Shellfish Committee

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REPORT OF THE

WORKING GROUP ON CEPHALOPOD FISHERIES AND LIFE HISTORY

Santa Cruz de Tenerife, Spain
7–9 April 1997

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International Council for the Exploration of the Sea

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1 INTRODUCTION

1.1 Terms of Reference

The Working Group on Cephalopod Fisheries and Life History [WGCEPH] (Chairman: Dr U. Piatkowski, Germany) met in Santa Cruz de Tenerife, Spain, from 7–9 April 1997 to (ICES C.Res.1996/2:47):

a) update currently available landing statistics;

b) collect and evaluate data on the life history and exploitation of relevant cephalopod stocks;

c) describe trophic interactions between cephalopods and other marine resources;

d) review trade statistics of cephalopods;

e) review current assessments of loliginid squid in France and UK.

1.2 Attendance

Sixteen of the currently appointed WGCEPH members (names are marked with an * plus ten non-members and observers attended the 1997 WGCEPH meeting in Santa Cruz de Tenerife:

Pedro Andrade	Faro, Portugal
Nick Bailey*	Aberdeen, UK
Eduardo Balguerías	Santa Cruz de Tenerife, Spain
Herman Bjørke*	Bergen, Norway
Teresa Borges*	Faro, Portugal
Peter Boyle*	Aberdeen, UK
Tom Cross	Cork, Ireland
Manuela Morais da Cunha*	Lisbon, Portugal
Earl Dawe*	St. John's, Canada
Maria del Mar Fernandez*	Santa Cruz de Tenerife, Spain
Paul Galvin	Cork, Ireland
Angel González*	Vigo, Spain
Angel Guerra*	Vigo, Spain
Carlos Hernández	Santa Cruz de Tenerife, Spain
Drosos Koutsoubas	Heraklion, Greece
Helen Martins	Horta, Azores, Portugal
Ana Moreno*	Lisbon, Portugal
João Pereira*	Lisbon, Portugal
Uwe Piatkowski (Chairman)*	Kiel, Germany
Graham Pierce*	Aberdeen, UK
Julio Portela*	Vigo, Spain
Mario Rasero*	Vigo, Spain
Catalina Raya	Santa Cruz de Tenerife, Spain
Paul Rodhouse*	Cambridge, UK
Jan Sundet	Tromsø, Norway
Phil Trathan	Cambridge, UK

The twenty-six participants represented eight countries (number of persons in parenthesis): Canada (1), Germany (1), Greece (1), Ireland (2), Norway (2), Portugal (6), Spain (8), and UK (5). The complete list of participants is given in Annex 1. The names of appointed members to WGCEPH are provided in Annex 2.

The following members notified the Working Group that they were unable to attend the meeting: Sophie des Clers, UK; Lisa Hendrickson, USA; Vicente Hernández-García, Spain; Colm Lordan, Ireland (proxy Tom Cross); William Macy, USA; Jean-Paul Robin, France; and Mike Vecchione, USA.

1.3 Opening of the Meeting

The meeting took place in the conference room of the Centro Oceanográfico de Canarias in Santa Cruz de Tenerife from 7–9 April 1997. Local arrangements were perfectly organized by the hosts, in particular by Catalina Raya, Carlos Hernández and Eduardo Balguerias, and WGCEPH appreciated the superb atmosphere of the meeting.

1.4 Arrangements for the Preparation of the Report

The Chairman reminded participants that the ICES Secretariat requires that the Working Group report be drafted by the end of the meeting, as is now standard practice. This was not possible due to the fact that essential data were not available. Working Group members agreed to make these data available as soon as possible after the meeting and to send the relevant information to the Chairman. The Chairman agreed to prepare the report in collaboration with the participants but to include the missing data, and to undertake any final detailed editing of the text prior to submitting it to the ICES Secretariat.

1.5 Working Group Papers and further Presentations of Interest to WGCEPH

Five Working Group papers were available at the meeting and/or shortly thereafter. The information presented therein was partially used to compile the present report. The relevant papers are attached to this report as Annexes 3 to 7.

In addition, a number of oral presentations of general interest to the Working Group were given by some participants. Herman Bjørke (Norway) reported on new results on egg masses of the squid *Gonatus fabricii* caught with pelagic trawl off northern Norway. *G. fabricii* is the most abundant squid of the Arctic and sub-Arctic waters of the Atlantic. It is an important prey of many fishes, seabirds and marine mammals and the biomass of young *G. fabricii* in the upper 30 m of the Norwegian Sea has been assessed to be as high as 1.5 million tonnes during the summer of 1994 (Bjørke, 1995). The species, however, is not included in landing statistics and nothing is known about its recruitment.

Experiments on target strengths (TS) of the European flying squid *Todarodes sagittatus* with SIMRAD EK 400 echosounders were presented by Jan Sundet (Norway). Data indicate that TS-values differed markedly between live (–40 to –60 dB) and dead (circa –45 dB) animals investigated during the experiment as well as between animals of different size classes. Large animals showed smaller TS-values than small animals. Comparisons with experiments undertaken by Japanese researchers on *Todarodes pacificus* show that their TS-values were significantly higher (less than –30 dB) than those obtained in the Norwegian studies. This was explained by the different techniques which were applied. The Japanese group used frozen squid which obtained significant air inclusions. These inclusions make the squid similar to fish with swim bladders and are responsible for the increased TS-values that were in the range of values normally obtained from cod. The experiments show that further studies are needed to obtain meaningful conclusions.

Recent trends in total world landings of all cephalopods, including current main fisheries and new fisheries were presented by Paul Rodhouse (UK). Results show that total cephalopod landings have nearly doubled in the last decade (from circa 1.6 million tonnes in 1984 to circa 3 million tonnes in 1994). The increase has largely been due to oceanic squid caught over continental shelves. In general, neritic squid, cuttlefish, and octopus landings have changed little during this period. There is probably limited potential for further sustainable increases in neritic or shelf cephalopod fisheries. There is also evidence that cephalopod stocks have increased as fish stocks have declined but the volume has not been replaced. Off-shelf oceanic squid may have potential for increased exploitation but research is needed to support their sustainable management.

Another presentation by Paul Rodhouse described the variation and change of southwestern Atlantic cephalopod resources. The *Illex argentinus* stock is highly variable, catch rates fluctuated by a factor of about three between 1987 and 1996. The 1994–1996 catches do not reflect the full potential of this stock which is overexploited over its range—including the high seas. The *Loligo gahi* stock is also variable but less than *I. argentinus*. Catches have fluctuated by a factor of about two over the last decade. However, there is no evidence of overexploitation and, within the limits of natural variation, we can expect catches to remain stable. The *Martialia hyadesi* stock is not well researched. In the CCAMLR area management will reflect ecological sensitivity and the development of any new fishery will be cautious. Both presentations by Paul Rodhouse have been given at the 4th International Cephalopod Trade Conference SQUID 96 in New Orleans and will appear in the conference proceedings.

Earl Dawe (Canada) provided information on recent squid ageing studies. Results demonstrate the discrepancies in counting daily increment rings in squid statoliths when different investigators estimate the same statolith. Some counting experiments showed that countings of a statolith from an approximately 200 day-old squid with approximately 200 daily increments by different researchers were highly variable and differed as much as 40 recognized increments. The studies emphasise the general problem in ageing squid by counting hard increments.

2 CEPHALOPOD LANDING STATISTICS (TOR 1)

2.1 Compilation of Landing Statistics

As for last year, the present report updates the landing statistics available for cephalopod groups within the ICES area (Tables 1 to 6). Data are based largely on last year's report (ICES, 1996). New and additional information were provided by Working Group members in accordance with their national authorities. Additionally, available statistics originating from the ICES STATLANT 27A database were considered. As in previous years, however, the database information was incomplete and numbers were not identical with the information which Working Group members supplied. In cases of discrepancy, the larger number was always used in the tables in order not to underestimate the true catch. It must be noted that several ICES Member Countries did not supply updated information for 1996 (see below). In these cases, a number similar to the 1995 catch was taken as a best estimate. These estimates, as well as some numbers which were regarded as preliminary, are marked with a 'P' (provisional). It is hoped that these numbers will be more accurate in next year's report.

Tables 1 to 4 give information on annual catch statistics (1990–1996) per cephalopod group in each ICES division or sub-area, separated by country. The cephalopod groups in the tables comprise the following species:

Table 1. Cuttlefish (Sepiidae) and bobtail squid (Sepiolidae). The majority of landings summarised in these tables are catches of *Sepia officinalis*, the common cuttlefish.

Table 2. Common squid (includes the long-finned squids *Loligo forbesi*, *Loligo vulgaris*, and *Alloteuthis subulata*).

Table 3. Short-finned squid (*Illex coindetii* and *Todaropsis eblanae*) and European flying squid (*Todarodes sagittatus*).

Table 4. Octopus (*Eledone cirrhosa* and *Octopus vulgaris*).

A compilation separated into single species is not yet possible as countries report landings for cephalopod groups, mostly in the format given in the tables.

Table 5 summarises total annual cephalopod landings for the entire ICES area for major cephalopod groups. Table 6 provides information on total annual cephalopod landings for the entire ICES area for major cephalopod groups separated by country.

2.2 General Trends

From 1994 to 1995 total landings of each cephalopod group increased (Table 5) which is reflected in the increase of the total catch from 41,974 tonnes in 1994 to 50,677 tonnes in 1995. Provisional data for 1996 indicate that the total catch (approximately 50,000 tonnes per year) remained stable. The recent increase is mainly due to markedly higher yields of cuttlefish and octopus whereas total landings of common squid and short-finned squid only increased slightly. This development is the result of increased catches of cuttlefish taken by England and Wales, and France, and of octopus taken by Portugal (Table 6).

In Belgium cephalopods are only caught as by-catch and yields are relatively low. Major fishing areas are the southern North Sea and the English Channel. Common squid is the most important group with annual catches of 468 tonnes in 1995 and 447 tonnes in 1996.

In Denmark common squid is caught as by-catch in the trawl fishery and numbers are very low with a total of only 2 tonnes in recent years. Total catches are probably higher as indicated by inspections in Danish fishing ports (Hwide Sande, Hirtshals), but no registered information is available.

Cephalopod landings by UK vessels in England, Wales and Northern Ireland were provided to the Working Group from the database held at the CEFAS Fisheries Laboratory. The most important group landed in England and Wales is cuttlefish with landings of over 4000 tonnes in 1995 and 1996 from the Channel and western approaches. Common squid are also important for this area. Cephalopod landings for Northern Ireland are mainly squid from the Irish Sea (VIIa).

France is still the most important fishing nation for cuttlefish (*Sepia officinalis*) and common squid (*Loligo* spp.) in the ICES region. Major fishing grounds are the English Channel and the Bay of Biscay. During recent years (1990 to 1995) catches varied from about 10,000 to 20,000 tonnes for cuttlefish and approximately 4,000 to 7,000 tonnes for common squid. Data on landings in 1996 were not available and numbers similar to those from 1995 were provisionally listed in the tables.

As for other countries, cephalopods are no 'quota species' for Ireland. Therefore, available catch data have to be treated with great caution. Common squid (mainly *Loligo forbesi*) contribute the major share of cephalopods landed in Ireland and its catch peaked in 1995 with 1042 tonnes. They are mainly caught in ICES divisions VI and VII. A considerable amount of common squid caught in Irish waters is also landed in Spanish ports. Data on landings in 1996 were not available and slightly reduced (provisional) numbers compared to 1995 are listed in the tables. However, preliminary data on by-catches of short-finned squid in the demersal trawl fishery in Irish Waters were presented to the Working Group. Of these *Illex coindetii* shows the most potential for commercial exploitation. Numbers of *I. coindetii* by-caught in the deep-water (300–600 m) demersal trawl fishery increase in November and early December. The species occurs in abundance until early May when they seem to migrate away from the fishing grounds. During the 1996 season, the catch rates peaked in March at just under half a tonne per hour. During the 1997 season catch rates have been hampered by bad weather in February and large numbers of scad (*Trachurus trachurus*) in the fishing area.

In Norway the European flying squid (*Todarodes sagittatus*) again appeared in fishery statistics in 1995 with a total of 352 tonnes caught during the autumn. The possible 'return' of *T. sagittatus* to North European waters could not be confirmed, because no squid landings were reported in 1996.

Portugal regularly provides catch statistics for all major groups to ICES. Octopus catches (*Octopus vulgaris* and *Eledone cirrhosa*) increased remarkably in ICES sub-area IX from 9708 tonnes in 1995 to 11,437 tonnes in 1996. The fishing effort for octopus increases steadily. The percentage of the artisanal fishery in the octopus landings is more than 80 % which emphasizes the importance of this fishery for the local market (supply of restaurants). Further detailed information on cephalopod landings during the past ten years and on landings per gear type is provided in Annex 3.

Landings of cephalopods by UK vessels in Scotland were provided to the Working Group from the database held at the FRS Marine Laboratory. Final figures for 1995 and provisional figures for 1996 were made available for common squid (*Loligo forbesi*), octopus (*Eledone cirrhosa*), and cuttlefish (*Sepia officinalis*) and are presented in Tables 1 to 4. Cuttlefish landings were restricted to less than a tonne from ICES sub-areas IV and VI and octopus landings were similarly limited in these areas in recent years.

Detailed catch statistics from Spain were made available to the Working Group. A document summarising available Spanish cephalopod landings for the period 1990–1996 separated by species for ICES sub-areas VI, VII, VIII, and IX, is attached as Annex 4. Landings in 1996 were similar to recent years (Tables 1 to 4; Table 6), except for short-finned squid which increased from 862 tonnes in 1995 to 2409 tonnes in 1996. This increase, however, is most probably due to improved statistics. In former years, landings of short-finned squid were underestimated in the statistics.

2.3 Cephalopod Discards

WGCEPH pointed out that discards have gained major importance in many other target fisheries. Although the issue of discards is not presently a term of reference for the Working Group, it should be considered in future work (see Recommendations). Initial results on discarded cephalopods from commercial fisheries on the southern coast of Portugal were presented by Teresa Borges (Portugal). These findings were presented as a Working Group paper and are attached as Annex 5.

2.4 Conclusions

The quality of available landing statistics has been discussed in detail in earlier reports of WGCEPH. During recent years there have been considerable improvements, notably in the data supplied by Portugal and Spain. However, this year no updated information was available from France or Ireland.

As already outlined in earlier reports, difficulties in several aspects of data collection remain unresolved. Where cephalopod data are recorded, there is frequently uncertainty on the species composition. The extent of this problem varies from country to country, with some countries making no distinctions, some countries distinguishing between major groups such as cuttlefish, squid, octopus, and some countries providing details on individual species. As long as cephalopod species are not regarded as quota species, this situation will not change.

As an important first step for management advice, WGCEPH recommends that legislation on exploitation should be established. Furthermore, restrictions on the length and weight of exploited stocks should be introduced (see ICES, 1996).

3 COLLECTION OF DATA ON CEPHALOPOD LIFE HISTORY (TOR 2)

3.1 Compilation of Data

WGCEPH has compiled comprehensive data on the life history of all squid species which are exploited in the ICES area. New updates were provided by all Working Group members and are considered in Tables 7 to 11. The life history data will be reviewed regularly and information on new interesting species will be included.

Angel Guerra and co-workers (Spain) supplied additional information on life history, fisheries, parasites, and genetics on cephalopods from Spanish waters. The results are summarized in a working paper which is attached to this report as Annex 6.

3.2 Conclusions

The detailed information on cephalopod life history data collected by WGCEPH has generated great interest in recent years. As stated in earlier reports, ICES should initiate links between activities on cephalopods and those in environmental disciplines, such as hydrography, in order to investigate more fully the factors controlling recruitment in squid and distribution/migration patterns of juveniles and adults. Fisheries for these species are frequently characterised by their sporadic nature and environmental factors have been implicated although evidence has not been fully considered and it is not known whether processes operate at the egg, paralarval, or later life stages.

4 TROPHIC INTERACTIONS INVOLVING CEPHALOPODS (TOR 3)

4.1 Cephalopods as Predators

Comprehensive information on this subject has already been provided by WGCEPH in its 1996 report (ICES, 1996).

New information was presented on the feeding ecology of short-finned squid *Illex illecebrosus* at Newfoundland, Canada (Dawe *et al.*, 1997). Fish otoliths were collected from stomachs of short-finned squid at 11 coastal Newfoundland localities (1980–1993). Most otoliths were of young-of-the-year Atlantic cod (*Gadus morhua*) and they were common at all localities after July. Other important fish prey included capelin (*Mallotus villosus*), juvenile sand lance (*Ammodytes* sp.), Arctic cod (*Boreogadus saida*), Atlantic herring (*Clupea harengus*), redfish (*Sebastes* sp.), and unidentified hake (Gadidae). Results demonstrate the great importance of the predatory input squid has on commercially important finfish. Among the biases to estimate the effects of squid predation on fish are apparent tendencies for squid not to consume the heads and otoliths when they prey upon large fish, and for otoliths to remain in stomachs for variable periods of time depending on their size and shape.

Detailed information on the role of cephalopods as predators have been recently reviewed by Rodhouse and Nigmatullin (1996). The authors point out that resaerch on cephalopod stomach contents is hampered because the beak is used to bite prey into small pieces so hard parts, which are usually needed for identification, are often rejected causing potential bias in the estimation of diet. Cephalopods may also feed unnaturally in the presence of sampling gear. Despite these problems, there is a growing body of data on cephalopod predation collected during direct observations, by conventional visual analysis of stomach contents, and by serological methods. Most species feed on small crustaceans as juveniles and shift the diet to larger fish and other cephalopods during growth. This shift is accompanied by ontogenetic changes in the allometry of the brachial crown. There is increasing evidence that myctophid fishes are an important food resource for oceanic squid. When predation on commercial stocks of fish and crustaceans is involved, the effect of cephalopod feeding on recruitment may be significant. Most data suggest that cephalopods are trophic opportunists in marine food webs from polar to equatorial seas.

Further new information on feeding and foraging in cephalopods has been compiled by Hanlon and Messenger (1996) in their recently published book, 'Cephalopod Behaviour'. The book focuses on morphological adaptations for feeding, detecting and recognizing prey, capturing prey, modes of hunting, foraging strategies, prey types and the ontogeny of feeding, and cannibalism.

Finally, new information will soon be published by Dawe and Brodziak (in press) on trophic relationships, ecosystem variability and recruitment in short-finned squid of the genus *Illex*. In this publication the authors review ontogenetic trends in trophic interactions involving *Illex*. One of the main findings is that recruitment of *Illex illecebrosus* to a coastal fishery area near the limit of its distribution may be related to abundance of fish prey.

4.2 Cephalopods as Prey

Comprehensive information on cephalopods as prey was provided by WGCEPH in its 1996 report (ICES, 1996).

New information was supplied on cephalopod prey in stomachs of sperm whales stranded in the North Sea (Santos *et al.*, 1996a) and on cephalopod diets of small cetaceans stranded off northewestern Spain (Santos *et al.*, 1996b).

Clarke *et al.* (1996) examined the diet of blue sharks (*Prionace glauca*) in Azorean waters. In all, there were at least 11 species of fish and 37 species of cephalopods in the diet of 195 stomach contents caught off the Azores from October 1993 to July 1994. A number of rarely caught cephalopod species was an important component in the diet. Comparisons with swordfish and sperm whale diets from the same region clearly suggest selection in their predation.

Finally, WGCEPH points out that the importance of seabirds, seals, cetaceans, and fishes as cephalopod predators has been comprehensively reviewed by Croxall and Prince (1996), Klages (1996), Clarke (1996), and Smale (1996).

4.3 Conclusions

The role of cephalopods in oceanic and continental shelf food webs was discussed and the importance of interactions between squids and fishes was highlighted. It was recognized that the role of squids in heavily exploited continental shelf ecosystems may change due to recent declines in commercial fish resources. The spatial distribution and abundance of squid in such ecosystems may be positively affected by reductions in pressures of predation and competition, whereas they may be adversely affected by reduced availability of fish prey. It was also recognized that predation by squid may adversely affect recovery of depressed fish stocks. Difficulties in quantifying the effects of predation by squid were discussed and the use of parasite burdens as indicators of prey spectrum was suggested.

Further new results on this topic will be presented at the 1998 ICES Annual Science Conference in Lisbon during a Theme Session on the 'Impact of Cephalopods in the Food Chain and their Interaction with the Environment' which will be convened by two WGCEPH members, Uwe Piatkowski (Germany) and Manuela Morais da Cunha (Portugal). See Section 7.3 for further information on this topic.

5 TRADE STATISTICS INVOLVING CEPHALOPODS (TOR 4)

WGCEPH wants to point out that this topic has been comprehensively summarized in a report supplied by GLOBEFISH (1994), in which statistics on world production and trade in cephalopods from 1980 to 1993 are described. With a current value for European landings and exports of cephalopod resources running at over one billion ECU, the economic value of this animal group is widely acknowledged.

At the Working Group meeting, new information on trade statistics were provided by Germany and Portugal. German data show a steady increase of cephalopod imports from 1985 to 1995 (Figure 1). A maximum value of approximately 9000 tonnes was reached in 1995. These imports had a total value of nearly 50 million DM in 1995 (Figure 2). Data, although low if compared with other European nations such as Italy or Spain, clearly show the increasing importance of cephalopods on the German market. It must be noted, however, that many cephalopods are exported from Germany to other European nations after being processed as preserved food.

Portuguese trade statistics demonstrate a much greater importance of cephalopods on the Portuguese market than in Germany. Imports from 1985 to 1994 were in the range of 11,663 to 20,546 tonnes and exports varied between 930 and 3909 tonnes. Total import values were in the range of approximately 8 to 25 million ECU emphasizing their high economic importance in Portugal. A detailed compilation of the Portuguese trade statistics was provided as a Working Group paper and is attached as Annex 7.

6 CURRENT ASSESSMENTS OF LOLIGINID SQUID IN FRANCE AND UK (TOR 5)

In its 1995 report (ICES, 1995), the Working Group pointed out that ICES should be more proactive in encouraging national administrations to collect and collate basic fisheries data for the most common species disaggregated to the statistical square level. This will give a better picture of the actual removals by fishing, a clearer picture of cephalopod distributions, and will also provide the basic data for use in fisheries or population models.

Unfortunately, assessments on cephalopod species exploited in the Northeast Atlantic are still not available and TACs for the most important species cannot be recommended. This is mostly due to the inadequacy of basic fisheries data. In contrast, assessment and management techniques for annual migratory stocks of the short-finned squid *Illex argentinus* n the southwestern Atlantic have been provided recently (Basson *et al.*, 1997).

However, first assessments of the loliginid stock around the British Isles, including the English Channel and the Celtic Sea, have now become available (see Pierce *et al.*, 1996). The size of the *Loligo* stocks in northeastern Atlantic waters during the years 1989–1994 were estimated using depletion methods, based on fishery data obtained from UK and French fleets. For the northern North Sea (ICES division IVa) and at Rockall (ICES division VIb), depletion methods produced reasonably satisfactory and robust estimates of stock size, whereas estimates for the west coast of Scotland (ICES division VIa) and the English Channel were not sensitive to choice of input CPUE series. In area VIa, French and Scottish fleets showed distinct geographical and seasonal patterns of CPUE. Results indicate stocks of multiples of 10^6 animals, small compared to those of many other exploited marine species. However, *Loligo* is at the north of its range in the areas assessed and there is a need to extend studies to southern Europe, where improved fishery data are now becoming available (see above), and to obtain more information on natural mortality and migration. Due to the short life cycle of squid (see Table 8), in the event that stocks become subject to assessment and management, 'real-time' methods will be required (Pierce *et al.*, 1996).

7 ANY OTHER BUSINESS

7.1 Comments on Working Group Function

The use of prepared Working Group papers has substantially enhanced the efficiency of annual WGCEPH meetings. Additionally, examination of special topics has been provided by WGCEPH sub-groups in the form of presentations at recent ICES Annual Science Conferences (for example, see Pierce *et al.*, 1996, on stock assessment of *Loligo* spp.). Likewise, the possibility to communicate by e-mail with many members has greatly simplified the administration and coordination of the Working Group. However, some countries (e.g., France, Ireland) still do not have appointed members with sufficient responsibility to supply relevant information for the Working Group's terms of reference. Also, participation by French and U.S. members in recent Working Group activities remains limited.

7.2 Comments on Travel Funds

For some members the issue of travel funds has improved, but funding continues to be a major obstacle for many members desiring to attend annual meetings. WGCEPH strongly recommends that ICES Member Countries follow up their appointment of members to the Working Groups with some responsibility that travel funds are made available.

7.3 Contributions of WGCEPH members at the 1996 ICES ASC in Reykjavik

Several contributions have been presented by WGCEPH members at the last ICES Annual Science Conference in Reykjavik (1996) during the scientific sessions of the Shellfish Committee: Moreno *et al.* (1996) reported on age and growth of the squid *Loligo vulgaris* from Portuguese waters; Fernández-Núñez *et al.* (1996) gave information on the reproductive biology of *Octopus vulgaris* from the North Western African coast; Bjørke and Hansen (1996) presented recordings of mature *Gonatus fabricii* off the Norwegian coast; Hernández-García *et al.* (1996) described the cephalopod fishery off the Southwest of Gran Canaria; Rasero and Portela (1996) reported the occurrence of mated females of *Loligo gahi* in the Falkland Island fishery.

Two presentations on the cephalopod diets of cetaceans were given by Santos *et al.* (1996a, 1996b) during the scientific sessions of the Marine Mammals Committee.

7.4 Cephalopod Theme Session

At the 1998 ICES Annual Science Conference in Lisbon a Theme Session is planned on the 'Impact of Cephalopods in the Food Chain and their Interaction with the Environment'. WGCEPH has agreed to support this Theme Session and to promote it within the international community of cephalopod researchers. Co-conveners for the Theme Session will be Uwe Piatkowski (Germany) and Manuela Morais da Cunha (Portugal), both active members of WGCEPH. Four sessions have been allocated which will include three keynotes (30-minute talks) and seventeen papers (15-minute talks).

7.5 New EC Project on Cephalopod Resource Dynamics

A new large cephalopod project of the European Community's Research Programmes in the Fisheries Sector was started in 1996. Peter Boyle (UK), co-ordinator of the project and WGCEPH member, informed the Working Group of the aims and tasks of the new project 'Cephalopod Resources Dynamics: Patterns in Environmental and Genetic Variation'. The aim of the project is to improve understanding of the variability in distribution, abundance, and biological characteristics of economically important cephalopod stocks in EU waters of the Northeast Atlantic and the Mediterranean Sea. Specific objectives are (1) to develop a GIS system for cephalopod fisheries in European waters and to integrate fishery, survey, and environmental data at appropriate temporal and spatial scales; (2) to refine the quantitative description of seasonal and inter-annual patterns of distribution and abundance of fished cephalopods and develop models to predict their abundance from biotic and physical oceanographic parameters; (3) to use microsatellite DNA variation as an indicator of stock structure and interactions of neritic cephalopod resources through the use of DNA marker 'tags', supplemented with allozyme and mitochondrial DNA (mtDNA) studies to clarify selected problems of systematics; (4) to integrate the new environmental and genetic approaches with recent findings on biological variation in the European cephalopod populations of the Northeast Atlantic and the Mediterranean Sea, to determine whether this variation is due to plasticity of responses to environmental conditions or due to underlying genetic variation.

Participating institutions are from UK, Ireland, France, Spain, Portugal and Greece. The outcomes of the project will be made available as rapidly as possible through regular reporting at the WGCEPH and the ICES Annual Sciences Conferences. Most participants in the new project are current members of WGCEPH which will guarantee that the Working Group will largely benefit from the project and vice versa.

8 RECOMMENDATIONS

The attendance at the 1997 Working Group meeting in Santa Cruz de Tenerife was better than in all previous years highlighting the increasing importance of cephalopod fisheries in the ICES area. During discussion on a meeting place in 1998 several Working Group members responded positively with invitations. However, no final conclusions could me made. Therefore, WGCEPH recommends that it will meet for a period of three days in March 1998 at a place not yet decided.

Concerning Terms of Reference for 1998, it was decided to recommend:

a) update currently available landing statistics;

b) review the current status of data, methodology and results available for stock assessment of fished cephalopods, including information on stock identity, fishing effort and discards;

c) review greyish literature which is available and of importance to cephalopod fisheries;

d) contribute to the 1998 ICES Annual Science Conference Theme Session on "Impact of Cephalopods in the Food Chain and their Interaction with the Environment".

9 CLOSING OF THE MEETING

On behalf of WGCEPH, the Chairman thanked the staff of the Centro Oceanográfico de Canarias for their hospitality and closed the meeting at 16:00 hrs on 9 April 1997.

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Table 1. Landings (in tonnes) of Cuttlefish (Sepiidae) and Bobtail Squid (Sepiolidae).

Country	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996P**
ICES Division IVb (Central North Sea)							
Belgium	0	2	12	6	+	1	0
England & Wales	0	+	+	2	+	2	+
France	1	0	0	0	0	+	+P
Total	1	2	12	8	+	3	+P
ICES Division IVc (Southern North Sea)							
Belgium	0	9	13	25	13	15	5
England & Wales	2	15	26	22	47	163	90
France	118	43	111	173	191	348	200P
Total	120	67	150	220	251	526	295P
ICES Division VIa (NW coast of Scotland and North Ireland)							
England & Wales	0	+	1	+	1	+	+
France	1	4	0	0	1	1	1P
Total	1	4	1	+	2	1	1P
ICES Division VIIa (Irish Sea)							
Belgium	0	1	4	1	2	1	1
England & Wales	6	5	46	11	13	19	8
France	5	2	0	4	0	0	0P
Total	11	8	50	16	15	20	9P
ICES Divisions VIIb, c (West of Ireland and Porcupine Bank)							
England & Wales	0	0	0	0	5	0	+
France	1	0	0	0	1	+	+P
Total	1	0	0	0	6	+	+P
ICES Divisions VIId, e (English Channel)							
Belgium	0	15	20	24	19	19	11
Channel Islands	20	1	4	2	2	1	1P
England & Wales	3,000	642	898	1,882	1,797	3,925	4,038
France	12,754	7,545	4,504	9,216	6,440	7,966	7,000P
Total	15,774	8,203	5,426	11,124	8,258	11,911	11,050P
ICES Division VIIf (Bristol Channel)							
Belgium	0	4	4	11	14	4	1
England & Wales	83	28	35	95	38	42	64
France	67	10	17	27	22	32	30P
Scotland	5	0	0	0	0	0	0
Total	155	42	56	133	74	78	95P
ICES Divisions VIIg-k (Celtic Sea and SW of Ireland)							
Belgium	0	3	9	12	4	5	3
England & Wales	443	39	101	114	134	188	360
France	2,293	1,051	340	390	311	566	500P
Spain	16	20	2	2P	4	+	11
Total	2,752	1,113	452	518P	453	759	874P

Table 1. continued.

Country	1990	1991	1992	1993	1994	1995	1996P
ICES Subarea VIII (Bay of Biscay)							
Belgium	0	0	3	5	4	+	0
England & Wales	7	42	58	41	56	2	39
France	6,328	4,283	5,662	4,013	4,958	5,829	5,000P
Spain	494	614	551	575P	451	194	476
Total	6,829	4,939	6,274	4,634P	5,469	6,025	5,515P
ICES Subarea IX (Portuguese Waters)							
Portugal	1,608	1,197	1,230	1,205	1,120	981	1,625
Spain	1,011	911	1,029	832	773	1,025	924
Total	2,619	2,108	2,259	2,037	1,893	2,006	2,549
Grand Total	28,263	16,486	14,680	18,692	16,421	21,329	20,388P

Table 2. Landings (in tonnes) of Common Squid (includes *Loligo forbesi*, *Loligo vulgaris* and *Alloteuthis subulata*).

Country	1990	1991	1992	1993	1994	1995	1996P
ICES Division IIIa (Skagerrak and Kattegat)							
Denmark	19	13	37	2	0	1	1
Sweden	1	1	3	0	+	2	+
Total	20	14	40	2	+	3	1
ICES Division IVa (Northern North Sea)							
Denmark	5	7	7	1	1	1	1
England & Wales	4	1	9	1	1	+	+
France	26	10	6	1	0	+	+P
Germany	0	+	+	+	+	+	+
Scotland	952	549	561	242	93	268	263
Total	987	567	583	245	95	269	264P
ICES Division IVb (Central North Sea)							
Belgium	38	4	6	22	13	14	12
Denmark	9	2	10	2	+	+	+
England & Wales	83	22	50	22	4	22	21
France	4	2	0	0	0	1	1P
Germany	2	+	2	1	1	3	1
Scotland	151	62	106	36	5	25	14
Total	287	92	174	83	23	65	49P
ICES Division IVc (Southern North Sea)							
Belgium	142	19	35	84	113	153	113
Denmark	0	0	0	0	+	+	+
England & Wales	3	2	4	3	10	13	3
France	97	103	118	298	193	254	200P
Germany	+	+	+	1	2	6	2
Total	242	124	157	386	318	426	318P

Table 2. continued.

Country	1990	1991	1992	1993	1994	1995	1996P
ICES Division Vb (Faroe Grounds)							
England & Wales	+	0	0	0	1	+	0
Faroe Islands	+	+	+	+	1	+	+P
Scotland	2	+	5	+	+	+	1
Total	2	+	5	+	2	+	1P
ICES Division VIa (NW coast of Scotland and North Ireland)							
England & Wales	2	1	50	24	129	6	+
France	330	245	227	172	138	113	100P
Ireland	30	15	30	78	36	158	50P
Northern Ireland	1	3	21	4	15	10	4
Scotland	267	248	339	182	91	267	245
Total	630	512	667	460	409	554	399P
ICES Division VIb (Rockall)							
England & Wales	6	1	8	1	6	2	2
Ireland	10	26	50	5	6	5	5P
Scotland	70	21	65	9	28	6	17
Spain	0	0	0	2P	2	2	1
Total	86	48	123	17P	42	15	25P
ICES Division VIIa (Irish Sea)							
Belgium	36	1	6	0	3	2	13
England & Wales	37	25	74	112	133	19	23
France	31	41	65	52	30	20	20P
Ireland	5	4	5	112	66	192	100P
Isle of Man	12	7	15	15	6	7	7P
Northern Ireland	73	33	89	62	101	137	195
Scotland	9	6	19	10	4	2	2
Total	203	117	273	363	343	379	360P
ICES Divisions VIIb, c (West of Ireland and Porcupine Bank)							
England & Wales	0	1	13	47	79	2	+
France	61	59	20	58	66	14	20P
Ireland	10	24	40	35	11	282	100P
Northern Ireland	0	0	0	1	0	0	0
Scotland	2	2	5	1	18	1	+
Total	73	86	78	141	174	299	120P
ICES Divisions VIId, e (English Channel)							
Belgium	213	45	86	70	132	220	182
Channel Islands	2	0	1	0	0	2	2P
England & Wales	566	416	698	869	727	672	364
France	1,740	1,926	2,705	3,850	2,474	2,584	2,500P
Total	3,302	2,387	3,490	4,789	3,333	3,478	3,048P
ICES Division VIIf (Bristol Channel)							
Belgium	23	10	2	+	4	13	16
England & Wales	56	35	57	134	161	132	39
France	88	190	439	441	434	392	400P
Total	167	235	498	575	599	537	455P

Table 2. continued.

Country	1990	1991	1992	1993	1994	1995	1996P
ICES Divisions VIIg-k (Celtic Sea and SW of Ireland)							
Belgium	54	4	3	2	9	26	65
England & Wales	74	24	122	282	600	41	65
France	516	354	580	655	520	408	400P
Germany	0	0	0	0	0	2	0
Ireland	112	80	135	133	164	405	100P
Scotland	2	1	8	14	34	1	+
Spain	28	31	62	85	39	29	89
Total	786	494	910	1,171	1,366	912	719P
ICES Sub-area VIII (Bay of Biscay)							
Belgium	40	6	34	36	17	40	46
England & Wales	17	84	65	94	96	+	+
France	1,868	1,140	1,231	1,345	2,281	2,225	2,200P
Spain	323	189	267	33	588	196	427
Total	2,248	1,419	1,597	1,508	2,982	2,461	2,673P
ICES Sub-area IX (Portuguese Waters)							
Portugal	1,283	1,869	1,569	508	309	908	461
Spain	442	1,034	636	300	210	245	237
Total	1,725	2,903	2,205	808	519	1,153	698
ICES Sub-area X (Azores Grounds)							
Portugal*	333	258	72	108	114	250	200
Grand Total	11,091	9,256	10,872	10,656	10,319	10,801	9,330P

*Landings consist exclusively of *Loligo forbesi.*

Table 3. Landings (in tonnes) of Short-finned Squid (*Illex coindetii* and *Todaropsis eblanae*) and European Flying Squid (*Todarodes sagittatus*).

Country	1990	1991	1992	1993	1994	1995	1996P
ICES Sub-area I + II (Barents Sea and Norwegian Sea)							
Norway*	0	0	0	0	0	352	0
ICES Division Va (Iceland Grounds)							
Iceland*	0	0	0	0	0	11	2
ICES Division VIa, b (NW coast of Scotland and North Ireland, Rockall)							
France	1	1	+	+	+	+	+P
Ireland	0	0	0	0	0	96	50P
Spain	0	68	2	+P	0	0	0
Total	1	69	2	+P	0	96	50P
ICES Divisions VIIb, c (West of Ireland and Porcupine Bank)							
France	0	1	3	+	+	+	+P
Ireland	0	0	0	0	0	21	10P
Total	0	1	3	0	0	21	10P
ICES Divisions VIId, e (English Channel)							
England & Wales	7	0	0	0	0	+	0
France	250	315	335	344	359	+	+P
Total	257	315	335	344	359	+	+P
ICES Division VIIf (Bristol Channel)							
France	0	0	1	0	0	0	0P
ICES Divisions VIIg-k (Celtic Sea and SW of Ireland)							
England & Wales	0	0	0	0	0	29	13
France	35	61	68	42	27	66	50P
Ireland	0	0	0	0	0	167	50P
Spain	741	909	469	374	643	353	1,594
Total	776	970	537	416	670	615	1,707P
ICES Sub-area VIII (Bay of Biscay)							
England& Wales	0	0	0	0	0	6	0
France	188	172	426	376	316	523	400P
Spain	642	699	1,088	350	505	360	519
Total	830	871	1,514	726	821	889	919P
ICES Sub-area IX (Portuguese Waters)							
Portugal	310	509	766	259	190	101	120
Spain	100P	100P	100P	750	75	149	296
Total	410P	609P	866P	1,009	265	250	416
Grand Total	2,274	2,835	3,258	2,495	2,115	2,234	3,104P

*Landings consist exclusively of *Todarodes sagittatus*.

Table 4. Landings (in tonnes) of Octopus (*Eledone cirrhosa* and *Octopus vulgaris*).

Country	1990	1991	1992	1993	1994	1995	1996P
ICES Division IVa (Northern North Sea)							
England & Wales	1	0	0	0	0	+	+
Scotland	110	86	31	10	2	2	2
Total	111	86	31	10	2	2	2
ICES Division IVb (Central North Sea)							
Belgium	0	43	24	10	3	0	0
England & Wales	7	2	8	1	4	+	+
Scotland	1	1	1	2	1	0	+
Total	8	47	33	13	8	+	+
ICES Division IVc (Southern North Sea)							
Belgium	0	1	0	1	1	2	0
England & Wales	0	+	1	+	4	8	4
Total	0	1	1	1	5	10	4
ICES Division VIa, b (NW coast of Scotland and North Ireland, Rockall)							
England & Wales	1	5	4	+	1	+	+
Ireland	0	0	0	0	0	1	1P
Scotland	11	1	3	1	2	4	1
Spain	0	90	4	0	0	0	0
Total	12	96	11	1	2	5	2P
ICES Division VIIa (Irish Sea)							
Belgium	0	1	14	8	14	14	3
England & Wales	2	1	2	4	24	2	+
Ireland	0	0	0	0	+	1	1P
Total	2	2	16	12	38	17	4P
ICES Divisions VIIb, c (West of Ireland and Porcupine Bank)							
England & Wales	0	0	0	+	+	+	5
Ireland	0	0	0	3	2	2	2P
Total	0	0	0	3	2	2	7P
ICES Divisions VIId, e (English Channel)							
Belgium	0	0	1	2	+	6	1
England & Wales	9	9	20	21	60	77	76
France	0	7	24	20	31	97	50P
Total	9	16	45	43	91	180	127P
ICES Division VIIf (Bristol Channel)							
Belgium	0	1	2	4	6	9	7
England & Wales	1	1	8	13	26	8	7
France	0	0	2	12	2	9	5P
Total	1	2	12	29	34	26	19P

Table 4. continued.

Country	1990	1991	1992	1993	1994	1995	1996P
ICES Divisions VIIg-k (Celtic Sea and SW of Ireland)							
Belgium	0	1	2	6	10	27	20
England & Wales	3	3	22	57	77	144	130
France	4	1	5	8	6	18	10P
Ireland	0	0	1	1	2	21	10P
Spain	187	163	179	139	256	452	539
Total	194	168	209	211	351	662	709P
ICES Sub-area VIII (Bay of Biscay)							
Belgium	0	0	0	7	6	3	0
England & Wales	0	22	0	0	0	+	4
France	46	27	90	181	63	170	100P
Spain	2,683	1,679	2,511	2,136	1,434	1,779	2,323
Total	2,729	1,728	2,601	2,324	1,503	1,952	2,427P
ICES Sub-area IX (Portuguese Waters)							
Portugal	6,913	7,440	9,476	7,099	7,319	9,708	11,437
Spain	2,914	2,694	3,499	2,994	3,757	3,741	2,964
Total	9,827	10,134	12,975	10,093	11,076	13,449	14,401
ICES Sub-area X (Azores Grounds)							
Portugal*	33	7	11	7	7	8	16
Grand Total	12,926	12,287	15,945	12,747	13,119	16,313	17,718P

*Landings consist exclusively of *Octopus vulgaris*.

Table 5. Total annual cephalopod landings (in tonnes) in whole ICES area separated into major cephalopod species groups.

Cephalopod Group	1990	1991	1992	1993	1994	1995	1996P
Cuttlefish	28,263	16,486	14,680	18,692	16,421	21,329	20,388
Common Squid	11,091	9,256	10,872	10,656	10,319	10,801	9,330
Short-finned Squid	2,274	2,835	3,258	2,495	2,115	2,234	3,104
Octopus	12,926	12,287	15,945	12,747	13,119	16,313	17,718
Total	54,554	41,364	44,755	44,530	41,974	50,677	50,540

Table 6. Total annual cephalopod landings (in tonnes) in whole ICES area by country and separated into major cephalopod species groups.

Country	1990	1991	1992	1993	1994	1995	1996P
(a) Cuttlefish (Sepiidae and Bobtail Squid (Sepiolidae)							
Belgium	0	34	65	84	56	45	21
Channel Islands	20	1	4	2	2	1	1
England & Wales	3,541	771	1,165	2,167	2,091	4,341	4,599
France	21,568	12,938	10,634	13,823	11,924	14,742	12,731
Portugal	1,608	1,197	1,230	1,205	1,120	981	1,625
Scotland	5	0	0	0	0	0	0
Spain	1,521	1,545	1,582	1,409	1,228	1,219	1,411
Total	28,263	16,486	14,680	18,692	16,421	21,329	20,388
(b) Common Squid (*Loligo forbesi, Loligo vulgaris, Alloteuthis subulata*)							
Belgium	546	89	172	214	291	468	447
Channel Islands	2	0	1	0	0	2	2
Denmark	33	22	54	5	1	2	2
England & Wales	848	612	1,150	1,589	1,947	909	517
Faroe Islands	+	+	+	+	1	+	+
France	4,761	4,070	5,391	6,872	6,136	6,011	5,841
Germany	2	+	2	2	3	11	3
Ireland	167	149	260	363	283	1,042	355
Isle of Man	12	7	15	15	6	7	7
Northern Ireland	74	36	110	67	116	147	199
Portugal	1,616	2,127	1,641	616	423	1,158	661
Scotland	1,455	889	1,108	494	273	570	542
Spain	793	1,254	965	418	837	470	753
Sweden	1	1	3	0	+	2	+
Total	11,091	9,256	10,872	10,656	10,319	10,801	9,330
(c) Short-finned Squid (*Illex coindetii, Todaropsis eblanae, Todarodes sagittatus*)							
England & Wales	7	0	0	0	0	35	13
France	474	550	833	762	702	589	450
Iceland	0	0	0	0	0	11	2
Ireland	0	0	0	0	0	284	110
Norway	0	0	0	0	0	352	0
Portugal	310	509	766	259	190	101	120
Spain	1,483	1,776	1,659	1,474	1,223	862	2,409
Total	2,274	2,835	3,258	2,495	2,115	2,234	3,104
(d) Octopus (*Eledone cirrhosa, Octopus vulgaris*)							
Belgium	0	47	43	38	40	61	31
England & Wales	24	43	65	96	196	239	226
France	48	35	121	231	102	294	165
Ireland	0	0	1	4	4	25	14
Portugal	6,946	7,447	9,487	7,106	7,326	9,716	11,453
Scotland	122	88	35	13	5	6	3
Spain	5,784	4,626	6,193	5,269	5,447	5,972	5,826
Total	12,926	12,287	15,945	12,747	13,119	16,313	17,718

Table 7. *Sepia officinalis* and *Alloteuthis subulata*. Data on life history, environmental factors and fisheries.

	Sepia officinalis	*Alloteuthis subulata*
LIFE HISTORY		
Eggs:		
Egg principal axis (mm)	20 - 30	1.2 - 1.8
Potential fecundity	5,000	unknown
No. of eggs spawned per female	500 - 5,000	400 - 1,500
No. of spawning episodes	several (1 - 5)	several
Benthic or pelagic	benthic	benthic, attached to substrate
Duration of embryological development	80 - 90 days (15°C); 40 - 45 days (20°C)	not investigated
Paralarvae:		
Size at hatching (mantle lenghth in mm)	6 - 9	1.4 - 1.8
Temperature dependence	weak - medium	medium
Location in water column	benthic	rarely found; pelagic?
Duration in plankton	no planktonic phase	15 - 30 days
Reproductive cycle:		
Spawning season	early spring to summer	all year; mainly spring to autumn
Spawning location	shallow waters	shallow waters
Spawning depth	2 - 50 m	8 - 200 m
Preferred substrate	sandy and muddy bottoms	sandy and hard bottoms
No. of cohorts per year	at least 2	2 (or 3)
Growth:		
Mantle length at full maturity; male (mm)	70 - 210	40 - 200
Mantle length at full maturity; female (mm)	42 - 250	50 - 120
Weight range at full maturity; male (g)	33 - 957	3.5 - 10
Weight range at full maturity; female (g)	72 - 1,560	4.5 - 16
Lifespan	16 - 24 months	10 - 12 months
Minimum age at maturity	16 months	variable; at ca. 10 months
Form of growth (mantle length)	sigmoid	exponential
Population recruitment: how variable	unknown	unknown
Natural mortality rates	unknown	high during early stages
Distribution:		
Geographic	North East Atlantic (25-57°N) and Mediterranean shelf waters	North East Atlantic (20-60°N) and Mediterranean shelf waters
Bathymetric	surface - 300 m	surface - 200 m; max. 2,000 m
Migration pattern (e.g. inshore-offshore)	offshore - inshore	inshore - offshore
Migration scale (e.g. m; km; etc.)	30 - 50 km	unknown

Table 7. Continued.

	Sepia officinalis	*Alloteuthis subulata*
ENVIRONMENTAL FACTORS		
Habitat:		
Depth range of paralarvae (m)	epibenthic in shallow waters	45 - 102
Depth range of juveniles/adults (m)	10 - 300	15 - 300
Temperature range of paralarvae (°C)	10 - 30	2 - 25
Temperature range of juveniles/adults (°C)	10 - 30	2 - 25
Salinity range of paralarvae (S ‰)	18 - 36	unknown
Salinity range of juveniles/adults (S ‰)	18 - 36	unknown
Effects on survival, development, growth	not as important as in squid	probably very strong
FISHERIES		
Directed or by-catch	both	by-catch
Seasonality of fishery	all year; mostly NOV - JUL	no season
Geographic location of fishery, main fishery nations	English Channel to Portugal; France, Portugal, Spain, UK	throughout range of distribution
Inshore or offshore	inshore	inshore
Fishing methods	traps and gillnets, artisanal fishery (91% in Portugal)	trawling
Estimated catch data:		
Quality	poor	not available and mixed with other loliginid squids
Landings in ICES region (= FAO 27)	ca. 25,000 t (1995)	353 t (Portugal, 1990)
Range of landings over past 10 years in ICES region	5,000 - 27,000 t	unknown
Availability of CPUE data	not available	not available
Mantle length range of exploited population	40 - 350 mm	100 - 200 mm
Weight range of exploited population	15 - 2,800 g	5 - 35 g
Exploitation level	high	unknown
Stock recruitment relationship	unknown	unknown
Timing of recruitment to fishery	JAN - JUL	early summer
Variability of recruitment into fishery	unknown	unknown
Environmental influences on catch	new moon, storms	currents, hydrography
Assessment:		
Stock biomass or abundance	unknown	Max.= 132 ind./h; 0.7 hg/h Min.= 14 ind./h; <0.1 kg/h (Portugal 1990; 1992)
No. of stocks identified	local stocks identified	unknown
Method applied	no assessment	swept area method; abundance indices from survey cruises (Portugal)
Research activities in ICES area:		
Country	France, Portugal, Spain	Portugal
Region	ICES divisions VII - IX	ICES division IX

Table 8. *Loligo forbesi* and *Loligo vulgaris*. Data on life history, environmental factors and fisheries.

	Loligo forbesi	*Loligo vulgaris*
LIFE HISTORY		
Eggs:		
Egg principal axis (mm)	3 - 5	2 - 4.1
Potential fecundity	5,000 - 32,000	3,000 - 25,000 (average 17,000)
No. of eggs spawned per female	ca. 2,000	ca. 3,000 - 5,000
No. of spawning episodes	several (2 - 3?)	several (1 - 2?)
Benthic or pelagic	benthic, attached to substrate	
Duration of embryological development	1 - 3 months	40 - 45 days (13°C); 26 days (22°C)
Paralarvae:		
Size at hatching (mantle lenghth in mm)	2.7 - 4.9	1.2 - 3
Temperature dependence	strong	
Location in water column	planktonic; rarely found, low numbers close to bottom	
Duration in plankton	1 - 3 months	ca. 2 months
Reproductive cycle:		
Spawning season	OCT - MAY; extended; peak in DEC - JAN	all year, extended; peak mainly in winter
Spawning location	coastal shallow waters	
Spawning depth	10 - 300 m	5 - 195 m
Preferred substrate	hard substrate	hard substrate; coarse sand
No. of cohorts per year	multiple "microcohorts"; ≤ 2	multiple cohorts
Growth:		
Mantle length at full maturity; male (mm)	100 - 650; (240 - 937)*	75 - 500
Mantle length at full maturity; female (mm)	175 - 350; (200 - 462)*	75 - 350
Weight range at full maturity; male (g)	155 - 3,700 (average 2,000) (370 - 8,300)*	22 - 1,690
Weight range at full maturity; female (g)	200 - 1,150 (average 1,500) (260 - 2,200)*	23 - 1,272
Lifespan	6 - 18 months (average 15 - 18)	7 - 22 months (average 12 - 14)
Minimum age at maturity	6 months; variable	7 months; variable
Form of growth (mantle length)	exponential	initially exponential
Population recruitment: how variable	variable; higher during summer	variable; high in spring/summer
Natural mortality rates	high, if compared to fish	
Distribution:		
Geographic	North East Atlantic (25-62°N) and Mediterranean shelf waters; Azores; central East Atlantic	North East Atlantic (15-60°N) and Mediterranean shelf waters; central East Atlantic
Bathymetric	shelf & shelf edge; 10 - 550 m; mainly in 50 - 250 m	shelf & shelf edge; 10 - 300; mainly in 10 - 100 m
Migration pattern (e.g. inshore-offshore)	inshore - offshore	
Migration scale (e.g. m; km; etc.)	<500 km	<200 km

* in Azores region

Table 8. Continued.

	Loligo forbesi	*Loligo vulgaris*
ENVIRONMENTAL FACTORS		
Habitat:		
Depth range of paralarvae (m)	10 - 100 m	10 - 120 m
Depth range of juveniles/adults (m)	10 - 500 m; mainly 100-200m	10 - 300 m; mainly 15-100m
Temperature range of paralarvae (°C)	10 - 20	10 - 20
Temperature range of juveniles/adults (°C)	6 - 24	10 - 25
Salinity range of paralarvae (S ‰)	30 - 36	30 - 36
Salinity range of juveniles/adults (S ‰)	30 - 36	30 - 36
Effects on survival, development, growth	high	
FISHERIES		
Directed or by-catch	both	both
Seasonality of fishery	all year; with variable peaks, mostly in early autumn	
Geographic location of fishery	throughout range of distribution	
Inshore or offshore	coastal continental shelf; mainly inshore	
Fishing methods	trawling; hand-jigging	mostly trawling, manual jigging
Estimated catch data:		
Quality	poor; data not fully reported and not separated by species	
Landings in ICES region (= FAO 27)	11,000 t (1995)	
Range of landings over past 10 years in ICES region	8,000 - 12,000 t	
Availability of CPUE data	available only for some countries	
Mantle length range of exploited population	70-640 mm (average 110 mm) <940 mm (Azores) 340-680 mm (Canaries)	60-500 mm (average 110 mm)
Weight range of exploited population	20 - 3,700 g (average 60 g) <8,300 g (Azores) 1,050 - 4,100 (Canaries)	10 - 1,000 g (average 40 g)
Exploitation level	variable/unknown	
Stock recruitment relationship	weak	
Timing of recruitment to fishery	all year; seasonal peaks	
Variability of recruitment into fishery	high	
Environmental influences on catch	moon light; rough weather	
Assessment:		
Stock biomass or abundance	preliminary estimates for northern range; abundance indices from research cruises (Portugal)	
No. of stocks identified	offshore and coastal European stock differences; separated stock around Azorers	1 (European shelf)
Method applied	DeLury depletion methods	
Research activities in ICES area:		
Country	France, Portugal, Spain, UK	France, Portugal, Spain, UK
Region	throughout ICES regions	throughout ICES regions

Table 9. *Illex coindetii* and *Todaropsis eblanae*. Data on life history, environmental factors and fisheries.

	Illex coindetii	*Todaropsis eblanae*
LIFE HISTORY		
Eggs:		
Egg principal axis (mm)	<1.0	1.4 - 1.7
Potential fecundity	6,500 - 285,000 (max.: 729,000)	124,000 ± 18,000
No. of eggs spawned per female	4,000 - 120,000	122,000 ± 18,000
No. of spawning episodes	several	several; probably 4 - 10
Benthic or pelagic	pelagic	probably pelagic
Duration of embryological development	unknown	
Paralarvae:		
Size at hatching (mantle lenghth in mm)	0.8 - 1.0	unknown
Temperature dependence	strong	probably strong
Location in water column	planktonic	
Duration in plankton	unknown	
Reproductive cycle:		
Spawning season	all year, peaks in spring, autumn	all year, peaks in spring
Spawning location	probably slope water	probably shel edge
Spawning depth	unknown	probably above 150 m
Preferred substrate	unknown	associated with sandy or muddy bottom
No. of cohorts per year	unknown	
Growth:		
Mantle length at full maturity; male (mm)	95 - 360	98 - 168
Mantle length at full maturity; female (mm)	79 - 380	107 - 222
Weight range at full maturity; male (g)	30 - 1,549 (average 400)	90 - 300
Weight range at full maturity; female (g)	32 - 1,180 (average 750)	144 - 720
Lifespan	12 - 14 months	ca. 12 months
Minimum age at maturity	unknown	220 - 280 days
Form of growth (mantle length)	linear?	linear
Population recruitment: how variable	linear in post-recruits	highly variable
Natural mortality rates	very high in early stages	
Distribution:		
Geographic	Eastern Atlantic Ocean: 15°S to 60°N; Mediterranean Sea; Sea of Marmara; Caribbean Sea	Eastern Atlantic Ocean: 36°S to 60°N; Mediterranean Sea; Australia; Indian Ocean
Bathymetric	30 - 1,000 m	20 - 800 m
Migration pattern (e.g. inshore-offshore)	unknown	seasonal bathymetric migrations
Migration scale (e.g. m; km; etc.)	unknown	km

Table 9. Continued.

	Illex coindetii	*Todaropsis eblanae*
ENVIRONMENTAL FACTORS		
Habitat:		
Depth range of paralarvae (m)	20 - 280 (mainly 60 - 100)	20 - 280 (mainly 60 - 100)
Depth range of juveniles/adults (m)	30 - 1,000 (mainly 150 - 250)	20 - 800 (mainly 200 - 250)
Temperature range of paralarvae (°C)	13 - 20	13 - 20
Temperature range of juveniles/adults (°C)	7.5 - 20	6 - 20
Salinity range of paralarvae (S ‰)	unknown	
Salinity range of juveniles/adults (S ‰)	35.6 - 36.5 (mainly 35.8 - 36.0)	35.2 - 36.0 (mainly 35.8)
Effects on survival, development, growth	very strong	
FISHERIES		
Directed or by-catch	by-catch	
Seasonality of fishery	all year; higher in spring and autumn	
Geographic location of fishery, main fishery nations	continental shelf and slope regions off Ireland, Portugal, Spain	
Inshore or offshore	offshore	
Fishing methods	trawling	
Estimated catch data:		
Quality	poor; data not fully reported, species not separated and mixed with other short-fin squids	
Landings in ICES region (= FAO 27)	ca. 2,300 t (1995)	
Range of landings over past 10 years in ICES region	1,500 - 6,000 t	
Availability of CPUE data	not available	
Mantle length range of exploited population	55 - 380	42 - 220
Weight range of exploited population	4 - 1,500	6 - 720
Exploitation level	low	probably low
Stock recruitment relationship	unknown	
Timing of recruitment to fishery	all year; peaks in autumn	
Variability of recruitment into fishery	high	moderate
Environmental influences on catch	hydrography; currents	
Assessment:		
Stock biomass or abundance	unknown	
No. of stocks identified	1 in Galician waters by morphometrics and enzymes	1 in Galician waters by morphometrics and enzymes
Method applied	no assessment	no assessment
Research activities in ICES area:		
Country	Ireland, Portugal, Russia (ageing studies), Spain	Ireland, Portugal, Spain
Region	ICES divisions VIII - IX	ICES divisions VIII - IX

Table 10. *Todarodes sagittatus* and *Gonatus fabricii*. Data on life history, environmental factors and fisheries.

	Todarodes sagittatus	*Gonatus fabricii*
LIFE HISTORY		
Eggs:		
Egg principal axis (mm)	unknown	5
Potential fecundity	unknown	unknown
No. of eggs spawned per female	12,000 - 18,000	ca. 10,000
No. of spawning episodes	2?	pelagic
Benthic or pelagic	Benthic?	Benthic
Duration of embryological development	unknown	unknown
Paralarvae:		
Size at hatching (mantle lenghth in mm)	unknown	3
Temperature dependence	unknown	3.9 - 4.4
Location in water column	unknown	0 - 1,000 m
Duration in plankton	unknown	ca. 6 months
Reproductive cycle:		
Spawning season	autumn - winter, early spring (northern range)	DEC - APR
Spawning location	slope waters; west off Ireland?	continental slope of North East Atlantic; grounds of bottlenose whales
Spawning depth (m)	80 - 700 (off Portugal)	>400
Preferred substrate	unknown	unknown
No. of cohorts per year	unknown	unknown
Growth:		
Mantle length at full maturity; male (mm)	>130 (mainly >250)	175 - 250
Mantle length at full maturity; female (mm)	>190 (mainly >250)	250 - 340
Weight range at full maturity; male (g)	>150 (mainly >400)	88 - 226
Weight range at full maturity; female (g)	493 - 1,156 (Canaries)	400 - 615
Lifespan	<24 months	>12 months
Minimum age at maturity	ca. 12 months	unknown
Form of growth (mantle length)	linear	linear
Population recruitment: how variable	probably highly variable	unknown
Natural mortality rates	very high in early stages	unknown
Distribution:		
Geographic	whole North East Atlantic; Mediterranean Sea	Labrador Sea, Barents Sea and Norwegian Sea and adjacent waters
Bathymetric	0 - 1,000 m	0 - 2,700 m
Migration pattern (e.g. inshore-offshore)	pronounced feeding migrations	unknown
Migration scale (e.g. m; km; etc.)	unknown	unknown

Table 10. Continued.

	Todarodes sagittatus	*Gonatus fabricii*
ENVIRONMENTAL FACTORS		
Habitat:		
Depth range of paralarvae (m)	surface waters?	0 - 2,000
Depth range of juveniles/adults (m)	0 - 1,000 (mainly 500 - 700)	<2,700
Temperature range of paralarvae (°C)	unknown	0.5 - 14
Temperature range of juveniles/adults (°C)	5 - 7 (northern range) 16 - 24 (Canaries)	0.5 - 14
Salinity range of paralarvae (S ‰)	unknown	31.2 - 35.3
Salinity range of juveniles/adults (S ‰)	unknown	31.2 - 35.3
Effects on survival, development, growth	strong	unknown
FISHERIES		
Directed or by-catch	directed and by-catch	no fishery
Seasonality of fishery	AUG - DEC (ICES sub-area IIa)	all year
Geographic location of fishery, main fishery nations	North East Atlantic slope regions; Norwegian fjords	North East Atlantic slope regions
Inshore or offshore	mainly inshore	offshore
Fishing methods	jigging; purse seines (Canaries)	trawling
Estimated catch data:		
Quality	poor; data not fully reported, species not separated and mixed with other squids	
Landings in ICES region (= FAO 27)	ca. 400 t (1995)	unknown
Range of landings over past 10 years in ICES region	0 - 15,000 t	unknown
Availability of CPUE data	not available	not available
Mantle length range of exploited population	ca. 200 - 400 mm (Norway) 147 - 340 mm (Canaries)	>200 mm in by-catch
Weight range of exploited population	150 - 4,000	unknown
Exploitation level	variable	no exploitation
Stock recruitment relationship	unknown	unknown
Timing of recruitment to fishery	3 - 4 months	unknown
Variability of recruitment into fishery	high (one year class)	unknown
Environmental influences on catch	hydrography, currents	unknown
Assessment:		
Stock biomass or abundance	unknown	unknown
No. of stocks identified	probably 2 (northern range, and southwestern range)	unknown
Method applied	no assessment	no assessment
Research activities in ICES area:		
Country	Ireland, Norway; Spain	Germany, Iceland, Norway
Region	whole ICES region	ICES divisions I, II, Va; IX

Table 11. *Octopus vulgaris* and *Eledone cirrhosa*. Data on life history, environmental factors and fisheries.

	Octopus vulgaris	*Eledone cirrhosa*
LIFE HISTORY		
Eggs:		
Egg principal axis (mm)	1.9 - 3.3	6.7 - 7.5
Potential fecundity	500,000	2,000 - 7,500
No. of eggs spawned per female	100,000 - 500,000	unknown
No. of spawning episodes	1 (within 1 - 2 months)	1 (extended over 3 - 4 weeks)
Benthic or pelagic	Benthic, protected by female	
Duration of embryological development	125 days (13°C); 30 - 60 days (15-20°C); 25 days (25°C)	3 - 4 months
Paralarvae:		
Size at hatching (mantle lenghth in mm)	1.4 - 2.0; 1.4 mg	ca. 3
Temperature dependence	strong	strong
Location in water column	planktonic	planktonic
Duration in plankton	5 - 12 weeks	few days
Reproductive cycle:		
Spawning season	FEB - OCT; peaks in June and September	all year; peaks between April to October
Spawning location	shallow waters, inshore	
Spawning depth	< 100 m	< 200 m
Preferred substrate	rocky and sandy bottom, caves	flat muddy and rocky bottom
No. of cohorts per year	2 or more	probably 1 annual recruitment
Growth:		
Mantle length at full maturity; male (mm)	85 - 250	50 - 180
Mantle length at full maturity; female (mm)	126 - 260	110 - 400
Weight range at full maturity; male (g)	200 - 6,100	400 - 700
Weight range at full maturity; female (g)	390 - 5,200	150 - 2,000
Lifespan	12 - 24 months	12 - 24 months
Minimum age at maturity	10 - 18 months, variable	ca. 12 months, variable
Form of growth	exponential	exponential ?
Population recruitment: how variable	highly variable	highly variable (MAR-JUL)
Natural mortality rates	very high	
Distribution:		
Geographic	cosmopolitan; in all North East Atlantic coastal waters, from southern North Sea to west of Africa; Mediterranean Sea	North East Atlantic coastal and shelf waters from Norway to Portugal, Iceland; eastern Mediterranean Sea
Bathymetric	benthic; 2-100 m; max. 400 m	benthic; 0-200 m (shore line); max. 770m
Migration pattern (e.g. inshore-offshore)	inshore for spawning	inshore for spawning
Migration scale (e.g. m; km; etc.)	< 50 km	unknown (few km?)

Table 11. Continued.

	Octopus vulgaris	*Eledone cirrhosa*
ENVIRONMENTAL FACTORS		
Habitat:		
Depth range of paralarvae (m)	surface - 500	0 - 500
Depth range of juveniles/adults (m)	surface - 200 (mainly 50 - 85 m)	0 - 770 (mainly 225)
Temperature range of paralarvae (°C)	10 - 25	unknown
Temperature range of juveniles/adults (°C)	10 - 30	unknown
Salinity range of paralarvae (S ‰)	not documented	unknown
Salinity range of juveniles/adults (S ‰)	32 - 40%	unknown
Effects on survival, development, growth	strong	strong
FISHERIES		
Directed or by-catch	both	by-catch
Seasonality of fishery	all year	MAR - JUL
Geographic location of fishery, main fishery nations	whole range of distribution; Portugal, Spain	whole range of distribution in 10 - 12 m; Portugal, Spain
Inshore or offshore	inshore	mostly inshore
Fishing methods	traps and pots; trawling	bottom trawls; seines; pots
Estimated catch data:		
Quality	poor; data not fully reported and not separated by species	
Landings in ICES region (= FAO 27)	ca. 12,000 t (1995)	
Range of landings over past 10 years in ICES region	7,000 - 18,000 t	
Availability of CPUE data	not available	not available
Mantle length range of exploited population	34 - 260 mm	unknown
Weight range of exploited population	100 - 14,000 g (average 500 g)	<ca. 2,000 g
Exploitation level	high	variable/unknown
Stock recruitment relationship	unknown	unknown
Timing of recruitment to fishery	all year	unknown
Variability of recruitment into fishery	variable; mostly high	unknown
Environmental influences on catch	wind; hydrography	unknown
Assessment:		
Stock biomass or abundance	unknown	unknown
No. of stocks identified	unknown	unknown
Method applied	no assessment	no assessment
Research activities in ICES area:		
Country	Portugal, Spain	Scotland
Region	ICES divisions VIII - X	Scottish waters

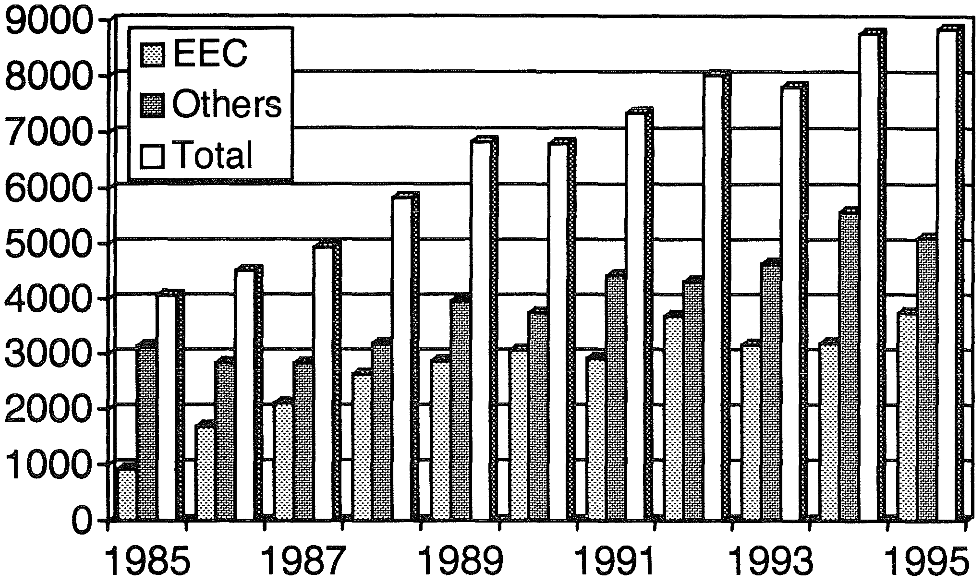

Fig. 1. Germany. Annual cephalopod imports (1985-1995). Numbers are in metric tonnes.

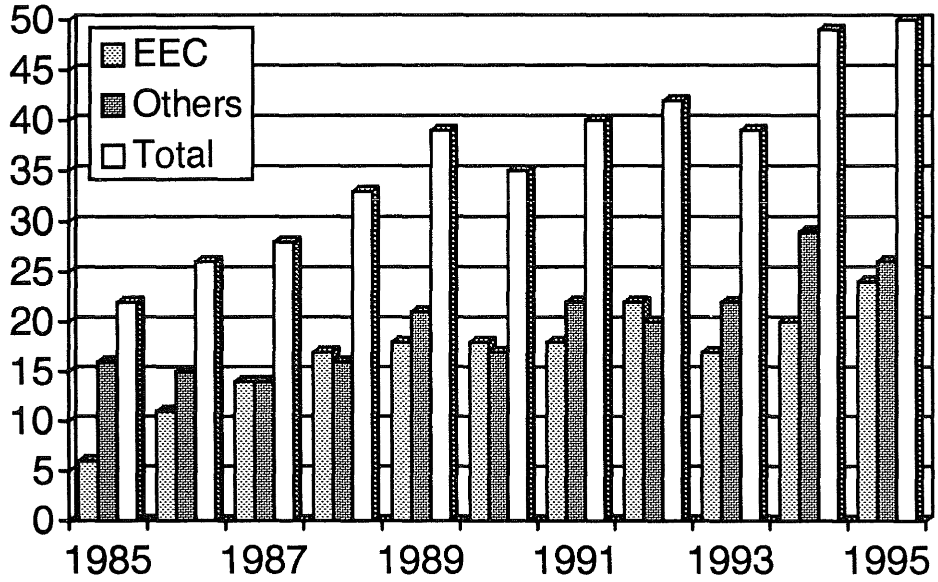

Fig. 2. Germany. Total value of annual cephalopod imports (1985-1995). Numbers are in million DM.

ANNEX 1

WGCEPH MEETING, 7-9 APRIL IN SANTA CRUZ DE TENERIFE, SPAIN

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ANNEX 2

WGCEPH

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ANNEX 3

Working document for the ICES Working Group on Cephalopod Fisheries and Life History Meeting: 7-9 April 1997, Tenerife, Spain

Portuguese cephalopod fisheries from ICES Division IXa

by

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This working document includes the information resulting from the data that was gathered and analysed, by IPIMAR, from the following sources:

Landing statistics - Direcção Geral das Pescas (National Fisheries Directorate);
Exploited population - IPIMAR "Plano Nacional de Amostragem Biológica" (National Biological Sampling Program Database); monthly market biological sampling;
Stock biomass and abundance - IPIMAR bottom trawl surveys database (Cruzdem).

1. Annual landings

The most important Portuguese cephalopod landings are Octopods (*Octopus vulgaris* and a small percentage of *Eledone cirrhosa*), followed by cuttlefish (*Sepia officinalis*), long-finned squid (*Loligo vulgaris* and sometimes a small percentage of *Loligo forbesi*) and short-finned squid (mainly *Illex coindetii* and *Todaropsis eblanae* and probably a small amount of *Todarodes sagittatus*) (Table 1).

Table 1 - Cephalopod landings from ICES Division IXa.

Cephalopods	**1995**		**1996(provisional)**	
	(tonnes)	%	(tonnes)	%
Octopods	9 708	83	11 437	84
Cuttlefish	981	8	1 625	12
Long-finned squid	908	8	461	3
Short-finned squid	101	1	120	

Since 1987 to 1995 landings of Octopods have varied between 7000 and 10000 tonnes, reaching in 1996 the higher amount, 11437 tonnes. Cuttlefish landings were slightly higher in the eighties, increasing again in 1996 (Fig.1).

Long-finned squid landings peaked in 1991, sharply decreasing since then. Though, in 1995 an increase has occurred, in 1996 landings decreased once again. Landings of short-finned squid were generally lower, following a pattern somewhat similar to the one of long-finned squid (Fig.2).

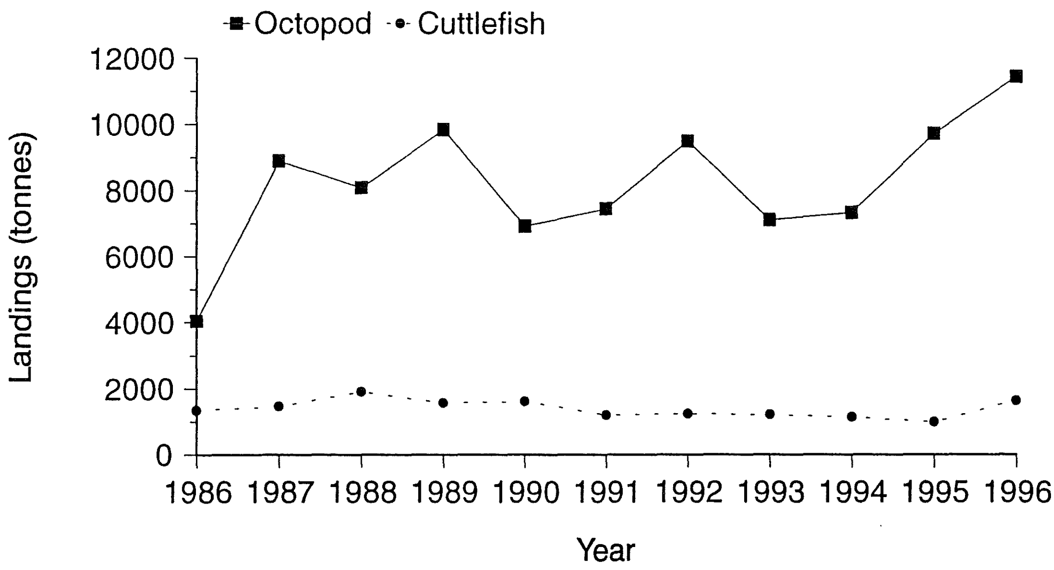

Fig. 1 - Octopus and Cuttlefish landings from 1986 to 1996.

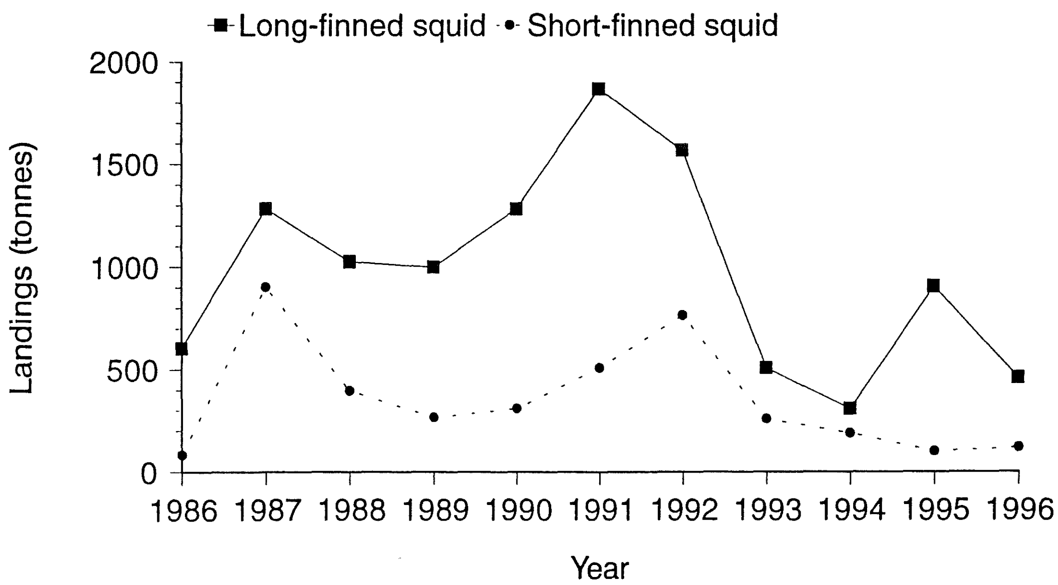

Fig.2 - Long-finned and Short-finned squid landings from 1986 to 1996.

Most cephalopods are caught with artisanal gears. Octopods are caught mainly with traps and pots and around 20% with trawl. Cuttlefish is caught mainly with gill nets, trammel nets and jigs and only 10% with trawl. Short-finned squids are caught mainly with gill nets and around 25% with trawl. Long-finned squid is an exception: more than 90% of these squids come from the trawl fishery and the remaining are caught mainly with gill nets and jigs (Fig.3).

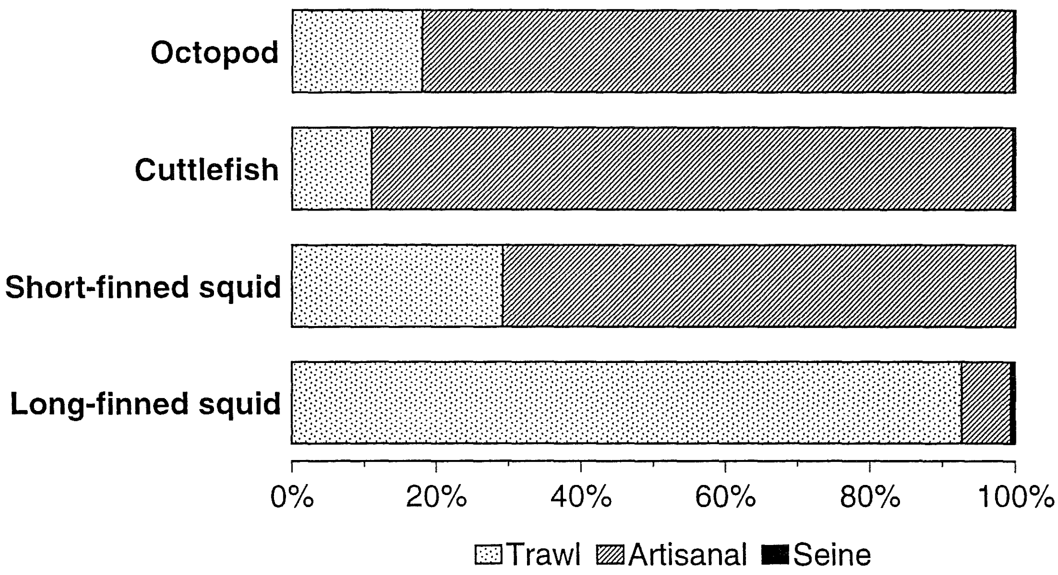

Fig.3 - Cephalopod landings by gear type in 1996.

More information on cephalopod fisheries in ICES Division IXa is summarised in tables 2, 3, 4 and 5.

Table 2 - Portuguese fisheries of Octopod species in ICES Division IXa.

FISHERIES	*Octopus vulgaris*	*Eledone cirrhosa*
Directed or by-catch	directed (pots and traps) and by-catch (trawl)	by-catch (trawl, others?)
Seasonality of fishery	higher between March and June in the northwest coast and between October and March in the south coast	?
Geographic location of fishery	mainly in the south coast	?
Inshore or offshore	inshore	inshore-offshore
Fishing methods	Artisanal (fishery with traps and pots, almost only *Octopus vulgaris*)=86.1%, Trawl=13.4%, Seine=0.5%	
Quality of catch data	reasonably accurate	poor
Range of landings (1986 to 1996)	4 034 - 11 437 tonnes (almost only *Octopus vulgaris*)	
Availability of CPUE data	?	not available
Mantle length range of exploited population	60-260 mm	?
Weight range of exploited population	?	?
Exploitation level	high	probably low
Timing of recruitment to fishery	?	?
Variability of recruitment to fishery	?	?
Environmental influences on catch	?	?
Sock biomass (1990 to 1995) "Swept area method"	not available	Max=170 tonnes (1994); Min=1 tonne (1995)
Stock abundance (1981 to 1995)	not available	Max=4.1 ind./h and 0.32 kg/h (1994); Min=0.01 ind./h and 0 kg/h (1995)

Table 3 - Portuguese fisheries of Cuttlefish in ICES Division IXa.

FISHERIES	*Sepia officinalis*
Directed or by-catch	directed (jigs) and by-catch (gill nets, trammel nets and trawl)
Seasonality of fishery	higher between Nov. and June
Geographic location of fishery	mainly in the south coast
Inshore or offshore	inshore
Fishing methods	Artisanal=91%, Trawl=8%, Seine=1%
Quality of catch data	reasonably accurate
Range of landings (1986 to 1996)	981 - 1 898 tonnes
Availability of CPUE data	not available
Mantle length range of exploited population	90-350 mm (modal classes = 100 to 150 mm)
Weight range of exploited population	?
Exploitation level	?
Timing of recruitment to fishery	?
Variability of recruitment into fishery	?
Environmental influences on catch	?
Sock biomass (1990 to 1995) "Swept area method"	?
Stock abundance (1981 to 1995)	?

Table 4 - Portuguese fisheries of Long-finned squid species in ICES Division IXa.

FISHERIES	*Loligo vulgaris*	*Loligo forbesi*
Directed or by-catch	directed (manual jigging) and by-catch (trawl, gill nets and seine)	
Seasonality of fishery	all year; higher August-December; peak=October	
Geographic location of fishery	Portuguese coast, mainly in the north west coast	
Inshore or offshore	inshore (coastal continental shelf)	
Fishing methods	trawling=92%; gill nets and jigs=8% (in 1995 and 1996)	
Quality of catch data	reasonably accurate, but species reported together	
Range of landings (1986 to 1996)	309-1869 tonnes	
Availability of CPUE data	small sample from the trawl fishery	
Mantle length range of exploited population	60-400 mm (mode = 110 mm)	70-640 mm (mode = 110 mm)
Weight range of exploited population	10-970 g (mode = 40 g)	20-3640 g (mode = 60 g)
Exploitation level	high	
Timing of recruitment to fishery	all year, higher in spring	
Variability of recruitment into fishery	high	
Environmental influences on catch	lower catches with moonlight and rough weather	
Sock biomass (autumn from 1990 to 1995) "Swept area method"	Max.=1114 tonnes (1991); Min=36 tonnes (1994)	Max=187 tonnes (1990); Min=0 tonnes (1995)
Stock abundance (autumn, from 1981 to 1995)	Max.=50.9 ind./h and 4.6 kg/h (1988) Min=2.5 ind./h and 0.1 kg/h (1994)	Max=14.7 ind./h (1983) and 5.2 kg/h (1987) Min=0 ind./h and 0 kg/h (1981 and 1995)

Table 5 - Portuguese fisheries of Short-finned squid species in ICES Division IXa.

FISHERIES	***Illex coindetii***	***Todaropsis eblanae***
Directed or by-catch	by-catch (all nets)	
Seasonality of fishery	higher between November and April	
Geographic location of fishery	mainly in the northwest coast	
Inshore or offshore	offshore	
Fishing methods	Artisanal (mainly gill-nets)=66.1%, Trawl=33.7%, Seine=0.2%	
Quality of catch data	reasonably accurate, but with species reported together	
Range of landings (1986 to 1996)	84 - 902 tonnes	
Availability of CPUE data	not available	
Mantle length range of exploited population	110-300 mm	
Weight range of exploited population	?	?
Exploitation level	?	?
Timing of recruitment to fishery	?	?
Variability of recruitment to fishery	?	?
Environmental influences on catch	?	?
Sock biomass (autumn, from 1990 to 1995) "Swept area method"	Max=895 tonnes (1992); Min=3 tonnes (1994)	Max=37 tonnes (1992); Min=0.9 tonnes (1993)
Stock abundance (autumn, from 1981 to 1995)	Max=80.2 ind./h and 6.4 kg/h (1987); Min=0.06 ind./h and 0.01 kg/h (1994)	Max=5.5 ind./h and 0.3 kg/h (1983); Min=0 ind./h and 0 kg/h (1981)

2. Monthly landings

Octopods landings peaked generally in March and April, but a second peak occurred in November of 1995 and July of 1996. Higher landings of Cuttlefish are observed from January until May and differences in annual landings from 1995 to 1996 were a result of higher landings in those months, in 1996 (Fig.4).

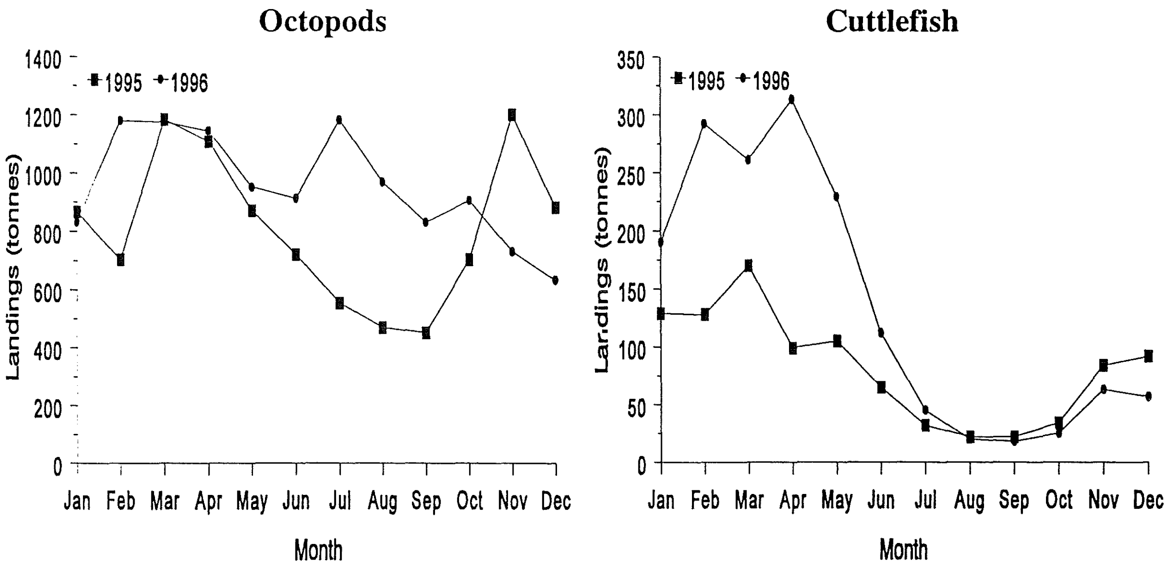

Fig.4 - Octopods and Cuttlefish monthly landings from ICES Division IXa in 1995 and 1996.

Long-finned squid landings are higher from August until December, peaking in October and short-finned squid landings are higher between November and April, with peaks varying between years (Fig.5).

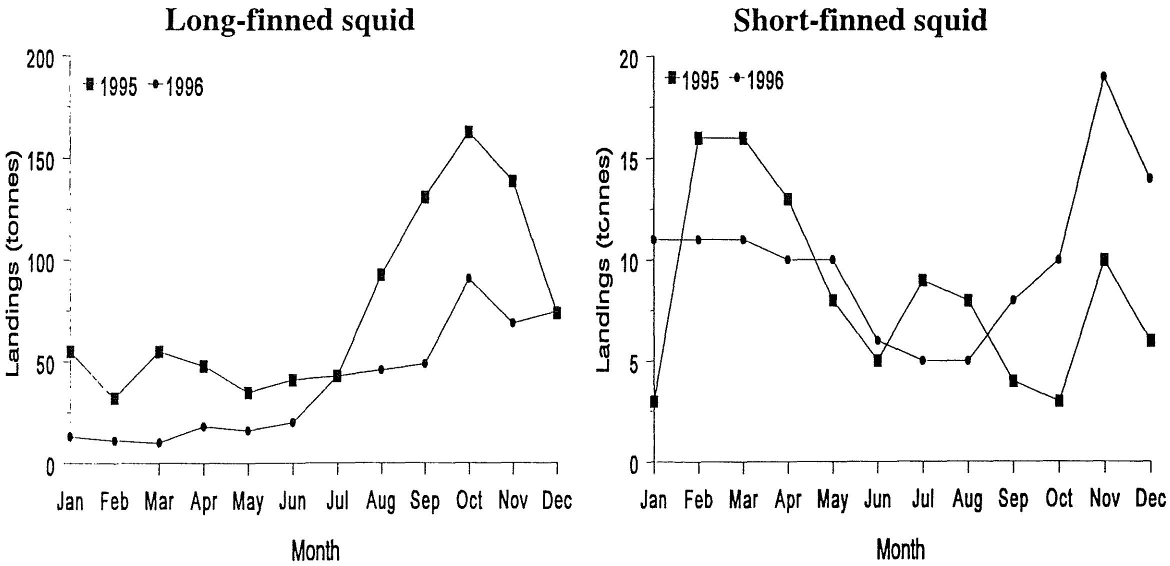

Fig.5 - Long-finned and short-finned squid monthly landings from ICES Division IXa in 1995 and 1996.

ANNEX 4

Document presented to the:

I.C.E.S. WORKING GROUP ON CEPHALOPOD FISHERIES AND LIFE HISTORY

Santa Cruz de Tenerife, Canary Islands, Spain. **April 7th-9th, 1997**

SPANISH CEPHALOPOD LANDINGS IN ICES WATERS, 1990-1996
(Subareas VI, VII, VIII and IX)

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This is a report of the cephalopods caught by the Spanish fleet in ICES waters and landed in Spanish ports. At the working group of 1996, a similar report for the period 1990-1995 was presented by the authors. Since then, an effort has been made to obtain higher quality data and to update and complete the statistics. The result of that effort is that, this year, data from 1996 and some previous years have been compiled from a total of 61 Spanish Atlantic ports (135 % more than last year), including all the Atlantic fishing harbours with relevant cephalopod landings, and almost all the harbours with medium and small landings. As an example of this improving effort, data from the Basque Country since 1994, that were not collected by the authors for the report of last year, are included in this paper, due to the collaboration of the Basque fisheries authorities (AZTI). Due to these improvements, the data presented last year must be substituted by those appearing in this paper.

The origin of the data are the statistical databases compiled in the fish markets at the ports. Due to the difficulty in monitoring landings in the fish markets, unknown portions of landings are occasionally not registered in the statistics. Also, in some cases, cephalopod landings from some ports (or for some species) were not available for any given year due to several reasons (technical, political,...). For the above reasons, the information presented in this document should be considered with caution as it is probably an underestimated approach to real landings.

Cephalopods are caught by artisanal vessels targeting *Loligo* spp., *Sepia* spp. and *Octopus vulgaris* in ICES divisions VIIIc and IXa. Cephalopods are also by-catch of the trawling fishery operating in ICES areas VI, VII, VIII and IX.

Except for the two octopod species (*Octopus vulgaris* and *Eledone cirrhosa*), most landings were not separated by species in the statistics, and data have been classified into the following groups:

"Loligo spp" includes *Loligo vulgaris* and *L.forbesi*, mainly the former species

"Cuttlefish" consists of *Sepia officinalis, S. elegans* and *S. orbignyana*, although most of the catch comprises the first species.

"Ommastrephids" comprise *Illex coindetii* and *Todaropsis eblanae*, and some irrelevant quantities of *Todarodes sagitattus*.

"Alloteuthis spp." includes *Alloteuthis media* and *A. subulata.*

Table 1 and Figure 1 show the total amount of cephalopods caught by the Spanish fleet in ICES waters and landed in Spanish ports. Data are shown by species or group of species for the period 1990-1996. Landings are given by year, but also the average for each species or group of species is presented in the table.

Data from Table 1 are subdivided into Tables 2 to 6: Tables 2 and 3 show the cephalopod landings from subareas VI and VII, respectively, while those from Divisions VIIIa,b,d are shown in Table 4. Table 5 shows landings from Division VIIIc, and Table 6 shows the data for Division IXa.

Two clarifications must be done about the data shown in Tables 3 (Subarea VII) and 6 (Division IXa):

i) in one of the most important ports of Division IXa (the port of Marín, near Vigo) there are cephalopod landings coming from Subarea VII and Division IXa. Statistics of both areas separately were available only for 1996, and landings of that year coming from each zone are included in their respective tables. However, statistics of the period 1991-1995 did not register landings from each area separately. Owing to it, Marín cephalopod landings of the years 1991 to 1995 were not included in Table 3, not in Table 6 either. These landings (from both areas together) are reported separately in Table 7. Only as an orientative information, the proportion represented by each area in the Marín landings of 1996 is offered in Table 8.

ii) in other of the important ports of the same area (Riveira, also placed near Vigo), statistics for the period 1994-1996 in Division IXa include unknown quantities of ommastrephids registered under the category *Eledone cirrhosa* (probably between one third and one half of the total *E. cirrhosa* landings were actually ommastrephids). So, landings shown in Table 6 (Division IXa) are biased during 1994-1996, being the *E. cirrhosa* landings overestimated, and those of the ommastrephids underestimated. Only as information, the whole landings that were registered as *E. cirrhosa* at the port of Riveira are offered in Table 9.

TABLE 1. Total Spanish cephalopod landings (tons) caught in ICES waters during 1990-1996.

YEAR	*Loligo* spp.	Cuttlefish	Ommastrephids	*O. vulgaris*	*E. cirrhosa*	*Alloteuthis* spp	TOTAL
1990	793.2	1520.2	1383.8	3529.1	1105.6	no data	8331.9
1991	1263.8	1544.8	1676.1	3159.6	718.2	no data	8362.6
1992	964.7	1581.9	1559.6	4287.0	1341.4	no data	9734.7
1993	351.2	832.3	724.1	3393.8	1066.2	66.0	6433.7
1994	790.3	1227.4	1223.1	4381.1	1066.4	49.3	8737.6
1995	422.9	1218.6	862.3	4237.1	1733.0	49.9	8523.8
1996	707.3	1409.8	2489.1	3624.9	2201.3	46.4	10478.7
AVERAGE	756.2	1333.6	1416.9	3801.8	1318.9	52.9	

TABLE 2. Spanish cephalopod landings (tons) caught in ICES Sub-area VI during 1990-1996.

YEAR	*Loligo* spp.	Cuttlefish	Ommastrephids	*O. vulgaris*	*E. cirrhosa*	*Alloteuthis* spp
1990						
1991			67.8		89.7	
1992			1.7		3.5	
1993	no data		no data		no data	
1994	1.8					
1995	2.4					
1996	1.1					

TABLE 3. Spanish cephalopod landings (tons) caught in ICES Sub-area VII during 1990-1996.

YEAR	*Loligo* spp.	Cuttlefish	Ommastrephids	*O. vulgaris*	*E. cirrhosa*	*Alloteuthis* spp
1990	27.7	16.0	741.3		186.7	
1991	30.9	19.5	908.9		162.8	
1992	61.9	2.0	469.1		178.6	
1993	84.5	no data	374.3		139.1	
1994	39.2	4.2	642.5		256.3	
1995	29.4	0.3	352.6		451.7	
1996	88.8	10.8	1594.4		539.4	

TABLE 4. Spanish cephalopod landings (tons) caught in ICES Divisions VIIIa,b,d during 1990-1996.

YEAR	*Loligo* spp.	Cuttlefish	Ommastrephids	*O. vulgaris*	*E. cirrhosa*	*Alloteuthis* spp
1990	260.4	445.4	244.4		240.1	
1991	162.4	581.0	25.1		90.1	
1992	198.2	541.6	364.4		214.4	
1993	2.1	no data	20.7		0.1	
1994	509.1	440.7	346.1		200.1	
1995	141.8	162.9	95.3		82.7	
1996	348.5	364.6	158.2		114.9	

TABLE 5. Spanish cephalopod landings (tons) caught in ICES Division VIIIc during 1990-1996.

YEAR	*Loligo* spp.	Cuttlefish	Ommastrephids	*O. vulgaris*	*E. cirrhosa*	*Alloteuthis* spp
1990	63.0	47.8	398.1	1764.1	678.8	
1991	36.5	33.3	674.2	1212.6	375.7	
1992	68.6	9.3	724.4	1352.0	944.9	
1993	30.6	10.3	329.1	1208.8	927.0	
1994	79.2	9.5	159.3	868.9	364.9	
1995	54.4	30.9	265.0	1121.5	573.8	
1996	77.6	110.8	440.8	1527.1	680.9	

TABLE 6. Spanish cephalopod landings (tons) caught in ICES Division IXa during 1990-1996.

YEAR	*Loligo* spp.	Cuttlefish	Ommastrephids	*O. vulgaris*	*E. cirrhosa*	*Alloteuthis* spp
1990	442.0	1011.0	no data	1765.0	no data	no data
1991	1034.0	911.0	no data	1947.0	no data	no data
1992	636.0	1029.0	no data	2935.0	no data	no data
1993	234.0	822.0	no data	2185.0	no data	66.0
1994	161.0	773.0	75.3	3512.2	245.1	49.3
1995	194.8	1024.6	149.4	3115.5	624.7	49.9
1996	191.3	923.6	295.7	2097.8	866.1	46.4

TABLE 7. Cephalopods landed (tons) at the port of Marín during the years 1991 to 1995. Subarea VII and Division IXa together.

YEAR	*Loligo* spp.	Cuttlefish	Ommastrephids	*O. vulgaris*	*E. cirrhosa*	*Alloteuthis* spp
1991	45.1		389.0		740.5	
1992	11.6		509.7		799.5	
1993	17.5		125.7		472.0	
1994	29.1		181.8		420.5	
1995	41.6		203.8		739.2	

TABLE 8. Percentage of the cephalopods landed at the port of Marín during the year 1996 coming from Subarea VII and Division IXa respectively.

ICES Area	*Loligo* spp.	Ommastrephids	*E. cirrhosa*
VII	92.2	87.4	13.2
IXa	7.8	12.6	86.8

TABLE 9. Landings registered as *Eledone cirrhosa* at the port of Riveira (IXa), including undetermined quantities of Ommastrephids.

YEAR	Tons registered as *E. cirrhosa*
1994	245.1
1995	516.2
1996	421.7

ANNEX 5

ICES Working Group on Cephalopod Fisheries and Life History

Tenerife, Spain

7-9 April 1997

DISCARDED CEPHALOPODS FROM THE COMMERCIAL FISHERIES ON THE SOUTH COAST OF PORTUGAL

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CCMAR

UNIVERSITY OF ALGARVE

Introduction

The incidental capture of species toward which there is no directed effort is characteristic of commercial fisheries and is termed by-catch. Some or all of this by-catch may be discarded at sea in the form of whole fish or other animals such as invertebrates, marine mammals, reptiles and birds. By-catches are unavoidable because while most fishing gears may be size-selective, they are not very species selective. In multispecies situations with nonselective gears such as trawls, the by-catch and the discard catch may be a significant portion of the total catch. Between 17.9 and 39.5 million metric tonnes - average 27 million tonnes - of fish are discarded each year in commercial fisheries, according to a report from the FAO (A Global Assessment of Fisheries Bycatch and Discards - FAO Fisheries Technical Paper 339, 1995).

The quantity and composition of by-catch and corresponding discard catch varies considerably with fishery, gear type, area, and season. Some gears such as octopus pots are highly selective. However other gears such as gill nets and trawls capture a wide variety of fish, and other organisms.

Various categories of discards can be identified, depending on the frequency of the catches giving rise to them (occasional, frequent or regular), the sensitivity of public opinion ("sensitive species") and their economic importance (whether or not species are marketable). Marketable species may be discarded for economic reasons (small size, low value, insufficient storage capacity, bad appearance) or because of regulatory requirements (quotas, minimum size restrictions). Some species may be discarded because they have no value or no ready market. Some non-marketabe species may actually be endangered or protected organisms such as marine mammals, seabirds, and reptiles.

The assessment of by-catches and discards in coastal fisheries has important biological and socioeconomic considerations in the management of fisheries. Discards represent a loss in terms of production. This is particularly important when discards consist largely of juveniles of marketable species. The by-catch of juveniles may have a significant impact on recruitment to the commercial fishery. Discards of non-marketable species may represent losses in economic opportunities in cases where these could be used in the production of fish meal, fish oils, fish pastes, or other products.

The effects of the discarding of by-catch at sea on community structure, trophic interactions, and stability are poorly known. However, there is some evidence that large quantities of discards may have a significant impact on multispecies fisheries. With the increasing emphasis on multispecies or ecosystem-based management approaches, it is necessary to assess and quantify discard composition and mortality. The by-catch of rare and/or endangered species, particularly marine mammals, sea birds, and reptiles is an increasingly sensitive and important area, with implications for environmental impact, fisheries management and regulation.

An analysis of the literature has shown that discarding is an important problem. Within the EC there is a great variation due to type of fishery, type of gear and socio-economic aspects. In Portugal, coastal fisheries employ a great variety of techniques ranging from trawls to artisanal gears. The by-catches and discards of many of these fishing gears have not yet been studied in terms of composition, quantity, causes, possible impacts, and management implications.

For the purpose of this study by-catch is defined as any organism caught unintentionally, and discards are the component of the by-catch which is not used in any way.

The study area

The Portuguese mainland coast extends over a total length of some 760 km, comprising the north-south western coast (600 km) and the east-west Algarve coast (160 km).

The maritime area under Portuguese jurisdiction covers an extensive area of the Atlantic (319 000 km2) and forms, in terms of productivity, part of the heterogeneous transition zone between the Mediterranean Sea and the Atlantic Ocean.

The richest waters are located close to the coast (the continental shelf is not very wide), while significant areas stretch over great depths with limited levels of productivity.

Fishing is concentrated on a relatively small group of species. Particularly important for their relative weight in catches are sardine, horse mackerel, chub mackerel, blue whiting, Atlantic mackerel, hake, European anchovy, pouting, scabbard fish, seabream, monkfish, octopus and clams.

The southern region of Portugal - Algarve - presents two distinct types of coast: the occidental coast (Barlavento) with a coastline dominated by cliffs, from Cabo S. Vicente to near Faro (Quinta do Lago); and the oriental coast (Sotavento) with sandy beaches, starting near Faro (Quinta do Lago) and ending in Vila Real de Santo António, near the Spanish border. Associated with the different types of bottom in the two areas are differences in species composition and relative abundances. This is reflected in the legislation concerning gill nets. To the east of Cabo Sta. Maria (Faro), 60 mm meshes are allowed during part of the year, whereas to the west 80 mm is the legal mesh year around.

The division of the Algarve coast into two areas, east coast (Sotavento) and west coast (Barlavento), is also due to the direction and frequency of the winds. In these areas the south-west winds are dominant not only in speed, but also in frequency, while the north-west and south-east winds are moderate winds.

The Algarve region, with an area of 4 960 Km2 and a coast line of about 160 Km, is the region of Portugal most dependent on fisheries. Fishing activities have traditionally had an important role in the area, and are a significant source of employment along the entire coastal area, particularly in the municipality of Olhão.

The Fishing Fleet

The Portuguese fishing fleet is very diversified and employs different gears and methods according to the characteristics of vessels, the fishing zone, and fish stocks exploited.

In order to identify specific characteristics and common problems, the Portuguese fishing fleet is divided into the following components: long-distance, purse-seiners, trawlers and multi-purpose. For this study, the long-distance fleet was not considered, since it is traditionally directed to operating outside the waters under Portuguese jurisdiction (EEZ).

In June 1995, the number of fishing vessels registered in the Algarvian ports were more than 3 500 (Table 1). (Note: The division by "Local" and "Coastal" fishery, is based on the TAG of the fishing vessel. For this study only the Coastal fishery was studied). The number of fishing licences issued for the Coastal fishery in the Algarve coast, is given in Table 2. It is important to note that the number of licences exceeds the number of boats, due to the fact that one boat can have more than one licence (for different fishing gears).

The Main Fishing Ports in the Study Area

The characteristics of the coastline and the proximity of the principal fishing grounds - due the narrowness of the continental shelf - has for many decades led to intense fishing activity along the coast of the Algarve region.

There are 10 main fishing ports in the south Portuguese coast (Algarve coast):

East coast (Sotavento)	West coast (Barlavento)
Vila Real de St. António	Albufeira
Tavira	**Portimão**
Fuseta	Lagos
Olhão	Sagres
Faro	
Quarteira	

The ports of Olhão, in the east, and Portimão, in the west, are the principal centres for the registration of vessels and fish landings.

Sampling Strategy

It is particularly difficult to know in advance where the fishing boats are going to fish. Many of the fishing boats decide where they are going to fish after they leave the port. Therefore, the sampling could not be based on fishing zone.

The sampling strategy had to be based on a random stratified sample of the fishing vessels by métier (five), coast in the region (east and west), and season (four).

The division of the ports in terms of east and west coast, which is also sometimes used by the administration, was made at the beginning of our study. However, since the two most important ports (Olhão and Portimão) are located in the east and west coast, respectively, it was decided to concentrate our efforts on 3 fishing trips per métier and season, with 2 from the east coast (the side with more fishing vessels) and 1 from the west coast.

1st Stratum - Métiers

- fish-trawl,
- crustacean-trawl,
- demersal purse-seiners,
- pelagic purse-seiners,
- trammel-net ,
- gill-net

Our efforts were, however, mostly concentrated on the first four métiers.

2d Stratum - Area (fishing port)

East side (Sotavento)	West side (Barlavento)
Vila Real de Stº António	Albufeira
Tavira	Portimão
Fuseta	Lagos
Olhão	Sagres
Faro	
Quarteira	

Our efforts were, however, concentrated mostly on Olhão and Portimão.

3d Stratum - Season

Spring
Summer
Autumn
Winter

Since, by definition, discards are never landed, it was necessary to have observers on board the fishing boats. This methodology allows us to get extra information, important not only for the statistical analyses, but also for the understanding of the reasons for discarding.

In the case of relatively small amounts of discards, the entire catch of discards was brought back to the laboratory. When the quantity of discards was large, sub-samples were taken (15-30 Kg) and estimates of the total amount of discards were made on board. In this way, the composition of the discard catch can be made based on the sub-sample. The only work which was left to do on board was with the commercial species (the species to be landed).

On board the fishing vessels, all information needed for the characterisation of the fishing vessel, the casting of the nets and catch was recorded. When allowed by the fishermen, length of the commercial species was also recorded.

Biological Studies

The objective of the sampling is to obtain, not only discard rates, but also some biological information on the discarded species caught by the most important métiers.

As mentioned before, all the discards or sub-samples were brought back for laboratory studies. In case of large quantities, samples were taken, frozen and later studied in the lab.

The basic biological information recorded in the laboratory was the length, weight, sex and maturation.

All species caught are classified by their frequency of rejection on a scale of 3:

1 - occasional (species only occasionally are discarded)
2 - frequent (species frequently discarded)
3 - regular (species always discarded)

Some Results

The project officially started in February 1996, but the sampling started in March. Therefore, two seasons have been covered: spring and summer. However, the weather this year made things very difficult with unusually strong rains and winds. During the spring we were unable to meet our objectives in terms of number of trips.

A total of 20 fishing vessels were sampled, with a total of 45 trips, equivalent to 560 hours at sea.

Tables 3 and 4 show the characteristics of the fishing vessels sampled and the characteristics of their fishing gears, respectively, by métier.

To date a total of 177 species have been identified from all *taxa*, of which 13 species of cephalopods. Table 6 shows all species identified, until now, and their classification by the frequency of rejection.

Biological data have been collected and organised, but due to the enormous number of species, only 148 specimens of cephalopods have been studied until now (Table 7).

No quantitative results are present in here, since we have not carried out a full data analysis. This will be done in the last phase of the project.

Table 1. Fishing vessels registered in the Algarve coast.

PORT	COASTAL			LOCAL	TOTAL
	Trawls	Purse Seines	Multipurpose	Multipurpose	
Villa Real de St. António	21	6	28	226	281
Tavira	1	1	45	229	276
Fuzeta	1	2	19	162	184
Olhão	6	15	38	401	460
Faro	1	0	17	175	193
Quarteira	0	6	17	194	217
Sotavento (East)	30	30	164	1387	1611
Albufeira	0	2	3	112	117
Portimão	9	8	24	299	340
Lagos	0	5	20	246	271
Sagres	0	4	20	170	194
Barlavento (West)	9	19	67	827	922
TOTAL	39	49	231	2214	2533

Source: Direcção Geral das Pescas (June 1995)

Table 2. Fishing licenses issued for the coastal fishery in the Algarve coast in 1993.

PORT	FISHING GEAR																TOTAL
	Longlines	Pots Alcatruzes	Purse Seines	Bottom Gillnets	Liftnets Sacadas	Traps Murejones	Drifting Gillnets	Jigging Toneiras	Dredges Ganchorras	Traps Covos	Crustacean Trawls	Fish Trawls	Trammel Nets	Pelagic Lonlines	Shrimp Nets	Beach Seines	
Vila Real St. António	8	4	7	10	0	0	3	1	5	6	18	7	14	1	0	0	84
Tavira	24	23	7	22	0	4	2	0	1	26	0	1	25	0	0	0	135
Fuzeta	30	15	2	12	0	3	1	0	0	8	0	0	6	0	0	0	77
Olhão	23	10	23	20	2	5	5	0	5	7	9	0	20	1	0	0	130
Faro	17	9	5	13	4	6	1	0	2	15	0	1	13	0	0	0	86
Quarteira	12	17	10	15	1	4	1	3	1	16	0	0	18	0	0	0	98
Sotavento (East)	114	78	54	92	7	22	13	4	14	78	27	9	96	2	0	0	610
Albufeira	3	1	2	6	1	1	0	1	0	3	0	0	7	0	0	0	25
Portimão	26	8	22	15	1	12	0	0	0	21	7	3	14	0	0	0	129
Lagos	11	9	15	21	1	8	0	2	0	9	0	0	21	0	0	0	97
Sagres	26	2	7	20	1	8	0	1	0	15	0	0	21	4	0	0	105
Barlavento (West)	66	20	46	62	4	29	0	4	0	48	7	3	63	4	0	0	356
TOTAL	180	98	100	154	11	51	13	8	14	126	34	12	159	6	0	0	966

Source: Direcção Geral das Pescas (January 1993)

Table 3. Characteristics of the fishing vessels during spring and summer 1996 in the Alagarve coast.

CHARACTERISTICS OF FISHING VESSELS						
Boat Code	Type	Yera of construction	CFF (m)	TAB	Power (hp)	Power (kW)
CT1	Crustacean Trawl	1970	23,00	123,17	500	368
CT2	Crustacean Trawl	1969	---	104,23	430	316
CT3	Crustacean Trawl	1968	25,50	88,52	470	346
PS1	Demersal Purse Seine	1969	14,26	20,80	142	104
PS2	Demersal Purse Seine	---	13,30	13,50	98	72
PS3	Demersal Purse Seine	1967	16,25	27,19	190	140
PS4	Demersal Purse Seine	1980	15,10	29,07	195	143
FT	Fish Trawl	1970	34,05	179,53	900	662
PS5	Pelagic Purse Seine	1961	---	35,38	300	221
PS6	Pelagic Purse Seine	1966	21,63	40,99	320	235
PS7	Pelagic Purse Seine	1958	21,88	44,69	250	184
T1	Trammel Net	1962	---	---	---	4
T2	Trammel Net	1963	---	45,00	45	33

Source: Direcção Geral das Pescas (June 1995)

Table 4. Characteristics of the fishing gears used in the fishing vessels during spring and summer in the Algarve coast

NETS	FISHING GEAR			
	Crustacean Trawl	Fish TRawl	Purse Seines	Trammel Net
Doors	Present	Present	Absent	Absent
“Retenida“	Absent	Absent	Present	Absent
Knot	Present	Present	Absent	Present
Length (m)	[57-60]	55	[700-1000]	4550
Height (m)	---	---	[74-120]	1,50
Mesh size (mm)	[55-65]	[65-70]	[16-18]	80

Table 5. Cephalopod species discarded and their classification by frequency of rejection.

Family	Species	Trawl		Purse-seine		Multi
		A	B	C	D	E
Sepiidae	*Sepia elegans*	2				
	Sepia officinalis			1	1	1
	Sepia orbignyana	2				
Sepiolidae	*Rossia macrosoma*	2	2			
	Sepiola spp.	2				
Loliginidae	*Alloteuthis* spp.			2	2	
	Loligo vulgaris		1	1	1	
Ommastrephidae	*Illex coindetii*	2	2			
	Todaropsis eblanae	2	2			
Octopodidae	*Eledone cirrhosa*	2	2			
	Octopus salutii (?)	2				
	Octopus vulgaris			1	1	1
	Scaeurgus unicirrhus (?)	2				

Frequent	1
Regular	2

Table 6. Biological data of cephalopod species discarded.

Species	Sample (n)				Mantle length (cm)			Weight (g)				Métiers
	Males	Indet.	Females	Total	Min.	Avg.	Max.	Min.	Avg.	Max.	Total	
Alloteuthis spp.	1	1	2	4	4,3	5,3	6,4	3,1	4,4	5,6	17,6	**DPS**/PPS
Loligo vulgaris	5	1	3	9	3,7	7,2	19,5	3,1	32,5	212,1	292,5	PPS/FT/**DPS**
Eledone cirrhosa	8	0	5	13	10,5	29,2	52,0	134,1	316,0	571,9	316,0	**CT**/FT
Octopus salutii (?)	0	2	2	4	6,6	43,8	90,6	80,5	205,2	341,1	820,9	CT/PPS
Octopus vulgaris	0	0	2	2	10,0	10,4	10,7	306,7	325,4	341,1	650,8	PPS/DPS
Scaeurgus unicirrhus (?)	1	0	0	1	---	---	---	---	---	---	68,8	CT
Illex coindetii	15	0	10	25	12,9	17,2	26,5	84,0	204,0	529,0	5100,5	CT
Todaropsis eblanae	5	0	7	12	11,1	13,5	17,6	97,9	190,5	354,1	2285,7	**CT**/FT
Sepia elegans	9	0	12	21	3,9	4,7	5,3	6,3	10,4	15,1	218,3	CT/**FT**
Sepia officinalis	2	0	1	3	4,9	7,7	10,9	16,6	69,8	140,4	209,5	**DPS**/PPS
Sepia orbignyana	0	0	3	3	5,3	5,6	5,9	18,9	24,3	33,6	73,0	CT
Rossia macrosoma	26	1	23	50	2,4	5,1	8,1	3,7	47,9	143,3	2395,9	**CT**/FT
Sepiola spp.	0	1	0	1	---	---	---	---	---	---	3,1	CT
TOTAL	72	6	70	148								

Legend:

DPS - Demersal Purse Seine
PPS - Pelagic Purse Seine
CT - Crustacean Trawl
FT - Fish Trawl

ANNEX 6

ICES Working Group on Cephalopod Life History
7-9 April 1997, Tenerife, Spain

Report on Life history, Fisheries, Parasites and Genetics

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A. General

The main theories of ageing of cephalopods has been reviewed by A. Guerra, 1996, Iberus 14 (2): 125-130. A genetically programmed ageing theory is proposed to explain the short life of most cephalopod species. Different experiments are proposed to test this theory and the advantage of cephalopods as experimental animals for such studies are summarized.

B. *Sepia officinalis*

Studies about allozyme electrophoresis for 32 presumptive loci revealed low level of genetic variability for *Sepia officinalis, Sepia elegans* and *Sepia orbignyana* from the NW Iberian Peninsula (A. Sanjuan, M. Pérez-Losada, A. Guerra, Marine Biology 126: 253-259, 1996). Mean expected heterozygosity estimates were <0.052. No significant diffreneces in allozyme frequencies were detected among populations of either *S. officinalis* or *S. orbignyana*. The genetic identities (I) of *S. officinalis* and *S. orbignyana* (I=0.12) and *of S. elegans* (I=0.13) were significantly different from that of *S. elegans* and *S. orbignyana* (I=0.49). The former are typical of values for confamiliar genera and a new generic status is proposed for the later two species, which become *Rhombosepion elegans* (Blainville, 1827) and *R. orbignyana* (Férussac, 1826).

On the other hand, M. Pérez Losada, A. Guerra and A. Sanjuan (1996, Comparative Biochemistry and Physiology, Vol. 114B (1): 11-18) showed that the activity of a large number of enzymes decreased faster in the digestive gland of the three above mentioned species than in the mantle muscle after 6-12 hours at room temperature. Consequently, the authors suggested that mantle muscle rather than digestive gland should be used for routine electrophoretic studies in *Sepia* species obtained from commercial catches.
A phylogenetic reconstruction analysis, applying Warner parsimony method and using *Illex coindetii* as out group showed only one most parsimonious tree. *S. elegans* and *S. orbignyana* were found to be a sister group. The topology agrees with that recently obtained from mitochondrial r-DNA sequences, and both molecular data are on line with previous morphological results. They confirmed the view that *S. elegans* and *S. orbignyana* belongs to a different genera (Rhombosepion) from that of S. officinalis (*Sepia "sensu stricto"*).

The Ecophysiology of Cephalopod group is actually the coordinator of the Project "Edad y crecimiento de los cefalópodos *Sepia officinalis* y *Octopus vulgaris*" funded by CICYT (MAR95-1919-C05). This project involves other four partners (Centro Oceanográfico de Canarias, IEO; Instituto de Ciencias del Mar, CSIC Barcelona; Laboratorio de Parasitología, Universidad de Vigo and the Laboratorio de Xenética Evolutiva Molecular, Universidad de Vigo). This project started in October, 1995 and will finish in December, 1998. To date, the results obtained by our group can be summarised as follows:

1. Seasonal samplings during one year on *Sepia officinalis* from specimens collected in the wild in the Galician coast (NW Spain) has been undertaken.

2. Culture of *Sepia officinalis* from the hatching until the specimens reach different ages has been carried out under different conditions of temperature and feeding regime.

3. The age and growth of the culture specimens is being compared with those obtained in the wild using hard structures (statoliths, cuttlebones, eye lenses and beaks) and biochemical growth indices (RNA, DNA and proteins).

4. The statoliths of *Sepia officinalis* were ground and polished in different planes using the techniques developed for *Illex*, *Loligo* and *Todaropsis* species. Growth rings were revealed using semiatomatic counts of an image analysis system (IAS) and SEM. The success of these studies were not complete because it was only possible to visualize growth increments in a small portion of the statolith in both, wild and culture specimens.

5. Tetracycline was used to validate the daily periodicity of the growth increment depositions. To date, the attempts carried out using different techniques to supply the marker were unsuccessful.

6. Chemical microanalyses by EDAX in the wing and lateral dome of statoliths of *Sepia officinalis* and *Loligo vulgaris* were made to test Lipìnski's hypothesis of the statolith deposition procces.

7. Biomineralization is being studying to deep understanding of the role of proteins in the calcium carbonate deposition.

8. Morphometric measures and number of lamellae were obtained from all cuttlebones of wild and culture specimens. The preliminary analyses of the data show that the lamelae deposition have not a daily periodicity. The periodicity could be more related to growth than age. To types of cuttlebones were observed: type A and type B. Both types correspond to different growth phases of the animal. A study of the variation of two short-life isotopes (oxigen 16-18 and carbone 12-13) is being carried out in order to test the possibility for ageing the animals from their cuttlebones.

9. Two techniques to visualize the eye lenses growth layers has been developed using optical and electronic microscopy. The layers can be visualized using both techniques. However, the techniques has to be improved to interpretate the periodicity of the layers.

10. Biochemical growth indices were used with wild specimens and with those obtained in two culture experiences. The first experience was undertaken with juveniles and adults mantained in captivity during 40 days at two different temperatures (13-15°C and 18-20°C) and at two different feeding regimes. The second one was carried out with post-hatched specimens under the same conditions of temperature and feeding regimen than the first experience.

These studies will partially constitute the PhD Thesis of Vera Bettencourt.

C. *Loligo vulgaris* and *Loligo forbesi* reproductive pattern

The reproductive pattern of both loliginid squids are summarized in F. Rocha and A. Guerra (J. Exp. Mar. Biol. Ecol., 207: 177-189, 1996).

This studies were carried out between February 1991 and February, 1993. The mature females of both species have several modes of egg sizes and developmental stages within the ovary. Several signs indicate that both, female *Loligo vulgaris* and *Loligo forbesi*, undergo partial ovulation at the time of spawning. The spawning period is relatively long altough in no case represents the greatest fraction of the animal's life cycle. Egg-lying occurs in separate bunches and somatic growth between egg-batches has not been observed. This reproductive pattern is defined as intermitent terminal spawning.

D. *Todaropsis eblanae* life cycle

Some aspects of the PhD Thesis of Mario Rasero, defended in Santiago de Compostela on June 1996, about this species in the NW Spanish coast can be summarised as follows.

1. Spawning of *T. eblanae* occurs throughout the year altough it is more intense during spring and summer seasons when a high primary production is observed in the Galician coast. Recruitment also occurs all year round being more intense during the end of the summer and the autumn. Size at first maturity were 131 mm ML for males and 162-166 for females. Higher proportion of mature individuals of both sexes was found in the northern coast of Galicia in comparison with the western one. The most likely cause of this event can be the migration of mature individuals of the western area to zones hardly accesible to fishing vessels operating there. Total fecundity was estimated to range between 5,000 and 30,000 oocytes. This could

be the lowest value of fecundity observed in ommastrephids. Mature oocytes diameter ranged from 1.2 to 1.8 mm. This species shows an intermitent spawning and partial ovulation. Nidamental glands seems to have loading and discharging cycles simultaneously to those observed in the oviduct.

2. Age and growth was study from modal progression analysis and growth increments analysis from the statoliths. The daily periodicity hypothesis was indirectly validated. The age of the sampled individuals ranged from 5 to 11 months. Life span of the species may be slightly greater than 12 months. Back calculations showed that the animals hatched troughout the year. Seasonal varations in growth rates were observed. Average growth rates were 0.3 mm ML/day in males and 0.9 mm ML/day in females.

3. From genetic and morphometric beak studies it was concluded than *T. eblanae* in Galicia constitutes just one population unit. A global hypothesis to explain the population structure and the variation observed troughout the time could be summarized as folows: the main spawning area of this species within the studied area lies of western Galicia, a relatively more productive area than the northern one. In the western area spawning occurs all year round altough it is more intense during spring and summer. At this time of the year, as primary production increases in the north, spawning extends toward this area. Bathymetric migrations in the western area makes the adult population less accesible to fishing than in the north. This is due to the greater intensity of recruitment, to the narrowest of the continental shelf and to the different behaviour of the fishing fleet.

E. *Illex coindetii*

Age and growth of *I. coindetii* in the northwest fishery of Spain were estimated from statoliths of 341 specimens (170 males and 171 females) ranging from 48 to 379 mm ML. Weight-at-length of mature males was greater than that of immature males and mature and immature females. Lifespan was estimated at 13 months for males and 15 months for females. Recruitment to the fishery occurs approximately at the age of three months. ML instantaneous growth rates were 0.72 mm/day for males and 0.84 mm/day for females. Weight growth rate was 2.22 g/day for males and 3.66 g/day for females. Maturity stages, however, influence the increase in weight in both sexes, such that weight-at-age was greater for mature than for immature individuals. The age at which individuals mature is variable ranging from 140 to 200 days in males and between 183 and 285 in females. Growth rates in both sexes depended on the season of hatching. Squid hatched in winter attained larger sizes for the same age than squid in other seasons. These seasonal differences in growth were only evident after squid had reach eight months of age. Reading daily increments in statoliths seems to be a reliable techniques for studying the age and growth of *Illex coindetii*. An extended information about this subject is included in: "Age and growth of the short-finned squid *Illex coindetii* in Galician waters based on statolith analysis" (González, Castro and Guerra, 1996, ICES J. Mar. Sci. 53: 802-810).

F. Predatory relationships of *Illex coindetii* and *Todaropsis eblanae* in the Galician coast.

This studies are comprised in M. Rasero, A.F. González, B.G. Castro and A. Guerra (J. Mar. Biol. Ass. UK, 76:73-87, 1996).

A sample of 334 stomach contents of *Todaropsis eblanae* (34-222 mm ML) and 267 stomach contents of *Illex coindetii* (50-379 mm ML) collected by commercial trawlers was examined. A total of 21 (*T. eblanae*) and 23 (*I. coindetii*) different prey items, belonging to three zoological groups (Teleostei, Crustacea and Cephalopoda) were ingested by these cephalopods. 43% of the T. eblanae diet was composed by blue whiting (*Micromesistius* *poutassou*). The diet of these squid species was significatly influenced by the geographical area (both species), size (*T. eblanae*) and maturation (*I. coindetii*). Feeding rate of both species decreased with size, but the percentages of stomachs with food remains increased in maturing and and mature females. Weight of preys ingested depended on available prey size. In small individuals, maximum prey weight was very close to the squid weight. Both squid species are mainly neritic, nekto-benthic predators, but *I. coindetii* seems to have a broader and more pelagic diet.

G. Fisheries of *Illex coindetii* and *Todaropsis eblanae*

Studies about the fisheries of *Illex coindetii* and *Todaropsis eblanae* off Galician waters are summarised in A.F. Gonzalez, M Rasero and A. Guerra (Nova Acta Científica Compostelana, 6: 1991-203, 1996). Tha abundance indices for 21 cruises of fish prospection performed on the continental slope and shelf of Galicia (30-500 m depth) between 1973-1991 showed that *Illex coindetii* appeared in this zone in significant value from 1984 onwards and its abundance experienced a maximum in 1987. The abundance of *Todaropsis eblanae* seems to be related with upwelling proccesses. Both species are taken as by catch in the trawler fishery targetting hake, blue whiting, horse mackerel and Norway lobster in the Iberian Atlantic. In Galicia, the annual catch during this period varied between 490 and 2,352 tonnes, experiencing important monthly and interannual fluctuations, with the highest unloading indices being recorded in spring and autumn. Catch of both species off the Galician coast represented 26% in weight and 14% in economic value with regard to the total cephalopod catches between 1980 and 1991 whereas taking Spain as a whole, both species represented 10% in weight and 4% in economic value of the total for cephalopods. The short-finned squid (ommastrephids) fishery in Galicia does not appear to be overexploited.

H. *Octopus vulgaris* culture

A.F. González and A. Guerra have undertaken a culture experience of subadults and adults of *O. vulgaris* during 6 months within the Project "Edad y crecimiento de los cefalópodos *Sepia officinalis* y *Octopus vulgaris*" funded by CICYT (MAR95-1919-C05). This experience was carried out in four horizontal tanks of 2,000 l of capacity each in an open system. Specimens were fed ad libitum with discrads (*Polybius henslowii*) of the fishery. The water temperature ranged from 12-15oC. The preliminary results show that the animals grows from 700 to 3,800 g in an average time of 6 months. Under particular conditions it was shown that the tanks can support densities of 5 kg per squared meter. Mortality was 10%.

C. Hebberecht and A. Guerra demonstrated the adaptation and optimal growth of O. vulgaris using a floating system composed by four vertical hauls specillay designed for this study. The animals were mantained in a Ria during five months (July to November, 1996). The diet were composed by different species of discards (bivalves, crustacenas and fish).

I. Parasites

The biotic relationships of *Illex coindetii and Todaropsis eblanae* in the northeast Atlantic and its evidence from parasites studies is summarized in S. pascual, A.F. González, C. Arias and A. Guerra (Sarsia, 81: 265-274, 1996).

The parasites were collected from 1,200 short-finned squid (*Illex coindetii* and *Todaropsis eblanae*) caught as by-catch in a multispecies trawling fishery in the northwest Spanish Atlantic waters in 1992-1993. Parasites found included six species of helminths, three tetraphyllidean cestodes, two trypanorhynchidean cestodes and one ascaridoid nematode. *Phyllobotrium* sp. and *Anisakis simplex* B were used in host-parasites relationships. Levels of infection varied signifficantly with host size or stage of maturation for both squid species. Regional variation in infection level seems attributable to geographical variation in availability of prey, discreteness and movements of host populations and to size or age-related changes in the prey selection of their host. Parasite evidences suggest that both ommastrephids squids are sympatric species sharing similar econiches and serve as diet for large top predators of northeast Atlantic. Parasites may also be useful as an indirect indicator of the migratory habits of the squid.

A new species of *Stellicola* (Copepoda, Lichomolgidae), *Stellicola hochbergi* has been described for Illex coindetii of the Atlantic coast of the Iberian Peninsula (López-González and Pascual, 1996, Hydrobiologia, 339: 1-6).

Gamogomy and sporogony of *Aggregata octopiana* were commonly observed during histological examination of the digestive tract and the connective tissue sheath of wild *Octopus vulgaris* from the Ria de Vigo (NW Spain). In massive infections, numerous oocytes were found in the muscular tissue (Estévez *et al.*, 1996, Dis. Aquat. Org., 27: 227-231).

ANNEX 7

Working document for the ICES Working Group on Cephalopod Fisheries and Life History Meeting: 7-9 April 1997, Tenerife, Spain

Portuguese cephalopod trade statistics

by

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1. Fish and Shellfish trading

Portugal trades a great variety of marine resources in different forms (alive, fresh, chilled, frozen, salted, canned and transformed in sub-products). Imports of marine resources have been always higher than the exports, reflecting the importance of marine resources in the Portuguese food habits. The turnout of national catches has always been insufficient to meet national demand. Imports reached 268 thousand tonnes (561 765 thousand ECU) in 1995 whereas only 64 thousand tonnes were exported (Fig.1)(ca. 114 435 thousand ECU).

Frozen marine products are exported mainly to Japan (ca. 50% until 1989), followed by the UK (30-32% in 1989 and 1990 and 73% in 1991), France (ca. 9-15% until 1989), Denmark (21-22%, since 1990) and Spain (5-23%, since 1987).

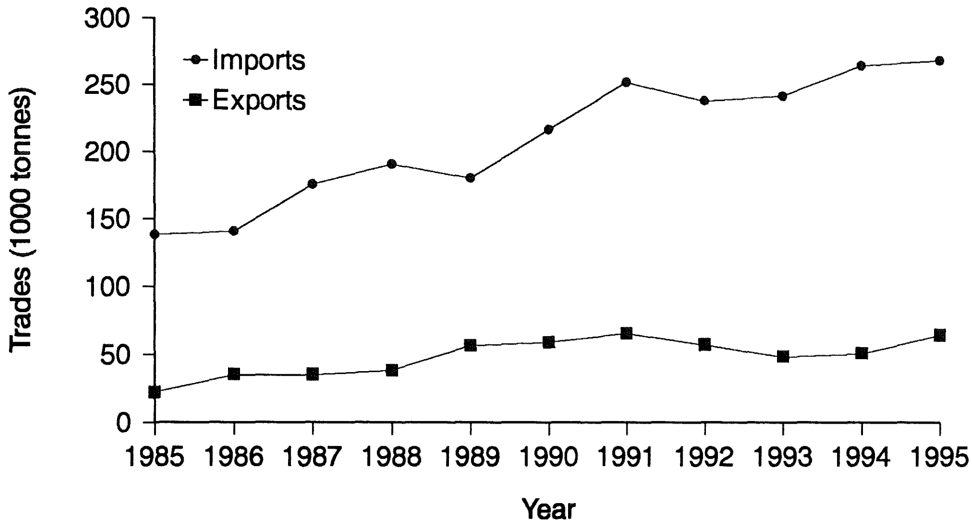

Figure 1 - Portuguese fish and shellfish trades.

2. Cephalopod trading

Cephalopods represent between 0.01% and 0.1% of Portuguese marine resources traded. Portugal imports 11000 to 21000 tonnes of cephalopods and exports only 1000 to 4000 tonnes. They are imported mostly frozen (95%). The exports of alive, fresh or chilled cephalopods represent 20% of the total and the remaining are exported frozen. Among the marine resources exported frozen, *Octopus* spp. stays in the 4-5th place in weight and 2nd-3rd in value and long-finned squids in 6-7th place in weight and value. Cephalopods are also traded canned and as part of fish/shellfish flour. However the amount is not usually reported separately.

Cephalopods are reported in several categories, of level of identification and preservation, listed in table 1.

Table 1 - Cephalopod trade categories.

	TRADE CATEGORIES	PRESERVATION
Cuttlefish and bobtail squid	- bobtail squid (*Sepiola* spp.)	frozen
	- other cuttlefish (*Sepia officinalis, Rossia macrosoma)*	frozen
	- cuttlefish and bobtail squid (*Sepia officinalis, Rossia macrosoma, Sepiola* spp.)	not specified
Long-finned squid	- *Loligo vulgaris*	frozen
	- *Loligo pealei*	frozen
	- *Loligo patagonica*	frozen
	- *Loligo* spp.	frozen
Short-finned squid	- *Illex* spp.	frozen
	- *Todarodes sagittatus*	frozen
Octopods	- *Octopus* spp.	alive, fresh or chilled
	- *Octopus* spp.	frozen
	- *Octopus* spp.	not specified
Unspecified squid	- *Loligo* spp., *Todarodes sagittatus*	alive, fresh or chilled
	- *Loligo* spp. and *Todarodes sagittatus*	not specified
	- other squid (*Nototodarus* spp., *Sepioteuthis* spp.)	alive, fresh or chilled
	- other squid (*Nototodarus* spp., *Sepioteuthis* spp.)	frozen
	- other squid (*Nototodarus* spp., *Sepioteuthis* spp.)	not specified
Unspecified cuttlefish, bobtail squid and squid	- cuttlefish, bobtail squid and squid	alive, fresh or chilled
	- cuttlefish, bobtail squid and squid	not specified

Cuttlefish, short-finned squids and *Octopus* spp. are exported almost only from the mainland. Long-finned squids are exported from the mainland and from the Azores (ca. 8.1%).

Imports and exports of cephalopods, in weight and value, from 1985 to 1994 are listed in tables 2 to 5. All cephalopod trades are listed in table 6. Where the symbol * appears in tables, statistics refer to the period January to July.

Portugal imports mainly squids (70-95%, 1985-1992) of which *Loligo* spp. were the majority between 1988 and 1992. In 1993 and 1994 imports of squid decreased to 40-50% of the total cephalopod imports. Exports of cuttlefish and squid are much lower than imports. *Octopus* spp. exports were higher than imports until 1989, but a significant increase of imports was verified since then.

Among *Loligo* species, *Loligo vulgaris* is the most important species imported. *Loligo patagonica* was only traded between 1990 and 1992 with around 1000 tonnes of imports and 50 tonnes of exports (fisheries of the Portuguese fleet in the Falklands). *Loligo pealei* accounts for 2% of *Loligo* imports (20-300 tonnes).

Table 2 - Cephalopod imports in weight (tonnes), by groups of categories.

Groups of categories	1985	1986	1987	1988	1989	1990	1991	1992	1993*	1994
Cuttlefish and bobtail squids	695	1610	1257	1484	77.5	2346	3209	2380	2072	3615
Long-finned squids	750	7278	3412	5244	6960	5621	9518	7907	1047	2488
Short-finned squids:										
Illex spp.	7445	2407	6039	1493	1858	1158	2373	1299	609	1636
T. sagittatus frozen	161	41	0	0	7	53	60	21	0	0
Unspecified squid	3827	7037	4081	2771	2119	2717	2226	2605	1085	2653
Unspecified cuttlefish, bobtail squid and squid	-	-	-	0.2	2040	2	71	12	388	727
Octopus spp.	62	289	195	671	281	1390	3089	3145	2075	2979

Table 3 - Cephalopod imports in value (kECU), by groups of categories.

Groups of categories	1985	1986	1987	1988	1989	1990	1991	1992	1993*	1994
Cuttlefish and bobtail squids	770	1760	1400	1600	105	2325	3750	3340	3310	7070
Long-finned squids	520	4200	2700	4950	5220	4670	7950	6735	1285	4305
Short-finned squids:										
Illex spp.	3140	1715	4420	850	1305	960	1630	830	420	2040
T. sagittatus frozen	95	30	0	0	5	70	100	30	0	0
Unspecified squid	2940	3825	2945	1335	1365	1630	2050	1805	1055	2770
Unspecified cuttlefish, bobtail squid and squid	-	-	-	0.2	2415	2	95	20	305	1290
Octopus spp.	75	435	180	590	330	2510	5770	5300	3350	7035

Table 4 - Cephalopod exports in weight (tonnes), by groups of categories.

Trade categories	1985	1986	1987	1988	1989	1990	1991	1992	1993*	1994
Cuttlefish and bobtail squid	39	18	62	19	82	189	153	312	49	214
Long-finned squids	62	280	165	342	278	751	697	648	381	19
Short-finned squids:										
Illex spp.	250	6	65	22	29	0	432	214	16	8
T. sagittatus frozen	27	4	0	0	0	0	9	4	0	0
Unspecified squid	515	299	382	326	817	491	734	690	127	112
Unspecified cuttlefish, bobtail squid and squid	-	-	-	18	46	55	11	37	61	113
Octopus spp.	752	820	1084	950	2657	813	701	648	373	468

Table 5 - Cephalopod exports in value (kECU), by groups of categories.

Trade categories	1985	1986	1987	1988	1989	1990	1991	1992	1993*	1994
Cuttlefish and bobtail squids	80	40	95	45	75	352	235	520	100	510
Long-finned squids	60	440	295	490	500	700	775	650	400	55
Short-finned squids:										
Illex spp.	395	4	145	10	50	0	415	180	25	15
T. sagittatus frozen	95	1	0	0	0	0	10	20	0	0
Non specified squid	425	470	840	685	1910	1265	1725	1445	155	185
Unspecified cuttlefish, bobtail squid and squid	-	-	-	35	85	40	30	60	145	255
Octopus spp.	1365	2080	2040	2305	7050	2535	2225	1595	845	1435

Table 6 - Cephalopod trades.

Cephalopods	1985	1986	1987	1988	1989	1990	1991	1992	1993*	1994
Imports (tonnes)	12940	18662	14984	11663	13343	13287	20546	17369	7276	14098
(MEcu)	7.54	11.84	11.65	9.33	10.75	12.17	21.34	18.06	9.73	24.51
Exports (tonnes)	1645	1427	1758	1677	3909	2299	2737	2552	1007	930
(MEcu)	2.42	3.04	3.42	3.57	9.63	4.87	5.42	4.47	1.67	2.46

Data sources:

Anonymous. 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993 and 1994 - *Estatísticas de Pesca*. Instituto Nacional de Estatística.

Anonymous. 1995 - *Recursos da Pesca*. Direcção Geral das Pescas.