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International Council for the
Exploration of the Sea

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REPORT OF THE WORKING GROUP ON THE ASSESSMENT OF THE EUROPEAN EEL

Nantes, France, 22 - 24 September 1987

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1. Introduction

It was decided at the 74th Statutory Meeting (C. Res 1986/2:5:20) that the working group on the assessment of the European eel (Chairman: Mr. W. Dekker) will meet in IJmuiden from 8-10 september 1987 with the following terms of reference:

- a) describe the eel fisheries in European water for both elvers (glass eels) and post-elvers (adults) including the position and description of fisheries (marine, brackish, or fresh water), annual quantities caught, and, in the case of elvers, disposal of catches (consumption, transplantation, aquaculture);
- b) provide evidence for the number and identity of the eel stocks in European waters;
- c) present available time series of catch and effort data for adult eels and elvers and analyze such time series to determine:
 - i) if a correlation exists between indices of abundance for adults and elvers;
 - ii) if it is possible to attribute any declines in abundance to any particular factors (e.g., increases in catches of elvers or physical, chemical or other environmental changes)
- d) identify possible management strategies for eel, taking into account in particular the reproductive biology of the species, and indicate whether it is essential to maintain escapement (return of mature eels to the sea) above a minimum level to insure recruitment and, if so, specify that level;
- e) investigate whether there is any evidence that parasitism is a major factor affecting the viability of eel populations and, if so, whether there is any evidence to relate the rate of infestation to the importation of elvers or exotic species from outside Europe;
- f) identify deficiencies in the available data and recommend actions to be taken to reduce or eliminate such deficiencies.

However, in communications between WG members, it was realized that changing place and date to 22-24 september 1987 in Nantes would allow more members to join in the meeting. Since no member objected, this change was made.

The following scientists participated in the meeting:

| | |
|---------------------|-------------|
| I. Boetius | Denmark |
| W. Dekker, chairman | Netherlands |
| Y. Desaunay | France |
| G. Fontenelle | France |
| D. Gascuel | France |
| D. Guerault | France |
| H. Koops | FRG |
| C. Moriarty | Ireland |
| C. Rigaud | France |
| S. Treite | Norway |

Additionally, information by correspondence was received from H. Wickström (Sweden), C. Belpaire (Belgium) and M. da Franca (Portugal)

2. Description of fisheries

To describe fisheries in the different countries concerned, the following items are needed.

- fishing methods
- fishing areas
- fishing effort
- catch

The only data available are catch per country, published in statistical tables from the FAO (which separate fresh and seawaters) and from Statistical Bulletin of ICES which are summarized in table 2.a (last column). The data in these tables are inadequate for a number of reasons:

- many gaps for fresh or sea waters occur for some countries
- no distinction between fisheries or eel culture is possible nor between commercial and non commercial catch
- some intermediate production may be counted several times. For example, catch of glass eels for transportation may be added to catch of grown eels.
- There is no possibility of assessing the accuracy of the data
- there is no separation of life stages, glass eels and grown eels for example
- absence of data may indicate either lack of information or no exploitation.

So, it is impossible to make profit of these statistical data now to show an eventual trend in the production per country or all over the eel area, nor to quantify the actual impact of exploitation by fishing on the eel stock.

To compensate for this lack of data, a questionnaire was circulated within the working group before the meeting. The results, together with data added during the meeting, are presented in table 2.a and 2.b.

Considering the disposal of catches of glasseels: based on data from the questionnaire, it can be concluded that more than 90 % of the catch of Portugal and France (being approx 750 tonnes) is exported for consumption (mostly to Spain), while the rest of their catch and the total catch of Belgium, FRG, Norway, Denmark, Netherlands, Ireland (being less than 20 tonnes in total) is used for transplantation purposes (all countries) and aquaculture (mostly France). But these data are based on not very accurate estimates by national representatives.

3. Number and identity of stock

The present knowledge of the W.G. indicates the existence of only one breeding stock. All analyses on morphology, electrophoresis and coinciding recruitment indices confirm this statement. So until contradicting results appear the W.G. regards the East Atlantic, The Mediterranean and the Baltic populations to originate from the same

stock.

However, factors as: water temperature, food supply and salinity, influence the growth, biomass, time of silvering and other factors so much, that the management of the eels in its growing phase has to be separated in several management units.

In the propagation phase a stock wide management could be necessary. This is deferred to paragraph 5 below.

4. Available time series

4.1. Summary of time series

Table 4.1.a gives a summary of data available in the series from 14 management units, 8 being river catchments, 6 being countries indicating marine or freshwater. Data on glass eel catch extend back to 1924 in the case of the Loire but data on effort in this fishery extends only to 1977.

Catch by constant effort in Lough Neagh is obtainable since 1965. Yellow eel catch data in the IJsselmeer extend from 1945 to 1986 but no long series for effort are available. Silver eel catch by constant effort is known for Lough Neagh since 1960 and since 1930 for Sweden. There is therefore no possibility of comparing catch data between management units over a long period.

General inferences may, however, be drawn from data collected by the EIFAC Working Party on Eel and presented by MORIARTY (1987). Correlation between river catchments is not observed on a year by year basis and it appears that local hydrographic factors exert a considerable influence on the glass eel catch. Disregarding local variations, however, it appears that recruitment of glass eels during the period 1980 to 1986 has been substantially lower than in the previous decade.

4.2. Correlation of time series on elvers and on adults

Correlation between glass eel and adult abundance observations on the development of fisheries for grown eels in watercourses where stock enhancement by transport of glass eels has taken place have been published by LEOPOLD and MORIARTY (1982). These clearly show the expected result that increased glass eel supply brings about increased yields. No such correlations can be made using currently available data. The observation of low recruitment of glass eels since 1980 has not been matched by any observation on declining catches of grown eels, except for the IJsselmeer, where the drop in recruitment resulted in a decline in abundance of the youngest yearclasses in recent years (DEKKER, 1987).

4.3. Variations in eel abundance

4.3.1. Possibility of decline in production

The decline in production observed in some of the available time series (4.1) are confirmed by data collected by the EIFAC W.G. on Eel

(MORIARTY, 1987).

Other indices of immigration to river systems demonstrate such a general trend both in areas with commercial fisheries (GUEREAULT et al, 1986, GASCUEL, 1987) and in areas where glass eels are captured for transport (MORIARTY, 1986).

The observation that recruitment of glass eels has been low on the Atlantic coast north of Spain since 1980 may probably be accepted as a biological fact rather than a result of unquantified changes in fishing effort. In addition, strong indications of a serious decline in recruitment to the Baltic and adjacent areas, especially the Danish coastal waters, have been reported to the Working Group. Growth of the eel in northern Europe is so slow that except in the case of Denmark and Sweden, it is too early to confirm a decline in yield of grown eels caused by poor recruitment. The possibility remains, however, that recruitment though low is adequate.

The most prudent conclusion would be that a decline in recruitment may have taken place which could lead to a decline in production. It is therefore desirable to take steps to ensure that fluctuations in recruitment and yield may be measured in the future.

4.3.2. Possible causes of a decline

Poor recruitment of glass eels could be caused by a number of factors. The Working Group agreed that the following are plausible, even though none have been quantified:

- Incidence of the swim bladder nematode *Anguillicola* could debilitate spawning migrants.
- Pesticide or crude oil residues could reduce spawning ability.
- Pollution of the breeding ground could reduce survival of the larvae.
- Cyclical variations in ocean currents could cause variations in the numbers of glass eels reaching particular coastal regions.

Furthermore, many factors may influence production during continental phases of the eels life cycle. Several cases have been documented of extensive habitat alteration on an European scale;

- obstructions to migratory paths by damming (MORIARTY 1982);
- by pollution (NAISMITH, 1987);
- by power plants (BOIGONTIER, MOUNIE 1984);
- reduction in habitat quality (Anon, 1984) and
- area.

Overfishing on each stage of this species must also be considered (DEKKER, 1987).

On the other hand, sociological changes may result in reduced fishing effort and reduced yield. Such a development is taking place in the Lough Neagh fishery.

In addition to all these factors *Anguillicola* as a relatively new parasite might lead to stock deterioration in the near future.

Any or all of these factors could lead to a reduction of spawning stock. However, a number of factors could reduce their incidence. In particular four observations were cited.

- 1) In spite of an enormously increased capture of Japanese glass eels

in recent years, no reduction of supply has been reported. The inference is that spawning escapement remains adequate.

- 2) Many watercourses exist in Europe and North Africa where little or no fishing for glass eels or grown eels takes place. It seems likely to the Group that these rivers can sustain adequate potential spawning eels.
- 3) It is possible that, in the French and Iberian estuaries where major glass eel exploitation takes place, recruitment greatly exceeds the numbers of juveniles required to populate the inland waters.
- 4) Existing glass eel transportation may enhance the spawning stock by increasing survival from glass eel to adult.

5. Possible management strategies

5.1. Stock-wide management

The number of elvers immigrating the European river systems has declined. But the available data do not allow to state that:

- a) the decrease in glass-eel recruitment will continue
- b) the catch of grown eel show a corresponding decline
- c) the decrease in glass-eel recruitment originate from a decreasing number of spawners
- d) the decrease in silver eel catches is caused by overexploitation of glass-eels

Thus there are no biological reasons to enforce stock wide management strategies, except for striving towards more uniform regulations based on common biological sense.

The general advise perhaps may be to stock waters artificially where the natural immigrating of young eels is (or has become) too low or not existing.

5.2. Local management

Different from the previous section are advises and regulations for populations in catchment areas resp. water bodies which are based on regional aspects and knowledge and which cannot be replaced by supraregional responsibilities. This does not include common research methods or jointly operated management actions.

6. Parasites (and diseases)

Importing fish in general includes the risk of introducing new infectious diseases and parasites. In the case of eels live eels have been imported in the past from the Far East, from Australia and New Zealand and from North America. There are no reports about new infectious viral or bacterial diseases.

There are indications of the introduction of parasites of the "Dactylogyrus"-group (Pseudodactylogyrus) but there are no indications of impact on eel populations in the wild, however, under farming conditions "Dactylogyrus" is one of the major problems and chemical

control seems to work less efficiently than in the past.

With *Anguillicola* -a parasitic swim bladder nematode of *Anguilla* spp-a possibly dangerous parasite has entered Europe. Three species are known, two in the Far East (*A. globiceps* and *A. crassa*) and one in Australia-New Zealand (*A. australiensis*) Import of live eels from those regions has occurred since mid 1970, and although these imports have not been checked, there can be no doubt that these eels from regions, where *Anguillicola* is indigenous have carried the parasite. So there is no need to consider unlikely alternative vectors, such as non-anguillid species. Three species of *Anguillicola* have been reported in Europe.

No data are available about the single species distribution.

Anguillicola as a genus (or family) has spread in the meantime over nearly all of western and central Europe (samples from Portugal, Ireland, Greece, Turkey, Sweden were parasite free, which must not mean, that all water in those countries are free).

The parasite spreads on its own but the spread is considerably accelerated by transport of live eels inside Europe (young eels for stocking and live transport and storing of consumption eels). The percentage of eels infected and the number of parasites per infected eel has increased in recent years in several inland waters and infection rate of or near 100% are not uncommon in The Netherlands and in Germany.

Concerning artificial stocking of water, it can be expected that

- a) all stocking materials of eel fingerlings available will be infected (unless grown from glass eels under certain farming conditions).
- b) glass eels are likely to be parasite free
- c) glass eels from saline water are parasite free

No chance can be seen of getting rid of this new parasite and hardly any to stop further spreading (except for isolated areas like Ireland, because the parasite cannot propagate in saline waters).

Up till now there are no indications that this parasite causes any harm to inland water eel populations (although growth retardation or feed conversion reduction should be likely and are reported from Italy under farming conditions) There are however, reports of increased mortalities of infected eels during transport and storing.

If the swim bladder, however, has a major function for the ocean migration of mature (silver) eels, this parasite may become a danger for the eel stock in total.

7. Deficiencies in data, future work of the WG

It was realised by the WG that the currently available time series on eel are not nearly complete: many countries are missing, and available time series are not very comparable in detail (see sections 2 and 4.1).

Available time series do suggest declines of abundances in certain areas (Baltic, and glass eels throughout Europe) but the magnitude and importance of these cannot be judged.

Thus, a more thorough search for available data scattered over administrative units seems appropriate.

This should comprise at least:

- data with reference to the year 1985, or otherwise, as close to it as possible
 - data divided according to management units
 - stocking densities, natural or artificial
 - number of licences or units of gear or persons involved
 - resulting catch volume, classified according to life stages of the eel
- Comparison of the results of this survey over longer time periods (e.g. 10 years) may provide a firm basis for future stockwide management actions.

But it was realised, that the current WG will not be able to effectively conduct such a survey, because

- only a small number of the countries having eel fisheries are represented in the WG
- the WG is not able to enforce such a survey by national representatives especially in view of the amount of work involved in gathering information from many administrative bodies

Thus, a survey by a central agency is recommended.

7.1. Growing phase

Since the growing phase of the eels life is usually confined within national waters, the establishment of an international database aiming to completeness is redundant.

However, it is realised that national surveys (on a catchment area basis) are of prime interest for the rational exploitation of eel populations. On the international level, the joint development of management evaluation methods is urgently needed, while on the national level governments should be encouraged to enhance the monitoring of their eel populations and fisheries.

Thus, it is recommended that this WG will, in future meetings, consider the application of available methods, like stock-production-methods and length-based-methods to a number of case studies on natural fisheries, and consider the adaptations needed in view of the peculiarities of the biology of the eel.

7.2. Propagation phase

7.2.1. Glass eels

In view of the large number of national surveys for glass eels (section 4.1.), the WG decided that the establishment of additional surveys is, at this moment, not the most urgent need.

However, problems exist in the evaluation of the various time series, notably the nature of the relationship between catch and abundance and the relationship between abundance and flow-through of glass eels. Thus, coordinated (rather than jointly operated) research is clearly needed; future meetings of this WG may concentrate on this.

7.2.2. Silver eels

The number of time series on silver eels is very small (section 4.1.) and, as far as this WG could judge, not at all representative for the

whole distribution area of the European eel. Additionally, there are documented case studies showing that neither commercial nor research catches quantitatively reflect silver eel abundance or escapement, separate factors like weather and moon phase having a large, but yet not quantified effect (Lindroth, 1979; Renström, 1979). Therefore, the establishment of a stockwide quantitative spawning stock biomass index is not at all likely. This inhibits any study on the spawning stock-recruitment relationship. In the foreseeable future, local work on the effect of stocking densities on population characteristics, (with particular reference to sex ratios) and on the correct monitoring of silvreeel escapement should be given high priority.

8. Recommendations

It is recommended that:

- 1- international statistics on eel fisheries (Bulletin Statistique, FAO Statistical Yearbook) should be classified by life stages, giving glass eels and grown eels (yellow eel + silver eel) seperately.
- 2- future meetings of the ICES-eel-assessment WG will be attended by representatives of all member countries within the distribution area of the eel, and that the Council invites non-member countries within that area to these meetings.
- 3- an international inquiry for data on eel fisheries will be organized, to assemble all data available on the regional administrative level. To evaluate any assumed changes in the fisheries, this inquiry should be repeated after ten years.
- 4- the application and, if necessary, adaptation of quantitative assessment methods to data on the growing phase of eel populations within single management units be studied by a further meeting of this WG (stock-production methods, time series analysis, length based methods)
- 5- national studies on glasseel immigration and monitoring be encouraged, and a future meeting of this WG study the joint analysis of multiple (national) time series together.
- 6- national agencies are encouraged to undertake studies to assess the magnitude of amateur fishing on eel.
- 7- an international study of infection of European eel by *Anguillicola* spp. is undertaken with particular reference to:
 - a) distribution and abundance of *Anguillicola*
 - b) impact on yield and spawner production
 - c) impact on gonad development

9. Literature

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Table 2.a Catch of glaseels and grown eels estimated from data available to the WG and compared to official data.

| country | glaseel | grown eel inland | grown eel Atlantic | grown eel Baltic | grown eel Mediterranean | grown eel total | eel total total | FAO statistics |
|-------------------------|---------|---------------------|-----------------------|---------------------|----------------------------|--------------------|--------------------|----------------|
| Norway | - | - | 350 | - | - | 3509 | 350 | 346 |
| Sweden | - | >31 | 240 | 850 | - | 1121 | 1121 | 1335 |
| Finland | - | 2 | - | 1 | - | 3 | 3 | 38 |
| Denmark | + | 136 | 311 | 1785 | - | 2231 | 2232 | 2192 |
| FRG | + | >1000 | 176 | 72 | - | 1248 | 1248 | 307 |
| Netherlands | + | 1900 | 250 | - | - | 2150 | 2150 | 1094 |
| Belgium | - | + | + | - | - | - | + | - |
| Ireland | 7 | 856 | - | - | - | 856 | 863 | 962 |
| France | 500 | >1000 | 475 | - | 2000 | 3475 | 3975 | 1483 |
| Portugal | 350 | - | 1000 | - | - | 1000 | 1350 | 20 |
| represented in total | 857 | 4925 | 2802 | 2708 | 2000 | 12435 | 13292 | 7777 |
| not repre- sented | | | | | | | | 5612 |
| grand total | | | | | | | | 13389 |

Notes: -grown eels include yellow eel and silver eel
 -FAO statistics give encrease catch of 1981, all life stages included
 -this table includes exactly known statistics as well as rough guesses

Table 2.b Presence of different classes of fishing gear in participating countries
 on a semi-quantitative scale.
 (- absent, + present, * important)

| country | area | Glasseels | fixed gears | movable | longline | trawl | angling | fixed gears | movable | trawl |
|-------------|-----------|-----------|----------------|---------|----------|-------|---------|----------------|---------|-------|
| Norway | marine | - | - | - | - | - | - | - | - | - |
| Denmark | inland | - | * | + | + | - | + | * | * | - |
| | Baltic | - | * | * | + | * | + | + | * | + |
| | North Sea | - | * | * | + | + | + | + | * | + |
| F.R.G. | inland | + | * | + | + | + | * | + | - | - |
| | Baltic | - | + | + | - | - | + | - | + | - |
| | North Sea | - | + | - | - | * | + | - | - | - |
| Netherlands | inland | - | * | * | + | - | * | + | * | - |
| | marine | + | + | - | - | + | + | - | + | * |
| Ireland | inland | + | * | - | * | - | - | * | - | - |
| | marine | - | + | - | - | - | - | - | - | - |
| France | inland | - | * | - | + | - | * | * | + | - |
| | Atlantic | * | + | + | - | + | * | + | - | - |
| | Mediterr. | - | * | - | - | - | + | + | - | - |

Table 4.1. a Summary of time series on eel populations available to the working group.

| country | area | prod. tonnes | landings data | | sampling data | | effort data | | years |
|-------------|------------|--------------|---------------|------|---------------|------|-------------|------|-------|
| | | | first | last | first | last | first | last | |
| ----- | | | | | | | | | |
| Glasseel | | | | | | | | | |
| Norway | Imsa | 0 | 1975 | ctd | 1984 | ctd | 1975 | ctd | |
| Denmark | | 1 | 1971 | ctd | 1984 | ctd | - | - | |
| FRG | Ems | 6 | 1960 | ctd | - | - | - | - | |
| Netherlands | IJsselmeer | 1 | 1955 | ctd | 1970 | ctd | 1955 | ctd | |
| Ireland | Shannon | 2 | 1977 | ctd | - | - | 1977 | ctd | |
| | L. Neagh | 5 | 1965 | ctd | - | - | 1965 | ctd | |
| France | Vilaine | 45 | 1972 | ctd | 1975 | 1985 | 1977 | ctd | |
| | Loire | 125 | 1924 | ctd | 1976 | 1981 | 1977 | ctd | |
| | Sevre N | 27 | 1962 | 1983 | 1981 | 1984 | 1962 | 1983 | |
| | Somme | 1 | 1980 | ctd | - | - | 1980 | ctd | |
| Yellow eel | | | | | | | | | |
| Norway | Imsa | 2 | 1975 | ctd | 1980 | ctd | 1975 | ctd | |
| Sweden | Baltic | 850 | - | - | 1977 | 1982 | - | - | |
| | Marlaren | 20 | - | - | 1982 | ctd | - | - | |
| | Hjalmar | 11 | - | - | 1982 | ctd | - | - | |
| Finland | | 2 | 1978 | 1984 | - | - | - | - | |
| Denmark | | 1500 | 1908 | ctd | occasionally | - | - | - | |
| FRG | | 400 | - | - | occasionally | - | - | - | |
| Netherlands | IJsselmeer | 750 | 1945 | ctd | 1970 | ctd | - | - | |
| | marine | 250 | - | - | 1970 | ctd | - | - | |
| | fresh | 750 | - | - | 1970 | ctd | - | - | |
| Ireland | Shannon | 6 | 1984 | ctd | 1969 | ctd | 1984 | ctd | |
| | L. Neagh | 600 | 1960 | ctd | 1985 | ctd | ? | ctd | |
| France | Blavet | 5 | 1983 | ctd | 1983 | ctd | 1983 | ctd | |
| | Loire | 40 | 1977 | ctd | - | - | - | - | |
| Silver eel | | | | | | | | | |
| Denmark | | 400 | 1908 | ctd | occasionally | - | - | - | |
| FRG | | 400 | - | - | occasionally | - | - | - | |
| Netherlands | IJsselmeer | 150 | 1955 | 1970 | 1970 | ctd | - | - | |
| | marine | * | - | - | 1970 | ctd | - | - | |
| | fresh | 250 | - | - | 1970 | ctd | - | - | |
| Ireland | Shannon | 50 | 1969 | ctd | 1978 | ctd | 1969 | ctd | |
| | L. Neagh | 200 | 1960 | ctd | - | - | 1960 | ctd | |

