Objective Delineation of Untrawlable Areas in Alaska Bottom Trawl Surveys

Michael Martin

December 13, 2011
Advantages:

• Knowledgeable and Experienced Captains
• Experienced Crew (critical for gear maintenance and safety)
• Cost savings
• Flexibility
• Standardization of methods
So, what might effect the decision on trawlability?

Different vessels
- Different echosounders/frequencies
- Different settings
- Vessel characteristics (e.g., pitch/roll)
- Noise sources

Different captains/crew
- Bottom trawling experience (especially with survey gear)
- Net-mending experience

Recent experience
- Recent gear damage
- Difficulty finding tow in stratum

Current conditions
- Sea state
- Time of day
- Distance to next station
Most Risk-Averse Captain

Fish Habitat

Survey Area
Less Risk-Averse Captain

Fish Habitat

Survey Area
Methods

Oscar Dyson

Multibeam data (Simrad ME-70)
- 31 beams
- 73-117 khz
- Pulse length 1.536 ms
- Athwartship coverage +/- 65 degrees

Split-beam data (EK-60)
- 5 frequencies (18, 38, 70, 120, 200 khz)
- 38 khz used for rockfish backscatter estimates
- 1 second ping rate
- 0.512 ms pulse length

ROV (Phantom DS4)

Epic Explorer
- Trawl
- Drop camera
- Split Beam data (ES-60)
Variance to mean ratio used to classify echo samples as coherent or incoherent for each set of pings (1 at each of five frequencies)

Coherent portion used to estimate slope
Slope estimated by fitting plane to x, y, and z Cartesian distances of coherent portion of each ping via least-squares.

ANOVA used to accept/reject valid estimates.
mean = -0.58
mode = -0.94

97% of estimates within 2 degrees or multibeam value

Difficult to fit near-zero slope

Pitch/Roll not considered
\[ p_{i,f} = p_{o_{i,f}} e^{-2k_f^2\rho_i^2 \cos^2 \phi_{i,f}} \]

where:

\( p \) = seabed echo pressure (10^{Sv/10} \times \text{integration layer thickness})

\( p_0 \) = zero roughness echo amplitude

\( k \) = acoustic wave number \( (2\pi / \lambda) \)

\( \rho \) = rms roughness

\( \phi \) = off normal incidence angle (slope)

\( i = 25 \text{ m interval} \)

\( f \) = frequency
Multibeam backscatter normalized to 45 degrees

Hardness
Noise at deeper depths – 200 khz
Potential Barriers to Implementation on Chartered Survey Vessels:

- Multiple frequencies?
  - Plan to redo analysis with 2 frequencies (38 and 120 kHz) and compare results

- Must be able to do in essentially real time?

- Availability of heave/pitch/roll data?
Special Thanks to:

NPRB

Officers and Crew of the Oscar Dyson
Captain and Crew of the Epic Explorer

Co-PI’s:
Tom Webber UNH (multibeam data)
John Butler SWFSC (ROV photos)
Darin Jones (rockfish Sa data)
Chris Wilson
Alex DeRobertis
Chris Rooper
Mark Zimmermann
Mark Wilkins