B. Speed of tow

The EBSS survey targets an average towing speed over ground of 2.5 knots with an acceptable range of momentary towing speed between 2.2 knots and 2.8 knots when the net is in contact with the bottom and in fishing configuration. It is important to keep the vessel speed as constant as possible and near 2.5 knots when the net is fishing on bottom. After brake-set, vessel speed can be used to regulate sink time of the trawl, however vessel speed should be as close to 2.5 knots as possible when the net reaches the bottom. Monitor vessel speed frequently during a tow using the NOAA supplied GPS unit.

C. Duration and distance of tow and use of trawl mensuration / performance monitoring instrumentation

The performance and geometry of the trawl are measured using several sensors. Net height and width is measured in real time using SCANMAR sensors mounted on the center of the headrope and on the upper bridle just forward of the wingtips. Depth and temperature data is measured using a self-contained bathythermograph mounted near the center of the headrope. Bottom contact information will be measured with a self-contained Bottom Contact Sensor (BCS) mounted at the center of the footrope. Detailed descriptions of the rigging for each of these sensors is provided in the AFSC Net Mensuration Manual, which is carried aboard all survey vessels. Annual training is mandatory for all staff operating net mensuration and monitoring instruments and interpreting the data collected with them.

Target tow duration is 30 minutes, which equates to approximately 1.3 nmi or 2.4 km at the standard towing speed of **2.5 knots**. The start of the 30 minute towing period is determined from the net height data and is defined as when the height decreases to 8 m. Winches are engaged and haulback begins 30 minutes later. Tows may be shortened due to obstructions, inability to follow a depth contour, hangups, gear problems, or extremely large catches which affect the efficiency of the trawl.

After a haul is completed, data from each of the sensors will be synchronized with the GPS data and displayed simultaneously using custom designed software (ScanPlot). Using this software, the operator will determine the precise moments that the footrope initially contacts (On-Bottom) and leaves bottom (Off-Bottom) and calculate the duration, distance fished, and average net spread and height during each tow. The trace of the BCS data is the most useful tool for determining the On- and Off-Bottom times. The transition between when the net is on or off bottom is usually clearly signaled by an abrupt change in readings from around 40 degrees to around 60 degrees (vice versa when leaving bottom). Distance fished is determined from the vessel track between the On- and Off-Bottom positions.

D. Direction of tow

On the EBSS survey, the towing direction is dictated by bottom topography, current direction, wind speed and direction, and wave height and direction. Bottom topography often precludes all but a single towing direction to complete a tow successfully because of the need to follow a depth contour. In strong current, the tow is directed up-stream to prevent net distortion. In strong winds, the trawl is directed up-wind to allow the skipper better control of vessel direction and towing speed. In summary, tow direction is not a random variable, but it is not always predictable because of variation in wind and current.

E. Location of suitable sampling sites

The EBSS survey uses random sampling within strata defined by depth and sub-area. To minimize lost time in transit, stations should be completed in the order of proximity, proceeding from one station to the next closest station. Prior to trawling, each station should be surveyed, using a depth sounder, to determine if it is in the correct depth stratum and trawlable. Unfortunately the best available bathymetry data is poor and the actual station location and depth must be changed from the redetermined stations. A successful sampling area with a good potential for success is characterized by relatively low relief substrate with at least 1.5 nmi of trawlable bottom within the depth stratum boundaries. If trawlable ground is not found at the predetermined site, a search should be conducted within the same sub-area and depth stratum to locate another site as close to the original site as possible. A site is designated as untrawlable if the skipper and/or FPC determine that the bottom topography precludes a successful tow due to potential net damage, insufficient distance, widely changing depth range, and obstruction in the tow path. Trawlable ground decisions are governed by the skipper and FPC's experience with the net and its ability to perform given the bottom topography.

F. Successful tow criteria

The success of a tow should be assessed considering events during the trawl operation as well as examination of data after the tow is completed. Attention to the net mensuration monitor may indicate a tear-up or obstruction causing the net to deviate from normal dimensions. Under some conditions it may be impossible to maintain proper speed during the tow. After the tow, examination of the net for evidence of damage and examination of the trawl mensuration data, bottom contact data and depth data are used to assess trawl performance. The following are minimal criteria which must be met to consider a haul satisfactory:

1. The BCS tilt angle should indicate proper footrope bottom contact (variable footrope contact indicates poor performance).

2. Net mensuration data should indicate the net dimensions are within those expected for the towing depth.

3. Trawl time should be > 15 minutes and < 35 minutes.

If the tow is deemed unsuccessful then a second attempt is made at the same location, or another location is found in the same depth and sub-area, to replace the unsuccessful tow. At the end of the survey, mensuration data is reviewed by another party and any differences in opinion are discussed. The FPC has the final determination.

G. Vessel and winch operations

During trawl deployment, vessel speed should be maintained at least 1 knot faster than the net pay out rate (up to brake-set). Deploy the wire to the prescribed length using the painted marks on the wires. Set the brakes at the determined warp length and adjust the vessel speed to 2.5 knots as soon as possible. Use vessel speed to regulate settling rate of the trawl. Vessel speed should be as close to 2.5 knots as possible when the net is on the bottom. Speeds between 1 and 2 knots can be used to increase sink rate and speeds up to 3.5 knots can be used to decrease the sink rate. The auto-trawl system should be ON during the tow to avoid net damage if there should be a hang-up or a large catch. The skipper should haul back the trawl and end the tow by "popping" the net off the bottom as quickly as possible. This is accomplished in most cases by increasing engine RPM when starting the winches. Use net mensuration data to verify that the skipper is quickly lifting the trawl net off bottom.

Appendix B. Catch Processing and Collection of Biological Data (From Hoff, 2016)

Catches were sorted, weighed, and enumerated for all species of fishes and invertebrates. The catch was processed in one of two ways: either by sorting the entire catch and weighing each species in aggregate or by weighing the net codend and discarding the predominant species (except for a weighed and sexed random length frequency sample) and the rest of the catch sorted and weighed by species. Random samples of species that were designated for biological data collection were set aside after weighing. Total weight and numbers for each species were recorded onto a paper on-deck catch form. In cases where individuals could not be reasonably enumerated (i.e., corals, sponges, bryozoans, ascidians), only total weight was recorded. For large numbers of an individual species in a single haul, the total number was extrapolated from subsample weight and count of 50-200 individuals. In most cases fish length frequency subsamples were used for extrapolation of the total haul count for individual species.

A random subsample of 100-150 fish, depending on the size range for the species, was selected for length frequency measurements. The sex of each individual was determined by internal examination of the gonads or by external characters (e.g., claspers for elasmobranchs), and specimens were sorted into baskets of males, females, or undetermined sex. Fork length (FL) was measured for most fishes, except for elasmobranchs which were measured to total length (TL) and macrourids to preanal-fin length (PAFL). Fishes and cephalopods were measured to the nearest centimeter on an in-line bar-coded length board using a Nexus Android tablet with an inhouse

developed application, which uses a bar-code reader wand and species-specific numerical codes. Length data were downloaded into a database, examined for accuracy, and paper copies printed. All crab species were measured to the nearest 1.0 mm using vernier calipers and recorded to a Logic Instrument Android tablet and an in-house developed application program.

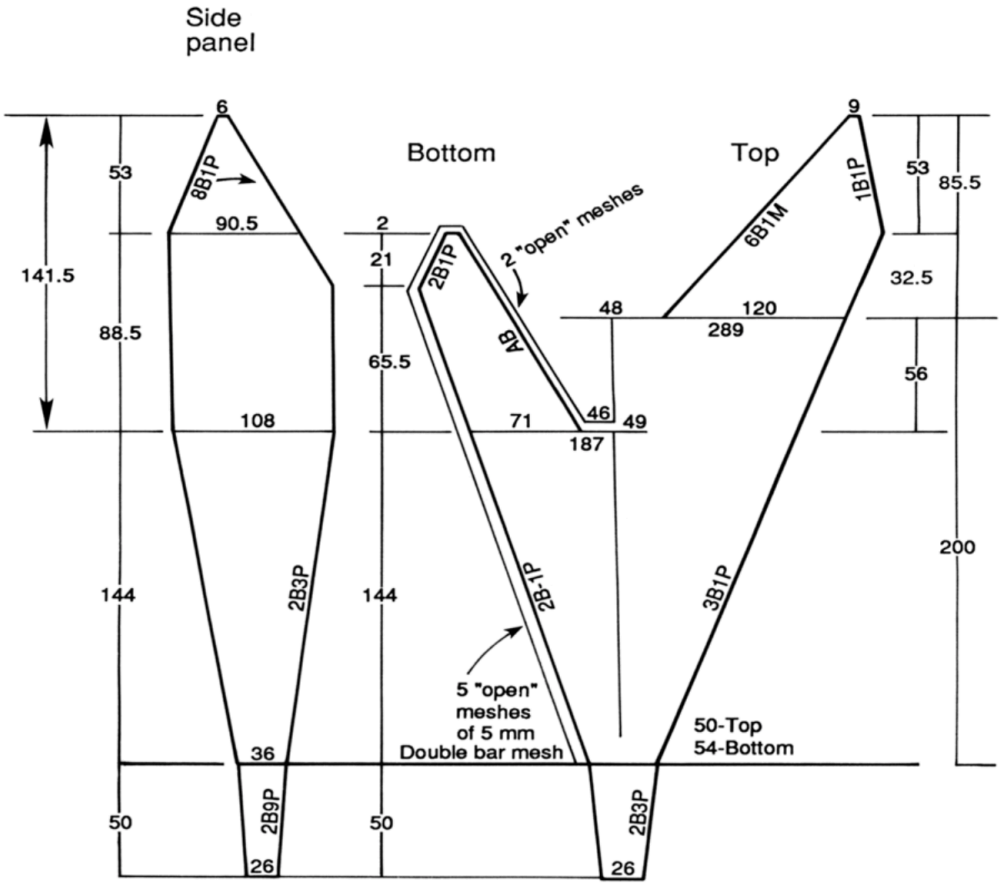
Otoliths (age structures) were collected from commercially and ecologically important

fish species utilizing a stratified sampling regime based on geographic subarea and length. Otoliths of each species were collected from 1 to 3 specimens/cm/sex/subarea with the exception of rougheye rockfish (S. aleutianus) and blackspotted rockfish (S. melanostictus), for which there was an attempt to collect otoliths from all fish encountered. At the time of otolith collection, the sex, fork length (cm) or pre-anal fin length (PAFL), and weight (kg) of each specimen were recorded on paper forms.

Appendix C. Trawl Diagrams

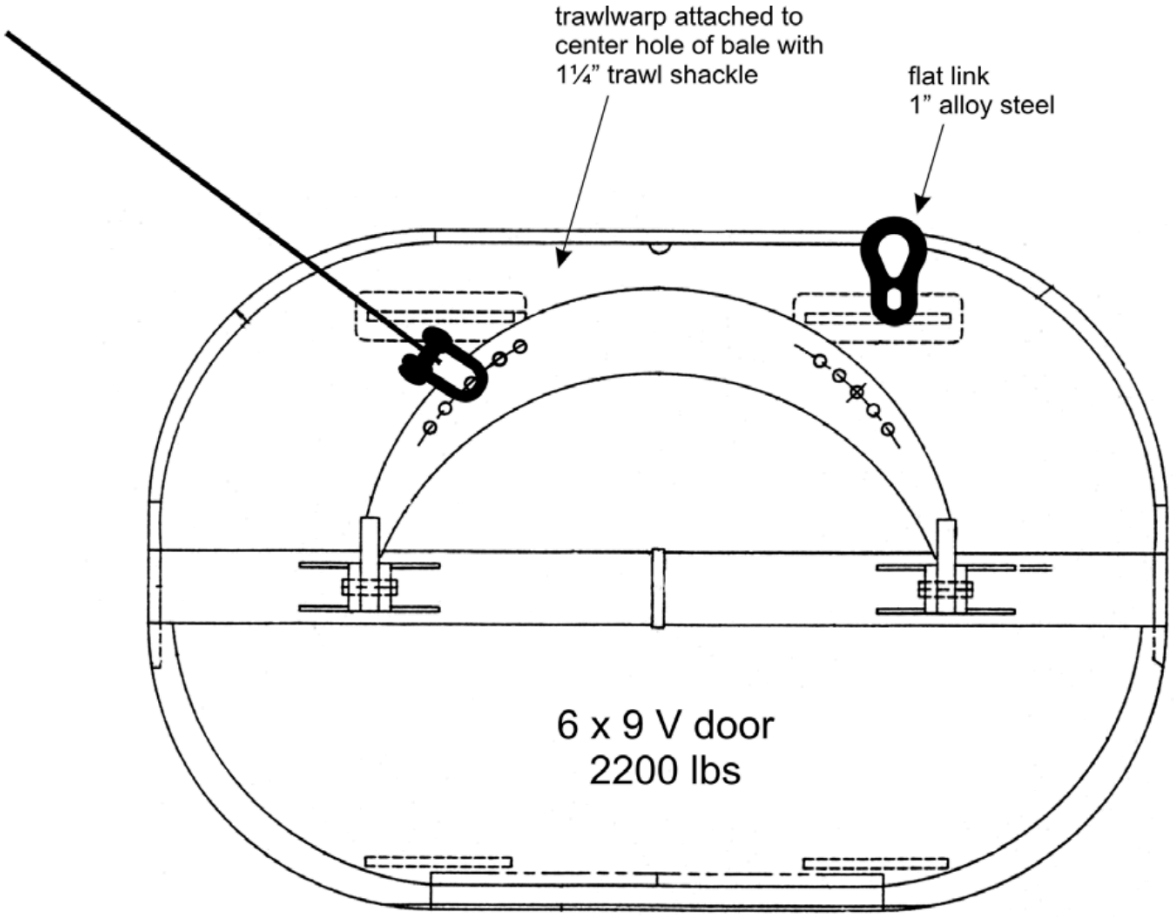
Eastern Bering Sea Slope Bottom Trawl Survey
Net Plan for Poly Nor'Eastern Trawl
("Cut Plan" = Total Mesh Counts)

Twine Sizes: top and sides 4 mm
bottom and intermediate 5 mm

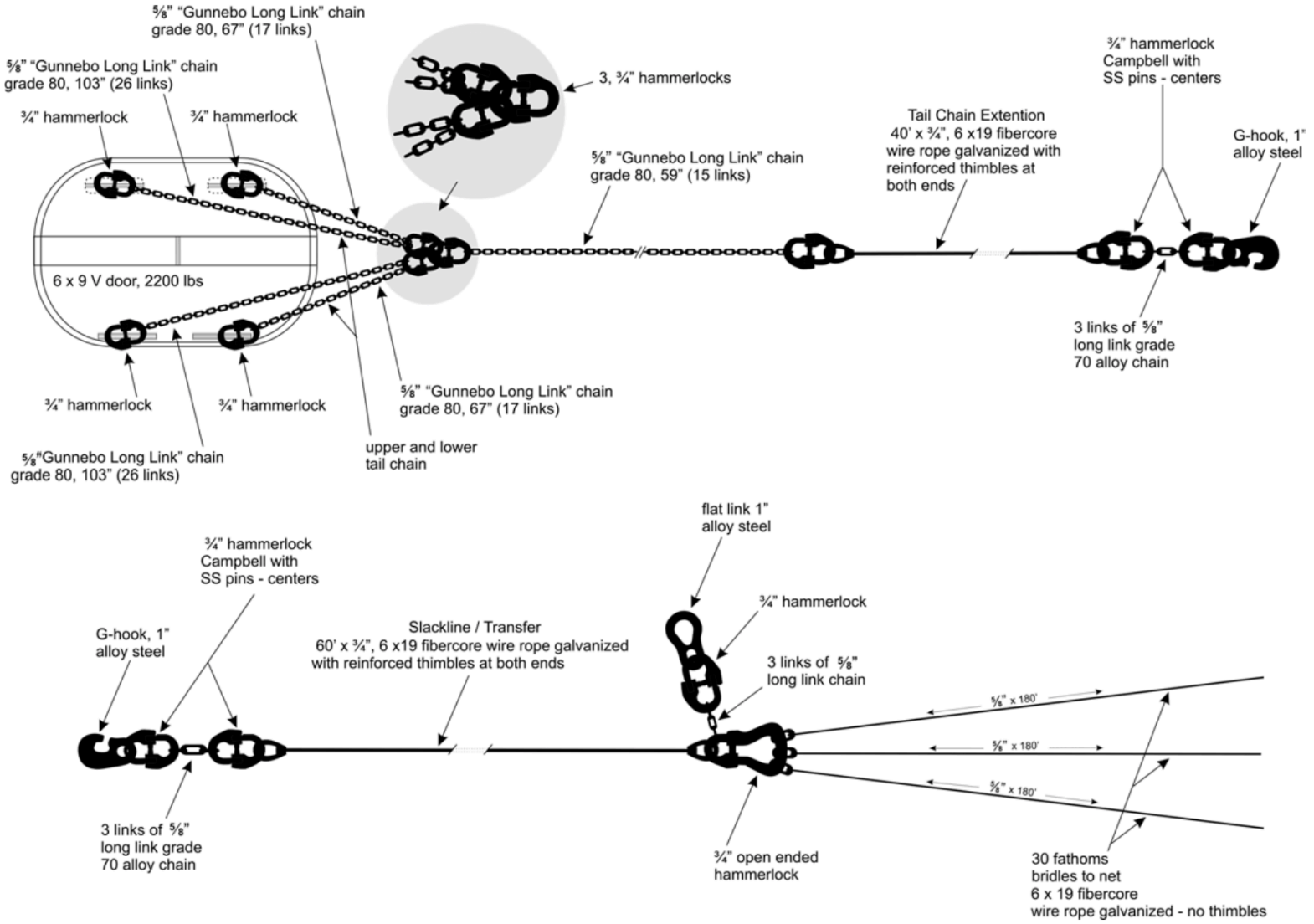


Web: Chaffing strip along inside of Bottom wings and Busom. Cut 8 meshes wide. 5 mm Double Bar mesh, goring 3 meshes on each side (leaving 2 open meshes). Secure 3 mesh of gore on inside (Bar Cut) of Bottom wings, and securing other gore to footrope (Bolsh).

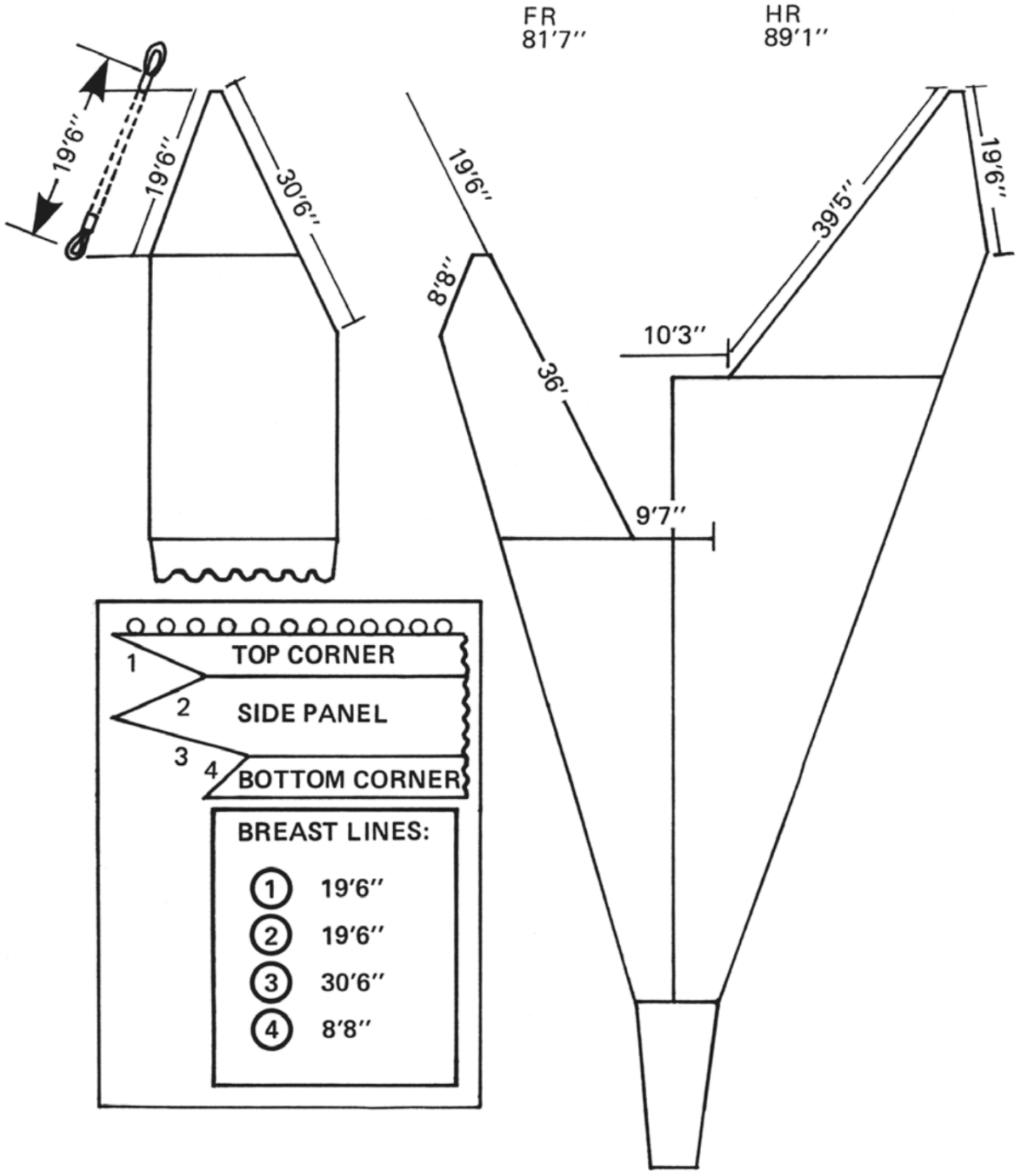
Eastern Bering Sea Slope Bottom Trawl Survey
Trawl Door Rigging Plan Detail for Poly Nor'Eastern Trawl
Sole Manufacturer NET Systems, Inc., Bainbridge Island, WA



Eastern Bering Sea Slope Bottom Trawl Survey
Trawl Door Rigging Plan for Poly Nor'Eastern Trawl

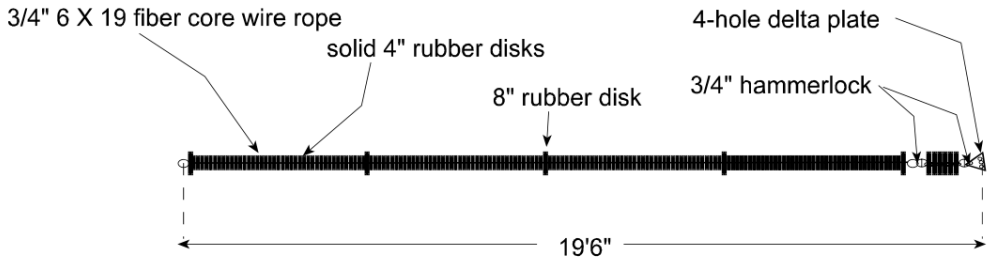


Eastern Bering Sea Slope Bottom Trawl Survey
Framing Lines for Poly Nor'Eastern Trawl

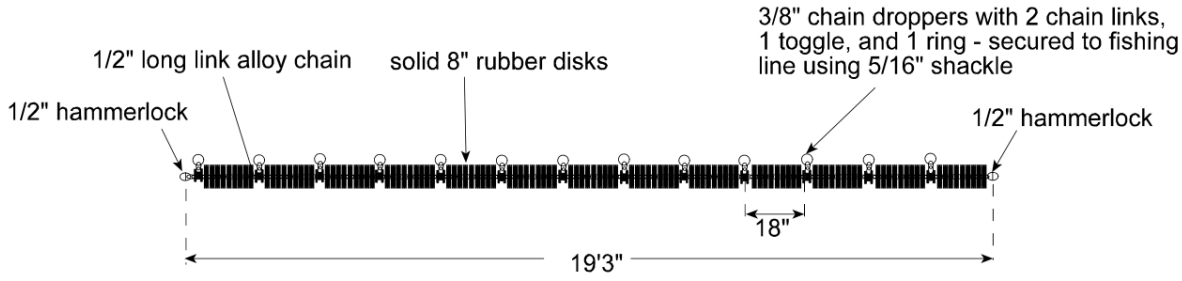


Eastern Bering Sea Slope Bottom Trawl Survey
Groundgear Construction Plan for Poly Nor'Eastern Trawl

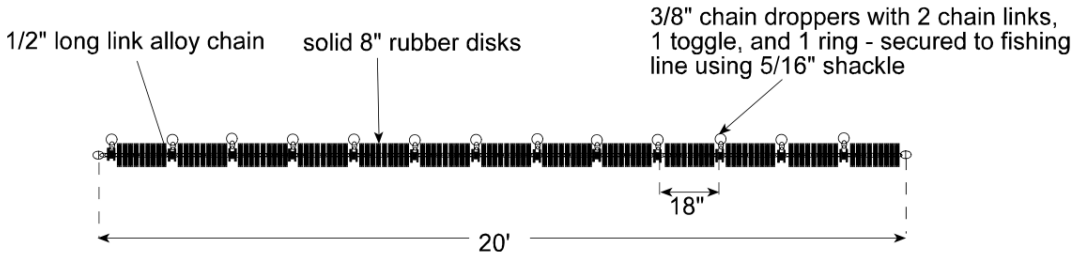
Outboard section



Middle section



Inboard section



Survey Trawl Check List
Eastern Bering Sea Slope Bottom Trawl Survey
Poly Nor'Eastern Trawl

Vessel	
Cruise	
Date	
Checked by	
Checked by	
Net I.D. number