International Council for the
Exploration of the Sea

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Administrative Report

BIOLOGICAL OCEANOGRAPHY COMMITTEE

1980

by

K. Vagn Hansen

Belgium

(R. De Clerck & Ph. Polk)

The study concerned the interactions between the compartments in the plankton of different water masses.

1. Phytoplankton.

   Study of the primary production in enclosed areas, near-shore and open sea.

   Biomass measurements of the phytoplankton compartment.

   Activity studies : - light-dependence of the particulate and extracellular production of the phytoplankton.

   - kinetically (quantitative) determinations of the phytoplankton extracellular organic matter, and phytoplankton respiration measurements.

2. Zooplankton.

   Study of population dynamics of Copepodes : modelling of planktonic populations, population genetics of Harpacticoids.

   Vertical migration behaviour.

   Grazing activities of the dominant species in enclosed areas, near-shore and open seas.

   Distribution patterns of fish eggs and fish larvae. Feeding behaviour in fish larvae.

3. Bacterio-plankton.

   Determination of dissolved organic matter : sugar, carbohydrates, BOD, TOC. Study of activities : total planctonic respiration ; specific heterotrophic activities : incorporation of radioactive substrates.

Canada

(J.-C. Therriault)

FISHERIES AND OCEANS

MARINE ECOLOGY LABORATORY, BEDFORD INSTITUTE OF OCEANOGRAPHY, DARTMOUTH, NOVA SCOTIA

Progress has been made in understanding the influence of environmental factors on the photosynthetic parameters of phytoplankton. During 1980 a major cruise to the Arctic was carried out aboard CSS HUDSON. Results are not fully analyzed, but will add a new dimension to our understanding of the interactions of light and temperature as they affect phytoplankton production. In the same area, studies of zooplankton grazing at low temperatures, and studies of the role of microplankton were carried out. Distributional pattern of zooplankton and micronekton are being worked out for the areas of Melville Bay, West Greenland and Lancaster Sound.

Bioacoustic methods and the BIONESS sampler (an automated sequential sampling device for ichthyoplankton and micronekton) have been used to investigate horizontal and vertical distribution patterns on the Scotian Shelf. There are striking differences in the detailed vertical distribution of organisms over the shelf and in the waters beyond the shelf break, with high concentrations at the front associated with the shelf break.

A four-year field program to investigate the dynamics of communities in the upper reaches of the Bay of Fundy, prior to possible construction of a tidal barrage, has been almost completed. There is a strong seasonal pulse of production by Corophium which is utilized in early fall by migrating birds. Primary production for the system comes from

phytoplankton and diatoms at the sediment surface, but it has proved impossible to balance the budget without postulating a substantial input of organic detritus from adjacent salt marshes.

A detailed study of the early life history of mackerel in George's Bay suggests that instead of there being a single critical stage in the early development, mortality is fairly evenly distributed through several months. A new bioenergetic approach to fish recruitment has been used to make a distinction between factors influencing fecundity and factors influencing larval mortality. Environmental changes have their effects mainly on larval mortality, while adult population density affects mainly fecundity. The analysis explains differences between species in the shape of the stock-recruitment curve, and suggests that for many stocks environmental factors exert an overriding influence on recruitment.

RESEARCH AND RESOURCES SERVICES, ST.JOHN'S, NEWFOUNDLAND

Studies on the major groundfish stocks and physical and biological oceanography of Flemish Cap continued in 1980 as part of the Flemish Cap International Project. Results from initial work carried out on Flemish Cap in 1978 and 1979 were reported through NAFO during the September 1980 meeting of the Scientific Council.

In summary, redfish larvae were the most abundant on Flemish Cap in 1978 and 1979, beginning in April and extending through July. Abundant concentrations to the north and west of central Flemish Cap, coinciding with high chlorophyll biomass and primary production, suggests larval persistence within a zone of high production driven by the Labrador Current impinging on the Cap. Plankton biomass and production was consistently low over shoal waters $\leq$ 200 m depth. Cod eggs and larvae

were extremely low in abundance, corresponding with very low biomass estimates for the adult stock.

Cod feeding studies indicated good and poor years of predation on juvenile (≤10 cm) redfish corresponded with the presence and absence, respectively, of larger redfish larvae during July 1978 and 1979. This indicates high mortality of the early larval redfish in 1979. The importance of juvenile redfish availability for cod feeding and growth on Flemish Cap had previously been demonstrated. Thus, the success of both cod and redfish stocks on Flemish Cap may be directly linked to the success of redfish larvae during their first two months of growth.

Small fluctuations in cod vertebral averages from 21 year-classes of cod produced during 1940-68 on Flemish Cap indicated small yearly variation in environmental factors (i.e. temperature) during the early larval stages of cod.

Preliminary analysis of drogued satellite tracked buoys and moored current meter data support the hypothesis of a weak anticyclonic gyre on Flemish Cap. There was a noticeable 4-day periodicity in the current pattern and indication of a strong semi-diurnal tidal signal. All six buoys deployed on Flemish Cap in 1979 exited in the southeast quarter.

Work will continue in 1981 with further results being reported through NAFO during the September 1981 meeting of the Scientific Council.

ARCTIC BIOLOGICAL STATION, STE.ANNE DE BELLEVUE, QUEBEC

Investigations were carried out on variations in chlorophyll, phytoplankton species and nutrients related to diurnal and tidal cycles in

an arctic inlet. Further in situ experiments on effects of heavy metals on production of seaweed and phytoplankton were carried out. Several new records of copepods inhabiting the sea ice were reported and work was conducted on the relationship between in-ice and under-ice zooplankton. Three of the dominant macrozooplankton species (Mertensia, Parathemisto and Sagitta) were studied with emphasis on energy content, biochemical composition, energy-biomass relationships, feeding rates, storage and utilization of nutritional resources, respiratory metabolism and growth rates. A study of detrital fallout was initiated with first results showing unexpectedly large quantities of material collected. Studies on seasonal variations in bacteria counts and heterotrophic activity were carried out at 3 sites. Activity was shown to be closely related to primary production and levels of nutrients and organic material.

Publications were concerned with a short biological survey of a small arctic bay, estuarine zooplankton, a survey of ice microalgae, reproduction and respiratory metabolism of isopods, caloric content of macrozooplankton and an inshore zoobenthos species survey.

DIVISION D'OCEANOGRAPHIE BIOLOGIQUE, REGION DU QUEBEC, QUEBEC

Une étude de la variabilité du système de production biologique de l'estuaire maritime du Saint-Laurent a été entreprise en 1979 et l'échantillonnage s'est poursuivie en 1980. Cette étude vise à caractériser la production primaire et secondaire à diverses échelles de variabilité spatiales et temporelles et à examiner le flux d'énergie et de carbone organique entre ces deux niveaux trophiques dans cet estuaire. D'autres études visant à examiner comment les concepts traditionnels sur l'éco-physiologie des organismes phyto-et zooplanctoniques peuvent

s'appliquer dans ce milieu estuarien ont également été entrepris et se poursuivent en 1981. Les résultats spécifiques des travaux entrepris en 1980 seront rapportés dans les rapports subséquents.

UNIVERSITIES

GIROQ (GROUPE INTERUNIVERSITAIRE DE RECHERCHE OCEANOGRAPHIQUES DU QUEBEC)

GIROQ, fondé en 1970, est un groupe de recherche multidisciplinaire comprenant environ 70 personnes (chercheurs et personnel de soutien) qui sont distribuées dans les laboratoires des trois universités québécoises participantes: l'université Laval, l'université de Montréal et l'université McGill.

Le GIROQ poursuit des recherches sur les quatres thèmes suivants: (1) Le contrôle physique et biologique des processus de production en milieu estuarien pélagique: étude des fronts; modélisation de la circulation estuarienne; circulation résiduelle en été et en hiver; stabilité de la colonne d'eau et disponibilité des éléments nutritifs; variabilité lumineuse de haute fréquence et photosynthèse phytoplanctonique; rythmes endogènes du phytoplancton; relations trophiques phytoplancton/ zooplancton; échanges zooplancton/suprabenthos; (2) L'écologie des poissons marins: étude des larves dès leur premier jours, en vue d'établir l'influence des interactions multispécifiques de leurs déplacements et de leur répartition en tache, sur la croissance, la survie et le recrutement; étude des juvéniles et des adultes des espèces d'importance commerciale, en vue de cerner les facteurs qui régissent la croissance, la répartition, le frai et la migration dans un écosystème estuarien; (3) Le milieu benthique: étude de la zone déterminée par l'interface entre la couche d'eau immédiatement en contact avec le fond,

et le substrat où vivent les communautés animales et végétales; courants de turbidité liés aux phénomènes de resuspension par les courants de marée, transport et déposition de la matière en suspension; éléments traces et composition chimique des dépôts: structure, distribution et succession démographique des communautés benthiques; dynamique de population et production des organismes littoraux; (4) Océanographie nordique: étude océanographique de la biologie et de la physique des eaux côtières des baies d'Hudson et de James, et impact du développement hydro-électrique sur l'écosystème marin nordique.

INSTITUT NATIONAL DE LA RECHERCHE SCIENTIFIQUE, RIMOUSKI, QUEBEC

Les travaux de l'Institut national de la recherche scientifique de Rimouski sont centrés sur l'étude de la biologie, de la physico-écologie et de la biochimie des organismes marins. Les projets de recherche portent: sur la détermination d'un indice de l'état physiologique du phytoplancton basé sur une mesure de l'activité enzymatique; sur le mode et la physiologie de la nutrition des copépodes; sur les modes et les sites de fixation des métaux en traces chez les invertébrés marins; sur la distribution des métaux en traces dans l'eau, le seston, le zooplancton et la moule bleue; sur la culture massive du phyto-et du zooplancton dans un milieu à circulation continue; sur la caractérisation d'antibiotiques dans le plancton marin (en collaboration avec l'INRS-Santé et l'Institut Armand-Frappier); sur le flux de matières particulaires dissoutes et de traces métalliques entre l'estuaire et le golfe du Saint-Laurent.

MARINE SCIENCES CENTRE, McGILL UNIVERSITY, MONTREAL, QUEBEC

Current research projects in biological oceanography carried out in the north Atlantic area by the Marine Sciences Centre are the following: Identification of the water masses of the Northeastern Gulf of St.Lawrence by various biological and physico-chemical means; oxygen distribution in the Gulf of St.Lawrence and biological implications; phytoplankton of the St.Lawrence Estuary related to the change in the populations in the transition from fresh to salt water; ice biota in the Gulf of St.Lawrence; biology and behavior of the Narwal in Canadian Eastern Arctic; biology of the isopod Mesidotea entomon; Energy transfer by benthic organisms; biological survey of the central basin of the Bideford River estuary (P.E.I.); survey of the bottom fauna along the north shore of the Gulf of St.Lawrence between Pointe des Monts and Grande Ile in the Mingan channel.

Denmark

(E. Smidt)

Greenland waters

Plankton : Sampling of zooplankton with stramin net (2 m ring diameter, half hour oblique hauls from about 50 m depth) was made in July at the Standard Oceanographic Sections in the Davis Strait (from Fylla Bank to Egedesminde) in the area west of Disko and the Disko Bay, and throughout the year in the inshore area of Godthaab. Volume was measured. Invertebrates and fish eggs and larvae were sorted and counted.

Finland

(J. Lassig)

Institute of Marine Research, Helsinki

Phytoplankton, primary production, chlorophyll a and related parameters were studied every second week (twice during the ice period) at one station in the western part of the Gulf of Finland and at 15 stations in the entire Baltic Sea as stipulated in the monitoring programme for the Baltic Sea (Helsinki Convention).

Zooplankton was sampled (Hensen net) three times a month (once during the ice period) at two coastal stations in the Gulf of Finland, one station in the Archipelago Sea and one in the Bothnian Bay. Zooplankton was sampled (WP-2 net) at 26 stations in the entire Baltic Sea according to the monitoring programme for the Baltic Sea (Helsinki Convention).

Benthic macrofauna communities were studied in the deep areas of the Baltic Sea. The stations of the monitoring programme of the Baltic Sea (Helsinki Convention) were included in the survey.

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 at each power plant.

Phytoplankton and primary production studies 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, Raahe 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 northern Baltic Proper.

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 14 stations off Helsinki and Espoo.

Phytoplankton, primary production 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.

Zooplankton was sampled at 5 stations simultaneously with phytoplankton.

Tvärminne Zoological Station of the University of Helsinki

Macrozoobenthos was studied every week in the archipelago and twice a month in the sea zone during the ice-free period. The oxygen consumption of the benthic community was studied every week during the summer at one station in the archipelago.

Studies on periphyton and Fucus vesiculosus were continued in the archipelago.

Åbo Akademi, Turku

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

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

University of Turku

Dynamics of Mesidotea entomon (Isopoda) and production ecology of zooplankton were studied in the Archipelago Sea.

Effects of ferry traffic on fishes and fishery were studied in the Archipelago Sea.

Monitoring of the Fucus vesiculosus biocenose was continued.

University of Oulu

Mesidotea entomon (Isopoda), zooplankton and sediment were sampled in the northern Bothnian Bay once a month during the ice-free period at 2 stations for analyses of elements.

France

(N. Lacroix)

MINISTÈRE DES TRANSPORTS

INSTITUT SCIENTIFIQUE ET TECHNIQUE DES PECHES MARITIMES (ISTPM)

. Recherche au niveau de la gestion des stocks halieutiques : étude de l'ichthyoplancton pour la détermination des stocks de géniteurs. Participation aux travaux internationaux pour les larves de hareng en Mer du Nord et pour les oeufs de maquereau dans le golfe de Gascogne.

. Structure et évolution d'une fraction des peuplements zooplanctoniques, essentiellement oeufs et larves d'espèces exploitables (crustacés et poissons) en relation avec l'installation sur le littoral de centrales électriques de grande puissance. Les secteurs étudiés comprennent les côtes du sud de la Mer du Nord, de la Manche et du nord du golfe de Gascogne.

. Influence des chocs mécaniques, thermiques et chlorés sur la survie des oeufs et larves de poissons et sur différents groupes zooplanctoniques et phytoplanctoniques.

. Etude de la production phytoplanctonique et de la biomasse bactérienne du bassin de Marennes-Oléron (zone estuarienne du golfe de Gascogne).

. Recherches sur les possibilités d'accroître les peuplements d'algues exploitables par substitution d'espèces sur les côtes de la Manche. Expériences réalisées sur *Laminaria hyperborea* et *Laminaria digitata*.

. Recherches sur l'incidence des hydrocarbures sur les stocks d'algues exploitables des côtes bretonnes.

MINISTÈRE DE L'INDUSTRIE

CENTRE NATIONAL POUR L'EXPLOITATION DES OCEANS (CNEXO)

. Etude de l'écosystème pélagique du front thermo-halin Liguro-provencal. Etude comparative des processus de production planctonique suivant les structures (zone de front, de remontée, stratifiée).

. Etude du cycle annuel des populations planctoniques des côtes nord-Finistère. Mise en évidence d'une succession des populations caractérisée par une variation cyclique des taux d'activités des enzymes digestives.

. Etude de l'écosystème benthique profond. Organisation et réalisation des campagnes "Demeraby" (plaines abyssales centrales atlantiques) et "Biogas XI" (golfe de Gascogne).

Au cours de ces campagnes, un échantillonnage intensif de la faune benthique a été réalisé afin d'estimer en terme d'énergie les différents échelons de la pyramide trophique. Estimation de la pression de l'échelon carnivores-nécrophages sur le benthos. Colonisation d'un substrat défauné et croissance des organismes. Quantification du flux d'énergie particulaire vertical.

MINISTÈRE DES UNIVERSITÉS

UNIVERSITE DE PROVENCE - AIX MARSEILLE

Laboratoire de Biologie animale (plancton) Marseille

. Copépodes du Plateau continental atlanto-marocain. Synthèse de 6 années de recherches : étude quantitative saisonnière et géographique, relations avec l'hydrologie locale (phénomène d'upwelling, notamment) ; étude qualitative (composition, diversité du peuplement et leurs variations, groupements écologiques, relations trophiques) ; essai zoogéographique.

. Etude infraspécifique des Hoplophoridés (Décapodes pélagiques) des croisières du "Dana" (1922-1930) dans l'Atlantique. Relations écologiques.

. Ecophysiologie : poursuite des recherches ultrastructurales et cytochimiques sur la digestion et l'ovogénèse des Copépodes pélagiques.

. Ultrastructure comparée des yeux de deux Chaetognathes de profondeur (*Sagitta macrocephala* et *S. planctonis*) (spécimens originaires de l'Atlantique). Essai de synthèse sur l'ultrastructure des organes oculaires dans le taxon.

. Dents et organe vestibulaire des Chaetognathes au microscope électronique à balayage (spécimens d'origine atlantique en majorité). Relations taxonomiques, écologiques et biologiques.

Station marine d'Endoume

. Dynamique de la production organique primaire dans les systèmes d'apport nutritif directs, principalement d'origine profonde (upwelling côtiers, divergences du large) et secondairement d'origine terrestre (systèmes de dilution locaux). L'étude vise après l'obtention de l'état descriptif (répartition des taux photosynthétiques) l'évaluation des bilans sur la base des mesures directs (C13, C14, C15) et du flux des apports nutritifs. La dynamique des écosystèmes est analysée par le biais d'une approche théorique (modélisation faisant intervenir les données de cynétique d'assimilation du C et de N et les données hydrodynamiques). Les incidences des facteurs de pollution sur l'écosystème et les compositions du plancton marin sont examinées au moyen d'analyses statistiques.

. Etude de l'évolution dynamique dans le temps et dans l'espace, des peuplements macrobenthiques, notamment des substrats meubles, en fonction des variations naturelles (climatiques, courantologiques, sédimentologiques, ou des perturbations apportées par l'activité humaine (apport, transfert et stockage des polluants dans les sédiments, restructuration des rivages...).

. Mise en évidence expérimentale (*in vivo* et *in vitro*) des processus biologiques et physiologiques conduisant aux déséquilibres des populations et communautés telles qu'elles sont observées dans le milieu naturel.

. Participation à des activités de sauvegarde et de protection des milieux naturels en se basant sur la connaissance écologique des milieux "sains" et "perturbés".

. Etude des peuplements installés sur substrat dur ; inventaires, dynamique, évolution en fonction des conditions et des transformations (naturelles et dues à l'homme) du milieu.

. Phénomènes de bioconstruction et de biodestruction ; variation des rapports animaux/végétaux en fonction des conditions de milieu ; fossilisation des espèces constitutives des biothermes.

. Recherches sur la structure et la dynamique des peuplements marins benthiques des substrats meubles. Aspect démographique et aspect biologique.

. Evaluation du flux d'énergie transitant dans le réseau trophique lié aux biocoenoses benthiques de fonds meubles. Relation Benthos/Pelagos - Microphytobenthos/Meiobenthos - Meiobenthos/Macrobenthos - Meio-macrobenthos/Mégabenthos vagile. Au sein du Macrobenthos relations Proies/Prédateurs.

. Etude de l'activité des micro-organismes marins dans les eaux côtières et lagunaires et dans les milieux marins perturbés, au moyen de méthodes expérimentales pratiquées *in situ* et *in vitro*. Les études concernant la production primaire intéressent la recherche de la nature des facteurs limitants de la croissance des algues, les éléments altéragènes inhibant leur développement, le rôle des espèces nanoplanctoniques et l'assimilation photohétérotrophe. Les recherches ayant trait aux bactéries portent sur les aspects qualitatifs et quantitatifs dans la restauration d'un milieu maritime perturbé.

. Distribution et évolution des constituants biochimiques de la matière organique dans l'eau et les sédiments marins, en relation avec l'activité biologique.

. Influence des facteurs du milieu sur la physiologie de certains invertébrés marins : contrôle de la croissance, de la reproduction et des activités digestives. Contrôle des fonctions physiologiques des crustacés ; relations biochimiques entre Microsporidies et Crustacés hôtes ; variations des protéines de l'hémolymphe ; métabolisme des lipides, des acides aminés, des protéines et des caroténoïdes.

. Etude systématique, écologique et dynamique de la phase embryonnaire et larvaire des téléostéens en milieu naturel. Transferts d'énergie à partir du comportement alimentaire, des besoins nutritionnels et des rendements énergétiques. Etude écophysiologique : adaptations enzymatiques, rythmes alimentaires et équilibre hydrominéral.

. Systématique évolutive d'invertébrés (Spongiaires, Brachiopodes, Phoronidiens), basée sur la taxonomie, l'écologie et la cytologie comparée des formes actuelles, et leurs relations avec des formes fossiles apparentées. Interactions entre hôte et parasite dans une association de type parasitaire.

UNIVERSITE DE NANTES

Laboratoire de Biologie marine, Nantes

. Etude du fonctionnement d'un écosystème estuarien (Loire). Distributions saisonnières de l'ichthyofaune reliées aux conditions hydrologiques du fleuve.

. Mise en évidence d'un certain nombre de corrélations entre les compositions qualitatives et quantitatives des divers peuplements des grandes vasières estuariennes avant modification du milieu par des travaux d'aménagement.

. Etude de la productivité primaire des eaux littorales de la baie de Bourgneuf.

UNIVERSITE DE BRETAGNE OCCIDENTALE

Laboratoire d'Océanographie biologique, Brest

. Recherches sur la connaissance de l'écosystème côtier et de son fonctionnement : étude du benthos de la plate-forme continentale nord-Gascogne, recherches sur la macrofaune, le microphytobenthos et le méiobenthos. Ce secteur fait l'objet d'un suivi écologique à long terme afin de comprendre le fonctionnement normal de l'écosystème benthique et de dégager les fluctuations temporelles.

. Recherches sur le pélagos. Les études sont réalisées dans la zone du front thermique ouest-Bretagne. Confrontation des données de terrain avec les résultats de télédétection satellitaire.

UNIVERSITE PIERRE ET MARIE CURIE - Paris

Laboratoire Arago, Banyuls-sur-Mer

. Etude de l'écosystème pélagique :

- production primaire pélagique : structure et rendements des communautés phytoplanctoniques naturelles du point de vue de l'assimilation du carbone : utilisation de la lumière '- efficacité du système pigmentaire - rôle des éléments nutri-

tionnels et des vitamines. Cette approche vise à définir avec précision les éléments limitant la photosynthèse pélagique dans les régions de remontée d'eau profonde et les zones de divergence ;

- production secondaire pélagique : bilan énergétique au niveau trophique. Structure quantitative et qualitative des communautés de copépodes pélagiques dans différentes aires géographiques : recherches de constantes écologiques - indice de stabilité des biomasses - constitution élémentaire - valeur calorifique - détermination des conditions trophiques et de l'état des communautés - étude fine des différents paramètres de la production secondaire en zone néritique : dynamique de population et production, respiration, croissance et reproduction.

Structure et fonctionnement de l'écosystème benthique - Production, bilan et flux énergétique aux différents échelons. Dynamique des populations des espèces principales et cycles biologiques *in situ*. Budgets énergétiques - Relations eau surnageante - sédiments - matière organique - bactéries - mangeurs de dépôts et filtreurs. Relations meiofaune - prédateurs.

. Recherches en biologie cellulaire. Cytologie ultrastructurale des Dinoflagellés libres et parasites. Etude de la cinétique de leurs divisions nucléaires avec des dérivés microtubulaires. Etudes des structures chromosomiques avant et pendant la division, couplée à l'étude biochimique et structurale de la chromatine. Recherche sur les effets des micropolluants à l'échelle infracellulaire chez les Dinoflagellés.

Station marine de Villefranche-sur-mer

Etude de la dynamique des populations en microécosystèmes ;
biologie et écophysiologie du zooplancton et du phytoplancton ;
recherche sur les complexants d'origine planctonique dans l'eau de mer ;
acquisition et traitement statistiques des données océanographiques ;
biochimie des transferts trophiques ;
écologie du microzooplancton ;
reproduction des organismes marins.

Station biologique de Roscoff

. Etude des écosystèmes benthiques de la Manche en conditions naturelles ou perturbées.

. Etude d'écosystèmes littoraux et estuariens (Baie de Morlaix) : rôle du phytoplancton, du microphytobenthos, des bactéries, du microbiotecton et de la méiofaune.

. Etude des acides gras des microvibrions marins.

. Etude comparée de chlorophycées marines des côtes françaises se rattachant aux genre *Ulothrix* et *Urospora*. Les résultats obtenus portent sur les modalités de reproduction en fonction des facteurs du milieu.

. Etude des peuplements d'algues benthiques de la Manche et de l'Atlantique-nord.

UNIVERSITE DES SCIENCES ET TECHNIQUES DE LILLE

Station marine de Wimereux

. Etude de l'hydrobiologie du détroit du Pas-de-Calais, connaissances physicochimiques et productivités pélagiques (phyto- et zooplancton). Etude des peuplements benthiques.

. Recherches molysmologiques dans les zones littorales proches de Calais - Dunkerque (Manche orientale).

. Etude de la nocivité de différents polluants sur les chaînes alimentaires.

AUTRES ETABLISSEMENTS

COLLEGE DE FRANCE

Laboratoire de Biologie marine - Concarneau

. Etude de l'alimentation des poissons. Espèces et quantités consommées, variations géographiques et saisonnières, la zone étudiée s'étendant des Shetland au golfe de Gascogne.

INSTITUT OCEANOGRAPHIQUE, PARIS

. Recherches sur la nutrition des organismes marins à partir des substances organiques dissoutes dans l'eau de mer. Etudes faites sur les larves de l'oursin *Arbacia* et chez les Tintinnides.

. Etude de la toxicité de différents hydrocarbures aromatiques polynucléaires sur le plancton.

. Recherches sur les processus d'adaptation à la lumière chez les copépodes marins, (Pontellidés). Influence du facteur lumière sur les migrations verticales de ces espèces.

. Recherches photochimiques : étude de la phototransformation de certaines des fractions de la matière organique dissoute des eaux de mer.

German Democratic Republic

(E.A. Arndt)

Plankton research in the Baltic Sea continued at the Institute of Marine Research of the Academy of Sciences of the GDR during 1980.

Sites in the Belt Sea and international stations in the Baltic proper were investigated during four seasonal cruises (scheduled voyages in March/April, May, August and October/November). In addition to comprehensive studies of physical and chemical parameters, the programme included biological observations regarding phytoplankton composition, chlorophyll, primary productivity and zooplankton. The GDR also fulfilled its contribution to the BMP of the Helsinki Convention in the course of these cruises.

One station in the Central Arkona Sea was investigated 15 times covering especially the most productive time of the year to obtain a better insight into the annual production cycle.

The Department of Biology of the Wilhelm Pieck University, Rostock participated in the qualitative and quantitative analysis of the phytoplankton, zooplankton and zoobenthos samples taken in connection with the BMP of the Helsinki Convention.

Furthermore, qualitative and quantitative studies were undertaken at intervals of 14 days on the phytoplankton and zooplankton in the Greifswalder Bodden and at a few stations on the seaward coast of Rügen in order to obtain information regarding the food available to the larvae and juveniles of the Rügen spring herring.

The Department of Biology of the Wilhelm Pieck University, Rostock also continued its work on the complex ecosystem analysis of the chain of boddens south of Darss-Zingst during the year, main attention being paid to the following aspects and scientists engaged at the Biological Station Hiddensee of the Ernst Moritz Arndt University Greifswald participating in some of the work:

- recording of meteorological, hydrophysical, hydrochemical and hydrobiological primary data (incl. biomass and production, phytoplankton and zooplankton, phytobenthos, zoobenthos, microbiology);
- ecological investigations into the following problems:
  - effects of rapid variations in hydrographic conditions on planktic primary production,
  - the exchange of substances at the sediment-water interface,
  - qualitative and quantitative analysis of the zoobenthos with special regard to food sources for fish and the establishment of communities in meiomesohaline brackish waters,
  - premature variability of abiotic and biotic factors on the basis of a 10-day synoptic study;
- studies on the resistance and tolerance of selected organisms to abiotic factors, including pollutants, and the effects of temperature and salinity fluctuations on the performance of organisms.

Federal Republic of Germany

(J. Lenz)

Institut für Meereskunde, Kiel

Kiel Bight and Baltic Proper

The regular sampling programme for chemical and biological data including the measurement of primary productivity in Kiel Bight, started in 1979 within the framework of the International Baltic Sea Monitoring Programme, was continued at three fixed stations in Kiel Bight.

A detailed analysis of the 19-year data series on hydrographical, chemical and planktological parameters collected at a permanent station in the western Kiel Bight at monthly intervals between 1957 to 1975 formed the subject of a doctoral thesis.

The planktological work within the interdisciplinary Joint Research Programme SFB 95 at Kiel University named 'Interaction between the sea and the sea bed' concentrated on the ratio between formation of particulate organic matter through primary production in the water column and its subsequent sedimentation to the sea bottom. In this way, the fate of the phytoplankton spring bloom could be closely followed by the employment of sediment traps. Methodological investigations on the behaviour and efficiency of different types of sediment traps were included in the project.

With the help of satellite photos the commencement of the phytoplankton spring bloom and eutrophication processes were studied in the southern Belt Sea.

Work on the summerly mass occurrence of blue-green algae (Nodularia spumigena and Aphanizomenon flos aquae) in their relation to the availability of inorganic nutrients was continued. Special emphasis was laid

on possible interrelationships between phytoplankton and bacteria. Experiments with methylamine isotopes which are used as analogue for ammonium uptake showed that there exists, especially in the oligotrophic waters of the Baltic, a strong competition between phytoplankton and bacteria for this nitrogen source.

During a cruise with RV 'Alkor' to the Skagerrak in late summer, the physiological activity of copepodit stage V of Calanus was studied with special emphasis on its overwintering behaviour. The activity of its digestive enzymes showed an inverse correlation to the depth in which the specimens were caught. This points to a gradual transition into the diapause-like overwintering stage during which the specimens remain in a state of torpor without feeding.

Possible effects of oil pollution on the sediments of the Kiel Fjord and the Schlei where herring use to spawn as well as on the ripe herring themselves and their eggs were studied.

The image analyzing system 'Quantimet' was tested in counting and size classification of zooplankton organisms in preserved samples. By means of a correlation established between the average area of single specimens measured by the system and corresponding dry weight determinations, it was possible to obtain reliable biomass values for copepod species in different size categories.

Atlantic

In close cooperation with Portuguese colleagues, the distribution of sardine eggs and larvae in regard to phytoplankton and zooplankton abundance was studied during a cruise with RV 'Poseidon' to the shelf areas off Portugal in April.

Standard surveys on herring larvae and mackerel eggs and larvae were continued in the North Sea and adjacent areas of the North Atlantic.

Much effort was invested in working up the large collections of fish fry sampled in the Equatorial Atlantic during a 5 month expedition with RV 'Meteor' in 1979. The biological programme included the measurement of primary productivity as well as the assessment of phytoplankton and zooplankton standing stock in the upper 300 m along a standard section across the equator.

Many members of the departments of Planktology and Fisheries Biology took part in the Antarctic Expedition with RV 'Meteor' starting in November within the great international BIOMASS Programme. The main aim is the study of phytoplankton and zooplankton ecology with special emphasis on the development of phytoplankton blooms near the ice edge and on the life history and feeding habits of krill, Euphausia superba. The investigation of the Antarctic ecosystem will keep the institute's members occupied during the next years.

Biologische Anstalt Helgoland

Routine measurements of hydrographical, chemical and biological parameters have been continued at Helgoland Roads (54^{o} 11,3' N, 07^{o} 54,0' E). Five times a week, temperature, salinity, nutrients (PO_4, NO_2, NO_3, NH_4, SiO_2), yellow substances ('Gelbstoff') and biomass as organic carbon, derived from microscopic counts (inverted microscope), were measured.

The long-term trend (19 years) indicates an increase of the phytoplankton stock as a consequence of the increase of the phosphate concentration superposed by a periodical oscillation with a 'wave length' in the range of five to six years.

Monthly cruises were made from Helgoland to the estuaries of the Elbe River, the Eider River, and the Weser River for hydrographical, chemical, and biological investigations.

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 seasonal and spatial 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 12 years at Helgoland Roads.

Horizontal and vertical distribution of particulate suspended matter and phytoplankton stocks were investigated qualitatively and quantitatively in the German Bight, North Sea. Vertical sample series were taken on 76 stations with 10 nautical miles distance east of 6^{o} 25' E and south of 55^{o} 10' N during a quasisynoptic cruise with RV 'Gauss' from the German Hydrographic Institute, Hamburg, from 23 June to 2 July, 1980.

Remote sensing of the sea surface of the Wadden Sea of Sylt (German Bight) was conducted from an airplane (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Oberpfaffenhofen) with simultaneous ground truth measurements from a ship (RV 'Mya', Biologische Anstalt Helgoland) during high tide and low tide of the same day (10 May, 1980), in order to test how far the different seston quantities and qualities in various parts of the Wadden Sea can be detected by remote sensing techniques.

Ecological studies in the 'Königshafen', a semi-enclosed embayment of the Wadden Sea of Sylt (German Bight) were continued. Seston-, phytoplankton- and mesozooplankton-components were analyzed as well as the hydrographical parameters (temperature, salinity, nutrients, oxygen) in the course of the year. Measurements on growth rates and respiration of benthic communities were continued. Measurements on growth conditions of dominant phytoplankton species were concluded.

Iceland

(I. Hallgrîmsson & Th. Thordardóttir)

Zooplankton

In 1980 zooplnakton sampling was carried out at 518 stations during 7 cruises:

In late April, 66 zooplankton stations were worked on the shelf area off the west, south and south-east coasts.

In early May, 107 stations were worked on the shelf area around Iceland; the sampling in these cruises was carried out with a Hensen net, fine-meshed vertical net and Gulf III sampler.

In April and May 116 zooplankton stations were worked in two surveys south-west off Iceland and at East Greenland.

In late May to mid-June, 100 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 June, a deep-water sampling, down to 1 000 m, was carried out at 21 stations in the waters south-east off Iceland and south off the Faroes.

In early June, a prawn larvae sampling was carried out with a Gulf III sampler at 108 stations in and off the fjords of north-west Iceland.

The continuous plankton surveys between Reykjavik and New York and Reykjavik and Sule Skerry, worked in cooperation with the Institute of Marine Environmental Research, Plymouth, are still in progress.

Phytoplankton

The methods used in the phytoplankton investigations in Icelandic waters were much the same as in previous years. Primary productivity was measured with the C-14 technique at light saturation on samples from standard depths (0, 10, 20 and 30 m) and at the same time depth samples were collected for quantitative analysis of the phytoplankton. Chlorophyll *a* was measured in one litre samples from the 10 m level, and *in vivo* chlorophyll *a* and transparency were continuously registered at 3-4 m levels in the surveys made on the vessel R.V. "Bjarni Sæmundsson". Light penetration (Lambda quanta meter), Secchi depth and colour index were measured when possible.

Net samples were collected at the surface with a phytoplankton net (mesh size 20 µm).

The phytoplankton investigations were carried out in surveys which were similar to and and covered the same areas as those of previous years. The first one in late April covered the coastal area from Isafjördur(at the north-western peninsula) to Berufjördur (at the south-eastern coast), the second one in early May covered the coastal area all around Iceland, the third one was the traditional spring survey (in May-June) when coastal and oceanic waters all around Iceland were surveyed, and the fourth one in August (0-group survey) when the survey area was similar to that of the spring survey. In addition to previous years' surveys, phytoplankton investigations were carried out during 8-17 July, mostly in coastal waters off the north-western, northern and eastern coasts.

During the 48 hour period of 7 to 8 August repeated measurements of primary productivity were carried out in situ and by our incubator method simultaneously at a location in the southern Faxabay.

Phytoplankton for Chlorophyll a measurements only was sampled weekly at two stations in Isafjardardjúp (the north-western peninsula) and at one station off the island Grîmsey (off the north coast).

Further sampling of phytoplankton for Chlorophyll a measurements only was also made during cruises to the fjord area off the north-western peninsula (5 June - 12 June) and to the deep oceanic waters south of Iceland (19 - 28 June).

During 1980, primary productivity was measured in 1 932 samples and Chlorophyll a in 692 samples.

Ireland

(B. McK Bary & M.M. Parker)

1. Department of Fisheires & 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).

Observations and recording of algal blooms and "red tides" continues. In August and September, Gyrodium aureolum Hulbert blooms again affected the south west coast though these were less intense in previous years. A nationwide survey for paralytic shellfish toxin revealed only trace amounts, associated with Prorecentrum micans blooms.

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. The team is participating in the EEC's COST 47 project on Coastal Benthic Ecology.

b) Department of Oceanography

Biological oceanography in the Department is based on simultaneous sampling of zoo- and/or phyto-plankton and chemical and physical properties of the waters of the western and southern Irish coasts. Research in hand concerns fluctuation in numbers and environmental relationships of Calanus finmarchicus and C.helgolandicus; occurrences of and interactions between fish larvae in oceanic and neritic waters; the larval stages of euphausiids and planktonic indicators of two-way flows through a strait. Phytoplankton, with emphasis towards red-tide, is studied off the south coast and in the Shannon estuary.

3. University College, Cork (Zoology Department)

A littoral and sub-littoral ecological survey carried out at selected rocky sites in Bantry Bay by scientists from the Zoology Department, University College, Cork is being completed.

A study on short time scale fluctuations and vertical movements of meio fauna in Cork Harbour intertidal muds is in progress.

4. Other studies on marine ecology are reported under the MEQC Administrative Report as they are related to pollution matters.

Netherlands

No report received.

Norway

(G. Berge)

1. Institute of Marine Research, Bergen and Biological Station Flødevigen, 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 5th 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). During 1980, a special computer program has been designed for a further treatment of the collected data.

1.1.3 The study of the phytoplankton and its primary production at the ice edge was continued in summer 1980. Special emphasis was done in the collection of biological data to be used in a mathematical model of the production processes in the area. This study is part of an interdisciplinary program 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°, zooplankton sampling was made in duplicate at 303 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 A study of the zooplankton 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 (See 1.1.3). (In 1980, 307 zooplankton samples were taken at 75 stations. The material was worked as for 1.2.1).

1.2.4 An interdisciplinary programme designed to investigate the survival of and feeding in cod larvae was started in 1975 and continued in 1980, with special emphasis on the feeding of larvae in relation to the distribution of food organisms. An *in situ* particle rate meter has been developed based on the HIAC particle counter to study the small scale distribution of zooplankton organisms.

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 12 400 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 controlled experiments in plastic enclosures on the pelagic system. Experiments on the effect of oil on various chemical and biological components were carried out as a joint project with a number of Norwegian marine science institutions. The studies in the plastic enclosures and in Lindåspollene proper have provided data for parameter estimation for the mathematical model on the dynamics of the pelagic system.

2.2 The study of the phytoplankton primary production in relation to light levels and with respect to size fractions has continued in Korsfjorden. In October experiments on the effects of

bottle size on primary production started. Grazing studies are being carried out on the basis of pigment analyses of size-fractioned zooplankton samples in relation to phytoplankton standing stock. The effects of environmental events, particularly water exchange, on zooplankton populations is also under investigation.

2.3 Studies have commenced on the productivity of coastal waters and on the seasonal levels of activity of zooplankton in fjord, coastal and Atlantic water masses, using the University's new research vessel.

Department of Fisheries Biology.

2.4 In a landlocked fjord,Lindåspollen, studies on eggs and larvae of herring have been continued in order to assess the stock size and the reproduction of the herring stock in the area.

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

3.1 Phytoplankton.

Within the framework of the National Monitoring Programme for Water Resources Chlorophyll a has been used as eutrophication index in several polluted fjords. Quantitative phytoplankton samples were collected in some of these fjords.

3.2 Benthic communities.

Registration of shore and shallow water communities by diving were routinely applied in recipient investigations and monitoring. Lower limit of benthic algal growth has been used to characterize the mean light conditions- Structure of soft bottom fauna have also been studied at several of the localities selected for the above mentioned National Monitoring Programme. Stereophotography at fixed sites down to 30 m took place twice a year in two fjords partly relieved from pollution.

3.3 Levels of heavy metals and organic micropollutants (PAH, PCB etc) in benthic organisms (mostly seaweeds and mussels) have been recorded for monitoring purposes or in connection with application for discharge permits.

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 light, transmission and scanning electron microscopy, were continued. (K.R. Gaarder, in cooperation with E.R. Heimdal, Bergen). An investigation on Coccolithophorids from the northern part of the eastern central Atlantic has been finished, I. Holococcolithophorids published, II. Heterococcolithophorids delivered for publication.

4.1.2.2 Light and electron microscope studies of the morphology, taxonomy, and distribution of the diatom genus Thalassiosira were continued. (G.R. Hasle, E.E. Syvertsen, partly 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.E. Syvertsen).

4.1.2.4 An investigation of the morphology and taxonomy of the diatom genus Eucampia is in progress (E.E. Syvertsen, G.R. Hasle).

4.1.2.5 An investigation of the nitrogen turnover in the phytoplankton of the inner Oslofjord was continued. 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 An investigation of a massive bloom of Prorocentrum minimum (Dinophyceae) in the outer Oslofjord was published (K. Tangen).

4.1.2.7 Taxonomy and morphology of dinoflagellates were studied by means of light transmission and scanning electron microspes (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 was finished (student).

4.1.2.9 An introduction to living and Quarternary 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 are continued (E. Syvertsen).

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

4.1.2.12 Development of ultra- and nanoplankton flagellate communities were studied in oil polluted and non-polluted enclosures (bags) in the sea (J. Throndsen).

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

4.1.2.14 Chlorophylls and carotenoids of the marine alga Eutreptiella gymnastica (Euglenophyceae) (T. Bjørnland).

4.1.2.15 Structure elucidation of new carotenoids from the Dinophyceae and Euglenophyceae (T. Bjørnland in cooperation with Synnøve Liaaen-Jensen and Anne Fiksdahl, Trondheim).

Projects 4.1.2.1 - 7 and 4.1.2.10 - 12 and 4.1.2.15 will be continued in 1981.

4.2. Zooplankton

4.2.1. Studies on the variability of replicate samples of neuston were completed (student, Schram).

4.2.2. Studies were continued on the occurrence of adults and developmental stages of the eye-maggot (Lernaenicus sprattae) of the sprat (Schram).

4.2.3. Seasonal occurrence in the Oslofjord of larvae of decapod crustaceans was investigated (student, M.Christiansen)

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, E.E. Syvertsen, in cooperation with Prof. von Stosch, Marburg).

4.3.2 An investigation of two marine epiphytic Fragilaria species is in press (G.R. Hasle, E.E. Syvertsen).

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

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

4.3.5 Small-scale surveys of algal flora and vegetation in fjord areaes outside the Oslofjord (students, J. Rueness).

4.3.6 A study of grazing by Littorina on littoral green algae in the inner Oslofjord has been published (T.E. Lein).

4.3.7 Field manipulative experiments on competitive relationships between green alga and Fucus are continued..

4.3.8 Studies on the structure and chirality of red algae carotenoids (T. Bjørnland in cooperation with Synnøve Liaaen-Jensen, Trondheim and Gunnar Borch, Lyngby, Denmark).

4.3.1 - 8 will be continued in 1981.

4.4. Zoobenthos

4.4.1. Work on the problems with biological interactions (predation, competition, succession) as background 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. Factors controlling community structure in a benthic community of soft-sediments in Oslofjord were studied (Gray).

4.4.3. Work was done on classification and dynamics of benthic animal communities in Oslofjord (students, Gray).

4.4.4. Extensive work was done on the reproduction biology, population strategy, energy budget and production of various polychaetes (Capitellidae, Nereis, Ophiodromus, Pectinaria, Polydora). (students, Gray, Schram).

4.4.5. Work was done on the energy metabolism in Mya arenaria (student, Gray).

4.4.6. Ecological studies were made on some species of Gammaridae (student, Gray).

4.4.7. Field studies were carried out on the behaviour of the edible crab (Cancer pagurus) (student, Beyer).

4.4.8. Methodological and ecological studies were commenced on soft bottom foraminifera (students, B.Christiansen, Beyer).

5. University of Tromsø and Museum of Tromsø

5.1 Phytoplankton

5.1.1 The monitoring of standing stocks of phytoplankton in Skjomenfjord, Northern Norway, after the building of a hydroelectric power plant (H.Chr. Eilertsen). This is part of a long-term study to assess the potential effects of regulating freshwater on the marine ecosystem in a fjord.

5.1.2 Phytoplankton species succession, abundance and dynamics of growth in Balsfjord (H.Chr. Eilertsen.)

5.2 Zooplankton

5.2.1 The monitoring of standing stocks of zooplankton in Skjomenfjord, Northern Norway, after the building of a hydroelectric power plant, including the interaction of zooplankton with hyperbenthos (N.J. Sands).

5.2.2 Zooplankton scattering layer - experimental echo sounding experiments (Chris Hopkins).

5.3 Zoobenthos

5.3.1 Monitoring of hard-bottom fauna i Balsfjord, Northern Norway, with special emphasis on effect of sedimentation (B.Gulliksen)

5.3.2 Manipulation of hard-bottom communities in Balsfjord, Norther Norway (B. Gulliksen).

5.3.3 Effect of pollution on benthic communities in the Tromsø area (B. Gulliksen, B. Holte, K-J. Jakola).

5.3.4 Mapping of hard-bottom communities around the coasts of Spitsbergen and Bjørnøya (B. Gulliksen, O.K. Sandnes).

University of Tromsø.

Institute of Biology and Geology.

Zooplankton.

Ecological studies on the zooplankton community of Balsfjorden, first began in 1976, are being continued. The life cycles and seasonal biochemical cycles of the dominant species have been investigated. Work is progressing on examining the overwintering and reproductive strategies. This work has, where possible, been carried out with regard to relating changes and fluctuations to those of the physical environment (eg incident light, hydrography, particulate matter) and to those of the phytoplankton (in co-operation with the phytoplankton workers). (C.C.E. Hopkins, S. Falk-Petersen, K. Tande, S. Grønvik).

Studies of zooplankton sound scattering layers, chiefly krill (euphausiids), in North Norwegian fjords are being carried out with 38 kHz and 120 kHz echosounders coupled to a digital echointegrator. The trophodynamic and behavioural interactions between krill SSLs and fjord fish are also being examined. (C.C.E. Hopkins, S. Falk-Petersen, F. Pettersen).

A long range research and development program was started in 1974 at the Royal Norwegian Council for Scientific and Industrial Research (SINTEF) of the University of Trondheim under the title "Havbiomodeller" (translation: "Ocean Biomodels"). The goal of this program is to establish mathematical models of the marine echosystem of the Barents Sea. The model consists of sub-models describing physical and chemical oceanography, growth and distribution of phytoplankton and zooplankton, and the state and migratory pattern of the main fishing stocks. A preliminary model has been developed for zooplankton; the experimental work necessary to provide appropriate data for it is being carried out in Tromsø. At present work is being focused on the ingestion and digestion sub-models, and growth rates as functions of temperature and food concentration and quality, for Calanus finmarchicus (K.S. Tande, C.C.E. Hopkins).

Fish

Research was started to examine the importance of zooplankton in the diet of capelin (Mallotus villosus) in Balsfjorden. The growth of capelin is being examined in relation to seasonal changes in the physical environment, and food quality and quantity in the fjord. (C.C.E. Hopkins, student).

Hypobenthos.

The population dynamics, production, and ecological energetics of the deep-water prawn (Pandalus borealis) is being studied in Balsfjorden. (C.C,E. Hopkins, 2 students).

Zoobenthos.

Investigations on the bottom fauna of the Barents Sea and the Spitzbergen area. (E. Oug).
Population dynamics of Macoma calcarea (E. Oug, student).

Systematics and zoogeography of the Terebellomorpha (Polychaeta). (Torleif Holthe).
Investigations on the deep sea fauna of the Norwegian Sea (Torleif Holthe and collaborators).
Zoogeography of the Echinoderms of North Norway (T. Holthe, student).
Population dynamics of Pectinaria hyperborea in Balsfjorden, North Norway (T. Holthe, student).

Reproduction and larval development of echinoderms, particularly star-fishes (I.-B. Falk-Petersen).

Reproduction and larval development of sea urchins (S. Lønning Vader, I.-B. Falk-Petersen, W. Vader, 1 student).

Fish development.

Fertilization and early development of marine fishes (cod, flatfishes) are studied by morphological (including EM) and physiological methods (S. Lønning Vader, J. Sundet, E. Kjørsvik, 1 student).

6 University of Trondheim

6.1 Phytoplankton

6.1.1 A study on growth rate and chemical composition of marine diatoms in in situ dialysis culture as a function of temperature, light intensity and day length was continued. (E. Nost Hegseth, E. Sakshaug)

6.1.2 Investigations of growth rate and chemical composition of the diatom Skeletonema costatum as a function of light intensity and day length in pseudoturbidostat cultures were continued. (E. Sakshaug)

6.1.3 A report on an investigation of the distribution, species composition and chemical composition of the phytoplankton off the Møre coast in 1975-1979 has been submitted for publication. (E. Sakshaug, E. Nøst Hegseth, and L. Jørgensen in cooperation with Dr. S. Myklestad.)

6.1.4 Continued observations on the phytoplankton distribution in the Trondheimsfjord, with special emphasis on the first spring bloom. (E. Nøst Hegseth)

6.1.5 In situ chlorophyll/fluorescence measurements were performed in Trondheimsfjorden simultaneously with the passing of a Nimbus-satelite. (E. Nøst Hegseth, E. Sakshaug, in cooperation with Dr. A. Jensen.)

6.2 Zooplankton

6.2.1 A report on the chemical components of Calanus finmarchicus has been prepared. (L. Jørgensen)

6.2.2 Use of energy by a winter population of Calanus finmarchicus is studied. (L. Jørgensen)

6.2.3 Routine sampling of zooplankton once a month by Nansen 75/180 µm net continued at two oceanographic stations in Trondheimsfjorden (J.-A. Sneli)

6.3 Phytobenthos

6.3.1 Single and synergetic effects of heavy metals (Cu, Zn, Pb, Hg, and Cd) on the length growth of intertidal fucoid algae are studied. Three publications on the subject were published. (T. Strømgren)

6.4 Zoobenthos

6.4.1 Investigations on deep-water molluscs in the Norwegian Sea outside Troms were continued. (J.-A. Sneli together with scientists from Tromsø and Oslo.)

6.4.2 Taxonomy and occurrence of Scandinavian and Arctic turrid prosobranchs are studied. (J.-A. Sneli, Ø. Stokland)

6.4.3 Material for dating of live and dead Lophelia pertusa and bivalves by stable isotope chronology to establish rate and time of growth were collected. The information obtained will be used for paleoclimatic reconstructions. (J.-A. Sneli in cooperation with Dr. W.H. Berger, La Jolla.)

Poland

No report received.

Portugal

(A.R. Cascalho & T. Neto)

Instituto Nacional de Investigação das Pescas, Lisbon

Upkeep of the phytoplankton cultures stock (phytoflagellates, diatoms, dinoflagellates, chlorophyceae); development of ten litre monoalgal cultures to feed the zooplankton stock cultures (Ma. Antónia Sampayo).

Studies on productivity of phytoflagellates and dinoflagellates (Ma. Antónia Sampayo).

Studies on the nutritional value of the phytoplankton cultures (Ma. Antónia Sampayo).

Study of a red water in the Algarve coast 11 July 1980 (report in press; Ma. A. de M. SAMPAYO and Graça CABEÇADAS).

Upkeep of the zooplankton culture stock (copepods and rotifers) (Ma.Helena Vilela)

Continuation of the production experiments with the rotifer Brachionus plicatilis in five litre aquaria using live and inert food (Ma.Helena Vilela).

Continuation of the food quality experiments with the harpacticoid copepod Tigriopus brevicornis in small volumes (Ma. Helena Vilela).

In preparation a paper " Ria de Faro-Olhão. I. Pigments and predominant plankton in sea water samples from May 1972 to May 1973" (M.E. Assis Margulhão, M.A. de M. Sampayo and M.H. Vilela).

Study of phytoplankton integrated in the program "Environmental study of the Tejo estuary" coordinated by Comissão Nacional do Ambiente (Ma. Teresa Moita).

Study of zoo and ichthyoplankton related with Sardina pilchardus (W.) spawning and breeding areas between Cabo da Roca and Vila Nova de Mil Fontes (Ma. Hortense Afonso, Ma. Emília Cunha, Ma. de Fátima Quintela, Ma. Teresa Rodrigues and Francisca Varela).

Study of zooplankton collected by N.E. "NORUEGA" with a WP-2 net along the coast of Portugal during June 1979 (I. de Paiva e T. Neto).

Preliminary studies on the dynamics of natural zooplankton populations from Ria de Faro-Olhão, with special reference to the copepod species Acartia clausi (Giesbrecht) and Euterpina acutifrons Dana (Ma. Emília Cunha).

Instituto Hidrográfico, Lisbon

Analysis of abundance and composition of plankton from Ria de Faro (March to November 1980); Costa do Sol (August to November 1980), Ilha de Sta. Maria (Azores) (June to September, 1980) and Ilha da Madeira (April, June, September to November, 1980) (Ma. de Lourdes V. Shirley).

Serviço de Estudos do Ambiente, Lisbon

Study of phyto-and zooplanktonic communities of estuarine zones and their dynamic.

Study of benthonic communities in estuarine zones (Ma. Constança Peneda)

Laboratório de Botânica - Núcleo de Ecologia da Faculdade de Ciências, Lisbon

Salt marsh vegetation structure and dynamic in Tejo estuary (F. M. Catarino, M.I. Caçador and M.I. Ramos).

Spain

(J. Corral & A. Dicenta)

INSTITUTO DE INVESTIGACIONES PESQUERAS

PHYTOPLANKTON

Taxonomical studies on an area affected by the urban runoff near Barcelona have been started.

A study on Chorophyll a and primary production distribution in the area covered by the cruise "Mediterráneo I" has been finished, as well as a summary report on phytoplankton communities in the upwelling off NW Africa.

ZOOPLANKTON

The Chaetognats of the continental shelf off Galicia have been studied. Another study on the Ostracods and Cladocerans in the Western Mediterranean Sea is being continued.

A generalised study on the temporal changes on copepods inhabiting the continental shelf, has showed a close relationship between succession and temperature and food. This has confirmed the relictic character of Pseudocalanus elongatus living in the Alboran Sea.

The study of the copepods community on the upwelling off NW Africa and the Thaliacea off Galicia are being continued, while a study on the zooplankton community in the Ria de Pontevedra (NW Spain) that receives wastes from a paper mill factory has just been started.

As for the area of Barcelona, a study of an annual cycle of decapod larvae in the waters off Barcelona has been undertaken, while the study on the Heavy Metals (Hg, Pb, Cd) inside Barcelona Harbour has continued.

INSTITUTO ESPAÑOL DE OCEANOGRAFIA

PHYTOPLANKTON

The studies on primary production, succession and nutrient intrusions in an annual cycle in the Ria de Arosa are being continued.

In the Ria de Muros (NW Spain), a study on phytoplankton has been realised as well as on the continental shelf.

ZOOPLANKTON

A preliminary comparative study between zooplankton communities in the Ria de Arosa and Ria de Muros in terms of dry biomass, zooplankton carbon and nitrogen and caloric content has been finished. Strong differences resulted in the comparison of these two Rías because Muros has a typical neritic community dominated by small copepods such as Paracalanus, Pseudocalanus, Temora and Acartia, whreas the community of Arosa is dominated by the larvae of the decapod Pisidia longicornis.

Studies of the communities of zooplankton in the continental shelf off Galicia have been started and those of the zooplankton of the Bay of Santander and its surroundings are being continued.

As for the area of the Delta del Ebro (NE Spain), studies on the zooplankton communities and the influence from the continental waters have been realised in spring of 1980.

Sweden

No report received.

United Kingdom

1. England and Wales

(D.J. Garrod)

1. MAFF Fisheries Laboratory, Lowestoft

A. Plankton studies in the seas around the British Isles

(i) Studies on the development of fish eggs in a controlled temperature incubator were undertaken at sea. The fish species examined were Trisopterus minutus, Pollachius virens, Pollachius pollachius, Melanogrammus aeglefinus and Sprattus sprattus. All but the sprat experiment were successful. This is part of a continuing programme to support spawning surveys for stock assessment purposes.

(ii) Two surveys of the spawnings of mackerel in the Celtic Sea and Bay of Biscay were carried out in May and June as part of an International programme to estimate the size of the western mackerel spawning stock.

(iii) Three surveys were conducted to assess herring larval abundance; again as part of the MAFF contribution to International surveys. One survey was to the eastern English Channel and southern bight of the North Sea in January and two to the west central North Sea in September and October. A fourth cruise in September was undertaken to assess the variability in replicate hauls near a station of high density herring larvae on the Whitby spawning grounds.

(iv) The patch study proposed in 1979 was undertaken on a limited scale with a single cruise by R.V. CIROLANA to the plaice spawning grounds in the Southern Bight in March. On this cruise a patch of plaice larvae was tracked over a four week period from the centre of the Southern Bight to Texel Island. This work was carried out in collaboration with ships and staff from the Dutch research laboratories (Texel and K.N.M.I.).

During this survey the new software to handle information recorded by the data logger was tested for the first time.

(v) Vertical distribution studies on lobster larvae continued in Bridlington Bay in August. The results indicated that larvae migrate vertically at dawn and dusk, in response to rapid changes in light levels and are probably affected by tidal mixing. Consequently surveys with neuston nets are not suitable for accurate estimates of abundance to be made and the work has been discontinued until a suitable quantitative sampling method can be designed.

(vi) Three cruises were undertaken to the west central and central North Sea between July and September to investigate (a) circulation off the north east coast of England, (b) the Flamborough Front and (c) the distribution of chlorophyll 'a' in mixed and stratified water. Particle counting and sizing equipment (HIAC) was used on all three cruises. The links between temperature discontinuities, chlorophyll 'a' and particle sizes is currently being assessed throughout the area of this study.

B. Gear development

(i) The HIAC particle counter has been adapted to size and count (a) preserved organisms in plankton samples and (b) eggs from fish ovaries or berried crustaceans.

Institute for Marine Environmental Research, Plymouth

1. The Continuous Plankton Recorder Survey

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 US National Marine Fisheries Service.

During 1980 Recorders were towed 86,081 miles by 24 ships of eight nations (Denmark, France, Iceland, Netherlands, Norway, Republic of Ireland, Sweden and the UK). The CPR survey began in 1931 with three routes in the southern North Sea. Since 1948 the plankton has been collected, analysed and the results processed in the same way. 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, U.K. Details of the data processing procedures are given by J M Colebrook in Bull. mar. Ecol., 8, 133-142.

2. Undulating Oceanographic Recorder

The Undulating Oceanographic Recorder (UOR) has been towed regularly between Plymouth and Roscoff (PR route - see Figure 1) by M V Cornouailles (by kind permission of Brittany Ferries). The UOR is a self-contained oceanographic sampler which can be towed by "ships-of-opportunity". It is used to carry instrumentation to sample plankton continuously and to measure chlorophyll (range 0 to 100 mg m^{-3}), radiant energy (range 0 to 1000 u E m^{-2} s^{-1}) temperature (range 0 to 30°C) and salinity (range 32 to 37 °/oo), all of which are recorded, with the measurement of depth (range 0 to 100 m) by a miniature digital tape recorder with a resolution of 0.1 % of full scale.

3. Fish eggs and larvae

IMER collaborated with MAFF and DAFS in four cruises to the west and south west of the British Isles to study (a) the vertical distribution of mackerel eggs and larvae, macro and micro zooplankton and chlorophyll (using the Longhurst Hardy Plankton Recorder; (b) embryonic development rate of fish eggs; (c) mortality rate of mackerel eggs at different stages of development; (d) diel periodicity of feeding of mackerel larvae; (e) specific gravity of mackerel eggs.

4. Comparative Ecosystem Study

Comparative studies at a site over the Continental Shelf in the Celtic Sea and a site in the open ocean at 59°00'N, 19°00'W were continued. Measurements were made of (a) the vertical distributions and diurnal migrations of the dominant zooplankton; (b) feeding rates under ambient conditions; (c) primary production and (d) the chemical and physical environment.

The Continuous Plankton Recorder Survey 1980. The routes are identified by code letters

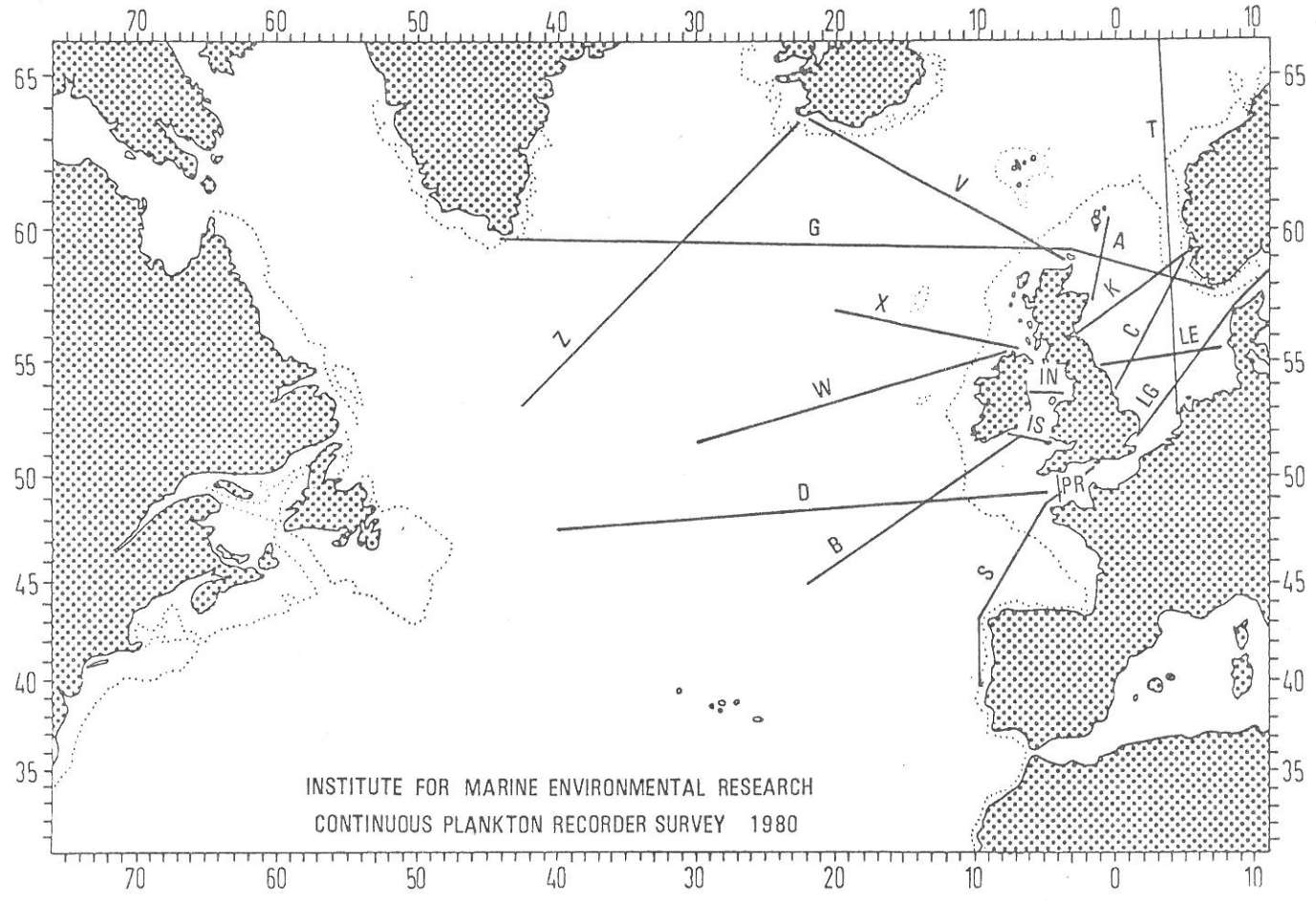

Figure 1

2. Scotland

(R. Jones)

1 Marine Laboratory Aberdeen

Scyphomedusae

Scyphomedusae were collected, as in previous years, during the International O-group gadoid survey in the North Sea. Estimates of abundance and distribution of the commoner species, Aurelia and Cyanea, have been derived and compared to those in earlier years.

Enclosure experiments

An experiment using four, 300 m^3 enclosures was conducted at Loch Ewe from March-July 1980. Fertilized Clyde spawning herring eggs were introduced into each of the enclosures and their subsequent development followed until after metamorphosis of the herring larvae.

Two enclosures were treated with North Sea oilwell "production water" at a concentration simulating conditions in the vicinity of a platform. The other two served as controls. Larval growth rates, mortality, morphometric development and aspects of biochemical composition (total C, N, and lipid analysis) were monitored, and samples of larvae were taken for otolith examination. Larval gut contents are also being examined. Simultaneous samples of phytoplankton and zooplankton were also taken from the enclosures together with measurements of heterotrophic and primary production. The data is still being evaluated and it is intended to make comparisons between autumn and spring spawning larvae particularly in relation to primary and secondary production.

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 on generating an area of high summer phytoplankton production.

Theoretical studies of energy flow through food webs

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). Studies of the Rockall Trough

The seasonal sampling of the demersal fish, zooplankton and micronekton has been completed and the main emphasis during 1980 has been on the food and feeding of the benthic, benthopelagic, bathypelagic and mesopelagic fishes. Macrobenthos sampling has continued at reduced frequency and the laboratory investigations have concentrated on studies of reproduction and population dynamics. The meiobenthic programme in the Rockall Trough and the Porcupine Sea Bight and Abyssal Plain has continued and some progress has been made in the analysis of the harpacticoid populations.

There has also been a microbiological input from the Heriot-Watt University and the University of Galway. The joint study with the Institute of Oceanographic Sciences of the demersal fish populations of the Porcupine Sea Bight progressed well in 1980.

(K. Sherman & G.D. Grice)

Studies of Very Large Ecosystems (VLE's)

Studies of VLE's were made in the Gulf of Maine, on Georges Bank, Southern New England, and the Mid-Atlantic Bight, off the Southeast U.S., and in the Gulf of Mexico. The MARMAP survey unit of the National Marine Fisheries Service (NMFS) at Sandy Hook, New Jersey, completed the fourth consecutive year of intensive field work in shelf and slope waters off the middle Atlantic and northeast coast of the United States, an area of some 260,000 km^2. Broad scale surveys of shelf and slope waters were underway during 10 months of the year. They utilized 238 vessel days, collected 2,000 plankton samples and recorded nearly 50,000 observations of temperature, salinity, dissolved oxygen, chlorophyll a, nutrients and ^{14}C. Analyses of ichthyoplankton samples over the past four years reveal marked seasonal differences in the abundance of eggs and larvae but several consistent patterns emerged. Among the most noteworthy were: the high abundance of sand lance larvae during the winter months, especially off Southern New England; the continued low abundance of Atlantic herring larvae during autumn on Georges Bank; and the recurrent overlap in areas of high chlorophyll a concentrations, zooplankton biomass; and dense patches of fish eggs and larvae. Based on the distribution and abundance of eggs and larvae, initial spawning success during the peak spring and summer period was greater in 1977 and 1979, when spring warming began in April, than in 1978, when an unusually cold spring delayed warming by several weeks. Although sand lance (Ammodytes spp.) larvae continued to dominate our ichthyoplankton collections during the winter of 1980, their overall mean abundance (64 larvae/10m^2 surface area) was drastically reduced from the record high level observed in 1979 (417 larvae/10m^2 surface area). The center of their abundance in 1980 remained off Southern New England, in the vicinity of Nantucket Shoals, where they had been most abundant since shifting from Georges Bank in 1976. Whereas the three winters of 1977 to 1979. produced record cold conditions, the weather moderated during the winter of 1980. During the autumn of 1979 Atlantic herring larvae increased in abundance over 1977 and 1978 levels along the western part of the Gulf of Maine, but for the third consecutive year, herring larvae were scarce to absent on Georges Bank where they were most abundant during the 1960's. In addition to monitoring seasonal and annual changes in the distribution and abundance of fish eggs and larvae, we have intensified our efforts to derive spawning stock estimates based on fish eggs collected on MARMAP surveys. Work is currently in progress on yellowtail flounder, silver hake, bluefish and haddock. Taxonomic studies on the early stages of Phycis and Urophycis, Sebastes and Liparis are underway, and the guide to the identification of early stages of marine fishes from the western Atlantic is under review.

At the Woods Hole Laboratory of NMFS, progress has been made in the analysis of larval Atlantic herring data from 39 surveys conducted by the International Commission for the Northwest Atlantic Fisheries in the Georges Bank - Nantucket Shoals area over the 1971-1978 spawning seasons (October-February period). Seasonal abundance estimates by one-millimeter length classes and their confidence intervals were made using the delta-distribution to account for the high proportion of empty hauls on these surveys. For the fully vulnerable length classes, length-specific instantaneous mortality rates were estimated by log-linear regression for each season. Age specific mortality rates were estimated similarly after adjusting for length-class duration using a Gompertz growth model based on otolith daily growth increments. The mortality curve also provides a series of initial larval abundance estimates by extrapolating back to size at hatch.

Mortality rates are being compared within each season and from year to year in relation to: the initial and subsequent abundance of larvae; their spawning time and location; larval size, growth, condition, and prey selection; recruitment; and changes in hydrographic and climatic patterns. The larval herring time series includes a wide range of initial larval abundance estimates, mortality rates, and other conditions in which to examine some of the leading hypotheses controlling larval survival and eventually their recruitment. It appears that high larval survival is associated with the high abundance of their prey, Pseudocalanus minutus. Larval herring prey selection and morphological condition from three contrasting spawning seasons (1974, 1975, and 1976) are being examined in detail. Studies are also in progress on the composition, abundance, and distribution of the total ichthyoplankton and zooplankton from the same series of surveys.

Studies of spatial and temporal patterns of the dominant zooplankton of the VLC's off the northeast U. S. were investigated during 1980 by NMFS staff at Narragansett. Collections were made jointly by scientists and ships of the U. S., Poland, and the USSR during 13 MARMAP surveys of the shelf in 1978 and 1979, from the Gulf of Maine to Cape Hatteras. Distributions of the three dominant copepod species exhibited consistent seasonal patterns of abundance: in the early spring Calanus finmarchicus is the predominant zooplankter in the northern part of the shelf (Gulf of Maine, Georges Bank). It is succeeded later in the year (late-summer and autumn) by Centropages typicus on Georges Bank. In Southern New England the percent of C. finmarchicus dominance is reduced. Early in the year (February-March) Pseudocalanus minutus is the predominant zooplankter; it is succeeded by C. typicus later in the year. Dominance in the Mid-Atlantic Bight is shared by P. minutus and C. typicus in winter-spring. By summer C. typicus succeeds P. minutus in dominance. Changes in copepod densities appear related by hydrographic fronts off the Chesapeake, Delaware, and Hudson estuaries, around the periphery of Georges Bank, and in the Nantucket Shoals-Rhode Island Sound areas. Based on the demographic patterns of abundance of the zooplankton, the important predator-prey relationships to be considered in relation to growth and survival of larval fish are: herring and P. minutus in the Gulf of Maine in autumn; cod and haddock with C. finmarchicus on Georges Bank in spring; mackerel, silver hake, and Urophycis spp. with C. typicus in summer; and herring with

P. minutus in autumn in Southern New England; and bluefish with C. typicus in the Mid-Atlantic Bight during summer.

Experimental studies by NMFS staff at Narragansett included a preliminary study of the effects of water temperature on the timing of yolk absorption and first feeding in haddock and winter flounder larvae was completed along with studies of the effects of water temperature on the relationship between RNA-DNA ratio and growth rate in haddock, winter flounder and summer flounder larvae. RNA-DNA ratio was found to be a good estimator of growth rate in these species. A study of the effects of existing contaminant burdens on the viability of striped bass eggs and larvae from selected east coast river systems was undertaken in cooperation with the U. S. Fish and Wildlife Service, Columbia National Laboratory.

In the first year of the proposed three year study larvae from females taken from five river systems were reared in "clean" water at the Narragansett Laboratory. Growth and daily mortality was monitored together with selected classes of biochemicals including RNA and DNA. Analysis of tissue contaminants is being conducted at the Columbia Laboratory. A nitrogen budget for larval summer flounder was estimated using measurements of growth rate, and ammonia and primary amine excretion. The budget includes an estimate of the daily cycle of nitrogen excretion and allows the estimation of the changes in daily ration and growth efficiency with growth and development during the larval stage.

Ecosystem dynamics and food chain investigations were conducted by the NMFS staff at Woods Hole. Refinements were made in the energy budget for Georges Bank. Standing crop estimates of macrozooplankton were used in place of theoretical food web calculations for deriving minimum estimates of zooplankton production. The zooplankton production estimate for Georges Bank was only about twice that for the North Sea on a per unit area basis, whereas primary production is on the order of at least 4 times as high on Georges Bank compared with the North Sea. Since pelagic fish production per m^2 is lower on Georges Bank than the North Sea, there appears to be a large discrepancy in the energy flow between the two seas. Comparisons with the Nova Scotian Shelf also show an apparent deficit in pelagic fish production compared with the North Sea but the difference is small relative to that for Georges Bank. Studies will continue in an effort to distinguish between errors of estimation and possible fundamental differences among these ecosystems.

Work continued on refining estimates of prey selection and food consumption in fishes. Several reports were completed describing predator-prey relationships for major demersal species (15 Gadiformes and 8 Pleuronectiformes), and were summarized in a number of documents presented at the 1980 ICES meeting. Experimental laboratory studies on digestion rates of several species of demersal fish also were initiated in Woods Hole.

Larval fish research continued at the Beaufort Laboratory, Southeast Fisheries Center of the National Marine Fisheries Service in 1980 with both field studies and laboratory experiments on the growth and survival of Leiostomus xanthurus (spot), Micropogonias undulatus (Atlantic croaker), Brevoortia tyrannus (Atlantic menhaden), and B. patronus (Gulf menhaden). Field studies were conducted off the North Carolina coast and in the northeastern Gulf of Mexico. The North Carolina cruises, conducted during the winter, collected specimens for age and growth, distribution, and predation effects analyses. Larval ages were determined for spot and croaker using otoliths and were used to calculate age an entry into the estuary. Chaetognaths associated with ichthyoplankton collections are being sorted and identified and their role as larval fish predators examined. In the Gulf of Mexico, sampling and analyses were directed to evaluate the impact of pollutants in the Mississippi River plume on fish larvae and their food supply. Using a multiple opening and closing net system (MOCNESS), larvae and zooplankton were sampled at several depths both day and night. Fish were taken to determine food preference and age. The study objective is to identify and describe the potential pathways of energy transfer and the effects of pollutants on the food web which supports larval croaker and menhaden, two species of prime importance in the northern Gulf. This research in the Gulf of Mexico on larval fish, their food and trace metal effects is being conducted cooperatively with scientists from NOAA's Atlantic Oceanographic and Meteorological Laboratory in Miami, Florida. Laboratory studies complementary to the above field work continued describing morphological indicators of starvation for spot and Atlantic menhaden, two species we routinely spawn in the laboratory. In-situ experiments with Atlantic menhaden larvae held in an enclosure were initiated to determine growth rates under natural conditions of known age and size fish larvae.

During 1980 the Miami Laboratory, Southeast Fisheries Center of the National Marine Fisheries Service conducted a biological oceanographic cruise in the Gulf of Mexico in February and March. The cruise covered the entire Gulf with the chief purpose being an ichthyoplankton survey. The samples collected from this survey have been sorted and identifications will be completed in 1981. In addition to the survey, a study of the abundance and distribution of phytoplankton productivity was done under contract by researchers of Texas A&M University. The results obtained showed that chlorophyll a values (used as a measure of phytoplankton standing crop) averaged 0.172 mg/m^3 (st. dev. + 0.786) for surface samples (n = 247). Integrated chlorophyll values (in the water columns studied at the eight stations occupied) averaged 15.19 mg/m^2. Chlorophyll a maximum was found to correspond to about 10% to 20% of surface light level. Following the chlorophyll a maximum, there was a general decrease in this algal pigment. Substantial amounts of chlorophyll a were found below the euphotic zone at all the stations occupied. The phaeopigments showed more or less similar distribution to that of chlorophyll a. Phaeopigments maximum layer either coincided with chlorophyll maximum or was located at deeper depths (by about 10 to 20 m). Primary production averaged 34.41 mg C/m^3 day for surface samples and 1.11 g C/m^2/day for integrated values. Except for the relatively high primary production data during this winter cruise, most of the phyto-

plankton standing crop, nutrient salts, gelbstoff and suspended particles showed the kind of distribution and concentrations one would normally expect to find in oligotrophic tropical/subtropical oceanic waters. Ultimately the results of this work will be used to analyze the relationship between the distribution and concentration of phytoplankton and ichthyoplankton.

Plankton Ecology Investigation

At Woods Hole Oceanographic Institution studies on dormancy in copepods has demonstrated that photoperiod is the primary factor influencing the formation of diapause egg production by Labidocera aestiva. It appears that the expression and timing of diapause differs between populations of this species from different latitudes. In situ methods have been developed for estimation of grazing rates of salps and estimates have been made of growth rates and fecal pellet production. Systematic and distribution studies of oceanic ctenophores continue as well as examination of the interaction between hyperiid amphipods and gelatinous organisms. The behavioral and physiological responses of selected copepod species to their food supply is being investigated. These studies include: 1) behavioral analyses of the allocation of time by copepods during the various stages of the feeding process (using video tape analysis), 2) comparisons of behavior under various food regimes, and 3) assessment of feeding rates and egg production rates for copepods in North Atlantic Slope Water and Gulf Stream Warm Core Rings. Experiments on the interaction between microzooplankton and phytoplankton have shown that the tintinnid Favella is a selective predator on dinoflagellates and field studies have demonstrated that it co-occurs with blooms of dinoflagellates. Research on toxic dinoflagellates in Southern New England has focused on mechanisms underlying the apparent geographic dispersal of the causative organism Gonyaulax tamarensis. These studies included surveys for the resting cysts of this organism throughout the estuaries and coastal waters of the region, assessment of vertical migration patterns during different stages of a toxic bloom, detailed examination of the triggering factors for sexual reproduction leading to cyst formation, and quantitative surveys of the dynamics of cyst deposition, burial, and germination throughout a bloom cycle.

Cooperative work between Rutgers University, Bigelow Laboratory of Marine Science and Woods Hole Oceanographic Institution concerning experiments on iron metabolism of coastal and offshore phytoplankton is underway. To date, with only one exception all clones from oceanic waters have proved to have such a low Fe requirement that they will at least survive in Sargasso Sea water enriched with nitrate, phosphate, and silicate having a total Fe content of only $c < 10^{-8}$M. The one exception is the red-colored blue-green Synochococcus sp., which behaves much more, in its Fe requirement, like a coastal alga. Most coastal algae die unless 10^{-7}M Fe or more is available. In particular, all the coastal and oceanic clones of Thalassiosira pseudonana fit this pattern. Experimental work is also being carried out on the copper response of Fe-limited Thalassiosira pseudonana clones. Contrary to expectations, the oceanic clones, when sufficiently deprived of iron, were exceedingly sensitive to pCu; they died at copper ion activities that are non-toxic to Fe-sufficient cells. The coastal clones did not show this alteration of copper response when Fe-starved, though the effect of Fe-starvation was more marked, in the sense of being much more easily attained.

Plankton investigations at the Graduate School of Oceanography include work on bacterioplankton, phytoplankton, and zooplankton. The biomass and division rates of bacterioplankton has been measured at sea, in Narragansett Bay and at the Marine Ecosystems Research Laboratory. The relationship of bacterial biomass and division rates to the production of dissolved and particulate carbon, and to the grazing rates of ciliates and flagellates is being studied. Work on phytoplankton community succession in Narragansett Bay has continued a 19-year tradition of a weekly sampling program. This has been combined with laboratory studies and computer models to analyze reasons for observed seasonal cycles. Growth rates of dinoflagellates at sea and in Narragansett Bay have continued with emphasis on the New England red tide dinoflagellate, Gonyaulax tamarensis and on oceanic species in the genus Ceratium and Pyrocystis. Investigations of in situ growth rates, bioluminescence, phosphate and nitrogen kinetics, vitamin requirements, dinoflagellate toxins, and heterotrophic capabilities have been carried out. Studies of the biology of diatom resting spores has continued. The relationships between the plankton cycles and the benthic recycling of nutrients has continued at the Marine Ecosystems Research Laboratory, along with studies of how pollutants change the pelagic community species composition. The bioluminescence of oceanic zooplankton has been examined, with emphasis on larvaceans, tunicates and ostracods. An analyses of copepod swimming rates and characteristic patterns of movement during grazing are being related to pollutant concentrations. The distributions of benthopelagic zooplankton in the deep sea are under investigation.

Plankton research at the Marine Sciences Research Center, State University of New York (Stony Brook) includes studies on the biology of small (approximately 3 μm) chlorophytes in a eutrophic estuary on the south shore of Long Island and investigation of the nitrogen cycle and tidal mixing of the estuary.

Plankton research at Lamont-Doherty Geological Observatory includes observations of chlorophyll a and physical parameters at the shelf edge front in the Middle Atlantic Bight. Data are being analyzed to establish the degree to which physical phenomena at fronts control the distribution of phytoplankton. A project was initiated to study the physiological ecology and life history of radiolarians in the N.W. Atlantic. A separate project will characterize the bentho-pelagic zooplankton communities of selected submarine canyons off the eastern seaboard, and compare these communities to those found over the adjacent continental slope. In continental shelf studies, emphasis is on the examination of the fate of primary production and the implications grazing and particle decomposition have for overall transport and transfer rates of particulate matter. Microbiological research is concentrated on documenting bacterial abundance, biomass and production in estuaries, river plumes and the continental shelf of the Middle Atlantic Bight. Emphasis is on specifying relative distributions of free vs attached bacterial cells and their respective activities.

Plankton research at the Skidaway Institute of Oceanography is oriented towards understanding how biological processes are related to physical and chemical processes on the southeastern shelf of the U.S.A. Thus, a large-scale study with 2 vessels was carried out in April 1980 to describe how plankton abundance and productivity is related to hydrographic parameters on the shelf and the shelf-break where episodically upwelling occurs. A study on the

relationship between chlorophyll and fish larval abundance on the S. E. Shelf is initiated this spring. High concentrations of fish larvae have been observed on the outer shelf and the shelf-break which are regions of high primary productivity due to upwellings. The relation of food size and abundance vs. food intake by nauplii, copepodids and adults of abundant copepod species is studied simulating summer intrusion conditions on the S. E. Shelf. A model has been developed that describes the flux of fecal pellets from a copepod assemblage as this develops on the S. E. Shelf. Cinematographic studies of feeding behavior of copepods complement feeding experiments.

Plankton research at the Rosenstiel School of Marine and Atmospheric Sciences continues along the same lines as last year. It 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.

Benthic Studies in the NW Atlantic off the U.S. Coast

John B. Pearce

During the past 12 months the NMFS/Ocean Pulse and NOAA/Northeast Monitoring Programs have conducted extensive cruises to establish, in part, benchmarks for biological effects assessment. For the first time synoptic measurements of benthic community structure have been made at locations along the entire U.S. eastern seaboard. Stations are located in relatively pristine habitats such as Pigeon Hill in the Gulf of Maine and at Georges Bank; while other benthic sampling stations have been located along gradients of pollutants emanating from industrialized or developed areas such as Portland Harbor (Maine), the Hudson-Raritan estuary, Delaware Bay, and Chesapeake Bay. At the same time as information on benthic communities was being developed we also worked with academic personnel to collect a variety of environmental samples and data useful in establishing the relative degree of contamination within the particular habitats. The following is a breakdown of our research findings by area.

New York Bight: The New York Bight (NYB), and especially the NYB apex, has long been documented as a contaminated area. The apex has the greatest inputs of contaminants of any open coastal area of the northeast U.S. shelf and perhaps of any similar area in the world. Biological effects studies indicated impacts of this gross contamination, at both population and community levels. According to several indices, benthic macrofauna community structure in the apex of the New York Bight, especially near the dumpsites, has been altered relative to other portions of the shelf. Numbers of species of benthic macrofauna per unit

area of seabed (species richness) provided one index of change due to environmental quality. This is among the most stable variables under natural conditions and is often reduced by physical and chemical stress. Relatively low numbers (~30) in the region-wide surveys are characteristic of most shallow and Georges Bank stations; stresses such as wide temperature fluctuations (at the inshore stations) or coarse, shifting sediments probably prevent establishment of populations of many benthic species. In areas of stable sediments, only four stations averaged fewer than 30 species. Low number of species at NYB apex sites were due, in part, to dumping activities and contaminants flowing out of the Hudson-Raritan estuary. Comparison of 1978-1980 data on NYB apex sites with 1973-1974 information for the same sites indicated no conspicuous temporal change in environmental quality.

Data on populations of amphipod crustaceans also point to the effects of contaminants of New York Bight benthos. Ampeliscids, and amphipods in general, were rare or absent in the NYB apex sampling and monitoring; those which were present, such as Uniciola irrorata, are often recognized as tolerant of a wide range of ecological conditions. Dense populations of Ampelisca agassizi appear approximately 90 km down the Hudson Shelf Valley implying that significant contaminant effects have not yet extended this far from the head of the valley. Data indicate that amphipod densities at New Jersey inner shelf stations are consistently lower than at control stations off Long Island. While the latter is in a physically similar environment it is influenced less by contaminants from the apex dumpsites and Hudson-Raritan plume. It is important to note that surf clam spatfall follows a similar pattern, with higher settlement densities seen off western Long Island than off northern New Jersey.

Recovery of benthic macrofauna has been monitored following a hypoxia-related dieoff along the New Jersey coast in 1976. Amphipods, and several other orders of crustacea which brood small numbers of young (and thus have limited dispersal ability), recolonized the affected area very slowly.

Outside the New York Bight Areas: Contaminant related effects on benthic macrofauna community structure have been noted in several areas outside the NYB. Portland Harbor (Maine) was reported by Bigelow Laboratory scientists to be impacted, based on the low numbers of species and altered faunal composition found there. Particulary affected were areas downstream from a pulp mill, which had the highest organic carbon loading (39%) reported, and was almost abiotic. A domestic waste dumpsite in the area, with high carbon content (15%), did not show similar changes. Offshore Casco Bay sites were rich in species and probably had not undergone significant degradation.

At the Massachusetts Bay site off Boston, faunal biomass was observed dominated by polychaetes; this is the only soft-substrate station, aside from the New York Bight dumpsites, where such predominance, possibly stress-related, was found.

In the Delaware Bay area, stations inside the bay and 8 km south of the bay mouth (the direction usually followed by the bay's plume) are being studied by biologists of the University of Delaware and were reported dominated by the bivalve Tellina agilis and polychaete Mediomastus ambiseta, both of which are often found in polluted environments. Contaminant buildup and associated changes in benthic community structure have been recorded in swales in the vicinity of the Philadelphia industrial waste and sewage sludge dumpsites, located approximately 72 km off Delaware by EPA and NOAA personnel. There was also a possible indication of recent mortalities of the ocean quahog, Arctica islandica, associated with disposal activities. Since these dumpsites have been restricted recently to dumping, they provide an opportunity to determine rates of recovery following pollution abatement.

Recent benthic studies have uncovered no other significant examples of spatial or temporal trends in numbers of species, species composition or amphipod populations that are suspected of being contaminant related. Low numbers of species and few

amphipods were found in the "Mud Patch" south of Nantucket and at several Casco Bay stations, but in these instances it is likely that extremely fine sediments accounted for the observed community structure. Benthic macrofauna data from coastal and shelf sites are valuable in establishing benchmarks against which to measure future changes due to natural variability, catastrophic events and pollution. Benchmark sampling and monitoring since 1974 in the Baltimore Canyon trough, a petroleum development area off New Jersey, will permit detection of effects there. At least 2 years of benchmark benthic data on the proposed offshore Norfolk (Virginia) dredge material disposal site will be available before any of the proposed dredge material dumping occurs at that site. Six years of data on the sensitive and trophically important ampeliscid amphipods afford a specialized tool for detection of impacts at the Casco Bay, Georges Bank, Block Island Sound, Hudson Shelf Valley, Baltimore Canyon trough, and Philadelphia and Norfolk dumpsites.

Benthic microbiology involved the use of certain bacteria to indicate fecal contamination of sediments and thus the possibility of pathogen effects on living resources. Confirmed E. coli were detected at 9 of 44 stations in the New York Bight and Long Island Sound during our summer 1980 cruises. Significant concentrations were found only at the New York dumpsites. On the other hand, Clostridium perfringens, a human pathogen, was detected in sediments with concentrations up to 10^5-10^6 colonies per gram of sediment, not only at the New York sewage sludge dumpsite but also at stations south and west of the dumpsite. Other elevated counts were observed at stations off New Hampshire, presumed to be uncontaminated, and to a lesser extent off Chesapeake Bay, Delaware Bay, and Rhode Island; the values were three or four orders of magnitude lower than those found in the New York Bight.

In addition to the work with benthic communities per se, various benthic biologists currently monitor a standard suite of measurements for sediment quality. These include bacterial and viral indicators, trace metals (cadmium, chromium, copper, nickel, mercury, lead, and zinc), total organic carbon (TOC), total organic nitrogen (TON), grain size, coprostonol, polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PNAHs), and seabed respiration.

Evidence of sediment contamination based upon trace metal levels generally indicates higher than ambient values in three areas, the New York Bight apex, the mud patch southwest of Nantucket Island, and a site east of Cape Cod. Based upon the data collected during 1980, levels of cadmium were approximately 4 ppm in the New York Bight apex versus less than .3 ppm throughout the remainder of the OP area. Chromium levels were nearly 130 ppm in the apex versus 10 ppm or less elsewhere except in the mud patch where levels of 20 ppm were found. Copper was high in the inner New York Bight (111 ppm) with significantly lower levels at other stations.

The highest levels for nickel were found off Portland (Maine) harbor entrance, with the next highest levels in the New York Bight apex. High concentrations were also found at the dredge disposal in the New York Bight apex; in Portland Harbor; Jeffrey's Ledge; Massachusetts Bay; Buzzards Bay; and the station south of Nantucket Island. Zinc levels were found to be exceedingly high, above 200 ppm, in the New York Bight apex relative to the remainder of the shelf. Elevated zinc levels, but less than that measured in the apex, were found at Portland Harbor, Buzzards Bay, south of Nantucket Island, and at one station near the mouth of Delaware Bay. Data from stations extending down the Hudson Shelf Valley from the Bight apex indicate a gradient in trace metal levels from the apex to the canyon mouth at the edge of the shelf. Sediments on Georges Bank contain relatively low concentrations of all metals sampled.

Total organic carbon (TOC) in sediments was highest in the Christiaensen Basin of the New York Bight apex; which includes the sewage and dredge spoil dumpsites;

values are in the range of 1-2 percent (dry weight), approximately an order of magnitude higher than values in uncontaminated sediments.

Seabed oxygen consumption and ammonium flux measurements indicate organic loading to the seabed and may be used to identify areas of organic loading. Organic loading and concomitant oxygen consumption influenced dissolved oxygen concentrations in bottom waters. Such measurements were made on approximately a quarterly basis for 6 years at stations in the New York Bight. The dredged material and sewage sludge dumpsites have shown very high oxygen consumption values, up to 40 or more ml O_2/m^2-hr. Respiration at other sites in the Bight and over the northeastern shelf are generally less than half that rate. There were no sampling sites that show a uniformly low respiration, except one location in the northeast region of Georges Bank, a coarse, gravelly habitat. Temporal variation in seabed respiration existed at all sampling sites. There was no clear seasonal trend, nor was there evidence of a year-to-year increase or decline in respiration at a given site.

Ammonium-nitrogen flux from the seabed was measured at stations throughout the shelf area in September 1980. Again, the New York Bight dumpsites show values one to three orders of magnitude higher than values elsewhere; one exception is in the mouth of the Delaware Bay, where values of 300-400 u mole NH_3/m^2-hr are comparable to the New York dumpsite values. Ammonium fluxes at several inshore stations south of Cape Cod (Buzzards Bay, Narragansett Bay Mouth, and Block Island Sound) are in the range of 40-70 u mole NH_3/m^2-hr.

Polychlorinated biphenyls (PCBs) in sediments were measured at 40 stations in the Middle Atlantic Bight, and ranged from not detectable to 160 ppm. Maximum concentrations are centered south and west of the New York Bight apex sewage sludge and dredge spoils dumpsites and quickly fall to undetectable levels within 34 km seaward of those sites. PCB levels of 0.2 to 35 ppm have also been reported in the sediments of Buzzards Bay, affected by industrial wastes from New Bedford, Massachusetts.

Corprostanol (a fecal steroid) in sediments was determined for the New York Bight stations. This variable ranged from 11 ppm, at the sewage sludge dumpsite, to undetectable levels offshore. However, this variable is dissimilar in distributional behavior to PCBs in that its distribution extended to the south and east of the site. The distribution of the coprostanol/total steroids ration indicates that the only region where sewage sludge contributes significantly to the sediment-organic load is in the vicinity of the dumpsite itself. The coprostanol/PCB ratio indicates that sediment PCB's are derived from sewage at the sewage dumpsite and adjacent areas to the south and east; whereas PCB's are derived from dredge spoils at the dredge spoil site and adjacent areas.

Polynuclear aromatic hydrocarbons (PAH) concentration distribution in sediments were patchy in the inner New York Bight, and decreased on either side of the Bight apex and along the Hudson Shelf Valley, with values ranging from not detectable to 2000 ppb.

The Marine Ecosystems Research Laboratory (MERL) of the University of Rhode Island, researches marine benthic ecosystems in microcosm tanks (2 m in diameter and 5 m high) and the effects of various toxic chemicals and other perturbations in these systems. The research is funded by the U.S. Environmental Protection Agency.

Results from operations through three annual cycles demonstrates that in both chemical and biological composition and chemical and biological processes and annual cycling, the systems behaved in ways similar to comparable regions in Narragansett Bay, Rhode Island.

A major benthic sediment gradient experiment was conducted during the past year in the nine regular tanks. Three sediment trays were filled with Providence River sediments, three from our traditional site north of Jamestown and three

from Rhode Island Sound. This experiment has the practical aims of observing recovery from sewage stress and also the possible effects of dredge spoil disposal on the overlying water column.

Several tracer experiments were conducted in single tanks with radiolabeled metals to provide information on their behavior and to measure particle flux to the sediment and back diffusion of dissolved forms. In addition, experiments were conducted with ^{14}C labeled organic compounds (dimethylbenzanthracene, pentachlorophenol) and their behavior and degradation rates traced through several compartments of the ecosystem. Also, short chain volatile organic compounds (SO) were spiked into individual tanks and their disappearance and degradation monitored.

U.S.S.R.

(A.A. Nejman & V.M. Ryzhov)

To determine the feeding conditions for commercial fish, an assessment of winter euphausiid stocks in the Barents Sea was undertaken in 1980. The development of zooplankton was studied of zooplankton collected in the spring-summer period on the spawning grounds and drift routes of fish larvae in the areas off the north-eastern coast of Norway and in the south-western Barent Sea. The plankton investigations in the Norwegian Sea in June 1975-1980 were generalised and the most productive areas were identified as follows : the degree of dependence of the development of the main species of phytoplankton on the supply with biogenous elements, thermocline height and the depth of the layer of rapid density gradient was found; thecharacterisitcs of the deepwater shrimp larvae distribution was determined, and the species cimposition of blue whiting food and its fattening features in different areas of the Norwegian Sea were determined. The feeding and biological indices of capelin and its nutritive base in winter and summer in the eastern areas of the Barents Sea were investigated.

235 phytoplankton samples were collected, 1 800 zooplankton samples, 431 euphausid samples taken by trawl-attached net, 2500 deepwater shrimp larvae were identified and measured, quantitative analysis of the feeding of 600 capelin, and field analysis of the feeding of 29 000 blue whiting were carried out.

On the basis of the joint phyto- and zooplankton collections, the factors determining the intensity of zooplankton development in the biological spring were revealed by means of statistical methods (factor analysis). The abundance of all phytoplankton in the 20-0 and 50-0 m layers and the number of algae cells of average volumes (5 000-10 000/m^3) the rate of competition for food of Calanoida with other zooplankters Oikopleura sp., Calyptopis, Furcilia and Euphausiacea.

In 1981 the plankton investigations in the Barents and Norwegian Seas will be continued in accordance with the same programme.

Food supply of fish in the Baltic Sea

Zooplankton

Seasonal surveys in the Baltic Sea were conducted in February, May, August and October-November on standard stations (areas 25, 26, 28, 29). 146 samples were taken. In the Gulf of Riga, samples were taken monthly from April to November. On standard stations samples were taken 3 - 5 times a month, in all, 319 samples.

In the Gulf of Finland seasonal surveys were conducted in May, August and October-November on standard stations. In the open Baltic Sea and the Gulf of Riga, 101 samples for the study of the content of toxicants in plankton were taken. Samples were taken with the Juday net 37/50 with a mesh size of the filtering cone of 0.09-0.16 mm.

Nektobenthos (mysids)

In the Baltic Sea (areas 26-28) samples were taken in January, April, June, July and September on standard sections by a 10 feet Isaaks-Kidd trawl. The fishing was done at night by the step method. 121 samples were taken. In the Gulf of Riga, samples were collected by seasons. On standard sections they were taken three times a month from April to November by Rass trawl. 45 samples were collected. In the Gulf of Riga, 15 samples were taken in the coastal areas.

Zoobenthos

Samples were collected in several areas of the Gulfs of Riga and Finland. 35 samples were taken by Van-Veen bottom dredge.

Sprat and herring feeding

Samples were taken from trawl catches in January, March-May and July in areas 26 and 28. In area 28, 465 stomachs of herring and 120 of sprat were collected, and in the area 26, 490 and 200 stomachs respectively.
