Fisheries Technology Committee **ICES CM 2003/B:04**
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REPORT OF THE

ICES Study Group on Acoustic Seabed Classification

Bergen, Norway
17–18 June 2003

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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1 INTRODUCTION

The inaugural meeting of the Study Group on Acoustic Seabed Classification (SGASC) was held at the Institute of Marine Research, Bergen, Norway, on 17–18 June 2003. The Study Group currently consists of 41 scientists, representing eleven different countries (Annex 1). Industry representatives of seabed classification technologies included Simrad, Quester Tangent, Echoview and Echoplus. A total of twenty seven scientists attended the two day meeting (Table 1). However, time conflicts with other Study (SGTSEB), Planning (PGHAC) and Working (WGFAST) Groups meant that only eleven scientists participated fully over the two-day period. The meeting was chaired by John Anderson (Canada), and Gary Melvin (Canada) was appointed Rapporteur. A brief history of ICES activities that led to the creation of the Study Group was presented by the Chair. Specific reference was made to previous meeting reports by the Working Group on Effects of Extraction of Marine Sediments on the Marine Ecosystem (WGEXT 2001, 2002) and the Working Group on Marine Habitat Mapping (WGMHM 2002). The Study Group agreed to consider the recommendations of the WGEXT and WGMHM in the work of the Study Group. To this end, participation by interested members of the other Study Groups is encouraged. The Chair of SGASC had contacted the Chairs of WGEXT and WGMHM prior to their April 2003 meetings, asking that the SGASC terms of reference be brought to the attention of their memberships and encouraging participation in the work and activities of the SGASC.

The terms of reference (Annex 2) for the Study Group were reviewed and discussed. To meet the terms of reference it was felt that a comprehensive review of existing knowledge and technologies was necessary. In particular, there is a need to review the existing theory of sound scattering from seabeds as a background for this work. There is a need to review and define the relevant scales of operation with respect to fisheries conservation, both from theoretical and application perspectives. Defining the relevant spatial and temporal scales was thought to be a necessary step towards understanding *a priori* the types of questions that we are trying to address with acoustic seabed classification technologies. Clearly, there is a need to review existing and emerging acoustic seabed classification technologies and assess their capabilities to objectively classify marine habitats in relation to previously defined scales of operation. The review should be inclusive of acoustic technologies deemed capable of classifying seabed habitats. This would include single beam echosounders (SBES), multi-beam echosounders (MBES), sidescan sonar and any other relevant acoustic system. The review of technologies would include objective methods of acoustic seabed classification in relation to marine habitats, including both deterministic and probabilistic methods. The Study Group acknowledged that classification of acoustic images can be done through visual interpretation of seabed features and the assignment of attributes. However, the Study Group concluded that acoustic classification of seabeds based on quantitative methods was more appropriate to the remit. Quantitative methods would include both deterministic and probabilistic approaches. Finally, the Study Group felt there was a need to review validation techniques (i.e., ground-truthing) currently being used to interpret acoustic images and classification of seabeds. Validation techniques cover a wide range of sampling tools from bottom grab samples, that are analysed for such things as sediment size and biological species composition, to sophisticated camera systems capable of operating continuously over large scales.

A discussion of specific issues attempted to further define and focus the work of the Study Group. The definition of seabed habitat features will include both physical and biological attributes. At traditional echo sounding frequencies (approximately 30 kHz to 300 kHz) most of the acoustic information for bottom classification will be from the topography and materials of the immediate water/bottom interface. However, it may be useful to define the extent of interest to acoustic seabed classification from up to one meter below and one meter, or more, above the substrate surface. This zone is intended to include biogenic structures directly associated with the seabed. Acoustic seabed classification results will be related to the shape and geological nature of substrate itself and to marine organisms, including finfish, invertebrates and benthic species. Acoustic classification of deep, subsurface geological features will not be part of the Study Group's mandate, as these are only measured by low frequency seismic systems. Issues of acoustic seabed classification will include spatial (topographic, 3D) and spatial temporal (4D) components. The Study Group will develop recommendations on data quality and data content standards, following the QTC outline and in relation to standards already contained in the HAC data standard, by coordinating with the Planning Group on HAC Data Exchange Format (PGHAC).

To meet the terms of reference the Study Group concluded that an ICES Cooperative Research Report should be developed for publication by 2005, the end of the three year mandated period. To this end, the Study Group developed a draft table of contents that would form the basis of the report (Annex 3). To meet the goals of the Study Group a steering committee was formed that includes John Anderson (Canada), Van Holliday (USA), Rudy Kloser (Australia), Dave Reid (Scotland) and Yvan Simard (Canada). The steering committee will work to identify a group of experts that will participate as authors for the various report chapters. The Study Group encourages participation by members of both WGMHM and WGEXT and requests that experts in acoustic seabed classification and its application to seabed habitat mapping issues be identified from within their memberships. The Study Group reported to the WGFAST on 21 June 2003 during its annual meeting in Bergen, Norway. The Study Group will report to the Fisheries Technology Committee and the Marine Habitat Committee by 31 July 2003. The Study Group plans to meet in one year's time on 18 and 19 April 2004 immediately in advance of the WGFAST annual meeting to be held in Gdynia, Poland.

ANNEX 1: LIST OF PARTICIPANTS

NAME	ORGANIZATION	COUNTRY
Alvsvåg, John	Institute of Marine Research	Norway
Anderson, John (Chair)	Department of Fisheries and Oceans	Canada
Byham, Paul *Non-Member*	Systems Engineering & Assessment Ltd.	UK
Christensen, Ole *Non-Member*	Losmasse (Marine Geology - Geophysics)	Norway
Collins, Bill *Non-Member*	Quester Tangent Corporation	Canada
Forbes, Hamish *Non-Member*	Seatronics	UK
Fossa, Jan Helge *Non-Member*	Institute of Marine Research	Norway
Gauthier, Stephane *Non-Member*	University of Washington, WA	USA
Gerlotto, Francois *Non-Member*	IRD/France	France
Goss, Cathy *Non-Member*	British Antarctic Survey	UK
Holliday, Van *Non-Member*	BAE SYSTEMS	USA
Karp, Bill *Non-Member*	National Marine Fisheries Service	USA
Kieser, Robert *Non-Member*	Department of Fisheries and Oceans	Canada
Kloser, Rudy *Non-Member*	CSIRO	Australia
Korneliussen, Rolf *Non-Member*	Institute of Marine Research	Norway
Lied, Thorbjorn *Non-Member*	Simrad	Norway
Macaulay, Gavin *Non-Member*	NIWA	New Zealand
Melvin, Gary *Non-Member*	Department of Fisheries and Oceans	Canada
Michaels, William *Non-Member*	National Marine Fisheries Service	USA
Mincassian, Armen-Sjur *Non-Member*	University of Oslo	Norway
Orlowski, Andrzej	Sea Fisheries Institute	Poland
Reid, Dave	Marine Laboratory	UK
Severin, Vladimir *Non-Member*	AtlantNIRO	Russia
Simard, Yvan	Université Rimouski/DFO	Canada
Stensholt, Boonchai	Institute of Marine Research	Norway
Wilson, Chris *Non-Member*	National Marine Fisheries Service	USA
Wilson, Matt *Non-Member*	Sonardata	Australia

ANNEX 2: TERMS OF REFERENCE FOR THE STUDY GROUP ON ACOUSTIC SEABED CLASSIFICATION (SGASC)

a) evaluate acoustic seabed classification technologies and applications, its underlying physics, theoretical basis, and empirical practices in relation to:

   i) scales of observations, data quality and standards;

   ii) classification methods and criteria;

   iii) ground-truthing means;

   iv) sampling design;

b) discuss methods and approaches to combining the above ancillary information in studies on fish distribution, abundance and ecology.

ANNEX 3: DRAFT TABLE OF CONTENTS FOR THE PROPOSED ICES COOPERATIVE RESEARCH REPORT ON ACOUSTIC SEABED CLASSIFICATION DEVELOPED DURING THE INAUGURAL MEETING OF THE STUDY GROUP ON ACOUSTIC SEABED CLASSIFICATION (SGASC), 17–18 JUNE 2003

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Acoustic diversity

The classification process
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Resolution in range and time
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Spatial Interpolation between transects

Classification of scale, for example Greene *et al.* (1999)

5 **Review of Acoustic Seabed Classification Systems**
Brief description of application and physical principles
Single Beam Echosounder Systems (SBES)
Multibeam Echosounder Systems (MBES)
Sidescan Sonar Systems

Bathymetric Sidescan Sonar (interferometric)
Other techniques and potential future developments [separate Chapter?]

6 **Acoustic System and Calibration Requirements**
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Signal Analysis and Feature extraction
Image Processing

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