ICES WGFAST REPORT 2015

Second Interim Report of the Working Group on Fisheries Acoustics, Science and Technology (WGFAST)

29 May 2015

Nantes, France

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Executive summary

The Working Group on Fisheries Acoustic Science and Technology (WGFAST) met in Nantes, France, on 29 May 2015. Verena Trenkel, France, served as Chair. There were 43 participants who discussed the report from the linked Working Group on Target Classification (WGTC), the needs created by the increasing use of wideband acoustics and resulting potential future activities for WGFAST, the contribution to the South Pacific regional management organization (SPRFMO) initiative on calibrating echosounders on fishing vessels, the organization of an ICES training course on how to run an acoustic survey and other initiatives.

The working group meeting followed the ICES Symposium on "Marine Ecosystem Acoustics – observing the ocean interior across scales in support of integrated management", which attracted 214 participants from 31 countries. During the symposium 94 talks including three key note talks and 87 posters were presented on i) recent developments in acoustic sensor and platform technologies, ii) acoustic characterization of aquatic organisms, ecosystem structure, and ecosystem processes and iii) the contribution of acoustics to integrated ecosystem assessments and management. The presentations were followed by lively debates.

1 Opening of the meeting

Verena Trenkel (Ifremer, France), WGFAST Chair, opened the meeting, and welcomed the working group members to the Institut Français de Recherche pour l'Exploitation de la Mer (Ifremer) in Nantes, France.

The Chair Verena Trenkel introduced the structure of the working group and the terms of reference.

2 Adoption of the agenda

The **Working Group on Fisheries Acoustics, Science and Technology** (WGFAST), chaired by Verena Trenkel, France, will meet in Nantes, France, on 29 May 2015, to work on ToRs and generate deliverables as listed in the Table below.

WGFAST will report on the activities of 2015 (year 2) by 30 June 2015 to SSGIEOM.

ToR descriptors

ToR	Description	Background	Duration	Expected deliverables
a	Produce a list of papers originating from the community of the WGFAST working group	The WGFAST community produces several papers every year, and an update on recent WGFAST activities that acknowledges ICES is important.	Year 1, 2 and 3	An updated list of references
b	Present recent work within the topics "Applications of acoustic methods to characterize ecosystems", "Acoustic properties of marine organisms", "Behaviour", and "Emerging technologies, methodologies, and protocols".	Create a venue for informing the group members on recent activities and seeking input to furhter developement. An overview of the different contributions will be presented in the annual report.	1,2,3	Report
c	Write a review to showcase the work of WGFAST with particular emphasis on its relevance to the ICES/ACOM strategic plans	After three years a review paper will be written to showcase the work of WGFAST	3 year	Write a review paper showing the WGFAST contribution over the last 3 years
d	Organize international acoustic symposium	Organize the 8th international symposium with working title "Marine Ecosystem Acoustics – observing the ocean interior across scales in support of integrated management"	2015	Symposium and special issue in ICES Journal of Marine Science
e	Organize joint sessions at ICES ASC	Organize joint sessions with survey working groups to foster collaboration regarding the use of acoustics data and cross-fertilization	2 or, 3	Topic session at ICES ASC

Note on Tor b)

As the ICES Symposium on Marine Ecosystem Acoustics took place prior to the working group meeting, all recent work was presented and discussed at the symposium (see Tor d).

Additional topics for the meeting:

i) Initiatives by SPRFMO (Francois Gerlotto).

ii) Report from the working group on Acoustic target classification (WGTC; Rolf Korneliussen).

During the WGFAST meeting, time will be available for presentations and discussions on general interest topics including recommendations for an ICES acoustic training course and an update on recent advances and uses of acoustic wideband methods.

3   TOR a: List of papers originating from the community of the WGFAST working group 2014–2015

Listed below are publications and reports for which WGFAST participants made significant contributions to and which benefited from discussions during WGFAST meetings.

Peer-reviewed publications

Chu, D., and Eastland, G. C. 2015. Calibration of a broadband acoustic transducer with a standard spherical target in the near field. Journal of the Acoustical Society of America, 137: 2148–2157.

Chu, D., Jech, J.M., Tomich, S.D., Hufnagle, L.C. Jr. 2015. A high-resolution acoustic imaging system to map interior fish morphology. Mar. Tech. J., 49(2): 59–69.

Dunford, A. J, O'Driscoll, R. L., and Oeffner, J. 2015. Improvements in estimating an acoustic target strength-length relationship for hoki (*Macruronus novaezelandiae*). Fisheries Research, 162: 12–19.

Gauthier, S., Oeffner, J., and O'Driscoll, R.L. 2014. Species composition and acoustic signatures of mesopelagic organisms in a subtropical convergence zone, the New Zealand Chatham Rise. Marine Ecology Progress Series, 503: 23–40.

Jech, J. M., Sullivan, P. J. 2014. Distribution of Atlantic herring (*Clupea harengus*) in the Gulf of Maine from 1998 to 2012. Fisheries Research, 156: 26–33.

Trenkel, V. M., Hintzen N. T., Farnsworth K. D., Olesen C., Reid D., Rindorf A., Shephard S., and Dickey-Collas M. 2015. Identifying marine pelagic ecosystem objectives and indicators for management. Marine Policy, 55: 23–32.

Reports

Demer, D. A., Berger, L., Bernasconi, M., Bethke, E., Boswell, K., Chu, D., Domokos, R., *et al.* 2015. Calibration of acoustic instruments. ICES Cooperative Research Report No. 326. 133 pp.

O'Driscoll, R. L. 2015. Acoustic biomass estimates of southern blue whiting on the Bounty Platform in 2014. New Zealand Fisheries Assessment Report, 2015/02. 28 p.

O'Driscoll, R. L., Bagley, N. W., Ballara, S. L., Ladroit, Y. 2015. Trawl and acoustic survey of hoki and middle depth fish abundance on the west coast South Island, July–August 2013 (TAN1308). New Zealand Fisheries Assessment Report, 2015/20. 104 p.

O'Driscoll, R. L., Ladroit, Y., Dunford, A. J., MacGibbon, D. J. 2015. Acoustic survey of spawning hoki in Cook Strait and Pegasus Canyon during winter 2013. New Zealand Fisheries Assessment Report, 2015/04. 51 p.

O'Driscoll, R. L., Oeffner, J., Dunford, A. J. 2015. Acoustic biomass estimates of southern blue whiting on the Bounty Platform in 2013. New Zealand Fisheries Assessment Report, 2015/01. 28 p.

4 TOR d: Organize international acoustic symposium

The ICES Symposium on Marine Ecosystem Acoustics – observing the ocean interior across scales in support of integrated management – was held in Nantes, France from 25–28 May 2015. The primary aim of the symposium was to bring together scientists and ideas from various fields to facilitate and catalyse interdisciplinary interactions, with acoustics as the central tool, to further the development of marine ecosystem acoustics. This was the 7th ICES sponsored Symposium on Fisheries Acoustics and Technology investigating aquatic ecosystems.

The Symposium was organized around three main themes:

- Recent developments in acoustic sensor and platform technologies: 35 oral presentations
- Acoustic characterization of aquatic organisms, ecosystem structure, and ecosystem processes: 41 oral presentations
- The contribution of acoustics to integrated ecosystem assessments and management: 15 oral presentations

Ninety-seven poster presentations contributed to all three themes.

The symposium was attended by 214 participants from 31 countries:

COUNTRY	NUMBER OF PARTICIPANTS
Argentina	1
Australia	13
Belgium	1
Canada	8
China	2
Dankmark	1
Faroes Islands	4
France	25
Germany	1
Ghana	1
Greenland	1
Ireland	1
Island	2
Italy	4
Japan	24
Kuwait	1
Mexico	2
Netherlands	5
New Zealand	4
Norway	30
Peru	4

Country	Number of participants
Portugal	1
Russia	1
Saudi Arabia	1
South Africa	2
South Korea	5
Spain	9
Sweden	3
Turkey	1
UK	17
USA	39

Participants of ICES Symposium on Marine Ecosystem Acoustics, 25–28 May 2015, Nantes, France.

4.1 Summary session reports

4.1.1 Recent developments in acoustic sensor and platform technologies

A series of talks and posters described the development of new platforms for sensors used in fisheries acoustics. A new generation of compact, low-power acoustic instruments are being deployed on a wide variety of new platforms including moorings, ocean-going robotic vehicles, fishing vessels and fishing trawls and tags on fish. These tools are undergoing rapid development and becoming increasingly available to practitioners of fisheries acoustics, and have the potential to provide a large amount of data in a cost-effective manner. From the discussions during the question periods, it was evident that this work is largely in early stages of development, and will be an active area of research in fisheries acoustics in the next decade. The primary challenge in the use of these platforms is how the data from these new platforms are going to be used for science and management advice. These alternative platforms are likely to be more

limited in their capabilities than ships: for example, acoustics is often conducted to-gether with net sampling, but this will not be possible with many of these, and species identification may be difficult. There is thus a need for studies examining the ad-vantages and limitations of the data produced with new platforms and their potential applications.

A series of talks presented how passive acoustics could be used to measure noise, lo-cate cetaceans as well as fish, and study their behaviour. Passive and active acoustics were combined to study cetaceans in relation to their trophic environments. The in-crease of anthropogenic sound in the water is a concern and is being monitored using networks of stations equipped with hydrophones. Automated algorithms such as ma-chine learning algorithms are now available for real-time data analysis and noise iden-tification. The noise field generated by scientific echosounders was modelled taking into account sound level, pulse length, radiation and multi-paths. Physiological dam-age to cetaceans is improbable with fisheries echosounders. However, behavioural change is unknown and dedicated studies are needed. It was shown how the use of hydrophones (passive acoustics) could serve to identify cetacean calls. The periods of cetacean migration in the Bering Sea were identified. Migrations coincided with the unset of zooplankton production and ice free periods. Passive acoustics was also used to study fish grunts and automated data analysis packages are available for their char-acterization. Grunts show cyclical variation with environmental drivers such as tide, light, season and their conjunction, with for instance, more grunts occurring at high tide after sun set. Yet, what the fish are talking about is still unknown. One study demonstrated how coupling passive and active acoustics on a single survey could help understand the distribution of cetacean in their trophic surroundings. Passive acous-tics was also used to locate cetaceans and multifrequency active acoustics to discrimi-nate and map the fish species which are their prey. More work is needed to understand the scales of the spatial interactions and the specialization on particular prey.

The use of multibeam and omnidirectional (azimuthally) sonars for quantitative esti-mates of fish, such as school biomass estimates, was discussed by several contributors. Efforts to reach these quantitative estimates has led to work on calibration issues, on software to perform schools extraction using image processing approaches, and the impact of fish swimming behaviour and orientation on the acoustic measurements. Fish tracking and behavioural studies using these tools remain an oft-discussed aspect of classification. Complementary collection of vertical echosounder data with multibeam and omnidirectional echosounder data appears to be more common, at least partly because these tools are becoming more widely available on ships, with each tool providing a unique set of advantages and helping to overcome the shortcomings of the other.

Several presenters examined the accuracy of processing techniques in wide-ranging topics: fish length estimates from DIDSON data, or seabed habitat classification, and an empirical study on the frequency-dependent sound absorption coefficient that is commonly used to adjust acoustic estimates. A study that attempted to unify the acous-tic theory used for vertical beam echosounders was also presented.

Several contributions discussed the use of broadband systems. The potential for these new tools is being explored by several different institutes. There was discussion of the broadband transducer technology, the challenges of using broadband echosounders near boundaries, and the use of broadband acoustic signals for species classification. Several challenges related to these new systems clearly remain including the genera-tion of new techniques for calibration, range performance issues, and susceptibility to

noise. The comparison of frequency responses from sampled species and sizes is being actively addressed. Among the expected improvements from these new systems are better identification of targets for both scientific purposes and to better avoid bycatch on commercial fishing vessels.

4.1.2 Acoustic characterization of aquatic organisms, ecosystem structure, and ecosystem processes

The presentations highlighted progress in the application of acoustic methods to studying organisms ranging from zooplankton to fish using multifrequency acoustics, optical and various capture technologies.

The spatial and temporal features of euphausiids in relation to environmental condition and predation pressure were studied using integrated acoustic, optical and net sampling techniques. The arrival of large zooplankton was identified as a feature that could be used to determine the release timing of juvenile salmon for stock enhancement using moored acoustic profilers. One study presented automated data analysis techniques to estimate the seasonal pattern of size-specific zooplankton biomasses using upward-looking acoustic profilers of an ocean observatory. All the three talks showed that acoustics, and multifrequency acoustics in particular can play an important role in the study and classification of zooplankton in ecosystem studies.

Mesopelagic organisms, or the ubiquitous deep-sea sound-scattering layers (SSLs), has drawn increasing attention in the acoustic community, and was the focus of about twelve oral presentations and posters in this Symposium. Two related talks were presented in this session. The first study differentiated the various migrating layers using multiple frequencies aided with theoretical scattering models and net trawls. While the second study employed similar techniques to study the SSLs, it drew the attention to resonant scattering that can complicate the biomass estimation of mesopelagics using acoustic methods.

Several talks dealt with acoustic detection/identification of various targets in distinct environments using different acoustic methods and data analysis techniques. Various approaches used for remote species identification in the challenging coral reef environment were reviewed and an analytical approach developed for the classification of fish based on habitat and acoustically derived parameters. A stepwise top thresholding post-processing technique was presented to separate week targets, such as jellyfish and zooplankton, from stronger fish targets in mixed echo registrations, a "mission impossible" before the development of the multifrequency techniques. Broadband acoustic were used to study the acoustic property of cod eggs and larvae in relation to their age and life stage in an experimental setup; concurrent video observation confirmed that the ping-to-ping variation in the backscattering property of the larvae is correlated with the swimming motion of the larvae. An eight-month multifrequency observation of the migrating community in the high Arctic using a moored acoustic system was presented. For this dataset, species of copepod and krill of different size classes were identified, and krill was found to be the most likely group to be responsible for midwinter DVM behaviour. Several statistical methods were used to classify acoustic targets, such as random Forests, which were demonstrated for Antarctic krill, icefish and mixed aggregation in the Southern Ocean and a semi-supervised, non-parametric Bayesian mixture model, which was used to allocate backscatter to different categories for walleye pollock survey in the Bering Sea. Line fishing and video footage provided multiple lines of evidence to interpret target classifications obtained with acoustics combined with the traditional trawling method.

The important topic of target strength (TS) was the focus of several presentations. Experimental observations of the TS and tilt angle were reported for ribbonfish, an important commercial fish with extremely elongated body shape and gas-filled swimbladder. A large change in target strength was found from the vertical to horizontal tilt angle orientation of this species that explained changes in observed echo intensity. Tethered TS measurements were reported for three important zooplankton groups, namely euphausiids, copepods and amphipods. The measurements agreed reasonably well with DWBA model predictions, except for the high oil content copepod specimen, indicating that the oil sack needs to be considered during modelling exercises. Lateral TS measurements and frequency responses of herring and mackerel were obtained with a four frequency broadband acoustic system lowered into the fish layers. The lateral TS (f) were compared with the dorsal TS (f) and empirical individual directivity measurements, and it showed that the lateral scattering is much less directive than that of the dorsal aspect, which is relevant to biomass estimation of these fish using sonars. Lateral TS frequency response measurements were obtained for 45–55 cm saithe with a moored four frequency acoustic system. The study showed that the lateral TS of saithe increased smoothly across the four frequencies and is opposite to the reported trend in frequency response from dorsal aspect of the same species. Lastly, in situ TS measurements and Kirchhoff Ray Mode (KRM) model results of fish species in a mixed demersal fishery were presented.

Several contributions utilized acoustic instrumentation to observe fine scale processes in situ or in controlled mesocosm experiment. The applications ranged from behavioural processes and distribution patterns within marine protected areas and in the vicinity to subsea structures to behavioural changes in fish exposed to noise and other anthropogenic stressors. Other contributions addressed the use of acoustics to observe fine scale behaviour and distributions within the deep scattering layer and relating that to the behaviour of top predators and how the interactions affected prey distribution. Fine scale vertical migrations resolved using bottom moored echosounders were shown and the use of acoustics to resolve social behaviour in jellyfish. There was a contribution addressing the use of multibeam echosounders to extract species-specific school structures.

The acoustics characterization and classification of ecosystems and ecosystem processes at large-scales was highlighted by several talks and posters. These presentations focused on the mesopelagic organisms and how acoustic data can be used to study their behaviour, biomass and comparisons between biogeographic provinces at basin scales. The talks highlighted the complexities in the species in the mesopelagic region and difficulties in converting scattering to biomass. This difficulty was highlighted by the changing scattering of gas bladders with depth due to resonance and the difficulty in distinguishing between fish and siphonphores. Understanding these issues is necessary to make quantitative use of the data in ecological models. Two papers were presented on the progress being made integrating acoustic data into ecological models that focused on the mesopelagic region. These presentations highlighted the great potential of acoustics to help understand the global mesopelagic habitat where ongoing detailed region studies and better acoustic coverage are needed.

4.1.3 Contribution of acoustics to integrated ecosystem assessments and management

The keynote by Mark Dickey-Collas provided a thorough introduction to what an integrated assessment is and the potential contributions of acoustics. There are different definitions and legal frameworks around the world for integrated assessments but the

most commonly used is that developed by FAO, which considers the biological eco-system, human exploitation activities and ecosystem services. Integrated assessments are an element of the ecosystem approach to manage anthropogenic pressures on the marine ecosystem. The first steps of an integrated assessment are to define the elements of the system to assess and scope achievable objectives to the assessment. For that collaboration with society and stakeholders is key. Two major challenges are to convert information (data) into knowledge for a purpose and methodology for undertaking the integration between a variety of indicators. For instance, can we set targets for a food-web? Acoustic surveys provide a large amount of information about the ecosystem. In particular, they not only provide information on fish stocks abundance series but also inform on many other components of the ecosystem such as plankton, micronekton and seabed. The presentation was themed as exploiting the "gold mine" of acoustics for integrated assessments.

Acoustic stock estimates result from the combination of various parameters including target strength, length distribution, age–length keys, identification of echotraces and spatial distribution of backscattered energy. The session presented methods to combine different sources of information and their corresponding errors and in particular, Bayesian approaches. Catchability of the stock to the surveys was also considered. Using maps of length histograms was proposed rather than mean length per trawl. A major issue discussed was the correlation between error sources.

A number of talks combined several observation methods and habitat modelling to improve abundance or biomass estimates. For example, school counting using sonar data were combined with echosounder or sonar data for estimating school size/density. This approach raises the issue of school detectability being a function of school size. The use of various optical methods depending on the species of interest was discussed for abundance estimation in untrawlable habitats. To upscale estimates from the small observation field to relevant large-scales they proposed to combine estimates with habitat suitability maps. In another study aerial photograph, based estimates of juvenile bluefin tuna school size were combined with acoustics derived estimates of school height and width to obtain abundance estimates. Clam abundance was estimated combining clam habitat estimates derived from multibeam sonal data with dredge samples.

Several talks considered the relationship between biotic and abiotic conditions and local abundance/distributions, which has consequences both for management and for survey design. One study investigated whether there was evidence of a top down effect of walleye pollock on Euphausiids, which could lead to a negative relationship between Euphausiids and walleye pollock local abundances (or more correctly reduce Euphausiid production but this is not measurable with acoustics). The results did not provide much support for the hypothesis while temperature had a negative effect on Euphausiid abundance in one area indicating a potential environmental effect. The theme of spatial distributions was continued by the empirical analysis of density-dependence in the spatial distribution of anchovy. High abundance leads to high density values becoming more dense and spatially more heterogeneous which raises questions for optimal acoustic survey design. Eelgrass spatial distributions were estimated using acoustic data and then transformed to eelgrass biomass estimates assuming a certain biomass density making use of spatial variations in seagrass growth explained by bathymetry and variations between years explained by wind. The potential impact of wastewater discharge plumes on the behaviour of migrating salmon was studied using acoustic fish tracking.

The final set of talks dealt with acoustic and other data collected during ordinary fishing operations. The acoustic data collection programs implemented by the fishing industry in Australia and New Zealand and in Peru were presented. Another study investigated whether real-time acoustic sonar information on catches could be used to reduce slipping in purse-seine fisheries. VMS data provided information on fish presence which was then compared to acoustic survey data using spatial indices.

5   TOR e: Organize theme sessions at ICES ASC

WGFAST together with the Working Group on Integrating Surveys for the Ecosystem Approach (WGISUR) and co-sponsored by PICES is organising Theme Session C at the 2015 ICES Annual Science Conference in Copenhagen on Ecosystem monitoring in practice.

The potential topics for a theme session or other session type including stakeholder participation at the 2016 ICES ASC were discussed and the topic "Fishing vessels as scientific platforms" was selected. Sascha Fässler, Steven Barbeaux and Frederico Iriarte will prepare a proposal and solicit Martin Pastoors to contribute. The submission deadline is 1 September 2015.

6   Reports and updates from associated groups and miscellaneous issues

6.1   Update from SSGIEOM

Nils Olav Handegard, Co-Chair of the joint ACOM – SCICOM Steering Group on Integrated Ecosystem Observation and Monitoring (SSGIEOM), informed the working group about the initiative for hosting interpreted acoustics data at ICES. This initiative is co-funded by the European AtlantOS project.

6.2   Study Group on Calibration of Acoustic Equipment (SGCAL)

The CRR on Calibration of Acoustic Instruments, prepared by the study group has been published. The Chair thanked the lead author David Demer and all co-authors for their efforts, which led to this very useful CRR.

6.3   Working group on target classification (WGTC)

The Working Group on Target Classification met in Nantes, France, on Saturday 23 – Sunday 24 May. The meeting was chaired by Rolf Korneliussen (IMR, Norway). The meeting was attended by 23 participants. This was the second meeting. The content and outline of the planned CRR on multifrequency target classification were discussed and contributions to each chapter identified.

6.4   Calibrating echosounders on fishing vessels (SPRFMO initiative)

In 2014, the South Pacific Region Fisheries Management Organization (SPRFMO) created a task group on the theme of "Fishing vessels as scientific platforms". The objective of this group is to make acoustic data (and other data) collected routinely aboard fishing vessels useful for stock assessment in an Ecosystem Approach to Fisheries framework. The first activity of the task group is to define and elaborate calibration procedures adapted to fishing vessels. A workshop on calibrating echosounders on fishing vessels will be held in Peru in September 2015. The workshop will bring to

together international experts for providing ideas and preparing guidelines for calibrating echosounders on commercial fishing vessels, e.g. by carrying out 1-2 comprehensive calibrations per year, regular routine verifications of the satisfactory performance of acoustic devices and some limited daily tests.

The topic is of great interest to WGFAST. To coordinate the contribution by WGFAST a topic group was created. This topic group on calibrating echosounders on fishing vessels will be led by Richard O'Driscoll and Adam Dunford (NIWA, New Zealand). The proposed members of the topic group are Tim Ryan (CSIRO, Australia), "to be decided" (IMR, Norway), Sascha Fässler (IMARES, The Netherlands), Steve Barbeaux (NOAA, USA), Sophie Fielding (British Antarctic Survey, UK) and Martha Uumati (Namibia).

The aim the topic group is to contribute to the SPRFMO initiative and to prepare a manual for the ICES Survey Protocols (SISP) series with practical sheets on how to calibrate echosounders on commercial fishing vessels.

6.5 Wideband acoustics discussion forum

An open forum on the topic of wideband acoustics was convened immediately following the close of the SOMEAcoustics symposium on Thursday 28 May. The conveners were Gareth Lawson, Andone Lavery, Tom Weber, and Mike Jech. The meeting was very well attended (over 100 participants) and the discussion was broad-ranging and productive. Some consensus suggestions that came out of the discussion:

- **Manual.** Broadband acoustics, and the EK80 in particular, requires some kind of manual; ideally this would be better for the EK80 than it was for the EK60. Arguably, best would be for it to be a peer-reviewed publication. Perhaps it could have some kind of working DOI that would allow appendices to be added as methods/approaches evolve. The ICES Survey Protocols (SISP) series offers this possibility.

- **Evaluation**. Ultimately a series of comparisons will need to be made between the EK80 and EK60, including running the EK80 in CW mode; comparing individual standard frequencies extracted from running the EK80 in FM mode (e.g. extracting the 38 kHz component from FM data); and assessing the additional benefits of the FM data. Cooperation within the community on these tests would maximize efficiency of effort.

- **Common test data (and code).** Test data, perhaps from standard targets and/or from real scatterers, should be made available for cross-comparison and verification of processing methods. This could be hosted on some kind of website. For those developers willing to share, code could be made available on the site as well. This would allow a standardization of methods (Egil Ona even suggested a certification process).

- **Future workshops.** A more formal workshop focused on broadband methods would be of benefit to the community. Suggestions included taking advantage of the Euro-fleet, using the University of Bergen's ship-time on the "GO Sars", or US NOAA workshop programs. The former two would include ship-time and would thus allow new data to be collected and ideas/processing methods/etc. tested. This could be followed up by data processing and interpretation by individuals and then a second workshop on processing methods.

- **Working groups**. A new ICES working group focused on broadband methods seems appropriate. Also suggested was a working group examining the effects on marine mammals of active acoustic systems, both broadband and other. The terms of references of this new working group will be discussed at the WGFAST meeting in 2016 with the aim for the group to start in 2017 (if approved by ICES).

6.6 ICES acoustics training course

The organization of an ICES training course on how to run a fisheries acoustics survey was discussed and the idea accepted. The target audience are fisheries scientists running surveys using acoustic methods on research vessels or other platforms. The training course will provide an introduction to standard practices for acoustic biomass estimation but also to more recent developments such as the use of multifrequency information for scrutinising echograms. The course will not be instrument specific but aim at covering the most commonly used systems and software packages. The course will be a combination of theory and hands on experience analysing data samples (Egil Ona is happy to share data samples he uses for teaching). The training course will be developed by Paul Fernandes (University of Aberdeen, UK) and John Horne (University of Washington, USA) with input from Dezhang Chu (NOAA, USA).

6.7 Miscellaneous issues

The potential impact of echosounders and sonars on marine organisms, in particular marine mammals, is becoming limiting for acoustic data collection in certain cases. It was decided that WGFAST would try to have a session on this topic at the 2016 WGFAST meeting and invite an expert in the area to give an overview. The topic is at the centre of the International conference on 'Effects of Noise on Aquatic Life' (http://www.an2016.org/) which will take place in Dublin in July 2016 and there might be opportunities for WGFAST to link with this event.

Annex 1: List of participants

Surname	First name	E-mail	Affiliation	Country
Barbeaux	Steven	steve.barbeaux@noaa.gov	NOAA	USA
Calise	Lucio	lucio.calise@zunibal.com	Zunibal S.L.	Spain
Carrera	Pablo	pablo.carrera@vi.ieo.es	IEO	Spain
Chu	Dezhang	dezhang.chu@noaa.gov	NOAA	USA
De Robertis	Alex	alex.derobertis@noaa.gov	NOAA	USA
Doray	Mathieu	mathieu.doray@ifremer.fr	Ifremer	France
Escobar-Flores	Pablo	pesc003@aucklanduni.ac.nz	University of Auckland	New Zealand
Fässler	Sascha	sascha.fassler@wur.nl	IMARES	The Netherlands
Fernandes Paul	Paul	fernandespg@abdn.ac.uk	University of Aberdeen	UK
Fielding	Sophie	sof@bas.ac.uk	British Antarctic Survey	UK
Gastauer	Sven	sven.gastauer@wur.nl	IMARES	The Netherlands
Gauthier	Stephane	Stephane.Gauthier@dfo-mpo.gc.ca	DFO	Canada
Gerlotto	François	francois.gerlotto@gmail.com	IREA France	France
Guillard	Jean	jean.guillard@thonon.inra.fr	INRA	France
Handegard	Nils Olav	nilsolav@imr.no	IMR	Norway
Horne	John	jhorne@uw.edu	University of Washington	USA
Iriarte Ahon	Federico	federico.iriarte@mwbrands.com	MWBrands	Ghana
Jech	Mike	michael.jech@noaa.gov	NOAA	USA
Jónsson	Sigurður Þór	sigurdur@hafro.is	Marine Research Institute	Iceland
Kaljuste	Olavi	olavi.kaljuste@slu.se	Swedish University of Agricultural Sciences	Sweden
Kloser	Rudy	rudy.kloser@csiro.au	CSIRO	Australia
Korneliussen	Rolf	rolf.korneliussen@imr.no	IMR	Norway
Kubilius	Roka	rokas@imr.no	Metas/IMR/UiB	Norway
Larson	Niklas	niklas.larson@slu.se	IMR, Aqua-SLU	Sweden
Macaulay	Gavin	gavin.macaulay@imr.no	IMR	Norway
MacLennan	David	maclennan22@aol.com	MCS Consultants	UK
McQuinn	Ian	ian.mcquinn@dfo-mpo.gc.ca	DFO	Canada
Melvin	Gary	gary.melvin@dfo-mpo.gc.ca	DFO	Canada
O'Donnell	Ciaran	ciaran.odonnell@marine.ie	Marine Institute	Ireland
O'Driscoll	Richard	richard.odriscoll@niwa.co.nz	NIWA	New Zealand
Ona	Egil	egil.ona@imr.no	IMR	Norway

Surname	First name	E-mail	Affiliation	Country
Parsons	Miles	m.parsons@cmst.curtin.edu.au	Curtin University	Australia
Peña	Héctor	hector.pena@imr.no	IMR	Norway
Petitgas	Pierre	pierre.petitgas@ifremer.fr	Ifremer	France
Reynisson	Pall	pall@hafro.is	Marine Research Institute	Iceland
Ryan	Tim	tim.ryan@csiro.au	CSIRO	Australia
Schaber	Matthias	matthias.schaber@ti.bund.de	Institute of Sea Fisheries (vTI)	Germany
Scoulding	Ben	b.scoulding@abdn.ac.uk	University of Aberdeen	UK
Thomas	Jenny	jenoma@bas.ac.uk	British Antarctic Survey	UK
Trenkel	Verena	verena.trenkel@ifremer.fr	Ifremer	France
Uumati	Martha	uumati@gmail.com		Namibia
van der Kooij	Jeroen	jeroen.vanderkooij@cefas.co.uk	Cefas	UK

Annex 2: Agenda

Nantes, 29 May 2015, Ifremer, centre Atlantique, rue de l'île d'Yeu

Time	Agenda
9:00	WGFAST opening
	Summary of symposium – Verena Trenkel
	SSGIEOM Update – Nils Olav Handegard
	SGCal Update – David Demer
	WG Target Classification Update – Rolf Korneliussen
	SPRFMO Task group on Fishing Vessels as Scientific Platforms – François Gerlotto
	Acoustic training course – to be identified
	Any other business
13:00	Meeting closes

Annex 3: WGFAST multi-annual terms of reference (TORs) for the period 2014-2016

The **Working Group on Fisheries Acoustics, Science and Technology** (WGFAST), chaired by Verena Trenkel, France, will meet in Vigo, Spain, 19–22 April 2016, to discuss and generate deliverables as listed in the Table below.

WGFAST will report on the activities of 2016 (the third year) by 30 June 2016 to SSGIEOM, SCICOM & ACOM.

ToR descriptors

ToR	Description	Background	Science plan topics addressed	Duration	Expected deliverables
a	Produce a list of papers originating from the community of the WGFAST working group	The WGFAST community produces several papers every year, and an update on recent WGFAST that acknowledges ICES is important.		Year 1, 2 and 3	An updated reference list
b	Present recent work within the topics "Applications of acoustic methods to characterize ecosystem", "Acoustic properties of marine organisms", "Behaviour", and "Emerging technologies, methodologies, and protocols".	Create a venue for informing the group members on recent activities and seeking input to furhter developement. An overview of the different contributions will be presented in the annual report.		1,2,3	Report
c	Write a review to showcase the work of WGFAST with particular emphasis on its relevance to the ICES/ACOM stragegic plans	After three years a review paper will be written to showcase the work of WGFAST		3 year	Write a review paper showing the WGFAST contribution over the last 3 years
d	Organize international acoustic symposium	Organize the 8th international symposium with working title "Marine Ecosystem Acoustics – observing the ocean interior across scales in support of integrated management"		2015	Symposium and special issue in ICES Journal of Marine Science

e	Organize joint sessions at ICES ASC	Organize joint sessions with survey working groups to foster collaboration regarding the use of acoustics data and cross-fertilization	2 or, 3	Topic session at ICES ASC

Supporting information

Priority	Fisheries acoustics and complementary technologies provide the necessary tools and methods to implement the ecosystem approach to fisheries management within ICES and research into their application and further development is vital.
Resource requirements	No new resources will be required. Having overlaps with the other meetings of the Working, Planning, Study and Topic Groups increases efficiency and reduces travel costs.
Participants	The Group is normally attended by some 60–70 members and guests.
Secretariat facilities	None.
Financial	No financial implications.
Linkages to ACOM and groups under ACOM	There are no obvious direct linkages.
Linkages to other committees or groups	The work in this group is closely aligned with complementary work in the FTFB Working Group. The work is of direct relevance to the survey planning groups within SSGIEOM and WGISUR.
Linkages to other organizations	The work of this group is closely aligned with similar work in FAO, the Acoustical Society of America, the South Pacific Regional Fisheries Managament Organisation and the American Fisheries Society.