GFCM:SAC8/2005/Dma.7

October 2005

E

GENERAL FISHERIES COMMISSION
FOR THE MEDITERRANEAN

COMMISSION GÉNÉRALE DES PÊCHES
POUR LA MÉDITERRANÉE

GENERAL FISHERIES COMMISSION FOR THE MEDITERRANEAN

SCIENTIFIC ADVISORY COMMITTEE

Eighth Session

Tirana, Albania, 25-28 October 2005

REPORT OF THE WORKSHOP ON STANDARDIZATION OF SELECTIVITY METHODS APPLIED TO TRAWLING SÈTE, FRANCE, 9-11 SEPTEMBER

Report on ATSELMED workshop

IFREMER Pôle Mer et Lagune

Sète 9, 10 & 11 February 2005

A working group of the GFCM on the standardization of the selectivity methods applied to trawling in the Mediterranean sea ,organized by IFREMER with the participation of FAO projects, COPEMED and ADRIAMED organizations.

Opening of the meeting (Wednesday February 9)

Thirty scientists of eight Member States of the CGPM and from Denmark, Finland, Argentina and Colombia, fishing gear technologists or persons in charge of research programmes on the selectivity of fishing gears met in Ifremer Sète Pôle Mer et Lagunes.

After the welcome speech and having excused Franco Biagi, Juan-Pablo Pertierra, representatives the European Commission, Rafaël Robles, director of COPEMED, and Fabio Massa, directors of ADRIAMED, Jacques Sacchi, in the name of Ifremer, opens the meeting in the presence of Corrado Piccinetti, president of the scientific committee of the CGPM, and Jordi Lleonart, representing the FAO.

The agenda of the meeting is then presented and the main objectives of the present working group reminded, i.e. they above all aim to consolidate the knowledge obtained on the experimental methodology and protocols and to determine what is to be adapted to the specificity of the Mediterranean trawl fisheries.

The working group thus begin by examining various cases of studies achieved in the Mediterranean ;then the fundamental rules on selectivity statistical analysis are explained so that on the third day meeting proposals on priority actions towards a better standardisation of the working methods and data transfer be defined.

Session 1 Case studies - Review of recent selectivity studies

Chairman: Mario Feretti, (CIRSPE, Rome);
Rapporteur: Jacques Sacchi (IFREMER, Sète)

Ten papers were presented orally on most varied subjects like the study of multispecific inshore fisheries and deep shellfish fisheries. The scientists were requested to focus on the choice of the methods used, the difficulties encountered and the constraints linked to putting into practice the selectivity measures to the concerned fishing fleets. The documents given in annex which tackle with these points are summarized hereafter.

1. **Marouene Bdioui and Rhida M'Rhabet. "Etude de l'influence de l'ouverture des mailles et de la forme des mailles de la poche sur la sélectivité des chaluts à crevettes tunisiens".**

In Tunisia, shrimp trawls and traditional Mediterranean trawls are used for deep-sea fishing.. These fisheries generate a great variety of by-catch and mainly small fish of great commercial value (red mullets). The study presented here aimed at determining and improving the selectivity of the

professional trawls. The tests achieved onboard the R/V Hannibal enabled to obtain by the covered cod-end method the selectivity curves and parameters of three grids (48, 52, 60 mm) for the principal species (hake, red porgy, red mullet, bug). For both the Mediterranean trawl and the shrimp trawl, the values of L50 obtained for these species with a 40 mm mesh size are below their size of the first sexual maturity. They are higher only with a larger mesh size (52 mm for the red mullet) or square meshes (48 mm for the mullet). The development of a shrimp selective trawl combining both a grid and a guidance panel provided better results than the Canadian selective device Nordmore, by allowing the discard of a high proportion of immature fish and an increase of the hourly yields.

2. **Corrado Piccinetti, Nicola Ungaro, Antonello Sala, Mario Ferretti. "Approach and methodology used in fishing experiments with square mesh cod-end in Adriatic Sea".**

The present paper presents the approach and methodology employed to measure the selectivity and the effectiveness of the square meshes applied to the type of trawl most commonly used at Adriatic Sea. Seventeen fishing experiments were completed to this end by the vessels of research Dallaporta and Andrea. The selectivity of square mesh and diamond mesh shape bottoms were achieved separately by the use of a double 20 mm mesh size cod-end, equipped with plastic hoops to avoid masking the bottom tested. The adopted hanging ratio of square meshes panel is 25%. To compare the effectiveness of the two systems, the hauls were completed alternatively with one then the other type of cod-end, the yields expressed as a whole and and by species being given in number and weight in kg/km2. The trawl geometry and efforts exerted on the trawl gear were constantly measured during each haul, using Scanmar equipment and tension sensors. The selectivity parameters were then calculated for each haul using software CC2000 while the average selectivity curves were obtained by the method of Fryer (1991).

Compared with the observations obtained for diamond mesh bottoms of same dimensions, no significant difference was noted, neither between the vertical and horizontal openings, nor between the forces of resistance of the trawls. The specific composition is also identical but with weaker yields for the square mesh; for instance if one obtains a profit in weight of 64% for hake the total effectiveness is decreased by 20 %.

In conclusion, the use of a square mesh bottom trawl involves a selectivity higher than with diamond meshes. This higher selectivity however involves an economic loss due to the youngest fraction of stock, as it is the case for the red mullet.

3. **Enric Massutti, Beatriz Guijarro, Jorge Baro, & Isabel Muñoz."Selectivity of diamond and square mesh cod-ends in the deep water crustaceans trawl fisheries off Balearic Islands (Western Mediterranean)".**

The present contribution describes the effects of square mesh cod-end selectivity in deep trawl fisheries which exploit the Norway lobster (Nephrops norvegicus) and the red shrimp (Aristeus antennatus) in the west of the Mediterranean sea. A total of 38 tests was carried out in autumn 2002 and in spring 2003, onbaord a professional trawler working on the continental slope of the South of the Balearic Islands, between 251 and 737 m depth. A conventional trawl of type "huelvano" was used with alternatively a diamond mesh cod-end and a square mesh cod-end, both of a 40 mm nominal mesh size. A 20 mm cover cod-end was added for selectivity measurement purposes. All the grids were measured with gauge ICES calibrated at 4 kgf.

To take into account the effect of the various strategies of fishing, the standardised specific composition of the captures (kg/hour) was analysed by hierarchical classification. The rates of escapement and discards as well as the loss and economic effectiveness (value ratio of the capture retained compared to the total capture) were considered and analysed by variance analysis for each season, each depth and each shape of mesh. The saturation effect for both the mesh shapes was also tested from the comparison of the escapement rates for the capture selected. The selectivity by size was modelled by means of the generalised logistic curve. For all the species, the first capture sizes significantly increase when adopting square mesh to the detriment of diamond mesh. Furthermore, there is no difference in the composition of the captures of the two types of cod-ends nor of the commercial yields of the main species. In conclusion, if the fact of changing mesh shape involves

small but significant increase in the rate of escapement (between 5 and 15%) and between 1.4 and 2.4 % of economic loss, then the outputs of the main species, in terms of biomass and economic effectiveness would be probably remain.

4. **Jorge Baro, I. Muñoz, E. Massuti, B. Guijarro, M. Garcia, A. Fernandez. "Selectivity of diamond and square mesh cod-endcod-ends in the coastal trawl mixed fisheries off the Spanish Mediterranean".**

This study was undertaken on the coastal mixed trawl fisheries in three different areas, Málaga, Alicante and Majorca Island, between 50 and 500 m, in autumn and in spring, with the aim of studying the selectivity of square and diamond mesh cod-ends on the main coastal species. These experiments were conducted onboard trawlers representative of the Spanish Mediterranean fleet which exploits the fishing zones between 50 and 800 m; two types of trawls were tested, among the gears the most in use, the "cuadrado" with a larger opening, and the "tangonero" mostly used for deep sea fishing.

These experiments were based on the cover cod-end method. The duration of trawling is the same as that of the fishing vessels in each zone, i.e. between 90 and 240 mn ,on the usual zones of fishing. Three strata depths were concerned : 50-100 m; 100-200 m; 200 m.

Since haul duration depends on several factors, including the layer sampled and of the relative abundance of the species, the data of capture were standardised in g/h so that the various yields be compared. The differences between the total captures obtained with each type of mesh were analysed using ANOVA software for the main species. The yields obtained with each type of cod-end were compared by test T of Student. Moreover, the possible differences between the frequencies of distributions obtained with each cod-end were tested with the test of Kolmogrov-Smirnov. Finally the L50 of the principal species were obtained by adjustment with the logistic function.

315 hauls were thus examined; if there is no significant difference between the yields of both types of cod-ends, as regards most of the species, on the other hand in the square mesh configuration the L50 of these species are higher than those obtained with diamond mesh, for for an identical 40 mm mesh size, and they are in particular equal to or larger than the legal minimal size for Mullus spp., S. smaris and M. Poutassou. Furthermore, the discards are lower than with a diamond mesh cod-end. Although further experimentation are necessary, investigating other periods of the year and zones and different strata along with survival estimates of the individuals that have escaped, these first results give to think that the use of square mesh configuration can only improve in the short term, middle or long term the way many target species are exploited.

5. **Paola Belcari & Claudio Viva. "Study on the effects of fitting square-mesh sections to the selectivity of demersal trawling in Northern Tyrrhenian Sea (western Mediterranean)".**

The square mesh panels used in the British and Irish Norway lobster fisheries definitely show capacities for releasing the small individuals, with negligible consequences on the value of the commercial landings. Experiments were thus achieved in the Northern Tyrrhenian sea, from the port of San Stefano, on trawling targeting deep pink shrimp, Parapenaeus longirostris between 100 and 300 m. These fisheries captures also other species of high commercial value, with mostly juveniles, especially of hake, blue whiting, which results in high rates of discards. The selective device, which was built by fisheries industrialists on the principles defined by Robertson (1993) consisted of a 3 m long x 6 m wide panel of 40 mm nominal size square meshes, placed ahead the cod-end at 6 m distance from the closing rope.

The tests were carried out on board a professional fishing vessel from spring 2003 to spring 2004 included. The method consisted in measuring over a whole season by the cover cod-end method the selectivity of a commercial trawl with a 40 mm nominal size diamond mesh cod-end with that of an experimental trawl fitted with a square mesh panel of the same mesh size. All the hauls were completed in the same way; the date, position, depth, speed, the warp length were noted as well as the weights by species for a capture, for each of the hauls. The 50% retention rate (L50), the selection factor (SF) and the selection interval (SR) were obtained by adjusting the data to a logistic curve.

The first results show that with the experimental trawl equipped with a square mesh panel, if the quantity of P. longirostris is around 10% less than that obtained with a commercial trawl, the L50 of the individuals captured with the square mesh is approximately 20% higher. Although the analyses of the other species being in hand, for most of them the results remain similar.

6. **Fabio Fiorentino, M. L. Bianchini, S. Ragonese, Brian Rosso, Alicia Mosteiro, Matthew Camilleri, P. Rinelli. " Experiences of trawl selectivity of diamond mesh cod-endcod-ends in main target species of the Strait of Sicily and adjacent seas".**

This contribution is a review of the studies conducted on the selectivity of diamond mesh cod-ends of the trawls used in the Strait of Sicily and adjacent seas, in particular on Aristeomorpha foliacea, Parapaenaeus longirostris, Merluccius merluccius and Mullus barbatus; the method of the cover cod-end being that the most used. An inventory of the principal parameters of these species was drawn up; the analysis of the literature shows the existence of a linear relation between mesh opening and L50 as well as SF; Fiorentino (1998) deduces an estimate of the relationship between it and the mesh size from different selectivity studies, in particular for hake.

7. **Alen Soldo. "Selectivity of bottom trawls used in Eastern Adriatic".**

The present study compares the selectivity of three types of cod-ends (mesh size 48 mm, 60 mm, and 60 mm equipped with a 60 mm square mesh panel), adapted to the principal trawls used in the East of the Adriatic, the "tartana" typical Mediterranean trawl and the double panel trawl, with larger opening.

The experiments carried out onboard the R/V Bios required the use of (i) underwater video recording to observe the behaviour of the various selective devices; (ii) a system to control the geometry of the various trawls; (iii) a sonar to measure the spacing between the panels; (iv) dynamometers to record the tension of warps. Observations were thus carried out on the changes of horizontal and vertical openings, spacing between panels and the tensile strength (kN) of the trawls in relation to the trawling speed.

The selectivity parameters for M. merluccius, N norvegicus and M. barbatus were achieved using a heaving bag fitted with hoops made of composite rope and by adjusting the data to a logistic function. The comparison between the various results was completed by variance analysis.

A comparison of the results of six various trawl structures for hake show significant differences. The main results show that the best conditions of selectivity were obtained with the double panel trawl, of 60 mm mesh size and fitted with a 60 mm square mesh panel.

8. **Francisco Sardà, Nixon Bahamón and Petri Suuronen. "First experiences with grids in the Spanish Mediterranean sea ; success and failures in multi-species trawl fishery".**

Two campaigns were completed in the Spanish Mediterranean to test selective grids on bottom trawls and to determine the most satisfactory bar spacing to allow the maximum escapement of the juveniles of M. merluccius and M. barbatus in the Mediterranean multi-specific fisheries. Thirty eight hauls were achieved onboard a professional vessel, ten with square mesh cod-ends, sixteen with grids offering a 20 mm spacing between bars, and eight with grids offering a 15 mm bar spacing. A device was built which consists of a lengthening piece fitted with a grid leading to three cod-ends allowing the separation in three categories, i.e. the large individuals, the smaller ones, and the refuse.

A comparison of the captures achieved with the three types of devices on the fishing zones of the delta of Ebre showed significant differences in the selectivity parameters of the various commercial species captured and loss rates per escapement. Furthermore, it showed that regarding multispecific fisheries the choice of a selective single device did not turn out to be an optimal solution for all the species. A compromise must be found between the type of device, the L50 and the capture loss. In addition, when compared with the advantages of the square mesh cod-ends, the selective grids are more effective and allow a better survival after escapement, but they are more expensive and can be easily blocked. The talk concludes by underlining the interest which the development of these systems represents for the improvement of the selectivity of the trawl fisheries for hake and red mullet in the Mediterranean.

9. **Alfonso Izzo. "Experiences of selectivity on hake with escapement grids for juveniles in Argentina".**

The document retraces the various experiments on bottom trawl selectivity carried out in Argentina on hake (M. hubbsi) fisheries. Since 1970, studies were conducted on diamond mesh cod-end selectivity, of 56 mm, 96 mm and 120 mm mesh size, on the use of a square mesh panel of 45 mm mesh size placed ahead of the extension piece, and on the use of selective grids. System DEJUPA created by the INIDEP in 1995 can be implemented on side trawlers as well as on back slope trawlers in three sizes according power engine, less than 300 HP, from 300 to 800 HP and for more than 800 HP. This type of grid is placed between the belly and the cod-end and allows the juveniles of hake escape through the outlets at both sides of the DEJUPA, behind the grid. Two logistic selectivity curves for hake were estimated according two different mesh size codend corresponding to different bar spacings. A cover codend method were use to collect the fish escaping from the codend while an inner codend retained the fish escaping through the grid. A Norway flexible grid (FLEXIGRID) with a 40 mm spacing was also tested and adjusted in the course of three campaigns completed in 2001 and 2002 onboard research and commercial vessels. The selectivity parameters were determined by the use of two retention cod-ends. The selective performances of a grid of the same type with a 35 mm bar spacing are also in progress.

Finally, a device consisting of a double grid (DISELA II) designed to facilitate the escapement of hake captured in the shrimp fisheries was tested. The selectivity curve for hake was obtained by paired gear method. All the selectivity data were adjusted to a logistic model by maximum of probability. The selectivity parameters were calculated using the softwares CC2000, ECModel (Constat) and Excel spreadsheet Aubone2002.

10. **Angeliki Adamidou et Argyris Kallionotis « Short presentation of the NETRASEL project concerning the Greek trials**

The Norway lobster is an important commercial species for trawl fisheries in Greece. The separation of Norway lobster, shrimps and fish turns out to be almost feasible by using selective devices as demonstrated by the two tests achieved in the North of the Aegean Sea.

The present paper, which was not presented, summarizes the selectivity experiments carried out within the framework of project NETRASEL (FAIR CT 98 4164) on the development of semi-rigid grids to reduce the by-catches of fish and juveniles of Nephrops norvegicus. These experiments were completed in 2000 in two different seasons with grids consisting of vertical bars at their upper part and of an opening at their lower part. A guiding panel was placed before the grid in order to make it easier for the shellfish to enter by the lower opening. Three grids with different bar spacing and opening width were tested. The comparison of the catches in the lower and higher cod-ends show that substantial proportions of Norway lobster and shrimps can be separated from fish.

Discussions

The various talks led to a free exchange of questions within the audience on points as various as the choice of the selective devices, their design, their setting and the parameters taken into account. It appears clearly that the choice of the selective devices is definitely dictated in most of the cases by the will to stick to the professional fishing conditions and the supposed behaviour of the species which are meant to escape.

If a square mesh configuration of the cod-ends mainly aims at keeping the meshes open, the square mesh panels, separating panels and grids are used to investigate the differences of behaviour; thus, the study strategies are different.

The selective devices must be designed most carefully, special care being paid to the choice of materials, twines and especially the hanging ratio of the square mesh panel on the diamond mesh cod-end.

It is reminded that if the grids offer undeniable advantages in terms of selectivity for quite specific fisheries, their design, their mounting still present some disadvantages that have to be analysed and mastered; among these disadvantages, let's mention their overall dimensions which clutter the deck of

the small boats, their stability during trawling, their clogging by remains, these being as many elements to be taken into account under the experimental conditions.

The more their design is sophisticated, the more one is tempted to take into account all the elements but the more the risk of neglecting the usual conditions of operation of the trawls is high. Especially when using a cover cod-end, it is strongly recommended to make sure to avoid the selective device being masked by the cod-end. The use of flexible reinforcements (hoops, composite rope) or "kites" of the cover cod-ends was strongly recommended as well as to check by underwater video that the whole devices is operated properly.

From the discussions it emerges that none of the experimental methods can be privileged; alternate hauls or cover cod-end method must be chosen as a function of the experimental conditions, these having to be as close as possible to the industrial fishing conditions. On the other hand, the audience agreed on the necessity to take into account in the course of operation the maximum of variables likely to act on catch effectiveness (geometry of the trawl, speed of trawling, etc.) and more particularly the necessity to respect the ISO standards of representation of the physical parameters (trawls, power, etc).

Session 2: Behaviour and survival after escapement

Chairman : Francisco Sardà (CICS, Barcelona)
Rapporteur : Pascal Larnaud (Ifremer Lorient)

11. Antonello Sala. “Cod-end selectivity, fish escape behaviour and fish morphology in the Mediterranean sea trials of UE project PREMECS-II”.

A predictive model was developed within this EU project carried out by Ifremer, Marinlab, Difres and Ismar laboratories. This deterministic model is based on the comprehension of the mechanical and biological processes which control the selectivity of the cod-end of the trawls. The influence of the characteristics of the twines that constitute the trawl, the interactions between the vessel, fishing operations, state of the sea, rig of the trawl and design of the cod-end, the morphology and behaviour of fish escapement were taken into account in the final model. Tests on selectivity and submarine visualization of the operations were completed by the research vessel Dallaporta. Some physical parameters of the vessel (warp tension, number of propeller, fuel consumption) and trawl gear (spacing between panels, horizontal and vertical openings) were recorded in the course of fishing. With an aim of minimising the environmental parameters, all hauls were achieved during the same periods of time, of depth and state of sea.

The selectivity of the cod-end was measured by the technique of the double cod-end, the latter being mounted on hoops. Experiments more particularly dedicated to the analysis of the behaviour of escapement and its quantification were performed using mini TV cameras fixed inside and outside of the cod-end to quantify the escapement. The morphology of the principal species was measured starting from samples trawled in April-May during the post breeding phase and September after the summer feeding period.

The results of this study more particularly underline the influence of the number of meshes of the circumference of the cod-end, the twine diameter and even more important, its stiffness. As many parameters liable to alter the effects of an increase in mesh size. This study also led to the development of software PRESEMO to simulate the various modes of escapement for fish populations of given morphological characteristics and distribution.

12. Petri Suuronen. “ Factors affecting the survival of fish escaping from trawl cod-end”. Methods to study survival ”

The selectivity has a high potential to reduce the mortality of the fished non targeted species and juveniles ; now, its use is justified only if a significant number of fish which have escaped survive. Many mechanisms can affect the escapement of a fish from a trawl cod-end : these are extrinsic, like the temperature of water, the speed and the duration of trawling (phase of pre-capture) or intrinsic, like the selective system and the predation (phase of post escapement).

Various effects can occur in a cumulated and variable way, depending on the species and size of fish (fragility, vulnerability, aptitude to swim, physical strength, etc.), to the mesh size and shape, to the selective device, to the characteristics of twine (friction, saturation...), and to the aptitude of fish to escape.

The present paper defends a standardization of the methods assessing mortality after escapement by enumerating some principles on which should be based any experimental step on this topic. Therefore, the present report presents a method developed by Lehtonen et al.. (1998) allowing a sample of escaped individuals to be recovered at any time of trawling, under commercial conditions of fishing and to estimate the rates of survival for hauls more or less long. More particularly, the way the fish that have escaped must be captured and recovered and the way the effects of the various traumatisms caused by the escapement and various handling must be analysed are detailed.

Based on an experimentation completed in the Baltic sea, the author stresses that 92% of mortality occur on the first day ; the temperature of the water has a cumulative effect on mortality, all the more that it is high (thus, the mortality can be higher during the summer or in our Mediterranean waters).

Lastly, to give a fish more chances to survive after its escapement, it it is essential that it escapes quickly and before entering the trawl cod-end where the risks of getting wounded are higher. For this purpose, a number of precautions are recommended here, like the choice of the positioning of the selective devices, of nonabrasive materials, and generally the improvement of the design of the gears. In some cases, the use of other techniques of capture and the fact of avoiding zones to strong density of juveniles, of non targeted species can be solutions more adapted to reduce this masked mortality associated with the escapement.

Discussions

The two last papers highlight the interest to study the role of the behaviour of the individuals fished, the first for comprehension of the escapement by modelling of all the surrounding physical variables and the second with for objective the evaluation of the effects of these variables on survival after escapement.

After some interventions on the variability of the behavioural reactions according to the species and the conditions of the medium, the audience proposes to conduct research in this field as a priority for the future.

Session 3 experimental Reliability and constraints

Chairman and speaker : Rene Holst (Report, Hirtshall)
Rapporteur : Serge Mortreux (Ifremer Sète)

If most of the various aspects of trawl selectivity are already largely detailed in the CIEM handbook, it seems convenient to insist on their fundamental principles by paying particular attention in an attempt to make out what was essential and possible to adapt to the specific conditions of the various Mediterranean fisheries.

It was thus requested from Rene Holst, consulting expert and statistician, to conduct this session around a general presentation of the various statistical methods considered for the study of trawl selectivity and the adaptability to the Mediterranean context.

The stake mainly consists in describing strict and reliable statistical methods, taking into account the specific characteristics of the Mediterranean fisheries, methods that can be adopted as standard so as to allow exchange and comparison of results.

Once presented the principles on which the selectivity studies are founded, the report describes the various experimental methods which can be used as a function of the cases considered. The most usual techniques to estimate the selectivity of a simple haul are that of the double cod-end and of double devices and alternate hauls. They all have in common the capture of fish in two compartments one of which not being selective. They can be used for both the measurement of the selectivity of a simple selective device such as mesh, and the combination of several selective devices or multi-

compartments. The statistical model SELECT seems to be a strict model changeable and general enough to be used for the analysis of a simple haul of all the types of gears.

The analysis of many hauls, which is inherent in any experimental process as reminded by the speaker, imposes to take into account the variability between the hauls; the model of Fryer (1991) satisfies perfectly this requirement, as it can take into account the fixed or random effects. If other statistical analysis software exists and if other methodologies remain to be explored, the methodological approach of a selectivity study rests on the respect of a number of fundamental steps.

It is mainly recommended to take into account all the points to be settled and the respect of a schedule of experimentation and analysis established from the very start of the project, while taking particular care in the design and the construction of the experimental gear. The problem of under-sampling and more generally the need for data bases dealing with selectivity and accessible to every one is also tackled.

Discussions

Rene Holst' speech gave rise to various remarks and queries on the difficulty to apply the methods described and more particularly on the interpretation of the results.

The two main questions concern the problems induced by the smallness of the captures and of the mesh size traditionally used in the Mediterranean trawl cod-ends.

Dealing with the first point means to achieve an analysis of the cumulative samples under-represented, which may give result bias.

The second point deals with the difficulty met in constructing a cover cod-end or reference cod-end, known as non-selective, with meshes smaller than those investigated, without taking the risk of decreasing too much the circulation inside this cod-end and its filtration.

The same problems related to the modification of flow circulation inside of the studied cod-ends can arise with the use of twin trawls or trouser trawls which cod-end circumference will be intrinsically smaller than that of simple trawls of the same power.

The answers that the described statistical methods enable to analyze as a whole most of the problems of small samplings as well as of cumulative data. Rene Holst reminds that the experimentation must be planned, considering that the choice must bear on what is in practice the most easy to achieve while keeping as close as possible to the conditions of commercial fishing. The degree of accuracy aimed and the likelihood to achieve the goal must be defined; the number of hauls required may be determined from a pilot experiment. Once this number established, the experimental scheme can be traced and must be respected scrupulously.

Session 4 : Synthesis and recommendations

Chairman: Corrado Piccinetti (Lab. di Biologia Marina E Pesca Univ.di Bologna Fano); Rapporteur: Henri Farrugio (Ifremer Sète)

Corrado Piccinetti opens the session by reminding that the Mediterranean fisheries consists of a set of areas with different histories and traditions. If in addition, the trawls are not the most numerous devices, they remain however the least selective. There are many types of Mediterranean trawls; these are different from one area to the other (inshore fishery is different from deep-sea fishery for instance); all these differences must be taken into consideration for a good management of the fisheries.

Synthesis of the presentations

Mario Ferretti, reports on the work presented during the 1st session, listing the various topics investigated and underlining the significant differences between the results. He recommends to be exact and precise when giving some technical characteristics such as speed, , the representation of the trawls and their rigging, the characteristics of the vessel, etc. Lastly, he insists on the necessity to use as much as possible the type of trawls used by the fishing industry, with the same parameters in order to be as close as possible to the professional fishing conditions.

During the discussion, Mario Ferretti reminded that it is necessary to respect the standards of representation of the trawls and the necessity ot be precise in terms of hanging ratio of the square meshes and grid assembly (Claudio Viva, Antonello Sala).

Furthermore, Mario Ferretti reminds that the grids must be measured at the opening of the wet mesh using gauge ICES, currently the most used by the scientists at least until OMEGA system is adopted. Unfortunately, this gauge does not allow to measure very small meshes (lower than 25 -30 mm), like those of the trawls used by small pelagic.

Corrado Piccinetti points out that one of the first conclusions that arises from the works presented during these sessions is that square mesh is more selective than traditional mesh, whatever the species or the depth; yet, its use may involve economic losses for some fisheries, fact that must be taken into account.

Moreover, Jordi Lleonart asserts that it does not seem necessary to go on studying the diamond mesh selectivity but rather investigate the way to use square meshes. Enric Massutí comes in support of this assertion by recalling that all communications presented to the Working Group have shown that the "experimental" square mesh have been demonstrated more selective than the "traditional" diamond mesh, by increasing the L50 of target species and by reducing discards. Moreover, it has been demonstrated that there are no differences in the species composition of catches and commercial yields of main species exploited with these two mesh shape in the deep water crustaceans trawl fishery developed off Mallorca (Balearic Islands). For these reasons, he considers that the introduction of 40 mm square-shaped mesh in the cod-end could be an optimal and realistic management measure for this fishery. Although this change would produce a small, but significant, increment in the escapement ratio and the economic loss at short term, the yields of main species, in terms of biomass, and the economic efficiency would maintain. In addition, Enric Massutí and Jorge Baro underline that the application of this square mesh would improve the exploitation pattern of the main species and could reduce the impact of this fishing exploitation on the ecosystems and on the benthic communities.

As regards selectivity applied to fisheries, it is admitted that selectivity alone cannot solve all the problems of stock management but it must be combined it with other measures such as for example seasonal closings of reproduction areas, seasonal protection of zones, the reduction of effort, the control of production, etc. With this goal in mind, Corrado Piccinetti, reminds that the GFCM is currently preparing a definition of operational units of which the selective characteristics of the fishing gears which operate there must be defined for each type of vessel.

Francisco Sarda as chairman of the second session reminds that the selectivity depends on the behaviour of the species, in particular on the way the fish escape, by the top, by the bottom or by the middle of a panel of meshes. He stresses the importance of studying the morphology and behaviour according to the various types of meshes and of the utility of the video to achieve this purpose.

The problem of survival after escapement is then tackled showing that it is different according to the species, the animals with a carapace being by principle more resistant. Lastly, although few quantified elements are available either on square mesh (Francisco Sarda) or on grids (Serge Mortreux) the animals that survive are in better state than with traditional meshes.

The discussion that ensues gives rise to a number of comments on the compared interest of grids and square mesh. Among the queries, Fabio Fiorentino wonders what effect the fact of changing the shape of the mesh has on the selection range; this point remains to be solved

Finally, Rene Holst starts drawing up the report of the session he conducted, by reminding the general outlines of his presentation; he insists on the interest of associating statisticians at the moment the projects are conceived, this both to define an experimental plan and to answer the problem of the standardization of the results.

Examination of proposals and recommendations

A - Network of technologists

The necessity to be assisted by technologists to assess the stocks, and for the sub- committee on environment (protection of certain species and ecosystems) incite to create a network of Mediterranean technologists. Each participant is thus asked to provide a list of technologists of their country likely to join this group of experts.

In addition, although north and southern Europe fisheries being very different, the contribution of non Mediterranean technologists to work interesting the Mediterranean fisheries would be appreciated, so connections with other groups as those of ICES must be developed.

François Gerlotto, president of ICES Fish Captures committee (FCC), agrees on this point, and confirms the interest there would be to work with ICES Fishing Technique and Fishing Behaviour (FTFB) of the on these very points. He suggests that this committee (backed by the FAO and ICES organizations) be opened to the Mediterranean scientists, and that the objectives and results of the working group hosted in Sète be presented at the next meeting of this working group in Rome (18 – 23 April, 2005).

Lastly, Jordi Lleonart suggests that the GFCM be informed of the perpetuation of this working group.

B - Selectivity data base

As suggested by Rene Holst and a number of attendees, it seems essential to draw up a complete list of all the bibliographical information on selectivity studies, including all the technical data and parameters of selectivity available.

The attendees are requested to send all the data and information they possess to Jacques Sacchi who, with Serge Mortreux and Mario Ferretti, will draw up a synthesis.

C - Practical guide of selectivity study

Throughout the debates, it appeared necessary to establish with more preciseness the way selectivity studies must be conducted so that the results be more easily comparable, and especially so that they be reliable by the respect of a protocol approved by the scientific community and the fisheries industry.

It is not question of a new handbook on selectivity, the one published by the CIEM fully covering the requirements on the matter, but rather guide-lines, detailing in a practical way the main steps towards the achievement of a study dedicated to the selectivity of Mediterranean trawls.

All the attendees having agreed on this point, Jacques Sacchi is in charge of the preparation of a project on this topic, project that will be passed round so that each member of the working group comments on it.

D - Dissemination of the results to the fisheries industry

If an increase of the minimal cod-end mesh size can reduce the capture of small individuals, it remains an unpopular measure to the fishermen. The technical development of selective devices such as separating grids, square mesh cod-ends or escape panels offer more acceptable possibilities to improve selectivity. However, the fisheries industry must be involved mainly in the improvement of the feasibility and effectiveness of these devices so that the fishermen adopt them more easily. The attendees suggest to associate the fisheries industry and the net manufacturers to the works of this group. This proposal could be presented at the next meeting of MEDISAMAC association of Mediterranean fishermen.

Closure of meeting (Friday February 11)

The various points of the agenda having been dealt with, the members and organizers of the working group having been thanked for the quality of their participation the meeting is closed.

ANNEXE A : List of the participants

ABID Noureddine
INRH
Résidence Line n°58, avenue Mohamed V, Place Roudani –B.P. 5268 - Tanger
Maroc
Email : noureddine_abid@yahoo.com.
Tel : +212 039325139

BAHAMON Nixon
CSIC
Instituto de Ciences del Mar, Passeig Maritim de la Barceloneta 27 - Barcelona
España
Email : bahamon@icm.csic.es.
Tel :+34 912309500

BARO Jorge
IEO
Instituto espanol de oceanografia, centro oceanografico de Malaga, Puerto pesquero S/N, 29640 – Fuengirola
España
Email : jorgebaro@ma.ieo.es
Tel :+34 952476355

BDIOUI Marouene
INSTM
Port de Pêche de la Goulette – 2060 La Goulette – Tunis - Tunisie
Email : bdioui_marouene@yahoo.fr.
Tel : +216 71735848

BELCARI Paola
UNIPI
Dipartimento Scienze uomo e ambiente (University of Pisa), via Volta 6, 56100 - Pisa
Italia
Email : belcari@discat.unipi.it.
Tel : +39 050 2219022

CHEILARI Anna
NCMR
Hellenic Center for Marine Research – Hellinikon, 16610 – Athènes –
Grèce
Email : annachil@ncmr.gr.
Tel :+30 210 9822557

COBANI Mimoza
Fishery Directorate, Ministry of Agriculture and Food – Tirana
Albanie
Email : inspeshkimit@dfishery.gov.al.
Tel :+355 4228621

FARRUGIO Henri
CS-CGPM
Ifremer
Avenue Jean Monnet, B.P. 171 – 34200 - Sète
France
Email : henri.farrugio@ifremer.fr.
Tel :+33 (0)4 99 57 32 00

FERRETTI Mario
CIRSPE
Centre italien de recherches et d'études sur la pêche, via de'Gigli d'oro N. 21 – 00186 – Roma
Italia
Email : mferretti@cirspe.it.
Tel : +39 066869400

FIORENTINO Fabio
IAMC-CNR
Section of Mazara del Vallo, via L. Vaccara, n°6 - 91026 Mazara Del Vallo
Italia
Email : fabio.fiorentino@irma.pa.cnr.it.
Tel :+39 923948966

GERLOTTO François
IRD et CIEM/ICES
Avenue Jean Monnet BP 171 - 34200- Sète
France
Email : francois.gerlotto@ird.fr.
Tel : +33 (0)4 99 57 32 00

HOLST Rene
CONSTAT
The North Sea Center, PO Box 104
Groenspaettevej 10, 9850 Hirtshalls
Danemarck
Email : rene@constat.dk.
Tel : +45 98 92 19 79

IZZO Alfonso
INIDEP
Victoria Ocampo 01,
7600 Mar del Plata
Argentine
Email : izzoalfonso@hotmail.com.

LARNAUD Pascal
Ifremer
8 rue François Toullec – 56100 Lorient
France
Email : pascal.larnaud@ifremer.fr.
Tel : +33 (0)2 97 87 38 41

LLEONART Jordi
FAO
Viale delle Terme di Caracalla – Rome
Italie
Email : jordi.lleonart@fao.org.
Tel :+39 0657056354

LUCCHETTI Alessandro
CNR -ISMAR
National Research Council – Institute of Marine Sciences Fisheries section, largo fiera della pesca 2 – Ancona
Italia
Email : a.lucchetti@ismar.cnr.it.
Tel : +39 071 2078839

MALLOL Sandra
Universitat de Girona – Fac. Ciencies – Zoologia – Campus Montilivi S/N – 17071 –Girona
España
Email : sandramallol@yahoo.com
Tel : +34 660314254

MASSUTTI Enric
IEO
Instituto Espanol de Oceanografia (IEO) de les Balears, moll de ponent S/N 07015 – Palma de Mallorca
España
Email : enric.massuti@ba.ieo.es.
Tel : +34 971401561

MORTREUX Serge
Ifremer
Avenue Jean Monnet, B.P. 171 – 34200 – Sète
France
Email : serge.mortreux@ifremer.fr.
Tel :+33 (0)4 99 57 32 00

PETRAKIS Georgio
NCMR
Helenic Centre of Marine Research, via Kosmas, Hellinikon, 16610 Athens
Greece
Email : gpetr@ncmr.gr.

PICCINETTI Corrado
Président CS-CGPM
Laboratorio de. Biologia marina e pesca, viale adriactico 1/N – 61032 – Fano
Italia
Email : cpiccinetti@mobilia.it.
Tel :+39 0721/802689

ROSSO Brian
Malta CFS-MARSALOKK Centre for Fisheries Sciences, Fort San lucjan, Qajjenza Rd, M'Xlokk, (Marsalokk) BBG06
Malta
Email : brianrosso@yahoo.com.
Tel : +356 99451563

SACCHI Jacques
Ifremer
Avenue Jean Monnet, B.P. 171 – 34200 – Sète
France
Email : jacques.sacchi@ifremer.fr.
Tel : +33 (0)4 99 57 32 00

SALA Antonello
CNR-ISMAR
National Research Council – Institute of Marine Science – Fisheries section, largo fiera della pesca, 2 – Ancona
Italia
Email : a.sala@ismar.cnr.it.
Tel : +39 071 2078828

SARDA Francisco
CSIC
Instituto de Ciences del Mar, Passeig Maritim de la Barceloneta 37 – 08093 Barcelona
España
Email : siscu@icm.csic.es.
Tel : +34 932309549

SOLDO Alen
IOF-SPLIT
Institute of oceanography and fisheries, Set. I. Mestrovica 63, 21000 - Split
Croatia
Email : soldo@izor.hr.
Tel : +385 (0) 21 358688

SUURONEN Petri
CSIC
Instituto de Ciencies del Mar, Passeig Maritim de la Barceloneta 37-49, 08003 Barcelona
España
Email : petri.suuronen@icm.csic.es
Tel : +34 93230 9568

VIVA Claudio
UNIPI-PISE
Centro interuniversitario di biologia marina di Livorno – viale nazario sauro 4 – 57128 – Livorno
Italia
Email : viva@discat.unipi.it
Tel : +39 050 2219095

ANNEXE B - Agenda

Wednesday 9 February

9H00 Welcome address

9H15 Jacques Sacchi Introduction et présentation du programme

Introduction and program presentation

9H30 – 12H00 Session 1: Revue d'études de cas (*Review of cases studies*).

Animateur (*Chairman*): Mario Feretti, (CIRSPE Rome);
Rapporteur: *Jacques Sacchi (Ifremer)*

1. Marouene Bdioui. "Etude de l'influence de l'ouverture des mailles et de la forme des mailles de la poche sur la sélectivité des chaluts à crevettes tunisiens".
2. Corrado Piccinetti. "Approach and methodology used in fishing experiments with square mesh cod-end in Adriatic Sea".

10H00 – 10H20 coffee break

3. Enric Massutti: "Selectivity of diamond and square mesh cod-ends in the deep water crustaceans trawl fisheries off Balearic Islands (Western Mediterranean)".
4. Jorge Baro. "Selectivity of diamond and square mesh cod-ends in the coastal trawl mixed fisheries off the Spanish Mediterranean".

11H00 discussions

12H00 – 14H00 lunch

5. Paola Belcari. "Study on the effects of fitting square-mesh sections to the selectivity of demersal trawling in Northern Tyrhenian Sea (western Mediterranean)".
6. Fabio Fiorentino. "Experiences of trawl selectivity of diamond mesh cod-ends in main target species of the Strait of Sicily"..
7. Alen Soldo. "Selectivity of bottom trawls used in Eastern Adriatic".
8. Francisco Sardà. "First experiences with grids in the Spanish Mediterranean sea ; success and failures, mono and multi-species selectivity".
9. Alfonso Izzo. "Experiences of selectivity on hake with escapement grids for juveniles in Argentina".

16H00 – 16H20 coffee break

16H20 discussions

17H00 – 18H30 Session 2: Behaviour and survival after escapement

Animateur: Francisco Sardà (CICS, Barcelone);
Rapporteur: Pascal Larnaud (Ifremer Lorient)

10. Antonello Sala. "Cod-end selectivity, fish escape behaviour and fish morphology in the Mediterranean sea trials of UE project PREMECS-II".

Discussions.

11. Petri Suuronen. " Factors affecting the survival of fish escaping from trawl cod-end". Methods to study survival ".

Discussions.

18h30 *welcome aperitif*

Thursday 10 February

9H30 – 18H00 Session 3: S*tatistical reliability and experimental constraints*

Animateur: Rene Holst (Constat, Hirtshall);
Rapporteur: Serge Mortreux (Ifremer Sète)

10H00 – 10H20	coffee break
11H00	questions et discussions
12H00 – 14H00	lunch
16H00 – 16H20	coffee break
17H00	questions et discussions

Friday 11 February

9H00 – 13H00 Session 4: SYNTHESIS & RECOMMENDATIONS

Animateur: Corrado Piccinetti (Lab. di Biologia Marina e Pesca Univ.di Bologna Fano);
Rapporteur: Henri Farrugio (Ifremer Sète)

9H00	final discussion & synthesis
10H15 – 10H30	coffee break
10H30	proposals for the next future :
	- manuel de sélectivité : contenu; comité de rédaction (selectivity manual,
	- base de données de sélectivité; (intérêt, site) Selectivity data base (interest, site)
	- réseau de technologistes et coopération scientifique (technologist network & scientific cooperation)
11H30	recommendations & conclusion
13H00	fin du groupe de travail.

ANNEXE C - LIST OF THE COMMUNICATIONS

1. Rhida M'Rhabet et Marouene Bdioui. "Etude de l'influence de l'ouverture des mailles et de la forme des mailles de la poche sur la sélectivité des chaluts à crevettes tunisiens" (ppt).

2 Corrado Piccinetti, Nicola Ungaro, Antonello Sala, Mario Ferretti. "Approach and methodology used in fishing experiments with square mesh cod-end in Adriatic Sea" (ppt).

3. Enric Massutti, Beatriz Guijarro, Jorge Baro, & Isabel Muñoz : "Selectivity of diamond and square mesh cod-ends in the deep water crustaceans trawl fisheries off Balearic Islands (Western Mediterranean)", (ppt, txt).

4. Jorge Baro, Isabel. Muñoz, Enric Massuti, Beatriz. Guijarro, Manuel Garcia, A. Fernandez. "Selectivity of diamond and square mesh cod-ends in the coastal trawl mixed fisheries off the Spanish Mediterranean" (ppt, txt).

5 Paola Belcari. "Study on the effects of fitting square-mesh sections to the selectivity of demersal trawling in Northern Tyrhenian Sea (western Mediterranean)" (ppt).

6 Fabio Fiorentino, Sergio Ragonese, Brian Rosso, Alicia Mosteiro and Matthew Camilleri. "Experiences of trawl selectivity of diamond mesh cod-ends in main target species of the Strait of Sicily" (ppt).

7. Alen Soldo. "Selectivity of bottom trawls used in Eastern Adriatic" (ppt).

8 Francesc Sardà, Nixon Bahamón and Petri Suuronen. "First experiences with grids in the Spanish Mediterranean sea ; success and failures in multi-species trawl fishery" (ppt).

9 Alfonso Izzo. "Experiences of selectivity on hake with escapement grids for juveniles in Argentina" (ppt).

10 Antonello Sala. "Cod-end selectivity, fish escape behaviour and fish morphology in the Mediterranean sea trials of UE project PREMECS-II".

11 Petri Suuronen. " Factors affecting the survival of fish escaping from trawl cod-end". Methods to study survival " (ppt).

12 Angeliki Adamidou & Argyris Kallionotis, "Short presentation of the NETRASEL project concerning the Greek trials" (txt).

13 Rene Holst "Summary of statistical methods for towed gear selectivity analysis (pdf).

14 Antonello. Sala, F.G. O'Neill, G. Buglioni, G. Cosimi, V. Palumbo1 and A. ucchetti. Development of an experimental method for quantifying the resistance to opening of netting panels (ppt).

***