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Offshore Scallop Gear Research

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In 1961 Canadian and United States scientists undertook further analysis of accumulated offshore scallop gear selection data and collected additional information on this subject. This project was undertaken at the urging of the commissioners of ICNAF who requested a comprehensive statement on the advisability of introducing a ring size regulation to the Subarea 5 Georges Bank scallop fishery. Canada agreed to examine data from both United States and Canada and provide a statement of the analysis.

Present Practices of Fishery

Fishing gear, described by Posgay (1957), and practices of both Canadian and United States fleets are essentially the same. The catch is dumped on deck, sorted and culled. The 50% cull point for both fleets is 95-100 mm shell height (5-year-old scallops). Scallops larger than this (markets) are shucked immediately, the large adductor muscle being the only part of the animal that is landed. Scallops smaller than the cull point (discards) are shovelled overboard along with the trash. The subsequent history of these discards is unknown but Medcof and Bourne (1962) have indicated that a significant fraction (about 20%) may be lethally damaged, particularly if they remain on deck for long periods of time.

It has been postulated that delaying the age at which the scallops are first shucked would produce an increase in yield. The best method of delaying the age at which the fishermen first shuck scallops (i.e., delay the age at which scallops are first shucked from 5- to 6-year-olds, 96.2 to 108.4 mm) is to prevent these scallops from being retained in the drag. From the results of mesh experiments with otter trawls, it was felt that if the size of the ring used on scallop drags was increased, the age at first capture could be delayed, the number of discards reduced and benefit to the fishery would accrue.

Results of Work Prior to 1961

United States scientists conducted gear research in 1957, 1958 and 1959 and compared catches made with 4-, 3½- and 3-inch ring gear to those made with 2-inch ring gear (Posgay, 1958). The standard ring used by the commercial fleet has a 3-inch inside diameter. In all these trials two drags were towed simultaneously, the standard experimental drag with 2-inch rings on one side and the experimental gear on the other. Since both drags cover essentially the same bottom and sample the same population we can directly compare catch per tow.

All tows made during these trials were only 10 minutes' duration on relatively clean bottom. No measurement of the amount of trash was made and the effect of multiple linkage was not studied.

The selection curves obtained comparing catches of the 4-inch ring drag to those of the experimental standard show that the 4-inch ring drag retains 100% of scallops 105-110 mm and larger in shell

height. The selection curves are not as sharp as observed with some otter trawl data. The 4-inch ring gear consistently caught more scallops over 105-110 mm than the smaller ring gear, indicating that it is more efficient at catching this size scallops than the smaller ring gear.

Canadian investigators compared catches of a 4-inch ring drag with those of a 3-inch ring (Bourne, 1960). The data were obtained on a commercial dragger during commercial fishing operations and no comparisons on a catch per tow basis were possible. The 4-inch ring caught less trash, fewer discards and appeared to be more efficient at catching market-size scallops than the 3-inch ring.

1961 Studies

Methods used in both United States and Canadian 1961 gear studies were similar to those used by United States investigators in previous years. A standard 3-inch ring drag was towed on one side and the experimental ring gear was towed simultaneously on the other side. Essentially identical populations are sampled and we can compare the catch per tow of the two rings. Canada used a chartered commercial dragger, M.V. Cape Eagle, and the United States, the research vessel M.V. Delaware.

Canada compared catches of a 4-inch ring gear to those made with the standard 3-inch ring. The United States used the same standard and compared catches of 4-inch and 5-inch rings with it. Both countries studied the effect of multiple linkage of rings on catch and measured the amount of trash landed.

There were certain differences between the gear trials of the two countries. United States tows were all 10 minutes' duration, while Canadian tows were all commercial length, 20-30 minutes. Canadian tows were made on trashier bottom than United States tows.

Results of 1961 Studies

Data are summarized in Tables I to IV and illustrated partly in Figs. 1 and 2.

Selection curves based on Canadian data comparing catches made with the 4-inch ring gear against those made with 3-inch ring gear with various linkages are summarized in Table I and illustrated in Fig. 1. The 3-inch ring gear was always linked one on the top and two on the bottom. The resulting curves are much more horizontal and selection poorer than is noted with most otter trawl data. The 4-inch ring retains 100% of scallops 105 mm and over in shell height and apparently is more efficient than the standard ring at catching scallops larger than this size, since the curves extend well beyond the 100% line. It is difficult to pick out a 50% selection point. The larger ring gear caught less trash (16% less by volume) and fewer discards (22% less by number, of scallops less than 100 mm in shell height).

It is evident from Table II that in the United States gear trials one drag was more efficient at catching scallops than the other. A gross comparison shows one drag was about 1.5 times more efficient than the other. This difference in efficiency does not appear to be consistent in any one particular size group. Hence in the initial series of analysis, the size groups of the inefficient drag were simply multiplied by 1.5 and the gear compared on a catch per tow basis. This method undoubtedly introduces further error but it provided some useful information.

The problem of a difference in efficiency of the two drags brings up the question of whether there was a marked difference in efficiency between drags in other gear experiments. It can only be stated that we have no reason to believe this was the case. All gear used in other tests belonged to commercial boats under charter and to all appearances the sets of gear were identical.

When the United States data for 4-inch rings, Table III, are treated in the above manner, the resulting selection curves are a little sharper than those derived from the Canadian data, but they were less sharp than the selection curves obtained in previous United States gear trials. Again in this 1961 data, scallops 105-110 mm shell height are retained 100% by the larger ring. The 50% selection point is much less distinct than with the previous data. Furthermore there is again the tendency for the curve to go above the 100% line indicating that the larger ring is more efficient at catching markets than the 3-inch ring.

These data were also analysed using catch per 10,000 feet towed as a basis of comparison. Catches made by the experimental ring size gear and the standard ring on the same drag frame were calculated for 10,000 feet towed. The catch of each size group was then expressed in terms of the experimental ring gear catch compared to the standard on a percentage basis. The resulting curves (Fig. 2) show much more scatter and the selection curves are much flatter. Scallops over 105 mm are completely retained by the 4-inch ring and the 50% selection point is much more obscure. Once again, the 4-inch ring appears to be more efficient at catching scallops over 105 mm than the 3-inch ring.

The United States data were further analysed by equalizing numerically all data over 105 mm for consecutive hauls and then calculating the number of scallops caught by the 3-inch ring drag from this corrected value. As was the case with the Canadian 1959 data when a similar method was used (Bourne, 1960), the 4-inch ring caught more markets and fewer discards than the 3-inch ring.

The methods outlined above to compare the 4-inch with the 3-inch ring drag were used in comparing the 5-inch with the 3-inch drag, Fig. 2, Table IV. Only rarely did the 5-inch ring gear catch 100% of what the 3-inch ring did and it did not appear to be more efficient at catching larger scallops as was the case with the 4-inch ring. It should be pointed out that even with short 10-minute tows, this ring still caught appreciable quantities of 100-105 mm scallops. Certainly more data with this size ring are needed before a definite statement can be made on its selectivity.

There may be another source of error in the 5-inch ring data in addition to the one mentioned above. The bag of the drag was extremely stiff and this may have altered its fishing efficiency. The gauge of wire used in 3- and 4-inch rings is 5/16 inch but in the 5-inch ring it is 3/8 inch. The links used to join the rings are made to accommodate 5/16-inch wire. When these links were used with the 5-inch ring, the bag of the drag was so stiff it probably did not fish with the same efficiency as when 3- and 4-inch rings were used.

Results of both countries indicate that multiple linkage did not appreciably alter the selectivity of the rings. This means that the inter-ring space is not as important in escapement as was formerly thought.

Discussion

The selection curves for scallop gear show more scatter than those observed for otter trawls and the slope of the line is not as steep. Two factors probably contribute greatly to this. Firstly scallops, unlike finny fish, do not struggle to get out of a drag and escapement depends on mechanical sorting. Secondly scallop drags, unlike otter trawls, become plugged with trash. This reduces selection more and more as plugging continues (i.e., as the length of tow is increased). This can be seen by comparing Canadian and United States data. The United States tows were all of short duration and little trash was brought up. The selection curves of these gear trials are sharper and the line steeper than the Canadian results which were obtained by longer hauls.

Catches from those parts of Georges Bank that supply most of the landings are composed of approximately 50% trash. This trash, particularly in commercial-length tows, plugs up the rings and inter-ring spaces and reduces the amount of sorting that can take place.

Increasing the ring size from 3 to 4 inches would (1) reduce the catch of 4-year-old and younger scallops; (2) not appreciably alter the catch of 5-year-olds (95-100 mm); (3) increase the catch of older year-classes and (4) reduce the amount of trash caught. If the fleet were required to use a 4-inch ring, the yield would not be increased by postponing the age at which they are first shucked. However, it may increase the yield by reducing the deck damage to discards which are now hauled on deck but culled and thrown back.

A spot check of the scallop fleets of both countries in December 1961 showed the following: In the United States fleet, 19 boats were using a 4-inch ring and 42 boats a 3-inch ring. Six Canadian boats were using 4-inch rings and 24 boats a 3-inch ring. These boats were not using the 4-inch ring because of its increased efficiency at catching markets but because it brought up less trash and made the catch easier to handle. Recently, however, some of the Canadian boats have reverted back to the 3-inch ring since they claim the 4-inch ring is not standing up to modern fishing practices and is soon pulled out of shape.

If the ring size of the fleet were increased to 4½ or 5 inches, the catch of 6-year-olds and older scallops might increase, but the catch of 5-year-olds would decrease. From the limited data available we cannot calculate what percentage of 5-year-olds would be released by these rings nor can we calculate just what increase in yield might accrue by the introduction of rings larger than 4 inches.

Even if the postponing of the size at which sea scallops are first shucked would result in an increase in yield, the complex manner in which the present drags catch and retain various sizes of scallops prevents us from predicting the precise results of changing the size of the ring and link used.

These studies indicate that adjusting the ring size of present types of drags will not produce a good savings gear. It may be necessary to design an entirely different gear which will fish selectively for the desired sizes while releasing or not capturing the smaller sizes.

References

Bourne, Neil. 1960. Selection of Georges Bank scallops by Canadian draggers. Proceedings & Selected Reports ICNAF Standing Committee on Research & Statistics, 1960 Annual Meeting, pp 62-65.

Medcof, J. C., and Neil Bourne. 1962. Survey of causes of mortality in stocks of sea scallops. Unpublished Manuscript.

Posgay, J. A. 1957. Sea scallop boats and gear. Fisheries Leaflet 442, U.S. Dept. Int., Fish and Wildlife Service.

Posgay, J. A. 1958. Maximum yield in the sea scallop fishery. ICNAF Document 28, Serial No. 554.

Table I

Gear Selection Data - M.V. Cape Eagle, August-September 1961

Gear	3" S/D vs 4" S/D		3" S/D vs 4" D/D		3" S/D vs 4" D/T		3" S/D vs 4" D/Q	
Length (mm.)	Number		Number		Number		Number	
20-25								
25-30								
30-35	17	6	-	-	-	6	43	-
35-40	34	33	9	-	17	19	40	-
40-45	109	28	9	10	51	31	37	48
45-50	155	235	17	17	90	232	124	58
50-55	287	184	91	42	119	270	324	90
55-60	584	256	179	116	323	206	341	160
60-65	1,171	667	362	331	926	745	763	297
65-70	2,470	2,021	1,000	822	2,344	2,092	1,743	1,197
70-75	5,588	5,160	799	1,452	5,391	3,882	3,404	2,423
75-80	8,269	4,469	676	1,053	8,365	4,939	4,363	2,200
80-85	7,259	6,192	322	356	9,236	5,004	5,448	3,687
85-90	10,625	8,208	426	484	8,470	6,123	5,036	4,118
90-95	5,721	7,670	212	209	7,597	6,938	11,488	9,233
95-100	3,330	2,768	317	210	2,875	3,524	5,769	4,085
100-105	4,164	3,199	351	289	1,084	1,108	696	1,568
105-110	4,700	4,371	567	642	1,468	1,474	824	517
110-115	3,990	3,988	563	565	1,284	1,821	655	854
115-120	3,300	3,416	407	396	1,377	1,756	832	821
120-125	3,378	3,901	249	240	1,770	2,409	859	799
125-130	2,646	3,061	144	116	1,406	1,789	846	719
130-135	1,811	2,011	91	53	817	1,133	639	648
135-140	1,062	796	13	21	301	266	170	242
140-145	629	735	20	15	172	146	39	124
145-150	38	6	2	3	29	6	-	-

S/D - rings in bag of drag joined by 1 link on top and 2 on bottom.
D/D - rings in bag of drag joined by 2 links on top and bottom.
D/T - rings joined by 2 links on top and 3 on bottom.
D/Q - rings joined by 2 links on top and 4 on bottom.

Gear Selection Data - M.V. Delaware Cruise 61-13, August 1961

Gear	3" S/S vs 3" S/S		3" S/D vs 3" S/S		3" D/D vs 3" S/S		3" D/T vs 3" S/S		3" T/T vs 3" S/S	
Distance towed (ft)	33,816		20,328		16,416		25,772		16,872	
Length (mm.)	Number		Number		Number		Number		Number	
30-35								1		
35-40							2	2		
40-45							2	2	1	
45-50	1				3		9	8	9	
50-55	2		4	1	6	2	28	17	16	3
55-60	1		6	1	5	1	46	36	28	6
60-65	3	1	1	4	9	1	29	23	18	2
65-70	4	3	9	3	7	1	21	13	24	4
70-75	16	9	21	7	10	8	49	24	36	12
75-80	37	8	60	53	56	42	124	78	103	56
80-85	101	32	31	115	51	92	82	140	89	111
85-90	515	228	613	675	856	555	910	645	871	541
90-95	962	493	1,122	1,020	1,374	934	1,652	1,079	1,503	862
95-100	871	637	1,073	696	1,305	738	1,450	863	1,204	699
100-105	383	424	403	205	468	288	562	319	492	243
105-110	161	180	132	139	172	158	257	190	210	135
110-115	210	136	141	157	225	155	271	172	189	134
115-120	210	114	180	107	221	132	231	152	170	104
120-125	217	173	136	87	187	127	220	133	138	138
125-130	172	154	114	80	213	158	234	144	163	216
130-135	250	169	123	88	227	135	288	146	179	163
135-140	219	122	89	45	136	84	197	104	114	115
140-145	180	99	49	23	60	22	96	44	55	52
145-150	52	22	18	10	13	3	27	9	10	30
150-155	28	15	6	2	2	1	6	5	9	7
155-160	4	--								4
160-165		--								
165-170		1								

Table III

Gear Selection Data - M.V. Delaware Cruise 61-13, August 1961

Gear	4" S/S vs 3" S/D		4" S/D vs 3" S/D		4" D/D vs 3" S/D		4" D/T vs 3" S/D	
Distance towed (ft)	25,368		29,328		13,484		24,640	
Length (mm.)	Number		Number		Number		Number	
35-40					1			
40-45	3		2	1	3	1	1	1
45-50	2	1	6	5	9	3	3	1
50-55	11	4	23	22	16	17	7	12
55-60	22	2	25	30	10	23	15	25
60-65	12	3	26	17	6	12	7	13
65-70	6	4	12	29	9	14	7	14
70-75	16	21	39	39	15	22	16	34
75-80	47	42	66	109	32	83	35	102
80-85	46	61	78	146	56	136	52	109
85-90	389	516	551	559	296	361	319	510
90-95	648	825	1,085	1,222	507	522	618	1,003
95-100	563	564	1,163	1,088	447	381	808	911
100-105	287	229	555	456	184	137	489	405
105-110	192	128	294	191	147	88	262	223
110-115	220	128	310	163	156	91	337	225
115-120	221	118	264	177	110	65	280	180
120-125	211	131	233	183	101	76	247	168
125-130	270	183	264	224	167	116	303	234
130-135	262	170	319	173	141	117	352	232
135-140	135	110	237	182	82	47	211	123
140-145	75	65	122	86	30	15	103	69
145-150	11	10	38	10	7	2	24	13
150-155	5	5	19	8	3		3	3
155-160	1	1		1	1			

Table IV

Gear Selection data - M.V. Delaware Cruise 61-13, August 1961

Gear	5" S/S vs 3" S/D		5" S/D vs 3" S/D		5" D/D vs 3" S/D		5" D/T vs 3" S/D	
Distance towed (ft)	18,132		25,868		19,564		29,152	
Length (mm.)	Number		Number		Number		Number	
30-35		1						
35-40	1	2						
40-45	1	6		3	1			1
45-50	--	12	1	9	1	8		3
50-55	3	31	--	32	2	38		13
55-60	4	41	2	26	4	43	3	18
60-65	4	28	2	22	3	37	2	25
65-70	3	33	2	20	1	17	2	17
70-75	1	60	5	48	6	45	1	25
75-80	6	120	7	132	9	112	8	59
80-85	19	230	18	179	33	172	7	143
85-90	104	833	103	1,024	96	797	44	678
90-95	167	1,804	160	1,871	191	1,530	145	1,362
95-100	230	1,635	185	1,613	116	1,621	183	1,310
100-105	115	667	110	897	78	730	136	595
105-110	73	305	112	437	72	313	154	345
110-115	66	246	72	316	73	217	161	312
115-120	53	158	60	198	65	174	143	208
120-125	37	120	78	135	69	136	104	164
125-130	88	140	136	190	140	153	163	207
130-135	157	153	210	176	133	139	235	204
135-140	100	89	109	86	62	81	188	100
140-145	25	27	53	32	18	33	98	49
145-150	1	3	7	3	5	9	22	14
150-155			1	2			7	4
155-160								1

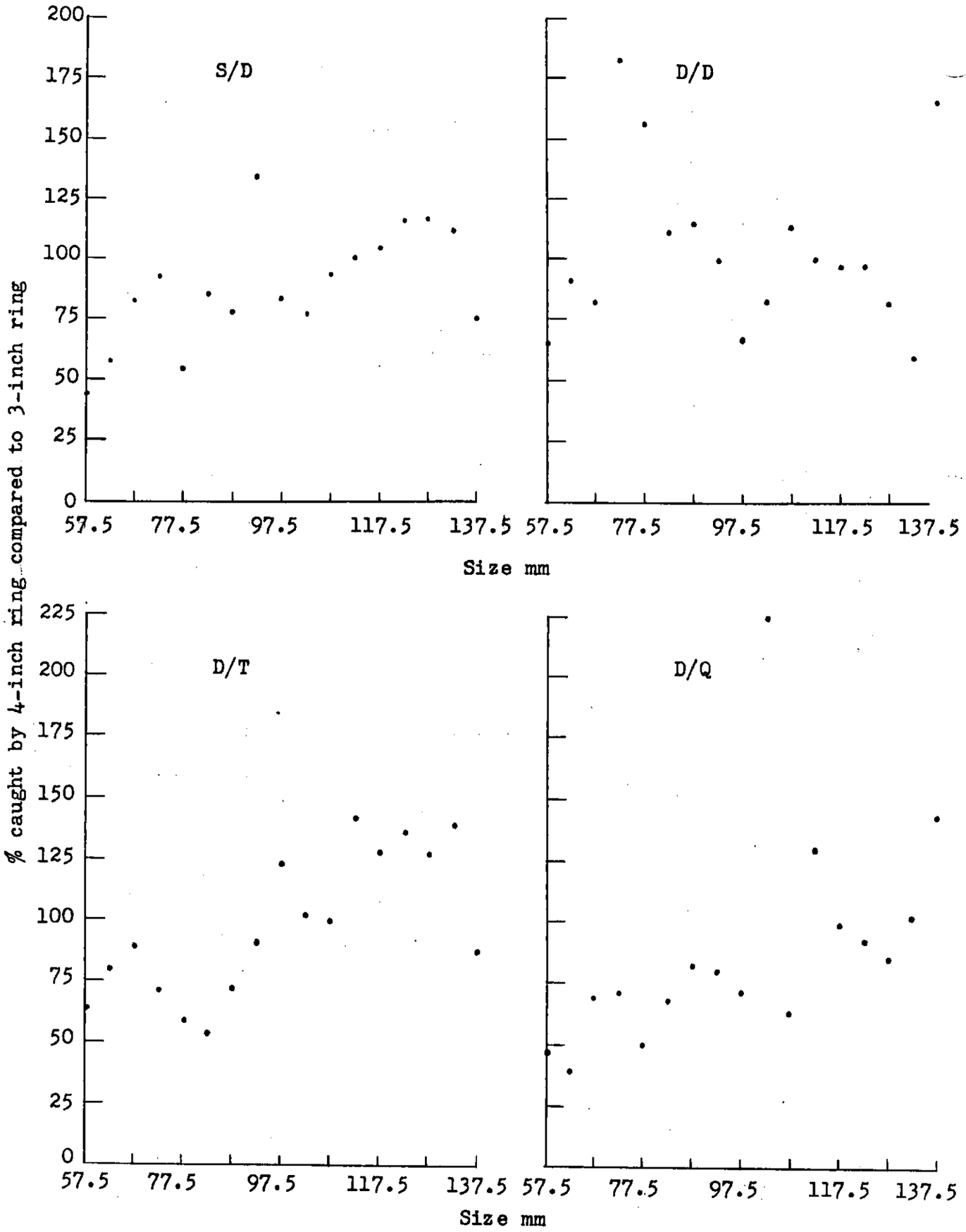

Fig. 1. Selection of scallops caught by 4-inch ring drag compared to catch by 3-inch ring drag. Scallops are grouped in 5-mm size groups. Figure shows the selection under four different types of linkage. Data collected August-September 1961 on M.V. Cape Eagle.

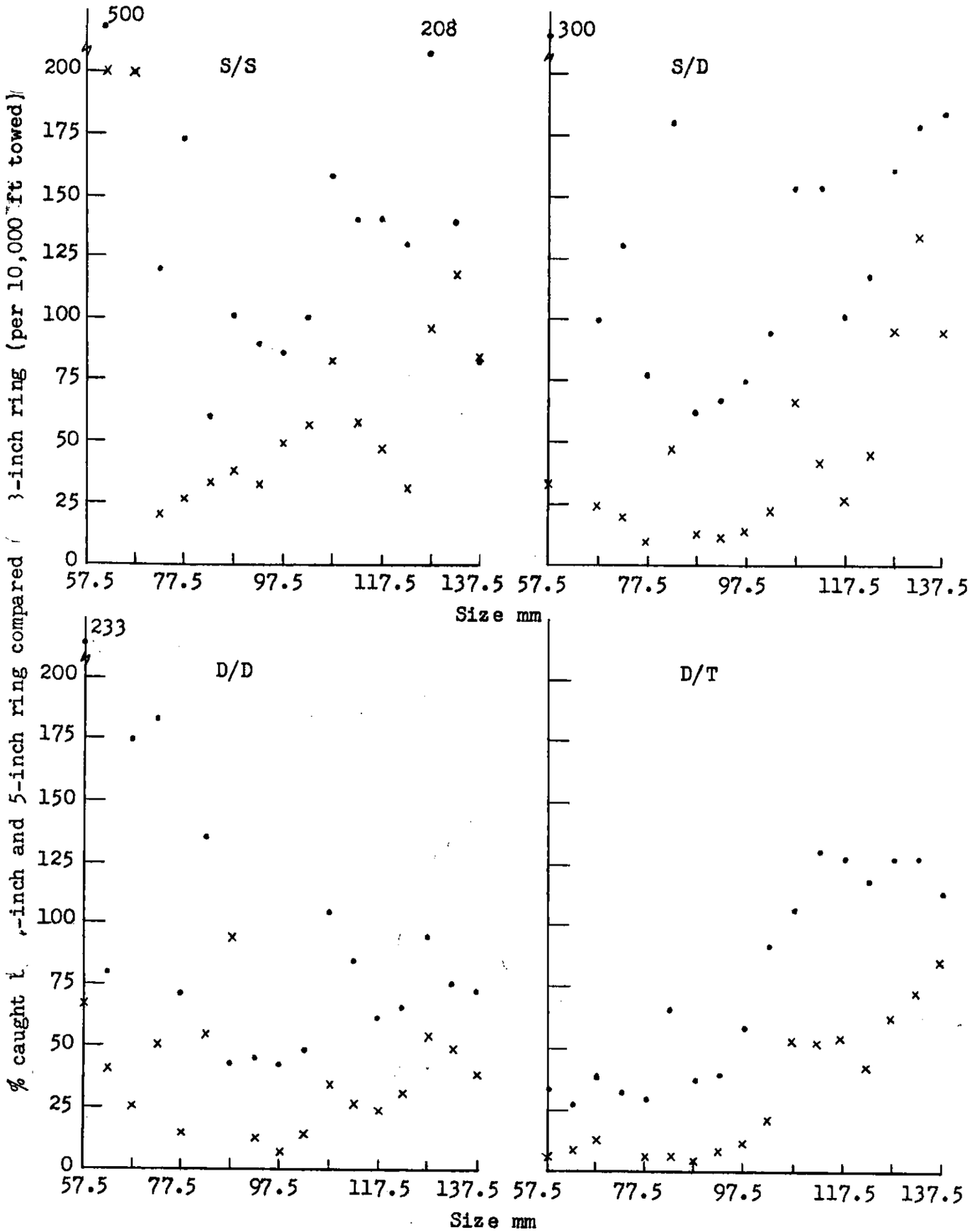

Fig. 2. Selection of scallops caught in 10,000 feet towed by 4-inch and 5-inch rings compared to similar catches by 3-inch ring. Consecutive tows of the 3-inch, 4-inch and 5-inch rings, when they were on the same drag frame and linked in the same fashion, were compared. Scallops are grouped in 5-mm size groups. Selection under four different types of linkage is shown. Data collected in August 1961 on M.V. Delaware.
(• = 4" and × = 5")