Simultaneous estimates of fish abundance with data from echosounder and sonar

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ABSTRACT

Echosounder beams observe a fairly narrow sector close to the vessel, so that small pelagic schools close to the sea surface are difficult to observe, especially when a protruding instrument keel is used. The arctic fish species capelin is typically distributed in mid-water and show weak vessel avoidance and is therefore considered ideal for abundance estimation based on echo sounder data, unlike many other fish species that some years have vertical distributions extending towards the sea surface, increasing the probability for a variable survey bias. In the present study an echo sounder and a sonar have been used to map the horizontal and vertical distribution of capelin and herring to give simultaneous density estimates.

MATERIAL AND METHODS

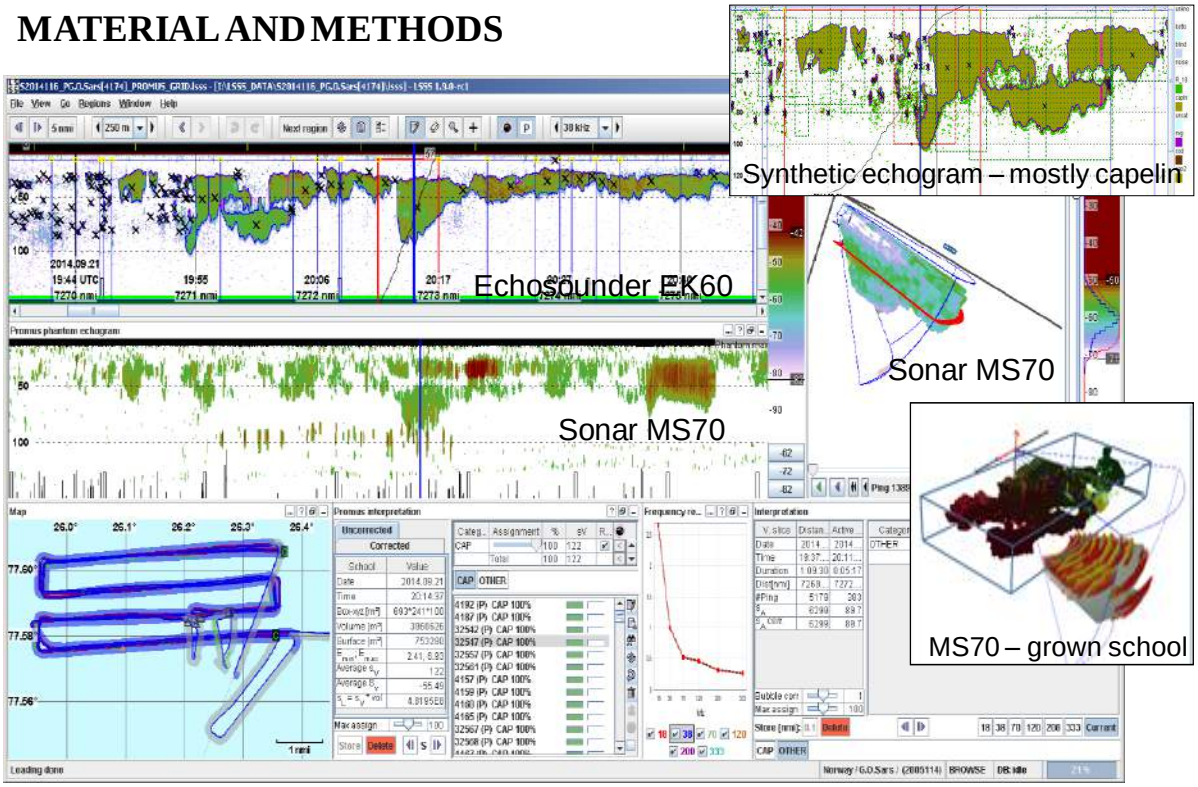

Figure: Capelin close to surface. Upper left: echosounder data. Upper right: synthetic echogram showing capelin as brownish. Middle left: echogram based on sonar data. Middle right: one 3-dimensional ping showing capelin. Lower right: grown school of capelin and part of bottom below. Lower left: survey grid covered.

Capelin is known to show little avoidance, and is therefore considered to be an ideal species for comparison of abundance estimates based independently on echosounder and on sonar. Here abundances based on measurements from a 6-frequency echosounder EK60 (18 – 333 kHz) are compared to measurements from a quantitative scientific 500-beam sonar MS70 (75 – 112 kHz) in the entire water column. A challenge is that the target strength of capelin as seen from a side-looking sonar is unknown, so it has to be estimated.

RESULTS

Comparison of echo-sounder and sonar abundance for the acoustically ideal fish (capelin)

Capelin target strengt from downward looking echosounder (±13° tilt variation dorsal)
38 kHz: TS_{38} = 19.1 Log L -74.0 [dB];
94 kHz: TS_{94} ≈ 19.1 Log L -77.2 [dB] (suggested), 3.2 dB from 38 kHz

Target strengt of capelin as seen from sonar could be considered as being omnidirective, i.e. ±90° ”tilt” variation side-aspect (i.e. not milling). Provided arbitrary swimming direction, we guess 3 – 4 dB lower side-aspect than dorsal.

Resulting measurements from three independent covarages

	MS70 (94kHz)	**[DEG]**	**EK60 (38kHz)**	**EK60/MS70**
1:	$\mathbf{s_A}$=1253	112	$\mathbf{s_A}$=6525	5.2 (7.2 dB)
2:	$\mathbf{s_A}$=497	112	$\mathbf{s_A}$=3544	7.1 (8.5 dB)
3:	$\mathbf{s_A}$=213	115	$\mathbf{s_A}$=1055	5.0 (7.0 dB)

SUMMARY

Solved issues:

- Data processing is fast enough,
- Abundance estimation seem to be reliable

Remaining issues:

- Some undesired signals are difficult to handle automatically
- Measurements are not reliable near the seabed

Management of marine resources is supported by extensive use of acoustic data. Ecosystem management requires simultaneous observations of marine organisms and their interactions. The use of quantitative sonar combined with vertical oriented echo sounders is essential.