# REVIEW OF SCALLOP GEAR MODIFICATION REPORT

## Context

The Maritimes Centre for Science Advice received a request from Fisheries and Aquaculture Management (FAM) on 25 June 2007, asking:

1) What are the conclusions of the available information, reports, and analyses on gear design (in Canada, the US, and Internationally) on the potential for mitigating bycatch in the sea scallop (*Placopecten magellanicus*) fishery in the Maritimes Region?

2) Based on these conclusions, are there modifications to gear that could be applied to achieve a reduction of groundfish bycatch in the Maritimes Region?

3) What further research or experimentation can be identified, if any, that would evaluate the effectiveness of groundfish bycatch mitigation techniques for the scallop fishery in the Maritimes Region?

A summary report of available information to address these questions was produced on 21 February 2008. This report was reviewed by DFO Maritimes on 11 April 2008. The report has been prepared as a Research Document for future reference as a summary of the literature review and recommendations that were presented (Walsh 2008). This Science Response Report contains the DFO Maritimes Science response to the questions asked by FAM after review of the summary report and upon further deliberation.

## Background

The management of bycatch is fundamental to Canada's ecosystem approach to fisheries management. Since 1996, the scallop fishery in the Maritimes Region has been required "to return to the water in a manner that causes the least possible harm to all other species of fish caught incidentally which fishing for scallops" (DFO 2008), with the exception of monkfish, which may be retained. There are a number of different strategies for managing bycatch, including catch quotas, modifications to the timing of fishing activities, modifications to the location of fisheries, and modifications to gear. This report is concerned only with modifications to fishing gear.

Since the mid-1990s, both the Atlantic Canadian and U.S.A. scallop fishing industries have studied the engineering performance of scallop rakes (dredges), and potential modifications to reduce bycatch of finfish while minimizing the loss of scallops. There are no regulations related to allowable scallop gear in the Maritimes Region, but mesh size of twine top panels and ring size in the rake bags are regulated in the U.S.A. At present, Atlantic Canadian scallopers generally fish twin New Bedford style rakes ranging in size from 14 ft on the wetfish vessels to 17 ft, and occasionally a 20 ft rake, on the factory freezer vessels. The ring size in the bag of rakes is mainly 3 inches although some factory freezer vessels are using a ring size of 4 inches. The wetfish trawlers and some freezer trawlers generally use a 5 or 6 inch diamond mesh rope back, which may be hung square, while some factory freezer trawlers use a 16 inch knotless square mesh rope back. The rope backs are generally made of 1.5 inch polyethylene rope or 5/8 inch polysteel rope. The webbing is approximately 5 ft deep by 11-13 ft wide. On the larger

rakes a pair of gooseneck rollers (wheels/discs) may be used to stop the nose from digging into the substrate. Towing speeds while fishing range from 3 to 5.5 knots and tow duration commonly ranges from 20 to 30 minutes. Tow duration mainly depends on bottom, catch-rates and weather. A 3 to 1 scope ratio is used while fishing in depths of 40-50 fathoms.

## Analysis and Responses

### Information Sources

Eleven reports documenting experimental trials to reduce finfish bycatch in the Canadian and U.S.A. scallop rake fishery were reviewed. While some modifications to the frame of the dredge, i.e., bail, cutting bar and pressure plate were examined, most experiments concentrated on changing either the mesh size or mesh shape of the rope back panel and the ring size. While there were issues with the experimental designs, data collection and analyses, the information and analysis contained within the reports could be used to address the questions posed.

### What are the Conclusions of the Available Information, Reports, and Analyses on Gear Design on the Potential for Mitigating Bycatch in the Sea Scallop Fishery in the Maritimes Region?

Available information, reports and analysis related to the effects of scallop gear design on mitigating finfish bycatch in the sea scallop fishery provided preliminary results that may be applicable to the scallop fishery in the Maritimes Region.

Results indicted that modifications to the rake frame of the scallop rakes/dredges can result in reductions to finfish bycatch. Chains hanging from the bridle bars can reduce cod and haddock, and may have limited impact on scallop catch. The addition of a tickler chain just behind the cutting bar seemed to have little effect on reducing cod, haddock and flatfish catches. The use of a cookie sweep mounted just in front of the cutting bar appeared to be the most effective at reducing bycatch. It can be effective at reducing catches of yellowtail, skates and other flatfish while increasing the catches of scallops, and it could be used to scare fish out of the way before they enter the bag path.

Results indicated that modifications to the rope back/twine top panel can also result in reductions to finfish bycatch. Large escape windows in the rope back often led to a reduction in bycatch of cod, haddock, flatfish and scallops depending on their location and size. Experiments that modified the mesh shape, i.e., diamond versus square, were inconclusive.

Results indicated that increasing the ring size in the ring bag from 3.0 inches to 3.5 inches may lower the bycatch ratio without loss of scallops, and increasing the ring size from 3.5 to 4.0 inches may reduce bycatch of small flatfish (no roundfish caught) with minimal loss of commercial scallops.

Increasing the mesh size of the rope back/twine top panel appears to have the potential to reduce finfish bycatch without greatly reducing catch of scallop (Table 1).

*Table 1. Percent mean reduction in catch in experiments using scallop gear with a variety of mesh sizes and shapes. Notes: [1]Henriksen's estimates are averages of trips. [2]T45 mesh is diamond mesh turned 45 degrees, i.e., hung square. [3]DuPaul's average estimates of flatfish are 4% for blackback and 21% for windowpane flounders. [4]Smolowitz' estimates are overall means for the combined experiments.*

| Study | Mesh Size / Shape | Yellowtail % Mean Reduction | Cod/Haddock % Mean Reduction | Flatfish % Mean Reduction | Skate % Mean Reduction | Scallops % Mean Reduction |
|---|---|---|---|---|---|---|
| Henriksen et al. (1997)<br><br>69 tows in 2 trips [1] | 8" T45 mesh[2] vs. 6" diamond mesh (control) | 36% | Insufficient data | 44% | 37% | -2% |
| DuPaul et al. (1999)<br><br>224 tows in 1 trip | 8" T45 mesh[2] vs. 8" diamond mesh (control) | -12% | - | 13%[3] | 0% | 2% |
| Henricksen et al. (1997)<br><br>49 tows in 3 trips [1] | 10" diamond mesh vs. 6" diamond mesh (control) | 47% | 77% | 40% | 18% | 28% |
| Smolomitz et al. (2004)<br><br>200 tows in 4 trips [4] | 10" diamond mesh vs. 6" diamond mesh (control) | 58% | - | 47% | 39% | 8% |

## Based on These Conclusions, are There Modifications to Gear that Could be Applied to Achieve a Reduction of Groundfish Bycatch in the Maritimes Region?

A rope back mesh size larger than 5-6 inches may be effective in reducing the bycatch of finfish relative to scallops. A ring size greater than 3 inches could also reduce finfish bycatch to some extent. Many of the experimental trials were conducted in U.S.A. waters where species and size compositions can differ from those in Canadian waters. As a consequence, it is possible that the effectiveness of these modifications would differ depending on the fishing area. Rigorous experimental trials conducted in the Maritimes Region may help to determine whether these results would be achieved in areas likely to be fished by the Atlantic Canadian scallop industry.

## What Further Research or Experimentation can be Identified, if any, that Would Evaluate the Effectiveness of Groundfish Bycatch Mitigation Techniques for the Scallop Fishery in the Maritimes Region?

The following additional studies are recommended to address this and the previous questions:

A) Use of video to explicitly consider fish and scallop behaviours, and the effects of hydrodynamics of the rake/dredge in the capture process.

B) Comparison of twine, which is used in the U.S.A., versus rope, which is used in Canada.

C) Evaluation of the effect of modifying the distance between the pressure plate and the rope back and the effect of modifying the length of the rope back.

D) Documentation of modifications that have been made to commercial scallop fishing operations, potentially by placing DFO Science staff on vessels.

E) Conduct of experimental trials to determine the potential effectiveness of adjusting the hanging ratio of the rope back and its overall length in relation to the dredge.

## Conclusions

A number of experimental studies have been conducted in Canada and the U.S.A. to investigate the potential for mitigating finfish bycatch in the scallop fishery. While there are issues with the experimental designs, data collection and analyses of many of these studies, their results are informative and several gear modifications (e.g., increasing the mesh size of the rope back top panel, increasing the ring size) appear to have potential for reducing finfish bycatch in the scallop fishery. However, many of the experimental trials were conducted in U.S.A. waters where species and size compositions can differ from those in the Maritimes Region, and, as a consequence, it is possible that the effectiveness of these modifications would differ depending on the fishing area. Rigorous experimental trials conducted in the Maritimes Region may help to determine whether these results would be achieved in areas likely to be fished by the Atlantic Canadian scallop industry.

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## Sources of Information

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