Fisheries Technology Committee **ICES CM 2000/B:5**

REPORT OF THE

JOINT SESSION OF THE ICES WORKING GROUPS ON FISHERIES ACOUSTIC SCIENCE AND TECHNOLOGY (FAST) AND FISHING TECHNOLOGY AND FISH BEHAVIOUR (FTFB)

IJmuiden, The Netherlands
12 April 2000

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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1 TERMS OF REFERENCE

In accordance with ICES Annual Report 1998/1999, a joint session of the Working Group on Fishing Technology and Fish Behaviour (WGFTFB) and the Working Group on Fisheries Acoustics Science and Technology (WGFAST) met under the chairmanship of Mr J. Massé (IFREMER, France) in Haarlem, Netherlands on 12 April 2000 to:

a) present common interest studies between FAST and FTFB members;
b) consider as a special topic, tools and studies about visualisation and measurement of behaviour;
c) make recommendations for further studies on the effects of fish behaviour on direct assessment methods;

2 MEETING AGENDA AND APPOINTMENT OF RAPPORTEUR

The Chair opened the meeting and appointed Dr. D. G. Reid of the Marine Laboratory, Aberdeen, UK, as rapporteur. Due to the variety of papers presented, an open agenda was adopted.

3 PRESENTATIONS

3.1 John Churnside: Airborne LIDAR

This presentation demonstrated the use of laser observations from aircraft. The advantages are that:

- transects can be done at 140km.h^{-1}.
- There is no vessel avoidance.
- It is also much cheaper: Ship c. $200 p. hour p. km & Light Plane c. $5 p. hour p. km.
- But there is poorer depth resolution (c.1m) and penetration (c. 50m).

The system uses blue green laser for minimum attenuation in coastal waters. It has been used in West USA and in Spain.

Penetration is down to 50m in good conditions and signal return depends on foam on surface. Calculation equations are very similar to echo-sounder calculations and include; absorption, TVG and backscatter, however fish have a back scatter which are very similar to water.

Comparison trials using sounder and LIDAR on RV gave good qualitative comparisons although sounder gave more detailed resolution. Species ID remains a problem. There are some problems with data analysis – computer scrutiny particularly. Studies have been made on anchovy in California, herring in Washington, and juvenile sardine and anchovy in NW Spain. Systematic comparison trials have been carried out in Galicia, Spain as part of JUVESU EU project.

Need to be able to do TS analogue experiments. Some trials at Scripps have been done using cross-polarized returns from fish targets. This can allow biomass estimation, in gram per m.sq.

We can also get other data from plane surveys, although some require extra instrumentation e.g.; water clarity, chlorophyll fluorescence – uses an additional red receiver – only in top 5m; SST using IR detector, like satellite gets skin temperature; ocean colour using a multispectral camera.

There is no evidence that it can blind marine mammals, light levels are kept well below human safety levels.

Can be used in future to:

1. Identify empty areas
2. Give target strength as index of abundance
3. Give quantitative values

There remain problems with species ID and TS to biomass conversion.

Questions:

Q. What is the scale of reflectivity?
A. Low due to fish trying to look like water, the dynamic range is about 80dB.
Q. Could you use different angles to increase reflectivity and reduce surface reflection?
A. Yes but it is difficult to quantify – currently uses 15 degree angle to reduce reflection.
Q. Why use low ping rate?
A. Technical limitation in the laser faster means weaker.

3.2 Gerald Denny: New broad band fish identification system

Why use broadband? It has a wider frequency range and gives: Species ID and Size estimation etc. also good for non swim bladder fish, and has high resolution.

The system produces broad band sound then deals with signal resolution using matched filters. Resolves at c. 2cm. Then system takes spectra in areas where targets are identified. This shows up species specific features and also random patterns. This has given unique patterns for 21 different fish species, using Neural Nets. Some trials give about 80% species ID on single echoes; this improves with multiple echoes. On average 85% ID are correct and 3% wrong.

System is based on RDI ADCP, WinNT – It has real time data collection and display. And has playback analysis and for classifier training. This high processing means a ping rate of around 2.5 seconds.

This system was trialed in 21 species and locations around US. Frequencies at single beam 110-190 & 55-90, and split beam 220-370 kHz. Transceiver is currently an analogue system, with digitising at top end.

Q. Can this split multi species schools into species and sizes?
A. Yes.

3.3 Chris Glass: Fish behaviour from UW video and photos

Discussion of required new developments in using video and still photos of fish behaviour around gear. Much film etc has been collected and archived in many centres. Much has not been analysed and will be deteriorating. What can we do? Can we quantify behaviours from these films?

Experience shows that different operators can perceive different behaviours in the same piece of film. How do we change this to a repeatable and valid analysis?

Two phases for recovery exercise identified.

1. Survey on what IS done now, and too define list of measurement tasks
2. Literature review of analysis and software

There was a questionnaire and survey aimed at the FTFB community, to find out what was being done, and on what material, and what was measured. This included requests for other disciplines approaches. Very low response!!!!

There may be better methods in biomedical industry. In FTFB there is no evidence of any systematic approach – too much look-see type work. Major problems with quality of data and of data collection. Some software packages were identified which could be used for image enhancement and quantification.

Conclusion:

1. Few people are using modern IA systems
2. Commercial software is available and suitable
3. None has ever been used!

Recommendations:

1. There are problems but they can be resolved with modern software
2. Much data is on old video formats and is difficult to store. This should be digitised NOW.

3. Could transfer to DVD

Questions

Q. Possible EU concerted action? Could such a project include a sort of behavioural model development?

3.4 Ole-Arve Misund: Sonar recordings of Pilchard Schools

This paper presented sonar recordings made in Namibia, incorporating TS modelling studies to allow abundance estimates from sonar (SIMRAD SF950 95kHz). The work used SODAPS system on recorded sonar data. Also used EK500 38 kHz. Vessels included FRV Nansen and two Namibian pursers.

Schools could be seen at up to 2000m range. Observed schools were measured with sonar from RV and then echo-sounder from pursers.

Schools were studied only at night. But they school throughout night. The school was then monitored during whole transit, and getting velocity, area, Sv etc, while tracking. There was a good relationship between area and intensity. The sonar recorded only four schools, with a mean speed about 1m per sec. The EK500 then recorded Sa and dimensions of school. Then the purser caught the whole school. Schools had biomasses of between 40 to 170 tonnes. Larger areas were recorded on EK500 than from sonar, possibly due to avoidance. Measured densities were between 2 and 20 fish per cubic metre.

Live pilchard were caught and transported to shore for x-raying and model calculations. See next paper (3.5.).

3.5 John Horne & Mike Jech: Incorporating behaviour in TS predictions of fish schools – Namibia II

Multiple cylinder based back-scatter models for TS determination.

We often get wide variation in TS from even a single tethered fish due to the behaviour. A fish is a directional scatterer and changes in orientation change TS. We can use x-ray to look at variation in shape etc of swim bladder, particularly the surface of the swim bladder at a variety of angles. Changes in gonads and gut fullness can also change apparent TS. Many other factors affect measured TS, both physical and biological. But most importantly, behaviour: orientation and activity.

Behaviour; relative orientation, direction of movement (yaw), aspect or tilt, roll of fish or school. Compounded with angle of view.

TS was modelled using dorsal and lateral x-ray. The fish is modelled as series of cylinders (fish and swim bladder). Does the model work? Comparison to field data is difficult due to limited data, but there was a reasonable fit to some known data.

Tilt is well known to affect TS, and this also varies with fish length to frequency relationship. For this sonar work roll can also represent and is inter-related to the sonar angle.

The researchers combined TS to length relationships with tilt and roll distributions to give effective TS for a school of fish. Effective TS can be greater with tilt and roll at high fish length than simple TS/L would suggest, but different tilt and roll angles have strong influence in both directions.

This then allows the building of an *effective* TS for fish in a school to allow calculations of packing density. Included in the calculation are; school area, heading, speed, sonar tilt, school Sv and calculated effective TS. Densities were in similar order of magnitude to those calculated from EK500. So possible biomass estimation!

Q Variation in shape and fish density are known to have effects at same scale as tilt, has this been incorporated.
A. No, Model has homogenous body.
Q. Does variation in the number of cylinders in model have any effect?
A. Yes!!

3.6 Charles West: Measurements of distance fished during the trawl retrieval period

This is an important and slightly controversial parameter collected for trawl surveys. Nominal distance trawled = distance and time covered from stated start to end. But this ignores any fishing by the gear before and after theoretical start and end. So the gear was monitored accurately during tow. E.g. Gear takes longer to separate from the ground at greater depths and this varies between vessels. But is trawl stopping fishing during this time?

Distance towed after nominal end increased with depth and was ship variable. Potentially in deep water gear could fish almost double the nominal distance, and during heaving period, could be at least as fast as during the tow and sometimes 50% faster. Calculations were performed using simple ship position and assumptions about warp geometry etc. or using ITI trawl monitoring gear. Both showed reasonable agreement.

Q. Why in some cases did post trawl distance DECREASE with depth?
A. As some boats could not keep gear down as they were at the limit of their trawlable depth.

3.7 Bo Lundgren & Dave Somerton: Contact centre for FTFB and FAST

There has been a FAST contact point until recently. This has run for some years but now ICES switch to NT has stopped service.

Other problems observed:

1. Regular and reliable updating of email address list.
2. Some people are “unofficial” i.e. not recognised by ICES, but wanted on the list.
3. Problems with SPAM.
4. Problems with changes, resignations etc.

Possible answers:

1. One master list for all with a homepage.
2. One webmaster for each WG to control addresses.
3. Homepage should contain contacts for people to apply to become “official”.
4. Retain automatic forwarding but with strict size limitation to avoid serious spamming problems.

FTFB have web page in Alaska Fisheries Centre, this includes official list, but could also have unofficial list with all FTFB participants regardless of “official” status.

The homepage is used for announcements, but could be expanded to have maps info etc. Could have reports as PDF files for down loading. The homepage has no link from ICES!

Discussion:

Bill Karp - Possibility to have a joint homepage at AFC. This was volunteered and accepted.

Ole Misund – This should be done officially through ICES who may want to run it themselves.

Francois Gerlotto – Many thanks to Bo Lundgren for his work to date for FAST. Yes we need a new efficient system especially due to the upcoming acoustics symposium in 2002.

John Simmonds – let’s do it now!!

Dick Ferro – Homepage also used to circulate questions and ideas. Perhaps this could be relevant to video archive question.

3.8 Francois Gerlotto: ACTIVE a new acoustic and behaviour project at IRD Montpellier

This is a project with activities in many parts of the world. – Peru, Chile, Hawaii, Seychelles, Mexico etc. It is aimed at studying the impact of fish behaviour in fisheries research – especially in terms of catchability, in it's widest sense. Aimed at the behaviour of pelagic fish in three aspects;

1. Pelagic habitat – i.e. no fixed geographical reference e.g. Tuna but also some small pelagics ref: FADS.
2. Self organisation – models of simple fish decisions to build structures i.e. schools.
3. Regionalised variables e.g. geostats.

Three behavioural characteristics to be studied

1. Aggregative behaviour i.e. FADS, but not schooling.
2. Gregarious behaviour e.g. schooling.
3. Occupation of space. In relation to e.g. Hydrology.

Methods to be used

1. Observation – acoustic.
2. Experiments – from observations from models.
3. Modelling.

Specific projects

1. Tuna and FADs.
2. Spatio-temporal dynamics of schooling etc. in S. American clupeids.
3. The pelagic habitat – Tuna and longlines - how a given fish occupies space in relation to external influences.
4. Predator prey reactions with fish and fishermen.

3.9 J. Masse: PELASSES - a new program using Acoustics

This new program which began in February 2000, will be carried out in the frame of the last call of proposal about the CEE Common Fishery Policy. This project aimed at "Direct abundance estimation and distribution of pelagic fish species in North East Atlantic waters. Improving Acoustics and daily egg production methods for sardine and anchovy" (Pelagic Assessment).

It is planned with Spain, Portugal, France and Great Britain (surveys in 2000 and 2001). The first objective is to study by acoustic the distribution and abundance of pelagic fish, in a narrow time window, in the potential area for sardine, between Gibraltar and Celtic Sea. The second objective is to study the feasibility of using CUFES (Continuous Under-water Fish Eggs Sampler) to evaluate the number of fish eggs by continuous pumping sea-water under the surface, in order to assess the spawning stock of main pelagic species at the same time of acoustic. The results will be used during ICES working groups in charge of the assessment of sardine, anchovy, mackerel and horse mackerel and in the frame of respective fisheries ecology programs.

It is a real opportunity to combine the respective efforts of Portugal, Spain and France who carry out acoustic surveys for several years in their own areas in order to have a global coverage of the pelagic ecosystem at different levels and observation scales. It will be also the opportunity to standardise the methods (tools, strategy, data processing) and have a common approach on the pelagic fish community in an ecological and assessment point of view. With this aim in view, it was agreed by all the participants to store the acoustic data with MOVIES software in HAC format for at least two frequencies (38 and 120 kHz) and take advantage of these surveys to try to progress in echo-traces identification and combination of acoustic data to other observations as eggs distribution or environmental conditions.

3.10 Ron Mitson – ICES Coop report 209: Five years on

The original report covered two frequency zones:

- up to 1kHz –range of fish hearing
- beyond 1kHz – echosounder effects

Fish hearing threshold is approximately 75dB. Reaction level is 30 dB above this and at 20m range we add an extra 26dB.

The report led to ICES recommended noise limits for all new vessels or indeed all vessels used in research. The new plot for these starts at 0.01 kHz due to reduced concern about infrasound.

Original report indicated that most vessels were over the limits, at least at some frequency ranges. It also showed in some vessels that had variable pitch props that this caused major changes in noise for small speed changes. Only Corystes and Scotia lie within spec. To date, other new ships are less satisfactory. An important point is that there are substantial changes possible in a vessel's noise with different prop pitches, and these may impact on fish responses.

It should be emphasised that different fish have different hearing thresholds, of which herring and cod were the most sensitive. Noise specs are means of port and starboard data and there may be differences between these, which should be considered.

Noise emission will probably change with trawling; an example with Scotia was presented. When trawling with the wind, Scotia was within ICES line, against the wind; she was over spec at 0.5 kHz.

Conclusions

1. Noise will remain steady at constant speed and course.
2. Variable pitch props are a problem.
3. Weather may have an impact.
4. Spherical spreading is assumed but not certain.
5. Rain on surface may effect fish hearing.
6. Variations in fish hearing with time (age?) may occur but is unknown.

Q. What about noise of pelagic trawls?
A. Most work has been on bottom trawls – little known.
Q. Can you monitor noise from own vessel?
A. Yes, see Diner below.
Q. Can a quiet vessel slip above threshold and then be apparently noisy (ref Wilson in FAST)?
A. Yes, probably but little understood.
Q. What about the impact of sound gradient as opposed to sound level?
A. Probably important, old study on Corystes showed haddock responded to 300Hz transients.
Q. Can you use hydrophones on buoys to do noise studies?
A. Possible.

Official addendum to report was that vessels should use AC converted to DC and the propulsion should be run from DC.

3.11 Noel Diner: SABRINA a system for acoustic monitoring on FRV THALASSA

It is known that the old Thalassa caused some fish school avoidance. There is some evidence of this also with the new vessel. In both cases avoidance only occurred at some times and not others. Also the old Thalassa had a substantial change in trawl catch following engine changes. So IFREMER aim to have ongoing acoustic emission profile recording and display.

Two hydrophones were placed on hull, for lower and higher frequencies. One hydrophone forward and one near prop. These were integrated and logged on PC.

System allows a monitoring mode to see what the vessel is doing, a waterfall mode to track history and an automatic mode to monitor a whole survey.

To a useful extent the on board measurements are in good agreement with sound range observations, at both survey speed and in simulated trawls. These are both over ICES spec around 20 – 140 Hz. Vessel has fixed pitch prop.

Q. Is it DC current supply?
A. Yes, but pulsed with synchronous electric motor.

3.12 Dave Reid: Seabed Classification

A presentation was made to the joint session of the conclusions on seabed classification of the FAST WG. A resume of two presentations given at FAST was given. One was by John Breslin from Ireland on the new EchoPlus system and the second was from John Anderson on a model application of the Quester-Tangent system in Canada.

It was concluded that there was a great deal of scope for the application of these systems in a wide range of fisheries research areas.

Several important points were stressed in the presentation:

1. It is vitally important that any use of any of these systems include the collection of extensive ground truth data. Ideally, this should be in the form of TV observations coupled with grab sampling.

2. Any use of these systems should include a consideration of the spatial scales involved. Spatial scale should be considered at three levels;

- The scale of spatial heterogeneity of the substrate to be surveyed.
- The spatial scale of the data required, in the context of the particular study.
- The resolution limit (the footprint) of the equipment to be used.

3. The members of the WG are of the opinion that none of the currently available systems are capable of resolving more than 6 to 8 different substrates in a given scenario. The resolvable types will depend on the spatial scale of the study.

In the future, it is expected that the main developments in this field will involve the inclusion of more than one frequency with different bottom penetration characteristics, and the integration of these techniques with others, such as swathe bathymetry and TV surveys.

3.13 Francois Gerlotto Report of discussion on fish avoidance during the FAST

A synthesis of the discussion on fish avoidance during the FAST session was given. A resume of the four papers presented was done:

- G. Arnold. Fish avoidance and fisheries acoustics.

- Fernandes and Brierley: P. Fernandes. An investigation of fish avoidance using an Autonomous Underwater Vehicle.

- F. Gerlotto. Some observations on fish avoidance in several seas.

- C. Wilson. Consideration in the analysis of acoustic buoy data to investigate fish avoidance.

- R. Vabö. Effect of fish behaviour on acoustic estimates on NS herring.

The general conclusion is that fish avoids a survey vessel (G. Arnold) in a large part in relation to the noise radiated by the vessel (P. Fernandes: R/V Scotia which is very silent has a weak effect on avoidance; C. Wilson: the same fish avoids differently according to the type of vessel that is approaching a buoy). The spatial fish behaviour and avoidance follows a pattern that can be described when a series of data is available (R. Vabö: movements of NS herring in time and depth is described from a series of surveys), but present a rather high variability (F. Gerlotto: the same stimuli give different results on the same species in different areas). The main solutions that can be given are (1) to operate silent vessels, (2) to draw the behavioural patterns in a given area, (3) to record the avoidance reaction using lateral observation through multibeam sonar.

3.14 Ole-Arve Misund: The Scientists problems: expectations and demands

IMR document on requirements for new vessel build.

The main problem is perceived as being fish avoidance, this is based on studies over the last 20 years.

IMR maintain that fish DO avoid research vessels.

The current IMR fleet has limited ability to catch large and fast swimming speed esp. for pelagic trawls. The survey strategies require targeting single species or assemblages due to the vessels being limited to one type of gear.

Surveys can produce variable and unreliable estimates. Credibility of acoustic survey estimates is currently low, in some situations.

New build is aimed at a vessel that can produce absolute abundance estimates; that can be a silent, with no avoidance; that has state-of-the-art acoustics, and that can use multiple specialised trawling gear.

The ship needs to be;

1. Big (75 x 15m)
2. Stable
3. Quiet
4. Strong 8000Hp

State-of-the-art acoustics needs;

1. Keels
2. Multi frequency
3. Quantitative sonars etc

On board requirements are;

1. Trawls for bottom and pelagic trawls available simultaneously
2. Recording of operation and performance parameters
3. Acoustic monitoring of fish distribution and behaviour during sampling

The vessel should also have conventional plankton gear and multi frequency plankton acoustic gear plus full hydrographic measuring systems

Q. What sort of bottom gear, you should want non-selective gear not commercial?
A. Yes, and they want good heavy appropriate gear.
Q. Why aim for absolute indices when stock assessment scientists don't want them?
A. Maybe they do, in some cases.
Q. How do you deal with multi vessel surveys?
A. Not a problem with stable stocks but must be considered for migrating stocks.
Q. It is difficult to do everything as this will be expensive and always a compromise?
A. This can be dealt with!

3.15 Dave Somerton: The effect of speed through the water on footrope contact of a survey trawl

Abstract

The effect of speed through the water (STW) on the bottom contact of a trawl footrope was experimentally investigated for the poly North eastern trawl, the bottom trawl used by the Alaska Fisheries Science Center (AFSC) to conduct stock assessment surveys. Repetitive tows were made at speeds over the ground (SOG) from 2.0 - 5.0 knots at 0.5 knot intervals, bracketing the 3.0 knot SOG standardly used during the surveys. For each tow, STW was measured by placing on the trawl a self-recording oceanographic current meter and a commercially available STW sensor designed for use on trawls. Height of the center bobbins above the bottom was measured using a bottom contact sensor (BCS) developed at the AFSC. At STW < 2.5 knots, the center bobbins were resting on the bottom and, based on video observations, were actively rolling. At 3.0 knots, the bobbins were off the bottom by an average of 1.8 cm and were often not rolling but were sufficiently close to the bottom to leave a mudcloud. At 4.0 knots, the bobbins were off the bottom by an average of 6.7 cm and rarely left a mudcloud. At 5.0 knots, the bobbins were off the bottom by an average of 14.8 cm. However at STW > 4.5 knots the BCS itself was observed to lift off the bottom and the predicted

distance is likely substantially underestimated. The results of the study indicate that footrope contact, and therefore trawl efficiency, is not independent of trawl speed. This implies that reductions in the variance of survey CPUE might be achievable if towing speed was standardized to STW rather than SOG.

4 GENERAL DISCUSSIONS

Steve Walsh of Canada proposed a symposium on fish behaviour in relation to scientific operations maybe for 2003 in April in Bergen. This is in recognition of the success of the 1992 symposium in attracting fish behaviour specialists who work beyond the FTC community. It should be recognised that if this again occurs the FTC WGs should make every effort to recruit and maintain relationships with this wider community.

4.1 Development of the Joint session

A proposal was made to extend the scope of the JS and to include a number of special topics. This may require extension of the JS and possible inclusion of more topics of general interest. The JS recognises that there are often papers of interest in one WG which are of interest to members of the other. It was therefore agreed that in future the two Chairs should jointly chair and co-ordinate the scope and inclusions for the JS.

4.2 Special topics for future Joint Sessions

1. JS should continue to provide scientific advice to support the proper configuration and design of new research vessels with consideration of fish avoidance and related behavioural phenomena. This may require invitation of behavioural physiologists etc. to facilitate these discussions and advice through keynote presentations.

2. Effects of sound from research vessels that is above and below the range of fish hearing. It is recognised that most attention in vessel radiated noise has concentrated in the range of fish hearing or echo-sounder frequencies. There are however indications that fish can be affected by both ultra and infra sound and this should be investigated further.

3. Seabed classification, particularly by acoustic techniques. It is recognised that the remote acoustic classification of seabed substrate and topography is important for many aspects of fisheries science. There are important new initiatives occurring in a number of countries. Important aspects for consideration should be;

- Spatial scales of substrate variability in relation to system resolution
- Multi-frequency methodologies
- Integration of different methodologies e.g. swathe bathymetry, substrate classification and TV.

This topic is proposed in consideration of the proposed Theme Session at ASC 2001 on impact of fishing on seabed fauna, for which these methodologies are directly relevant.

5 RECOMMENDATIONS

The joint session recognised the importance of providing comprehensive Internet communications services for participants in FTC WG activities. These services should include email list serving provision of WG meeting schedules and registration materials, facilitation of information exchange among members and other functions required by members. The JS members accept the offer of Dave Somerton and Bill Karp of the US NMFS Alaska fisheries Science Center to support this need and request that they co-ordinate with the ICES Secretariat as appropriate. The persons appointed to manage the mail lists should either be WG members or work closely with WG members.

The WGFAST and WGFTFB Joint Session should meet in Seattle, USA on Wednesday 25 April 2001 (the FTFB and FAST WG will meet on 23-24 and 26-27).

The joint session agrees that fish behaviour should be seen as a key area of research for FTC. In this context fish behaviour should be seen in two aspects

1. The impact of fish behaviour on accuracy and precision of stock assessment surveys. The most important aspect of fish behaviour for study remains fish avoidance (both to the vessel and survey gears).

2. The potential for acoustic (also video and LIDAR) techniques to provide information about fish behaviour in a wider sense which may be of use in management and assessment, as well as being of biological and ecological interest.

6 CLOSURE

The Chair thanked the staff of RIVO-DLO, Ijmuiden, for their hospitality, and members of the Working and Study Groups for their efforts and contributions.

7 PARTICIPANT LIST

See in Appendix 1

Appendix 1

List of Participants

WGFAST

Lars Andersen	Norway
John Anderson	Canada
Geoff Arnold	UK
Frederik Arrhenius	Sweden
Eckhard Bethke	Germany
Guillermo Boyra	Spain
John Breslin	Ireland
Andrew Brierley	UK
James Churnside	USA
Jeff Condiotty	Simrad USA
Bram Couperus	Holland
John Dalen	Norway
David Demer	USA
Noël Diner	France
Paul Fernandes	UK
Catherine Goss	UK
Eberhard Götze	Germany
John Horne	USA
Michael Jech	USA
Erwan Josse	France
Olavi Kaljuste	Estonia
Bill Karp	USA
Robert Kieser	Canada
Chris Lang	Canada
Jacques Massé	France
Dave MacLennan	UK
Ole Arve Misund	Norway
Ron Mitson	UK
Hans Nicolaysen	Norway
Kjell Olsen	Norway
Heikki Peltonen	Finland
Dave Reid	Scotland
Philippe Roux	France
Yvan Simard	Canada
Haakon Solli	Norway
KarlJohan Staehr	Denmark
Frank Storbeck	Holland
Ingvald Svellingen	Norway
Gordon Swartzman	USA
Mats Ulmestrand	Sweden
Chris Wilson	USA

WGFTFB

Gerard Bavouzet	France
Eckhard Bethke	Germany
Mike Breen	UK
H. Arnold Carr	USA
Johan Coenjaerts	Belgium
Niels Daan	The Netherlands
Ole Eigaard	Denmark
Arill Engås	Norway
Dan Erickson	USA
Karel Essink	The Netherlands
Marianne Farrington	USA
R.S.T. Ferro	UK
Mark Fonds	The Netherlands
Ronald Fonteyne	Belgium
Alain Frechet	Canada
Dag M. Furevik	Norway
Otto Gabriel	Germany
R.D. Galbraith	UK
Kjell Gamst	Norway
Chris Glass	USA
Hallvard Godøy	Norway
Norman Graham	UK
S.J. de Groot	The Netherlands
Pingguo He	Canada
William Michael Hickey	Canada
Rene Holst	Denmark
Roger Horton	UK
Odd Børre Humborstad	Norway
Bjørnar Isaksen,	Norway
Terje Jørgensen	Norway
Cecilie Kvamme	Norway
Klaus Lange	Germany
P-O. Larsson	Sweden
Sven Gunnar Lunneryd	Sweden
Svein Løkkeborg	Norway
Phil MacMullen	UK
Bob van Marlen	The Netherlands
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Leif Nøttestad	Norway
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Esteban Puente	Spain
Andrew Revill	UK
Craig S. Rose	USA
Chris Smith	South Africa
Aud Vold Soldal	Norway
David Somerton	USA
Peter Stewart	UK
Karl-Johan Stæhr	Denmark
Jozef Swiniarski	Poland
Mats Ulmestrand	Sweden
Benoît Vincent	France
Stephen J. Walsh	Canada
Vidar G. Wespestad	USA
Charles W. West	USA