Living Resources Committee **ICES CM 1999/G:4**

DRAFT

REPORT OF THE

WORKING GROUP ON CEPHALOPOD FISHERIES AND LIFE HISTORY

Iraklion, Crete
25–27 March 1999

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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1 INTRODUCTION

1.1 Terms of Reference

ICES Council Resolution 1998/2:48 stated that the Working Group on Cephalopod Fisheries and Life History [WGCEPH] (Chair: Dr G. Pierce, UK) would meet in Heraklion, Greece, from 25-27 March 1999 to:

a) update currently available landing statistics;
b) review the results of national and transnational projects collecting data on fished cephalopods, especially those studying migration and distribution patterns of juveniles and adults, and the factors affecting recruitment;
c) continue the compilation of data, methods and results available for stock assessment of fished cephalopods, including information on stock identity, fishing effort and discards;
d) develop a bibliographic database of cephalopod literature, including grey literature;
e) obtain peer review of the Working Group report from an appropriate scientist prior to the ASC, and send the review to the chair of the Living Resources Committee;
f) comment on the draft objectives and activities of the Living Resources Committee component of the ICES five years plan, and specify how the purpose of the Working Group contributes to it.

WGCEPH will report to the Living Resources Committee at the 1999 Annual Science Conference.

Justification: Cephalopods are key members of the marine food chain, and support important fisheries. The study of cephalopod population dynamics and trophic interactions is therefore a major element of the Living Resources Committee science programme. Cephalopod studies continue to expand globally, and the new data need to be updated and assessed annually.

1.2 Attendance

Sixteen of the currently appointed WGCEPH members (names are marked with an *) and 18 observers (mainly participants[†] in a current FAIR project on cephalopods which held its Annual Co-ordination Meeting immediately preceeding this meeting) attended the 1999 WGCEPH meeting in Heraklion.

1	Nick Bailey*†	UK	19	Helen Martins	Portugal
2	Eduardo Balguerias†	Spain	20	Ana Moreno*	Portugal
3	Jose Bellido	UK/Spain	21	Catalina Perales†	Spain
4	Herman Bjørke*	Norway	22	João Pereira*†	Portugal
5	Prof Peter Boyle*†	UK	23	Dr Uwe Piatkowski*	Germany
6	Prof Tom Cross†	Ireland	24	Dr Graham Pierce (Chair)*†	UK
7	Manuela Morais da Cunha*†	Portugal	25	Julio Portela*†	Spain
8	Dr Heather Daly	UK	26	Dr Mario Rasero*†	Spain
9	Vincent Denis†	France	27	Dr Jean-Paul Robin*†	France
10	Eileen Dillane†	Ireland	28	Dr Paul Rodhouse*†	UK
11	Dr Paul Galvin†	Ireland	29	Natasha Rougeron†	France
12	Ines Gonçalves	Portugal	30	Dr Begoña Santos*	UK
13	Dr Angel González*	Spain	31	Marina Santurtún	Spain
14	Joaquin Gracía	Spain	32	João Sendão	Portugal
15	Dr Angel Guerra*	Spain	33	Claire Waluda†	UK
16	Simeon Hill	UK	34	Dr Jianjun Wang†	UK
17	Dr Drosos Koutsoubas*†	Greece			
18	Eugenia Lefkaditou	Greece			

These participants represented 8 ICES Member Countries (France, Germany, Greece, Ireland, Norway, Portugal, Spain, UK). A full list of participants including contact addresses 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: Teresa Borges (Portugal), Martin Collins (UK), Earl Dawe (Canada), Eilif Gaard (Denmark), Lisa Hendrickson (USA), Colm Lordan (Ireland), William Macy (USA).

1.3 Opening of the Meeting

The meeting took place in the Conference Room of the Institute of Marine Biology, Heraklion from 25-27 March 1999. The agenda of the meeting is given in Annex 3.

1.4 Arrangements for the Preparation of the Report

The Chair reminded participants that the ICES Secretariat requires that the Working Group Report should be drafted by the end of the meeting. Prior to the meeting, responsibility for preparation and collation of material for the *tor*, as well as for presentation of the material to the meeting, was delegated to the following members and observers: Uwe Piatkowski (*a*), Heather Daly and Lisa Hendrickson (*c*), Begoña Santos (*d*) and Nick Bailey (*f*).

It was agreed that amended text, updated during and following the meeting, would be submitted electronically to the Chair, who undertook to write and circulate a final draft to members and attendees prior to the review process (*tor e*).

1.5 Working Group Papers

Thirteen Working Documents (WD) were available at the meeting and shortly thereafter. Information contained therein was widely used to compile the present report. Annex 5 contains a list of Working Documents.

2 CEPHALOPOD LANDING STATISTICS (TOR A)

2.1 Compilation of Landing Statistics

The present report updates landing statistics which were available for cephalopod groups caught in the ICES area from 1992 to 1998 (Tables 1 to 6). The data largely originate from the ICES STATLANT database and from additional and more precise information supplied by Working Group members. If numbers extracted from the ICES database and those provided by Working Group members were not identical, the bigger catch number was considered to be appropriate for inclusion into this report.

As in previous years, landings information in the ICES database was incomplete and did not cover all ICES nations. For example, French data from 1992 to 1997 must be considered as preliminary, as the French authorities have informed ICES that they will resubmit their data. Irish data on squids were not separated into common and short-finned squid in 1996 and 1997. From 1995 to 1997, preliminary data from Norway and Spain has, as yet, not reported. However, relevant data of Norway and Spain were provided in detail by Working Group members from these countries and are added to the present report.

It should be noted that several ICES member countries could yet not supply updated information for 1998. In these cases the 1997 catch was taken as a best estimate and is marked in the tables as provisional (P). It is hoped to improve these numbers in the next year's report. In general, all 1998 data given below should be considered as preliminary.

Tables 2.1 to 2.4 give information on annual catch statistics (1992-1998) per cephalopod group in each ICES Division or Sub-area separated for each nation. The cephalopod groups of the tables comprise the following species:

- Table 2.1. Cuttlefish (Sepiidae). The majority of landings summarised in this table are catches of *Sepia officinalis*, the common cuttlefish, plus small amounts of *S. elegans* and *S. orbignyana*. WGCEPH considers that no bobtail squids (Sepiolidae) occur in the reported catches.
- Table 2.2. Common squid (including the long-finned squids *Loligo forbesi*, *L. vulgaris*, *Alloteuthis subulata* and *A. media*). The majority of common squid landings are *L. forbesi* and *L.vulgaris*.

- Table 2.3. Short-finned squid (*Illex coindetii* and *Todaropsis eblanae*) and European flying squid (*Todarodes sagittatus*).
- Table 2.4. Octopods (including *Eledone cirrhosa*, *E. moschata* and *Octopus vulgaris*).

A compilation separated into single species is still not possible as countries report landings for cephalopod groups, mostly in the format as given in the tables. Table 2.5 summarises total annual cephalopod landings in the whole ICES area for major cephalopod groups. Table 2.6 provides information of total annual cephalopod landings in the whole ICES area for major cephalopod groups separated for each fishing nation.

2.2 General Trends

Total reported annual cephalopod landings within the ICES region varied between 37,581 t and 48,661 t during the reported period of 1992 to 1998 (Table 2.5). Data for 1998 are still provisional, but indicate that the total catch of approximately 46,258 t is in the range of the previous years. Cuttlefish landings increased remarkably from 1996 to 1997, mostly due to French catches in the English Channel. These data have to be taken with caution, however, as France will resubmit statistics (see above), and the present data taken from the ICES database might be erroneous. Total landings of common squid remained stable during the last few years, whereas catches of short-finned squid increased, particularly from 1996 to 1997 (Table 2.5). This is mostly due to the larger amount taken by the Spanish fleet in ICES Sub-areas VIII and IX. The only decreasing trend could be observed in octopods which can be attributed to the lower catches Portugal has reported from ICES Sub-area IX in 1997 and also for 1998. In terms of total cephalopod landings, the most important nations in 1997 were France (18,141 t), Portugal (12,053 t) and Spain (11,628 t) who together took more than 85% of the total reported cephalopod catch in the ICES region during that year. The major fishing nations, from North to South, are briefly reviewed in the following paragraphs:

The only species which has been commercially caught in Iceland is the European flying squid. No fishery to speak of has taken place on this species for 15 years. During the last three years small traces of the species have been reported as by-catch in the redfish fishery south and southwest of Iceland. According to fishermen these traces were still evident in 1998. However, as the amount is so limited (Table 2.3), no market has developed around the species and hence the squid has no commercial value and the small amount is simply discarded.

In Norway only the European Flying squid (*Todarodes sagittatus*) is landed. After its total absence in the early 1990s it appeared again in the fishery statistics in 1995 with a total of 352 t which were caught in autumn. The possible "return" of *T. sagittatus* into North European waters could not be confirmed, because in 1996 no catches were reported. Landings increased again in 1997 with a total of 192 t but in 1998 only ca. 2 t were landed. Thus the status of this species in European waters remains unclear.

There have been no recordings of the European flying squid (*Todarodes sagittatus*) in the Faroe Islands during the last years. However, the long-finned squid *Loligo forbesi* occurs on the Faroe Bank just southwest of the Faroe shelf. The species has not been caught commercially, but during 1997 and 1998 research has been undertaken to evaluate a possible fishery. There were several research cruises in 1997 and 1998 using bottom trawls, and their catches were quite significant (5.4 and 26 t, respectively) and were sold ashore which indicates a possible market for that species.

Denmark regularly reports small amounts of common squids in landings. The amounts landed in 1997 and 1998 (16-17 t) were small but represent an increase over the previous four years (1 – 5 t).

Landings of cephalopods by UK vessels in Scotland have increased substantially from 1997 to 1998, particularly in long-finned (common) squid (Table 2.6). In 1998 the catch yielded 1,528 t whereas in 1997 it was 1,001 t. This figure makes Scotland to the third most important fishery nation on common squid within the ICES region. The increase is mostly due to higher catches in the northern North Sea.

Common squid (mainly *Loligo forbesi*) contribute the major share of cephalopods landed in Ireland and its catch peaked in 1995 with 1,042 t. 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 1997 and 1998 were not available in detail, but reported as mixtures of long-finned and short-finned squid. Like in many other ICES nations cephalopods are not "quota species" in Ireland. Therefore, available catch data have to be treated with great caution.

In Belgium cephalopods are caught as a minor by-catch in the major fishing areas of the southern North Sea and the English Channel. Common squid form the most important group, peaking at 468 t in 1995.

Cephalopod landings reported by England, Wales and Northern Ireland mostly originate from the English Channel and the Celtic Sea where an intense fishery takes place. As in previous years the most important group in 1998 were cuttlefish with 2,643 t. Total catch of common squid decreased markedly from 2,037 t (1997) to 1,628 t (1998). During the last decade England, Wales and Northern Ireland have developed to the most important cephalopod fishery nation after France, Portugal and Spain.

France remains the most important fishing nation concerning cuttlefish (*Sepia officinalis*) and common squid (*Loligo* spp.). Major fishing grounds are the English Channel and the Bay of Biscay. From 1992 to 1997 catches varied from 7,742 to 14,511 t in cuttlefish and from 2,708 to 6,400 t in common squid. These figures, however, must be viewed with caution, as France intends to resubmit an update of cephalopod fisheries statistics to the ICES data base.

There were no significant changes in the cephalopod landings reported by Spain during the last few years except for short-finned squid which decreased from a total of 3,539 t in 1997 to 2,404 t in 1998. However, Spain remains the main fishery nation for short-finned squid in Europe. Octopods (5,772 t) and short-finned squid (2,404 t) were the two most important cephalopods resources for the Spanish fishing fleet in 1998. A detailed WG document describing the important octopus fishery in the Spanish waters of the Gulf of Cadiz was provided in the 1998 report of WGCEPH. It is estimated that around 50% of octopus landings and more than 50% of common squid landings from artisanal fisheries in Galicia (NW Spain) do not enter official figures. Increasing efforts have been made in recent years to improve data for official landings of cephalopods by the Spanish and Basque fleets landed at Basque Country ports. The trawlers from the Basque Country trawlers land cephalopods mainly from the Bay of Biscay, as well as the Celtic Sea, Porcupine Bank western part of Helidor Island and around Rockall Bank. Smaller vessels fish predominantly in the eastern Cantabrian Sea. A detailed Working Document (WD) describes the Basque Country fishery and includes landings from 1994 to 1998 (WD 1). Data from Galician fisheries are described in WD 7.

Portugal regularly provides detailed catch statistics of all major groups to ICES. All groups form important fishery resources. Octopus catches (*Octopus vulgaris* and *Eledone cirrhosa*) decreased during the last three years in ICES Sub-area IX from 11,652 t (1996) to 9,119 t (1997) and to 6,446 t in 1998 (Tables 2.4; 2.6). Cuttlefish (*Sepia officinalis*) landings in Sub-area IX remain relatively constant since 1996 and peaked in 1998 to 1,734 t. Squid (Common and Short-finned squid) are comparatively less important in Portuguese landings showing a little increase in 1997 with 1,147 t (long-finned squid) and in 1998 with 388 t (short-finned squid), respectively. A comprehensive review of the Portuguese cephalopod fisheries and their trends was provided as a WG document and is compiled in Annex 5 of the group's 1998 report. It is noteworthy that in the Azores (ICES Sub-area X) the landings of *Loligo forbesi*, which is subject of an artisanal fishery in the region, dropped considerably from 303 t in 1997 to 98 t in 1998.

Although there is some variation, total landings of cephalopods in Greece from surrounding seas have steadily increased since 1984. WD 2 provides a detailed Working Document on Cephalopod resources in the Eastern Mediterranean with particular emphasis in Greek Seas: Present and Future perspectives.

A brief summary of the landings from the *Loligo pealei* and *Illex illecebrosus* fisheries in the Northeast USA (NAFO areas 5 and 6) has been provided by Jon Brodziak (Woods Hole, USA) (Table 2.7). The landings for *L. pealei* have been increasing since 1996 after a sharp deline. The *I. illecebrosus* fishery has remained relatively stable, with the largest landings for 5 years in 1998.

2.3 Conclusions

As in the previous year, WGCEPH emphasises that the (low) quality of available landing statistics has been discussed in detail in earlier reports. During recent years there have been considerable improvements, notably in the data supplied by Portugal and Spain. However, this year no updated information were available from France and Ireland.

Difficulties still remain in several aspects of data collection. 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 making no distinctions, some distinguishing between major groups such as cuttlefish, squid, octopus, and some providing details on individual species. As long as cephalopod species will not be regarded as quota species this situation will not change. First important steps for management advice will be achieved by legislations on exploitation. Further restrictions in length and weight of exploited stocks should be introduced.

3 REVIEW THE RESULTS OF NATIONAL AND TRANSNATIONAL PROJECTS COLLECTING DATA ON FISHED CEPHALOPODS ESPECIALLY THOSE STUDYING MIGRATION AND DISTRIBUTION PATTERNS OF JUVENILES AND ADULTS, AND THE FACTORS AFFECTING RECRUITMENT (TOR B).

A full list of current research projects and activities relevant to WGCEPH appears as Annex 4. Those presented and discussed during the meeting are described briefly below (see also section 4 of this report for those projects relating to stock assessment *tor c*).

3.1 Cephalopod Resources Dynamics: Patterns in Environmental and Genetic Variation

This current (1997-2000) project funded under the EC FAIR programme involves nine partner institutions in six EU (and ICES) nations. Co-ordinated by Professor Peter Boyle at the University of Aberdeen, the specific aims of this project are:

- 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.
- To refine the quantitative description of seasonal and inter-annual patterns of distribution and abundance of fished cephalopods and to develop models to predict their abundance from biotic and physical oceanographic parameters.
- To use microsatellite DNA variation as an indicator of stock structure and interactions of neritic and oceanic cephalopod resources through the use of DNA marker "tags", supplemented with allozyme and mitochondrial DNA (mtDNA) studies.
- To integrate the new environmental and genetic approaches with recent findings on biological variability in the European cephalopod populations of the north east Atlantic and Mediterranean, to evaluate whether this variation is due to plasticity of responses to environmental conditions or due to underlying genetic variation.

Two presentations were given; on population genetics by Professor Tom Cross (Ireland), and on GIS by Dr Jianjun Wang (UK).

3.1.1 Genetic variation

The genetic studies under the FAIR project are able to address fishery-related questions such as:

- Is there discernible stock structure through the range of a species?
- Is the structure stable?
- Can we assist management by homing in on discontinuity?

The work uses microsatellite DNA (i.e. short repeat sequences of 2-4 base pairs which are "hypervariable". To date, "primers" have been developed which can identify alleles at 5 or more genetic loci in *Sepia officinalis, Loligo forbesi, Loligo vulgaris, Octopus vulgaris, Todaropsis eblanae* and *Illex coindetii*. Preliminary results of population screening for the two long-finned (ommastrephid) squid species suggests that there are genetic differences between samples from different areas of EU waters.

3.1.2 GIS

Geographic information systems (GIS) represent a tool of increasing interest for fishery management, due to their ability to integrate large and diverse spatially referenced datasets and to display spatial information on biological variables (e.g. abundance) in relation to one or more other variables describing the biotic or abiotic environment. This facilitates hypothesis generation and visual analysis of patterns. In short-lived species such as cephalopods, environmental factors can be as important or more important than fishery mortality in driving population dynamics and determining spatial patterns of abundance. The FAIR project is developing GIS for the NE Atlantic, Mediterranean and Saharan Bank fishery areas.

3.2 Status and assessment of cephalopods in the CECAF area

Eduardo Balguerias (Spain) presented a talk on cephalopod fisheries in the CECAF region (west of Africa, 25°N to 10°N including the Saharan Bank 21° to 25°N). Current research is funded by the EU (the FAIR project described above, the European Fish Ageing Network project, also funding for national and a west African fishery databases) and by the Spanish government (through the Instituto Español de Oceanografía, for work on fishery monitoring and on octopus fisheries). Assessment of West African cephalopod fisheries is carried out by a Working Group under the auspices of CECAF (see section 4). Landings from the CECAF area are not fully documented due to pirate fishing. CPUE has dropped since the 1970s.

Three cephalopod species are important in the area:

- *Octopus vulgaris*. There appear to be three "stocks" – North, Cape Blanc, Senegal. *Octopus vulgaris* is scarce elsewhere in the CECAF area. It is the most important species in the Saharan Bank fishery.
- *Sepia offinialis* and *S. hierreda*
- *Loligo vulgaris* – in deeper waters

For the Saharan Bank, the most northern part of the CECAF area, there is a long historical series of landing data (since 1974). Initially, the statistics were probably not very accurate. Cephalopod catches increased into the 1980s but *Octopus vulgaris* catches have declined since 1991. Initially the fishery was largely prosecuted by the EU (Spain) but an increasing proportion of fishing is now by Moroccan vessels, due to agreements restricting Spanish fishing.

For Mauritania there are catch data since 1984 and total cephalopod catches have fluctuated over the years. The fleet is composed mainly of Mauritanian flagged foreign vessels. In 1995, EU vessels entered the fishery. *Octopus vulgaris* is still the most important species.

Off Senegal there have been wide interannual fluctuations in *Octopus vulgaris* catches, probably reflecting variable recruitment. *Sepia* is more important further north. This trend continues off Gambia, Guinea-Bissau and Guinea-Conakry. In the latter area *Octopus vulgaris* catches are very low. This represents the south end of distribution range of *Octopus vulgaris*.

Assessment: four different working groups have tried to assess all stocks. For *Sepia officinalis* and *Loligo vulgaris*, stock boundaries are unknown and catches less well known than for *Octopus vulgaris*. Data for *Octopus vulgaris* are better although initially stocks were not well defined and it was difficult to separate landings by area – large ships took on board *Octopus vulgaris* from smaller vessels fishing in all areas. Fits to the Schaeffer model were initially poor but the model has since been improved. Octopus stock biomass is estimated to be 400,000 t (from 1.2 million tonnes initially) in the Saharan Bank. In Cape Blanc the stock is 0.3 million tonnes to 0.06 million tonnes and catches are now around the estimated MSY.

3.3 Research on *Gonatus fabricii* in Norwegian waters

Herman Bjørke (Norway) presented results from research surveys on biomass estimates and the life-cycle of *Gonatus fabricii*. The abstract of a recent publication appears below:

Ontogenetic changes in morphometric and reproductive indices of the squid *Gonatus fabricii* (Oegopsida, Gonatidae) in the Norwegian Sea - Alexander I. Arkhipkin and Herman Bjørke.

Ontogenetic changes in morphometric and reproductive indices were studied using 166 individuals of the arctic gonatid squid *Gonatus fabricii* (7.3-322 mm PL) collected in the southern part of the Norwegian Sea. Body proportions and consistency of the mantle and fins do not change in maturing and mature males. On the contrary, during maturation the females lose their tentacles first, then horny rings of their 4th arm suckers, and then muscular part of their body turned to be watering and gelatinous. Unlike most squids, *G. fabricii* females start mating at the maturity stage III, and all but one female at the stage IV had mated, as well as all spent females. Females have high values of both GSI and maturity indices comparing to those of the North Pacific gonatids whereas GSI of males were low probably due to slow functioning of both testis and spermatophoric gland, and long accumulation of spermatophores in the Needham sac. It is suggested that the gelatinization of female body tissues is an adaptation for a deepwater bathypelagic 'brooding' of the negatively buoyant egg-mass caused by the high specific density of the secretion from the nidamental glands in gonatids.

3.4 Use Of A Geographic Information System To Study Management Of Cephalopod Fisheries: Comparison Of British (N.E. Atlantic) And Spanish (Mediterranean) Cephalopod Fisheries

This project is funded by the EU's TMR programme (1997-99) and hosted by Graham Pierce (UK). The grantholder, Jose Maria Bellido (UK/Spain), presented results on the use of geostatistical methods to improve abundance estimates for cephalopods.

Geostatistical methods are based on the assumption that the spatial structure of data can be inferred, i.e. that some type of spatial correlation is present. Variogram analysis depends on values at a point being more closely related to values at nearby points than to values at far-away points. This relationship can be quantified as a variogram. A spherical model was applied to fishery abundance data on squid in Scottish waters and gives a good fit. Further detail on this study is provided in WD 3.

3.5 Development of Software to Estimate Unreported or Misreported Catch and Effort Data and to Apply Fishery Management Models

This EU-funded Study Project (1998-99) is co-ordinated by Angel Guerra (Spain). Angel Guerra and Joaquin Gracía (Spain) described the project (see also section 4.12).

The cephalopod fishery in Galicia is highly complex, involving many ports, many gears, and multi-species fisheries. Fishery data collection is difficult. In 1990, Victor Gómez-Muñoz (1990, *Bull. Mar. Sci.*) published a method of using interview data to estimate fishery catch and effort. This method was designed for small and multi-species fisheries. It has been previously applied to clam fishing in Galicia. Símon *et al.* (1996) applied the model to the squid hand-jig fishery, showing that around 50% of *Loligo* landings were unreported. The current project has now been running 1 year. It involves interviews and on-board observers and design of new software. The software based on *Visual Fox Pro* and has three modules:

- Data entry: via a series of forms, form interviews, ports, vessels, catches, fishing markets, comments.
- Data manipulation
- Application of the Gómez-Muñoz model

3.6 Discards of cephalopods and biological data on *Octopus vulgaris*

Ines Gonçalves (Portugal) and João Sendão (Portugal) described current a Study Project "Analysis of fisheries discards from the south coast of Portugal", co-ordinated by Teresa Borges (Portugal). Cephalopod discards from commercial fisheries on the south coast of Portugal are being monitored from four main métiers:

i) fish trawls,

ii) ii) crustacean trawls,

iii) iii) demersal purse-seines, and

iv) iv) pelagic purse-seiners.

The reasons for the cephalopod discards are mainly the lack of markets. In addition, in the commercial species (e.g. *Loligo vulgaris*) damaged animals may be discarded. Two working documents on this project (WD 11 and 12) were available. A second Study Project is also run by the same team, "Cephalopod Resources Dynamics & Fisheries Trends in the Algarve and Gulf of Cádiz" (see section 4.7).

3.7 Cephalopod Fishery of the Basque Country fleets in the North-eastern Atlantic waters 1994-1998

Marina Santurtún (Spain) presented information on current studies in the Basque Country (see also WD 1). Data categorisation in the fishery is by group, e.g. cuttlefish, flying squids (ommastrephids), squids (loliginids). Loliginid squid catches are very seasonal, e.g. mainly in November-January in ICES area VI. Catches are higher in area VIII (there is a longer season); only in area VIIIc are there substantial catches all year round. Cuttlefish landings show a very similar seasonal pattern although none are caught in area VI. Short-finned squid catches peak in March-June. The octopus season extends throughout the year except around December when the boats move to area VIIIc to avoid rough weather.

3.8 Data Collection for Assessment of Fished Cephalopod Stocks

This EU-funded Study Project is co-ordinated by Graham Pierce (UK). Heather Daly described the work programme and presented some results. Since this presentation directly concerned stock assessment, it is described in more detail in section 4.

3.9 Assessment of *Loligo gahi* and *Illex aregntinus* in the South Atlantic

Work by RRAG (Renewable Resources Assessment Group) Imperial College London, on the South Atlantic *Loligo gahi* and *Illex argentinus* fishery was described by Simeon Hill and is detailed in section 4.

3.10 Analysis and Evaluation of the Fisheries of the Most Commercially Important Cephalopod Species in the Mediterraean Sea.

A summary of the work currently carried out under a current EU-funded Study Project on fished cephalopods, involving three Mediterranean countries (Greece, Spain and Italy), has been provided by Eugenia Lefkaditou (NCMR, Greece). The aim of the project is to study the spatial and temporal distribution of the five most commercially important species, analyse interactions between gears used, and evaluate the economic importance of the fisheries as well as provide management options. Details of the project appear in WD 4.

3.11 Summary

Presentations to WGCEPH illustrate the range of nationally and EC-funded research programmes on cephalopod biology and fisheries. Only one current project within EU waters directly concerns stock assessment, although several other projects specifically address gaps in the available data. Nevertheless, assessment is not currently possible in the majority of cephalopod fisheries.

Presentations concerning fisheries in the Southwest and eastern central Atlantic illustrate alternative approaches to cephalopod fisheries management. The extent to which methods used in these areas could be applied within European coastal waters requires further study. In contrast to the directed cephalopod fisheries in the former two areas, most cephalopods caught in European coastal waters are by-catches of multispecies finfish fisheries.

4 CURRENT STATUS OF DATA, METHODOLOGY AND RESULTS AVAILABLE FOR STOCK ASSESSMENT OF FISHED CEPHALOPODS, INCLUDING INFORMATION ON STOCK IDENTITY, FISHING EFFORT AND DISCARDS (TOR C)

4.1 Introduction

In 1998, the WGCEPH discussed principles underlying stock assessment and the 1998 report assembles this material and presents tabulations of basic fishery data on the main fished cephalopod species in the ICES area.

During the 1999 WGCEPH meeting discussions on this *TOR*, two Working Papers were tabled, a Working Paper previously circulated in 1998 by Nick Bailey (UK) (see WD 13) and a new Working Paper by Lisa Hendrickson (USA) (see WD 8). Both review general principles underlying assessment. Oral presentations were given by Heather Daly (UK), Simeon Hill (UK) and Natasha Rougeron (France). The following test is based on information drawn from these sources and subsequent discussions. In the following sub-sections, work involving (a) assessment using depletion methods, (b) assessment using other approaches, (c) discards and (d) related studies are described.

4.2 Assessment of squid in Falklands Islands waters

Simeon Hill from RRAG (UK) described assessment and management in the Falkland Islands squid fisheries. Depletion-based assessment is among the most promising methods for assessing cephalopods in the ICES area (Anon., 1998a). This type of assessment relies on the fact that the depletion of a population will be associated with an observable downward trend in CPUE (or a similar index) over time (see Beddington *et al.*, 1990; Rosenberg *et al.*, 1990; Basson & Beddington, 1991; Basson *et al.*, 1996; Agnew *et al.*, 1998 for details). Such methods have been used in the management of commercially exploited squid stocks around the Falkland Islands since the late 1980s. There are two stocks; an ommastrepharid, *Illex argentinus*, and a loliginid, *Loligo gahi*. The former is targeted mainly by jiggers and is also fished in Argentine waters while trawlers, operating entirely within Falkland waters, target the latter. The

Renewable Resources Assessment Group (RRAG) at Imperial College provides management advice and assessments for this fishery.

The Falkland squid stocks are managed by a combination of effort limitation and a minimum allowable escapement. An allowable effort for each stock is calculated before the season opens and an appropriate number of licenses are made available. Real time assessments performed during the fishing season monitor squid abundance and the fishery can be closed if projections suggest that the stock will be depleted below a threshold level (40,000 tonnes for *Illex argentinus* and 10,000 tonnes for *Loligo gahi*). This threshold is set at a level that avoids high probabilities of low recruitment in the following season (Basson *et al.*, 1996). This replaces a proportional escapement criterion for ending the fishery and is essentially equivalent to the "precautionary" reference point as recognised in fisheries in the ICES area. A multiple-fleet assessment method is used, in which the efficiency of a vessel is related to its size class. An annual swept area survey is used to provide an complimentary assessment of *Illex argentinus* abundance. When a depletion model cannot be used, prior estimates of vessel efficiency, based on previous assessments, are used to estimate population size (Agnew *et al.*, 1998).

There are several features of the Falkland squid fishery which make it particularly amenable to depletion assessment. Management by effort limitation is thought to reduce the probability of underreporting associated with quota-based management. Assessments require "real-time" data collection and catch and effort data are resolved by vessel and by day and reported frequently. Observers continuously monitor biological parameters, providing length, weight and Lipinski scale maturity data.

Good quality biological data are important for calculating population numbers from catch weights. Both Falkland squid species have quite complex population structures, for example two recruitment pulses of *Loligo gahi* can occur within the space of two months. Biological data are also important for distinguishing between these subgroups when fitting depletion models. The temporal patterns of CPUE and concurrent biological data are used to determine when one recruitment group is replaced by another.

Depletion based assessments require the input of a parameter *m*, the natural mortality of the species over the time unit used in the CPUE series. Depletion assessment methods for cephalopod populations currently use a fixed value of *m*. Many cephalopods are, however, subject to temporal variations in natural mortality over their life times. Methods exist for modelling variable rate natural mortalities (Caddy, 1991, 1996). The application of variable *m* to depletion models would be fairly simple to accomplish and might possibly increase the biological realism of such models. However, the natural mortality of cephalopods is usually unknown and problematic to estimate. Furthermore, depletions are usually fitted over periods where the squid population is in on adult feeding grounds and therefore at a life period when Caddy (1996) estimates that *m* is relatively constant. The behaviour of depletion models with fixed values of *m* is well understood and these models have proved useful in assessing cephalopod stocks. More complex models should be used with caution.

RRAG are currently developing Bayesian assessment methods for squid fisheries.

4.3 Assessment of loliginid squid in Scottish waters

Heather Daly (University of Aberdeen, UK) presented background information and results of the current Study project "*Data Collection for Assessment of Fished cephalopods*".

This study employed depletion methods as implemented in the software package CEDA (Catch Effort Data Analysis), developed by MRAG Ltd, London (1995). Depletion models have provided the best method for assessment in cephalopod fisheries in the SW Atlantic (Beddington *et al.*, 1990; Rosenberg *et al.*, 1990; Pierce & Guerra 1994). The fundamental principle behind depletion models is very simple: as animals are removed from the stock, its size will decrease and this will be reflected in a decline in landings per unit effort (LPUE). This means that a pre-requisite for the model is that the stock declines over a defined period after a peak in landings. For the Scottish fishery, the decline in LPUE for *Loligo forbesi* occurs over approximately 6-7 months from October-November until April-May.

The CEDA package requires several input parameters including total landings, an abundance index (e.g. LPUE from one fleet), mean body size (to convert landings in weight to landings in numbers) and an estimate of natural mortality (WD 6 for further details).

Retrospective stock assessments using the CEDA depletion model have been carried out for the West Coast of Scotland (ICES VIa) *Loligo forbesi* stocks from 1970-1996. The abundance index used all gears and the mean body size included data from market sampling over 7-8 years. Three levels of monthly natural mortality were used in the assessment, following Pierce *et al.* (1996) of 0.025, 0.167 and 0.26, which correspond to annual mortality rates of 0.3, 2 and 3.12

respectively. The intermediate value corresponds approximately to the value estimated from Pauly's equation. The assessments were run twice, first with no recruitment and second with a recruitment index of < 150 mm mantle length. Inclusion of a recruitment index is justified by the apparently continuous recruitment throughout the year. Both assessments used the log-normal error model, which seems to be most appropriate in this case (see WD 6) and results are shown in Figs. 4.1 & 4.2 for no recruitment and with a recruitment index respectively.

Both figures produced reasonable fits for the data in most years and results are shown in Tables 4.1 and 4.2.

4.4 Assessment of the English Channel Cuttlefish Stock

The stock of *Sepia officinalis* from the English Channel fishery has been studied by Matthew Dunn as part of a an EU-funded (FAIR) project. Results on assessment of this stock appear in his PhD thesis (Dunn, 1999a) and a recent paper in *Fisheries Research* (Dunn, 1999b); see also the 1998 *Report of the Study Group on the Assessment of Other fish and Shellfish Species* (Anon., 1998b). Since the early 1980's there has been a rapid increase in landings of cuttlefish by UK vessels in the English Channel, with annual landings increasing from 26 tonnes in 1980 to over 4000 tonnes in 1996 (MAFF data). In UK vessels offshore beam trawls account for the majority of landings (64% of landings in the 1994/95 season). The fishery is strongly seasonal, peaking in the autumn/winter months (September to April) with negligible landings outside this period. The second most important gear type for cuttlefish is otter trawl, accounting for up to 17% of landings in the 1994/95 season. This inshore fishery operates during the summer spawning season from April to June in some areas, as well as during the winter months as the stock migrate to over-wintering grounds. Netting in eastern English Channel also contributes to landings, 6% in the 1994/95 season during March to June. Cuttlefish traps are also becoming increasingly important in cuttlefish landings.

The depletion model was applied to the offshore beam trawl fishery for UK vessels only, assuming a discrete UK stock. It was also assumed that otter trawls operate exclusively on inshore grounds and beam trawls operate exclusively on offshore grounds. If discards are assumed to be 0, the catch per unit effort (U) of the offshore beam trawl is

$$U = q\alpha N$$

Where α is the proportion of the stock on the offshore grounds

q is the catchability

N is the total number of cuttlefish in the stock

To estimate the proportion of the stock available on each fishing ground, relative LPUE was used. This required standardisation of effort between inshore otter trawls and offshore beam trawls. Some beam trawlers and otter trawlers operate together and LPUE were estimated for a number of vessels, some of which use both gears. Comparing catch rates leads to the simple conversion factor for otter trawl LPUE to beam trawl LPUE of 1.62. After expressing all U (catch per unit effort) in terms of beam trawls it is possible to estimate α, the proportion of the stock on the offshore grounds in any time period *t* by

$$\alpha_t = U_{t,}\text{ offshore} /(U_{t,}\text{ offshore} + U_{t,}\text{ inshore})$$

Data on landings were converted from weights to numbers, taking into account growth in body weight over the period modelled. A 50:50 sex ratio and a single cohort in the landings were assumed. Mean weight at age was predicted from seasonal growth curves. Catch was assumed to occur at the middle of the time periods, so the number of survivors at time t+1 is

$$N_{t+1} = (N_t \exp(-M/2) - C_t) * (\exp(-M/2))$$

Where M is natural mortality between *t* and *t*+1

C_t is the number caught at time t

This basic depletion model was applied to LPUE data summed over 2-week periods from Sept 1994 to May 1995. The model was fitted using a log maximum likelihood function and assuming a normal error model. The normal error model gave the best fit (as compared to gamma and log-normal error models) and showed the best distribution of the residuals plots. The model was sensitive to values for M and the conversion factor.

4.5 Assessment of Loliginid Squid in the English Channel

Natacha Rougeron (France) presented results from the French partners (Université de Caën) in the Study Project "*Data Collection for Assessment of Fished cephalopods*".

The package CEDA has been used to carry out assessments of loliginids using the various fleets in the English Channel. The log-normal error model is used and assessments extend from 1989-97.

Biological data arise from market samples in Port-en-Bessin, by commercial category, raised to give average body weight in landings. Market sampling also allow estimation of the proportion of the two *Loligo* species in landings. Monthly mean body weights and recruitment indices follow a regular seasonal pattern. The two species recruit at different times during the year. Fishery data derive from French and British fishery statistics. Landings and, to a lesser extent, effort also follow a clearly defined seasonal pattern.

Some unusual results were obtained, with the 1996 giving very different results from the other seasons whatever fleet was used. A detailed Working Document on this work appears as WD 5.

4.6 Assessment of Cephalopod Stocks in Spanish Coastal Waters

Mario Rasero (Spain) presented results of studies at the Instituto Espanol de Ocenografia (Vigo) undertaken as part of the Study Project "*Data Collection for Assessment of Fished cephalopods*".

In the Galician fishery preliminary depletion stock assessments have been carried out for *Eledone cirrhosa, Todaropsis eblanae* and *Illex coindetti* using the CEDA package. Assessments included a recruitment index and the model run with both log-normal and normal error models. The results show that in general higher r^2 were obtained using a log-normal error model but that the distribution of the residuals was poor in many cases.

4.7 Assessment of Cephalopod Stocks in the Algarve, Portugal

In March 1998 the EU-funded project "Cephalopod Resources Dynamics & Fisheries Trends in the Algarve and

Gulf of Cádiz" (ALCACEPH), co-ordinated by Teresa Borges (Portugal), started, with the main objective of studying the fisheries biology and assessment of all commercial species of octopus and cuttlefish in the south of Portugal (Algarve) and Gulf of Cádiz (Portuguese and Spanish waters). Biological information on all species discarded in the Algarve is also important to this project. The institutions which are participating are the Centre of Marine Sciences (CCMAR) of the University of Algarve, and the Instituto Español de Oceanografia, Centre of Cádiz.

Currently assessments of cephalopod stocks in the Algarve are underway. Historical data are being compiled from fisheries statistics of several cephalopods (long-finned squid, short-finned squid, octopods and cuttlefish), for a time series analysis. Attempts are being made to overcome some problems associated with accessing official statistics. The required information has to be collected on the basis of the fishing/selling process (licenses, which boats have specific licenses, inquires, etc.). The compilation of all possible data for fishing effort is also in progress, involving enquiries to fishermen.

4.8 Stock Assessment in the Saharan Bank Cephalopod Fisheries

The following text is a summary of results from the latest WG stock assessment of *Octopus vulgaris* in the CECAF (FAO Committee for the Eastern Central Atlantic Fisheries) region, as presented by Eduardo Balguerias (Spain).

<u>Area</u> Octopus stocks from the north-western African coast (Western Sahara, Mauritania and Senegal) are normally assessed in the frame of ad hoc WG organised by the CECAF (FAO Committee for the Eastern Central Atlantic Fisheries) and other regional institutions. A total of 4 WG have taken place to date, 1978, 1982, 1986 and 1997, covering the stocks recognised in the region between the Strait of Gibralter (36°N) and the mouth of the Congo River (6°S). Additionally several specific assessment meetings have been held in Morocco (1991) and Mauritania (1989, 1995 and 1998).

Methodology. The methodology used has been the same throughout, uses catch and effort data of the different fleets targeting each species. It is based in production models, both in equilibrium and dynamic. There are reports from the last 2 WG which detail the many constraints and assumptions for application of the model. In the first WG global estimate of CPUE calculated on the basis of total catches and standardised effort values using a reference fleet were attempted to try to adjust traditional surplus production models of Fox, Schaeffer or Pella-Tomlinson. Since 1997 dynamic production models have been introduced and the effort standardisation is made using GLM and GAM.

Several analytical approaches, such as LCA or VPA, have been applied in some WG. The main problems are the large uncertainty in growth parameters and M, both of which are related to methodological difficulties in assessing the age of the species in the region. Another important problem is the apparent high variability in growth and the transformation of individual weights into lengths to carry out the analysis (the only available information on the population structure is the weight frequency distributions.

4.9 General Remarks on Stock Assessment

Over many years in the CECAF area methods developed for fish have been applied to cephalopod stock assessment. Although production models seem to be intrinsically unsuited to short-lived species, they have been applied with some success. Currently, in common with the current assessment and management regime for Falklands squid fisheries, most studies favour the use of depletion methods for assessment of cephalopod stocks.

The CEDA (Catch Effort Data Analysis) software package, developed by MRAG, London, and described during the 1998 ICES WGCEPH meeting, offers a simple, user-friendly means of fitting depletion models. Users should however be aware of the limitations and assumptions of the package.

Work on cuttlefish stocks in the English Channel (Dunn, 1999a,b) used a slightly more complex version of the depletion approach, allowing movement of the stock between two areas. Even when the assumptions of the model are met, the application to by-catch fisheries can only provide retrospective assessment (the data are not available in real time).

General points:

- More detailed biological data are still needed on, e.g. natural mortality, which may vary through the year
- Lack of good quality fishery data on cephalopod fisheries makes assessment difficult
- Improved data on cephalopod fisheries would be useful but will only be possible if driven by legislation
- The choice of models depends on biology, quality of data available and the context/objectives
- Alternative models should be tried and compared
- Assessment results should if possible be compared with results from directed surveys
- Sensitivity analyses should be carried out
- The quality of data needed depends on objectives and time-scale
- More complex models however always need better data

4.10 Discard Sampling in Scotland

Quantification of mortality in cephalopod stocks caused by fishing is not complete without some information on the proportion of discards. Observers aboard commercial fishing vessels are the best way to accurately record discards and identify the criteria used in discard decisions (e.g. species, size or condition).

In collaboration with the Aberdeen University team, the Fisheries Research Services discard programme run through the SOAFED Marine Laboratory in Aberdeen have included cephalopods in the species that are monitored by observers. Preliminary findings from the programme have revealed that considerable amounts of the ommastrephid squid *Todaropsis eblanae* are caught and discarded, as much as 3-4 60 kg boxes per trip. The main reason that fishermen give for discarding this species is because they had no commercial value. In one case, the *T. eblanae* were thought to be poisonous.

As well as this, two observer trips aboard commercial fishing trawlers, the *Tenacious* and the *Enterprise* have been completed to record cephalopod discards and to provide some method of checking the reliability of official statistics by comparison with on-board observations. During the week aboard the *Tenacious*, which took place at the low point in the squid fishing season in June, only 6 individuals of *L. forbesi* were caught. All the cephalopods caught on this trip, including 97 *T. eblanae*, 2 *I. coindetti*, 5 *Todarodes sagittatus* and 44 *Eledone cirrhosa*, were discarded. The other observer trip took place during December, at the height of Scottish cephalopod landings, with no *L. forbesi* discarded and 7 boxes landed. Only a few other cephalopods were caught and all were discarded. Interviews with fishermen in Scottish waters show that *L. forbesi* is only discarded when very few specimens are caught and larger quantities of *T. eblanae* are routinely discarded. The fishermen also reported that the amount of *T. eblanae* discarded does not vary appreciably throughout the year.

Stock assessments using the depletion method apply to squid already recruited into the fishery. In the Scottish fishery, comprising mainly demersal trawls and seines, recruitment occurs around mantle lengths of 150 mm (Pierce *et al.*, 1994). Despite the theoretical minimum landing size of 100 mm mantle length, which should apply throughout European waters, *L. forbesi* as small as 40 mm mantle length have been recorded in landings. Scottish fishermen seem unaware of this limit and SFPA (Scottish Fishery Protection Agency) or SOAFED do not record or enforce minimum landing size in cephalopods. Smaller mesh sizes in a directed fishery mean the size at recruitment is likely to be smaller, perhaps down the minimum legal size. The size of recruits for other commercially important cephalopods in European waters has not been reported.

4.11 Discarding in the Saharan Bank Fishery

Information on discards is extensive and it should be noted that discards studies conducted in NW Africa have, until now, considered the problem from a fin-fish point of view: discards of fin-fish and invertebrate other than cephalopods in cephalopod fisheries.

There have been several surveys carried out in recent years (1976, 1977 (2), 1989 (2), 1990 & 1992) to assess the level of discards in cephalopod and crustaceans trawl fisheries occurring in the Sahara and Mauritania. Results indicate that at the time of the surveys discards of cephalopods in these fisheries were negligible. Over 60 species were discarded and discards comprised 50% of the total catch by weight. However, within the last 2 years new regulations and a legal minimum landing size have been introduced in these fisheries. A recent finding from an observer trip onboard a vessel fishing for cephalopods is that the new regulation seems to be causing an increase in discarding of undersized cephalopods.

Results of the study to estimate discards in the crustacean fishery of Mauritania (1992) show that although more than 140 species are caught, only a few have sufficient commercial value to make it worth landing them. In terms of weight, cephalopods account for an average 11% of the total catch: 4.1% of which is comprised of octopus and 3.8% of cuttlefish.

4.12 Estimating Unreported Catch and Effort in Galicia, Spain

Angel Guerra, Angel González and Joaquin Gracía (Instituto de Investigaciones Marinas, Spain) presented information on a current study Project (see also section 3.5).

Data are being compiled in the Galician fishery from visiting ports and interviewing fishermen. Official catch statistics, as well as information on number of vessels per gear and monthly total catches of target species by gear from a total of 50 interviews to date are being collected and compared with those figures being offered by the Government of Galicia. New software is currently under development to use the data in the application of the Gómez-Muñoz model for multi-species fisheries.

4.13 Natural Mortality of *Loligo* in UK Waters

A good estimate of the level of natural mortality in fished cephalopods is an essential component of an accurate stock assessment. Assessments based on De Lury depletion models can be very sensitive to the natural mortality parameter (Pierce *et al.*, 1996). In the study by Pierce *et al.* (1996), to assess stocks of *Loligo forbesi* in the northern North Sea, west coast of Scotland, Rockall and the English Channel, the authors used three estimates of natural mortality. These values were based on information from the *Illex argentinus* fishery in the south Atlantic (Beddington *et al* 1990), an empirical relationship developed for finfish stocks by Pauly (1985), and an intermediate estimate to assess the sensitivity of stock assessments to M.

Previous studies on fish diets from European waters are often of limited use for the estimation of fish predation on cephalopods. This is due to either cephalopods not being identified to species, or the origin of the fish sampled, e.g. from regions with low cephalopod abundance. Some species of cephalopod have no commercial value, (e.g. sepiolids), and their predation is irrelevant when calculating M, making it essential to identify prey accurately.

Recently, a new study on the diets of commercially important fish from the northern North Sea, west coast of Scotland and English Channel has been carried out using stomach contents analysis and is currently under review. Samples from 6 research cruises and 2 commercial trawlers, totalling 3035 stomachs from 23 species, were examined. Fish and crustacean prey dominated in the majority of fish stomachs with incidence of cephalopods relatively low. A total of 76 cephalopods from a range of species and sizes were identified in stomach contents. The most frequently recorded category was Sepiolidae (at least 34 individuals), a family which has no commercial value. Only during the winter survey were some commercial squid species (*Loligo* spp.) observed in fish stomachs, although still in relatively small quantities and comprising mainly of pre-recruit individuals.

Only one of the Scottish surveys, during the main *Loligo* spawning season, produced more than one *Loligo* individual. The six *Loligo* found in the Dec. 1998 sample were small specimens, only two of which had reached the size of full recruitment to the fishery (around 15 cm mantle length, Pierce *et al* 1994). Two *Loligo* were recorded in the stomach of a bib in the English Channel and the individual for which size could be estimated was a post-recruit (17.7 cm).

Despite the relatively small sample sizes from the present study the results of generally low occurrence of cephalopod prey support findings from similar studies (e.g. Daan 1989; Hislop *et al.* 1991). The results suggest that commercially important finfish species do not have a significant impact on post-recruit commercial cephalopod species, although predation on pre-recruits may be significant. Consumption of pre-recruit squids is technically irrelevant to the depletion model but additional data on this predation could be used to help predict the strength of recruitment, which in annual species, directly determines adult stock size.

Further sampling of stomach contents throughout the season is required to improve estimates, with variations such as locality and predator size also considered.

4.14 Analysis of Enviromental Effects on Catches of *Loligo pealei* and *Illex illecebrosus*

Work by Jon Brodziak (Northeast Fisheries Science Center, Newport) and Lisa Hendrickson (Northeast Fisheries Science Center, Woods Hole) on the impact of a variety of environmental effects on trawl catches of commercial cephalopods. Effects including average depth of tow, time of day, bottom temperature and age/maturity of the squid (adult or juvenile) were analysed and results have recently been published (Brodziak and Hendrickson 1999). Results show that all the factors under analysis had some detectable effects on both species, and highlights the potential for selection during trawling for improved catches.

4.15 Concluding remarks

The 1998 Report of WGCEPH included a summary of characteristics of the various cephalopod fisheries in European waters, compiling data relevant to assessment and management. These have been updated and appear as Tables 4.3-4.7.

5 REVIEW OF LITERATURE IMPORTANT TO CEPHALOPOD FISHERIES (TOR d)

In considering this TOR, the attention of WGCEPH was drawn to the existence of an extensive database of cephalopod literature maintained through the SIRIS site of the Smithsonian Libraries. Furthermore, papers in mainstream peer-reviewed journals are already logged in widely available on-line academic databases such as BIDS. Hence, in addressing this TOR, WGCEPH focused on publications relevant to ICES (i.e. material relevant to cephalopod life history and fisheries) and restricted its attention to recent material (starting 1996). Furthermore, the WGCEPH paid particular attention to the grey literature that is not compiled elsewhere.

References were provided by Sigurd von Boletzky (Observatoire Océanologique de Banyuls, France), Catalina Perales Raya, Ignacio Sobrino, Ana Moreno, Simeon Hill, João Sendão, Jean-Paul Robin, Uwe Piatkowski and Angel Guerra. References were also collected through searches of BIDS, the FAO web page and the ICES web page.

Two Working Documents are listing grey literature (WD 9) and a separate compilation of journal papers, books and book sections (WD 10).

The meeting discussed the format and location for these compilations and it was agreed to make them generally available via the University of Aberdeen web site, initially in a Word processor format but ultimately in a format suitable for direct import into bibliographic databases.

6 PEER REVIEW OF THE WORKING GROUP REPORT (TOR e)

The meeting agreed that John Caddy might be asked to referee the Report and that the Report also be sent to Jon Brodziak, a member of WGCEPH not present at the meeting.

7 COMMENT ON THE DRAFT OBJECTIVES AND ACTIVITIES OF THE LIVING RESOURCES COMMITTEE COMPONENT OF THE ICES FIVE YEARS PLAN, AND SPECIFY HOW THE PURPOSE OF THE WORKING GROUP CONTRIBUTES TO IT (TOR f).

The Working Group obtained the following version of the draft objectives and activities of the Living Resources Committee from its Chair, Dr Colin Bannister:

LIVING RESOURCES COMMITTEE (Draft Objectives at January 1999)

Objective 1. Develop our knowledge of the life history and population dynamics of living resources populations. Justification: In order to provide advice on the management of marine resources, basic biological information is required on life history, recruitment, growth, maturity and mortality. This information is used to model populations and their response to exploitation. Since populations interact with each other, this basic biology is needed for both target and non-target species.

Objective 2. Co-ordinate national programmes aimed at monitoring the abundance and distribution of marine populations. Justification: most living resources in the ICES area are exploited by several countries, each with its own programme of research. Monitoring programmes are an essential element in research on population biology and the provision of management advice. ICES can substantially enhance national programmes by fostering co-operation through co-ordinated work. This reduces duplication of effort and enhances the utility of data collected to the benefit of all participants.

Objective 3. Investigate the biological effects of non-commercial by-catch in fisheries on marine populations and the ecosystems. Justification: Most fisheries take a by-catch of non-target species or an unwanted size component of the target species. Frequently this by-catch is discarded at sea and will have a direct impact on the populations concerned. There will also be other indirect effects on the ecosystem by altering energy flows. Certain sea birds, for example, may benefit from discarded fish. Such effects on the ecosystem need to be understood and quantified so that the broader effects of fishing can be appropriately managed.

Objective 4. Investigate trophic relationships in marine ecosystems and develop multispecies models suited to management issues. Justification: The development of an ecosystem approach to fishery management requires an understanding of how ecosystems function and how populations interact. It is, for example, important to understand the potential impact of fishing populations at the base of the food chain on higher trophic levels. ICES will support research on trophic relationships and multispecies modelling to assist the development of an ecosystem approach to management.

The Working Group considered that the objectives provide a fairly balanced plan for addressing several key aspects of living resource populations - notably biology, abundance, ecosystem effects and population interaction. A plan incorporating these features should yield quantitative information on the dynamics of living resources and the responses of targeted and by-catch species to exploitation while also providing insight on ecosystem aspects. Furthermore, the objectives will provide a focus, for the next few years, on areas of immediate relevance to cephalopods.

For many species of cephalopods, certain basic biological information is sparse; this makes development of population models difficult. Attention to objective 1, which highlights both target and non-target species, should help to address these shortfalls. The emphasis on monitoring of abundance (objective 2) should facilitate progress in quantitative estimation of cephalopods which is important for both specific fisheries issues and a more general understanding of the ecological importance of these animals in the north east Atlantic. The Working Group could also identify important cephalopod issues relating to objectives 3 and 4. For example, numerous species of smaller cephalopods (e.g. the sepioloids) are discarded in parts of their range. The implications of this are not known. Similar uncertainty surrounds the question of the effect of by-catch induced removal of small prey fish species on squid feeding opportunities. It is very important that the ecological position of squid in waters covered by ICES is understood and that they are not overlooked in the setting up of ecosystem models or the development of ecosystem approaches to management.

The purpose of the cephalopod WG, as currently outlined in the TOR and Justification contained in the 1998 Council Resolution C. Res.1998/2:48, already contributes to the objectives of the 5 year plan. Recent meetings of the Group have highlighted the need for additional biological data and quantitative information, while improvements in fishery data provision have permitted process in the assessment of the abundance of these animals. In recent years, studies of trophic interaction involving squid have frequently figured in Working Group discussions - it is the Group's intention that this subject will be revisited as new data become available. There is an important assumption in the justification for the Group, that cephalopods are key members of the food chain and support important fisheries - one of the purposes of the WG is to establish just how key an element they are in the north east Atlantic. A clearer picture of their role will go a long way to advancing Objective 4 of the strategic plan.

Although the Working Group broadly welcomed the objectives, it was felt that some additional points could be made to strengthen the plan. Firstly, objective 1 might be improved by mention of the value of ICES fostering links with other forums or organisations involved in dealing with marine resources. Exchange of expertise on common problems would be an efficient development. Similarly, reference to the need to make comparisons with related living resource species in other parts of the world would be welcomed. It was generally agreed that objective 2 would be strengthened if ICES not only co-ordinated national programmes aimed at monitoring, but was more proactive in actually encouraging nations to be vigilant in collecting and supplying data. ICES might also like to consider rewording objective 2 to indicate recognition of and support for special data needs. In the case of cephalopods, data collection on shorter time scales and with less delay in provision would facilitate some of the methods currently being investigated in some parts of the world assessment and management of cephalopods requires real-time data provision. Other groups of organisms e.g. crustaceans may have additional needs. It is recognised that ICES is constrained to some extent by practises within member nations but the Group feels a clearer signal needs to be provided by ICES for more flexible and relevant procedures.

Finally, the objectives make no mention of environmental aspects. In the past the effects of environmental factors on fisheries have been highlighted but rather less attention has been paid to the possibilities of picking up environmental signals from living resource populations. The short life cycle of squid makes them particularly sensitive to environmental fluctuation or aberrant conditions - it is possible that changes in abundance or distribution could be utilised for monitoring large scale environmental events.

8 ANY OTHER BUSINESS

There was some discussion in the meeting of prospects for applications for new projects under Framework 5

9 RECOMMENDATIONS

Members of WGCEPH discussed the terms of reference of the group and proposed the following *TOR* for 2000:

a) update currently available landing statistics and information on fishing effort and discards;

b) continue the compilation of methods and results available for stock identification and estimation of population size of fished cephalopods;

c) review the results of national and transnational projects collecting data on fished cephalopods, especially those studying relationships between abundance and environmental conditions, factors affecting recruitment, migration and distribution patterns of juveniles and adults, and trophic interactions;

d) continue development of a bibliographic database of cephalopod literature relevant to fisheries, including grey literature;.

WGCEPH will report to the Living Resources Committee at the 2000 Annual Science Conference. A date and location for the WGCEPH meeting in 2000 will be set once various project co-ordination meeting have been fixed.

Justification: Cephalopods support important fisheries in the ICES area. However, they remain outside the scope of the European Community's Common Fisheries Policy and understanding of stock dynamics, particularly in European coastal waters, remains poor. Official statistics on cephalopod fisheries are generally of low quality but are currently supplemented by data collected under various research projects. New data and information on the state-of-the-art in cephalopod fishery assessment and management need to be updated and reviewed annually.

10 CLOSING OF THE MEETING

The Chair thanked the Working Group participants for their attendance and participation, and the local hosts for their hospitality. He closed the meeting at 16.00 hrs on 26 March.

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Table 2.1. Landings (in tonnes) of Cuttlefish (Sepiidae).

Country	1992	1993	1994	1995	1996	1997	1998P
ICES Division IVa (Northern North Sea)							
Scotland	0	0	0	0	0	25	15
ICES Division IVb (Central North Sea)							
Belgium	12	6	+	1	1	2	4
England, Wales & Northern Ireland	+	2	+	2	+	+	+
Scotland	0	0	0	0	0	0	38
Total	12	8	+	3	1	2	42
ICES Division IVc (Southern North Sea)							
Belgium	13	25	13	15	5	4	6
England, Wales & Northern Ireland	26	22	47	163	90	22	28
France	52	96	96	177	88	173	173
Total	91	143	156	355	183	199	207
ICES Division VIa (NW coast of Scotland and North Ireland)							
England, Wales & Northern Ireland	1	+	1	+	+	0	+
France	+	+	1	1	3	3	3
Scotland	0	0	0	0	0	0	7
Total	1	+	2	1	3	3	10
ICES Division VIIa (Irish Sea)							
Belgium	4	1	2	2	1	1	2
England, Wales & Northern Ireland	46	11	13	19	8	1	1
France	+	4	+	+	1	+	+
Scotland	0	0	0	0	0	0	15
Total	50	16	15	20	10	2	18
ICES Divisions VIIb, c (West of Ireland and Porcupine Bank)							
England, Wales & Northern Ireland	0	0	5	0	+	0	0
France	0	+	2	0	+	0	0
Total	0	+	7	0	+	0	0
ICES Divisions VIId, e (English Channel)							
Belgium	20	24	19	19	11	6	22
Channel Islands	4	2	2	1	11	31	27
England, Wales & Northern Ireland	898	1,882	1,797	3,925	4,050	1,632	2,344
France	3,465	7,218	4,379	7,597	5,833	9,365	9,365
Total	4,387	9,126	6,197	11,542	9,905	11,034	11,758
ICES Division VIIf (Bristol Channel)							
Belgium	4	11	14	4	1	1	0
England, Wales & Northern Ireland	35	95	38	42	64	44	41
France	18	28	22	14	33	33	33
Total	57	134	74	60	98	78	74
ICES Divisions VIIg-k (Celtic Sea and SW of Ireland)							
Belgium	9	12	4	5	2	3	6
England, Wales & Northern Ireland	101	114	134	188	367	463	210
France	342	391	307	385	1,576	1,560	1,560
Spain	2	2	4	+	11	52	181
Total	454	519	449	578	956	2,078	1,957

Table 2.1. continued.

Country	1992	1993	1994	1995	1996	1997	1998P
ICES Sub-area VIII (Bay of Biscay)							
Belgium	3	5	4	+	+	0	0
England, Wales & Northern Ireland	58	41	56	2	40	37	19
France	4,531	3,007	3,572	2,672	1,208	3,377	3,377
Portugal	0	0	0	0	11	8	11
Spain	551	575	451	194	476	398	593
Total	5,143	3,628	4,083	2,868	1,735	3,820	4,000
ICES Sub-area IX							
Portugal	1,230	1,205	1,120	981	1,625	1,415	1,723
Spain	1,029	832	773	1,025	924	1,072	1,195
Total	2,259	2,037	1,893	2,006	2,549	2,487	2,918
Grand Total	12,455	15,616	12,877	17,435	15,440	19,728	20,946

Table 2.2. Landings (in tonnes) of Common Squid (includes *Loligo forbesi, Loligo vulgaris, Alloteuthis subulata* and *A. media*).

Country	1992	1993	1994	1995	1996	1997	1998P
ICES Division IIIa (Skagerrak and Kattegat)							
Denmark	37	2	0	1	1	6	8
Sweden	3	0	+	2	+	+	+
Total	40	2	+	3	1	6	8
ICES Division IVa (Northern North Sea)							
Denmark	7	1	1	1	1	2	5
England, Wales & Northern Ireland	9	1	1	+	+	+	3
France	6	1	+	+	+	+	+
Germany	+	+	+	+	+	+	+
Scotland	561	242	93	268	292	453	844
Total	583	245	95	269	293	455	852
ICES Division IVb (Central North Sea)							
Belgium	6	22	13	14	9	7	13
Denmark	10	2	+	+	+	9	3
England, Wales & Northern Ireland	50	22	4	22	20	39	143
France	+	+	+	1	0	0	0
Germany	2	1	1	3	1	3	5
Scotland	106	36	5	25	14	66	211
Total	174	83	23	65	44	124	375
ICES Division IVc (Southern North Sea)							
Belgium	35	84	113	153	87	39	45
Denmark	0	0	+	+	+	+	+
England, Wales & Northern Ireland	2	4	3	10	13	3	3
France	113	281	187	182	83	85	85
Germany	+	1	2	6	2	1	6
Total	152	369	313	354	175	128	138

Table 2.2. continued.

Country	1992	1993	1994	1995	1996	1997	1998P
ICES Division Vb (Faroe Grounds)							
England, Wales & Northern Ireland	0	0	1	+	0	+	+
Faroe Islands	+	+	1	+	+	5	26
France	+	0	+	0	0	0	0
Scotland	5	+	+	+	1	1	1
Total	5	+	2	+	1	6	27
ICES Division VIa (NW coast of Scotland and North Ireland)							
England, Wales & Northern Ireland	71	28	144	16	53	40	3
France	227	172	138	98	102	133	133
Ireland	30	78	36	158	50	128	128
Scotland	339	182	91	267	307	301	273
Total	667	460	409	539	512	602	537
ICES Division VIb (Rockall)							
England, Wales & Northern Ireland	8	1	6	2	8	5	3
France	+	0	+	0	0	0	0
Ireland	50	5	6	5	5	+	+
Scotland	65	9	28	6	17	5	25
Spain	0	2	2	2	1	1	6
Total	123	17	42	15	31	11	34
ICES Division VIIa (Irish Sea)							
Belgium	6	0	3	2	8	2	5
England, Wales & Northern Ireland	163	174	234	156	218	125	173
France	65	52	30	14	5	8	8
Ireland	5	112	66	192	349	39	39
Isle of Man	15	15	6	7	3	2	1
Scotland	19	10	4	2	2	3	2
Total	273	363	343	373	582	179	228
ICES Divisions VIIb, c (West of Ireland and Porcupine Bank)							
England, Wales & Northern Ireland	13	48	79	96	307	236	231
France	20	58	66	22	81	83	83
Ireland	40	35	11	282	105	15	15
Scotland	5	1	18	1	+	45	+
Total	78	141	174	401	493	379	329
ICES Divisions VIId, e (English Channel)							
Belgium	86	70	132	220	163	76	185
Channel Islands	1	0	0	2	1	15	4
England, Wales & Northern Ireland	698	869	727	672	393	503	413
France	2,595	3,663	2,353	2,548	1,842	1,536	1,536
Total	3,380	4,602	3,212	3,442	2,399	2,130	2,138
ICES Division VIIf (Bristol Channel)							
Belgium	2	+	4	13	12	6	6
England, Wales & Northern Ireland	67	134	162	132	39	77	28
France	443	442	434	275	160	163	163
Total	502	576	599	420	211	246	197

Table 2.2. continued.

Country	1992	1993	1994	1995	1996	1997	1998P
ICES Divisions VIIg-k (Celtic Sea and SW of Ireland)							
Belgium	3	2	9	26	63	10	15
England, Wales & Northern Ireland	122	282	600	1,002	1,394	938	621
France	582	657	506	344	177	226	226
Germany	0	0	0	2	+	+	0
Ireland	135	133	164	405	242	259	259
Portugal	0	0	0	0	3	0	0
Scotland	8	14	34	1	121	127	127
Spain	62	85	39	29	89	332	292
Total	912	1,173	1,352	1,819	2,029	1,892	1,540
ICES Sub-area VIII (Bay of Biscay)							
Belgium	34	36	17	40	46	14	63
England, Wales & Northern Ireland	65	94	96	55	46	71	8
France	1,046	1,070	1,759	1,320	317	1,223	1,223
Portugal	0	0	0	0	2	2	2
Spain	267	33	588	196	427	328	282
Total	1,412	1,233	2,460	1,611	838	1,638	1,578
ICES Sub-area IX							
Portugal	1,569	508	309	908	584	842	1,011
Spain	636	300	210	245	237	338	317
Total	2,205	808	519	1,153	821	1,180	1,328
ICES Sub-area X (Azores Grounds)							
Portugal*	72	108	114	250	200	303	98
Grand Total	10,581	10,184	9,659	10,713	8,627	9,279	9,452

*Landings consist exclusively of *Loligo forbesi*.

Table 2.3. Landings (in tonnes) of Short-finned Squid (*Illex coindetii* and *Todaropsis eblanae*) and European Flying Squid (*Todarodes sagittatus*).

Country	1992	1993	1994	1995	1996	1997	1998P
ICES Sub-area I + II (Barents Sea and Norwegian Sea)							
Norway*	0	0	0	352	+	192	2
ICES Division Va (Iceland Grounds)							
Iceland*	0	0	0	11	3	5	+
ICES Division VIa, b (NW coast of Scotland and North Ireland, Rockall)							
France	+	0	+	+	2	+	+
Ireland	0	0	0	96	110	110	110
Spain	2	+	0	0	0	0	0
Total	2	+	+	96	112	110	110
ICES Division VIIa (Irish Sea)							
France	0	+	0	0	+	+	+
Ireland	+	+	66	17	23	23	23
Total	+	+	66	17	23	23	23
ICES Divisions VIIb, c (West of Ireland and Porcupine Bank)							
France	4	+	+	0	+	+	+
Ireland	0	0	0	21	36	36	36
Total	4	+	+	21	36	36	36
ICES Divisions VIId, e (English Channel)							
England, Wales & Northern Ireland	0	0	0	+	0	1	9
France	2	+	+	+	+	+	+
Total	2	+	+	+	+	1	9
ICES Division VIIf (Bristol Channel)							
France	1	+	+	0	+	+	+
ICES Divisions VIIg-k (Celtic Sea and SW of Ireland)							
England, Wales & Northern Ireland	0	0	0	29	13	4	4
France	70	42	27	25	3	16	16
Ireland	0	0	0	167	312	312	312
Spain	469	374	643	353	1,594	1,039	865
Total	539	416	670	574	1,922	1,371	1,197
ICES Sub-area VIII (Bay of Biscay)							
England, Wales & Northern Ireland	0	0	0	6	0	3	6
France	412	358	268	127	69	127	127
Portugal	0	0	0	0	0	12	5
Spain	1,088	350	505	360	599	1,431	1,038
Total	1,500	708	773	493	668	1,573	1,176
ICES Sub-area IX							
Portugal	766	259	190	101	121	352	383
Spain	100	100	75	149	296	1,069	501
Total	866	359	265	250	417	1,421	884
Grand Total	2,915	1,485	1,775	1,814	3,181	4,732	3,437

*Landings consist exclusively of *Todarodes sagittatus*.

Table 2.4. Landings (in tonnes) of Octopods (*Eledone* spp. and *Octopus vulgaris*).

Country	1992	1993	1994	1995	1996	1997	1998P
ICES Division IVa (Northern North Sea)							
England, Wales & Northern Ireland	0	0	0	+	+	+	0
Scotland	31	10	2	2	2	6	13
Total	31	10	2	2	2	6	13
ICES Division IVb (Central North Sea)							
Belgium	24	10	3	0	0	0	2
England, Wales & Northern Ireland	8	1	4	+	+	+	1
Scotland	1	2	1	0	+	+	1
Total	33	13	8	+	+	+	4
ICES Division IVc (Southern North Sea)							
Belgium	0	1	1	2	0	2	1
England, Wales & Northern Ireland	1	+	4	8	4	1	+
Total	1	1	5	10	4	3	1
ICES Division VIa, b (NW coast of Scotland and North Ireland, Rockall)							
Belgium	0	0	0	0	0	1	1
England, Wales & Northern Ireland	4	+	1	+	+	+	+
Ireland	0	0	0	1	1	1	1
Scotland	3	1	2	4	1	1	1
Spain	4	0	0	0	0	0	0
Total	11	1	3	5	2	3	3
ICES Division VIIa (Irish Sea)							
Belgium	14	8	14	14	3	18	38
England, Wales & Northern Ireland	2	4	24	2	+	1	+
France	0	+	+	+	0	0	0
Ireland	0	0	+	1	1	1	1
Scotland	0	0	0	0	+	+	0
Total	16	12	38	17	4	20	39
ICES Divisions VIIb, c (West of Ireland and Porcupine Bank)							
England, Wales & Northern Ireland	0	+	+	+	4	3	6
France	0	0	+	+	0	+	+
Ireland	0	3	2	2	2	2	2
Total	0	3	2	2	6	5	8
ICES Divisions VIId, e (English Channel)							
Belgium	1	2	+	6	1	1	1
England, Wales & Northern Ireland	20	21	60	77	75	37	17
France	24	20	31	45	22	6	6
Total	45	43	91	128	99	44	24
ICES Division VIIf (Bristol Channel)							
Belgium	2	4	6	9	6	6	2
England, Wales & Northern Ireland	8	13	26	8	6	9	4
France	2	12	3	2	2	1	1
Total	12	29	35	19	14	16	7

Table 2.4. continued.

Country	1992	1993	1994	1995	1996	1997	1998P
ICES Divisions VIIg-k (Celtic Sea and SW of Ireland)							
Belgium	2	6	10	27	17	13	6
England, Wales & Northern Ireland	22	57	77	144	127	66	67
France	6	10	7	17	2	3	3
Ireland	1	1	2	21	9	9	9
Scotland	0	0	0	0	5	0	0
Spain	179	139	256	452	539	240	301
Total	210	231	352	661	699	331	386
ICES Sub-area VIII (Bay of Biscay)							
Belgium	0	7	6	3	1	4	0
England, Wales & Northern Ireland	0	0	0	+	5	23	1
France	77	163	57	61	17	20	20
Portugal	144	+	154	107	113	75	57
Spain	2,511	2,136	1,434	1,779	2,323	2,688	2,776
Total	2,732	2,306	1,651	1,950	2,459	2,810	2,854
ICES Sub-area IX							
Portugal	9,476	7,099	7,319	9,708	11,523	8,980	6,350
Spain	3,499	2,992	3,757	3,741	2,964	2,640	2,695
Total	12,975	10,093	11,076	13,449	14,487	11,620	9,045
ICES Sub-area X (Azores Grounds)							
Portugal*	11	7	7	8	16	64	39
Grand Total	16,077	12,732	13,270	16,250	17,781	14,922	12,423

*Landings consist exclusively of *Octopus vulgaris*.

Table 2.5. Total annual cephalopod landings (in tonnes) in whole ICES area separated into major cephalopod species groups.

Cephalopod Group	1992	1993	1994	1995	1996	1997	1998P
Cuttlefish	12,455	15,616	12,877	17,435	15,440	19,728	20,946
Common Squid	10,581	10,184	9,659	10,713	8,627	9,279	9,452
Short-finned Squid	2,915	1,485	1,775	1,814	3,181	4,732	3,437
Octopods	16,077	12,732	13,270	16,250	17,781	14,922	12,423
Total	42,028	40,017	37,581	46,212	45,029	48,661	46,258

Table 2.6. Total annual cephalopod landings (in tonnes) in whole ICES area by country and separated into major cephalopod species groups.

Country	1992	1993	1994	1995	1996	1997	1998P
(a) Cuttlefish (Sepiidae, mostly *Sepia officinalis*)							
Belgium	65	84	56	45	21	17	40
Channel Islands	4	2	2	1	11	31	27
England, Wales & N. Ireland	1,165	2,167	2,091	4,341	4,619	2,199	2,643
France	8,409	10,747	8,380	10,848	7,742	14,511	14,511
Portugal	1,230	1,205	1,120	981	1,636	1,423	1,734
Scotland	0	0	0	0	0	25	22
Spain	1,582	1,409	1,228	1,219	1,411	1,522	1,969
Total	12,455	15,616	12,877	17,435	15,440	19,728	20,946
(b) Common Squid (*Loligo forbesi, Loligo vulgaris, Alloteuthis subulata, Alloteuthis media*)							
Belgium	172	214	291	468	382	154	332
Channel Islands	1	0	0	2	1	15	4
Denmark	54	5	1	2	2	17	16
England, Wales & N. Ireland	1,260	1,656	2,063	2,176	2,481	2,037	1,628
Faroe Islands	+	+	1	+	+	5	26
France	5,100	6,400	5,476	4,803	2,708	3,457	3,457
Germany	2	2	3	11	3	4	11
Ireland	260	363	283	1,042	751	441	441
Isle of Man	15	15	6	7	3	2	1
Portugal	1,641	616	423	1,158	789	1,147	1,111
Scotland	1,108	494	273	570	754	1,001	1,528
Spain	965	418	837	470	753	999	897
Sweden	3	0	+	2	+	+	+
Total	10,581	10,184	9,659	10,713	8,627	9,279	9,452
(c) Short-finned Squid (*Illex coindetii, Todaropsis eblanae, Todarodes sagittatus*)							
England, Wales & N. Ireland	0	0	0	35	13	8	19
France	490	402	296	152	74	143	143
Iceland	0	0	0	11	3	5	+
Ireland	+	+	66	301	481	481	481
Norway	0	0	0	352	0	192	2
Portugal	766	259	190	101	121	364	388
Spain	1,659	824	1,223	862	2,489	3,539	2,404
Total	2,915	1,485	1,775	1,814	3,181	4,732	3,437
(d) Octopods (*Eledone cirrhosa, Eledone moschata, Octopus vulgaris*)							
Belgium	43	38	40	61	28	45	51
England, Wales & N. Ireland	65	96	196	239	221	140	96
France	109	206	98	124	42	30	30
Ireland	1	4	4	25	13	13	13
Portugal	9,631	7,106	7,480	9,823	11,652	9,119	6,446
Scotland	35	13	5	6	3	7	15
Spain	6,193	5,269	5,447	5,972	5,826	5,568	5,772
Total	16,077	12,732	13,270	16,250	17,781	14,922	12,423

Table 2.7. Total annual cephalopod landings (in tonnes) for Northeast USA (NAFO areas 5 & 6) for *Loligo pealei* and *Illex illecebrosus*.

Species	1994	1995	1996	1997	1998
Loligo pealei	22576.8	18531.0	12458.8	16186.8	18457.2
Illex illecebrosus	18350.0	14057.7	16969.2	13631.4	22705.3

Table 4.1 Scottish *Loligo forbesi* assessments. Results from the CEDA package, assuming no recruitment, for Area VIa. Gaps indicate that no fit was possible.

Year	Monthly mortality M	Population size (x 10^6)	R^2	Catchability Q (x 10^{-6})	Residuals: goodness of fit
1970-71	0.025	0.1057	0.904	1.59E-05	Reasonable
1970-71	0.167	0.1483	0.895	1.10E-05	Reasonable
1970-71	0.26	0.1959	0.889	8.27E-06	Reasonable
1971-72	0.025	0.0568	0.303	5.53E-06	Good
1971-72	0.167	0.1048	0.303	2.97E-06	Good
1971-72	0.26	0.2059	0.309	1.53E-06	Good
1972-73	0.025	0.6806	0.163	1.60E-06	Reasonable
1972-73	0.167	486.3000	0.125	2.71E-09	Reasonable
1972-73	0.26	644.6000	0.041	2.97E-09	Reasonable
1973-74	0.025				
1973-74	0.167				
1973-74	0.26	0.1165	0.811	1.69E-05	Reasonable
1974-75	0.025	0.1093	0.984	1.42E-05	Reasonable
1974-75	0.167	0.1447	0.984	1.09E-05	Reasonable
1974-75	0.26	0.1779	0.983	8.95E-06	Reasonable
1975-76	0.025	0.3129	0.957	1.25E-05	Reasonable
1975-76	0.167	0.4201	0.955	9.23E-06	Reasonable
1975-76	0.26	0.5270	0.953	7.31E-06	Reasonable
1976-77	0.025	0.1993	0.882	1.09E-05	Reasonable
1976-77	0.167	0.2535	0.864	8.55E-06	Reasonable
1976-77	0.26	0.3023	0.851	7.13E-06	Reasonable
1977-78	0.025	0.6379	0.565	3.41E-06	Poor
1977-78	0.167	1.7300	0.577	1.34E-06	Poor
1977-78	0.26	15.5300	0.588	1.57E-07	Poor
1978-79	0.025	0.2417	0.895	8.19E-06	Reasonable
1978-79	0.167	0.3795	0.867	5.72E-06	Reasonable
1978-79	0.26	0.5402	0.845	4.29E-06	Reasonable
1979-80	0.025	0.0977	0.942	8.02E-06	Good
1979-80	0.167	0.1401	0.939	5.46E-06	Good
1979-80	0.26	0.1897	0.937	3.98E-06	Good
1980-81	0.025				
1980-81	0.167	0.1145	0.517	3.70E-06	Reasonable
1980-81	0.26				
1981-82	0.025	0.1703	0.986	1.47E-05	Good
1981-82	0.167	0.2175	0.986	1.17E-05	Good
1981-82	0.26	0.2586	0.986	1.00E-05	Good
1982-83	0.025	0.4682	0.867	8.59E-06	Reasonable
1982-83	0.167	0.5831	0.907	1.05E-05	Good
1982-83	0.26	0.6811	0.903	9.15E-06	Good
1983-84	0.025	0.1181	0.596	4.90E-06	Reasonable
1983-84	0.167	0.2307	0.585	2.50E-06	Reasonable
1983-84	0.26	0.4998	0.580	1.17E-06	Reasonable
1984-85	0.025	0.0858	0.869	6.75E-06	Reasonable
1984-85	0.167	0.1306	0.849	4.61E-06	Reasonable
1984-85	0.26	0.1830	0.835	3.39E-06	Reasonable
1985-86	0.025	0.2132	0.566	2.80E-06	Good
1985-86	0.167	0.6216	0.557	9.39E-07	Reasonable
1985-86	0.26	184.1000	0.556	3.31E-09	Poor

Table 4.1 Continued

Year	Monthly mortality M	Population size (x 10^6)	R^2	Catchability Q (x 10^{-6})	Residuals: goodness of fit
1986-87	0.025	0.2529	0.828	2.93E-06	Good
1986-87	0.167	0.5266	0.806	1.47E-06	Good
1986-87	0.26	1.3130	0.791	6.05E-07	Good
1987-88	0.025	0.4075	0.847	2.70E-06	Poor
1987-88	0.167	0.9450	0.837	1.24E-06	Poor
1987-88	0.26	2.9990	0.830	4.07E-07	Poor/Reasonable
1988-89	0.025	2.0170	0.599	1.43E-06	Good
1988-89	0.167	33.8600	0.625	8.74E-08	Good
1988-89	0.26	4416.0000	0.562	9.37E-10	Reasonable
1989-90	0.025	0.9567	0.685	3.16E-06	Reasonable
1989-90	0.167	1.9340	0.656	1.61E-06	Reasonable
1989-90	0.26	4.4070	0.637	7.28E-07	Reasonable
1990-91	0.025	0.9699	0.844	2.09E-06	Poor
1990-91	0.167	3.0980	0.844	7.19E-07	Reasonable
1990-91	0.26	3088.0000	0.839	7.96E-10	Poor
1991-92	0.025	0.8434	0.488	1.59E-06	Poor
1991-92	0.167	3.9590	0.433	3.47E-07	Poor
1991-92	0.26	1571.0000	0.362	1.05E-09	Poor
1992-93	0.025	1.0090	0.664	2.25E-06	Poor
1992-93	0.167	2.6780	0.653	8.66E-07	Poor
1992-93	0.26	30.9500	0.649	7.71E-08	Poor
1993-94	0.025	0.3844	0.799	3.46E-06	Good
1993-94	0.167	0.8176	0.797	1.59E-06	Good
1993-94	0.26	2.5550	0.798	5.09E-07	Good
1994-95	0.025	1.3280	-0.362	1.11E-06	Reasonable
1994-95	0.167	490.2000	-0.546	3.79E-09	Reasonable
1994-95	0.26	1482.0000	-1.642	1.74E-09	Good
1995-96	0.025	0.7992	0.693	2.37E-06	Good
1995-96	0.167	3.5990	0.694	5.55E-07	Good
1995-96	0.26	1329.0000	0.627	1.73E-09	Good
1996-97	0.025	1.1910	0.812	3.78E-06	Poor
1996-97	0.167	2.8560	0.810	1.55E-06	Poor
1996-97	0.26	15.7600	0.811	2.84E-07	Poor

Table 4.2 Scottish *Loligo forbesi* assessments. Results from the CEDA package, using a recruitment index (proportion of animals <150mm ML), Area VIa. LPUE data from all gears combined; log-transformed data.

Date	Mortality	Population size	R^2	Catchability (q)	Lamda	Residuals: goodness of fit
1970-71	0.025	104439	0.903	1.61E-05	1.9E+01	Poor
	0.167	136409	0.891	1.22E-05	6.5E+00	Poor
	0.26	172853	0.884	9.49E-06	2.6E+01	Reasonable
1971-72	0.025	55978	0.302	5.64E-06	8.5E+00	Good
	0.167	97136	0.296	3.19E-06	4.8E+00	Good
	0.26	190250	0.304	1.62E-06	2.1E+00	Good
1972-73	0.025	669143	0.162	1.63E-06	1.0E+01	Reasonable
	0.167	794219776	0.125	1.66E-09	1.1E+06	Reasonable
	0.26	1051328448	0.055	1.31E-09	1.4E+08	Reasonable
1973-74	0.025	70360	0.814	2.77E-05	1.4E-01	Good
	0.167	87100	0.806	2.27E-05	1.2E+00	Good
	0.26	102940	0.803	1.93E-05	4.9E+00	Good
1974-75	0.025	107926	0.948	1.44E-05	7.2E+01	Reasonable
	0.167	132397	0.982	1.22E-05	1.2E+02	Reasonable
	0.26	155399	0.980	1.06E-05	1.2E+02	Reasonable
1975-76	0.025	308988	0.957	1.27E-05	9.3E+00	Reasonable
	0.167	386555	0.952	1.02E-05	7.8E+00	Reasonable
	0.26	463012	0.949	8.53E-06	3.3E+00	Reasonable
1976-77	0.025	148399	0.925	1.80E-05	2.9E+04	Reasonable
	0.167	164104	0.910	1.74E-05	3.5E+04	Reasonable
	0.26	175808	0.900	1.71E-05	3.8E+04	Reasonable
1977-78	0.025	630972	0.564	3.44E-06	3.5E+00	Poor
	0.167	1633543	0.574	1.41E-06	7.1E+00	Poor
	0.26	17711954	0.588	1.36E-07	1.2E+03	Poor
1978-79	0.025	238629	0.894	8.34E-06	2.5E+01	Reasonable
	0.167	349534	0.861	6.28E-06	1.5E+00	Reasonable
	0.26	476895	0.837	4.89E-06	7.8E-01	Reasonable
1979-80	0.025	96467	0.942	8.17E-06	8.7E-02	Good
	0.167	128829	0.938	6.04E-06	2.0E+00	Good
	0.26	166585	0.935	4.62E-06	8.6E+00	Good
1980-81	0.025	53290	0.927	1.94E-05	8.7E+03	Reasonable
	0.167	62565	0.929	1.84E-05	9.5E+03	Reasonable
	0.26	70027	0.929	1.76E-05	9.9E+03	Reasonable
1981-82	0.025	152512	0.993	1.75E-05	9.7E+03	Good
	0.167	180024	0.992	1.55E-05	1.0E+04	Good
	0.26	203253	0.992	1.42E-05	1.1E+04	Good
1982-83	0.025	446852	0.827	1.00E-05	7.4E+03	Good
	0.167	521649	0.871	1.07E-05	5.5E+03	Reasonable
	0.26	590064	0.927	1.39E-05	1.6E+03	Poor
1983-84	0.025	83199	0.617	7.46E-06	1.7E+04	Reasonable
	0.167	131456	0.595	4.69E-06	2.2E+04	Reasonable
	0.26	206400	0.587	2.99E-06	3.0E+04	Reasonable
1984-85	0.025	84784	0.868	6.84E-06	1.7E+00	Reasonable
	0.167	120320	0.845	5.06E-06	2.8E+00	Reasonable
	0.26	161530	0.830	3.88E-06	5.9E-01	Reasonable
1985-86	0.025	70634	0.693	1.06E-05	4.3E+04	Poor
	0.167	89873	0.672	8.29E-06	5.1E+04	Poor
	0.26	111844	0.662	6.65E-06	6.0E+04	Poor
1986-87	0.025	249693	0.827	2.97E-06	1.4E+02	Good
	0.167	491020	0.803	1.57E-06	3.5E+02	Good

Table 4.2 Continued

Date	Mortality	Population size	R^2	Catchability (q)	Lamda	Residuals: goodness of fit
	0.26	1101771	0.789	7.30E-07	4.6E+02	Good
1987-88	0.025	402780	0.846	2.73E-06	2.8E+01	Poor
	0.167	890981	0.834	1.29E-06	1.3E+02	Poor
	0.26	2781003	0.829	4.36E-07	1.2E+02	Poor
1988-89	0.025	346442	0.770	9.34E-06	3.8E+05	Good
	0.167	469344	0.764	7.23E-06	4.5E+05	Good
	0.26	610415	0.763	5.75E-06	5.1E+05	Good
1989-90	0.025	701250	0.693	4.73E-06	9.6E+04	Good
	0.167	1255818	0.653	2.61E-06	1.0E+05	Good
	0.26	2576124	0.633	1.28E-06	1.1E+05	Good
1990-91	0.025	746223	0.848	2.80E-06	6.5E+04	Good
	0.167	2617948	0.843	8.56E-07	2.3E+04	Reasonable
	0.26	214693728	0.840	1.11E-08	2.4E+06	Poor
1991-92	0.025	832402	0.487	1.61E-06	1.3E+02	Poor
	0.167	3686460	0.431	3.72E-07	2.1E+03	Poor
	0.26	345091168	0.377	4.28E-09	1.9E+07	Poor
1992-93	0.025	997443	0.663	2.27E-06	5.0E+02	Poor
	0.167	2513450	0.651	9.17E-07	2.9E+02	Poor
	0.26	27127108	0.649	8.80E-08	7.7E+03	Poor
1993-94	0.025	227194	0.876	7.66E-06	4.5E+04	Good
	0.167	304509	0.867	5.69E-06	5.8E+04	Good
	0.26	400856	0.863	4.31E-06	7.2E+04	Good
1994-95	0.025	148673	0.125	9.78E-06	2.4E+05	Good
	0.167	220086	0.011	7.44E-06	2.9E+05	Good
	0.26	325290	-0.056	5.40E-06	3.6E+05	Good
1995-96	0.025	433269	0.769	4.88E-06	1.2E+05	Good
	0.167	773255	0.755	2.82E-06	1.9E+05	Good
	0.26	1607296	0.749	1.37E-06	3.5E+05	Good
1996-97	0.025	644675	0.940	1.18E-05	1.7E+05	Good
	0.167	813658	0.940	9.70E-06	2.0E+05	Good
	0.26	972460	0.941	8.32E-06	2.4E+05	Good

Table 4.3. Loliginids and octopods in Scottish waters

	Loliginids in Scottish waters	Octopods in Scottish waters
DEFINITION OF STOCK		
Species composition (species which are not distinguished in landings statistics)	Mainly Lf, some Lv in the south. Small amounts of As may also be landed and occasionally Te, Ts or Ic may be mixed in with loliginids.	Mainly Ec in the North, possibly some Ov in the south
Approximate boundaries	ICES areas IV a,b,c V b, VIa,b.	-
Data on genetic structure	Lf genetically identical throughout Continental shelf (Brieley *et al*, 1995), some microsatellite evidence of separate offshore stock (Paul Shaw, University of Hull, pers. comm.)	No data
Distribution and movements	Movements around UK can be inferred from distribution of catches - squid seem to move into N. Sea from west coast of Scotland and English Channel. Note: *Loligo* thought not to live in deep water (>200m).	No data
Pragmatic considerations	The ICES fishery subdivisions are convenient units. Movements of squid between areas may necessitate aggregation into larger areas. Rockall should be kept separate.	No data
DESCRIPTION OF FISHERIES ON STOCK		
Nations involved	Scotland, England (including Wales and N. Ireland), French, also Belgium, Holland, Denmark, Spain)	Scotland, England (including Wales and N. Ireland), French, also Belgium, Holland, Denmark, Spain)
Type of fishery	By-catch	By-catch. Not always landed.
Gears	Demersal trawls and seines (mainly)	Demersal trawls and seines (mainly)
Size of vessels	Mainly small trawlers	Mainly small trawlers
Number of vessels		
Operational range	Coastal waters, some to Rockall and Faroe. Typically go to sea 1-7 days	Coastal waters, some to Rockall and Faroe. Typically go to sea 1-7 days
Season	All year round in coastal waters, landings peaking in winter; fishing at Rockall mostly in summer	Landed all year round
By-catch spp.	N/A	N/A
Legislation	Minimum landing size of 10 mm ML applies in theory	None

Table 4.3. Loliginids and octopods in Scottish waters (continued)

	Loliginids in Scottish waters	Octopods in Scottish waters
FISHERY TRENDS		
Interannual (Landings, Effort, LPUE)	Big interannual fluctuations in landings and LPUE against a background of quite consistent effort. Peak landings in 1989	Not analysed
Seasonal (Landings, Effort, LPUE)	In coastal waters, regular seasonal peak in September-December, summer (May-August) peak at Rockall	Not analysed
DATA FOR ASSESSMENT		
Fishery data: collection / quality control	From logbooks and markets, screened and corrected data ultimately entered into FRS database. Some misreporting of areas known to occur, squid sometimes recorded under "other" species	From logbooks and markets, screened and corrected data ultimately entered into FRS database.
Fishery data: spatial and temporal resolution	Monthly, by ICES rectangle, by gear	Monthly, by ICES rectangle, by gear
Fishery data: access	FRS database, Aberdeen	FRS database, Aberdeen
On-board observers	Planned as part of current project	Planned as part of current project
Market sampling programmes	Some market sampling since 1995 (also within project)	None
Discard data	Recorded in Scottish discard sampling since 1998 (University of Aberdeen project), thought to be little discarding	Recorded in Scottish discard sampling since 1998 (University of Aberdeen project), thought to be little discarding
Survey data (groundfish, acoustic, jigging, pre-recruit, plankton	Length-frequencies recorded in all Scottish trawl surveys (1974 onwards at least). Recent English surveys also record cephalopods. Paralarvae (few) retrospectively extracted from plankton hauls	No data
Length-frequency and recruitment	Data collected in Scotland under current project	No data
Species composition	Samples from Scottish markets rarely contain Lv	No data; thought to be mainly Ec
Natural mortality data	Some data available on incidence in diets of marine mammals (M.B. Santos, unpubl. data; Pierce & Santos, 1996)	No data
ASSESSMENT		
Fishery-independent: surveys	Survey data analysed by Pierce *et al.* (1998)	No assessment
Analytical approaches	De Lury depletion method using CEDA package attempted for 1989-94 data (Pierce *et al.*, 1996)	No assessment
Other	Forecasting from temperature (Pierce, 1995, Robin & Denis, submitted; Pierce & Boyle, In Prep.). Analysis based on GIS in progress under current projects	No assessment

Table 4.4. Loliginids and Octopods in Portuguese waters

	Loliginids in Portuguese waters	Octopods in Portuguese waters
DEFINITION OF STOCK		
Species composition (species which are not distinguished in landings statistics)	Lf, Lv, As, Am (less common)	Ov, Ec, Em
Approximate boundaries	ICES Areas VIII, IX, X	ICES Areas VIII, IX, X
Data on genetic structure	Lf on the coast identical to that further North; in the Azores Lf is probably a separate sub-species (Brierley *et al.*, 1995)	No data on coastal stocks. Two populations distinguished by size in the Azores (J. Pereira & M. Cunha, IPIMAR, pers. comm.)
Distribution and movements	On the mainland coast, Lv is found closer inshore than Lf. Lv shows major concentrations in the North and South - less in between. Lf is less common further south and currently (1998) absent from the mainland coast.	Occurs all along the mainland coast: Ov inshore, Ec offshore, Em inshore, only in south. Sedentary as adults, paralarvae of Ov planktonic
Pragmatic considerations	Separate west Portugal plus Galicia (mixed Lf and Lv) from south Portugal and Cadiz. Treat the Azores separately.	Separate west Portugal plus Galicia (mixed Lf and Lv) from south Portugal and Cadiz. Treat the Azores separately.
DESCRIPTION OF FISHERIES ON STOCK		
Nations involved	Portugal, Spain	Portugal, Spain
Type of fishery	By-catch (trawl, purse seine and some artisanal gears) and directed (jigs). Hand jigs in the Azores	By-catch (trawl) and directed (artisanal gears and sometimes trawl)
Gears	trawl, purse seine, artisanal gears (hand jigs, nets)	Mainly caught by trawls in North and traps in North and South. Only 10% of catches come from trawling. In Azores, mostly by scuba divers
Size of vessels	Mean trawler length = 31 m; a third of artisanal vessels with lengths <5 m, half between 5 and 15m and the remainder >15 m. Small vessels in the Azores.	Mean trawler length = 31 m; a third of artisanal vessels with lengths <5 m, half between 5 and 15m and the remainder >15 m.
Number of vessels	Mainland: 105 trawlers (mean between 1990 and 1993), 9172 artisanal vessels in 1995.	Mainland: 105 trawlers (mean between 1990 and 1993), 9172 artisanal vessels in 1995.
Operational range	Whole coast, all year for every fleet	Whole coast, all year for every fleet
Season	Trawling all year but most catches in autumn (Sep-Dec)	Throughout the year, highest Jan-July
By-catch spp.	None in the jig fishery	No data
Legislation	Minimum landing size = 10 cm ML. No trawling is allowed within 6 miles of coast.	No trawling is allowed within 6 miles of coast. Min. weight = 750g.
FISHERY TRENDS		
Interannual (Landings, Effort, LPUE)	Landings very variable (lowest in 1994, highest in 1991). Trawling effort increased until 1990 then decreased until 1995. Number of trawlers taking loliginids decreased since 1992. Number of jigs increased from 1993 to 1995.	Landings: increasing trend for all gears since 1960. Licences for traps increasing 93-95
Seasonal (Landings, Effort, LPUE)	One peak in landings (Sep-Dec). One peak in LPUE (Oct-Dec) except in years of low LPUE (which show variable patterns)	Highest landings Jan-July, sometimes into autumn as well.

Table 4.4. Loliginids and octopods in Portuguese coastal waters (continued)

	Loliginids in Portuguese waters	Octopods in Portuguese waters
DATA FOR ASSESSMENT		
Fishery data: collection / quality control	Landings data from markets is screened and entered into the DGP database. Some errors in assigning names of categories in the market. After further screening, data entered into IPIMAR database. Fishing effort from sample of trawl fishery (hours fishing, since 1988), and number of licences for artisanal fishery.	Landings data from markets is screened and entered into the DGP database. Some errors in assigning names of categories in the market. After further screening, data entered into IPIMAR database. Fishing effort from sample of trawl fishery (hours fishing, since 1988), and number of licences for artisanal fishery. In the Algarve, observers provide independent data
Fishery data: spatial and temporal resolution	Annual and monthly landings by gear type and trawl effort (1986-present), reported by port, assigned to ICES rectangle (trawl fishery - from sample of log books; artisanal fishery - assume catches taken nearby).	Annual and monthly landings by gear type and trawl effort (1986-present), reported by port, assigned to ICES rectangle (trawl fishery - from sample of log books ; artisanal fishery: assume catches taken nearby).
Fishery data: access	DGP and IPIMAR databases. Azores data held at DOP, Azores	DGP and IPIMAR databases
On-board observers	Since 1996 in Algarve, for discards project	Currently in the Algarve
Market sampling programmes	Market sampling since 1980 for biological data	On west coast since 1977. In the Algarve recently under current project
Discard data	Discard data collected by current discards project, since 1996 in the Algarve	On-board observers for discards in the Algarve
Survey data (groundfish, acoustic, jigging, pre-recruit, plankton	Groundfish surveys provide data on distribution of loliginids and biological data; twice per year since 1980	Cruises south of Lisbon ran 1990-95 twice a year
Length-frequency and recruitment	Market sampling: length-frequency data since 1980, reproductive data from 1990	Length-frequency data for the whole coast since 1980. Biological data available from West coast sampling since 1997, also from on board observers and markets in the Algarve under current project
Species composition	No data on proportions of species in landings but could be obtained from survey data	Monthly sampling at market to identify % of each species. Most artisanal landings are Ov.
Natural mortality data	Stomach contents of fish analysed from crustacean trawls in the Algarve	Stomach contents of fish analysed from crustacean trawls in the Algarve
ASSESSMENT		
Fishery-independent: surveys	No assessment	No assessment
Analytical approaches	Data are suitable for use of depletion methods. Preliminary assessment using CEDA carried out during WG meeting in 1998	No assessment
Other	No assessment	No assessment

Table 4.5. Cuttlefish and ommastrephid squid in Portuguese waters

	Cuttlefish in Portuguese waters	Ommastrephids in Portugal
DEFINITION OF STOCK		
Species composition (species which are not distinguished in landings statistics)	Mainly So but small animals taken can be a mix of So, Se, Sr	The most common is Ic. Te is also caught, Ts more rarely. The proportions of Ic and Te change from year to year
Approximate boundaries	Areas VIII, IXa	Areas VIII, IXa
Data on genetic structure	No data	No data
Distribution and movements	Inshore species mainly, big ones offshore, extend into brackish estuarine waters. In Algarve, possible inshore migration of So into rias for reproduction, e.g. Ria Formosa by Faro	Offshore species, Te more inshore than Ic. Both more abundant in NW coast.
Pragmatic considerations	Separate west Portugal plus Galicia (mixed Lf and Lv) from south Portugal and Cadiz.	Separate west Portugal plus Galicia (mixed Lf and Lv) from south Portugal and Cadiz.
DESCRIPTION OF FISHERIES ON STOCK		
Nations involved	Portugal, Spain	Portugal, Spain
Type of fishery	By-catch and directed artisanal	By-catch only
Gears	Trawl, purse seine and (mainly) artisanal (traps, nets)	Trawl and gillnets
Size of vessels	Mean trawler length = 31 m; a third of artisanal vessels with lengths less than 5 m, half between 5 and 15m and the remainder >15 m	Mean trawler length = 31 m; a third of artisanal vessels with lengths less than 5 m, half between 5 and 15m and the remainder >15 m
Number of vessels	105 trawlers (mean between 1990 and 1993); 9,172 artisanal vessels in 1995.	105 trawlers (mean between 1990 and 1993); 9,172 artisanal vessels in 1995.
Operational range	Whole coast, all year for every fleet and also in estuaries	Whole coast, all year for every fleet
Season	Higher in Feb-May	Higher Nov.-April
By-catch spp.	N/A	N/A
Legislation	Minimum ML = 10 cm	None
FISHERY TRENDS		
Interannual (Landings, Effort, LPUE)	Relatively constant from year to year	Irregular, decreasing landings in recent years
Seasonal (Landings, Effort, LPUE)	Landings peak Nov-June	Landings peak Nov-Apr
DATA FOR ASSESSMENT		
Fishery data: collection / quality control	Fishery data as for other cephalopods in Portugal	fishery data as for other cephalopods in Portugal
Fishery data: spatial and temporal resolution	Fishery data as for other cephalopods in Portugal	fishery data as for other cephalopods in Portugal
Fishery data: access	DGP and IPIMAR databases	DGP and IPIMAR databases
On-board observers	Currently in the Algarve	Currently in the Algarve
Market sampling programmes	Monthly length-frequency in several markets since 1980	Monthly length-frequency in several markets since 1980
Discard data	On board observers for discards in the Algarve	Ommastrephids are discarded by trawlers, crustacean trawlers especially, on board observer for discards in the Algarve
Survey data (groundfish, acoustic, jigging, pre-recruit, plankton	Cruises S of Lisbon ran 1990-95 twice a year. (Reproductive data collected in groundfish surveys and on-board observers)	Groundfish surveys twice per year since 1980

Table 4.5. Cuttlefish and ommastrephid squid in Portuguese waters (continued)

	Cuttlefish in Portuguese waters	Ommastrephids in Portugal
DATA FOR ASSESSMENT		
Length-frequency and recruitment	Monthly length-frequency collected in market samples since 1980	Monthly length-frequency collected in market samples since 1980
Species composition	No data on proportion of species in landings. Mainly So	No data on proportion of species in landings
Natural mortality data	Stomach contents of fish analysed from crustacean trawls in the Algarve	Stomach contents of fish analysed from crustacean trawls in the Algarve
ASSESSMENT		
Fishery-independent: surveys	No assessment	No assessment
Analytical approaches	No assessment	No assessment
Other	No assessment	No assessment

Table 4.6. Loliginids and octopods in the Gulf of Cadiz

	Loliginids in Gulf of Cadiz	Octopods in Gulf of Cadiz
DEFINITION OF STOCK		
Species composition (species which are not distinguished in landings statistics)	Lv, As, Am. Note: Lv is distinguished from *Alloteuthis* spp.	Ov, Ec, Em. Ov is the most important cephalopod species for fisheries in the area. Note: Ov is distinguished from *Eledone* spp.
Approximate boundaries	IX (Gulf of Cadiz)	IX (Gulf of Cadiz)
Data on genetic structure	No data	No data
Distribution and movements	Data exist on depth distribution from surveys	Data exist on depth distribution from surveys. Abundance in Cadiz declining 1994-97 (increasing in Galicia)
Pragmatic considerations	Could be combined with adjacent Portuguese waters	Could be combined with adjacent Portuguese waters
DESCRIPTION OF FISHERIES ON STOCK		
Nations involved	Spain	Spain
Type of fishery	Mainly by-catch of trawling	By-catch and artisanal. Some trawlers occasionally target octopus.
Gears	Trawl	Trawl, artisanal gears (hand jig, clay pot, trap).Trawling is more important.
Size of vessels	Average size of trawlers: GTR 25, length 14 m	Average size of trawlers: GTR 25, length 14 m. Artisanal boats on average have GTR 5, length 7 m
Number of vessels	273 trawlers	273 trawlers, 892 artisanal boats
Operational range	Spanish waters of Gulf of Cadiz	Spanish waters of Gulf of Cadiz
Season	All year, main catches in August to January	Trawl landings quite constant through the year, artisanal landings highest Nov-Mar
By-catch spp.	N/A	N/A
Legislation	Minimum landing size 10 cm ML for Lv	Minimum landing size 1 Kg for Ov

Table 4.6. Loliginids and octopods in the Gulf of Cadiz (continued)

	Loliginids in Gulf of Cadiz	Octopods in Gulf of Cadiz
FISHERY TRENDS		
Interannual (Landings, Effort, LPUE)	LPUE quite consistent over 1993-97. Effort and catches were higher in 1993. Artisanal catches quite consistent (146-236 tonnes) during 1993-97.	LPUE high 1993-95 then declined drastically in 1996-97, artisanal landings also descreased 1996-97. Total landings all fleets 2763 tonnes in 1994, 319 tonnes in 1997. No effort data for artisanal fleet
Seasonal (Landings, Effort, LPUE)	Peak of LPUE in Aug-Jan	Data not available at meeting
DATA FOR ASSESSMENT		
Fishery data: collection / quality control	Managed by IEO	Managed by IEO
Fishery data: spatial and temporal resolution	Landings data available by month, by port, by fleet. Effort data for trawlers available on same basis but no effort data for the artisanal fleet. Since 1993, *Loligo* from *Alloteuthis*.	Landings data available by month, by port, by fleet. Effort data for trawlers available on same basis but no effort data for the artisanal fleet. Since 1993 Ov and *Eledone* data have been collected separately.
Fishery data: access	IEO database	IEO database
On-board observers	Programme starting	Programme starting
Market sampling programmes	Since 1993 used to separate species (as above)	Length-frequency data collected and Ov distinguished from *Eledone*
Discard data	One year's data from a project	One year's data from a project
Survey data (groundfish, acoustic, jigging, pre-recruit, plankton	Numerical and biomass indices available since 1993, usually 1 or 2 surveys per year (8 surveys since 1993), 30 hauls per survey. Some data on all cephalopods.	Numerical and biomass indices available since 1993, usually 1 or 2 surveys per year (8 surveys since 1993), 30 hauls per survey. Length data for Ov, Ec, Em
Length-frequency and recruitment	No data	Length-frequency from market sampling and surveys
Species composition	*Loligo* and *Alloteuthis* separated	Ov and *Eledone* separated
Natural mortality data	No data	No data
ASSESSMENT		
Fishery-independent: surveys	No assessment	No assessment
Analytical approaches	No assessment	No assessment
Other	No assessment	No assessment

Table 4.7. Cuttlefish and ommastrephids in the Gulf of Cadiz

	Cuttlefish in Gulf of Cadiz	Ommastrephids in Cadiz
DEFINITION OF STOCK		
Species composition (species which are not distinguished in landings statistics)	So, Se Note: So and Se are distinguished	Ic, Te (Ts appears in surveys)
Approximate boundaries	Area IXa	Area IXa
Data on genetic structure	No data	No data
Distribution and movements	Survey data exist	Survey data exist
Pragmatic considerations	Could be combined with adjacent Portuguese waters	Could be combined with adjacent Portuguese waters
DESCRIPTION OF FISHERIES ON STOCK		
Nations involved	Spain	Spain
Type of fishery	By-catch and artisanal	By-catch only
Gears	Trawl, artisanal gears. Trawlers occasionally target *Sepia*.	Trawl
Size of vessels	Average size of boats: GTR 25, length 14 m, artisanal boats on average have GTR 5, length 7 m	Average size of boats: GTR 25, length 14 m
Number of vessels	273 trawlers, 892 artisanal boats	273 trawlers
Operational range	Spanish waters of Gulf of Cadiz	Spanish waters of Gulf of Cadiz
Season	No data	No data
By-catch spp.	N/A	N/A
Legislation	Minimum landing sizes: So 8 cm ML, Se 4 cm ML	None
FISHERY TRENDS		
Interannual (Landings, Effort, LPUE)	LPUE quite consistent year to year in trawl fleet. Artisanal landings also consistent: 630-826 tonnes per year 1993-97	No data on trends
Seasonal (Landings, Effort, LPUE)	Catches highest Oct-Mar	No data
DATA FOR ASSESSMENT		
Fishery data: collection / quality control	Managed by IEO	Managed by IEO
Fishery data: spatial and temporal resolution	Landings data available by month, by port, by fleet. Effort data for trawlers available on same basis but no effort data for the artisanal fleet. So separated from Se/Sr	Landings data available by month, by port, by fleet. Effort data for trawlers available on same basis but no effort data for the artisanal fleet.
Fishery data: access	IEO database	IEO database
On-board observers	One year, during a project	One year, during a project
Market sampling programmes	None	None
Discard data	One year, during a project	One year, during a project

Table 4.7. Cuttlefish and ommastrephids in the Gulf of Cadiz (continued)

	Cuttlefish in Gulf of Cadiz	Ommastrephids in Cadiz
DATA FOR ASSESSMENT		
Survey data (groundfish, acoustic, jigging, pre-recruit, plankton	Numerical and biomass indices available since 1993, usually 1 or 2 surveys per year (8 surveys since 1993), 30 hauls per survey. Length data for So	Numerical and biomass indices available since 1993, usually 1 or 2 surveys per year (8 surveys since 1993), 30 hauls per survey. Some data on all cephalopods.
Length-frequency and recruitment	From survey data	No data
Species composition	So and Se are separated	No data
Natural mortality data	No data	No data
ASSESSMENT		
Fishery-independent: surveys	No assessment	No assessment
Analytical approaches	No assessment	No assessment
Other	No assessment	No assessment

(Species key: Lf *Loligo forbesi*, Lv *Loligo vulgaris*, As *Alloteuthis subulata*, Am *Alloteuthis media*, Ic *Illex coindetii*, Te *Todaropsis eblanae*, Ts *Todarodes sagittatus*, Ov *Octopus vulgaris*, Ec *Eledone cirrhosa*, Em *Eledone moschata*, So *Sepia officinalis*, Se *Sepia elegans*, Sr *Sepia orbignyana*)

Figure 4.1 Stock assessment of *Loligo forbesi* in Scottish water using the no recruitment CEDA depletion model.

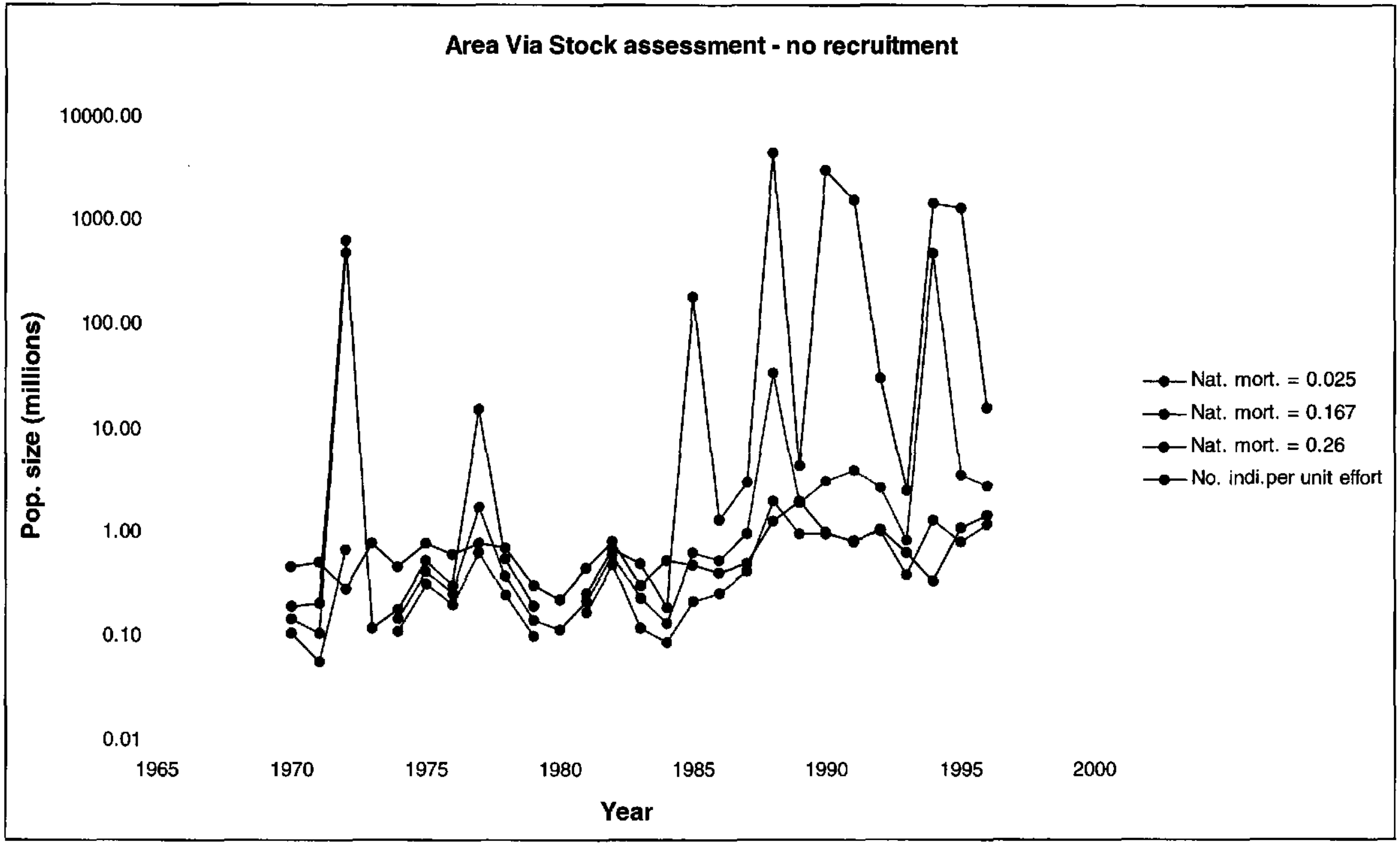
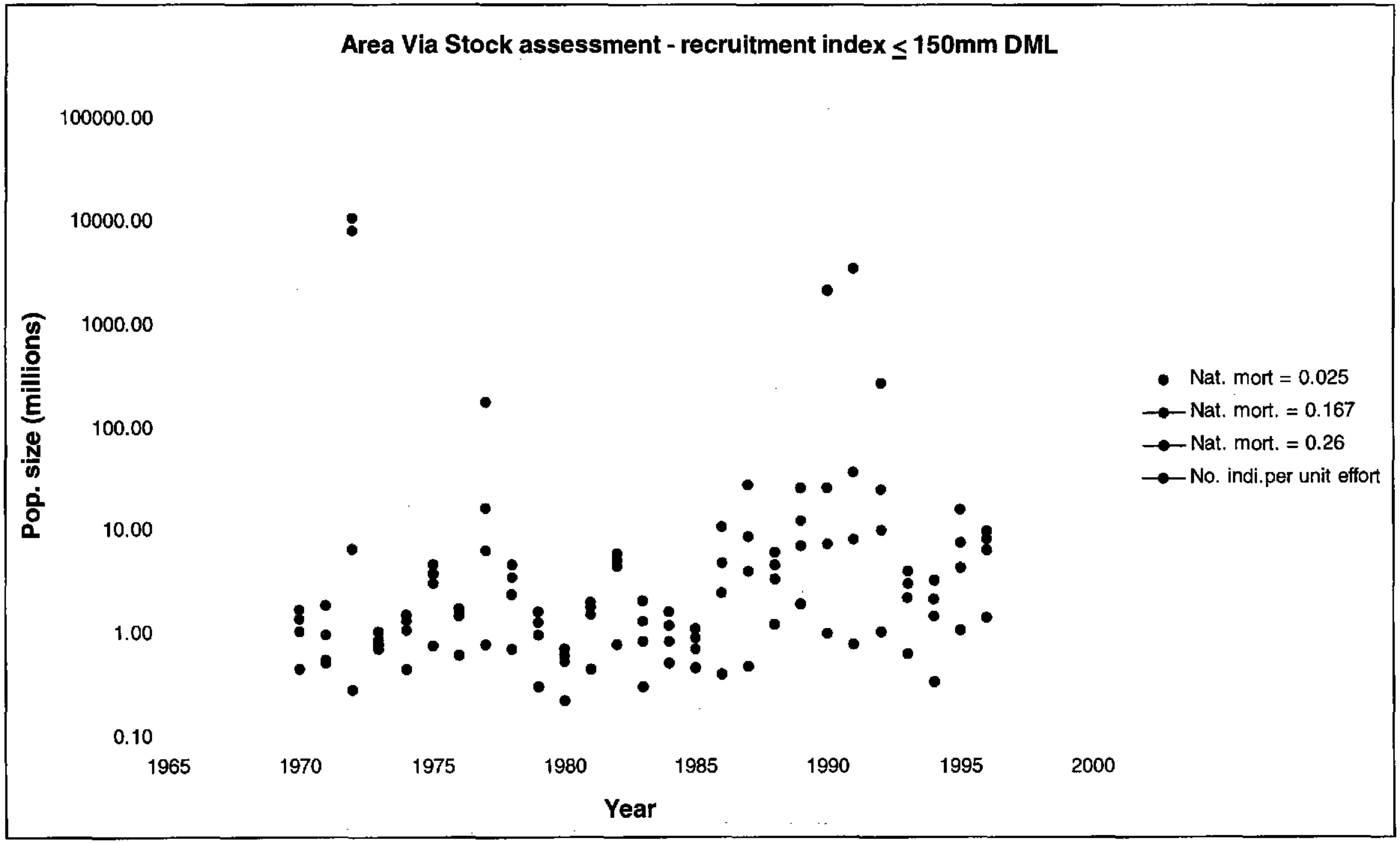


Figure 4.2 Stock assessment of *Loligo forbesi* in Scottish water using the CEDA depletion model with a recruitment index ≤ 150mm DML.



ANNEX 1

WGCEPH MEETING, 25-27 MARCH 1999 IN HERAKLION, GREECE

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ANNEX 2

WGCEPH

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ANNEX 3

WGCEPH MEETING, 25-27 MARCH 1999 IN HERAKLION, GREECE

AGENDA

1. Opening of the Meeting
2. Introduction
3. Adoption of 1998 Report
4. Report of the Chairman
5. Terms of Reference

5.1 Cephalopod Landing Statistics

5.2 Current Status of Data, Methodology and Results Available for Stock Assessment of Fished Cephalopods

5.3 Review of Grey Literature Important to Cephalopod Fisheries

5.4 Peer review of the Working Group Report

5.5 Comment on the draft objectives and activities of the Living Resources Committee component of the ICES five years plan, and specify how the purpose of the Working Group contributes to it

5.6. Review the results of national and transnational projects collecting data on fished cephalopods, especially those studying migration and distribution patterns of juveniles and adults, and the factors affecting recruitment

6. Other Business
7. Recommendations
8. Closing of the Meeting

ANNEX 4

WGCEPH MEETING, 25-27 MARCH 1999 IN HERAKLION, GREECE

Current projects relevant to WGCEPH

EC FAIR programme

TITLE	CO-ORDINATOR	DATES
Cephalopod Resource Dynamics: Patterns in Environmental and Genetic Variation	P.R. Boyle (University of Aberdeen)	1997-2000

EC Study Projects

TITLE	CO-ORDINATOR	DATES
Analysis of fisheries discards from the south coast of Portugal	T. Borges (Universidade do Algarve)	
Cephalopod Resources Dynamics & Fisheries Trends in the Algarve and Gulf of Cadiz	T. Borges (Universidade do Algarve)	
Analysis And Evaluation Of The Fishery Status Of The Most Commercially Important Cephalopod Species In The Mediterranean Sea	Fisheries Research Institute N.Ag.Re.F., Kavala, Greece	1998-2000
Development of Software to Estimate Unreported or Misreported Catch and Effort Data and to Apply Fishery Management Models	A. Guerra (Instituto de Investigacions Mariñas)	1998-1999
Data Collection for Assessment of Fished Cephalopod Stocks	G.J. Pierce (University of Aberdeen)	1997-1999

EC Training and mobility projects

TITLE	CO-ORDINATOR	DATES
Use Of A Geographic Information System To Study Management Of Cephalopod Fisheries: Comparison Of British (N.E. Atlantic) And Spanish (Mediterranean) Cephalopod Fisheries	G.J. Pierce (University of Aberdeen)	1997-1999
Trophic interactions of pelagic squid and fish in the North East Atlantic: application of stable isotope and fatty acid techniques to improve understanding of pelagic food webs	G.J. Pierce (University of Aberdeen)	1999-2002

Projects based in the USA

TITLE	COMMENTS	DATES
Review of the cephalopods of the western North Atlantic *Evolution and phylogeny of coleoid cephalopods* *In-situ observations on deep-sea cephalopods* *Paralarval development and early life history* *Antarctic cephalopod taxonomy and biology*	Information supplied by Mike Vecchione. Projects funded by National Museum of Natural History and the Smithsonian.	

ANNEX 5

LIST OF WORKING DOCUMENTS

WGCEPH Meeting, 25-27 March 1999 In Heraklion, Greece

1 Notes on the Cephalopod fishery of the Basque country fleets in the North-eastern Atlantic waters during the period 1994–1998.

2 Cephalopod resources in the eastern Mediterranean with particular emphasis in Greek seas: Present and future perspectives.

3 Spatial analysis of the squid distribution (*Loligo forbesi*) in the North-eastern Atlantic by geostatistics.

4 Analysis and evaluation of the fishery status of the most commercially important Cephalopod species in the Mediterranean Sea.

5 English Channel Loliginids stock assessment.

6 Commentary on the CEDA software package.

7 Spanish Cephalopod landings in ICES waters, 1998 (Sub-areas VI, VII, VIII and IX).

8 (Lisa Hendrickson doc.)

9 Grey Literature 1996–99 relevant to WGCEPH.

10 Cephalopod Literature 1996-99.

11 Cephalopods discarded in the southern coast of Portugal (Algarve).

12 *Octopus vulgaris* (Cephalopoda: Octopodidae) Gametogeneses: A histological approach to the verification of the macroscopic maturity scales.

13 Formal layout of assessment material – A suggestion for WGCEPH.