International Council for the
Exploration of the Sea

C.M. 1976/L:1
Administrative Report

PLANKTON COMMITTEE

by

G. Hempel

1975

Belgium

(R. de Clerck & L. De Coninck)

The study on the distribution in space and the evolution in time of sole eggs and larvae was continued during 1975.

The densities of the sole eggs and larvae along the Belgian coast were determined by means of the Dutch type Gulf Sampler on 47 stations. The sampling took place from March till June on a fortnightly basis.

It can be assumed that the recruitment of the year class 1975 will not enlarge considerably the stock size of the Southern Bight sole population, as the recorded densities indicated a poor year class.

Canada

(T. Platt)

Work has continued on the relationship between patchiness in the plankton and the physical structure of the environment. A theoretical form has been proposed for the variance spectrum of chlorophyll in the mixed layer of the ocean. The critical parameters are the net rate of reproduction of phytoplankton and rate of dissipation of turbulence. In the range of length-scales from 1 km to 100 km, the variance of chlorophyll should vary inversely as the wavenumber. A technique has been proposed for isolating the portion of chlorophyll variance not correlated with temperature. Several such residual spectra have been calculated for data from the Gulf of St Lawrence which are consistent with the theoretical spectrum.

During August 1975, a major cruise was made in the region near Yarmouth, Nova Scotia to study the spatial distribution of phytoplankton in an upwelling region. Low temperature surface waters which occur in this region during most summers are believed to result from upwelling induced by either winds or tides. Two ships, one employing a towed pump and the other a Batfish with an *in situ* fluorometer, mapped out the spatial structure of chlorophyll in the region. One 60 km transect was completed with the Batfish five times in a 10-day period. At the same time an airborne programme was carried out to measure the surface chlorophyll concentration remotely by a variety of instrumental techniques. The results of this experiment will provide a description of the variability of a large range of scales of spatial variability and should give a good base from which further development of automatic plankton survey instruments can be made.

Analysis of zooplankton sampling data was carried out to determine the spatial and temporal variability of zooplankton samples collected on fixed and random stations. The aim of this work is to measure the degree of variability encountered by different sampling methods, and to develop techniques that require fewer samples to be taken but at the same time provide the best possible estimate of the true population means of the different species of zooplankton.

An investigation has been made of the mathematical representation of the relationship between photosynthesis and light for phytoplankton (excluding the light-inhibition regime). All the available models in the literature have been reparameterised for ease of comparison, and fitted to data from 188 duplicate experiments made on natural phytoplankton populations from the coastal waters of Nova Scotia. This analysis gave unambiguous results on the choice of the most consistently useful empirical description of light saturation curves for coastal populations. Both the initial slope of the curve and the assimilation number varied about five-fold throughout the year. The distribution of the results for the initial slope has positive skewness, asymptotic to a figure that agreed very well with an estimate (based on quantum efficiency) of the physiological maxiumum attainable value. The time average of these figures indicated that on the average the coastal phytoplankton are producing at only 45 % of the maximum capacity. The initial slope was shown to be independent of temperature, but correlated with light-history of the cells. On the other hand, the assimilation number depends strongly on temperature, but not on light-history. The initial slope and the assimilation number are correlated with each other, and the relationship is independent of depth. This work, which is continuing, should improve our capability for predicting phytoplankton production in the field.

Further research has been carried out on the metabolism of the coastal zooplankton community in relation to the kinds and amounts of particulate matter available as food. Particular attention has been given to the distribution of digestive enzymes in the zooplankton. A significant regression could not be found between the respiratory rate of the animals and any measure of potential food supply, but the rate of ammonia release could be predicted from the amounts of carbon and nitrogen in the particulate matter, and their distribution in the form of protein and carbohydrate. Similarly, carbohydratases were well correlated with high levels of carbohydrates in the particulate matter, and likewise proteinases and protein. Protein was characteristic of spring time phytoplankton communities, but carbohydrate tended to dominate at other seasons. Particle size also seemed very important in controlling zooplankton production and the collapse of the population in the fall was not so much because of low particle concentration in general, but due to the absence of smaller phytoplankton species. Laboratory feeding studies showed that more of the neritic zooplankton species tested could make use of members of the dinoflagellate genus Ceratium which dominates the fall plankton community in Bedford Basin.

Several species of tintinnids were brought into laboratory culture during the past year and their life cycles clarified. Resting stages were encountered and cultures re-established from them. Certain tintinnids appear to be suitable food for some neritic copepods.

A cruise was made in the Gulf of St Lawrence to study the vertical migration of euphausids and continue the development of the 120 kHz sonar as a quantitative zooplankton instrument.

Development work was started on a multi-net tucker trawl that will take zooplankton samples on command as well as telemeter data on depth, flow rate, temperature and light intensity. The first tests of this net will be made early in 1976.

Denmark

(E. Smidt)

Home waters

The Baltic. In order to estimate the biomass of the spawning cod stock in the Bornholm Basin, the number of cod eggs per m^2 has been estimated in four equidistant periods during the spawning time, by means of the CalcoFi-net and 1 m ring-net in March, April and May.

The North Sea. The herring larval surveys by the Gulf III sampler were undertaken in September.

West Greenland waters

Routine sampling with stramin net (2 m ring diameter, $\frac{1}{2}$ hour oblique hauls from about 50 m depth) was undertaken on 4 east-west standard sections in the Davis Strait in July, primarily for estimating numbers of cod larvae. Sampling was further made throughout the year on one section. Fish eggs and larvae and invertebrates were sorted and counted.

Finland

(Å. Niemi)

Institute of Marine Research, Helsinki

Phytoplankton and primary production

a) Investigations on phytoplankton, primary production (^{14}C *in situ*, and in incubator in constant light and temperature), total phosphorus and nitrogen, and environmental parameters were made in unpolluted sea areas at 5 coastal stations : Orrengrund (mid part of the Gulf of Finland), Kopparnäs (western part of the Gulf of Finland), Tvärminne (entrance to the Gulf of Finland), Kaskinen (northeastern part of the Bothnian Sea) and Ulkokalla (Bothnian Bay).

   Samples were taken every second or third week except for Kaskinen, where only one study was made in July. At Kopparnäs 4 studies during the ice-free period have been made. During the ice period, samples were taken more sporadically.

b) During the cruises with RV "Aranda" (May-December) net samples (20 μ m) of phytoplankton were collected in the central and northern parts of the Baltic Sea.

Zooplankton

Zooplankton sampling (Hensen net, mesh size 150 μ m, vertical hauls : 25-0 m) continued at the following coastal stations : Orrengrund (1967 -), Tvärminne (1966 -), Seili in the Archipelago Sea (1966 -), and Krunnit in the Bothnian Bay (1966 -). Samples were taken three times a month (once a month during the ice period).

Institute of Radiation Protection

Phytoplankton and primary production studies (^{14}C *in situ*) were performed once or twice a month during the ice-free period, around the locality of the nuclear power plants in the Lòviisa Archipelago in the Gulf of Finland and in the Rauma Archipelago in the Bothnian Sea.

National Board of Waters, Water Research Office

Phytoplankton and physical-chemical parameters were measured twice a year, at the beginning of March and in early August, at about 30 stations in the Gulf of Finland and the Gulf of Bothnia.

Helsinki City Water Conservation Laboratory

Phytoplankton and zooplankton (vertical series, mesh size 50 µm) were sampled and primary production (^{14}C, in situ) and environmental parameters were measured in the archipelago waters off Helsinki and Espoo twice a month during the ice-free period. Samples were taken at several stations from the severely polluted inner bays to the unpolluted area outside the archipelago.

Åbo Akademi

Primary production and phyto- and zooplankton were studied in semi-enclosed meromictic bays in the Åland Archipelago.

University of Turku

Zooplankton was sampled at two localities in the Archipelago Sea for analysis of the PCB-group components.

University of Oulu

Plankton studies in the Liminka Bay continued. Hydrographical and plankton studies in the NE shallow coastal sea area off Oulu were performed during the summer period, and under the ice in spring.

University of Helsinki, Tvärminne Zoological Station

Enrichment experiments with natural phytoplankton in the Tvärminne Archipelago (from the inner bays to the sea area) were made from April to November. The aim is to clarify the factors regulating the primary production.

France

(L. Marteil)

Travaux de l'Institut des Pêches maritimes

Ichthyoplancton (Mmes Arbault et Lacroix)

1. Etude des oeufs et larves de maqueraux dans le golfe de Gascogne de 1964 à 1973

   De cette étude, on peut retenir que les oeufs de maqueraux peuvent apparaître dans le golfe de Gascogne pendant la seconde quinzaine de février comme février 1972, mais ils sont rares et localisés surtout dans le sud du golfe. La ponte s'intensifie rapidement et atteint son maximum en mai, elle couvre une aire vaste, les plus grosses concentrations s'effectuant sur le talus ou sur la plate-forme continentale au fond du golfe entre la Loire et la Gironde. En été, la reproduction touche à sa fin et s'éparpille dans tout le golfe.

2. Etude des prélèvements des campagnes d'ichthyoplancton dans le golfe de Gascogne en vue de l'etude quantitative des oeufs et larves de Clupéidés

Ces prélèvements ont été effectués au filet Bongo, les masses de plancton recueillies sont importantes.

Le dépouillement de la campagne de mars a été commencé.

Zooplancton (Mme Beaudouin)

Le travail a porté principalement sur l'étude et l'inventaire des euphausiacés, mysidacés, larves de décapodes récoltés dans le golfe de Gascogne en 1971 et 1972, à raison de quatre campagnes trimestrielles par année. La distribution saisonnière des espèces inventoriées donne lieu à une publication sur les résultats de 2 années.

Des résultats anciens ont été repris concernant l'inventaire pour les campagnes timestrielles de 1971, des groupes planctoniques suivants : chaetognathes, siphonophores, salpes, dolioles, méduses. Leur répartition saisonnière sera présentée au CIEM sous forme de cartes de distribution.

Travaux du Laboratoire de Biologie Animale (Plancton) Marseille

Aire du CIEM

Copépodes de la côte atlantique du Maroc (inventaire; répartition quantitative, géographique et saisonnière; données écologiques). M.L. Furnestin et M. Belfquih.

Décapodes pélagiques de la province atlanto-méditerranéenne (inventaire, taxonomie infraspécifique, biogéographie, biologie comparée). J.P. Casanova.

Histologie et ultrastructure des organes oculaires de Chaetognathes (Sagitta, Eukrohnia). Etude expérimentale des migrations pigmentaires et des diverses relations écologiques (F. Ducret).

Application de méthodologies nouvelles

a) à l'étude des Thécosomes (J. Rampal):

- étude microarchitectural de la coquille au microscope électronique à balayage en vue d'une révision phylogénétique du groupe;

- application de méthodes d'analyse mathématique (statistique descriptive, tests d'hypothèse, analyse multivariée) à l'étude des variations géographiques infraspécifiques chez les Thécosomes actuels et fossiles.

b) à l'écophysiologie de la nutrition chez les Copépodes (J. Mazza, J. Arnaud, M. Brunet).

- étude expérimentale du comportement alimentaire vis-à-vis d'algues (isolées ou en mélange) et de nauplii d'Artemia : ration journalière et taux de filtration;

- étude histologique et histochimique du tube digestif en microscopie photonique et électronique; comparaison des structures chez diverses espèces ou des individus de même espèce à différents états.

Germany, Federal Republic of

(G. Hempel)

1. Institut für Meereskunde Kiel

The departments of Marine Plankton and of Fisheries Biology carried out a plankton survey in the upwelling area off Spanish Sahara in January-February. RV "Meteor" and RSS "Discovery" sampled plankton of all size fractions along three sections of about 90 n.m. in length normal to the coast. For macroplankton and micronecton the British RMT 8+1 with opening closing device was employed at various depth layers down to ca. 450 m. Bongo nets for oblique tows and the newly developed Tetra-net (4 bags of 500, 200, 100 and 50 micron mesh size combined in one frame) for vertical hauls were used for the study of ichthyoplankton and its food in the upper 200 m. A total of 123 hauls was made. On 32 stations neuston was collected as well. The working up of the ichthyoplankton collections of previous expeditions in the area between Gibraltar and Dakar was continued.

On the same expedition smaller zooplankton was sampled by the multi-net opening/closing device. For a detailed study of the composition of zoo- and phytoplankton together with the abundance of detritus in relation to physical and chemical parameters in distinct depth zones above and below the thermocline, samples were taken by a large rosette sampler with 6 bottles of 100 l each. Most of the sampled volume was fractionated by filtering. Live copepods and phytoplankton were used for feeding experiments and for starting cultures. Particular attention was given to the mass colonies of Thalassiosira parthenaia which is the dominant form in certain areas and phases of upwelling. Primary production measurements on this diatom as well as on the total phytoplankton were carried out throughout the cruise. Microbiologists determined the number and biological activity of bacteria at various depth-layers comparing areas of different upwelling activity.

In the North Sea, ichthyoplankton was collected during three cruises, mainly for collecting herring larvae in winter and spring in the Southern and German Bight and in September in the Orkney-Shetland region. Similar surveys were carried out in the area of Georges Bank-Gulf of Maine, both in spring and in the autumn.

Various plankton studies in Kiel Bight were carried out, partly in all year round programmes, e.g. covering productivity measurements and sampling of phytoplankton and seston off Boknis Eck in the Kiel Bight. This long-term sampling project of Prof. Krey was partly discontinued at the end of the year. Two intensive sampling schemes are located at Kiel lighthouse and off Bülk, in addition nutrients and physical parameters were regularly measured along the 6 m line in the Kiel Bight. Studies of the eutrophication included also monthly measurements of carbon, nitrogen, chlorophyll a, ATP, carbohydrates, protein and lipids. As in 1974, a set of plastic bag experiments were carried out in July/August. Regular sampling of ichthyoplankton in the western Baltic including Kiel Bight and Bornholm Basin was continued with special emphasis on the vertical distribution of eggs of cod and sprat and of herring larvae.

The expedition Baltic '75 employed several research vessels in April/May 1975 in the Bornholm Basin for studies of physical and chemical oceanography but also on the distribution and development of plankton communities and their relation to physical and chemical parameters and sedimentation.

2. Biologische Anstalt Helgoland

Routine investigations in measuring hydrographical, chemical and biological parameters at Helgoland Roads were continued. Five times a week temperature, salinity, nutrients (PO_4, NO_3, NO_2, SiO_2) chlorophyll, and phytoplankton

(inverted microscope) were measured. Further weekly determinations were made of the bacterial numbers (pour plate method) in the surface film and at a depth of 1 m, the BOD and the surface tension. The studies on the distribution and ecology of Noctiluca miliaris were continued.

This routine was accompanied by some smaller cruises around Helgoland, by a three week hydrographical-planktological investigation in July in the FLEX area, and by a special international three week expedition to study the hydrocarbon distribution in the North Sea and the microbiological consequences.

Observations of hydrography (t, S) phytoplankton, zooplankton and (especially copepods and their larval stages) and seston composition as well as nutrient measurements were continued in the Waddensea of Sylt.

The long-term fluctuations near Helgoland with respect to nutrients, phytoplankton and bacteria and the nutrient situation in the Elbe River have been investigated and submitted to the ICES North Sea Symposium.

Iceland

(I. Hallgrímsson)

Zooplankton

Zooplankton was sampled at 568 stations during 1975, mostly from March to August. The areas surveyed were the coastal waters around ICELAND as well as the northern part of the Irminger Sea and waters of the East-Icelandic Current.

The sampling was carried out with Hensen net (50 - 0m), Icelandic High-speed Samplers at three different levels (5, 15 and 25 m depths) and Gulf III sampler.

Pandalus borealis larvae were also sampled in fjords of the northwest coast in two surveys.

A continuous plankton survey Reykjavik-Newfoundland and Reykjavik Suleskerry was carried out as previously in cooperation with the Oceanographic Laboratory Edinburgh.

Ireland

(F. A. Gibson)

No work to report for 1975.

Netherlands

(P. Korringa)

Rijkinstituut voor Visserijonderzoek

Phytoplankton monitoring in the Dutch coastal area has been continued in the year 1975. On the basis of this material a species diversity index of the Shannon weaver type was computed for the two predominant groups in the phytoplankton, viz. diatoms and dinoflagellates.

The results were compared with the rate of dilution of North Sea water caused by river influx, expressed in salinities. The figures obtained clearly demonstrate that lower salinities did not necessarily lead to a decline in the diversity index.

Mass development of the dinoflagellate Prorocentrum redfieldi, tentatively associated with shellfish toxicity, was recorded in the autumn. Up to 952 000 cells/litre of this species were counted, a manifold of that found in September 1974. Prorocentrum micans did not reach more than 2 200 cells/litre. Goniaulax c.f. spinifera was observed in small numbers only, but of Exuviella apora a maximum number of 55 000 cells/litre has been enumerated.

As usual, a fair number of plankton samples was collected and analysed for quantitative studies on herring larvae, on shrimp larvae along the Dutch coast and on eggs and larvae of sole in the Wadden Sea. These investigations will be discussed in the reports of the relevant committees.

Nederlands Instituut voor Onderzoek der Zee

Samples collected monthly in the Southern North Sea in 1973 and 1974 were analysed. Biomass estimates were made of 60 zooplankton species, of which the calanoid copepods and arrowworms were distinguished as to development stage and length class. About 200 phytoplankton species were counted, sized and identified.

As in 1974, the wax and wane of the spring bloom of phytoplankton and zooplankton in the eastern part of the Southern Bight of the North Sea was followed from week to week from January to June. It was found that the spring development of calanoid copepods in Dutch coastal waters depends more upon abiotic factors such as the increasing water temperature, than upon the spring bloom of phytoplankton, which in these vertically homogeneous waters is closely related to light conditions (incident solar radiation, water depth and turbidity).

Preliminary simulation models of the plankton dynamics in the Southern Bight were formulated, based on the measurements of the biotic and abiotic components of the plankton system (primary production, chlorophyll, phytoplankton and zooplankton biomass, oxygen and nutrient concentrations, light, turbidity, etc.).

Norway

(G. Berge & F. Beyer)

1. Institute of Marine Research, Bergen

1. 1 Phytoplankton

1. 1.1 The long-term monitoring programme on the coastal banks off Western Norway was contiued in 1975. During April, measurements of primary production rates, phytoplankton standing stocks (as chlorophyll a), light penetration, turbidity and particle size frequency were made. The primary production rates per unit of chlorophyll a at standard conditions (P.I.) were calculated and showed an average value somewhat higher than in previous years while a lower average daily primary production was observed.

1. 1.2 During 1975, a baseline resource study was carried out over the Continental Shelf off northern Norway (Troms-Finmark), in order to describe the natural fisheries resources and the underlaying production systems before a planned oil exploitation in this area. In this context six cruises were undertaken during May, June, August and October where the following parameters were measured : primary production rates, phytoplankton biomass, zooplankton taxa and biomasses, light penetration, turbidity, particle size frequency distribution and hydrography. The yearly primary production was calculated and varied within the area between 35-80 gC/m^2. Of this annual production 50% or more took place during May and June. The primary production rates per unit of chlorophyll a (P.I.) showed small variations during the year (P.I. = 2.2; s.d.:1.33; n = 431). A report is in press.

1.1.3 As part of the "Joint Norwegian Coastal Current Project" sponsored by the Norwegian Oceanographic Committee, 470 samples were collected for pigment analysis mainly from 5 m depths. The collection was made by 5 research vessels during 25 May - 6 June and covered the coastal bank area along the entire Norwegian Coast. A preliminary report on the horizontal distribution of chlorophyll along the Norwegian coast together with other complementary data (hydrography, zooplankton, taxa and biomass) is in preparation. At the same time about 6 000 samples for nutrients determination were collected and are still under analysis.

1.1.4 The long-term programme of environmental investigations in the Norwegian fjords was continued. Ten fjords in southern Norway, and 24 in western and northern Norway were surveyed in March and November repectively. Nutrients, oxygen, primary production, chlorophyll and particle size frequency distributions were measured. Reports concerning these and previous results will be published in 1976.

1.1.5 In the major part of the above-mentioned programmes continuous and simultaneous measurements of water transparency and in vivo fluorescence were made.

Preliminary results showed a good relationship between the two parameters for open sea and coastal waters. This relationship when applied to near shore waters and fjords, where there is not always a good agreement between the parameters, permitted to identify and roughly to quantify the presence of non-planktonic particles affecting the transparency of the water.

1.1.6 In connection with the planning of thermic power stations the baseline studies of phytoplankton, zooplankton and fish productivity in the Oslofjord and adjacent coastal waters continued. During the year 10 surveys of the area were made. The results were published in Fisken og Havet, serie A, and in a report to the Norwegian Authority of waterways and electric power (Institute of Marine Research, Biological Station, Flødevigen).

1.2 Zooplankton

1.2.1 Sampling was continued at the permanent oceanographic stations along the coast of Norway, West Spitsbergen and at station Mike in the Norwegian Sea. The working up of the material was this year postponed in favour of the high priority baseline study in Northern Norwegian Coastal waters.

1.2.2 In the Norwegian Coastal Current Project, zooplankton was sampled at 418 stations in 26 sections along the entire coast of Norway during the period 27 May - 6 June. At each station at least two vertical hauls were taken with Juday nets (J.36, mesh size 180 µ), surface hauls were taken with J. 36 and the Otter surface sampler (OSS 40, mesh size 263µ). The latter was mainly being intended for sampling of tar balls, but fish eggs, larvae and zooplankton were simultaneously collected and studied. In all, 1 118 plankton samples were collected.

1.2.3 As a link in the baseline investigations preceding an oil prospecting programme off northern Norway, zooplankton was sampled at a series of sections between Andøya and North Cape (ref. to 1.1.2). Vertical hauls with J. 36 were taken at 161 stations. Surface hauls were taken at 22 stations with OSS 40 and oblique hauls at 16 stations with Bongo net (B. 20, mesh size 500µ).

The plankton material has been worked up by the short-cut method, fish eggs and larvae separated and analysed and plankton volumes measured by the displacement method. The data are processed in a computer programme and will be reported during the first half of 1976.

1.2.4 During a cruise to the Azores with the RV "G.O.Sars" in November-December vertical hauls with J. 36, were taken at 39 stations, oblique hauls with Bongo net B 60 at 19 st., and surface hauls with OSS 40, at 47 st.

1.2.5 Investigations related to commercial exploitation of zooplankton (Calanus) continued. Off Bergen the spring plankton was more abundant than in 1974, displacement volumes averaging 35-80 ml/m^2. Echo recordings were only partly successful. During experimental fishery about 13 metric tons of Calanus sp. were captured with individual catches of 2 tons during 8 hours towing with twin trawls with openings 5 x 4 m. In a small anchored trap (opening 1.6 x 0.9) 60 kg of plankton were taken over one night.

Off northern Norway the summer zooplankton was more scarce than in 1974.

1.2.6 Krill (Euphausiids). Experimental fishery for krill was carried out in March in the Norwegian Channel and in fjords south of Bergen with a trawl specially designed for the purpose. Some 150 kg of Meganyctiphanes norvegicus were captured in a 30 minutes haul. In other hauls, krill was mixed with Maurolicus muelleri and catches of a few hundred kg were obtained.

2. University of Bergen - Biological Station Espegrend

Work in 1975 was concentrated on studies of populations from two fjord areas :

2.1 Continued sampling from 1973 to 1975 in fjords in Ryfylke, NE of Stavanger, which are scheduled to be affected by a hydro-electric scheme, is providing a three-year picture of the plankton stocks and their natural fluctuations before the artificial regulation of fresh water begins to take effect. A preliminary report on the zooplankton of the year 1973 has been completed (A. Fosshagen).

2.2 Numerical analysis of the individual growth and the population growth, recruitment, and mortality of macroplanktonic species in Korsfjorden, Western Norway, has been further developed. A start has been made in integrating results from biomass estimations, calorimetric and biochemical analyses, and feeding experiments with the field results, in order to elucidate the trophic dynamics of the community. (J.B.L. Matthews).

3. Norwegian Institute for Water Research (NIVA), Oslo

Phytoplankton

Eutrophication effects in the Oslofjord were studied by means of chlorophill measurements and cell counts from quantitative samples and through growth potential experiments in the laboratory. Material was also collected from other fjords for reference purposes.

4. University of Oslo, Institute of Marine Biology and Limnology

I. Phytoplankton surveys

a) The investigation of the spring phytoplankton in the spawning areas of cod and herring (Lofoten to Möre) was continued in collaboration with the Marine Research Institute of the Fisheries Directorate, Bergen. This investigation is part of the Norwegian IBP/PM programme (I. Nygaard, T. Braarud).

b) Phytoplankton was examined as part of oceanographic surveys carried out in connection with hydroelectric power-plant projects. Samples from two of these surveys have been worked up and reports have been

prepared : (i) from Skjomen, near Narvik (published by B. Schei); (ii)from the Hardangerfjord (by A. Dick, unpublished). A third survey, in the Ryfylke Fjords, is in progress (I. Nygaard, T. Braarud).

c) A report is in preparation on the summer and autumn phytoplankton of Nordåsvatn,a land-locked fjord near Bergen (K. Tangen).

II. Special phytoplankton studies

a) Taxonomic studies on coccolithophorids, by means of transmission and scanning electron microscopy, were continued (K.R. Gaarder).

b) Morphology, taxonomy and distribution of marine plankton diatoms were studied by means of light and electron microscopes (G.R. Hasle, D.L. Evensen).

c) An investigation was made of variations in diatom shell morphology brought about by changes in growth conditions (G.R. Hasle, others).

d) Enrichment experiments and other studies of the possible role of silicone as a limiting nutrient in the Oslo Fjord were concluded (B.J. Lanemyr).

e) Experiments were started on the suitability of water in the inner Oslo Fjord as a growth medium for representative plankton algae (E. Paasche).

f) The effect of Cu on species composition in natural phytoplankton communities was studied in a controlled ecosystem pollution experiment in Loch Ewe, Scotland (K. Tangen).

g) A report is in preparation on sea discoloration during 1974 in the Oslofjord due to coccolithophorid and dinoflagellate blooms (K. Tangen).

h) Taxonomy and morphology of dinoflagellates were studied by means of light and scanning electron microscope (J. Throndsen, B. Dale, K. Tangen).

i) Studies on flagellates from Japanese waters (J. Throndsen).

Programme for 1976

The investigations mentioned under Ib, IIa,c,e,h and i will be continued.

The following special studies will be undertaken :

1) Light and electron microscope studies of morphology, taxonomy and distribution of marine planktonic diatoms, particularly Thalassiosira spp. (G.R. Hasle).

III. Zooplankton

a) Local studies of the quantitative composition of zoo-neuston, zoo hyponeuston and zooplankton were carried out in the Oslofjord (T. Schram).

b) Diurnal changes in the relation between zooplankton and hyperbenthos were studied over soft bottoms of various depths in the Oslofjord (F. Beyer).

5. University of Tromsø, Marine Biological Station

I. Phytoplankton

Quantitative samples from 7 depths were collected monthly from March to October at 4 stations in the Balsfjord. Surface samples were taken weekly off the Biological Station during the same period (B. Schei).

II. Zooplankton

a) In the Tromsø area, relative abundances of the more common species have been estimated in a material consisting of samples collected regularly from one to three depths at intervals of one to three weeks in the Balsfjord,

Ramsfjord, Kobbevaagen, Haaköybotn and Grötsundet, and irregularly from some other localities. In addition, because of an apparent deficiency in current methods in the taxonomy of tintinnids, approximately 470 photographs have been made of some of the common species, with an aim of demonstrating variability of shell shape species, and the propriety or lack of propriety of the species as currently delimited in taxonomic works. The genera involved in this are Parafavella, Ptychocylis and some forms in Tintinnopsis (Charles C. Davis).

b) In the Lofoten, investigations of the relative abundance and patchiness of cod eggs and larvae and Calanus finmarchicus were commenced in April.

6. University of Trondheim, Biological Station and the Institute of Marine Biochemistry

Phytoplankton and zooplankton

a) Biochemical and biological investigations of the spring diatom bloom were carried out in the Trondheimsfjord. Similar studies were made in June in a section 125 nautical miles long from Grip (off Kristiansund). Zooplankton was also collected.

b) In the Trondheimsfjord, whole-year studies were carried out on the biomass of copepods, especially Calanus finmarchicus, as a function of season, stage and sex. Parameters measured were C, N, P, ATP, carbohydrates, chlorophyll and fluorescence.

Poland

(Wl. Mankowski)

Polish plankton research concerned, as usual, the phyto- zoo and ichthyo-plankton and was conducted all over the southern Baltic area from the Arkona Deep to the Gdańsk Deep. Samples were taken at routine stations and, during certain biologically important periods, some additional stations as well.

Phytoplankton was taken with a 5l-sampler (Hydro-Bios) at the depths of 0, 5, 7.5, 10, 15 and 20 metres. Quantitative determinations were made using the Utermöhl microscope.

For qualitative study, i.e. for phytoplankton composition, the material was sampled with the Copenhagen net (gauze nr 25xxx). The hauls were made vertically and separately from particular water layers.

Zooplankton samples were taken vertically with a Hensen net from the bottom to the sea surface 3 times at each station. This material was separated into macro- and ichthyoplankton. The quantities have been calculated as numbers per 1 m^2 of sea surface.

In the first half of the year the zooplankton was also sampled with a Bongo apparatus. The size of the net meshes was 0.333 mm. The main subject for this research was ichthyoplankton.

In addition there were control investigations of chlorophyll concentrations in April at 23 stations and in October at 37 stations.

Measurements of primary production and chlorophyll concentrations took place in April and May at depths of 0 m, 10 m and 20 m.

Phytoplankton, primary production(by oxygen method) and chlorophyll concentration (by SCOR-UNESCO method) were also studied in the Vistula Firth.

Moreover, the zooplankton material was collected from outside the Baltic area, viz. from the waters of the Hornsund Bay (Spitsbergen): 5 samples from June 1975 have been determined. Phyto- and zooplankton material was also collected in the period from June to September every other week with an Apstein net (Gauze nr 25xxx) in vertical hauls (56 samples).

The plankton material collected for 1967-1973 off the North West African Coasts have been worked up. The main subject of this study were Mysidacea and Sagitta enflata.

Portugal

(T. Neto & G. Vilarinho)

Plankton studies were continued along several lines at sea and by plankton cultures.

Within the framework of monitoring the coast of Sines, Lagoa de Sto André and the beaches near Cape Sines the quantitative and qualitative studies were carried out of phyto- and zoo-plankton, including determination of the diversity index and of indicator species (T. Lopes, C. Motal, L. Fernandes, J. Calejo Monteiro).

In the area near Cabo Verde Islands zoo-plankton had been collected by a neuston net in 1970. The samples were analysed for pontellids (Copepoda) (I. Paiva) and Siphonophora calycophorae (T. Neto) and a paper was published on marine copepods of Cabo Verde Islands (E. Marques): "Contribuição para o conhecimento dos Copépodos marinhos de Cabo Verde (ilhas Brava, Fogo, S. Tiago e Maio). II parte - Harpacticoida e Ciclopoida". Garcia de Orta, sér. Zool. 4(1). 1975. Lisboa.

Spain

(J. Corral & M. Durán)

Instituto de Investigaciones Pesqueras

Phytoplankton

Studies on the relation between heterogeneity of distribution of plankton organisms and environmental data. Physical and chemical data were related to continuous, qualitative and quantitative variations in the phytoplankton samples.

Concentration of particulate nitrogen was studied in the region of upwelling in NW Africa in relation to the various oceanic parameters.

In order to get better information from the spectres of chlorophyll pigments in continuous records, studies were carried out on multivaried statistical analyses of corresponding absorbances at different wavelengths of the spectre.

New equipment has been installed for automatic determination of primary productivity through radioactive tracers and through the Radiochromatogram Scanner Packard 7.201.

Qualitative and quantitative plankton studies were made in Cádiz Bay.

Zooplankton

Analysis of the samples gathered by the "Atlor II" cruise (along Cabo Blanco) was made, as well as a study on the vertical distribution of populations in relation to water masses off the Sahara, Mauretania and Senegal coasts. This study includes mainly the biomass and systematical and ecological aspects of the most important groups (copepods, euphausiids, pteropods, salps, doliolids, appendicularia and mollusc larvae).

A monographic study on Euphausiids from the NW African West Coast has been made.

Another study on cladocera and ostracods collected by the "Maroc-Iberia I" cruise which covered the Spanish Sea and the Alborán Sea has been completed.

Studies on ecology of the zooplankton at the Catalonian coasts were initiated and periodical visits were made to three fixed stations off Barcelona. Cooperative studies were also started on functional morphology of copepod species by microscopic and electronic techniques.

Studies on the physiology of plankton organisms deal with the effect of light on feeding and metabolic activity of several copepod species, aiming at a relation with the depth where the zooplankton is found during the day time.

Ichthyoplankton

The distribution of some fish larvae species caught by the "Atlor III" and "Atlor V" cruises in NW African coastal waters has been studied (anchovy, sardine and sable). The distribution of flatfish egg and larvae (Pleuronectiforms) on the Sahara Shelf was described.

Instituto Español de Oceanografía

Phytoplankton

Taxonomic studies of phytoplankton in the Ría de Arosa in relation to physical and chemical factors of the environment have been continued.

Measurements of primary production were made by ^{14}C and biomass estimation and by studying chlorophyll pigments during the four year seasons.

Studies on the correlation between pigments (phaeophytines) in deep waters and dissolved oxygen as well as with diverse forms of nitrogen has been continued.

Zooplankton

Studies were made on feeding, excretion and oxygen uptake by herbivorous copepods in oligotrophic waters. The contribution of zooplankton formation of phaeopigments was determined.

Techniques are worked out for the study of copepod feeding through enzymes of the amylase type.

Studies on zooplankton communities in the Ría de Arosa and Ría de Muros have been continued.

Eutrophic water studies were also started concerning the feeding, oxygen uptake and excretion by planktonic crustacea.

Sweden

(A. Lindquist)

Baltic

Measurements of primary production have been carried out at 5 stations in the open sea, the northernmost one in the Gulf of Bothnia (Institute of Marine Research, Lysekil & Göteborg =IMR). Measurements of primary production with ^{14}C-technique have also been carried out near Askö (Askö Laboratory) and in the Øresund (Marine Botanical Laboratory, Lund). Considerable attention has been paid to the methodology used. Even other methods for estimations of primary production have been studied (fluorescence, University of Umeå).

The dynamics of the plankton spring bloom have been studied in detail in relation to water temperature, salinity and micro zooplankton (IMR, Askö).

In the skerries of Stockholm the role of nutrients and chelators was studied as well as the mechanism of N-fixation (Inst. of Plant Physiology, Uppsala). Phytoplankton as such has been studied in connection with the investigations mentioned above as well as more independently. The studies covered many parts of the Baltic, including the Øresund (all the mentioned Institutes). The content and enrichment of Cd, As, Hg has been studied in plankton algae and zooplankton in the Bothnian Bay and in the Øresund (State Board of Environment Protection and Marine Botanical Laboratory, Lund).

A number of remote sensing experiments have been carried out in order to study organic production over extensive areas.

The studies on the occurrence of fish eggs and larvae in the Baltic proper have been continued. Species of special interest have been herring, sprat, cod (IMR)

Kattegat and Skagerrak

Currents, water exchange and transport of nutrients have been studied as a part of the joint Danish-Swedish investigation of the Kattegat (IMR). Samples have also been taken for analysis of phytoplankton.

The distribution of fish larvae (and eggs) has been studied and this investigation is part of a long term programme for herring and elvers.

United Kingdom

(D. Harding)

The Lowestoft plankton surveys

1. Phytoplankton studies were confined to writing up work on annoplankton and chlorophyll observations made in the Barents Sea over the past 5 years and on the comparisons between the fluorometric and spectrophotometric methods used to estimate the standing stock of phytoplankton in terms of chlorophyll.

2. Work on the zooplankton was devoted to counting and measuring larval herring form the ICES surveys; counting fish eggs and larvae from the surveys along the west coast of Britain; completing counts of material collected in previous years and processing the results for publication;

reviewing archived data for publication and planning for the 1976 series of surveys off the northeast coast of England.

a. Herring larvae

Three cruises were carried out in 1975 "Cirolana"1/75, 24-27 January to the English Channel, 30 stations sampled; "Corella" 13/75, 6-13 September at Orkney, Shetland and Cape Wrath, 110 stations sampled and "Corella" 15/75, 8-14 October to the central North Sea, 105 stations sampled.

The results of these surveys suggested that the production of herring larvae was considerably reduced from the 1974 estimates. The data will be presented to the ICES Herring Working Group in February 1976 and the results of all the international surveys will be collated by Mr Vøgg Jakobsen for the meeting of the Herring Larval Working Group in May 1976.

b) Inshore surveys

Three plankton surveys off the west coast of Britain, between the Scilly Isles and the Mull of Galloway were carried out in February, April and June 1975 to estimate the distribution and abundance of the eggs and larvae of commercially important fish species which spawn close inshore.

The results showed that the major difference from the 1972 surveys was in the distribution of pilchard eggs and larvae. In 1972 pilchard larvae were confined to the sea area south of Milford Haven whereas in 1975 the larvae were found further to the north in Cardigan Bay and to the northeast Irish Sea.

c) Published and archived data relating to the spawning of the plaice in the Southern Bight were re-analysed to estimate mortality in the egg stages and to look at the long-term trends in egg production. The results were presented to the ICES Symposium on "The changes in North Sea Fish Stocks and their Causes" which was held in Århus in July 1975. The growth and mortality of larval plaice in the patches identified for the diffusion analyses presented at this symposium is now being examined in detail.

Cod egg mortalities have been estimated from the Southern Bight cod spawnings in 1968,1969 and 1971 and the growth and mortality of larval cod as they drift to their nursery areas is currently under investigation.

The distribution, abundance and dynamics of zooplankton patches including the eggs and larvae of all fish taken in the 1968 and 1971 surveys is also under review. 'Ring' structures which correspond to ecological waves, originally identified for Oikopleura populations, have now been found for a variety of copepod and larval fish distributions.

Gut contents of all the common fish larvae, except clupeids, found in the Southern Bight and Eastern Channel, have continued and general patterns of feeding behaviour established for larval species.

3. Experimental work

Pseudocalanus has been grown through its life cycle from egg to adult over a range of temperatures, between 3.6°C and 14.5°C. The results are now being applied to survey results form the Southern Bight in 1968 and 1971. Similar studies are well advanced for Calanus and projected for Paracalanus.

4. Gear development

The flume studies on the hydrodynamics of plankton samples were completed in 1975 and are now being prepared for publication.

The electronic package for the changing net sampler has been renovated and will be tested at sea during the Northeast coast surveys in 1976.

5. Future surveys

A series of 10 surveys of the sea area off the NE coast of England, between 53°30'N and 56°N and offshore to 2°East have been planned for 1976. The surveys will concentrate on the distribution and abundance of the eggs and larvae of commercially important fish species. A hydrographic support programme involving arrays of recording current meters, sea bed drifter releases, nutrient analyses and temperature and salinity measurements should allow a detailed description of the larval drift in this sea area.

2. Scotland

(J.A. Adams)

1. Marine Laboratory, Aberdeen (DAFS)

The Plankton on Inshore and Shelf Waters

Although a number of surveys have been carried out there is little to report under this heading. Data obtained during the past fifteen years are being evaluated and prepared for at least limited circulation (J.A. Adams, J.H.A. Martin, D.V.P. Conway, S.J. Hay, N.T. Nicoll and J. Dunn).

Scyphomedusae of the North Sea

The fifth survey of the distribution and abundance of scyphomedusae in the summer months benefitted from the kind cooperation of four other institutes taking part in the international 0-group gadoid surveys. As a result data were obtained from a large part of the North Sea and these will be described in a paper to be presented to ICES in 1976. (S.J. Hay, J.A. Adams).

Plankton population dynamics

Computer simulation models of the planktonic ecosystem have developed along three lines :

(i) A twelve layer model of vertical structure has been used to explore the effects of vertically varying phytoplankton concentrations on zooplankton growth represented by six cohorts of a copepod (Calanus).

(ii) Horizontal variations in phytoplankton and zooplankton abundance have been studied in relation to the effects of horizontal dispersion and the theoretical results compared with detailed observations in the northern North Sea.

(iii) A multispecies phytoplankton-zooplankton model has been developed to investigate factors determining species composition at both trophic levels (J.H. Steele, B.W. Frost, E.W. Henderson).

Distribution and abundance of fish eggs and larvae

Surveys were continued basically as described for 1974 except that no surveys for plaice eggs and larvae were carried out and the sprat egg and larvae survey was restricted to the Moray Firth and east coast of Scotland. The 1975 data on herring larvae will be presented to the 1976 ICES meeting (A. Saville, D.W. McKay) as will the past few years' data on sprat eggs and larvae (R.S. Bailey).

Ecology of larval gadoids

During April and early May 1975 gadoid larvae, micro and macro zooplankton were sampled within the area 59°45'N-61°15'N 00°30'W-01°30'E east of Shetland. Associated observations were obtained of surface temperature, salinity, nitrate, chlorophyll a, and subsurface currents (as indicated by parachute drogues).

The distribution, abundance and size composition of the larval fish have been determined and the stomach contents of the main gadoids (Norway pout, saithe, haddock, whiting and cod) analysed. These data are now being studied with regard to inter-specific competition, daily periodicity of feeding, daily food consumption, selectivity of feeding in relation to food organisms present and the effects of environmental conditions (R.C. Minton, D.V.P. Conway).

Environmental, including pollution, factors affecting herring egg and larval development and survival

The study of the effects of different types of water on the development and survival of spring spawned herring eggs and the resulting larvae were continued in 1975 using water from Ballantrae Bank and Irvine Bay. Unlike the results obtained in 1973, but like those of 1974, no significant difference was found in the times taken for the eggs to hatch or in larval mortality after hatching. However, it was found that the larvae from the eggs kept in the Loch Ewe water were up to about 0.5 mm larger on hatching than those from eggs kept in Ballantrae Bank water (I.G. Baxter).

In addition to the experiments described above, an attempt was made to study the growth and survival of herring larvae in two of the large plastic enclosures (each of about 100 m^3) in Loch Thurnaig. About 24 000 fertilised eggs were placed in one enclosure and about 25 600 in the other; 80 to 90% subsequently hatched. Peak numbers of up to 300 larvae per haul of a small plankton net were caught five days after the commencement of hatching but ten days later numbers had dropped to zero. No feeding was observed (N.T. Nicoll, I.G. Baxter).

In the autumn, preliminary experiments were carried out on the effects of oil on the eggs and larvae (I.G. Baxter, D. Whitford).

Zooplankton studies at Loch Ewe

The zooplankton studies at Loch Ewe using the large plastic enclosures in Loch Thurnaig (a small bay at the head of the loch) were similar to those described last year.

Further observations were obtained on the lobate ctenophore Bolinopsis infundibulum. The results of experiments in which the Bolinopsis were given copepod prey, differed from the 1974 results in that egg production rather than body growth took place, egg production being seen to be a function of food abundance. Bolinopsis were photographed in situ in the loch as the initial part of a study of the mechanism of feeding while a monthly survey of the Bolinopsis population was started in September 1975 using conventional net sampling at a number of positions and counting by divers at four depths in the water column at a fixed diving site. (J.C. Gamble and others).

Experimental phytoplankton studies related to marine pollution

The maintenance of seven bacteria free algal cultures (diatoms and flagellates) has continued.

A Bioflow chemostat has been used to demonstrate the effect of single doses of copper and steady state continuously growing cultures of Phaeodactylum and of Cricosphaera in artificial medium.

Phaeodactylum survived single doses of up to 64 mg/l copper with no diminution in growth rate and with considerable uptake in copper. Cricosphaera survived 6.4 mg/l copper also with no diminution in growth rate.

A multi-stage continuous culture unit has been built to demonstrate the effect of copper present at a constant level on continuous cultures of Cricosphaera and Phaeodactylum in sea water media. Inhibition of Phaeodactylum at 0.64 mg/l and of Cricosphaera a6 6.4 mg/l was demonstrated. The unit was also used to provide copper free and copper treated material for feeding to zooplankton (J.A. Mowat and S.N. Reid).

The programme for 1976

Many investigations will be basically as described in previous years. Two aspects of the work should however be noted: these are the laboratory's involvement in FLEX during the first half of the year and further experiments in the large plastic enclosures in the second half. During these latter experiments attempts will be made in particular to (i) study the survival of larvae hatched, in the enclosures, from the eggs of autumn spawning herring and (ii) study the transfer of mercury from the water column to the sediment.

2. Oceanographic Laboratory, Edinburgh (IMER)

The Continuous Plankton Recorder Survey

The survey by the Continuous Plankton Recorder was continued in 1975 on the same basis as in previous years. Recorders were towed at a depth of ten metres at monthly intervals, when possible, along the standard routes shown in Figure 1.

During the past year, Recorders were towed for 118 000 miles by 31 ships of eight nations. The present survey has been in operation since 1948 and since then the plankton has been collected and the results have been processed in exactly the same way (see Colebrook, Bull. mar. Ecol., 8, 123-142). Further details may be obtained on application to the Oceanographic Laboratory.

The Plankton Indicator Survey

Studies of the planktonic environment of the herring fisheries off the northeast coast of Scotland were continued in 1975. Samples were taken from fishing vessels and research vessels of the Department of Agriculture and Fisheries for Scotland, the Ministry of Agriculture, Fisheries and Food and the Fishery Protection Service.

It has become increasingly difficult to obtain adequate plankton samples with the Plankton Indicator, especially in the Buchan area of the fishery. Traditionally, most of the samples have been taken by the fishermen, but the character of the fishery has changed in recent years; drifters have been replaced by purse seiners and it is difficult for fishermen to deploy Plankton Indicators from purse seine vessels. Samples from other sources are not taken consistently.

The research programme generated a hypothesis that the location of the herring stocks along a north-south axis appears related to the distribution of the two principal food organisms of the herring, Calanus finmarchicus and Spiratella retroversa and these in turn depend on the strength of the Atlantic inflow into the North Sea. The main objective of the programme since 1972 has been to test this hypothesis.

A comparison between results from the Plankton Indicator Survey with these from the Continuous Plankton Recorder Survey suggests that this objective can be achieved using the results from the CPR Survey.

Therefore, it is proposed that the Plankton Indicator Survey designed to investigate the biological environment of a herring fishery off northeast Scotland should not be resumed in 1976, but that the present level of sampling with the CPR in this area should be continued indefinitely.

Ocean Weather Ship Programme

A plankton modelling experiment has been maintained at Ocean Weather Station INDIA (59°00'N 19°00'W) since March 1971. Scientists worked on board Ocean Weather Ships on duty at INDIA from March to June 1975.

Measurements were made of :

a) the vertical distribution of the zooplankton in the upper 500 metres using Longhurst/Hardy Plankton Recorders;

b) primary productivity (^{14}C method), chlorophyll concentration and phytoplankton (species counts) in the upper 200 metres;

c) salinity, temperature and nutrients in the upper 200 metres;

d) organochlorines and heavy metals in the plankton;

e) solar radiation and light attenuation in the surface waters.

The Ocean Weather Ship Service was reorganised in June 1975 and Ocean Weather Station INDIA was abandoned. Consequently, this programme has been stopped.

These surveys form part of the programme of the Institute for Marine Environmental Research, a component of the U.K. Natural Environment Research Council; the Continuous Plankton Recorder Survey is also supported in part by the Ministry of Agriculture, Fisheries and Food.

Programme for 1976

(i) The CPR Survey will continue on the same basis as in previous years.

(ii) IMER is participating in FLEX 76.

3. Dunstaffnage Marine Research Laboratory (SMBA)

The work done in 1975 was as follows:

(i) Studies of growth of euphausiids and commercial decapod crustaceans.

(ii) Examination of integumental sensillae in a variety of pelagic crustaceans.

(iii) Biology of inshore and offshore populations of Euchaeta norvegica.

(iv) The manufacture and transference of the spermatophore by male Euchaeta norvegica.

In 1976 it is hoped to complete the extensive work on integumental sensillae of calanoid copepods and also the studies of the populations of Euchaeta norvegica. The collection of seasonal samples of bathypelagic plankton (deeper than 2 000 m) was completed in January and analyses of the samples have started.

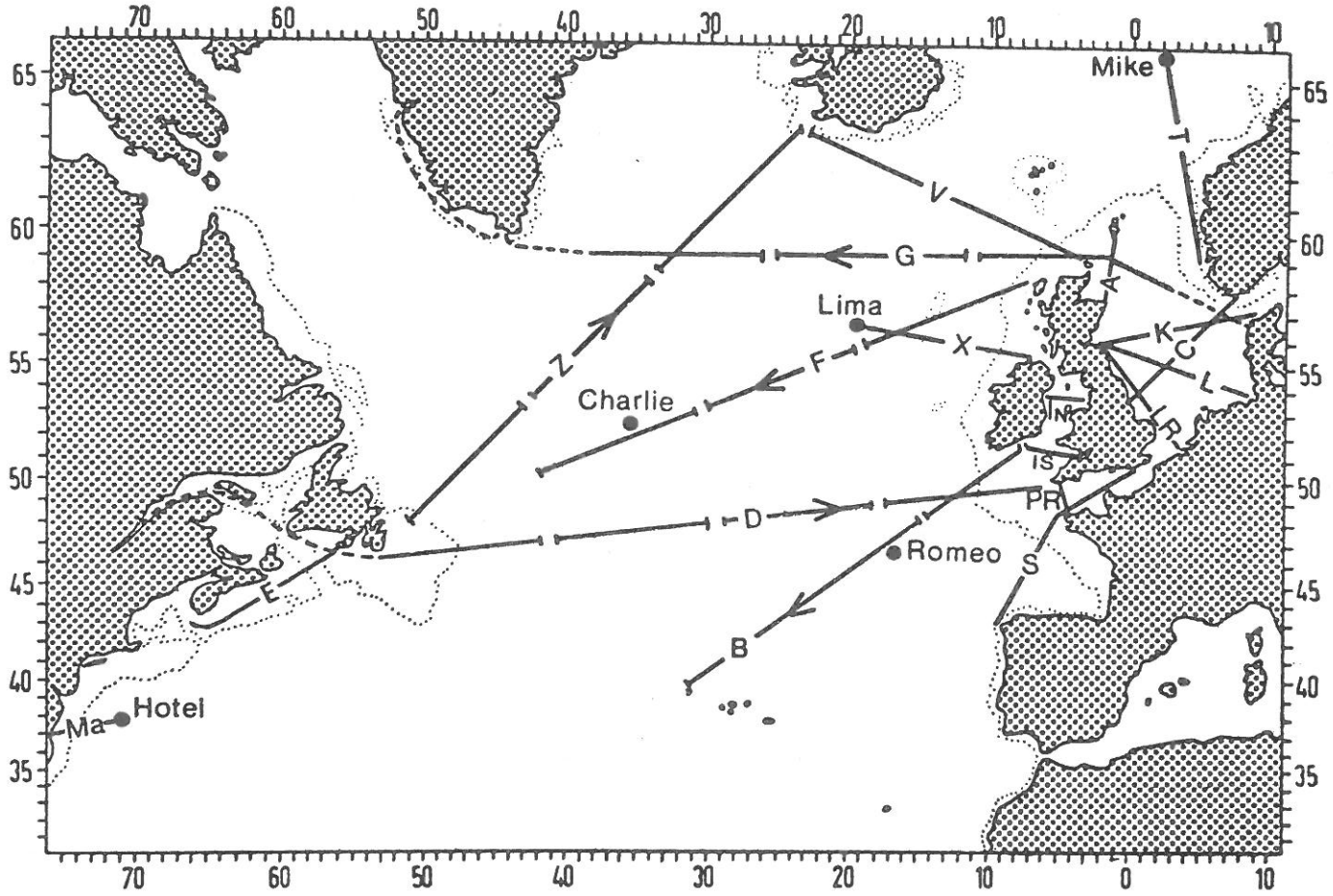

Figure 1

The Continuous Plankton Recorder Survey during 1975. The routes are identified by code letters and the Ocean Weather Stations by their international names. Route MA is maintained by the United States National Marine Fisheries Service.

U.S.A.

(K. Sherman & G.D. Grice)

Plankton/Fisheries Investigations

Ichthyoplankton surveys by the National Marine Fisheries Service (NMFS) and cooperating groups continued in 1975 along the Atlantic Coast from the Gulf of Maine to the Florida Straits, using standard MARMAP sampling methods. Collections were made in autumn and spring from the Bay of Fundy to Cape Hatteras during groundfish surveys (NMFS, Woods Hole and Sandy Hook). In addition, six countries participated in the fifth annual ICNAF larval herring survey (Canada, Federal Republic of Germany, German Democratic Republic, Poland, USA, USSR) covering the Georges Bank and adjacent waters. Sampling extended from the onset of spawning in September 1975 through larval development in March 1976. Environmental observations were more extensive in 1975-76 than in previous years and included measurements on plankton production (nutrients, chlorophyll, ^{14}C, O_2, phytoplankton, zooplankton), temperature, salinity and meteorological parameters. Comparisons of the catching efficiencies of the 0.505 and 0.333 mm mesh bongos used on the ICNAF surveys are underway at the Narragansett Laboratory. Ichthyoplankton samples are being processed at the newly established Polish Plankton Sorting Center in Szczecin and at the Plankton Laboratory of the Northeast Fisheries Center, Narragansett, Rhode Island.

The State of South Carolina continued the monitoring of ichthyoplankton distribution and abundance from Cape Hatteras to Cape Canaveral in spring and autumn. The area from Cape Canaveral to the Florida Keys was surveyed systematically for larval tunas by the staff of the Southeast Fisheries Center Miami. Off the Carolina coast the Atlantic Estuarine Center, Beaufort, continued investigations on the relationship between Ekman transport and onshore drift of larval menhaden. Correlations examined in 1975 indicate that sustained onshore drift contributes significantly to year class strength of menhaden. The Center is also continuing an investigation of sampling variations of fish eggs and larvae. To establish a range of sample variance of fish eggs and larvae off the Carolina coast simulataneous surveys were conducted within 5 miles of shore and 35 miles offshore in cooperation with the National Science Foundation; replicate hauls were made over a six-day period. The Gulf Coastal Fisheries Center, Galveston, conducted a series of ichthyoplankton surveys to monitor changes in the abundance of fish eggs and larvae in coastal waters of the Gulf of Mexico. On the Pacific Coast, plankton and larval fish assessments were undertaken by the Southwest Fisheries Center, La Jolla, as part of the CalCOFI Programme. Two other countries participated in the 1975 CalCOFI surveys. Mexico surveyed ichthyoplankton in a series of transects extending CalCOFI coverage southward off Baja California and the USSR sampled fish eggs and larvae off the California Coast during a three-week period. Comparisons on the zooplankton catching efficiencies of the bongo and CalCOFI samplers continued. Based on a comparison of 90 samples, the bongos collected 50% more zooplankton than the CalCOFI nets.

Plankton and larval survival experiments were continued by NMFS in 1975. At the Narragansett Laboratory a bioenergetic model was completed for analysis of feeding and survival of winter flounder, Pseudopleuronectes americanus larvae. Results indicate a "critical period" of survival during the 10 to 15 days following the change from endogenous to exogenous feeding. Work at Narragansett is continuing on the metabolism of larval fishes including haddock, Melanogrammus aeglefinus; yellowtail, Limanda ferruginea; and scup, Stenotomus chrysops. In situ observations on the environmental conditions influencing larval survival were continued at the Southwest Fisheries Center, La Jolla. Observations were made during 1975 on the distribution of larval food patches of phytoplankton, particularly dinoflagellates and the survival of anchovy larvae. Results indicate that

larval survival depends on the stability of the oceanic regime and the aggregation of larval food organisms into dense patches. Where oceanographic or meteorological conditions disrupt this stability, larvae die from lack of food.

Plankton/Ecology Investigations

Investigations at the Woods Hole Oceanographic Institution (WHOI) were continued on Gulf Stream cold core rings, large cyclonic eddies consisting of entrapped slope (sub-arctic) waters, formed when meanders of the Gulf Stream become detached to the south of the stream. They persist in the Sargasso Sea for periods up to two years or longer and there may be as many as a dozen or more present in the Sargasso Sea at any one time. The rings provide unique sites for studying interactions between two oceanic plankton communities and offer rare opportunities of distinguishing between the effects of the physical chemical environment on the structure and function of an oceanic community from biological interactions between species. Current research involves periodic cruises on which measurements are made on phytoplankton, zooplankton and mid-water fish as well as suites of hydrographic measurements within selected rings adjacent Sargasso Sea waters, and the Slope water giving rise to the ring core.

Other aspects of phytoplankton species research at WHOI, the Bigelow Laboratory, at Harvard University, at State University of New York, and the University of Rhode Island are studies of their distribution, bloom dynamics and succession in coastal and oceanic waters. Included in these studies are comparative investigations of the genetic properties of diatoms, vitamin-B cycling, silicon accumulation in relation to light physiology and nitrogen fixation and cycling in the Sargasso Sea. Environmental physiology of Gulf of Maine phytoplankton is being examined through periodic observations and assessments of population structure, productivity, light penetration, nitrogen uptake, carbon-14 fractionation, nature of excreted organic material and measurement of electron transport system and ATP activity.

At WHOI studies of zooplankton involve laboratory and field observations of feeding, behaviour, distribution and symbiotic associations of siphonophores, medusae, salps and other gelatinous organisms, zooplankton patchiness, and experimental work to further clarify the role of resting eggs in species of temperate copepods which appear seasonally in neritic waters. Zoogeographic analysis of other zooplankters continues especially of decapod, stomatopod larvae and euphausiids. The productivity of continental shelf waters off Georgia and Florida is being investigated through seasonal studies of plankton and benthos by the Skidaway Institute of Oceanography. Systematic and zoogeographic studies of copepods in the Gulf of Mexico and pteropods in the Sargasso Sea are being conducted at Texas A&M University.

U.S.S.R.

(A.F. Karpevich & T.K. Sysojeva)

432 phytoplankton, 1 808 zooplankton and 477 euphausiid samples were collected in 1975 by the scientists of the Polar Research Institute of Marine Fisheries and Oceanography (PINRO). Quantitative analysis of feeding was made for 592 specimens of cod fry and 225 specimens of adult polar cod. 1 380 plankton samples were analysed. The abundance of euphausiids in the Barents Sea in winter was determined;

treatment of these data gave an idea of the abundance, distribution and peculiarities of the specific and age composition of euphausiids in the Barents Sea in 1975. The data obtained characterise the summer food base for commercial fishes. An analysis was made of the spring-summer development of plankton collected in the southwestern Barents Sea in 1974. Feeding of 0-group Barents Sea cod of the 1974 year class was studied.

Based on many years' data in the Barents Sea euphausiids (1953-1975) factors were identified which determine the total abundance of these crustaceans and the annual fluctuation in abundance.

Experiments were conducted, arriving at an understanding of the seasonal fluctuations in bacterioplankton abundance, its production and the efficiency of bacteria consumption by zooplankton organisms. It was found in the case of the Ura-Cuba Inlet that the bacterioplankton concentrations are sufficient to meet the food requirements of zooplankton.

In the Baltic Sea and the Gulf of Riga 640 samples of zooplankton were collected in accordance with standard methods. The 1949-1974 data were also analysed. The result was an assessment of zooplankton abundance by seasons, by depth and by areas in the Baltic Sea snd the Gulf of Riga. The productivity and the rate of metamorphosis for Acartia and Pseudocalanus were studied.

Variations in the composition and abundance of zooplankton through many years (1949-1974) as well as the regularities in plankton distribution by sea areas (1960-1974) were studied. The main causes which determine these factors were revealed.

240 samples of nektobenthos were collected. The biology, distribution and changes in the abundance of mysids were studied in the Gulf of Riga. Methods for quantitative estimates of mysids in various biotopes were worked out.

2 500 herring and sprat stomachs were examined for food analysis. Food composition, feeding intensity, trophic relations and influence of feeding conditions on biological characteristics of herring and sprat in different periods of their annual cycle were studied.