Factors affecting trawl catchability

A number of factors might cause variation in trawl catchability including temperature, light intensity, current, towing speed, fish density and weather.

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Michigan Sea Grant hosted a “Factors Affecting Trawl Catchability” workshop at the Lake Superior Technical Committee meeting in Duluth, Minnesota in January 2012. This workshop was held as a follow-up to the November 2011 meeting sponsored by New York Sea Grant, U.S. Geological Survey (USGS) and Memorial University. Paul Winger, from Memorial University in St. Johns, Newfoundland, introduced the Marine Institute and presented his own research factors influencing trawl catchability. Work at the Marine Institute focuses on the flume tank to test efficacy of fishing gear. Both the water and floor move, while the gear remains in front of observers. Major research areas include fishing gear design and testing, fishing vessel design, fisheries development, resource assessments for emerging fisheries, and fish behavior.

Research on fish behavior in relation to bottom trawls was reviewed. Fish can escape gear in pre-gear zone (ahead of doors), at the mouth of the trawl, and from in the net. Trawls aim to move fish to the center of trawl path. One challenge with trawls is that it is difficult to assess effective swept area, given the length of the trawl rope. The dominant stimulus ahead of the gear is low frequency noise produced by vessel and trawl. There can be significant avoidance behavior observed with split beam hydroacoustics with pelagic fish, but it is difficult to predict and model responses. Groundfish tend to dive and become more susceptible to bottom trawls up to 200 m, and catchability is inversely related to depth. Telemetry data show avoidance behaviors occur when vessels are 1-2 km away and individual fish can increase or decrease swimming speed. Otter trawls create sound and noise as the doors dig into sediment and create lift to spread net. Clouds of sediment create a visual threat, so fish trapped within the clouds tend to stay there. As the fish see net, they turn and usually swim with net until they are exhausted and fall back into the net. For herding to be effective, fish must swim at a speed faster than the trawl. They must also have sufficient endurance to reach the trawl path.

Once in the mouth of trawl, fish have nowhere to go. They typically orient with the trawl and move at speed of trawl. The time until capture depends on how long each species can swim with trawl before tiring. There is a wide range of endurance (seconds up to 15 minutes) depending on trawl speed. As the fish become exhausted, most fall back into the trawl but some escape over the headline or under the headgear. Inside the net, fish can escape from the cod end, or anywhere in the net, depending on fish and mesh sizes.

Catchability changes due to the vulnerability and availability of fish. A number of factors might cause variation in these parameters including temperature, light intensity, current, towing speed, fish density, weather, lack of standardized operating procedures and gear specifications. Temperature is believed to be a key factor, though there is little supporting empirical evidence, but effects are assumed because temperature affects behavior in so many ways. For example, both the likelihood of a reaction and reaction distance to the trawl was always lower in winter for cod, which means trawls can get closer before there is an observed behavioral response. Some research demonstrates that temperature affects behavior in sweep zone. Using American plaice, fish have a greater chance of being herded at higher temperatures, meaning in winter they will have a greater chance of escape as they will not be herded far enough to reach the trawl path. At the trawl mouth, temperature should affect length of time fish could swim along with trawl based on bioenergetic relationships. In cold water, maximum swimming speed and endurance decrease, leading to an overestimate of population abundance. Another key factor is likely light intensity. In the far field zone, there are reduced responses at lower light levels. At the trawl mouth, vulnerability of fishes to capture increases greatly at night. Bottom current is another important factor, as currents can affect how a net fishes; side currents move around zones of vulnerability and can change escapement. Finally, any subtle changes in speed of trawl can influence vulnerability. There is a need to standardize surveys to generate consistent indices.

The session concluded with a look at how the Yankee trawl performs, which is the trawl gear currently used on the Great Lakes by the U.S. Geological Survey. The Marine Institute assessed the net against a variety of parameters. The good news is that the net’s performance does not change much under changing conditions

(speed, bridle lengths, extra floats, etc.), but the bad news is that the trawl underperforms. The head rope lines are too loose and the trawl does not open more than 1 m when it was expected to open 2.2 m. The Lake Superior Technical Committee provided suggestions about potential research including installing cameras on head ropes (the recommended cameral costs about $15,000). There were also suggestions that investigation occur of going to a different trawl with concerns raised about how the trawl data is currently used. It is used to make comparisons across lakes, habitats, depths, etc., but a determination on catchability changes over different conditions is still needed. This may help answer the question on why the estimates on siscowet lake trout abundance, presented in a previous Michigan Sea Grant workshop on siscowet lake trout, had an estimate by USGS of 45 million pounds while the MSU Quantitative Fisheries Center data showed an estimate of 600 million pounds.

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