



Evaluating a large-mesh belly window to reduce bycatch in silver hake (*Merluccius bilinearis*) trawls



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ABSTRACT

Small-mesh trawls targeting silver hake (*Merluccius bilinearis*) in Northeastern USA are managed as exemptions to the northeast multispecies management plan. These exemptions require that the catch of regulated groundfish species is less than 5% of the total catch weight for small-mesh gears targeting silver hake. At present, only a raised footrope trawl (RFT) or drop-chain-only trawl (DOT) (in New England, it is specifically called “sweepless trawl”) in conjunction with a Nordmøre-style grid can be used to land silver hake with small mesh off the coast of Maine. The historical Maine silver hake fishing grounds have a very rugged bathymetry that makes the use of these modified groundgears difficult, if not impossible. This study tested a trawl with and without a large-mesh belly window (LMBW) using a traditional rockhopper footrope for 58 tows and reduced the bycatch of red hake (*Urophycis chuss*) and aggregated bycatch. There was no significant difference in the predicted mean catch of silver hake between trawls (although the LMBW trawl had a 13.50% reduction). Additionally, there was no difference in catch for commercial-size silver hake (>20 cm) between the two trawls. Both video and length analysis determined that small silver hake were caught less frequently by the LMBW trawl. These results indicate that a small-mesh trawl employing a LMBW can effectively be used to commercially target silver hake off Maine (USA), replace the requirement of a RFT or DOT, and maintain the less than 5% regulated groundfish requirement.

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1. Introduction

In the Northwest Atlantic, silver hake (*Merluccius bilinearis*, commonly known as whiting) is found along the continental shelf from Cape Fear (USA) to the Gulf of St. Lawrence (Canada), and is targeted commercially on Georges Bank, off Southern New England, and in the Gulf of Maine by US fishermen (Morse et al., 1999). Silver hake is a slender, fast swimming, schooling species that migrates inshore during spring and summer, and offshore to the continental slope in fall and winter (Bigelow and Schroeder, 1953; Morse et al., 1999). Silver hake can be found throughout the water column, but take diel migrations in pursuit of prey, and are usually associated with the benthic zone during the day, making them accessible to bottom trawls (Bowman and Bowman, 1980).

Due to adult silver hake's small girth, they are managed under exemptions to the northeast multispecies management plan of the

New England Fishery Management Council, allowing mesh sizes smaller than the minimum mesh (165.1 mm) for groundfish. The exemption permits silver hake to be targeted by small-mesh trawls in designated areas, at specified time periods, with specific gears, bycatch reduction devices (BRD), or a combination thereof (Fig. 1). This exemption pertains to gears used to target species within the small-mesh multispecies complex, which includes silver hake, red hake (*Urophycis chuss*), and offshore hake (*Merluccius albidus*). Silver hake are managed in two stocks, northern and southern, neither of which are overfished nor undergoing overfishing (New England Fisheries Management Council (NEFMC), 2012). Despite stable populations of silver hake, their co-occurrence with many regulated groundfish species (RGS) requires management strategies to take into account the effect the silver hake fishery has on RGS.

Exempted gears must demonstrate that catches of RGS consistently do not exceed 5% of the total catch weight, and do not jeopardize fishing mortality objectives (New England Fisheries Management Council (NEFMC), 2012). Regulated groundfish species in this context include: Atlantic cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), yellowtail flounder (*Limanda ferruginea*), pollock (*Pollachius virens*), redfish (*Sebastes fasciatus*), white hake (*Urophycis tenuis*), witch flounder (*Glyptocephalus*

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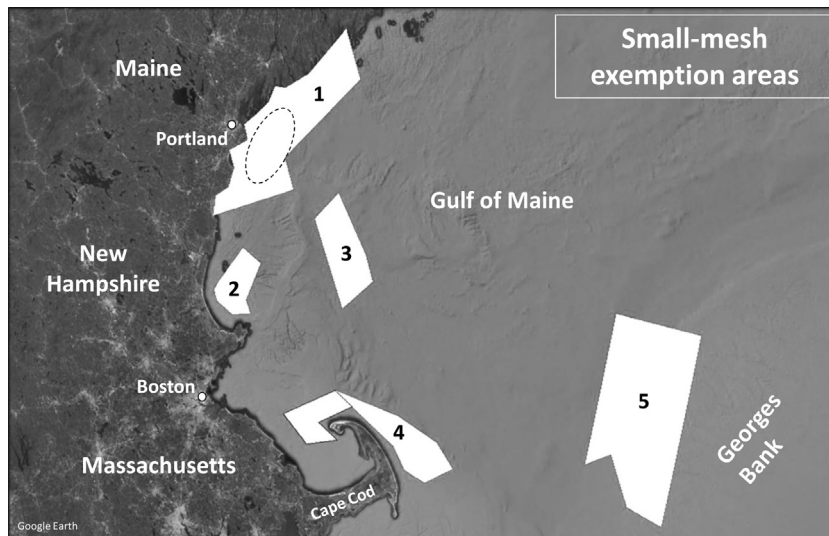


Fig. 1. Time-area-gear exemptions for silver hake (*Merluccius bilinearis*) in the Gulf of Maine and Georges Bank. Exempted gear includes small-mesh, raised footrope or drop-chain-only trawls (or called sweepless trawl in New England, U.S.), and separator grids. 1—GOM raised footrope area, 2—small-mesh area I, 3—small-mesh area II, 4—raised footrope exemption area, and 5 - Cultivator Shoal exemption area. The dashed circle indicates the location where sea trials were carried out.

cynoglossus), American plaice (*Hippoglossoides platessoides*), winter flounder (*Pseudopleuronectes americanus*), and windowpane (*Scophthalmus aquosus*). For Maine, the small-mesh exemption requires the use of a raised footrope or drop-chain-only trawl in conjunction with a Nordmøre-style grid (Kenny et al., 1992) with 50 mm spacings in the trawl extension (New England Fisheries Management Council (NEFMC), 2012).

A raised footrope trawl (RFT) uses drop chains to extend the distance between the fishing line and the groundgear, effectively “raising” the fishing line above the seabed (He, 2007). McKiernan et al. (1998) and Sheppard et al. (2004) showed that a RFT could maintain commercial levels of silver hake catch while limiting RGS catches to 2.3% of the total catch in Massachusetts waters. Additionally, Sheppard et al. (2004) showed that a modified RFT without groundgear that maintained the fishing line above the seabed with drop chains alone, similar to those described in Rose (1995) and He (2007), could also catch commercial levels of silver hake while maintaining RGS bycatch below the 5% threshold for the Massachusetts silver hake fishery. This groundgear design was originally called “sweepless trawl” by Sheppard et al. (2004), but the word “sweep” has a different meaning outside of New England. We therefore will use the term “drop-chain-only trawl” (DOT) for this manuscript. These gears, while performing well in research, have proved impractical with varied results, and in some cases have incurred damage when fished on irregular fishing grounds (Milliken and DeAlteris, 2004; Capt. V. Balzano, F/V *North Star*, pers. obs.).

Since the implementation of the time/gear exemption areas, silver hake catches have gradually increased within Massachusetts waters, but have remained at or near zero in Maine (Bayse et al., 2013). The RFT and DOT trawl, required by exemption, are considered unfishable in Maine waters due to its rugged bathymetry. The coastal Maine sea floor is considered the most complex along the US east coast due to its rocky and irregular topography (Trumbull, 1972; Barnhardt et al., 1998), with very limited flat grounds suitable for fishing with a RFT or DOT. When fishing with the exempted footropes in Maine, there was frequent tearing of the belly netting when turning or fishing over rough grounds, requiring a traditional rockhopper footrope to effectively fish (Capt. V. Balzano, F/V *North Star*, pers. obs.).

Milliken and DeAlteris (2004) tested a modified trawl to reduce groundfish bycatch in the southern silver hake fishery as an alterna-

tive to a RFT. By implementing a large-mesh belly window (LMBW) just aft of the footrope, the authors were able to reduce the bycatch of flatfish by 71%, RGS by 61%, and incurred no significant loss of silver hake. The study tested various belly windows of different mesh sizes and twine colors. The most successful configuration, with the best balance between retaining silver hake and reducing groundfish bycatch, was a 406 mm mesh size panel of 7.6 m across and 2.6 m long, installed 0.61 m behind the fishing line. Hasbrouck et al. (2013) also applied a large-mesh panel in the belly of a squid trawl, and successfully reduced winter flounder catch in the Southern New England longfin inshore squid (*Doryteuthis pealeii*) fishery. In the UK’s Shetland mixed whitefish fishery, large-mesh panels were added to the belly of the trawl and reduced the capture of Atlantic cod, while not reducing the capture of haddock and European whiting (*Merlangius merlangus*) (Kynoch et al., 2009, 2011).

Flatfish are the primary component of RGS bycatch when using a 254 mm rockhopper and excluder grid in the Maine silver hake fishery (Schick, 2005). The LMBW design takes advantage of flatfish’s general association with the bottom and tendency to stay low upon entrance into the trawl mouth (Rose, 1995; Bublitz, 1996; Albert et al., 2003). Additionally, the LMBW could increase the escape of juvenile RGS (i.e., Atlantic cod, haddock, etc.) and juvenile silver hake. Discards of juvenile silver hake are a concern due to the truncated age structure of silver hake, with 64% of landings consisting of two to three year old fish (Helser and Mayo, 1994). Fish have a length-dependent swimming capability; larger fish have the capacity of cruising for long periods of time with a trawl, while smaller fish quickly exhaust, which can lead to collision with the net, and potentially escaping out of the LMBW (He and Wardle, 1988; Videler and Wardle, 1991; He, 1993; Winger et al., 2010).

If a conservation engineering approach similar to the LMBW could be shown to reduce RGS bycatch in the Maine silver hake fishery, an additional exempted gear could be added to allow successful harvest of under-exploited silver hake resources off Maine’s coast. Thus, this project explored the effectiveness of a LMBW to reduce the bycatch of RGS, and maintain a commercial catch rate of silver hake, while using a rockhopper footrope. A successful design would present a functional alternative for the Maine small-mesh fishery to target silver hake while meeting conservation requirements.

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