Midwater Trawl Net Mouth Measurement

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Introduction

To calculate fish abundance estimates from midwater trawl catch data, it is necessary to first determine the volume of water filtered by the net. The filtered volume is calculated based on the area of the net mouth opening while under tow and the distance traveled through the water.

Currently, the Department of Fish and Game's Fall Midwater Trawl (FMWT) and San Francisco Bay Study (Bay Study) surveys use a midwater trawl net (MWT) to sample the water column. Historically, it has been estimated that the MWT fishes with a mouth area of 10.7 m^2 (80% of maximum).

This study was designed to compare the estimated net mouth area to the actual area measured while under tow. In addition, this study will investigate mouth geometry under the range of tow conditions experienced while trawling, including net mouth area and gear depth during an entire tow from net deployment to retrieval. Here we present results from the first two days of field work.

Methods

The MWT net mouth is 3.7 m x 3.7 m with a metal door attached to each corner that connects to the bridle. Top and bottom bridle cables connect together at a swivel 30.5 m ahead of the net mouth; the swivel is connected to the main cable attached to the winch. The metal doors counteract the drag on net material to hold the net mouth open when towing.

Two standard cable types are currently used: 6 mm Kevlar (spectra) cable on FMWT's vessel RV *Scrutiny* and 6 mm steel cable for Bay Study's vessel RV *Longfin*. A standard tow is 12 minutes, during which the net is retrieved obliquely through the water column. The length of cable deployed varies between 30.5 m (bridles only) and 91.4 m (bridles plus 61.0 m of cable) depending on water depth.

Desert Star Systems (Marina, CA) designed a custom acoustic measuring system (Net Track) that includes four responder units, one attached to each corner of the net mouth (Figure 1). Each responder is connected to the main underwater junction box, which is connected to a surface power station onboard the vessel (Figures 1 and 2). This power station links to a laptop computer that is equipped with Net Track software, designed to interpret and display data from the responders (Figure 3).
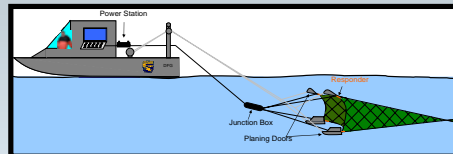
Methods (cont.)

Figure 1. Net Track gear set up on a research vessel.

The responders use synchronization signals (pings) to determine six distances among them – the four edges of the net mouth and two diagonals. Net Track software uses these measured distances to calculate the area and visually displays the information in real time every four seconds. The recorded data is saved in raw format and exported into Excel.
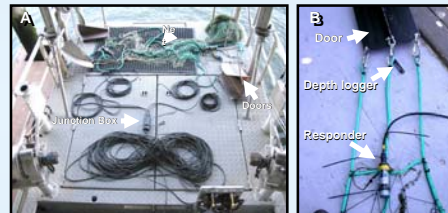

Figure 2. Net Track setup A) including MWT net, doors, responders, cables, and junction box and B) responder and Vemco depth logger attached to door.

Vemco depth loggers were attached to the port side top and bottom doors and used to record the depth (m) over time as the MWT is fishing (Figure 2).

Figure 3. Net Track A) real time display of net mouth area during tow and B) responder configuration in the MWT net at end of tow.

Results

RV *Longfin*

- A total of 17 tows were conducted (Table 1)
- Average mouth area was 9.1 m^2 at 30.5 m deployment and 9.4 m^2 at 91.4 m deployment

- Average mouth area remained consistent until the last three minutes of each tow
- Average bottom door depth was less than 2 m off the bottom at 91.4 m deployment

RV *Scrutiny*

- A total of 13 tows were conducted
- Average mouth area was 10.9 m^2 at 30.5 m deployment and 11.4 m^2 at 91.4 m deployment
- Average mouth area remained consistent until the last three minutes of each tow
- Average bottom door depth was less than 2 m off the bottom at 91.4 m deployment

Table 1. Summary of average mouth area and average bottom door depth by deployment length on each vessel.

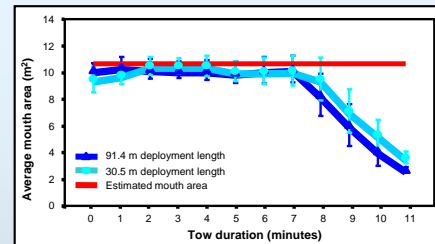|	Deployment Length (m)	Number of Tows	Average Mouth Area (m^2)	Average Bottom Door Depth (m)
RV *Longfin*	30.5	7	9.1	3.1
	91.4	10	9.4	10.1
RV *Scrutiny*	30.5	5	10.9	4.3
	91.4	8	11.4	10.8

Figure 4. Average MWT (±1 SD) mouth area (m^2) by minute during standard tows for minimum and maximum cable deployments conducted on the RV *Longfin* on October 1, 2008.
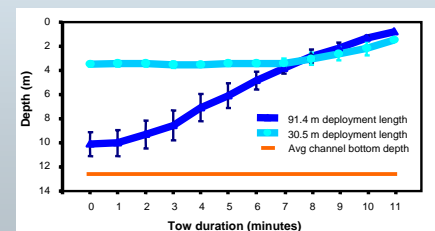

Figure 5. Average MWT bottom door depth (±1 SD) by minute during standard tows for minimum and maximum cable deployments conducted on the RV *Longfin* on October 1, 2008.
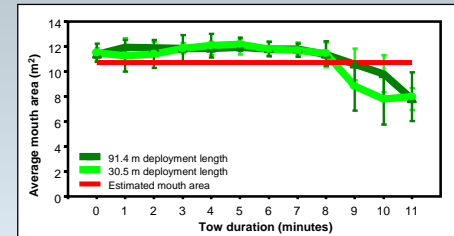

Figure 6. Average MWT (±1 SD) mouth area (m^2) by minute during standard tows for minimum and maximum cable deployments conducted on the RV *Scrutiny* on October 2, 2008.
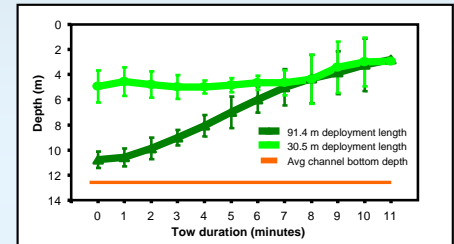

Figure 7. Average MWT bottom door depth (±1 SD) by minute during standard tows for minimum and maximum cable deployments conducted on the RV *Scrutiny* on October 2, 2008.

Discussion

- Average mouth area on both vessels was consistent with the historical estimate throughout the majority (75%) of the tow (Figures 4 and 6)

- During the last three minutes of the tow the bridles begin spooling on the winches and cause the doors to vertically collapse (Figures 4 and 6)

- The gear fishes at a maximum depth of approximately 10.8 m and may not effectively sample the bottom of deep channels (Figures 5 and 7)

- MWT gear does not fish with the same mouth area or attain the same bottom door depth between vessels. Both measures may be affected by cable material.