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Design and Parameters of the Official Survey Gear for the Chesapeake Bay Multispecies Monitoring and Assessment Program (ChesMMAP) Aboard the *R/V Virginia*

Trawl Specifications

The net used by the ChesMMAP Trawl Survey is a four seam, three bridle trawl, the fishing circle of which is 200 meshes of 12cm braided polyethylene (PE) twine (Figure 1). The top square, top bellies, and the second and third bottom bellies are 6cm, 1.8mm braided PE. The first side panel is 12cm, 3mm braided PE. The top and bottom wings, along with the bunts and first bottom belly, are made of 12cm, 3mm PE webbing as well. Top and bottom wings, along with bunts and the first bottom belly, are made of 12cm, 3mm braided PE. The selvedge, 4 meshes deep on bottom wing bars, and 4 meshes deep on top wing bars, are made of 12cm, double 3mm braided PE. The 2.5 meshes-deep panel just forward of the square on the top of the net, and just forward of the first bottom belly on the bottom of the net (colloquially known as 'rock-band'), is also 12cm, 3mm braided PE (Figure 1a). All webbing, with the exception of the codend liner, is dark green in color with a red tracer within the braiding. Five meshes are put into each gore (again with the exception of the codend liner, see below). Port gores are wrapped with red braided PE twine, while starboard gores are wrapped using dark green braided PE (Figure 2).

The codend is made of 12cm, double 3mm braided PE with a 2.54cm knotless nylon liner. The codend is 50 meshes in diameter (clear count, not including gores) and 50 meshes deep with 25 0.6cm x 5.1cm stainless steel rings at the terminus. The codend has two gores, each containing 6 meshes (3 from each of the top and bottom panels). The liner is 671cm (22') in length with a single gore containing 5 meshes. Fifty pickup meshes are added to the top of the liner to facilitate easier liner changes at sea (Figure 3).

The headrope is 996cm (32' 8") eye to eye, and is made of 1.3cm (1/2") Ultra-High Molecular Weight Polyethylene (UHMwPE) line that is gray in color (common manufacturers are Dyneema and Spectra) (Figure 4). Eyes are spliced by the manufacturer into the UHMwPE on each end. The headrope eye, the 2 top jib end meshes, and top eye of the upper wing end are put into a 1.3cm (1/2") galvanized Blue Line bow shackle. This shackle is also connected to a 61cm (2') eye to eye wing extension wire constructed of 6.5mm (1/4") s/s wire and 6.5mm (1/4") s/s thimbles at each end. Total headrope length (including extension wire, shackles, and UHMwPE) is 1127 cm.

Sixteen, 20.3cm (8") orange center-hole floats are mounted vertically to a float line made of 1.3cm (1/2") polydacron 3-strand, twisted buoyant line (Figure 4). Starting 30.5cm (1') from the center mark of the float line running in either direction, floats are affixed with a spacing of 61cm (2') using #8 virgin polyester twine (Figure 5).

The up & down lines (also called "breast" lines) define each wing end and are each 1.3cm (½") UHMwPE. The upper wing end is 244cm (8') eye to eye, while the bottom wing end wing end is 203cm (7' 8") eye to eye. Eyes are spliced by the manufacturer into the UHMwPE on each end. The top eye of the upper wing end goes to a 1.3cm (1/2") galvanized Blue Line bow shackle (referenced above). The bottom eye of the upper wing end, the middle jib end meshes, and top eye of the bottom wing end are put into another 1.3cm (1/2") galvanized Blue Line bow shackle. A 61cm (2') middle wing extension made of 6.5mm (1/4") s/s wire with s/s thimbles at each end is attached to the aforementioned bow shackle. The bottom eye of the lower wing end, bottom jib end meshes, and the 3/8" hammerlock extending from the footrope, are all put into a 1.3cm (1/2") galvanized Blue Line bow shackle. Into the aforementioned galvanized 1.3cm shackle is a 61cm (2') eye to eye bottom wing extension constructed of 9.5mm (3/8") s/s wire with s/s thimbles at each end. This wing extension is connected

to one of the 9.525mm (3/8”) galvanized swivels of the lower steel swivel plate (also called “tri-plate” or “delta plate”) using a 9.525mm (3/8”) hammerlock. This swivel plate is a custom cut and welded triangular piece of 12.7mm (1/2”) steel with three 9.525mm (3/8”) swivels permanently fixed, one in each triangular point. Attached to the other lower swivel on this plate is the hammerlock containing the extension chain from the sweep (described below). The single forward swivel of the plate is attached to a 14 link piece of 9.525mm (3/8”) chain using a 9.525mm (3/8”) straight shackle. The end of this chain is connected to the lower bridle via a 12.7mm (1/2”) straight shackle further described below. These connections can all be seen in Figures 6 and 7.

The footrope is 1112cm eye to eye (1134cm effective working length, including hammerlocks) constructed of 12.7mm (1/2”) rubber covered s/s wire. The wire is covered with 3.8cm rubber spacers called “cookies”. Ninety, 2-hole hangers are used to connect the footrope to the selvedge (Green and white 5mm braided PE twine is used to facilitate this connection), and 18, 1-linkers made of 11mm “quick link” chain (single link pieces) are used to connect the footrope to the zipper traveler (Figure 8). The hammerlock containing the eye of each end of the footrope is joined to the 1.3cm (1/2”) galvanized Blue Line bow shackle (described above) containing the lower up and down line eye and bottom jib end meshes. The total footrope length (footrope, hammerlocks, shackles, extension wires) measures 1205cm.

The sweep used by the ChesMMAP survey is a “flat sweep” constructed of 12.7mm (1/2”) s/s wire and is covered with 5cm rubber cookies and measures 1134cm eye to eye. Eighteen 1-linkers made of 9mm long link chain are used to connect the sweep to the zipper traveler (Figure 8). Each drop chain is spaced 60cm apart. The first and last links are spaced 40cm from each end eye. Wire clamps are used every 180cm to keep the cookie spacers tight on the wire. In between each clamp is 6, .454kg (1 pound) lead spacers and three of the above described 1-linkers (Figure 9). In each end eye of the sweep is a 9.525mm (3/8”) hammerlock connecting the sweep to the 61cm (2’) extension chain. This extension chain is connected to the remaining lower swivel of the swivel plate previously described above using another 9.525mm (3/8”) hammerlock.

Winch and Hardware Specifications

The trawl winches aboard the *R/V Virginia* are Hawbolt HDD1230/S, each spooled with 250m of 9.525mm (3/8”) s/s wire, machine crimped with a s/s thimble at the bitter-end. The port and starboard side wires are left and right-hand lay respectively. The manufacturer specification for winch speed on the HDD1230/S is 200ft./minute, however, winch speed was calculated during typical setting and hauling of the ChesMMAP fishing gear (200x12 trawl and Thyboron 44” Type IV doors) and averaged about 240ft./minute. Port and starboard sides each have a 12.7mm (1/2”) s/s bow shackle (or “straight shackle”) joining the thimble to a 3/16” s/s swivel. The opposing side of this swivel is joined to the tow-point link of a brail chain (see below) on the front side of the door. (Figure 10)

The brail chain on each door serves as the tow-point connection. This component is 18 links of 9mm long-link chain (94cm total working length) and is fixed to the aft most mid bracket and the forward mid bracket of the door using a 12.7mm (1/2”) bow shackle. Beginning from the forward bracket, the tow-point shackle (described above) picks up links 3 and 5 of the brail chain (leaving the 4th link hanging slack) and is fixed to a 15.8mm (5/8”) s/s swivel, the opposite side of which is fixed to the thimble of the main trawl warp (also described above). Also located on the front side of the door is the idler hookup. A 1.5T “Viking Link” is fixed to the lower spare bracket using a 12.7mm (1/2”) s/s bow shackle. (Figure 10)

The trawl doors are Thyboron 44" (0.88m²) Type IV. Each door weighs 120kg in air (including knife edges, see below) and is painted blue in color by the distributor. Paint is maintained on exposed areas by VIMS staff using oil-based "Safety Blue" paint made by Rustoleum brand. Each door is outfitted with two, 2-hole steel knife edges on the footing (also called "shoes") using 1 3/16" bolts and locking nuts. Each knife edge weighs 4.616kg in air and is included in the total weight of each door listed above as the door will not be deployed without knife edges affixed. (Figures 10 and 11)

The backside of each trawl door is outfitted with a three-connection-point chain configuration (forward-mid, aft-upper, and aft-lower) and are all joined to a single 100mm x 150mm link (also called "master link"). The backstrap chain material is 9mm long link chain. Each piece fixed to its respective bracket and to the master link using 9.525mm (3/8") "D" shackles on each end. The middle chain (also called the "long chain") is 18 links total length and is fully let-out with no links hanging (94cm working length). The upper chain is 8 links total length and has one link hanging (37cm working length). The lower chain is 8 links total length and has no links hanging (42.25cm working length). A 12.7mm (1/2") s/s bow shackle is fixed through the master link of the backstrap chains and through the thimble-eye of the backstrap wire (described below), and serves as the joining point of the trawl doors to the rest of the fishing gear (Figure 12).

The backstrap extension wire is 366cm (12') eye to eye of 9.525mm (3/8") s/s wire, machine crimped with a s/s thimble on each end. The forward thimble of the backstrap wire is fixed to the master link of the backstrap chains via the s/s bow shackle described above. The aft thimble of the backstrap wire is fixed using another 12.7mm (1/2") s/s bow shackle to a 1.5T steel "Viking Link" to facilitate connection to and from the idlers (described below) during setting and hauling.

The idlers are 610cm (20') eye to eye of 15.8mm (5/8") Polydacron line. An eye-splice is performed on this line by VIMS staff to produce the proper eye to eye length. One end of the idler is fixed to the upper spare bracket on the front side of the door (described above), the opposite end is attached to a 6.3mm (1/4") hammerlock using another 12.7mm (1/2") s/s bow shackle. This hammerlock is a component of the "main hookup", further described below (Figure 13).

The main hookup is based around a steel swivel plate (also called "tri-plate" or "delta plate"). The swivel plate is a custom cut and welded triangular piece of 12.7mm (1/2") steel with three 9.525 (3/8") swivels permanently fixed, one in each triangular point. The single forward swivel of the plate is attached to an 8 link (27.5cm effective working length) piece of 9.525mm (3/8") chain using a 12.7mm (1/2") Green Pin "D" shackle. The pin of the shackle is through the first link in the chain. Through the seventh link of the chain is the hammerlock (described above) connecting the idler to this main hookup. The eighth link of 9.525mm s/s chain is connected to a 1.5T Viking Link clip using another 9.525mm (3/8") hammerlock. This Viking Link clip connects to the Viking Link clip on the aft thimble of the backstrap extension wire described above (Figure 13).

Both port and starboard top wing extension wires and mid wing extension wires each connect to a 914cm (30') eye to eye 8mm (5/16") steel bridle wire. These upper and middle bridle wires are eye spliced with soft eyes on each end. Both top and mid bridles are joined together at their terminus by a 9.525mm (3/8) straight "D" shackle (Figure 14). Also joined in this 9.525mm shackle is a third 914cm, 8mm steel bridle wire connecting the upper and middle bridle wires to one of the two aft swivels on the main hookup (described above). The bottom wing extension chain is joined to an 1829cm (60') eye to eye 1.27cm (1/2") steel bridle wire. This wires joins all of the footgear connecting hardware to the other aft swivel on the main hookup.

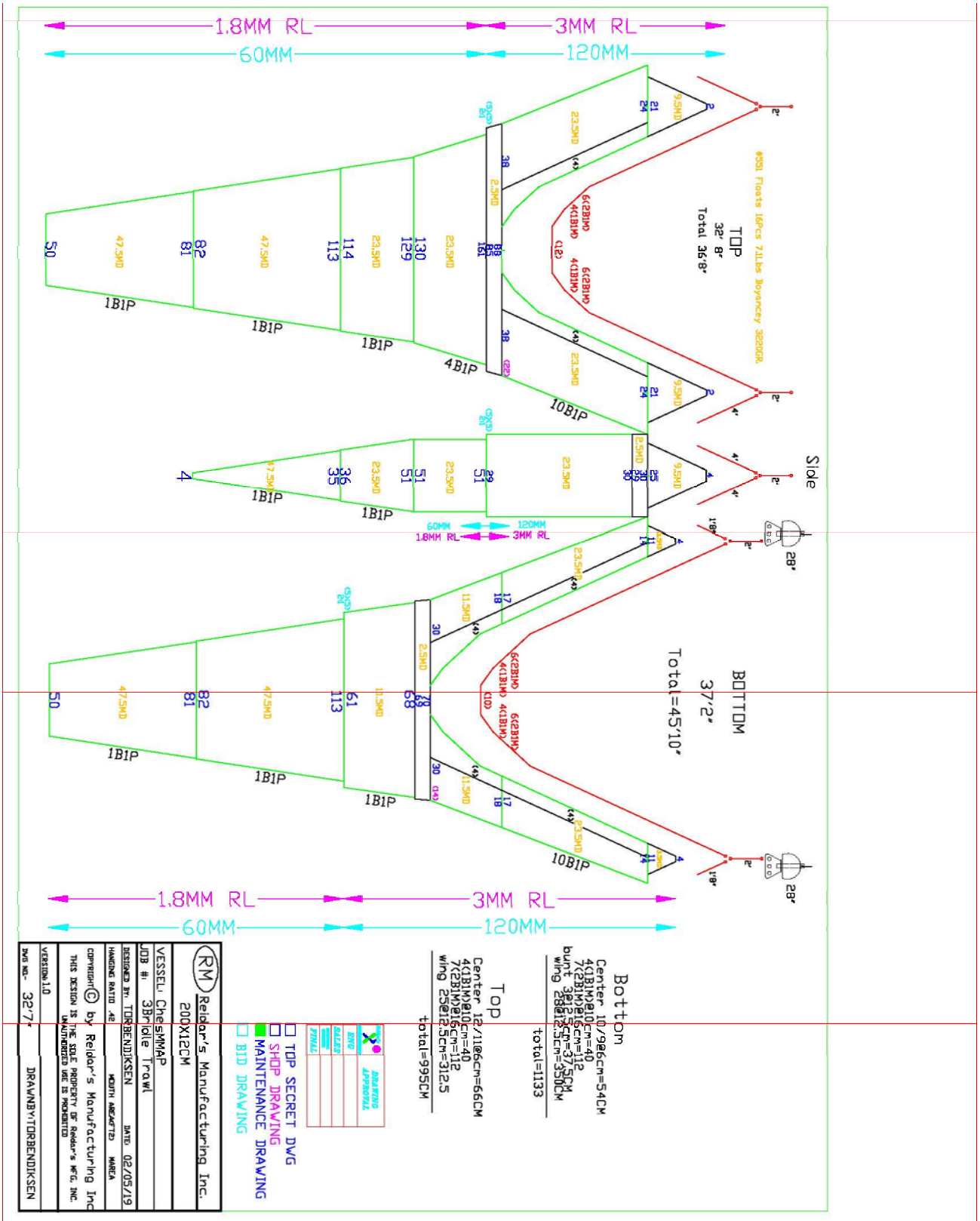

Figure 1a. Net plan for the 200x12cm trawl used by the ChesMMAP survey (plan owned by Reidar's Manufacturing)

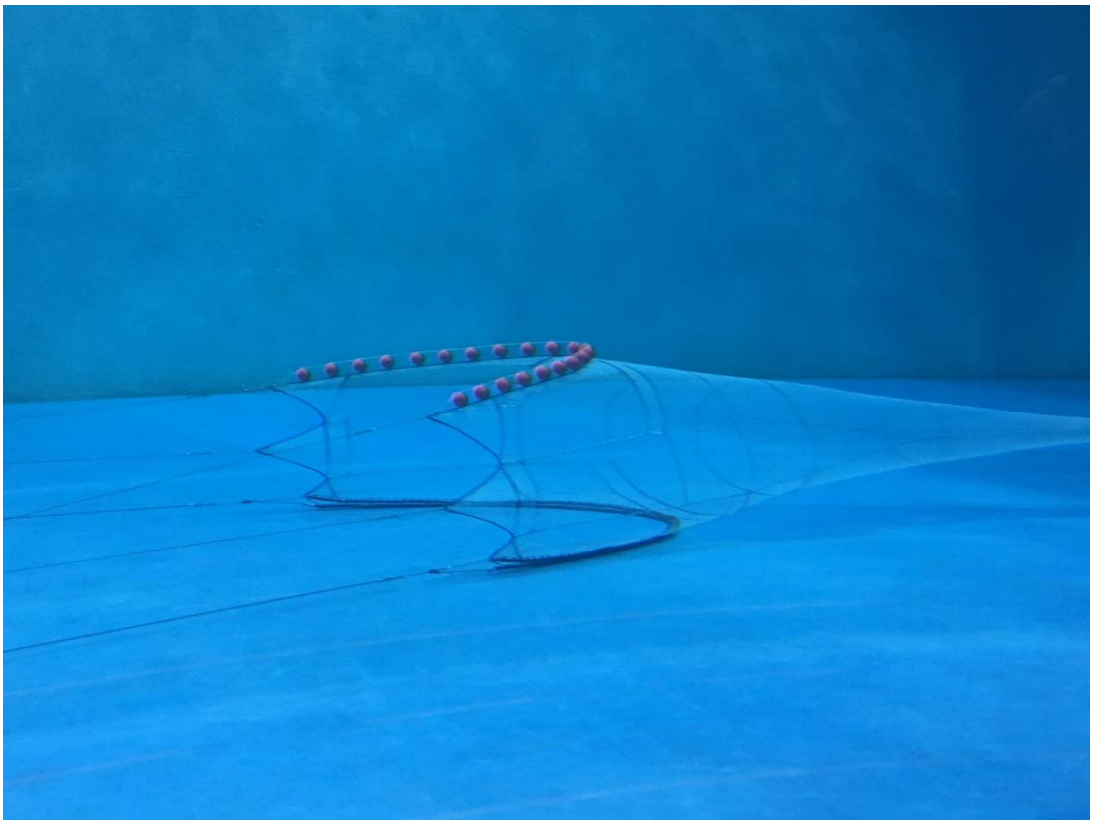

Figure 1. View of the 200x12 trawl in the flume tank in Newfoundland, Canada. Note: Since this picture was taken, the number of floats has been lessened from 20 (pictured above) to 16 due to brand preference and buoyancy specifications

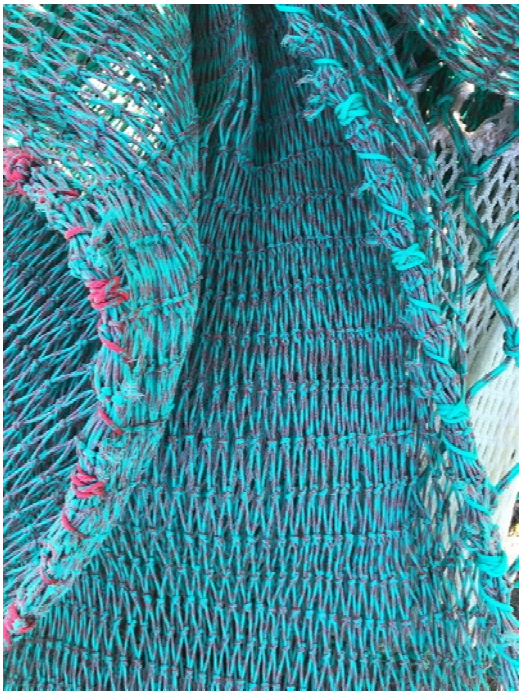

Figure 2. Port and starboard gores wrapped in respective colors. Net constructed using green PE twine with a red tracer.

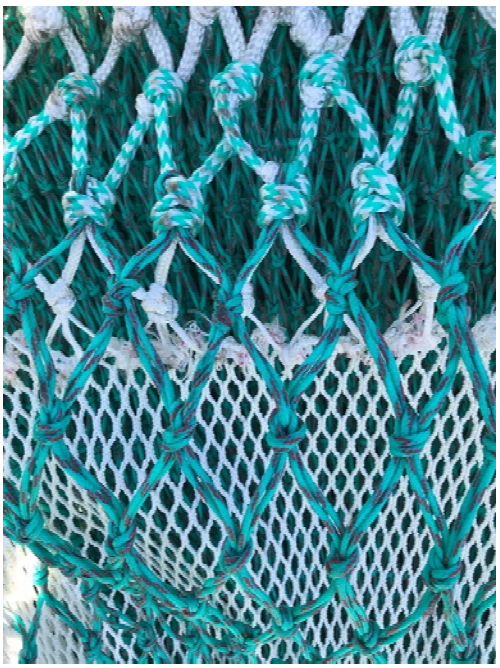

Figure 3. Codend and codend liner attachment

Figure 4. Headrope and floatline with 8” center-hole floats spaced 2’ apart

Figure 5. Attachment of center-hole float using #8 polyester twine

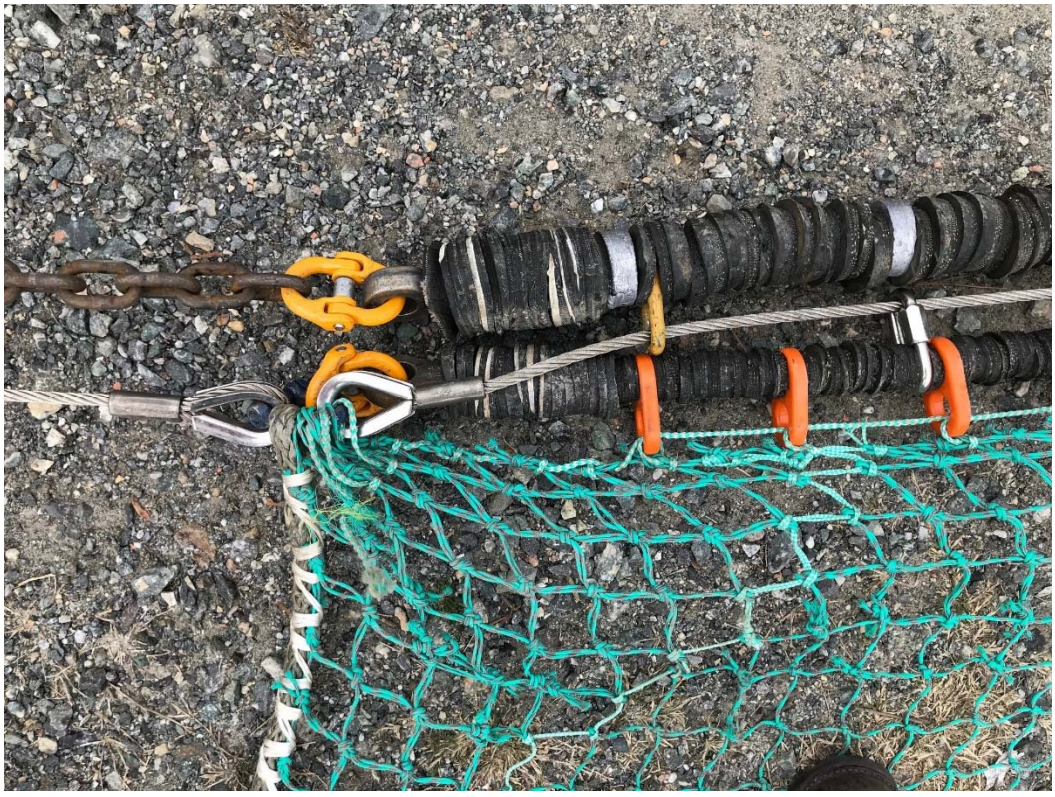

Figure 6. Footgear eyes, up and down line eye, bottom wing end meshes and hammerlocks joining the footgear to the (pictured below) bottom swivel plate and bridle connection

Figure 7. Footgear extensions connection to the bottom swivel plate

Figure 8. Zipper traveler connecting the footrope to the flat sweep

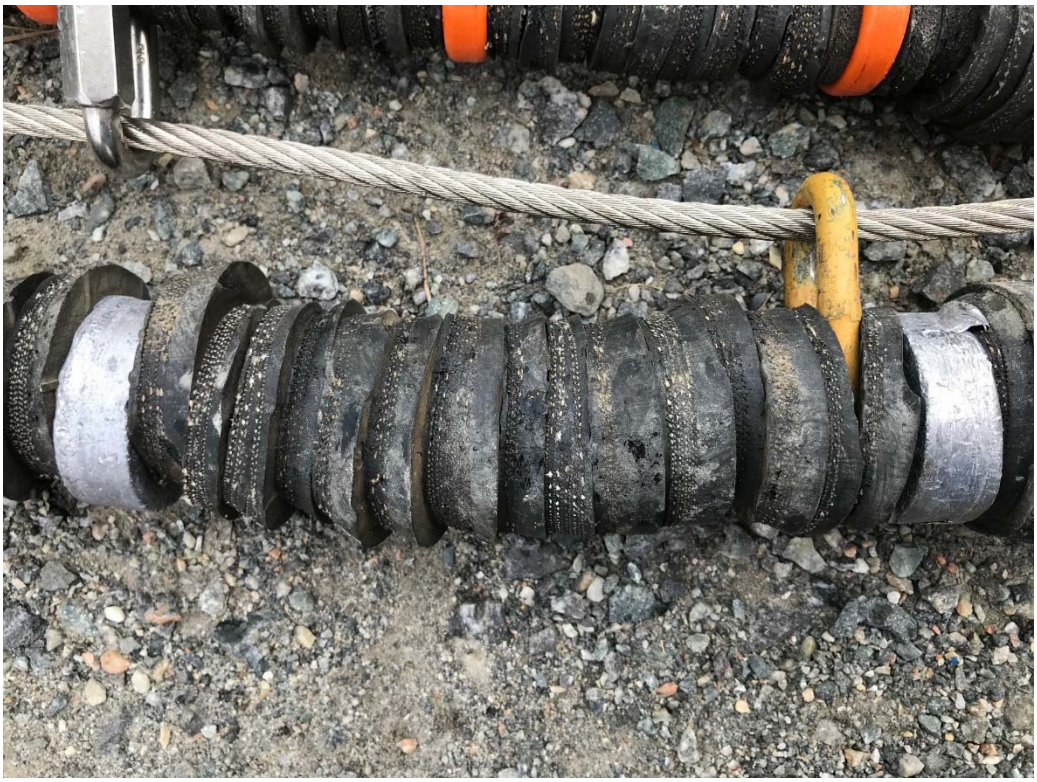

Figure 9. Flat sweep cookies, 1-linkers, and 1-pound lead spacers

Figure 10. Thyboron Type IV 44" trawl door used on the ChesMMAP survey. Tow-point swivel and shackle connected to the brail chain, through links 3 and 5. In the stationary link above the brail chain is the Viking Link used to connect the idler to the trawl door while towing. Note, knife edges have been removed in photo for storage purposes

Figure 11. Trawl door outfitted with knife edges

Figure 12. Backstrap chains and master-link. Forward thimble of backstrap extension wire is connected here via a ½" s/s bow shackle

Figure 13. Main hookup. Top: Idler seen coiled – Viking Link for switching connections between door (while fishing) and net drum idler (while setting and/or hauling). Left: Viking Link used to connect this main hookup to the backstrap extension wire. Right: Swivel plate connecting the main hookup to the single top bridle (before the split), and the bottom bridle via ½" straight "D" shackles.

Figure 14. Both the upper and mid bridles joined to a single 3/16" bridle wire via a 3/8" straight "D" shackle