

BIOLOGICAL OCEANOGRAPHY COMMITTEE

by

T. Platt

1979

Belgium

(R. De Clerck and Ph. Polk)

A. PHYTOPLANKTON.

Studies on the primary production in the Southern Bight of the North Sea.

Possible importance of the excretion of phytoplankton.

Natural mortality of phytoplankton.

B. ZOOPLANKTON.

1. Elaboration of modelling of the biomass of the most important Copepod population in the Southern Bight.
2. Continuation of grazing experiments at nearly in situ conditions (natural concentrations of Zoo- and phytoplankton), determination of energy-transfer of living phytoplankton to zooplankton.
3. Grazing experiments on total particles (living and non-living material) and selection due to particle-size.
4. Drifting and development of fish eggs.
5. Study of vertical migration of zooplankton.
6. Population dynamics of copepods.

C. BACTERIOPLANKTON.

Total planctonic respiration measurements (oxygen consumption, dark CO<sub>2</sub> fixation) heterotrophic activity measurements : incorporation and respiration of radioactive substrates.

Determinations of organic matter concentration (BOD, TOC) ; glucose and carbohydrates concentrations and activities.

Discussion of those results in function of two main problems :

- contradiction between total primary production and total consumption.
- relative role of zooplankton and bacteria in recycling the organic matter.

#### D. SEABIRDS.

Distribution of seabirds in the North Sea, in connection with food distribution and the ecological structure of the water bodies.

Canada<sup>1)</sup>  
(T. Platt)

Studies on plankton toxins of direct importance to shellfish and finfish fisheries continued, with emphasis on the fate of Gonyaulax toxins in the food chain and consequences to finfish (St. Andrews).

In brief summary, the rapid uptake of Gonyaulax toxins by each of several zooplankters has been demonstrated in grazing experiments performed in the laboratory. Furthermore, toxin retention by the zooplankters was shown for at least six days after ingestion of the dinoflagellates. The significance is that a variety of planktonic herbivores are capable of transferring Gonyaulax toxins to marine fish. This was supported during the summer of 1979 by a herring kill off Beaver Harbour, N.B., caused by Gonyaulax toxins which were, in this case, transmitted by the cladoceran Evadne normanni, unlike the 1976 Grand Manan herring kill in which pteropods were involved.

In view of the thought prevailing before the 1976 herring kill that fish in general were insensitive to the toxins of the east coast Gonyaulax, the sensitivities of adult fish (herring, pollock, flounder) to the toxins were determined. Pollock and flounder were found to have similar sensitivities to oral doses of toxins as herring (i.e., LD50=650 µg/kg), meaning

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<sup>1)</sup> Part of the Canadian report to the Shellfish Committee may also be of interest to the members of the Biological Oceanography Committee.

that kills of fish other than herring are possible, as evidenced by recent reports from other areas of kills of sand lance and menhaden in association with Gonyaulax blooms.

An hypothesis that Gonyaulax toxins in zooplankton could influence fisheries resources through increased mortality of larval fishes was tested. In order to investigate this, herring larvae were reared in the laboratory for 10 weeks past yolk-sac stage. Experiments showed nearly a 20% increase in mortality of herring larvae over just 4 days when Gonyaulax toxin-containing copepods versus toxin-free copepods were eaten, which has obvious implications for year-class strengths.

These new results set the stage for development of a general assessment of the scope of Gonyaulax effects on fisheries.

In addition, three summer algal blooms related to Bay of Fundy fish kills and other fisheries problems were investigated in 1979. The first was the Gonyaulax bloom which caused a herring kill off Beaver Harbour and symptoms of paralysis in herring off Grand Manan. The second was a bloom of Mesodinium rubrum in the southwestern Bay of Fundy causing "red water" and which was, perhaps, a contributing factor in the Beaver Harbour herring kill. The third was a bloom of the dinoflagellate Peridinium trochoideum, which occurred along with its cysts in long, sticky, mucilaginous threads in the surface waters of the Bay of Fundy, badly fouling trawl lines as well as herring weirs.

Hydrographic, meteorological, and shellfish toxicity data for the past 20 years have been obtained and logged on computer forms in order to generate a predictive device for the timing and severity of Gonyaulax blooms.

Bedford Basin zooplankton have been used to study the feeding behaviour and nutrition of copepods and the life cycles of representative micro-zooplanktonkters(Marine Ecology Laboratory). On the basis of laboratory-determined rates, it was calculated that from 20% to 50% of the daily plant

production, in terms of carbon and nitrogen, could be grazed off by the zooplankton during the spring bloom. Of that ingested, about 13% of the carbon and 29% of the nitrogen might be incorporated into zooplankton growth. Absorption efficiency was about 60% regardless of food concentration or amount of food ingested. It has also been shown that the relative occurrence of digestive enzymes used by copepods to process different nutritional substrates are highly correlated with the relative abundance of different substrates in the ambient food particle population. The multi-net, multi-sensor BIONESS has been brought to operational status and is now equipped with sensors for CTD, roll, pitch, yaw, illumination, and internal and external flow. It is also now associated with optical (camera, strobe) and acoustic (120 kHz) tools for observing plankton before the nets. It has been used to study the orientation, and hence acoustic properties, of euphausiids in scattering layers, as well as mesoplankton ecology at the shelf-break front of the Scotia Shelf and Arctic.

The Atlantic mackerel (Scomber scombrus) begins to spawn in the southern Gulf of St. Lawrence in early July. This coincides with the maximum biomass of summer plankton. The eggs have an average size of 1.3 mm at the beginning of the spawning season and this decreases to 1.1 mm by mid-August. This follows a corresponding decrease in the mean size of the plankton. The size correlation was as important as the plankton biomass in determining the abundance of suitable food organisms for the newly hatched larvae. Thus, both the timing of the onset of spawning and the progressive decrease in egg size during the spawning season ensure that larvae are produced at the



correct time and size for them to encounter an abundant supply of appropriately sized food organisms.

The larvae of the Peruvian anchovy (Engraulis ringens) are 2.8 mm in length on hatching and subsist on the yolk sac for 2.75 days (at 18°C). They begin feeding 1.35 days after the disappearance of the yolk sac when they average 4 mm in length. When offered a variety of natural planktonic food they selected copepod nauplii and copepodites and three genera of phytoplankton; Actinocyclus, Gymnodinium and Coscinodiscus. During growth from 4 mm to 6 mm, 68% (by vol.) of the diet consisted of zooplankton and 32% phytoplankton. The average size of both types of food was 60  $\mu$ m.

The initial modelling of the oceanographic structure of Georges Bay has been completed (Marine Ecology Laboratory). The clockwise gyre in Georges Bay is generated by an alongshore current across the mouth of the bay. The size and intensity of the gyre depend on low values of bottom friction relative to horizontal friction. The gyre decreases in magnitude over the upper 20 m, and close to the bottom (30 m) there is an outflow of water from the bay. Associated with the gyre is a lens of warm water in the middle of the bay that is surrounded by cooler water. The effect of this structure on the ecology of the bay is being investigated.

In the plankton studies it was found that peaks in phytoplankton production followed by increases in zooplankton biomass and increases of organic sedimentation occurred at 4-5 week intervals between May and November. Since these observations suggested that a tight coupling

exists between the supply and utilization of organic matter studies to examine seasonal differences in particle size distribution in the plankton in relation to larval fish were continued and expanded.

Studies on primary productivity, phytoplankton growth rates, effects of crude oils and heavy metals on plant stocks and population dynamics of plants were carried out (Arctic Station, St. Anne de Bellevue). The second year of a 3-year bacteriology project was completed in Davis Strait and Baffin Bay. Bacterial heterotrophic activity was measured. The seasonal capacity of bacteria in natural waters to mineralize crude oils was investigated, along with the effects of dispersants and nutrient supplements on this activity. Studies on the biochemical composition of major macrozooplankton were begun. A one-season biological survey of a small harbour on the Davis Strait shore of Baffin Island was carried out in response to anticipated oil drilling activities.

Published work during the year was concerned with effects of oil and dispersants on benthic invertebrates, seasonal biochemical cycles in a benthic amphipod, primary production in an Arctic bay, bacterial activity in Davis Strait, sea ice microalgae from three Arctic localities, and near-shore zoobenthos. Reprints are available on request.

An international project on the Flemish Cap initiated by ICNAF, and continuing under NAFO, is investigating causes of the observed wide fluctuations in year-class strengths of cod and redfish on the Flemish Cap. Very intensive biological and oceanographic observations were made in 1979 through the use of research vessels, moored current meters and satellite tracked buoys. Results are reported to NAFO.

Within the framework of a major pelagic program in the St. Lawrence Estuary (GIROQ, Québec) many projects have recently come to a conclusion. The analysis of physical data demonstrated the low contribution of the high frequency fluctuations to the total energy of the outflow in the Middle Estuary. The investigations on primary production have pointed out an endogenous circadian rhythm in the photosynthetic capacity of phytoplankton, and other endogenous cycles with a periodicity close to that of the tides. The effect of the 2-week tide component on the factors controlling the chlorophyll distribution and the gradient of plankton diatoms in the Middle Estuary has also been demonstrated. It was also established that the effect of the semi diurnal component of the tide on the vertical stability of the water column can be an important factor influencing short term variability in distribution and in photosynthetic capacity of phytoplanktonic organisms in the Lower Estuary.

As far as zooplankton is concerned, a linear mathematical model has been developed that can take into account the variability generated by the passive advection of the longitudinal gradients of zooplankton in the Middle Estuary. Two other studies have also come to an end, one of which analyses the increasing variance of zooplanktonic components in relation with the temporal extension of sampling, while the other estimates, in the Middle Estuary, the zooplankton exchange between two basins partially isolated by a shelf. Finally, a new method has been worked out to extract ATP in composite zooplankton samples, with a view to estimating temporal fluctuations of live biomass in the Estuary, during neap and spring tides; their analysis suggests that there is no mass mortality even when there is strong advection.

A study of seasonal cycles of planktonic Mysidaceae of the Saguenay Fjord has also been completed, showing that they seem to avoid competition by inhabiting both extremities of the Fjord in the summer. The growth rates of the downstream species are remarkably high in summer due to the abundance of food originating in the Estuary. The role of interspecific competition in the early developmental stages of herring, capelin and smelt, in the regulation of recruitment in adult stocks has also been investigated. A study of food habits of larvae, young and adult capelin, has been completed: the different characteristics of herring populations in the Gaspé area and in the Estuary have been established. Finally, a method has been worked out to evaluate recruitment in the populations of Mackerel in the Gulf of St. Lawrence using the relation between egg abundance and environmental factors, particularly temperature.

Benthic research was centered on the distribution and abundance of intertidal and subtidal epibenthos in the Estuary and the Gulf of St. Lawrence. The distribution and abundance of subtidal epibenthos is also under study on both sides of the Lower Estuary, with special attention to the populations dynamics of sea urchins and their influence on the benthic vegetation. Littoral investigations initiated in 1978 include intertidal and subtidal community relationship, in particular the blue mussel communities, as influenced by the physical environment, the effect of ice, and seaweed and phytoplankton productivity. Extensive studies of the comparative structure of offshore benthic communities of the Estuary and of Baie-des-Chaleurs in the Gulf are also being carried out.

In a recently completed project an assessment has been made of the importance of nutrient recycling by sea birds in the St. Lawrence Estuary. The conclusion is that sea birds can hardly be viewed, except perhaps under the most special circumstances, as important agents in the dynamics of nutrient regeneration processes of marine coastal waters of the St. Lawrence estuary (Québec region).

Denmark

(K. Vagn Hansen)

Danish Institute for Fisheries and Marine Research (D.F.H.)

The project initiated in 1978 on short term variations in physical, chemical and plankton parameters measured at fixed stations in the Kattegat was repeated in May and expanded by including light and turbidity measurements in cooperation with the Institute of Physical Oceanography, University of Copenhagen.

Department of Ecology and Genetics, Aarhus University.

One main project of the laboratory is the microbial cycling of nitrogen, sulfur and carbon in marine sediments. Studies are carried out in laboratory sediment systems and in shallow water estuarine sediments. In June a cruise was conducted in Kattegat and Skagerrak in order to quantify the total mineralization in sediments and the relative importance of nitrate and sulfate reduction, methanogenesis and aerobic mineralization.

Other projects are concerned with the mechanisms of speciation, microevolution and interspecific interactions in marine sibling species. Work is carried out on marine Gammarus in inner Danish waters and in the Baltic, on the Cardium complex of species, on Hydrobia and on Sphaeroma.

Marine Biological Laboratory, Helsingør, Copenhagen University.

Ecology, plankton: The behaviour and production of seston was studied in the northern Oresund. Measurements were made on nutrients ( $PO_4$ ,  $NO_2$ ,  $NO_3$ ,  $NH_4$ ,  $SiO_2$ ) of organic carbon and nitrogen, plant pigments, ATP, phyto- and zooplankton quantities, and of the hydrographical parameters: salinity, oxygen,

temperature, pH, light, current and production. Weekly samples were taken at depth intervals of 2 meters.

Ecology, level bottom: The following projects were continued: Feeding and population structure of juvenile Amphiura, commensalism between species of Lysella, polychaetes and brittle stars, activity of Nematodes in bottom sediments, population analysis of Bathyporeia species.

Physiology: The physiological mechanisms which makes it possible to live under highly fluctuating conditions of salinity and oxygen content were investigated on shrimps from the Sound:

At present the function of the blood and the blood pigment, haemocyanine of Palaemon adspersus is examined on animals exposed to fluctuating oxygen content simultaneously with registrations of the frequencies of heart and the scaphognathite activity of the shrimps.

At the laboratory Crangon vulgaris is used as a standard test animal in experiments on adaptations to low salinity. the latest measurements have been focussed at the excretion of ammonium from the antenna gland, and on the concentration of magnesium ions in the urine in the blood.

A shore crab project describes the migrating behaviour of Carcinus maenas together with simultaneous measurements of the concentrations of ions, proteins etc. in the blood.

Activity patterns and blood characteristics were monitored on populations of crabs, exposed to various combinations of salinity and temperature.

#### GREENLAND

#### Greenland Fisheries Investigations (G.F.U.)

Plankton. Routine sampling of zooplankton with stramin net, (diameter 2 m, oblique hauls from appr. 50m, duration 30 min.) were continued at 3 east-west standard oceanographic sections in the Davis Strait off Holsteinsborg, Sukkertoppen, and Godthåb in July and inshore at Godthåb throughout the year. Invertebrates and fish eggs and larvae were sorted and counted.

FINLAND

(J. Lassig)

Institute of Marine Research, Helsinki

Phytoplankton and primary production ( $^{14}\text{C}$  in situ and in vitro) hydrography, hydro-chemistry and chlorophyll-a were studied every second week (twice during the ice-period) at one station in the western Gulf of Finland. Chlorophyll a was measured at 15 stations in the Gulf of Bothnia, the Gulf of Finland and the Baltic Proper as stipulated in the monitoring programme for the Baltic Sea (Helsinki Convention).

Zooplankton sampling (Hensen net, mesh size 150  $\mu\text{m}$ , vertical haul 25-0 m) has been continued at two coastal stations in the Gulf of Finland, one station in the Archipelago Sea and one in the Bothnian Bay. Samples were taken three times a month, once a month during the ice period. Zooplankton was sampled at 21 stations in the Gulf of Bothnia, the Gulf of Finland and the Baltic Proper in the spring and autumn as stipulated in the monitoring programme for the Baltic Sea (Helsinki Convention).

Benthic macrofauna was sampled at 116 stations in the Gulf of Finland and the Baltic Proper in May and June in order to follow the occurrence of benthic macrofauna in areas with periodically unfavourable oxygen conditions. Macrozoobenthos was sampled from 14 stations in the Baltic Sea as stipulated in the monitoring programme for the Baltic Sea (Helsinki Convention).

In August methods for studying phytoplankton, primary production, chlorophyll-a, zooplankton and benthic macrofauna were intercalibrated as a joint exercise between the Baltic Sea states. The work was carried out within the framework of the Helsinki Convention.

Institute of Radiation Protection, Helsinki

Benthos studies were carried out in the vicinity of two nuclear power plants, one in the Gulf of Finland, and one in the Bothnian Bay. Samples have been taken twice at 9 stations.

Phytoplankton and primary production studies ( $^{14}\text{C}$  in situ) were performed once or twice a month during the ice-free period around the two nuclear power plants mentioned.

National Board of Waters, Water Research Office, Helsinki

The influence of industrial pollution on the composition of benthic macrofauna were studied off Rauma and Naantali in the Bothnian Sea, and off Kokkola, Raahen and Tornio in the Bothnian Bay.

Phytoplankton primary production was measured mainly in August at some coastal stations in polluted areas of the Gulf of Finland and the Gulf of Bothnia. Special investigations were performed off several residential areas.

Nitrogen fixation studies were carried out in the Gulf of Bothnia.

In August methods for studying chlorophyll-a were intercalibrated as a joint exercise between the Baltic Sea states. The work was carried out within the framework of the Helsinki Convention.



Water Conservation Laboratory of Helsinki City

Macrobenthos studies were continued monthly during the ice-free period at one station off Helsinki, and three times at 9 stations off Espoo.

Phytoplankton primary production ( $^{14}\text{C}$  in situ and in vitro) and bacteria were studied twice a month during the ice-free period in eutrophied waters off Helsinki and Espoo at several stations from the severely polluted bays to the unpolluted area outside the archipelago.

Tvärminne Zoological Station of the University of Helsinki

Macrofauna was sampled from several stations in the Pojoviken and the vicinity of the research station according to a stratified random sampling design.

Åbo Akademi, Turku

Macrobenthos samples were taken at 19 fixed stations in the archipelago of Åland. Effects of artificial wave exposure of ferry traffic on phytobenthos were studied.

Primary production and phytoplankton were studied in semienclosed meromictic bays in the Åland archipelago.

University of Turku

Dynamics of Mesidotea entomon (Isopoda) were studied in the Archipelago Sea.

Zooplankton was sampled in the Archipelago Sea for analyses of the PCB group components.

University of Oulu

Zooplankton investigations were performed in the sea area of the northern Bothnian Bay twice a month during May-November.

Mesidotea entomon (Isopoda), zooplankton and sediment were sampled in the northern Bothnian Bay 2 times in the summer at 4 stations for analyses of elements.



France

(D. Woehrling)

Ce rapport rassemble, pour chacun des organismes cités, les principaux axes de recherches pouvant se rattacher au thème de l'océanographie biologique.

1.- MINISTERE DES UNIVERSITES

1.1. UNIVERSITE D'AIX-MARSEILLE

1.1.1. Laboratoire de biologie animale (Plancton), Marseille

Etude infraspécifique des Hoplophoridés (crustacés décapodes pélagiques) dans l'Atlantique, relations écologiques.

Chaetognathes : étude des dents et organe vestibulaire au microscope électronique à balayage. Relations taxonomiques et biologiques (spécimen d'Atlantique oriental en particulier) ; étude histologique et ultrastructure comparative des yeux : *Sagitta planctonis*, espèce pélagique profonde, et *Spadella cephaloptera*, espèce benthique néritique (spécimens d'Atlantique tempéré et de Méditerranée).

Ecophysiologie de la nutrition chez les copépodes en milieu expérimental. Différenciation histologique (ultrastructure) et histochimique des diverses catégories cellulaires du tube digestif.

1.1.2. Station marine d'Endoume et Centre d'Océanographie

Etude de la production primaire pélagique dans les zones d'enrichissement (secteurs d'upwelling côtier, aires de divergence, zones soumises à apports terrigènes) ; approche théorique par modélisation. Etude de l'assimilation de composés azotés. Ecologie générale du microplancton. Etude des potentialités photohétérotrophes des algues unicellulaires. Importance de la matière

organique dissoute comme source d'azote pour les algues marines. Dynamique du système production-régénération et rapports avec les phénomènes hydrologiques. Etude des modifications par pollution. Etude de l'activité des microorganismes dans les eaux côtières et lagunaires, naturelles ou perturbées (expérimentations *in situ* ou *in vitro*).

Processus de production (nutrition, métabolisme, excrétion, transferts d'énergie, croissance et reproduction) chez les copépodes. Répartition et métabolisme des copépodes hyponeustoniques. Ethologie des crustacés, en particulier des peracarides (principalement mysidacés). Etude du phytoplancton et du zooplancton en milieu perturbé. Structure et répartition des foraminifères planctoniques.

Structure et évolution (dans le temps et l'espace) des peuplements benthiques littoraux et circalittoraux. Rôle des facteurs naturels ou induits par l'homme. Etude expérimentale (*in vivo* et *in vitro*) des processus biologiques et physiologiques conduisant aux déséquilibres des communautés naturelles. Ecologie de la faune vagile. Constructions biogènes en zone photophile. Faciès à hydroïdes. Distribution et écologie des bryozoaires. Biogéographie, croissance et fossilisation des madréporaires.

Systématique et écologie de diverses annélides polychètes ; écophysiologie des isopodes ; systématique, écologie et biogéographie des pycnogonides. Systématique des cyclostomes ; systématique évolutive des spongiaires, brachiopodes et phoronidiens. Systématique, écologie, bioérosion des cyanophycées endolithes. Ecophysiologie et cycle vital des mollusques d'intérêt commercial. Ecologie du méiobenthos abyssal et des copépodes harpacticoïdes. Distribution, alimentation et éthologie des décapodes du golfe de Gascogne.

Ecophysiologie et mécanismes d'adaptation des crustacés (notamment décapodes); modification des systèmes enzymatiques. Ichthyoplancton : systématique, écologie, écophysiologie (adaptations enzymatiques, rythmes alimentaires, équilibre hydrominéral, régulation endocrine). Biologie des jeunes stades de Mugilidés (croissance, alimentation, enzymes digestifs) ; utilisation des aliments chez le bar (*Dicentrarchus labrax*) et la sole.

Production benthique des fonds meubles. Structure et dynamique de la macrofaune à partir de la biologie et de l'écophysiologie des espèces dominantes. Peuplements de microphytes benthiques. Fonctionnement énergétique (au niveau primaire) des écosystèmes infralittoraux. Relations proies-prédateurs au sein du macrobenthos infralittoral. Relations benthos-pelagos, microphytobenthos-méiobenthos, macrobenthos - méiobenthos et macrobenthos-mégabenthos vagile.

Distribution et évolution des constituants biochimiques dans l'eau et les sédiments marins en relation avec l'activité biologique. Activités métaboliques à l'interface eau-sédiment, rôle de la méiofaune. Mécanismes de dégradations des pigments photosynthétiques dans l'eau et les sédiments.

## 1.2. UNIVERSITE DE BORDEAUX

Institut Universitaire de Biologie Marine, Station biologique,  
d'Arcachon

Ecologie des milieux littoraux marins et lagunaires, principalement l'échelon benthique. Mécanismes de production : recrutement et établissement des organismes, transformations énergétiques de la matière organique au niveau de l'interface eau-sédiment. Ecophysiologie et adaptation des organismes.

Etude de la plateforme littorale sud-Gascogne : supra-benthos (constitution, structure démographique et production), mollusques lamellibranches (dynamique des populations, structure des peuplements), mixobenthos temporaire (structure et rôle dans la productivité de l'écosystème littoral).

Estuaire de la Gironde (golfe de Gascogne) : plancton, faune vagile, macrofaune sessile et endogée.

Dynamique des populations, interactions trophiques (diatomées, macrophytes, bactéries, plancton, méiofaune, macrofaune invertébrée, poissons). Métabolisme, flux d'énergie. Physiologie comparée (microflore, méiofaune, poissons juvéniles et adultes).

1.3. UNIVERSITE DE BRETAGNE OCCIDENTALE (U.B.O.), BREST

Institut d'études marines

Etude chimique des zones d'enrichissement (secteurs d'upwelling côtier et zones de divergence) et des masses d'eaux superficielles (et problèmes relatifs au développement phytoplanctonique). Evaluation de la matière organique dissoute des eaux côtières bretonnes.

Peuplements benthiques du plateau continental atlantique, étude intégrée de l'écosystème aux différents maillons de la chaîne trophique ; fertilité relative des fonds. Estimation de la productivité secondaire par la dynamique des populations-clefs. Suivi pluriannuel, successions écologiques. Populations zooplanctoniques en rade de Brest en proche Iroise (côtes de la Bretagne).

Etude de l'alimentation des poissons en fonction de l'âge et de la saison, relations avec les invertébrés benthiques. Etude des effets physiologiques de la pression hydrostatique et de la température. Etude expérimentale de l'action de la lumière et de la photopériode sur la croissance de jeunes turbots (*Psetta maxima*) et soles.

Etude de la nutrition minérale des algues. Distribution des éléments minéraux en fonction du métabolisme des tissus et des ions ; échanges ioniques entre *Ascophyllum nodosum* et *Polysiphonia lanosa*.

1.4. UNIVERSITE DE CAEN

1.4.1. Laboratoire d'algologie fondamentale et appliquée

Inventaire du phytoplancton et du microphytobenthos de l'estuaire et de la baie de Seine. Etude du macrophytobenthos dans la baie des Veys et dans l'estuaire de la Seine (secteur de la Manche).

Evaluation des stocks et cartographie de *Laminaria digitata* et *L. hyperborea* de la côte normande (secteur de Manche) ; dynamique des populations.

Etude biosystématique des Chrysophycées et des Prymnésiophycées  
(avec cultures et examen au microscope électronique à balayage).

Recherches sur l'écophysiologie des laminaires (dynamique des populations, croissance, facteurs de reproduction, hybridations inter-spécifiques, parthénogénèse).

#### 1.4.2. Laboratoire maritime, Luc-sur-Mer

Biologie et écologie des mollusques et des crustacés, aspects fondamentaux et appliqués.

Mécanismes d'actions des facteurs écologiques sur le contrôle de la différenciation et de la physiologie sexuelles des gastéropodes. Etude écophysiologique des cycles annuels de reproduction des lamellibranches, notamment rôle de la température.

Analyse des facteurs écologiques biocénotiques et dynamique des peuplements de crustacés dans les milieux lagunaires et littoraux. Biogéographie et répartition des isopodes. Recherches sur la génétique, le polymorphisme et la spéciation du crustacé isopode *Jaera albifrons*.

Evaluation de l'impact écologique d'aménagements littoraux.

#### 1.5. UNIVERSITE DES SCIENCES ET TECHNIQUES DE LILLE

##### Institut de Biologie Maritime et Régionale, Wimereux

Description du phytoplancton et analyse de la productivité primaire pélagique du littoral de la Mer du Nord et de la Manche orientale. Systématique, écophysiologie et productivité secondaire des invertébrés benthiques du littoral de la Manche et de la Mer du Nord.

Productivité secondaire des copépodes d'un écosystème semi-fermé (bassin portuaire de Dunkerque dans le sud de la Mer du Nord). Suivi écologique du site littoral de Gravelines (sud Mer du Nord) : phytoplancton et production primaire, zooplancton, bactérioplancton. Evolution de la biocénose benthique. Dynamique des populations d'*Abra alba*.

Essais de cultures d'algues en laboratoire puis en bassins pilotes (*Gracilaria*, *Chondrus* et *Gigartina*) selon différentes techniques culturales.

1.6. UNIVERSITE DES SCIENCES ET TECHNIQUES DU LANGUEDOC, MONTPELLIER

Laboratoire d'Hydrobiologie marine

Etude de la faune benthique des milieux lagunaires (littoral méditerranéen) ; structure des peuplements.

Bactériologie en milieu littoral naturel et perturbé. Ecologie bactérienne.

1.7. UNIVERSITE DE NANTES

Institut des Sciences de la nature, laboratoire de biologie marine

Etude de la faune des milieux marins et saumâtres de l'estuaire de la Loire (nord du golfe de Gascogne) et du littoral proche.

Sels nutritifs, phytoplancton et microphytobenthos des eaux littorales de la baie de Bourgneuf : étude des successions de populations, de la production des algues unicellulaires, du rendement de l'utilisation des éléments biogènes et leur fertilité potentielle ; essais d'amélioration de la production des eaux de claires à huîtres.

Dynamique de populations d'Hermelles en baie de Bourgneuf, de crustacés et de poissons dans l'estuaire de la Loire. Structure des réseaux alimentaires et peuplements associés.

Etude biogéochimique du transfert des métaux dans les réseaux alimentaires.

1.8. UNIVERSITE PIERRE ET MARIE CURIE, PARIS

1.8.1. Laboratoire Arago, Banyuls-sur-Mer

Production primaire et secondaire planctonique en mer oligotrophe et eutrophe (aire de divergence et upwelling). Etude expérimentale de la cinétique des éléments nutritifs chez le phytoplancton. Rôle des copépodes pélagiques dans les transferts d'énergie entre phytoplancton et échelon tertiaire.

Relations milieu pélagique-milieu benthique. Relations matière organique-méiobenthos, prédation de la méiofaune par les poissons et les crustacés ; cycle biologique, production, budgets énergétiques.

Rôle des Phaeophycées (Fucales et Ectocarpales) au sein de l'écosystème benthique. Ascidies didemnidae : systématique, écologie, complexe biocénotique associé.

Etude des composants nucléaires chez les dinoflagellés. Organites cytoplasmiques participant à la division nucléaire. Action de polluants (métaux lourds, organochlorés, organophosphorés), sur les dinoflagellés.

#### 1.8.2. Station marine de Villefranche-sur-Mer

Echantillonnage en continu de paramètres hydrologiques et biologiques en mer Ligure (Méditerranée). Modèles de prédiction.

Cultures phytoplanctoniques monospécifiques (et algorithme) et multispécifiques à partir de peuplements naturels ; étude et modélisation de la croissance et de la productivité primaire contrôlée.

Etude biologique et écologique de groupes zooplanctoniques, notamment études de dynamique des populations à partir d'échantillonnages (cycles vitaux, relations avec les masses d'eau dans le cadre de l'étude de la mer Ligure, séries chronologiques) et nombreux élevages en laboratoire.

Etude des lipides et des enzymes digestifs chez différents groupes planctoniques. Etude bioénergétique des larves et des adultes d'oursin.

#### 1.8.3. Station biologique de Roscoff

Etude des écosystèmes benthiques de la Manche et de la Mer Celtique (description et cartographie bio-sédimentaire) ; (430 stations d'échantillonnage en Mer Celtique centrale). Etude de la dynamique des écosystèmes naturels et perturbés. Evolution des peuplements de macrobenthos des baies de Morlaix et de Lannion (Manche ouest).

Paramètres physicochimiques et biologiques des masses d'eau de la baie de Morlaix : salinité, température, sels nutritifs, oxygène dissous, pigments chlorophylliens, protéines et glucides particuliers, poids sec sestonique, production primaire, phytoplancton. Variations à court terme en fonction de la marée et des échanges eau-sédiment.

Suiyis écologiques des sédiments en zone estuarienne dans les sables fins sublittoraux (baie de Morlaix) et dans les vases fines estuariennes (Slikkes). Fluctuations saisonnières de divers paramètres (température - granulométrie - potentiel redox - hydrocarbures - teneur en eau interstitielle - chimie de l'azote - flore bactérienne hétérotrophe - pigments chlorophylliens - microphytobenthos - microfaune et méiofaune) mesurées par carottages de périodicité mensuelle. Simulations de l'écosystème des sables fins littoraux au laboratoire.

Etude de l'impact de flux croissants de matière organique sur la structure des peuplements bactériens et de la méiofaune ; effet des produits de dégradation des hydrocarbures sur les écosystèmes.

#### 1.9. UNIVERSITE DE POITIERS

Laboratoire de biochimie marine et phycoécologie, la Rochelle

Systématique et biologie des mollusques nudibranches (régime alimentaire, ponte, cycle, embryogénèse, métamorphose, croissance juvénile). Ecophysiologie de la croissance et de la sexualité.

Echanges biochimiques phytoplancton-milieu.

Effets de cultures expérimentales intensives d'algues dans les marais littoraux sur les biocénoses aquatiques d'eaux douces, saumâtres et marines.

## 2.- MINISTERE DE L'INDUSTRIE

### 2.1. CENTRE NATIONAL POUR L'EXPLOITATION DES OCEANS (CNEXO)

Etude de l'écosystème pélagique de la Manche : analyse de la dynamique et de l'évolution du système peuplements planctoniques-milieu. Processus



de production en conditions hydrologiques particulières (front thermique). Description du stock trophique complémentaire : analyse qualitative et quantitative des particules en suspension, étude des déchets et fécès. Substances de réserve du phytoplancton, taux de croissance, taux d'ATC, adaptations et besoins trophiques. Indices d'état physiologique et analyse des enzymes digestives.

Caractéristiques quantitatives des différents échelons trophiques de la faune benthique et étude de la dispersion (détritivores et nécrophages carnivores) dans différents bassins océaniques soumis ou non à des apports terrigènes (plaine abyssale de l'Amazone, secteur du centre Atlantique).

Estimation du flux énergétique vertical particulière : importance des apports organiques et bilan énergétique, pièges à sédiments fixes et dérivants. Etude des voies d'incorporation de la matière organique dans la chaîne trophique, intensité du processus (carrotier autonome, respiromètre *in situ*). Vitesse de colonisation en milieu abyssal, croissance d'organismes benthiques (module autonome de colonisation).

Analyse du métabolisme bactérien dans les sédiments et rôle des bactéries dans l'écosystème benthique abyssal.

Structure des peuplements planctoniques et benthiques en relation avec l'impact de construction puis de mise en service de centrales nucléaires (Côtes de la Manche et du sud de la Mer du Nord).

### 3.- MINISTERE DES TRANSPORTS

#### INSTITUT SCIENTIFIQUE ET TECHNIQUE DES PECHEES MARITIMES (ISTPM)

Meilleure connaissance de la biologie du merlu : étude de la localisation et de l'importance d'une partie des frayères dans le golfe de Gascogne ; distribution et abondance des espèces trophiques en Mer Celtique (essentiellement euphausiacés et mysidacés).

Structure et évolution d'une fraction des peuplements zooplanctoniques (essentiellement oeufs et larves d'espèces exploitables : crustacés et poissons) en relation avec l'implantation de centrales nucléaires (côtes de la Manche, du sud de la Mer du Nord et du golfe de Gascogne) ; pêches à l'échantillonneur Bongo (filets de 315 et 500 microns).

Amélioration des méthodes d'identification des larves de crustacés décapodes commerciaux.

Evaluation et localisation précise des stocks d'algues exploités ou exploitables au moyen d'une cartographie en couleur au 1/10 000 le long du littoral breton. La portion de littoral cartographiée en 1979 s'étend de l'archipel des Sept-îles à Bréhat.

Etude des interactions entre espèces exploitables, incidence de la récolte.

Suivi des effets des pollutions naturelles ou accidentelles (Amoco-Cadiz).

Etude biologique et essais de culture en milieu naturel de l'algue *Undaria pinnatifida* introduite accidentellement en France.

Etude des possibilités de cultures en milieu naturel et en bassin pour l'algue *Eucheuma spinosum* en Guadeloupe (Antilles françaises).

#### 4.- GRANDS ETABLISSEMENTS

##### COLLEGE DE FRANCE

##### Laboratoire de biologie marine de Concarneau

Etude de la colonisation des surfaces dures par les algues et les invertébrés (sessiles et mobiles) en relation avec les conditions de milieu.

Etude de l'alimentation des poissons : détermination de la nourriture des principales espèces de gadidés intéressant les pêches dans la zone Ecosse-Mer Celtique ; variations qualitatives et quantitatives en fonction des espèces prédatrices, de la saison, du secteur géographique ; principales espèces de poissons-proies, évaluations des quantités ingérées annuellement par les différents stocks.

Etude au niveau moléculaire des modalités d'adaptation de la crevette *Palaemon serratus* aux variations des paramètres physiques de l'environnement (populations de la baie de Concarneau, nord du golfe de Gascogne) : étude du développement larvaire, corrélation avec les variations de lumière et de température ; caractérisation histophysiologique des structures hormonales du pédoncule oculaire en fonction des cycles biologiques, action de la température et de la lumière. Modifications de structure de la LDH musculaire et de l'amylase comme un élément dans le processus de régulation thermique ;

étude de la synthèse des protéines musculaires et des protéines digestives de l'hépatopancréas en relation avec l'acclimatation thermique.

#### 5.- ASSOCIATIONS SANS BUT LUCRATIF

##### INSTITUT OCEANOGRAPHIQUE, PARIS

Analyse du benthos de la rade de Brest et cartes de répartition.

Etude du métabolisme du cuivre chez certains mollusques littoraux (*Patella sp.*, *Littorina littorea* et *Thyas sp.*) par spectrographie de rayons X, émission ionique secondaire, diffractions d'électrons et réactions histochimiques.

Etude histochimique du tube digestif larvaire et juvénile des poissons (bar et guppy), modifications au cours du développement, relations avec les phases critiques de la morphogénèse.

Recherche de l'excrétion éventuelle de riboflavine et de ptéridines chez les civelles. Etude des propriétés photochimiques des ptéridines et des flavines en eau de mer. Etude chimique des pigments caroténoïdes à rôle protecteur de certaines espèces de l'hyponeuston.

Etude de l'importance de l'incorporation de substances organiques dissoutes chez les invertébrés marins ; action de facteurs externes sur l'absorption d'acides aminés, d'acides gras et de vitamines (par exemple chez *Artemia salina*).

Etude écophysiologique de la respiration des crustacés décapodes et des poissons marins : action de la concentration d'oxygène et de gaz carbonique dissous sur la ventilation branchiale de *Carcinus maenas* et sur la ventilation branchiale et l'équilibre acido-basique de divers téléostéens et élasmobranches.

Autres organismes effectuant des recherches pouvant se rattacher au thème de l'océanographie biologique (rapports non reçus au moment de la rédaction de ce compte rendu) :

MINISTERE DE L'AGRICULTURE

Centre technique du génie rural des eaux et forêts (CTGREF)

MINISTERE DES UNIVERSITES

UNIVERSITE DES SCIENCES ET TECHNIQUES DU LANGUEDOC, MONTPELLIER

Station de biologie marine et lagunaire de Sète.

German Democratic Republic

No report received.

Germany, Federal Republic of

(J. Lenz)

Institut für Meereskunde, Kiel

Kiel Bight and Baltic proper

A regular sampling programme for chemical and biological data including the measurement of primary productivity was started in 1979 within the frame of the International Baltic Sea Monitoring Programme.

Work on the mass occurrence of blue-green algae (Nodularia spumigena and Aphanizomenon flos-aquae) was continued. Of great help are satellite photos which also may provide interesting information on other blooms of phytoplankton, e.g. the spring bloom of diatoms in the western Baltic. Possible interrelationships between bacteria and blue-greens were studied.

The importance of Aurelia aurita as key predator of zooplankton including fish larvae was studied in detail both in the Baltic and in the North Sea. At the same occasion the distribution of dominant elements of zooplankton was surveyed.

Two projects in benthos research were continued: the regeneration of nutrients in the sediment and at the bottom-water interface and the colonization of artificial sediments.

#### North Sea

RV 'Alkor' operated in the eastern North Sea in August in order to study the predator-prey relationship amongst mackerel larvae. The same cruise served as an intensive test for the newly developed plankton sampling system 'Messhai'.

#### Bermuda

In close cooperation with members of the BIWI-Project (Bermuda Inshore Water Investigation) planktological productivity studies including the process of sedimentation were carried out in Harrington Sound. A special study is conducted on the species succession of phytoplankton.

#### Equatorial Atlantic

During the first half of 1979 RV 'Meteor' worked in the equatorial current system at Lat.  $20^{\circ}$  W to study its influence on primary productivity and the distribution of plankton and fish larvae in relation to the different water masses. A main subject was the seasonal dependence of the equatorial upwelling.

A basic standard programme was carried out during the observation period of 5 months. Measurements included hydrographical, chemical and planktological parameters such as chlorophyll a, particulate C and N, primary production and species composition of phytoplankton. Different size groups of zooplankton and fish larvae were sampled with two types of multiple opening/closing nets and with two different neuston samplers.

In addition to the basic programme, special studies were conducted on the growth rate of dominant phytoplankton species, the occurrence of the digestive enzymes trypsin and amylase in different zooplankton species and the food selection of herbivorous copepods being offered natural phytoplankton.

#### B-iologische Anstalt Helgoland

Routine measurements of hydrographical, chemical and biological parameters have been continued at Helgoland Roads. Five times a week, temperature, salinity, nutrients ( $\text{PO}_4$ ,  $\text{NO}_3$ ,  $\text{NO}_2$ ,  $\text{NH}_4$ ,  $\text{SiO}_2$ ) and chlorophyll a were measured and phytoplankton species composition analysed

by the inverted microscope technique. In addition once a week, bacterial numbers (pour plate method) in the surface film and at a depth of 1 m were determined and BOD and surface tension measured.

The long-termed ecological studies on the development and distribution of Noctiluca miliaris in the German Bight have been continued. Seasonal fluctuations and annual abundance of this dominant dinoflagellate have now continuously been recorded over a period of more than 10 years at Helgoland Roads.

A special study of the plankton community in the German Bight, including the analysis of particulate matter (seston) and the measurement of hydrographical and chemical properties (micronutrients) of the water masses, was carried out aboard RV 'Friedrich Heincke' in August. The sampling grid with a station distance of 10 nautical miles was the same as in previous years. Additional samples were obtained from a cruise of RV 'Gauss' in May/June.

Ecological studies in the Wadden Sea of Sylt (German Bight) were continued. The analysis of seston and plankton composition in dependence of hydrography and season was supplemented by experimental work on growth conditions of dominant phytoplankton species. Investigations on the productivity of benthic communities were started.

#### Institut für Hydrobiologie und Fischereiwissenschaft, Hamburg

Studies initiated in 1977 on the structure of the pelagic and benthic communities in the central Red Sea, accomplished by toxicological investigations, have been supplemented by a second survey into the same area in 1979.

First results have been published and reported on symposia at Helgoland and at Khartoum. These investigations contribute to an environmental programme to assess the risk of mining metalliferous sediments from the deep Red Sea.

Analysis of samples of macro- and meiobenthos and of zooplankton taken in 1975 and 1977 from the upwelling area off Northwest Africa have been continued.

Sample sorting and data evaluation from the Fladenground-Experiment (FLEX) in the northern North Sea have been completed.

In cooperation with the Biologische Anstalt Helgoland a plankton programme was carried out within the frame of an eel-expedition into the Sargasso Sea in spring 1979. To study the vertical and horizontal

variabilities related to the thermal front, samples were taken by nets of 0.05, 0.1 and 0.3 mm mesh size at the surface (Neuston net) and over five depth ranges (multiple opening-closing net). The analysis of this material is in progress.

In 1979 the institution was also engaged in ecological and toxicological studies in the waddensea areas of the German Bight.

#### Institut für Meeresforschung, Bremerhaven

The studies on benthos ecology in the estuary of the River Weser and in the German Bight have been continued. Special emphasis is laid on the analysis of distribution patterns and long-term variations.

Ecological investigations are combined with taxonomical and experimental work. Many studies are directly or indirectly concerned with the effects and extent of marine pollution and the role of micro-, meio- and macrobenthos organisms acting as decomposers, indicators and accumulators of pollutants in coastal areas.

#### Forschungsinstitut Senckenberg für Meeresgeologie und Meeresbiologie, Wilhelmshaven

The biological investigations mainly concentrated on pollution problems in benthic communities, especially in tidal flats. For comparative studies, samples were collected from other regions, too, including coastal areas of Norway, Taiwan and U.S.A.

#### Iceland

##### Phytoplankton (Th. Thórdardóttir)

Phytoplankton investigations were carried out in a similar way as in previous years. Samples for measurements of primary productivity were collected at standard depths (0, 10, 20 and 30 m) and for chlorophyll a at 10 m. Samples for the study of the abundance and composition of phytoplankton were taken at the same standard depths and Secchi disc readings were made whenever possible.

The investigations were mainly carried out in 3 extensive hydrobiological surveys all around Iceland at approximately the same time as similar surveys in preceding years. During the period 18 April to 8 May the whole coastal area was



surveyed and the area from Ísafjörður southwards to Berufjörður was surveyed twice. The coastal as well as oceanic waters were surveyed in the traditional spring survey which took place 27 May to 15 June, and the Selvogsbanki was repeated at the end of the survey. During 0-group surveys 9-29 August almost the same area was investigated as in the spring survey.

Further measurements of primary productivity and Chl a were made in limited areas at other times of the year, such as in the waters off the northwestern peninsula during 18-25 July (23 stations) and in the southern part of Faxaflói 15-17 September (10 stations).

Further sampling for Chl a measurements and for the analysis of phytoplankton composition (0 m) was made in the fjords of NW Iceland (Ísafjarðardjúp, Arnarjörður, Dýrafjörður, Patreksfjörður) during 8-14 June (33 stations) and at different times of the year at two nearshore localities, the one near Húsavík (in North Iceland) and the other at the entrance to Reykjavík harbour. In 1979 primary productivity measurements totalled 2156 and Chl a 765 samples.

### Zooplankton (I. Hallgrímsson)

In 1979 zooplankton sampling was carried out at totally 406 stations in 6 cruises:

In late April 64 zooplankton stations were worked on the shelf area off the W, S, and SE coasts.

In late April - May 108 stations were worked on the shelf area round Iceland, the sampling in above cruises was carried out with a Hensen net, finemeshed vertical net and Gulf III sampler.

In April and May 8 zooplankton stations were worked in two surveys W- and SW off Iceland.

In late May to mid June 130 stations were worked around Iceland, both on and off the shelf. This sampling was carried out with a Hensen net, Gulf III sampler and Icelandic High Speed Samplers in two layers.

In early June a prawn larvae sampling was carried out with a Gulf III sampler at 96 stations in and off the fjords of NW-Iceland.

As previously, the continuous plankton surveys between Reykjavík and New York and Reykjavík and Sule Skerry, worked in cooperation with the Institute for Marine Environmental Research, Plymouth, were still in progress.



## Ireland

(B. McK Barry and M.M. Parker)

1. Department of Fisheries and Forestry, Aquatic Environmental Unit. Benthic ecological surveys form part of the marine protection programme of the Unit (See Administrative Report of Marine Environmental Quality Committee).

Observation and recording of algal blooms and red tides continues. In August and September, extensive Gyrodinium aureolum Hulbert blooms again affected the south west coast and were implicated in a kill of caged fish in Dunmanus Bay.

2. University College, Galway. Faculty of Marine Science

a) Zoology Department, Benthos Team

Extensive and intensive ecological studies of selected communities of both soft and hard sub littoral benthos is continuing in Galway Bay and Kinsale. Particular attention is being paid to the biology and autecology of key species. In association with, and by courtesy of, the Station Biologique de Roscoff, France, extensive mapping of the Celtic Sea benthos was undertaken.

b) Department of Oceanography

Biological oceanography in the Department of Oceanography, University College, Galway continues to be based on research programmes in which physical, chemical and biological sampling at sea are carried out together at each station occupied.

Areas concerned have been along the west and south coasts of Ireland viz., Galway Bay, the lower 50 km of the Shannon Estuary, Bantry, Long Island and Roaringwater bays on south west coast, and off Kinsale on the south coast.

There are studies in hand on the ctenophora of western Irish coastal waters, their biology and oceanographic relationships; the zooplankton and the occurrences and abundances of species in relation to the freshwater-sea water interactions and circulation in the Shannon Estuary; a comparison of the oceanographic conditions and of zooplankton occurrence and abundances in Roaringwater - Long Island Bays with Bantry Bay; the occurrences and fluctuations during the year of Calanus finmarchicus and C. helgolandicus and the relationship of these to seasonal condition in western Irish coastal waters.

There is also a study of seasonal fluctuations of phytoplankton and of oceanographic conditions in the Kinsale area, with special reference to biologically - caused discoloured water (e.g., red tide).

These and earlier, similar studies, are providing insights, based on quantitative data, of one important ecological feature, namely, the interrelationships among species' occurrences, numbers, and distribution (and through these, on zooplanktonic populations) of both short- and long-term environmental changes.

3. Other studies, mainly benthic and littoral, are carried out as baseline surveys. See Administrative Report of the Marine Environmental Quality Committee

4. Bantry Bay

A littoral and sub-littoral ecological survey is being carried out at selected rocky sites in Bantry Bay by scientists from the Zoology Department, University College, Cork. This is an extension of baseline survey work carried out in this area in the early 1970s.

Netherlands  
(J.J. Zijlstra)

Phytoplankton monitoring of the Dutch coastal area of the North Sea was continued for the 7th year. The diatom spring bloom was followed by dominance of *Rhizosolenia* sp. Unarmoured dinoflagellates dominated thecate forms.

During the summer primary production was measured in the southern North Sea with several versions of the  $^{14}\text{C}$  method. The samples taken for phytoplankton analysis were also investigated with high-performance liquid chromatographic (HPLC) methods to determine quantitatively the amount of chlorophylls, various chlorophyll derivatives, and carotenoids.

Zooplankton was sampled during a series of weekly summer cruises. The decline in the population of herbivores was accompanied by an increase in numbers of fish larvae. An interesting succession of pelagic predators was observed. Two of the most important herbivorous copepods of the North Sea are being reared successfully in the laboratory in continuous cultures.

Population density, growth rate and productivity of the Wadden Sea benthos were measured for the 10th consecutive year. Causes and consequences of the large annual variations are being analysed. The low temperature during the severe winter of 1978/1979 had an adverse effect on a number of species but total biomass was not influenced greatly.

In the central North Sea the seasonal variation of the infaunal biomass (benthos) was studied at  $53^{\circ}00'N3^{\circ}55'E$  and at  $53^{\circ}45'N4^{\circ}20'E$ .

Norway

(G. Berge and F. Beyer)

1. Institute of Marine Research, Bergen and Biological Station Flodevigen, Arendal.
- 1.1 Phytoplankton
  - 1.1.1 The monitoring of primary production and standing stocks of phytoplankton over the coastal banks off western and northern Norway continued for the 4th year, covering the spring season three times at six sections across the Norwegian economic zone. The results are being combined with the previous material in a study of the annual primary production and its fluctuations. The study constitutes a component of a biological baseline and monitoring study related to the oil exploitation programme on the shelf. The following parameters are included: primary production rates, chlorophyll a, hydrography, nutrients and zooplankton. Turbidity and chlorophyll in vivo fluorescence were continuously recorded at the 5 m level (IMR).
  - 1.1.2 A long-term programme on environmental conditions in the Norwegian fjords (IMR) was continued. About 30 fjords along the whole Norwegian coast were surveyed in November - December and samples for analysis of nutrients, oxygen, salinity and temperature were collected (IMR).
  - 1.1.3 A study of the phytoplankton and its primary production at the ice edge in the Barents Sea was started in summer 1979. This study is part of an interdisciplinary programme designed to investigate the biological production processes in this **important** fishing area.
  - 1.1.4 Effects of Ekofisk crude oil on phytoplankton has been studied on diluted natural populations and on unialgal cultures. (BSF).
  - 1.1.5 Nitrate, ortophosphate, chlorophyll a and fixed samples of phytoplankton are analyzed from stations along the hydrographical section Torungen - Hirtshals in Skagerrak (BSF).
- 1.2 Zooplankton
  - 1.2.1 At 6 permanent oceanographic stations along the coast the routine sampling of zooplankton by Juday 36/180 m nets continued. Zooplankton volumes, species composition and stages developments are recorded.

1.2.2 As a component of the Joint Coastal Current Programme as well as the Biological Baseline and Monitoring Programme (see 1.1.1) related to oil exploration and exploitation north of N 62° 0', zooplankton sampling was made in duplicate at 378 stations on five sections across the shelf. The stations were each operated 3 - 7 times during the year. Additionally, once a week vertical hauls 200-0 m and 50-0 m were made from weather ship "Ami" at N 71° 30' and E 19° 00'. The material was worked as for 1.2.1.

1.2.3 Investigations in connection with commercial exploitation of zooplankton (Calanus) were temporarily suspended. The fishery of Calanus is developing slowly with annual catches increasing to 100 - 150 tonnes.

### 1.3 Ichthyoplankton

1.3.1 All fish eggs and larvae collected by the Institute since 1976 have been identified and recorded. This is partly a component of a biological baseline and monitoring programme preceding the planned oil exploitation programme on the shelf north of N 62°, (see 1.1.1 and 1.2.2). The recordings also go towards an increased knowledge about spawning seasons and behaviour of the larvae of different fish species. About 10 500 samples have been worked up since 1976.

## 2. University of Bergen

### Institute of Marine Biology.

2.1 Studies in the land-locked fjord system Lindåspollene have continued, with particular emphasis on improvements to the plankton model of the system, and on the production of benthic diatoms. Experiments in plastic enclosures of the water column have been started to investigate succession in the phytoplankton and herbivorous zooplankton.

2.2 In the open fjord system, Korsfjorden, primary production has been further studied in relation to light levels and with respect to size fraction, and studies on grazing have been undertaken based on plant pigment analyses of size fractioned zooplankton samples.

2.3 Study of the food organisms recorded in the stomachs of demersal fish and an investigation of the occurrence and diversity of epibenthic crustaceans, both aimed at elucidating plankton/benthos relationships in Norwegian fjords, have continued.

2.4 The usefulness of biochemical estimates (nucleic acids, adenine nucleotides) in ecological studies has been further investigated with particular emphasis on possible distinctions between different components of a community.

2.5 A report describing the present status of the zooplankton of Ryfylkefjordene has been completed in anticipation of changes in the system as a consequence of a hydroelectric development, and the corresponding report on the benthos is being compiled.

Department of Fisheries Biology.

2.6 In a landlocked fjord, Lindåspollen, egg and larvae of herring have been collected and analysed to study the stock size and the reproduction of the herring stock in the area.

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

3.1 Phytoplankton

3.1.1 Studies of eutrophication effects in the Oslofjord have continued by means of chlorophyll measurements and algal growth potential experiments in the laboratory. Quantitative phytoplankton samples and net samples were also collected.

3.2 Pollution effects in benthic communities.

3.2.1 Studies of sublittoral hard bottom areas in the Frierfjord and the Iddefjord have continued by means of stereophotography of fixed sites. This undestructive sampling technique has been used to follow the in situ epifauna changes with time. It provides interesting information on species and ecology, and the project will continue in 1980.

3.2.2 Monitoring of littoral community response and levels of fluoride and PAH in algae and snails, has continued in the recipient for scrubber effluent from Lista Aluminium Smelter.

3.2.3 Benthic baselines and contamination levels of PAH in several species of algae, mussels, snails and echinoderms have been performed for localities in Southern Norway.

3.2.4 In the Frierfjord soft bottom fauna studies were made at three localities in the inner fjord. Investigations are made at 5 year intervals to monitor changes in water quality, especially organic pollution and oxygen depletion.

4. University of Oslo

Institute of Marine Biology and Limnology.

4.1 Phytoplankton.

4.1.1 Phytoplankton surveys.

4.1.1.1 The investigation of the spring phytoplankton in the spawning areas of cod and herring (Lofoten to Møre) in collaboration with the Institute of Marine Research, Bergen, was continued. This investigation is part of the Norwegian IBP/PM programme. A first report has been published (T. Braarud, I. Nygaard). A second report was submitted for publication in Sarsia.

- 4.1.1.2 Phytoplankton was examined as part of oceanographic surveys carried out in connection with the hydroelectric power-plant projects. The final phytoplankton report has been prepared.
- 4.1.1.3 A survey of dinoflagellate cyst distribution along the Norwegian coast was continued (B. Dale).
- 4.1.2 Special phytoplankton studies.
- 4.1.2.1 Taxonomic studies on coccolithophorids, by means of transmission and scanning electron microscopy, were continued. (K.R. Gaarder, in cooperation with B.R. Heimdal, Bergen).
- 4.1.2.2 Morphology, taxonomy, and distribution of the diatom genus Thalassiosira were studied by means of light and electron microscopes (G.R. Hasle, in cooperation with Dr. G.A. Fryxell, Texas).
- 4.1.2.3 Investigation of seasonal and spatial distribution of the diatom genus Thalassiosira in Norwegian and adjacent waters is in progress (G.R. Hasle, E. Syvertsen).
- 4.1.2.4 An investigation of the morphology and taxonomy of the diatom genus Cerataulina was published. Similar investigations of the diatom genus Eucampia and on a new diatom family are in progress (G.R. Hasle, E. Syvertsen, the latter investigation in cooperation with Prof. H.A. von Stosch, Marburg).
- 4.1.2.5 An investigation of the nitrogen turnover in the phytoplankton of the inner Oslofjord was initiated. Among the methods used in this work is the determination of nitrate, ammonia and urea uptake by N-15 as measured in an emission spectrometer. Similar techniques will be used in an investigation of the nitrogen turnover in a landlocked fjord in Western Norway, organized jointly with the Institute of Marine Biology at the University of Bergen (E. Paasche, S. Kristiansen, students).
- 4.1.2.6 A summary of dinoflagellate blooms in Norwegian waters was prepared (K. Tangen).
- 4.1.2.7 Taxonomy and morphology of dinoflagellates were studied by means of light transmission and scanning electron microscopes (B. Dale, K. Tangen).
- 4.1.2.8 A report on a smaller field investigation of phytoplankton composition and distribution at an inshore locality in southern Norway is in preparation (student).
- 4.1.2.9 An introduction to living and Quaternary dinoflagellate cysts is in preparation (B. Dale).
- 4.1.2.10 Pigmentation and morphology (including fine structure) of small unarmoured dinoflagellates have been studied (K. Tangen, T. Bjørnland).
- 4.1.2.11 Influence of growth conditions on diatom frustule morphology, and diatom resting spore formation and morphology were investigated (E. Syvertsen).

4.1.2.12 Vertical movement of ultra- and nanoplankton flagellates were studied in artificial water columns (J. Thronsdalen).

4.1.2.13 A note on the temperature range of Coccolithus pelagicus has been published (T. Braarud).

Projects 4.1.2.1 - 7 and 4.1.2.10 - 12 will be continued in 1980.

#### 4.2 Zooplankton

4.2.1 Hyponeuston investigations based on the application of new gear were continued (T. Schram).

4.2.2 A paper on the life history of the eye-maggot of the sprat, Lernaenicus sprattae, was published (T. Schram).

4.2.3 Investigations of copepod parasites on the polar cod from Spitsbergen are in progress (T. Schram).

#### 4.3 Phytobenthos

4.3.1 Investigation of the morphology and taxonomy of species of a new diatom family, Cymatosiraceae, is in progress (G.R. Hasle, in cooperation with Prof. von Stosch, Marburg).

4.3.2 Experimental taxonomy and life history studies of selected red algae (J. Rueness, M. Rueness).

4.3.3 Autecological studies of selected algae in the inner Oslofjord (T.E. Lein, J. Rueness, students).

4.3.4 Small-scale surveys of algal flora and vegetation in fjord areas outside the Oslofjord (students, J. Russenes).

4.3.1 - 4 will be continued in 1980.

#### 4.4 Zoobenthos

4.4.1 Work on the problems with biological interactions (predation, competition, succession) as back ground noise in biological monitoring studies was continued. Field manipulative experiments on subtidal sediment and on subtidal rocky bottom communities were carried out by means of SCUBA diving (J. S. Gray and collaborators).

4.4.2 Investigations on the meiobenthos of the inner Oslofjord were commenced (J. S. Gray, student).

4.4.3 Investigations were carried out and reports published on the biology of gobiids (I.H. Hesthagen).

#### 4.5 Fish

4.5.1 Work was completed on the biology of the sprat in the polluted water of the Oslofjord (F. Beyer, student).

4.5.2 Field investigations of the swimming behaviour and local migration of eel in the Oslofjord were completed (students).



Poland

(K. Siudziński)

Sea Fisheries Institute, Gdynia

Baltic

The long term and complex observation on hydrographic conditions and biology were continued in 1979 in the southern Baltic on standard stations during 8 cruises.

In all 198 stations were occupied and examined for T, S, O and nitrophosphate.

On 150 stations 240 samples for phytoplankton, 245 samples for zooplankton and 70 samples for benthos were collected.

NW - Atlantic

RV "Wieczno" took part (5 October - 21 November) in a Joint Polish/US Survey off the New England Coast. The objectives were:

- collect food and feeding related information from sharks, swordfish and tuna,
- collect tissue samples from sharks for age, growth, reproduction and contamination studies,
- mark apex predators with standard dart tags,
- examine warm water eddies for associated predator species,
- acoustic telemetry experiments with Blue Sharks (Prionace glauca),
- monitor seasonal changes in the distribution and abundance of ichthyoplankton and their predators and prey, and to collect oceanographic data relating to these changes.
- phytoplankton sampling for studies of qualitative and quantitative distribution,
- observation of the distribution of marine birds, and collection of certain species for the study of food habits.

Antarctic

During the fourth Polish Antarctic Expedition in December 1978 through March 1979 the main objective were:

- distribution of phytoplankton,
- feeding of krill and distribution of krill eggs and larvae,
- collecting meteorological and oceanographic data (T, S, O and nutrients) to find factors influencing changes in distribution of phytoplankton and krill concentration, and to determine water mass dynamic in Antarctic region.



### West Coast of Africa

RV "Włoczek" has conducted (March-May 1979) as a part of fishery research meteorological and hydrological measurements along the coast of Senegal, Gulf of Guinea and Namibia,  
Experimental studies on adaptation and feeding of rainbow trout in brackish waters.

### Institute of Oceanography of the Gdańsk University

The institute's activities in the field of biological oceanography can be divided in three geographical areas.

#### Gulf of Gdańsk

- continuation of experimental studies on influence of some environmental factors (temperature and light intensity) on rate of photosynthesis of macroalgae: Fucus vesiculosus, Pilayella sp., Ceramium sp, Enteromorpha spp. and natural phytoplankton community from Gulf of Gdańsk,
- studies on growth of Fucus vesiculosus influenced by growth hormones (gibereline),
- studies on rate of bioenergetic processes of Baltic crustacea: Crangon crangon, Palaemon adspersus, Neomysis vulgaris in relation to food and temperature,
- studies on population dynamic and biology of shallow-water benthic species: Cardium glaucum, Mytilus edulis, Crangon crangon.

#### Coastal Spitsbergen (Hornsund)

- In Summer 1979 (June-September) continuation of studies on amphipod ecology, distribution and abundance,
- collection of hydrochemical data, plankton and benthos related to these changes to establish a functional model of polar estuary.

#### Southern Ocean and Antarctic Shelf

- studies on zooplankton distribution in the Open Ocean (transect S-Africa to Antarctica) and in the Admiralty Gulf with special regards to Copepods and Chaetognats collected in 1968-69 and in 1978,
- collecting of water samples for organic carbon determination in summer in Scottia Sea.

### Department of Biology of Medical Academy - Gdańsk

Subject of the experimental investigations in 1979 were the effects of chronic toxicity exerted by the following pollutants of industrial

origin on some animals from the Bay of Gdańsk:

1. some detergents a.o. a commercial product "SOLO", a mixture of nonionic and anionic surfactants (for household purposes), and an oil-spill remover Gamlen "CW" Solvent;
2. crude Ramashkino oil and some of its derivatives.

The experimental animals were: Aurelia aurita L., Crangon crangon L., the crucial carp (Carassius carassius L.), the pike (Esox lucius L.). Beside these inhabitants of the Bay of Gdańsk, also carp fry was used in one of the experiments.

The pollutants mentioned above induce sublethal changes in: the enzymic system, the reproductive activity, embryonic and larval development, and also red blood and white blood count.

The general conclusion is that chronic sublethal toxicity may severely affect or even destroy some marine ecosystems.

#### Biological Station of Gdańsk University in Górkki Wschodnie

In 1979 the research work of the Biological Station of Gdańsk University was concerned with biochemistry and marine pollution;

- comparative studies on NADP-linked dehydrogenases in extracts of various tissues obtained from four species of fish (herring, cod, flatfish and eel) and three crustaceans (shrimp and two crabs),
- effect of the anionic detergents on central nervous system of the shrimp Crangon crangon,
- effect of the oil on tissues of the shrimp Crangon crangon.

#### Department of Oceanology of Polish Academy of Science - Sopot

Within the frame of the Baltic Monitoring Programme measurements of the primary production and the chlorophyll a concentration were performed. Water samples were taken at seven points from different depths of the upper 20 m thick layer of water in the part of Baltic subjugated to Poland. The samples were taken in 1979 four times in: March, May, August and October.

#### Agriculture Academy in Szczecin

Biological capacity of the Baltic coastal zone.

Portugal

(M.T. Neto and A Ribeiro Cascalho)

1. Plankton

Upkeep of the phytoplankton culture stock (phytoflagellates, diatoms, dinoflagellates, chlorophyceae); development of ten litre monoalgae cultures to feed the zooplankton stock cultures (M<sup>a</sup>.A.Sampayo).

Start of productivity experiments with phytoflagellates and dinoflagellates (M<sup>a</sup>.A.Sampayo).

Studies on the nutritional value of the phytoplankton cultures (M<sup>a</sup>.A.Sampayo).

Upkeep of the zooplankton culture stock (copepods and rotifers) (M<sup>a</sup>.Helena Vilela).

Culture of Brachionus plicatilis in five and twelve litre aquaria using alive and inert food as an assay to obtain better concentrations for aquaculture support (M<sup>a</sup>.Helena Vilela).

Start on food quality experiments with the harpacticoid copepod Tigriopus brevicornis in small volumes (M<sup>a</sup>.Helena Vilela).

Continuation of the study of phyto and zooplankton in samples collected from March 1976 till December 1977 in "Musgos" fish pond on the right side of Sado estuary (M<sup>a</sup>.Helena Vilela and M<sup>a</sup>.A.Sampayo).

Physical and biotic parameter dynamics integrated in the program "Environmental study of the Tejo estuary" coordinated by Comissão Nacional do Ambiente (Núcleo de Ecologia, Dpt de Botânica, Fac. de Ciências Lisboa).

Study of phytoplankton integrated in the program "Environmental study of the Tejo estuary" coordinated by Comissão Nacional do Ambiente (M<sup>a</sup>.Teresa Moita and A.Rodrigues).

"Impact study of the Setúbal thermoelectric plant.

Preliminary results. Phase I". Publ. Serv.Estudos do Ambiente (M<sup>a</sup>.C. Peneda).

Study of zoo and ichthyoplankton related with Sardina pilchardus (w) spawning and breeding areas between Cabo da Roca and Vila Nova de Milfontes (M<sup>a</sup>.Hortense Afonso, M<sup>a</sup>.Emília Cunha, M<sup>a</sup>.Fátima Quintela, M<sup>a</sup>.Teresa Rodrigues and Francisca Varela).

Phytoplankton study from Peniche (L.Cabeçadas and A.M.Costa).

Zooplankton study from Peniche and Tejo estuary (P.Sobral).

Ichthyoplankton studies from Peniche, Tejo and Sado estuaries (P.Ré).

"The eggs and planktonic stages of portuguese marine fishes. I - Ichthyoplankton from the coast of Algarve". Arq.Mus.Boc.(2<sup>a</sup>.sér.), 7 (3):23-51 (P.RÉ, 1979).

"The eggs and planktonic stages of portuguese marine fishes. II - Ichthyoplankton of Tejo estuary" Bolm. Soc. port.Ciênc.Nat.(in press) (P.RÉ).

#### Outside of the ICES region

"Neuston do arquipélago de Cabo Verde" (Campanha do R.V. "Walther Herwig em Dezembro de 1970).

I. Sifonóforos calicóforos (T.Neto).

II. Pontelídeos (Copepoda. Calanoida) (I.Paiva).

Bol. Inst. Nac. Invest. Pescas (impress)

## 2. Benthos

Salt marsh vegetation structure and behaviour in Tejo estuary, Castro Marim and Ria Formosa, Algarve (Núcleo de Ecologia, Dpt de Botânica, Fac.Ciências. Lisboa)

Estuarine and littoral benthic populations ecology (L.Saldanha).

Littoral and estuarine benthic populations ecology (F.Andrade e L.C. da Fonseca)

Benthic sponges from Continent and Azores (M<sup>a</sup>.Teresa Lopes)

Intertidal benthic studies from Peniche/Lagoa de Óbidos (C.Sousa Reis).

## 3. Food chains

Anquilliformes fishes: systematics, ecology and feeding habits (L.Saldanha)

Estuarine benthic fishes: systematics, reproductive cycle and feeding habits (M<sup>a</sup>.J.Costa).

#### Spain

No report recieved.

Sweden

(L. Hernroth)

Baltic Sea

In the open Baltic Sea, the Hydrographical Laboratory of the Swedish Fishery Board in 1979 conducted two cruises in the off-shore monitoring programme (May-June and October-November). On each cruise 7-9 stations were visited in the Baltic proper and 5 in the Bothnian Sea. The parameters measured were: primary production (incubator) chlorophyll-a and qualitative phyto- and mesozooplankton analysis.

The University of Uppsala in 1979 initiated a project concerning the effects on the phytoplankton community caused by industrial and thermal pollution. Pilot studies have started in the Rönnskär area in the Bothnian Sea and will soon be extended to the Forsmark area which is the site of a nuclear power plant.

The Askö laboratory, in the archipelago south of Stockholm, continued their long-term pelagic monitoring programme also in 1979. Two stations were visited 25 times during the year and the sampling covered most biotic and abiotic parameter with reference to the pelagic ecosystem.

On the south-coast of Sweden, the University of Lund in the autumn of 1979 started a programme for evaluating the productivity of shallow marine bays. Benthic and pelagic algae and their productivity were sampled and analysed, chlorophyll was measured and this at a frequency of approx. 10-15 times per year.

Kattegat and Skagerrak

As a part of the off-shore monitoring programme, the Hydrographical laboratory of the Swedish Fishery Board has measured primary production and chlorophyll in the Kattegat and Skagerrak area on one cruise in May and one

in October. Samples for qualitative analysis of phyto- and zooplankton were also taken on these occasions.

As a part of their routine programme, the Institute of Marine Research in Lysekil has made several ichthyoplankton surveys in the area during the year. The gears used have been 60 cm Bongo-nets and IKMWT.

In the Gullmar-fjord, an intensive pelagic project similar to that of the Askö laboratory has been run for its second year. At an interval of 10 days sampling and analysis of hydrography, nutrients, light, primary production, chlorophyll phytoplankton, meso- and macrozooplankton have been made by the Kristineberg Marine Biological Station.

Studies, especially concentrated to the life-cycles of cladocerans and chaetognaths, has been conducted by scientists from the University of Stockholm.

The Tjärnö laboratory, situated on the northern part of the Swedish west-coast, has for several years taken an active part in the research concerning aqua-culture. In their area, an increasing number of Mytilus farmers have started commercial cultures. As a consequence thereof, the Tjärnö laboratory has started a research programme aimed at describing those parameters in the pelagic zone which regulate the growth of the mussels. The number of observations have been approx. 25 during the year.



United Kingdom

1. England

(D.J. Garrod)

1. MAFF Lowestoft Fisheries Laboratory

A. Plankton Studies in the seas around the British Isles

- (i) The data from the NE Coast survey carried out in 1976 has now been analysed for publication in a series of technical reports and scientific papers. The data have been used to construct a two dimensional simulation of the geographical and seasonal progression of primary and secondary production throughout the area. This model has achieved a satisfactory representation of production in the 'spring bloom' period but additional variables would be necessary to achieve a comparable simulation of the changes that took place in the second half of the year.
- (ii) Data from the 1978 studies on a patch of plaice eggs in the Southern Bight have now been fully analysed. The results indicate that the state-of-the-art hydrographic techniques now give reasonable agreement between dye-diffusion experiments and current meter arrays and that the movements of a specific patch of eggs could be predicted accurately enough to identify its position on successive survey grids as would be required to conduct a full scale study on the eggs and larval stages of **fish between spawning and metamorphosis**.
- (iii) Analysis of the dietary characteristics of larval fish has been undertaken to identify possible areas of competition between species or heavy dependence on a particular prey organism, and the feeding of twenty-two species of fish larvae off the NE coast of England has been described. These studies have now been extended to more detailed investigation of the nutritional requirements of plaice and cod larvae, comparing the growth and development of laboratory reared larvae with wild specimens. Attempts are being made to age these larvae by daily rings on the otoliths and to determine their nutritional status to identify what proportion of larvae might not be viable although alive at the time of capture.
- (iv) Studies have also been carried out between 1976 and 1979 to determine the diet of pelagic and semi-pelagic fish which were considered to be potential predators of fish eggs and larvae, and the results of these studies are now being written up for publication. In 1979 an attempt was made to estimate the abundance of the predators acoustically and to look for aggregations of fish in relation to plankton patches. The usual problems were encountered with the acoustic equipment, namely : missing fish which were close to the bottom; identifying species and sizing individuals. Consequently we failed to obtain a good estimate of predation pressure by this method.
- (v) Vertical distribution studies have been carried out on the larvae of the lobster (*Homarus gammarus*) on the NE coast in 1979. The results suggest that low density coupled with variation in vertical distribution will make it extremely difficult to sample lobster larvae quantitatively with our present sampling methods.
- (vi) Two cruises were carried out aboard RV CORELLA in August/September and in October as part of the International series of herring larval surveys.
- (vii) One survey was conducted aboard RV CORELLA in July to examine the structure of the oceanographic front off the NE Coast of England using a profiling fluorometer. This work demonstrated that the high chlorophyll 'a' concentrations of the front were continuous with similar and higher chlorophyll 'a' concentrations in the thermocline further off shore. In a follow up to this cruise aboard RV CIRCLANA in September high chlorophyll 'a' values have been found in association with the thermocline throughout the North Sea varying

in intensity with the strength of the mixing through the thermocline and with its depth in the water column.

- (viii) A cruise to the English Channel aboard RV CORELLA in April/May 1979 was aimed at estimating the extent and intensity of the sole spawning from the distribution and abundance of eggs.

B. Gear development and instrumentation.

- (i) Calibration studies on an unencased 20" Lowestoft plankton sampler fitted with conical nose cones with a range of small diameter apertures have shown that the ratio of volume of water accepted to external flowmeter revs per second remains stable up to  $\frac{1}{8}$  clogging of the net area.
- (ii) The sea going HIAC particle counting and sizing system is now operational and has been used (a) in conjunction with a fluorometer, to measure chlorophyll 'a', and environmental sensors to examine 'fronts' and sludge dumping areas in the Southern North Sea, and (b) to examine the size range of particulate material in sediments in the English Channel and Irish Sea.
- (iii) Electronic environmental sensors, meteorological instruments and ships navigation equipment have all been linked to the ships computer aboard RV CIROLANA, and a series of programmes written to process and vet the data. This instrumentation is to be tested on a patch cruise in the Southern North Sea in the Spring of 1980.

2. The Continuous Plankton Recorder Survey (IMER)

The survey by the Continuous Plankton Recorder was continued on the same basis as in previous years. Recorders were towed at a depth of 10 m at monthly intervals along the standard routes shown in Figure 1. In addition three routes were operated by the U.S. National Marine Fisheries Service.

During 1979, Recorders were towed for 94 645 miles by 21 ships of eight nations (Denmark, France, Norway, Iceland, the Republic of Ireland, the Netherlands, Sweden and the U.K.). The CPR survey began in 1930 with three routes in the southern North Sea; since 1948, the plankton has been collected, analysed and the results processed in the same way. Measurements of temperature were taken on the K, C, IN and FR routes. An inventory of the survey is produced every year and is available on request to the Director, Institute for Marine Environmental Research, Prospect Place, The Hoe, Plymouth, PL1 3DH, England. Details of the data processing procedures are given by J M Colebrook in Bull. mar. Ecol., 8, 193-142.



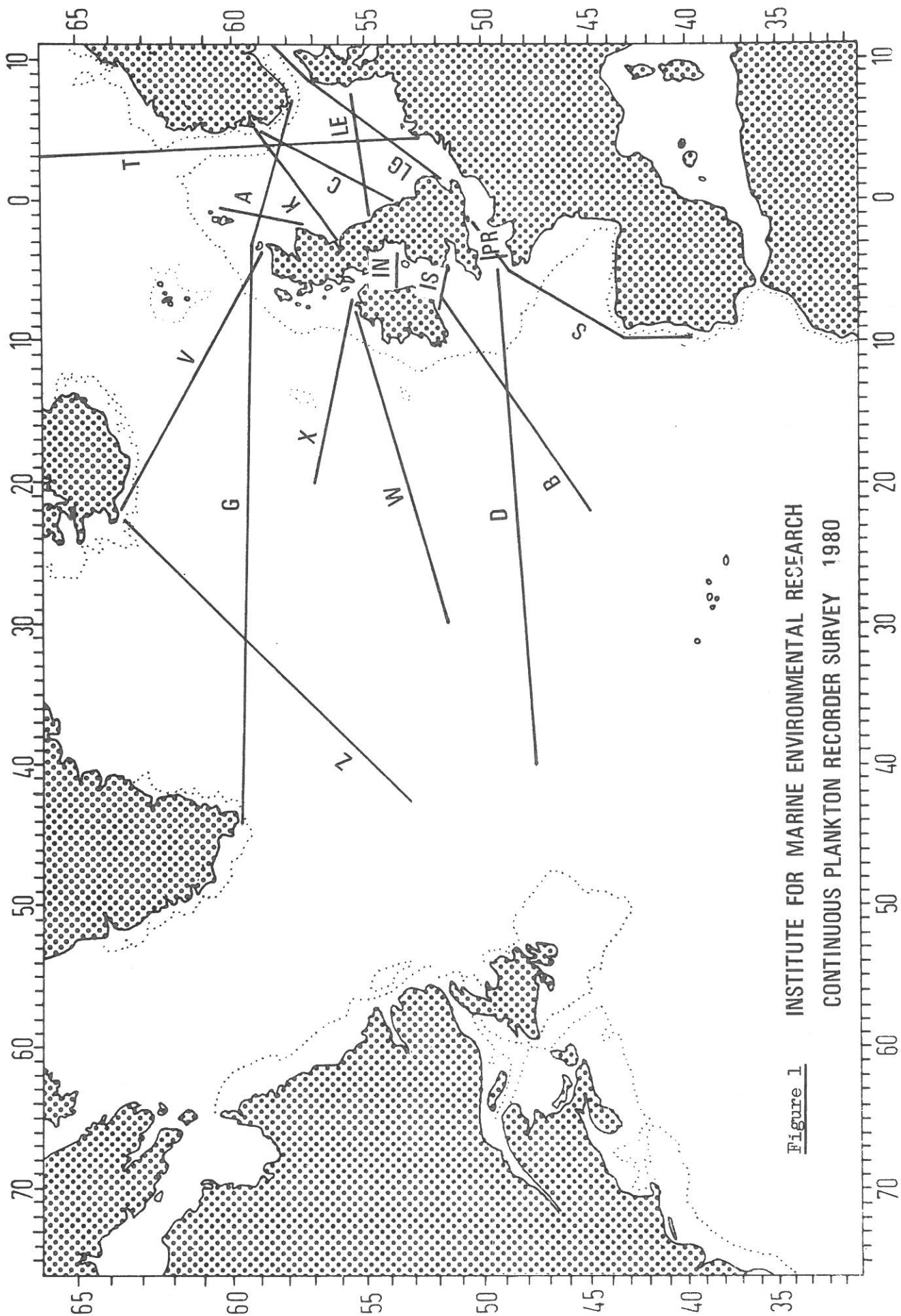


Figure 1 INSTITUTE FOR MARINE ENVIRONMENTAL RESEARCH  
CONTINUOUS PLANKTON RECORDER SURVEY 1980

## 2. Scotland

(R. Jones)

### 1. Marine Laboratory Aberdeen

#### Scyphomedusae

The ninth survey of the distribution and abundance of scyphomedusae was carried out as part of the 1979 International O-group gadoid survey.

Surveys were carried out in Loch Ewe during the summer growing season May-October 1979, on the populations of scyphomedusae. Data were obtained on growth rate, abundance, distribution patterns and associated gadoids.

#### Growth of herring in large plastic enclosures

Experiments and trials to improve techniques were carried out on herring larvae both from spring and autumn spawned stocks.

#### Ecology of larval gadoids

The study of the ecology of late gadoid larvae east and north of Shetland continued with a survey during the period 9 May to 1 June 1979.

#### Ecology of O-group gadoids during early winter

A third, and possibly, final, survey was carried out from 24 October-13 November. As was found in the previous surveys in 1977 and 1978, the only gadoid which occurred frequently in the near-surface catches was O-group whiting which had a length range of 1.5 to 11.5cm. On a single occasion (statistical rectangle 47F1), 35 O-group haddock of 7.0-12.0cm were caught near the surface but this species was absent, or present as single specimens in the rest of the near-surface catches.

The most common fish species caught in surface ichthyoplankton hauls were O-group rocklings, Clupeids, lumpsuckers, Cyclopterus lumpus and three-spined sticklebacks.

#### Summer Productivity Studies east of Orkney

Studies continue on the drift of herring larvae, the circulation and contribution of the Fair Isle current to the water balance of the North Sea, and the influence of this current in generating an area of high summer phytoplankton production.

#### Theoretical studies of energy flow through food web

Further work has been done on the simulation of primary production and of energy flow through simple food webs.

### 2. Dunstaffnage Marine Research Laboratory, Oban (SMBA)

A study of the deep-sea demersal fish populations on the slope to the west of the Hebrides has been completed with a cruise on RRS Challenger in January 1979. This study includes the analysis of stomach contents with the aim of determining the main links in the food chain of both demersal and mesopelagic fishes.

Quantitative studies have been made of the macrobenthos of the Rockall Trough. Investigations have been made of the deep-sea meiobenthos, with core samples being taken from the Rockall Trough and from the Porcupine Abyssal Plain. The ability of the SMBA multiple corer to obtain undisturbed cores of sediment has led to a limited deep-sea microbiological programme being carried out by the SMBA and other institutes.

U.S.A.

(K. Sherman and G.D. Grice)

Ichthyoplankton-Zooplankton Assessments

During 1979, the laboratories of the National Marine Fisheries Service, Northeast Fisheries Center at Woods Hole, Narragansett, and Sandy Hook, expended considerable effort in studies dealing with assessments of changes in the abundance of the ichthyoplankton and zooplankton fields in the continental shelf ecosystem off the northeast coast. Eight MARMAP surveys were conducted over 250,000 square kilometers of shelf including the Gulf of Maine, Georges Bank, Southern New England, and the Mid-Atlantic Bight. The surveys were conducted in cooperation with AtlantNIRO, Kaliningrad, and Morski Instytut Rybacki, Gdynia. On each of the surveys, collections were made for ichthyoplankton, zooplankton, and neuston. At each sampling location water column measurements included nutrients, temperatures, salinities, chlorophyll, and  $^{14}\text{C}$  productivity. Preliminary analyses of the survey data at the Narragansett Laboratory indicated good correlations between seasonal changes in the abundance of the dominant ichthyoplankton and zooplankton species with laboratory based temperature indices of growth and survival. The seasonal maxima and minima primary production for chlorophyll and nutrients in the area from Nova Scotia to Cape Hatteras are now being defined, and seasonal as well as between-year variability will be described. Production rates are being determined for net plankton ( $> 20$  microns), nanoplankton ( $< 20$  microns), and dissolved organic carbon (DOC). Measurements of chlorophyll a were made in April 1979 as part of a cooperative (21 State, Federal, and private organizations) Large Area Marine Productivity Experiment (LAMPEX) to map chlorophyll a in surface waters of the continental shelf from Cape Hatteras to the Gulf of Maine. Chlorophyll a determinations served as sea-truth for NASA's measurements made via remote sensing using U-2 and C-130 aircraft. Scientists at NEFC collected and reduced sea-truth data for calibration of the remote sensors. Cooperative studies were conducted with scientists from the U.S.S.R. aboard a Soviet research vessel during September, October, and November to document short-term changes in the phytoplankton, microzooplankton, and macrozooplankton communities during autumn in an area covering the southern Gulf of Maine to the New York Bight. Using a Coulter Counter and gut fluorescence techniques, copepod grazing experiments were carried out on Georges Bank. In addition, autoradiographical measurements on phytoplankton species production rates complemented phytoplankton community production rate measurements in a time-series experiment conducted on Georges Bank. A comparison of Bongo net ichthyoplankton and zooplankton retention rates as effected by towing speed and mesh size has been completed. Plots of Daily Nimbus 6 satellite monitored drogue positions obtained on a study of near surface circulation on and in the vicinity of Georges Bank during December 1978 and March, May and August 1979 are being used in an effort to estimate residence times and transport of ichthyoplankton in the Georges Bank area. Marked seasonal and areal variations in circulation patterns and residence times have been observed. The view of Georges Bank circulation which emerges from these data is consistent with and adds substantially to what we have learned during earlier Lagrangian and Eulerian measurement programs. Cooperative research with the

University of Rhode Island on high speed processing of zooplankton samples using improved computerized pattern recognition techniques was continued at the Narragansett Laboratory. Total counts and size-frequency distributions of zooplankton varying in size between 0.05 mm to 3.00 mm can be made in minutes with a simple, processor-controlled vidicon system. Major representatives of North Atlantic zooplankton can be accurately classified to group (e.g., copepods, fish eggs, fish larvae, cladocerans, chaetognaths, euphausiids) using discriminant analysis of simple morphometric relations (length:width:perimeter:area). Identification of commonly occurring copepod species appears possible for samples taken with a 333 micron aperture net.

The MARMAP I survey unit at Sandy Hook, New Jersey, completed the third consecutive year of intensive field work. Surveys of shelf and slope waters were underway during 11 months of the year. This multi-disciplined fisheries ecosystem study is designed to investigate linkages between plankton production and fish stocks in coastal waters from Cape Hatteras to Nova Scotia. Research vessels and scientific personnel from GDR, USSR and Poland participated. Ichthyoplankton research stresses the multispecies approach for monitoring seasonal and annual changes in the distribution, abundance and production of fish eggs and larvae. Seasonal egg production is subsequently used to estimate adult spawning biomass of principal species. The population estimate for Atlantic mackerel ( $1.2247 \times 10^9$ ) compared favorably with the estimate derived through cohort analysis ( $1.3786 \times 10^9$ ) of commercial and research trawl collections. Current emphasis is on analysis of eggs and/or larvae of sand lance, yellowtail flounder, Atlantic cod, haddock and butterfish. The dramatic increase in abundance of sand lance larvae observed since the mid 1970's continued in 1979. As in 1978, major concentrations were centered off Southern New England, on and around Nantucket Shoals. Overall, abundance estimates in 1979 were 17% greater than 1978 estimates. Since 1977 sand lance larvae have comprised >90% of the winter ichthyoplankton community on shelf waters from Cape Hatteras to the Gulf of Maine. Preliminary analyses of larval data (1974-79) for Atlantic cod and haddock reveal that: (1) Georges Bank is the most important spawning area; (2) there are marked intraspecific differences in abundance estimates between years but interspecific comparisons within years generally parallel each other; (3) within year spatial distributions of the two species are similar in late winter and spring; (4) spawning intensity for both species varies during the season but fits into a pattern that generally holds from year to year; (5) during cold winters cod spawning is disrupted or greatly reduced and the onset of haddock spawning is delayed; (6) there is no apparent correlation between larval abundance and recruitment success for either species. Years of high larval abundance produced weak year classes but 1975, a year of moderate abundance and high winter survival of larvae, produced a strong year class for both species.

At the Woods Hole Laboratory processing of the 0.333-mm mesh ichthyoplankton samples was completed for the 1971-1977 ICNAF larval herring time series, and final summary and analysis of larval herring growth and mortality was begun for the Georges Bank region. Processing of subsamples of invertebrate zooplankton samples for selected years of this seven-year series was also completed, and analysis of abundance and composition of zooplankton in relation to larval growth is in progress. Work continued on processing and analysis of the 1978 larval herring patch study on Georges Bank. A meeting was held in December 1979, at Dartmouth, Nova Scotia, to review the status of data analysis from this



experiment. More than 20 reports have been written or are in progress on various aspects of biological and physical oceanographic studies conducted during the patch study. Results of all the ICNAF larval herring studies including the patch study will be reviewed at a workshop in Woods Hole, April 1980.

Larval research in experimental trophodynamics at Narragansett focused on quantifying individual variability of several biological processes. In particular, daily mortality rates during the first two weeks following hatching, hourly feeding rates, and the relationship of activity level to metabolism were determined for several species. Biochemical research continued to emphasize the usefulness of RNA/DNA ratios as a larval condition index. Experiments were completed relating RNA/DNA and temperature changes at a constant feeding level. A larval nitrogen budget was established in assimilation rate experiments. Preliminary experiments on the identification of digestive enzymes and the use of electron transport activity as a measure of metabolism were also initiated. Considerable effort was spent in planning and coordinating various phases of larval laboratory and field research conducted within the Marine Ecosystems Division. This was in response to the need for more information on the processes that control larval growth and survival and to interact with information generated from broadscale ichthyoplankton surveys.

Several studies on the taxonomy of early life stages of fish are underway at Sandy Hook including: completion of, "A Guide to the Early Stages of Marine Fishes Occurring in the Western Atlantic with Emphasis on Species Found North of Cape Hatteras," which includes egg and larval descriptions of 290 species of fishes; a study of larval and juvenile Phycis and Urophycis including development, distribution, seasonality, and relative abundance, with emphasis on Southern New England and New York Bight waters; a review of the developmental descriptions of larval gadids and improved descriptions based on western Atlantic material; preparation of manuscripts describing egg and larval development of: tilefish, Lopholatilus chamaeleonticeps, and six species of the genus Liparis; and an analysis of the morphology of larval Sebastes fasciatus and S. mentella.

Work continued at Woods Hole on development of an energy budget and a multispecies fish production model for Georges Bank. Earlier estimates of the very high level of primary production (400-500 gC/m<sup>2</sup>/yr) on Georges Bank have been confirmed by more recent measurements, and productivity of other trophic levels also appears unusually high. In comparison with the North Sea Georges Bank appears much more productive per unit area at all trophic levels, except for pelagic fish production which appears to be about 25% lower on Georges Bank. Loss of plankton production from Georges Bank through advective processes is one possible mechanism for such a discrepancy, and evaluation of this factor among others was begun. Processing was completed on the 1973-76 fish food habits data base for Georges Bank. These data will form the basis for partitioning daily ration estimates of all major finfish according to size of predator and the composition and size of prey. In 1980, these estimates will be used in the multispecies fish production model for Georges Bank to begin evaluation of the potential effect of predator-prey interactions in relation to variable recruitment and different fishing strategies.

During 1979 the Ecology Division of the Beaufort Laboratory, Southeast Fisheries Center, continued ongoing research on: (1) the importance of natural factors in regulating the survival and growth of estuarine-dependent larval and

juvenile fish, (2) the effects of man-induced stress on fish survival, and (3) the development of techniques to spawn and rear fish in the laboratory.

Physiological and developmental studies at Beaufort utilizing laboratory-spawned eggs and larvae are continuing. Studies include: (1) the effects of adult acclimation temperature on egg quality and temperature tolerance of the larval stages; (2) starvation time of first-feeding larvae; and (3) developmental descriptions of larvae of selected sciaenids, serranids and clupeids. The fish spawning and larval rearing support project is continuing, and a pilot study has been started to spawn Atlantic menhaden (Brevoortia tyrannus) using 2-year-old stock. During 1979, six larval fish cruises were completed off the North Carolina coast. These cruises collected larval fish for: (1) age and growth studies; (2) predation studies; and (3) distribution studies. A new cooperative investigation with NOAA's Environmental Research Laboratory, AOML, began in 1979 in the Gulf of Mexico (GOMEX). This program will include laboratory and field studies on ecological processes that regulate food web dynamics leading to larval fish. Operations include cruises to quantitatively sample for larval fish and their food in two areas of the Northern Gulf of Mexico (Mississippi River Delta and Cape San Blas, Fla.). Larval fish will be taken for gut analysis and for otolith aging. Attempts will be made to identify and describe the potential pathways of energy transfer and pollutants through the food web which supports the survival and growth of larvae of ecologically and economically important fishes in the northern Gulf of Mexico.

During 1979 the Miami Laboratory, Southeast Fisheries Center of the National Marine Fisheries Service (at Miami, Florida) analyzed results of ichthyoplankton surveys which had been conducted in the Gulf of Mexico in May of 1977 and 1978. The larval fishes of the families Scombridae and Xiphiidae were studied in detail, and the results were submitted to the International Convention for the Conservation of Atlantic Tunas (ICCAT) meeting in Madrid, Spain in November 1979. These results will be published by ICCAT in its Collective Volume of Scientific Papers in 1980 with the following authors and titles: W. J. Richards and T. Potthoff, "Distribution and Abundance of Bluefin Tuna Larvae in the Gulf of Mexico in 1977 and 1978," and (same authors), "Larval Distributions of Scombrids (Other Than Bluefin Tuna) and Swordfish in the Gulf of Mexico in the Spring of 1977 and 1978." Staff members participated in the Symposium on Early Life History of Fish held at Woods Hole, MA, on 2-5 April, 1979. The following research results were presented: "Kinds and Abundance of Fish Larvae in the Caribbean Sea," by W. J. Richards, and "Larval Development of Scombrolabrax heterolepis (Pisces, Gempylidae) with Comments Concerning Its Resemblance to Tuna Larvae," by T. Potthoff, W. J. Richards, and S. Ueyanagi. Other work completed in 1979 included the description of the larvae of Lutjanus griseus, the gray snapper, which will be published in the Bulletin of Marine Science in 1980. Research is continuing on Caribbean larvae, a compilation of all records of the larvae and juveniles of scombrid fishes, and a systematic study of the larvae of gempylids and trichiurids. We have been loaned the DANA collections for this latter study; and in a preliminary review, have noted that a significant portion of larvae identified to these groups are actually young of the family Lutjanidae. An ichthyoplankton survey of the Gulf of Mexico is planned for March of 1980 which will include collection of ground truth data for the Coastal Zone Color Scanner satellite. A major effort is being initiated to study the Gulf of Mexico as an ecosystem using remote sensing devices. This is a cooperative effort with the Northeast Fisheries Center and other agencies.

## Plankton Ecology Investigations

Several aspects of plankton research are being conducted at the Woods Hole Oceanographic Institution. Genetic variability and differentiation have been documented in populations of a number of oceanic and neritic species of diatoms, dinoflagellates, and coccolithophores. It has been shown that for the niche components studied, differentiation does not occur at the same hydrographic boundary for all species. There is strong circumstantial evidence of selection for phytoplankton strains resistant to high metal activities in regions subjected to metal pollution, and for strains resistant to organic substances in regions presumably contaminated. Study of species responses to the metal regimes characteristic of different hydrographic regions continues to be the main effort, though light regimes have been found to have significantly different effects on neritic and oceanic species. Tintinnids and other marine ciliates are being studied in culture for evidence of interactions between populations of these herbivores and populations of their prey notably dinoflagellates. Research on the effects of photoperiod and temperature on subitaneous and diapause egg production by the calanoid Labidocera aestiva has been carried out. This work is based primarily on rearing individuals under controlled environmental conditions in the laboratory. Complementing this research, are investigations of the type of egg produced by individual females from Vineyard Sound, MA, and a study of subitaneous and diapause egg production by a southern population of L. aestiva from the Atlantic coast of Florida.

Plankton research at Harvard University has focused upon the nutritional sufficiency of near surface oceanic waters. New techniques have been applied to increase the ability to discern the physiological state of oceanic phytoplankton and to determine the actual relative to the potential growth rate of these organisms. Field studies are assessing the significance of recycled nitrogen in the nutrition of natural assemblages of phytoplankton in the Southern Ocean, the Sargasso Sea, and New England coastal waters.

Plankton investigations at the Graduate School of Oceanography at the University of Rhode Island include work on bacterioplankton, phytoplankton, protozoa and zooplankton. Studies on the role of diatom resting spores and the genetic variability of the neritic diatom species Skeletonema are being conducted as well as studies on phytoplankton species succession in Narragansett Bay based on weekly collections carried out over 19 years. There are also autecological experiments on key phytoplankton species and experimental grazing studies. Analysis of species succession considers light, nutrients as well as zooplankton interaction and computer modelling. The interaction of bacteria biomass and growth rate with phytoplankton carbon excretion has been studied at sea and in Narragansett Bay as well as the role of protozoa as predators on bacteria and nanoplankton. Growth rates of dinoflagellates in the sea have been investigated along with their bioluminescence, phosphate kinetics, heterotrophic capabilities, vitamin requirements and other factors. Studies continue in the Marine Ecosystems Research Laboratory on the interactions of the planktonic and benthic communities in the presence of pollutants.

The Oceanographic Sciences Division of Brookhaven National Laboratory is continuing its program on coastal trophic dynamics in the New York Bight and Georges Bank areas. Investigations on phytoplankton productivity and distribution



are directed towards developing models for estimating productivity from a few, well defined, environmental variables. In addition, floristic studies of phytoplankton distribution have been undertaken to relate seasonal variation in physical, chemical, and biological parameters to phytoplankton community structure. These field studies are supplemented with a laboratory program emphasizing phytoplankton biochemistry and physiology. In situ fluorometers have been successfully deployed with a moored array of remote devices sensing temperature, salinity, and current vectors, and resulting in continuous fluorescence records synoptic with current vectors.

Considerable effort is being made to examine the natural pathways and rates of material transfer between phytoplankton and the predominant copepods, and to determine the subsequent fate of the ingested material as it is partitioned into growth, reproduction, metabolism, and feces.

Ingestion, respiration, excretion, egg production, and defecation rates were simultaneously measured for Centropages typicus, the predominant copepod in this system during the summer and fall. The distribution and abundance of copepods was also determined, using both net tows and a high yield pumping system. Information on total grazing stress, nutrient recycling, feces production, and other major shelf processes is available.

Centropages typicus is being cultured at three temperatures and at three food concentrations at each temperature, to determine how these factors interact to determine growth rate, body size, and associated physiological parameters. Laboratory studies of the feeding rates of developmental stages of C. typicus and Pseudocalanus in natural seawater are continuing. The synthesis of laboratory and field information on the predominant zooplankton species of the New York Bight into a model of population and species processes is beginning.

A variety of plankton research programs are underway at the State University of New York - Stony Brook Marine Science Research Center. Included among these are nitrogen cycling in Great South Bay and in the euphotic zones of the Caribbean and Sargasso Seas. Primary productivity measurements and phytoplankton species distribution are being studied in the New York Bight and Great South Bay, Long Island, New York. Grazing rate of tintinnids and copepods are being measured in relation to temporal variation in phytoplankton off the south shore of Long Island.

At the Lamont-Doherty Geological Laboratory field and laboratory plankton research involves (1) time and space dependent variations in the biomass and growth of plankton populations, (2) the environmental factors responsible for these variations, and (3) quantification of the cause and effect relationships between environmental factors and plankton populations. Field research to date has been concerned with understanding the factors responsible for changes in phytoplankton and zooplankton biomass on time scales of hours to days and space scales of meters to kilometers with an emphasis on phytoplankton growth and zooplankton grazing. Because temperate coastal environments exhibit a high degree of variability on these time and space scales, most of the field research is being conducted in the Hudson Estuary and New York Bight. Laboratory studies are primarily concerned with phytoplankton photosynthesis and respiration in

variable light environments which phytoplankton populations are exposed to as a consequence of vertical mixing, internal waves and changes in incident radiation due to variable cloud cover.

Plankton research at the Chesapeake Bay Institute expanded during 1979 to include investigation of vertical mixing processes in resupplying nutrients to estuarine phytoplankton assemblages. The topic is approached through a combination of field measurements and computer modeling with a two-dimensional hydrodynamic model coupled to a compartmented nutrient cycle model. Studies on the nature of dissolved organic carbon released from phytoplankton revealed the occurrence of a class of polysaccharides released during photosynthesis from phytoplankton in culture and in diverse natural assemblages from Chesapeake Bay, the Gulf Stream edge and the western Sargasso Sea. Work continues on the identification and ecological role of these compounds. During 1979, it was demonstrated that the dinoflagellate *Prorocentrum* retains its viability during a 200 km subsurface transport below the 1% light level by increasing its pigment concentration to enhance photon capturing ability and performing low level photosynthesis. The exact nature of the pigment increase is presently being investigated. The role of estuarine circulation patterns, in particular frontal convergences and subsurface currents in determining the distribution of sexual forms of dinoflagellates as well as predators is also being examined. Microzooplankton research has been centered on three themes: assessment of the microzooplankton assemblage in the Chesapeake Bay, study of the life cycles and the feeding and growth dynamics of estuarine rotifers, and development and application of a technique to measure the in situ population growth rates of planktonic ciliates.

At the Virginia Institute of Marine Science work continued on the plankton collections obtained from the Middle Atlantic Bight during 1975-1977. A monitoring program for lower Chesapeake Bay has been designed to describe plankton interchange between the Bay and Shelf.

Plankton research at the Rosenstiel School of Marine and Atmospheric Sciences involves investigations on the ecology of ctenophores and chaetognaths from south Florida waters. Particular concern is with feeding rates of these predators as a function of food concentrations, and the relationship between experimental laboratory results and the natural environment. Laboratory experiments continue on the ingestion and growth of copepods on phytoplankton, bacteria and detritus. The ecology of larval fishes is being investigated through laboratory studies of the bioenergetic relationships of several kinds of larvae and experiments on predation on larval fish.

Plankton research at Duke University has concentrated on the processes responsible for large-scale variations in primary and secondary productivity in the continental shelf waters of the U. S. between Cape Hatteras and Cape Canaveral and in the Equatorial Pacific. Observations taken during the last decade are being analyzed to determine whether or not the low frequency oceanographic variability has occurred and whether or not that variability might drive the variations in primary and secondary productivity. Other studies that are continuing are: (1) analysis of the spatial and temporal variation of phytoplankton species and chemical composition in small lateral estuaries; (2) investigation of the impact of various food supplies on the reproductive success of copepods; (3) regulation of phytoplankton growth by secondary growth factors and trace metals.

Plankton research at the Skidaway Institute of Oceanography includes studies of processes on the southeastern continental shelf of the U.S.A. During late winter the distribution and abundance of doliolids over time was investigated in relation to hydrographic parameters. In April 1979 the combined efforts of physical, chemical, and biological oceanographers describing plankton processes in shelf break upwellings were continued. A six-week study was conducted during summer to describe the development of phyto- and zooplankton assemblages in a newly stranded intrusion of cold nutrient-rich Gulf Stream water off the northeastern Florida coast. Laboratory research continued on omnivorousness of calanoid copepods. Kinematographic studies on food gathering and ingestion of calanoid copepods were intensified.

USA activities in the benthos<sup>1)</sup> (J.B. Pearce)

As has been the case in recent years, the majority of published and unpublished reports in the area of benthic ecology has been concerned with the effects of man-induced perturbations on bottom-dwelling populations and communities. Dauer and his colleagues at Old Dominion University (Norfolk, Virginia) investigated the impacts of nonpoint pollution on benthic invertebrates in the Lynnhaven River estuary in Virginia (Dauer et al., 1979). Such studies are becoming increasingly important because of the effects of eutrophication due to fertilizers, the toxicity of pesticides, etc., on benthic and demersal resources.

Other investigators have continued the long history of studying the effects of thermal discharges on benthic community structure. Loi and Wilson (1979) found that there were no measured effects on the benthos near the Calvert Cliffs Nuclear Power Plant (Maryland) in Chesapeake Bay. The State of Maryland funded extensive studies of seasonal effects of thermal discharges on the benthos at the C.P. Crane Generating Station on Chesapeake Bay.

Several studies were concerned with the effects of various contaminants on the biology of bottom-dwelling organisms. For instance, Greig (1979) studied the uptake of several toxic metals by three species of molluscs. Cucci and Epifanio (1979) investigated the long-term effects of petroleum (crude) on larval and juvenile development of the mud crab, and Morgan and Sommer (1979) researched problems of PCBs in estuarine sediments of Chesapeake Bay. All of these studies were conducted to understand better how contaminants affect benthic populations, and are representative of a multiplicity of investigations ongoing in regard to this subject.

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<sup>1)</sup>References to the publications mentioned are found in Document C.M.1980/L: 2

Many United States benthic ecologists continue to be interested in the relationships between organisms and the sediment habitat. Cochran and Aller (1979) used radioisotopes to investigate particle reworking in New York Bight sediments by the *Nucula-Nephtys* assemblages. Nilsen et al. (1979), under funding of the U.S. Environmental Protection Agency (EPA), studied the biochemical structures of Chesapeake Bay sediments as part of the EPA Chesapeake Bay program, while Wetzel et al. (1979) investigated the roles of submerged aquatic vegetation in sediment stability as part of the same program. Similar investigations of the role of benthic organisms in sediment stability were carried out by Maurer and Aprill (1979) at the mouth of Delaware Bay. Finally, several authors were concerned with the autecology of various taxa in relation to sediment; Bierbaum (1979) conducted an extensive study of the influence of sedimentary factors on the distribution of the important benthic amphipods, and Myers (1979) studied the seasonal changes in the burrowing of mantis shrimp (*Squilla*) in Narragansett Bay (Rhode Island).

Maurer et al. (1979a) were concerned with the important problems connected with seasonal fluctuations in benthic assemblages of Delaware Bay, while Reid (1979) continued research on long-term variations in the mud-bottom macrofauna of Long Island Sound. Baselines for his study were published in Reid et al. (1979). Maurer et al. (1979b) reported on seasonal changes in the feeding types of benthic invertebrates in Delaware Bay.

Virnstein (1979) conducted an important study of predation on benthic infauna by the commercially valuable fishes and blue crabs in Chesapeake Bay. His findings included the fact that the abundant invertebrate species were prevalent because they are able to avoid predators by several means.

Finally, several benthic ecologists continued descriptive studies of benthic communities. Larsen (1979) reported on benthic macrofauna in estuaries of the coast of Maine. He found that 1) water-column stability was the overlying determinant of observed community patterns, and 2) there were significant changes in density, dominance, and species composition during a period between his study and one conducted in 1955. Maurer et al. (1978) finalized an extensive investigation of benthic assemblages in Delaware Bay. Their results indicated that some assemblages have well-defined boundaries whereas the borders of others are less distinct and these seem to be distributed along an environmental continuum defined by sediment type and salinity.

Ecologists and biologists of the National Marine Fisheries Service, Northeast Fisheries Center, continued their extensive studies of benthic community structure of the continental shelf from the Canadian border to Cape Hatteras, as part of the OCEAN PULSE program. Their studies included measurements of physical and biological responses, behavioral changes, and studies of disease in addition to the classical descriptive and functional measurements of the benthos. Benthic ecologists at the Woods Hole Laboratory continue to work up extensive data collections made over the entire continental shelf during the period 1963-7. Numerous reports and papers have evolved from these studies done in cooperation the U.S. Geological Survey, and others.



U.S.S.R.  
(A.A. Nejman)

To estimate the feeding conditions of commercial fishes, an assessment of winter euphausiids stock in the Barents Sea was made in 1979. Analysis of spring-summer growth of zooplankton, collected on the spawning grounds and on the drifting routes of fish larvae in the areas off the north-eastern coast of Norway and in the south-western Barents Sea was carried out. Distribution of deep-water shrimp larvae was investigated and the dependence of shrimp aggregations in the open sea regions on the coastal concentrations was found. Food interrelations and nutritive base of capelin and polar cod in winter and summer season in the eastern Barents Sea were investigated. Common areas of fish feeding were located and it was discovered that the competitive relations between capelin and polar cod were most aggravated in warm years; the peculiarities of spring-summer growth of plankton in the Norwegian Sea were cleared up. The data collected for many years on phytoplankton and euphausiids abundance in the southern Barents Sea were generalized. There were collected 199 phytoplankton samples, 1180 zooplankton samples, 217 samples of euphausiids, taken by trawl-attached net and 154 samples, taken by Isaac-Kidd trawl; about 4000 larvae of deep-water shrimp were identified and measured. Quantitative-weight analysis of feeding of 2000 capelin and polar cod specimens was made.

Many years investigations on phytoplankton made it possible to determine phytoplankton species vegetating during all seasons in the Main Branch of Murmansk Current, to discover dominating

species and season groupings, to find out optimum temperature and salinity for main mass species of plankton Algae and effect of some environmental factors on vertical distribution of phytoplankton during different periods of vegetation.

The data for many years (4 800 samples) on euphausiids abundance survey in the southern Barents Sea were generalized in order to elucidate the main dynamics trends and the contribution of some species to total abundance formation that would allow to predict fish nutritive base.

In 1979 the following works were conducted in the Baltic Sea:

- stock composition and seasonal dynamics of zooplankton in the Baltic Sea, the Gulf of Riga and the Gulf of Finland were investigated. Abundance assessment and biological studies of zooplankton by depth zones, seasons and sea areas were done; the dynamics of specific and age composition was revealed;
- stock composition and distribution of zooplankton in coastal areas of the Gulfs of Riga and Finland in relation to anthropogenic pollution were investigated; the amount of food (zooplankton) consumed by fish in separate bays was assessed;
- the influence of food supply (zooplankton) on the abundance of spring herring and smelt year-classes in the north-eastern Gulf of Riga was investigated. The strength of 1979 spring herring year-class was assessed. The evaluation of the relation of food zooplankton (for fish larvae) and the strength of smelt populations was found;
- relations of biogens, phyto- and zooplankton were investigated. It was pointed out that phosphorus as well as nitrogen were the limiting biogens in the Baltic Sea in 1970's. Revealed relations

could be used for predicting zooplankton condition in summer-autumn period in open areas of the Baltic Sea;

- the influence of zooplankton on distribution of herring and sprat during the feeding period was studied. The existence of direct relations of the vertical distribution of food zooplankton and fishes was marked;
- long-term dynamics of zooplankton in the Gulf of Riga (1960-1978) was investigated. It was revealed that in the 1970's considerable changes of fauna caused by natural and anthropogenous factors occurred as compared with the 1970's. In the open area of the Gulf the : increase of abundance and biomass of all groups of animals except Limnocalanus was found, the redistribution of food consumed in separate areas and changes of the vertical distribution of biomass were observed. The change in growth rate of herring was mainly caused by these factors. In shallow areas (Pyarny Bay) the increase of the importance of non-feeding zooplankton (rotifers), the decrease of Copepoda abundance and the index of specific variety occurred on the background of the increase in the total abundance of zooplankton;
- seasonal variations of the weight were studied and annual amount of principal zooplankton species of the gulfs (Eurythemora and Acartia) was approximately valued;
- the consequence of oil pollution in the area of Saaremaa and Khijumaa Islands was investigated. No marked influence of oil pollution on specific composition and development of zooplankton was found;
- the composition of the stock and distribution of nektobenthos in the bays of the Gulf of Riga and the Gulf of Finland were investigated. The influence of the raise of bottom waters in the area of the coastal slope on the concentrations of mysids was shown;



- food consumed (by zooplankton) in the small bays of Estonian coasts (Gulfs of Riga and Finland) was evaluated; the influence of pollution on the composition, abundance, distribution of zoobenthos was marked:

- the feeding of herring and sprat in the Baltic Sea in July 1978-July 1979 was analysed.

In 1979 536 zooplankton samples, 19 nektobenthos samples, 16 zoobenthos samples were taken, 1520 stomachs were analysed.

