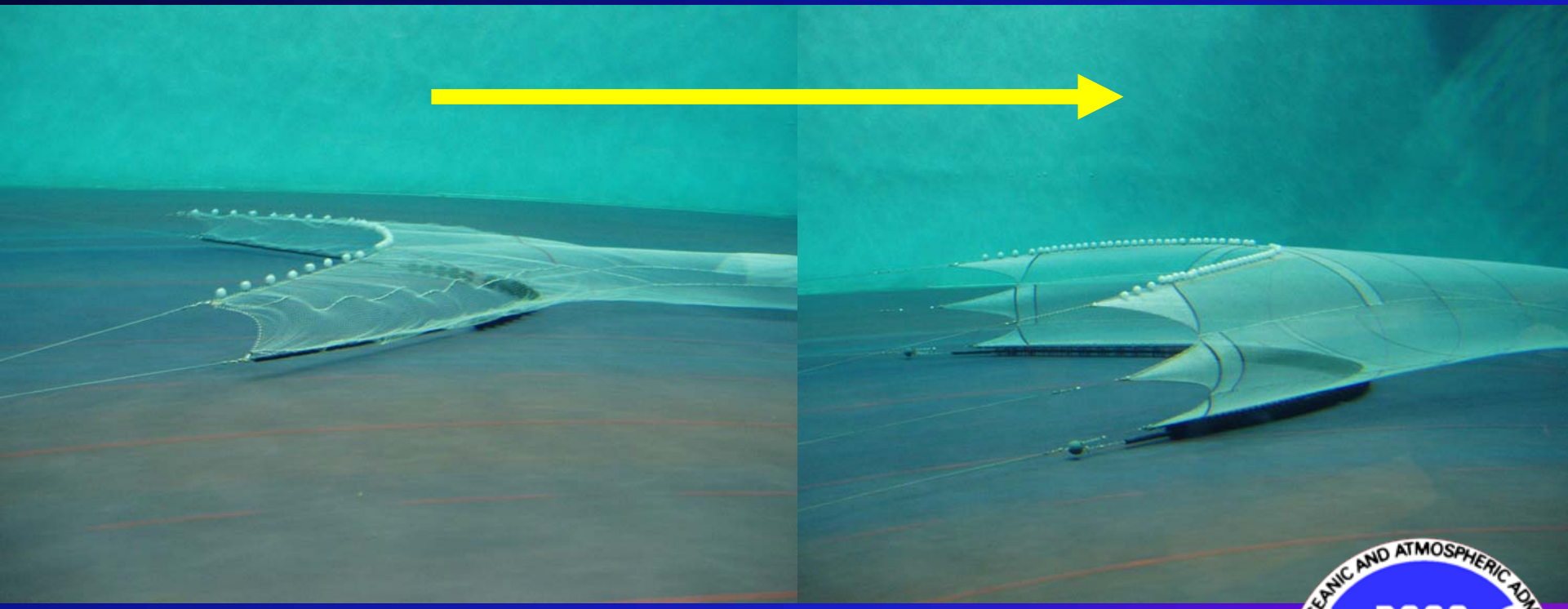
Update on Survey Activities and Bottom Trawl Survey Calibration



Russell W. Brown, Ph.D.
Ecosystem Surveys Branch
Northeast Fisheries Science Center

Presentation Overview

- **Current and Upcoming Survey Activities**
- **Review of New Trawl Survey Gear Package**
- **Flume Tank Video of 400 x 12 4-Seam Trawl**
- **Other Protocol Changes to improve consistency**
- **Autumn 2007 Issues**
- **Rationale for Trawl Door Decision**
- **Current Calibration Activities**

2008 Survey Activities

- Spring Bottom Trawl Survey & Calibration
  - RV Albatross IV and FSV Henry Bigelow
  - March 3, 2008 – May 16, 2008
- 2008 Scallop Dredge Survey
  - RV Hugh R. Sharp (University of Delaware)
  - June 21 – July 8, 2008 & July 28 – August 7, 2008
  - Plan to use modified survey dredge redesigned cooperatively through the Scallop Survey Advisory Process
- 2008 Surfclam and Ocean Quahog Dredge Survey
  - RV Delaware II
  - June 30 – August 7, 2008
  - Transition to Industry Vessel (Clam Advisory Process)

2008 Survey Activities

- 2008 AFMSC Northern Shrimp Bottom Trawl Survey
  - RV Gloria Michelle (22 sea days)
  - July 20 – August 16, 2008
- 2008 Herring Acoustics Survey
  - RV Delaware II
  - September – October, 2008
- 2008 Autumn Bottom Trawl Survey & Calibration
  - RV Albatross IV and FSV Henry Bigelow
  - September – November, 2008
- Recent completion of a Section 7 Consultation for Turtle Takes and a NEPA Environmental Assessment

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Key Attributes of New Trawl System

- Representative sample of a variety of species and sizes (multispecies survey)
- Maximum catchability between the wing ends and minimum sampling between the wing ends and doors (minimal herding)
- Consistent bottom contact
- Higher headrope height
- Ability to sample a variety of habitats

- Standardization: "Easily maintained, consistent performance"

Change in Survey Tool

- Move from lower efficiency sampling tool (Albatross IV towing Yankee 36) to a higher efficiency sampling tool (Bigelow towing 400 X 12 Four Seam Trawl)

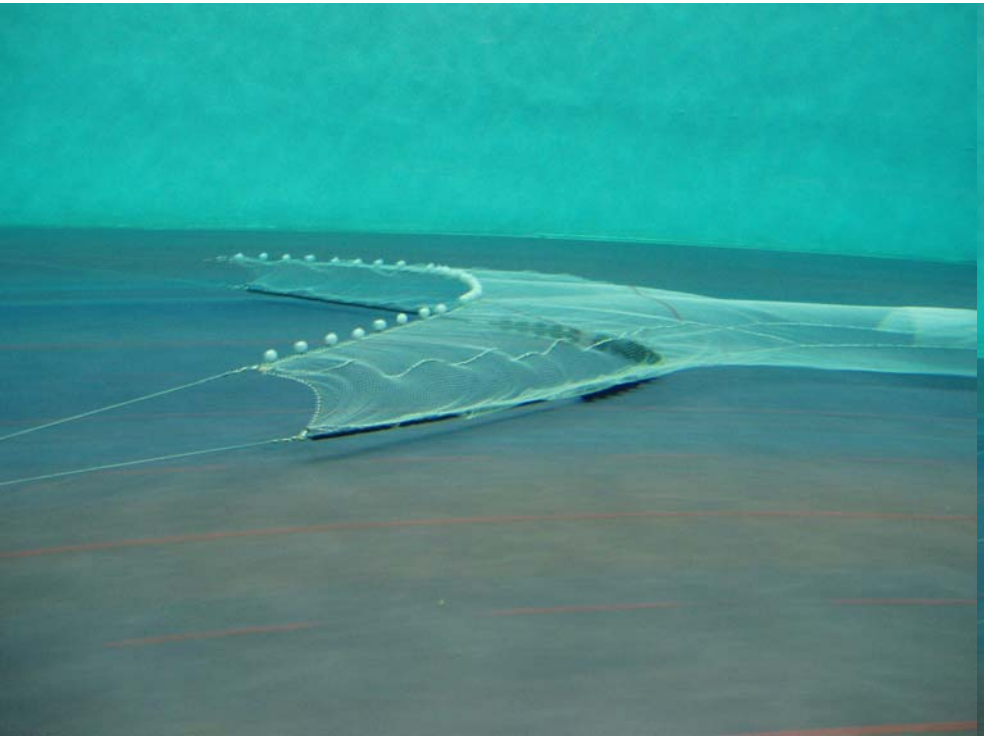
- Objective of survey is to provide:
  - Trends in abundance and biomass
  - Biological information including size and age composition, sex, maturity, diet composition

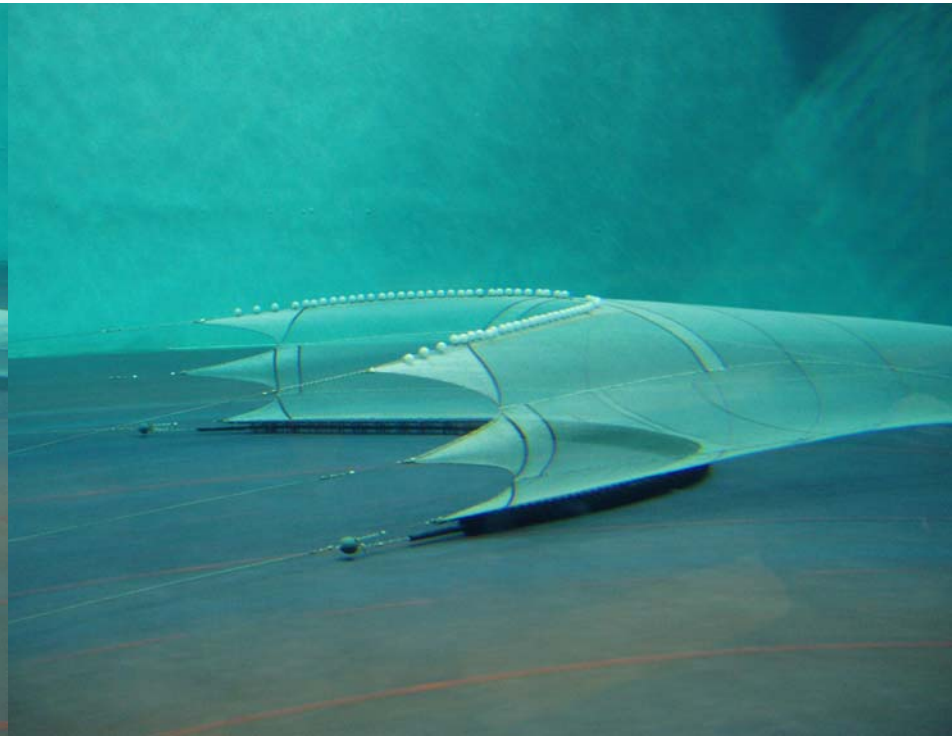
- Lower efficiency sampling tool can meet these objectives

- High efficiency sampling tool will meet these objectives, hopefully with lower variability

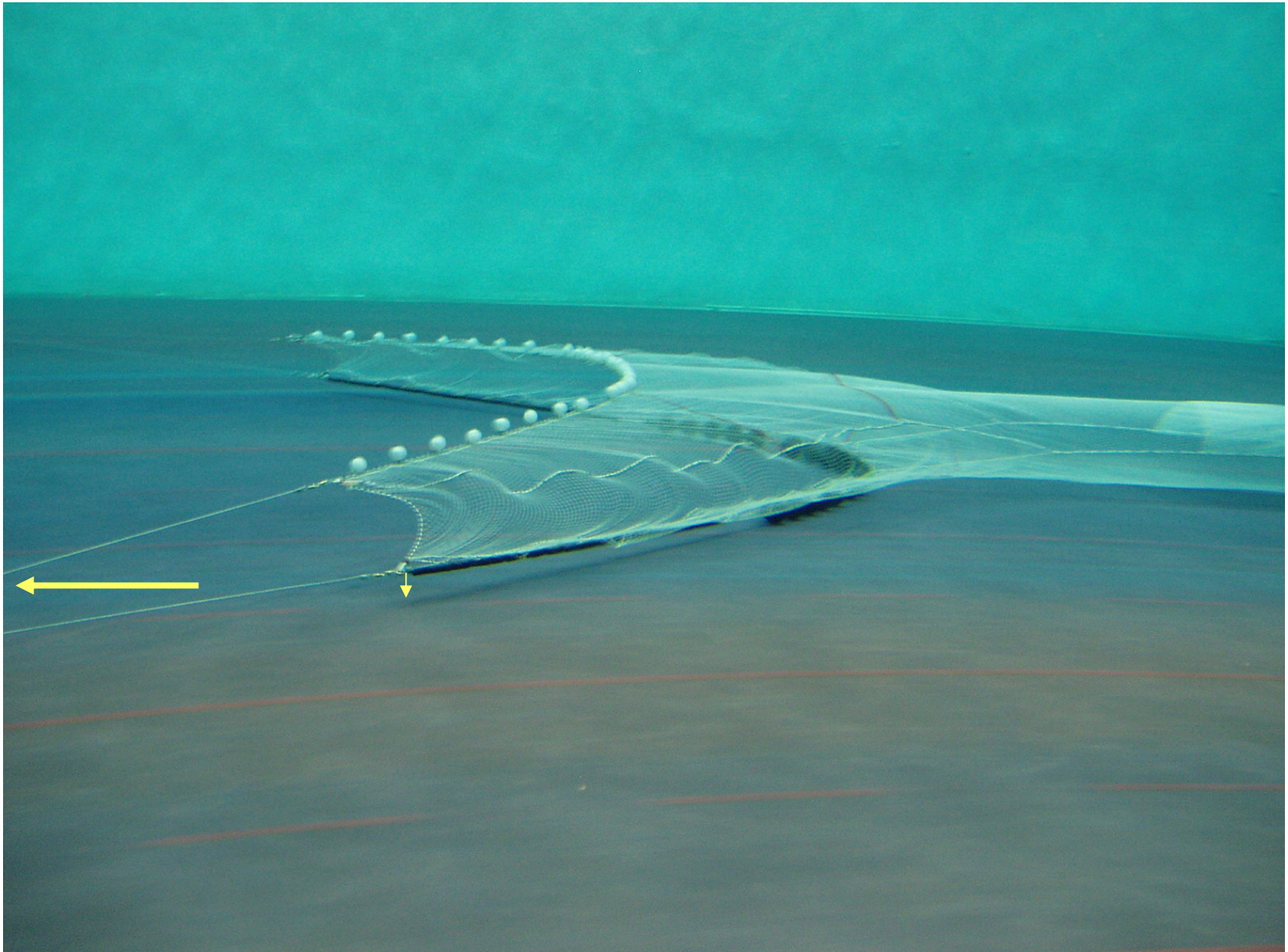
- High efficiency sampling tool inspires confidence

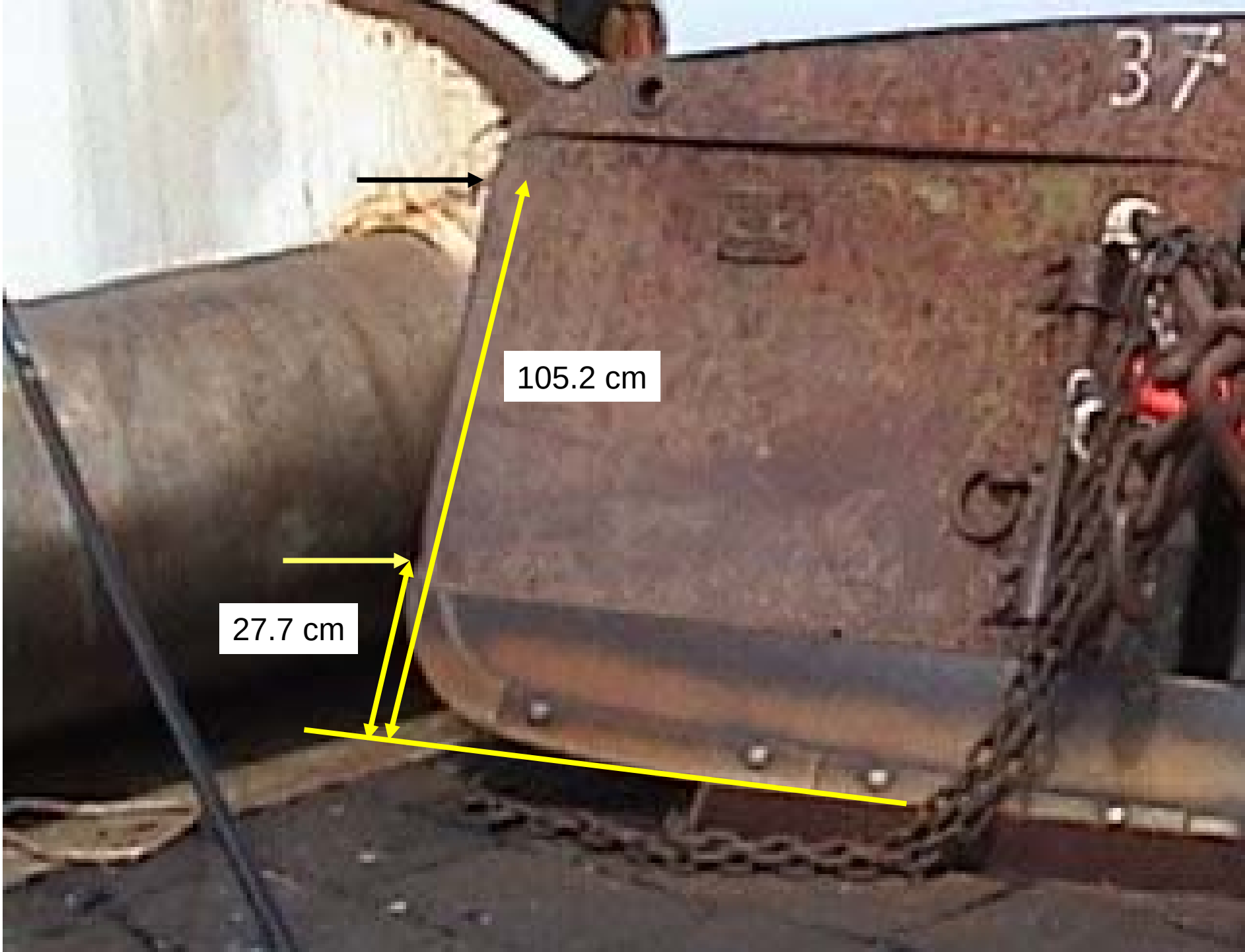
Yankee vs. 4 Seam Trawl





Issues with the Yankee Model

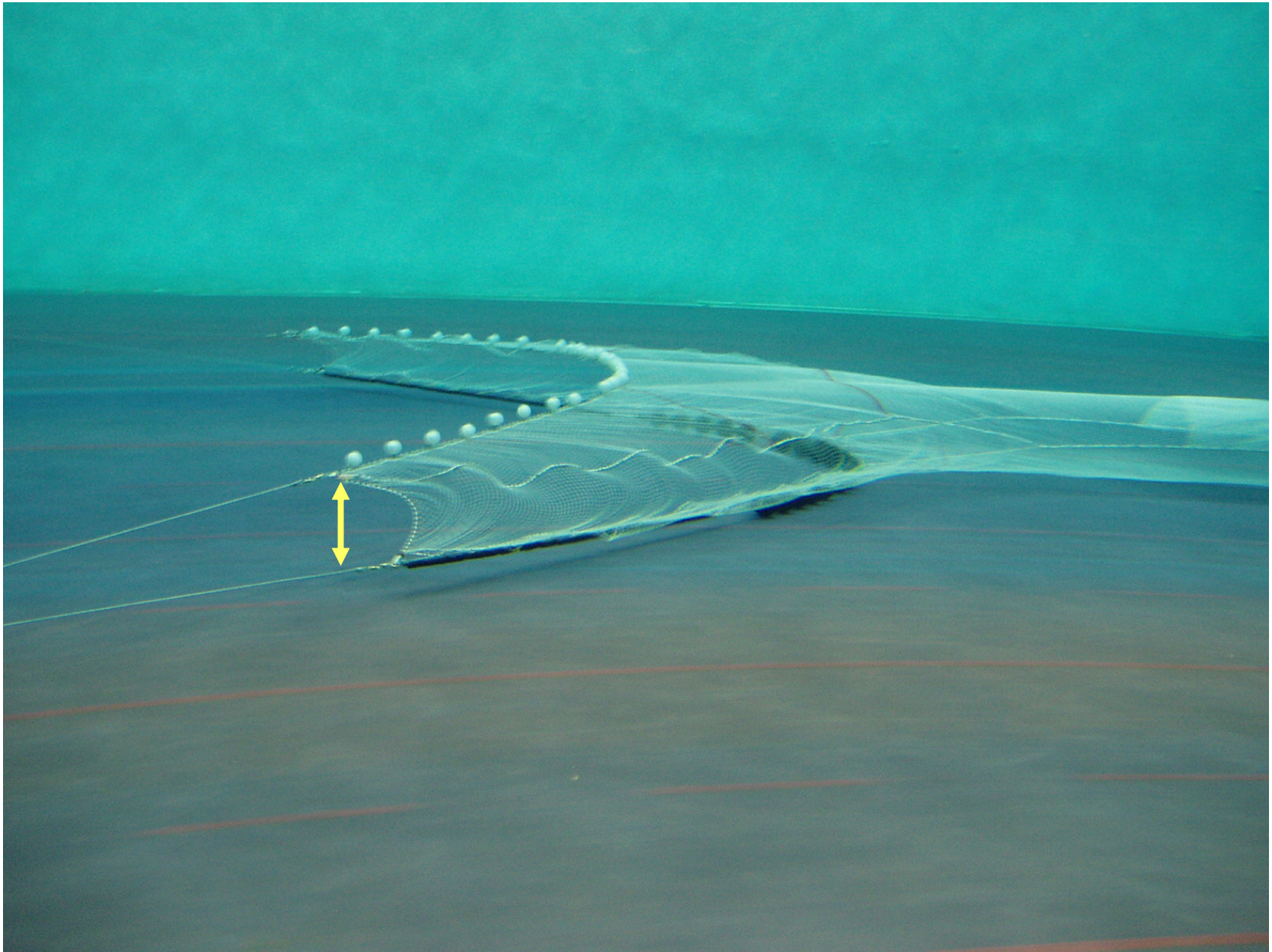



105.2 cm
27.7 cm

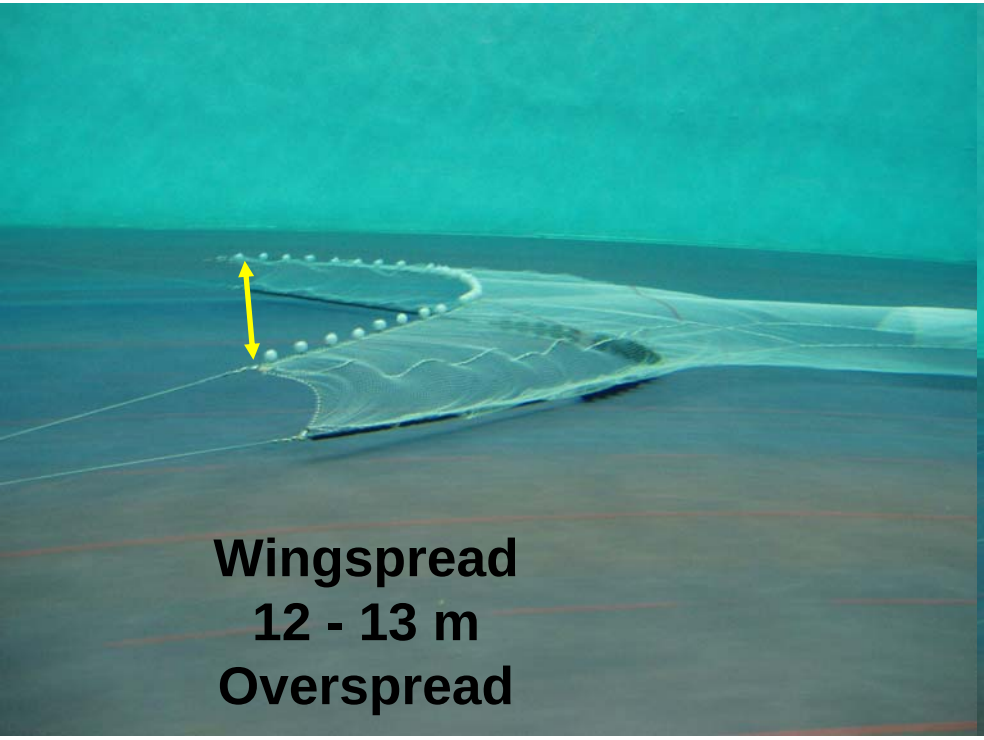

37

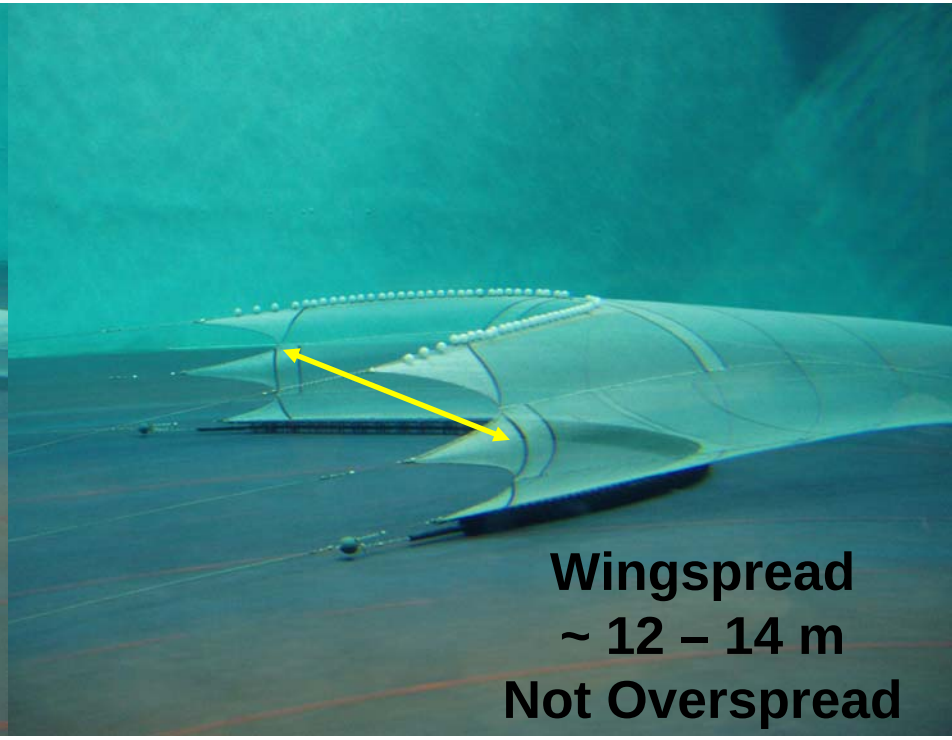

37

Issues with the Yankee Model

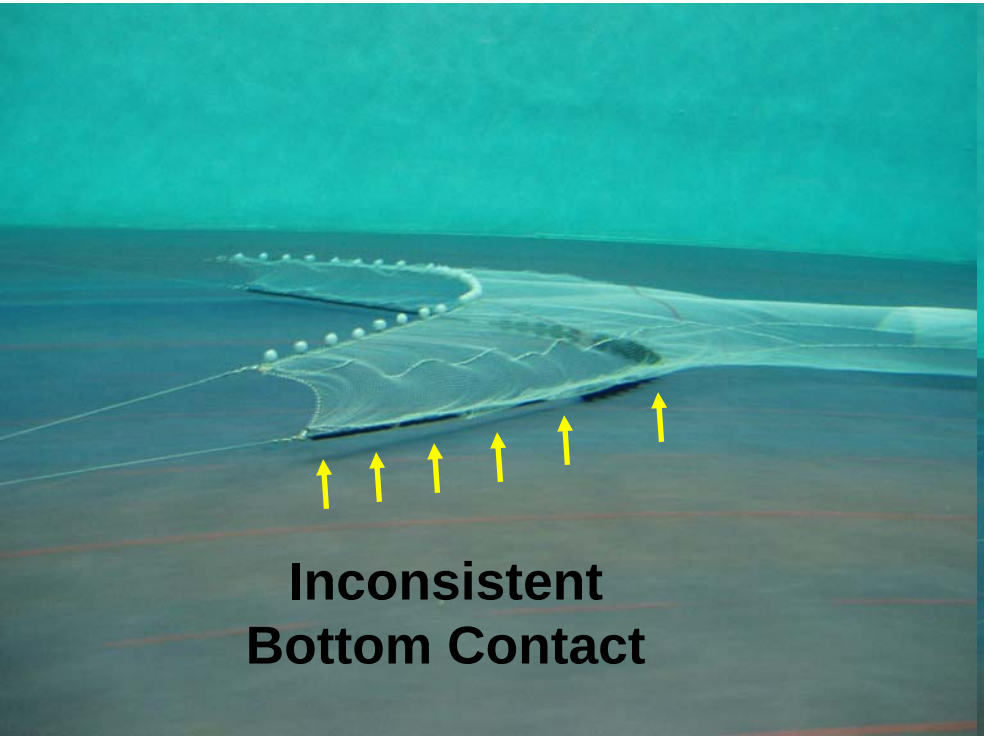


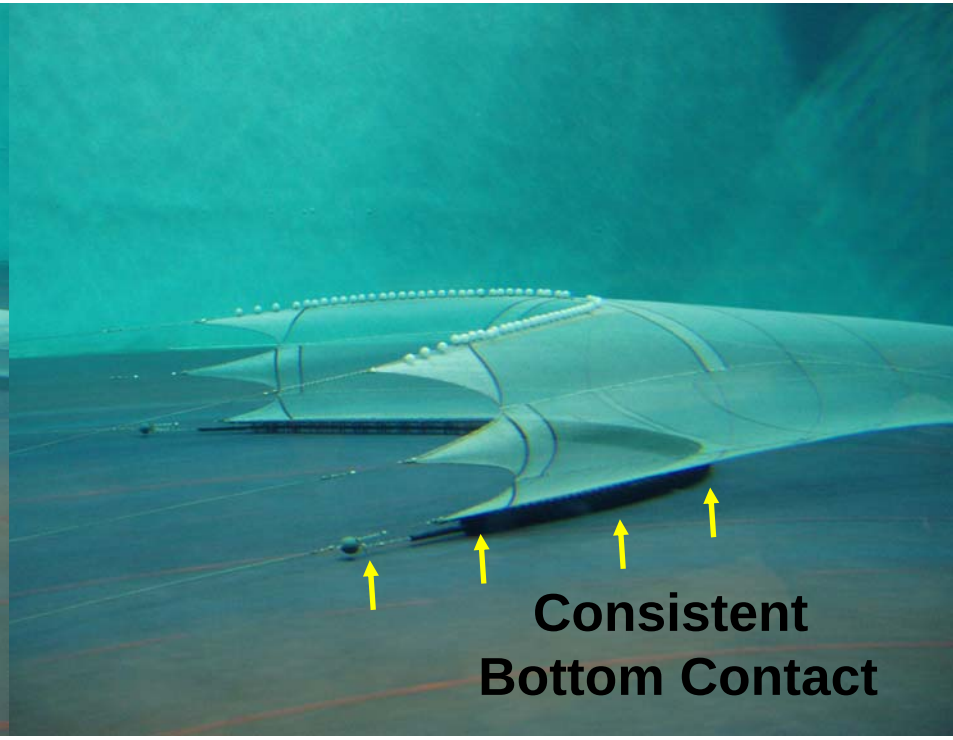
Yankee vs. 4 Seam Trawl



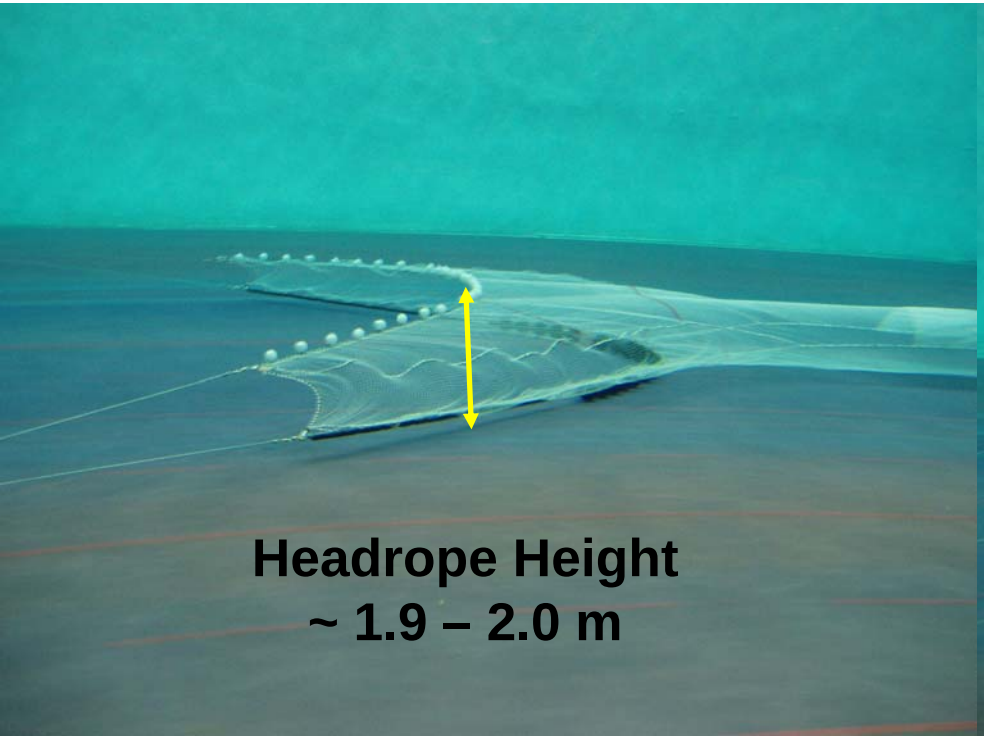


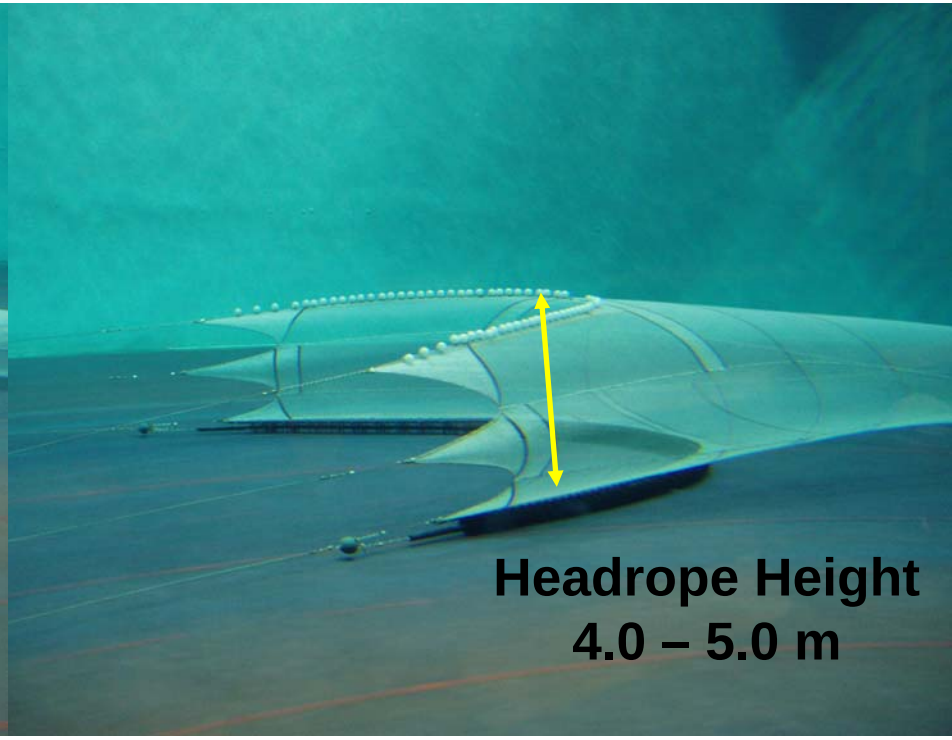
Yankee vs. 4 Seam Trawl



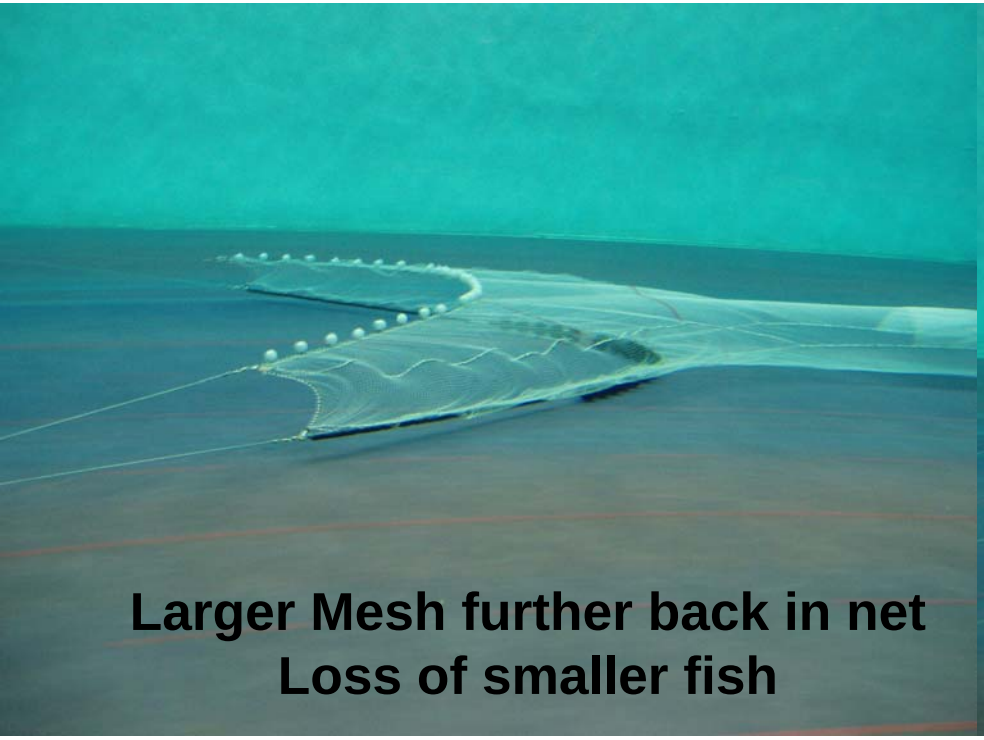


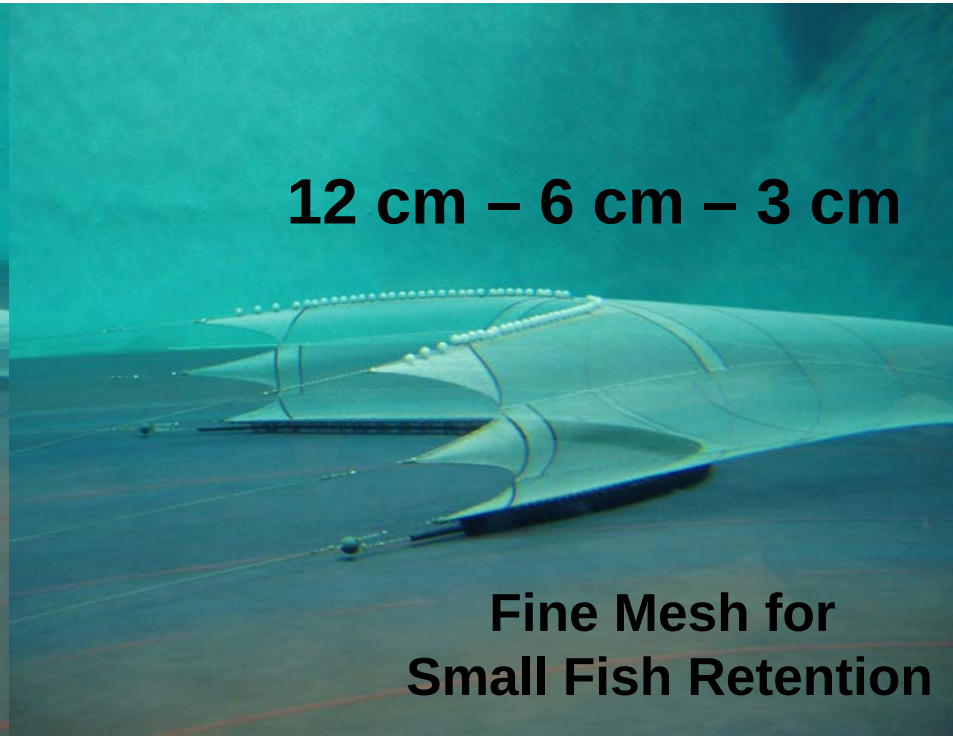
Yankee vs. 4 Seam Trawl





Yankee vs. 4 Seam Trawl





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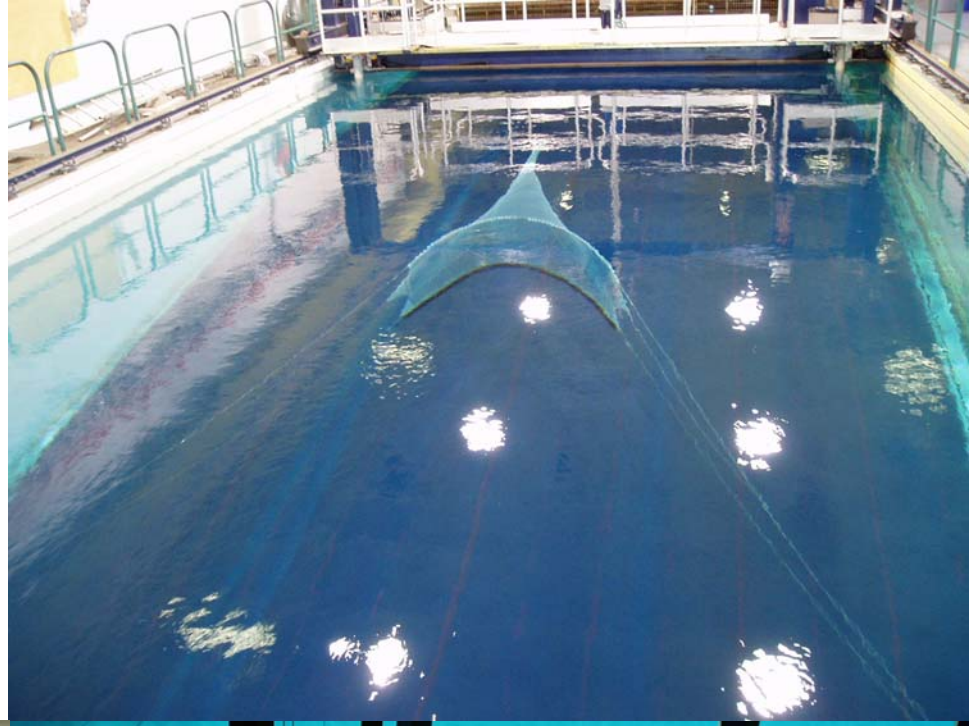
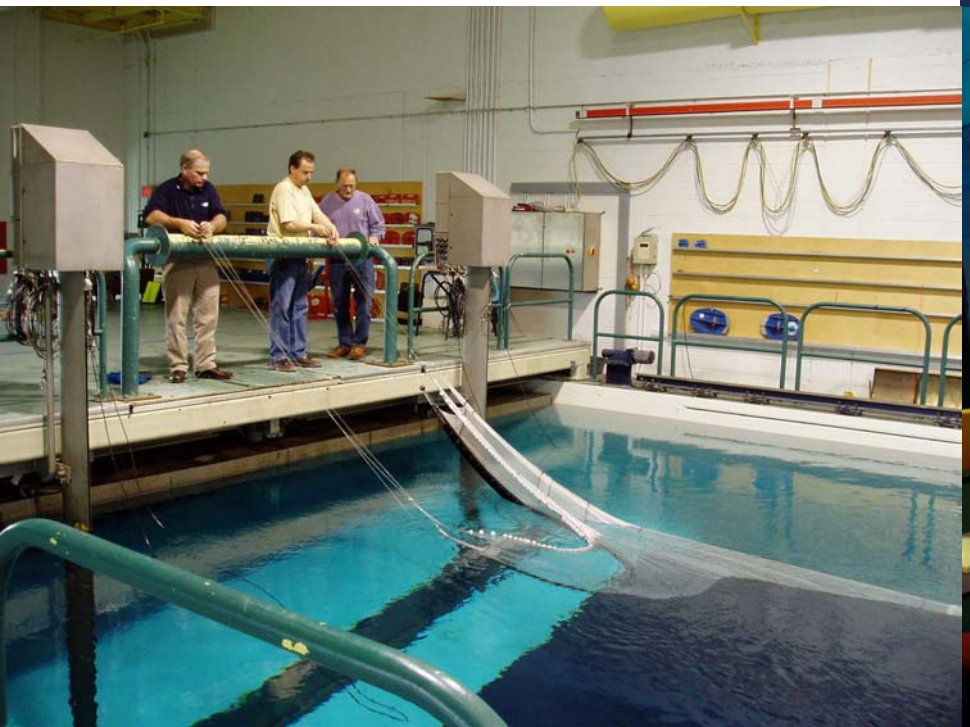
Flume Tank Testing
400 X 12 cm Four Seam Trawl

June 1-3, 2005
Marine Institute, Memorial University
St. Johns, Newfoundland

1:7 scale model
Changes to net design made after this modeling effort





Flume Tank Videos

- Four Seam Net @ Target Door Spread (32-m)
- Effects of Speed with fixed door spread
- Effects of Changes in door spread at fixed speed
- Trawl warp offset
- Broken top and middle bridles

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Setting and Hauling Timing

- **Setting and Hauling Duration Affected By:**
  - Winch speed
  - Vessel speed
  - Scope/Wire Out/Depth
  - Operator behavior

Setting and Hauling Timing

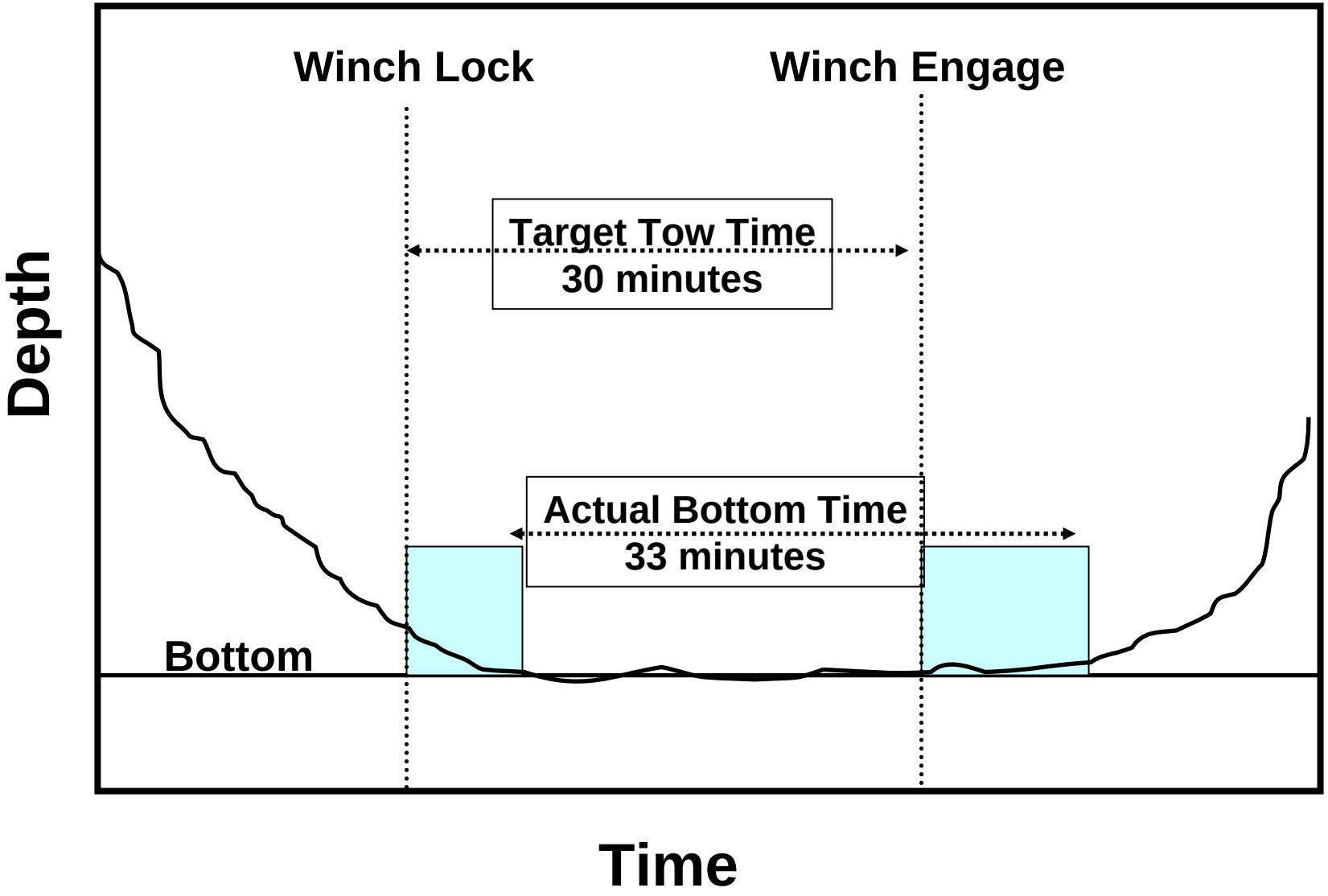
- **Setting and Hauling Variability Affects:**
  - Fishing in the water column
  - Gear settling and lift-off times
    - Variability in time fishing on bottom
  - Catch washing out of the net

Protocols for Standardizing Time Fishing on Bottom

- **Albatross:**
  - Winch lock to winch engage
    - Net usually not on bottom at winch lock – especially true in depth water
    - Net does not instantaneously lift off bottom - especially in deep water and with slow retrieval
    - Actual bottom time often exceeds target time

- **Albatross – Delaware Catchability Differences:**
  - Delaware catches 10-40% more fish
  - Hypothesis: differences in winch speed translating in greater effective bottom time for Delaware

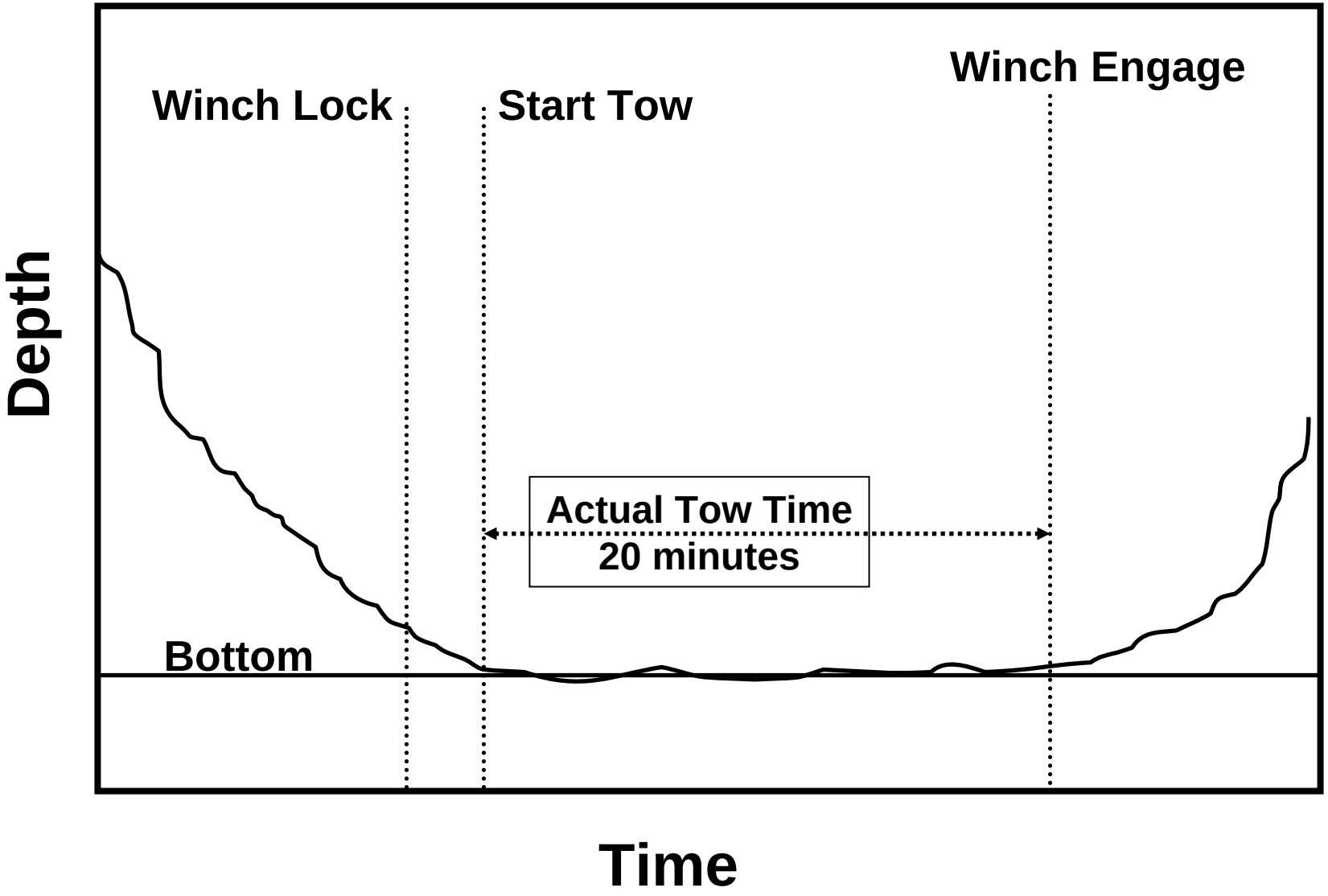
Theoretical Tow



New Protocols for Standardizing Time Fishing on Bottom

- **Bigelow:**
  - Start Tow:
    - Based on lead fishermen interpretation of net mensuration information (height sensor, depth sensor, changes in door spread)
  - End Tow:
    - 20 minutes after start tow
    - Given the combination of winch speed and horsepower, liftoff times are generally in seconds (not minutes)
  - Standardization of effective tow time becomes more critical with shorter target tow times

Theoretical Tow



Why is tow time being shortened?

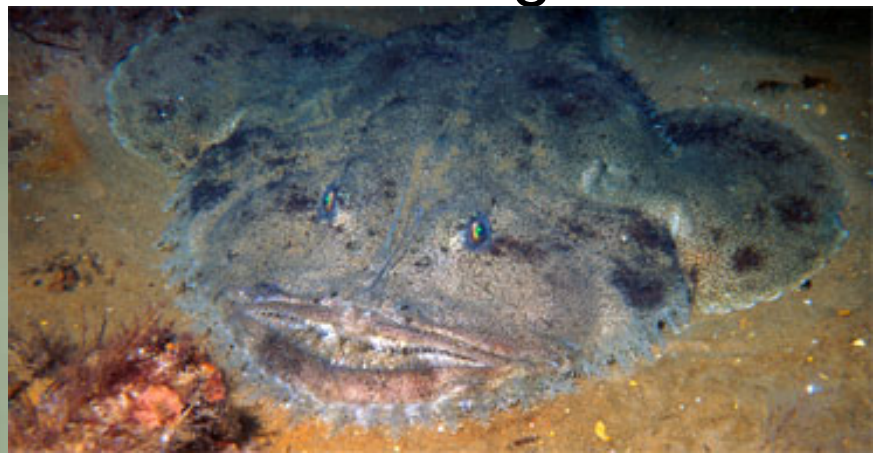
- **Tow Times:**
  - Albatross/Delaware: 30 minutes
  - Bigelow: 20 minutes

- **Higher catchability of four-seam trawl gear**
  - Time savings is in the catch handling and processing
    - Time savings in terms of towing is 10 minutes
    - Time savings in terms of catch processing is 33%

- **Advantages:**
  - Ability to occupy stations in areas limited by fixed gear, bad bottom
  - Avoid unnecessarily killing fish

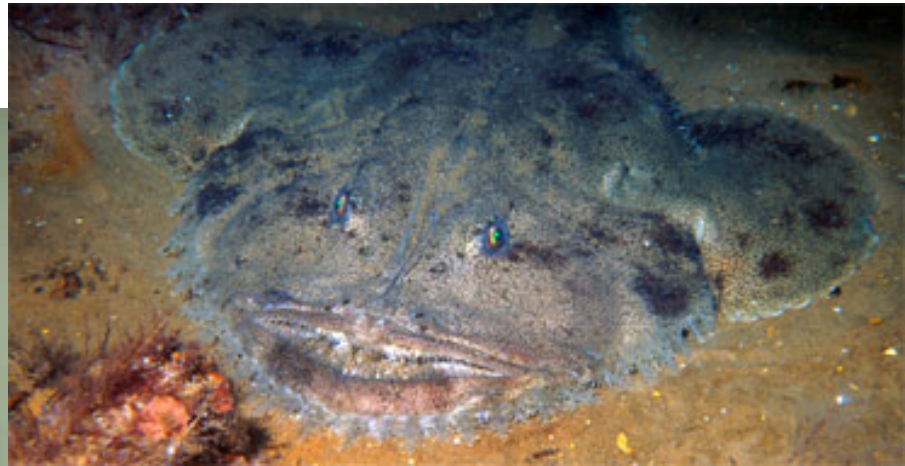
Towing Speed

- Higher Speeds
  - Increased in door and wing spread
  - Reduced headrope height
  - Loss of bottom contact by the ground gear
  - Reduced catchability of sedentary demersal species
  - Increased catchability of fast swimming or "burst" speed species



Towing Speed

- **Lower Speeds**
  - Reduced in door and wing spread
    - Possible door collapse at low speeds
  - Increased headrope height
  - Increased catchability of sedentary demersal species
  - Reduced catchability of fast swimming or “burst” speed species



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Autumn 2007 Issues

- **Bigelow Propulsion Issues**
  - **Lost almost all of planned operational time**
- **Autotrawl Issues**
- **Trawl Door Performance Issues**

Autotrawl System Purpose

- **Dynamic winch operation to optimize trawl net performance**
- **Two Operational Approaches**
  - Balance tension between trawl warps
  - Optimize orientation of flow into the net using an acoustically reporting flow sensor in the mouth of the net
- **Published Scientific Studies (Kotwicki et al. 2004)**
  - Straight warps vs. Autotrawl (tension) vs. Autotrawl (Net sensor)
  - Autotrawl (tension) provided most consistent gear performance across a variety of conditions

Autotrawl System Issues

- **June 2007 Survey Protocol Development Cruise**
  - Apparent offset to one side much of the time
  - Did not correspond to equal tension on trawl warps
  - System less dynamic than observed on other vessels

- **August 2007 Survey Protocol Development Cruise**
  - Rapp-Hydema tech rep on vessel to diagnose and solve system performance issues
  - Tech rep noted that warp tensions (averaging 1.8 tons) were low relative to system design capabilities
  - System adjustments seemed to solve performance issues

- **September 2007 Calibration Leg 1**
  - Bigelow propulsion issues do not allow for adequate evaluation of Autotrawl system performance

- **November 2007 Calibration Leg 6**
  - Autotrawl system performance issues are apparent again

Autotrawl System Modifications

- **Modifications to increase system sensitivity**
  - Removed one winch motor
  - Replaced a second winch motor with a larger motor to provide future flexibility relative to system sensitivity
  - Completed software modifications relative to different motor configuration

- **Modifications to allow for system performance evaluation**
  - Changed the data “feed” to allow for simultaneous viewing and recording of both the calculated wire out based on winch drum rotation and a separate instrumented wire counter
    - Capability to capture both sets of data in our Scientific Computing System at one second intervals during tows

Current Autotrawl Performance

- System sensitivity has been significantly increased
- System is consistency balancing tension between warps, which corresponds to equal warp lengths under most conditions
- System is dynamic in response to vessel pitching caused by marginal sea states
- System correctly orients trawl mouth under “extreme conditions”

Trawl Door Performance Issues

- Inconsistent spread performance
- Door spread performance outside target ranges identified by the Panel
- Door shine patterns that concerned us
- Underwater video images concerned us
- Impossible to isolate door performance issues from Autotrawl issues

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Trawl Door Testing

- **Thyboron Type IV 84”**
- **Nets High Aspect 2.5 m^2**
- **Thyboron Type IV 80”**
- **Thyboron Type IV 76”**
- **Thyboron Type II 80”**
- **Thyboron Type IV 66” (in Council motion)**

- **PolyIce Oval 2.5 m^2**
- **Patriot 1.5 m^2**
- **PolyIce Oval 2.2 m^2**
- **Euronet Polyvalent 450 kg**

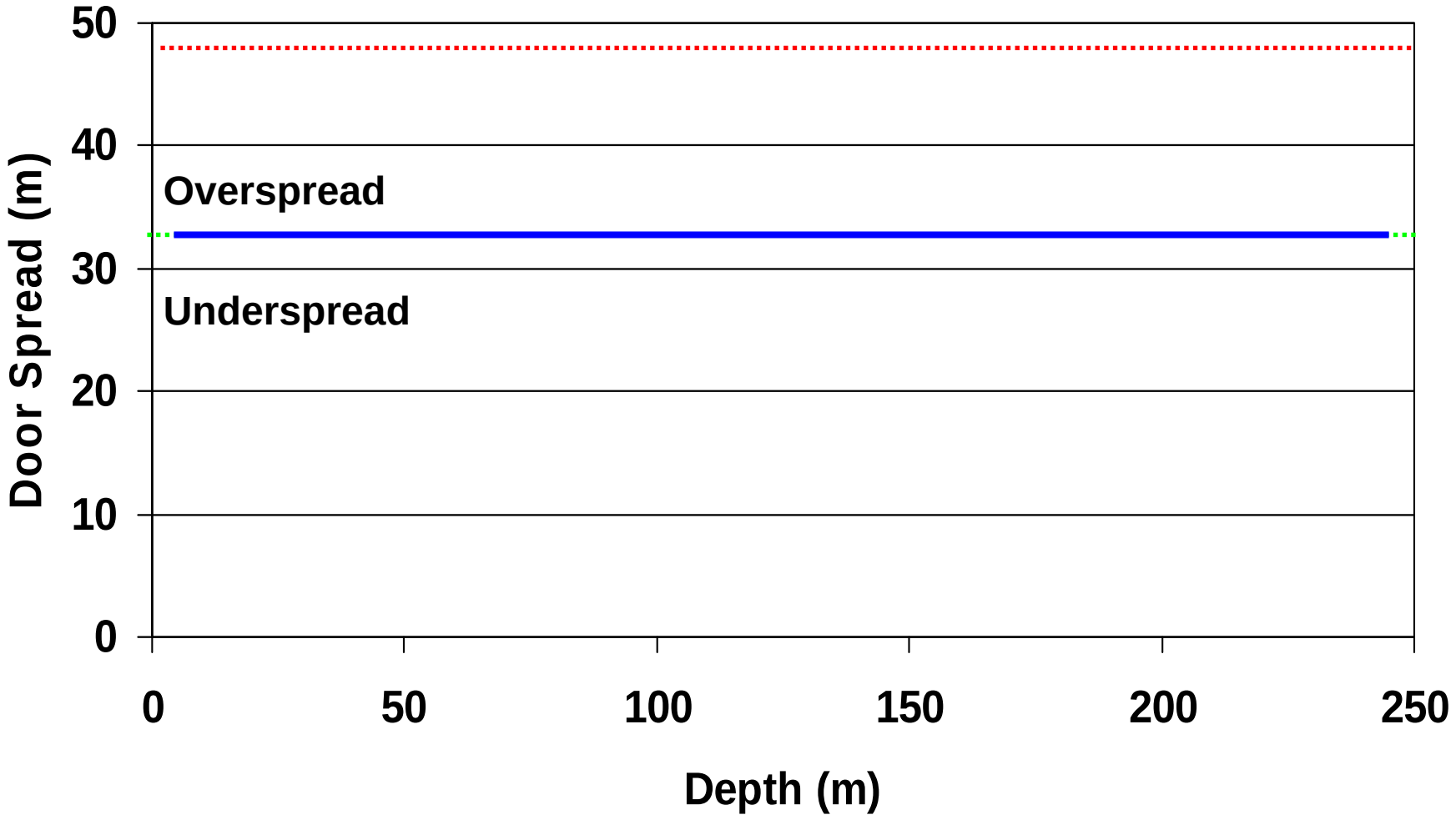
2.2 m² Poly-Ice Oval Trawl Doors

- Built 550kg each.
- 12ft long, ½” chain backstraps
- NEFSC Measured Door Weights: With Simrad sensor brackets
  - Port= 546.5kg (1205lbs)
  - Starboard= 546.5kg (1205lbs)

Rationale for Door Choice

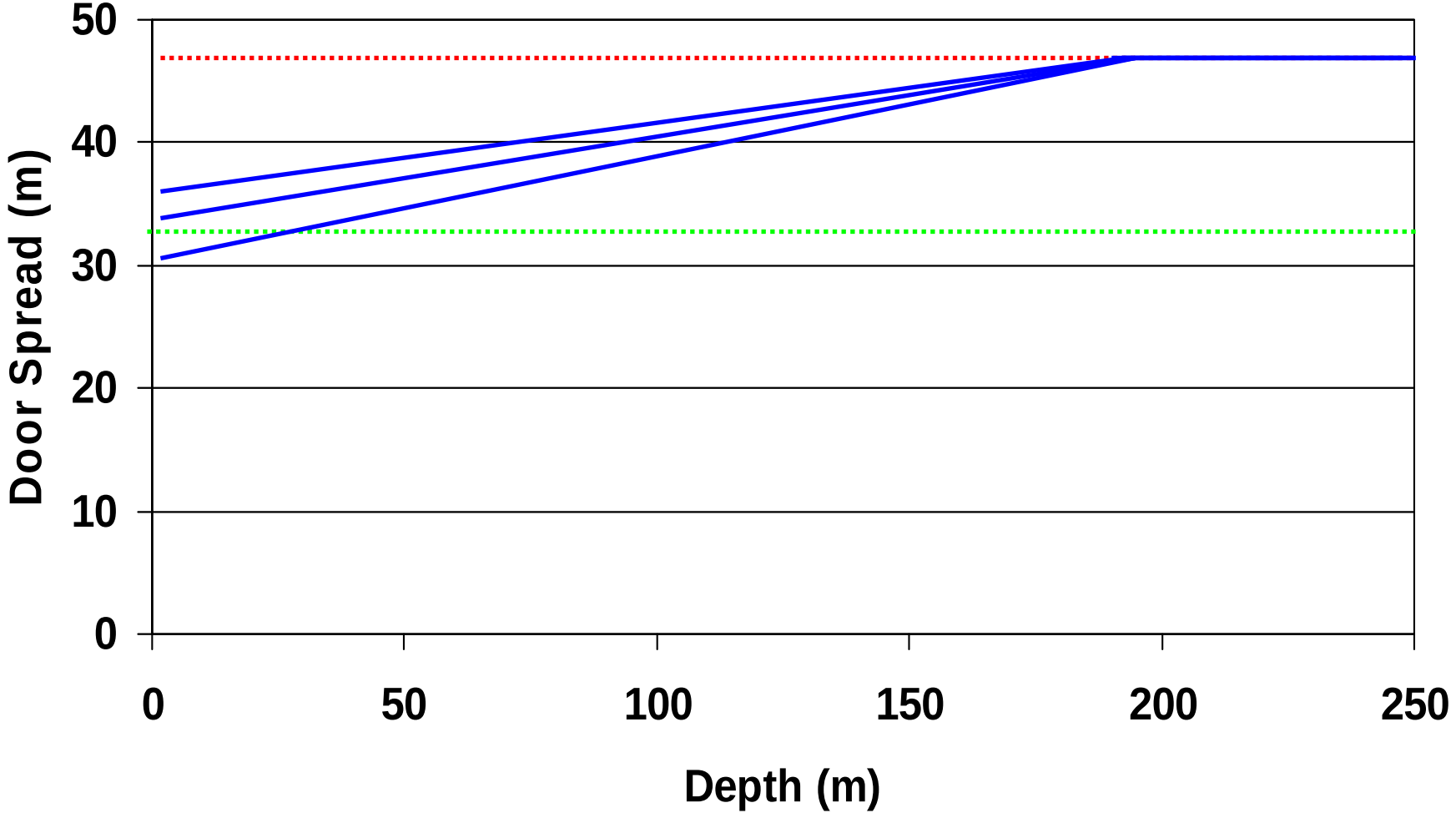
- Less Efficient / Less Spreading Power
- Consistent performance across a range of depths
- Weight: Heavier (550 kg)
  - More robust to maintaining bottom contact in marginal weather conditions
- Consistency across habitat (sand, mud, cobble, bolders)
- Ability to withstand major rock collisions

Door Efficiency / Depth Relationship



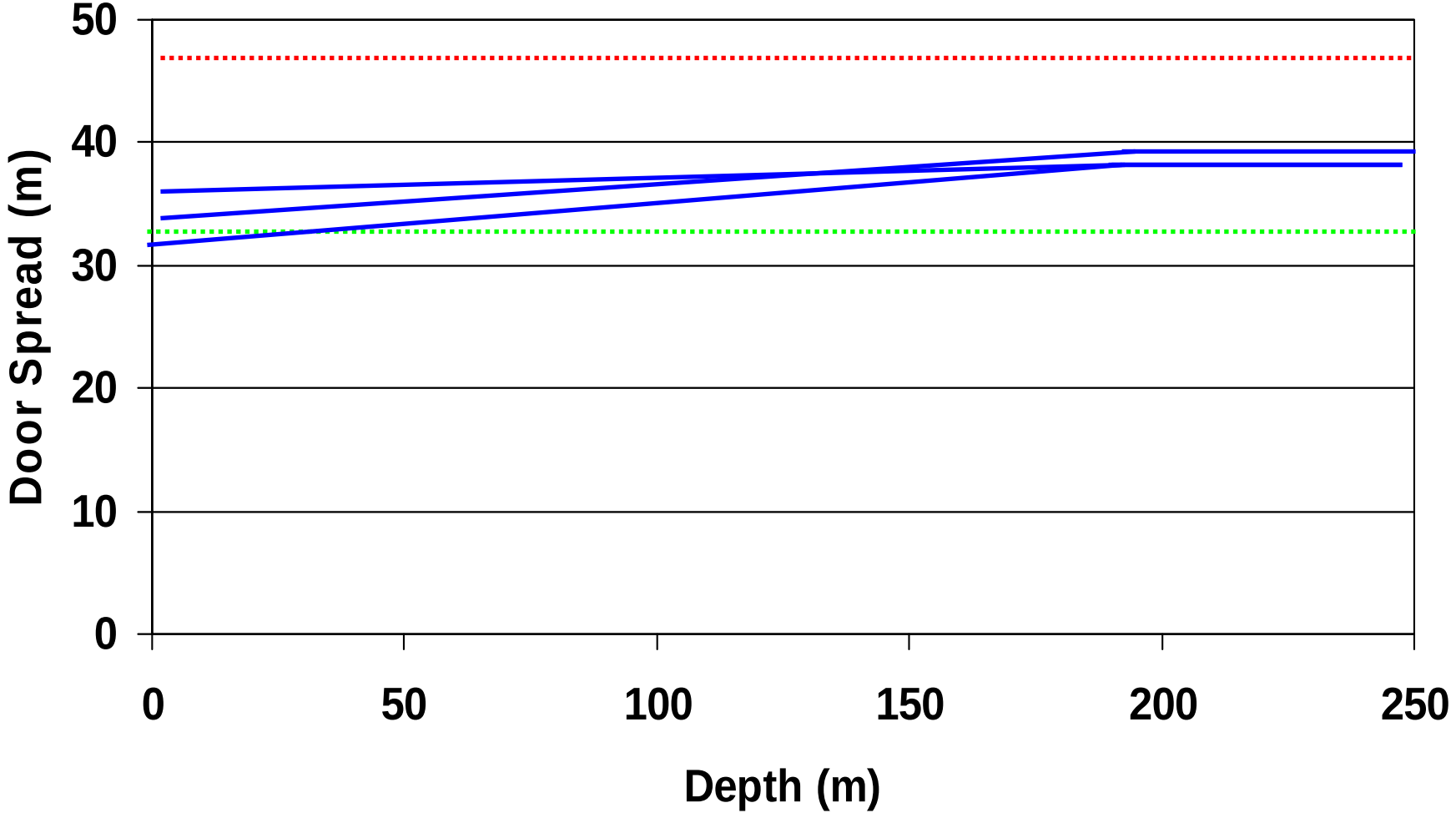
Highly Efficient Trawl Doors

Thyboron Type IV, Nets High Aspect



Less Efficient Trawl Doors

PolyIce Oval, Thyboron Polyvalent



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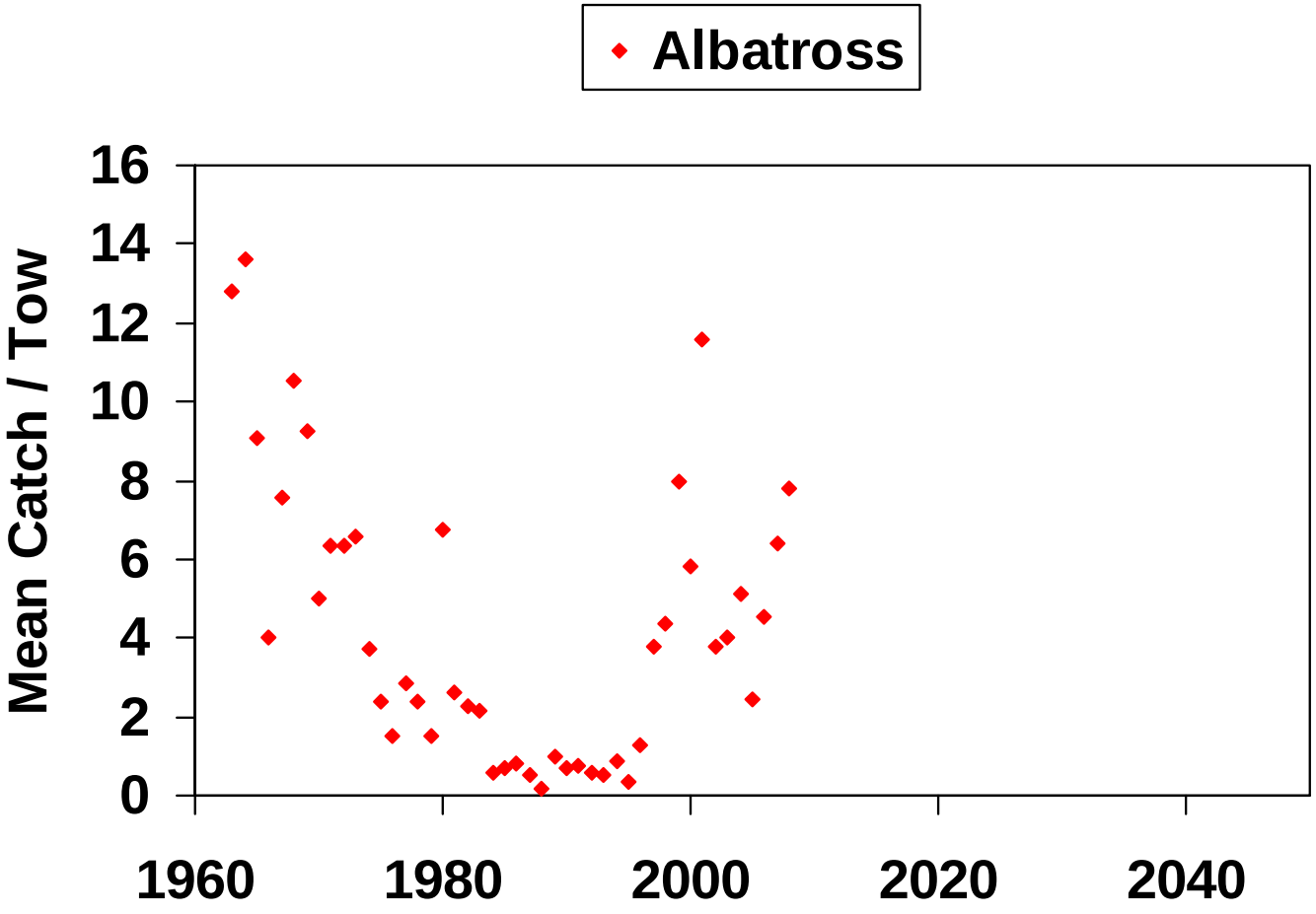
NEFSC Bottom Trawl Changes

- Vessels
  - FV Albatross IV & Delaware II
  - FSV Henry B. Bigelow
- Bottom Trawl Gear
  - Yankee 36 Bottom Trawl
  - Modern Trawl Gear Designed in Conjunction with Stakeholders
- Survey Design
- Changes to Survey Protocols
  - Tow speed
  - Tow duration
  - Setting/Hauling


RV Albatross IV

FRV Henry B. Bigelow

Why Conversion Coefficients?



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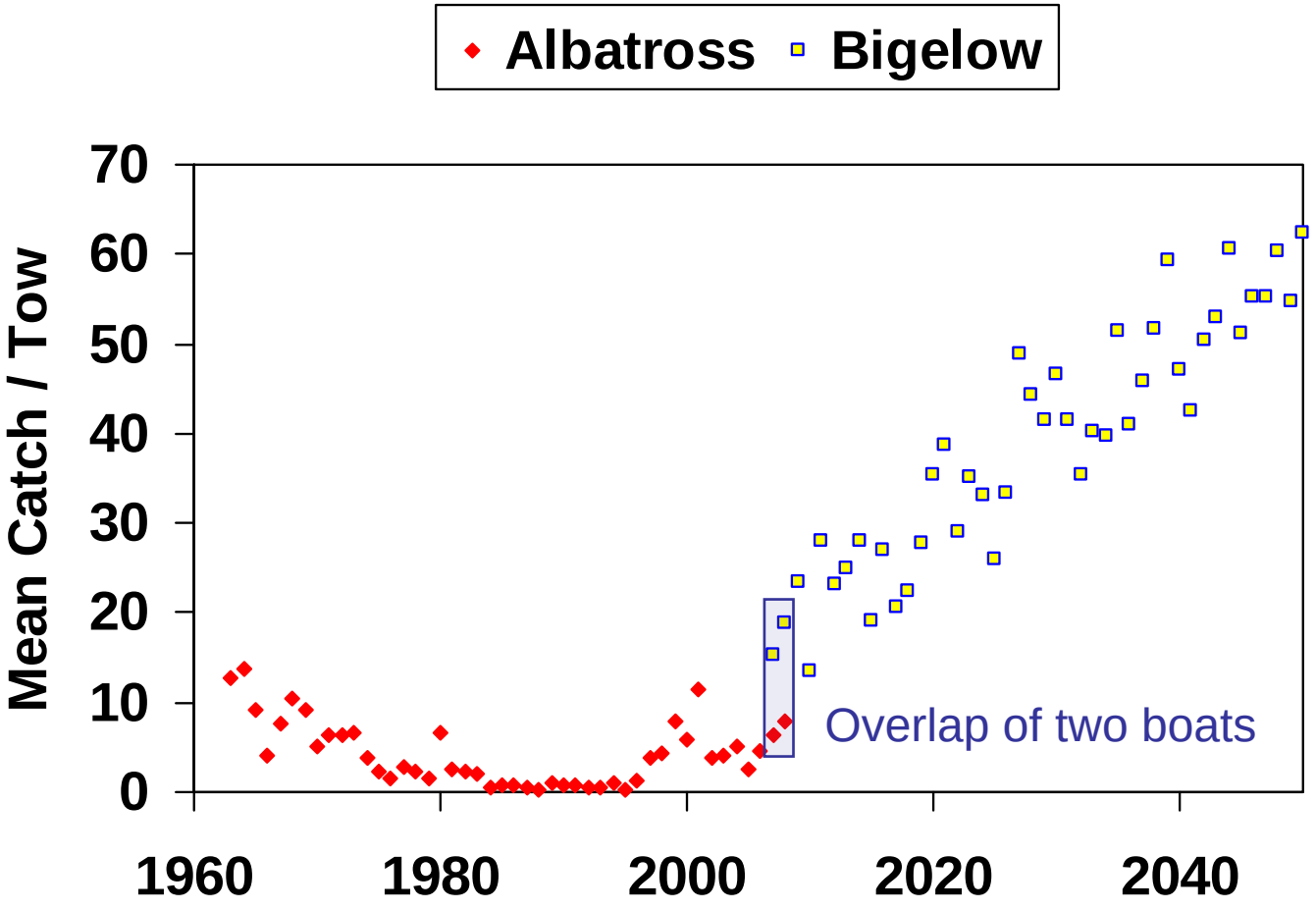

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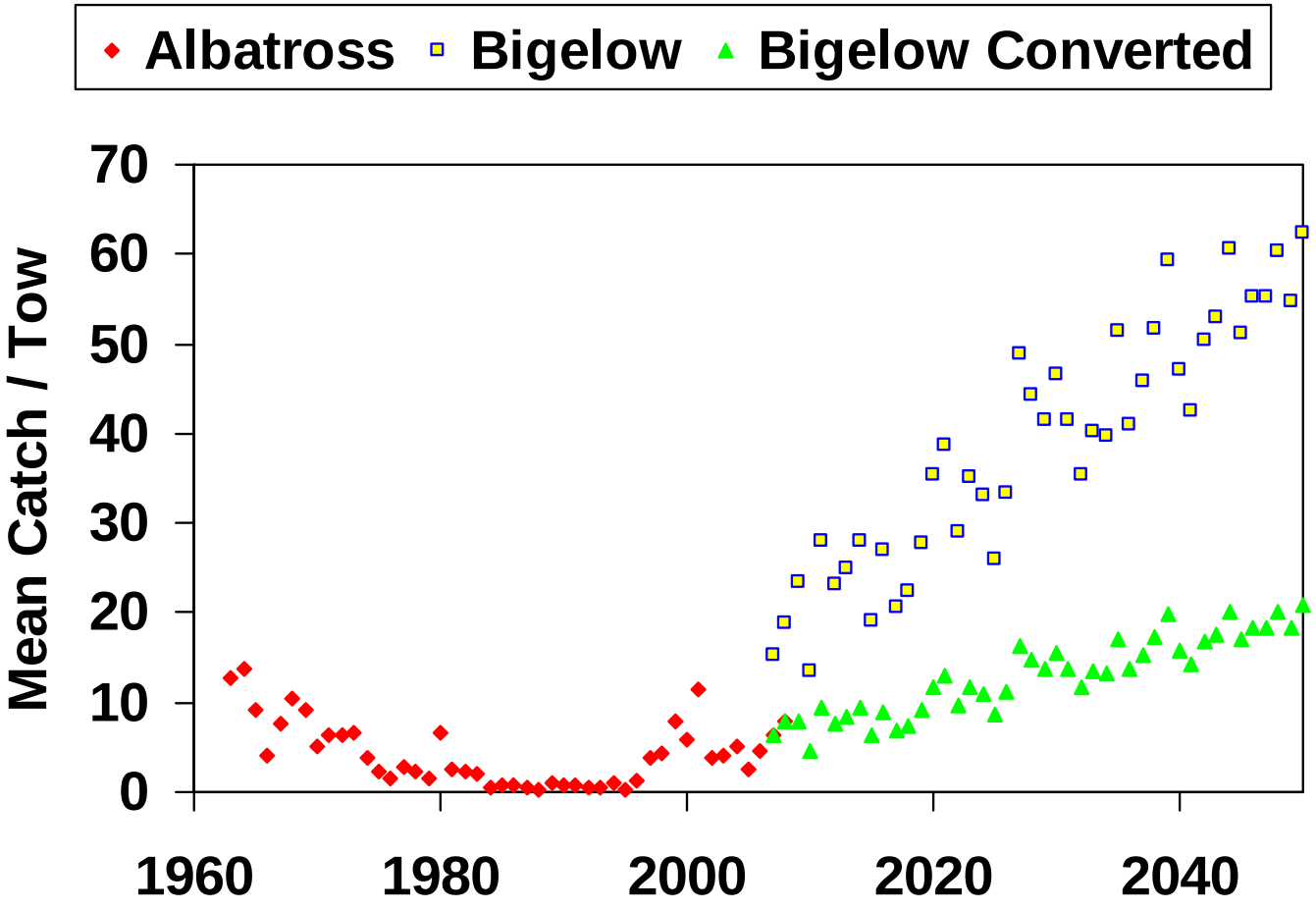

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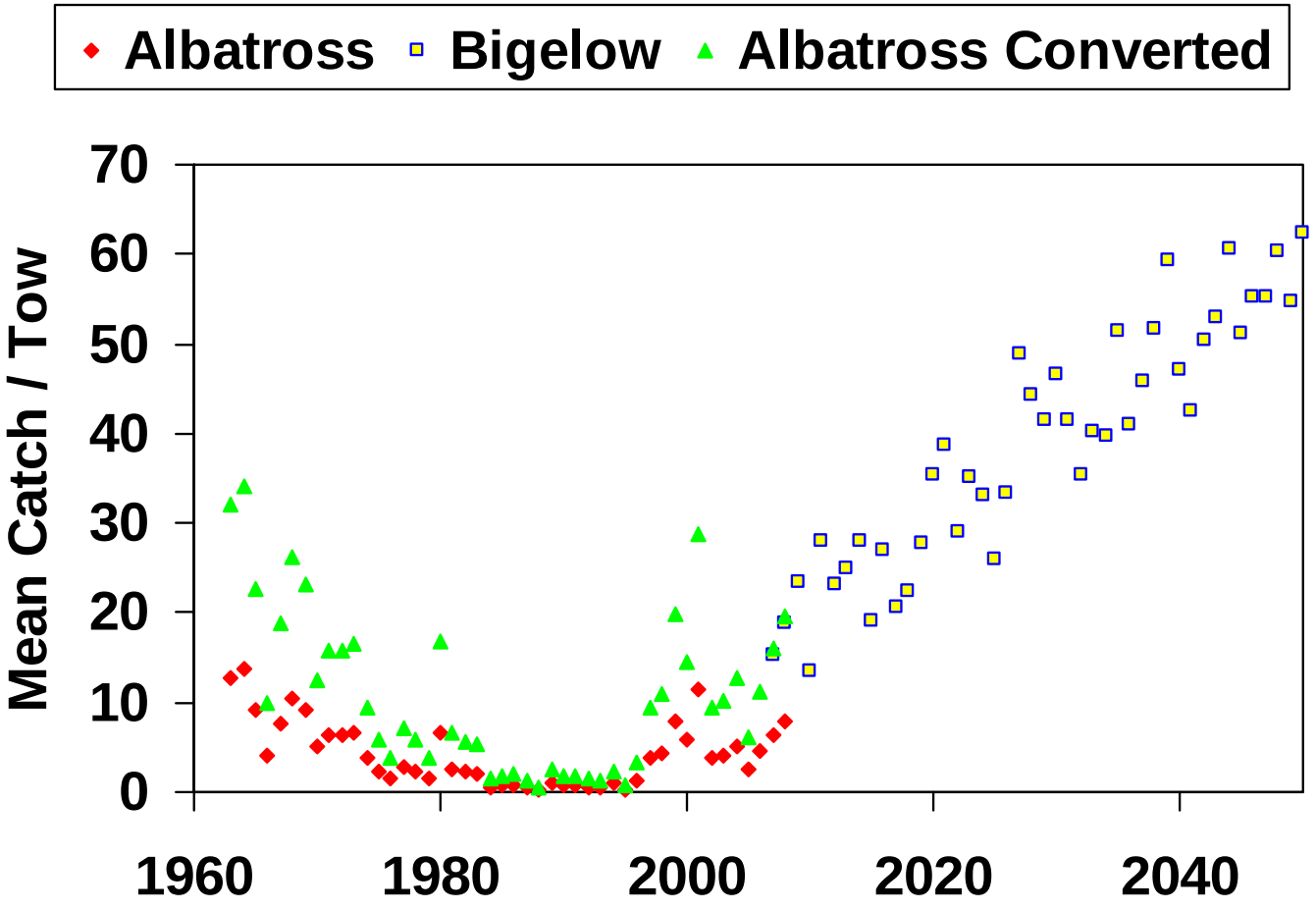


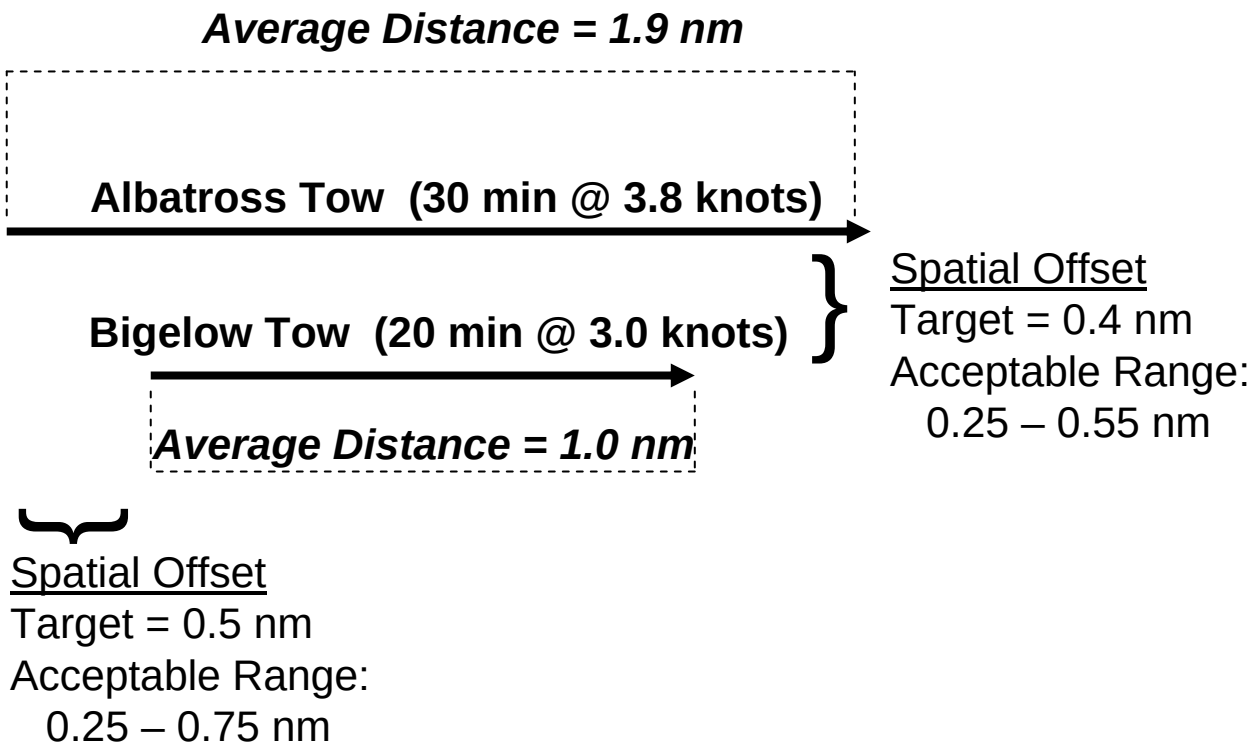
2008-2009 Calibration Plans

- 2008 Spring Bottom Trawl Survey
  - Paired towing at most stations where depth not limiting
- 2008 Spring Site Specific Experiments
  - Paired towing targeting specific species and/or habitats of concern
- 2008 Autumn Bottom Trawl Survey
  - Paired towing at most stations where depth not limiting
- 2008 Autumn Site Specific Experiments
  - Paired towing targeting specific species and/or habitats of concern
- Peer Review: June 2009

Calibration Design Review

- April 27-29, 2007
- Paired Towing Experiment
  - Lots of discussion about “vessel effects”
  - Presence of one vessel affecting the catch of the other
- Center proposed design was to tow closely together and attempt to estimate the “vessel effects”
- Panel recommendation was to isolate vessels temporally and spatially to reduce possibility of vessel effects
- Trade-off between possible vessel effects and spatial variability with increased distance and/or time

Spatial Relationship of Paired Tows



Temporal Relationship of Paired Tows

Albatross Tow (30 min @ 3.8 knots)

Bigelow Tow (20 min @ 3.0 knots)

<u>Temporal Offset</u>
Bigelow Tows Starts
25 minutes later
Acceptable Range:
20-45 minutes later

<u>Temporal Offset</u>
Bigelow Tow Finishes
15 minutes later
Acceptable Range:
10-35 minutes later

Calibration Progress to Date

- Spring Survey has surveyed the mid-Atlantic Bight, Southern New England and most of Georges Bank

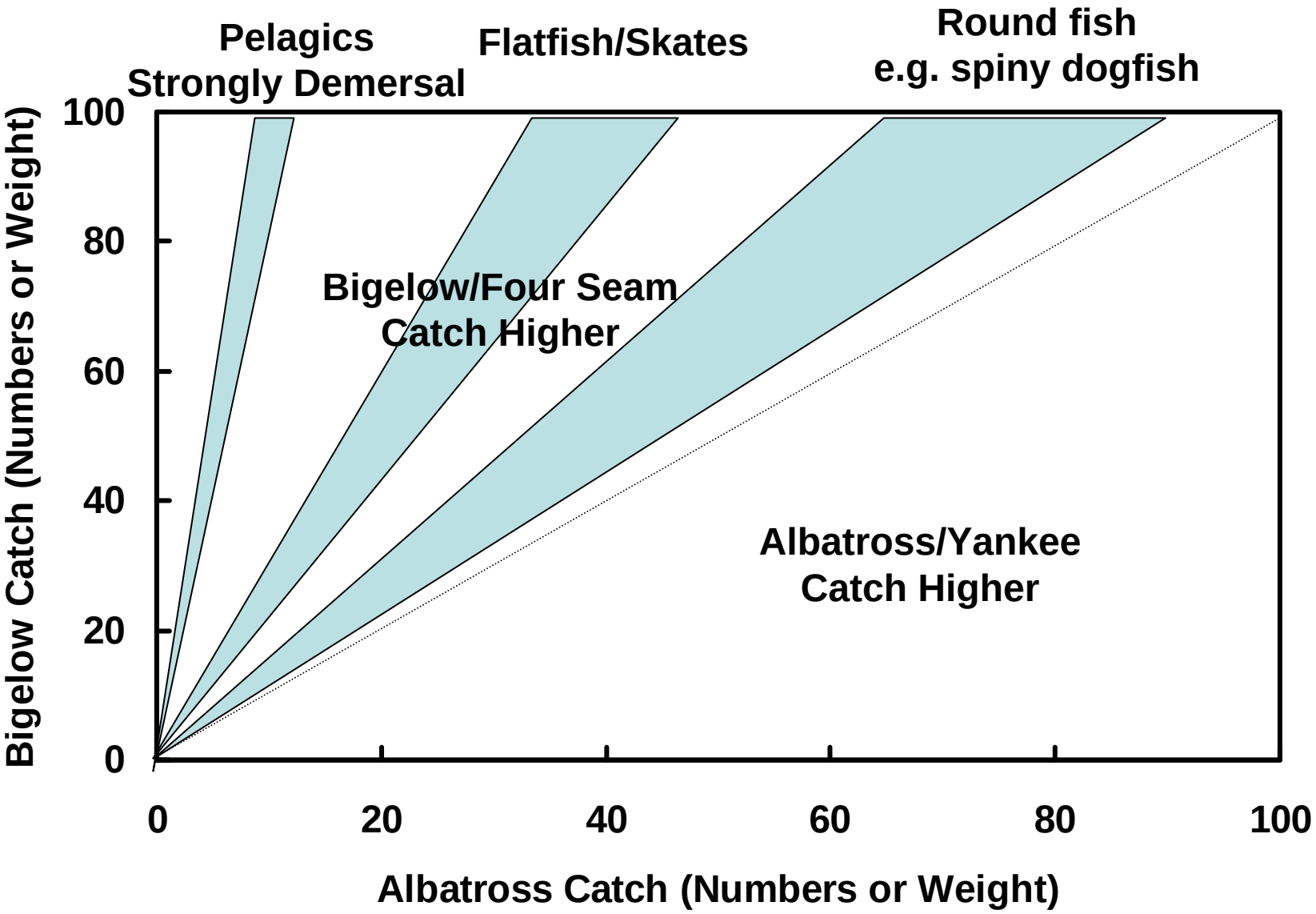
- **168** usable paired tows through Friday, April 11th out of 240 Albatross survey tows

- Paired tows are not attempted, completed or usable for a variety of reasons:
  - Draft Issues / Too Shallow (Bigelow, 17.5%)
  - Mechanical Issues (either vessel, 7.5%)
  - Space limitations (towable bottom, fixed gear, 1.3%)
  - Tear Up or Gear Performance Issues during the tow (1.3%)

- Paired tow production/success is slightly greater than projected during the design phase of the experiment

- Both vessels currently working along the northern edge of Georges Bank and into the Gulf of Maine

Typical Calibration Graph



February 6-8, 2007 NEFMC Meeting

Portsmouth, NH

"That the Trawl Survey Advisory Panel recommends as specified in technical addendum: a three bridle four seam 400 X 12 cm net; use of one of two sweeps (1 rockhopper or 1 cookie); 66" type IV thyboron door (or doors with equivalent performance, i.e. 4.5 to 5.5 meter head rope height, 12.5 to 14.5 meter wing spread, and 30 to 35 meter door spread at 3.2 knots) to be utilized for future bottom trawl surveys on the FSV Henry B. Bigelow."

February 6-8, 2007 NEFMC Meeting

Portsmouth, NH

“That the Trawl Survey Advisory Panel recommend that NOAA establish a formal training program for all personnel involved with the vessel fishing crew, survey leadership and shore based personnel for the handling, repairing and construction of fishing gear utilized during fishery surveys by the NEFSC.”

NEFSC Gear Training Program

- Intense 3-day course conducted for Survey and Vessel personnel
- 1st Course: December 6-8, 2005
  - Led by the Marine Institute
- 2nd Course: January 16-18, 2008
  - Led by DeAlteris Associates
- Intend to conduct courses on an alternate year basis during winter in port period (next course: Winter 2009/2010)

Summary

- Involve stakeholders in the process
- Design and test a more efficient sampling tool
- Develop training programs to ensure consistency
- Calibrate the current Albatross survey with the new Bigelow survey