

04-105-03 Mid-Water Pelagic Trawl

**ADD THIS NEW APPENDIX 2.
for NWFSC Operations**

(Follows behind SWFSC Appendix 1. Format)

December 32, 2009

**Northwest Fisheries Science Center
Standard Operating Protocols for
Pre-Recruit Pacific Hake and Juvenile Rockfish Survey**

**Prepared by Personnel from
Northwest Fisheries science Center**

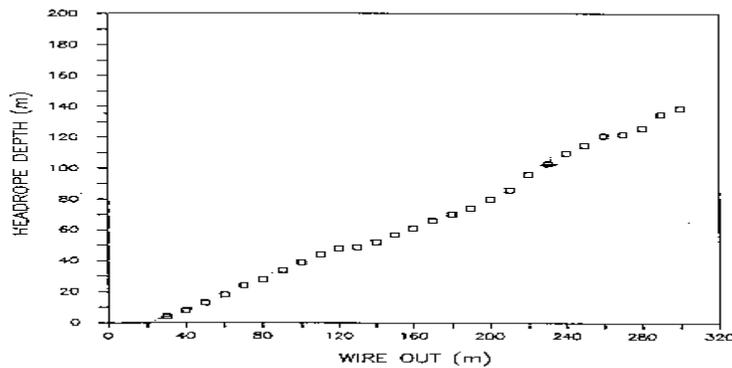
Introduction:

The Northwest Fisheries Science Center (NWFSC) in cooperation with the West Coast Fishing Industry conduct a Pre-Recruit Pacific Hake and Juvenile Rockfish Survey onboard a chartered West Coast trawler. This survey design is based on the Southwest Fisheries Science Center (SWFSC) Pelagic Juvenile Rockfish Recruitment Survey, but covers an expanded area north of the SWFSC survey. Midwater trawling operations are conducted during night-time hours due to potential net avoidance during daylight hours. The objective is to capture, identify, and enumerate pre-recruit Pacific hake and pelagic juvenile rockfishes to develop annual abundances indices.

Protocol 1: Determination of Gear Depth

Gear depth is determined by measuring and marking the vessels trawl wire at the start and completion of the survey. The trawl wire is marked at 10 m intervals for 150 m by inserting fabric markers into the wire braid. These marks are used to determine the wire out for each haul and the gear depth based on the sink rate of the gear at a fixed towing speed.

Plot of relationship between amount of wire out and depth of net headrope. An RPM of 650 (2.0 knots) was held constant.



A Furuno Acoustic Headrope Sensor is used as a second method to electronically measure gear depth in real time. This sensor measures pressure and calculates depth. The sensor is attached prior to each haul at the center of the trawl headrope. Readings from the headrope sensor may be recorded manually by the Chief Scientist throughout the trawl or electronically.

Pre-Recruit Pacific Hake and Juvenile Rockfish Survey Trawl Stations

Survey Days	Transect Latitude	Comments	Survey Days	Transect Latitude	Comments
1	44° 30'	Start of Pre-Recruit Survey	17		Break Half Moon Bay
2	44° 00'		18	37° 00'	Calibration with NOAA Ship
3	43 °30'		19		Calibration with NOAA Ship
4	43 °00'		20		Calibration with NOAA Ship
5	42° 30'		21	36° 30'	End Southern Leg
6	42° 00'		22		Transit to Newport, OR
7	41° 30'		23		Transit to Newport, OR
8	41° 00'		24		Break Newport, OR
9		Break Eureka, CA	25		Transit to Juan de Fuca Canyon
10	40° 30'		26	48° 00'	
11	40° 00'		27	47° 30'	
12	39° 50'		28	47° 00'	
13	39° 00'		29	46° 30'	
14	38° 50'		30	46° 00'	
15	38° 00'	Calibration with NOAA Ship	31	45° 30'	
16	37° 30'	Calibration with NOAA Ship	32	45° 00'	End of Pre-Recruit Survey

Standards for Achieving Target Headrope Depth

Target headrope depth is a primary criterion for our trawl standardization and consistency. Target headrope depths, while trawling, are achieved and maintained by the amount of wire out for the trawl warps and charter vessel speed through the water. All available evidence and past studies indicate that pelagic juvenile rockfishes are evenly distributed in the upper mixed layer along the central California coast. Variances of +/- 5 meters for the trawl headrope depth during deployment is not a significant issue, but we endeavor to fish as close to the target headrope depth as possible. A Furuno Acoustic Headrope Sensor (pressure-depth sensor) is attached to the trawl net headrope during each deployment to measure headrope depth in real time during the haul.

During mid-water trawl deployments (setting, fishing, retrieving), the charter vessel's speed is maintained at approximately 2.7 knots, speed through the water. Speed variations are allowed based on the horsepower and winches of the charter vessels, but the target is 2.7 knots and should be adhered to as closely as possible. The expertise of the Captain with deploying trawl gear on the charter vessel will be used to make necessary adjustments in vessel speed and rate of deployment of the gear to the required depth. A test tow if needed may be conducted at the start of the survey to confirm gear sink rate and charter vessel speed required to meet survey depth requirements. The Furuno Acoustic Headrope Sensor will be used to confirm depth in real time. Monitoring and recording of tow speed will be accomplished in real time using the GPS unit supplied by the charter vessel. Should the GPS fail; the Captain should use other vessel instrumentation that he/she believes most closely monitors the vessel speed. In such cases, Captain and Chief Scientist will document the instrumentation used to monitor tow speed.

For a target headrope depth of 30 meters we use between 75 (minimum) and 90 (maximum) meters of wire out. The exact amount of wire out for the trawl warp is determined after the first trawl of the night from examination of the Furuno Acoustic Headrope Sensor data, the observation of the number of marks on the wire used and the Captain's expertise. Heavier weather usually requires more warp.

Standards for Duration and Direction of Trawl Deployments

The standard duration for fishing the trawl net at the target headrope depths is 15 minutes. In areas of high jellyfish concentrations, "test" trawl deployments will be made with a 5 minute, fishing at target depth, duration. Fishing at target headrope depth begins when the designated amount of warp is out, with winches braked. All aft deck lights will be turned off when the net is at target headrope depth so that no lights are visible when the net is fishing at depth. An acceptable standard 30 meter target depth tow normally takes 10 minutes to set and 10 minutes to retrieve, if setting or retrieving takes 20 minutes or more the tow may be repeated at the discretion of the Chief Scientist.

The standard tow direction is downwind with following seas dead astern. If both the wind and seas are calm then the tow direction will be towards the next trawl station. If

only the wind is light, the tow direction will be down swell. In high cross currents, the course will be altered into or with the current. Maximum sea state is determined by the combination of wind and swells with the height of the seas being more significant than wind speed during the trawling operations. The Captain and the Chief Scientist will decide when trawling operations are no longer safe. Final decisions on matters of vessel safety are the responsibility of the vessel Captain. The Chief Scientist may use his or her discretion to determine if conditions are compromising data quality and decide to suspend operations.

Standards for Recording Trawling Operations Information

The Captain and or Chief Scientist will record all pertinent trawling operations information into the Marine Operations Log. The following specific information is to be logged either electronically or in written form during a tow:

Trawl Station Number-Depth ID
Sweep Number
Gear Type: MWT
Sequential Haul Number
Bottom Depth
Cloud Cover
Date-Time and Location When Net Goes In the Water
Date-Time and Location When Net Begins Fishing at Target Depth
Date-Time and Location When Net Haulback Begins
Date-Time and Location When Net is Back on Deck
Meters of Wire out for the Warp

Observations of Weather and Sea State will be made at each trawl site and updated if condition change. These observations will at a minimum include:

Wind Speed
Wind Direction
Barometric Pressure
Sea Surface Temperature
Salinity

Standards for Handling the Trawl Net and the Catch

The Captain shall be responsible for having the charter vessel: (1) on station, (2) at towing speed, (3) ensuring proper operation of the trawl winches, and (4) the setting, fishing, and retrieving of the trawl net.

When the codend is back on deck at the end of a tow the net and catch will be handled as follows:

The Fishing Crew will retrieve and spool the bridles and entire net, then open the codend liner into containers that the scientists provide at the net reel. The codend liner will be shaken down by the Fishing Crew, once on the net reel and then the entire codend is shaken down until clean on the deck to ensure that all catch is clear of the net before the next tow. The Fishing Crew will ensure that the V-doors and transfer cables are secured. The codend liner will be re-closed with a cinching cowbell by the Fishing Crew. The scientists and Fishing Crew will carry the catch to the sorting area for sorting, identification, enumeration, and preservation.

Standards for Trawling Operations in Case of Problems:

All tows are classified and documented on the success, problems, or failure of the tow. The Chief Scientist is responsible for assigning classification and documentation of each tow. The following are examples of problems or failures during a tow:

- The amount of time during the set and/or retrieval is too long
- Unacceptable amounts of jellyfish in the catch
- Gear damage or malfunction
- Evidence of net contact with the bottom
- Visible sunlight in the sky when tows are performed near dusk and/or dawn
- Geographic position of tow too far away from the trawl station position

The starting position for a tow will be within one mile of the station. In rare instances, navigational constraints may not allow a mid-water trawl to occur within a one mile radius of the specific station location. These tows will be considered on a case by case basis by the scientific party to determine the appropriate disposition. Tows are repeated at the discretion of the Chief Scientist and Captain based on the success of the trawl and the constraints of time, navigation, and weather.

Protocol 2: Use of Autotrawl Systems

Not applicable for the NWFSC/West Coast Fishing Industry Pre-Recruit Pacific Hake and Pelagic Juvenile Rockfish Survey.

Protocol 3: Operational Protocols for Mid-Water Trawling:

Mid-Water Trawl

The NWFSC/ West Coast Fishing Industry Pre-Recruit Pacific Hake and Juvenile Rockfish Survey is conducted from May to June from 48° N to 36° 30' at stations across the continental shelf. A minimum of 5 stations are sampled on cross shelf transects located at 30 nm intervals along the coast. A modified anchovy midwater trawl with an 86' headrope and 1/2" codend with a 3/8" liner is used to obtain samples of juvenile hake and rockfish, based on the design used in the SWFSC/SC survey. Trawling was done at night with the head rope at 30 m at a speed of 2.7 kt. Trawl tow duration at depth was 15 minute duration at target depth were conducted along transects located at 30

nm intervals along the coast. Stations were located along each transect from 50m bottom depth seaward to 700 m with hauls taken over bottom depths of 50, 100, 200, 300, and 500 meters at each transect. In the 2007 survey it was difficult to do stations at 50 depths or less because of large numbers of crab pots at these depths during the time of the survey.

All fish and invertebrates captured are identified to the lowest identifiable taxa and enumerated. All juvenile rockfish collected are placed in bags with haul information tags, and frozen. The juvenile rockfish are delivered to the NWFSC which arranged for the fish to be identified.

Vessel inter-calibrations will be carried out between the charter vessel and the NOAA vessel. The vessels will tow in the same direction with approximately 500 m distance between vessels. Tows will be started at the same time and tows will be made for the 15 minutes at the same depth.

Protocol 4: Trawl Construction and Repair:

Midwater Trawl Description

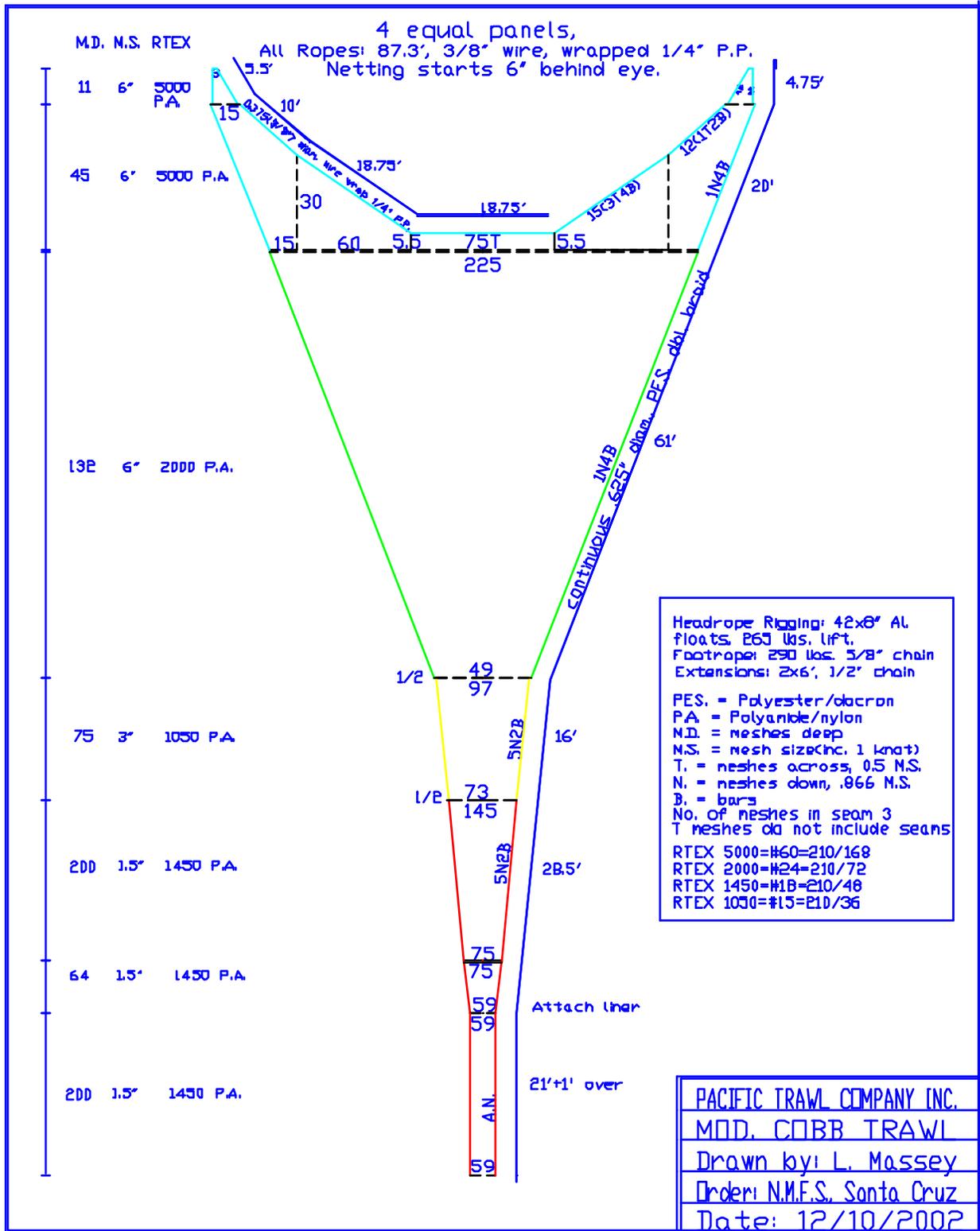
The midwater trawl net is known as the modified California Department of Fish and Game "Anchovy" Net. It is also commonly referred to as the NMFS Modified Cobb Trawl.

A 3/8" (0.95 cm) fine mesh, knotless, white liner is inserted in the codend to retain small midwater organisms. The mesh liner is 25 feet (7.6 meters) wide with 7.75 feet (2.4 meters) per panel, with 4 panels. The overall length of the liner is 30' (9.5 meters). The overall length of the entire net is 154 feet (47 meters) and has a square mouth of 86 feet per side (26.2 m per side). The net is constructed of nylon webbing and the mesh size (stretched) decreases from 6 inches (15.2 cm) in the wings and body to 1.5 inches (3.8 cm) in the codend. The codend is secured by a cowbell during tows. A zipper is also sewn into the meshes above the liner in order to release large catches of jellyfish. To open the net vertically, 42 eight inch (20.3 cm) floats are attached to the headrope. 145 lbs. of 5/8" chain is attached to the bottom of each wing and along the footrope. There is a 6 foot, 1/2 inch chain, extension to the lower bridles. Total chain weight of 325 lbs. The bridles are V shaped with each section being 180 feet (55 meters) long. The doors are 5' x 7' steel V doors manufactured by Net Systems, Inc. USA. Each door weighs approximately 830 lbs.

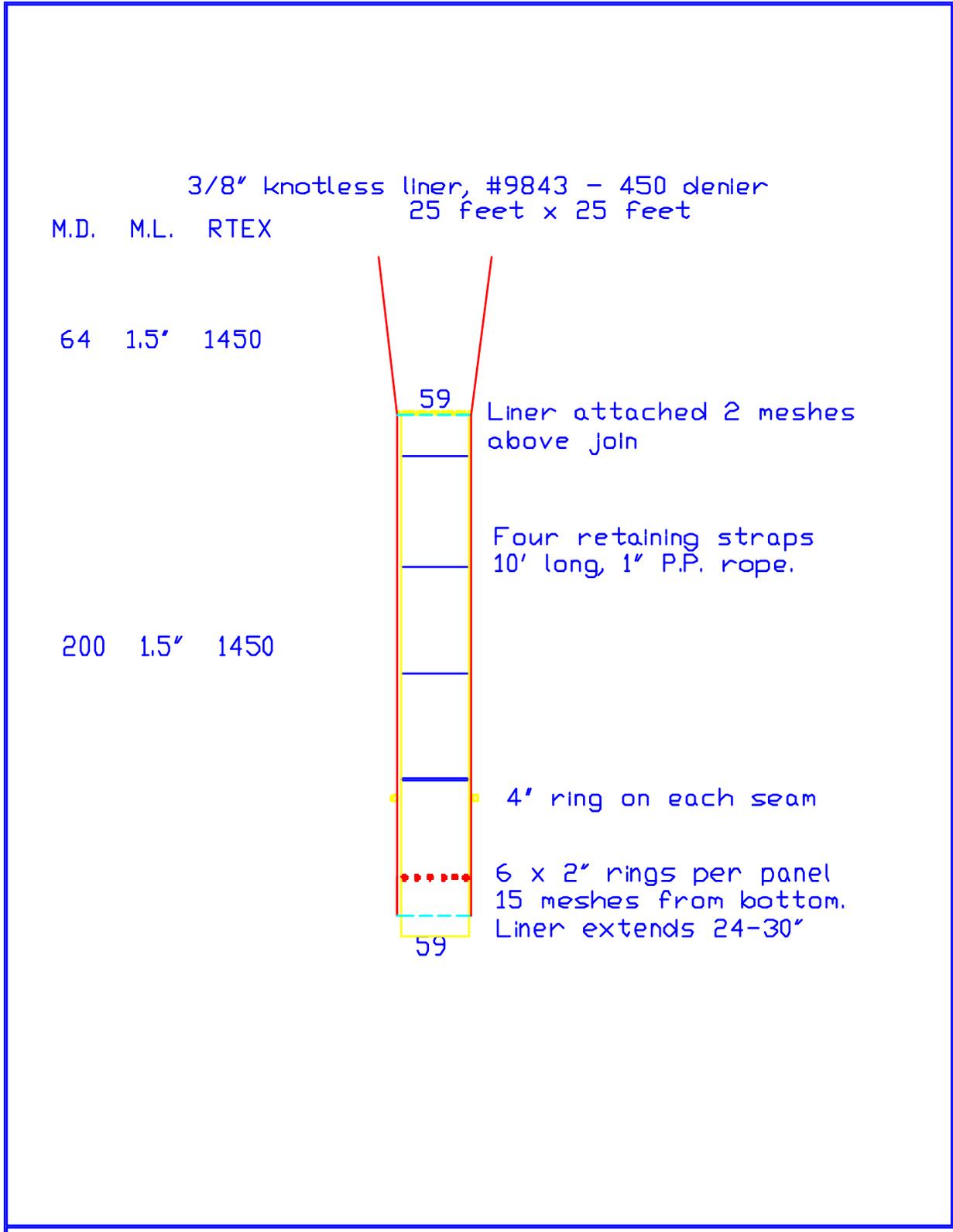
The trawl nets will be inspected prior to the survey. Major repairs shall be made by a qualified netloft in accordance to the following net plans. In addition, the nets will be inspected at a minimum biennially by a qualified netloft to ensure they are in good condition and continue to meet the net plan specifications. Repairs may be made by the charter vessel's crew during the survey at the discretion of the Chief Scientist. The Chief Scientist will contact NOAA Science Point of Contact (POC) or Contract Officer's Technical Representative (COTR) for the contract if there are any questions regarding the

net condition or specifications. Older trawl nets may be kept as a backup net if the newest net is damaged beyond repair during the cruise. We construct the trawl nets to the same standards each time one is built. Following are plans for the net, liner, and doors and a trawl construction materials list.

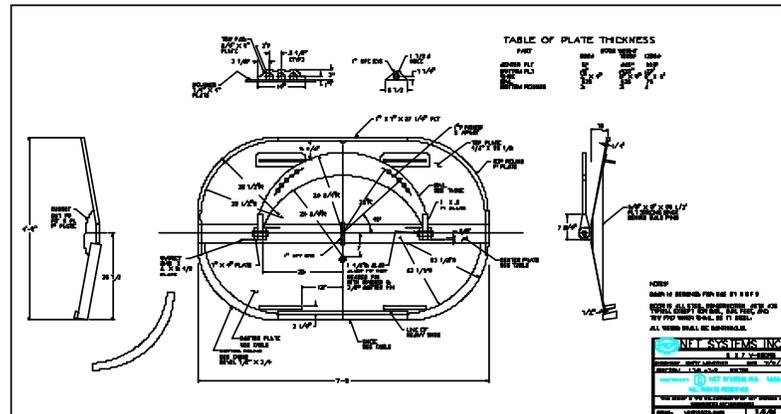
Net Plan:



Codend Liner Plan:



Door Plan:



Mid-Water Trawl Construction Materials List:

WEBBING:

Mesh sizes listed in the net plan are given in “stretched measure”, a standard method of measuring mesh size that includes the length of one knot, designated K.C. Wings and body of trawl constructed of 6" #60T three strand nylon - dyed green.

CODEND LINER:

Liner in codend~ 3/8" #9843 - Knotless 450 denier, 25' wide by 7.75' long per panel with 4 panels connected to form cylinder. Overall dimension is 25' wide by 30' long. White or off-white in color.

WIRE:

6 x 19 Galvanized fiber core, eyes are formed using galvanized reinforced thimbles.

ROPE:

Headrope/Footrope/Breastlines are all 3/8" wire rope.

FLOATS:

Forty-Two 8" side lug or center hole trawl floats, equally spaced along headrope, 256 lbs. static lift.

RIBLINES:

5/8" Samson@ 2n1 stable braid, Dacron, light bonding. One link of deck lashing chain is seized to the eye of the ribline and forward end (at wing tips) of ribline is equal to the length of the headrope/footrope/breastlines. Two thimble eyes and chain link secured to the eye of the ribline, are attached to the bridles using one 5/8" hammerlock. Riblines are measured with 400 lbs. of tension on rope.

FOOTROPE:

86' of 3/8" 6 x 19 galvanized fiber core wire rope. (86' does not include the length of the thimble eye at either end) 145 lbs. of chain is secured to the footrope along each wing tip, lashing every 6th link to the wrapped wire rope. Footrope extension of linked grade 80 deck lashing chain is connected to the footrope wing tip using a 5/8" hammer-lock. Overall length of footrope extension including hammerlock is 6 feet.

HEADROPE & BREASTLINES:

86' (not including length of thimble eyes) of 3/8" 6 x 19 galvanized fiber core wire rope. Wire is served with 3/8" three strand polypropylene rope

BRIDLES:

V shaped, 1/2" wire rope, 180' (55 meters) long, terminated with thimble eyes.

DOORS:

Two 7'x5' steel V doors, each weighing approximately 830 lbs. Manufactured by Net Systems Inc. USA, (800-722-5568, <http://www.net-sys.com>). Door tail chains of 13mm long link chain are attached to the center hole of the two tail chain brackets using a 5/8" safety shackle. The upper of these chains is 8.5' long, and the lower is 8.5' long. They come together into a 13mm hammerlock, to which is attached a single 13mm chain which is 31' long. This chain terminates in a 19mm G hook, joined to the chain with a 13mm hammerlock. A pendant of approximately 24 inches of 7/16" medium link chain, is attached to the inside, upper, aft bracket. At the end of this pendant, a 19mm recessed link is attached with a 13mm hammerlock.

Trawl Repair Checklist

The charter vessel's Captain and Fishing Crew in collaboration with the Chief Scientist or cruise leader will address all aspects of the trawl checklist prior to the cruise, and as repairs are required to the trawl during the course of the survey.

COMPONENT	SPECIFICATION	PORT	STARBOARD
Bridles	180' (55m) x 6" 6x19 wire rope		
Doors	7'x5' V-door with transfer cables		
Furuno Acoustic Headrope Sensor	Batteries charged and attached to the center of the headrope		
Net Panels	Correct meshes, no tears-holes-breaches*		
Overall Net Length	47 meters (154 feet)		
Footrope	86' x 3/8" wire rope with 290lbs of 5/8" chain and two 6' 5/8" chain extensions		
Headrope	86' x 3/8" wire rope with 42 x 8" evenly spaced floats		
Codend Liner	3/8" fine mesh, clean, and attached in codend		
Riblines	5/8" Samson 2n1 stable braid with robust lashings to the webbing**		
Hammerlocks, G-Hooks, Thimble Eyes	Robust structural integrity and lack of significant corrosion		

* Replacement netting and twine should be the same size and color. Knitted meshes should be the same size or larger, and knots pulled tight.

** Replacement ropes should be of the same material, be within 2" of specified length, and should be replaced when outer cover is damaged.