Preliminary trials of a new scallop dredge in the Isle of Man

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Introduction

Dredging for scallops is widely recognized to exert a significant negative impact on the benthic community, including undersized and non-selected scallops. Cliff Goudey of the Massachusetts Institute of Technology (MIT) has recently developed a novel type of dredge that uses passive hydro-pressure instead of teeth to dig scallops from the sediment. This prototype gear underwent a preliminary evaluation on the Isle of Man in April 2007. Both research and commercial vessels were used, and the local industry encouraged to participate actively in the process. We hope to employ a version of the gear as part of a developing management strategy for Manx/Irish Sea scallop and queenie fisheries.

Methods

The prototype hydrodredge (Figure 1) was shipped to the Isle of Man from MIT. A bag (Figure 2) was fabricated on the Island by a local gear manufacturer. The bag comprised a belly of steel rings (55 mm internal diameter) and netting top of 60 mm stretched mesh. Both dimensions were smaller than the current legal minimum and intended to retain all scallops.

The first two days of the survey took place on R.V. Prince Madog, and followed a loose protocol intended to allow *ad hoc* changes to rigging, fishing speed, tow period etc. Several fishermen attended each day and were encouraged to contribute insights and suggestions. The hydrodredge was fished on a single warp running directly to a winch mounted on the starboard side of the vessel. To evaluate the effect of the hydro 'cups', one tow was made with these removed. To enable rough comparison of hydrodredge catch to commercial gear, the hydrodredge was replaced for several tows by a pair of standard Newhaven dredges (2 x 2ft width) fished on a 4ft tow bar. Gear type, B.S.T., position, depth and sea state were recorded for all hauls. All scallops (*P. maximus*) caught were measured (width, mm) and aged (years), and all queenies (*A. opercularis*) were measured (width, mm). Larger bycatch species taken in the hydrodredge were identified and enumerated over all hauls.

The third survey day took place on M. F. V. Bounty, a commercial scallop beamer. This enabled simultaneous deployment of the hydrodredge and standard commercial dredges, and facilitated fisher's input on rigging, ground selection and deployment. The protocol was again highly adaptive. To evaluate the effect of the hydro cups, one tow was again made with these removed. Tow and catch data were recorded as for Prince Madog. In addition, all scallops were assigned a damage index of 1 (undamaged) to 5 (upper or lower shells snapped or detached). Number of scallops caught was compared between the hydrodredge and 3 x 2ft commercial dredges, representing approximately similar total area fished. Damage index and length-frequency distribution of scallops were compared between gears. Length-frequency of the hydrodredge catch with cups was compared to catch without cups.

Results

R. V. Prince Madog

Five successful tows were made with the hydrodredge and four with the standard dredges (Table 1). The hydrodredge made good catches of queenies but only caught about 29% as many scallop as in the standard gear (Table 2). Bycatch in the hydrodredge was dominated by crabs, urchins and starfish (Table 3).

M. F. V. Bounty

Five successful tows were made, including one tow using the hydrodredge without cups (Table 4). Scallop catch in the hydrodredge varied between approximately 10-95% of that in the standard dredges (Table 5; Figure 3). Damage index (1-5) was significantly higher for scallops in the standard gear (Paired t-test, $P=0.002$), with 45% of scallops in the standard and 31% of scallops in the hydrodredge having an index of ≥ 3, indicating severe shell damage. Length-frequency of scallop catch >MLS (110mm) was similar between gears. The small mesh bag on the hydrodredge resulted in greater catches of undersized scallops (Figure 4). For the tow without cups, the hydrodredge was noticeable less efficient, catching few, very small scallops (Figure 5).

Discussion and Conclusions

The University of Wales – Bangor research vessel R.V. Prince Madog provided an ideal platform for preliminary trials of the new hydrodredge. The experienced crew and excellent facilities of the vessel allowed the team to acquire insight valuable in an initial evaluation aboard a commercial vessel. Working on M. F. V. Bounty provided a more realistic fishing situation, with the significant advantages of simultaneous deployment of two gears, rapid changes to deployment technique and grounds, and fisher's insight.

Overall, the trial results seem quite positive. The gear proved sufficiently robust to fish moderately rough ground and could easily be deployed from a commercial vessel. Some necessary but simple improvements became evident, particularly replacement of the plastic hydro cups with steel and the addition of a chain mat to exclude larger rocks.

The dredge caught a lot of queenies and the skipper of the *Bounty* became quite excited about its potential in this respect. Scallop catch was disappointing but would likely improve radically with some simple modification. Very positively, the hydrodredge caused far less damage to scallops than conventional gear. This implies less bycatch mortality and may have useful implications within a broader management strategy. Interestingly, the hydrodredge seemed to compare better to commercial gear on rougher ground. On one tow at a warp ratio of 3:1, the scallop catch was almost equal between gears and the hydrodredge caught fewer stones. It seems possible that the hydro pressure continues to act amongst rocks where toothed dredges may be hopping along.

Future trials should follow a robust experimental design in which the hydrodredge and commercial gear are deployed for a number of randomly assigned tows across different ground types. The effect of the cups must be carefully evaluated, and the benthic impact assessed using divers or extensive camera work. The industry must stay closely involved and encouraged to contribute actively to the process.

Table 1. Tow data from preliminary trials of the hydrodredge aboard R.V. Prince Madog.

Gear	**Date**	**Time**	**Station**	**Tow #**	**Shooting position**		**Hauling position**		**Course**	**Depth**	**Speed**
					Lat	Long	Lat	Long			
Hydro	25-Apr-07	1229	Laxey	1	54 13.539	04 21.556	54 12.701	04 22.316	221	25.9	
Hydro	25-Apr-07	1436	Laxey	3	54 14.285	04 20.751	54 12.754	04 22.266	206	26.6	2.8
Standard	25-Apr-07	1542	Laxey	4	54 14.354	04 19.641	54 13.938	04 21.111	208	26.4	2.7
Standard	25-Apr-07	1623	Laxey	5	54 13.500	04 21.573	54 12.937	04 22.090	204	26.8	2.9
Hydro	26-Apr-07	1158	Laxey	6	54 12.965	04 22.045	54 14.457	04 20.702	30	25	2.5
Hydro	26-Apr-07	1244	Laxey	7	54 14.724	04 20.547	54 14.704	04 20.436	204	25.4	3.4
Hydro	26-Apr-07	1329	Laxey	8	54 12.794	04 22.279	54 14.704	04 20.436	37	21.3	2.7
Hydro (no cups)	26-Apr-07	1428	Laxey	9	54 15.085	04 20.142	54 13.054	04 22.011	205	24.9	2.5
Standard	26-Apr-07	1514	Laxey	10	54 12.813	04 22.220	54 14.111	04 20.957	26	25.9	3
Standard	26-Apr-07	1551	Laxey	11	54 14.143	04 20.879	54 12.788	04 22.152	210	23.1	3

Table 2. Catch of scallops during trials of the hydrodredge aboard R.V. Prince Madog.

Tow #	Hydrodredge	Standard
1	4	16
2	7	16
3	8	29
4	7	34
5	8	.

Table 3. Dominant bycatch species taken in the hydrodredge during three tows on a soft substrate in Laxey Bay.

Species	#
Echinus acutus	104
Asterias rubens	200
Ophiura albida	82
Pagurus bernhardus	61
Neptunia autigua	37
Psammechinus miliaris	47

Table 4. Tow data from preliminary trials of the hydrodredge aboard M. F. V. Bounty.

Gear	**Date**	**Time**	**Station**	**Tow #**	**Shooting position**		**Hauling position**		**Depth**	**Speed**
					Lat	Long	Lat	Long		
Hydro	27-Apr-07	1014	8m Douglas	1	54 08.720	04 14.80	54 07.80	04 15.72	18.4	3
Hydro	27-Apr-07	1056	8m Douglas	2	54 07.76	04 16.06	54 08.57	04 15.11	28.7	3
Hydro	27-Apr-07	1213	8m Douglas	3	54 08.50	04 13.76				3
Hydro	27-Apr-07	1248	8m Douglas	4			54 04.82	04 12.55		3
Hydro (no cups)	27-Apr-07	1500	8m Douglas	7	54 04.41	04 13.20	54 03.68	04 14.74		3

Table 5. A comparison of scallop (*P. maximus*) catches between the hydrodredge and 3 x 2ft standard dredges fished simultaneously on opposite sides of a commercial beam trawler.

Tow #	Hydrodredge	Standard
1	3	34
2	11	44
3	9	36
4	14	15
Sum	37	129
Mean	9.25	32.25

Figure 1. The novel hydrodredge being hauled from a Manx commercial vessel.

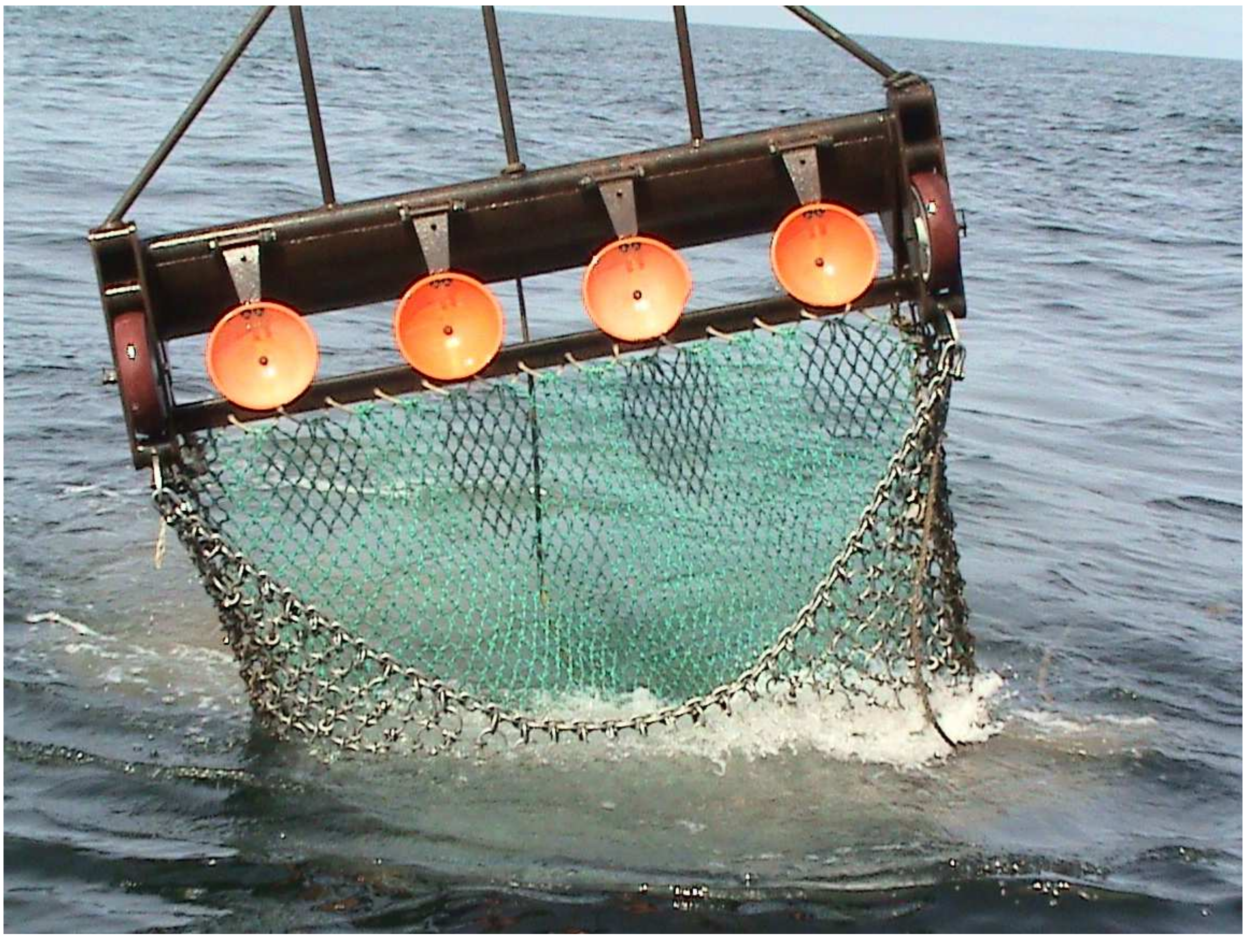

Figure 2. Experimental bag fitted to the hydrodredge during preliminary trials.

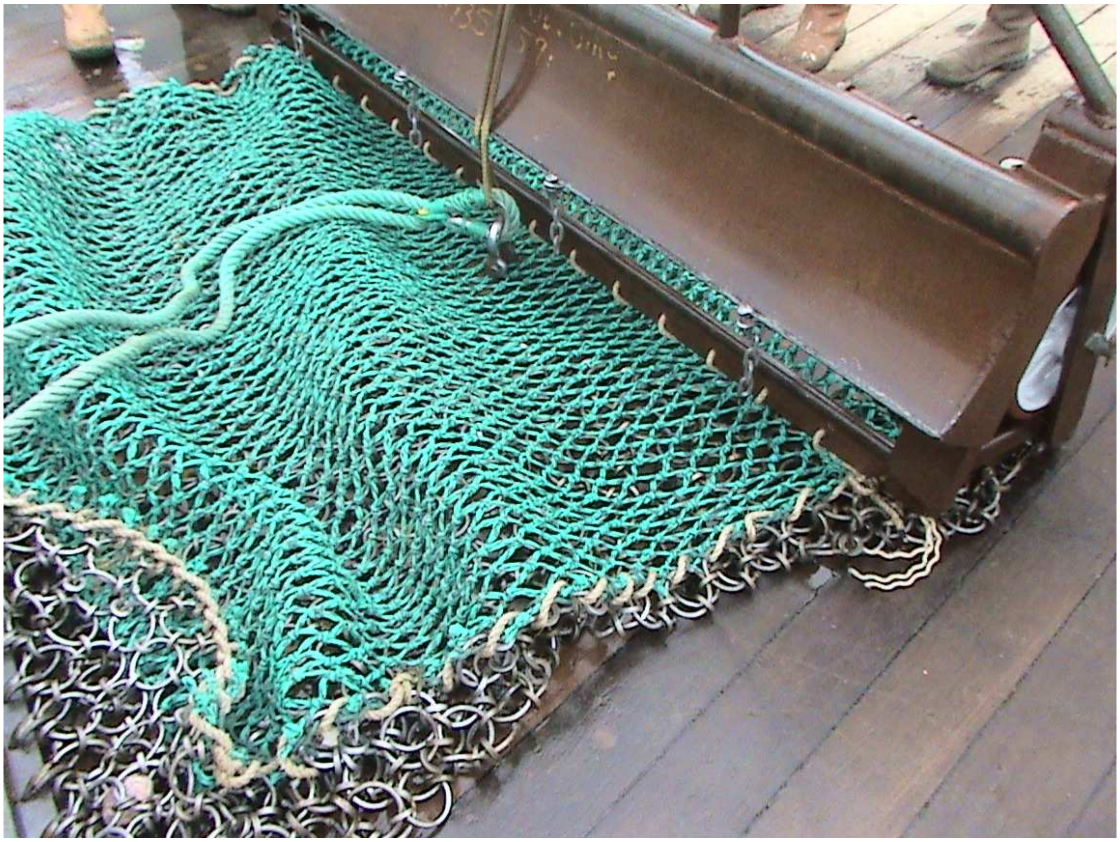

Figure 3. A comparison of scallop catches between hydrodredge and 3 x 2ft standard dredges fished simultaneously on opposite sides of a commercial beam trawler.

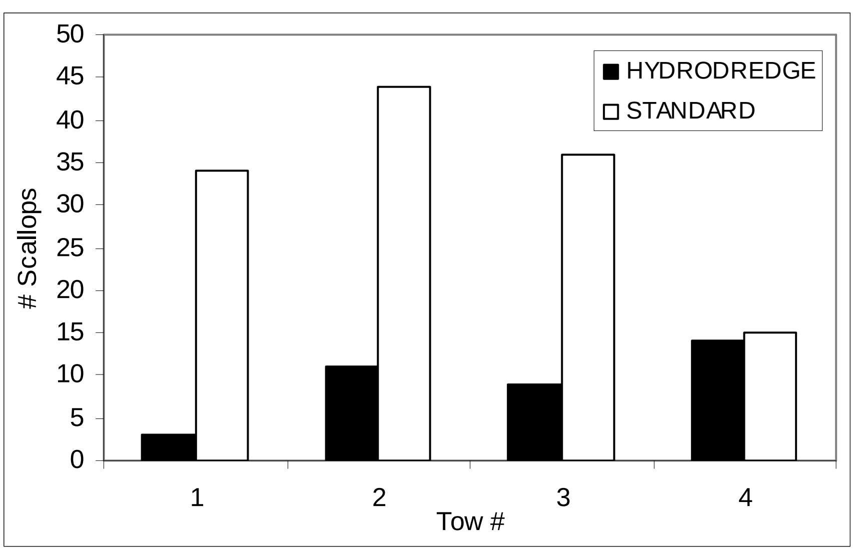

Figure 4. Length-frequency distribution of scallops compared between the hydrodredge and 3 x 2ft standard dredges fished simultaneously on opposite sides of a commercial beam trawler.

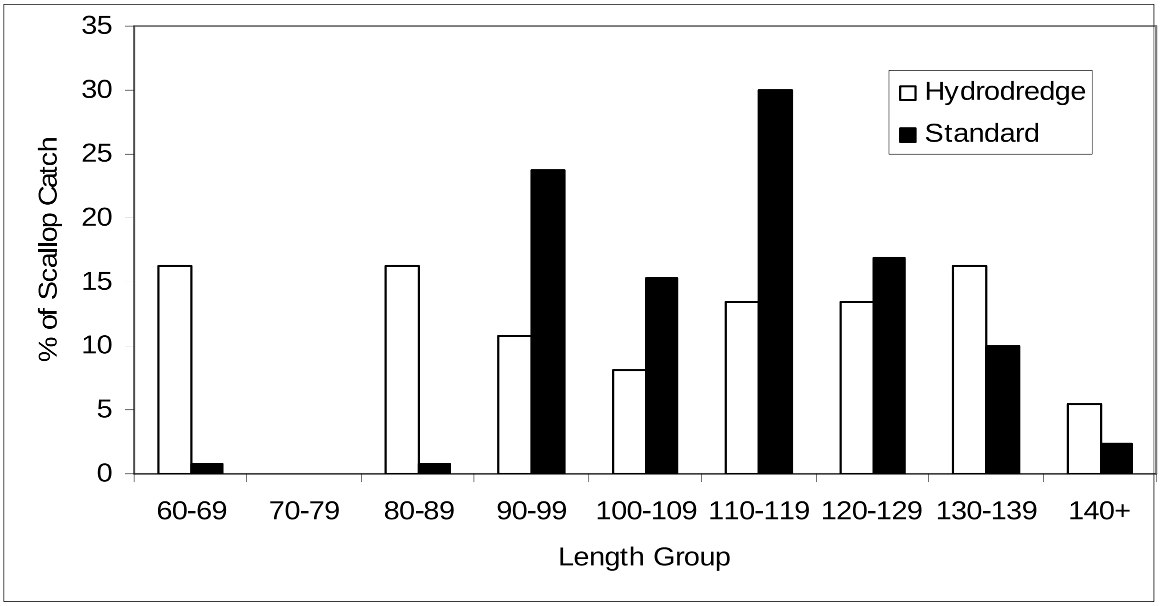

Figure 5. Comparison of length-frequency of scallops caught in hydrodredge with cups (mean from 4 tows) and without cups (1 tow).