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

23–24 May 2009

Ancona, Italy

ICES
International Council for the Exploration of the Sea
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Conseil International pour l'Exploration de la Mer

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Executive summary

The first meeting in the ICES Study Group on Turned 90° Codend Selectivity, focusing on Baltic Cod Selectivity (SGTCOD) was held on 23–24 May 2009 in Ancona, Italy. The Study Group chaired by Bent Herrmann and Waldemar Moderhak will run for three years. The meeting was hosted by Antonello Sala from CNR-ISMAR. The meeting was held just after the ICES WGFTFB 2009 meeting and was attended by 16 participants from 11 different nations.

One objective for the first meeting was to establish the group and to update all the participants on the objective for the work in SGTCOD. The final objectives for the three year run of the group work are as follow:

- Evaluate the effect of turning diamond netting by 90º (T90) on codend selectivity
- Improve knowledge on 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 will 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). A case study on Baltic cod will be conducted. An important objective for the first meeting was to obtain an overview of experimental data and theoretical methods already available to help achieving the final objectives. A number of presentations were therefore given on experimental data or theoretical methods and results. Those presentations made it evident that a lot of selectivity data has been collected over the years and are available for the groups work. Underwater video recordings showing different codends and escape behaviour of Baltic Sea cod are also available. Together with applying the theoretical methods the data forms the basis for the future work in the group. But a systematical review of all the data available is needed. The group identified gaps in knowledge which did lead to the production of a relevant action plan. It was identified that specific data on morphology of Baltic Sea Cod would be beneficial. Some additional selectivity experiments would be necessary for a systematical assessment of the benefit on selectivity of turning codend netting by 90º with a similar T0 codend as baseline. Theoretical estimations of codend shapes for different amount of catches were to be carried out with the aim of theoretical estimation of the codend selectivity. It was agreed that assessing the shapes of different nettings in laboratory and analyzing mesh shapes with respect to selective properties would help understanding and quantifying the basic selective properties of T90 compared to T0. Besides trials for Baltic Sea cod, a more general knowledge could be obtained by also proposing experimental and theoretical work to be carried out for other different types of fisheries.

On some specific points there are differences in opinion on the performance of T90 codends and on what is causing it between members in the SGTCOD group. But it is expected that these differences will help the group in producing a critical scientifi-

cally based evaluation according to the final objectives for the work of the group. Together 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. Members of the group also represent practical knowledge about the fishery in the Baltic Sea to ensure the case study for the Baltic Sea cod can be carried out in a relevant way.

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

1 Adoption of the agenda

The group adopted the following agenda for the meeting:

23 May

09:00–09:05 Registration

09:05–09:10 Welcome and Housekeeping Issues (Host)

09:10–10:00 Aims of the SGTCOD (B. Herrmann)

10:00–10:30 Coffee break

10.30–11:00 Introducing to the T90 idea and presentation underwater movies of different codends type (W. Moderhak)

11:00–11:45 Recent Swedish investigations in the Baltic Sea (D. Valentinsson)

11:45–13:15 Lunch

13:15–14:45 Danish investigations on the selectivity performance of T90 codends (B. Herrmann)

14:45–15:05 Theoretical calculation of mesh shapes in codends (D. Priour)

15:05–15:30 Recent German selectivity trials in Baltic Sea (H. Wienbeck)

15:30–15:50 Coffee break

15:50–16:30 Discussion based on presentations "open floor" (Chairs)

16:50–17:10 Review on data and knowledge available. Identification of gaps in knowledge (Chairs)

17:10–17:30 General Discussion, the way ahead (Chairs)

24 May

08:30–08:45 Housekeeping (Host)

08:45–10:00 Summarize the knowledge on T90 selectivity properties (Chairs)

10:00–10:30 Coffee break

10:30–11:00 Suggestions for next SGTCOD meeting (Chairs)

11:00–11:45 Preparation of report, conclusions (Chairs)

11:45–12:00 Closure

2 Summary of the presentations

Seven presentations were given of which the first six were planned according to the agenda. Below is given a short summery of the individual presentations, while selected pictures and results selected from the presentations are shown in annex 3.

2.1 Presentation :1 "Aims of the SGTCOD" by Bent Herrmann

The terms of reference for the study group were presented:

a) evaluate the effect of turning diamond netting by 90º (T90) on codend selectivity
b) improve knowledge on 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

The objectives will be reached by combining field experiments (size selectivity experiments), laboratory experiments with nettings (loaded by different forces comparing mesh openness), laboratory experiments with fish morphology specific on Baltic cod (FISHSELECT) and theoretical approach (structural mechanics for bending of mesh bars under load and computer simulations). A case study on Baltic cod will be conducted.

2.2 Presentation 2: "Introducing the T90 idea and presentation underwater movies of different codends type" by Waldemar Moderhak

The presentation started with historical and technical review of the T90 meshes codends.

In the early 1990s a new netting material with very good selective and protective properties was created and developed at the Sea Fisheries Institute in Gdynia, Poland. This netting material with meshes turned 90° is presently known as T90 netting.

The investigations of characteristics of selective codends with meshes turned 90° (T90) have been carried out by the Sea Fisheries Institute (MIR), Gdynia, Poland since 1996 and then in close cooperation with the Institute for Baltic Sea Fisheries, Rostock (former Institute for Fishery Technology and Fish Quality, Hamburg), Germany. Studies on properties of subjected codends T90 were conducted on board of the Polish and on German research vessels. Starting from year 2000 the turned codends investigations were conducted also on commercial fishing vessels, aiming to check protection abilities as well as to test durability during normal commercial fishing.

The construction of the turned meshes T90 is based on typical diamond knotted netting but that has to be turned through 90°. Therefore, the production of netting for codends with meshes turned does not require any changes in machinery or production technology in net factories. The turned codends (T90) can be made of polyamide (PA) or polyethylene (PE), single or double twine netting, as one or two panel constructions. The turned codend extension (T90) has to be made of the same turned meshes netting as codend construction.

According to the presenter, the advantages of the T90 codends related to the other type constructions that have been recognized up to now as follows:

- very good selective and protective properties (sharp selective curve, small by-catch and discard)

- better fish condition and thus survive rate of fishes
- better quality of fish caught, bigger diameter of the codend – more room for fish collected
- improved catch abilities (catch rate)
- less fuel consumption and in consequence less air pollution
- "clear" fishing - less work for a crew
- stability during whole towing - short fishing operation time
- simple construction
- low price of turned (T90) codend
- better breaking strength of turned netting
- netting availability and difficult to manipulate to reduce selectivity

All the above mentioned points can be reduced to one extremely important and that is environment friendly fishing.

According to the presenter it may be stated that codend with meshes turned 90° (T90) can introduce a new level of selectivity and fish protection in fisheries by:

- retaining small number of juveniles and undersized fish
- small by-catch and discard of other rounded fishes

and:

- by-catch of flatfish is comparable to that retained by diamond codend construction
- general idea of the turned (T90) codends can be applied for designing and constructing other T90 codends, with appropriate mesh sizes and meshes around for particular fish species

At the end there were presented extensive fragments of underwater video recordings of T0 (diamond), T90 and Bacoma codends. Those recordings demonstrated differences in behaviour with regard to longitudinal and perpendicular deformation and motion of the netting. T90 codends showed superior parameters among the presented construction types.

Based on sea trials conducted it was emphasised and showed that proper work of T90 codend needs right perimeters relation of T90 codend (and extension, if necessary) to, for example, a diamond (standard) belly end part.

2.3 Presentation 3: "Recent Swedish investigations in the Baltic Sea" by Daniel Valentinsson

Recent Swedish catch comparison trials comparing catches in a new industry-proposed codend with large square mesh side panels to the conventional Bacoma codend was presented. The new codend design was put forward as a potential way to mitigate some of the negative aspects of the Bacoma codend (reduced selectivity with large catch volumes, instability, high costs and cumbersome repair and maintenance). Data were analyzed using GLMM-methodology. Initial results indicated no difference in cod catches between the two gears. Further industry consultations, gear development and gear trials will follow during the next year.

2.4 Presentation 4: "Danish investigations on the selectivity performance of T90 codends" by Bent Herrmann

A method (NETVISION) for a first simple evaluation of the shapes of meshes in netting panels under bi-directional tension uses as T0 and as T90 was presented. Together with FISHSELECT, to assess the morphological condition for mesh penetration of fish (Fish. Res. 97 page 59–71), the obtained mesh shapes can be used to access and compare the basic selective properties of the same netting panel under bi-directional tension when applied as T0 and as T90 netting.

Results for a comparative flume tank test of a T0 and a T90 codend were presented.

2.5 Presentation 5: "Theoretical calculation of mesh shapes in codends" by Daniel Priour

It was demonstrated how the finite element method, meant for estimation of trawl netting shapes, could be used in relation to the work of the group.

The numerical models of netting could be used in two ways:

a) The numerical models used with fish behaviour modelling (PRESEMO or FISHSELECT) could investigate factors affecting the selectivity process. This can include comparing sea tests with similar numerical results.

b) The numerical models could be used to assess the mechanical properties of the netting used in codend. This can be done by comparing deformation tests of netting with numerical simulations.

During the discussion of the presentation it was brought up that the model of Priour (FEMNET), when applied in connection with the codend simulation tool PRESEMO, has been used to predict the individual and combined effect of turning T0 netting to T90 together and/or reducing the number of meshes around the circumference by 50% (Fish. Res. 84, page 222–232).

2.6 Presentation 6: "Recent German selectivity trials in Baltic Sea" by Harald Wienbeck

Preliminary Results from three German sea trials (2008 and 2009) on codend selectivity of Baltic cod were presented. In two of the cruises selectivity results for a T0 codend (96 or 100 meshes around) and attached to T0 extension (96 or 100 meshes around) were compared to selectivity results for a T90 codend (48 or 50 meshes around) and attached to an extension (48 or 50 meshes around). In one of these cruises Dyneema netting was used while the other used Redline and Euroline. In the third cruise selectivity for a T90 codend (50 meshes around and T90 extension) was compared to a Bacoma design (100 meshes around and T0 extension with 105 meshes around). In general the covered codend method was used with cover mesh size of 80 mm. Underwater videos were shown.

2.7 Presentation 7: "Critical review of selectivity studies with 40mm square-mesh codend. Is square-mesh better selective than large mesh size?" by Antonello Sala

A critical analysis of selectivity research allowed to observe a number of main factors affecting the trawl selectivity in Mediterranean. It was not only a mere review of the available papers, but also an attempt to describe how some technical parameters (e.g. mesh size, mesh configuration, twine diameter, mesh hanging ratio) affect the codend selectivity.

We have found:

- A highly significant effect of mesh configuration on L50. This effect is higher in round fish such as hake probably due to fish morphology.
- Problems arising from the use of different terminology by the different authors.
- Data missing for some important parameters: twine diameter, codend circumference, extension description.

The selectivity of 40 mm diamond-mesh codend has been reported to be rather poor because a large proportion of the codend catch is immature and smaller than the minimum landing size or first maturity size. The square-mesh codend plays a role which is as important as mesh size. However, square-meshes were found to be unsuitable for flat and/or deep-bodied fish as these escape more readily from diamond-meshes. In particular, better values of L50 were found for all species with the exception of scaldfish. We confirm that, apart most of the flatfish species, make the best use of the square-mesh opening, either because of their body shape or because of forcing their body to penetrate through the mesh. In conclusion, enforcement of installation of square-mesh codends in Mediterranean demersal trawl fisheries can be a suitable technical solution to decrease the capture of immature individuals. We also discussed the effect of mesh configuration and mesh size on the codend selectivity considering a recent study in Sicilian waters (Lucchetti *et al.*, 2008). In this experiment four codends with two different mesh sizes across two mesh configurations have been tested: therefore mesh size and mesh configuration were included as explanatory variables in the statistical analysis. Consequently we can discuss the advantage/disadvantage of using e.g. a 40-mm square-mesh codend instead of 50-mm diamond-mesh codends as requested in the new Council Regulation (EC) No 1967/2006. From the literature we know that the increase in mesh size produces both an increment in L50 and an unwanted increment in SR. The results attained in the present study allow to conclude that the use of 44 mm square-mesh codend results in L50 similar to that of the 54 mm diamond-mesh codend and better SR.

3 Review on data and knowledge available

Based on the presentations it was evident that a lot of selectivity data for T0, T90 and Bacoma codends has been collected over the years and are available for the groups work. Most of this information has not yet been published in international scientific journals. Underwater video recordings showing different codends (T0, T90 and BACOMA) and escape behaviour of Baltic Sea cod are also available. Together with applying the theoretical methods described in the presentations the data forms the basis for the future work in the group. But a systematically review of all data available is needed.

4 Identification of gaps in knowledge

It was identified that specific data on morphology of Baltic Sea Cod would be beneficial. Some additional selectivity experiments would be necessary for a systematical assessment of the benefit on selectivity of turning codend netting by 90º with a similar T0 codend as baseline. Theoretical estimations of codend shapes for different amount of catches were to be carried out with the aim of theoretical estimation of the codend selectivity. It was agreed that assessing the shapes of different nettings in laboratory and analyzing mesh shapes with respect to selective properties would help understanding and quantifying the basic selective properties of T90 compared to T0. Besides trials for Baltic Sea cod a more general knowledge could be obtained by also proposing experimental and theoretical work to be carried out for other and very different fisheries.

Based on the gaps in knowledge identified members of the group agreed on proposing a number of actions to be carried out in order to meet the terms of reference for the group. The table below summarizes these Action Items.

Action Item Title	Responsibility	Schedule	Comments
Collection of Morphology data for Baltic Sea Cod and Flounder.	Harald Wienbeck & Bent Herrmann	Oct 2009	Use FISHSELECT in Lab. Fac. In Rostock. Combined with sea trials
Review existing underwater recordings and propose new recordings for different netting materials.	Harald Wienbeck Waldemar Moderhak Bent Herrmann		Waldemar to visit Harald July 2009
Systematically go through and review selectivity data collected so far (All T0, T90, BACOMA).	Harald Wienbeck Waldemar Moderhak Bent Herrmann		
Propose new German sea trials to collect covered codend selectivity data for 4 different codend designs.	Harald Wienbeck to coordinate with Bent Herrmann	Before May 2010	Redline PE, twine single 5mm, mesh size 110mm nom. A: T0n92, B: T0n50, C:T90n92, D:T90n50. n means number of open meshes in circumference. 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 lower 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).	Manu Sistiaga to consult Waldemar Moderhak on design	Before May 2011	Setup preferable in a twin rig with covers on both side. Mesh size 135 mm. in all cases n is identical.
To propose to CNR to conduct a T0, T45 and T90 selectivity experiment in the Mediterranean Sea (Red mullet and Hake).	Antonello Sala To consult Waldemar Moderhak on design	Sept. 2010	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 analyze shapes of single meshes.	Bent Herrmann Harald Wienbeck to help on providing specific nettings	Before end of 2009	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.	Antonello Sala		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.	Daniel Priour Waldemar Moderhak Bent Herrmann		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.	Daniel Priour Waldemar Moderhak Antonello Sala Bent Herrmann		Designs to be defined June 2009. Catch weights up to 500 kg. Model 1: FEMNET (Priour) Model 2: model of Moderhak.

5 Conclusion

On some specific points there are differences in opinion on the performance of T90 codends and on what is causing it between members in the SGTCOD group. But we expect that these differences will help the group in producing a critical scientifically based evaluation according to the terms of reference given for the work of the group. Together 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. Members in the group also represent practical knowledge about 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 next years. In that respect it is also critical the members are able to provide a fulfilment of the action items proposed in this report. The number of participants in this first meeting of the group was satisfactory and we hope that many will be able to participate in the next meetings of the group and the work in between the meetings. We hope the European Commission will continue to be represented at the meetings. We strongly hope that the Baltic countries not represented at the first meeting, will participate in meetings of the study group in the future.

Annex 1: List of participants

Name	Institute	E-mail
Waldemar Moderhak	Sea Fisheries Institute	moderhak@mir.gdynia.pl
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Bent Herrmann	Denmark Technical University	bhe@aqua.dtu.dk

Annex 2: SGTCOD Draft Resolution for the 2010 meeting

The **Study Group on Turned 90° Codend Selectivity, focusing on Baltic Cod Selectivity** [SGTCOD] (Co-Chairs: Bent Herrmann, DIFRES, Denmark and Waldemar Moderhak MIR, Poland) will have a back-to-back meeting with WGFTFB in VENUE [to be confirmed] on DATE 2010 [to be confirmed] to:

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

b) improve knowledge on 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 DATE 2010 for the attention of the SGESST.

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 and relation to action plan:	Action Item 3.16, 3.17, 3.18, 5.8, 5.11, 5.16, 6.3 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 mechanisms 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.
Justification of Venue (in a non-ICES Member Country)	See Justification under WGFAST Terms of Reference.

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 Fisheries Technology Committee. It is also very relevant to the Working Group on Ecosystem Effects of Fisheries and Baltic Fisheries Committee
Linkages to other organizations:	The work of this group is closely aligned with the EU and Baltic Sea Regional Advisory Council.

Annex 3: Selected pictures and results from the presentations

Presentation 2: "Introducing the T90 idea and presentation underwater movies of different codends type" by Waldemar Moderhak

Figure 1. T90 history

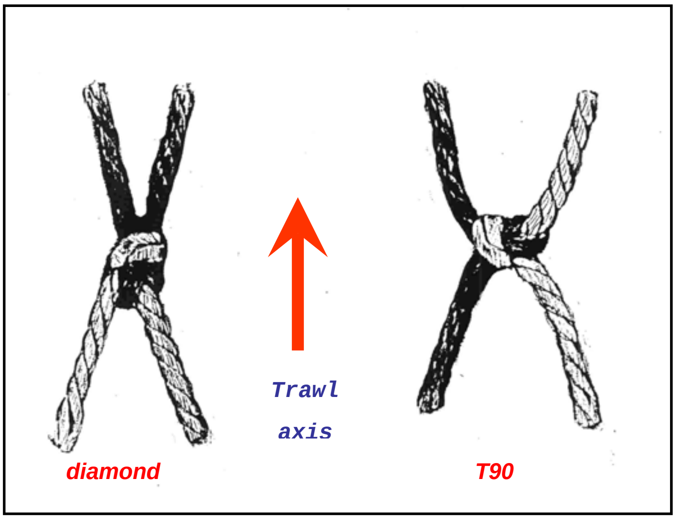

Figure 2. Mesh bars shape around knots of two different oriented meshes; diamond (left) and T90 (right)

Figure 3. Model of T90 codend (1:3)

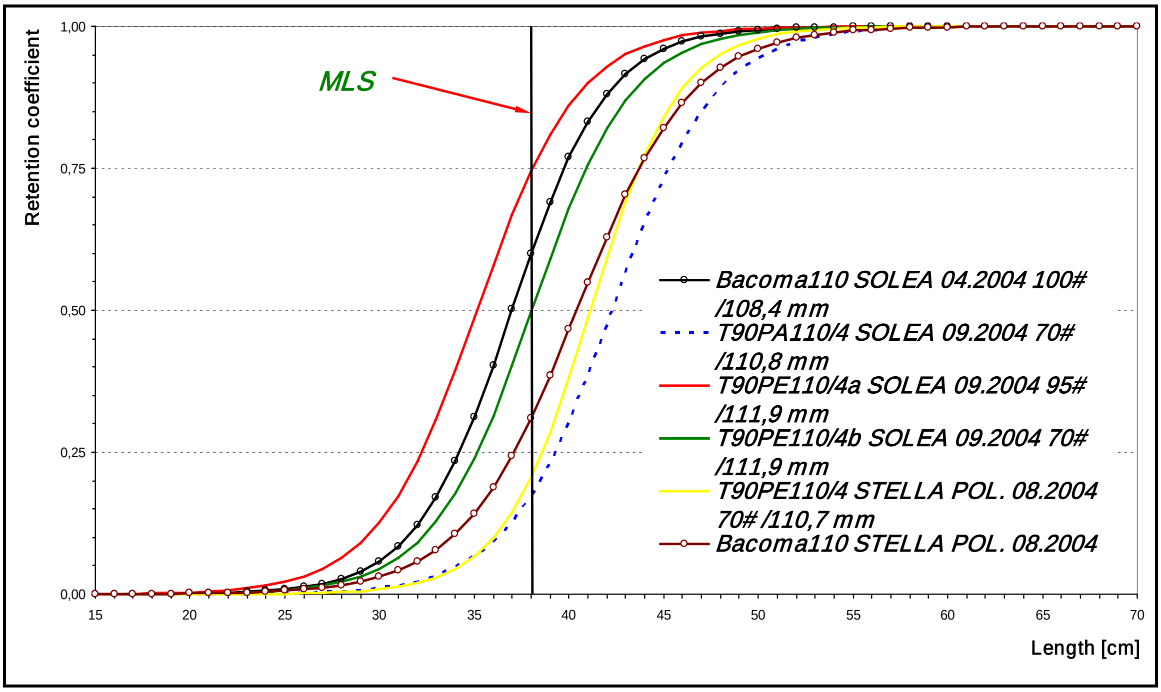

Figure 4. Selectivity of T90 and Bacoma cod codends – SOLEA 2004

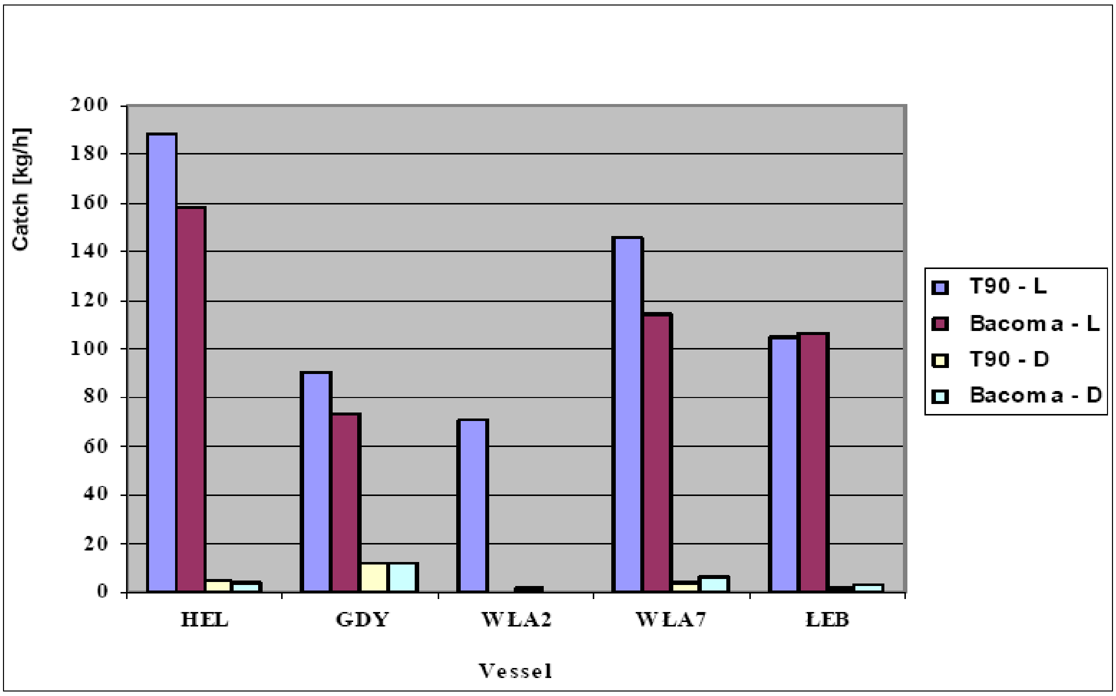

Figure 5. Discard results

Presentation 3: "Recent Swedish investigations in the Baltic Sea" by Daniel Valentinsson

Figure 6. Industry proposal

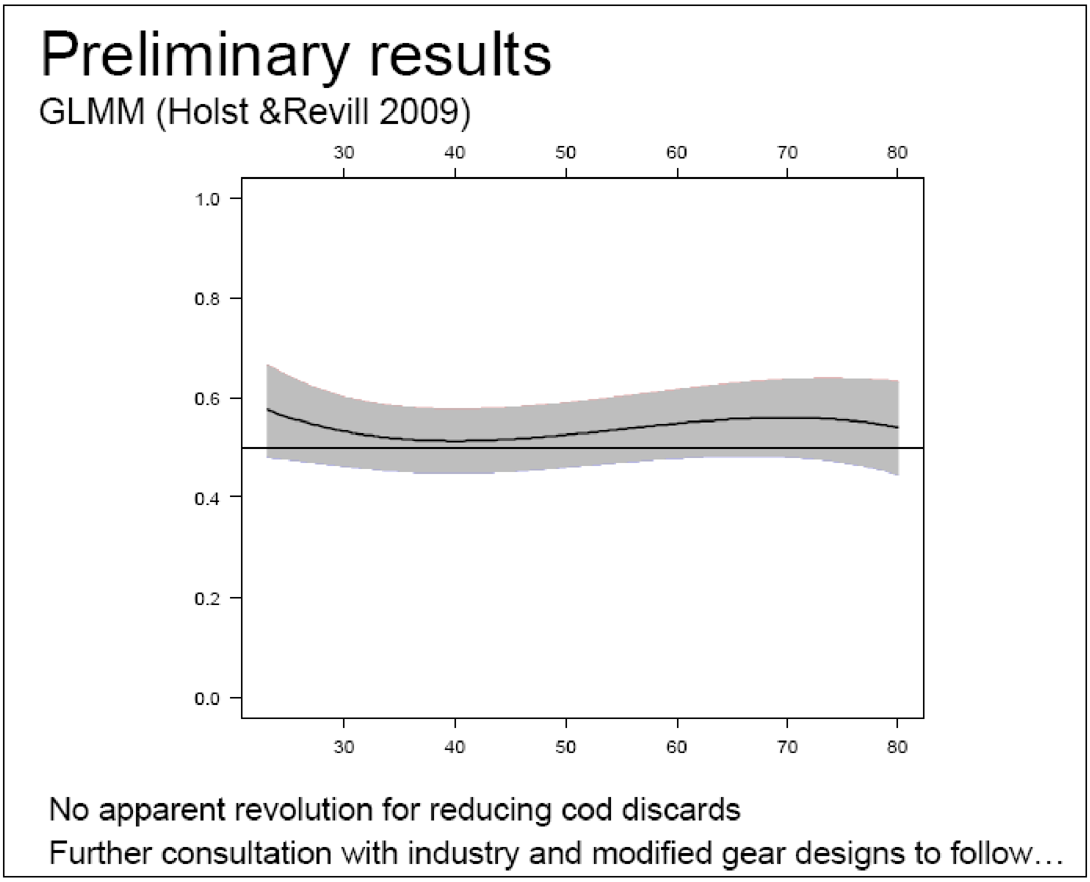

Figure 7. Results from preliminary analysis

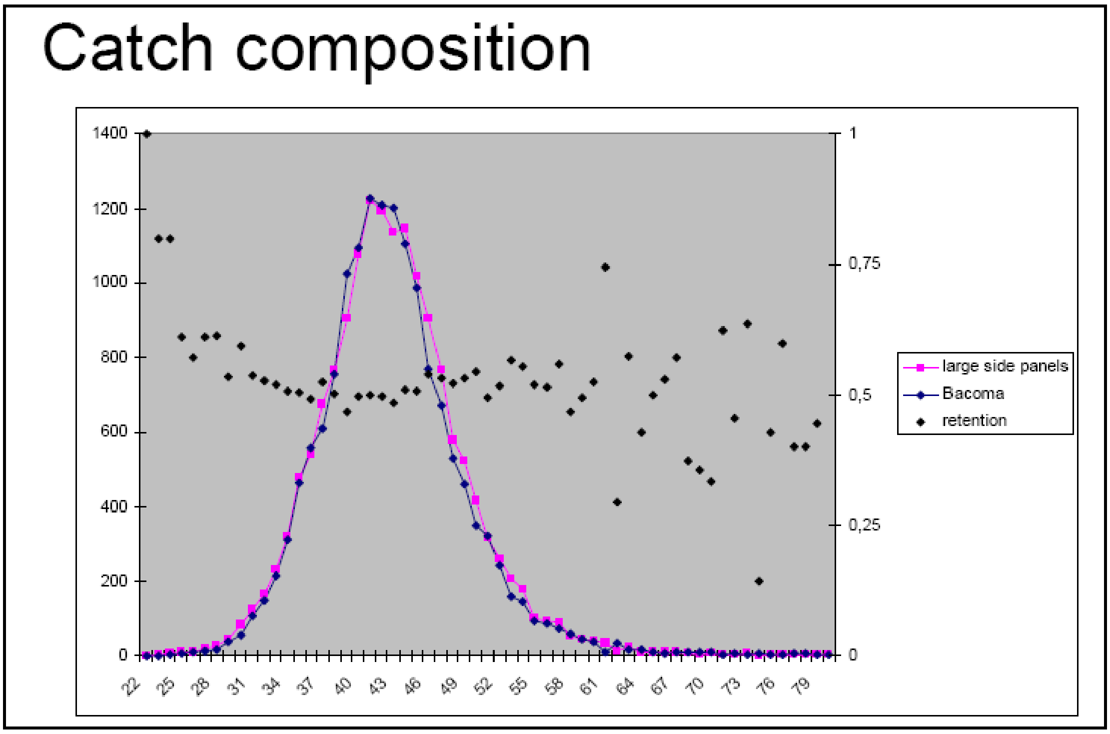

Figure 8. Catch composition data

Presentation 4: "Danish investigations on the selectivity performance of T90 codends" by Bent Herrmann

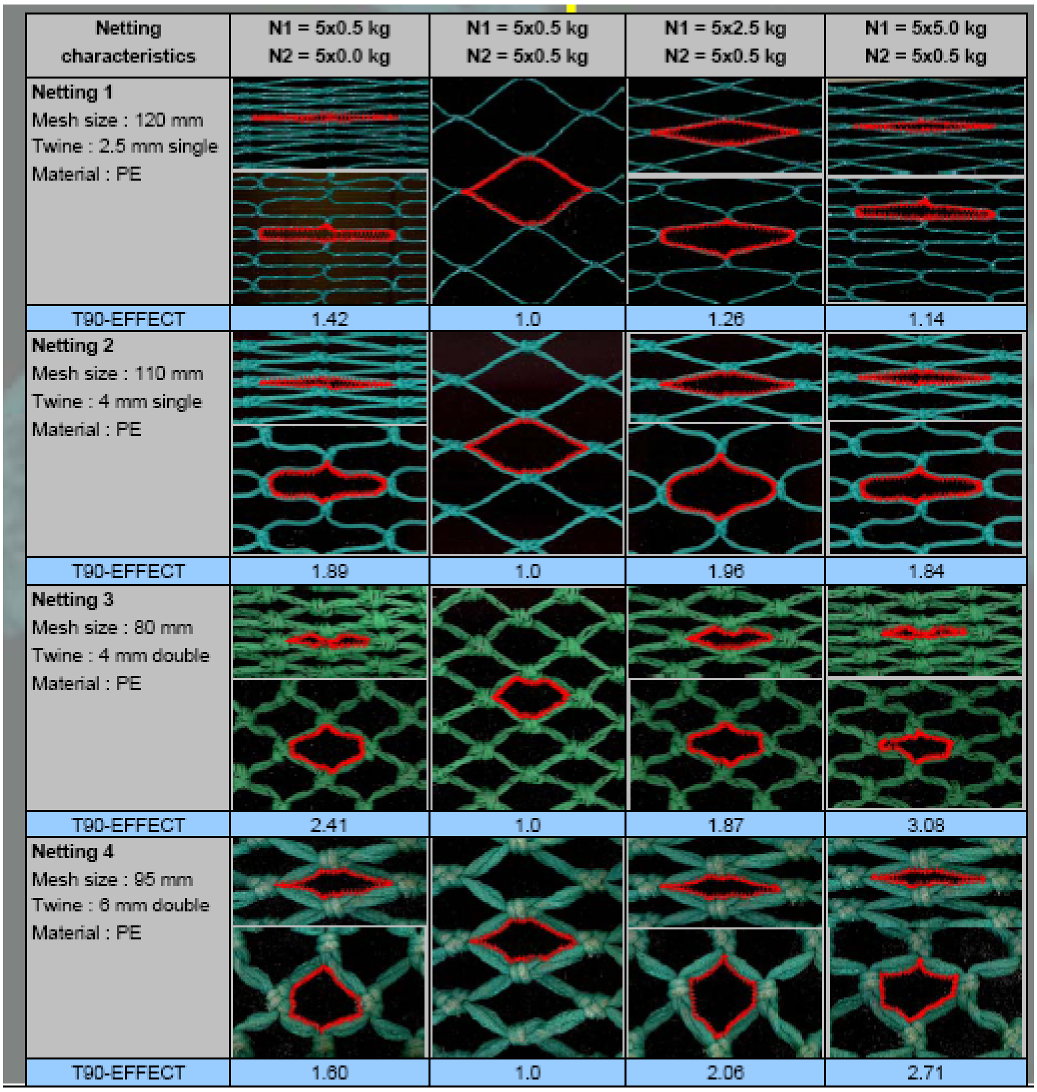

Figure 9. Methods for investigation of T90-effect for netting panels – pilot results

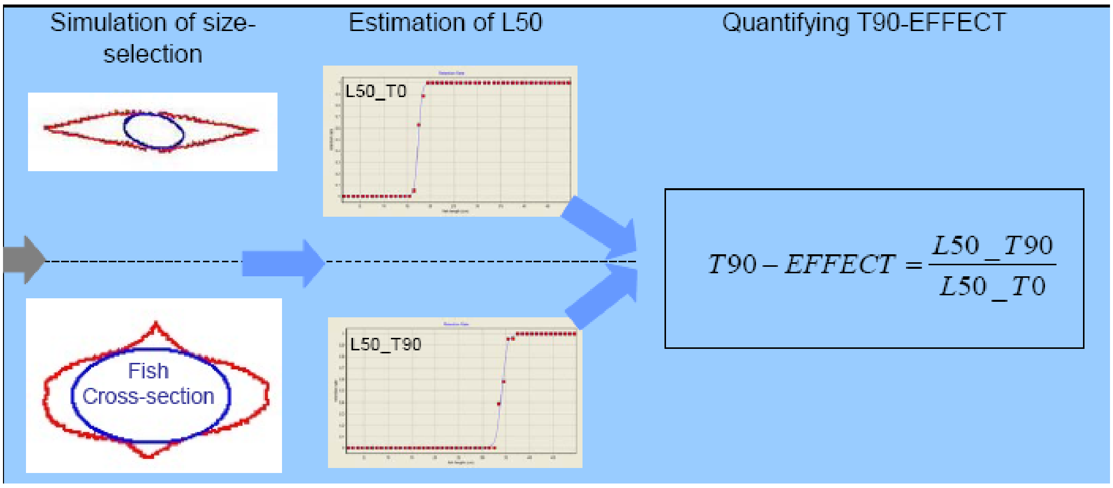

Figure 10. FISHSELECT method to estimate T90-effect

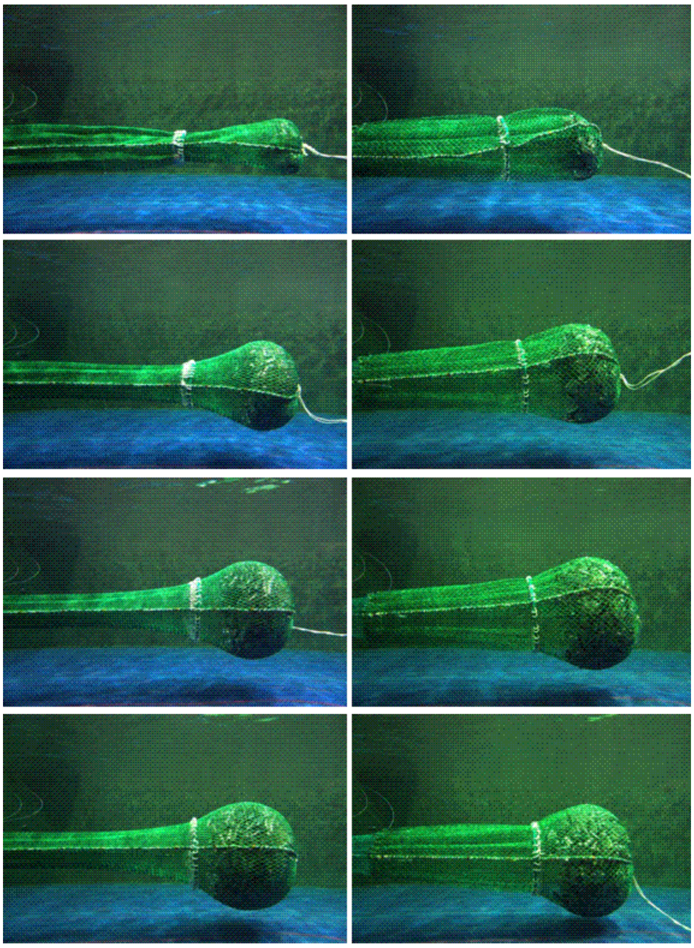

Figure 11. Flume tank comparison of T0 (left) and T90 codend shapes for different amount of catch (from top 50, 300, 600, 900 kg).

Presentation 5: "Theoretical calculation of mesh shapes in codends" by Daniel Priour

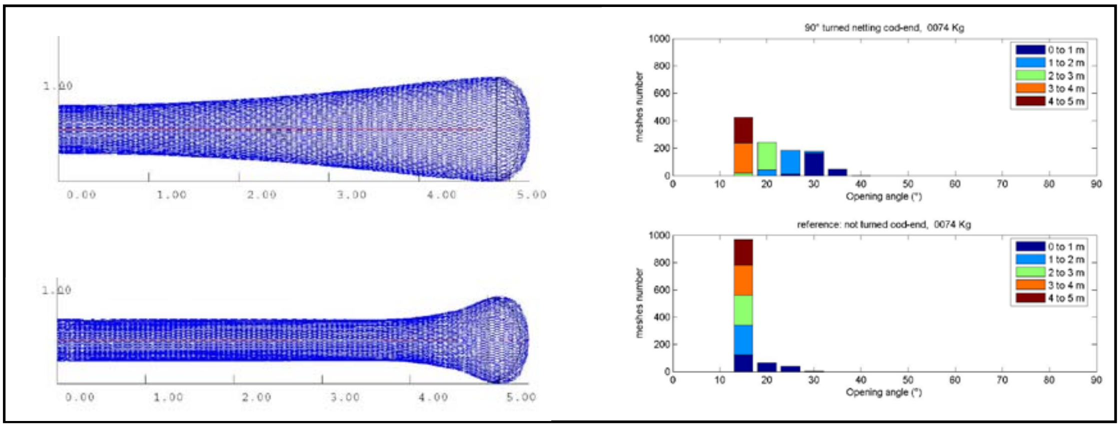

Figure 12. FEMNET comparison of T90 (top) and T0 codends

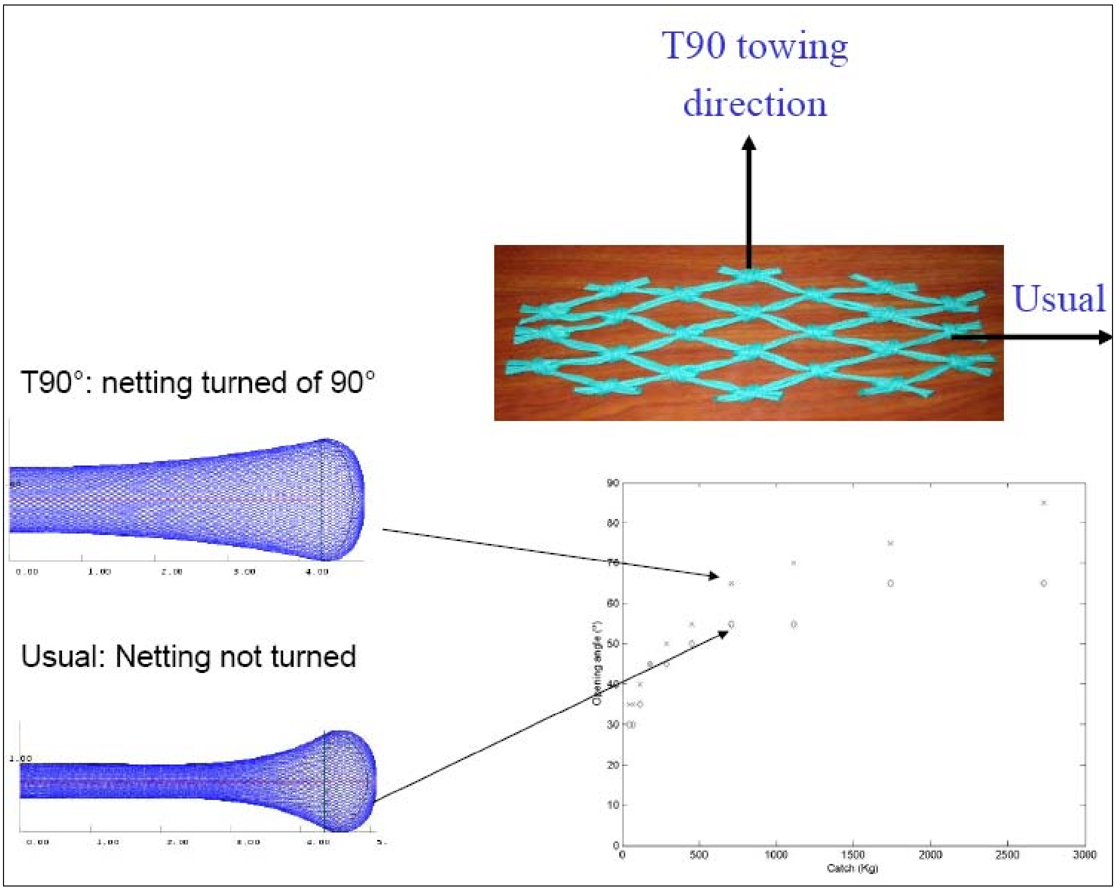

Figure 13. FEMNET T90 and T0

Presentation 6: "Recent German selectivity trials in Baltic Sea" by Harald Wienbeck

No.	Codend type	Mesh opening MO (mm)	L 50 (cm)	Selection range (cm)	Selection factor (L50/MO)
1	BACOMA	112,4	38,7	5,46	3,4
2	T90 PA D5	112,9	39,1	4,82	3,5
3	T90 PE D5 Euroline premium	109,0	37,8	4,47	3,5
4	T90 PE S5 Euroline	112,9	39,7	5,54	3,5

Figure 14. Selectivity results from Solea cruise no 586

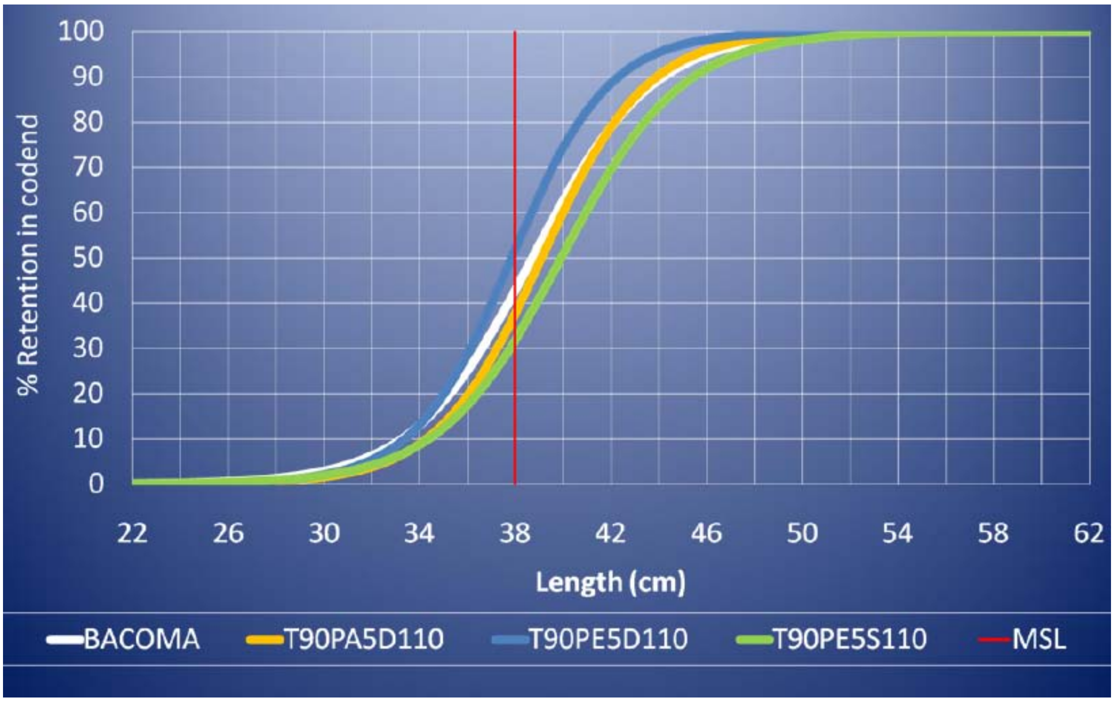

Figure 15. Selectivity curves from Solea cruise no 586

Cruise No. FRV "Solea"	Research period	No. of hauls	No. of codend type tested	Codend modification
603	27.03.-3.04.2009	17	3	Net material

No.	Codend type	Mesh opening MO (mm)	L 50 (cm)	Selection range (cm)	Selection factor (L50/MO)
1	T0 PE110S5 Redline 96#	115,1	32,1	6,3	2,8
2	T90 PE110S5 Redline 48#	114,4	39,5	5,7	3,5
3	T90 PE110S5 Euroline Premium 48#	111,4	39,7	6,1	3,6

Figure 16. Selectivity data from Solea cruise no 603

Rang	Jahr	Monat	Reise	Steert Typ	Material	Garndurchmesser [mm]	Einzel / Doppel Garn	BACOMA Maschenöffnung [mm]	Tunnel #	Steert #	L50 [cm]	SR [cm]	Maschenöffnung [mm]	Selektionsfaktor	Mess-Methode	Maschenöffnung korrigiert [mm]	Selektionsfaktor korrigiert
1	2008	September	SO 594	T90	DYNEEMA	2.5	E	-	50	50	44.10	4.60	107.90	4.09	OMEGA	107.9	4.09
2	2008	September	SO 594	T90	DYNEEMA	2.5	D	-	50	50	43.10	4.90	109.40	3.94	OMEGA	109.4	3.94
3	2008	September	SO 594	T90	PE	5	E	-	50	50	42.30	4.60	112.90	3.75	OMEGA	112.9	3.75
4	2008	September	SO 594	T0	DYNEEMA	2.5	E	-	100	100	39.20	6.80	108.50	3.61	OMEGA	108.50	3.61
5	2003	September	SO 513	BACOMA	PE	4	D	110	105	100	39.10	6.20	107.40	3.60	ICES	108.90	3.59
6	2008	April	SO 586	T90	PE	5	E	-	50	50	39.70	5.50	112.90	3.52	OMEGA	112.9	3.52
7	2008	April	SO 586	T90	PE	5	D	-	50	50	37.80	4.50	109.00	3.47	OMEGA	109	3.47
8	2008	April	SO 586	T90	PA	5	D	-	50	50	39.10	4.80	112.90	3.46	OMEGA	112.9	3.46
9	2008	September	SO 594	T0	DYNEEMA	2.5	D	-	100	100	37.80	8.50	109.60	3.45	OMEGA	109.60	3.45
10	2005	April	SO 539	BACOMA	PE	4	D	110	105	100	38.80	6.18	112.50	3.40	OMEGA	112.5	3.45
11	2008	April	SO 586	BACOMA	PE	4	D	110	105	100	38.70	5.50	112.40	3.44	OMEGA	112.4	3.44
12	2004	April	SO 522	BACOMA	PE	4	D	110	105	100	36.85	5.60	108.40	3.40	OMEGA	108.4	3.40
13	2004	September	SO 531	BACOMA	PE	4	D	110	105	100	38.50	4.40	113.90	3.38	OMEGA	113.9	3.38
14	2002	April	SO 490	T90	PE	4	D		50	50	33.83	6.23	99.13	3.41	ICES	100.63	3.36
15	2005	September	SO 547	T90	PE	4	D	-	50	50	38.40	4.15	114.23	3.36	OMEGA	114.23	3.36
16	2005	September	SO 547	BACOMA	PE	4	D	110	105	100	37.88	4.88	113.00	3.35	OMEGA	113	3.35
17	1998	September	SO 431	T0	PE	5	E		100	100	39.75	10.06	117.20	3.39	ICES	118.70	3.35
18	1999	April	SO 440	T0	PE	4	E	-	100	100	37.71	7.00	116.70	3.23	ICES	118.20	3.19
19	1999	April	SO 440	T0	PE	4	D	-	100	100	33.11	7.81	117.30	2.82	ICES	118.80	2.79
20	2001	April	SO 473	T0	PE	6	E	-	100	100	31.70	6.96	119.95	2.64	ICES	121.45	2.61
21	2002	April	SO 490	T0	PE	4	D	-	100	100	33.84	7.73	130.49	2.56	ICES	131.99	2.56
22	2002	April	SO 490	T0	PE	6	E	-	100	100	33.25	7.49	129.59	2.58	ICES	131.09	2.54
23	2001	September	SO 481	T0	PE	6	D	-	100	100	28.77	7.58	117.14	2.45	ICES	118.64	2.42
24	2001	September	SO 481	T0	PE	8	E	-	100	100	27.24	5.53	118.91	2.29	ICES	120.41	2.26
25	2001	April	SO 473	T0	PE	8	E	-	100	100	26.80	6.90	118.78	2.25	ICES	120.28	2.23

korrigierte Maschenöffnung:
Die mit der alten ICES 4kg gauge Methode gemessenen Maschenöfnungen müssen mit einem offset von 1.5mm korrigiert werden, damit sie mit den Werten aus der neuen Methode mit der OMEGA gauge verglichen werden können.
Quelle: OMEGA Workshop, Ancona, Italien, 2004
Das Gesamtergebnis ändert sich durch die Korrektur jedoch nicht.

Figure 17. Summary of selectivity results

Presentation 7: "Critical review of selectivity studies with 40mm square-mesh codend. Is square-mesh better selective than large mesh size?" by Antonello Sala

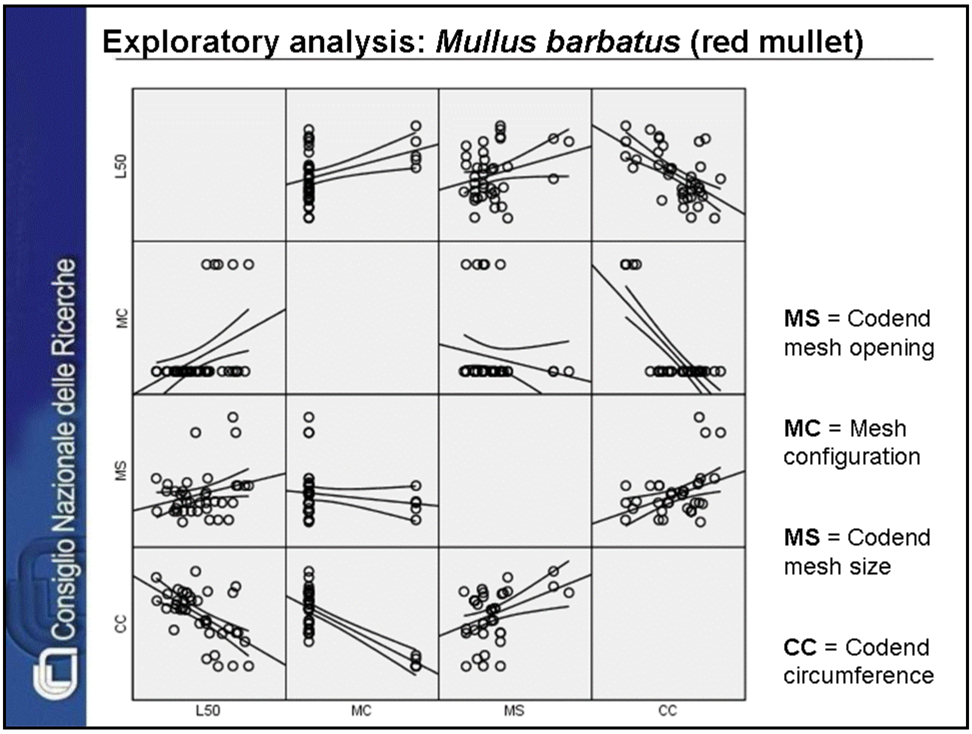

Figure 18. Exploratory analysis: *Mullus barbatus* (red mullet)