International Council for the
Exploration of the Sea

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REPORT OF THE JOINT EIFAC/ICES WORKING GROUP ON EEL

Oviedo, Spain, 26 September–1 October 1994

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A Joint EIFAC/ICES Working Group on Eel was established in 1993 and held its first meeting from 26 September–1 October 1994 in Oviedo, Spain. Dr C. Moriarty (Ireland) chaired the meeting which considered the terms of reference set by the ICES Council at its 81st Statutory Meeting in 1993, as follows:

C.Res.1993/2:60 A Joint EIFAC/ICES Working Group on Eel will be established under the chairmanship of Dr C. Moriary (Ireland), with membership to include the EIFAC Working Party on Eel and appropriate ICES experts, and will meet for 5 days either in Spain in September 1994 or in the Netherlands in May 1995 at national expense to:

a) gather information on the stock of eel;

b) prepare case studies relating to the biology and management of eel and faciliate their publicaton;

c) prepare reviews of specified topics in eel biology and management with a view to making recommendations for cooperative research;

d) consider the reasons for the reduced catches of young eel in European and American rivers.

The report of this meeting, published in 1994 by the European Inland Fisheries Advisory Commission (EIFAC) as EIFAC Occasional Paper No. 30, is attached.

EUROPEAN INLAND FISHERIES ADVISORY COMMISSION
INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA

REPORT OF THE 1994 SESSION OF THE EIFAC/ICES WORKING GROUP ON EEL

Oviedo, Spain, 26 September - 1 October 1994

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
EUROPEAN INLAND FISHERIES ADVISORY COMMISSION
Rome, 1994

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PREPARATION OF THIS REPORT

This report summarizes the discussion, conclusions and recommendations of the 1994 Session of the EIFAC/ICES Working Group on Eel held in Oviedo, Spain, 26 September to 1 October 1994.

European Inland Fisheries Advisory Commission.
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ABSTRACT

The 1994 Session of the re-appointed EIFAC/ICES Working Group on Eel took place from 26 September to 1 October 1994 in Oviedo, Spain in conjunction with the VIII Congress of Societas Europaea Ichthyologorum. The Session was attended by 40 participants, of which 34 were from EIFAC or ICES member countries, three from Sri Lanka, and one each from Hong Kong, New Zealand and Republic of China. Papers and posters were contributed under the following headings (numbers in parentheses): Larval and elver studies (13); Continental stages: population and fisheries (9); Continental stages: growth and feeding (4); Continental stages: migration (3); Physiology, genetics and culture (10); Parasites and contamination (4). The cooperative programme on growth had received 100 case studies from 10 countries which will be incorporated in a database. Ten countries had provided preserved specimens for a glass eel bank being maintained in Ireland.

The Working Group has noted the persistence of low catches of elvers over a wide area of the European continent and, incidentally, reports of poor recruitment of other species of *Anguilla* in the Indian and Pacific Oceans. It has put forward recommendations that urgent attention, in the form of enhanced research effort, be given to the possible effects of this on stocks and fisheries.

Distribution

ICES
Participants to the Working Party
FAO Fisheries Department
FAO Regional Fishery Officers
EIFAC Mailing List

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I. INTRODUCTION

1. The 1994 Session of the ICES/EIFAC Eel Working Group took place from 26th September to 1 October 1994 in Oviedo, Spain. It was held in conjunction with the VIII Congress of Societas Europaea Ichthyologorum on *Fishes and their Environment*.

2. Christopher Moriarty, Chairman of the Working Party, welcomed the participants (see Annex B) in the company of the organizer of the Congress, Dr. Javier Lobon-Cervia. He had been especially pleased to record the participation of scientists from Hong Kong, New Zealand, Sri Lanka and Taiwan whose work provided information of six additional species of *Anguilla*, some of which had received little attention by research workers, but whose comparative study in both oceanic and continental phases is of importance to a better understanding of the European eel.

3. Moriarty gave apologies from a number of members who were unable to attend and noted in particular the retirement of Professor Giuseppe Colombo who had given long and valued service to the Working Party and had hosted its Session in Ferrara, Italy in 1981.

4. The Agenda (Annex A) was adopted.

5. Julian Reynolds was appointed Rapporteur and was assisted by Richard Donnelly and Brian Knights.

II. REPORT BY CHAIRMAN ON INTERSESSIONAL MATTERS

6. Moriarty announced that the 81st Statutory Meeting of ICES, held in Dublin in 1993, had agreed to the proposal of EIFAC that a joint Working Group on Eel be re-established and had approved its terms of reference. This proposal was adopted by the Eighteenth Session of EIFAC held in Rome, Italy from 17 to 24 May 1994. Moriarty had been appointed Chairman of the new Working Group and Willem Dekker, Chairman of the former ICES Working Group on Eel, had been appointed Vice-Chairman. The terms of reference were read to the Working Group and adopted by it (Annex B).

7. During the intersessional period the following had occurred:

(i) The selected papers from the Seventh Session had been published as *Irish Fisheries Investigations* Series A No. 36 and had been circulated to all authors. Copies were available from Moriarty on request.

(ii) Selected papers from the Eighth Session had been accepted for publication in *Archiwum Rybactwa Polskiego*.

(iii) The Cooperative Groups on Eel Recruitment, on Growth and on Contaminants had reported progress and these issues would be covered in the current Session.

III. LARVAL AND ELVER STUDIES

8. White presented information on recruitment of Severn eels, compiled from direct and indirect sources. Recruitment has declined by 50% over the past 15 years. Oceanic factors are possibly implicated: known changes in position and strength of the Gulf Stream

may affect breeding and larval survival and migration. Tesch commented that the Gulf Stream may not be the major transport mechanism.

9. A model for seasonal variation in glass eels was presented by Desaunay for Guerault, based on two years' study. A sample of 140 otoliths of type 3, examined under SEM, indicated some days before start of feeding, 182 days leptocephalus, 85 days glass eel making a total larval life of about 9 months. Larger, winter-caught glass eels (71 mm), would spend the leptocephalus stage in summer and the glass eel starvation stage in autumn, while those hatching in autumn would be leptocephali in spring to summer. They would be caught in autumn at a mean length of 68 mm. Data for the 1920s catches in the Bay of Biscay indicated longer and heavier glass eel than are caught today, suggesting long term, perhaps oceanic, variation. Jellyman suggested that some glass eels may be unable to enter river mouths due to drought, and suffer physiological stress at that time.

10. Lara described glass eel fisheries in the Nalan estuary, NW Spain. Since the increased popularity of these for consumption in the 1960s, the fishing had intensified. Catches were greatest in the 1970s, declining after 1980 to a low of 7 t in 1990. The decline is attributed to poor recruitment. as prices have remained high (max £150 or 30 000 pesetas per kg at Christmas). Tzeng had noted similar peaks in 1977 in Pacific eels, indicating that global factors may be involved. Desaunay stressed the unique scientific importance of eels for studies of global environmental change.

11. Tesch presented material on eel larval captures on his latest cruise of autumn 1991. Captures of 2.8 to 3.25 larvae per towing hour showed younger larvae predominating off Portugal and older, longer ones in the Bay of Biscay, contrary to the hypothesis of transport by the Gulf Stream. He stressed the importance of continuing such cruises.

In response to a suggestion by Moriarty that the Working Group recommended to ICES that Directors of Scientific cruises should be informed of our requirements, Tesch stressed the need for an experienced specialist on eel larvae to take part in such cruises. He mentioned that Strehlow was suitably qualified.

12. Reynolds described the development of a pilot glass eel fishery for the River Shannon in Ireland, to supplement dwindling elver catches for restocking. Glass eels were present only from January to May, with peak catches February to April, depending on water discharges. 'Robust' and 'gracile' forms were described for samples, the changing proportions of each over time contributing to different sample characteristics.

13. Tesch and Antunes described SEM otolith studies and discussed the problem of quantifying the diffuse zone in larval eel otoliths. Leptocephali never occur on the continental shelf, while glass eels have been found outside it. The duration of metamorphosis is very variable. Desaunay said he believed metamorphosis to be protracted and should be considered as being complete at the start of feeding by the glass eel. Faster transformation may lead to enhanced survival.

14. Lecomte-Finiger gave details of elver otolith SEM studies which indicated egg, leptocephalus, metamorphosis, transition and marginal growth zones. Ontogenetic change is indicated at the end of the leptocephalus daily growth pattern; the glass eel gut is not functional until later. The transition double check suggests physiological or environmental stress. Degree of pigmentation does not always correlate with otolith age history. While the larva may decrease in length, the otolith still continues to grow.

15. Moriarty summarized the present situation with regard to elver supply in Europe from Sweden to Portugal. High catches in the 1970s had been followed by low catches in the 1980s. Statistical tests had indicated significant correlation between rivers. Long-term reductions in catches have been observed in the Baltic and North Sea rivers. There was an indication of an upward change in 1994, including a notable increase to a catch of 90 t in the Loire. For the first time in this regular report, data from the River Severn, UK and the St. Lawrence River, Canada were incorporated. The Canadian data showed an increase for 1994 of juvenile eels mainly from the 1990 glass eel immigration. The improvements in 1994, however, could not be taken as evidence of a reversal of the downward trend. The weight of evidence appeared to favour the hypothesis that the decline in catch had been caused by oceanic rather than anthropogenic effects. It was strongly emphasized, however that, despite the inability to control ocean-based problems, there was scope for significant improvements in the management of recruitment.

16. Svedäng demonstrated that active density dependent migration of eels from Kattegat/Skagerrak into the Baltic was less important than supposed. Unlike the west coasts, Baltic populations had proved to be dominated by one year class.

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17. Budimawan (presented by Lecomte-Finiger) showed daily growth increments and age at recruitment of *A. marmorata* glass eels in four Asian estuaries.

18. Rui Bessa demonstrated the annual changes in the length, weight and width of glass eels caught throughout the year from May 1991 to May 1994 from the Liz river in Portugal.

19. Strehlow illustrated the second and largest known specimen of the very rare congrid larva *Leptocephalus pseudomicrocephalus* from the northeast Atlantic. The specimen measured 467 mm and characteristics include high number of myomeres and short anal and dorsal fins.

20. Walsh presented SEM otolith studies of glass eel from the Shannon Estuary, Ireland. Diet studies indicated that stomach fullness and prey item diversity increase through the glass eel season.

21. Williamson presented in poster form (i) a request that the Working Group consider a quarterly central Atlantic transect, from the Grand Banks to 30°N 40°W, to investigate oceanic movements and (ii) a proposal for nomenclature of the life stages of the eel.

IV. CONTINENTAL STAGES: POPULATION AND FISHERIES

22. Jellyman described growth rates of *Anguilla australis* and *A. dieffenbachii* in New Zealand fresh waters. Length at given age shows wide variation within and between populations, with growth rates averaging 2 to 3 cm per year in the wild, but more rapid in culture. Generation times are 25 and 40 years respectively for females of the two species, necessitating conservative management policies such as upper size limits. Ages of at least 90 years had been observed. With densities in the wild up to 1 000 kg per ha, growth may be suppressed by availability of food and interference competition.

23. Chan commented on differences in growth rates between wild and cultured eel and asked whether slow growth in culture is of behavioural or genetic origin. The problem of sex determination was aired by several speakers, including Boetius and Knights. Gelin commented on the potential of old eels for bioaccumulation.

24. Lobon-Cervia discussed longitudinal variations in population dynamics in a Cantabrian river. Eels were small, short-lived and about 99% were male and sex ratio appeared to be independent of density. Mean size increased with distance from the river mouth. Seasonal catch variations were related to temperature and activity.

25. Moriarty described a long-term study, begun in 1981, of the eel population in a small section of Lough Derg in Ireland. Numbers caught by constant effort showed expected variation between winter and summer and an unexpected low catch at midsummer. Variation between years correlated with total degree days from January to the end of May. The results confirmed the need for very long term observations in interpreting eel population material.

26. Cumaranatunga presented biological details for *A. nebulosa* and *A. bicolor* in sympatry and allopatry. The former was less tolerant of low oxygen than the latter, which was the dominant species in lagoons and reservoirs.

27. McCarthy summarized an external report on natural recruitment, fishery yields and current management in Ireland. Lack of adequate data has precluded accurate assessments but, for example, modelling the lough Neagh/River Bann system has allowed calculation of target elver restocking densities for the four major catchments.

28. Various management systems to enhance stocks (glass eel/elver translocation, facilitating upstream migration) were discussed and the need for a comprehensive large scale management plan noted.

29. Data from a study of two Swedish lakes stocked with elvers in 1980 were presented by Wickström. Recapture rates were about 11% (mainly migrating silver eel) in one lake, compared to only 1.7% (mainly fyke-netted yellow eel) in the other. Positive economic returns were achieved in the former within 10 to 11 years, profitability being strongly dependent on ecological productivity and growth rates and returns from male and female silver eel catches. Such long-term studies are essential in validating biological and economic bases for stocking and commercial exploitation.

30. Boëtius outlined studies over three seasons with different mesh sizes in fyke nets. The percentage of undersized eels ranged between 56 and 69, but did not differ significantly between nets; thus, despite an increase from 12 to 18 mm meshes, small eels were still retained. She proposed that small eels might be more effectively excluded by the use of a larger mesh size in the leader.

31. Donnelly presented past data analysis of records of silver eel catches and elver stockings in the River Shannon in Ireland dating back to 1938 and 1959 respectively. Using regression analyses a return after 15 years of 2.9% was found for the lower catchment and a return of 0.4% in the upper catchment after 11 years. The value of such analyses was discussed, with reference to the varying quality of the data sets.

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32. Hegedis described a number of short (3-4 km) streams on the south Adriatic coast of Montenegro, all of which held populations of eel. Their size distribution depended mainly on the characteristics of the bottom and the macrophytic vegetation. All life stages were observed, glass eel in March and silver eel migration beginning in October and November.

V. CONTINENTAL STAGES: GROWTH AND FEEDING

33. Reynolds presented Poole's growth data for an unexploited population of slow-growing eels in Ireland. Mark-recapture and otolithometry both indicated growth rates of 1-2 cm per year, with much individual variation. Growth was usually fastest in the first year.

34. McCarthy described feeding of eels in a lowland Irish river system: feeding was significantly affected by temperature. *Simulium* was eaten mainly by smaller eels and *Gammarus* by larger. Klein Breteler recommended a bio-energetic approach to such food studies and commented on the low growth rates observed despite apparent availability of food.

35. Lara presented data on feeding of eels in a Spanish river. Despite fears among sport fishermen, there was little dietary overlap with salmonids. Fish were rare as prey, despite the importance of the streams as salmonid nurseries. Several participants commented that removal of eel was not desirable in the enhancement of sport fisheries, and that different feeding strategies allow co-existence.

36. Klein Breteler compared relative survival and growth performance of eels of different provenance in drainable 0.2 ha mesocosm ponds in the Netherlands. Yield per recruit was higher for stockings of Portuguese glass eels, than for stockings of English. Growing-on Portuguese glass eels and stocking them post-winter did not significantly shorten the time taken to reach a certain size.

VI. CONTINENTAL STAGES: MIGRATION

37. Cullen analyzed variations in silver eel catch on the River Shannon at Killaloe in Ireland. Lights inhibited catches; daytime catches were negligible and yellow eels were only very rarely seen. Water flow had important influence on catches. Wickström commented on the occasional females of exceptional size and suggested that their growth and silvering strategies may differ from the normal.

38. Knights reviewed information on design and validation of the efficacy of passes for juvenile eels. He stressed the need for careful design, incorporating suitable flow rates and for the use of rubble or other appropriate substrate at entrance and exit.

39. White presented results of a 3 year study of migration (using traps on migration barriers) in the Severn and Avon rivers in England. Elver catches at the tidal head were $<0.1\%$ of the commercial glass eel catch, but natural mortality was thought to be a major factor. Numbers of migrants trapped decreased, but size and age increased with the

number of migration barriers. Migratory tendencies of individuals were very variable and maximum migrations correlated with temperatures > 16°C. The use of eel passes and stocking was endorsed.

VII. PHYSIOLOGY, GENETICS AND CULTURE

40. Strontium and calcium levels in Japanese eel otoliths were described by Tzeng. Incorporation rates reflect the environment and changes in microchemistry are seen during migration from ocean to fresh water. In discussion, it was noted that the Japanese elvers move more rapidly into fresh water than does *A. anguilla* which may move between fresh and saline environments more than once.

41. Studies of body composition of *A. bicolor* and *A. nebulosa* in Sri Lanka presented by Ranawickrama showed gonadosomatic indices were strongly correlated with body length. The high protein content emphasized the value of both species as a food source. It was noted in discussion that the fat contents of yellow eels were too low for smoking.

42 Vithanage showed that weight and length of otoliths of *A. bicolor* and *A. nebulosa* increased linearly with body length of yellow eels. The nucleus, glass eel region and a number of fine rings were discernible under light microscopy.

43. Eel farmers in the Far East (as in Europe) often claim there are variations in performance of glass eels caught at different times and locations. A north-south cline of isozyme genotypes of *A. japonica* was found by Chan *et al.*, possibly relating to differences in distances between spawning grounds and capture sites. Genetic variations were, however, not statistically significant. In discussion, reference was made to studies which suggested that there were no differences between Irish and Italian *A. anguilla*.

44. PCR amplification and RFLP studies of 5S ribosomal DNA of *A. anguilla* were reported by Martinez. He recommended appropriate DNA markers for future population/ gene mapping studies.

45. Peters presented Verhijen and Flight's paper on commercial methods of slaughter. Salting, icing and spinal transection do not render eels brain-dead and the application of methods of humane killing should be considered. A video of the experiment was shown.

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46. Tagliavini analysed genetic variability of cytochrome by sequences, using PCR techniques and showed that comparisons of eel from within Italy gave little evidence of variability while samples of *A. rostrata* were clearly distinct, supporting the theory of the existence of two species.

47. Gelin's poster giving estimates of production of eel by intensive culture in Europe led to the recording of additional information (Annex D). Over 6 000 t are produced, requiring an estimated 15 to 20 t of glass eel.

48. Appelbaum presented information on sex ratios among eels raised in culture. Morphometric parameters could be used to distinguish the sexes, in particular head length and body shape.

49. Hegedis described the effects of food deprivation and feeding on different sizes of eel fed with different levels of protein on ammonia production and oxygen uptake.

VIII. PARASITES AND CONTAMINATION

50. Knights reviewed recent studies of eel contamination by organochlorine compounds and heavy metals (biomonitoring, pathology/toxicity and planned/ongoing). Particularly pertinent long-term biomonitoring data sets have indicated falls in OCs in the Rhine and Meuse. PCB levels have been more stable and data provide evidence of pollution 'hot spots'. Members were requested to provide information for future reviews.

51. Biomonitoring studies of PCBs in eel as indicators of pollution in a Finnish lake (due to a papermill discharge between 1956 and 1984) were presented by Tulonen. Concentrations decrease downstream and have been diminishing with time, but levels in some eels have exceeded statutory levels for human consumption. Future eel stockings and exploitation might depend on future trends in PCB contamination.

52. Hahlbeck showed that the prevalence of infection of eel swimbladders by *Anguillicola crassus* on the German Baltic coasts and some inland waters had decreased between 1991 and 1993. Infestation rates varied between 16 to 97%, tending to be lower in outer coastal waters. Although data - and discussions - did not provide any conclusive evidence of deleterious effects on eel stocks and breeding migration, further monitoring was recommended.

53. Holmgren showed that experimental rearing of individually marked elvers produced more females (14%) at 26°C, compared to 7 to 8% females at 17° and 20°C. Rapid initial growth characterized males rather than females. She stressed how several factors might confound an interpretation that the temperature effect on the sex ratios really reflects the effect of temperature on sex determination.

IX. COOPERATIVE STUDIES

PROGRAMME ON GROWTH

54. A discussion was led by Klein Breteler on progress made by the group since its last meeting in Olsztyn. An agreed questionnaire had been circulated, to which 18 replies had been received, contributing details of over 100 case studies from 10 countries. The lack of southern European data was noted with regret.

55. It was agreed that the questionnaire survey be continued, with a second call for data, and an appropriate clarification of the status of the dataset as a publication would be considered. Categories for marine and brackish-water eels should be included in the questionnaire, together with space for a measure of abundance or cpue. The convener of the group, Guy Fontenelle, would be requested to decide on the extent of circulation of the database desirable during the inter-sessional. The meeting thanked Klein Breteler for his work in collecting the data in the absence of Fontenelle.

BANK OF PRESERVED GLASS EELS

56. Donnelly, convener of the group, had provided a poster describing its achievements. He conducted a discussion on the work. Nine Atlantic European countries and Morocco

had responded promptly to the request of material (Annex F). This is now held at Trinity College, University of Dublin to be made available for research workers. The exercise would be repeated in 1994-95. Reynolds agreed to circulate statistics on the holdings to donors. It was noted that members from Asian countries and New Zealand would be willing to contribute material to the bank and some of them would be interested in using the European specimens. Tesch suggested that leptocephalus material might be available from the Helgoland Marine Institute.

57. It was agreed that: (i) all requests for material from the Bank should be directed through the Chairman of the Working Group; and (ii) arrangements be made to deposit a small sub-sample of all material in a national museum.

X. EEL RECRUITMENT AND STOCKS

58. A discussion was led by Boëtius and covered a wide range.

59. Anecdotal data for the River Severn suggested long-term fluctuations which might be similar to those observed in recent times. Catches had been good in the 1890s and poor in the 1930s. The Loire showed a similar low level in the 1930s. The fact that many hundreds of tonnes of glass eels have been caught in the Loire in good seasons suggested that natural mortality could be extremely high.

60. The Baltic had never had a large immigration at the glass eel stage, being supplied largely by juvenile eels. Ascending eel in Finland are of average length 35 cm. Due to a number of factors, including the building of hydro dams, stocking is now needed to maintain the populations. Rates up to 1 000 individuals per ha per year have been quoted for Sweden. Density-dependent mortalities were not observed by Klein Breteler below a rate of 1 500 glass eel per hectare. Sweden restricts importation of glass eel to the River Severn because of disease risk from other sources.

61. A problem exists because the effects of depletion of stock may not be appreciable until a period of 5 to 10 years has elapsed from the beginning of a period of poor recruitment. Many views on the need for action were aired, but it was agreed that there is no sound scientific basis for recommending curtailment of fishing for any life stage. Notwithstanding the lack of hard evidence, the current decline in glass eel catch could not be ignored. It was necessary to continue to draw the attention of Governments to the situation. There was full agreement that further research is urgently needed and that the methodology for more effective distribution of the existing stocks was well established. It was either in preparation or in action in particular countries.

XI. POPULATION AND MANAGEMENT

62. During a discussion led by Wickström, attention was drawn to the findings by Westin that silver eels originating from stocked translocated elvers did not show normal migration patterns out of the Baltic compared with wild stocks. The implications are that such translocated eel may not add to the spawning stock.

XII. OTHER MATTERS

63. Wickström and Klein Breteler drew attention to the probability that one or more of the Indo-Pacific species of *Anguilla* have breeding grounds relatively close to the coast.

The meeting agreed that the identification of such breeding grounds could provide an extremely valuable source of information on the early development of the other members of the genus. It could yield, at relatively low cost, data of great practical importance which cannot be sought at present because of the high cost of Sargasso Sea investigations. Wickström and Klein Breteler were requested to present a more detailed proposal to the next Session.

XIII. RECOMMENDATIONS

64. Considering the evidence of continuing low catches of elvers over a wide area of the European continent, the joint EIFAC/ICES Working Group on Eels recommended:

(i) That urgent attention be given to making an assessment of trends in recruitment, contamination, parasitic infestation and fisheries and their effects on stock and yield of the species.

(ii) That a special meeting at the next Session be held jointly with oceanographers to consider oceanic factors which might explain recently recorded changes in the abundance of larvae and of catches of glass eel.

(iii) That member Governments of ICES and EIFAC take steps to ensure that all existing collections of eel catch statistics be maintained and that efforts be made to enhance their quality and scope. In particular, it is highly desirable that national statistics identify the quantities of the major life stages.

(iv) That larval cruises by research vessel, such as those established by Tesch in 1977 and discontinued in 1992, be resumed with the involvement of personnel adequately qualified in the sampling and handling of the leptocephalus.

The Working Group proposes that these Recommendations be adopted by the Nineteenth Session of EIFAC and by the Third Statutory Meeting of ICES.

XIII. DATE AND PLACE OF NEXT MEETING

55. It was decided that the period of two and a half years needed to return the sequence of meetings to its usual date of May in alternative years was undesirably long. Therefore the next meeting should be held in June 1996, shortly after the EIFAC Session. Willem Dekker, Vice-chairman of the Working Party would be asked to host the next session at the laboratory to RIVO, IJmuiden, Netherlands. Should he be unable to do so, a decision on location would be taken by the Chairman and Vice-Chairman.

ANNEX A

AGENDA

1. Opening of the Meeting
2. Adoption of the Agenda
3. Appointment of the Rapporteur
4. Report by the Chairman on inter-sessional matters
5. Larval and elver studies
6. Continental stages: population and fisheries
7. Continental stages: growth and feeding
8. Continental stages: migration
9. Physiology, genetics and culture
10. Parasites and contamination
11. Co-operative studies
12. Eel recruitment and stocks
13. Population and management
14. Other matters
15. Recommendations
16. Date and place of next meeting
17. Adoption of the report.

ANNEX B

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ANNEX C

LIST OF PAPERS PRESENTED AND POSTERS EXHIBITED

LARVAL AND ELVER STUDIES

White, E & B, Knights : Factors affecting the recruitment of eels in the rivers Severn and Avon, England.

Guerault, D. & Y. Desaunay : Biometry and otolithometry of *Anguilla anguilla* (L.) glass eels: towards a model for seasonal variation?

Lara, M . J.: Glass eel (*Anguilla anguilla* L.) statistics from the professional fishery in the Nalon Estuary (NW Spain).

Antunes, J. C. & Tesch, F-W.: Eel larvae (*Anguilla anguilla* L.) caught by R. B. "Heincke" at the European continental slope in the autumn of 1991.

Reynolds, J. D., Donnelly, R. & Walsh, T.: Biology and fisheries potential of glass eel in the Shannon Estuary, Ireland.

Antunes, J. C. & Tesch, F.-W.: Critical consideration of the so-called "metamorphosis zone" when identifying daily rings in the otoliths of glass eels and eel larvae (*Anguilla anguilla* L.)

Lecomte-Finiger, R: What can otolith microstructure tell us about events in the early life history of the European eel?

Moriarty, C.: Atlantic elver supply 1993-94.

Svedang, H.: Recruitment of eel *Anguilla anguilla* to the Baltic Sea.

Budimawan, M.: Daily growth increments and age at recruitment of *A. marmorata* glass eels in four estuaries: Poso (Indonesia), Tanshui and Shuang hsi (Taiwan) and Hamuta (Tahiti).

Rui Bessa, M. C.: Three years of biometric parameters of elvers from the Portuguese Liz river for aquaculture purposes.

Strehlow, B.: The second and largest record of a *Leptocephalus pseudomicrocephalus* in the Iberian basin.

Strehlow, B.: Investigations of enzymes of the digestive tract of leptocephali.

Walsh, T. & Reynolds, J.: Growth and feeding of Irish glass eels and elvers.

CONTINENTAL STAGES: POPULATION AND FISHERIES

Jellyman, D.: Growth rates of freshwater eels in New Zealand and implications for management of the commercial fishery.

Chan, I. K. K., Chan, D. K. O., Lee, S. C. & Tsukamoto, K.: Population genetic of the Japanese eel *Anguilla japonica*.

Lobon-Cervia, J., Utrilla, C. G. & Rioncon, P. A.: Longitudinal variations in the population dynamics of the European eel *Anguilla anguilla* (L.) in a Cantabrian river basin.

Moriarty, C.: Observations on the eel population of an Irish lake.

Cumaranatunga, P. R. T., Ranawickrama, A. S. K., Wickström, H. & Vithanage, C. V. S.: Distribution and recruitment of *Anguilla bicolor* and *Anguilla nebulosa* in the river systems of southern Sri Lanka .

McCarthy, T. K., O'Farrell, M. M. McGovern, P. & Duke, A.: Irish eel fisheries: current status and stock enhancement options.

Wickström, H. & Westin, L.: The biological and economical yield from a long-term eel stocking experiment.

Boëtius, I.: Changes in catch composition of eels *Anguilla anguilla* (L.) caught in fyke nets with different mesh size in the Holbaek inlet (Northern part of Sealand).

Donnelly, R. E. & Reynolds, J.D.: Past data analysis of elver stocking and silver eel catch in the Shannon catchment, Ireland.

Hegedis, A., B. Mickovic, M. Nikcevic, I. Damianovic and R. K. Andjus : A survey of eel habitats in inland waters along the south Adriatic coast.

CONTINENTAL STAGES: GROWTH AND FEEDING

Poole, W. R. & Reynolds, J. D.: Growth of yellow eels in western Ireland: A comparison between two methods.

McCarthy, T.K. & Callaghan, R. M.: The food and feeding activity of eel (*Anguilla anguilla* L.) in an Irish river system.

Lara, M. J.: Feeding of eels *Anguilla anguilla* (L.) in the Narcea basin (Asturias NW Spain).

Klein Breteler, J.: Stockings of pre-winter and post-winter glass eels and of elvers from aquaculture: growth and survival in mesocosms.

CONTINENTAL STAGES; MIGRATION

Cullen, P., McCarthy, T.K., O'Farrell, & O'Connor, W.: Some factors affecting the variation of silver eel *Anguilla anguilla* (L.) catches at the Killaloe eel weir, Ireland.

Knights, B. & White, E.: Review of passes for eels.

PHYSIOLOGY, GENETICS AND CULTURE

Tzeng, W. N.: Effects of ambient salinity and temperature on otolith strontium/calcium ratios of the eel, *Anguilla japonica*.

Ranawickrama, A. S. K., Cumaranatunga, P. R. T. & Wickström, H.: Changes in body constituents of *Anguilla bicolor* and *Anguilla nebulosa* during their development.

Vithanage, K. V. S., Cumaranatunga, P. R. T. & Wickström, H.: Relationship of size of *Anguilla bicolor* and *Anguilla nebulosa*; to the size of the otolith during their development.

Chan, I. K. K. , D. K. O. Chan, S. C. Lee and K. Tsukamoto.: Population genetics of the Japanese eel *Anguilla japonica*.

Martinez, J. M., Pendas, A., Moran, P. & Garcia Vazquez, E.: Chromosomal mapping and genetic variability of the 5 s and major ribosomal RNA genes in eel.

Verheijen, F. J. & Flight, W: Commerical slaughter of eel; experimental tests show methods are unacceptable.

Tagliavini, J., S. Salvadori, A. Cau, G. Gandolfi and A. M. Deina.: Cytochrome b sequences in the European eel *Anguilla anguilla* (L.).

Gelin, K. : Production of eel by intensive culture in Europe.

Appelbaum, S. Morphometric parameters distinguishing sex in cultured eel.

Hegedis, A., B. Mickovic, M. Nikcevic and R. K. Andjus : Feeding-induced metabolic changes in juvenile eels cultured in a warm-water recirculation system.

PARASITES AND CONTAMINATION

Knights, B: A review of pollutant contamination of eels, 1994.

Tulonen, J.: Concentration of PCB and other organic chlorine compounds in eels of the Vanajavesi watercourse in southern Finland in 1990-1993.

Hahlbeck, E.: Differences in occurrence of the nematode *Anguillicola crassus* in eels *Anguilla anguilla* (L.) from the Baltic Sea and adjacent coastal waters and freshwater of Germany.

Holmgren, K.: Influence of water temperature and growth hierarchy position on sex of experimentally reared eels.

PAPERS RECEIVED AS ABSTRACTS BUT NOT PRESENTED

Kangur, A. and K. Kangur: The diet of bream *Abramis brama* (L.) and eel *Anguilla anguilla* (L.) in relation to abundance of benthic organisms in Lake Vortsjärv (Estonia).

Nasar S. S. T.: Small-scale eel culture systems.

Petukhov, V. B.: Physiological bases of European eel artificial reproduction: current state and future prospects.

ANNEX D

THE STATUS OF INTENSIVE EEL CULTURE

Information compiled by Curt Gelin with assistance from Working Group members

	Number of farms	Estimated tonnage
Belgium	2	100
Denmark	30	1000
France	1	25
Germany	3	100
Hungary	1	50
Italy	120	1000
The Netherlands	35	1500
Norway	1	120
Portugal	2	40
Spain	4	155
Sweden	4	200
United Kingdom	1	25
Greece	3	25