



**Title page:** The design, development, and field testing of an innovative circular net pen to be used to assess bycatch mortality of Atlantic cod at sea.

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**4. Major accomplishments and milestones** The PI's were funded through a project development award by the Northeast Consortium to design and test an innovative open net system to study discard mortality at sea. The net was custom built by *Reidar's Manufacturing Inc.* (Fairhaven, MA). The fundamental design of the net pen consists of a collapsible spherical column that floats at the surface and is weighted down but suspended above the seafloor (Figure 1; Appendix 1). The net pen measures 3.3 m in diameter with a maximum net sock height of 20 fathoms. Five, half inch marine grade aluminum rings, enhanced with rod stiffeners provide structural support, maintain the maximum breadth of the top and bottom of the pens, and stop lateral displacement (Appendix 1). Thirty two high impact floats line the top ring and provide buoyancy as well as a lip to keep cod from escaping through the top of the net. There is also a removable inner net that can serve as a shield to eliminate avian predation and/or increase the "lip" size of the ring when in place. The body of the net pen is constructed of 4" square spectra netting. The bottom of the pen is designed as a pot with an opening akin to the codend of a trawl net. This overall design has made for easier storage, transport, deployment, haul-back, and reduction in depth when in use. This free floating net is then tended by a fishing vessel which is anchored to and floats with the net.

The net pen was tested for a 24 hour period in September 2007. During this time period, the net was deployed and retrieved 15 minutes later and then re-deployed for 24 hours before final retrieval (Figure 2). The pen was re-deployed for 30 hours on April 16<sup>th</sup> and 17<sup>th</sup>, 2008. During this experiment, 40 trawl caught cod were placed in the net (Figure 3). A video camera was inserted into the pen and cod were actively seen swimming within the net. Moreover, it appeared that individual cod were using the net at different depths to recover from the trawling process.

During the deployment times, the structural integrity of the net was maintained, even when the sea wave-height increased to 2-4 foot for an extended period of time and with the tethering vessel anchored to the sea floor. Based on the success of the net design and

the ability for cod to use the net to recover from the trawling process, we believe the net can be deployed for any length of time under the same sea conditions to study discard mortality in a variety of fish species.

**5.Unexpected difficulties and project alterations: N/A**

**Next steps, tasks for the next 6 months:** Future work surrounding this study will focus on two areas. One will be traveling to conferences and on site to meet with colleagues in order to improve the methodologies and net design. The second will be to focus on obtaining additional funding in order to conduct large scale bycatch mortality studies.

**7. Impacts and applications:** Now that the net pen has been shown to work through field testing, the logical next test is to use it for the purpose it was created for. Thus, this net would be the first of its kind to address discard mortality of trawled cod under natural conditions, generating data that can be directly considered by the Stock Assessment Review Committee (SARC) within the next NOAA Northeast Regional Stock Assessment Workshop (SAW) for the cod. In providing a scientific basis for management, the SARC considers studies of this nature for the SAW. In addition, this net can be used as an innovative protocol for accurately assessing the short-term discard mortality of additional gadoids and finfish. The spacious open-net system to be utilized will enable the monitoring of fish in a manner significantly closer to what would be experienced under actual commercial fishing conditions while still allowing the assessment of robust sample-sizes. Such a development will reduce interferences from holding tanks/cages (e.g. forced barotraumas) and strengthen the accuracy of short-term discard mortality estimates for cod and additional species in future studies.

As previously mentioned we envision this system, or a modification of it, to be used to estimate short-term discard mortality of various other commercial species in the northwest Atlantic. Moreover, while not monetarily feasible in the proposed study, the use of these net pens to study other causes of mortality such as time on deck, sampling during the summer and winter seasons, or the physiological parameters (i.e changes in cortisol levels) behind the observed mortalities, will only increase our understanding of the fate of discards in the multispecies trawl fishery. Future work left on the duration of the grant period will be consultations with other fisherman, scientists and industrial partners in how we can best facilitate new funding for new studies with this net design.



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