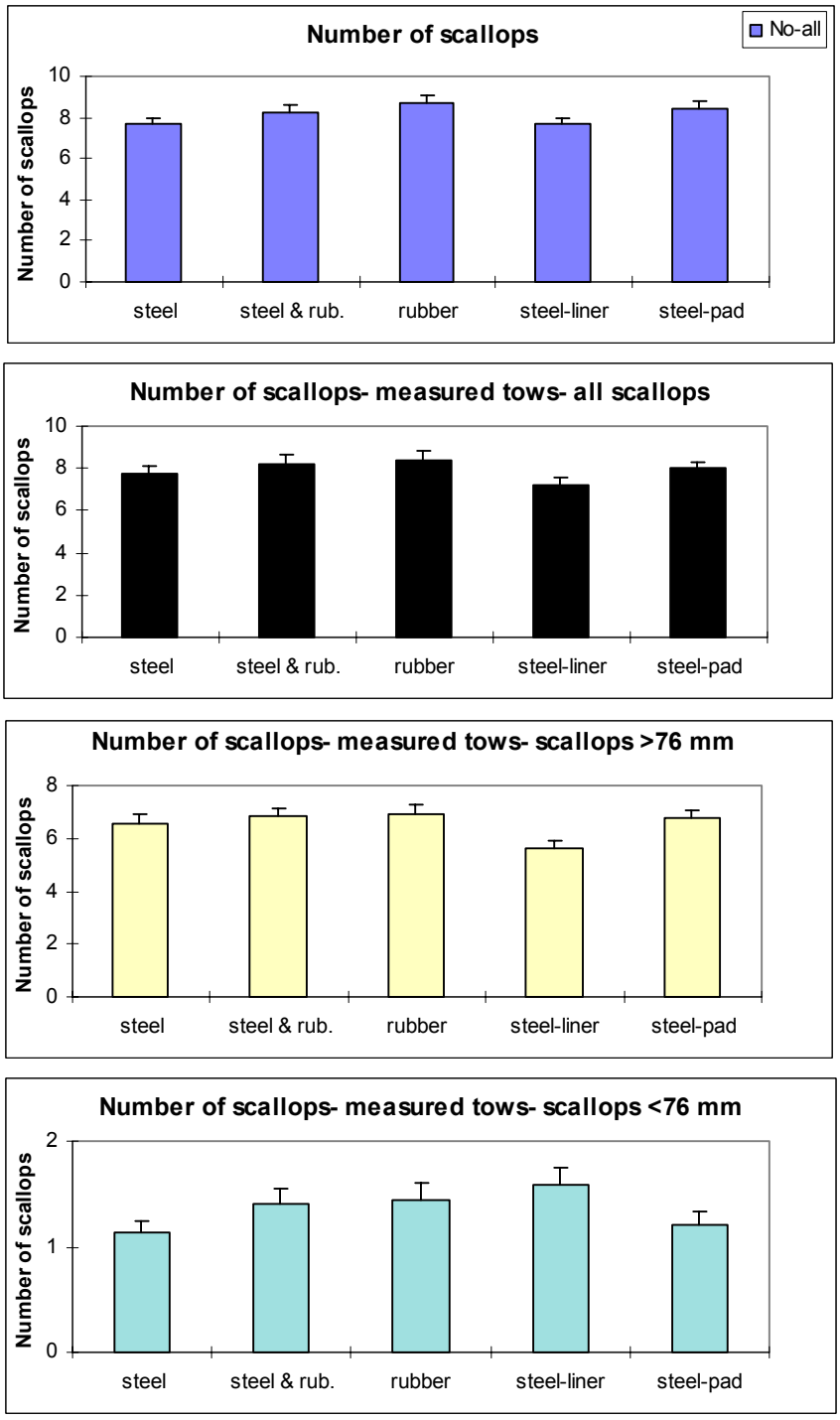


Figure 3. Mean number of scallops for measured tows by scallop size.

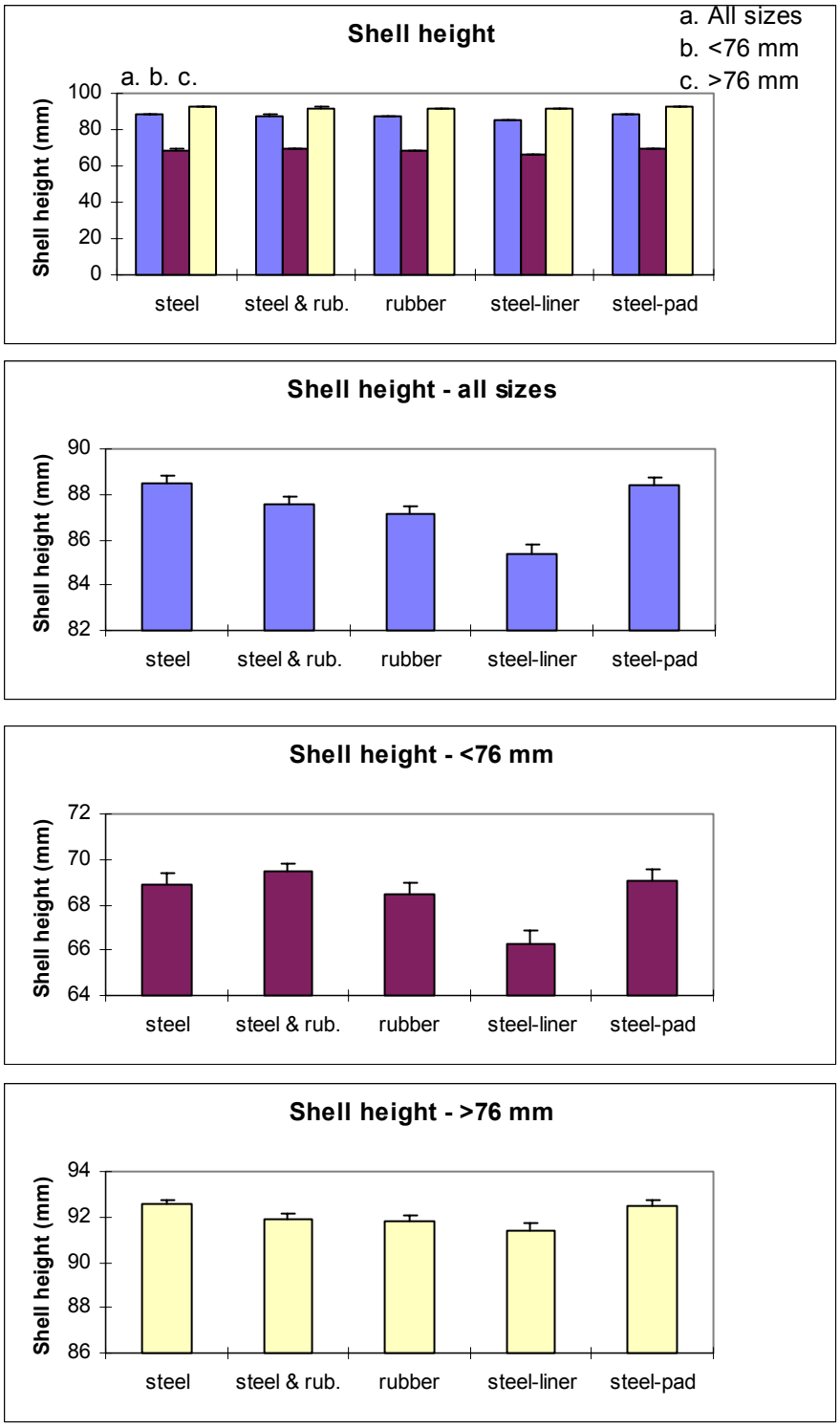


Figure 4. Mean shell height for scallops from measured tows by different scallop size.

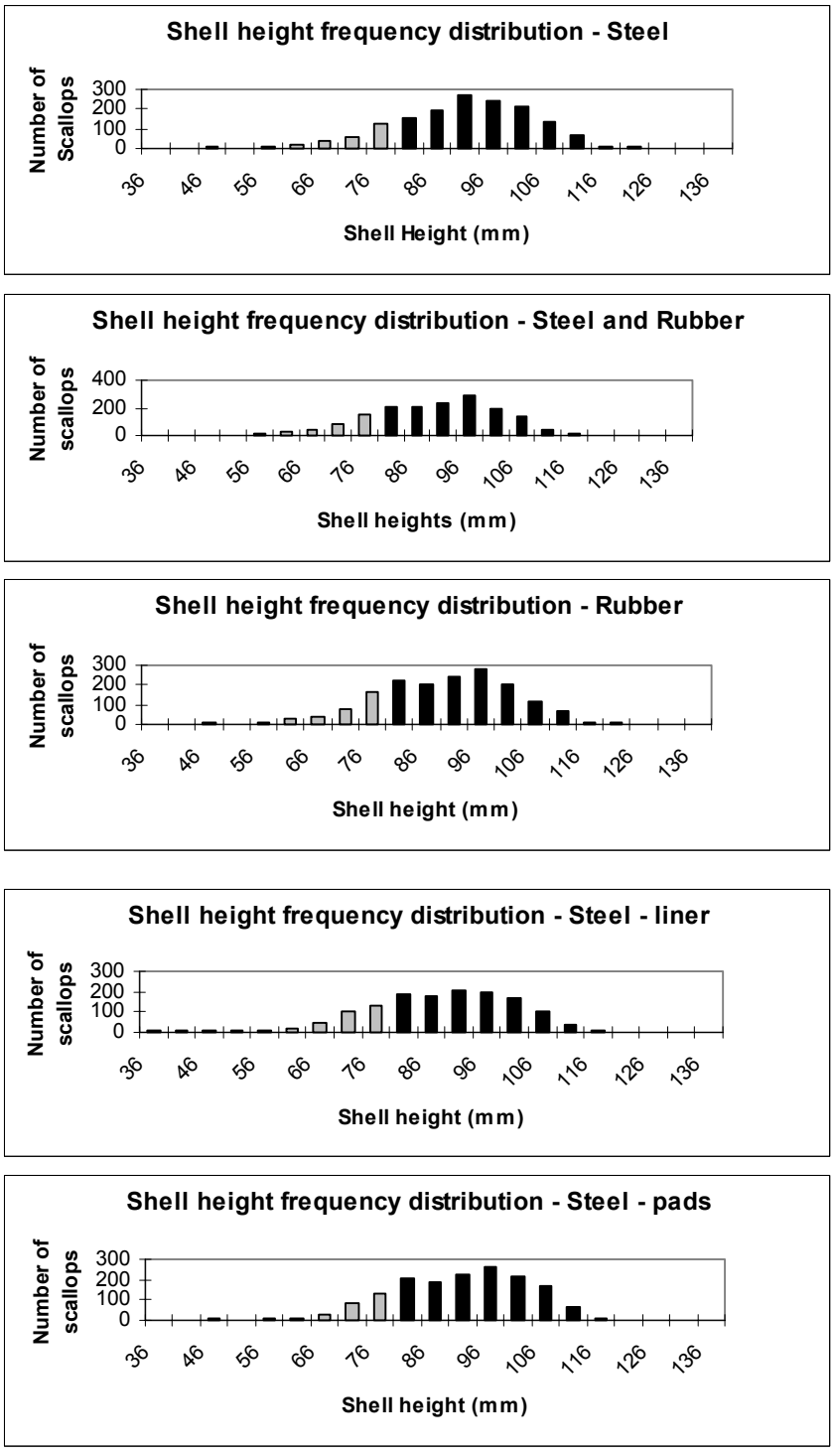


Figure 5. Shell height frequency distribution for all measured tows for each bucket type.

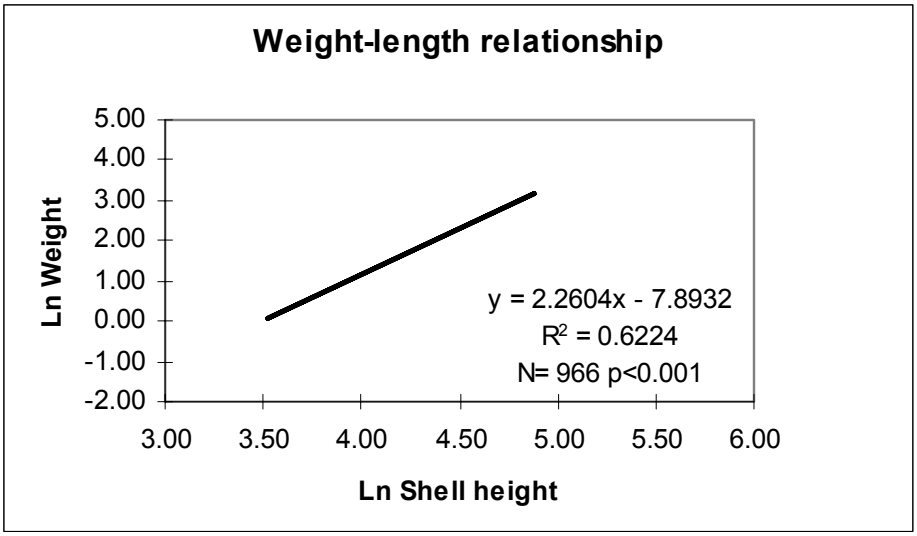
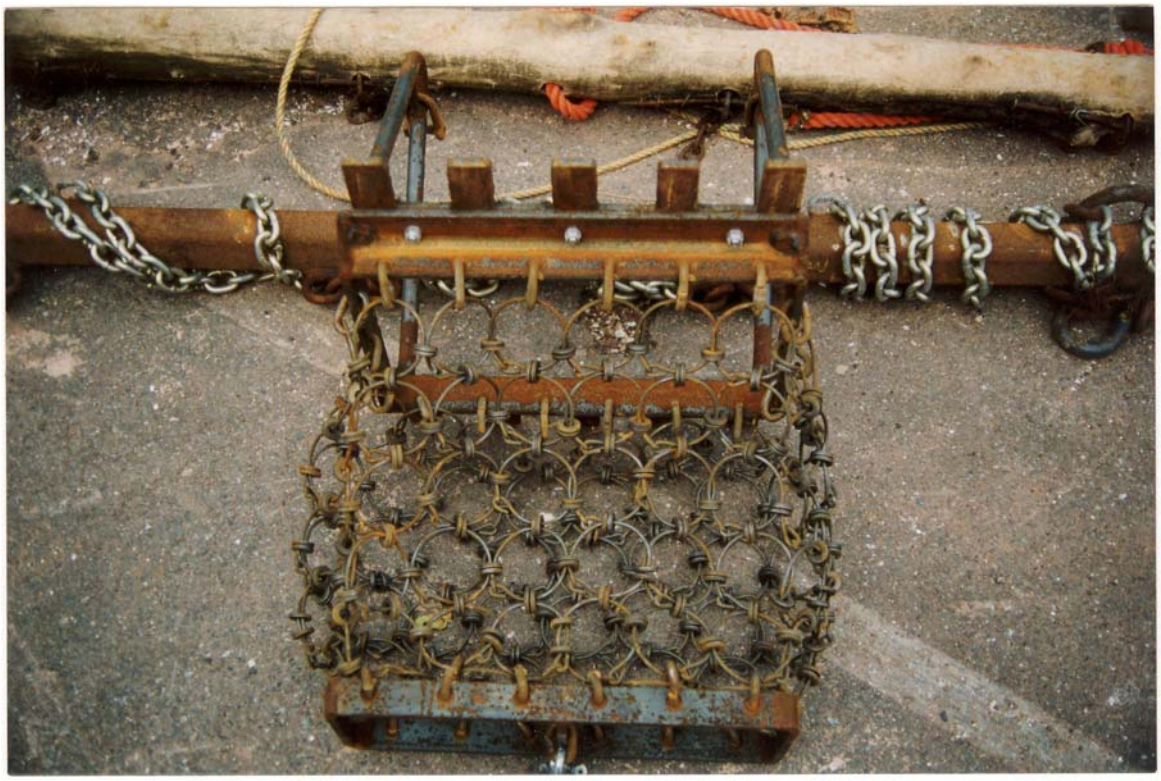


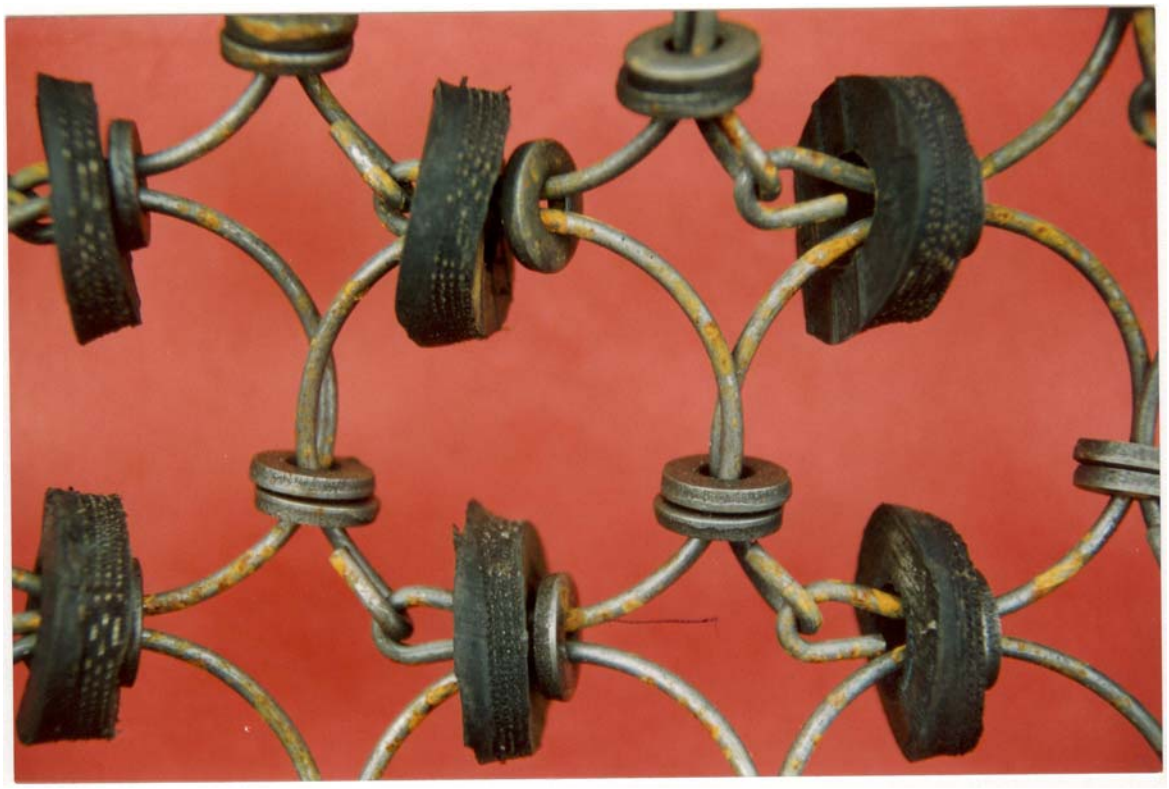
Figure 6. Weight-length relationship for scallops from Northumberland Strait.

Annex 1

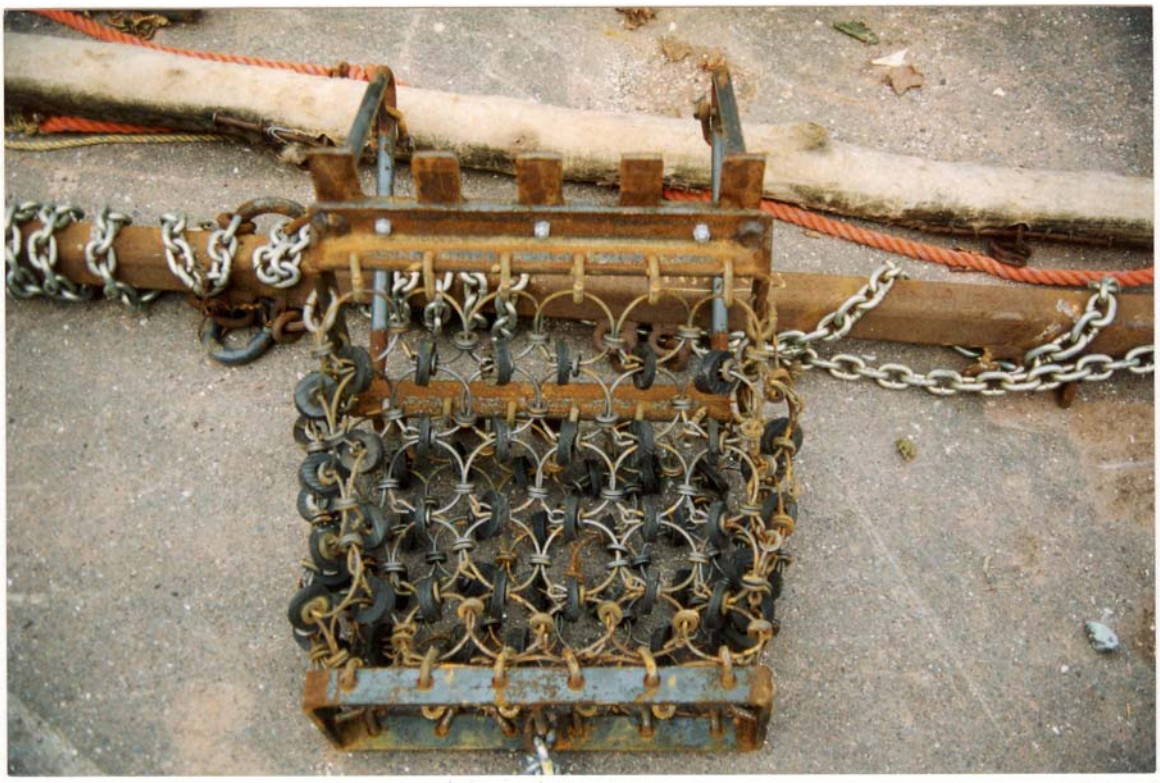
Photographs to illustrate the different bucket configurations, the Vexar and the sampling sheets.

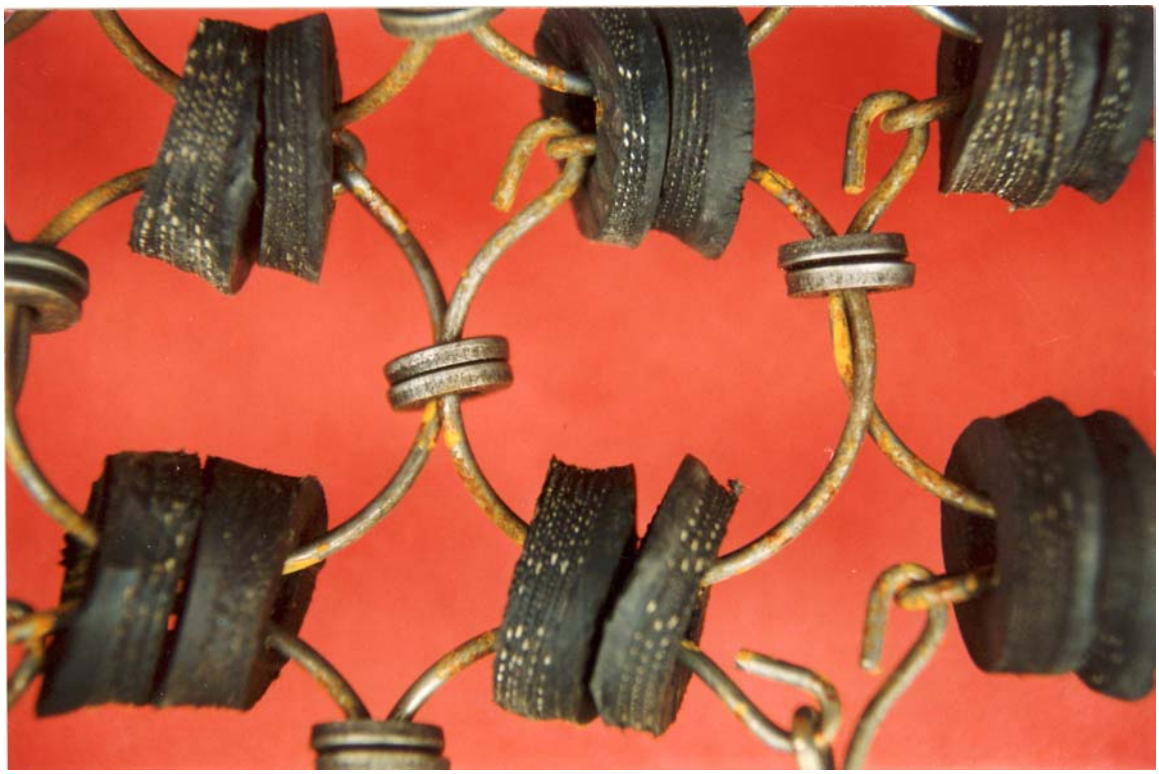
Scallop bucket made with 76 mm (3 inch) rings and steel washers (steel).



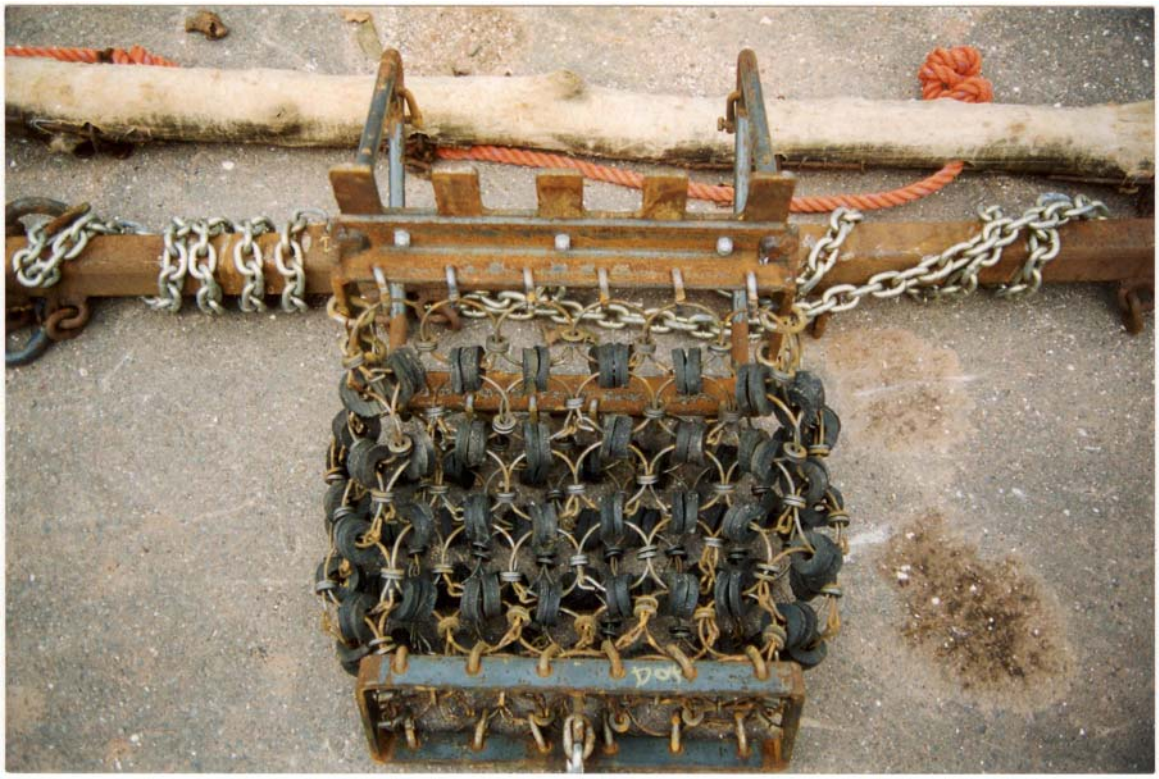


Scallop bucket made with 76 mm (3 inch) rings and steel and rubber washers (rubber and steel).

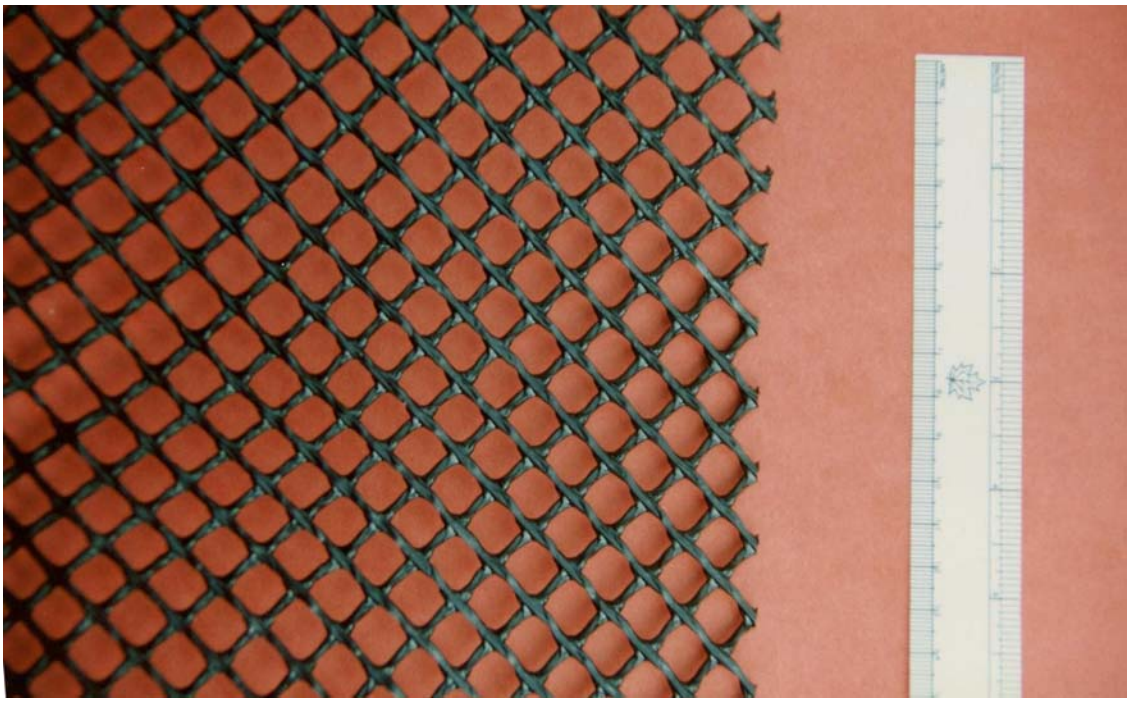




Scallop bucket made with 76 mm (3 inch) rings and rubber washers (rubber).



Scallop bucket made with 76 mm (3 inch) rings and steel washers and rubber pads (steel-pad).



Vexar used to line two buckets made with 76 mm (3 inch) rings and steel washers

Data sheets used by field assistants to collect information (below).