Appendix B

Industry-Based Survey
for
Gulf of Maine Cod
Pilot Study

Survey net selection memorandum, net plan, sweep schematic, and door end detail schematic

MEMORANDUM

TO: Earl Meredith, Linda Mercer, Cheri Patterson

FROM: Bill Hoffman

CC: David Pierce, Thomas Moth-Poulsen

DATE: May 4, 2003

RE: Division of Marine Fisheries trawl net recommendations for the Industry-Based Survey

During the months of March and April of this year, the Division of Marine Fisheries *(MarineFisheries)* has been collecting advice and information to determine the trawl net specifications that should be adopted as the standardized gear that will be deployed for the Industry–Based Survey (IBS) pilot program. Representatives from the New England commercial fishing industry, The Centre for Sustainable Aquatic Resources of Memorial University of Newfoundland (CSAR), and Canadian Department of Fisheries and Oceans (DFO) have been consulted. Most of these consultations have been in the form of telephone interviews; however, in response to a suggestion by the IBS implementation committee, a gear workshop was also held on March 18th, 2003 with industry representatives, National Marine Fisheries Service (NMFS), and *MarineFisheries*. As expected, there was a variety of opinions on which style trawl should be used in the survey, and what characteristics this trawl should have. After sorting through the compilation of information, *MarineFisheries* has determined that the following trawl net specifications should be adopted in the final design.

Net size:

At the gear workshop the group decided that the fishing circle, which is the circumference measurement of the opening of the trawl starting just behind the sweep, is the most common parameter when selecting the trawl. It is recommended that the fishing circle should be approximately 150'. This size was agreed upon by industry as a mid-sized commercial trawl that could be towed by all involved vessels and would be capable of producing a representative sample while not catching too many fish.

Mesh size and material:

As suggested by the implementation committee, 4.5" mesh should be used in the body of the trawl with 2" mesh used in the codend. During our discussions it was agreed this size is appropriate for two reasons. First, it is not so small that it would cause a backflow at the mouth of the trawl, which is believed to alert larger fish

allowing them to avoid being caught, as well as blowing smaller fish out of the trawl at the end of the tow. Second, 4.5" mesh is large enough to allow water to flow through the trawl resulting in a reduction of drag. Reduced drag is important because it allows vessels to tow more efficiently. It also will allow the trawl to be towed at quicker speeds (e.g. 3 knots, which is a component of the towing protocol) while still maintaining its geometric shape and bottom contact. Mesh diameter and material were also considered, and it was decided that 3mm Euroline would be the most appropriate for the trawl. This material is more robust and has a higher tensile strength than a traditional 3mm polyethylene twine. This twine is anticipated to withstand the rigors of the survey and, due to its tight cylindrical weave, will be more hydrodynamic, thus further reducing drag and the possibility of a backflow effect. Adding larger meshes in the square and the wings was considered to reduce drag, but changing mesh sizes throughout the trawl would complicate the design. It was agreed that for the ease and speed of repairs the trawl should be as simple as possible. Therefore, it is recommended that the 4.5" mesh be used throughout the body of the trawl, including the wings and square, and continuing down through the extension to approximately one fathom before the codend. In front of the codend it will be necessary to taper the mesh from 4.5" to 2", therefore it is recommended that a brief section 3" twine be incorporated before the codend. This twine will not only make a smooth transition to the codend, but will prevent the backflow effect in front of the codend.

Sweep and ground gear:

Because many of the sample sites will be over unknown bottom structure, it will be important that the sweep be able to tow over adverse bottom types while maintaining constant contact with it. To accomplish this it is recommended that a standard commercial "rockhopper" sweep be utilized including 14" rockhopper disks in the belly of the trawl tapering out 8" on the wings. They should be mounted on a rubber covered cookie wire with 6" disks staggered in between the rockhopper disks to act as suction breakers.

Cables, trawl doors, and floats:

These three elements of the trawl are highly contributing factors that affect how the trawl fishes. Through adjustments and alterations of the above, the trawl can be made to optimally fish. It was a consensus through our consultations, that the best way to establish the final configuration of these items will be through tests performed at a flume tank. As discussed below, results will allow us to adjust and alter the cables, trawl doors and floats, to optimize the trawls fishing potential. One characteristic that will be tested is a cookie cutter covered leg. It was recommended by industry that these legs, ranging from 1/2"-5/8" in diameter, be deployed in the survey. This is a common configuration that is often used in commercial dragging operations, and it is believed that this style leg creates an enhanced mud cloud and is more resilient over time.

Trawl Style:

It has been discussed and agreed the trawl that is selected for the survey must be: 1) designed to specifically target cod, 2) have a sound design and construction that would be recognized and accepted by industry and scientists, 3) capable of fishing on all bottom types (e.g., hard, soft, mixed, gravel, mud, sand, etc.), 4) easily repairable either on the vessel or on shore, 5) rigid, such that the trawl is resistant to being distorted or collapsing under different variables, (e.g. excessive strains, picking up debris on ground gear, etc.), and 6) an elevated head rope height, to ensure that cod higher in the water column, be captured.

Through our consultations, 2-seam and 4-seam trawl designs were identified as the two styles of trawls that would meet the set criteria. Both styles are commonly used today throughout the Gulf of Maine by New England groundfishermen. A 2-seam trawl is made out of two panels of mesh, a top and a bottom, which are laced along the two sides known as the gore line, selvage, or lastridge. A 4-seam trawl, commonly called a box net, has four panels of twine (top, bottom, and two sides) that are laced together to form 4 gore lines. Each trawl has its advantages and disadvantages, but both are proven commercial designs that will catch cod.

One of the strengths of a 4-seam trawl is its advantageous geometric shape. The trawl tends to maintain a gradual taper, round opening, and a high head rope height. A gradual taper down the belly and extension is important for catching cod because the fish aren't forced into a tighter space when dropping back into the trawl, allowing them to be caught more easily. Headrope height is desirable because it covers a greater percentage of the vertical water column therefore increasing its ability to capture cod that may be hovering above (e.g. spawning or feeding aggregations) the sea bed floor. A 4-seam trawl generally has good vertical lift. This lift keeps the belly of the trawl up off of the bottom where it could be damaged by obstructions or hard bottom, and as a result allows the trawl to be towed over variable bottom types. If damage does occur, it is usually limited to the bottom belly of the trawl. Gore lines are the strength of any trawl as they carry much of the weight of the catch. Having four gore lines makes the 4-seam robust and will hold up well when making large catches. The four gore lines also allow fishermen to have more control to tune the gear.

One disadvantage of the 4-seam trawl is its complex design. Dealing with four panels can be confusing for fishermen when working on a deck of a boat. If damage occurs, repairs can be more time consuming resulting in loss of valuable survey time. Its design allows more options to control the trawl, but as a result it compromises its stability. This trawl will not maintain its perfect shape if obstructions (e.g. old or lost fishing gear, logs, boulders, or other debris) become lodged in the trawl or ground gear. If areas of the trawl are altered (e.g. stretched headrope or footrope, uneven wires, etc) this, too, will have a negative impact on its ideal shape and, ultimately, its effectiveness.

The 2-seam trawl is reportedly the most commonly used commercial trawl style in New England, and is for several reasons. The main advantage to the 2-seam trawl is its stability. It is a very tolerant trawl to the prior mentioned obstructions and alterations and will maintain its geometric shape under these circumstances. Its two-panel construction uses a reduced amount of material. The trawl requires less labor to build, and therefore the overall cost of the trawl is less. For the same reasons, if damage occurs, the 2-seam trawl is generally quicker to repair. It is very versatile, as the trawl's headrope can be shortened to make a low profile trawl (commonly used to capture flat fishes) or can be lengthened into a "balloon top" to give it a high profile (which is used to catch gadids or small pelagics). Some industry representatives mentioned that they believed the 4-seam trawl had a higher headrope height, but after researching this topic we found that this was not necessarily the case. In a report that was produced by the MIT Sea Grant Program and the Center for Fisheries Engineering Research titled: Report No. 10 Standard Series Trawl Tests by Cliff Goudey, seventeen 4-seam and 2-seam trawls were tested and compared at the David Taylor Naval Ship R&D Center flume tank. It was shown that 4-seam and 2-seam set at the same parameters, and, towed, under the same conditions, maintained similar geometric dimensions.

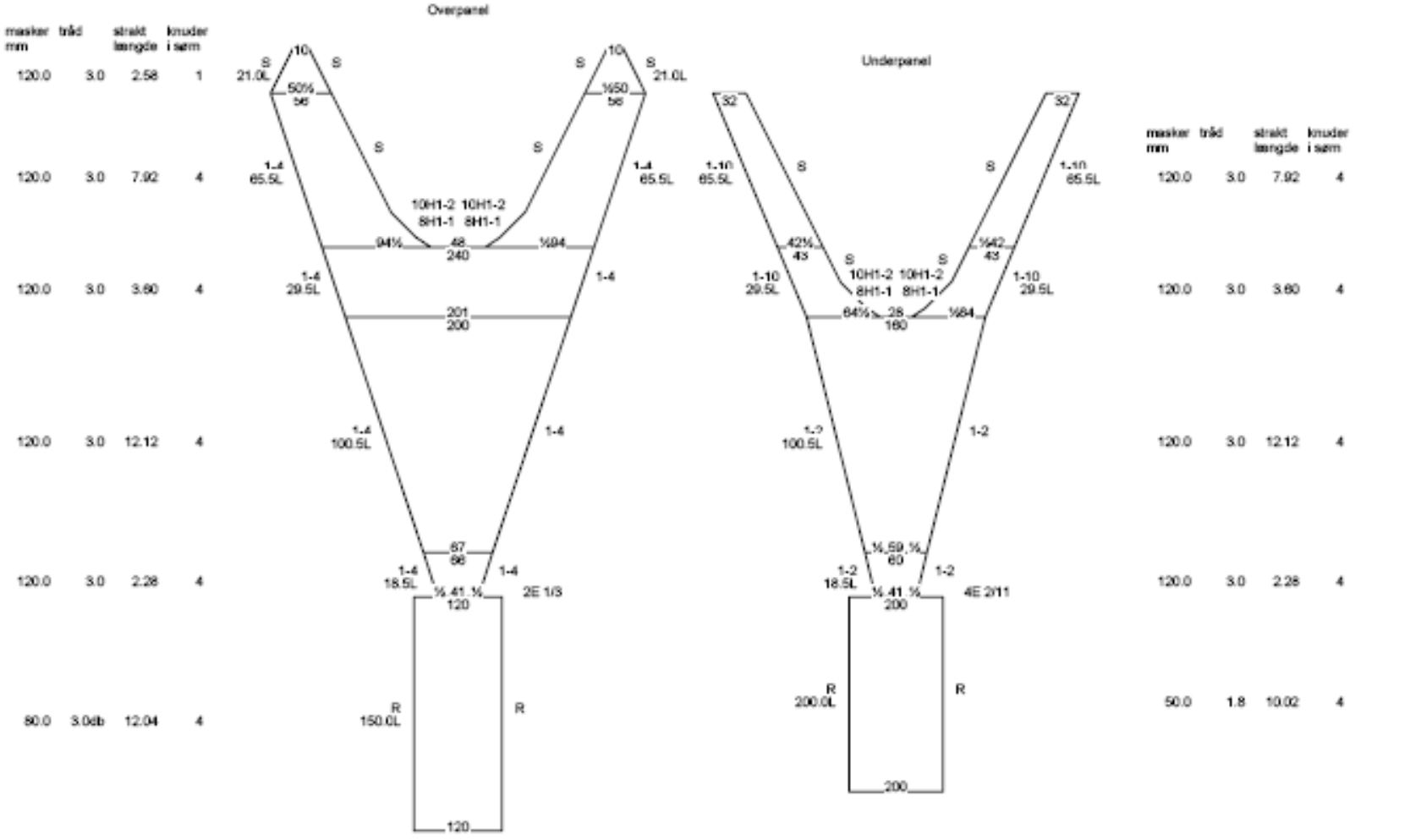
During consultations, fishermen, scientists, and trawl builders, all agreed that the selected trawl design is not as important as the ability to standardize the gear and document that it is operating properly. Because of the survey design, the selected gear will be used on many different vessels and by many different fishermen. Therefore, a key to the success of the survey will be the ability to quickly and easily calibrate the gear as well as maintain the optimal fishing shape from each tow and vessel. The 2-seam trawl offers the best opportunity to achieve this and therefore *MarineFisheries* believes this is the best trawl design for the IBS.

Flume Tank:

Once the final trawl design is selected, *MarineFisheries* intends of to have a model of the trawl manufactured and tested in a flume tank at (CSAR) in St. John's, Newfoundland. This is the largest flume tank in the world and they have extensive knowledge and experience testing otter trawl trawls used in commercial and research operations (e.g. NEFSC bottom trawl survey, DFO bottom trawl survey, DFO sentinel survey, *MarineFisheries* raised footrope trawl, etc.). While testing the trawl at this facility, gear specialists will be able to make adjustments to the trawl until it is operating at an ideal geometric shape. This shape is the trawls optimum fishing shape, and is important because it yields the highest fish retention. The recorded angles, heights, spread, needed lift, and door sizes that were measured can then be applied to the trawl when at sea allowing the gear to be calibrated quicker and easier. Another benefit from the flume tank tests will be the production of a "report" for the captains for the selected trawl. This report will describe what effect minor changes to the rigging and towing speed will have to the trawl geometry and tell the captains where to increase attention on rigging parameters and towing. If financially feasible, *MarineFisheries* hopes to invite operating

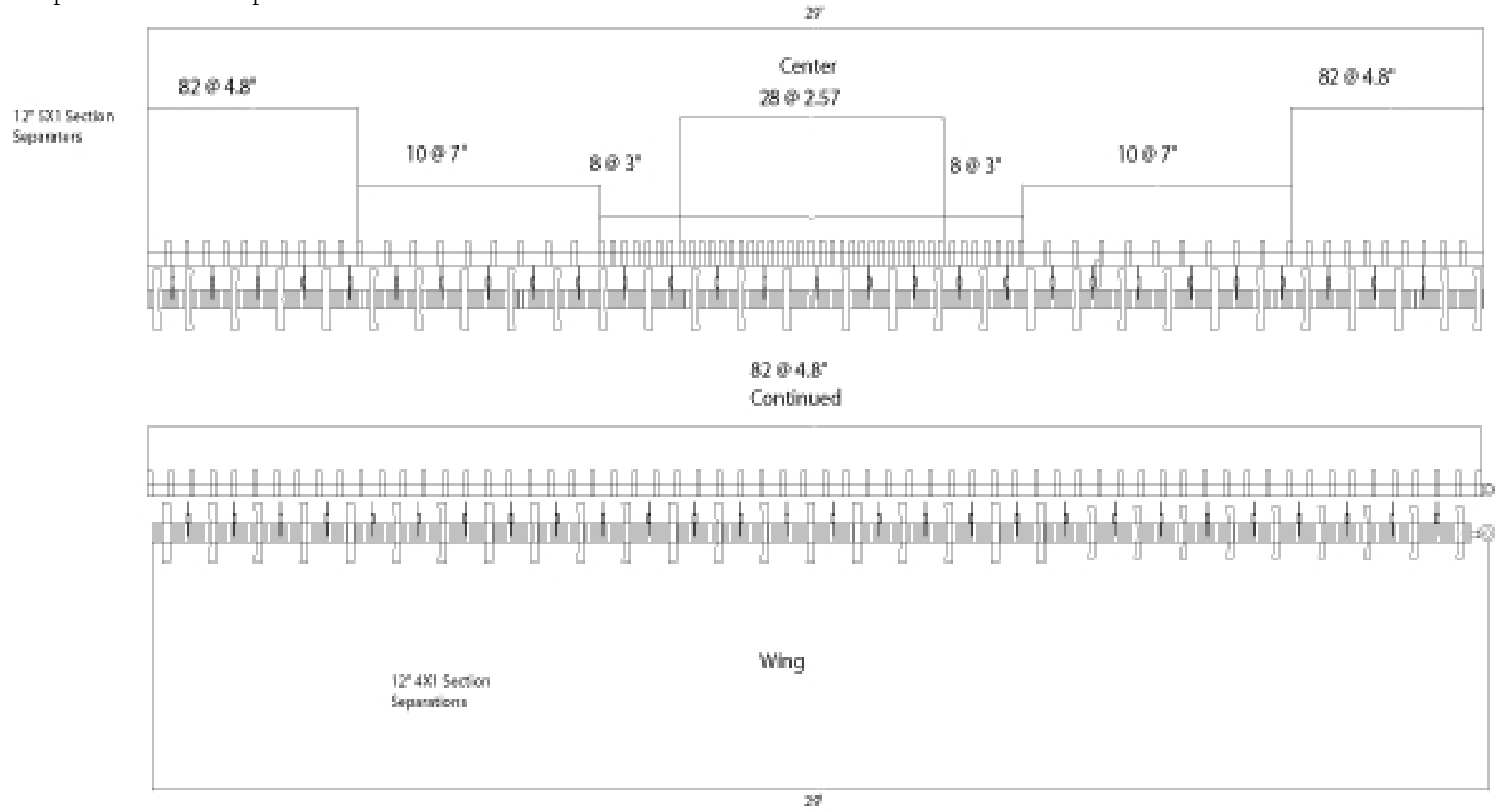
vessel captains/owners and other industry representatives to attend the testing of the trawl. This will not only give an excellent opportunity to train the fishermen that will be using the standardized gear, but will allow other industry and interested parties to observe the vigilant steps that are being taken to assure quality control throughout the survey.

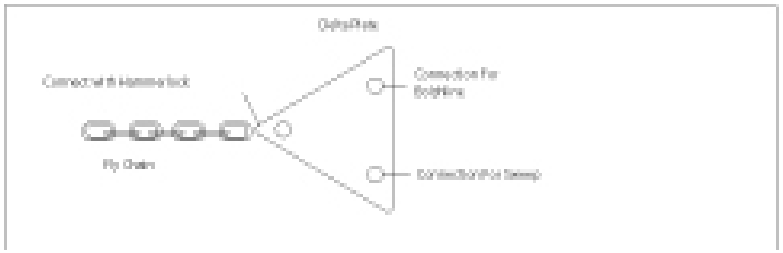
Appendix B (cont). Net plan for the IBS for GOM cod survey net, the Reidar's 360



Sweep schematic

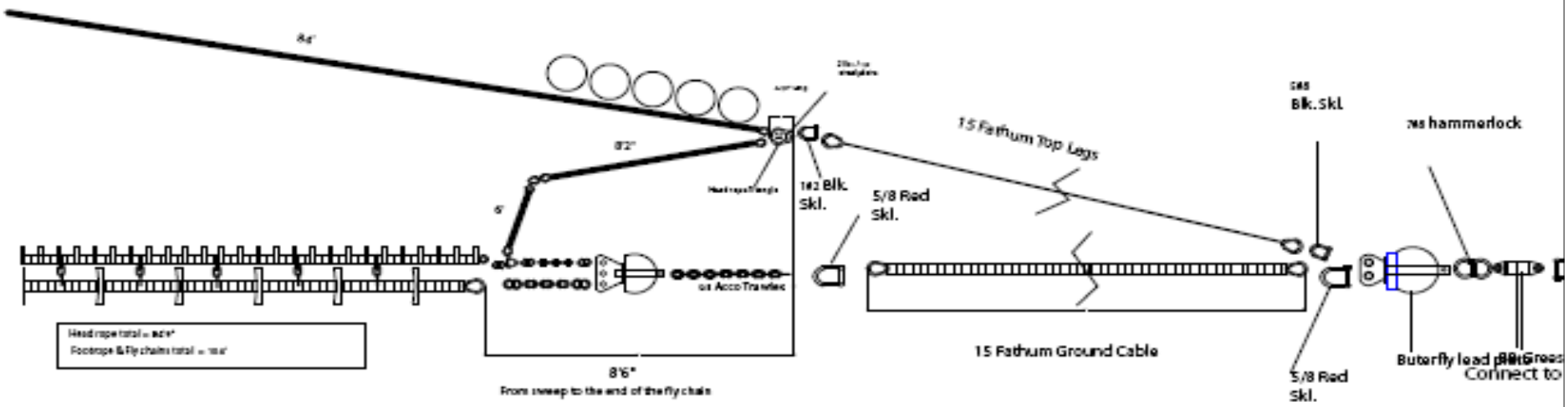
Sweep schematic and tri-plate detail





Door end detail

Door End Detail



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