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Report of the Study Group on Turned 90° Codend Selectivity, focusing on Baltic Cod Selectivity (SGTCOD)

31 August - 3 September 2010

Hirtshals, Denmark

ICES International Council for the Exploration of the Sea

CIEM Conseil International pour l'Exploration de la Mer

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Executive summary

The second meeting in the ICES Study Group on Turned 90° Codend Selectivity, focusing on Baltic Cod Selectivity (SGTCOD) was held from 31 August – 3 September 2010 in Hirtshals, Denmark. Originally the meeting was planned for 11–14 May at IMR in Reykjavik, Iceland. However, because of volcano activity on Iceland during spring it was necessary to postpone the meeting at the last minute. The meeting was then re-scheduled to August/September. The re-scheduled meeting was hosted by DTU AQUA and was attended by eight participants from three different nations.

The Study Group chaired by Bent Herrmann and Waldemar Moderhak will run for a period from 2009–2011. The objectives for the three year run of the group are as follows:

- Evaluate the effect of turning diamond netting by 90° (T90) on codend selectivity;
- Improve knowledge of the size selection processes in T90 codends compared to T0 codends (normal direction of diamond netting);
- Attempt to quantify the magnitudes of the effects of different factors (construction, generic netting properties, stock specific morphology, catch composition);
- Develop a guide on T90 codend constructions with respect to size selection properties and optimal construction and;
- Review available data on fish survival and in particular cod escaping from T90 codends.

These objectives were planned to be reached by combining field experiments, laboratory experiments with nettings, laboratory experiments with fish morphology specific on Baltic cod and theoretical approaches (structural mechanics and computer simulations).

The meeting included a two days workshop on analysis of selectivity data using both new and historical case data for Baltic cod and other data of relevance for the work of the group. This provided a forum for a detailed revisit to some of the old results and interpreting them in a new context. An important objective for the meeting was to review and discuss the results from the new research carried out since the group's first meeting based on actions agreed during the first meeting. A number of presentations were therefore given on the new experimental data and the analysis of these. A first scientific paper based on some of these new data on Baltic cod demonstrated the importance of considering the number of meshes in the codend circumference for the size selection of cod in T0 and T90 codends. Comparing these results with results from another set of new data further demonstrated that the effect of turning netting (from T0 to T90) is very dependent on netting twine characteristics. Based on acknowledgement of this a new experiment to in a systematic way study the effect of twine characteristics on size selection of Baltic cod in T0 and T90 codends was proposed during the meeting as a new action for the group. From January 2010 has the mesh regulation for the fishery targeting Baltic cod changed. Results for size selection from new experimental fishing with T90 and BACOMA codends complying with the new regulation were also presented at the meeting. The analysis indicated increased signature of a dual selection process in the BACOMA codend probably resulting from increased unbalance between the window mesh size and the mesh size in the lower diamond mesh panel. A clear dual selection signature could lead to high selection range and could potentially lead to high discard rates or considerable loss of

fish of legal size through codend size selection. To be able to investigate selective properties linked to survival rates of escapists it was proposed as a future action to investigate and compare when during the fishing process Baltic cod escape from the T90 codend and to investigate if this pattern is different from what take place in the other legal design (BACOMA). Besides the new experimental data for size selection of Baltic cod in T0 and T90 codends new data for size selection of cod from T90 codends applied in other fisheries was also presented at the meeting; these included data from Norway and Denmark. The meeting also revealed that the planned data collection of morphology of Baltic Sea Cod had also been carried out in accordance with the planned schedule from the first meeting. However, analysis of these data still remains to be carried out. Overall, it was concluded that good progress has been made towards achievement of the final goals for the work of the group. It may however be difficult to complete the work within the three year life frame for the study group.

The report includes a short description of the main findings and the identified new actions necessary to help achieving the final objectives.

1 Adoption of the agenda

The group adopted the agenda for the meeting, full details of which can be found in Annex 2 of this report.

2 Summary of relevant results from the presentations and the workshop

According to the agenda were a number of presentations given during the meeting. Below is a short summery of the most important results reported in the presentations and from the workshop.

2.1 Combined analysis of experimental data for four different codends made of *Redline* netting

Initiated by an action proposed at the first meeting (A1.4 , see Section 3) the size selectivity of four different codends made of same type of netting was assessed on a German research cruise (Solea 610) with Harald Wienbeck as cruise leader and a number of the other members of SGTCOD participating (Waldemar Moderhak, Daniel Stepputtis, Bent Herrmann). The objective of the experiment was to be able to assess to what extent turning codend netting 90 degrees (T90) and halving the number of meshes (from 92 to 46) in the codend circumference contribute alone and in combination to the improvement of codend size selection of Baltic cod compared to in a traditional diamond mesh codend (T0). Although the netting used was not identical with that used in a previous simulation-based study on haddock most results were find to be in line with the predictions from simulations. Both halving the number of meshes in the codend circumference and turning the netting direction 90 degrees had a statistical significant and positive effect on the size selection of Baltic cod. The best results were obtained in the codend in which both factors were applied together. For this codend, very little between-haul variation in the size selection, especially compared to the reference codend in which none of the factors were applied was observed. These results demonstrate that turning the codend netting 90 degrees can significantly improve the size selection of Baltic Sea cod compared to a traditional diamond mesh codend. But results from the data analysis (using the SELNET tool) also showed that for the specific netting type applied that 71% of the total increase in L50 for Baltic cod by applying both factors (turning netting 90 degrees and halving number of meshes in codend circumference) can be achieved by only halving the number of meshes in the codend circumference. Because the current Baltic fishery management is based on detailed technical regulations, the results also demonstrate how important it is that the implemented T90 legislation takes into account the number of meshes in the codend circumference. A further consequence of the importance of meshes in the codend circumference on the selective properties of a T90 codend is that this effect has to be considered when comparing size selection for T90 and BACOMA codends. Thus, this comparison should preferable be done for an optimized T90 regarding number of meshes around. Results reported are specific for the netting applied (5 mm single twine polytit COMPACT) and should in general not be extrapolated to codends made of other twine constructions. Figure 1 show the netting applied stretched as T0 (left) and as T90 (right).

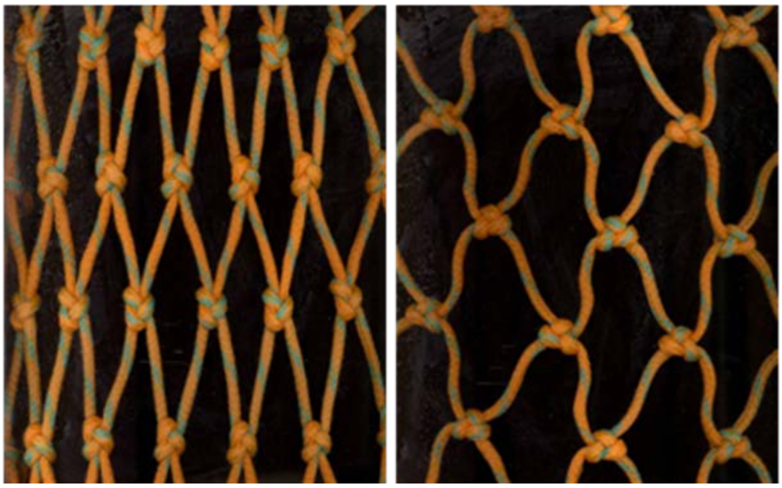

Figure 1. Polytit COMPACT (redline) applied for the codends.

Figure 2 shows mean Selection curves for the four codends tested.

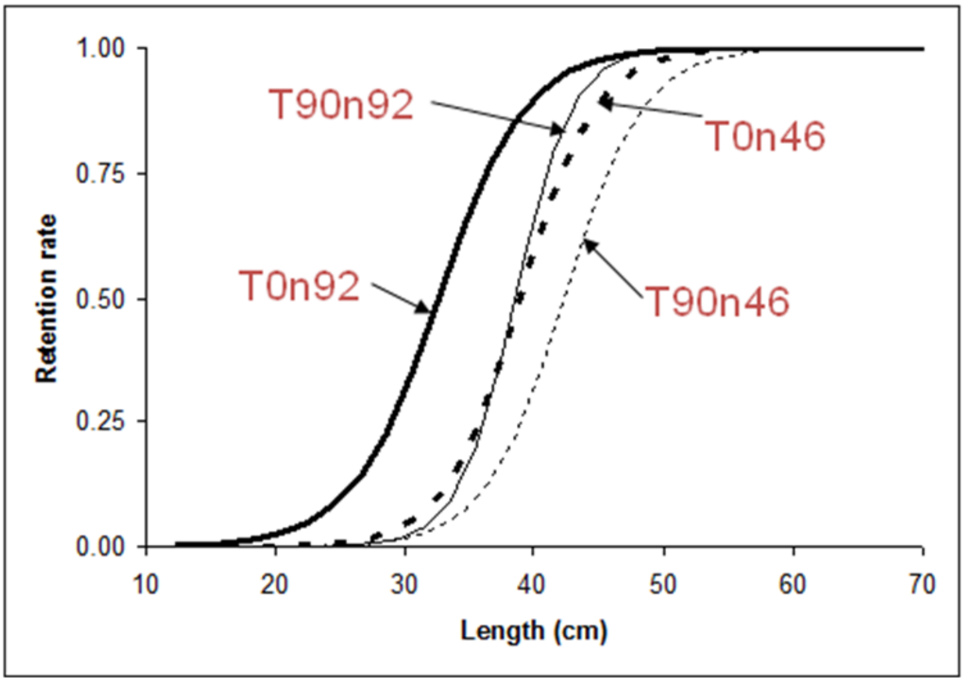

Figure 2. Mean selection curves for the four codends tested.

The study reported here is detailed described in a scientific paper being published in the journal 'Fisheries Research' ("Effect of netting direction and number of meshes around on size selection in the codend for Baltic cod (Gadus morhua)" by Wienbeck, H., Herrmann, B., Moderhak, W., Stepputtis, D. DOI: 10.1016/j.fishres.2011.01.019).

2.2 New experimental results obtained for codends made of Dyneema netting

A German research cruise (Solea 619) carried out in March 2010 tested the size selection of Baltic cod in codends made of 2.5 mm single twine dyneema netting (double knotted). Three codends were tested T0n88 (standard diamond mesh codend with 88 open meshes in codend circumference), T0n44 (standard diamond mesh codend with 44 open meshes in codend circumference) and T90n44 (90 degree turned netting (T90) codend with 44 open meshes in circumference). The objective of the study was: 1) to establish basic values for the L50 for Baltic cod size selection for the thin twine Dyneema netting; 2) to demonstrate that the relative effect of turning netting by 90 degrees or halving the number of meshes in the codend circumference can be considerable dependent on the twine characteristics of the codend netting (using the results reported in Section 2.1). The German research cruise had participation of a number of the members of SGTCOD: Harald Wienbeck (cruise leader), Daniel Stepputtis, Waldemar Moderhak, Ludvig Krag, and Bent Herrmann. Figure 3 shows the netting and one of the codends.

Figure 3. Dyneema single 2.5 twine and codend (right) applied during the cruise.

The data analysis was carried out in the analysis tool SELNET using the method described by Fryer (1991) considering netting direction and number of meshes in codend circumference as fixed effects. The analysis showed that halving the number of meshes in the codend circumference statistical significantly increased L50 for Baltic cod. No additional effect was obtained by additional turning the netting to T90. Figure 4 show the mean selection curves for the three codends tested during the cruise.

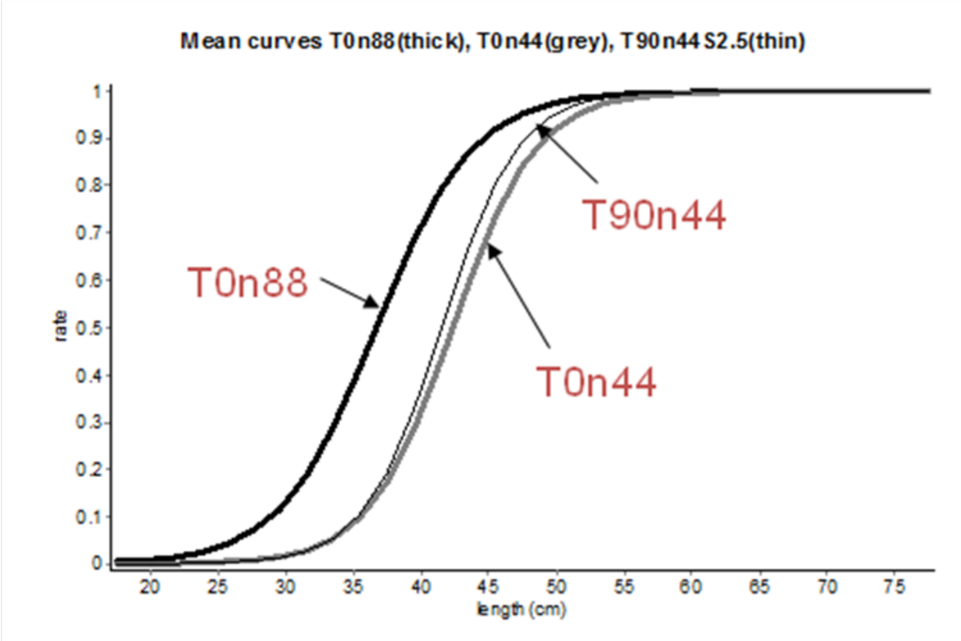

Figure 4. Mean selection curves for the three codends (T0n88, T0n44, T90n44).

Based on these results, together with the one reported in Section 2.1, it is evident that codend twine characteristics will have considerable influence on the achievable improvement of size selection of Baltic cod by turning codend netting 90 degrees compared to a traditional diamond mesh codend. Based on this observation the need for a systematic investigation of the effect of codend twine characteristics on the size selection of Baltic cod for T0 and T90 codends was obvious. This resulted in the proposal for a new action for the group (see Section 4 action A2.1).

2.3 New experimental results obtained for codends complying with the new regulation in Baltic Sea

During the German research cruise Solea 619, mentioned in Section 2.2, additional experimental fishing was conducted. Aim of the experiments was to investigate the size selectivity properties of the gear described in current legislation for the Baltic Sea (from 2010). Thus a T90 codend (with mesh size of 127 mm; nominal mesh size 120mm) and a BACOMA codend (with square mesh panel mesh size 129 mm; nominal mesh size 120mm; lower panel made of 105mm diamond mesh netting) were tested using the covered codend method. Figure 5 show results from analysis of the average selection for the two codends based on using a double bootstrapping method in the analysis tool SELNET using the S2Logit curve to describe the experimental data.

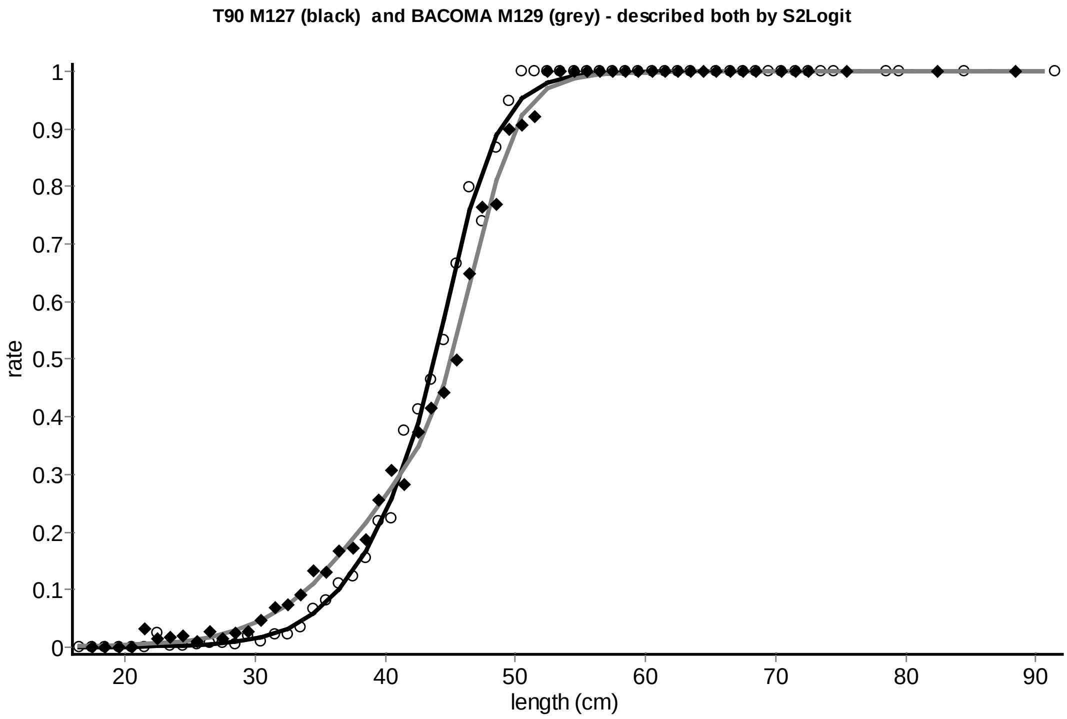

Figure 5. Average size selection for T90 120mm codend (black curve) and BACOMA 120mm codend (grey curve).

Even though the BACOMA M129 has a bigger average L50 than the T90 M127 codend, it will retain more small individuals as the lower part of the selection curve is rather flat. This flat part of the BACOMA codend average selection curve could be interpreted as an indication of increased signature of a dual selection process in the BACOMA codend. This may be as a result of an increased unbalance between the window mesh size and the panel mesh size in the diamond mesh lower panel. This dual selection can lead to a high selection range and to higher discard rates or considerable loss of fish of legal size through codend size selection. The dual selection hypotheses is further supported by that the traditional Logit curve, mostly applied to describe experimental selection data, is very poor at describing the BACOMA size selection data for Baltic cod compared to a S2Logit curve (implemented in SELNET) which can account for a dual process. This is demonstrated on Figure 6.

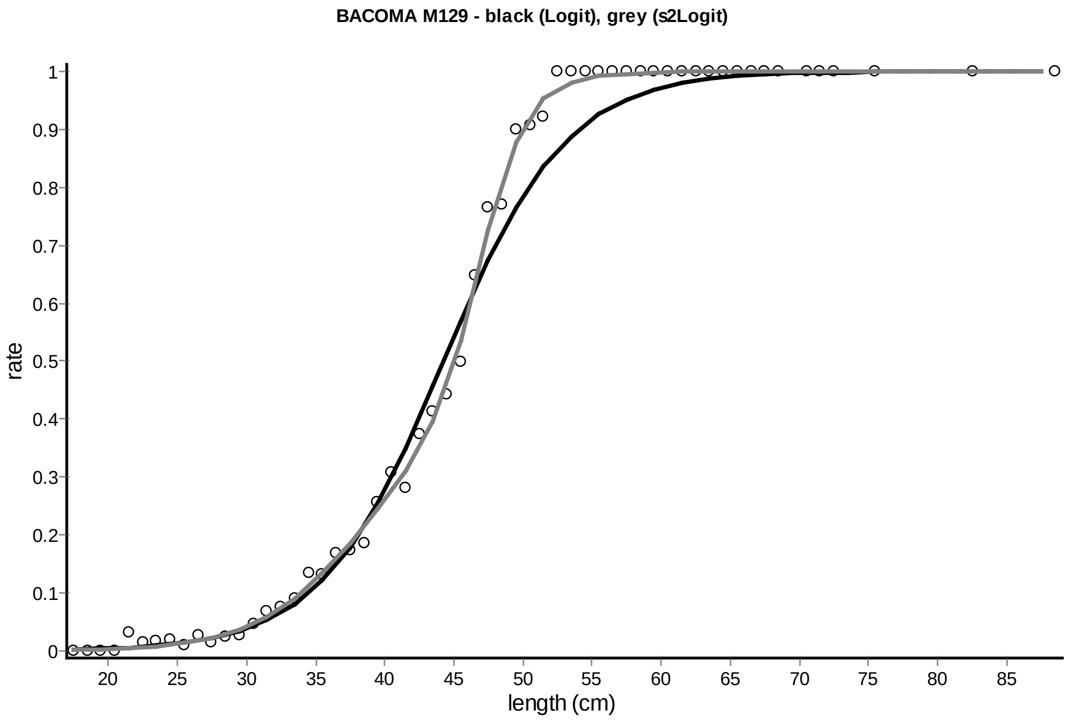

Figure 6. Fit of Logit curve (black) and S2Logit curve (grey) to the BACOMA average size selection data.

From Figure 6 it is clear that using a traditional Logit curve in estimation of (for example) expected discard rates or loss of legal sizes could lead to considerable bias in results.

The SGTCOD group agreed that it would be relevant to study these phenomena in more detail because the BACOMA codend is currently the only legal alternative to the T90 codend and widely used in commercial Baltic fishery (new A2.3, see Section 4).

2.4 Danish selectivity experiments comparing T0 and T90 with focus on escapement during different phases of the fishing process

Sea trials were carried out in the Northern Kattegat and the Skagerrak. The objective of the experiment was to compare the size selectivity of a T90 codend with a standard codend constructed of the similar netting mounted in standard direction. The codends are fished simultaneously in a twin trawl rig but using the covered codend method. A new codend cover design with two separate collecting bags was developed to assess escape during haul-back separately from during towing near the seabed. Escapement during haulback might cause additional unaccounted mortality. Sea trials were conducted on board a commercial vessel, with Niels Madsen as cruise leader. The two codends were made of the same nominal 90 mm 4 mm double Polyethylene (PE) netting. Both codends had 100 meshes in circumference including 4 meshes in both selvedges. For each codend a dual sequence model was fitted to the data. The dual sequence model can explicit account for that not necessary all individual are able attempt to escape from the codend during the towing along the seabed. Therefore is this type of model is especially suited to describe the three-compartment experimental data with separate collecting covers of escapists during towing and during haulback operation (including at the surface) which results from the experimental design applied. Data was analysed to model the length dependent overall codend retention, escapement during towing and escapement during haulback operation on average for the group of hauls. To mitigate underestimation of parameter confidence limits a double bootstrap method accounting for both within and between-haul variation in the escapement processes was applied. Data was analysed using the software tool SELNET.

Figure 7 plots the average results obtained for cod during the experiments.

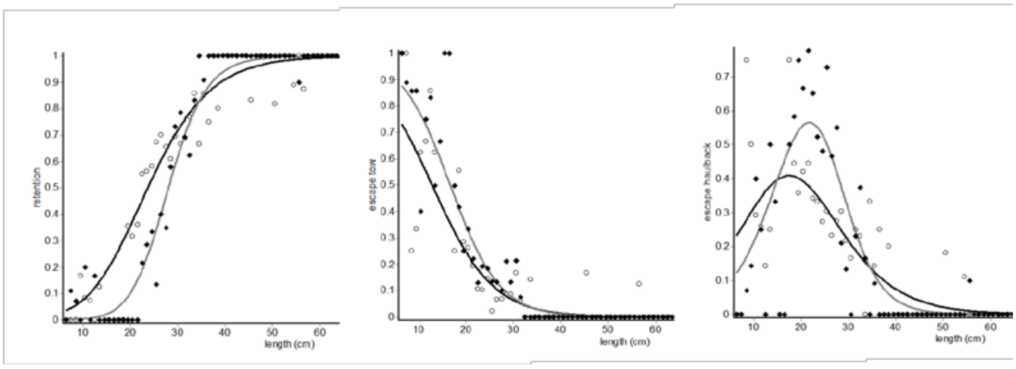

Figure 7. Results for cod for T0 (black curve) and T90 (grey curve): overall codend retention (left), escape during towing (middle), escape during haulback operation (right).

As Figure 7 indicate was the escapement rates during towing (middle plot) higher for T90 compared to the for T0 codend. Whereas there was a weak indication of that more very small cod might be escaping from the T0 codend during haulback which in turn could affect their mortality in a negative direction. Overall the results indicate that the T90 codend might have a bigger L50 for cod compared to the similar T0 codend. But unfortunately was none of the results for size selection of cod in the T0 and T90 codends statistical significantly different. However this can be related to the limits number of cod in the trial. Definitive conclusions for cod can thus not be made on basis of this dataset. It was therefore also impossible to judge whether or not all cod actually attempt to escape during towing or not from analysis of this dataset.

Besides data for cod did the experiment provide results for plaice and nephrops and these data were much stronger compared to for cod. Figure 8 plots the results for plaice whereas Figure9 contains results for Nephrops.

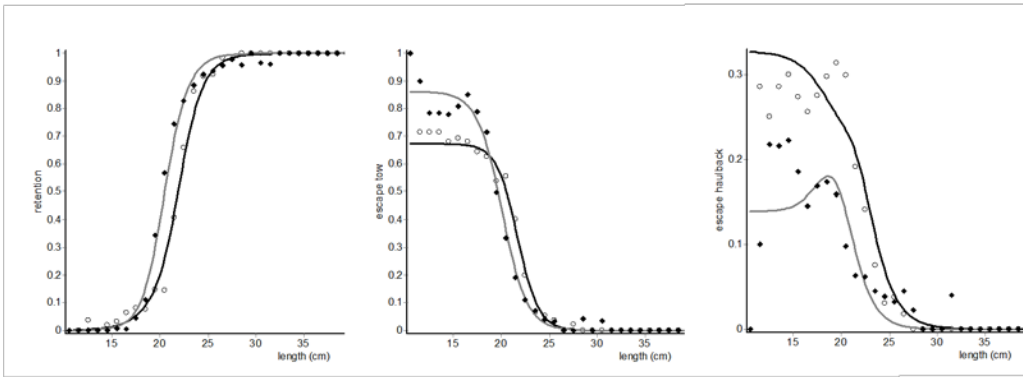

Figure 8. Results for Plaice for T0 (black curve) and T90 (grey curve): overall codend retention (left), escape during towing (middle), escape during haulback operation (right).

For plaice the overall L50 was found to be significant smaller for the T90 codend compared to for the T0 codend (left plot on Figure 8). This could likely be related to that the morphology of a flatfish like plaice fits better to a more closed diamond mesh compared to a more open T90 mesh having a shorter inside horizontal opening. Interesting does the results for both T0 and T90 codends show that not all plaice actually make attempt to escape during towing (middle plot in Figure 8). This effect is statistical significant. The curves indicate that more very small plaice escape from the T90 codend during towing (< 18 cm) compared to the T0 codend. But it has not yet been investigated if this effect is statistical significant. In general is the escapement rates higher for the T0 codend during haulback operation (right plot in Figure 8) compared to for the T90 codend.

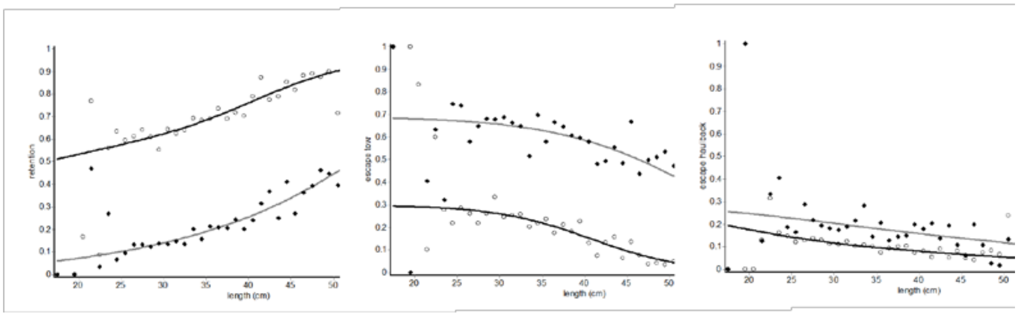

Figure 9. Results for *Nephrops* for T0 (black curve) and T90 (grey curve): overall codend retention (left), escape during towing (middle), escape during haulback operation (right).

For *Nephrops* was the retention rates generally much higher for the T0 codend for all cl compared to for the T90 codend (left plot in Figure 9). The difference for was significant different for all length classes between 25 and 49 mm. For both codends most of the escapement occurred during towing (compare middle and right plot in Figure 9). With a minimum landing size at 40 mm (carapax length) the results demonstrate that introducing this T90 design into the fishery would result in a considerable loss of legal sizes *Nephrops* compared to the T0 codend.

Results from this experiment will be detailed described in a scientific paper.

2.5 T90 experiments from Norway

These experiments were carried out on board RV "Jan Mayen" (63.8 m LOA and 4080 HP) during March and April 2010. The fishing grounds were off the coast of Troms (north of Norway). The experiments were conducted by the University of Tromsø and Manu Sistiaga and Roger Larsen were in charge of the experiments. Data was collected for cod and haddock. The covered codend method was applied. The purpose of the cruises was to test a 135 mm (nominal) mesh size T90 codend constructed of 8 mm polyethylene single twine (type: Cotesi greenline, Figure 10). The codend had a total length of 12.50 m and was constructed in two panels with three sections that included a 2½ T0 diamond mesh section in front and a 4½ T0 diamond mesh section closest to the codeline. The main T90 diamond mesh section was built from 150 x 25 meshes and two meshes from each side of each panel were fixed to the lastridge.

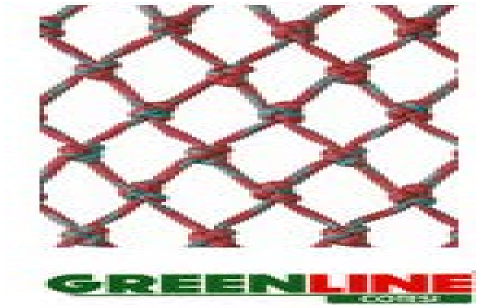

Figure 10. Codend netting applied during the cruises.

Contrary to the scientific cruises conducted in the Baltic Sea with T90 codends, the Norwegian cruises enabled testing the possibility for the performance of T90 codends to be affected by very big amounts of catch in the codend. The cruises included hauls where the total catch in the codend exceeded 4000 kg. The data analyses were carried out in SELNET considering codend catch weight at end of haul as a fixed effect and using the method described in Fryer (1991) for handling fixed effects. For one of the two datasets, L50 for cod was found to decrease significantly with increased codend catch (Figure 11).

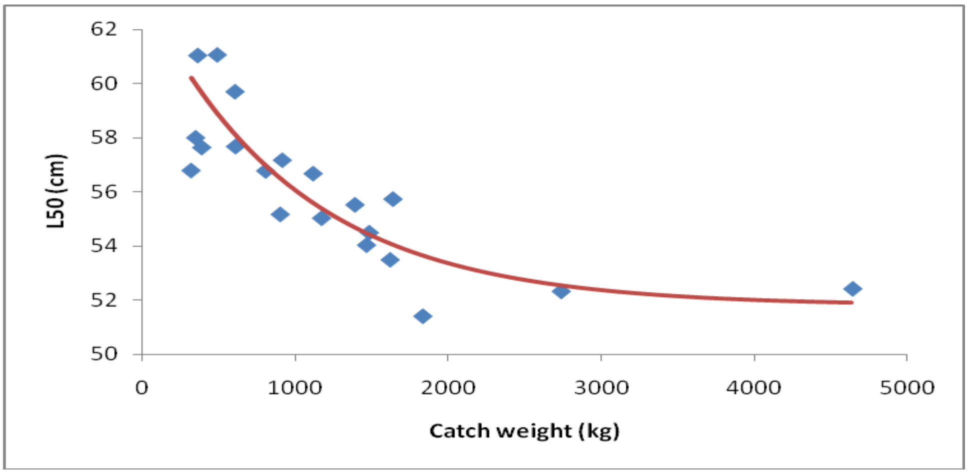

Figure 11. L50 vs. codend catch weight for cod and the T90 codend used during the experiments carried out in Norway. The marks represent experimental results for individual hauls whereas the curve represents the fit of formula (1) to the data applying the method described in Fryer (1991).

Based on the AIC-value, the exponential model applied in SELNET (Formula (1); Figure 11) provided a better description of the observations than the simple polynomial models offen applied. The following model was applied:

$$L50 = L50_{intercept} + \Delta L50_w \times \exp\left(-\frac{w}{1000}\right) \qquad (1)$$

The results from Norway demonstrate the relevance of including catch data in the analyses when investigating the size selective properties of T0 and T90 codends at commercial catch levels.

2.6 The FISHSELECT approach to investigate codend selection in Baltic Sea

According to what was planned during the first SGTCOD-meeting, FISHSELECT morphology data (see Herrmann *et al.*, 2009) were collected for Baltic Sea cod. This information will help investigating the relationship between the size selection, fish morphology and codend mesh geometry in T0, T90, BACOMA and other gear constructions. Data collection was carried out on Solea (Cruise 619). Additionally, FISHSELECT data were also collected for plaice, flounder, dab, turbot and whiting. Except for turbot, very strong datasets were collected for these all the species which makes up the commercial demersal species present in the Baltic. The analysis of data has not yet been completed but all morphometric data have been processed.

2.7 Theoretical approach to the T90 codends selectivity

The selective properties of a T90 codend depend on the proper shape of the T90-meshes. The mesh opening is determined by the forces acting on mesh bars, and by the twine stiffness (thickness). Based on the opening mechanism of T90 meshes and the cross sectional shape of Baltic cod, it is possible on a way of theoretical calculation to find the optimal mesh bar thickness that will create the best conditions for release of juvenile and undersized cod (Figure 12 and Figure 13). Both at low and at high values of stiffness (thickness) the length of escaping cod is smaller. At low twine thickness the T90 mesh is far stretched and then meshes are relative small open, and at high thickness the lengthwise opening is also small.

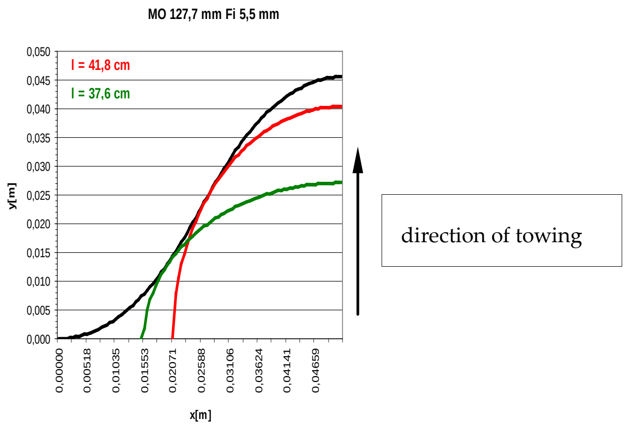

Figure 12. Length that cod can escape from a T90 codend (black is the deformed T90 mesh bar and red ("Vertical" position of cod) or green ("Horizontal" position of cod) the cross section of the fish).

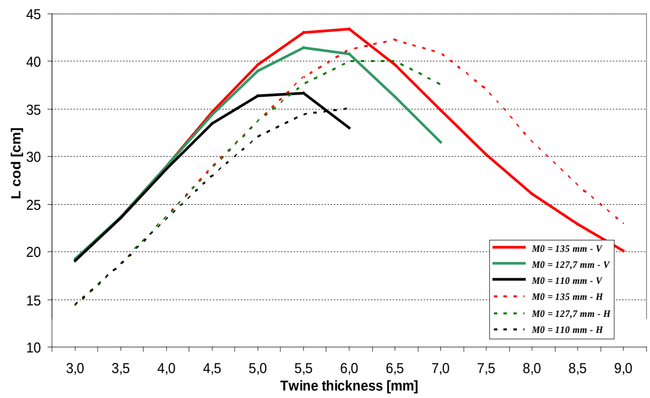

Figure 13. Calculated length of cod vs. twine thickness for T90 codends.

3 Follow up on actions from first meeting

During the first SGTCOD meeting (Ancona May 2009) several Action Items (tasks) were proposed for the group to be able to address the terms of reference. Totally 10 actions (A1.1 – A1.10) were proposed to the group. Since the first meeting, considerable progress has been made for several of the actions and some have been finalized. A few actions have not yet been addressed and it is questionable if it will be possible for the group to make progress on these during the groups three year live time. The table below summarize the actions from the first meeting and comment on their status.

Action Item Title/No.	Responsibility	Schedule/Status	Comments
Collection of Morphology data for Baltic Sea Cod and Flounder. A1.1	Harald Wienbeck and Bent Herrmann	March 2010 Data has been collected for 6 species including cod and flounder. Data are partly processed but analysis remain.	Data collection was carried out at sea (Solea cruise 619). Data to be processed until SGTCOD 2011
Review existing underwater recordings and propose new recordings for different netting materials. A1.2	Harald Wienbeck Waldemar Moderhak Bent Herrmann	Partly being carried out. But some new recordings would be benificial	Waldemar to visit Harald July 2009 Germany currently update their underwater-observation equipment. A new towed ROV is currently under purchase.
Systematically go through and review selectivity data collected so far (All T0, T90, BACOMA). A1.3	Harald Wienbeck Waldemar Moderhak Bent Herrmann	In good progress	- all relevant German trawl selectivity data summarized in a databases - Scientific papers in preparation.
Propose new German sea trials to collect covered codend selectivity data for 4 different codend designs. A1.4	Harald Wienbeck to coordinate with Bent Herrmann	Finalized. Data collected on Solea cruise 610 (10/2009). Data analysed and a scientific paper in press	Redline PE, twine single 5mm, mesh size 110mm nom. A: T0n92, B: T0n50, C:T90n92, D:T90n50. n means number of open meshes. The experimental design has to comply with the scientific justification for the work of the group. Extension pieces to be identical for all four designs (T90 n50?). Maybe there are some practical problems that will lead to a smaller number of meshes around for the n92 designs. This needs clarification before the experiment is done.
To propose to UIT to conduct a T0, T45 and T90 selectivity experiment in the Barents Sea (cod and haddock). A1.5	Manu Sistiaga to consult Waldemar Moderhak on design	Before May 2011. A sea trial with a T90 codend was been carried out in Barents Sea. Provisorial results presented at SGTCOD 2010 meeting.	Setup preferable in a twin rig with covers on both side. Mesh size 135 mm. in all cases n is identical.

ACTION ITEM TITLE/NO.	RESPONSIBILITY	SCHEDULE/STATUS	COMMENTS
To propose to CNR to conduct a T0, T45 and T90 selectivity experiment in the Mediterranean Sea (Red mullet and Hake). A1.6	Antonello Sala To consult Waldemar Moderhak on design	September 2010 No progress reported during Sceond meeting	Setup covered codend method. Mesh size 40 mm. Matrix design with 6 configurations (n 280 as baseline design + n expected optimal for T90 design)
To make lab. Experiments with different nettings used as T0 and T90 under different loading conditions record and analyse shapes of single meshes. A1.7	Bent Herrmann Harald Wienbeck to help on providing specific nettings	Before end of 2009. Netting provided. But experiments have not been carried out yet.	NETVISION method. The group to help defining and providing relevant nettings for the experiment.
To carry out testing of mesh opening stiffness, breaking elongation and neutral angle for the same nettings materials as had or will be used during the sea trials. A1.8	Antonello Sala	No progress reported during second meeting	To apply a similar procedure as in EU project PREMECS
To use two different models to estimate shapes of T0 and T90 codends (Baltic Sea) for different amount of catches. With the intention to use PRESEMO to simulate size selection of cod. A1.9	Daniel Priour Waldemar Moderhak Bent Herrmann	Shape calculations for codends used in A1.4 have been provided by Priour.	Designs to be defined June 2009. Catch weights up to 10000 kg. Model 1: FEMNET (Priour) Model 2: model of Moderhak.
To use two different models to estimate shapes of T0 and T90 codends (Mediterranean Sea) for different amount of catches. With the intention to use PRESEMO to simulate size selection of Red Mullet and Hake. A1.10	Daniel Priour Waldemar Moderhak Antonello Sala Bent Herrmann	No progress reported during the second meeting	Designs to be defined June 2009. Catch weights up to 500 kg. Model 1: FEMNET (Priour) Model 2: model of Moderhak.

4 New actions proposed at the meeting

Based on the discussions during the presentations and the additional information gained from the analysis of historical data during the SELNET workshop three new actions for the group were identified and proposed (A2.1, A2.2, A2.3). These new actions are listed in the table below.

Action Item Title/No.	Responsibility	Schedule/Status	Comments
Propose new German covered codend sea trials to systematically investigate the influence of twine characteritics on codend size selectivity of Baltic cod. A2.1	Harald Wienbeck Bent Herrmann Waldemar Moderhak	March 2011	The same netting should be applied for both T0 and T90 codends. Both single (s) and double(d) twine netting should be tested. Meshsize should the same for all designs (120 mm to comply with new regulation) and number of open meshes in codends circumference should be the same (50). Number of meshes in selvedges should be the same. The follwing design configurations should the used both as T0 and T90 : 3d, 4s, 4d, 6s, 6d, 8s. The same type of material should be applied to construct all codends (could be Polytit COMPACT). All codends should tested attached to the same extention piece (T90 d5, 50 open meshes around, meshsize 120)
Propose new German covered codend sea trials with dual sampler to escapement pattern of Baltic cod escaping from T90 and BACOMA codends. A2.2	Bernd Mieske Niels Madsen Daniel Stepputtis Ludvig A Krag Bent Herrmann	Nov-Dec 2010. Experiments conducted, analysis in progress	Bernd Mieske to consult Niels Madsen to build on experience and equipment from DTU AQUA
To investigate further the dual selection in BACOMA codends including proposal of new German sea trials to improve knowledge and find designs to mittigate this effect. A2.3	Bent Herrmann Harald Wienbeck Daniel Stepputtis Bernd Mieske	On going	Re-analyse existing data collected by Harald Wienbeck and split coverdata collected by Bernd Mieske. Consider new experiments.

5 Conclusion

The work of the group is in good progress including establishing knowledge of the fundament mechanisms of importance for size selection in T0 and T90 codends. Scientific documentation of the work of the group is in progress. But it will be difficult to finish the work and the documentation of it within the planned three year run of the group.

So far, the following provisional scientific conclusion can be made on the basis of the progress in the understanding:

- Number of meshes around codend circumference needs to be considered for T0 and T90 codend size selection (effect being experimentally predicted by Galbraith *et al.*, 1994 and theoretically for other species by O'Neill and Herrmann 2007, Herrmann *et al.*, 2007 and Sala *et al.*, 2007). – is considered in current legislation for use of T90 in Baltic Sea trawl fishery.
- The "T90-effect" (= the improvement of size selectivity by turning a specific codend netting by 90 degrees compared to the same T0 design) is very dependent on netting properties (Twine, material,..) – it depends on simple mechanical properties!!
- We begin to understand the mechanisms affecting size selection in T90 and T0 codends. This will enable future discussions on size selectivity in the Baltic to be based on a scientific understanding.
- A lot of old data can now be re-analysed in the frame of the established new scientific understanding

Regarding the participation in the second SGTCOD meeting would we have hoped that more than the 8 participants covering 3 different nations around the Baltic Sea would have participated (Annex 1). The cancelation and re-scheduling of the meeting obviously prevented some members from participation. The members of the group represent experiences and skills on the necessary scientific disciplines, both experimentally and theoretically, to enable the necessary work to be carried out. Even more importantly, members of the group have access to vessel time to carry out the experimental fishing proposed as actions for the group and hence being vital for the fulfilment of the terms of reference. Members in the group also represent practical knowledge of the fishery in the Baltic Sea to ensure the case study for the Baltic Sea cod can be carried out in a relevant way. It is though critical that the members are able to continue participating in the group work in the final year of the group.

6 Reference list

Fryer, R.J. 1991. A model of between-haul variation in selectivity. ICES J. Mar. Sci 48: 281-290.

Galbraith, R. D., Fryer, R. J., Maitland, K. M. S. 1994. Demersal pair trawl cod-end selectivity models. Fisheries Research 20: 13–27.

Herrmann, B., Priour, D., Krag, L.A. 2007. Simulation-based study of the combined effect on cod-end size selection for round fish of turning mesh 90 degrees and of reducing the number of meshes in the circumference. Fisheries Research 84: 222-232.

Herrmann, B., Krag, L. A., Frandsen, R.P., Madsen, N., Lundgren, B., Stæhr, K.J.S. 2009. Prediction of selectivity from morphological conditions: Methodology and case-study on Cod (*Gadus morhua*). Fisheries Research 97: 59-71.

O'Neill, F.G., Herrmann, B. 2007. PRESEMO- a predictive model of codend selectivity- a tool for fisheries managers. ICES Journal of Marine Science, 64: 1558–1568.

Sala, A., Priour, D., Herrmann, B. 2006. Experimental and theoretical study of red mullet (*Mullus barbatus*) selection in codends of Mediterranean bottom trawls. Aquatic Living Resources 19: 317-327.

Wienbeck, H., Herrmann, B., Moderhak, W., Stepputtis, D. *(in press).* Effect of netting direction and number of meshes around on size selection in the codend for Baltic cod (*Gadus morhua*). Fisheries Research in press (DOI: 10.1016/j.fishres.2011.01.019).

Annex 1: List of participants

NAME	INSTITUTE	E-MAIL
Waldemar Moderhak **(Chair)**	Sea Fisheries Institute	moderhak@mir.gdynia.pl
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Bent Herrmann **(Chair)**	Denmark Technical University	bhe@aqua.dtu.dk

Annex 2: Agenda

31 August 2010

SGTCOD presentations

09:00 – 09:10	Registration
09:10 – 09:20	Welcome, Housekeeping Issues, programme for the week (Chairs)
09:20 – 09:40	Aims and goals of the SGTCOD (Chairs)
09.40 – 10.00	Gear research in Denmark (Part I – experimental work) (N. Madsen)
10:00 – 10:15	Coffee break
10:15 – 10:30	Gear research in Denmark (Part II – theoretical work) (B. Herrmann)
10:30 – 10:50	Underwater observations of T90, T0 and BACOMA codends (W. Moderhak)
10:50 – 11:10	Combined analysis of experimental data for four different codends made of *Redline* netting (B. Herrmann)
10:50 – 11:15	New experimental results obtained for codends made of *Dyneema* netting and for codends complying with the new regulation in Baltic Sea (H. Wienbeck)
11:15 – 11:35	Danish selectivity experiments comparing T0 and T90 with focus on Escapement during different phases of the fishing process (N. Madsen)
11:35 – 11:50	T90 experiments from Norway (B. Herrmann)
11:50 – 13:00	Lunch
13:00 – 13:30	The FISHSELECT approach to investigate codend selection in Baltic Sea (L. Krag)
13:30 – 15:00	Are there alternatives to T90 and BACOMA? (presentation + floor discussion) (B. Herrmann/All)
15:00 – 15:20	Coffee break
15:20 – 16:30	Follow up on planned actions from last meeting and discussion of proposal for new actions (Chairs)

1 September 2010

09:00 – 16:00 **SGTCOD/SELNET Mini Workshop on estimation of size selection in trawls (especially in codends).** One purpose of this workshop is to review, analysis/re-analyse and discuss selectivity data available and being relevant to SGTCOD. A further purpose is to identify needs for new data for further evaluation
(Chairs)

Members are encouraged to bring their own selectivity data. Available data will be analysed in the workshop using the software tool SELNET which will be provided and installed on the members own computers. The day will begin with an introduction to statistical analysis of selectivity data and on how to use SELNET. Between practical use of SELNET to analysis the data members bring there will during the workshop be several small demonstrations on how to use the different facilities in SELNET.

10:30 – 10:50 Coffee break

12:00 – 13:00 Lunch break

14:00 – 14:20 Coffee break

2 September 2010

09:00 – 16:00 **Continuation of SGTCOD/SELNET Mini Workshop on estimation of size selection in trawls (especially in codends).**

10:30 – 10:50 Coffee break

12:00 – 13:00 Lunch break

14:00 – 14:20 Coffee break

3 September 2010

Continuation of SGTCOD

09:00 – 09:10 Housekeeping
(Chairs)

09:10 – 10:00 General discussion, the way ahead, and preparation of report
(Chairs)

10:00 – 10:30 Coffee break

10:30 – 11:00 Further preparation of report, conclusions
(Chairs)

11:00 – 11:15 Suggestions for date and venue for next SGTCOD
(Chairs)

11:15 – 12:00 Concluding remarks and closure of the meeting
(Chairs)

Annex 3: SGTCOD Draft Resolution for the 2011 meeting

The **Study Group on Turned 90° Codend Selectivity, focusing on Baltic Cod Selectivity** (SGTCOD) chaired by Bent Herrmann, Denmark and Waldemar Moderhak, Poland, will meet in Reykjavik, Iceland at the Marine Research Institute (just prior to the planned WGFTFB 2011 meeting in Reykjavik), 4-6 May 2011 to:

a) Evaluate the effect of turning diamond netting by 90° (T90) on codend selectivity;

b) Improve knowledge of the size selection processes in T90 codends compared to T0 codends (normal direction of diamond netting);

c) Attempt to quantify the magnitudes of the effects of different factors (construction, generic netting properties, stock specific morphology, catch composition);

d) Develop a guide on T90 codend constructions with respect to size selection properties and optimal construction; and

e) Review available data on fish survival and in particular cod escaping from T90 codends.

SGTCOD will report by 30 June 2011 (via SSGESST) for the attention of SCICOM.

Supporting Information

Priority	The current activities of this Group will lead ICES into issues related to the effectiveness of technical measures to change size selectivity and fishing mortality rates. Consequently these activities are considered to have a very high priority
Scientific justification	The use of T90 codends is legal in the Baltic Sea cod fishery and there is an increasing global interest in using T90 for towed fishing gears. The basic mechanizms governing T90 performance are, however, not well understood or quantified. In order to address this it is proposed to set up a Study Group specifically to look at all issues relating to the use of T90 netting as a means of improving selectivity. The objectives will be reached by combining field experiments (size selectivity experiments), laboratory experiments with nettings (loading by different forces comparing mesh openness), laboratory experiments with fish morphology specific on Baltic cod (FISHSELECT) and theoretical approach (structural mechanic for bending of mesh bars under load and computer simulations). A case study on Baltic cod will be conducted. We expect that the benefit of T90 on size selectivity will depend on the netting panel construction (twine thickness, twine stiffness, single/double twine, ratio between mesh sizes (mesh bar)/twine thickness). Therefore all T90 experiments should be evaluated against a baseline of experiments with similar diamond mesh codends (T0) made of the same netting and having the same number of meshes around. For the comparison of results from sea trials regarding the performance of T90 it is important that the trawl designs in front of the codends (T0 and T90) are identical. It is also important that the experimental design take into account potential confounding effects like vessel size. The level of unaccounted mortality of cod escaping through T90 codends will also be considered specifically for the Baltic.
Resource requirements	The research programmes, which provide the main input to this group, are already underway, and resources are already committed. The additional resource required to undertake additional activities in the framework of this group is negligible.

Participants	The Study Group is likely to attract 10–15 participants from Baltic countries and a further 5 experts in the field.
Secretariat facilities	None.
Financial	No financial implications.
Linkages to advisory committees	ACOM
Linkages to other committees or groups	There is a very close working relationship with all the groups of the SSGESST. It is also very relevant to the Working Group on Ecosystem Effects of Fisheries and SSGRSP
Linkages to other organizations	The work of this group is closely aligned with the EU and Baltic Sea Regional Advisory Council.