

**Intergovernmental Oceanographic Commission**  
*Reports of Meetings of Experts and Equivalent Bodies*



14 JAN. 1988

**IOC-FAO Guiding Group  
of Experts on the Programme  
of Ocean Science  
in Relation to Living Resources**

**Second Session**

Rome, 8-12 June 1987

**Unesco**

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IOC-FAO/GGE-GSLR-II/3  
Paris, 18 November 1987  
English only

In this Series, entitled

**Reports of Meetings of Experts and Equivalent Bodies**, which was initiated in 1984 and which is published in English only, unless otherwise specified, the reports of the following meetings have already been issued:

1. Third Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans
2. Fourth Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans
3. Fourth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of «El Niño» (*Also printed in Spanish*)
4. First Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in relation to Living Resources
5. First Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in relation to Non-Living Resources
6. First Session of the Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
7. First Session of the Joint CCOP (SOPAC)-IOC Working Group on South Pacific Tectonics and Resources
8. First Session of the IODE Group of Experts on Marine Information Management
9. Tenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies in East Asian Tectonics and Resources
10. Sixth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
11. First Session of the IOC Consultative Group on Ocean Mapping (*Also printed in French and Spanish*)
12. Joint IOC-WMO Meeting for Implementation of IGOS XBT Ships-of-Opportunity Programmes
13. Second Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
14. Third Session of the Group of Experts on Format Development
15. Eleventh Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
16. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
17. Seventh Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
18. Second Session of the IOC Group of Experts on Effects of Pollutants
19. Primera Reunión del Comité Editorial de la COI para la Carta Batimétrica Internacional del Mar Caribe y Parte del Océano Pacífico frente a Centroamérica (*Spanish only*)
20. Third Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
21. Twelfth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
22. Second Session of the IODE Group of Experts on Marine Information Management
23. First Session of the IOC Group of Experts on Marine Geology and Geophysics in the Western Pacific
24. Second Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in relation to Non-Living Resources
25. Third Session of the IOC Group of Experts on Effects of Pollutants
26. Eighth Session of the IOC-UNEP Group of Experts on Methods, Standards and intercalibration
27. Eleventh Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (*Also printed in French*)

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1. OPENING

Dr. A. Bakun, Chairman of the IOC/FAO<sup>1</sup> Guiding Group of Experts on OSLR called the Session to order at 09.30 on Monday, 8 June 1987, at FAO Headquarters, Rome, Italy.

Dr. Armin Lindquist, FAO Assistant Director-General a.i. (Fisheries Department), welcomed the participants and, recalling the multidisciplinary character of the OSLR programme, emphasized the need to bring together the oceanographic and fisheries science communities to solve the research problems prioritized by the Group. He pointed out the interest of FAO in developing jointly with FAO the major OSLR initiatives such as SARP and TRODERP in the context of the International Recruitment Programme (IREP) and noted that in spite of budgetary constraints affecting the Organization, OSLR has been maintained as a priority programme in the FAO budget.

The List of Participants is given in Annex V.

2. ADMINISTRATIVE ARRANGEMENTS

2.1 ADOPTION OF THE AGENDA

The Provisional Agenda (Doc. IOC-FAO/GGE-OSLR-II/1 prov.) was introduced by the Chairman for consideration of the Group.

The Guiding Group adopted the Agenda for the Session. The Agenda is presented as Annex I.

2.2 DESIGNATION OF RAPPORTEUR FOR THE SESSION

Dr. Peter Rothlisberg was proposed as Rapporteur for the Session. This proposal was unanimously accepted by the Group.

2.3 CONDUCT OF THE SESSION, TIMETABLE AND DOCUMENTATION

Drs. Fernando Robles and Jorge Csirke, Technical Secretaries for the Session, explained the modus operandi and proposed a timetable for the meeting. They also briefly reviewed the working documents and reference material (Doc. IOC-FAO/GGE-OSLR-II/4 prov.). The List of Documents distributed for the Session is presented as Annex VI.

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<sup>1</sup> A List of Acronyms and Abbreviations is given in Annex VI.

3. REVIEW OF INTERSESSIONAL ACTIVITIES

3.1 THE INTERNATIONAL RECRUITMENT PROGRAMME (IREP)

3.1.1 Sardine/Anchovy Recruitment Project (SARP)

In the absence of Dr. R. Lasker, who has been the major co-ordinator of the development of the SARP project, the Chairman provided information on the progress in SARP project development during the intersessional period.

(i) Eastern Pacific SARP

- (a) Following Recommendation 1 of the initial Session of the Guiding Group, the IOC-FAO Sardine/Anchovy Recruitment Project (SARP) Consultation was held at the Southwest Fisheries Center in La Jolla, California, from 5 to 9 November 1984. Participants at the Consultation included the Scientific Secretary General of CIPS, and scientists from Chile, Peru, Ecuador, Mexico, USA, Canada, Brazil, Argentina, Portugal and Spain. Proposals were written for three regional SARP exercises: one addressing the sardine population off central and northern Peru (also to include Ecuadorian input), one addressing the sardine population off northern Chile (also to include Peruvian input), and one addressing the anchovy population off the western USA and Mexico. All three proposals were for full scale "SARP Within-year Experiments", involving (1) repeated surveys of spawning intensity and of oceanographic and biological conditions related to starvation, predation, advection, etc., over an extended spawning season, and; (2) birthdating, via daily otolith readings, of late larvae and early juveniles to determine variation in relative survival rate.
- (b) Following Recommendation 5 of the initial Guiding Group Session, a Training Course on Egg Production Method to Estimate Spawning Biomass in SARP Experiments was sponsored by IOC, FAO, and GIZ, at the Instituto del Mar del Peru (IMARPE), Callao, from 9 to 20 December 1985. The course was attended by 23 participants from Argentina, Brazil, Chile, Ecuador, Peru and Uruguay.
- (c) Following Recommendation 6 of the initial Guiding Group Session, a two-week training course on various methodologies essential to SARP exercises was supported by IOC, Unesco and GIZ, and organized by the Southwest Fisheries Center in La Jolla, California, from 11 to 22 November 1985. Fifteen scientists from Chile, Peru, Ecuador, and Mexico participated. Visiting scientists from Argentina, Japan and Morocco also attended lectures and various laboratory and shipboard sessions and demonstrations. Subjects treated included histology, daily otolith reading, data processing

and analysis, and oceanography and satellites.

- (d) A prototype SARP exercise, funded entirely by NOAA (US Government), was scheduled off southern California for the winter-spring anchovy spawning season of 1986. A pre-SARP oceanography survey of the area was implemented during summer 1985. Two SARP surveys were successfully accomplished during January 1986, after which the programme was abruptly terminated due to withdrawal of funding because of federal budget restrictions. The successful completion of two SARP cruises did serve to demonstrate the feasibility of these operations. Another attempt to perform the complete Within-year SARP Experiment on the anchovy stock located off the western USA and northern Mexico is now planned for 1990.

(ii) Southern Atlantic SARP

At the La Jolla SARP Consultation, scientists from Brazil and Argentina expressed their desire to proceed with SARP experiments as soon as possible. Besides some training activities, regional experiments have not yet been designed, in the overall context of SARP. Some bilateral funding prospects are likely, especially in Brazil.

(iii) North-eastern Atlantic SARP

An OSLR/SARP Seminar on Potential Application of New Techniques in the Study of Recruitment for Pelagic Coastal Fisheries on the Iberian Shelf (Doc. IOC-FAO/GGE-OSLR-II/Inf.2) was held in Vigo, Spain, from 30 September to 4 October 1985. The Seminar was mainly funded under a USA-Spain bilateral programme. A proposal for funding, under the same scheme, of a three-year SARP exercise was approved in 1986. A SARP training course organized under this programme, with the assistance of IOC and the Unesco Division of Marine Science, was held in Vigo, from 24 November to 3 December 1986 and attended by specialists of Spain and Portugal.

SARP teams in Portugal and Spain have agreed on a three-year programme as follows:

- Year 1 - Training, standardization of techniques, and spawning habitat definition
- Year 2 - Egg production stock biomass assessment
- Year 3 - SARP Within-year Experiment involving short-term scale estimates of larval production and survival index based on daily ageing.

Certain at-sea training and equipment intercalibration activities have already been accomplished in connection with this programme.



(iv) Other Eastern Pacific SARP-related activities

(a) The Peruvian anchoveta

Dr. Daniel Pauly presented the key results of an ongoing international multidisciplinary project between IMARPE, GTZ and ICLARM on "The Peruvian anchoveta and its upwelling ecosystem: Three decades of changes".

The project, started in 1981 and now nearly concluded, aimed at assembling on a monthly basis long time series (covering at least the years 1953 to 1982) of all measured variables likely to have affected the Peruvian Current region and its fish resources (especially anchoveta).

The time-series that were assembled cover oceanography and meteorology (sea surface and subsurface temperature, upwelling and turbulence indices, incident solar radiation), population size of and anchoveta consumption by key predators (three species of guano birds, three species of fish, and two of seals), fishery biology data on the anchoveta (catches and their size composition, growth and egg production). The data assembled allowed derivation of other time series (e.g., size-structured monthly population estimates for 1953 to 1981) and quantification of important processes (e.g., extent of anchoveta egg cannibalism and density dependence of its growth, fishermen's non-compliance with fishery regulations, dissipation of economic rent in the Peruvian reduction fishery, etc.). Overall, the study brought together more comprehensive data than have ever been assembled on the topics in question. Consequently, advances have been made in our understanding of anchoveta recruitment variability, as was indeed the hope of those who supported or performed this project.

The complete results - 20 papers in all - will be available in August 1987 in a book ("The Peruvian anchoveta and its upwelling ecosystem: Three decades of changes", Eds. D. Pauly and I. Tsukayama) which will contain all the raw data used in the study and which also be available in the form of diskettes for standard personal computers.

The Guiding Group expressed its support to the approach used in this project, particularly its emphasis on retrieving, standardizing and analyzing the extensive data sets held in various laboratories - both in developing and developed countries - and in bringing together scientists from numerous countries and disciplines.

(b) The Talcahuano-Gulf of Arauco study

Dr. P. Bernal, Vice-Chairman of the Guiding Group, provided information on this study. The daily-ring technique has been applied to the southern stocks (37°S) of Sardinops sagax and Engraulis ringens off Talcahuano and Gulf of Arauco.

In this same region, multidisciplinary studies by Chilean, US and Swedish scientists have continued during 1985 and 1986. The main focus of these studies has been:

- To understand the oceanographic and ecological mechanisms that control the establishment of highly localized spawning/feeding grounds within Eastern Boundary Currents.
- To study the physical and biological mechanisms responsible for the formation/destruction of layers of high concentration of food particles.

In both cases studies made use of the new "GISMO" instrument, developed at University of Gothenburg, which had been proposed to be used in the Peruvian and Chilean SARP proposals.

Dr. Gary Shaffer, Principal Investigator of the Swedish contribution to these efforts, has presented a new proposal to extend these types of multidisciplinary research to other latin-american countries, in preparation of their active participation in IREP and in the extension of SARP to the south-western Atlantic region. Among these countries are Argentina (which has already committed ship-time), Brazil and Uruguay.

(v) IOCEA-I Proposal

Dr. F. Robles introduced this item. He pointed out that during the First Session of the IOCEA Regional Committee for the Central Eastern Atlantic (Doc. IOCEA-I/3), a recommendation was approved to initiate IREP studies in the north-western African region. As part of this, the establishment of a regional group of experts on OSLR was recommended to the Fourteenth Session of the IOC Assembly. IOCEA-I also endorsed the development of a SARP component for pelagic species of upwelling systems off Western Africa, stressed the importance of a strong TEMA element to support these studies and emphasized the importance of co-ordinating these activities with those of the FAO Committee on Eastern Central Atlantic Fisheries (CECAF).

The Guiding Group considered that the major benefit of association of this region with the general SARP effort would be through collaborative initiatives via the inferential approach outlined by the Halifax IREP Workshop (Doc. IOC Workshop Report No. 44). Important aspects of the inferential approach include: (i) the establishment of environmental and biological data bases, and (ii) definition of characteristics, geography and

seasonality of spawning habits. These activities would form the basis for exploratory data analysis via empirical time series modelling and application of the comparative scientific method. This would provide the basis for the application in Central Eastern Atlantic of results from intensive SARP experiments conducted elsewhere.

(vi) Project on sprat recruitment in FRG and UK

Dr. J. Alheit, Co-ordinator of these activities, presented this subject.

In January 1987 a meeting was held in Bremerhaven by various German and British scientists to co-ordinate studies on the processes controlling sprat recruitment (Doc. IOC-FAO/GGE-OSLR-II/Inf.3). Sprat was selected for recruitment studies within the framework of IREF and SARP, for the following reasons:

- widespread distribution in Europe and therefore very suitable for comparative studies on an international scale in a range of contrasting environments;
- relatively long spawning period (batch spawner) which allows studies of eggs and larvae over a relatively long period under differing environmental conditions;
- all life stages are easily accessible from the research laboratories;
- reproductive biology is very similar to anchovies and sardines, the target species of the "Sardine/Anchovy Recruitment Project" (SARP);
- large population fluctuations over relatively short periods.

Sprat recruitment is investigated according to the SARP approach as outlined in the Report of the Halifax Workshop of IOC in 1983 (IOC Workshop Report N° 33). Specific objectives of the sprat studies are, amongst others:

- to determine the availability of suitable phytoplankton as a diet for first-feeding fish larvae;
- to determine the horizontal and vertical distribution of zooplankton in relation to hydrographic conditions and food availability for fish larvae;
- to determine the free amino-acid, vitamins and polyunsaturated fatty acids present in various zooplankton species and their developmental stages and in fish larvae;
- to describe the diet of fish larvae, in particular of sprats (Sprattus sprattus), from gut contents analysis and feeding experiments;

- to assess the effects of feeding conditions in the daily mortality of fish larvae and to relate these to hydrographic conditions;
- to determine the nutritional status of fish larvae in relation to their feeding environment;
- to estimate quantitatively predation on sprat eggs and larvae from stomach contents of potential predators and by co-occurrence of prey and potential predators in relation to hydrographic conditions;
- to investigate the influence of drift on larvae;
- to determine relative recruitment by using daily growth rings on otoliths and comparing the birth date distribution of late larvae or juveniles to production of early larvae.

These studies are carried out by projects in three contrasting environments:

(a) Sprat recruitment project in German Bight, North Sea

The investigations begun in 1986 as a joint effort of the Alfred-Wegener Institut for Polar and Marine Research (Bremerhaven), the Institut für Hydrobiologie und Fischereiwissenschaft (Hamburg) and Biologische Anstalt Helgoland. An important feature is the close co-operation between biologists and physical oceanographers in the studies of the influence of different water masses (e.g., frontal systems, stratified water columns, mixed water columns, transition zones) on larval survival.

(b) Irish Sea Project

Production processes and fish recruitment in the Irish Sea have been studied since 1987 with the aim of attempting to explain why fish production per unit area in the Irish Sea is believed to be less than one-third that of the North Sea. This difference is thought to be the result of lower recruitment due to the higher mortality of young stages of fish, which is caused, in turn, by properties of the production cycle in the Irish Sea; The hypothesis is that the observed reduced fish production in the Irish Sea is a direct consequence of differences in phytoplankton and zooplankton species and production in seasonally stratified and mixed water columns. Sprat has been selected as a "target" species in the Irish Sea for the above-mentioned reasons. The "Irish Sea Project" is a co-operative venture between the MAFF Laboratory (Lowestoft), the Institute for Marine Environmental Research (Plymouth) and the Marine Science Laboratory (Menai Bridge) with French and German collaboration.

(c) Project on interactions between the important fish species in the Bornholm Basin, Baltic

The project aims at studying the environmental and biological dynamics in a heavily exploited ecosystem in relation to the relevant fish stock parameters of sprat, herring and cod. These studies will be carried out by the Institut für Meereskunde (Kiel) with the Danish collaboration.

For further funding to enhance the co-operation of the three projects, particularly the exchange of scientists and equipment, a joint German-British proposal will be submitted in 1987 under the heading: "Co-operative studies on the processes controlling sprat recruitment in contrasting environments".

The Guiding Group noted with great interest these ongoing and planned activities on sprat and considered they represent an important contribution to the development of the SARP concept (See Recommendation 1, (a)).

3.1.2 Tropical Demersal Recruitment Project (TRODERP)

The Guiding Group analyzed the recommendations made in the IOC/FAO Workshop on Recruitment in Tropical Coastal Demersal Communities which was held in Ciudad del Carmen, Mexico, 21-25 April 1986 (Doc. IOC Workshop Report No. 44), and expressed satisfaction for the very detailed analyses carried out by the TRODERP Workshop in order to bring attention to ocean science in relation to tropical living resources. The best contribution of this workshop was to identify a clear framework for common problems, questions and hypothesis in the inter-tropical belt, and to produce proceedings with selected orienting papers (being printed at IOC, Paris).

(i) TRODERP in IOCARIBE

Dr. A. Yañez-Arancibia, Chairman of the IOCARIBE Group of Experts on TRODERP, informed about the first session of this Group, held at the IOC Secretariat for IOCARIBE, Cartagena de India, Colombia, 19-21 May 1987 (Docs. IOCARIBE/GE-TRODERP-I/3 and 3S). This Group, taking into account the general characteristics of coastal demersal resources of the region, the general interest of IOCARIBE Member States, and the present state of development and progress of relevant research, suggested the three following sub-projects for IOCARIBE/TRODERP:

- (a) Sub-project IOCARIBE on Recruitment of Coastal Demersal Fishes in Estuarine Deltas and Continental Shelf (FEDERP = Fish Estuarine-Deltaic Recruitment Project).
- (b) Sub-project IOCARIBE on Recruitment of Penaeid Shrimps (PREP = Penaid Recruitment Project).

- (c) Sub-project IOCARIBE on Recruitment of Demersal Species Associated to Coral Reef and Hard Bottom Ecosystems (CORDERP = Coral Reef Demersal Recruitment Project).

Focal areas and focal species or group of species are indicated in the Summary Report of the Session.

The Group of Experts of IOCARIBE considered that the next step in developing the regional components of TRODERP, will be to proceed with a detailed elaboration for the FEDERP, PREP and CORDERP proposals. In this context, the Group pointed out that regional information is, in general terms, rather limited and is found dispersed and in a heterogeneous level. For these reasons the Group of Experts suggested the following main actions to follow up and implement these components:

- IOCARIBE Workshop to review the detailed design for the three proposals.
- Organization of training courses to include methodological aspects and related post-graduate research.
- Organization in due course, of a Regional IOCARIBE Symposium to evaluate results obtained in the implementation of the three Sub-projects.
- Start a process of collection, collation and integration of information related to the three proposals particularly regarding the suggested focal areas and species groups.

A number of basic scientific questions on FEDERP, PREP and CORDERP to be examined during the Workshop mentioned in (i) were also formulated.

In addition, the IOCARIBE Group of Experts on TRODERP included general recommendations on: the study of resources non covered by the three Sub-projects such as crabs and squids); strengthening national projects and research related to TRODERP; and, regional mechanisms to improve communication on the subject.

The Guiding Group examined and noted with satisfaction the implementation of TRODERP in the IOCARIBE region and endorsed the proposals of the regional Group of Experts (see Recommendation 3).

(ii) TRODERP in WESTPAC

Dr. P. Rothlisberg, Chairman of the WESTPAC Task Team on OSLR, was invited to introduce the proposal for a collaborative, interdisciplinary study on recruitment of penaeid prawns in the Indo-West Pacific region (WESTPAC-PREP; Doc. IOC-FAO/GGE-OSLR-II/Inf.4).

Justification

Penaeid prawns form the major component of the export revenue

generated from fisheries products in many countries throughout the Indo-West Pacific and also form the basis of many intensive small-scale fisheries. Most countries in the region are experiencing similar management problems brought about by increasing fishing pressure and declining catches. The urgent need for improved management strategies of these fishery resources was clearly recognized during a recent Indo-Pacific Fishery Commission (IPFC) Symposium on the Exploitation and Management of Marine Fishery Resources in South-east Asia, held at Darwin, Australia, in February 1987.

Management of penaeid prawn species, however, is complicated by the inherent year-to-year variability in recruitment of young prawns into the various fisheries. This variability is influenced by changes in climatic conditions such as monsoonal rainfall, temperature and cyclones as well as changes in the prawn stocks resulting from increased fishing pressure. Rational management can only be obtained if the natural environmental variation and habitat degradation can be separated from those perturbations caused by fishing.

The overall aim of the project is to equip each participating country with sufficient information to develop their own national capacity to manage their prawn fisheries. The project will consist of two main phases. The first phase involves an assessment of existing data and planning. The second phase will be the collection of data by each country and will be followed by periodic meetings to compare results and make management recommendations relevant to those countries.

It is hoped that the project will be a joint IOC/FAO project and will run in conjunction with a similar project in the western Atlantic (IOCARIBE/PREP) proposed during the recent IOCARIBE session on TRODERP.

### Planning

The first phase of the project will be a mission to the region to assess the sources of biological and environmental data from relevant agencies and individuals. A questionnaire has been prepared which details the types of data being sought.

A Workshop will be held in July 1988 in Australia with the following aims:

- (a) To review the existing data sets relevant to prawn recruitment at a variety of life history stages (both published and unpublished data);
- (b) To conduct preliminary analyses on the data to highlight its strengths and shortcomings;
- (c) To standardize methods for the collection of relevant environmental and biological data for at least two common species throughout the region viz.: Penaeus merguensis, P. semisulcatus.

The Workshop will provide hands-on experience in data analysis and modelling in three main areas: life history dynamics, spawning stock-recruitment relationships and environmental effects on interannual variation in recruitment.

After the Workshop and prior to the operational phase of the project, a meeting involving senior scientific administrators from participating countries and delegates from potential funding agencies, will be held to work out funding strategies. After this initiative it is hoped that each participating country/institution will be responsible for administering its own operations funds obtained from national governments, international funding bodies, etc. Given sufficient funding, each country will be responsible for its own data collection and analysis, with workshops and exchange of scientists to provide the necessary training and standardization of techniques.

During the operational phase of the project, to start in July 1989, data to be collected will include at least:

- Seasonal abundances of prawn larvae, juveniles, adults and spawning activity of selected species (e.g., P. merguensis and P. semisulcatus).
- Environmental data including input from oceanographic surveys, meteorological observations and habitat studies involving coastal vegetation (mangrove and sea-grass).

Following data collection, the next stage will be:

- Modelling the effects of fishing pressure and environmental forcing on prawn population dynamics.
- Recommendations concerning future management strategies and implementation on a national level.

The Guiding Group acknowledged with great interest the WESTPAC-PREP proposal and endorsed strongly its implementation through IOC/FAO (see Recommendation 4).

(iii) TRODERP Related Studies

The Guiding Group noted with appreciation the advances made by two co-operative Japanese studies: (a) Japanese-Thai study on production mechanisms in the Gulf of Thailand, including taxonomy, community structure, life history and productivity, and the effects of the by-catch fishery on the stocks of commercially important fisheries; (b) the reproduction of the Japanese eel and its environment in the Western North Pacific. A suggestion for a training workshop on ichthyoplankton taxonomy in the region was also brought to the Group's attention.



### 3.1.3 Proposal for a Squid Recruitment Project

Dr. M.R. Clarke, Secretary of the Cephalopod International Advisory Council (CIAC) presented a brief review of squid biology (see Annex III) that was followed by a summary of the current knowledge of recruitment processes in squid provided by Dr. R.K. O'Dor, Chairman of the CIAC/IREP Sub-Committee. Evidence was presented that variations in physical oceanographic features play a key role in the recruitment processes of *omastrephid* squid, which are the basis for most large-scale squid fisheries, making them particularly interesting in the OSLR context. However, problems associated with the localization of spawning areas and eggs preclude direct measurement of recruitment processes in this group at present. Recruitment in *loliginids*, which have mass spawnings at identifiable benthic sites was suggested as a more tractable alternative, but the lack of reliable data from the more artisanal fisheries for these species and the lack of a clear role for oceanic processes argued against early initiation of an IREP.

There was, nonetheless, strong interest amongst the Guiding Group in the eventual development of an IREP component on *omastrephid* stocks such as that for *Illex argentinus* in the future, and the Group recommended preliminary activities preparatory to a full-scale study (see Recommendation 5). These included: (1) The publication in 1990 of an edited volume assembling data related to squid recruitment; and, (2) support for a symposium in Japan in 1991.

The proposed review would: (a) assemble and analyse available data sets which show concurrent fluctuations in squid and fish catches; (b) assemble data on spawning sites and spawning variability in various *loliginids*; (c) catalogue available zooplankton collections which could be examined for cephalopod paralarvae; (d) review the available information on cephalopod population dynamics.

The Symposium on Cephalopod Ageing and Growth in Relation to Squid Fisheries would be conducted in connection with a planned CIAC workshop and would emphasize topics aimed at clarifying squid longevity such as: (a) life history studies; (b) hard structures, growth and ageing; (c) growth and bioenergetics; (d) comparative studies of squid growth; (e) growth versus reproduction in squid; (f) growth and recruitment in squid fisheries.

As a contribution to the review by OSLR/IREP and as a general preliminary to the meeting in Japan, CIAC has planned regional meetings for scientists concerned with cephalopod fisheries in order to:

- (i) Provide basic information to non-specialists on cephalopods relevant to an understanding of their exploitation so that they may be better able to: (a) understand the differences between cephalopod and fish biology; and (b) seek the relevant information from the fisheries in order to understand stocks which will eventually form a basis of management.

- (ii) Assemble information from participants on the artisanal and other cephalopod fisheries around the coasts of the region. This information will include relevant catch statistics, archival and historical data, both published and unpublished.
- (iii) Facilitate examination of adults, larvae and spawn from fisheries to determine the species and life history stage involved (which is not always known).

Workshops on cephalopods for Latin America (Ecuador) and China (Zungdao or Shanghai) are being planned and steered by CIAC, and proposals are discussed for a meeting in Indonesia.

The Guiding Group noted the value of these initiatives and endorsed their implementation.

#### 3.1.4 Activities under the IREP Steering Group of ICES

Mr. R. Jones, Chairman of the ICES Steering Group on IREP, provided the Guiding Group with a detailed account on corresponding intersessional activities (see Annex III).

The Guiding Group welcomed the positive ICES response to the IOC request for co-operation in OSLR/IREP. The Group was particularly gratified to learn that an IREP Steering Group has been set up and that its Chairman was enabled to attend the present Session.

The Guiding Group reassured ICES that the IREP concept, at least in the form it now takes, does not imply that there is a single dominant process determining recruitment, or that a single "experiment" could solve it. The IREP concept acknowledges (in contrast), that a wide range of approaches drawing upon a variety of scientific disciplines and research skills, are required to gain a better understanding of what is actually one of the most fundamental problems facing fisheries and oceanographic science. The form of any particular project needs to be closely attuned not only to the biology of the species and its environment, but also to the available manpower and logistic resources.

The Guiding Group recognized the long experience and range of skills in the ICES countries for tackling various aspects of recruitment in fish and hoped that the fruits of this experience and the utility or otherwise of new techniques and methodologies, could be made available through OSLR as a guide outside the ICES in studies that are engaged on or proposing to begin, some kind of recruitment project. In return, the Guiding Group may be able to help by informing ICES of developments elsewhere which would not otherwise have come to the notice of the Council.

The Guiding Group noted with interest several recruitment projects in progress in the ICES area which have much in common with the IREP concept. Among these are the multinational fish larval patch studies, the research by France on the early-life history of sole, and by France and Canada on scallop.

The Guiding Group especially commended to ICES the sprat recruitment project proposed jointly by the Federal Republic of Germany and the United Kingdom. It is now realized that the sprat is a batch-spawner, and for this and other reasons the study of its recruitment processes is likely to have much in common with the Sardine/Anchovy Recruitment Project (SARP) which is well developed by the USA (SWFC), an adaptation of which is now planned by Spain and Portugal on similar species in the North-eastern Atlantic.

The Guiding Group noted with interest the Mini-Symposium on Recruitment Processes planned by ICES for the 1987 Annual Meeting in Santander, Spain, and the Major Symposium on Early-Life History of Fish planned for the 1988 ICES meeting in Bergen, Norway. Both are of direct interest and relevance to IREP development and looked forward to their outcomes.

### 3.1.5 Other IREP-related activities and issues

#### French Recruitment Programme

Dr. J.P. Troadec presented the French Recruitment Programme which is conducted in co-operation between applied and basic research institutions. Investigations and results obtained on scallop and sole were given as examples.

Mollusc species have been retained considering potential applications of recruitment studies for the development of extensive forms of aquaculture; the possibility to artificially enhance the recruitment of wild populations gives particularly interesting experimental possibilities. Coastal species were selected for logistic reasons (notably access and sampling facility) as well as for the potential interest of recruitment studies for developing quantitative criteria and laws for the conservation of coastal environment carrying capacity.

The underlying strategy is to investigate the ecology and population dynamics of early stages on which marine populations concentrate their regulatory mechanisms. This implies simultaneous and high resolution observations of environment hydrodynamics, animal behaviour and population dynamics. Programme formulation encompassed:

- (i) identification of critical phases;
- (ii) formulation of theories to sketch most likely processes;
- (iii) develop and conduct research protocols to test hypotheses, notably with respect to relative roles of spatial (hydrodynamics) and energetic (trophic) phenomena in making the recruitment success.

The aim is to modelize the relevant processes. At the same time, methods are developed (daily age reading, starvation indices, fine scale plankton sampling, hydrodynamic models, etc.).

The programme relies on the active co-operation between physical and biological (planktologists) oceanographers, marine biologists, population dynamicists and aquaculturists. Co-ordination is achieved by a Scientific Committee and a newsletter is regularly issued to maintain contacts, exchange views, information and first results.

Techniques developed in aquaculture have proved very useful, for example: to investigate the role of temperature on gametogenesis and to further competence and viability of eggs and larvae; to develop daily ring reading methods; to derive starvation indices; etc...

Results have already been obtained on the role of temperature on gametogenesis and viability of eggs and larvae, as well as on the tide and wind-induced currents on the dispersal and circulation of scallop larvae relative to the location of adult beds. Sole seems to offer an appropriate model to test Sinclair's retention hypothesis as well as the role of coastal nurseries carrying capacity as a major factor limiting recruitment.

After an initial five-year period, the programme will be reassessed and, eventually, reoriented on the basis of the knowledge and experience acquired.

#### Palaeosedimentary analysis

The Chairman reported on discussions between members of the OSLR Guiding Group and members of the SCOR-IOC COCO on potential mutual interests of the two bodies in the subject of analysis of evidence of fish population variations deposited in sea-floor sediments. The Guiding Group noted the fact that fishery based data series are nearly always short compared to the periods of important components of climate scale environmental variability. Thus, time series stationarity, assumed on the statistical methodologies, is seldom achieved. This greatly complicates empirical analyses of the mechanistic linkages.

A very small number of sediment cores sampled off California has been richly cited as yielding important insights into long-period natural variability of fish populations and of interspecies interactions.

The Guiding Group considered that augmentation of the data base and its expansion to other regions would constitute very beneficial developments within the general IREP context. Preparation of a review of global opportunities for this type of activity, including the incidence of anoxic and nearly anoxic sea-floor areas and the incidence of varied sediments, would constitute an important initial step in promoting these developments. The Guiding Group noted that the usefulness of fish scale records for population studies would be greatly enhanced if the scales counted were also measured and aged, if at all possible.

#### Artificial reefs

Artificial reefs are attracting increasing interest in South-east Asia, i.e., in the WESTPAC region, and various programmes exist to set up such reefs, notably in Malaysia, the Philippines and Thailand. The SCORRAD

of IPFC during its Fifth Session in Darwin, Australia (February 1987) therefore suggested that the next IPFC Symposium, to be held in Colombo, Sri Lanka, in November 1987, be devoted to the biological and economic aspects of artificial reefs.

Presently, South-east Asian governments tend to expect artificial reefs to help them solve the resource allocation and coastal overfishing problems caused by demersal trawling.

These artificial reefs programmes may be viewed however as large-scale recruitment experiments, conducted in the type of communities that are the concern of TRODERP. They may greatly contribute to our understanding of recruitment processes, provided they cover close monitoring of the impact of these artificial reefs on recruitment of key species.

The Guiding Group felt that this situation would represent a favourable background for a well-focused recruitment research project to be conducted in the frame of the OSLR/IREP activities, and would encourage the submission of a relevant project proposal by a research group in the WESTPAC region.

#### Fisheries for larvae and extensive aquaculture

When considering briefly other potentially important fishery domains for which understanding of recruitment, survival and distribution processes could be essential, the Group examined the case of extensive aquaculture using wild seed stocks for production and relying therefore on wild stocks reproductive potential. This type of aquaculture is already important and will continue to develop in the future because of its low capital cost and manpower intensive, and represents a major potential source of wealth in rural coastal communities in developing and developed countries. The effects of diverting a sometime large amount of larvae and post-larvae from the wild stock productive mechanism are not known. Concern has been expressed, especially in penaeid shrimp culture, without enough grounds.

The Guiding Group agreed that attention should be given to the problem as the necessary research would produce useful insights on recruitment processes.

### 3.2 PHYTOPLANKTON BLOOMS, RED TIDES AND ASSOCIATED MASS MORTALITY OF MARINE ORGANISMS

This Item was introduced by the Technical Secretary, Dr. F. Robles, who gave the background and informed the Group of the different resolutions of IOC Governing Bodies on the subject.

#### 3.2.1 Contingencies for fish kills in the IOCARIBE region

Dr. A. Yañez-Arancibia, Chairman of the IOCARIBE Group of Experts on TRODERP, reported on the recommendations on this subject proposed by the First Session of the Group (Doc. IOCARIBE/GE-TRODERP-I/3). These recommendations were based upon the initial outputs of an Ad hoc IOCARIBE

Steering Committee for Developing Regional Contingencies for Fish Kills, which met in Mayagüez, Puerto Rico, 25-29 October 1982 (Doc. CARI/FK-I/3), proposing: the development of observational procedures for determining the cause of fish kills; a manual describing these procedures; a reporting format and data center; and training components.

The IOCARIBE Group of Experts recognized that these phenomena are frequent in the region. However, the magnitude of the problem is not well documented at the regional level. Therefore, the Group of Experts decided to re-examine this problem during its next Session considering additional information and guidance provided by: this Second Session of the IOC/FAO Guiding Group of Experts on OSLR; the International Symposium on Red Tides - Biology, Environmental Science and Toxicology (Takamatsu City, Japan, 10-14 November 1987); and, the IOC Workshop on International Co-operation in the Study of Ocean Blooms and Red Tides (same place, 16-17 November 1987). The IOCARIBE Group of Experts will also take into account, in due course, the outputs of the International Workshop on Red Tides being organized in Venezuela during 1988 by the Working Group on Aquaculture of the "Comision para la Pesca Continental y Acuicultura "(COPESCAL)" of FAO.

### 3.2.2 Symposium and Workshop on International Co-operation in the Study of Ocean Blooms and Red Tides

The second announcement for the International Symposium on Red Tides - Biology, Environmental Science and Toxicology - to be held in Takamatsu City, Kagawa, Japan, 10-14 November 1987, was presented to the Guiding Group by Dr. K. Kawaguchi. The terms of reference and themes of a two-day IOC Workshop on International Co-operation in the Study of Ocean Blooms and Red Tides (same place, 16-17 November 1987), which will discuss recent activities and results on the subject with reference to the OSLR and GIPME Programmes and potential research projects, were also reviewed (Doc. IOC-FAO/GGE-OSLR-II/Inf.5).

The Guiding Group recognized the importance of red tide phenomena and ocean blooms, in particular in connection with mass mortality of marine organisms, affecting natural populations and cultures.

The Guiding Group agreed that a special Sub-programme on red tides and ocean blooms should be included within OSLR at the same level as the ongoing IREP.

However, the Guiding Group felt that the actual membership of the GGE reflecting mainly expertise needed for IREP, does not properly cover scientific expertise in ocean blooms and red tides.

Therefore, the Guiding Group recommended that on the occasion of the International Symposium on Red Tides at Takamatsu, Japan, and associated IOC Workshop, the Chairman of the GGE, in conjunction with IOC and FAO, consider the expansion of the Group on OSLR to include experts on red tides. The expanded GGE will examine red tide initiatives during the intersessional period, taking into account the regional efforts already underway and within a framework that enables meaningful interregional comparison (see Recommendation 9).

### 3.3 OTHER OSLR COMPONENTS

#### 3.3.1 Second Western Atlantic Turtle Symposium (WATS-II)

The IOC Technical Secretary for the Guiding Group and Dr. A. Yañez-Arancibia informed the Guiding Group about the WATS-II Symposium to be held in Mayagüez, Puerto Rico, 12-16 October 1987 (Doc. SC-IOCARIBE-II/Inf.5).

The Guiding Group, after examining the declared objectives for WATS-II considered that this initiative does not comply with the terms of reference of OSLR components, especially as regards the multidisciplinary ocean science character of OSLR studies. The Guiding Group suggested that WATS may be better encompassed by a marine conservationist-oriented organization.

### 4. REQUIREMENTS FOR ONGOING AND PLANNED ACTIVITIES

#### Statistical Methods for the Analysis of Recruitment Time Series

The Guiding Group noted that valuable information can be obtained through the careful statistical analysis of recruitment variability and its relationship to the environment. However, there was some concern that the recent introduction of more sophisticated statistical techniques had not been universally beneficial: there are, for example, recent analyses in the literature which are based on the same data and yet reach directly opposite conclusions regarding the spatial scale of recruitment variability. The basic difficulty with the statistical analysis of recruitment stems from the basic data: the series are generally short and autocorrelated.

The Guiding Group also noted that although relevant statistical techniques are available they have not been widely adopted by the fisheries community. There was agreement that a thorough review of useful statistical techniques would be most beneficial at this time and that some specialists be invited to assist with the tasks and that an experts consultation be held in due time in order to prepare a document on the subject.

The tasks for the experts consultation would be as follows:

- (i) To review and recommend methods for constructing confidence intervals on basic statistical estimates which are derived from short autocorrelated time series (including sample correlation and a discussion of first-differencing and spectral analysis);
- (ii) To review techniques for determining the spatial scale of recruitment variability and relating multivariate recruitment data to environmental signals (including principal component analysis, compositing, canonical correlation analysis);

- (iii) To describe and review other miscellaneous statistical techniques which are relevant to the recruitment problem (including bootstrap techniques, ARIMA models);
- (iv) To provide examples, drawn from real fisheries problems, to illustrate the techniques.

The Guiding Group adopted Recommendation 8.

#### Data Set Assembling, Standardization and Exchange

The Guiding Group noted that there is, in conjunction with the study of recruitment, the need to assemble and standardize time series of variables reflecting habitat and/or resources, on appropriate time and space scales. This may involve compilation of time series such as the one from Peruvian fisheries, described by D. Pauly (this document, section 3.1.1 (iv), (a)), and palaeoclimatic information, described by the Chairman (this document, section 3.1.5). An example of such a potential source of data is the extant zooplankton collections in Peru and Chile, which date from the 1960's. This may involve additional sample sorting and/or data re-analysis using statistical methods recently developed. In the latter example, such a task may best be accomplished by the establishment of a network of plankton sorters in the region.

Major efforts and advances have been made by the international oceanographic community to enhance the exchange and archiving of physical data sets. While these advances have led to the availability of nearly real-time quasi-synoptic data to oceanographers working in developed countries, the centralization that these advances have implied, has resulted in fishery biologists, particularly those working in developing countries, having great problems to accede at reasonable costs, to the often local data sets needed for their work. The Guiding Group felt that this problem which was also recently addressed by the COCO at its Eighth Meeting (COC-VIII, Kiel, FRG, 25-29 May 1987) could be in a large part settled if the national and international data banks holding physical data would gear themselves to produce on request, at a low cost, local data subsets for analysis with standard microcomputers, preferably on 5 1/4" diskettes. This last point is important in that this specific medium, while of limited capacity, is extremely widespread in developing countries. Other media (e.g. optical disks) while technically more attractive will probably remain expensive, even if a specific standard for oceanographic data should emerge, which would take several years in any case.

The Guiding Group adopted Recommendations 2 and 7.

#### Atlas on Environmental Structure and Variability

The Guiding Group recognized that several ongoing and future OSLR/IREP initiatives will benefit from having estimates of oceanographic environmental variability in order to help in the design and interpretation of the more direct experimental studies on recruitment and proposed that effort be made to compile an Atlas on Environmental Structure and



Variability as related to marine resources.

In order to gain insights by comparison among similar oceanographic systems located in different geographical regions, the Guiding Group Recommended that several areas be selected within the following types of oceanographic systems:

- (i) Eastern Boundary Currents - Coastal Upwelling Zones
- (ii) Western Boundary Currents
- (iii) Shelf-systems
- (iv) Equatorial gulfs and embayments (for example, Gulfs of Guinea, Thailand and Panama and Bay of Bengal).

The fundamental target scale at which variability should be studied for OSIR purposes is defined by the distributional patterns of local population/stock-units of resource species or species groups.

Ideally the Atlas should cover nested spatial scales, whenever possible, and consider within-area variability, whenever present.

The Atlas is not envisaged to have an exhaustive character, but should provide sufficient backgrounds to encourage further national efforts to be developed so as to cover smaller scales or specific environments.

For the Atlas in order to give summarized information useful for fisheries research, it is necessary that the time-series generating seasonal or annual composites be made available to potential users through readily accessible means (diskettes).

#### Criteria for selection of areas

Specific areas should be selected on the basis of criteria of usefulness for recruitment studies and resources variability. The areas selected may be those where:

- resources are abundant
- the pattern of environmental and variability and/or that of the resource is characteristic (i.e., highly dynamic, very stable, high of low signal/noise ratio, etc.).
- data are sufficient for the analysis.

#### Criteria for selection of variables

A special group of OSIR should, through meetings or correspondence, determine what are the most likely relevant variables on the basis of which cautious comparative approaches could be developed (wind stress, turbulence, stability of water column, mixed layer depth, temperature gradient). These variables will then be included in the Atlas.

#### Suggested approach

- The Guiding Group determines which are the areas to look at and the variables to analyse to be included in the Atlas;
- SCOR is contacted for assistance and guidance in formulating OSLR requirements;
- IOC, in collaboration with FAO, undertakes the necessary contacts with potential funding agencies. If this succeeds, the Atlas is elaborated under the overall supervision of IOC-FAO/OSLR, assisted by SCOR.

The Guiding Group adopted Recommendation 6.

#### OSLR Newsletter

At its Fourteenth Session (Unesco, Paris, 17 March - 1 April 1987) the IOC Assembly instructed the Secretary to examine the possibility of an OSLR Newsletter being regularly published.

The Guiding Group discussed the opportunity, content and arrangements for such a publication. It noted that the OSLR research topics imply active interaction among the various disciplines of marine ecology, notably climatology, physical and biological oceanography, population dynamics and genetics, aquaculture and others. This is indispensable for the formulation and the conduct of new research concepts and strategies. New methods are required and need to be disseminated; information on early findings, meetings, publications, etc., need to be exchanged.

The Guiding Group considered that such a Newsletter would contribute to keep an active flow of information amongst scientists interested in OSLR and help to promote the concepts developed by OSLR. The Newsletter should cover the various OSLR programmes, but initially concentrate on recruitment and related studies.

The Guiding Group believed that the two international organizations co-sponsoring the OSLR programme should play the leading role in the edition, publication and circulation of the Newsletter and that the task be assumed by the technical secretaries responsible for OSLR.

The Guiding Group adopted Recommendation 10.

#### Interdisciplinary Collaboration

The Guiding Group expressed its concern that the benefits of incorporating a broad range of marine science specialties be continually pursued. The following were viewed as highly desirable actions:

- (i) Involving physical oceanographers at all stages of development of OSLR projects, especially including the early conceptual and formative stages.

- (ii) Ensuring that all multi-disciplinary activities are based on a unified experimental design in which the physical/biological questions are well posed and capable of yielding answers.
- (iii) Enlisting the collaboration of numerical ocean modelers, particularly those involved in 3-dimensional baroclinic models, in investigating the interaction of biological behaviour with physical transport mechanisms.

5. ELECTION OF OFFICERS OF THE GUIDING GROUP

Drs. A. Bakun and P. Bernal were re-elected to act, respectively, as Chairman and Vice-Chairman of the Guiding Group of Experts for the next intersessional period.

6. DATES AND PLACE OF THE THIRD SESSION OF THE GUIDING GROUP

The Guiding Group suggested that the next Session be held in Cartagena, Colombia, around February 1989, eventually in conjunction with the Symposium on TRODERP proposed by the corresponding IOCARIBE Group of Experts. Final dates and place will be arranged by the IOC and FAO Secretariats in co-ordination with the officers of OSLR.

7. ADOPTION OF THE SUMMARY REPORT AND RECOMMENDATIONS OF THE SESSION

The Guiding Group adopted the Summary Report and the Recommendations.

The Recommendations are given in Annex II.

8. CLOSURE

The Chairman closed the Session at 14.00, Friday 12 June 1987.

ANNEX I

AGENDA

1. OPENING
2. ADMINISTRATIVE ARRANGEMENTS
  - 2.1 ADOPTION OF THE AGENDA
  - 2.2 DESIGNATION OF RAPPORTEUR FOR THE SESSION
  - 2.3 CONDUCT OF THE SESSION, TIMETABLE AND DOCUMENTATION
3. REVIEW OF INTERSESSIONAL ACTIVITIES
  - 3.1 THE INTERNATIONAL RECRUITMENT PROGRAMME (IREP)
  - 3.2 PHYTOPLANKTON BLOOMS, RED TIDES AND ASSOCIATED MASS MORTALITY OF MARINE ORGANISMS
  - 3.3 OTHER OSLR COMPONENTS
4. REQUIREMENTS FOR ONGOING AND PLANNED ACTIVITIES
5. ELECTION OF OFFICERS OF THE GUIDING GROUP
6. DATES AND PLACE OF THE THIRD SESSION OF THE GUIDING GROUP
7. ADOPTION OF THE SUMMARY REPORT AND RECOMMENDATIONS OF THE SESSION
8. CLOSURE

## ANNEX II

### RECOMMENDATIONS

#### The Guiding Group recommended:

##### Recommendation 1

The urgent implementation of within-year (high resolution) larvae experiments, and

- (a) of the SARP-type experiments presently underway in the European sprat resources;
- (b) of the planned experiments on sardines in the north-eastern Atlantic and on anchovies off western north America, the SARP experiments prepared in the south-eastern Pacific, as well as the potential experiments in the south-western Atlantic.

##### Recommendation 2

The analysis of historical data sets, as illustrated by the IMARPE/GTZ/ICLARM Peruvian anchoveta study, and of similar data sets elsewhere;

##### Recommendation 3

The implementation of the new initiatives of the IOCARIBE-Guiding Group of Experts on Recruitment in Tropical Demersal Communities (i.e., FEDERP, PREP and CORDERP);

##### Recommendation 4

The implementation of the new initiative of the WESTPAC-Task Team on Ocean Science in relation to Living Resources (PREP);

##### Recommendation 5

That FAO prepare a review of information on cephalopod recruitment mechanisms and variation, including interactions with exploited fish populations, and that FAO and IOC provide support for the Symposium on Cephalopod Ageing and Growth in Relation to Squid Fisheries, to be held in Japan in 1991;

##### Recommendation 6

That IOC in collaboration with FAO (and with the advice of SCOR) undertake the preparation of an Atlas on Environmental Structure and Variability for use in recruitment studies;

Recommendation 7

That the Technical Committee on IODE facilitate access to national and international physical data sets urgently needed by fishery scientists and oceanographers, particularly the facilitation of the definition and acquisition by users of data sub-sets at low cost and in formats compatible with micro-computers;

Recommendation 8

That IOC, in collaboration with SCOR, organize an expert consultation on the statistical analysis of recruitment time-series and arrange for the preparation of a handbook of basic techniques;

Recommendation 9

The widening of the Guiding Group expertise to cover red tides and related toxic and anoxic phenomena;

Recommendation 10

The implementation of the IOC Assembly's decision, at its Fourteenth Session, that an OSLR Newsletter be established.

## ANNEX III

ICES COMMITMENTS TO IREP

Two Working Groups have been set up to look into IREP-related matters, and these have met and reported back to ICES Statutory Meetings. The reports of these meetings are entitled "The Report of the IREP Study Group" (ICES CM1985/Gen:4) and "The Report of the IREP Steering Group" (ICES CM1986/Gen:7).

Report of the IREP Study Group

This study group was convened as a result of a recommendation from a meeting of an ad hoc group chaired by Dr. J. Steel and was established by the ICES Consultative Committee at the 1984 Statutory Meeting. It was chaired by Professor G. Kullenberg and Dr. J P Troadec, and the group met in Copenhagen in April 1985.

The objectives were to consider ongoing projects relevant to IREP and to formulate the steps needed to develop additional specific projects in the ICES area. The Group reviewed existing work in the ICES area and concluded that it was not realistic to propose any completely new activity or cooperative project. Instead the group decided to focus on areas where international cooperation would be useful and where existing resources could be utilized.

Report of the IREP Steering Group

This group, which was chaired by R Jones, met in Copenhagen in June 1986.

The terms of reference were to develop further an IREP-oriented strategy for recruitment research within ICES, to monitor ongoing activities, and, to develop topics for meetings.

The report was endorsed by ICES at the 1986 meeting. The Chairman's summary of the report is given below (ICES CM 1986/Gen:7, Revised).

The group has been asked to continue its work during 1987 and the present position is that this work is going on by correspondence.

Report of IREP Steering Group - Chairman's Summary

## 1. TERMS OF REFERENCE

The main points of the terms of reference of the IREP Steering Group were to:

- (i) develop further an IREP-orientated strategy for recruitment research within ICES,
- (ii) monitor ongoing activities, and
- (iii) develop topics for meetings

The main parts of the Report are summarized below.

## 2. AN IREP-ORIENTED STRATEGY

### 2.1 General considerations

Recruitment is the outcome of factors that influence mortality throughout the larval and juvenile stages and there appears to be no consensus of agreement about the relative importance to recruitment of the factors that operate at each of these two stages. Furthermore, at any one stage, mortality can be influenced by more than one factor. For example, at the larval stage mortality can be influenced by food concentration, predation, and/or advection. Again, there appears to be no consensus about which of these factors is most important. Also, it seems likely that a factor that is very important for determining recruitment in one species is not necessarily of equal importance for doing so in another.

In short, the Steering Group recognized that there is a great diversity of views about the processes that determine recruitment. It was concluded, therefore, that the time is not yet ready for planning a definitive experiment to resolve the recruitment problem. Instead, it was felt that the ICES strategy should be to monitor ongoing activities and to encourage those activities that appear particularly relevant towards understanding the recruitment process.

With this in mind, the Steering Group reviewed information about National Recruitment Projects, and drew attention, in particular, to the following topics:

- (a) Larval patch studies by several countries
- (b) Early life history of scallops by France and Canada
- (c) Early life history studies of sole by scientists from several institutes in France
- (d) Comparisons of cod and haddock populations in different parts of the North Atlantic
- (e) The role of coastal currents in determining recruitment in a number of cod populations
- (f) SARP-type studies including the Iberian SARP project
- (g) The effects of contaminants on the recruitment process

### 2.2 Technological limitations

The Steering Group recognized that whatever strategy ICES chooses to adopt, some effort must be directed towards resolving important technological limitations.

There are particular difficulties associated with the sampling of late larvae and "early juvenile" fish for example. More generally, there is the problem of reconciling biology and physics at the 20 km scale.

## 3. MONITORING ONGOING PROGRAMMES

The Steering Group took note of information provided in the Report of the IREP Study Group (CM 1985/Gen:4) and summarized further information in respect of USA, France, UK (Scotland), and Canada.



#### 4. THEME SESSIONS AND SYMPOSIA

The Steering Group drew attention to, and made suggestions about the following:

- (i) The Mini-Symposium to be held in 1987
- (ii) Theoretical basis for Recruitment Studies
- (iii) Geographic Population Structure of Marine Fish Species
- (iv) Comparative Recruitment Studies in different areas
- (v) Technological developments
- (vi) Recruitment variability in relation to anthropogenic and natural variables
- (vii) A proposal to hold the next "Early Life History" Symposium in Bergen in 1988.

## ANNEX IV

### REVIEW OF THE BIOLOGY OF COMMERCIAL SQUIDS

#### INTRODUCTION

Over 650 species of squids (and cuttlefish) are known. Squids represent a largely untapped biomass in all oceans as shown by their importance in the diet of cetaceans, seals, fish and birds. Sperm whales alone probably consume well over 100 million tons of squids annually nearly all species of which are only rarely caught by men.

#### MAIN FISHERIES

Since 1970 the recorded catch has been 1-1.5 million tons/year (1.5-2.1% of the total fish catch). Many artisanal squid fisheries are not recorded.

Ommastrephidae contribute about the 50% of the cephalopod catch. They are caught on the continental shelves, as follows: Japan area, Todarodes pacificus, O. bartrami; New Zealand and Australia, Nototodarus sloani, N. gouldi; Peru/Chile, Dosidicus gigas; Falklands/Malvinas, Illex argentinus; East Canada, Illex illecebrosus.

Loliginidae contribute about 25% of the cephalopod catch (mainly 8 species). All are caught on the continental shelves.

Sepiidae (cuttlefish) contribute about 14% of the cephalopod catch. All are caught on the continental shelves.

Minor fisheries are represented by Enoploteuthidae, Onychoteuthidae and Thysanoteuthidae.

All species are caught on the continental shelves by either jigging, trawling or seining. Less than 10% of the shelf area is fished for squid. 75 species are commercial of which 64 are caught inshore. Squids are usually a small percentage of the local landings because they are caught on the same grounds as finfish and often with the same gear.

#### BIOLOGICAL PARAMETERS

##### Spawning

Only is known for a few species (Todarodes pacificus, Illex illecebrosus, a few loliginids and Sepia species). Loliginidae and Sepiidae spawn on sea bottom, I. illecebrosus species in midwater (? + T. pacificus). Spawn is laid in "mops" of gelatinous fingers (loliginid species), in "grapes" (sepiid species), or in large gelatinous "torpedoes" (some oceanic species).

Spawning grounds are separate from feeding/fishing grounds (to judge from larval occurrence). Time of hatching decreases with increase in temperature (I. illecebrosus 14-21°C, 27-7 days) and increases with decrease in egg size (Sepia officinalis 15-25°C, 180-25 days). In one genus, eggs tend to be larger when the shelf is narrower (cf Loligo opalescens and L. pealei). Spawning extends over more than 6 months in most species studied (from cohorts). Females spawn only once and

then die or, in some species of the loliginids spawning is intermittent during the spawning season. Season of spawning species can vary according to latitude (L. pealei). Species may have populations spawning in 1 (I. illecebrosus), 2 (L. forbesi) or 3 (T. pacificus, Dosidicus gigas and Symplectotenthis onalaniensis).

### Hatchlings

Only definitely identified for very few species. (A book has been prepared, under FAO sponsorship, by the Cephalopod International Advisory Council-CIAC on "larval" cephalopod identification, after the CIAC Workshop on Early Growth States of Cephalopods, Banyuls-sur-mer, France, 17 June - 1 July 1985). Usually very rare in the plankton even in regions where spawn is collected. Development is direct with only minor features suggesting a metamorphosis. Not easily kept alive for more than a few days. Usually die when the yolk is used up. First feeding very critical stage of life (2-3 days). No oceanic species (e.g. Ommastrephidae) have survived yolk stage. Mortality rate (winter only): .0013 hatchlings survived to 14.5 mm in T. pacificus.

### Growth

Length-weight are related allometrically. Great variation in the growth rate according to species, age, temperature. Within populations genetic influence is not established. Growth is similar to the fastest growing fish. Planktonic stage is shorter than in fish. Asymptotic growth is not established. It has been shown that in some species (L. pealei, S. officinalis, D. gigas) the animals grow larger in the colder parts of the range. In the field, growth is only known from cohort analysis after entry to the fisheries. This is inaccurate because of immigration, emigration and gear selectivity. Most species which have been studied live for 1-2 years. In at least some species (S. officinalis and L. pealei and I. illecebrosus) early hatching individuals spawn after one year while later hatchlings from the same season grow slowly and spawn after two years.

Females usually grow to maturity in less than a year, have gonads up to 30% body weight. Die after spawning or at end of spawning season. Males have gonads up to 5% BW, mature more quickly and grow larger. Growth rings in the statolith promise to be a useful method of age determination. In several species these seem to be daily (I. illecebrosus, L. opalescens, Allotenthis subulata) and studies are underway on several other species.

### Fecundity

Varies from 70-700 thousand in the Ommastrephidae and 4-40 thousand in Loliginidae - less than fish as they only spawn once. If spawning is intermittent, as is thought for some species, this will be an underestimate.

### Food

Qualitatively the food is known for many species. All take a very broad spectrum of fish, crustaceans and squids. Many are cannibals and in I. illecebrosus, in which 35% of the food of sub-adult migrators may be from this source, it has been suggested that this is used as a method of overcoming food shortage during migration to spawning grounds. Little reliable quantitative data on food is available. Eat 3-15% body weight/day. Squids spend less than 12 hrs between meals.

### Shoaling

Only seen very rarely in young juveniles. Sub-adults and adults shoal in size groups in most species but in a few non-cannabilistic species shoals include a large size range. (Sepioteuthis spp.).

### Distribution

Ommastrephidae are caught during feeding sub-adult stage on the continental shelves. They migrate to deeper water as they mature and spawn at depths and places unknown, some in midwater (I. illecebrosus) and probably some on the bottom (T. pacificus, T. sagittatus). Some of these species probably spawn on or above the continental slope. While some are only ever caught near the shelves or slopes (I. illecebrosus, I. argentinus) others are distributed very much more broadly throughout the oceans (T. sagittatus, Ommastrephes bastrami, ? T. pacificus, ? Nototodarus sloanei) and it is likely that commercial fishing is only sampling a small part of the species.

### Populations

Very little is known about intra-specific groups but populations which spawn in separate locations and/or at different seasons are recognized in some species (T. pacificus, L. forbesi, S. officinalis). Genetic analysis of one species suggests that there is very little polymorphism within populations. If shown to be a general feature this should provide a very powerful tool for fisheries management. Work is underway in the U.K. on this.

### Numbers

Because of their brief life to spawning (1-2 years) and susceptibility to environmental changes, fisheries are very unpredictable and often fluctuate violently. A fairly typical cycle in many species is: low catches over about 10 years followed by a very high recruitment leading to 3-5 years of good fishing followed by another period of poor fishing. Such natural fluctuations, probably caused by events beyond man's control, bedevil some fisheries (I. illecebrosus, T. sagittatus, L. forbesi, Sepia officinalis) and have discouraged their management.

### LOGISTICAL PROBLEMS

1. Very few committed squid biology specialists (less than 30 worldwide).
2. Very little resource is made available to sample outside the fishing areas and seasons.
3. Sampling methods for spawn, young juveniles and spawning animals, are very inadequate.
4. Unpredictability of fisheries leading to short term expenditure on research when sustained expenditure is essential.
5. Biological differences between squids and most commercial (managed) fish species. New statistical approaches are necessary because of semelparous lifestyle.

## PRESENT APPROACHES

1. Pooling of research effort is essential to overcome difficulties of identification, low expenditure on sampling, requirement to develop methods for growth analysis and genetical analysis of populations. This is being attempted by CIAC which has organized two workshops and two symposia and has plans for two more workshops having relevance to fisheries (on particular systematic problems concerning commercial species and on age determination methodology). Plans have also been made for training workshops to be held in Ecuador and China to address fisheries problems and inform fisheries biologists about cephalopods (international support has not been forthcoming for the former of these and CIAC is presently seeking support for the latter).
2. A few research projects should be particularly encouraged:
  - (i) Larval studies on Illex. Their distribution and their numbers in both good and bad years for the fishery should be assessed by regular planktonic surveys with appropriate nets.
  - (ii) Genetic (protein) analysis of populations.
  - (iii) Development of statistical techniques for squid stock management.
  - (iv) Searches for spawn and spawning grounds of Ommastrephids and Loliginids. Video submersibles to give egg estimates. Use of ultrasonic tags to follow adults to spawning areas.
  - (v) Finfish catches and squid catches often seems to be related reciprocally. Steps should be taken to resolve this.
  - (vi) Studies on growth lines in statoliths. A meeting is planned by CIAC for 1991.
3. The main requirement in managing squid fisheries would seem to be to identify and correct recruitment overfishing.

ANNEX V

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ANNEX V I

LIST OF DOCUMENTS\*

<u>Document Code</u>	<u>Title</u>
<u>WORKING DOCUMENTS</u>	
IOC-FAO/GGE-OSLR-II/1 prov.	Provisional Agenda
IOC-FAO/GGE-OSLR-II/2 prov.	Annotated Provisional Agenda
IOC-FAO/GGE-OSLR-II/3 prov.	Draft Summary Report
IOC-FAO/GGE-OSLR-II/4 prov.	Provisional List of Documents
IOC-FAO/GGE-OSLR-II/5 prov.	Provisional List of Participants
<u>REFERENCE AND INFORMATION DOCUMENTS</u>	
IOC-FAO/GGE-OSLR-I/3	IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources (First Session, Paris, 16-20 July 1984)
IOC-FAO/GGE-OSLR-II/Inf. 1	Extracts of the Summary Report of the Fourteenth Assembly of IOC (Paris, 17 March - 1 April 1987)
IOC-FAO/GGE-OSLR-II/Inf. 2	OSLR/SARP Seminar on Potential Application of New Techniques in the Study of Recruitment for Pelagic Coastal Fisheries on the Iberian Shelf (Vigo, Spain, 30 September - 2 October 1985)
IOCEA-I/3	IOC Regional Committee for the Central Eastern Atlantic (First Session, Praia, Cape Verde, 19-23 January 1987)
IOC-FAO/GGE-OSLR-II/Inf. 3	Report of Meeting on sprat recruitment activities in UK and FRG (Bremerhaven, FRG, 15 January 1987)

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\* This List is provided only as a reference.  
Documents cannot be made available after the Session.

IOC Workshop Report No. 44	IOC-FAO Workshop on Recruitment in Tropical Coastal Demersal Communities (Ciudad del Carmen, Campeche, Mexico, 21-25 April 1986)
IOCARIBE/GE-TRODERP-I/3	Informe Resumido Primera Reunión del Grupo de Expertos IOCARIBE sobre Reclutamiento en Comunidades Demersales Costeras Tropicales (TRODERP) (Cartagena, Colombia, 19-21 de Mayo, 1987)
IOCARIBE/GE-TRODERP-I/3S	Executive Summary First Session of the IOCARIBE Group of Experts on Recruitment in Tropical Coastal Demersal Communities (TRODERP) (Cartagena, Colombia, 19-21 May 1987)
IOC-FAO/GGE-OSLR-II/Inf. 4	Proposal for a WESTPAC Interdisciplinary Study on Interannual Variability of Recruitment in the Banana Prawn, <u>Penaeus merguensis</u> , in relation to the physical dynamics of the nearshore coastal region
CARI/FK-I/3	Summary Report of the IOCARIBE Steering Committee for Developing Regional Contingencies for Fish Kills (Mayaguez, Puerto Rico, 25-29 October 1982)
IOC-FAO/GGE-OSLR-II/Inf. 5	Workshop on International Co-operation in the Study of ocean blooms and red tides (Takamatsu City, Kagawa, Japan, 16-17 November 1987)
SC-IOCARIBE-II/Inf. 5	Western Atlantic Turtle Symposium (Mayagüez, Puerto Rico, 12-16 October 1987)
IOC-FAO/GGE-OSLR-II/Inf. 6	IABO/Unesco "High Diversity Marine Ecosystems" - Actividades recientes.
IOC-FAO/GGE-OSLR-II/Inf. 7	Focusing on Squid Recruitment

ANNEX VII

LIST OF ACRONYMS

AQMRR	Advisory Committee on Marine Resources Research (of FAO)
CCCCO	Committee on Climatic Changes and the Ocean (IOC/SCOR)
CECAF	FAO Committee on Eastern Central Atlantic Fisheries
CIAC	Cephalopod International Advisory Council
CORDERP	Coral Reef Demersal Recruitment Project (of TRODERP)
CPPS	Comisión Permanente del Pacífico Sur (Colombia, Chile, Ecuador, Perú)
ENSO	El Niño - Southern Oscillation
FAO	Food and Agriculture Organization of the United Nations
FEDERP	Fish Estuarine Deltaic Recruitment Project (of TRODERP)
GIPME	Global Investigation of Pollution in the Marine Environment (IOC)
GTZ	Gesellschaft für Technische Zusammenarbeite (FRG)
IABO	International Association for Biological Oceanography
ICES	International Council for the Exploration of the Sea
ICLARM	International Center for Living Aquatic Resources Management
IGOSS	Integrated Global Ocean Services System (IOC/WMO)
IMARPE	Instituto del Mar del Perú
IOC	Intergovernmental Oceanographic Commission
IOCARIBE	IOC Sub-Commission for the Caribbean and Adjacent Regions
IOCEA	IOC Regional Committee for the Eastern Central Atlantic
IODE	International Oceanographic Data Exchange (IOC)
IPFC	Indo-Pacific Fisheries Commission (FAO)

IREP	International Recruitment Programme (of OSLR)
MAFF	Ministry of Agriculture, Fisheries and Food (UK)
NAFO	North-West Atlantic Fisheries Organization
NEAFC	North-East Atlantic Fisheries Commission
NEFC	North-East Fisheries Center (USA)
NMFS	National Marine Fisheries Service (USA)
NOAA	National Oceanic and Atmospheric Administration (USA)
OSLR	Ocean Science in Relation to Living Resources (IOC/FAO)
OSNLR	Ocean Science in Relation to Non-Living Resources (IOC/UN (OETB))
PREP	Penaeid Recruitment Project (of TRODERP)
PROCOPA	Programa Cooperativo Peruano-Alemán de Investigación Pesquera
SARP	Sardine/Anchovy Recruitment Project (of IREP/OSLR)
SCOR	Scientific Committee on Oceanic Research (ICSU)
SCORRAD	Standing Committee on Resources Research and Development (FAO/IPFC)
SWFC	Southwest Fisheries Center (USA)
TEMA	Training, Education and Mutual Assistance in the Marine Sciences (IOC)
TRODERP	Tropical Demersal Recruitment Project (of IREP/OSLR)
UNESCO	United Nations Educational, Scientific and Cultural Organization
WATS-II	Second Western Atlantic Turtle Symposium
WESTPAC	Western Pacific, Regional Committee for the Western Pacific (IOC)
WMO	World Meteorological Organization