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Final Report of the Working Group on Target Classification (WGTC)

17–18 April 2016

Vigo, Spain



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H. C. Andersens Boulevard 44–46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

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Executive summary

The Working Group on Target Classification (WGTC) met on three occasions, all immediately prior to the Working Group on Fisheries Acoustic Science and Technology (WGFAST) meetings: on 3–4 May 2014 in New Bedford, USA, on 23–24 May 2015 in Nantes, France, and on 17–18 April 2016 in Vigo, Spain. Rolf J. Korneliussen, Norway, served as chair. Thirty-one experts reported their interest to contribute to the WGTC, of which 25 actually contributed to the work. The WGTC chair reported results of the work from WGTC to WGFAST.

The first meeting reviewed literature and contained several presentations to bring WGTC members up to speed. The structure on the proposed CRR was decided, and the responsible for each section proposed ICES Cooperative Research Report (CRR) was decided. Work on some sections was done. The second meeting reviewed more literature, and slightly modified the structure of the proposed CRR, and work on the sections prior to the meeting were revised.

Acoustic data are currently being collected from a variety of acoustic systems in many countries to address a range of ecosystem monitoring and stock management objectives. There is no ICES CRR covering this topic, but there are two CRR in adjacent topics: CRR 238, Editor: David G. Reid, Echo Trace classification; and a CRR, Edited by John T. Anderson on Bottom classification. Note that the CRR 238 focused mostly on single-frequency and school-based methods, and that at the time work on multifrequency and wideband methods (while covered in that CRR) was more in development but now is much more mature.

The proposed CRR has avoided content of previous CRRs, e.g. on Echo trace classification (CRR 238, edited by David G. Reid, 2000) and Seabed classification (CRR 286, edited by John T. Anderson, 2007). Note that the CRR 238 focused mostly on single-frequency and school-based methods. The meaning of the term “Target classification” was decided during by WGTC to be regarded as essentially “species identification”. This proposed CRR is suggested to contain broad advices of needs to classify targets as well as examples, but is not suggested to be a strict recipe of how to classify targets.

The 2016 Vigo meeting of WGTC was entirely working on the proposed CRR itself. The work concentrated on ToR a) literature review and on methods for data collection and data preprocessing for optimal target classification, and on theoretical principles of target classification. The draft CRR currently contains 90 pages in 11 chapters and two appendixes. The CRR is intended to not be much longer than 125 pages, with practical use of the methods collected as case studies in appendixes being a large proportion (30–50%, 38% of the current draft). The draft CRR contains recommended protocols for methods to be used for target classification during ecosystem surveys including commonly used acoustic systems used in fisheries research and surveys principles of classification, general and specific to these selected systems and standard protocols for classifying multifrequency data.

The remaining work until the finalization of the CRR is to harmonize the sections, secure the allowance to use some of the figures, reorganize slightly the document, and expand some sections.

The target audience for the proposed CRR is decided to be:

- **Users:** Those that provide abundance estimates and those that carries out the surveys. Scientists and technicians that need to understand what can be

done, including possibilities and limitations, also being able to use existing processing tools and modify existing tools within their framework. This includes knowledge of what can be done and what cannot be done, but not more than at best basic knowledge for why.

- **Developers:** Thorough knowledge of the theories and their limitations, with the purposes of both using existing tools/programs, and also to implement own tools. The theories should be able to be implemented in own developed processing tools.

1 Administrative details

Working Group name

Working Group on Target classification (WGTC)

Year of Appointment within the current three-year cycle

3

Reporting year concluding the current three-year cycle

3

Chair

Rolf J. Korneliussen, Norway

Meeting venue(s) and dates

3–4 May 2014, New Bedford, USA, (16 participants)

23–24 May 2015, Nantes, France, (23 participants)

17–18 April 2016, Vigo, Spain, (14 participants)

2 Terms of Reference a) - z)

ToR	Description	Background	Science Plan topics addressed	Dur.	Expected Deliverable
a)	Review, summarize and report on the literature regarding (1). Acoustic systems currently used in fisheries research and surveys, (2) theoretical principles of target classification and (3) methods currently being practised;	The ICES reference for acoustic target classification needs to be useful to practitioners of fisheries acoustics and ecosystem surveys that produce data for stock management. The first step in this process is to review, summarize and report on the literature regarding the methods that are currently used in fisheries research and surveys. The theoretical principles for target classification must be summarized, and the methods currently being practised must be evaluated		2 years	Review document presented to WGFAST in 2015
b)	Develop recommendations protocols for methods to be used for target classification during ecosystem surveys including (1) commonly used acoustic systems used in fisheries research and surveys (2) principles of classification, general and specific to these selected systems (3) standard protocols for classifying multifrequency data	There is a need for recommendations to the ICES community for methods to be used for acoustic target classification. These methods cover commonly used acoustic systems used in fisheries research and ecosystem surveys, and must be generic enough for application in systems not specifically considered. The methods must be practical and based on solid theoretical principles.		3 years	Recommendations document presented to WGFAST in 2016
c)	Based on ToR a) and b) a CRR proposal should be developed for SCICOM consideration.	There is a recognized need to comprehensively document the current theory and recommended practice of acoustic target classification for use in Fisheries Science and ecosystem surveys, and publish them in an easily accessible report.		3 years	CRR proposal submitted for consideration by SCICOM in September 2016. CRR report itself to be submitted September 2017

3 Summary of Work plan

Year 1 (2014–2015)	Initiate the work
Year 2 (2015–2016)	Finalize the review (ToR a)
Year 3 (2016–2017)	Finalize recommendations and prepare a CRR proposal (ToR b) and c))

4 Summary of Achievements of the WG during 3-year term

- Work on CRR initiated;
- Literature review finalized;
- Proposed authors of several chapters CRR delivered sections for second draft;
- First 40 pages of CRR draft (from previous year) were revised;
- Proposed authors of several chapters CRR delivered sections for third draft;
- Additional 50 pages of CRR draft were put together, and 90 pages of the proposed CRR were revised.

5 Final report on ToRs, workplan, and Science Implementation Plan

ToR a) Fulfilled. Literature regarding acoustic systems used in fisheries research and literature regarding theoretical principles of target classification has been reviewed, and literature references are found in the proposed CRR draft. Methods currently being practised are partly referred (literature), and the most relevant methods are parts of the proposed CRR.

ToR b) Fulfilled. Recommended protocols for methods to be used for target classification during ecosystem surveys are developed. Methods commonly used, principles for classification, and standard protocols for classifications of multifrequency data are organized as chapters in the proposed CRR.

ToR c) Progress as planned. The results of ToR a) and b) are used to develop a proposed CRR. The proposed CRR can be considered for publication, although work still remains (as of August 2016).

The CRR is supposed to be a practical document. Highlights are illustrated by some figures in the case studies that show the methods actually work, e.g. Figure 1 in section 12.1.2, Figure 8 in section 12.1.4, and Figure 2 in section 12.1.5.

6 Cooperation

- Cooperation with other WG: WGFAST
- Cooperation with Advisory structures: none
- Cooperation with other IGOs: (TLA unknown)

7 Summary of Working Group self-evaluation and conclusions

- 1) Working Group name. Working Group on Target Classification
- 2) Year of appointment. 2013
- 3) Current Chairs. Rolf J. Korneliussen
- 4) Venues, dates and number of participants per meeting.
 - 3–4 May 2014 in New Bedford, USA, 16 participants
 - 23–24 May 2015 in Nantes, France, 23 participants
 - 17–18 April 2016 in Vigo, Spain, 17 participants

WG Evaluation

- 5) If applicable, please indicate the research priorities (and sub priorities) of the Science Plan to which the WG make a significant contribution.

A key procedure in acoustic biomass estimation is the correct assigning of backscatter to species or species-group level. It has been estimated that the systematic error, associated with the identification of acoustic backscatter can be as high as $\pm 80\%$. Automated species identification can be a valuable input to the scrutiny process and offers the potential for a more objective result.

- 6) In bullet form, highlight the main outcomes and achievements of the WG since their last evaluation. Outcomes including publications, advisory products, modelling outputs, methodological developments, etc.
 - *Giving requirements to data to be used in acoustic categorization*
 - *Showing algorithms to be used in acoustic categorization*
 - *Applying algorithms in case studies*
 - *The main outcome is a proposed CRR.*

- 7) Has the WG contributed to Advisory needs? If so, please list when, to whom, and what was the essence of the advice.

Not directly yet. The case studies do, however, show that many of the algorithms collected in the proposed CRR are being used by some institutions.

- 8) Please list any specific outreach activities of the WG outside the ICES network (unless listed in question 6). For example, EC projects directly emanating from the WG discussions, representation of the WG in meetings of outside organizations, contributions to other agencies' activities.

There are no outreach activities outside the ICES network directly connected to the WC

- 9) Please indicate what difficulties, if any, have been encountered in achieving the workplan.

No unexpected difficulties were met.

Future plans

- 10) Does the group think that a continuation of the WG beyond its current term is required? (If yes, please list the reasons)

No, provided the proposed CRR is to be submitted from WGTC September 2017. If not, the group need an extension.

- 11) If you are not requesting an extension, does the group consider that a new WG is required to further develop the science previously addressed by the existing WG.

There is currently a confusion if the proposed CRR is to be submitted in September 2017 or September 2016.

- 12) What additional expertise would improve the ability of the new (or in case of renewal, existing) WG to fulfil its ToR?

The WG had the necessary expertise.

- 13) Which conclusions/or knowledge acquired of the WG do you think should be used in the Advisory process, if not already used? (please be specific)

Several methods for automatic classification will support the process of scrutinizing acoustic data, and thereby indirectly reduce uncertainty in estimating fish stock abundance.

Annex 1. List of participants

Name	Address	E-mail
Rolf J. Korneliussen	Institute of Marine Research, PO box 1870 Nordnes, 5817 Bergen, Norway	rolf.korneliussen@imr.no
Alex DeRobertis	Alaska Fisheries Science Center 7600 Sand Point Way, NE, mail stop F/AKC1 Seattle, WA 98115, USA	Alex.DeRobertis@noaa.gov
Ian McQuinn	850, route de la Mer Mont-Joli, Québec Canada, G5H 3Z4	Ian.McQuinn@dfo-mpo.gc.ca
Anne Lebourges-Dhaussy	IRD, UMR LEMAR IRD Bretagne, ZI de la Pointe du Diable, BP70 29280 Plouzané, France	anne.lebourges.dhaussy@ird.fr
J Michael Jech	NEFSC 166 Water St. Woods Hole, MA 02543, USA	michael.jech@noaa.gov
Stephane Gauthier	Institute of Ocean Sciences, 9860 West Saanich Road, PO Box 6000, Sidney, British Columbia, Canada V8L 4B2	stephane.gauthier@dfo-mpo.gc.ca
Rudy Kloser	CSIRO, Hobart, Tasmania, Australia	Rudy.Kloser@csiro.au
John Horne	School of Aquatic and Fishery Sciences University of Washington Box 355020 Seattle, WA 98195, USA	jhorne@uw.edu
Dezhang Chu	NOAA/NMFS/NWFSC/FRAM 2725 Montlake Blvd. E. Seattle, WA 98112 USA	dezhang.chu@noaa.gov
Sven Gastauer	Center for Marine Science & Technology Kent Street Perth Western Australia 6845 Australia	Sven.gastauer@postgrad.curtin.edu.au
Briony Hutton	GPO Box 1387, Hobart Tasmania, Australia, 7001	briony.hutton@echoview.com
Reka Domokos	Ecosystems and Oceanography Division, Pacific Islands Fisheries Science Center, National Marine Fisheries Service, NOAA, 2570 Dole Street	reka.domokos@noaa.gov
Mathieu Doray	Ifremer, France Département Ecologie et Modèles pour l'Halieutique rue de l'Ile d'Yeu B.P. 21105 44311 Nantes Cedex 03, France	Mathieu.Doray@ifremer.fr
David Demer	NOAA Fisheries 1315 East-West Highway Silver Spring, MD 20910, USA	david.demer@noaa.gov
Marian Peña Saenz	Instituto Español de Oceanografía (IEO) España	marian.pena@ba.ieo.es

Ben Scoulding	IMARES, Haringkade 1, IJmuiden PO Box 68, 1970 AB IJmuiden The Netherlands	ben.scoulding@wur.nl
Pablo Carrera	Instituto Español de Oceanografía (IEO), Centro Oceanografico de Vigo, Subida a Radio Faro, 50 36390 Vigo, España	pablo.carrera@vi.ieo.es
Laurent Berger	Ifremer IMN/NSE/AS BP 70 29280 plouzane France	laurent.berger@ifremer.fr
Charles H Thompson	Southeast Fisheries Science Center, Mississippi Laboratories Rm2010, 1021 Balch Blvd, Stennis Space Center, MS 39529	Charles.h.thompson@noaa.gov
Toby Jarvis	GPO Box 1387 Hobart, Tasmania, Australia, 7001	toby.jarvis@echoview.com
Federico Iriarte	Fishing Harbour, Tema CE 11254, Tema, Ghana	Federico.Iriarte@mwbrands.com Faya2005s@yahoo.com
Mathias Scaber	Thünen-Institute of Sea Fisheries Palmaille 9, 22767 Hamburg, Germany	matthias.schaber@ti.bund.de
Pierre Petitgas	Ifremer Rue de l'île d'Yeu 44311 Nantes Cédex 03 France	Pierre.Petitgas@ifremer.fr
Sophie Fielding	British Antarctic Survey (BAS), Natural Environment Research Council, High Cross, Madingley Road, Cambridge, CB3 0ET, UK	sof@bas.ac.uk
Fabio Campanella	NOAA -National Ocean Service National Centers for Coastal Ocean Science 101 Pivers Island Road Beaufort, North Carolina, 28516, USA	fabio.campanella@noaa.gov fabiocampanella1@gmail.com
Sasha Fässler	Haringkade 1, IJmuiden PO Box 68, 1970 AB IJmuiden The Netherlands	sascha.fassler@wur.nl

Annex 2. Recommendations

ICES Working Group on Target Classification did not reach any recommendations within any of the meetings. There are, however, two challenges that have been discussed, namely the increased possibilities for reliable target classification due to the use of acoustic wideband, and also the challenges due to large amounts of data. That needs to be addressed by ICES Working Group on Fishery Acoustics Science and Technology (WGFAST). Furthermore, there is also a need for better tools to verify the results of target classification. That needs to be addressed by the ICES-FAO Working Group on Fishery Technology Fish Behaviour (WGFTFB).

It is recommended that WGTC meets also in 2017 for the final edits of the proposed CRR. There will be none presentations in the 2017 WGTC meeting since all participants are now expected to be up to speed on target classification methods. The 2017 meeting will solely be work on finalizing the report to be submitted in September 2017.

RECOMMENDATION	ADRESSED TO
1. Challenges connected to wideband acoustics need to be solved	WGFAST
2. Better tools to verify the classified targets is needed	WGFTFB