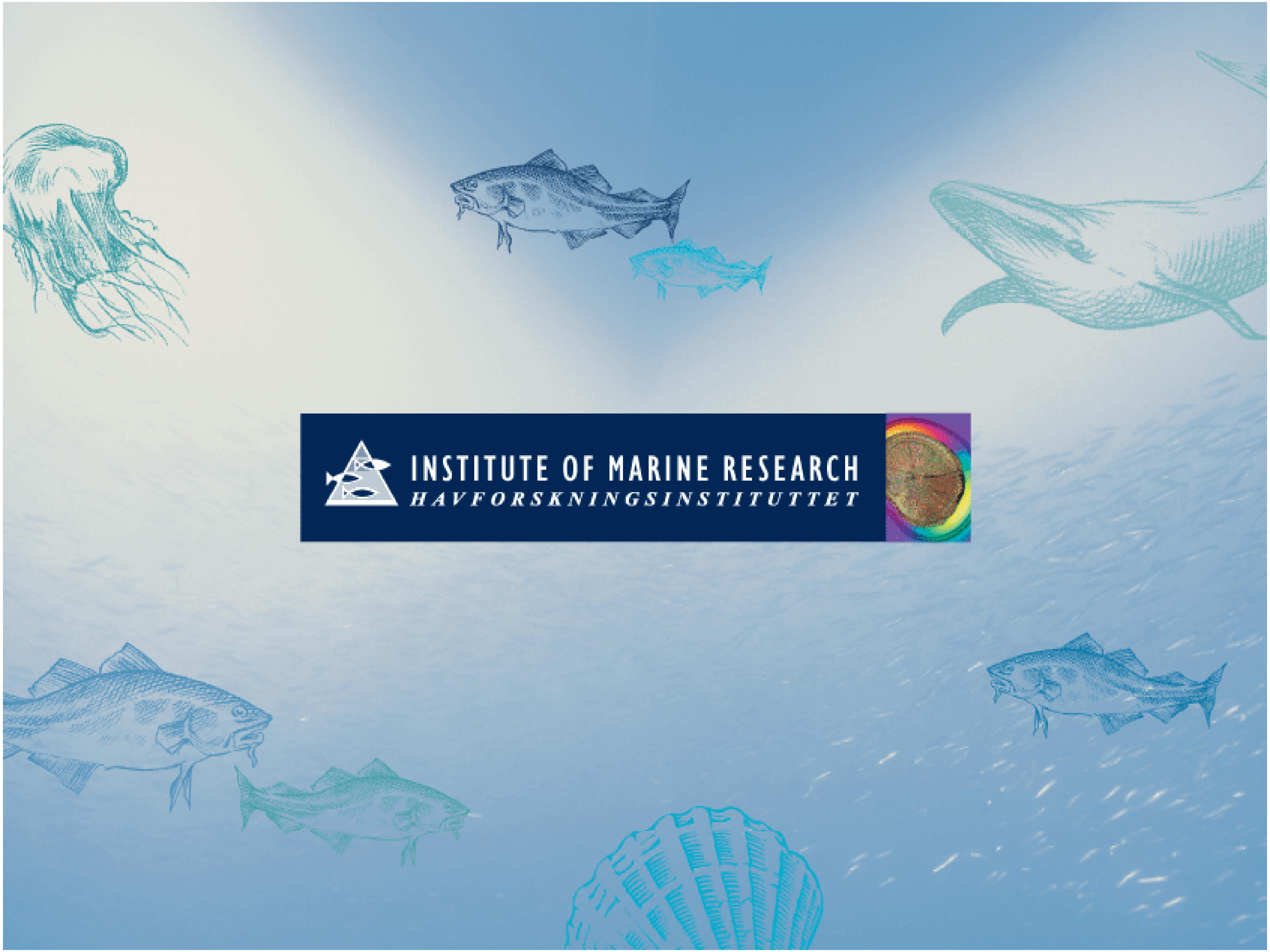

INSTITUTE OF MARINE RESEARCH
HAVFORSKNINGSINSTITUTTET

Summary of workshop: ”Optimisation of Research Vessel Design for Acoustic Sensors”, Kiel 16. March 2010

Hans Petter Knudsen

INSTITUTE OF MARINE RESEARCH
HAVFORSKNINGSINSTITUTTET

Invited speakers:

Dr.-ing. Uwe Hollenbach: Hull forms and Hydro-Acoustic and the Predictability of Bubble Sweep Down

Timothy Gates: Acoustic Issues on Multibeam Equipped Ships

Olivier Lefort: Gondolas and drop keels

Hans Petter Knudsen: Norwegian experience in implementing ICES 209

Dr.-Ing. Uwe Hollenbach
HSVA Hamburg Ship Model Basin:

THE HAMBURG SHIP MODEL BASIN
DESIGN • EXPERIMENTS • ANALYSIS

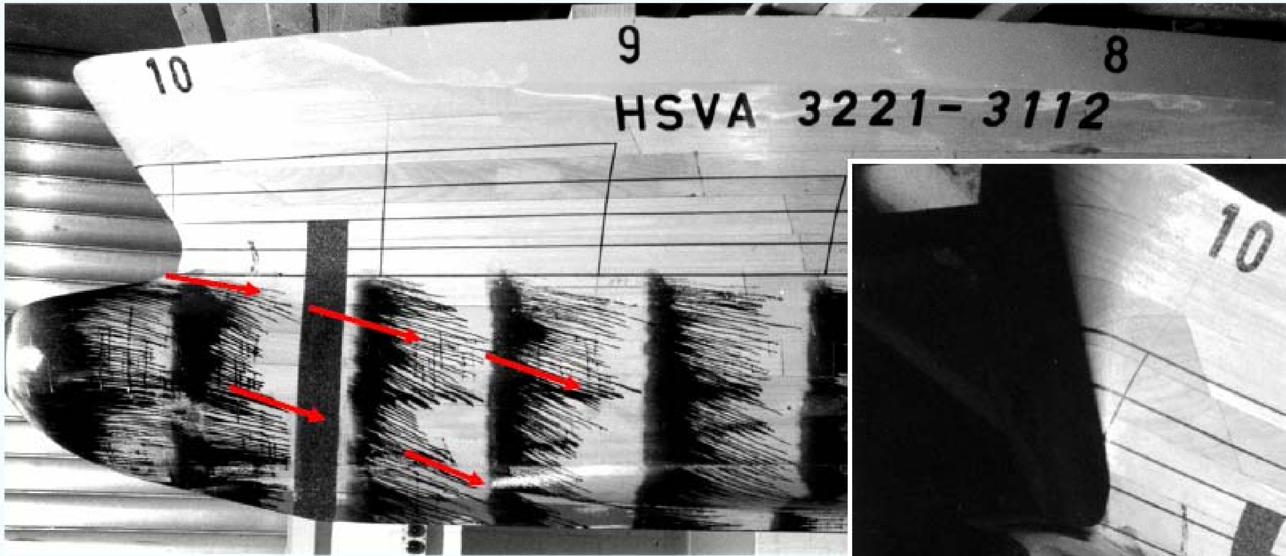
Hull Form and Hydro-Acoustics

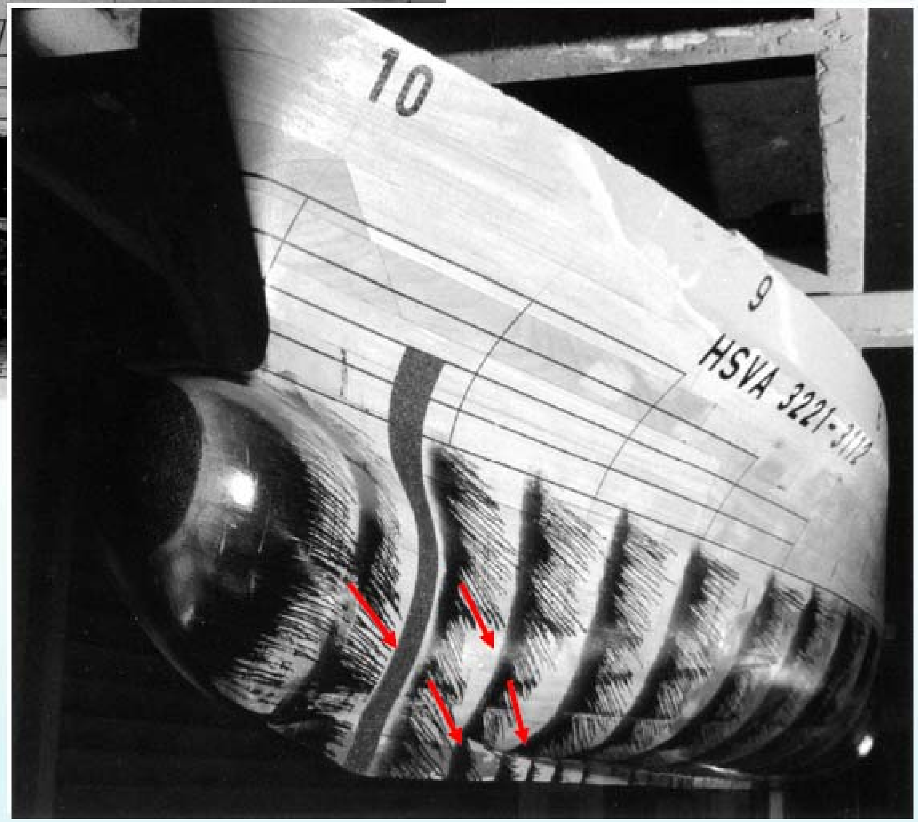
1. R/V "METEOR"
2. R/V "HEINCKE"
3. R/V "JAMES COOK"
4. Structure of Bow Waves
5. Mechanisms for Bubble Sweep Down
6. Proposed modern Hull Form for a Research Vessel
7. Appendages (gondolas, drop keels, etc.)
8. Predictions for Bubble Sweep Down – Numerical Calculations
9. Predictions for Bubble Sweep Down – Model Tests
10. Conclusions

Mechanism of the Bubble Sweep Down

1. The breaking bow (ships) wave generates air bubble clouds in vicinity of the water surface
2. In areas of low pressure (bulbous bow, forward shoulder, forward bilge area) air bubbles may emerge from saturated air
3. Transport of air bubbles from the water surface / from the ship sides along the flow lines to the sensor areas in the ships bottom
4. Heave and pitch motions additionally generate air bubbles and force the transport from the water surface along the flow lines to the ships bottom

R/V METEOR paint flow test





Recommendations for Research Vessel Design

1. Make your hull as long and as slender as possible, this will reduce the breaking bow wave and the generation of air bubbles in vicinity of the water surface.
2. Reduce the wave making for the operational draught and speed range of your research vessel and not only for the design draught and design speed.
3. Design the hull form in such a way to avoid strong downwards flow lines in the fore body.
4. Support the design process by numerical calculations. Start with potential flow methods in the first stage and validate the results by viscous flow methods including free surface.
5. Today there are no established numerical methods and/or model testing techniques to predict bubble sweep down!

Timothy Gates, ManTech, U.S.A.:

Acoustic Issues on Multibeam Equipped Ships (63 slides)

ISOM KIEL

16 March 2010

NAVSEA

NAVAL SEA SYSTEMS COMMAND

Carderock Division

SIGNATURES DIRECTORATE

NSWCCD

Typical Noise Sources

- Machinery noise
- Flow/hydrodynamic noise
- Appendage cavitation
- Propeller cavitation and noise
- Bubble sweepdown effects

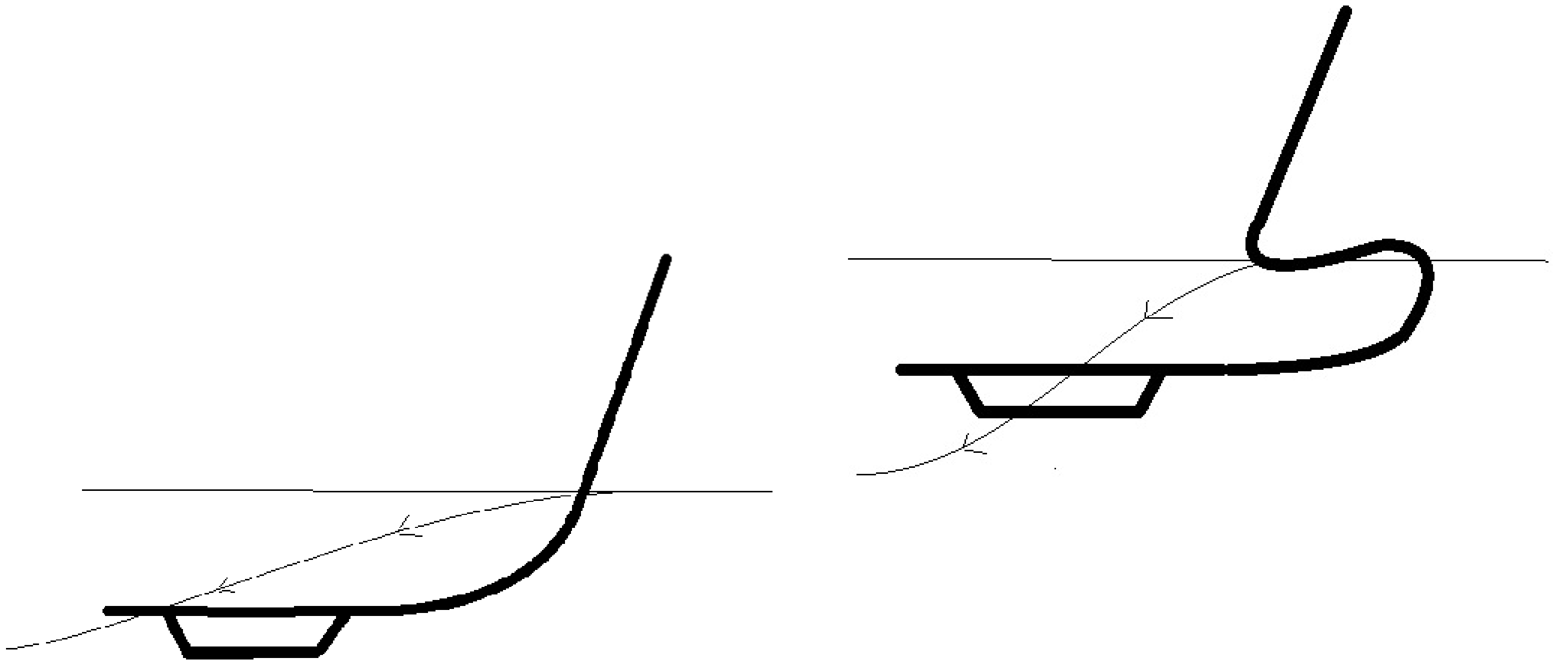
T-AGS 60 Class Current Configuration
Bubble Divertor

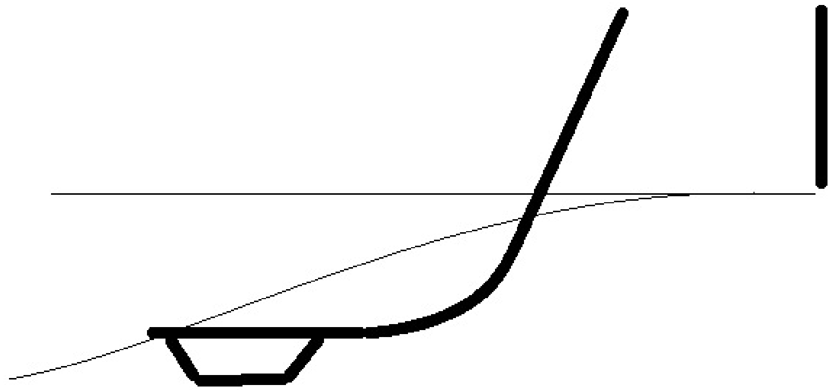
Photo courtesy of Mike Carver NAVO

Olivier Lefort, Ifremer:

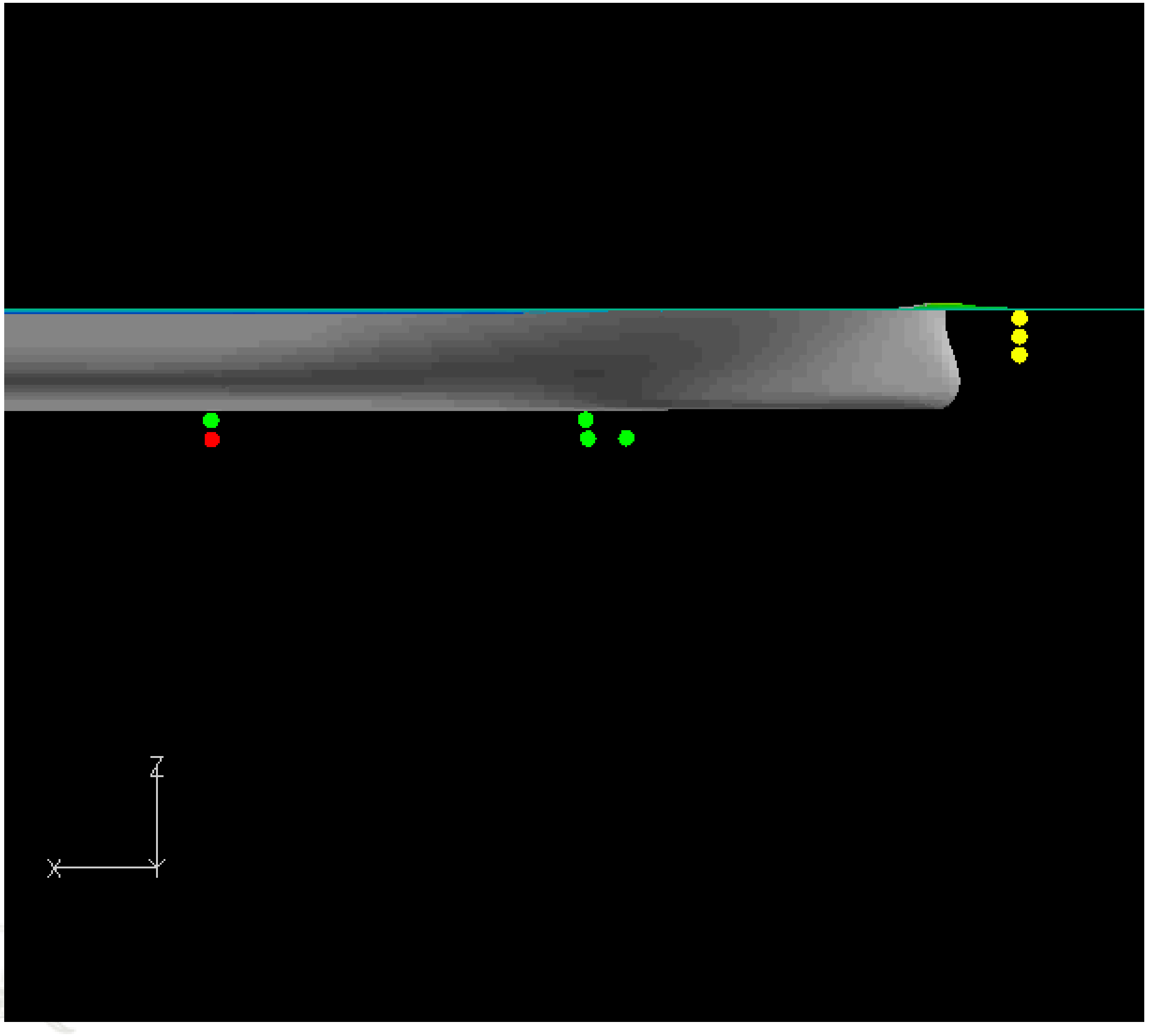
Gondolas and drop keels

Avoiding Bulbs





- Confirm the design before building trough towing tank trials with color injection at the bow and visualizations with cameras fixed in the water under the towing tank platform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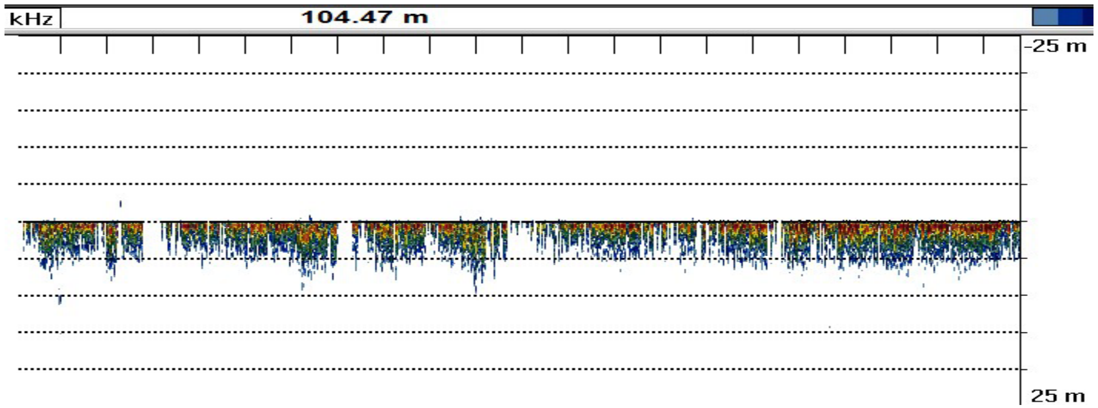
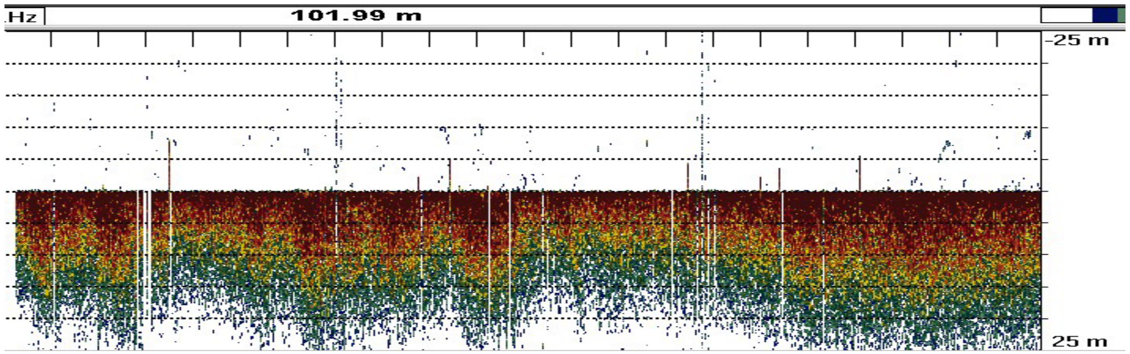


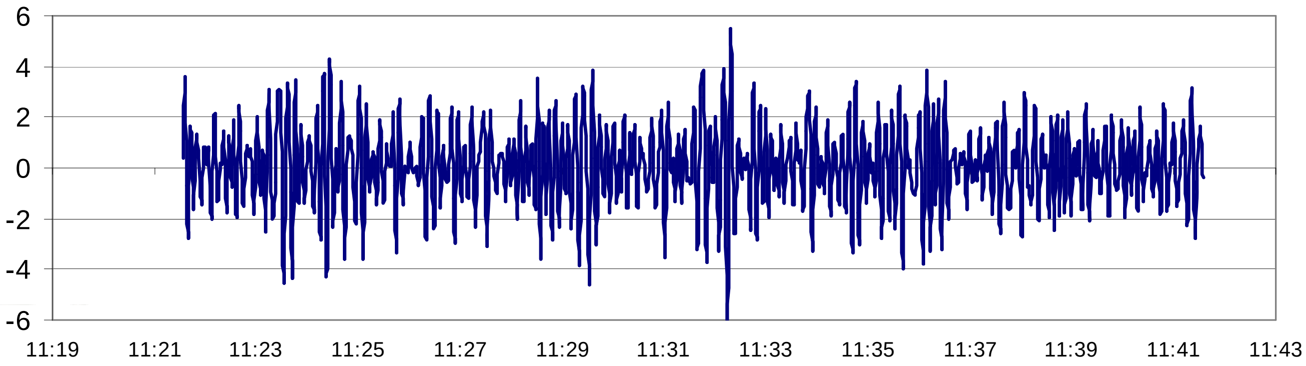
Gondola

False detections # 7



Transducer lower and forward

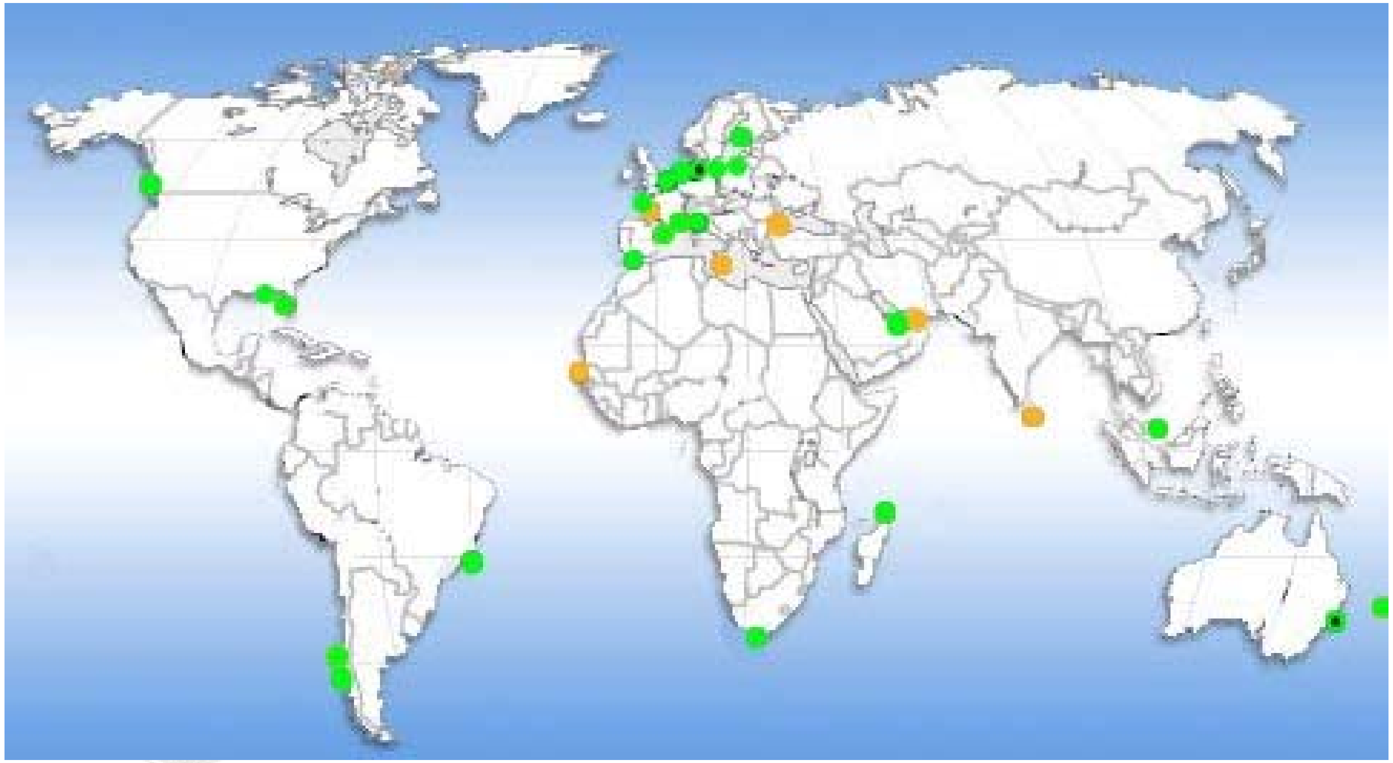
False detections < 1



Pitch

11H22 – mer de l'avant – 5 nds

Still a worldwide capability of dry-docking



Drydock possibility

Conclusions

- Those recommendations are NOT an insurance, but means of building a conviction and reduce risk against bubbles on transducers.

- We know quite nothing about bubbles size repartition in the water column and the influence of their size against transducers frequencies.

Norwegian experience in implementing ICES 209

Hans Petter Knudsen

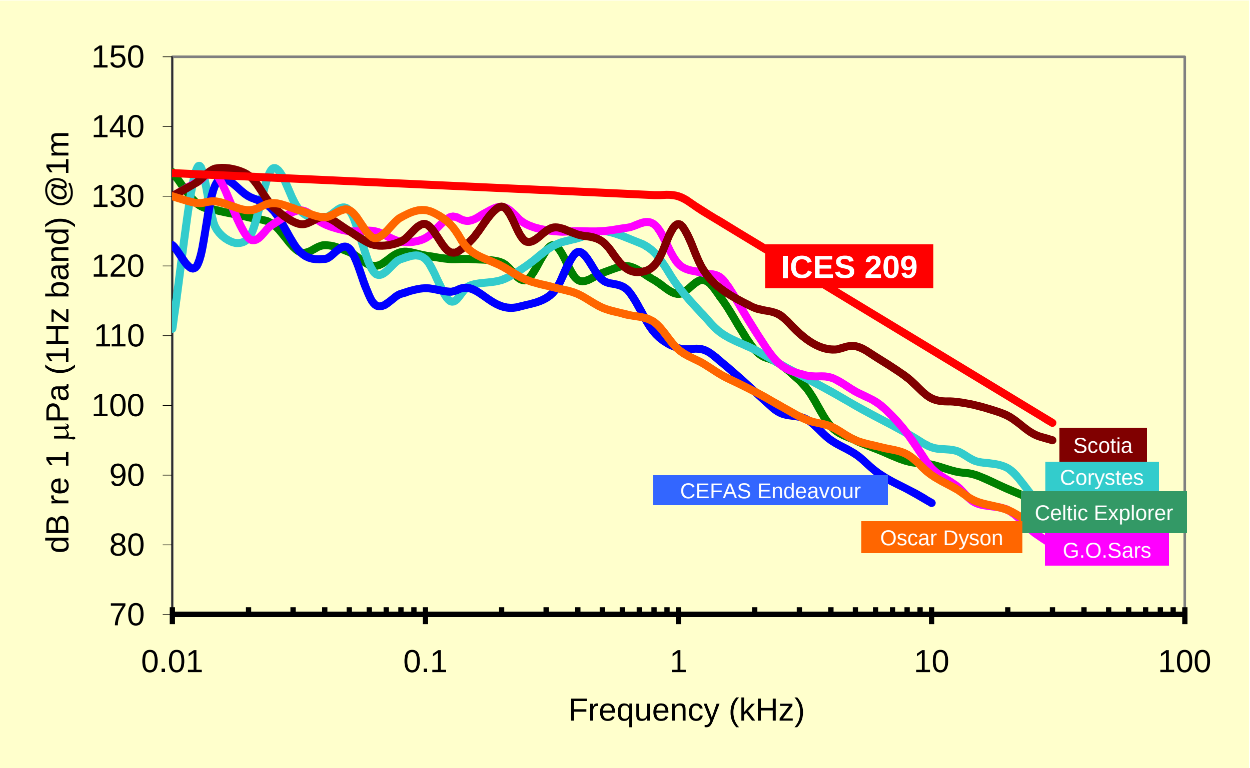
Optimisation of Research Vessel Design for
Acoustic Sensors,
Kiel 16. March 2010

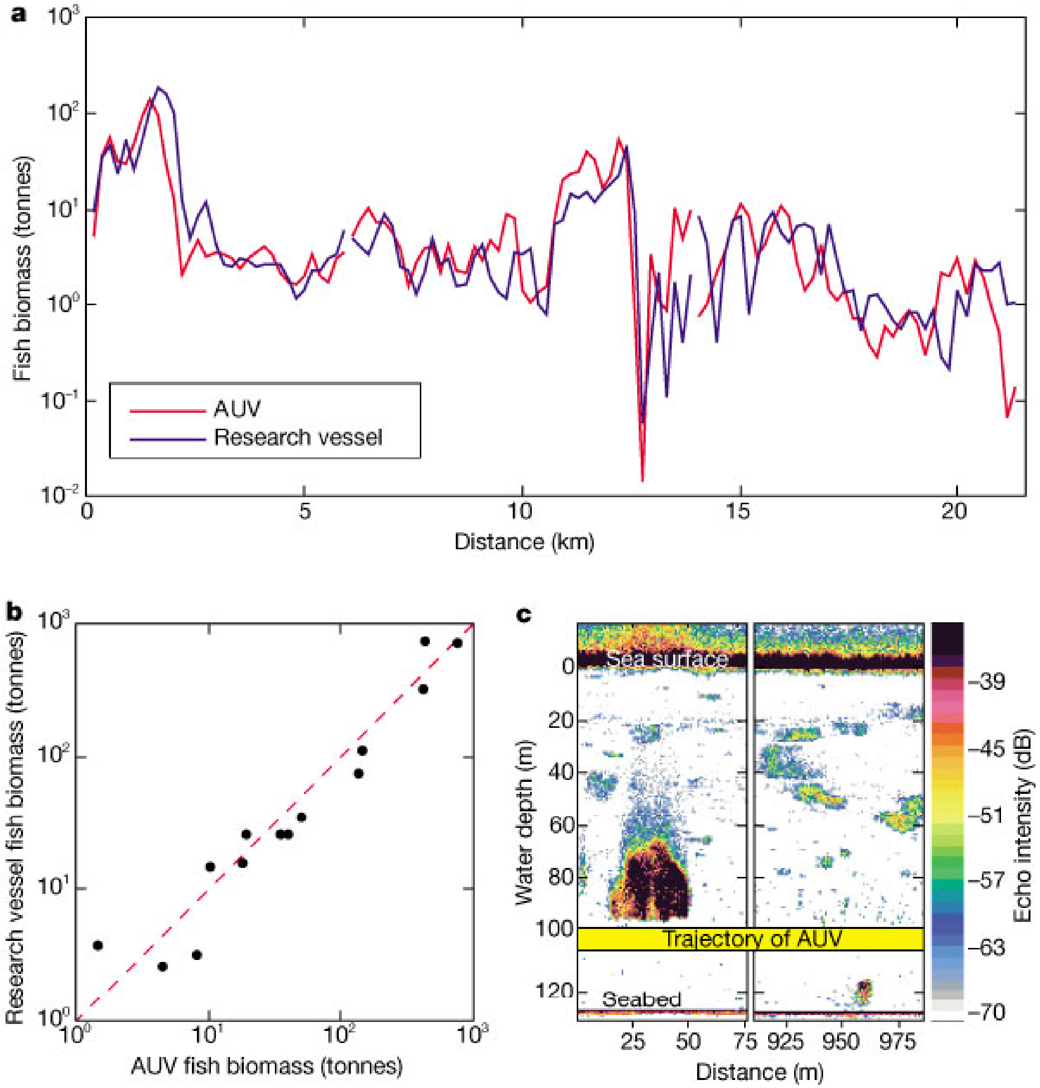
Background

What is reduced noise good for?

- Echo sounder performance
  - That is to run as fast as possible with acceptable noise level (a good echo sounder is less worth with a noisy vessel). This has always been an issue.
- Fish avoidance behaviour
  - Collect fisheries acoustics data under undisturbed conditions. Fish target strength and directivity is essential.
- Personnel comfort level and work environment
- Extended lifetime of machinery

Several recent research vessels comply with ICES 209



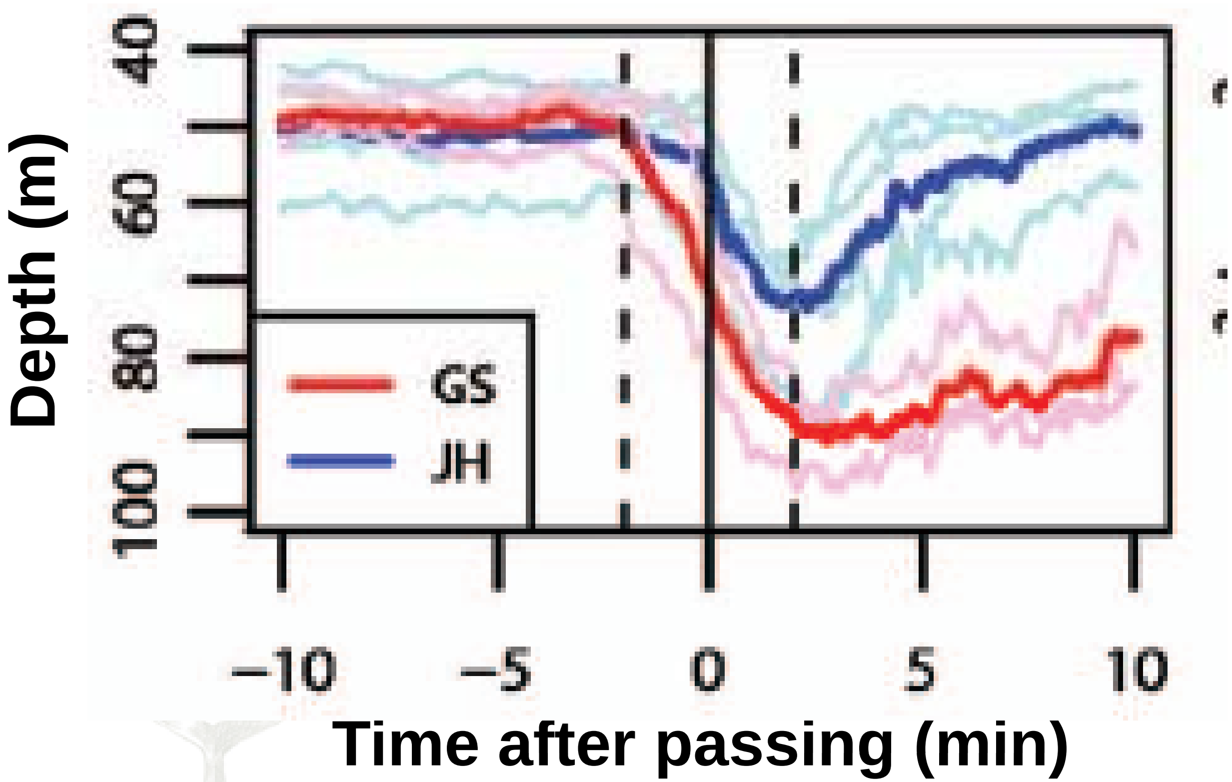


RV Scotia (1998)
vs
Autosub

Fish do not avoid survey vessels (Nature 2000)

P. G. Fernandes, A. S. Brierley, E. J. Simmonds, N. W. Millard, S. D. McPhail, F. Armstrong, P. Stevenson and M. Squires

Herring school avoidance behaviour



From: ”Silent research vessels are not quiet” JASA Express Letters

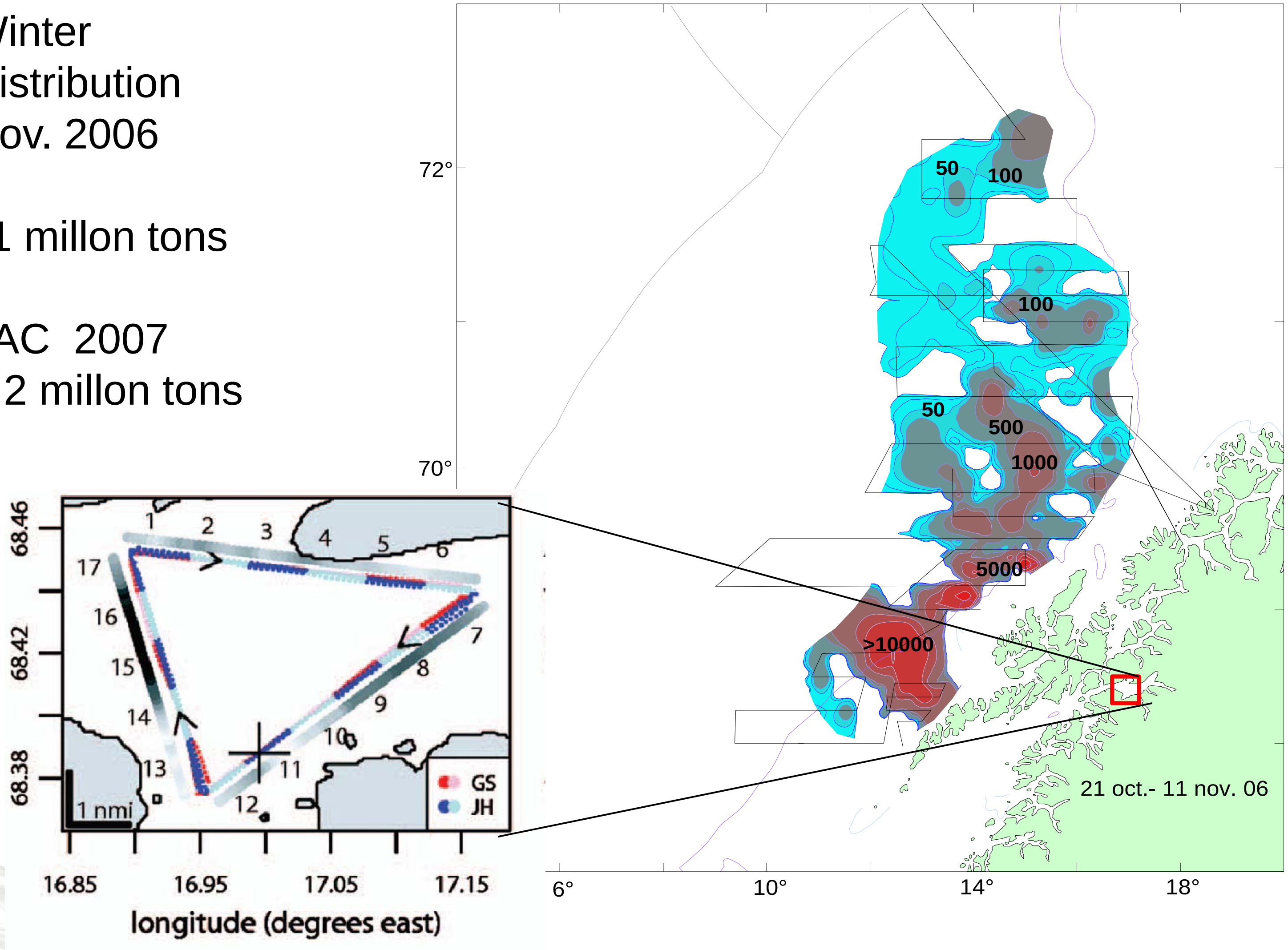
Egil Ona, Olav Rune Godø, Nils Olav Handegard, Vidar Hjellvik,
Ruben Patel and Geir Pedersen.
Institute om Marine Research, Bergen

Spring Spawning Herring

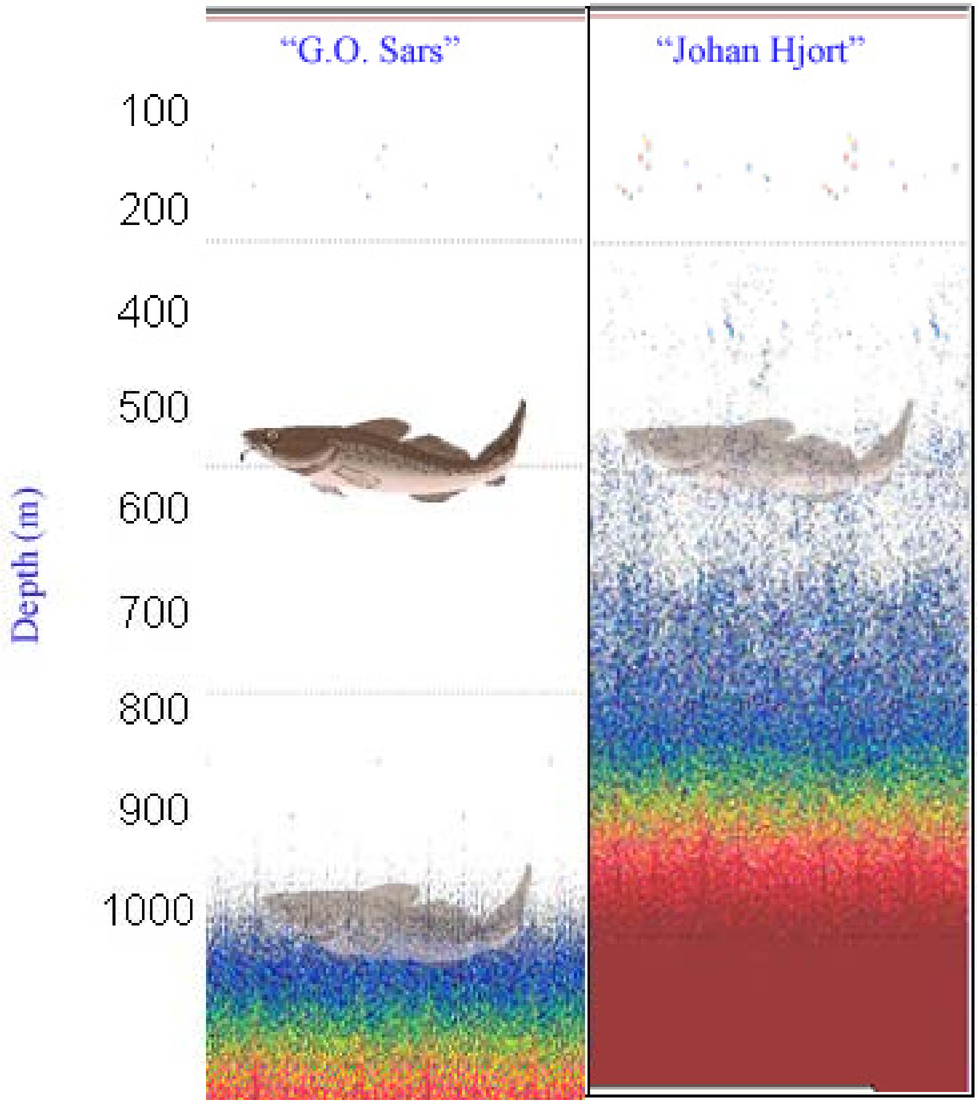
Winter
Distribution
Nov. 2006

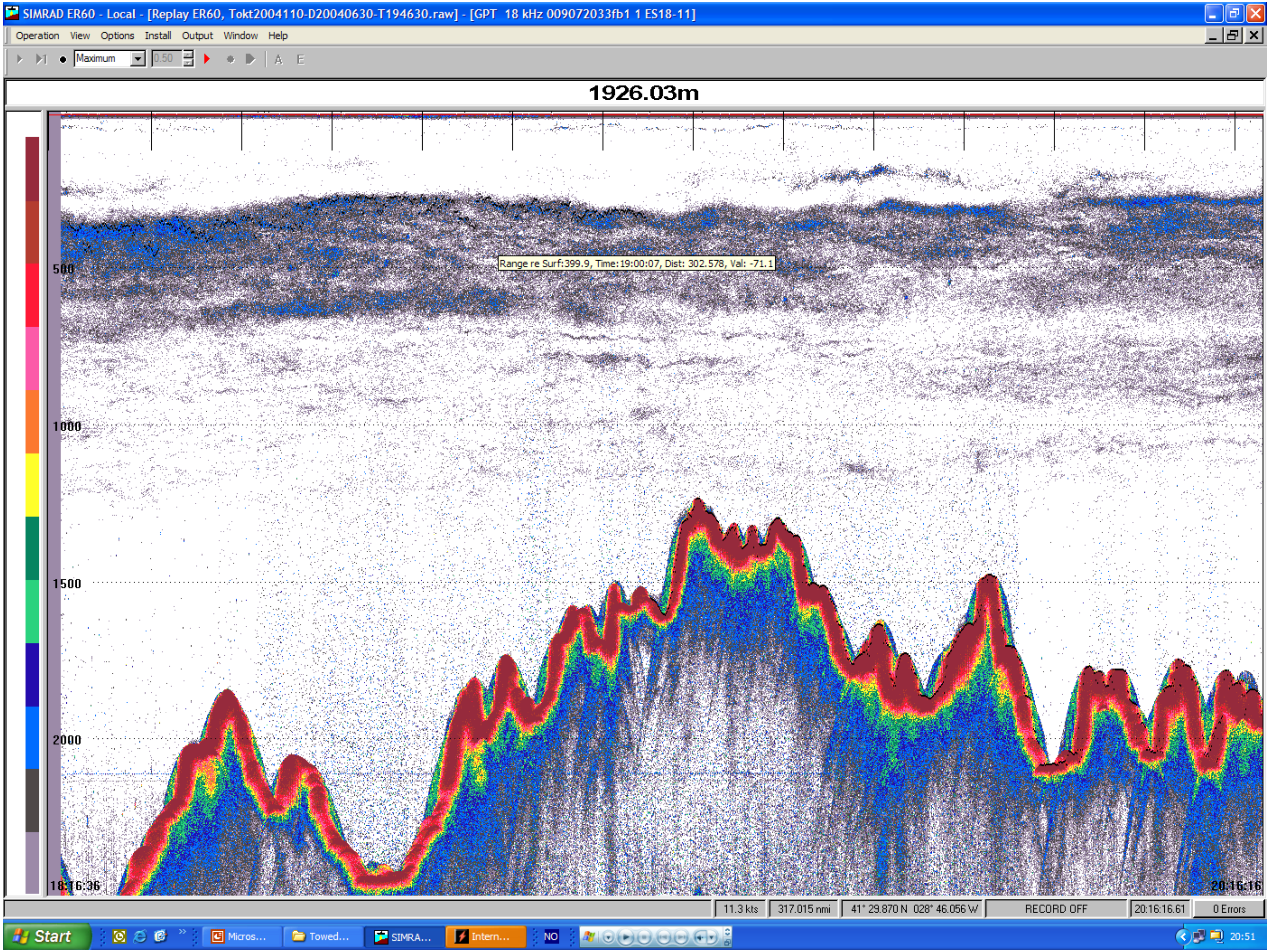
11 millon tons

TAC 2007
1.2 millon tons



Benefits from reduced noise




SIMRAD ER60 - Local - [Replay ER60, Tokt2004110-D20040630-T194630.raw] - [GPT 18 kHz 009072033fb1 1 ES18-11]
Operation View Options Install Output Window Help
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Range re Surf:399.9, Time:19:00:07, Dist: 302.578, Val: -71.1
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20:16:16
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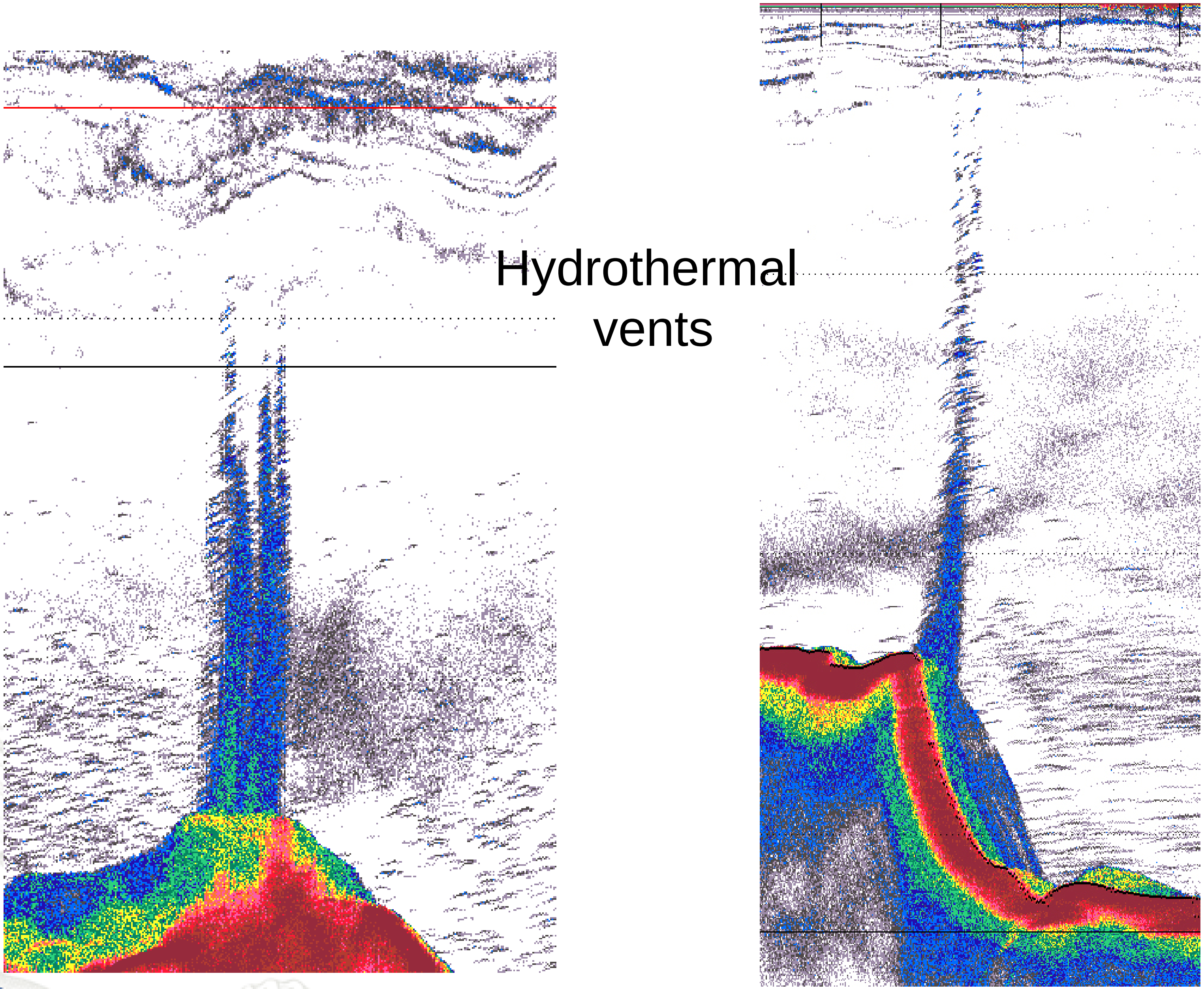
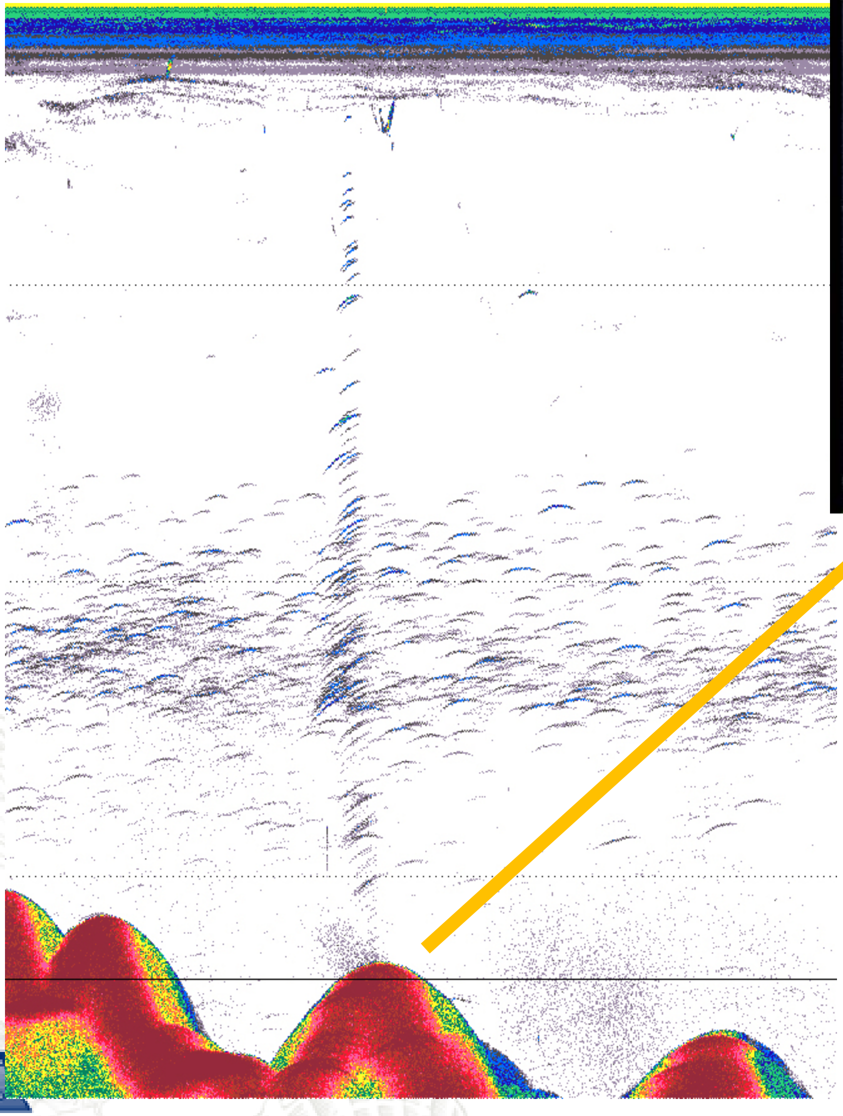
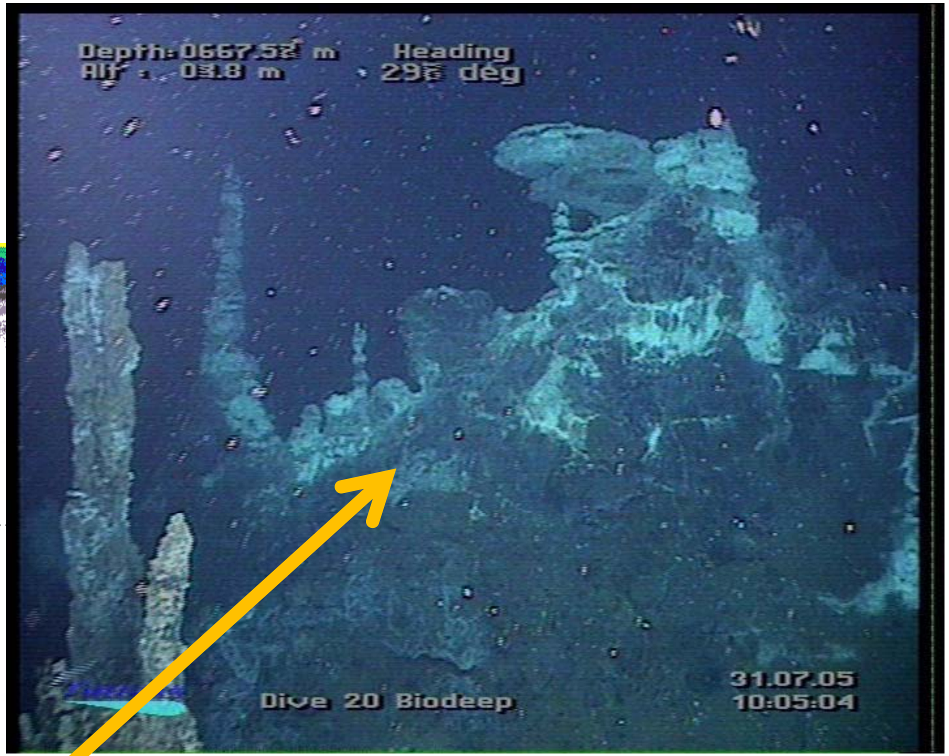


ER60 on RV G.O. Sars: color scale -100 dB





Fisheries acoustics helps geologists to discover fascinating landscapes

Conclusions

- The concept with resilient mounted diesel engines, DC motors and FPP is the only proven method to comply with ICES 209.
- The concept is considerably more expensive than conventional systems.
- Noise reduced vessels produce better acoustic data of all kinds.
- The personnel comfort and working environment is better.
- Some fish avoidance behaviour is not fully understood.