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INTERNATIONAL COUNCIL FOR THE
EXPLORATION OF THE SEA

C.M.1979/K:3
Shellfish Committee

REPORT OF THE WORKING GROUP ON ASSESSMENT OF CEPHALOPOD STOCKS

Aberdeen, Scotland, 6-7 March 1979

1. Introduction

1.1 The Working Group met at the Marine Laboratory, Aberdeen, Scotland, on 6-7 March 1979. This followed the Council's resolution (C. Res. 1978/2:6) made at the Statutory Meeting in Copenhagen in 1978, that the Working Group should examine the possibilities for cephalopod stock assessment and offer management advice, and assess the appropriateness of making Sepia officinalis a protected species.

1.2 The following scientists participated:

M R Clarke	United Kingdom
A Franklin	United Kingdom (England and Wales)
F G Howard (Rapporteur)	United Kingdom (Scotland)
Th K Kristensen	Denmark
J Mason (Chairman)	United Kingdom (Scotland)
B Mesnil	France
Kr Fr Wiborg	Norway

Apologies for absence were received from:

J Bravo de Laguna	Spain
A Guerra	Spain
E Pascual	Spain

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2. Review of Fisheries

2.1 In the ICES area the most important commercially exploited species of Decapoda are Sepia officinalis (cuttlefish), Loligo vulgaris, L. forbesi and Todarodes sagittatus. Todaropsis eblanae and Illex spp. are exploited to a lesser extent, and there may be some potential for increased exploitation of these species and for exploitation of Alloteuthis subulata and Gonatus fabricii.

Octopoda are exploited by France, Spain and Portugal, but no data are available on these fisheries.

Members were requested to review the areas and species fished by their own country. It was thought that available landing statistics were generally poor, and that consideration should be given to a more systematic breakdown of the species caught. Cephalopods could be classed as short-finned and long-finned squid, cuttlefish and octopods.

Landings for each country are shown in Table I.

2.2 Norway

Prior to 1972 a well established trawl fishery for the ommastrephid Todarodes sagittatus existed off the coast of north Norway (IIa) with annual catches of up to 10 000t, the squid being utilised in the production of fish meal and fish oil and as bait in line fisheries. Between 1972 and 1976 landings were low.

In 1977 stocks of Todarodes appeared off the west coast (IVa) and small catches were made in the winter months and during the spring of 1978. Catches

were made using Japanese jigging machines experimentally. Small boats using hand lines were also involved, and attained catch rates of up to 2t per day using two lines. The squid were landed primarily for the home human consumption market, and an intensive promotion campaign was developed.

2.3 Denmark

Denmark has no traditional history of squid fishing although landings of Loligo forbesi were made in the 1940s and 1950s, reaching 1 000 t in 1950. Few landings were then made until 1978 when 10 t of Todarodes sagittatus were caught in October - December in the northern North Sea (IVa). At present squid are taken as a by-catch in trawl fisheries and fishermen are being encouraged to expand this aspect of the fishery.

Small landings of Todaropsis eblanae, caught as by-catch in the blue whiting fishery west of Scotland (VIa, b), have also been made.

2.4 Scotland

Squid have been recorded in Scottish fishery landing statistics since the beginning of this century, but prior to 1950 they were landed for use as bait in line fisheries. The catches consisted primarily of Loligo forbesi, but included some Todarodes sagittatus and Todaropsis eblanae, no distinction being made in the statistical tables.

Since 1954 a human consumption export market has been developed for L. forbesi and squid landings have been almost exclusively of this species, particularly since the demand for bait in line fisheries has declined. Some Alloteuthis subulata may occasionally be landed with L. forbesi.

Squid are taken mainly as by-catch in trawl and seine net fisheries from grounds around the Scottish coast (IVa, b, VIa, VIIa) and at Faroe (Vb₁, b₂) and Rockall (VIb). In 1970-1972 a directed trawl fishery for L. forbesi was operated at Rockall.

The fishery at Rockall reached its yearly peak from June to August, while in most other areas the fisheries are primarily conducted during September to December. At Faroe peak landings occur from June to August and in October-November. Landings from this area have now fallen following the introduction of fishing restrictions.

Scottish landings have fluctuated considerably. During the past 20 years they have ranged from 80 to 1 300 t. The peak was reached in 1971, and recently landings have fallen to 200 t.

2.5 England and Wales

Three species of cephalopods are landed in England and Wales.

In recent years Sepia officinalis has become the subject of a directed fishery in the English Channel (VIId, e) in March, April and May. It is caught by trawl and trammel net in the inshore waters of the Solent and around the Isle of Wight. In late summer and autumn it is caught as by-catch in trawl fisheries in the western English Channel. In 1977 450 t were landed.

Loligo vulgaris is caught as by-catch in trawl fisheries in the western English Channel, in the Bristol Channel (VIIb) and off the south coast of Ireland (VIIg, h) where it is taken together with L. forbesi. L. forbesi is taken mainly at Rockall (VI b) and Faroe (Vb₁, b₂), a directed summer trawl fishery taking place in the early 1970s at Rockall. Landings are made throughout the year from elsewhere.

2.6 France

An important directed trawl fishery for Sepia officinalis occurs in the English Channel (VIIe) during the spring. A trap fishery exists in a number of places included St Brieuc. The fishery is based on the migration of Sepia eastwards in the Channel and is dependent on migration patterns. Off St Brieuc a directed trawl fishery is permitted from 15 April to 15 June inside the three mile fishing limit.

In the Bay of Biscay (VIII) a directed fishery for S. officinalis takes place in the early spring from Lorient. Cuttlefish are caught by both trawl and trap.

Sepia, Loligo vulgaris and L. forbesi are taken as by-catch in other trawl fisheries in the English Channel and Bay of Biscay, and L. forbesi is taken in other areas, including the North Sea, Faroe Rockall and north-west of Scotland (areas IVa, b, c, Vb₁, b₂, VIa, b, VIIb - k, VIII).

French landings of Sepia and Loligo were 3 900 t and 3 300 t respectively in 1974 and 6600 t and 4 100 t in 1975.

2.7 Spain and Portugal

No details of the fisheries were available, but cuttlefish, squid and octopods are caught by both countries in areas VIIg - k (South of Ireland), VIII(Bay of Biscay) and IX (Portuguese Waters).

3. Biology

3.1 The complete life history of most Decapoda is not fully understood but it seems that it is basically very similar in many species. They have a relatively short life span, under two years, and spawning is immediately

followed by mass mortalities. Brood strengths are believed to fluctuate widely. Most species are divided into two spawning populations, with winter and summer spawners.

3.2 Sepia officinalis

There appears to be mixing of the Bay of Biscay and English Channel stocks in the deep water south-west of the British Isles. Inshore spawning migrations occur, copulation occurs on the spawning grounds and spawning is immediately followed by mass mortality. There are two groups of spawners. Large early spawners spawn in the Bay of Biscay and in the English Channel when they are 18-20 months old, and small summer spawners spawn only in the Bay of Biscay when they are 12-15 months old. This latter group spawn in deeper waters than the earlier spring spawners.

Brood from the early spring spawning grow rapidly and mature during the autumn and winter when day length is short. These form the group of small summer spawners the next year. The brood from the summer spawning do not mature until their second autumn and form the group of large early spawners in their second spring.

In the spring, the Sepia stocks can therefore contain three size groups, two mature and one immature. The female lays an estimated 5 000 - 6 000 eggs.

3.3 Loligo vulgaris

The population structure and breeding cycle of L. vulgaris closely resemble those of Sepia with three size groups in the spring in the Bay of Biscay, spring and summer spawners and immatures. Few summer spawners are found in the English Channel. Copulation occurs while the animals are migrating to the

spawning grounds, and spawning is followed by mass mortality. Estimates of fecundity show that the female lays between 3 000 and 6 000 eggs in clusters of 50 to 150.

3.4 Loligo forbesi

The range of this species overlaps with that of L. vulgaris but extends further north. Little information is available on Bay of Biscay stocks but it would appear that two distinct spawning periods again occur. In the English Channel the stock is mainly of winter spawners with few summer spawners. The latter are probably strays from a more southern population.

At Rockall and west of the Outer Hebrides the position is less clear, with the possibility of a summer spawning stock. At Faroe and off the Scottish mainland only a spring spawning stock appears to be present.

3.5 Todarodes sagittatus

Little information is available on the life cycle of this species. From examination of statoliths it appears that two spawning populations are present, one winter and one summer.

Squid caught off northern Norway in October are thought to have been hatched in winter (December-January), and those caught off Shetland in January are thought to have been hatched in summer (June-July). It is thought that winter spawning areas occur along the slope from Scotland to western Ireland, and the summer spawning areas are nearer the Azores.

Migration patterns are little known and more data are required on maturity and spawning areas. Migrations are more extensive in northern than in southern waters, where the species is usually found in the deep waters off the edge of the shelf.

Egg counts of Todarodes show that up to 15 000 eggs are laid.

3.6 Todaropsis eblanae

This species has been fished in the Bay of Biscay by Spain and in the North Sea by Denmark. Quantities have also been taken in blue whiting fisheries in the north east Atlantic. In the Bay of Biscay, 90% of those taken in December were small with dorsal mantle lengths of 4-11cm. The remainder were adults, the males having a mean dorsal mantle length of 14cm and the females 20cm.

In May and June a second group was found, with smalls in the range 3-10cm (mean 6.5cm) and adult males of 14cm and females of 18cm.

3.7 Illex coindetii

In the NE Atlantic two spawning groups are again present, summer and winter spawners. The time scale of the spawning behaviour is apparently similar to that of Sepia. The spawning stocks aggregate in deep water areas.

Feeding Illex have been found in localised cold water areas with a soft mud substrate.

A pronounced sexual dimorphism is apparent in I. coindetii, but not in I. illecebrosus.

3.8 Alloteuthis subulata

Small localised stocks are found in inshore shallow waters of the North Sea. There is some evidence of a winter migration to deep water, but movement patterns are uncertain.

3.9 Gonatus fabricii

Large numbers of small individuals, 15-45mm mantle length, are found off northern Norway, off Greenland, and in the Central North Sea in summer and autumn. Few large individuals have been found, because trawl towing speeds were too low.

3.10 Age determination

All decapod species have calcareous statoliths which are laid down in a pattern of regular rings. Current work on the formation of these rings indicates that they may be daily growth rings. Baseline data on growth rates from examination of statoliths obtained from aquarium hatched animals would be invaluable.

3.11 Natural mortality

In all common species mass post-spawning mortality occurs. No estimates of natural mortality are available for the life history prior to spawning, although it is known that adult squid are prey for Cetacea and Pinnepedia.

4. Sampling Procedures

4.1 It was agreed that size should be expressed as the dorsal mantle length measured to the nearest $\frac{1}{2}$ centimetre below.

Samples should be sexed and the maturity stage noted. It was agreed that for maturity to be decided consistently under field conditions a simple macroscopic technique was required.

The following scale was decided upon:

Males

No spermatophores present	Immature	Stage I
Spermatophores in sac	Maturing	Stage II
Spermatophores in cirrus, cirrus large	Mature	Stage III

Females

No eggs in oviduct, relatively small nidamental glands	Non-spawners	Stage I
Eggs in oviduct, large nidamental glands	Spawners	Stage II
Spermatophores present (after copulation)	Copulated females	Stage III

Every effort should be made to sample and preserve cephalopods, including larval stages, caught in research vessel cruises, eg fish and larval surveys.

Where possible cephalopods should be preserved by deep freezing. If freezer facilities are not available, preservation should be in alcohol, since formalin adversely affects the calcareous statoliths.

5. Fishing Methods

5.1 In the area under review several different methods of capture are used. The most common method is otter trawling, subject to the mesh regulations pertaining to the Region in which it is used.

In Region 3 no specific regulations regarding the fishing of molluscs have been made, and therefore the Recommendation 1 mesh regulations for trawl

fishing apply, ie meshes must be not less than 60mm single twine or 65mm double twine. In Region 2 a minimum stretched mesh as small as 16mm is permitted in all mollusc net fisheries. In directed trawl fisheries for Sepia in the English Channel the mesh used in the United Kingdom fisheries is one of 70mm stretched. In France nets of 60-80mm stretched mesh are normally used. Other Region 2 otter trawl fisheries by the UK and France in which Sepia and Loligo are taken as by-catch are subject to Recommendation 1 (ie a 70mm minimum mesh is prescribed).

5.2 A certain amount of the United Kingdom effort is with the use of trammel nets. These are used throughout the year for bass and mullet fishing, but for a short period during the spring spawning Sepia alone are fished inshore.

5.3 In Scandanavia no specific mesh regulations are in force for directed cephalopod fisheries.

5.4 Little information is available on the selectivity of trawls for squid and more information is required before selection factors for the different species can be established.

5.5 In the Bay of Biscay and off Brittany, Sepia are caught by traps by French fishermen.

5.6 In Norway Todarodes have been taken by hand line and experiments have been conducted into the efficacy of Japanese jigging machines. This method worked reasonably well, but the jigs used were small, having only one row of hooks, and 50% of the catch was lost. The Japanese now recommend jigs

6.2 The group concluded that, on the basis of the available data no assessment could be made at present for any species.

6.3 For most species fishing is mainly on spawning concentrations. Fishing mortality therefore generally applies only to fully-grown adults, so that growth overfishing is unlikely to occur. It is, however, conceivable that recruitment/overfishing might occur if the spawning biomass was reduced too far. Consideration should be given to investigating the possibility of a stock-recruitment relationship.

6.4 Data already in existence should be compiled by each country concerned in a format suitable for a virtual population analysis. The necessary format would be one which shows the numbers of squid of each sex in each length group that are landed in a particular time period. Periods of one month are suggested.

A VPA could then be carried out, or perhaps an alternative approach be made depending on the available data. In the event of a VPA being the most suitable approach the results would give:

- a. an array of estimates of F at age,
- b. an estimate of the number of recruits in each year

6.5 Over a period of years a range of yields can be obtained. It would however be difficult to devise an appropriate strategy in any one year before the main fishing season unless the relative abundance of recruits could be previously estimated. Use might be made of data from regular fish and larval surveys provided that adequate details of cephalopod catch were kept.

7. Recommendations on Sepia officinalis

7.1 French, Spanish and Portuguese vessels land Sepia taken in trawl and trap fisheries in Region 3. Molluscs are not specified under NEAFC Recommendation 2 in this region and therefore trawl meshes used must be as laid down in Recommendation 1.

7.2 The two principal trawl fisheries directed at Sepia in Region 2 are both inshore in the English Channel, a French one off the north coast of Brittany and an English one mainly around the Isle of Wight and in the Solent. Despite the fact that in Region 2 small-mesh nets down to 16mm stretched mesh are permitted for molluscs under Recommendation 2, in neither of these directed fisheries are small meshes used.

7.3 In the English fishery Recommendation 1 meshes are used. The French fishery takes place off St Brieuc and St Malo, where fishing for Sepia is permitted within the 3 miles limit subject to an administrative decision each year. Fishing is by licence during the period 15 April-15 June and a stretched mesh size of 80mm is used.

7.4 In fisheries in which Sepia is taken as a by-catch Recommendation 1 meshes are used.

7.5 Trawling for cephalopods, which are very active, usually involves higher towing speeds than for fish. It would therefore be a positive disadvantage to use a fine-mesh net to fish specifically for Sepia since this would increase drag and reduce towing speed.

7.6 Sepia caught generally have a dorsal mantle length greater than 15cm. While little is known of mesh selectivity for Sepia, it is obvious that a small mesh is not necessary to retain animals of this size.

7.7 While no detailed studies of Sepia-directed fisheries have been made, scientists have gained the impression that the fish by-catch does not exceed 5% by weight of the total catch. This is to be expected since directed fisheries are on concentrations of Sepia, which tend to exclude fish.

7.8 It appears, therefore, that the EEC proposal to exclude Sepia officinalis along among molluscs from Recommendation 2 species is unlikely to result in protection of fish stocks; it is equally unlikely to have any effect on Sepia fishing.

7.9 There is at present no evidence of a need for management measures for Sepia, and therefore there appears to be no scientific justification for placing it in Recommendation 4 and making it subject to a minimum legal landing size even if it is removed from Recommendation 2.

8. Recommendations and Conclusions

The Working Group made the following proposals:

8.1 There appears to be no scientific justification for the EEC proposal to remove Sepia from the list of Recommendation 2 species on grounds of stock conservation of either Sepia or fish by-catch species.

8.2 The statistical returns of cephalopod landings should be improved to ensure that landings are classified as short-finned squid, long-finned squid, cuttlefish and octopods.

8.3 Data should be collected on the by-catch in all directed cephalopod fisheries.

- 8.4 The opportunity should be taken in all existing fish and larval surveys to record cephalopod catches by length, weight, sex and species. Echo sounder recordings of squid shoals would be invaluable particularly in the case of unexploited stocks. The effects of water temperature and other hydrographic features should be examined in relation to cephalopod behaviour.
- 8.5 It is recognised that deep sea cephalopod stocks are very poorly known, and it is recommended that expeditions aimed at these should be encouraged.
- 8.6 A standard measurement should be adopted for squid. The dorsal mantle length should be measured to the nearest $\frac{1}{2}$ centimetre below. Squid should be sexed and their maturity noted according to a simple three stage scale (See section 4).
- 8.7 The usefulness of the method of possible age determination by statolith ring counting was recognised. This technique should be further examined.
- 8.8 Further studies should be made on the biology and methods of capture of unexploited species such as Alloteuthis in order that their exploitability be determined.
- 8.9 Regular trawl hauls by the Marine Biological Association, Plymouth, to catch cephalopods for physiological experiments could be used to provide data on catch per unit effort.
- 8.10 Data on mesh selectivity should be obtained whenever the opportunity arises.

8.11 It was proposed that a future meeting be convened to discuss potential fisheries more fully.

8.12 The group also suggested that a further meeting to review progress and evaluate the possibility of carrying out stock assessments be held in two years' time, when more relevant data would have been obtained.

TABLE I

LANDINGS (TONNES) OF CUTTLEFISH, SQUIDS AND OCTOPODA, BY COUNTRY OF
LANDINGS FOR THE YEARS 1972-1977

	P 1977	P 1976	1975	1974	1973	1972
<u>Cuttlefish</u>						
Denmark	-	-	-	+	+	1
France	6 736	3 715	6 591	3 945	-	-
Ireland	1	-	-	-	-	-
Netherlands	84	75	36	49	31	41
Portugal	1 243	824	896	1 176	-	-
Spain	1 681	1 869	1 974	3 585	4 024	6 504
UK (England & Wales)	-	1	+	-	-	-
Total	9 745	6 484	9 497	8 755	4 055	6 546
<u>Squids</u>						
Belgium	278	97	206	90	155	112
Denmark	-	-	-	-	-	-
France	3 902	4 432	4 094	3 374	11 500 ^{a)}	7 441 ^{a)}
Germany Fed Rep	-	+	+	-	-	-
Ireland	169	7	-	-	-	-
Norway	260	-	-	-	-	+
Portugal	1 041	591	669	1 122	-	-
Spain	3 083	4 081	4 493	4 227	2 358	3 217
Sweden	-	-	+	+	+	+
UK (England & Wales)	1 042	908	650	230	244	142
UK (N Ireland)	230	119	65	12	58	11
UK (Scotland)	163	462	356	393	657	583
USSR	-	-	40	-	-	-
Total	10 168	10 697	10 573	9 448	14 972	11 506
<u>Octopoda</u>						
France	-	15	8	-	-	-
Portugal	3 598	4 471	4 461	2 459	-	-
Spain	3 752	3 120	6 530	4 971	9 349	14 950
UK (England & Wales)	-	+	-	-	-	-
Total	7 350	7 606	10 999	7 430	9 349	14 950

P : provisional

+ : magnitude less than half the unit used in the table

- : magnitude nil

a) includes cuttlefish