A REVIEW OF STUDIES OF FISHING GEAR SELECTIVITY IN THE MEDITERRANEAN
by
Peter Stewart

Edited by Rafael Robles and Pilar Hernández

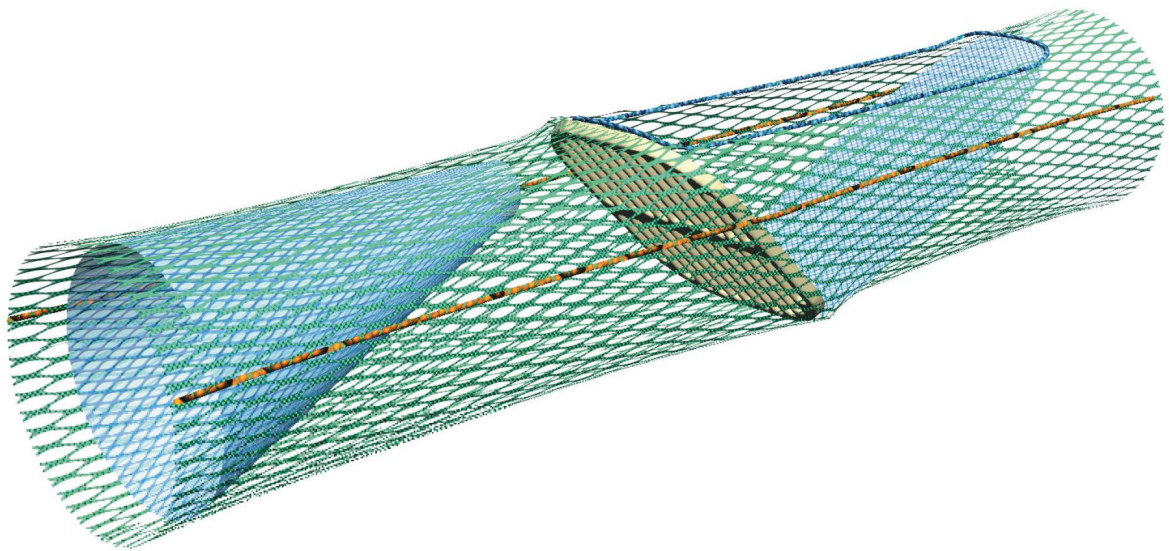COPEMED

AECI

FAO

Informes y estudios COPEMED

Number 9, September 2002

A REVIEW OF STUDIES OF FISHING GEAR SELECTIVITY IN THE MEDITERRANEAN
by
Peter A M Stewart

Edited by Rafael Robles and Pilar Hernández

Fishing gear selectivity studies in the Mediterranean: a review and a summary of the 2001 COPEMED Workshop report.

Cover picture: Experimental Sorting Grid for separating sizes and species of fish. UK Crown Copyright

Summary

There is considerable interest throughout the world in methods of improving the size and species selectivity of commercial fishing gears, to reduce fishin g mortality and to conserve fish stocks. Recent work in several Mediterranean fisheries suggests that the techniques developed elsewhere might be useful, even in multi-species fisheries, to reduce discarding, particularly of non-target species. This study was commissioned to review past and present work on gear selectivity in the Mediterranean, to assess the relevance of work done elsewhere and to advise on experimental methods.

By restricting the search to marine fisheries within the western and eastern Mediterranean, 116 relevant papers were found. A bibliography was compiled with nine categories: reviews, demersal fish selectivity, shellfish selectivity, novel cod-end selectivity, selectivity of set gear and artisanal fisheries, stock assessment surveys, gear performance and catch composition, techniques of measurement and analysis and by-catches of large sea creatures.

The scarcity of review papers demonstrated the need for this review. Selectivity parameters for a relatively small number of commercially important species are reported. The aim of most of the earlier work on gear selectivity was to determine the length and age at first capture, for stock assessment. The effects of increasing mesh size were often investigated. Small mesh cod-end covers were used. Small catches per haul of the species of interest, meant catches had to be pooled to estimate selection parameters and prevented estimation of variance. Recent work testing more selective cod-ends (square mesh, roped, narrow, etc) was carried out in Greece and Turkey. The complex effects on catch composition of altering cod-end mesh shape are also being studied. Artisanal fisheries are large, varied and important but most reported studies concentrated on the selectivity of gill and trammel nets.

The selectivity of survey trawls is an important issue for stock assessment and was studied for both survey and commercial trawls in international programmes, indicating large differences between gears. The catch composition of gears differs with their design and high opening nets were compared with traditional low headline nets in several studies.

Underwater observation of fish behaviour and gear operation was described in a few papers. Improved small mesh covers are now in use for measuring cod-end selectivity and studies of the survival of escaping fish are noted. There is some progress in data analysis. Trials of acoustic scaring methods for dolphins and Turtle Excluder Devices are described.

Key papers, describing the work done elsewhere to investigate and improve gear selectivity, are listed in the final section of the Bibliography. These identify the main
aspects of gear selectivity research to be considered by COPEMED and emphasise the importance of underwater observation in making progress in this area. The main findings of the fish behaviour studies, and the various techniques devised to improve the size selectivity of cod-ends and species separation are covered. Considerable effort went into refining and comparing methods for estimating cod-end selectivity, including hooped covers and various types of divided net. Data analysis methods developed in parallel now permit more comprehensive comparison of gear selectivity. Modelling the selectivity of nets is progressing, despite the number of technical, environmental and biological factors influencing selectivity.

Priorities for future work in the Mediterranean are considered in the review. Continuing and more precise work on the current types of commercial trawls is needed to determine age at first capture for assessment purposes. More selective fishing gears may not have general value in multi-species fisheries but may be effective in particular cases. It is worth trying to identify these fisheries and develop suitable gears. Progress will be made more quickly if the gears and fish can be observed underwater and the relative merits of RCVs, divers, hydrofoils and fixed cameras need to be assessed. Selection of fish by a gear is not confined to the cod-end, other components play a part. Catch composition depends on gear design and more study in this area is warranted to minimise the capture of non-target species. Varying cod-end mesh shape also affects catch composition and this needs more investigation. The species separating abilities of trawls with horizontal panels and of selection grids could be studied. Data analysis techniques need to be adapted to deal with small catches in an optimal manner to obtain parameter estimates with confidence limits.

There are management and economic considerations related to gear selectivity. The fisheries of the Mediterranean are very diverse and studies of comparative selectivity between metiers might reveal significant differences in selectivity. This would help to identify the fisheries where reducing by-catch and discarding would most benefit the stocks. All reductions in fishing mortality are achieved at the cost of a loss of marketable catch and income to the fishermen. These points need to be examined.

To assist the scientific committees responsible for the management of fish stocks in the Mediterranean, a workshop was held to review present and past studies on fishing gear selectivity and to identify priorities for future work. Delegates from member states of COPEMED and invited experts met on Kerkennah Island, Tunisia in October 2001. The delegates described current progress with their selectivity projects and the review of selectivity in this document was presented. Techniques developed elsewhere were considered and the need for selectivity data for stock assessment was explained. Data analysis methods, gear interactions with cetaceans and techniques for underwater observation where presented and discussed. There was a vigorous discussion on future priorities, concluding that work should concentrate on obtaining basic selectivity data and applying new analysis methods; studying the selectivity of coastal/artisanal fisheries; investigating the selectivity of survey gears; separating species in towed gears; reducing the by-catch of cetaceans. To aid this new work it was recommended that formal consultation with the fishing industry should take place; the capacity to observe gear and fish underwater should be developed; training in data analysis and fish behaviour should be arranged.

Introduction

FAO COPEMED Project decided to contract an international expert to pursue this study with the following terms of reference:

1) To review available data on the selectivity of fishing gears used in the Western Mediterranean Sea and consider the relevance to fisheries in this region of selectivity studies elsewhere.

2) Advise on the experimental methodology needed to determine selection parameters of current fishing methods and co-ordinate a Workshop to consider these issues, leading to recommendations on actions to improve knowledge of gear selectivity in the Western Mediterranean.

3) Prepare a written report on the findings of the initial studies and the proceedings of the Workshop.

Mediterranean fisheries are notable for the large number and variety of commercially important species caught and the range of fishing methods employed, from artisanal to industrial. Stocks are managed and conserved by regulations defining closed areas and seasons, minimum landing sizes and minimum mesh sizes. It is recognised that in multi-species fisheries, there is rarely a single minimum cod-end mesh size for towed nets which is appropriate for all the species caught in an area, due to differences in body shape and size at maturity. A mesh size appropriate for one species will be unsuitable for many others. The mesh sizes traditionally used in Mediterranean trawl fisheries are recognised as being too small for most of the species caught, since the selection range of the meshes ends below the size of sexual maturity. It is necessary to have information on cod-end mesh size selection for the commercially important species, for use in stock assessment calculations, and such data are collected. These studies sometimes include assessment of the effects of increasing minimum mesh sizes.

There is now considerable interest and activity throughout the world in improving the selectivity of fishing gears to reduce the capture and discarding of unwanted sizes and species of fish and of marine mammals. Much of the work done to improve fishing gear selectivity since 1980 was based on underwater observation of fish behaviour in nets. Knowledge of fish reaction and escape behaviour led to the development of novel cod-ends with more open meshes, of sorting grids and of other devices to improve both size and species selectivity. As an integral part of this work, techniques for the measurement of cod-end size selection were improved and new approaches to data analysis developed to give more reliable estimates of the selection parameters. The literature review shows that these new ideas and techniques are being applied in recent studies of the Mediterranean fisheries, with some success. In the Mediterranean multi-species fisheries, it seems likely that devices to separate species might potentially be of more value than size selective systems, in reducing the capture and discard of unwanted fish.

This report presents the literature review, discusses the work presented in the listed papers, summarises the work on fishing gear selectivity done elsewhere, considers its relevance to Mediterranean fisheries and suggests priorities for future selectivity studies in the Mediterranean.

Reviewing the Literature

A review of the literature on fishing gear selectivity studies in the Mediterranean was undertaken during 2001, starting with the Aquatic Sciences and Fisheries Abstracts (ASFA) database. This was extended by following up references in the papers found and requesting references from colleagues known to work on the subject. Although the initial idea was to concentrate on the Western Mediterranean, it was soon apparent that significant new work on gear selectivity is being published by Greek and Turkish scientists. To ensure that the literature review included all relevant material, it was extended to include studies from the whole Mediterranean Sea.

The colleagues who generously provided information and assistance were:

Mr Loris Fiorentini of IRPEM-CNR, Ancona;
Dr George Petrakis of NCMR, Athens;
Dr Pierre-Yves Dremière and Dr Jacques Sacchi of IFREMER, Sète;
Dr Ridha M'Rabet of INSTM, Tunis;
Dr Huseyin Ozbilgin of Ege University, Izmir;
Dr Alen Soldo of the Institute of Oceanography and Fisheries, Split.
Dr David Goodson, of the University of Loughborough.

The initial search produced around 140 references describing work in Spain, France, Italy, Jugoslavia, Tunisia, Morocco, Greece, Turkey, Cyprus, Egypt and Israel, the Turkish contribution being the largest. Papers on fisheries in fresh water and lagoons were omitted from the collection. Also, papers dealing with the Black Sea, the Sea of Marmara and the Atlantic just west of Gibraltar were excluded as they did not provide additional information or concepts relating to Mediterranean species. Some of the work was described in more than one document, eg contract report, thesis and publication and, in these cases, only the refereed publication was included. The remaining 115 papers are in many languages, but abstracts in English were obtained for most, though not all. The bibliography is available in two forms: a) a list of references and b) the same list with abstracts. "Selectivity" is often wrongly listed as a keyword for many papers which actually address another theme and hardly mention selectivity.

The references found were grouped in nine categories (listed below), with the number of papers selected in brackets. A tenth group was added of 23 key references to reviews and studies on gear selectivity carried out elsewhere. These were chosen as having direct relevance to the development of selectivity studies in the Mediterranean.

a) General documents and papers (5),
b) Gear selectivity for demersal fish species (27),
c) Gear selectivity for shellfish species (9),
d) Selectivity of novel cod-ends (18),
e) Selectivity of set gear (nets, traps, lines) and artisanal fisheries (15),
f) Stock assessment, surveys and selectivity of survey gear (15),
g) Gear performance and catch composition (9),
h) Techniques for the measurement and analysis of selectivity data (7+3),
i) By-catches of marine mammals and reptiles (11).
j) Key papers on gear selectivity studies conducted elsewhere (23).

In the following text, papers listed in the bibliography are referred to by section and number, eg paper c-7 or (c-7).

Studies on Gear Selectivity in the Mediterranean

a) General documents and papers

The literature search produced few documents giving an overview of selectivity studies and issues in the Mediterranean. There is a GCFM (General Fisheries Council for the Mediterranean) bibliography (1982) on Mediterranean fisheries (a-1) which considers practical aspects of fisheries amongst other topics; a 1999 paper (a-2) from the fisheries economists comparing Atlantic and Mediterranean fisheries management; a 1986 GCFM meeting report on technical fisheries matters (a-3); a French report of a meeting on mesh regulation (a-4) and a paper describing the Croatian fisheries which refers to technical management measures (a-5). A new review of the topic was clearly needed.

b) Cod-end mesh selection for demersal fish species

Interest in this basic aspect of selectivity is not new. Much of the earlier work in the1970s and 1980s was carried out and reported under the auspices of the GFCM. Usually the aim was to measure the lengths and ages at first capture of the commercially important species, for stock assessment purposes, rather than to investigate the possible beneficial effects of increasing mesh size. More recently however, EU funded contracts stimulated the study and improvement of gear selectivity. Most of the papers in this section come from Italy and Turkey. They report measurements of cod-end selectivity, concentrating on a few species, usually with the aim of investigating the biological and economic effects of increasing the minimum mesh size. If the measurement technique is mentioned in the abstracts, it is normally the covered cod-end method. Paper b-19 from Turkey, in contrast, describes the use of a trouser trawl to measure cod-end selectivity. Cod-end selectivity measurements for diamond mesh are included both in this section and in section d (novel cod-ends) for red mullet (Mullus barbatus), annular sea bream (Diplodus annularis), axillary sea bream (Pagellus acarne), whiting (Gadus merlangus euxinus), hake (Merluccius merluccius), Mullus surmuletus; pandora (Pagellus erythrinus); poor cod (Trisopterus minutus capelanus), Maena smaris. These are only a few of the many species caught and there are more data for red mullet than for any other species.

Selection parameters are often quoted in the abstracts, but usually without confidence limits. It is noted in some papers that the catch per haul of the target species is too small to allow calculation of a selection curve. Catches must be accumulated over several hauls to provide enough data for this purpose. Thus it is not possible to estimate the variability of the selection parameters. Paper b-22 by Fiorentini et al (1999) describes recent work in which catches were dominated by single species in some hauls and confidence limits for parameters were obtained. Combining the extensive data on red mullet should give an indication of the variability of the selection parameters obtained for that species, but no reference was found to such work.

c) <u>Gear Selectivity for Shellfish Species</u>

Nephrops norvegicus is an important commercial species in the Mediterranean and cod-end selectivity was measured using the covered cod-end method. The 50% retention lengths found for most of the commercial mesh sizes tested were less than the size of Nephrops at first maturity. This indicates that larger mesh sizes are needed to reduce fishing mortality on juveniles and enhance the stocks. The slopes of the selection curves were shallow, typical for this species, as the morphology of Nephrops prevents sharp selection. Selection data were also obtained for several shrimp species caught by trawls. Mesh selection is generally more effective on shrimps than on Nephrops as they do not have long claws to hinder passage through open meshes and the main problem is usually the retention of a large by-catch of small fish. Several Italian papers describe hydraulic dredging to collect molluscs. Size selection is achieved by using a grid to sieve the catch; mean selection being determined by bar spacing.

d) <u>Selectivity of Novel Cod-ends</u>

The papers in this group are from Greece, Turkey and Spain. They describe investigations of the comparative selectivity of square and diamond mesh cod-ends and the selectivity of square mesh escape panels, narrow cod-ends and cod-ends with shortened lastridge ropes. Small mesh enveloping cod-end covers were used in most studies but some tried the most recent designs of hooped cover to ensure that the cod-end meshes were unobstructed by the cover netting (d-2, 8, 12, 13). The commercial cod-end mesh sizes tested were found to be too small to allow the escape of immature fish and all types of novel design which increased mesh opening reduced the retention of round bodied fish. Square meshes were found to be unsuitable however, for flat and deep-bodied fish as these escape more readily from diamond meshes. This work shows that the introduction of a novel cod-end with a different mesh shape in a multi-species fishery would affect catch composition in a complex manner. For a set of 12 commercially important species, a square mesh cod-end used in a Spanish fishery reduced both the number and weight of undersized and discarded fish (d-18).

Paper d-9 by Stergiou et al (1997) describes a multi-variate analysis relating mesh size and type to the species composition and species diversity of the catches. The non-commercial fraction of the catch changes with increasing mesh opening and this approach may be valuable for investigating the biological and economic effects of using novel cod-ends to improve cod-end selectivity in multi-species fisheries.

Only one paper (d-16) by Tosunoglu (2001) describes the trials of a grid for separating fish by size, with good results. Recent unpublished work in Tunisia using a grid to separate shrimps from undersized fish also gave promising results. Sorting grids were originally developed for species separation in shrimp fisheries to reduce the fish by-catch, and their successful application depends on a knowledge of fish reaction in the cod-end. It is a technique which should be effective in multi-species fisheries although it complicates gear handling.

e) <u>Selectivity of Set Gear (nets, traps, lines) and Artisanal Fisheries</u>

These fisheries are very important in the Mediterranean, employing large numbers of fishermen and taking a significant proportion of the total catch. The gear selectivity in these fisheries and their impact on stocks needs to be understood but the search produced surprisingly few papers. Most of the reported work was on the selectivity of gill and trammel

nets with different mesh sizes, relating catch and discards to the current minimum landing sizes and comparing different metiers (e-14). Indirect methods of analysis were applied to the catch data in several cases. An important study (e-13) investigated the impact of new regulations on 20 set net metiers in the Tyrennhian Sea. Size and species selectivity were examined and capture by entanglement was found to be a determining factor. Tuna fisheries are described in only two papers (e-2 & e-6). Artisanal fisheries using several gears are described in papers e-7 & e-8, indicating wide differences in selectivity. No papers were found dealing with trap selectivity.

f) <u>Stock assessment, surveys and selectivity of survey gear</u>

These papers mainly describe stock assessment work using selectivity data, aimed at determining the population characteristics of commercially important species. The selectivity of survey trawls is an important factor referred to in several papers. It is essential to have current data on the selectivity of commercial and survey trawls to ensure that assessments are based on the characteristics of the fishing gears actually used in the fisheries. Paper f-2 is a review of activities in the FARWEST project concerning hake and shrimp. Paper f-10 is a review of the GRUND and MEDITS surveys. The selectivities of the MEDITS trawl and an Italian commercial trawl are compared in paper f-11, demonstrating significant differences for several species. Since both used a small mesh cod-end, the implication is that differential selectivity was taking place in the forward parts of the trawls. Most selectivity work was concentrated on cod-end selection, but the selectivity of the whole gear is important when sampling fish populations and merits more study.

g) <u>Gear performance and catch composition</u>

The selectivity of different fishing gears is often studied by comparing the length frequencies of catches. This avoids the complications of using small mesh covers, twin or divided trawls, but gives much less useful information. The papers in this group mainly report the results of such studies. Papers g-1 and g-7 deal with pelagic trawls, the latter including comparison with a purse seine catch. The others report work on demersal trawls, several comparing catches in high opening trawls with those in traditional low headline trawls. The high opening nets sweep a greater volume of water and generally catch more large fish. This topic is of continuing interest in Mediterranean fisheries, although the emphasis tends to be on improving catch rates rather than on assessing the effects on selectivity. Paper g-6 reports a study on catchability and the relationship between catch size and vessel horse-power. When there is investment in new and more efficient vessels, the likely effects on the stocks must be considered.

h) <u>Techniques for the Measurement and Analysis of Selectivity Data.</u>

This group of papers is concerned with progress in the techniques used to study, evaluate and develop the understanding of fishing gear selectivity and deals with fish behaviour, survival rates of escaping fish, measurement methods and data analysis. Three relevant papers in other sections are b-19, d-7 & d-8.

The successful development of new methods of improving fishing gear selectivity in areas outwith the Mediterranean was based on underwater observation of fish behaviour in and around fishing gears, particularly demersal trawls. Paper h-1 describes the use of an underwater vehicle to observe fish behaviour in the MEDITS trawl, and the use of small mesh

bags to trap fish escaping through or under the net body. These experiments are difficult and costly but provide sound knowledge of the processes determining capture efficiency and selectivity. A related issue is the survival rate of fish escaping through meshes and possibly suffering damage to body and scales. Paper h-4 describes an investigation of survival rates for M. barbatus and D. annularis, showing low survival of the former. Paper h-5 deals with the interaction between fish body shape and mesh shape in determining escape through meshes.

The small mesh cod-end cover was used in most reported work on measuring cod-end selectivity. There was concern about the possible masking of meshes by the large loose cover and hooped covers were developed recently to ensure that there is no chance of masking. Paper h-3 compares data obtained with hooped and non-hooped covers. (Hooped covers were used in the studies reported in papers d-2, 8, 12, 13.) The trouser trawl is another method recently used in the Mediterranean (b-19 & d-7), although the abstracts do not discuss the method of analysis applied.

Papers h-6 & h-7 describe computer programmes developed to analyse selectivity data, h-7 including gill net data. Programmes of this type are now in widespread use. Each fishing gear will sample a fish population differently and knowledge of comparative selectivity is needed to combine survey data obtained with different gears. Paper h-2 deals with analysing the data from plankton samplers but the approach is relevant to fishing gears. As mentioned above, the application of multi-variate analysis to multi-species catch data in paper d-8 shows promise.

i)   By-catches of Marine Mammals and Reptiles (11).

By-catches of large marine animals in fishing nets are undesirable as they can in time seriously reduce population numbers. Fishing gear is often damaged in the process and fishermen show great interest in methods of scaring these animals away from the nets. Papers i-1 to i-6 describe the extent of the by-catch problems in several Mediterranean fisheries, including bottom set nets, drift nets, long-lines and pelagic trawls. Acoustic methods of deterring dolphins from approaching fishing gears currently show much promise, although there is some evidence of habituation to the sound. Papers i-7 and i-8 describe respectively, bio-acoustic research on dolphins and a simple and effective application of acoustic scaring. A recent EC funded project ADEPTs (Acoustic Deterrents to Eliminate Predation on Trammel nets) has been conducted in Sicilian waters with encouraging results from the use of acoustic pingers to deter dolphins. The project bibliography is listed as paper i-9. Papers i-10 and i-11 describe trials of Turtle Excluder Devices in prawn trawls and also report some success.

Gear Selectivity Studies out with the Mediterranean

Much of the recent, successful work on fishing gear selectivity was carried out by institutes in Northern Europe and North America, co-ordinated within ICES. The aim was to conserve fish stocks by providing scientific support for the introduction of regulations defining minimum mesh sizes and other dimensions of fishing gears, to enhance the escape of unwanted sizes and species of fish. A selection of 23 papers and reports describing key aspects this work is given in section j of the literature review. These papers deal with fish behaviour in gears, cod-end selectivity, gill net selectivity, measurement methods, data analysis and cetacean deterrence.

In the 1950s and 1960s, studies concentrated on cod-end mesh selection to provide a scientific basis for regulations. The data were obtained mostly on low headline two-panel trawls. Attempts to improve the catching efficiency of trawls demonstrated that the processes of capture were little understood. During the 1970s, SCUBA diving teams were trained and towed underwater vehicles were developed, to enable direct observations to be made on fish and fishing gears. By observing fish behaviour in gears, the mechanisms of capture and selection were gradually explained and the knowledge provided a sound basis for the development of new selective gears (j-2, j-10 & j-11). Fish encountering a towed fishing gear react to the visual stimulus it presents and either avoid the gear or are steered into the net. Fish within the net are herded to exhaustion, then drift back to the cod-end where they have an opportunity to escape. The process varies according to the details of the visual stimulus, individual species behaviour, fish swimming capacity, towing speed, water temperature, gear size and construction. Thus the catch efficiency and selectivity of towed gears is highly variable.

It was observed that fish reacted in characteristic ways to each part of a trawl (otter boards, bridles, net wings, headline, foot-rope, net body and cod-end) as it approached. If some avoided the gear entirely, then a selection process was taking place, varying with species and size. When used for population surveys, knowledge of whole gear selectivity is required, since the cod-end catch does not give a true sample of the whole population. Escape under the foot-rope and through the panels in the net body was investigated by attaching bags to the net in these zones (j-6).

Fish tend to keep away from the netting walls when inside the gear and most escapes take place from the cod-end, although some fish will escape through steeply tapered netting. Cod-ends normally have a bulbous shape under tow and only a few meshes at the front of the bulge are open enough to allow round-bodied fish to escape. Observing the limited possibility of escape suggested that size selection in cod-ends could be improved by altering the design to create many more open meshes than simply by increasing the mesh size. Square mesh cod-ends and square mesh panels, shortened lastridge ropes, narrow cod-ends and 90° turned netting all have more open meshes. These cod-ends, for a given mesh size, all have greater 50% retention lengths (L_{50}) for round bodied fish (j-9) than conventional cod-ends. The body shapes of flatfish and deep-bodied fish are more suited to escape through diamond meshes. Increasing the mesh size in diamond mesh increases L_{50} but this effect is readily negated by increasing twine thickness and stiffness, the number of meshes around the cod-end circumference and relative panel lengths.

In mixed species fisheries, unwanted species are often caught and discarded. Differences in behaviour offer opportunities for separation and release of the non-target catch. A trawl with horizontal internal panels was devised to separate species entering the trawl at different heights (j-13). This trawl is ideal for separating cod from other gadoids and should be worth testing in Mediterranean fisheries. An alternative approach, developed initially for the shrimp fisheries (Pandalus Spp.) is the separating grid. The Nordmøre grid, invented in Norway, is inserted in the cod-end and diverts fish to an escape gap whilst allowing the smaller bodied shrimp to pass through (j-15). Grids were tested in many mixed fisheries and are most effective when there is a big difference in body shape between the species to be separated. Since the bars act as a sieve, grids may also used for size selection. Many complex designs were proposed to achieve both size and species separation and there are now several fisheries in which grid use is mandatory.

The need to reduce discarding in the demersal fisheries stimulated the study of cod-end selectivity in many countries. The subject was examined at a seminal EU Workshop in 1990 (j-3) and available data were reviewed by Wileman on an EU project (j-4). As noted above, many novel methods of increasing mesh opening and improving size selection were devised and tested. Research effort was then concentrated on refining these methods and on improving the techniques used to measure selection parameters.

The conventional measurement technique was to tow an enveloping small mesh cover around the cod-end to collect escaping fish. This gave a result for each haul but there were concerns about the possible masking effect of the cover, either obstructing the meshes physically or presenting a visual deterrent to the fish trying to escape. Alternative methods of measurement were tried: alternate hauls, twin and trouser trawls, and hooped covers. In practice, the alternate haul method is rarely effective as it requires a very large number of hauls to give a reliable result due to the high variance in catch size. Twin and trouser trawls tow both test and small mesh cod-ends simultaneously, giving a measurement for each haul. The two sides of twin and trouser trawls do not usually fish equally, and a technique of analysis, known as the SELECT method, was devised by Millar (j-8) to cope with this additional variance. It was soon realised that this method was applicable to all selectivity data, as it is based on comparing the catch at length of any two catch samples. The hooped cover has large rings to ensure that the cod-end and cover netting are well separated and estimates of the selection parameters obtained with this rig seem to have less variance. This method is currently the most reliable, provided the vessel used is large enough to handle the large cover (j-16). Fryer (j-7) investigated the variance of parameter estimates and showed how to obtain confidence limits, an important aspect in measuring cod-end selectivity.

The present measurement and data analysis techniques are described fully in an ICES Co-operative Report (j-1) written by the scientists who devised these new methods. This is essential reading for anyone embarking on a new programme of research on gear selectivity.

Although many of the factors affecting cod-end selectivity are now understood – cod-end geometry, catch size, fish condition, towing practice, environmental conditions – a comprehensive model of the selection process in cod-ends has still to be produced, but partial models exist. Reeves et al (j-18) produced a model of cod-end selectivity dependent on mesh size, cod-end circumference and extension length. A more recent model linking selectivity to mesh size, cod-end circumference and twine thickness was produced by Ferro and Graham (j-21). A Mediterranean model is likely to differ from the North Sea and Grand Banks models

due to different fish body forms and water temperature affecting fish activity. Dickson (j-19) developed a model describing capture by gill nets.

A review of the selectivity of set nets was written by Hamley in 1975 (j-5) and there is not a more recent review paper. There are many papers on set nets describing catches in specific fisheries, but little information on behaviour around the gear to explain the capture mechanisms. Tightly hung gill nets have a fairly narrow selection range and this is broadened by hanging the netting slackly and catching fish by tangling as well as gilling. Long-line catches are dependent on hook and bait size and fish interaction, and can be weakly selective in practice. The selection range is normally broader than that of gill nets. Huse et al (j-12) compared the relative selectivity of trawls, long-lines and gill nets in the Norwegian cod and haddock fishery. Comparative studies of this type reveal much about the stock composition, capture efficiency and size selectivity of different methods of capture.

Throughout the world, there is concern about the by-catch of cetaceans and other large marine animals in fishing gear. This has become the focus of many studies, to define the scale of the problem and to develop techniques to reduce the by-catch whilst allowing the affected fisheries to continue. Acoustic deterrence appears to be a promising method of diverting cetaceans from fishing gears and paper j-23 describes such work. Project EPIC (Elimination of harbour Porpoise Incidental by-Catch) has recently extended knowledge of cetacean behaviour and the effectiveness of acoustic deterrents in northern European waters.

Priorities for Future Research Work on Fishing Gear Selectivity in the Western Mediterranean

In the Mediterranean fisheries, many species, differing widely in size, body shape and behaviour, are of commercial importance. The situation differs markedly from that in the North Atlantic where the demersal fisheries are concentrated on a few species, mostly round-bodied. Successful size and species separation was achieved in these northern fisheries by devising new solutions for particular fisheries with few species. Improvements in selectivity in the multi-species Mediterranean fisheries are more problematic and the techniques devised elsewhere may be of limited value, but are worthy of investigation and trial.

The rapid progress made in this work in northern fisheries in the 1980s and 1990s was based on underwater observation of fish reacting to fishing gears, avoiding the need to speculate about the behaviour of fish in gears. This ensured that expensive trials to quantify gear selectivity were performed only on designs of fishing gear already known to be effective. A recent video-film produced by the Marine Laboratory, Aberdeen illustrates this approach to developing several techniques for improving gear selectivity (j-13). This should be applied in Mediterranean fisheries. Unfortunately, it is expensive. Diving teams and large underwater vehicles are costly but very effective for studying fishing gear and fish behaviour underwater. A simpler approach, not given much publicity, is the towed paravane designed in Finland. This carries a steerable TV camera and is suitable only for relatively shallow water, but the towing vessel need only be large enough to carry the cable winch. Given the reduced costs, trials of this device in Mediterranean fisheries would be worthwhile.

Size separation in trawls is determined mainly by cod-end mesh shape and opening, although towing speed has an influence. At low speeds, large fish are not exhausted by herding and can escape the net, and it is easier for smaller fish to escape through cod-end meshes. Square meshes suit round-bodied fish and diamond meshes suit fish with flattened bodies. The literature review has shown that there is an expanding body of work investigating the effect of mesh size and shape on cod-end selectivity in Mediterranean fisheries. To assess the merits of new mesh regulations for stock management and conservation, there is a need to relate changes in these parameters to the projected yield of the fisheries. Regulations on mesh size are easily circumvented by altering twine thickness and stiffness and netting panel dimensions. If it is proposed to introduce new regulations then information on these factors is needed to set realistic restrictions on cod-end construction.

Irrespective of the work being done to improve size selection in cod-ends, measurements of cod-end mesh selection in existing nets are required to define current fishing mortality rates for commercially important species and to estimate the age at first capture. Improvements in measurement technique would refine the accuracy of the estimates. Hooped covers are already in use in the Mediterranean to quantify cod-end selectivity and their more widespread use should generate more reliable data. The main difficulty in measuring cod-end selectivity parameters seems to be the relatively low catch rates per haul, requiring catches from several hauls to be pooled to derive selection curves. The variance of the parameters cannot be estimated but this is necessary information when studying novel cod-ends. Experienced statisticians should be involved in selectivity studies in the Mediterranean to investigate how best to analyse the data. More elaborate pooling methods have been suggested, such as combining catch data for species with similar morphology or of adjacent length classes. Bootstrapping is a new technique which might also be applied to this limited data. These ideas

should be tested on existing selectivity data from Mediterranean fisheries. With small catches, the use of trouser trawls to estimate selectivity is not likely to produce data amenable to analysis by the Millar method, but this also needs investigation.

Species separation within trawls can be achieved by having horizontal separator panels, sorting grids in the cod-end and different mesh shapes in the cod-end. Underwater observation is essential for developing these techniques in a fishery. Separator panels can only be installed sensibly in higher headline nets, as the typical low headline nets are unsuitable for this modification. This type of net should be tested in the Mediterranean fisheries. Grids are very suitable for separating shellfish from other kinds of fish, but can be blocked by large fish and debris. Different mesh shapes will preferentially select round or flat-bodied fish and could have advantages in some Mediterranean fisheries. The species separating potential of mesh shape needs more study. Since all these modifications make a net more complicated, costly or difficult to use, they can be unpopular with fishermen.

The survival rates of fish escaping through meshes is an important issue crucial to achieving real reductions in fishing mortality by introducing mesh size regulations. Study of this topic is not easy, usually requiring a diving team and the ability to capture escaping fish and to transport them to holding pens for observation (j-14). Such work can however, generate new knowledge of the capture process for many species and identify those most vulnerable to damage by mesh selection.

Recent progress on methods of deterring cetaceans from approaching both set nets and trawls justifies further work on the subject. Simple and cheap solutions will be the best for artisanal fisheries, but the price of acoustic "pingers" seems to be falling to levels at which widespread use might be possible. Extensive trials in commercial fisheries of the devices now available are required to encourage adoption by fishermen.

Given the diversity of gear and vessel types and sizes used by different fleets in the Mediterranean, a comparative study of the selectivity in each metier and its impact on the stocks could be valuable. This might reveal significant differences between metiers in gear selectivity and fishing mortality and thus identify the fisheries with the highest discard rates where improved methods would yield the highest dividends. The Norwegian application of the SELECT method (j-12) to compare catches by different gears (trawls, long-lines and gill nets) in the same fishery might be usefully applied to the multi-gear fisheries of the Mediterranean to investigate selectivity.

The papers comparing different types of trawl highlight differences in the catch composition. Differences in headline height, ground contact, bridle length and contact, wing construction, etc all influence the overall selectivity of a trawl. Continuation of this type of work to evaluate the performance of survey trawls could be instructive, especially catch variability due to environmental factors and sampling protocols (j-20). More knowledge of the catching performance of the common commercial trawls would also be useful to help assess their impact on the stocks. Traditional trawls can often select the target species efficiently, whereas larger trawls (as used in the North Sea) with faster towing speeds can be unselective. Trends in the design of trawls used in the Mediterranean should be monitored, to assess the effect on selectivity.

The introduction of new technical measures for fishing gear is only one approach to reducing fishing mortality. The existing approach of setting minimum landing sizes and imposing

closed area and seasons for certain fisheries reduces fishing effort and fishing mortality and these regulations should remain in force. Mesh size limits were not favoured in the past in the Mediterranean multi-species fisheries; one mesh size being suitable only for one or two species and not for others. The published work on new selective gear indicates however, that there is now widespread support from scientists in the Mediterranean countries for measures to reduce the by-catch in specific fisheries. Technical measures to improve selectivity and reduce discarding will only succeed if they have the support of the fishing industry. It is important to involve fishermen and industry organisations in trials of selective gear and to conduct many of these trials on chartered fishing vessels, to provide an immediate commercial assessment of the methods and to allow information to diffuse through the industry. It follows that economic studies of new management methods are required to support the introduction of more selective fishing gears.

Summary of the REPORT

COPEMED
Workshop on Fishing Gear Selectivity

Kerkennah, Tunisia

9 to 11 October 2001

The workshop was held on the Island of Kerkennah, Tunisia from 9 to 11 October 2001, co-ordinated by a FAO COPEMED consultant (Dr Peter Stewart).

Background and objectives

One of the main objectives of the project COPEMED has been, right from the beginning, to assist the Scientific Committees of the multilateral fisheries organisations on their decision making processes. The idea of this workshop arose as a response to a need for selectivity studies, expressed at the XXIV General Session of the GFCM, whose first goal would be to determine fish sizes at first capture then later to search for common regulations. At that meeting COPEMED decided to start compiling a bibliography for our area and to plan the organisation of a workshop to analyse the present status of Gear Selectivity Studies in the Mediterranean.

The organisation of this workshop is one step in the search for solutions that can be applied to our area to reduce the high mortality of non-target species and unwanted sizes of fishes and more widely to ensure the conservation and sustainability of our fisheries.

Programme

The workshop programme consisted of presentations by delegates of their current national programmes on fishing gear selectivity plus presentations by invited experts on:

- Review of published work on gear selectivity in the Mediterranean, and
- Review of methods used elsewhere to improve gear selectivity by Peter Stewart
- Selectivity data needed for Mediterranean fish stock asessment by Luis Gil de Sola
- Analysis of selectivity data by Rene Holst
- Interaction of cetaceans with fishing gears by David Goodson
- Techniques for underwater observation of fishing gears by Peter Stewart.

Recommendations

The delegates recommended that the following topics should have priority for study and funding in the future:

1) The collection of selectivity data for both commercially important and non-commercial species, caught by all types of fishing gears used in the different Mediterranean countries, with estimates of the variance of the selectivity parameters. Data collection methods should be standardised to aid comparability and new methods of analysis, eg bootstrapping, should be used in place of haul pooling to deal with the problem of low catch per haul for any species.

2) Investigation of gear selectivity in coastal/artisanal fisheries. The study of selectivity in regions with several different metiers would allow the selectivity of the various fishing methods to be compared and the least selective to be identified. This work would be suitable for a pilot project in a multi-gear fishery.

3) a) Investigation and monitoring of the sampling efficiency and selectivity of the trawls used in stock assessment surveys

   b) Techniques to separate species in towed gears should be developed to reduce the by-catch of unwanted species, eg grids within the net to separate crustaceans from fish

   c) Development and testing of devices to deter cetaceans from approaching nets is needed to reduce by-catch and gear damage.

4) In support of these proposals the group considered that progress could be made more rapidly by:

   a) Consulting the fishing industry and seeking their advice and co-operation
      when planning new projects to improve gear selectivity. This may assist the subsequent introduction of new management measures.

   b) Obtaining equipment to enable fish behaviour in fishing gears to be observed underwater. By understanding the processes of capture and escape for each species effective methods of selection can be developed more efficiently.

   c) Training of personnel in the study of fish behaviour and in the analysis of selectivity data. These methodologies are well developed and could be applied easily to Mediterranean fishery studies.

REFERENCES ON FISHING GEAR SELECTIVITY IN
THE MEDITERRANEAN
(with abstracts)

Compiled during 2001

References on Fishing Gear selectivity in the Mediterranean

This version of the Bibliography of studies on fishing gear selectivity in the Mediterranean contains the abstracts (in English) of the papers and reports, if available. The abstracts given for EU project reports and similar texts have been summarised.

The references are classified as already pointed out (see page 5)

a) General Documents and Papers

1) General Fisheries Council for the Mediterranean (GFCM). Sixteenth session, Rome, 27 September - 1 October 1982. Selected bibliography on Mediterranean fisheries (January 1978 - February 1982).
FAO-GCFM, Rome, Italy. 40 pp. Bibliogr.: 320 ref.
FAO GFCM/16/82/Inf-3 (GFCM1682Inf3)
English
The bibliography comprises 320 records which are grouped under the following headings: 1) practical aspects of fisheries; 2) aquaculture; 3) fishable stocks; 4) aquatic products and their utilization; and 5) marketing and economics of aquatic products.
Keywords: marine fisheries; bibliographies; MED-

2) Atlantic and Mediterranean fisheries management compared.
De Wilde, J.W.
Agricultural Economics Research Institute, The Netherlands.
Proceedings of the 9th annual conference of the European Association of fisheries economists EAFE. Editors: Boncoeur,J., Boude,J.P.; Rennes, France, ENSAR Halieutique, 1999, pp: 55-65.
English
Abstract: In a study commissioned by the European Commission a comparison has been made of fisheries management in the Mediterranean and in the Atlantic. The study concentrates on four major elements of fishery management: Stock conservation; Structural policy; Technical measures; Institutions and user participation. The main characteristics of each of these fields of management of the Atlantic and the Mediterranean fisheries are briefly described and subsequently compared. Conclusions are drawn on the implications for a Mediterranean CFP.
Key Words: Fishery management; Stock assessment; Fishery policy; Fishery regulations; Technology; Mesh selectivity; Fishing gear; Fishing vessels; Season regulations; ANE, Spain.

3) Report of the Technical Consultation of the General Fisheries Council for the Mediterranean on Fishing Technology and its Socio-Economic Aspects, Ancona, Italy, 20-22 March 1986.
FAO-GCFM. Rome, Italy. 1986. no. 358, 86 pp. ISBN 92-5-002456-8
English

Abstract: This meeting, the first of its kind to be organised by the GFCM, reviewed the problems relating to fishing gear and vessel technology, emphasis being placed particularly on energy costs, selectivity, small-scale fisheries and socio-economic aspects. Abstracts of the papers included as annexes are cited individually.
Keywords: Marine fisheries; fishery technology; conferences; fishery development; sociological aspects; MED.

4) Regulation des maillages dans les pecheries au chalut. Consequences biologiques et economiques. Application a la Mediterranee: Etude des problemes lies a la reglementation du maillage des chaluts dans le Golfe du Lion.
Dremière, P-Y.
Rapport final, Convention CEE-ISTPM/IFREMER: 29pp+annexes. Year ?
French

5) Some basic characteristics of Croatian marine fisheries and its legal regulation.
Cetinic, P and Soldo, A.
Acta Adriat., 1999, 40 (suppl): 91-97,
English.
Abstract: Any competent discussion of the bio-diversity and management of marine living resources of the Adriatic Sea requires, at least, basic information on the basic characteristics of Croatian marine fisheries. This paper presents the types and quantities of fishing gear and equipment used in Croatia, and the legal provisions regulating their use.
Keywords: Fisheries, fishing gear, Croatia.

b) Cod-end Mesh Selection for Demersal Fish Species

1) The selectivity of certain trawl cod-ends in Cyprus.
Livadas, R.J.
Minist. Agric., Dep. Fish., Nicosia, Cyprus
Report of the 2nd GFCM Tech. Consult.on Stock Assessment in the Eastern Mediterranean, Athens (Greece), 28 Mar- 1 April1988
Editors: Savini, M.; Caddy,-J.F.1989. FAO no.412 pp.180-189.ISBN-92-5-002813-X
English
Abstract: Mesh selectivity experiments on trawl cod-ends were carried out by the Department of Fisheries in September 1970 on a chartered commercial trawler. The purpose was to estimate the selectivity of two new trawl cod-ends, with a mesh opening greater than the one currently in use by the trawl fishery in Cyprus (32 mm). Average selection factor for the 34 mm cod-end for the 4 species: Mullus barbatus, M. surmuletus, Pagellus erythrinus , and Maena smaris are in the range of 2.80-3.75 and for the 40 mm cod-end for Maena smaris and Mullus barbatus , in the range of 3.40-3.88.
Keywords: trawl nets; mesh selectivity; fishery management; Mullus barbatus; Mullus surmuletus; Pagellus erythrinus; Maena smaris; MED-Cyprus.

2) Contribution to the knowledge on the short and long-term effects of the application of 40 mm cod-end mesh size in Adriatic trawl fishery-eastern Adriatic coast.
Jukic, S.; Piccinetti, C.
Inst. Oceanogr. and Fish., Split, Yugoslavia
Report of the 5th Tech. Consult. of the General Fisheries Council for the Mediterranean on Stock Assessment in the Adriatic and Ionian Seas, Bari (Italy), 1 Jun 1987. Editors: Caddy, J.F.; Savini, M. FAO GCFM, Rome, Italy,1988.No.394 pp. 282-290. ISBN 92-5-002677-3.

English
Abstract: The findings are presented of experiments conducted to evaluate the effects of using 40 mm cod end mesh size in the trawl fishery off the eastern Adriatic coast. Economic effects on the fishery are discussed in particular, and management implications considered.
Keywords: coastal fisheries; trawl nets; gear selectivity; fishery management; MED-Yugoslavia.

3) Protection of silver hake (Merluccius merluccius L.) population in the Adriatic Sea with regard to cod-end selectivity studies.
Granic, B.; Jukic, S.
Inst. Oceanogr. Fish., Split, Yugoslavia
Simpoziju o Aktualnim Problemina Ihtiologije i Ribarstva, Plitvice (Yugoslavia), 1980
Acta. Biol. Iugosl. E Ichthyol. 1982. vol. 14, no. 1, pp. 1-11. ISSN 0579-7152
Serbo-Croat
The paper deals with cod-ends mesh size selectivity experiments in connection to silver Hake (Merluccius merluccius (L.) population in the Adriatic sea undertaken by research vessels "Bios" (300 hp) and "Predvodnik" (240 hp) along the eastern Adriatic coast. Type of covered cod-end selectivity experiments were only carried out with synthetic cod-ends (210/18 Den) with knots of: 41,4 mm; 55,2 mm and 64,6 mm stretched mesh size.
Keywords: trawl nets; gear selectivity; Pisces; Merluciidae; Merluccius merluccius; marine fisheries; oxidation; MED-Adriatic.

4) On the selection of Upenelus molluccensis and Mullus barbatus by trawl cod-end in Israel fisheries.
Gillat, E.
Proc. Gen. Fish. Counc. Med. 1961. Vol 6: 93-106.

5) Cod-end mesh size effect on Italian otter trawl efficiency.
Koura, R., 1969.
Stud. Rev. Gen. Fish. Counc. Mediterr. No. 39: 13 – 21.

6) Mesh Selection Study of the Commercial Trawl Fishery.
Tsimenidis, N. and Petrakis, G.
7th Congress of the Greek Biological Society. 1985.
Greek
Abstract: Cod-end mesh selection studies were conducted aiming to provide a suggestion on whether an increase of the cod-end mesh size from 14 to 20 mm (knot-to-knot) should be enforced. The 50% retention length ranged from 9.1 to 16.7 cm and the selection factor from 2.47 to 4.54. It is suggested that an increase of the cod-end mesh size should be considered.
Keywords: selectivity, cod-end.

7) Selectivity of the Trawl Net on the Slope (250-750m) of the Ionian Sea (Central Mediterranean Sea).
D'Onghia, G., Mastrototaro, F., Maiorano, P. and Basanisi, M.
Biol. Mar. Medit. (1998), 5(2): 437-448.
Italian
Abstract: Data on trawl net selectivity by means of "covered cod-end method" were collected during three surveys carried out in the north-western Ionian sea. Apart from small specimens of Phycis blennoides and Plesionika martia, the 40 mm mesh size was not selective for Aristeus antennatus, Aristaeomorpha foliacea and the associated species in the catch, such as

Merluccius merluccius. Selectivity of 60 mm mesh size changed according to the season. The size at first capture (L_{50}) was 23.7 (SF = 0.40) for aristeus antennatus and 19.5 (SF = 0.32) for Aristaeomorpha foliacea. Even for mesh size of 60 mm the size at 50% of retention still remains much smaller than the size at first maturity of the target species of deep water fishing (250~750 m).
Kewords: Trawl surveys, deep water resources, selectivity, Ionian Sea.

8) Selectivity of a Commercial Bottom Trawl Net in the Tuscan Archipelago (Northern Tyrrenhian Sea).
Sbrana, M., Biagi, F., Sartor, P. and De Ranieri, S.
Biol. Mar. Medit. (1998), 5(2): 449-456.
Italian
Abstract: The selectivity of a commercial bottom trawl net in the Tuscan Archipelago was studied by the covered cod-end method. Specific composition and abundance of the catches in the cod-end and in the cover were compared. The percentage of retention and selectivity parameters for the main species of fish, crustaceans and cephalopods were analysed.
Keywords: selectivity, bottom trawl, hake, poor cod, Tyrrhenian Sea.

9) Selectivity Estimates for Mullus barbatus obtained with different methods and some considerations on their validity.
Voliani, A and Abella, A.
Biol. Mar. Medit. (1998), 5(2): 457-564.
Italian
Abstract: The estimation of cod-end mesh selection of an Italian bottom trawl net for Mullus barbatus (Mullidae, Osteichthyes) was done with two different approaches. The first one, was the so-called "covered cod-end technique". Six experimental hauls were done in areas and periods considered suitable for the above mentioned goal. A cover with a 16 mm stretched mesh size was positioned around the 38 mm mesh sized cod-end. The length composition of the individuals retained in the cod-end and of those passing into the cover were compared. This allowed fitting of a selection ogive and to estimate the length at first capture that resulted as 9.3 cm. A selection range of 8.5~10 cm and a selection factor of 2.44 were also estimated.
The second was an indirect approach, based on the analysis of the partially recruited portion of the catch curve. Data come from trawl-surveys performed in June and November 1994 and in June and October 1995. This methodology did not give reasonable results probably because it is not suitable for the estimation of selectivity of fast growing species, such as red mullet, whose exploitation starts early in their life cycle.
Keywords: Selectivity, Mullus barbatus, Northern Tyrrhenian Sea.

10) Trawl Selectivity in Merluccius merluccius on the basis of experiences reported in the literature.
Fiorentino, F., Zamboni, A. and Relini, G.
Biol. Mar. Medit. (1998), 5(2): 465-474.
Italian
Abstract: A set of published data concerning trawl selectivity in European hake was elaborated in order to estimate reference selection ogives for some critical cod-end mesh sizes. Firstly, a significant linear regression connecting the 50% retention length (L_{50}) to the opening of mesh size ($L_{50(cm)}$ = 0.4686 $MS_{(mm)}$ - 5.7792; n = 63; R^2 =0.9004) was found. Secondly, a second order polynomial regression was identified in order to relate the 50% retention length to the selection range (D) in the selectivity curve (D = 0.0145 $(L_{50})^2$ – 0.1063 (L_{50}) + 1.9796; n = 18; R^2 = 0.9004). Since it is possible to calculate the selection ogive

knowing L_{50} and D, these empirical relationships were finally used to estimate reference selection curves for different mesh sizes which are critical for Mediterranean hake fisheries. It is suggested to use these calculated selection vectors to stimulate changes in hake exploitation patterns. It is also possible to employ these vectors for standardising the left part of the length frequency distributions obtained by data collected during trawl surveys where trawlers used different mesh size cod-ends.

Keywords: Hake, Mesh opening, Length at first capture, Selection range, Selection ogive models.

11) Selectivity and Vulnerability of Hake in the Bottom Trawl Fishery.
Abella, A.J. and Serena, F.
Biol. Mar. Medit. (1998), 5(2): 496-504.
Italian

Abstract: A vector of selectivity/vulnerability by size for hake related to the traditional Italian bottom trawl net was constructed. Mesh selection experiments allowed definition of a selection ogive model for hake. The model, however, does not apply over a certain size because the probability of capture of larger individuals of the species declines with size. For older individuals, a vector of vulnerability-at-size based on F-at-size estimates obtained from trawl surveys catch structure was estimated and successively combined with the selection ogive. It is assumed here that the inclusion of this new vector in assessment models will produce more realistic results.

Keywords: selectivity, vulnerability, hake, stock assessment

12) Selectivity of an "Italian" trawl net in the southern Tuscan Archipelago.
Sbrana, M. and Sartor, P.
DSAT, University of Pisa and CIBM, Livorno.
EU Contract No. MA 3-621. Final Report 1994: 227-231.

Abstract: Within the research programme "FARWEST2" (MA 3-621), financed by DGXIV (fishing sector) of the European Economic Community, a research cruise to evaluate the selectivity of a trawl net of "Italian" type in the waters of the Southern Tuscan Archipelago (Western Mediterranean) was carried out. The cover-end method was used, employing a net with 34 mm cod-end mesh size as commonly utilised by some boats of the local fishing fleet. The specific composition and abundance of the catches obtained in the cod-end and in the cover-end were compared. The curves and parameters of selectivity for the hake, Merluccius merluccius, a species very important in this area was estimated: the length at 50% retained was 7.7 cm and the selectivity factor was 2.27.

Keywords: Selectivity; Merluccius merluccius; hake; trawl nets; Tuscan Archipelago.

13) Selection parameters for red mullet (Mullus barbatus L., 1758) in bottom trawl nets.
Tokaç, A., Tosunoglu, Z.
II International Symposium on Aquatic Products, Istanbul, Turkey, 1996. Istanbul University Journal of Aquatic Products, Special Issue, 1999: 517-534.
Turkish

Abstract: In this study, the aim was to determine the selection parameters of red mullet (Mullus barbatus L, 1758) in relation to its size and shape. This species is caught by bottom trawls in the summer and winter periods. The study was carried out in two different seasons to assess the effect of seasonal variation on selection. A series of experimental trawl hauls was carried out by R/V Egesüf in Gülbahçe Bay located in Izmir Bay in 1994. As a result of measuring 320 individuals chosen at random from the cod-end during summer, the average fork length and total length of red mullet were found to be 13.81±0.11 cm and 15.58±0.13 cm

respectively. On the other hand, the average fork length of the 323 individuals measured in winter was 14.87±0.10 cm. The average dorsal height was 3.16±0.03 cm in the summer and 3.35±0.02 cm in the winter. The girth was 8.76±0.06 cm. The 50% retention length, selection factor and selection range of red mullet in the winter were found to be 12.81 cm (fork length), 2.91 and 2.06 cm, respectively. The same selection parameters were 13.44 cm (fork length), 3.05 and 4.68 cm, respectively in the summer. The selection curves obtained separately from the length, dorsal height and girth data for red mullet showed a great similarity and there was also a linear relationship between length and girth.

Key words: Trawl, selectivity, Mullus barbatus, girth, dorsal height.

14) Selectivity of a trawl with a cod-end of 20 mm mesh for whiting (Gadus merlangus euxinus).
Erkoyuncu, I. and Samsun, O.
E.U. Journal of Fisheries and Aquatic Sciences, 1989, 6: 96-101.
Turkish

Abstract: In this study, L_{50} was found to be 15.7 cm. for whiting (Gadus merlangus euxinus) taken in two one-hour hauls by a trawl with a cod-end of average mesh size 20 mm. The selection range was 2.2 cm. and the selection factor 7.85. It is concluded that the minimum size limit can be useful in whiting fishing to protect small fish.
Keywords: Gadus merlangus euxinus, trawl, mesh selection.

15) Selectivity of demersal trawls for red mullet (Mullus barbatus L.).
Gurbet, R.
PhD Thesis. Ege University, Graduate school of natural and applied sciences, Department of fisheries and processing technology, Bornova, Izmir, Turkey. 1992. 149 pages.
Turkish

Summary: In this study, two bottom trawls, one with high opening and the other a Foça type trawl were used. The trawl with high opening was a two seamed net and the other a four seamed net. Cod-end mesh sizes of 36, 40, 44 and 48 mm were tested on these trawls. A small mesh cover was used to collect the fish which escaped from the cod-end. The selective effect on striped mullet was studied by comparing the sizes of fish inside and outside the cod-end. The findings were as follows: 44 mm mesh gave the best selection for the striped mullet among the various mesh sizes; cod-ends with 36 and 40 mm mesh size harm the stock by retaining undersized, immature fish; 48 mm mesh selects larger fish older than 3 years (L_{50} =17.50 cm) and some marketable fish escape. L_{50} was found to be 11.16 cm for the Foça type trawls. These nets catch fish 1 year old and over. They are made of misina and are less flexible than other polyamide nets. Therefore the selection length is smaller for a given mesh size than in other nets. The selectivity of Foça type trawls should be increased to protect the stock.
Keywords: Mullus barbatus, mesh selection, high opening and Foca trawls.

Associated references:
a) Investigation of the selectivity of different demersal trawl gears. Gurbet, R.
Ege University, Research Fund Project, 1993. No. 1990 S.Ü.F.A. 003, Bornova-IZMIR, 86pp. Turkish
b) A study of the selectivity of cod-ends of different mesh sizes on trawl nets for the protection of the demersal fish stocks. Gurbet, R.
I. National Ecology and Environment Congress, Izmir, 5-7 October, 1993. Turkish

16) Preliminary Results of Selectivity Experiments Performed in the Gulf of Tunis with the Tunisian Type of Mediterranean Trawl and the Shrimp Trawl.
M'Rabet, R.
Bull. Inst. Nat. Scient. Techn. Oceanogr. Pêche de Salammbô, 1994, 21: 24-29.
French

Abstract: The selectivity of the Tunisian type of Mediterranean trawl and of the shrimp trawl have been studied in the Gulf of Tunis on board the research vessel HANNOUN. The results obtained in the course of this study show that the selectivity of these trawls is poor, since the 50% lengths of the most abundant species in the catches, obtained by these trawls are mainly less than the size of maturity of these species. As a consequence of the selection factors for these most important commercial species, obtained during this study and the sizes of maturity of these species, the minimum mesh size of bottom trawls used in the Tunisian fisheries should be raised made equal to 48 mm.
Keywords: Trawls, mesh selection.

17) A comparison of the selectivity of Turkish and Italian bottom otter trawls.
Erdem, Y.
MSc. Thesis, Ondokuz Mayis Üniversitesi, Fen. Bil. Enst., Sinop, 46pp.
Turkish

Abstract: The purpose of this work was to compare the selectivity of Turkish and Italian bottom otter trawls with 18 mm cod-end mesh sizes for whiting (Gadus merlangus euxinus, Nord. 1940). The origin of both nets is the Mediterranean type bottom otter trawl, however, there are some differences in the cutting method and the mesh size of the belly. As a result, the 50% retention length, selection range and selection factor were determined as 13.0 cm, 4.0 cm, 7.222 and 14.7 cm, 3.2 cm, 8.167 for the Turkish and Italian trawls, respectively.
Key words: Bottom trawls, mesh selection, Gadus merlangus euxinus.

18) Measurement of the selectivity parameters of cod-ends in bottom trawl nets.
Tokaç, A.
E.Ü. Journal of Fisheries and Aquatic Sciences, 1993. 10: 223-246.
Turkish

Abstract: In this study the selectivity parameters and selection curves for 18 and 22 mm mesh size cod-ends on trawl nets were determined using the covered cod-end method. Fishing trials were conducted in Güzelbahçe Bay, in the western part of Izmir Bay, from 15 February – 15 March 1993 with a two-seam otter trawl on the vessel Hippocampus (16.5 m, 135 HP). Selectivity parameters and curves were derived by regression analysis. The results shoved 22 mm mesh cod-ends to have a much better selectivity than 18 mm mesh cod-ends for Mullus barbatus and Pagellus erythrinus, but no significant difference for Pagellus acarne.
Keywords: Mullus barbatus, Pagellus erythrinus, trawl, mesh selection.

19) A comparison of the selectivity of different mesh sizes using a bottom trawl with a divided cod-end.
Tokaç, A., Lök, A. and Metin, C.
E.Ü. Journal of Fisheries and Aquatic Sciences, 1993. 10: 257-274.
Turkish

Abstract: In the trawl fishery, many juvenile fish smaller than commercial size are caught with adult fish and discarded at sea. Most of these discarded juveniles are dead. To reduce the amount of discards at sea, Turkey has taken some measures like other countries in the world. Recently the minimum mesh size of trawl cod-ends was increased from 18 to 22 mm. In this study, we aimed to reveal the selectivity differences between the 18 mm mesh size used

before and the 22 mm mesh size now used. Also the effects of catch size and the composition on the cod-end selection were investigated. The study was carried out in Güzelbahçe Bay, the western area of Izmir Bay, in January, February and March 1993 by using an experimental bottom trawl. In this trawl a vertical panel in the cod-end was used for dividing the cod-end into two equal parts. The mesh sizes compared were 18 and 22 mm. It was observed that the 22 mm cod-end was more effective than the 18 mm cod-end for the protection of immature fish. However, it was found that mesh selection depended on fish body shape and fish behaviour.

Keywords: Trawl cod-end selectivity, trouser cod-end.

20) Efficiency and Catch Composition of a Turkish Bottom Trawl with Cod-ends of Different Mesh Sizes.
Erkoyuncu, I., Erdem, Y., Samsun, O.
E.Ü. Journal of Fisheries and Aquatic Sciences, 1995.12: 117-124.
Turkish

Abstract: In this study, the catch size, catch composition and selectivity of a Turkish trawl with cod-ends of 16, 18, 20 and 22 mm. mesh sizes for whiting (Gadus merlangus euxinus Nord.1940) were investigated. The work was carried out on commercial trawlers in the fishing areas of Sinop. The catch weights, 50% selection lengths (L_{50}), selection ranges (SR) and selection factors (SF) were determined as 545 kg, 12.51 cm, 3.39 cm, 7.82 for 16 mm; 552 kg, 14.47 cm, 4.01 cm, 8.04 for 18 mm; 400 kg, 16.21 cm, 3.84 cm, 8.11 for 20 mm; 342 kg, 17.59 cm, 3.92 cm, 8.00 for 22 mm cod-end mesh sizes respectively.
Key Words: Cod-end selectivity, bottom trawl, Whiting (Gadus merlangus euxinus)

21) The Effect of an Increase in Mesh Size on the Selectivity of the Shrimp Trawl used in the Tunisian Fisheries [for red mullet and hake].
M'Rabet, R.
Bull. Inst. Nat. Scient. Techn. Oceanogr. Pêche de Salammbô, 1998, 25 (in press).
French

Abstract: The study of the influence of cod-end mesh opening on the selectivity of the Tunisian shrimp trawl [*for fish species*] has been carried out in the Gulf of Tunis on board the research vessel HANNOUN. Comparison of the selection parameters of the traditional cod-end used by Tunisian fishermen (40 mm mesh opening) with the parameters obtained for a cod-end of 48 mm mesh has produced evidence of an improvement in the selectivity of the shrimp bottom trawl. The mesh size increase of 8 mm is not enough because the L_{50} of the two most abundant species in the catches, known as red mullet ($L_{50} = 13$ cm) and the whiting ($L_{50} = 14.3$ cm) are less than the sizes of sexual maturity (L_m) for these two species which are respectively 14.6 cm and 28.9 cm.
Keywords: Shrimp trawl, selection parameters, red mullet, whiting, Gulf of Tunis.

22) Cod-end selectivity measurements made within the EU Project: Development of a predictive model of cod-end selectivity (PREMECS).
Fiorentini, L et al.
Final Report 1999. Abstract compiled from the text of the report.
English

Abstract: The selectivity parameters of four cod-ends, varying in mesh size and meshes round the circumference were measured using the covered cod-end technique on a typical Italian commercial trawl in the Adriatic Sea. The mesh sizes tested were 24 and 28 mm bar length and the nominal circumferences were 6.7 and 7.8 m. The cover mesh bar length was 10 mm. Measurements were made in 1998 at a depth of 16 m and in 1999 at depths of 130 to 250 m.

In 1998, selectivity data were obtained on red mullet (Mullus barbatus), common pandora (pagellus erythrinus), squid (Loligo vulgaris) and cuttlefish (Sepia officinalis). In 1999, selectivity data were obtained on hake (Merluccius merluccius), blue whiting (Micromesistius poutassou), poor cod (Trisopterus minutus capelanus), Norway lobster (Nephrops norvegicus), red mullet (Mullus barbatus) and broadtail squid (Illex coindetti). In some hauls red mullet and hake dominated the catch. The 50% retention lengths were significantly different between test cod-ends and confidence limits were obtained for the parameters. Keywords: cod-end selectivity, mesh size, circumference, Adriatic.

23) Datos de selectividad obtenidos durante la Campana MERSEL 1091.
Gil de Sola, L.
Doc. Int. IEO (1991), Madrid. 21pp.
Spanish

24) Trawl selectivity in the western Mediterranean and the Adriatic Sea fisheries.
Gil de Sola, L.
EU Contract No. MA 3-621. Final Report 1994: 216-226.
Spanish

25) Results of selectivity experiments with different trawls on more important Adriatic demersal fish.
Ferretti, M. and Froglia, C.
Quad. Lab. Technol. Pesca. 1975. Vol. 2 (1): 3-16.

26) Compte rendu d'experiences de selectivite .
Jukic, S.
Rapp 3eme ess. Groupe du travail CGPM, Rome. Dec. 1971: 22-24.
French

27) Selectivita e capacita di cattura di una rete a strascico di tipo Italiano su popolazioni di Mullus barbatus L.
Froglia, C and Galli, B.
Quad. Lab. Technol. Pesca 1(1): 3-20, Ancona. 1970.
Italian

c) Gear Selectivity for Shellfish

1) Trawl selectivity studies on Nephrops norvegicus (L.) in the eastern Mediterranean Sea.
Mytilineou,C.; Politou,C.Y.; Fourtouni,A.
National Centre for Marine Research, Greece.
Scientia Marina Barcelona 1998, vol. 62, pp. 107-116. ISSN 0214-8358
English
Abstract: The trawl cod-end selectivity on Nephrops norvegicus was studied using diamond meshes of 16 mm, 20 mm, 24 mm and 26 mm nominal side mesh size. The cover cod-end method was applied for the sampling. The logistic function for the probability of retention by the cod-end was used for the estimation of selectivity parameters from all data combined. The results indicated that the 16 mm mesh size was not selective and that almost all individuals were retained. The 24 mm and 26 mm mesh size showed quite similar results and were a little more selective than the 20 mm mesh size. None of the experimental mesh sizes proved to be adequate for N. norvegicus, since all estimated values of length of 50% retention (L50) were

lower than the length at first maturity and those of length of 25% retention (L25) were lower than the legislated minimum landing size. It is suggested that mesh size should be much larger than 20 mm, the size legislated by E.U. for the Mediterranean.

2) Selectivity of Norway lobster Nephrops norvegicus (L.) in the northwestern Mediterranean
Sarda, F.; Conan, G.Y.; Fuste, X.
Inst. Cienc. Mar, Spain
Abstract: The selectivity of trawl mesh sizes of 38, 42, 45, 52, and 60 mm on Norway lobster (Nephrops norvegicus) in the Western Mediterranean was analysed. An outside cod-end liner and replications of hauls were used to fit logistic curves to the percentage retention for each size class. The results were analysed separately by haul and for all hauls combined for each mesh size using linear regression analysis and the maximum likelihood method, which yielded uninflected selectivity curves for Nephrops norvegicus. The results indicated that the 38-mm mesh captured practically all size classes. The 42 and 45 mm meshes also captured sizes whose L50 values was less than the size at first maturity. The 52 mm mesh yielded better results, which was nearly the size at first maturity. The 60 mm mesh permitted escapement of all first-spawning individuals, though the curve was too flat to be effective. The results of the different fits were discussed and related to such biological aspects as the sex ratio, size frequency, and size at first maturity. Based on the behaviour of the selectivity curves in the Norway lobster fishery in the Western Mediterranean, regulation of mesh size would not appear to be an optimum means of fisheries management.

3) Trawl gear selectivity and the effect of mesh size on the deep-water rose shrimp (Parapenaeus longirostris, Lucas, 1846) fishery off the gulf of Cadiz (SW Spain)
Sobrino, I.; Garcia, T.; Baro, J.
Instituto Español de Oceanografia, Cadiz, Spain;
Abstract: The deep-water rose shrimp (Parapenaeus longirostris, Lucas, 1846) is a typical shrimp which is one of the main target species in the demersal fishery in the Spanish south Atlantic region. In this paper, the selectivity parameters of this species have been studied in two different selectivity survey designs (research vessels and in commercial fishing vessels). We have found 2 mm difference between both methods in the 50% retention length (L_{50}). The selection factors obtained from the oceanographic vessels range from 0.37 to 0.49, while those from the commercial vessels are lower, from 0.32 to 0.39. The effects of mesh size changes in the present exploitation pattern are also considered. The present exploitation pattern is far from optimal due to an overexploitation of the smaller sizes. The different simulations of changes in mesh size do not show great differences in maximum sustainable yields, but important market variations occur above 30% and 50% over the present obtained values. In reference to the immediate effects which could produce an increase of the mesh size, losses of 36%, 51% and 62% for the referred mesh sizes (50, 55 and 60) using the selectivity parameters obtained from the surveys of research vessels are estimated. If obtained

from the surveys of the commercial vessels, these values correspond, respectively, to 27%, 42% and 73%.

4) Domestic wastes and the Nephrops norvegicus fishery in the Strait of Sicily.

Ragonese, S.; Rizzo, P.; Giusto, G.B.
Istituto di Tecnologia della Pesca e del Pescato, Mazara (TP), Italy

Abstract: Litter and Norway lobster (Nephrops norvegicus) specimens caught during a trawl survey in the Strait of Sicily were recorded. In 46 hauls, 2034 specimens and 349 waste items were counted.

5) Study on the efficiency of a turbo-pump dredger and the its effect on the benthic community.

Vaccarella, R.; Pastorelli, A.M.; Marano, G.
Lab. Biol. Mar., Bari, Italy

Abstract: The fishery of baby-clams (Chamelea gallina) and of other species of bivalve molluscs on the soft bottoms is carried out by dredges which take the molluscs from the bottom by means of a jet of water under pressure. Research carried out in 1988, showed that those gears have an effect on the benthic communities by upsetting the bottom, caused by the high pressure water jets from the nozzles surrounding the opening on the dredge, and the collection of organisms, according to the selectivity of dredge. After the passage of the dredge, some time is necessary for the texture of the substratum to reform. The recolonisation of the same area is carried out by worms in particular. For both the habitats concerned (beds of Ensis minor and of Chamelea gallina) it is possible to assume that between thirty and sixty days is sufficient to restore the original fauna.

6) Estimated retention rates by bar sieves for Venus verrucosa L. (Bivalvia: Veneridae).

Bello, G.
Lab. Prov. Biol. Mar., Bari, Italy

Abstract: In the southern Adriatic Sea the clam Venus verrucosa is collected by hydraulic dredges with bar sieves. This kind of sieve selects the bivalves by their width, a dimension with wide variability. Knowing the curvilineal regression equation between width (w) and length (l), the log-normal distribution of the values was verified on a sample of 565 specimens. It was calculated that, in order to avoid catching any undersized clam, 2.5 cm being the legal size, the bar sieve gap should be equal to 15.8 mm.

7) Contribution to the knowledge of Donax trunculus (Bivalvia) of the Versilia shores: Technological, commercial and statistical aspects of its fishery.
Baldaccini, G.; Bianucci, P.
Unita Sanitaria Locale 3 "Versilia", Viareggio, LU, Italy
15th Congr. della Societa Italiana di Biologia Marina, Trieste (Italy), 28 Sep 1983
Nova Thalassa. 1984. vol. 6 suppl, pp. 441-449.
Italian

Abstract: The fishery of Donax trunculus clams (arselia) on the shores of the Alto Tirreno Sea (Versilia, 44 degree N), is described. Some considerations about the dimension of the modal commercial size are presented. Results of selectivity trials made in the laboratory with different sieves are summarised and compared with the selectivity of those used in the fishery and the regression line of the species. The need for a regulation in the fishery for these molluscs is pointed out and the minimum size to be collected is suggested.
Keywords: clam fisheries; gear selectivity; Donax trunculus; fishery regulations; fishery data; MED-Italy-Versilia.

8) Study of the Selectivity and Assessment of the coefficient of retention of the trawl nets used for red shrimp fishing (Aristaeomorpha foliacea Risso, 1827 and Aristeus antennatus Risso, 1816; Crustacea – Aristeidae) in the Scicilian Channel.
Ragonese, S et al.
Project MED 92/010:1-98. 1995.

9) Modelisation de la selectivite des chaluts a langoustine (Nephrops norvegicus) du type "bou" catalan.
Conan, Y.G. and Sarda, F.
ICES CM 1991/D:16.
French

Abstract: The cod-end of a commercial fishing trawl, called "Bou" in Catalonia is usually closed at its rear end by twine sewn transversely into the meshes instead of being gathered inside the loop of a cod-end knot. An experiment was designed by F Sarda aboard commercial trawlers in order to investigate the particular type of selectivity of the "Bou" trawl. Commercial trawls were equipped with cod-ends made of different types of meshing, and covered with a false cod-end made out of fine meshing. The data on number of individuals retained within the cod-end and within the cover vs carapace size of Nephrops, were first analysed using contingency tables. Interactions between multiple factors were tested at levels two and three, in order to test for effects of tow number or sex on the retention within each mesh size category, and selectivity models were fitted by weighted linear least squares and by Log likelihood. A great variability was observed for the same mesh size as a function of haul number, the effects of selectivity at size tested by contingency tables usually differ significantly between hauls. The ranges of haul specific selectivity effects widely overlap for different mesh sizes, and it eventually occurs that a larger mesh size is on the average more efficient in retaining small individuals than a slightly smaller one. Selectivity curves do not fit a logistic or a cumulative mesh size due to a lack of inflexion point. At any given mesh size M, a good fit was obtained for a model of the type $R = 1 - 1/(exp(a(S - S_o)))$ where R is the proportion retained in the cod-end, S is the carapace length of an individual and S_o is the smallest size that may be retained by the cod-end. The parameter S_o does not vary much as a function of mesh size, while a increases with mesh size, this results in a flattening of the curves as mesh size increases. However, it was not possible to generalise the model in the form $a = f(M)$ due to a great variability in the results generated by uncontrolled factors independent from mesh size M. Practical conclusions are that it is not possible to define a

mesh size allowing 100% escape of individuals of sub-legal size: at large mesh sizes a high proportion of legal size individuals still escapes while numerous individuals of sub-legal size are still caught. These observations are quite similar to those of other authors describing selectivity of different types of Nephrops trawls, however the lack of an inflexion point in the selectivity curve of the "Bou" trawl shows that the effect is minimised in the latter cases. This peculiar selectivity curve may result from the particular method used for closing the rear end of the cod-end.

Keywords: Nephrops, cod-end selectivity, Bou trawl.

d) Selectivity of Novel Cod-ends

1) Selectivity of square and diamond mesh cod-ends in Hellenic waters.
Stergiou, K.I., Petrakis, G., Politou, C-Y., Karkani, M., MacLennan, D.N. and Ferro, R.S.T.
Final report on EU Contract XIV-I/ MED 92/020, November 1994. 54pp.
English

Abstract: In the present study, we compared the selectivity as well as the overall performance of the presently used, in Hellenic waters, 14 mm (knot-to-knot) diamond shaped cod-end (14D) with those of 20 mm square shaped (20S) and 20 mm diamond shaped (20D) cod-ends. This information is provided for the first time for Hellenic and E.Mediterranean waters. The present study was based on samples collected with a chartered professional trawler at five stations in the Trikeri Channel in October 1993 and at seven stations in the North Euboikos Gulf in March 1994, at depths ranging between 73 and 210 m. For the investigation of cod-end species overlap, Bray-Curtis similarity matrices of numbers and weights per hour of trawling of each species from each cod-end and station were compiled and subjected to both clustering and non-metric multi-dimensional scaling. Cod-end selectivity was estimated for six commercially important demersal species (Merluccius merluccius, Micromesistius poutassou, Trisopterus minutus capelanus, mullus barbatus, Nephrops norvegicus and Lepidorhombus boscii) as well as for four non-commercial ones (Gaidropsarus mediterraneus, Gadiculus argenteus argenteus, cepola macrophthalma and Symphurus ligalutus) using the covered cod-end method (cover: diamond-shaped, 10 mm mesh size, 10D). The selectivity of the cod-end was determined from the linear logistic function and selectivity estimates were derived from pooling the data over all hauls and seasons.

Keywords: trawls, selectivity, square and diamond mesh, Mediterranean.

2) The effects of different cod-end design on bottom trawl selectivity in Turkish fisheries of the Aegean Sea.
Lok, A, Tokac, A, Tosunoglu, Z, Metin, C, Ferro, R.S.T.
Aegean University, Faculty of Fisheries, Dept of Fishing and Processing Technology, Bornova, Izmir, Turkey.
Fisheries Research, 32 (1997): 149-156.
English

Abstract: The effect of different cod-end designs on bottom trawl selectivity was studied using the hooped cod-end cover method. The selectivities of three different cod-ends: standard, 15% shortened lastridge rope and narrowed circumference (to 120 mesh from 150 mesh), were measured for red mullet (Mullus barbatus L. 1758) and annular sea bream (Diplodus annularis L. 1758) in Turkish territorial waters of the Aegean Sea in June and September 1994. Selection curves and selection parameters were calculated using a logistic model. 50% retention lengths and selection factors for red mullet were higher for the shortened lastridge rope case and narrow cod-end than the standard cod-end. There was no significant difference for annular sea bream. This can be explained by the body shape

differences of the two species. The effects of different cod-end designs on the selectivity are discussed.

Keywords: Trawl selectivity; cod-end design; Shortened lastridge rope; Narrowed cod-end.

3) Selectivity of Square Mesh Windows in Fish and Nephrops Trawls.
Catalano, B. and Smith, C.
IMBC, Iraklio, Crete, Greece.
Final Report on EU Study Contract 1994/084. Chapter 4: Report of the work done by the Institute of Marine Biology, Crete, Iraklio. pp: 118-128.
Abstract: The Greek studies measured the selectivity of hake (Merlucius merlucius) and other by-catch species in the mixed fishery in the southern Aegean Sea. The effect on selectivity of two changes to the standard design of demersal trawl was assessed. A window of 52 mm white mesh was inserted in the top panel of the extension. A cod-end mesh size of 26 mm (the present minimum mesh size) was used in addition to the agreed 40 mm. A wide range of species were caught but it was found that few fish escaped through the square mesh window into the window cover, possibly because of the need for greater swimming ability than most of these small fish possessed. Cod-end selectivity was estimated from the pooled data for all hauls for each mesh size. A number of species were subject to 100% retention in the 26 mm cod-end (Merlucius merlucius, Spicara flexuosa, Illex coindetti). The 40 mm cod-end, on the other hand, showed improved selection for almost all species.
Keywords: trawls, square mesh window, selectivity

4) Size selectivity of diamond and square mesh cod-ends for Nephrops norvegicus in the Aegean Sea.
Stergiou, K.I, Petrakis, G. and Politou, C.-Y.
Fisheries Research, 1997. 29: 203-209.
Abstract: Trawl cod-end mesh selection for Nephrops norvegicus was studied in two experiments in the western Aegean Sea using the covered cod-end method (cover: diamond-shaped, 10 mm). The following cod-end mesh sizes were used: 14 mm (knot-to-knot) diamond shaped (14D) presently operated in the Hellenic commercial trawl fishery; 20 mm square-shaped (20S); 20 mm diamond-shaped (20D), this being the mesh size proposed by the European Union (EU) for the entire Mediterranean. Selectivity estimates were derived from pooling the data over all hauls and sampling dates. The results showed that the proportion of the population retained was higher for 14D than for 20D and 20S (0.99, 0.79 and 0.84 respectively). The direct estimation of the 50% retention length for 14D was not possible because of the very small number of specimens escaping through that cod-end. The results also suggested that 20S has a higher and sharper selectivity than 20D (higher 50% retention length and selection factor, lower selection range) and retains fewer undersized individuals than 20D. Yet, the 50% retention lengths for 20D and 20S were both lower than the length at 50% maturity, a fact indicating that even the use of 20S and 20D may provide little opportunity for reproduction.
Keywords: Aegean Sea; Diamond mesh; Nephrops norvegicus; Square mesh; Trawl cod-end selectivity.

5) Size selectivity of diamond and square mesh cod-ends for four commercial Mediterranean fish species.
Petrakis, G. and Stergiou, K.I.
ICES Journal of Marine Science 1997. 54: 13-23.
English

Abstract: In the present study, we compared the size selectivity of the 14 mm (knot-to-knot) diamond shaped cod-end (14D), presently used in Hellenic waters, with those of 20 mm square-shaped (20S) and 20 mm diamond shape (20D) cod-ends for four commercially important dmersal species (Merluccius merluccius, Micromesistius poutassou, Triseropterus minutus capelanus and lepiderhombus boscii). Cod-end selectivity was estimated using the covered cod-end method. Our results suggested that 14D was not selective for any of the target species and the proportion retained by 14D ranged between 0.88 and 1. In addition, only in the case of M. merluccius did the results suggest that 20S is significantly more selective and retains fewer under-sized fish than 20D. With the exception of M. merluccius, the direct estimation of the 14D L_{50} values was not possible, because of the small number of specimens retained by the cover cod-end of 14D. The L_{50} value of M. merluccius for 14D was lower than its currently enforced minimum landing size (MLS) and length at 50% maturity. In contrast, for 20S and 20D cod-ends, even though the estimated L_{50} values were generally close to, or higher than, the species' MLS, the L_{50} values of 20S for M. merluccius and that of 20D for L. boscii, were much smaller than their lengths at 50% maturity, a fact indicating that even the use of 20S and 20D respectively, provides small opportunities for reproduction. Hence, the appropriate mesh sizes for these two species must be greater than 20 mm and their MLS must be raised. In contrast, for T.m.capelanus and M. poutassou, the L_{50} values of 20D (but not of 14D) were close to their lengths at 50% maturity, a fact indicating that 20D is appropriate for these two species. The above mentioned facts clearly showed that (a) 14D is harmful, in terms of size of landed fish, for the Hellenic demersal stocks and hence its use should be discontinued and (b) the use of a single appropriate mesh size for the Mediterranean trawl fishery as a whole is impossible because of its multi-species nature and the different body sizes of species involved. Since the majority of the individuals escaping through the meshes of 20D and 20S are immature and under-sized (ie their length is smaller than the MLS), the replacement of 14D by either 20D or 20S, the former being the cod-end mesh size proposed by EU for the entire Mediterranean, will be accompanied by increased yield per recruit.
Keywords: Trawl cod-end selectivity, square mesh, diamond mesh, Merluccius merluccius, Micromesistius poutassou, Triseropterus minutus capelanus, lepiderhombus boscii, Aegean Sea, Mediterranean Sea.

6) The study of selectivity in the trawl fisheries aimed at the protection of demersal fish stocks.
Tokaç, A., Lök, A., Metin, C., Tosunoglu, Z., Ulas, A.
TÜBITAK-Research project report DEBAG, 1995.105, 79p.
Turkish
Abstract: Measurements of the size selectivity of conventional and modified cod-ends on standard and traditional trawls were made in the Aegean Sea in 1994. Data were obtained using the covered cod-end method for 36, 40, 44 and 48 mm. diamond and square mesh cod-ends. Analysis was performed by fitting logistic selection curves to catch data for striped mullet (Mullus barbatus Lin., 1758), annular sea bream (Diplodus annularis Lin.,1758), axillary sea bream (Pagellus acarne Ris.,1826), common pandora (Pagellus erythrinus Lin.,1758), poor cod (Trisopterus minitus capelanus Lace., 1800) and hake (Merluccius merluccius Lin., 1758). The selectivity of the modern standard trawl was found to be higher than that of the traditional trawl. Square mesh cod-ends gave higher 50% retention lengths and selection factors than diamond mesh cod-ends, both for striped mullet and axillary sea bream. However, the situation was not the same for annular sea bream, common pandora, poor cod and hake because of their body shape. It was found that cod-ends with shortened lastridge ropes and fewer meshes around the cod-end caught less small fish than a standard

cod-end. The showed that the selectivity of the traditional trawl was very low and that this type of gear needs to be improved. For the modern standard trawl 44 mm was determined as an appropriate mesh size, with the meshes around the cod-end reduced to 120 from 150, to improve selectivity.

7) Comparison of the Selectivity of 40 and 44 mm mesh sizes in a Trouser Bottom Trawl
Gurbet, R., Hossucu, H., Ilkyaz, A.T. ve Özekinci, U.
Proceedings of Mediterranean Fisheries Congress, 9-11 April 1997, Ege University, Fisheries Faculty, Bornova, Izmir, Turkey.
Turkish

Abstract: This work was conducted in Izmir Bay by the fishing vessel Murat Kaptan II from December 1996 to March 1997. A bottom trawl was used with a trouser cod-end to investigate the selectivity of diamond and square mesh cod-ends of 40 and 44 mm mesh size. For red mullet and hake L_{50}, selection ranges (SR) and selection factors (SF) were determined. The results were as follows:

Red mullet.	Diamond 40 mm: 13.59 cm, 3.54 cm, 3.
	Diamond 44 mm: 14.70 cm, 5.05 cm, 3.34.
	Square 40 mm: 14.29 cm, 2.29 cm, 3.57.
	Square 44 mm: 15.46 cm, 4.12 cm, 3.51.
Hake	Diamond 40 mm: 27.76 cm, 8.92 cm, 6.94.
	Diamond 44 mm: 28.27 cm, 7.35 cm, 6.42.
	Square 40 mm: 28.07 cm, 6.98 cm, 7.01.
	Square 44 mm: 30.17 cm, 6.53 cm, 6.85.

The L_{50} values found for both fish species were bigger than the minimum legal length. We can say that these mesh sizes or mesh shapes, when used to fish these species, will not have a negative affect on the stocks.

8) Selectivity of axillary Sea Bream (Pagellus acerna Risso, 1826) in a demersal trawl with different cod-ends.
Metin, C., Tosunoglu, Z., Lök, A., Tokaç, A.
E.Ü. Journal of Fisheries and Aquatic Sciences, 1997. 14: 153-171.
Turkish

Abstract: In this study, the selectivity of axillary sea bream (Pagellus acarne R.) in a modern demersal trawl net with 20, 22 and 24 mm square and diamond mesh cod-ends was investigated. A hooped cod-end cover was used as a selection sampling method. The cod-end was totally enclosed by the 12 mm (bar length) hooped cover to retain the fish which passed through the cod-end meshes. Selection curves were calculated using a probit model and selection parameters were calculated using a probit-regression analysis technique. It was found that the 20 and 22 mm square mesh cod-ends, and the 22 and 24 mm diamond mesh cod-ends were showing appropriate selectivity for axillary sea bream.

9) Selectivity experiments in the NE-Mediterranean: the effect of trawl cod-end mesh size on species diversity and discards.
Stergiou, K.I., Politou,E.D., Christou, E.D. and Petrakis, G.
ICES Journal of Marine Science 1997: 54: 774-786.
English

Abstract: In the present study we compare the overall performance of the 14 mm (from knot-to-knot) diamond shaped cod-end (14D) presently used in Hellenic waters, with those of 20 mm square shaped (20S) and 20 mm diamond shaped (20D) trawl cod-ends. The experiments took place at 12 stations in the western Aegean Sea and were based on the covered cod-end method (cover cod-end: 10 mm from knot-to-knot. 10D). The results of applying multivariate techniques to the different station/cod-end combinations suggest that they form groups which differ from each other in terms of species composition, species diversity and catch numbers/weights per hour of fishing. In general, the 10D covers of 20D and 20S were separated from the 10D covers of 14D. The 20D and 20S cod-ends were generally grouped together and separated from those of 14D and 10D. Finally, the 14D cod-ends either form groups by themselves or group together with the 10D cover cod-ends. In addition, the results indicated that the 20D and 20S cod-ends, when compared with 14D, allow significantly more individuals and number of species to escape through the meshes and are characterised by considerably higher commercial/non-commercial ratios in terms of both weight and number. In absolute numbers and weights 14D caught a very large quantity of non-commercial species whereas the weight of the commercial species caught was among the lowest. The commercial/non-commercial ratios of 20D were higher than those of 20S and, in absolute numbers and weights, 20S caught relatively more non-commercial species than 20D. These facts clearly indicate that 14D is harmful in terms of species diversity for the Hellenic demersal stocks and hence its use should be prohibited.
Keywords: trawl cod-end, selectivity, species diversity, discards, Aegean Sea, Mediterranean.

10) On the effect of square mesh on fishes with irregular body shapes.
Dahm, E., Metin, C and Hossucu, H.
Inf. Fischwirtsch. 1995. 42(4): 197-201.
German
Abstract: The publication compares the effect of square mesh cod-ends (ca. 40 mm mesh opening) on herring and Diplodus annularis, a Mediterranean fish. Whereas the first fish has a nearly circular cross-section, the second is laterally compressed. It is demonstrated that square mesh cod-ends are highly effective in sorting out herring below a defined length and the selectivity range is convincingly reduced with this type of cod-end compared to that of a conventional diamond mesh cod-end. It is well known that flatfish are not better selected by square meshes. When applying square meshes with Diplodus annularis the selectivity is shown even to deteriorate. These results suggest that contrary to the effects detected with fish of circular cross-section, diamond meshes offer to high-backed fishes like Diplodus a particularly good selection. Therefore, sorting grids might be a far better sorting device for this type of fish than square meshes.
Keywords: Mesh selection, square mesh, Clupea harengus, Diplodus annularis.

11) Investigation of the effects of using square mesh netting on the cod-end selectivity of modern style demersal trawls.
Metin, C.
PhD. Thesis. Ege University, Graduate school of natural and applied sciences, Department of fisheries and processing technology, Bornova, Izmir, Turkey. 1995. 69 pp..
Turkish
Abstract: (in German)

12) Preliminary experiments to develop species selectivity in bottom trawl cod-ends.
Metin, C., Lök, A., Ulas, A.
E.Ü. Journal of Fisheries and Aquatic Sciences, 1998. 15: 277-282.

Turkish

Abstract: Species selectivity experiments together with size selectivity studies on bottom trawls have been of increasing interest to fisheries scientists in last decade. The key issue in these studies is knowledge of fish behaviour. Different direct and indirect research methods can be used. In this study one of the indirect methods was used because it is easy and cheap. To determine the fish species escaping from a window in the top panel of the cod-end a hooped cover was used to retain the escaping fish. The results and the method used are discussed.
Keywords: selectivity, fish behaviour, escape panels.

13) Cod-end selectivities of a modified bottom trawl for three fish species in the Aegean Sea.
Tokaç, A., Lök, A., Tosunoglu, Z., Metin, C., Ferro, R.S.T.
Fisheries Research, 1998. 39: 17-31.
English

Abstract: Recently, the catch per unit effort of conventional bottom otter trawl nets used in the Aegean Sea has decreased and the mean body length of the major species has become smaller. The reason may be partly the poor selectivity of conventional trawl nets. It may be possible to modify trawl net design to improve selection and protect demersal fish stocks. This study presents selectivity results for the modified design. Cod-end selectivity of red mullet (Mullus barbatus L.), annular sea bream (Diplodus annularis L.) and axillary sea bream (Pagellus acarne Risso) were measured using the hooped covered cod-end method. Cod-end mesh selectivity experiments were carried out using 36 mm, 40 mm, 44 mm and 48 mm diamond and square mesh cod-ends both in Turkish and international waters of the Aegean Sea in 1995 on board R/V "Egesüf". The cover mesh size was 24 mm. A total of 85 successful tows were made, the raw data were assessed haul by haul and the valid hauls for each cod-end were combined. The selection of cod-ends was found from the linear logistic function and the selection curves and parameters were derived from these combined data by the maximum likelihood method. The square mesh cod-ends (36, 40 and 44 mm) improved selectivity for red mullet. 50% retention length and selection factors were higher for square mesh cod-ends than diamond mesh cod-ends. However, this did not apply to annular sea bream or axillary sea bream. For these species, it was found that there was no significant difference between diamond and square mesh cod-ends and the diamond mesh cod-ends even gave a slightly higher 50% retention length and selection factor than square mesh cod-ends for some mesh sizes. This result may be explained by the different body shapes and behaviour of the individual species.
Keywords: Aegean Sea; Mesh selectivity; Covered Cod-end; Mullus barbatus; Diplodus annularis; Pagellus acarne.

14) Preliminary experiments on the use of windows to improve selectivity in the bottom trawl.
Metin, C., Lök, A., Aydin, C.
E.Ü. Journal of Fisheries and Aquatic Sciences, 1998.15: 269-276.
Turkish

Abstract: Fishing grounds of the Aegean and Mediterranean Sea have different fish species which have different sizes and body shapes. In this situation to obtain acceptable selectivity is very difficult and to improve bottom trawl selectivity it is necessary to consider different techniques such as window and grid systems. In this study, the selectivity of striped mullet (Mullus barbatus) and annular sea bream (Diplodus annularis) was determined when using 22 mm diamond mesh shape windows in the top panel of the cod-end. The results showed that this window system was over-selective for striped mullet but gave lower selectivity for annular sea bream.

Keywords: trawls, selectivity, windows, sea bream, mullet.

15) Structural modifications to improve cod-end selectivity in the bottom trawl nets used in Turkish seas.
Tosunoglu, Z.,
PhD. Thesis. Ege University, Graduate school of natural and applied sciences, Department of fisheries and processing technology, Bornova, Izmir, Turkey. 1998. 121 pp.
Turkish

Abstract: In this study, it was aimed to improve size selectivity with different designs of cod-end on traditional bottom trawl nets. In addition, an attempt was made to determine changes in the demersal fish population of Gülbahçe Bay. Selectivity was measured by the covered cod-end method. The Logit symmetric analysis technique was used to calculate the parameters and draw selectivity curves. A square mesh top panel in the cod-end was shown the have the best selectivity with an L_{50} of 13.66 cm and 1.93 cm selection range for red mullet (Mullus barbatus L.). These values were found to be 13.57 cm and 2.05 cm for red pandora (Pagellus erythrinus L.). In addition, this cod-end design had the lowest proportion of young red mullet and red pandora under the minimum legal landing size. A diamond mesh cod-end (22 mm) had the highest L_{50} with 10.46 cm for annular sea bream (Diplodus annularis L.) due to its body shape. For axillary sea bream (Pagellus acarne Risso) with a shortened lastridge rope cod-end, L_{50} was 14.20 cm. The narrowest selection ranges obtained were 1.33 cm for annular sea bream from a narrow circumference cod-end and 1.95 cm for axillary sea bream from a rhomboid mesh cod-end (22 mm). The most suitable device to improve the selectivity of the traditional bottom trawl nets for different body shape fishes was found to be the square mesh top panel in the cod-end. Measurements of the same meshes in the towing direction of the polyethylene diamond mesh codend was compared before and after use. It was found that the average mesh size was 1.4% higher, after three 60 min. hauls., than the mesh size when the net was new and dry.
Key words: trawl, novel cod-ends, size selectivity.

16) Improving the selectivity of red mullet (Mullus barbatus L., 1758) in conventional bottom trawl nets.
Tosunoglu, Z.
E.Ü. Journal of Fisheries and Aquatic Sciences, 2001. (in press)
Turkish

Abstract: It is known that conventional bottom trawl nets have low selectivity for red mullet (M. barbatus). Further, there are few studies related to improving the selectivity of these nets. For this reason, improving the length selectivity of this species was attempted by testing four different designs of cod-end as well as a 44 mm conventional diamond mesh codend. The new cod-end types were a) a 44 mm, 15% shortened lastridge rope codend, b) a codend with 15% fewer meshes around, c) a full square mesh codend and d) a diamond mesh codend with a square mesh window in the upper panel. A standard bottom otter trawl was used in the selectivity experiments. Trawl hauls conducted in Izmir Bay were limited to 60 minutes. Selectivity of the cod-ends was measured using the hooped cover method. The raw data were assessed haul by haul and the valid hauls for each cod-end were combined and logit symmetric curves were fitted. The selectivity of the different cod-end designs was found to be higher for red mullet than in the normal cod-end. While this cod-end could not release fish exceeding 13.0 cm in length and had an 11.5 cm length at first capture, other all designs did so. The highest value of L_{50} found in a square mesh cod-end was 14.7 cm. Similar results were obtained for selection range. While this parameter was found to be 3.03 cm for the normal cod-end, it decreased to 1.93 cm for the cod-end with the square mesh escape panel.

Progress is being made in improving the length selectivity of red mullet by changing cod-end design on conventional nets.

Key words: trawl, red mullet, novel cod-ends, selectivity.

17) Improving length selectivity with sorting grids on bottom trawl nets
Aydin, C., Tosunoglu, Z., Tokac, A.
E.Ü. Journal of Fisheries and Aquatic Sciences, 2001, (in press).
Turkish

Abstract: Sorting grids can improve length selection in bottom trawl fishing. For these experiments, sorting grids with bar spacings of 20 and 15 mm, were installed at 60° and 120° angle of attack in the cod-end of a high opening bottom trawl. The grids were made from plastic (Polyethylene) framed with wood. The selectivity of the grid systems were assessed for red mullet (*Mullus barbatus* Linnaeus, 1758) and annular sea bream (*Diplodus annularis* Linnaeus, 1758), which are the major components of bottom trawl catches. All the grids tested showed improved selectivity for red mullet and annular sea bream, the 20 mm bar spacing giving the best results. The 60° angle of attack was more effective than the 120° angle on both species. The grid results are better than those obtained with different mesh sizes and shapes. The survival rate of the young fish which escape through the smooth, slippery, plastic bars is likely to be higher than for those escaping through net meshes.

Key words: Bottom trawl, sorting grid, selectivity, red mullet *(Mullus barbatus),* annular sea bream *(Diplodus annularis)*

18) Comparison of discarded, escaped and landed fish using diamond and square mesh cod-ends.
Mallol, S., Casadevall, M. And García-Berthou E.
Rapp. Comm. Int. Mer Médit., 36, 2001 p. 296
English

Abstract : We compared a 20 mm diamond-shaped codend with a 20 mm square-shaped codend. Sampling was conducted on a chartered commercial trawler in the Gulf of Lion during July and August 2000. The covered cod-end method was used . Number and weight of landed, discarded and escaped fish of twelve commercially important species were studied. Our results suggested great differences between the two cod-ends in the number and weight of fish escaped and discarded. Landed weight only differed between 0.01 and 8 % for all species studied excluding under-sized fish sold.

e) Selectivity of Set Gear (Nets, Lines & Artisanal Fisheries)

1) Driftnet fisheries in the Moroccan Mediterranean
Lahnin, A.
Institut scientifique des peches maritimes (ISPM), Morocco
Selection of documents presented at the eighth Technical Consultation on Stock Assessment in the Western Mediterranean Sea. Casablanca, Morocco,14-17 October,1996. Rome, Italy. FAO 1997 no. 550, suppl. no. 550, pp. 9-12.
ISBN 92-5-203992-9; ISSN 1014-6555
French

Abstract: A description is given of the Moroccan driftnet fisheries operating in the Mediterranean. Details are provided of the fleet, the nature of the gear, fishing operations and catches. Legislative measures are also covered.

Key Words: Marine-fisheries; Gillnets; Fishing gear; Fishing operations; Fishery regulations; MED, Morocco

2) Experimentation of a new long-lining system for the capture of bluefin tuna (Thunnus thynnus, L. 1758) in the Mediterranean: summary of the trials and analysis of the catches]

Palladino, S.; Pietrucci, A.
I.C.R.A.M., Roma, Italy

Abstract; A new long-lining system for bluefin tuna (Thunnus thynnus) was tested in the Mediterranean Sea during summer 1993. Most of tunas caught were large-sized adults.
Key Words: Tuna-fisheries; Long-lining; Fishing gear; Gear selectivity; Thunnus thynnus; MED.

3) A preliminary note on management of coastal resources along the eastern Adriatic coast by regulation of fishing gears: Mesh size selectivity.

Jardas, I.; Pallaoro, A.; Jukic, S.; Cetinic, P.
Inst. Oceanogr. and Fish., Split, Yugoslavia

Abstract: Preliminary results are presented of experiments conducted on gillnet mesh size selectivity of 28 mm with respect to the most common fish species found along the eastern Adriatic coasts. Body size parameters are given for the fish species caught and implications for management of the resources are considered briefly.
Keywords: coastal fisheries; gillnets; gear selectivity; mesh selectivity; fishery management; MED-Yugoslavia.

4) Gill net selectivity for four fish species (Mullus barbatus, Pagellus erythrinus, Pagellus acarne and Spicara flexuosa) in Greek waters.

Petrakis, G. and Stergiou, K.I.
Nat. Centre for Mar. Res., Greece

Abstract: In the present study, the size selectivity of gill nets for Mullus barbatus, Pagellus erythrinus, Pagellus acarne and Spicara flexuosa was estimated from samples collected with nets of 17, 19, 21 and 23 mm mesh size (nominal bar length). Sampling was conducted at 15 stations in the South Euboikos Gulf (western Aegean Sea) in 1992 and 1993. The individual selection factors ranged from 6.15 to 9.01 and the optimum selection lengths increased from 10.7 to 14.4 cm fork length (FL) for P. erythrinus, from 11.0 to 14.9 cm FL for P. acarne, from 13.3 to 17.9 cm FL for M. barbatus, and from 13.3 to 17.6 cm FL for S. flexuosa for the 17 and 23 mm gill nets, respectively. Comparisons between the estimated optimum selection lengths and the minimum legal landing sizes and sizes at 50% maturation as well as comparisons between the length frequency distributions of the above mentioned species in gill net catches with those in trawl catches are also presented and discussed.
Keywords: Gillnets; Gear selectivity; Mullus baratus; Pagellus erythrinus; Pagellus acarne; Spicara flexuosa; MED-Aegean Sea.

5) The selectivity of gill nets of different mesh sizes for Diplodus Annularis (Linn., 1758) and Spicara flexuosa (Rafinesque, 1810).
Metin, C., Lök, A., Ilkyaz, A.T.
E.Ü. Journal of Fisheries and Aquatic Sciences, 1998. 15: 293-303.
Turkish

Abstract: In this study, the size selectivity of gill nets for D. annularis and S. flexuosa was estimated from samples collected with nets of 18, 20, 22 mm. mesh size (nominal bar length). Selectivity parameters were estimated using the indirect method proposed by Holt (1963). The optimum catch lengths of D. annularis in 18, 20, 22 mm. mesh size were 10.08, 11.20, 12.32 cm and 15, 16.67 and 18.33 cm for S. flexuosa respectively. Overall selection factor and standard deviation were 5.60 and 1.86 for D. annularis and 8.33 and 1.21 for S. flexuosa respectively. Only the 22 mm mesh size nets showed suitable selectivity for D. annularis, but all mesh sizes tested were suitable for S. flexuosa.
Keywords: gill nets, selectivity, Diplodus annularis, Spicara flexuosa.

6) Population structure of Spanish catches of the bluefin (Thunnus thynnus) in the Mediterranean during 1985.
Rey, J.C.; Alot, E.; Ramos, A.
Inst. Esp. Oceanogr., Fuengirola, Malaga, Spain
Meeting of the ICCAT Standing Committee on Research and Statistics, Madrid (Spain), Nov 1986.
Collected Vol. Sci. Pap. ICCAT Recl. Doc. Sci. Cicta Colecc. Doc. Cient.Cicaa. 1987. vol. 26, no. 2, pp. 308-313. ICCAT SCRS/86/50.
Spanish

Abstract: Catches, in number of individuals per age class, are presented for the different fishing systems which catch bluefin (Thunnus thynnus) in the Mediterranean. Significant catches of age-0 fish are observed, which could mean that the recruitment levels are satisfactory in 1985. The hand-line fishery, along with the traps, is important in the catch of spawners between the ages of 5 and 14 years. Medium-aged fish (4 to 9 years) form an important part of the Mediterranean trap catches.
Keywords: tuna fisheries; gear selectivity; age groups; Thunnus thynnus; fishery biology; MED.

7) A multi-gear artisanal fishery in the Chioggia fleet (northern Adriatic).
Giovanardi, O.; Pranovi, F.; De Girolamo, M.
Istituto Centrale per la Ricerca scientifica e tecnologica Applicata al Mare Viale Stazione, 5, 30015 Chioggia Italy
27th Congr. della Societa Italiana di Biologia Marina, Portoferraio (Italy), 20-25 May 1996.
Biol. Mar. Mediterr. 1997 vol. 4, no. 1, pp. 528-529. ISSN 1123-4245
Italian

Abstract: A description of a multi-target artisanal fishery 'surviving' in the Chioggia fleet of Italy is reported. The study includes considerations about catch composition and changes of target and fishery area.
Keywords: Artisanal fishing; Fishing gear; Gear selectivity; Catch composition; MED-Italy Chioggia; MED-Adriatic North.

8) Small-scale fisheries in the South Euboikos Gulf (Greece): species composition and gear competition.
Stergiou, K.I., Petrakis, G. and Politou, C-Y.
National Centre for Marine Research, Agios Kosmas, Helliniko, Athens 16604, Greece

Abstract: In the present study, we compare the species composition and gear competition of the small-scale fisheries in the South Euboikos Gulf, Greece, from samples collected during 1992-1993 by beach seine (8 mm mesh size, bar length) and gill and trammel nets of different mesh sizes (gill nets: 17, 19, 21 and 23 mm, bar length; trammel nets: 19, 24 and 30 mm, bar length). The sampling depth ranged from 18 to 60 m. Comparisons used univariate and multivariate techniques based on species compositions and the commercial/total (C/T)) ratio in terms of weight and number. The results of the various techniques were in close agreement, complemented each other, and suggested that the eight gears used may be aggregated into three main groups: a) 30 mm trammel net (group I), which is highly selective when compared with all remaining gears; b) all remaining gill and trammel nets (group II); and c) beach seine (group III), which is an active unselective gear. These groups differed from each other in terms of species composition and, generally, diversity increased and C/T ratio decreased from group I and group III. The results indicate that banning the beach site seine could be essential for conservation of demersal and inshore bio-diversity.
Keywords: Artisanal fishing; Gear research; Check lists; MED-Greece.

9) Gill net selectivity for Diplodus annularis and Mullus surmuletus in Greek waters.
Petrakis, G. and Stergiou, K.I.
Abstract: The present study is the first concerning gill net selectivity in Greek marine waters. Selectivity estimates were made for Diplodus annularis and Mullus surmuletus. Sampling took place at 15 stations in the south Euboikos Gulf in 1992 and 1993 with a chartered commercial small scale fishing vessel. Samples were collected with gill nets of mesh sizes (bar length) of 17, 19, 21 and 23 mm. Individual selection factors for M. surmuletus and D. annularis ranged between 4.83 and 7.42 whereas the optimum selection lengths increased from 12.2 to 16.5 cm for M. surmuletus and from 8.8 to 11.9 cm for D. annularis, for the 17 and 23 mm nets, respectively. Comparisons between the estimated optimum lengths and the minimum legal landing sizes and between the length frequency distributions of the catches of D. annularis and M. surmuletus in gill nets and those in trawl nets are also presented.
Keywords: Diplodus annularis, gear selectivity, Greece, Mullus surmuletus.

10) A study on the selectivity of turbot (Scophthalmus maeoticus Pallas 1881) gill nets.
Erdem, Y.
PhD. Thesis. Ondokuz Mayis University, Graduate school of natural and applied sciences, Department of fisheries and processing technology, Samsun, Turkey. 1996. 63 pp.
Abstract: In this study, determination of the selectivity of gill nets was the aim. It was found that turbot reach sexual maturity at 3 years of age. The length-weight relationship of turbot was estimated as $W_t=0.0047 \, L_t^{3.4188}$ and the von Bertalanffy growth equation as $L_t=90.56(1-\exp(-0.1324(t+0.8543)))$. It is recommended to ban fishing of immature turbot under 3 years old and 40 cm in length, to ensure the sustainable use of the turbot population. Optimum selectivity lengths were estimated by a direct method as 30.49, 33.55, 36.74, 40.53, 45.42 and 50.55 cm for the six different gill net mesh sizes used and by an indirect method as 27.96, 32.41, 38.02, 43.51, 48.22 and 53.05 cm. There were no significant differences between the optimum selectivity lengths calculated by the direct and indirect methods.
Keywords: Turbot, gillnet selectivity, optimum mesh sizes, Holt (1963) methods.

11) Determination of gillnet selectivity using indirect methods of analysis on catches of red mullet (Mullus barbatus) and Annular Bream (Diplodus annularis).
Özekinci, U.
Proceedings of Mediterranean Fisheries Congress, 9-11 April 1997, Ege University, Fisheries Faculty, 35100, Bornova, Izmir, Turkey
Turkish

Abstract: In this study, the selectivity of gillnets was found for Mullus barbatus and Diplodus annularis for mesh sizes of 18-20-22 mm. Samples were collected from four stations near the Urla Coast. The selectivity parameters were estimated by using the indirect method developed by Holt (1963). The selection factors determined for 18-20 and 20-22 mm mesh sizes for red mullet and annular bream varied between 7.12-6.82 and 5.05-6.08, respectively. The optimum selection length was found for red mullet to be between 12.97-14.41 and 13.64-15 cm, and for annular bream to be between 9.08-10.08 and 12.14-13.36 cm.
Keywords: mullet, bream, gill nets, selectivity.

12) Trammel and Gill net Selectivity in the Adriatic and Tyrrenhian Sea
G. Fabi and S de Ranieri
EU Project Report 1994/086, 162 pp.
IRPM, Ancona, Italy
Italian or English ?

Abstract: The aim was to increase knowledge of the selectivity of commonly used net types. The selectivity of a traditional trammel net, a monofilament trammel net and a gill net was investigated in two coastal areas (central Adriatic and northern Tyrrenhian Sea) on samples collected during one year. Three mesh sizes for each set net were tested: 45, 70 and 90 mm (stretched mesh size). Catch efficiency, modality of capture and selection parameters for each net and each mesh size were estimated for nine species. Selectivity was estimated through an indirect and a direct method. The former was the Sechin model, on the estimation of the selection parameters on the basis of maximum girth and head girth data of the considered species. The direct method compared the length-frequency distributions of set net catches with the length-frequency distributions of the fish population at sea sampled through a bottom trawl net. The study advanced knowledge in the field of mesh selectivity of trammel and gill nets.
Keywords: Trammel net, Gill net, Adriatic Sea, Tyrrenhian Sea, selectivity.

13) Selectivity of Static Nets in the Mediterranean (SELMED)
Sacchi J, Carbajosa M J, Feretti M and Petrakis, G.
EU Project Report 1995/012, 99 pp + 7 annexes.
IFREMER, Sete, France.
French or English ?

Abstract: The objective was to assess the impact of new passive gear regulations on the selectivity of such metiers. The first stage was to identify the main metiers and define them in terms of fishing gear, fishing practices and catches. The aim was to identify the factors responsible for the selectivity of catches. This was achieved by examination of statistical documents, surveys and observation on board commercial vessels. The effects of changes of mesh size and net height on the selectivity of hake and mullet nets were investigated. These were expressed in terms of specific diversity and catch retention rate. Experiments were also carried out to improve hake gill nets and provide escape systems. Twenty types of metier were identified. Static nets have a relatively small impact on the fishery resource and the environment compared with other fishing methods. Their effectiveness can be further improved by a better control of entanglement factors and a better gear installation.

14) Hake Set Gear Fisheries in Mediterranean and Eastern Atlantic Waters
Biagi et al.
EU Study project 1997/0064.
CIBMEA, Livorno, Italy
English ?

Abstract: Significant differences were found in gear construction, fishing depth and season and catch composition between the Tuscan and Algarve gill net metiers. 67 and 23 species were taken in the two fisheries respectively. No hake were discarded in the Tuscan fishery but discards were noted in the Algarve fishery. The long line catches in the Algarve took 23 species, with no hake discards. No incidental catches of cetaceans were observed over two years. Length frequency distributions were compared. 50% of hake were caught in gill nets by tangling, independent of size giving wide catch size distributions. No difference was found between mesh sizes in hake bio-mass landed.
Keywords: hake, gill nets, long lines, selectivity.

15) Comparative Fixed Gear selectivity Studies in Portugal and Greece.
Erzini, K. et al. EU Project No. 96/065.
Laboratory of Ichthyology, Aristotle University of Thessaloniki, Greece.
English.

Abstract: The aim of the study was to quantify the catches in fixed gears by season in the Algarve and the Cyclades; to compare catches taken by long-lines with small hooks and gill nets within and between areas; to describe and compare the size selectivity of these gears for the most abundant species. Overall catches were much greater in the Algarve. Catch rates generally decreased with increasing hook size in the Algarve but there was no clear pattern in the Cyclades. In both areas, the smallest mesh sizes had the highest catch rates in numbers and these rates varied with season, reflecting seasonal changes in species composition and abundance. Multi-variate analysis showed a clear separation of the two gears in terms of catch composition by number and weight. Differences in dominance between gears, seasons and gear sizes were observed based on K-dominance curve analysis. For species caught by both gears in sufficient numbers, hooks generally accounted for larger fish and a wider size range than nets. The four mesh sizes used in the gill nets in both area caught relatively narrow length ranges and the modal lengths of the species gradually increased with increasing mesh size. In contrast, length frequency distributions for the four hook sizes for each species tended to be highly overlapped, with similar modal lengths or only small increases in modal length with increasing hook size. Gill net selectivity parameters were estimated using the SELECT model for nine species in each area. Parameters for long-line catches were estimated using the logistic selectivity curve. The study showed that these static gears had very different impacts on the demersal resources in the two areas.

f) Stock Assessment, Surveys and Selectivity of Survey Gear

1) Observations on the epi and mesobathyal cephalopod fauna in the eastern Mediterranean (Ionian and Aegean Seas)]
D'Onghia,G.; Matarrese,A.; Tursi,A.; Maiorano,P.; Panetta,P.
Instituto di Zoologia e Anatomia Comparata, Universita degli Studi, Via Orabona 4, 70125 Bari, Italy
25th Congresso della Societa Italiana di Biologia Marina, Alghero (Italy), 24-28 May 1994.
Biol. Mar. Mediterr. 1995 vol. 2, no. 2, pp. 199-204. ISSN 1123-4245.
Italian

Abstract: In the context of trawl surveys carried out from 1990 to 1993 on the bathyal bottoms of the north Ionian Sea and north Aegean Sea, a total of 18 cephalopod species were found in the former area and 22 in the latter. Some differences related to depth distribution and size and time of reproduction of the species were observed between the two basins, which presented a high affinity in the structure of the cephalopod fauna relative to the used gear.
Key Words: Cephalopod fisheries; Trawling; Fishery surveys; Catch composition; Gear selectivity; Bathyal zone; Cephalopoda; MED-Ionian Sea; MED-Aegean-Sea

2) FARWEST: An international research programme (1990-93) for the northwestern Mediterranean demersal fisheries
Farrugio, H.
IFREMER, 1 rue Jean Vilar, 34200, Sete, France
Report of the Seventh GCFM Technical Consultation on the Evaluation of Stocks in the Statistical Divisions of the Baleares and Lion Gulf. Sete, France, 19-23 September, 1994. Editor: Alaya,-H.B. FAO, Rome, Italy. 1996 no. 537 pp. 169-183. ISBN 92-5-203835-3; ISSN 1014-6555
English
Abstract: A general overview is provided of analyses and results which appear in the EEC reports for the FARWEST Programme concerning French, Spanish and Italian demersal fisheries. The database and associated procedures, data processing and results regarding hake (Merluccius merluccius) and gamba shrimp (Aristeus antennatus) are outlined. Stock assessments and modelling of the interactions between gears within single fisheries or between fleets in the case of shared stocks are detailed.
Key Words: demersal-fisheries; fishery-data; data-processing; stock-assessment; fishing-gear; gear-selectivity; development-projects; Merluccius-merluccius; Aristeus-antennatus; MED-FARWEST.

3) On the population dynamics of sardine, Sardina pilchardus (Walbaum, 1792), from the Catalan Sea (northwestern Mediterranean)
Pertierra, J.P.; Perrotta, R.G.
NOAA/Southwest Fish. Sci. Cent., P.O. Box 271, La Jolla, CA, 92038, USA
Scientia Marina Barcelona. Editor: Lleonart,-J. 1993 vol. 57, no. 2-3, pp. 235-241
ISSN 0214-8358
English
Abstract: In this paper, the sardine (Sardina pilchardus) resources of Catalan coastal waters are analysed. The period studied covers the years between 1988 and 1991. The resource has a stable bio-mass and the fish stock is under exploited. Current fishing gear seems to be adequate in selectivity. The natural mortality rate and fishing mortality are estimated.
Key Words: MED-Western Mediterranean; Sardina pilchardus; population dynamics; marine fish; fishing mortality; fishery resources

4) Growth of sand sole Solea (Pegusa) theophilus (Pisces Soleidae) from the coast of Roussillon (France).
Marinaro, J.Y.
Lab. Biol. Mar., Univ. Perpignan, 66025 Perpignan Cedex, France
Vie Milieu. 1991. vol. 41, no. 2-3, pp. 141-151; ISSN 0240-8759
French
Abstract: Investigations on growth, ageing and back-calculation were carried out on sand sole, Solea (Pegusa) theophilus (Risso, 1810) (= S. impar Bennett, 1831), caught in 1986 and 1987 by trammel net and otter trawl off the sandy beaches of Roussillon (French

Mediterranean). The hatching day was established as July 1st by plankton sampling in the spawning area. Rest lines - most of which were very clear - could be seen on the grinding surface of the otoliths. They were formed from November to May, as suggested by the marginal increment evolution, and are linked to the cooling of the sea. Therefore it was possible to read the age of most of the fish and to establish their growth in length expressed by a Von Bertalanffy curve. The seasonal oscillations of the condition factor show that the fish increase their reserves in the cold period. The selective properties of the fishing gear used to catch sand sole are noted as well as the harmful effects of the otter-trawl near the coast.
Keywords: Pisces; Soleidae; Solea Pegusa theophilus; growth curves; otolith reading; MED-France,Languedoc-Roussillon

5) Analysis of total mortality, selectivity and recruitment of Phycis blennoides (Brunnich, 1768) from Western Mediterranean Sea (Pisces: Gadidae).
Gallardo-Cabello, M.
Univ. Nac. Auton, Mex., Inst. Cienc. Mar Limnol., Mexico D.F., Mexico
An.Inst.Cienc.Mar.Limnol. Univ. Nac. Auton. Mex.1984. vol. 11, no. 1, pp. 217-224. ISSN 0185-3287
Spanish
Abstract: This paper deals about the total mortality, selectivity and recruitment for greater forkbeard, Phycis blennoides in the Western Mediterranean Sea. The analysed fishing gear is trawling in its modality: "bou". Parameters were carried out as follows: rate of total mortality, $z = 0.66$; selectivity (mesh size trawl 35 mm) 1 sub(c) = 114 mm, selection factor F.S. = 3.26 and recruitment, 20,002 fishes, year - class "O"/square miles, 19,601,960 fishes, year - class "O" in the total area.
Keywords: mortality; gear selectivity; recruitment; Phycis blennoides; MED-Western Mediterranean

6) Analysis of Merluccius merluccius trawl landings at Porto Santo Stefano (GR, Italy).
Viva, C.; De Ranieri, S.
Centro Interuniversitario di Biologia Marina, P.le Mascagni 1, 57100 Livorno, Italy
24th Congr. della Societa Italiana di Biologia Marina, San Remo (Italy), 1-5 Jun 1993
Biol. Mar. Mediterr. 1994 vol. 1, no. 1, pp. 321-322. ISSN 1123-4245
Italian
Abstract: Landings of hake (Merluccius merluccius) by the trawl fleet of Porto Santo Stefano (GR, Italy) were investigated. The two most important types of bottom otter trawls show the highest CPUE. The different action on the size composition of hake population is outlined.
Keywords: Gadoid fisheries; Trawling; Bottom trawls; Gear selectivity; Landing statistics; Size distribution; Catch effort; Merluccius merluccius; MED-Italy-Toscana.

7) Hake exploitation in the Gulf of Lyons: Further data.
Aldebert, Y.; Carries, C.
IFREMER, Stn. Sete, France
Bull. Soc. Zool. France. 1989. vol. 114, no. 4, vp
French
Abstract: Hake (Merluccius) is one of the most important demersal species of the Gulf of Lyons. It is exploited mainly by trawlers but also with gill-nets and bottom lines. Studies have been carried out on the stock of hake for several years using Virtual Population Analysis based on length-frequency distributions. Simulations were made on the long-term effects of mesh size and fishing effort in each fleet on catches, yield per recruit, and relative fecundity. These show that any increase of mesh size of trawls would improve catches mainly if

combined with a decrease of fishing effort. Some attention is given to hake fisheries management.

8) A study of the population characteristics of three Sparid species in the Gülbahçe Bay.
Tosunoglu, Z., Akyol, O., Metin, G., Tokaç, A., Ünsal, S.
E.Ü. Journal of Fisheries and Aquatic Sciences, 1997. 14: 127-143.
Turkish
Abstract: Some population characteristics of three Sparid species caught in the Gülbahçe Bay were examined in this study. Measurements were taken on 205 specimens of Diplodus annularis L., 1758, 204 of Pagellus erythrinus L., 1758 and 107 of Pagellus acarne R., 1826, to determine age composition, sex ratio, age-length and length-weight relationships, gonadosomathic index and condition factors. The cod-end selectivity of traditional bottom trawl nets with 22 mm bar length were also determined for these species.

9) Investigations of the growth and reproduction of the red mullet (Mullus barbatus Linnaeus,1758) population in the bay of Izmir (Aegean sea).
Akyol, O., Tosunoglu, Z., Tokaç, A.
Anodulu University, Journal of Science and Technology, 2001. (in press)
English
Abstract: Red mullet (Mullus barbatus L.) is one of the foremost economically important demersal fish species in Turkey. It has been determined that the age of red mullet caught in Izmir Bay ranges from I to IV and the mean fork lengths for these age groups are 11.25 cm, 13.44 cm, 15.51 cm and 17.53 cm, respectively. The length – weight relationship calculated for female + male was $W=0.0063.L^{3.3625}$. The Von Bertalanffy growth parameters were found to be $L\infty=27$ cm, $K=0.183$, $t_0=-1.506$ for all individuals measured. The highest condition factor was found in February as 1.807 for all individuals. Reproduction begins in June according to gonadosomatic index values. The first maturity length and age were 12.9 cm (FL) and 1, respectively. The first capture lengths (Lc) for trawl and beach seine nets were 11.51 cm and 13.43 cm, respectively.

10) Demersal trawl surveys in Italian seas: a short review.
Relini,G.
Universita di Genova, Laboratorio di Biologia Marina ed Ecologia Animale, Via Balbi, 5, 16126 Genova Italy; E-mail: biolmar@unige.it
Demersal resources in the Mediterranean, Pisa (Italy), 18-21 Mar 1998.
In: Proceedings of the Symposium on Assessment of demersal resources by direct methods in the Mediterranean and the adjacent seas, Pisa, Italy, 18-21 March 1998.
Editors: Bertrand, J.A., Relini, G., Plouzane, France. IFREMER 2000, no. 26, pp. 46-75.
ISBN 2-844330398; ISSN 0761-3962
English
Abstract: Within the framework of Italian Law 41/1982 regarding multi-annual plans to improve fishery management and fish farming, a part of the funding was allocated to the assessment of fishery resources, mainly by direct methods. Thus, in 1984-1985 bottom trawl surveys were initiated in all Italian seas within GFCM statistical sub-areas 37.1.3, 2.1, 2.2. Fifteen Operative Units were divided into three separate groups until 1993, and stratified

random sampling and transect system design were used. From 1993, the Operative Units were reduced to eleven, all belonging to the Gruppo Nazionale Risorse Demersali (GRUND). The same standardised protocol and stratified random sampling scheme were used in all seas during two surveys per year (1994-1995): one in spring and the other in autumn. Over a total surface area of 209,372 km2, 482 hauls per survey were carried out. The following ten target species were considered: Mullus barbatus (L.), Merluccius merluccius (L.), Phycis blennoides (Brunn.), Micromesistius poutassou (Risso), Nephrops norvegicus (L.), Aristaeomorpha foliacea (Risso), Aristeus antennatus (Risso), Parapenaeus longirostris (Lucas), Octopus vulgaris (Lam.), and Eledone cirrhosa (L.). At present, the GRUND-2 surveys (1996-1999) are combined with the international bottom trawl survey MEDITS (a single cruise in spring). All hauls of the previous two cruises per year are now concentrated in an autumn cruise, with 1,085 hauls over a surface area of 285,032 square kilometres. Within this programme, selectivity (cod-end mesh) and inter-calibration (boats and nets) investigations are planned or in progress.

Key Words: Demersal fisheries; Fishery surveys; Trawl nets; MED, Italy.

Species: Merluccius merluccius; Mullus barbatus; Phycis blennoides; Micromesistius poutassou; Nephrops norvegicus; Aristaeomorpha foliacea; Aristeus antennatus; Parapenaeus longirostris; Octopus vulgaris

11) Efficiency of the bottom trawl used for the Mediterranean international trawl survey (MEDITS).

Abstract: The aim of the work presented in this paper was to assess the relative efficiency of the GDC 73 sampling trawl used for the Mediterranean international trawl survey programme (MEDITS) compared with that of a typical Italian commercial trawl. The latter was chosen because it is commonly used by fishermen in the central Adriatic, where the experiment was conducted, and therefore appeared as the best possible sampler of the commercial species present in those areas. Moreover, this trawl is similar to the various trawls used for the Italian national survey programme (GRUND). Four fishing trips were conducted between 1996 and 1997 in different areas and seasons to sample different species. Each trip was conducted in the same fishing area. A cod-end cover mounted on the commercial trawl ensured that the cod-ends of the two nets had the same mesh opening. The two trawls were alternated daily. Net geometry (horizontal and vertical net opening) was measured during all tows. Catch data were converted into abundance per swept area before comparing the trawls. Efficiency comparisons were performed on ten fish species, one crustacean and four molluscs belonging to the MEDITS list of main reference species. The MEDITS trawl was significantly less efficient in terms of both weight and numbers of individuals fished for hake (Merluccius merluccius), common sole (Solea vulgaris) and Norway lobster (Nephrops norvegicus). A highly significant difference in favour of the commercial trawl was found in the weight, but not the numbers, of common pandora (Pagellus erythrinus). Efficiency differences were negligible for red mullet (Mullus barbatus), while the MEDITS trawl was significantly more efficient for the numbers of Atlantic horse mackerel (Trachurus trachurus). For all the other main reference species differences were not significant. The commercial trawl was more efficient for large individuals of some species. The relative efficiency of the MEDITS trawl was especially low for small-size classes of N.norvegicus. The results confirm the lower efficiency of the MEDITS compared with the commercial Italian trawl for benthic species, and its greater efficiency for some others released from the bottom as well as for the pelagic ones. These data allow the results of the MEDITS surveys to be compared with those of the

GRUND programme and with commercial-fleet catches in areas where the commercial trawls used are similar to the ones studied here.

12) New data on trawling in the Gulf of Lyons. Comparative selectivity of the Italian type trawls and the trawl with large vertical openings for the capelin.

Dremiere, P.Y.
Inst. Pêches Marit., Sete, France.

Abstract: In 1972 and 1973, comparative studies were carried out on the selectivity of the two types of trawl most commonly used for fishing Gadus capelanus along the French Mediterranean: the traditional one in which the mesh is practically closed during fishing and a more recent one, in which the mesh is more open in the water, and the bottom is less scraped. A greater selectivity coefficient was obtained for the more recent trawl, indicating that there is less chance of survival of small sized specimens with the traditional, local trawl. The general adoption of the trawl with large vertical opening is recommended because of the state of over-fishing already existing in the gulf of Lyon.

13) Selectivity of an 'Italian' trawl-net for hake (Merluccius merluccius) in the Tuscan Archipelago.

Sbrana, M.; Reale, B.
Dipartimento di Scienze dell'Ambiente e del Territorio, Universita di Pisa, Via Volta 6, 56100 Pisa, Italy.

Abstract: A survey carried out in September 1992 in the southern Tuscany Archipelago (Porto Santo Stefano, GR, Italy) allowed evaluation of the selectivity of an Italian trawl net with 34.0 mm cod-end mesh size for hake (Merluccius merluccius), chosen because of its abundance in the area.

14) Paramètres biologiques et dynamiques disponibles sur les principaux stocks halieutiques du Golfe de Lion; sous zone 37-2 du CGPM.

Dremiere, P-Y.

Abstract: The document has tables containing selectivity data.

15) Valores de talla de primera madurez y selectividad de varias especies comerciales de la costa catalana.

Martin, P. Y. and Sanchez, P.

Abstract: The document has tables containing selectivity data.

g) Gear Performance and Catch Composition

1) Performance tests in pelagic trawling: Italian tests in the Adriatic.
Fiorentini, L.; Paschini, E.; Cosimi, G.
Ist. Ric. Pesca Maritt., (C.N.R.), Ancona, Italy
Evolution of Technology in Italian Fisheries. FAO-GCFM, Rome, Italy.1987. no. 62 pp. 19-27; ISBN 92-5-002563-7
English
Abstract: The results are presented of tests conducted regarding Italian pelagic trawl nets used in the Adriatic. Behaviour of the trawls under various gear arrangements was examined and their fishing efficiencies with respect to Mediterranean fish species compared.
Keywords: pelagic fisheries; trawl nets; gear selectivity; fishing gear; MED-Italy; performance assessment; MED-Adriatic.

2) Comparative trawling between the Mediterranean trawl of Tunisian design and a high-opening trawl. Popularisation of the latter in Tunisia (1972-1975).
George,J.P, IFREMER, France.
Rapp.Doc.Inst.Natl.Sci.Tech.Oceanogr.Peche.Tunisia, 1978 (no. 1/78), 1-44
French
Abstract: Two trawls, one having a vertical opening of 4-4.5 m, and the other of 0.9-1.2 m, were employed for comparative fishing experiments. The high-opening trawl was seen to meet selectivity standards for large individuals of high commercial value (such as hake). The explanation for this is thought to be that large fish such as hake are less likely to escape the net than smaller fish such as red mullet. Efforts should be made to popularise the use of high-opening nets among Tunisian fishermen.
Keywords: gear selectivity; trawl nets; MED-Tunisia

3) Experimental and traditional trawl nets: comparison between the catches.
Cuccu, D.; Follesa, M.C.; Murenu, M.; Sabatini, A.; Vignolo, E.
Dipartimento di Biologia Animale ed Ecologia, Universita di Cagliari, Viale Poetto 1, 09126 Cagliari, Italy
26th Congresso della Societa Italiana di Biologia Marina, Sciacca (Italy), 22-27 May 1995.
Biol. Mar. Mediterr. 1996 vol. 3, no. 1, pp. 542-543. ISSN 1123-4245
Italian
Abstract: A comparative analysis between the traditional and experimental trawl net catches of fishing boats in the Sardinian Sea was carried out. Some differences between the two systems appear regarding the abundance of recruits of the dominant species - Merluccius merluccius.
Keywords: Trawl nets; Gear selectivity; Recruitment; Gadoid fisheries; Merluccius merluccius; MED-Italy-Sardinia.

4) Landings of traditional and wide vertical opening trawl-nets.
Sartor, P.; De Ranieri, S.
Dipartimento di Scienze dell'Ambiente e del Territorio, Via Volta 6, 56100 Pisa, Italy
CO: 24. Congr. della Societa Italiana di Biologia Marina, San Remo (Italy), 1-5 Jun 1993
Biol. Mar. Mediterr. 1994 vol. 1, no. 1, pp. 311-312. ISSN 1123-4245
Italian
Abstract: A comparative analysis was made between the landings of traditional and wide vertical opening trawl nets of a fishing fleet in the Southern Tuscan Archipelago (Porto Santo

Stefano, GR, Italy). Some differences between the two systems were noted, which above all concerned the composition in species, in the monthly landings per unit effort.
Keywords: Marine fisheries; Trawling; Fishing gear; Gear selectivity; Catch composition; Catch effort; Trawl nets; MED-Italy-Toscana.

5) Trials of an Irish Bottom Trawl in the Sea of Mahdia and Comparison of its Capture Efficiency with that of a Tunisian Type of Shrimp Trawl.
M'Rabet, R.
Bull. Inst. Nat. Scient. Techn. Oceanogr. Pêche de Salammbô, 1997, 24(1): 89-100.
French
Abstract: Trial of a new high opening Irish bottom trawl in the sea of Mahdia has shown that this trawl is more efficient. In fact, comparison of its capture efficiency with that of the Tunisian trawl most used in the Tunisian fisheries (shrimp trawl) shows that the capture efficiency of the Irish Trawl is three times better than that of the Tunisian trawl. Besides, the Irish trawl is more selective than the Tunisian trawl, since the catch taken by the Irish trawl is composed mainly of large fish. As a consequence, introduction of the Irish trawl into the Tunisian fisheries could contribute to resolving the problem of the fisheries of large quantities of small fish discarded into the sea and as a result preserve our marine resources.

6) Studies on trawl fishing gears in Egypt.
Shaheen, A.H.; Al-Sayes, A.A.
Inst. Oceanogr. Fish., Alexandria, Egypt
Bull. Inst. Oceanogr. Fish., Cairo. 1981. vol. 7, no. 3, pp. 549-558.
English
Abstract: The present work is the first attempt describing and correlating the horse power of the Egyptian boat's engine and both the area of board and the size of trawl. The catchability of the Italian trawls operating in the Egyptian water was evaluated, in the time being a correlation between the catch per day of the trawl and horse-power of the trawler is established.
Keywords: trawl nets; gear selectivity; fishing gear; comparative studies; MED-Egypt.

7) A study on the selectivity of mid-water trawls used to anchovy (Engraulis encrasicolus L.) fishing.
Erdem, Y, Erkoyuncu, I.
Mediterranean Fisheries Congress, 9-11 April 1997, Ege University, Fisheries Faculty, 35100, Bornova, Izmir, Turkey.
Turkish
Abstract: In this work, the selectivity of mid-water trawls was examined by comparison with the catch of a purse seine. In the experiments, 390 boxes ($\cong$ 8000 kg) and 304 boxes ($\cong$6060 kg) of anchovy were caught in two hauls of each cod-end mesh size with the mid-water trawl. The catch of the purse seine was 710 box ($\cong$13400 kg) in one haul. The mean lengths of the catches in the two cod-ends on the mid-water trawl and the purse seine were 10.35 ± 0.045, 11.08 ± 0.059 and 9.63 ± 0.047 cm, respectively. The 50% retention lengths were estimated as 9.34 and 11.07 cm for the two different cod-end mesh sizes on the mid-water trawl.
Keywords: Mid-water trawl, purse seine, mesh selection, anchovy.

8) Selettivita di una rete di tipo relingato.
Levi, D., Froglia, C. and Scorcelletti, R.
Quad. Lab. Tecnol. Pesca Ancona (1971). 2(1): 23-35.
Italian

9) Experiencias de selectividad en la pesquería de arrastre en el levante español.
Larrañeta, M.G., Suau, P. and San Feliu, J.M.
Inv. Pesq. (1969). 33(1): 15-53.
Spanish

h) Techniques of Measurement and Analysis

1) Escapement from the main body of the bottom trawl used for the Mediterranean international trawl survey (MEDITS).
Dremière, P-Y, Fiorentini, L., Cosimi, G., Leonori, I., Sala, A and Spagnolo, A.
Aquatic Living Resources, 1999, 12(3): 207-217.
English

Abstract: Escapement through the body or under the footrope of the sampling trawl used for the Mediterranean international trawl survey programme (MEDITS) was assessed i) by means of visual observations performed with a towed operating vehicle equipped with a high-sensitivity video camera, and ii) by attaching small bags to the outside of the trawl body and under the footrope. Due to the small size of most of the individuals present in the study area and to the towing speed, fish behaviour in front of the trawl could not be frequently observed. In contrast, their behaviour was easily observed inside the net, especially upstream and inside the cod-end. Some species, such as horse mackerel (Trachurus sp.), showed greater swimming endurance compared with others such as annular sea bream (Diplodus annularis). In three fishing trips conducted in different seasons in 1996 and 1997 to obtain data on several species in different areas of the Adriatic, six small net bags were mounted outside the body of the MEDITS trawl to quantify escapement through the trawl belly and under the footrope. Significant escapement of many species occurred in the near bottom part of the side panels. Norway lobster (Nephrops norvegicus) had the highest rate (64%), mainly represented by small-size individuals. The escapement of greater forkbeard (Phycis blennoides) was also high (53%). For hake (Merluccius merluccius), common pandora (Pagellus erythrinus) and poor cod (Trisopterus minutus capelanus), rates ranged from 10 to 16%. The escapement of red mullet (Mullus barbatus) was very low despite their great abundance. Blue whiting (Micromesistius poutassou) escaped mainly through the mid-height part of the side panel. This great variability of escapement values could affect the proportion rates of the species sampled during a standard survey. Different escape behaviours among size classes were observed for M.poutassou, T. minutus capelanus and P. erythrinus, with smaller individuals tending to escape towards the bottom and larger ones towards the higher parts of the trawl body. In the species where the escape rate was size dependent, therefore, the size frequency distributions obtained from the cod-end catch may not reflect actual size frequency distributions.
Keywords: Survey trawl selectivity, trawl escapement, bottom trawls, experimental fishing, underwater observations, Mediterranean.

2) A statistical method for correcting length-frequency distribution of fish larvae from mesh retention of three different ichthyoplankton samplers.
Siapatis, A.; Caragitsou, E.; Kavadas, S.; Papaconstantinou, C.
National Center of Marine Research, Ag. Kosmas, Hellenikon, Greece
Annu. Int. Symp. of the Fisheries Society of the British Isles, Galway (Ireland), 8-11 Jul 1997
Ichthyoplankton Ecology. Fisheries Society of the British Isles. 1997 p. 42
English

Abstract: Accurate estimates of length distribution of fish larvae sampled with ichthyoplankton nets are usually biased because large larvae have the ability to avoid the towing net and small larvae are extruded through the mesh. A Bongo net fitted with 0.3 mm and 0.5 mm mesh size nets, a Gulf III net with 0.25 mm mesh size net, and a Methot trawl with 3 mm mesh size net have been used for sampling ichthyoplankton in the Greek Seas for a period of five years. The length-frequency distribution of the various larvae sampled with these nets exhibit a significant difference. This was due to the different mesh sizes or towing speeds of sampling nets used, and also to the morphometry of the collected larvae. A statistical method for correcting catches of fish larvae taking into account the selectivity of the ichthyoplankton nets is used to estimate the real length-frequency distribution of the most abundant species larvae.
Keywords: Ichthyoplankton; Biological sampling; Samplers; Fish larvae; Size distribution; Body size; Gear selectivity; Fishing nets; MED-Greece.

3) Comparison of the effects on cod-end selectivity of using two different covered cod-end techniques in trawl selectivity measurements.
Tosunoglu, Z., Tokaç, A., Lök, A., Metin, C.
TÜBITAK, J. of Veterinary and Animal Sciences, 1997. 21: 449-456.
Turkish

Abstract: In this study, the effects on cod-end selectivity of using two different covered cod-end techniques, commonly used in trawl selectivity experiments, were tested with towing times of 30 and 60 minutes. It was suspected that the cod-end cover might mask the cod-end meshes. Standard and hooped cod-end covers were rigged in turn over the 22 mm nominal mesh size (knot to knot) two seam cod-end on a demersal trawl. The parameter L_{25} is most important in this respect as it indicates the relative proportion of small fish retained. Valid selection curves and parameters were obtained using each covered cod-end technique for red mullet (Mullus barbatus Lin. 1758). This species was the largest component of the catches in the demersal trawl fishery. L_{25} for red mullet was determined as 10.55 cm and 10.44 cm with the standard cover and 12.86 cm and 12.13 cm with the hooped cover, for 30 and 60 minute hauls respectively. The selection factors obtained were approximately 3.0. The masking effect of the cover, one of the most important factors affecting selectivity, has been removed by using the hooped cover, giving more reliable measurements of the cod-end selectivity parameters.
Key words: Trawl, Selectivity, Standard and hooped covers, Red mullet (Mullus barbatus).

4) Preliminary studies on the determination of survival rates of annular sea bream (Diplodus annularis L., 1758) and red mullet (Mullus barbatus L., 1758) after escaping from a traditional demersal trawl cod-end.
Metin, C., Lök, A.
E.Ü. Journal of Fisheries and Aquatic Sciences, 1997. 14: 325-335.
Turkish

Abstract: In this study, the survival rates of annular sea bream (Diplodus annularis L., 1758) and striped mullet (Mullus barbatus L., 1758) after escaping from a traditional bottom trawl cod-end with 22 mm. mesh size were investigated. Fish escaping from the cod-end were retained by a 12 mm mesh size hooped cover and were observed in tanks for a period of 8 days to determine their survival rates. These were found to vary between 67.5% and 90 % for the annular sea bream and 5 % and 20 % for the striped mullet.

Keywords: Mesh selection, survival of escaping fish, sea bream, mullet.

5) The importance of the relationship between mesh shape and fish body form in trawl net selectivity.
Tokaç, A., Tosunoglu, Z.
Proceedings of Mediterranean Fisheries Congress, 9-11 April 1997, Ege University, Fisheries Faculty, 35100, Bornova, Izmir, Turkey.
Turkish
Abstract: Mesh size and shape in the trawl cod-end and fish body form are now recognised as being amongst the factors affecting size selection of fish. The selective characteristics of fishing gears towed underwater, such as the trawl, depend on a complex system of interconnected technical and biological factors. In this study, the mesh shape and size formed in the cod-end in the process of fishing, and the fish body shape have been examined. The physical characteristics of fish are influenced by seasonal variation. Morphometric variables for four different fish species: red mullet (Mullus barbatus L), annular sea bream (Diplodus annularis L.), red pandora (Pagellus acarne L.) and axillary sea bream (Pagellus erytrinus Risso), are presented, as well as the relationship between mesh shape and body form for fishes belonging to various ecological groups. A series of experimental trawl hauls was carried out by R/V Egesüf in the Aegean Sea in 1996.
Keywords: selectivity, mesh shape, fish body form.

6) A Computer Programme on the Calculation of the Selectivity Parameters in Towed Fishing Gear illustrated for the Covered Cod-end Method (L50 version:1.0.0).
Ilkyaz, A.T., Metin, C., Kinacigil, H.T.
E.Ü. Journal of Fisheries and Aquatic Sciences, 1998. 15: 305-314.
Turkish
Abstract: In this study, a computer program was written, using the standard statistical methods, to calculate selectivity parameter from the data obtained by the covered cod-end method. L50, the selectivity parameter which symbolises the 50% retention length, is the name given to the computer program. L50 calculates the parameters: L_{25}, L_{50}, L_{75}, selection factor, selection range and draws the selection curve by using four methods of statistical analysis: loglog, cloglog, logit and probit.
Keywords: mesh selection, selectivity analysis.

7) A Software Package to Estimate Selectivity Parameters in Some Gears (GEARSEL Ver. 1.0).
Sari, M., Güven, B.
Proceeding of Eastern Anatolian region IV. Fisheries Symposium, 28-30 June, 2000, pp.179-185.
Turkish
Abstract: GEARSEL Ver. 1.0 has been prepared to aid selectivity research carried out to improve and optimise the exploitation of limited fish stocks. The program is based on summarised knowledge of the selective features of trawl and gill nets, calculation of selectivity parameters and drawing of selection curves. GEARSEL works in three stages: data entry, calculation of selectivity parameters and graphics.
Keywords: fishing gear selectivity, selectivity analysis.

Papers b)19 and d) 7 & 8 also contain information on new techniques.

Papers b) 19 & d) 7 describe the use of a trouser trawl to measure cod-end selectivity. Paper d) 9 describes the application of multi-variate analysis to catch data from a multi-species fishery.

i)   By-Catches of Marine Mammals and Reptiles

1) The environmental effects of fisheries in the Mediterranean.
Northridge, S. and Di Natale, A., 1991. Report to the EC Directorate General for the Environment, Nuclear safety and Civil Protection, Brussels. 48pp.
English

2) A review of the passive fishing nets and trap fisheries in the Mediterranean Sea.
Di Natale, A. and Notarbartolo-di-Sciara, G., Rep. Int. Whal. Commn.. (special issue) 1994, 15: 189-202.
English

Abstract: Cetacean mortality in passive fishing gear in the Mediterranean has not previously been the subject of systematic study. Data on passive fishing nets and traps are here presented for the majority of the principal national Mediterranean fisheries, including geographic information, a description of vessels, crew, gear, operations, economics and history, total landings, effort, interaction with cetaceans and, in addition, occasional bycatches of the endangered monk seal. Although data on total bycatch, species composition and CPUE are lacking, it is well known that cetaceans are incidentally caught in great numbers in fisheries in this region. Pelagic driftnets are responsible for the greatest proportion of the cetacean bycatch, although catches in coastal gillnets and traditional tuna traps also occur. Many of these fisheries are illegal but continuing. Recommendations for the conservation of cetaceans in the Mediterranean are made.
Keywords: Mediterranean, set gear fisheries, cetaceans, incidental capture.

3)An experience on the quantification and mapping of dolphin by-catches in the Sicilian Channel and testing of an acoustic-based possible solution.
Mazzola,S.; Patti,B.; Bonanno,A.; Cuttitta,A.; Basilone,G.; Tesler,W.; Tolstoganova,L.
Istituto di Technologia della Pesca e del Pescato, Via L. Vaccara 61, I-91023 Mazara del Vallo, Italy.
ICES Annual Science Conference, Baltimore, MD (USA), 25 Sep-3 Oct 1997
ICES CM 1997/Q:19
English

Abstract: This study assembles the results of the EC project coded MED93/011, aiming at gathering information about dolphin (Delphinus)-small pelagic fishery interaction in Sicilian waters. It was conducted following two different lines of investigation: 1. the quantification and mapping of dolphin by-catches which occurred during small pelagic fishery operations; 2. the study of the effects of acoustic signals, different by nature and structure, on dolphin behaviour evaluating the possibility of repelling dolphins from an area of the sea where fishing operations are taking place. To achieve the first objective, we collected data through interviews with the fishermen from the main Sicilian small pelagic fisheries. Data showed relative higher kill rates of dolphins in the western side of Sicilian waters and in fishing areas around Lampedusa island (Sicilian Channel). While following the second line of investigation, we carried out experiments in a dolphinarium aimed at selecting acoustic stimuli capable of keeping dolphins away from a certain area of the sea. The statistical analysis of the results allowed us to select a set of signals to be used for controlling dolphin behaviour at sea. In addition, we developed an electro-acoustic prototype capable of emitting

underwater acoustic signals. Finally, we implemented an experiment at sea while fishing vessels were at work to verify the operation and the effectiveness of our acoustic signals in repelling dolphins from a certain sea area. The experiments carried out at sea demonstrated that the acoustic signals used to provoke psychologically repelling stimuli (bottlenose dolphin and killer whale calls) worked well only for a short time. This fact suggests that in the future physiological methods could be studied for the purposes of repelling dolphins.

Keywords: Mid-water trawls; Echo surveys; Fish kill; Statistical analysis; Experimental research; Signal to noise ratio; Delphinus; Tursiops truncatus; Orcinus orca; MED-Sicilian Channel.

4) Are man and dolphin competing for the same resources in the Mediterranean? - evaluation of fish stocks through electro-acoustic surveys and studies on human fishing techniques and dolphinid hunting behaviour.

Azzali, M and Virno Lamberti, C. 1993. Eur. Res. Cetaceans (Abstracts), 7: p220.

Abstract: Since 1988, we have been conducting echosounder surveys in the Mediterranean in order to determine the absolute biomass of pelagic fish populations together with their spatial distribution and school structure. Simultaneously we have recorded data regarding the presence of various species of dolphins encountered during the survey. The has allowed to reveal a relationship between the type of aggregation within the schools and the species of dolphins sighted.

Where there has been evidence of very compact schools of blue fish (mainly clupeids) the visual sightings have typically involved the species bottle-nosed dolphin (*Tursiops truncatus*); on the other hand we have spotted the genus *Stenella* where the echosounder revealed a more dispersed type of fish aggregation. Geographically this difference is represented in the Adriatic and the Tyrrhenian Sea respectively.

The most relevant fishing methods employed in the Mediterranean are effectively based on the tendency of certain species to form compact schools. Thus it is reasonable to assume that there would be more competition between fishermen and *Tursiops* than with *Stenella*. If this is true, then can the extent of exploitation of the stocks damage the ecology of those cetaceans more closely competing with man? This is the object of present and future studies we are conducting.

Keywords: dolphins, aggregations, competition with fishermen.

5) Marine mammals interactions in Scombridae fishery activities: the Mediterranean case.
Di Natale, A, 1990. ICCAT. Coll. Vol. Sci. Pap., XXXIII: 140-142. Also published in FAO Fisheries Report, No. 449, FIPL/R449: 167-174.

6) Spanish driftnet fishery and incidental catches in the western Mediterranean.
Silvani, L., Gazo, M. and Aguilar, A. 1999. Biol. Conserv. 90: 79-85.
English

Abstract: The Spanish driftnet fishery operating since 1994 on the Mediterranean side of the Gibraltar Straits was an illegal activity whose main target was the swordfish *Xiphias gladius* but which also caught other species incidentally, particularly sunfish *Mola mola*. Observations during the 1993 and 1994 seasons showed that the fleet was composed of 27 boats deploying nets 3-4 km long. Swordfish constituted 7% of the catch in 1992, 5% in 1993 and 7% in 1994. Sunfish represented 71% of the catch in 1992, 93% in 1993 and 90% in 1994. Sea turtles, mainly loggerhead turtles *Carettea caretta*, constituted 0.32% of the total catch in 1993 and 0.92% in 1994. The incidental capture of small cetaceans, composed entirely of common dolphins *Delphinus delphis* in 1992 and of striped dolphin *Stenella coeruleoalba* and common dolphins in roughly equal proportions in 1993 and 1994,

constituted 0.9% of the catch in 1992, 0.6% in 1993 and 1% in 1994. The bycatch rate of dolphins was 0.1 individuals per km of net set. The total catch of dolphins can therefore be estimated at 366 (95% confidence interval 268-464) animals for the 1993 fishing season and 289 (CI 238-340) for that of 1994. If these figures are added to the undetermined catches of dolphins by the Italian and Moroccan driftnet fleets also operating in the region, it is possible that these catches are not sustainable.
Keywords: Striped dolphin, common dolphin, driftnet fishery, bycatch, southwestern Mediterranean.

7) Bioacoustic Research on Cetaceans in the Mediterranean Sea.
Pavan, G. and Borsani, J.F. 1997. Mar. Fresh. Behav. Physiol. 30(2): 99-123.
English.
Abstract: In recent years new impetus has been put into cetacean research in the Mediterranean Sea. From 1988 to 1994 research cruises were organised by our laboratory and the Tethys Research Institute within the seas surrounding the Italian peninsula and islands. Recordings of underwater sounds produced by cetaceans and other ethological and zoogeographical data were collected and analysed with the use of instruments and techniques mainly developed by the Laboratory of Marine Bioacoustics, which was conceived by the University of Padua and financed by the Inspectorate of Sea Defence of the Italian Ministry of the Environment.
Specific instruments and software packages were developed, including a high quality towed array of hydrophones, with its own amplifier and filtering unit, a portable Digital Signal Processing Workstation (DSPW) with real time analysis and file processing capabilities and an interactive Digital Sound Library (DSL).
Cetacean sounds were recorded in their natural environment from auxiliary sailing vessels up to 26 m long; sounds from six odontocete and one mysticete species were recorded, analysed, catalogued and organised in a sound library in order to allow flexible and specific access to sound information for research and other purposes such as environmental monitoring, species identification, censusing activities and educational applications.
Keywords: Bioacoustics, underwater, cetaceans, Mediterranean Sea.

8) Dispersion of Dolphins: materials and methods.
Ben Naceur, L, INSTM, La Goulette,Tunisia.
INSTM Rapport techniques. Poster
French.
Abstract: Dolphins compete directly with man as they have the same biological resources needs and are accused of destructive behaviour. The fishermen accuse them of destroying nets, with heavy economic loss in production, repair costs and replacement. In Tunisia, the problem is so important that the fishermen request radical intervention to reduce the number of these marine animals and their effects. With this aim, a mechanical sound generator was conceived in 1993 to perturb the echo location system of the dolphins. This device machine called the "dolphin tube" was put on sale nationally and its use gave satisfactory results for numerous fishermen. However, it would be pretentious to say that the problem is definitively solved. Technical development is still needed, taking in account the actual state of the dolphin populations: specific diversity, distribution, abundance, diet, behaviour etc.

9) ADEPTs Reference Data Base. Acoustic Deterrents to Eliminate Predation in Trammel nets. EC Project 98/019. 456 references on Cetaceans, Gear interactions and deterrence in the Mediterranean. Available from Dr A D Goodson, Underwater Acoustics Group, Dept. of

Electrical and Electronic Engineering, Loughborough University, Loughborough, LE11 3TU, U.K.
English

10) A preliminary study on excluding sea turtles from prawn trawls.
Atabey, S., Taskavak, E.
Turkish

Abstract: Because of the continuous increase in world population, sharing and over exploiting marine sources have endangered some marine species. Two species, *Chelonia mydas* (Linnaeus, 1758) (Green turtle) and *Caretta caretta* (Linnaeus,1758) (Loggerhead turtle) occurring and nesting on the Mediterranean beaches of Turkey have been listed and protected under the various endangered species acts. Also, the Nile soft-shelled turtle, *Trionyx triunguis* (Forskal,1775), *actually* a fresh water turtle, shares the same habitat as marine turtles in the eastern Mediterranean. Conservation measures for these species aim to protect the nesting habitats, eggs and hatchlings. Despite knowledge of sea turtle mortalities caused by commercial prawn trawlers, including capture areas, the species impacted, depths where the majority of captures occur, and the numbers captured and killed by shrimp trawls, there are no conservation measures for these species. In this study, the Turtle Excluder Devices (TEDs), developed principally to allow escape of sea turtles, were adapted for the prawn trawls used in the Eastern Mediterranean.
Key words: *Caretta caretta*, *Chelonia mydas*, Eastern Mediterranean, TED (Turtle Excluder Device)

11) Accidentally caught marine turtles and turtle excluder devices.
Atabey, S., Taskavak, E.
Turkish.

Abstract**:** This survey was carried out in 1998 (July and August). The area chosen for trawling was the water between Mordogan and Kumburnu in Izmir Bay. We focused on the adaptation of TEDs to the traditional prawn trawls utilised on the eastern Mediterranean coast of Turkey, where accidental captures of Caretta caretta and Chelonia mydas are excessive. One of the hard TEDs, Super Shooter, was found to be most suitable for the traditional prawn trawls. The effects of the net extension and the flaps on the fish harvest were not taken into consideration in the trials. It was observed that both Caretta caretta and Chelonia mydas were excluded by the modified super shooter. In addition to the tests of this model, we also observed and recorded the behaviour of both marine turtles in the trawl body.
Keywords: Super Shooter, TED, Caretta caretta, Chelonia mydas, prawn trawls, Mediterranean, Turkey.