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SCALLOP DREDGE SELECTIVITY EXPERIMENTS

by

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Summary

The effect of tooth spacing and mesh size on the catch of scallop dredges was studied in Kilbrennan Sound, west Scotland. There were significant teeth and mesh effects. Dredges 4 ft wide with 9 teeth and 4½ inch mesh caught virtually no scallops smaller than 70 mm. With 24 teeth and 1½ inch mesh efficiency was very low. The combination in commercial use (12 teeth and 3¼ inch mesh) caught the most scallops. It is suggested that 16 teeth and 2¼ inch mesh would be a suitable compromise for routine population sampling.

Introduction

Regular sampling of the stocks of scallops (Pecten maximus (L.)) in the Clyde Sea area has been maintained since the expansion of the scallop fishery in the early 1960s. Previous experience showed that dredges lined with fine mesh netting caught a higher proportion of small scallops than normal commercial dredges (Mason and Drinkwater, 1974). The fine mesh, however, soon became blocked by bottom deposits, and overall efficiency was low. This paper describes experiments designed to find the effect on the catch of different mesh sizes and tooth spacings.

Methods

The experiments were carried out from FRV "Goldseeker" using 4 ft (1.22 m) wide dredges similar to commercial ones but fitted with interchangeable tooth bars giving the following tooth spacings:

Number of teeth	Approximate space between teeth	
9	5 in. (127 mm)	
12	3 in. (76 mm)	(commercial)
16	2 in. (50 mm)	
24	1 in. (25 mm)	

The chain bellies and netting covers were also modified to give the following mesh sizes:

Nominal mesh	Belly ring diam. (internal)	Netting (stretched diag.)	
4½ in.	4¼ in. (108 mm)	4¼ in. (108 mm)	
3¼ in.	3¼ in. (83 mm)	3¼ in. (75 mm)	(commercial)
2¼ in.	2¼ in. (57 mm)	2¼ in. (57 mm)	
1½ in.	(3¼ in.) with complete lining of	1½ in. (38 mm)	

Two dredges with similar teeth were towed side by side on a towing bar and each mesh was compared with the other meshes as follows:

Experiment 1. Pluck Point (Kilbrennan Sound) March 1973

9 teeth	12 teeth	24 teeth
$4\frac{1}{4}$ v $3\frac{1}{4}$ in.	$4\frac{1}{4}$ v $3\frac{1}{4}$ in.	$4\frac{1}{4}$ v $3\frac{1}{4}$ in.
$4\frac{1}{4}$ v $1\frac{1}{2}$ in.	$4\frac{1}{4}$ v $1\frac{1}{2}$ in.	$4\frac{1}{4}$ v $1\frac{1}{2}$ in.
$3\frac{1}{4}$ v $1\frac{1}{2}$ in.	$3\frac{1}{4}$ v $1\frac{1}{2}$ in.	$3\frac{1}{4}$ v $1\frac{1}{2}$ in.

This was designed to show the general nature of the mesh and teeth changes and in particular the effect of wide mesh and tooth spacing.

Experiment 2. Clunaig (Kilbrennan Sound) March 1974

12 teeth	16 teeth	24 teeth
$3\frac{1}{4}$ v $2\frac{1}{4}$ in.	$3\frac{1}{4}$ v $2\frac{1}{4}$ in.	$3\frac{1}{4}$ v $2\frac{1}{4}$ in.
$3\frac{1}{4}$ v $1\frac{1}{2}$ in.	$3\frac{1}{4}$ v $1\frac{1}{2}$ in.	$3\frac{1}{4}$ v $1\frac{1}{2}$ in.
$2\frac{1}{4}$ v $1\frac{1}{2}$ in.	$2\frac{1}{4}$ v $1\frac{1}{2}$ in.	$2\frac{1}{4}$ v $1\frac{1}{2}$ in.

This experiment was designed to show in more detail the effects of meshes and tooth spacings smaller than those of the commercial dredge.

Five double hauls of 5 minutes duration were made with each pair of dredges, followed by five hauls with the port and starboard positions interchanged. This gave a total of 20 hauls with each gear combination in each experiment. After measurement the catches were returned to the sea in a random manner within the experimental areas. In both experiments an area about 1500 ft (450 m) by 150 ft (45 m) was chosen where scallops were relatively common, and a wide range of sizes present. The length of tow was about 1000 ft (300 m) and the depth 9-10 fathoms (16-18 m).

Results

Experiment 1

The catches of scallops ranged from 0 to 10 per haul. Examination of the variances within sub-classes showed a Poisson distribution. A square root transformation was therefore applied before an analysis of variance was carried out.

The average numbers of scallops caught by the various gears (Table 1) showed significant differences between the different tooth spacings and mesh sizes, the 12 ($3\frac{1}{4}$ in.) catching the most. A further breakdown of the catch into size groups is shown in Table 2.

The larger mesh sizes caught virtually no scallops below 70 mm while the $1\frac{1}{2}$ inch mesh caught only a small proportion $\geq$120 mm. The 12 ($3\frac{1}{4}$ in.) not only caught the highest mean number, but caught scallops in all size ranges.

Experiment 2

The total numbers caught are shown in Table 3. Catches were higher than in the first experiment, and it was possible to consider the different length ranges separately and analyse each range in the same way as the total catches were treated in Experiment 1.

(a) Total numbers caught There were significant teeth and mesh effects as follows:

Teeth	12	16	24
Mean number caught	16.3	12.7	9.7
Mesh	$3\frac{1}{4}$ in.	$2\frac{1}{4}$ in.	$1\frac{1}{2}$ in.
Mean number caught	15.5	15.8	7.4

The 12 ($2\frac{1}{4}$ in.) combination was the best.

(b) Number of scallops <70 mm Again the teeth and mesh effects were significant, the means being:

Teeth	12	16	24
Mean number caught	1.2	2.2	1.4
Mesh	$3\frac{1}{4}$ in.	$2\frac{1}{4}$ in.	$1\frac{1}{2}$ in.
Mean number caught	1.1	2.5	1.2

This shows the superiority of the 16 ($2\frac{1}{4}$ in.) gear.

(c) Number of scallops 70-119 mm The majority of scallops caught lay within this length range. The analysis again showed both significant teeth and mesh effects, but the pattern was not consistent throughout the sub-groups. This is shown in Table 4, which shows that the 16 ($3\frac{1}{4}$ in.) gear did relatively better than implied by the teeth and mesh averages while the 16 ($2\frac{1}{4}$ in.) was relatively poorer than these row and column means would suggest. The largest mean catch was made by the 12 ($2\frac{1}{4}$ in.) gear.

(d) Number of scallops ≥120 mm The teeth and mesh effects were again significant and the means were as follows:

Teeth	12	16	24
Mean number caught	4.2	3.3	2.1
Mesh	$3\frac{1}{4}$ in.	$2\frac{1}{4}$ in.	$1\frac{1}{2}$ in.
Mean number caught	4.1	4.0	2.0

The maximum number was caught by the 12 ($2\frac{1}{4}$ in.) gear.

Discussion

The main factors affecting dredge selectivity are the design of the dredge, the behaviour of the scallops and the nature of the sea bottom. Baird and Gibson (1956) stress the importance of tooth spacing, while Medcof (1952), investigating the effect of different ring diameters in the Canadian scallop fishery, found that larger rings reduced the number of small scallops caught. Caddy (1968) also working on the Canadian Placopecten magellanicus gives details of the behaviour of the dredge during fishing, and of the reactions of the scallop to the gear.

In the present work the effects of tooth spacing and mesh size are both demonstrated, and the mesh effects are the more important. The experiments were designed so that the other effects (behaviour and bottom) would be constant. It is interesting that the gears which caught more small scallops also caught, in general, large numbers of the smaller species Chlamys opercularis, but the pattern was not clearly defined, presumably because Chlamys is much more active, and is disturbed by continued fishing over one stretch of ground.

The results of Experiment 1 (Table 2) show that an increase from the standard mesh to $4\frac{1}{4}$ in. mesh or a change from the standard 12 teeth to 9 teeth would result in a considerable reduction in the numbers of small and medium scallops in the catches, with little change in the largest category (≥120 mm). Further work would be needed before the effects on a commercial fishery could be predicted with accuracy.

For routine sampling of populations over a wide area a dredge with a reasonably high overall efficiency is essential, so that adequate samples can be gathered in the time available. The proportion of small scallops in the catch will be smaller than that in the actual population but, so long as reasonable numbers are present, allowances can be made for this in estimating the abundance of pre-recruits. The present experiments suggest that the 16 teeth $2\frac{1}{4}$ in. mesh gear would be a suitable compromise.

The nature of the bottom is also of importance. The dredge is likely to bounce in some places and fill with mud and stones in others. This directly affects its efficiency. Its selectivity will depend partly on the amount and nature of the bottom deposits scraped up by the dredge. Some commercial scallop grounds are much "cleaner" than the grounds used in these experiments, and dredges do not become choked. Experience is now being gained with the 16 ($2\frac{1}{4}$ in.) gear on such grounds.

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References

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Table 1

Mean numbers caught per haul by each gear. March 1973

Mesh \ Teeth	9	12	24	Mesh means
4¼ in.	1.58	1.61	0.99	1.38
3¼ in.	2.84	4.77	2.92	3.47
1½ in.	1.27	1.97	1.75	1.66
Teeth means	1.94	2.70	1.88	

Table 2

Total numbers caught by each gear subdivided into size groups, March 1973

Mesh \ Teeth / Length mm	9				12				24				Mesh Total
	<70	70-119	≥120	Total	<70	70-119	≥120	Total	<70	70-119	≥120	Total	
4¼ in.	0	9	20	29	0	11	23	34	0	4	16	20	83
3¼ in.	0	39	19	58	3	71	20	94	0	44	12	56	208
1½ in.	11	8	5	24	16	20	5	41	11	17	6	34	99
Total	11	56	44	111	19	102	48	169	11	65	34	110	390

Table 3

Total numbers caught by each gear subdivided into size groups, March 1974.

Mesh \ Teeth / Length mm	12				16				24				Mesh Total
	<70	70-119	≥120	Total	<70	70-119	≥120	Total	<70	70-119	≥120	Total	
3¼ in.	13	225	94	332	37	230	85	352	15	163	61	239	923
2¼ in.	45	275	119	439	66	133	81	280	41	150	48	239	958
1½ in.	16	122	57	195	31	83	35	149	26	42	23	91	435
Total	74	622	270	966	134	446	201	781	82	355	132	569	2.316

Table 4

Mean catches by each gear of scallops in the range 70-119 mm, March 1974.

Mesh \ Teeth	12	16	24	Mesh Means
3¼ in.	11.5	10.8	8.1	10.2
2¼ in.	14.3	6.5	7.6	9.3
1½ in.	6.3	3.9	2.6	4.2
Teeth means	10.7	7.0	6.0	