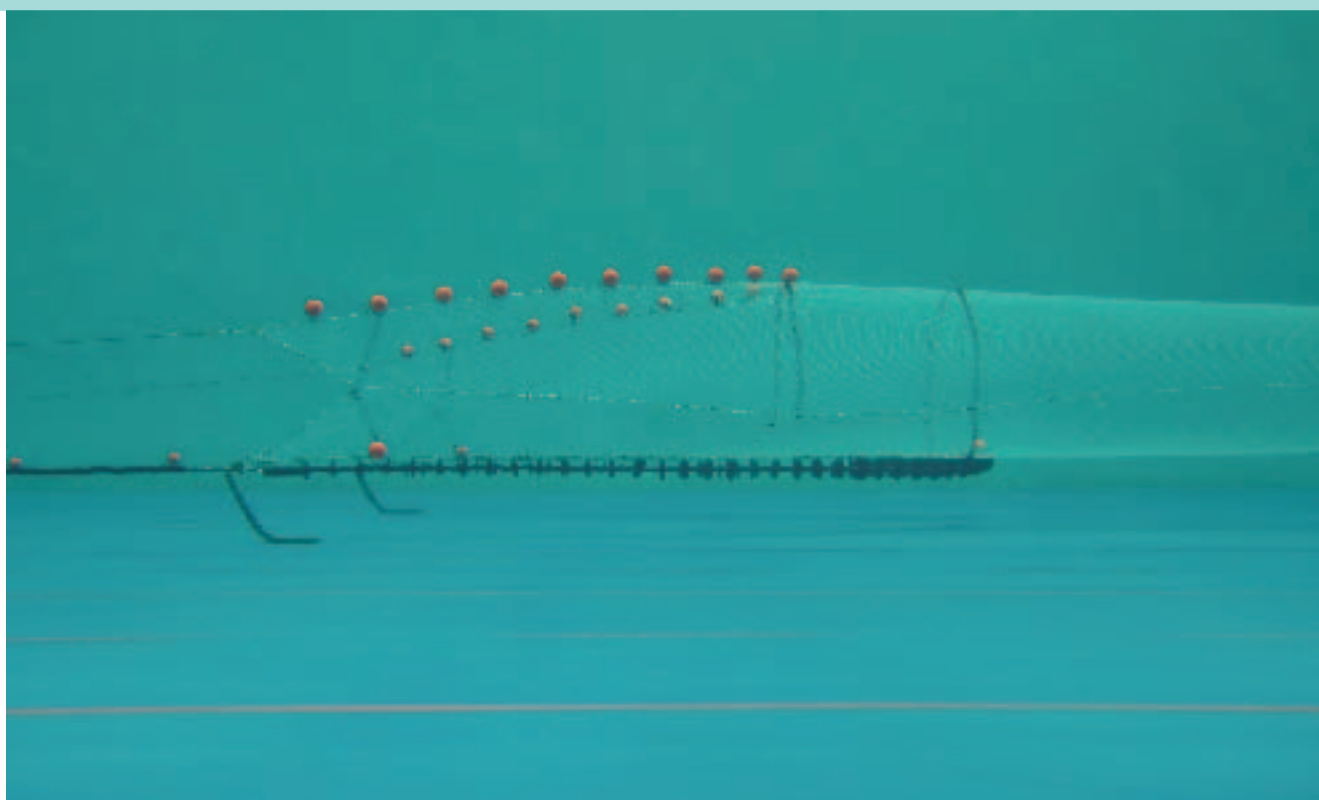


# Options to mitigate bottom habitat impact of dragged gears



***Cover photo:***

Picture showing "bottom-friendly" bottom trawl model in the flume tank of the Marine Institute of Memorial University of Newfoundland, Canada. Courtesy of Dana Morse of the Maine Sea Grant Program.

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by

**John Willy Valdemarsen**

**Terje Jørgensen**

**Arill Engås**

Institute of Marine Research

Bergen, Norway

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**By**

**John Willy Valdemarsen, Terje Jørgensen and Arill Engås**

Institute of Marine Research, Bergen, Norway

# Preparation of this document

This technical paper has been prepared within the FAO Fisheries and Aquaculture Department under the leadership of the Fishing Technology Service (FIIT) as a part of the Regular Programme on “Reviews of the impact of fishing gears on habitats and biodiversity”. It follows recent FAO documents focusing on issues related to impacts of bottom trawling, namely: “Impact of trawling and scallop dredging on benthic habitats and communities” (FAO Fisheries Technical Paper No. 472), “Mortality of fish escaping trawl gears” (FAO Fisheries Technical Paper No. 478), as well as related papers: “Discards in the world’s marine fisheries” (FAO Fisheries Technical Paper No. 470) and the “Global study on shrimp fisheries” (in preparation).

This document was written by John Willy Valdemarsen, FIIT consultant with Terje Jørgensen and Arill Engås as co-authors – all highly recognized experts on the subject. There is considerable ongoing debate and research on the possible bottom impact resulting from different kinds of bottom trawling, but less attention is paid to mitigation measures. This paper specifically reviews the current research and introduced practices to mitigate bottom impact caused by dragged gears.

# Abstract

Bottom trawling is a diversified fishing method which uses numerous types of gear designs, sizes, rigging and operational methods. Therefore, impact on the bottom habitat will differ among the various bottom trawl fisheries and also to a large extent depend on the bottom conditions in the area fished. During bottom trawling the primary function of the forward parts of the trawl is to maintain bottom contact, provide spread and herd the target species. These parts are the trawl doors, sweeps and bridles, and are essential for proper gear performance and capture efficiency.

This document describes the basic principles that can be used to reduce the impact of trawling, some of which are already developed as practical solutions and implemented in commercial fisheries. Overall, however, there are presently few examples of low bottom impact trawl gears in use in commercial fisheries. These basic mitigation measures aim at reducing pressure on the bottom of various trawl components and minimizing the impacted area while trawling.

Modifications to trawl doors that will reduce pressure on the bottom include the use of lighter doors and shortening of the warp-length-to-depth ratio (the extreme result of the latter option is off-bottom trawl doors). The impact by sweeps/bridles can be reduced with the use of discs or bobbins along the cable to raise them off the bottom and by off-bottom rigging of the lower bridle. Pressure of the ground gear can be reduced through the use of lighter gear components and gear components with lifting capabilities.

Reduction of the bottom area that is directly affected by trawl doors can be achieved with the use of high aspect ratio doors and by reducing the shoe angle relative to the towing direction. The affected area by sweeps/bridles can be reduced by shorter bridles, reduced sweep/bridle angle and by discs and bobbins mounted along the length of the wires. Ground gear modifications include reduction of the length of the ground gear and arrangements that reduce the number of contact points between the gear and the bottom.

Implementation of the above options may result in reduced capture efficiency for target species and acceptance of the technology by the fishing industry in their commercial fishing activity might therefore be difficult. Thus, research communities face many challenges to further develop bottom habitat friendly options.

Alternatively, to reduce the impact of traditional bottom trawling, a viable option might be to catch some of the targets while they are off-bottom with midwater trawls. This is an option worth considering for fish resources that, as adults, spend part of their life cycles off bottom.

Another alternative for exploiting near bottom organisms is to increase the use of stationary fishing gears which have much less impact on the bottom habitat. For some target species bottom set gillnets and longlines might be both practical and economical viable alternatives to bottom trawling, whereas other species like

shrimp and small non-shoaling fish species cannot be captured economically with such gears. For such species, bottom trawling is at present the only viable option.

Finally, a general improvement of the efficiency of bottom trawls can contribute to the reduction of bottom habitat impact, as less effort is needed to catch the allotted quotas. The management regimes in place might, to a large extent, encourage rational exploitation of the resource, such as the individual transferable quotas ITQ management system.

**Valdemarsen, J.W.; Jørgensen, T.; Engås, A.**

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# Contents

Preparation of this document	iii
Abstract	iv
List of figures	viii
<b>Introduction</b>	<b>1</b>
<b>Summary of what is known about the effect of dragged fishing gears on the seabed</b>	<b>3</b>
<b>Dragged gears</b>	<b>5</b>
Bottom otter trawling	6
Gear design and bottom impact	6
Mitigation of bottom impact	8
Trawl doors	9
Weights	13
Sweeps/bridles	13
Ground gear	14
Bottom pair trawling	17
Bottom impact	17
Mitigation of impacts	18
Beam trawling	18
Bottom impact	18
Mitigation of effects	18
<b>Off-bottom trawling</b>	<b>19</b>
<b>Alternative gears to catch demersal species</b>	<b>21</b>
Bottom-set gillnets	21
Bottom-set longlines	21
Traps and pots	22
Seine fishing	22
Purse-seining	22
<b>Increased catch rates to reduce seabed impact</b>	<b>23</b>
Seabed maps	23
Multirig bottom-trawling	23
Gear monitoring instruments	24
<b>Advantage of using lesser impacting gears</b>	<b>25</b>
<b>References</b>	<b>27</b>

# List of figures

1. Bottom otter trawling – single trawl rigging	5
2. Double bottom trawl rigging	6
3. Bottom pair trawl rigging	6
4. Beam trawl	7
5. General layout of a bottom trawl.	7
6. Examples of common ground gear designs used in commercial fisheries	8
7. Examples of bottom trawl doors	8
8. Two examples of roller clump weights used while double trawling	9
9. Three examples of sweep/bridle arrangement	9
10. Two examples of trawl doors with equal surface area but with different height/length ratio	10
11. Impacted widths of two equal trawl doors when door angles are 45° and 25°	10
12. Pressure against the bottom floor when using short and long warps in relation to the fishing depth	11
13. Off-bottom rigging of the trawl doors	11
14. The roll angles of two Thyborøn trawl doors with various length of warp to depth ratios	12
15. Bridle rigging with the lower bridle off the bottom	14
16. Sweeps where the wire ropes are lifted off the bottom along their entire length using discs	14
17. A bottom trawl equipped with drop chains	16
18. A ground gear where a few bobbins have bottom contact, whereas rockhopper discs in the centre and rectangular plates in the wing section are lifted a few centimetres off the bottom (developed in the EU-funded DEGREE project)	17

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# Introduction

Harvesting of marine resources in the vicinity of the bottom requires fishing techniques that often interact with the bottom habitat. Dragged gears in particular may interact with the bottom substrate and organisms living on the seabed or in the bottom substrate. The degree of contact between the fishing gear and the bottom habitat depends on the bottom substrate, the area covered by the particular gear and the pressure exerted on the bottom by the various gear components.

The ecosystem effect of the impact from dragged gear on the seabed has been intensively debated in recent years and several studies have been undertaken to resolve the issue (e.g. Dorsey and Pederson, 1998; Hall, 1999; Kaiser and de Groot, 2000; Linnane *et al.*, 2000; Anon., 2001; NRC, 2002; Sinclair and Valdimarsson, 2003; Barnes and Thomas, 2005). In addition, several working groups and focused topic groups of the International Council for the Exploration of the Sea (ICES), especially the Working Group on Ecosystem Effects of Fishing Activities and the Working Group on Fishing Technology and Fish Behaviour have examined the issue (ICES, 1988; 1999; 2000a; b; 2004). A recent ICES special topic group, “Mitigation measures against seabed impact of fishing operations”, concentrated on measures to reduce seabed impact through gear designs and operations (ICES, 2004).

Løkkeborg (2005) reviewed and discussed current knowledge about fishing impact in an FAO document. A brief summary of important findings in his study is presented in Chapter 2. The primary aim of this document, however, is to describe how physical impact of dragged gear, such as otter trawls and beam trawls can, be mitigated by modifications of the gears and the way they are operated.

Some marine organisms targeted with demersal gear have diurnal and/or seasonal vertical migrations. For these targets an off-bottom harvesting fishing technique might be a bottom-friendly alternative. Technologies to capture off-bottom organisms are briefly described in this document.

A significant quantity of demersal species are captured with gears such as seines, demersal long lines, set gillnets, traps and hook and line. Improving the efficiency and the operation of such gear might well result in an increased exploitation of many demersal resources with such fishing gears. This document therefore discusses which of these fishing gears could be alternatives to bottom-dragged gear for harvesting demersal resources and possible negative environmental impacts in using such alternative gears.

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# Summary of what is known about the effect of dragged fishing gears on the seabed

Several studies have been conducted to evaluate the physical and biological effects of dragged gear operations on benthic habitats and communities. Basically two methods have been employed to study such phenomena. One method is to compare physical and biological parameters on a site before and after disturbance by experimental fishing or alternatively compare an exposed site with an adjacent undisturbed control site (Freese *et al.*, 1999; Hansson *et al.*, 2000; Kenchington *et al.*, 2001). The other method is to compare commercial fishing grounds that have been heavily fished with areas that are lightly fished or not fished at all (Engel and Kvitek, 1998; Thrush *et al.*, 1998; McConnaughey, Mier and Dew, 2000).

The most serious effect of trawling has been demonstrated for hard-bottom habitats dominated by large sessile fauna. Organisms growing up from the bottom such as sponges, anthozoans and corals have been shown to decrease considerably in abundance in the path of the ground gear (Freese *et al.*, 1999; Moran and Stephenson, 2000; Fosså, Mortensen and Furevik, 2002). Such habitats are thus severely affected by fishing operations.

A few studies have been conducted to determine the impact of experimental trawling on sandy bottoms of offshore fishing grounds (Prena *et al.*, 1999). These studies showed declines in the abundance of some benthic species, but trawling disturbance did not produce large changes in the benthic community structure. These habitats may be resistant to trawling because they are subjected to high degree of natural disturbances such as strong currents and large temperature fluctuations.

Several studies have been conducted on the impact of shrimp trawling on soft bottoms (Hansson *et al.*, 2000; Drabsch, Tanner and Connell, 2001; Sparks-McConkey and Watling, 2001). However, clear and consistent effects of trawling disturbance have not been demonstrated in these studies. On the other hand, soft-bottom habitats show pronounced temporal changes due to natural disturbance, and potential changes attributed to trawling may be masked by this natural variability and therefore difficult to demonstrate.

Clear evidence of short-term effects of beam trawling has been demonstrated in several studies (Bergman and van Santbrink, 2000; Kaiser and Spencer, 1996). Intensive disturbance has been shown to cause considerable reduction in abundance of several benthic species. No disturbance effect of beam trawling was

documented in areas exposed to natural disturbances e.g. wave actions and salinity fluctuations confirming the general trend that exposed habitats seem to be less vulnerable to disturbance caused by towed gears.