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Report of the

Study Group on Mesh Measurements Methodology

Ostend, Belgium
19–21 March 2003

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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1 EXECUTIVE SUMMARY

The final meeting of the Study Group on Mesh Measurements Methodology (SGMESH) concentrated on the analysis and discussion of the inter-laboratory tests made to determine the most appropriate measuring force for the measurement of mesh opening, the proposal for a new mesh measurement methodology and the need for further standardisation in this matter. The ultimate aim is that the new methodology will be used by scientists, fisheries inspectors and the industry. Hence the Study Group was of the opinion that advice from inspection services and netting manufacturers should be sought in this matter and invited representatives of these services to its final meeting.

The Group came to the following conclusions:

1) A variable force proportional to twine linear density would be preferred but there are practical difficulties with this approach, principally the accurate measurement of linear density or twine diameter at sea.
2) It follows that two groups of netting are recommended to which two standard forces apply for:
   a) netting under 55 mm mesh size and b) netting of 55 mm or greater mesh size.
3) A longitudinal force is preferred to a perpendicular force and this confirms the principle of mesh measurement used in the present ICES gauge.
4) Analysis shows that a measurement force of 40 newton would be appropriate for the smaller, 100 newton for the larger mesh.
5) A force of 40 newton can be exerted by the current ICES gauge but 100 newton is out with the range of this instrument. The group is aware that a new gauge is being developed with a capacity of 180 newton but this instrument will not be available until 2005. It is recommended that in the meantime for scientific work the ICES 4 kg gauge be used but the results should be converted to 100 newton equivalent using a conversion formula.
6) In most cases the measurement of 40 meshes would be sufficient for a precision of 1 mm at 95% confidence limits. If this is not the case after 40 meshes then measurements should continue until such precision is attained.
7) It was noted there is variance in all methods of mesh measurement studied and this is attributed mainly to the variability of material.

The Group recommends that all participants should as far as possible adhere to the conditions set out above, whether they be Scientists, Inspectors, Netting Manufacturers, Net Makers or Fishermen. As advice derived from selectivity data determines mesh size regulations it is logical that all stakeholders should use the same system of mesh measurement. If these findings are accepted it will be necessary to change existing legislation and standards.

A draft ICES Cooperative Research Report edited by the Chair was discussed and will be finalised by the 2003 ASC.

2 TERMS OF REFERENCE

In accordance with ICES C.Res. 2002/2B02 adopted at the 2002 Annual Science Conference (90th Statutory Meeting) the Study Group on Mesh Measurements Methodology [SGMESH] (Chair: R. Fonteyne, Belgium) met in Ostende, Belgium from 19 –21 March 2003 to:

a) consider the results of additional tests on proposed measure forces recommended for mesh size measurements;
b) propose final specifications of a suitable mesh measurement methodology and the conditions under which mesh measurements for all fishing gears in ICES areas are made;
c) review the preparation of a proposed draft Cooperative Research Report on “Mesh Measurements Methodology”;

SGMESH will report by 15 April 2003 for the attention of the Fisheries Technology Committee. It will also make its report available to WGFTFB.

3 PARTICIPANTS

A list of all participants is presented in Annex 1.

The group was somewhat larger than usual due to the inclusion of fisheries inspectors from the various countries involved, netting manufacturers and an official from the European Commission.

4 AGENDA

See Annex 2.

5 REPORT

5.1 Opening

The Chair (Mr Ronald Fonteyne) opened the meeting at 0900 on 19 March and welcomed all members to the meeting. Each participant in turn was invited to introduce themselves with a brief description of their background.

5.2 Appointment of a rapporteur

Mr Derek Galbraith was appointed Rapporteur.

5.3 Adoption of the agenda

The agenda proposed by the Chair was adopted without change.

5.4 Report of past SGMESH activities

For the benefit of the new participants the Chair gave a summary account of the work of the group to date. He explained the limitations of existing methods of mesh measurement methods and restated that a primary objective of the meeting was to put forward proposals for appropriate standard measuring forces and for an appropriate measurement procedure. Such proposals if accepted would inform the work of the current EU shared cost project OMEGA (Q5CO-2002–01335) which will develop and test a new objective mesh gauge.

5.4.1 Definition of mesh opening

The new CEN/ISO International Standard EN ISO 1107 (CEN, 2003) on basic terms and definitions for netting for fishing nets, which redefines mesh opening by including the word " longest" in front of "distance between two opposite knots", was discussed. Problems have been encountered, particularly when measuring netting with large knots, as to where precisely to position the gauge. The group confirmed that for all diamond meshes i.e. those towed in N direction, this would be an appropriate definition. For square meshes (towed in the B direction) EU legislation (EC, 2003) now defines mesh opening as the longer of the two diagonal measurements of a mesh. The meeting felt this methodology would be appropriate for both square and 90° turned meshes (towed in T direction).

5.4.2 Inventory of netting materials

The Chair gave a brief summary of the inventory of netting materials used in cod-ends in ICES countries. Of the 128 entries 100 were constructed in polyethylene (PE), 24 in polyamide (PA) and 4 in polyester (PES). 104 mesh sizes ranged from 70 mm – 165 mm for larger species and 24 from 15 mm – 60 mm for smaller species. Twine thickness were between 1.8 mm and 9.4 mm. There were 43 nettings made up with single twine, 83 with double twine and 2 with triple twine. 118 were knotted and 10 knotless and of the twines used in these nettings 108 were of braided, 13 of twisted and 7 of Raschel construction.

The Chair pointed out that the inventory was now almost complete but there were still gaps, particularly in the last column which identified the fisheries in which these nettings were used. He urged members of the group to forward the missing information as soon as they could.

5.4.3 Inter-laboratory measurements

In the textile industry the principle of constant stress is used in twine measurement. The load applied is equivalent to 250 m (±25 m) of the yarn weight, which in practical terms equates to 25% of the linear density expressed in Rtex. This force is known as the Textile Standard Force or TSF.

Mesh measurements carried out using this force were compared to the results obtained using the 4 kg ICES gauge, wedge gauge using hand force and wedge gauge with 2 or 5 kg weights on selected netting materials. The relationship

between Rtex and twine thickness was also investigated. Twine samples were sent to FRS Marine Laboratory, Aberdeen and measured using a recently developed laser system specifically designed for this task.

The ratio between ICES 4 kg / TSF was plotted against both Rtex and twine thickness for both PE and PA twines and the results (Figures 1 and 2) show that the ICES 4 kg force is insufficient for most modern nettings. A cluster analysis carried out on these data gave similar results. A measuring force related to linear density or twine thickness was considered impractical due to the wide range of twines commonly used and practical difficulties with this approach, principally the accurate measurement of linear density or twine diameter at sea. When comparing existing methodologies the following points may be made:

- ICES 4 kg gauge gives lower results than wedge gauge for larger diameter and higher results for smaller diameter twines
- When using wedge gauges results using hand force are generally larger than those obtained when using a 5 kg perpendicular weight.

It was agreed that any proposals for new measuring forces should be based on the most frequently used twine diameters / materials. The current and proposed legal limitations on twine thickness should also be taken into account and in the interests of conservation any transition from one measuring force to another should not be detrimental to cod-end selectivity.

The most frequently used twine diameters and materials were established from the inventory and the appropriate TSF calculated. The current maximum permitted EU twine diameters are 5mm for double and 8mm for single twine. The equivalent TSF for such twines constructed in PE, the most commonly used material, is 10.659 kg and 13.636 kg respectively. It was decided therefore that tests using 10 kg and 13 kg weights be carried out on selected samples. The results are set out in Table 1.

The Chair explained how a longitudinal force giving the same results as the wedge hand force was calculated from a linear regression involving the ICES 4 kg, TSF, 10 and 13 kg measurements. This equivalent longitudinal force showed a large variability with 2.9 kg as a minimum and 21.1 kg as maximum value (Table 1). This variation could be attributed to both the human element and friction between gauge and netting. A histogram (Figure 3) was presented that showed the most frequent occurrences between 10 and 12 kg taking into account all samples, both PE and PA. The human factor that introduced variability into wedge hand force was discussed as were the new EU proposals to limit twine diameters to 4mm double and 6mm single. These would require equivalent measuring forces of 6.824 kg and 7.673 kg for PE netting. This would not necessarily be appropriate for twines used by ICES countries within the European Union.

The precision of measurement techniques was also discussed with regard to the number of meshes measured and the Chair explained the formula required to give ± 1 mm at 95% probability. To reach this precision only one of the netting samples measured required more than 60 meshes, 85 % of the samples required less than 40 meshes. The legitimacy of using wedge hand force as a comparison on which to base the new standard force was raised, and the point made that the wedge gauge with 2/5 kg perpendicular weights was the final arbiter of mesh opening as the law now stands. Surely this should be used as the benchmark for comparison? A proposal was made that a new histogram be drawn up using data based on wedge gauge with 5 kg weight rather than hand force. Such calculations required some time to carry out and the results were presented later in the meeting.

5.5 Related activities in the past year

The Chair updated the meeting on current developments in CEN/ISO, in particular the new international standard for measuring mesh size (ISO, 2002). This standard uses the wedge gauge with measuring weights of 2, 5 or 8 kg, dependent on the mesh size. The standard states that the method is suitable for laboratory conditions only and that it will be modified as soon as a method suitable for all environmental conditions becomes available.

The Chair also described the progress made by the OMEGA project in the manufacture of the prototype of an objective mesh measurement instrument and indicated that a presentation of this new gauge would be delivered later during the meeting, together with a practical demonstration of how it would be used.

The OMEGA gauge was discussed and it was pointed out that many of the practical problems met with when using the current wedge gauge (human factors, friction, difficulties of using perpendicular weights at sea) would not arise with this instrument. However, such precision instruments would need to be carefully used and maintained to ensure sufficient accuracy for legal prosecutions. It was postulated that once accustomed to the new gauge, the speed with

which inspectors could make measurements would probably be similar to that using a wedge hand gauge without weights. The validity in law and identification of electronic data were questioned, and technical specifications and calibration procedures discussed. It was thought that the lowest temperature capability of minus 10 degrees centigrade may not be adequate for work in some areas such as the Barents Sea. The likely price per instrument would be around 1200 euros, but no estimate of how much each statutory annual calibration might cost was available.

The presentation was made by Mr Lieven Demuynck of Marelec, followed by a demonstration of how measuring techniques would be carried out using full scale cod-ends in the Sea Fisheries Department net store.

5.6 Definition of new standard measuring forces

The histogram based on the wedge gauge with 5 kg weight showed values generally smaller than the wedge with hand force histogram, with two peaks at 4–6 and 8–10 rather than one at 10–12 (Table 1, Figure 4). There was still considerable variability but the mean value was adjudged to be just below 10 kg. This accords with the best estimate of longitudinal force exerted by the wedge gauge when the calculated theoretical force is reduced by friction (Anon., 2002.). For the smaller mesh sizes using a 2 kg weight, applying the same theoretical basis would result in a 4 kg longitudinal force. There were not enough measured samples in the inventory to demonstrate this conclusively but such a force would retain the status quo with no detriment to selectivity.

The question of where the line should be drawn between large and small meshes was discussed. Smaller meshes are generally constructed using thinner twines and larger meshes with thicker twines, so such a split is appropriate, but ought this to be based on mesh size or perhaps on twine thickness, as EU regulations now specify maximum permitted twine diameters? The difficulties of measuring twine thickness as opposed to mesh opening were pointed out and a proposal made to the effect that meshes of 55 mm and above be subject to the higher measuring force. This accords with EU legislation laying down twine thickness and would exclude most pelagic and Mediterranean gears. ISO (ISO, 2002) propose a split at 50mm for netting measurements using existing wedge gauges but it was thought that this could be changed to 55mm without too much opposition.

Histograms based on both wedge with hand force and wedge with 5 kg weight containing only PE samples were presented (Figures 5 and 6). The differences between 10 kg and 13 kg results were discussed and various plots showed little difference between the two for thicker twines, more so with thinner twines. The point was made that most existing selectivity data were based on measurements made with the ICES gauge, which uses least force of all methods reviewed. It was proposed that a median force be calculated between the 10 and 12 kg equivalent forces using available data. Tables for equivalent forces for both wedge with hand force and wedge with 5 kg for all samples and PE samples only covering 10, 11, 12 , 13 and 15 kg were presented, together with median and mean values for each case (Table 2). The overestimate of PA twines in the sample was discussed and considered unrepresentative, so attention concentrated the table for PE only.

This table suggests the appropriate values would be closer to 10 kg if based on wedge with 5 kg and 11 kg if based on wedge with hand force. A general debate ensued. Some argued that a 10 kg force would disadvantage fishermen but it was pointed out the difference between 10 kg and 11 kg would be minimal. From the point of view of the inspectors it was logical that the new force should be based on the wedge gauge with 5 kg weight and this was also the opinion of scientists in the light of present conservation concerns. It was pointed out that a vote could be called but it was also made clear that only ICES delegates could take part. The Chair proposed that a standard measuring force of 100 newton (9.81 kg) be adopted for meshes of 55mm or over and 40 newton (3.924 kg) for meshes with openings below 55mm. All participants agreed this proposal.

5.7 Specification of a suitable mesh measurement methodology – Conditions under which mesh measurements for all fishing gears in ICES areas should be made

The participants agreed on the following mesh measurement protocol:

a) A longitudinal force of either 40 or 100 newton will be used, depending on whether mesh opening is smaller or larger than 55mm.

b) For scientific purposes a minimum of 40 meshes will be required. If a precision of 1 mm at 95% is not achieved within these 40 meshes then measurements will continue until such precision is reached[1]. For Fisheries inspections the numbers of meshes to be measured will remain at 20 and 60 (as set out in e.g. EC, 2003).

c) When measuring cod-ends or extensions care must be taken to observe previous recommendations (Wileman et al, 1996; EC, 2003) with regard to nearness of selvedges, mendings, etc. For scientific purposes it is recommended that two rows of 20 meshes should be measured in an area where fish are known to escape, e.g. aft upper part of cod-end when targeting roundfish.

d) State whether netting is measured in a wet or dry state.

e) Meshes must be unfrozen

f) For scientific work the area measured must be clean and as free from sediment as possible. For inspection such matters are left to the discretion of Fisheries Inspectors.

g) Netting must be stretched in the direction of the long diagonal of the meshes (as per EC, 2003).

h) Square mesh netting will be measured on the longest diagonal (as per EC, 2003)

i) 90° turned netting will be measured on the longest diagonal.

It was noted in the1st Study Group Report (Anon, 2000) that problems may be met with loose knotless twisted netting, K meshes, etc. but no action is proposed due to small incidence of such cases.

5.8 Advice on improvements and further standardisation of current mesh measurement practices in view of the netting types now in use in ICES member countries

The Group recommends that all participants should as far as possible adhere to the conditions set out above, whether they be Scientists, Inspectors, Netting Manufacturers, Net Makers or Fishermen. As advice derived from selectivity data determines mesh size regulations, it is logical that all stakeholders should use the same system of mesh measurement. If these findings are accepted it will be necessary to change existing legislation and standards but this is not seen as an insurmountable problem.

Until an instrument capable of making such measurements becomes widely available the Group recommends that for scientific purposes the existing ICES gauge should continue to be used but in this interim period a conversion factor should be applied. This would deliver a mesh opening equivalent to that obtained using a longitudinal force of 100 newton. For inspection purposes use of the wedge gauge with 5 kg weight must continue until the necessary changes are made to regulations.

The conversion factor proposed is

Mesh (10 kg) =: 2.469 + 1.001 Mesh (4 kg) +0.000067 Rtex – 0.335 Mat +0.183 x No of twines

($R^2 = 0.9886$)

and requires the following information:

Linear density (Rtex); Material: PA = 1, PE = -1; number of twines (single = 1 / double = 2 / triple = 4).

It should be noted that the conversion is based on the measurements with the ICES gauge with 4 kg and 10 kg measuring forces. 10 kg corresponds to 98.07 N which is slightly lower than the proposed 100 N measuring force. This difference is regarded as being non-significant for mesh measurements.

Since twine diameter is related to the linear density, only the latter expressed in Rtex has been chosen as an independent variable. An additional term with the twine construction (twisted or braided) was found to be not significant.

The relation between twine diameter and Rtex is given by:

[1] This amends the recommendation made in the ICES selectivity manual for measuring a minimum of 100 meshes (Wileman *et al*., 1996).

for PA twines: $Rtex = 672.32\ D^{1.9297}$ ($R^2 = 0.9918$)

for PE twines: $Rtex = 438.71\ D^{1.9748}$ ($R^2 = 0.9521$).

The question of how to measure netting attachments was posed. The Group recommend that the same methods and conditions should be used for all areas of the gear as well as attachments, although this will not always be possible, e.g. for lifting bags with a limited number of meshes available for measurement. In some circumstances a certain amount of discretion will be required.

A discussion on basic methodology ensued. The recommendation made at the first meeting of the Study Group (Anon., 2000) for further investigation of the use of wedge shapes other than the flat gauge and of optical methods, was endorsed.

5.9 Any other business

No items were raised but the participants took the opportunity of updating Mr O'Shea, who had to leave the meeting for some time on EU business, on what had happened while he was absent. The Chair gave a brief resume of the work done and matters discussed, the decisions reached and the justifications for these decisions.

Mr O'Shea thanked the meeting for this but queried whether the cost of a new instrument could be justified when compared to the minimal cost of the current wedge gauges. The Chair pointed out that if regulations are made then they must be able to be enforced without disputes about the methodology, which is often the case with current equipment. The human element must be removed to obtain the necessary precision. Mr ten Have suggested that we should consider the costs and benefits involved. Financial costs would certainly be higher but accuracy would be significantly improved. The price of such new instrumentation should be considered within the context of the overall costs of inspections and prosecutions.

Mr O'Shea explained to the meeting how changes in EU legislation are brought about. Proposals may be made by individual member countries or advisory EU committees, but would have to be passed by the Council and this could take some time. The Chair thanked Mr O'Shea for this contribution.

5.10 ICES Cooperative Research Report

This part of the meeting was attended by SG members only.

The Chair set out the procedures and timetable required for a Cooperative Research Report. Although only the Chair of the Fishing Technology Committee need approve the document the question of a peer review was raised. On a previous project (Wileman *et al.*, 1996) three referees were invited to review the paper. The group decided that Dr Peter Stewart, Dr Steve Walsh and Mr Jose Gramaxo would be suitable candidates in this case. It was proposed that statistical advice should be sought from Dr R J Fryer, Statistics Group Leader, FRS Marine Laboratory, Aberdeen. The Chair will prepare a short text on the methodology of the statistics used for Dr Fryer's information.

The structure of the report was agreed at the previous meeting in Sète (Anon., 2002) and an incomplete draft was circulated to the participants prior to this meeting. Now that the final meeting report is available this first draft can be completed. The Group reviewed the draft section by section.

Introduction

The history of the current mesh measurement instruments used (wedge gauge, ICES gauge) will be explained and methodologies reviewed. The text from both Terms of Reference and Scientific Justification will be utilised. The Group met on four occasions, at IJmuiden, The Netherlands in 2000 (Anon., 2000); Seattle, USA in 2001 (Anon., 2001); Sète, France in 2002 (Anon., 2002) and Ostende, Belgium in 2003. The last meeting, where the final standard measuring forces were decided, included representatives from the Fisheries Inspectorates of the member countries, Eurocord, CEN and the European Commission.

Definitions

The CEN proposal (CEN, 2003) to change the wording of the definition of the mesh opening of diamond mesh was agreed but it was felt that definitions for both square and turned meshes should also be included. A more descriptive diagram of mesh opening was suggested to show that the gauge passes to one side of the knot to achieve the longest possible diagonal. New Commission Regulation (EC) No 129/2003 should be substituted for 2108/84.

Units

A new section on terminology was proposed to clear up differences between twine / yarn, diameter / thickness, etc.

Review of current mesh measurement practices

The new legislation concerned with twine thickness measurement (EC, 2003) and the availability of pliers to carry this out will be included in this section.

Scientific studies – approved

Mesh gauges – approved

Description and operation of the ICES mesh gauge – approved

Measurement procedure – approved

Discussion – approved

Enforcement practices

The point should be made that wedge gauges in USA are calibrated in one-sixteenth of an inch.

Measurement procedure

No hand force is used in USA, only 5 kg weight.

Discussion – approved

Production control – approved

Fishermen users

It was thought that fishermen are unlikely to use weights, only hand force.

Standardisation

The new ISO standard (ISO, 2002) was explained by the Chair. It was noted that the EU regulation on static gear (EC, 2003) requires a prescribed force. This should be included in the last paragraph.

Inventory of towed gear cod-end materials

This is still incomplete and missing information on the fisheries in which these nettings are used should be supplied to the Chair as soon as possible. There is also a lack of data from Sweden on escape panels and cod-end material (BACOMA) which Daniel Valentinsson will supply. Bill Hickey will also send corrections for Canadian material.

Experimental work

Introduction

It was suggested that this section should contain some theoretical text on twine stiffness and elongation and a small table comparing the different materials used. Linear functions should be used if possible. Data may be obtained from Klust (1982) or the EU FAIR project CT96 1555 Development of a predictive model of cod-end selectivity (PREMECS).

Mesh opening measurements – approved

Materials and Methods

Dr RST Ferro, FRS Marine Laboratory, Aberdeen will be invited to contribute some text on the new laser twine thickness measuring instrumentation.

Twine Diameter – approved

Linear density – approved

Mesh opening

It should be made clear in the paragraph on state of the netting that all samples were measured under normal laboratory conditions with no extremes of temperature and humidity.

Results and analysis

Twine diameter – approved

Linear density – approved

Comparison between twine diameter and linear density – approved

Mesh opening – approved

Comparison of existing technologies

60mm mesh opening should be changed to 55mm mesh openings. It was suggested that equations could be represented by a table and abbreviations improved by substituting letters for terms. New equations will be presented leaving out either Rtex or diameter after consultations with Dr Fryer.

After an example was presented and discussed it was agreed the scatter plots should be presented as well as equations. There would be six in all i.e. ICES gauge v wedge hand force; ICES gauge v wedge + weight; wedge hand force v wedge + weight for both large and small meshes. The question was asked if more explanations for each variable should be included. As a longitudinal force has been selected in preference to a vertical force can this be shown to be better in order to justify such a choice?

Some data were examined and no differences in the coefficients of variation were found. This point should be included in the report. The meeting was reminded that Ferro and Xu (1996) attributed this to manufacturing variation in the mesh size of the samples measured. The Chair proposed that advice also be sought from Dr Fryer on this matter.

Comparison between ICES gauge and TSF

It was suggested that a paired T-test should be used to examine statistical significance, as constant stress (TSF) is compared to constant force (ICES gauge) with each sample treated separately. A new table for ICES gauge and TSF should be constructed and each sample marked where a significant difference is found. Different symbols could be used for significant and non-significant differences in Figures 10 and 11.

Some doubt was expressed about whether a T-test was appropriate. With 60 meshes measured in each sample the Chair considered the data adequate and this point would be emphasised in the text. It was suggested that the scale for Figures 10 and 11 be altered to show trends more clearly, and that the symbols should differentiate between double and single twines. The meeting agreed that a cluster analysis should also be included in this section.

A further suggestion that the equations be presented in the form e.g**.** *ICES gauge / Wedge gauge = other terms* as this would be easier to show which factors had significance in multiple regression. What was needed was a way to demonstrate how much each factor contributes. It was agreed that Dr Fryer be consulted on this point.

Mesh measurement using 10 kg and 13 kg longitudinal force

A description of these experiments (see 5.2 above) and subsequent analysis (tables, histograms) will be presented. Table 6 gives a summary of the results obtained.

Discussion

The point was made that there was little difference in standard deviation between the ICES gauge and other results, and this should be made clear. It could then be followed by a statement that there is a larger variation between different forces when using the same method than there is between methods when using the same force. This would be a good justification to adopt a new method, from a legal standpoint. It was deemed important that the text makes clear a force equivalent to that exerted by a wedge gauge was sought, and that both wedge with hand force and wedge with weight were examined. The justification of the final choice made should also be set out.

It was felt the imposition of a 100 newton force in place of hand force may well result in some of the existing cod-ends used becoming illegal, and having to be scrapped. However the overriding consideration must be that there is no decrease in selectivity. A previous study (Ferro and Xu, 1996) suggests that a force of at least 8 kg (78.5 newton) is required to achieve similar mesh openings in dry PE netting to a wedge gauge with 5 kg weight, but this was based on much thinner twines.

Conclusion

This would be based on a summary of the terms of reference and a demonstration of how they were met. All participants considered this would be sufficient.

Proposals

1) Variable force proportional to twine linear density would be preferred but there are practical difficulties with this approach, principally the accurate measurement of diameter or linear density at sea.
2) It follows that SGMESH recommends groups of netting to which two standard forces apply for a) netting under 55mm mesh size and b) netting of 55mm or greater mesh size.
3) SGMESH recommends a longitudinal force in preference to a perpendicular force.
4) SGMESH confirms the principle of mesh measurement used in the present ICES gauge.
5) Analysis shows that 40 newton would be appropriate for the smaller, 100 newton for the larger mesh.
6) A force of 40 newton can be exerted by the current ICES gauge but 100 newton is out with the range of this instrument. The group is aware that a new gauge is being developed with a capacity of 180 newton in the EU shared cost OMEGA project Q5CO-2002–01335.

7) The above instrument will not be available until 2005. SGMESH recommends that in the meantime for scientific work the ICES 4 kg gauge be used but the results should be converted to 100 newton equivalent using the a formula.
8) In most cases the measurement of 40 meshes would be sufficient for a precision of 1 mm at 95% confidence limits. If this is not the case after 40 meshes then measurements should continue until such precision is attained.
9) It was noted there is variance in all methods of mesh measurement studied and this is attributed mainly to the variability of material.
10) Even when using standardised weights with the wedge gauge the variation in longitudinal force is still considerable.

References

List of participants

Glossary

All participants will be consulted and invited to contribute.

5.11 Closing of the meeting

The meeting was closed at 14.40 on 21 March, 2003.

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Table 1 – Mesh measurement results.

	mean mesh opening (mm)						mesh opening relative to TSF					equivalent force	
Yarn designation	ICES 4kg	TSF*	wedge hand	wedge 5/2kg	10 kg	13 kg	ICES 4kg	wedge hand	wedge 5/2kg	10 kg	13 kg	hand	5 kg
PA 4 BR DBL 12000	113.0	118.8	109.5	112.1	113.4	114.7	0.95	0.92	0.94	0.95	0.97	-16.89	-0.75
PA 6 BR DBL 20000	132.1	143.1	134.5	134.6	140.1	139.5	0.92	0.94	0.94	0.98	0.97	5.25	5.40
PA 8 BR SIN 35800	119.9	127.0	119.8	120.1	124.2	125.2	0.94	0.94	0.95	0.98	0.99	2.91	3.50
PA 8 BR DBL 15400	136.8	146.6	138.9	137.5	143.5	146.0	0.93	0.95	0.94	0.98	1.00	5.79	4.23
PE 4 BR DBL 5600	145.0	148.5	148.9	148.4	148.3	149.6	0.98	1.00	1.00	1.00	1.01	11.33	9.83
PE 5 BR DBL 8100	80.8	86.5	87.7	86.8	84.1	85.2	0.93	1.01	1.00	0.97	0.99	21.08	18.23
PE 5,5 BR DBL 10940	105.0	110.1	110.6	111.2	108.2	109.1	0.95	1.00	1.01	0.98	0.99	16.11	17.50
PE 6 BR DBL 11140	131.4	138.1	136.6	136.3	133.9	134.7	0.95	0.99	0.99	0.97	0.98	11.51	17.13
PE 4 BR SIN 5470 105	106.5	104.4	109.7	108.4	108.7	109.9	1.02	1.05	1.04	1.04	1.05	12.29	9.60
PE 4 BR SIN 5470 75	70.5	68.8	75	72.6	73.0	74.0	1.02	1.09	1.06	1.06	1.08	14.66	9.58
PE 4 BR DBL 6250	81.0	81.7	84.0	83.1	83.4	84.2	0.99	1.03	1.02	1.02	1.03	12.42	10.02
PE 5 BR SIN 8000	86.9	86.9	90.9	89.6	90.9	91.7	1.00	1.05	1.03	1.05	1.06	10.29	8.12
PE 3,2 BR TRI 5300	135.2	142.2	141.8	137.7	142.8	143.6	0.95	1.00	0.97	1.00	1.01	9.65	5.23
PE 5 BR DBL 13900	137.7	147.1	141.4	140.0	145.8	147.5	0.94	0.96	0.95	1.00	1.01	7.11	5.71
PE 6 BR DBL 10800	134.1	140.8	137.2	136.3	141.0	143.5	0.95	0.97	0.97	1.00	1.02	6.92	5.00
PE 7,1 UC SIN 21170	133.2	138.7	137.2	135.2	138.7	140.5	0.96	0.99	0.97	1.00	1.01	8.73	6.50
PE 10,8 UC SIN 53500	133.7	143.1	137.6	137.0	140.8	142.5	0.93	0.96	0.96	0.98	1.00	6.54	4.81
PE 3,5 BR SIN 3915	71.6	71.0	74.8	76.2	75.6	77.8	1.01	1.05	1.07	1.07	1.10	8.53	10.75
PE 3 BR SIN 4060	68.6	68.0	76.1	75.0	76.3	78.4	1.01	1.12	1.10	1.12	1.15	10.47	9.40
PE 5 BR SIN 13632	74.7	78.8	81.2	79.4	81.0	82.6	0.95	1.03	1.01	1.03	1.05	10.72	8.62
PE 6 BR DBL 14225	99.5	104.3	104.6	101.9	101.4	103.0	0.95	1.00	0.98	0.97	0.99	16.16	10.05
PE 4 BR DBL 5208	75.2	77.0	82.6	80.9	80.4	81.0	0.98	1.07	1.05	1.04	1.05	14.71	12.03
PE 6 BR DBL 12500	76.6	83.5	89.4	84.2	84.1	84.8	0.92	1.07	1.01	1.01	1.01	18.10	12.11

Table 2 – Occurrence of equivalent longitudinal forces with respect to longitudinal measuring forces in the range 10–15 kg.

All samples		Measuring forces						
		10 kg	11 kg	12 kg	13 kg	15 kg	Median	Mean
Equivalent force; wedge by hand	Numbers below	41%	55%	64%	73%	82%	10.6	11.0
	Numbers above	59%	45%	36%	27%	18%		
Equivalent force; wedge 5 kg	Numbers below	64%	77%	77%	86%	86%	9.5	9.2
	Numbers above	36%	23%	23%	14%	14%		

PE only		Measuring forces						
		10 kg	11 kg	12kg	13 kg	15 kg	Median	Mean
Equivalent force; wedge by hand	Numbers below	32%	47%	58%	68%	79%	11.3	12.0
	Numbers above	68%	53%	42%	32%	21%		
Equivalent force; wedge 5 kg	Numbers below	58%	74%	74%	84%	84%	9.6	10.0
	Numbers above	42%	26%	26%	16%	16%		

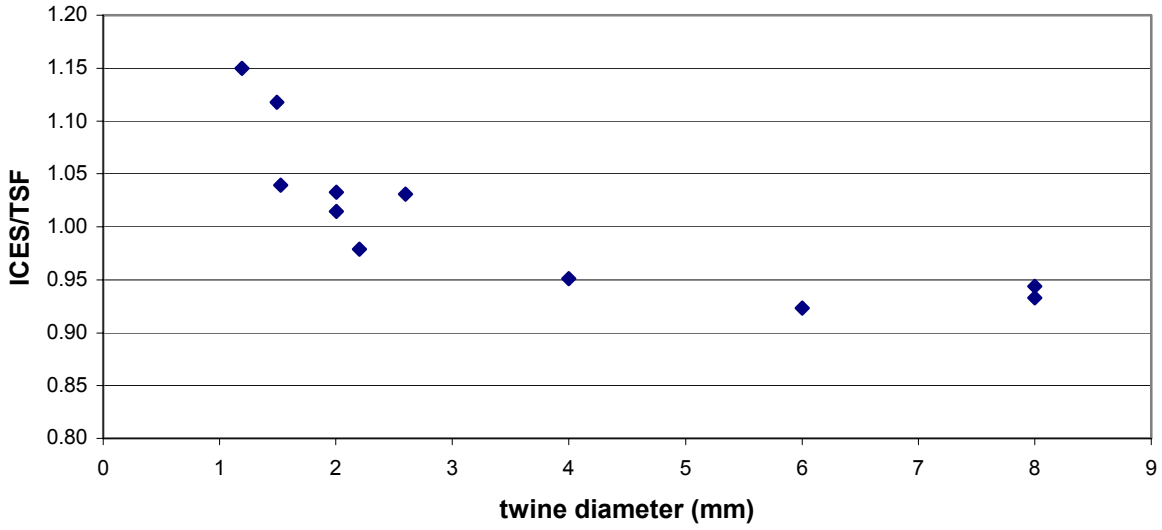

Figure 1. Ratio ICES/TSF in relation to the twine diameter for all PA nettings.

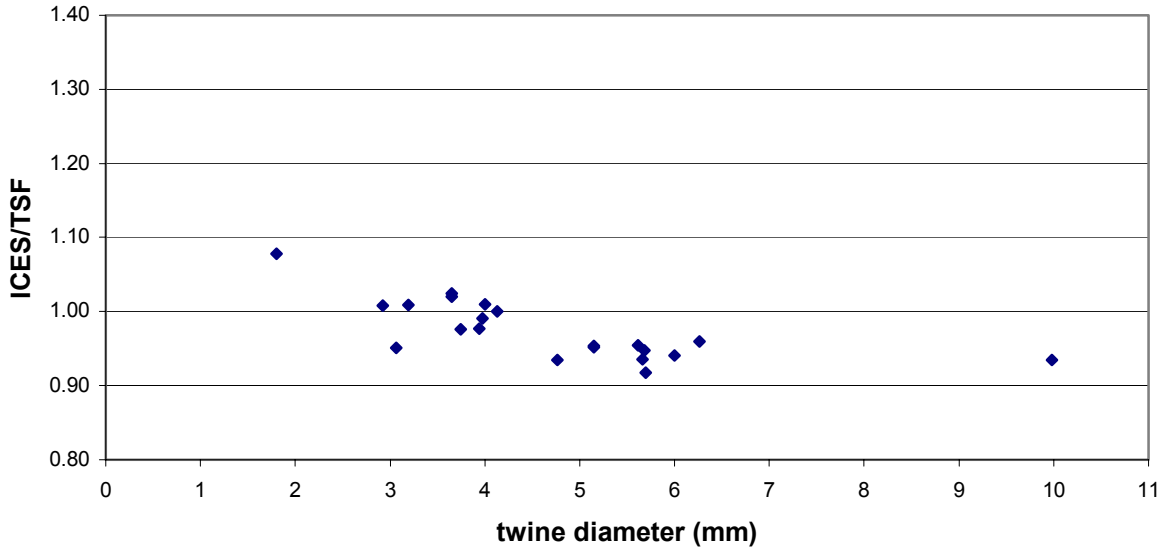

Figure 2. Ratio ICES/TSF in relation to the twine diameter for all PE nettings.

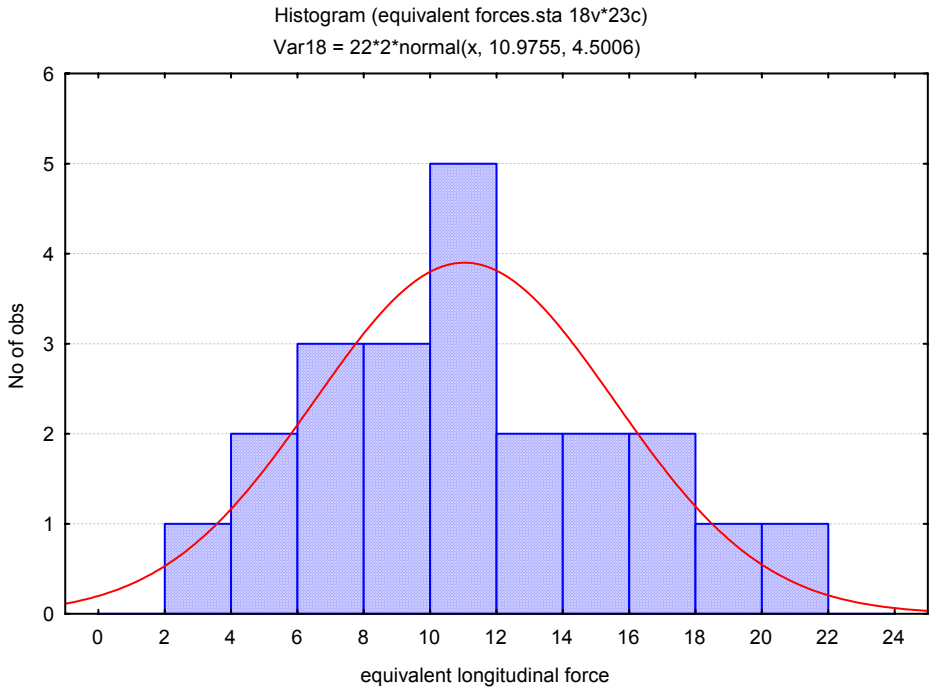

Figure 3. Histogram showing occurrence of calculated longitudinal forces equivalent to wedge gauge hand force – all samples.

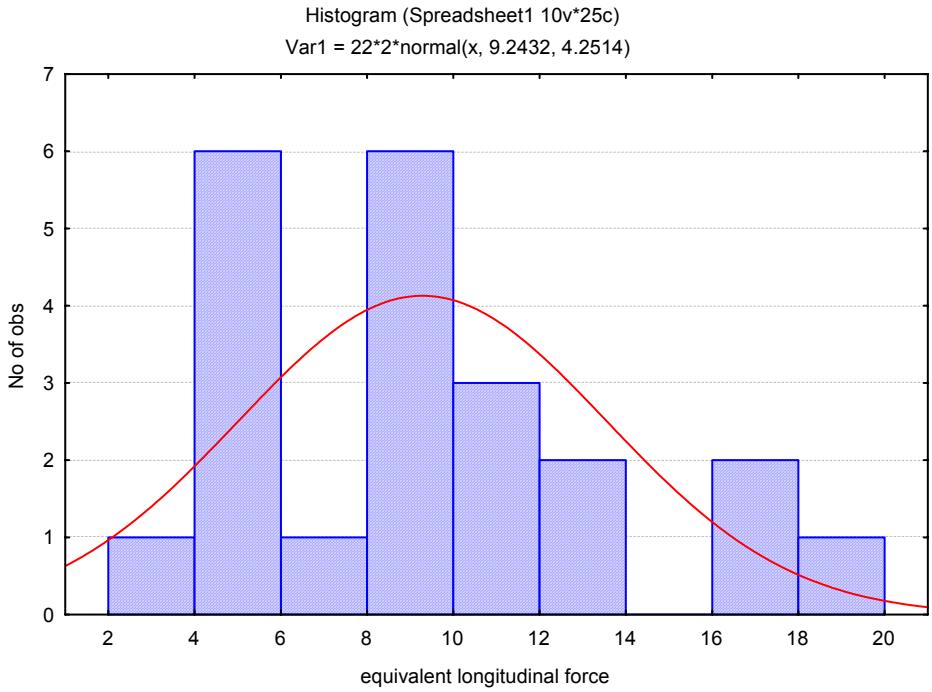

Figure 4. Histogram showing occurrence of calculated longitudinal forces equivalent to wedge gauge 5 kg force – all samples.

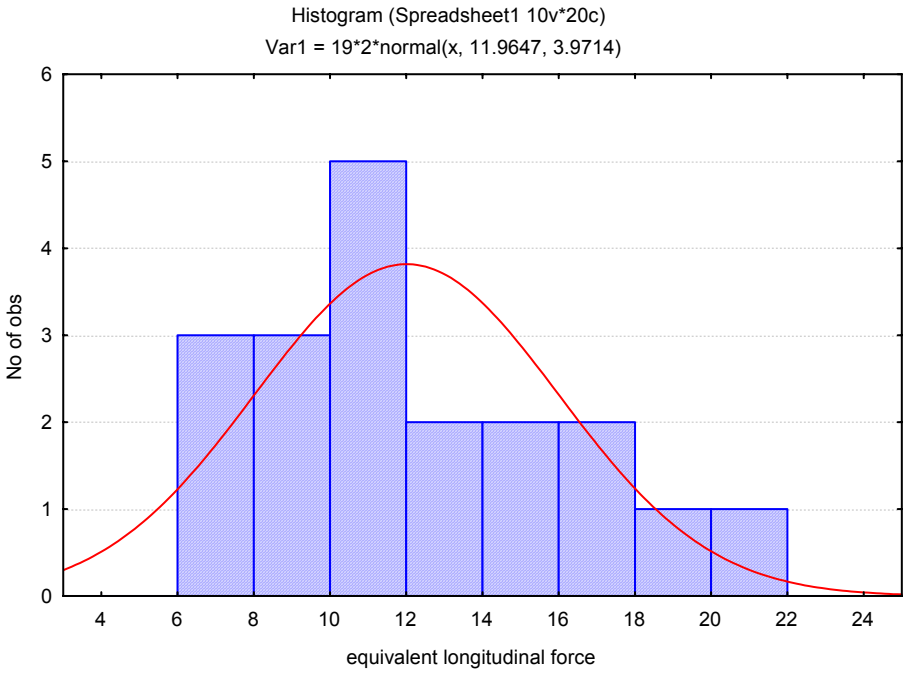

Figure 5. Histogram showing occurrence of calculated longitudinal forces equivalent to wedge gauge with hand force – PE samples only.

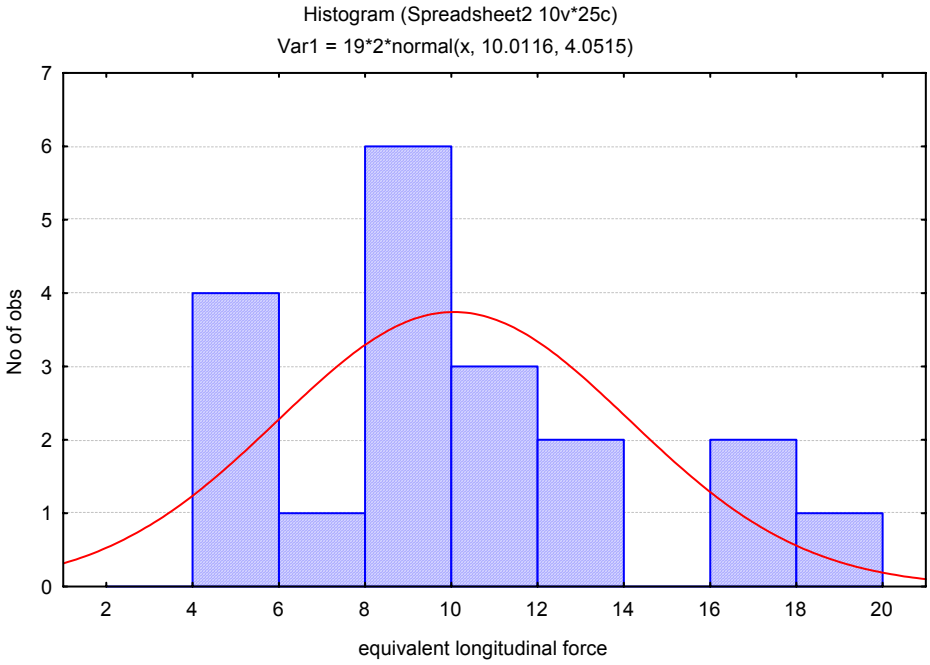

Figure 6. Histogram showing occurrence of calculated longitudinal forces equivalent to wedge gauge with 5 kg weight – PE samples only.

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ANNEX 2: AGENDA

19–20 March 2003

1) Opening
2) Appointment of a rapporteur
3) Adoption of agenda
4) Practical arrangements
5) Terms of Reference
6) Report of past SGMESH activities

    a) Definition of mesh opening
    b) Inventory of netting materials
    c) Inter-laboratory measurements
        - Twine diameter and linear density
        - Mesh measurements
            – ICES mesh gauge: 4 kg measuring force / Textile Standard Force
            – Comparison ICES gauge / wedge gauge hand operated / wedge gauge 2/5 kg
            – 10 and 13 kg measuring forces

7) Report of related activities in the past year:
    a) CEN/ISO
    b) OMEGA project
    c) Demonstration of the OMEGA mesh gauge model

8) Definition of new standard measuring forces
9) Specification of a suitable mesh measurement methodology – Conditions under which mesh measurements for all fishing gears in ICES areas should be made
10) Advice on improvements and further standardisation of current mesh measurement practices in view of the netting types now in use in ICES member countries
11) Any other business

21 March 2003

12) ICES Cooperative Research Report
13) Closing of the meeting