

International Council for the Exploration of the Sea

REPORT OF ACTIVITIES
BIOLOGICAL OCEANOGRAPHY COMMITTEE

K. SHERMAN

1983



Belgium

(R. De Clerck and Ph. Polk)

Laboratory of Ecology and Systematics, V.U.B., Brussels

Zooplankton Research (Daro, H. H.)

This research is a part of a general research program on the functioning of marine ecosystems. Comparisons are made among different ecosystems of the Channel and the North Sea (English and Belgian coast, southern Bight, Northern North Sea). Special attention is given to the role of grazing in these systems. Shipboard experiments were carried out and we found that the deeper and more stratified the water column is, the more important the role of zooplankton by its grazing activity is. The vertical distribution and day/night vertical migration of zooplankton seems to also play a role in the grazing pressure on the phytoplankton. Practical applications of this research are found in our study on the transfer of heavy metals and PCB's through the first levels of the food chain: in shallow water contaminants are more frequently attached to the particulate matter (organic or net) where phytoplankton is the most important carrier. In deep ecosystems phytoplankton pass through zooplankton and contaminants will reach the bottom in the form of fecal material.

Studies of the geographical distribution of coastal and pelagic fish larvae and eggs as well as their feeding behaviour and diet (by stomach analyses) are also a part of the zooplankton section.

Copepod Population Dynamics (Bergmans, M.)

Monitoring of the population dynamics of a guild of epibenthic copepods (Tisbe) has been carried out in the field and is being related to laboratory studies of the life cycle. Special attention is given to the following aspects: (i) knowledge of the reproduction performance in an

"ecological vacuum" (yielding null hypotheses on growth rates and age distribution in the field by excluding competition and predation effects); (ii) the possibility of adaptive fine-tuning of the life cycle (including effects on "r" and the "net reproductive rate") as a function of demographic conditions, i.e. in expanding, stable and declining populations.

Non-Living Particular Organic Matter (Pissierssens, P.)

Little is known about the role of Non-Living Particular Organic Matter (also called detritus) in the Food Mass of marine copepods. Therefore, our research is concentrated on three aspects:

- 1) Study of the NLPOM distribution in the Belgian Coastal Zone (Time, Space).
- 2) Estimation of the contribution of the NLPOM to the total Food Mass of marine copepods.
- 3) Study of the origin and composition of the NLPOM.

Primary Production (Joiris, C. and A. Bertels)

- 1) Incubation under fluctuating light conditions, in order to obtain a better evaluation of the real in situ net production.
- 2) Determination of phytoplanktonic respiration; in order to determine its relative role in total planktonic respiration.

Ecotoxicological Marine Research (Joiris, C., K. Delbeke and W. Overloop)

- 1) Estimation of transfer and biomagnification mechanisms of organochlorine residues and mercury in marine ecosystems (TPM, zooplankton, fish, birds, sediments) and integrating the results on contamination to biological activities (C. cyclus).
- 2) Comparison of the contamination level of coastal ecosystem with the Atlantic ecosystem.
- 3) Estimation of the evolution of the mercury contamination by analyses of seabird feathers.

Studies are also underway by M. Bossicart on The influence of temperature on the biological compartments in the sea, and by C. Joiris on The quantitative distribution of seabirds in relation to oceanological and ecological parameters.

Canada

(A. R. Longhurst)

The following is a brief summary of some of the relevant activities in Canada; for further details, please consult the individuals named in each section.

DEPARTMENT OF FISHERIES AND OCEANS

Marine Ecology Laboratory, Bedford Institute of Oceanography, P. O. Box 1006, Dartmouth, Nova Scotia, B2Y 4A2
(Dr. K. H. Mann, Director)

The Marine Ecology Laboratory has been involved in a number of major oceanographic cruises this year including studies in the oligotrophic Atlantic off Bermuda, the Scotian Shelf and the Eastern Canadian Arctic. These cruises have continued to add to the laboratory's archives of comparative data on primary and secondary production processes in diverse marine environments and have contributed substantially to our understanding of how environment is involved in the regulation of these processes. Experiments carried out during the Bermuda and Eastern Arctic cruises, for example, were designed specifically to determine the importance of light and temperature fluctuations in the vertical distribution and level of primary production in these physically contrasting environments. Emphasis has also continued to be placed on the influence of turbulence on primary production. Detailed vertical measurements of turbulence during these cruises using the Atlantic Oceanographic Laboratory-designed OCTUPROBE has proven most valuable for this work.

Another theme which has continued to carry much emphasis this year has been the distribution and significance of picoplankton to total primary productivity. One major objective of both the Bermuda and Arctic cruises was in fact to document the existence and quantitative significance of picoplankton. The laboratory's previous studies in tropical waters, for example, have shown that picoplankton are abundant and account for more than half the total productivity. It has been speculated, however, that their significance in polar waters should be negligible. Preliminary analysis from this year's arctic work shows this not to be the case. Although not as important as in temperate and tropical waters, picoplankton accounted for 10-30% of the arctic phytoplankton biomass and production.

Plankton studies in polar waters has expanded this year to include a comprehensive and collaborative (Winnipeg) study of epontic and pelagic plankton distribution and production at the Bayfield Laboratory near Resolute. These studies are designed principally to investigate plankton dynamics during the winter/spring non-navigable season in the Arctic. There is considerable evidence now that plankton production occurring before summer ice break-up may be critical for the long-term stability of the plankton and higher

trophic levels there. Marine Ecology Laboratory scientists also participated in the CESAR project on the Arctic Basin ice cap. Samples were collected for the analysis of the vertical distribution of plankton, particulate and dissolved organic matter and nutrients.

Much of the work on the Scotian Shelf reflected the increased activity of the Southwest Nova Scotia Fisheries Ecology Program in collaboration with scientists from the Marine Fish Division and Dalhousie University. Work with the ECOLOG acoustic fish detection device continued; intercalibration tests with net hauls were very successful. Studies of the fine scale distribution and survival of larval fish were also begun by the laboratory's newly-acquired fisheries ecologist. Cruise work for the Scotian Shelf Ichthyoplankton Program has ended but data analysis and archiving continue.

The Deep Ocean Ecology Program has continued to develop this year. Progress has been made in constructing new field sampling gear and in establishing laboratory facilities for specialized analysis of radionuclides. Cruise work involved gear testing, deployment and recovery of baited traps for bathypelagic and benthic amphipod studies and benthic sediment collections. Dialysis probe methods to study the diffusion of metals and radionuclides have been applied to inshore sediments; these techniques have demonstrated the role of microbiological (as opposed to abiotic) processes in controlling radionuclide diffusion in such sediments. These methods, and the equipment required for them, are being adapted for work in deep ocean sediments in a cruise planned in late 1984.

Centre Champlain des Sciences de la Mer, P. O. Box 500, Québec, Québec, G1K 7Y7

(Dr. J. Piuze, Directeur)

Au laboratoire du Centre Champlain des Sciences de la Mer, les travaux se sont poursuivis pour étudier la production et l'écophysiologie du phytoplancton en milieu estuarien. En particulier, une nouvelle méthode a été développée pour mesurer en continu certaines caractéristiques de la photosynthèse du phytoplancton à l'aide de mesures fluorimétriques. Cette méthode mesure en fait une caractéristique sur la courbe d'induction de la fluorescence qui est ensuite comparée à divers paramètres photosynthétiques dérivés des courbes de lumière-photosynthèse obtenues par incubation du phytoplancton à diverses intensités lumineuses. Dans la même veine, deux croisières dans l'estuaire et le golfe du Saint-Laurent ont été réalisées dans le but d'étudier l'influence du mélange vertical sur la productivité phytoplanctonique. Les travaux pour étudier la répartition spatiale et temporelle de la productivité hétérotrophique dans l'estuaire du Saint-Laurent et pour étudier la croissance et la physiologie de la microflore dans la glace de la Baie d'Hudson se sont également poursuivis. Des mesures acoustiques pour déterminer les facteurs qui sont responsables de la répartition des euphausiides dans l'estuaire du Saint-Laurent ont aussi été effectuées. On a étudié, en particulier, les facteurs qui contrôlent la formation et le maintien des aggrégations d'euphausiides dans ce milieu estuarien.

Finalement, une étude a débuté visant à examiner l'influence du phytoplancton sur le déclenchement de la ponte de certains invertébrés dans l'estuaire et le golfe du Saint-Laurent.

Marine Fish Division, Fisheries Research Branch, P. O. Box 550, Halifax, Nova Scotia, B3J 2S7
(Dr. J. E. Stewart, Director)
The Southwest Nova Scotia Fisheries Ecology Program completed its first field season of ten research cruises, with participation by the Marine Fish Division, Marine Ecology Laboratory, Atlantic Oceanographic Laboratory and Dalhousie University. The program was initiated by the Division to focus on the biology of haddock stocks in the area (NAFO Division 4X). Results of the first year's work have been summarized and documented in the Steering Committee Report No. 3. Circulation and dispersion studies indicated the presence of a larval retention area on Browns Bank in the form of a gyre which disintegrated several times during the study period. Such events during critical periods in the spawning season may be important in determining larval survival and year-class strength. Larval and juvenile distributions indicated that juveniles immigrate into the area during the pelagic phase by drifting in association with large jellyfish. Ground trawl surveys confirmed the presence of two major haddock concentrations in Division 4X whose relationships will be addressed through tagging and stock discrimination studies during 1984.

Stock discrimination work continued on silver hake, pollock and redfish on the Scotian Shelf with publications produced on the latter two species. For pollock, results suggested that current ideas on stock structure in the area may have to be revised.

Stock assessment methodologies were examined through contributions to a special publication on sampling commercial catches. Topics included methods of exploratory data analysis for commercial catches, variance estimators for length composition samples, and identification of influential variables in yield per recruit analysis.

Data collection for a study on seasonal variation of codworm (*Phocanema decipiens*) in grey seals on Sable Island was completed. Grey seals are the primary host of this parasite, which spends part of its life cycle encysted in the muscle of some commercial fish species where its presence has serious effects on salability. Intensive sampling over the year has provided data on feeding, growth, condition, mortality and migration of seals in the area necessary for population management as well as basic information on the codworm-seal interaction.

Fisheries and Environmental Sciences Division, Fisheries Research Branch, P. O. Box 550, Halifax, Nova Scotia, B3J 2S7
(Dr. J. E. Stewart, Director)
Studies have confirmed that shad stocks in the Bay of Fundy are drawn from populations spawning in all major rivers on the east coast of North America between Florida and Quebec. Population

estimates of shad have been completed in anticipation of a small-scale tidal power plant coming on line in Nova Scotia in 1984 on the Annapolis River. A study of fish migration through the turbine is planned for 1984.

In an attempt to develop a predictive device for forecasting *Gonyaulax* blooms in the Bay of Fundy, an analysis of the inter-relationship between environmental factors and shellfish toxicity for the past forty years is in progress. Despite a limited *Gonyaulax* bloom in 1983, many shellfish areas are still closed to harvesting because of toxin levels somewhat above the safety threshold, due perhaps to the ingestion of toxic, resting cysts of *Gonyaulax*. Experiments using ozonized sea water proved unsuccessful in removing paralytic shellfish toxins from soft-shelled clams. A bloom of *Gyrodinium aureolum* occurred in the Bay of Fundy in 1983. However, unlike the recent situation in Northwestern Europe, fish kills were not associated with the bloom.

Northwest Atlantic Fisheries Center, Fisheries Research Branch,
P. O. Box 5667, St. John's, Newfoundland, A1C 5X1
(Mr. M. C. Mercer, Director)

A cooperative sampling program for the Flemish Cap Project was proposed and carried out by Canada and the USSR during February-April 1983. The purpose was to sample cod spawning distributions, fecundity, changes in maturity and resulting egg and larval concentrations during the spring period on Flemish Cap. These data will be used to assess aspects of stock/recruitment relationships at low stock levels.

Analysis of larval redfish data indicated high larval mortalities during the years 1979 and 1981. These appeared to result from high surface water temperatures, especially during the May-June period, which reduced growth and increased mortality (ICES C.M.1983/G:12). Attempts to identify larval redfish using a variety of morphometric and meristic criteria and Principal Component Analysis indicated no significant differences. These analyses were done on both field-caught and pre-extrusion specimens, with the conclusion that there is at present no reliable technique to distinguish *S. mentella*, *S. fasciatus* or *S. marinus* during the larval stage.

A multidisciplinary study was carried out on the Southeast Shoal, Grand Bank, to examine production, community structure and physical dynamics affecting growth and distribution of yellowtail flounder eggs and larvae. Measurements of primary and secondary production, chlorophyll, nutrients, zooplankton, ichthyoplankton and physical oceanography were done by researchers from a number of laboratories. Analysis of data collected during May 1981 indicated strong physical and biological gradients from the shelf across the shelf break. Of interest was the higher abundance of fish larvae in other than productive waters which had traditional food items.

Several cruises to investigate the distribution and abundance of larval herring and capelin were carried out in Trinity and Fortune Bays, Newfoundland, in 1983. Extensive oceanographic data were

collected which will assist in the interpretation of larval growth and survival as well as the influence of oceanographic conditions on fish distribution. Proposed for 1984, in conjunction with routine surveys, is a physical oceanographic study to measure surface currents as these may affect transport and retention of fish eggs and larvae in Trinity Bay.

A study of physical dynamics in Fortune Bay, a Newfoundland fjord, continued for a third year. Results indicated a variable deep water inflow under the control of surface wind stress, although this varies with season. Offshore (upwelling) winds result in a flux of modified slope water from Hermitage Channel into Fortune Bay. Offshore (downwelling) winds result in an inflow of less dense Labrador Current water from the Avalon-St. Pierre Channel system. Examination of this unusual flux of two independent water sources into Fortune Bay continued through the fall/winter months in 1983/84.

A study of oceanographic currents, as these may affect drift of cod eggs and larvae, in the vicinity of Hamilton Bank, Labrador, was initiated in 1983. Initial results of CTD and current meter data indicate water over the bank is retained throughout the year while the transfer of water between inshore and offshore branches of the Labrador Current are confined to the saddles north and south of the bank.

The Department of Fisheries and Oceans, St. John's, and Memorial University of Newfoundland co-hosted the 46th Annual Meeting of the American Society of Limnology and Oceanography during 13-16 June 1983. The plenary session theme was Fisheries and Oceanography, chaired by Dr. John Steele, WHOI, with over 150 papers in aquatic science being presented during the meeting.

Arctic Biological Station, Fisheries Research Branch, 555 Boulevard Saint-Pierre, Ste. Anne de Bellevue, Quebec, H9X 3R4
(Dr. A. W. Mansfield, Director)

The major field site for biological oceanographic studies was again Frobisher Bay, southeastern Baffin Island. Additional investigations were carried out at Cape Hatt, northern Baffin Island, and in southeastern Hudson Bay, off the mouth of Great Whale River.

Studies in microbiology included work on bacterial production in conjunction with observations on primary production and selected environmental factors, and on effects of oil-dispersant mixtures on bacteria. There are indications that dispersed oil may have increased bacterial activity in bottom sediments.

Studies on detrital fall-out were continued, using specially designed traps. Seasonal trends in the rate of sediment accumulation are becoming apparent, with maximum rate of fall-out occurring in Frobisher Bay in August when about 20-25% of the material is organic in origin.

Studies on photosynthesis in phytoplankton and seaweeds continued. Both groups were found to be considerably lower in lipid than was expected from available information on cold-water forms.

The ice flora and phytoplankton from below the ice were collected from within and just outside the Great Whale River plume in southeastern Hudson Bay as part of a study of the effects of the seasonally varying river plume on the ice biota. Ice fauna and the under-ice zooplankton were considered as part of the same study, in which development of a fresh-water layer under the sea ice of the bay was found to exert a strong influence on the kind and quantity of the fauna associated with the lower surface of the ice.

Physiological investigations on macrozooplankton were continued. A distinct seasonal trend in metabolic rates was shown in the ctenophores, which are among the major predators on zooplankton. This appears to be a food-related condition and not a consequence of seasonal temperature variations. Population levels seem to remain quite stable through the year.

GIROQ (Groupe Interuniversitaire de Recherches Océanographiques du Québec)

Secrétariat, Pavillon Vachon, Université Laval, Ste-Foy, Québec,

G1K 7P4

(Dr. A. Cardinal, Secrétaire général)

Les travaux du GIROQ se sont articulés autour de trois axes principaux, et cette programmation se poursuivra au cours des prochaines années. Ces trois axes correspondent aux intérêts des trois équipes où sont regroupés les chercheurs du GIROQ.

- A. Les processus d'interface en milieu pélagique -- cinq projets se poursuivent dans ce cadre et portent sur les aspects suivants:
 - 1) le contrôle hydrodynamique de la photosynthèse phytoplantonique;
 - 2) la modélisation de la croissance du phytoplancton en fonction de l'hydrodynamique;
 - 3) l'entraînement, le mélange, les processus d'interface et la production des micro-algues sous couvert de glace en milieu côtier;
 - 4) l'utilisation de la fluorimétrie pour l'étude des écosystèmes particuliers aquatiques;
 - 5) l'impact des mouvements verticaux associés aux marées internes sur la dynamique des agrégats de zooplancton.
- B. L'écologie reproductrice des poissons -- six projets se situent dans ce cadre:

- 1) le contrôle environnemental de l'effort reproducteur chez les corégonines anadromes de la Baie de James;
 - 2) le réglage de la dérive larvaire de l'éperlan (Osmerus mordax) dans l'estuaire moyen du Saint-Laurent;
 - 3) la mortalité chez les stades larvaires du capelan (Mallotus villosus): les processus dépendants de la densité et le rôle des prédateurs planctoniques;
 - 4) la description des mécanismes d'apprentissage olfactif responsables de l'identification des rivières natales par le saumon (Salmo salar);
 - 5) description du patron de mortalité durant tout le cycle vital de trois espèces d'épinoches, et évaluation de l'influence de cette mortalité sur la fécondité des géniteurs;
 - 6) la description de la migration vers l'amont des civelles d'anguille (Anguilla rostrata) dans les rivières de la côte nord du golfe du Saint-Laurent.
- C. Le milieu benthique littoral de l'estuaire et du golfe du Saint-Laurent: aspects dynamiques et fonctionnels -- cinq projets s'insèrent dans cette programmation:
- 1) l'hétérogénéité du milieu et la répartition des organismes benthiques intertidaux;
 - 2) influence des écoulements d'eau douce sur la production benthique dans l'estuaire et le golfe du Saint-Laurent;
 - 3) écophysiologie, variations intraspécifiques et utilisation par les herbivores des diatomées marines benthiques de substrats durs;
 - 4) structure des communautés infralittorales du golfe du Saint-Laurent;
 - 5) effets du stress trophique sur les communautés suprabenthiques subpolaires.

McGILL UNIVERSITY

Institute of Oceanography, Redpath Museum, 859 Sherbrooke Street West, Montreal, Quebec, H3A 2K6
(Dr. J. B. Lewis, Director)
Dr. H. Reiswig was engaged in investigations of the glass sponges (Hexactinellida) of the inlet systems in British Columbia. The deeper communities were studied and sampled with the PISCES IV submersible while shallow water populations were worked upon with standard scuba. Tissue samples of eight species were fixed for fine structure analysis by transmission electron microscopy. To date,

inspection of three of these has been completed, with results confirming the unique tissue organization predicted previously for this group of sponges and strengthening the proposed subphylum status for the hexactinellids. Water samples were also collected to determine food resources utilized by these organisms. Analysis of the samples has been completed, and data reduction for manuscript preparation is now in progress.

Dr. J. B. Lewis continued his work on the ecology of tropical fauna of coral reefs. The main emphasis was upon primary production by the zooxanthellae of corals and other coelenterates. Investigation of the Holocene development of coral reefs in Barbados was initiated using ^{14}C dating methods. Analysis of the distribution of benthic fauna in the Gulf of St. Lawrence was continued.

Meiobenthic crustaceans, heretofore thought to be inbenthic species, were shown to migrate into the plankton at night. Planktonic crustaceans and chaetognaths were shown to migrate onto the benthos during daylight hours. Trophic interactions of these coupled benthic-pelagic taxa are now being studied by Dr. B. M. Marcotte. The behavioural ecology of epibenthic copepods was studied. Crowding caused vertical habitat displacement. The causes of fluctuations in marine Phanerozoic diversity were studied using oceanographic, climatological, geological and ecological data. The hypothesis was developed that oceanic turbidity was the motor, plate tectonics the tempo and perception the mode of evolution in Phanerozoic seas. Predictions from the hypothesis were tested using data as disparate as historical patterns in clay mineral deposits, the evolution of plants and especially the evolution of perceptual modalities, habitat preferences and foraging strategies of aquatic arthropods: trilobitomorpha, crustaceans and chelicerates. These predictions were confirmed (Marcotte). The effects of No. 2 Fuel oil on marine meiobenthic copepods were studied in microcosms (Stacey). The seasonal distribution of macrozooplanktonic amphipod crustaceans in the plankton and in sea ice in Frobisher Bay was studied and samples are being analyzed (Shea). The synergistic effects of salinity and a heavy metal effluent on the population growth of marine diatom were quantified. Intermediate concentrations of the heavy metal stimulated cell growth at salinities below 29‰ (Sabatini). Seasonal patterns in the secondary productivity of zooplankton inhabiting the three water masses of the estuary of the St. Lawrence River were quantified and the niche relations of the constituent species and age classes were partially specified (Rainville). The functional morphology of feeding in two congeners of benthic copepods was studied and a systematic hypothesis was developed concerning the familial status of these species. Predictions derived from this hypothesis were tested using museum specimens of related species (Johnson and Marcotte). The hypothesis that the predictability with which a food resource is supplied to a population affects that population's life history was tested on laboratory cultures of an epibenthic copepod species (Tisbe). Some of the predictions deduced from this hypothesis were disproved (Webb).

Dr. M. J. Dunbar reports the following: work continues on analysis of polar marine ecosystems; most recent paper, in press, is on evolutionary aspects of the ecosystems; experimental fishing in the Port Burwell Area, Ungava Bay; acting as consultant to the Makkivik Corporation; study of ice biota (diatoms and associated fauna) in the Gulf of St. Lawrence and in Northern Baffin Island (Eclipse Sound); climatic change in the sea and biological resources; special reference to the capelin (*Mallotus*) in the Barents Sea, and to cod, herring, capelin and others in the Canadian Atlantic and Subarctic region, eastward to Iceland; study of growth and life-cycle in the blue mussel, *Mytilus edulis*, in a raised fjord (Winton Lake) in eastern Baffin Island, an isolated and somewhat special population.

France

N. Lacroix and P. Lassus

Themes de recherches	Laboratoires francais concernes	Liaisons avec autres Laboratoires francais ou etrangers
ETUDES D'OCEANOGRAPHIE BIOLOGIQUES A CARACTERE GENERAL		
<u>Etudes de Synthese</u>		
- Modélisation et simulation expérimentale du réseau trophique planctonique	Station Zoologique Villefranche-sur-Mer durée : 5 ans	Rudger Boscovic Institut Zagreb (Youg.) City College NY (USA)
- Cycle annuel du plancton et des paramètres du milieu en eau côtière et du large et analyse du métabolisme des peuplements	Station Zoologique durée : 3 ans	Programmes FRONTAL et TROPHOS Coopération avec Italie
- Productions et transferts pélagiques dans le Pas-de- Calais	Station Marine de Wimereux Etude pluriannuelle	GRECOMANCHE (France)

Thèmes de recherches	Laboratoires français concernés	Liaisons avec autres Laboratoires français ou étrangers
- Evaluation et optimisation de l'échantillonnage et écologie littorale	Station Marine Etude pluriannuelle	GRECOMANCHE (France)
- Claires ostréicoles : mécanismes de transfert des nutriments (échelons Ier et IIer)	Laboratoire Biologie Marine - Nantes durée : 5 ans	CNRS-CNEXO-ISTPM (France)
- Cycles biologiques et flux énergétiques dans les écosystèmes productifs littoraux	Laboratoire Biologie Marine - Nantes durée : 5 ans	
- Etude régionale intégrée du golfe Normano-Breton (écologie)	Centre National pour l'Exploration des Océans (CNEXO-COB)	Divers labor. (France) et participation CEE
- Automatisation des analyses de pêches zooplanctoniques par analyse d'image	durée : 4 ans	NMFS - Narragansett Laboratory (USA)
- Séquences alimentaires chez le poisson de Mer Celtique	Collège de France Concarneau durée : 5 ans	
- Analyse de la composition spectrale des populations du mesozooplankton	Labor. ARAGO Banyuls	
- Transfert de matière organique entre les zones estuariennes et hauturières	Laboratoire Biologie Marine et Lagunaire Montpellier durée : 4 ans	MNHN Institut Géologie du bassin d'Aquitaine
<u>Etudes Fonctionnelles</u>		
- Etude biochimique du processus de nutrition des organismes planctoniques	Station Zoologique Villefranche-sur-Mer durée : 5 ans	Bedford Institut Dartmouth (Canada)

Thèmes de recherches	Laboratoires français concernés	Liaisons avec autres Laboratoires français ou étrangers
- Rôle des logettes d'appendiculaires dans le transfert de matière dans la mer	Station Zoologique Villefranche-sur-Mer durée : 2 ans	California State University (USA)
- Biologie des Céphalopodes (Embryologie de la Seiche, mécanismes endocrines, Protéines sanguines)	Station Marine de Wimereux Etudes pluriannuelles	Universités d'Anvers (Belgique) et d'Utrecht (Hollande)
- Recherches cytophysiologiques sur la nutrition et la reproduction des copépodes galanoides et harpacticoides	Laboratoire de Biologie Animale - Marseille durée : 2 ans	Laboratoire Hydrobiologie Marine Marseille/Luminy (France)
- Biologie de la reproduction des copépodes planctoniques	Laboratoire ARAGO Banyuls	Station Zoologique de Villefranche (France)
- Métabolisme (colorimétrie et respirométrie) des sédiments lagunaires	Laboratoire Biologie Marine et Lagunaire Montpellier durée : 4 ans	
- Etude de Dinoflagellés toxiques (cultures, toxines et leurs effets)	Laboratoire Biologie Cel. et Végétale Paris VII durée : 5 ans	Institut Mallarmé Tahiti (France) Institut Scientifique et Technique des Pêches Maritimes (I.S.T.P.M.) (France)
- Biochimie et Physiologie de l'acclimatation et de l'adaptation en milieu marin	Collège de France Concarneau durée : 5 ans	Zoologie Universit��t Nijmegen (Hollande) Centre National de la Recherche Scientifique (C.N.R.S.)

Thèmes de recherches	Laboratoires français concernés	Liaisons avec autres Laboratoires français ou étrangers
- Biologie et écologie des Céphalopodes	Laboratoire ARAGO Banyuls	Station Roscoff. Université de Caen (France) Universités de Cambridge (UK), d'Aberdeen (Ecosse) et de Dalhousie-Halifax (Canada)
- Aspects énergétiques et biochimiques comparés chez les algues à fucoxanthine	Laboratoire ARAGO Banyuls pluriannuel	
ECOSYSTEMES PLANCTONIQUES		
- Etude de la production phytoplanktonique du bassin de Marennes-Oléron (zone estuarienne du golfe de Gascogne). Valeur nutritive du milieu pour les mollusques.	Institut Scientifique et Technique des Pêches Maritimes (I.S.T.P.M.) La Tremblade	
- Surveillance de la composition du mesozooplankton en zone côtière. Etude de séries chronologiques pour différents groupes planctoniques.	Station Zoologique Villefranche-sur-Mer	
- Analyse de la participation de différents groupes planctoniques au transfert de matière dans l'écosystème pélagique (bactérioplancton, microplancton, mesozooplankton, macroplancton, méroplancton)	Station Zoologique Villefranche-sur-Mer durée : 5 ans	Bedford Institut Dartmouth (Canada)
- Distribution spatiale des organismes du microzooplankton	Station Zoologique Villefranche-sur-Mer durée : 3 ans	

Thèmes de recherches	Laboratoires français concernés	Liaisons avec autres Laboratoires français ou étrangers
- Etude du rôle du macroplankton gelatineux dans l'écosystème pélagique de la mer de Ligurie	Station Zoologique Villefranche-sur-Mer durée : 4 ans	CNEXO ; MNHN ; (France) ORSTOM (France) WHOI (USA)
- Chaînes alimentaires dans les écosystèmes productifs littoraux	Laboratoire Biologie Marine Nantes	
- Production primaire et verdissement des claires à huîtres (agriculture)	Laboratoire Biologie Marine Nantes	
- Structure et fonctionnement des écosystèmes planctoniques de zones frontales (bassin Liguro-provençal) et résurgences côtières (Portugal)	CNEXO - COB durée : 6 ans	GRECO MEDIPROD./CNRS (France) Labo Pêches et Museum de Lisbonne (Portugal) Université de Liège (Belgique)
- Etude du plancton de l'Antarctique (cultures - identification)	Laboratoire Biologie Cell. et Végétale Paris VII durée : 5 ans	TAF 1984 (France)
- Ecologie et physiologie du phytoplancton d'une zone néritique à forts apports terrigènes, le golfe du Lion	Laboratoire Arago Banyuls durée : 4 ans	Station Marine d'Endoume I.S.T.P.M. (France)
- Ecologie et physiologie du phytoplancton des hautes latitudes (Antarctique et Arctique)	Laboratoire Arago Banyuls pluriannuel	UBO - BREST (France) Université de Laval-Pêches et Océan (Québec)
- Distribution spatiale des oeufs et larve de sole dans le golfe normanno-breton	I.S.T.P.M. Laboratoire Plancton	

Thèmes de recherches	Laboratoires français concernés	Liaisons avec autres Laboratoires français ou étrangers
- Identification et quantification des oeufs de maquereaux dans le golfe de Gascogne et mer Celtique	I.S.T.P.M. Laboratoire Plancton	C I E M Laboratoire de Lowestoft (Angleterre)
- Identification et quantification des larves de hareng en mer du Nord et Manche orientale	I.S.T.P.M. Laboratoire Plancton	C I E M Laboratoire d'Aberdeen (Ecosse)
ECOSYSTEMES BENTHIQUES		
- Distribution générale et écologique de la faune benthique dans la Manche et les mers avoisinantes	Station Marine de Wimereux Etude pluriannuelle	GRECOMANCHE
- Inventaires faunistiques et floristiques, formations organogènes, du benthos des claires à huîtres	Laboratoire Biologie Marine Nantes	
- Etude de l'écosystème hydrothermal à l'axe des dorsales océaniques	Centre Océanologique de Bretagne (COB) Brest durée : 4 ans	PIRO (France) Scripps Institution of Oceanography California (USA) WHOI (USA) John Hopkins University (USA) University of Victoria (Canada)
- Etude de l'Environnement profond de la plaine abyssale du NE Atlantique	COB - Brest Durée : 4 ans	Brookhaven National Laboratory NY (USA) Université de Padova (Italie)
- Utilisation des ressources trophiques par le benthos. Ecophysiologie. Bilan énergétiques	Laboratoire ARAGO Banyuls Etude pluriannuelle	Programme TROPHOBENTHE (France)

Thèmes de recherches	Laboratoires français concernés	Liaisons avec autres Laboratoires français ou étrangers
- Recherches pluridisciplinaires sur l'écosystème des marges continentales	Laboratoire ARAGO Banyuls durée : 4 ans	Laboratoire de Sédimentologie et géochimie marine, CEA, Laboratoire micropaléontologie, MNHN, UBO, Ecologie et Biochimie microbienne du milieu marin (France) International Laboratory of marine radioactivity
- Macrofaune benthique et suprabenthique du plateau sud-Gascogne Meiofaune et macrofaune des sédiments lagunaires estuariens	Laboratoire Biologie Marine et Lagunaire Montpellier durée : 4 ans	COST 47
- Mise au point des techniques de cultures concernant les algues à vocation alimentaire ou industrielle (Laminaires)	Institut des Pêches Maritimes (I.S.T.P.M.) Laboratoire Algues	

PERTURBATIONS DES BIOGENOSES

Environnement Littoral

- Perturbations à long terme induites par la prolifération de certains groupes planctoniques (salpes, méduses)	Station Zoologique Villefranche-sur-Mer	MNHN (France)
- Analyse des perturbations des écosystèmes planctoniques. Etudes d'impact d'une centrale nucléaire, des travaux de génie civil. Effets des polluants métalliques	Station Marine de Wimereau durée : 2 ans	GRECOMANCHE CNEXO, ENSCLILLE, (France)

Themes de recherches	Laboratoires francais concernes	Liaisons avec autres Laboratoires francais ou etrangers
- Faunistique et aménagement littoraux	Laboratoire Biologie Marine Nantes	I.S.T.P.M. (France)
- Impact des grands aménagementés énergétiques littoraux sur les frayères et nurseries des poissons et crustacés en Manche	I.S.T.P.M. pluriannuel	
- Partie écologique de l'impact des grands aménagementés énergétiques	COB - ELGMM pluriannuel	Divers labos (France)
- Etude de l'impact sur l'environnement abyssal des activités humaines : rejet ou enfouissement de déchets radioactifs à faible et haute toxicité	COB duree : 3 ans	C E A (France)
- Eaux colorées : surveillance et étude des mécanismes de formation sur le littoral français	Laboratoire Effets Biologiques des Nuisances (I.S.T.P.M.) France pluriannuel	COB - ELGMM Université Paris VII UBO (France) Tohoku University (Japon) Laboratoire de Vigo (Espagne)
- Dystrophies : baie de Vilaine	Laboratoire Effets Biologiques des Nuisances (I.S.T.P.M.) France durée : 2 ans	COB - ELGMM (France)
<u>Etude Experimentale</u>		
- Etude des effets des polluants sur le phytoplancton	Laboratoire Biologie Cellul. et Végétale Paris VII durée : 5 ans	GIS Mer et Sante Marseille (France)

Themes de recherches	Laboratoires français concernés	Liaisons avec autres Laboratoires français ou étrangers
- Ecotoxicologie et Bionomie littorale et estuarienne	Collège de France Concarneau durée : 5 ans	
- Normalisation d'un test de toxicité utilisant une diatomée marine	I.S.T.P.M. (France) durée : 1 an	IRCHA, AFNOR (France) ISO (Hollande)
- Normalisation d'un test de toxicité utilisant un microcrustacé planctonique marin (copépode)	I.S.T.P.M. (France) durée : 2 ans	AFNOR (France)

Iceland

Th. Thórdardóttir and I. Hallgrímsson

Phytoplankton

Measurements of primary production and standing stock of phytoplankton were carried out in a similar way as in previous years. As a part of a project investigating the success of spawning and its relation to environmental conditions phytoplankton investigations were carried out in the coastal area southwest of Iceland during 20-24 April and 11-20 May. During May-June the long-term monitoring of primary production in coastal as well as oceanic waters all around Iceland was continued. In addition, studies were made during 15-22 August on the Chl a distribution in the surface layers of the coastal and oceanic waters west and north of Iceland. Investigations on P/I relations and comparison of in situ and incubator productivity were continued.

Zooplankton

In 1983 zooplankton sampling was carried out at 450 stations. The sampling took place both offshore and inshore and primarily during spring and summer. Most of the sampling was in general continuation of previous sampling and included observations of fish eggs and larvae. The samplings were carried out with Hensen and Juday nets, Icelandic High Speed Samplers and Gulf III samplers. Furthermore, experimental zooplankton pumping from various depths was worked. As in previous years, fish larvae sampling was carried out in spring in the Irminger Sea and the East-Greenland waters. The continuous plankton surveys

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

Ireland

(R. Grainger)

The Fisheries Research Centre has conducted surveys for herring larvae in the Celtic Sea during the spawning season (October-February) since 1978/79. Herring larval surveys have also been carried out in Divisions VIa and VIIb since 1981 (October-November).

In 1982 in conjunction with the Fisheries Laboratory, Lowestoft a Nephrops larval survey was conducted in the Irish Sea.

The University College, Galway is involved in ichthyoplankton research off the west coast of Ireland and in particular Galway Bay. This work is mainly descriptive but vertical and horizontal distributions are examined in relation to physical and chemical oceanographic data collected concurrently.

Norway

(G. Berge)

1. Institute of Marine Research, (IMR) Bergen and Biological Station Flødevigen, (BSF) Arendal.

1.1 Phytoplankton

1.1.1 The monitoring of primary production and standing stocks of phytoplankton of the coastal banks off western and northern Norway continued for the 8th year in a reduced form, covering the spring season one time at four sections across the Norwegian continental shelf. 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 was continued. About 30 fjords along the whole Norwegian coast were surveyed in November - December and analysis of nutrients, oxygen, salinity and temperature were made (IMR).

1.1.3 The study of the phytoplankton and its primary production at the ice edge in the Barents Sea was in 1983 extended to the shallower areas of the Spitsbergen bank and to the ice covered areas. In the phytoplankton field work, emphasis was also put on determining light-photosynthesis relationships for natural phytoplankton populations. This study is part of an interdisciplinary program designed to investigate the biological production processes in this important fishing area (IMR).

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, orthophosphate, chlorophyll *a* and fixed samples of phytoplankton are analysed monthly from stations along the hydrographical section Torungen - Hirtshals in Skagerrak (BSF).

1.2 Zooplankton

1.2.1 At 6 permanent stations along the coast the bi-weekly sampling of zooplankton by Juday 36/180 μ m nets continued. Zooplankton volumes, species composition and stage development are recorded (IMR).

1.2.2 A programme designed to develop new instruments for acoustic estimation of zooplankton biomass and species continued in 1983. Acoustic observations of zooplankton organisms by means of multiple-frequency sonar systems are compared to observations with conventional gears (Juday nets, Gulf III and Tucker nets) (IMR).

1.2.3 A study of the zooplankton at the ice edge in the Barents Sea started in 1979 continued. This study is part of an interdisciplinary programme designed to investigate the biological production processes in this important fishing area (see 1.1.3) (IMR).

1.2.4 An interdisciplinary programme designed to investigate the survival of and feeding in cod larvae was started in 1975 and continued in 1983, with special emphasis on the feeding of larvae in relation to the distribution of food organisms. An *in situ* particle rate meter and a plankton pump have been used in the study of small scale distribution of zooplankton organisms (IMR).

1.3 Ichthyoplankton

1.3.1 Investigations on the distribution of herring larvae in order to localize the main spawning grounds along the coast continued. Eggs and larvae of other species are also recorded. Two cruises were performed in 1983.

1.3.2 Postlarvae surveys which started off in 1977 were continued. The aim is to establish an index for the abundance of different species, with particular emphasis on cod in 1983.

1.3.3 Investigations on mackerel eggs in the North Sea continued.

Based upon intensive egg surveys one aims to establish the abundance of the North Sea mackerel spawning stock.

1.3.4 Investigations on Arcto-Norwegian cod eggs and larvae continued in the Lofoten area, with emphasis on the spawning of cod, the distribution and survival of eggs and larvae (see 1.2.4). In 1983 few egg surveys were conducted during the spawning season covering the total spawning area in Lofoten in order to estimate the abundance of the spawning stock of Arcto-Norwegian cod.

1.3.5 A study on the coastal cod stock in the Møre region continued in 1983. The eggs and larvae investigations were also continued.

1.3.6 Investigations on the distribution and abundance of capelin larvae continued in 1983 in cooperation with USSR.

1.3.7 Investigations on eggs and larvae of sprat were carried out to determine the state of spawning in the Ryfylke and Nordfjord areas in the western part of Norway (BSF).

2. University of Bergen

Department of Marine Biology

2.1 Studies in the land-locked fjord system Lindåspollene have continued, with particular emphasis on the vertical distribution of zooplankton and sedimentation rates in the water column. A special study has been made on the response on the pelagic ecosystem after adding rich water to enclosed water columns.

2.2 Critical assessment of phytoplankton production estimates has continued. Further information has been obtained on seasonal patterns of primary production in Korsfjorden and other fjords in the neighborhood of Bergen, and on the development of phytoplankton in coastal and offshore areas off western Norway.

2.3 Studies are continuing on the local distribution and composition of the zooplankton in the west Norwegian coastal area, with the aim of estimating the extent to which plankton is advected from one water mass to another.

3. Norwegian Institute for Water Research NIVA, Oslo.

3.1 Phytoplankton

Within the framework of the National Pollution Monitoring Programme levels of Chlorophyll *a* is used to indicate the degree of eutrophication in several polluted fjords. Quantitative phytoplankton samples were collected in some of these fjords along with nutrients and hydrographical measurements.

Extensive primary production measurements (Carbon 14) coupled with

automatic recording of chlorophyll fluorescence (Variosense) continued as part of a baseline study outside a planned gas terminal at Kårstø, south-western Norway (K. Sørensen, S. R. Erga).

3.2 Benthic communities

Registration of shore and shallow water communities by diving were routinely applied in recipient studies. The lower limit of benthic algal growth was used to characterize the mean light conditions (T. Bokn, J. Knutzen). Structure of soft bottom fauna was studied at several selected localities under the National Pollution Monitoring Programme (B. Rygg). Stereophotography at fixed sites down to 30 m took place twice a year in two fjords (N. Green, K. Kvalvågnaes). Long term effects of diesel oil on marine benthic communities in enclosures are studied at a biological experimental station, Solbergstrand, outer Oslo fjord (T. Bakke, T. Bokn). Experiments have been made on drill mud and cutting mixtures from offshore oil well drilling to investigate the suitability of the cuttings as substrate for a benthic community (T. Bakke, K. Naes).

4. University of Oslo

Department of Marine Biology and Limnology

4.1 Phytoplankton

Investigations were continued in the following areas:

- 4.1.1 Ultraplankton flagellates (J. Thrandsen)
- 4.1.2 Dinoflagellate taxonomy and fine structure; red tides (K. Tangen).
- 4.1.3 Carotenoids of Dinoflagellates and Euglenophytes (T. Bjørnland).
- 4.1.4 Nitrogen turnover in coastal waters: ^{15}N investigations (E. Paasche, S. Kristiansen).
- 4.1.5 Effects of oil pollution on phytoplankton communities (S. Kristiansen, J. Thrandsen, in cooperation with staff at the University of Bergen).

4.2 Zooplankton

- 4.2.1 The second one of three papers on larval development and metamorphosis of hesionids (Polychaeta) was published (Haaland & Schram).

4.3 Phytobenthos

Investigations were continued in the following areas:

4.3.1 Experimental studies on taxonomy, life histories and environmental control of growth and reproduction in red algae (J. Rueness).

4.3.2 Autecological studies of algae in the Oslofjord (J. Rueness).

4.4 Zoobenthos

4.4.1 Work was continued on classification and dynamics of benthic animal communities in Oslofjord (Gray, Valderhaug & students).

4.4.2 Studies on reproduction biology, population strategy, energy budget and production of various polychaetes were continued (Gray & collaborators).

4.4.3 C, N & P budgets were investigated for selected sediment-living species (Valderhaug, Gray).

4.4.4 At a coastal experimental station belonging to the Norwegian Institute for Water Research large indoor tanks were arranged to contain subtidal soft bottom communities under seminatural conditions. The aim is to study biological and chemical responses to arrival of organic particles at the sediment/water interface (Gray, Berge Schaanning).

4.4.5 A systematic review of the Oslofjord species of Polydora and Pseudopolydora (Polychaeta: Spionidae) was published (Ramberg & Schram).

5. University of Tromsø.

Tromsø Museum

5.1 Zoobenthos

5.1.1 Monitoring of hard-bottom fauna in Balsfjorden, Northern Norway, with special emphasis on effect of sedimentation (B. Gulliksen).

5.1.2 Manipulation of hard-bottom communities in Balsfjorden, Northern Norway (B. Gulliksen).

5.1.3 Effect of pollution on benthic communities in the Tromsø area (B. Gulliksen, B. Holte).

5.1.4 Mapping of hard-bottom communities around the coasts of Spitsbergen and Bjørnøya (B. Gulliksen).

5.1.5 Under ice fauna studies near Spitsbergen (B. Gulliksen).

5.2 Fish

5.2.1 Biology of the halibut, Hippoglossus hippoglossus (T. Haug, B. Gulliksen).

5.3 Birds

5.3.1 Mapping and population surveillance of seabirds in Northern Norway (W. Vader, R. Barrett, K.-B. Strann).

5.3.2 The food and breeding success of breeding seabirds in Northern Norway (W. Vader, R. Barrett).

Institute of Biology and Geology.

5.4 Phytoplankton

5.4.1 The importance of Phaeocystis pouchetii in the Arctic food web (J. P. Taasen, E. Øyg).

5.5 Zooplankton

5.5.1 Ecological Investigations of the Zooplankton Community of Balsfjorden have been continued. Research has concentrated on finding a biostatistical model for quantifying condition (based on changes in proximate biochemical content) in copepods and krill with respect to overwintering and reproductive demands (Hopkins, Grønvik, Tande & collaborators).

Work has continued on developing a physiological model describing food assimilation, respiration and production in the species complex Calanus finmarchicus, C. glacialis and C. hyperboreus in the Barents Sea (Hopkins, Tande & collaborators).

Research has been initiated to compare and contrast phytoplankton and zooplankton community structure in the fjords along West Spitzbergen. The species assemblages in the East Greenland current, Atlantic flow water, South Cape Spitzbergen current (polar water) and West Spitzbergen fjords are being classified using principle component analysis (Hopkins & collaborators).

5.6 Phytobenthos

5.6.1 Quantitative studies of algal communities in the littoral zone (T. E. Lein, 2 students).

5.7 Zoobenthos

- 5.7.1 Studies of the population dynamics, ecological energetics and production of the deep-water prawn (Pandalus borealis) are being continued in Balsfjorden and selected north Norwegian fjords. Recently this work has been expanded to include populations at West Spitzbergen (Hopkins & collaborators).
- 5.7.2 Investigations on the bottom fauna of the Barents Sea and the Spitzbergen area (E. Oug).
- 5.7.3 Population dynamics of Macoma calcaria (E. Oug, 1 student).
- 5.7.4 Intertidal distribution and zonation (E. Oug).
- 5.7.5 Systematics and zoogeography of the Terebellomorpha (Polychaeta) (T. Holthe).
- 5.7.6 Investigations on the deep sea fauna of the Norwegian Sea (T. Holthe).
- 5.7.7 Zoogeography of the Echinoderms of North Norway (T. Holthe, 1 student).
- 5.7.8 Growth of Modiolus modiolus (T. Holthe, 1 student).
- 5.7.9 Systematics of Oweniidae (T. Holthe, 1 student).
- 5.7.10 Reproduction and larval development of echinoderms, particularly star-fishes (I.-B. Falk-Petersen).
- 5.7.11 Ecology of Strongylocentrotus droebachiensis and S. pallidus in the Troms and Svalbard region (S. Lønning Vader, I.-B. Falk-Petersen, W. Vader).
- 5.7.12 Effects of aromatic hydrocarbons on sea urchin embryos (S. Lønning Vader, I.-B. Falk-Petersen, A. Møller Naley).

5.8 Fish

- 5.8.1 Fertilization and early development of marine fishes (cod, flatfishes, lumpsucker) are studied by morphological (including EM), physiological and genetical methods (S. Lønning Vader, E. Kjörsvik, A. Stene).
- 5.8.2 Effects of aromatic hydrocarbons on fish embryos and larvae (S. Lønning Vader, A. Møller Naley, A. Stene).
- 5.8.3 Interactive segregation between small pelagic fishes in a fjord system (S. Grønvik, A. Klemetsen).

5.8.4 Studies involving quantification of growth, especially with regard to the contrasting requirements of somatic and gonad growth, are being carried out on the capelin (Mallotus villosus) in Balsfjorden. Seasonal deposition of otolith zones is being analysed within the framework of an energetics model (Hopkins & collaborators).

5.8.5 Some aspects of the biology of polar cod (Boreogadus saida) (E. Oug, 1 student).

6. University of Trondheim

6.1 Phytoplankton

6.1.1 Variation in growth rate and fluorescence of marine planktonic diatoms exposed to Ekofisk crude oil in outdoor dialysis cultures were studied (E. Nøst Hegseth, K. Østgaard).

6.1.2 Metabolism of 3-1,3 glucans in diatoms (S. Mykkestad, K. Waarum).

6.1.3 Effects on growth rate and chemical composition of Skeletonema when adapting to different light intensities and photoperiods, and the combined effect of sun/shade adaptation and nutrient deficiency (E. Sakshaug).

6.1.4 Effects on growth rates and chemical composition of dinoflagellates when adapting to different light intensities and photoperiods (K. Tangen, R. Brokstad).

6.1.5 Taxonomy and morphology of two species in the "Gonyaulax tamarensis complex" (K. Tangen).

6.1.6 Occurrence of potentially toxic algae in relation to fish diseases and mussel poisoning (K. Tangen).

6.2 Zooplankton

6.2.1 Zooplankton and fish larvae kept in dialysis chambers (L. Jørgensen).

6.2.2 Routine sampling of zooplankton once a month by Nansen 75/180 μ m net continued at three oceanographic stations in Trondheimsfjorden (J.-A. Snøli, T. Strømngren).

6.3 Phycobenthos

6.3.1 Comparative studies of growth within species of Fucus (T. Strømngren).

6.4 Zoobenthos

- 6.4.1 Taxonomy and life history of deep water molluscs (J.-A. Sneli).
- 6.4.2 Taxonomy and zoogeography of archaeogastropods in Scandinavian and arctic waters (J.-A. Sneli).
- 6.4.3 Investigation on the bottom fauna of Vistenfjorden in Nordland county (J.-A. Sneli, T. Strømngren).
- 6.4.4 Investigations on the bottom fauna assumed to be affected by the activity of a paper pulp factory in the inner Trondheimsfjord (J.-A. Sneli, Ø. Stokland).

6.5 Ichthyoplankton and fish

- 6.5.1 NMR studies on changes in phospholipids during development of living embryos and yolk-sac larvae of plaice (Pleuronectes platessa) (H. Grasdalen, L. Jørgensen).
- 6.5.2 Carbon and nitrogen expenditure in eggs and larvae of cod (Gadus morhua) (L. Jørgensen).
- 6.5.4 Methods for biochemical genetic identification of planktonic fish eggs (with special emphasis on gadoids) by diagnostic enzyme loci have been developed and are now applied on a routine basis (J. Mork, G. Sundnes).
- 6.5.5 Population genetic studies in cod (Gadus morhua), halibut (Hippoglossus hippoglossus), capelin (Mallotus villosus), and Atlantic salmonids by means of haemoglobin polymorphism (J. Mork, G. Sundnes, T. Haug, E. Friis-Sørensen, T. Heggberget).

Poland

(K. Siudziński)

Sea Fisheries Institute, Gdynia

Baltic

A long-term programme on environmental conditions in the Polish Fisheries Management Zone was continued in 1983. Two cruises of RV Profesor Siedlecki on a standard grid of 100 stations and 7 cruises of RV Dr. Lubecki at 12 permanent stations were conducted. The aim of these studies is to monitor changes in the Baltic environment which influence the distribution and biomass of fish. Monitoring of phytoplankton, primary production, chlorophyll a, zooplankton biomass and

macrobenthos distribution was continued. Special emphasis was put on ichthyoplankton studies. Besides the observation of changes of abundance and distribution of eggs and larvae special studies on herring spawning in the Pomeranian Bay and Gulf of Gdańsk were conducted.

Experimental studies on influence of heavy metals on some Baltic animals were continued.

Institute of Oceanography of the Gdańsk University

Continuation of studies on:

- changes in the Gulf of Gdańsk biocoenosis
- influence of chosen physiological and chemical factors on production of Baltic algae
- ecophysiological processes /respiration, production, assimilation, filtration/ of Baltic crustacea and molusca.

Department of Plant Physiology of the Gdańsk University

Studies on "giberelin-like" substances in algae Chlorella vulgaris and Scenedesmus quadricauda isolated from Baltic phytoplankton samples. It was found that those substances are active and secreted to the environment can influence other organisms.

Studies were carried out on effect of some oil pollutants on green algae relative to light intensity and temperature.

Biological Station of the Gdańsk University at Górkki Wschodnie

The scientific programme includes problem of physioecology and comparative biochemistry of marine and brackish-water organisms. For example study on ammonium content in the tissues of selected squids or isolation of malic enzyme from shrimp abdomen muscle.

Institute of Oceanography and Sea Protection of Agriculture

Academy in Szczecin

Continuation of long-term programmes concerning ecology of Baltic Cladocera and Copepoda.

Department of Sanitary Hydrobiology of Agriculture Academy in Olsztyn

Studies on bottom fauna, zooplankton biomass and morphological studies on Furcellaria fastigiata from Vistula Lagoon and Puck Bay.

Department of Biology and Genetics of Medical School in Gdańsk

Cytogenetic analysis of chromosomes of the carp /Cyprinus carpio L./
after exposition to an anionic detergent.

Institute of Ecology of Polish Academy of Science, Warszawa

In cooperation with Sea Fisheries Institute in Gdynia onboard of RV
Profesor Siedlecki scientists have taken part in international SIBEX-
BIOMASS Programme, 8 Dec 1983 - 8 January 1984. Studies on temperature
and salinity distribution, chlorophyll content, composition and
distribution of bacteria, phytoplankton, zooplankton, fish and birds in
the Antarctic /Atlantic sector/ with special emphasis on biology of
krill Euphausia superba Dana were carried out.

Portugal

(T. Neto)

INSTITUTO NACIONAL DE INVESTIGAÇÃO DAS PESCAS (INIP): LISBOA

Upkeep of the phytoplankton stock cultures (phytoflagellates, diatoms,
dinoflagellates, chlorophyceae) (Ma. A. M. Sampayo et al.).

Development of 10 to 100 litre laboratory cultures to feed zooplankton
cultures (Ma. A. M. Sampayo et al.).

Outside (open air) microalgae production as new proteins (SCP) for food
and feed in 2000-6000 litre raceway pounds (Ma. A. M. Sampayo and M.F.G.
Martins).

Studies on some physiological aspects of microalgae, a biotechnological
approach (Ma. A. M. Sampayo et al.).

Studies on the nutritional value of microalgae (Ma. A. M. Sampayo et
al.).

Studies on an Olisthodiscus luteus red water at Cascais Bay, July 1982
(Ma. A. M. Sampayo and Ma. T. Moita).

Studies on a succession of red waters at Lagos Bay, Algarve coast during
July-August 1983 (Ma. A. M. Sampayo).

Studies on a fish mortality event in extensive fish cultures at Ria de Alvor, July 1983 (Ma. A. M. Sampayo and A. Vieira).

Phytoplankton studies on Cascais Bay an area favorable to red water events (Ma. A. M. Sampayo and Ma. T. Moita).

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

Study of the primary productivity in the Portuguese coast during 1981 (Ma. G. Vilarinho).

Study of the phytoplankton caught by the N. E. "Noruega" during 1981 in the Portuguese coast (A. M. Costa).

Upkeep of the zooplankton culture stocks (copepods and rotifers) (Ma. H. Vilela et al.).

Development of five and twelve litre cultures of the rotifer Brachionus plicatilis in laboratory conditions using microalgae and baker's yeast (Ma. H. Vilela et al.).

Production of Brachionus plicatilis in 500 litre cylindric tanks in the open air, with Nannochloris sp. and Saccharomyces cerevisiae (Ma. H. Vilela; A. F. Lupi).

Studies on the calorific content of Brachionus plicatilis produced with different kinds of food (Ma. H. Vilela).

Continuation of the food quality experiments with the harpacticoid Tigriopus brevicornis (Ma. H. Vilela).

Artemia growing experiments in 200 and 500 litre aquaria. Obtention of two and three days metanauplii fed on dried Spirulina to feed Palaemon serratus larvae (L. F. Narciso).

Red water studies in the Portuguese coast (Ma. T. Moita and Ma. E. Cunha).

Study on the distribution of zooplankton collected by the N. E. "Noruega" off Madeira in June and November/December, 1982 (Ma. E. Cunha).

Study of zooplankton integrated in the program "Environmental study of the Tagus estuary" coordinated by Comissão Nacional do Ambiente (P. Sobral).

Study of phyto and ichthyoplankton related with Sardina pilchardus (W.) spawning and breeding areas between capes Espichel and Sardão (Ma. H. Afonso, Ma. C. Monteiro, A. M. Costa, Ma. F. Quintela, Ma. T. Rodrigues and F. Varela).

Study of fish eggs and larvae collected by the N. E. "Noruega" in the Portuguese coast during 1981 (A. Farinha and I. Meneses).

Study of zooplankton collected by the N. E. "Noruega" with a WP-2 net along the coast of Portugal in 1979 and 1980 (I. de Paiva and T. Neto).

Studies of the population dynamics of three rocky intertidal species: Patella vulgata, P. depressa and P. aspera. Study of Gibulla and Monodonta species of the Portuguese coast (M. Guerra and Ma. T. Gaudêncio).

LABORATÓRIO NACIONAL DE ENGENHARIA E TECNOLOGIA INDUSTRIAL (LNETI): SACAVÉM

Ecological characterization of phyto and zooplanktonic populations in the power plant area of the Sado River.

Study of the power plant impact on the mortality rate of estuarine fish eggs and larvae.

Study and characterization of estuarine macrobenthos in the adjacent area of the power plant. Fouling quantification.

Spain

(E. López-Jamar)

A) PHYTOPLANKTON

1) Instituto Español de Oceanografía, La Coruña and Vigo Laboratories:

The Red Tide Monitoring Program studies the oceanographic conditions associated with the occurrence of toxic blooms in the Galician coast (NW Spain). Other than the routine sampling, five cruises were carried out during the August-October period. A Prorocentrum triestinum red tide was studied in detail, as well as the occurrence of Gymnodinium catenatum and Gyrodinium aureolum. P. triestinum, P. micans and G. aureolum were isolated in order to undertake bioassays to test their possible toxicity.

2) Instituto de Investigaciones Pesqueras de Vigo:

The effect of industrial wastes on phytoplankton communities of Ría de Pontevedra is being studied.

B) ZOOPLANKTON

1) Instituto Español de Oceanografía, La Coruña Laboratory:

Composition, spatial and temporal variation of zooplankton was studied along the North coast of Galicia (NW Spain). The zooplankton of La Coruña Bay (a highly polluted area) was also investigated.

- Ingestion rates of zooplankton were estimated "in situ" in the Ría de Arosa in order to determine secondary production.

- The larval development of *Pisidia longicornis* (a decapod ecologically very important in the Ría de Arosa) and of *Liocarcinus puber* (a commercially important decapod) was studied under laboratory conditions.

C) BENTHOS

1) Instituto Español de Oceanografía, La Coruña Laboratory:

- A study on the recolonization of infaunal benthos in a dredged area was made. Species composition and community structure seems to recover 6 months after the ending of the dredging operations, but biomass recovery is much lower. Population dynamics of *Thyasira flexuosa* is also being investigated, since a successful recruitment started last year, with no adult individuals present.

- A study on the infaunal benthos of the North coast of Galicia has recently started.

- The factors controlling the abundance and distribution of benthic decapods along the Galician Rías and the continental shelf are being estimated. The *Brachyura* species of Galicia were catalogued, and a taxonomic key was elaborated.

2) Instituto de Investigaciones Pesqueras, Vigo:

- Last year studies were focused on the improvement of methods for the estimation of liposoluble photosynthetic pigments and their degradation products in sedimentary systems.

- Meiofaunal studies on intertidal systems under different stress were undertaken. In Ría de Pontevedra, the effect of the shellfish exploitation on the meiofauna was estimated. Also, the role of the meiofauna in the ecosystem of a coastal pond in the Cies Islands was investigated.

3) Universidad de Santiago, Zoology Department:

- Ecological and faunistic studies on several taxonomic groups and on the interstitial fauna of sandy bottoms along the Galician coast were carried out.

- Biogeography and population dynamics of intertidal and subtidal macrozoobenthos in several sites of the Galician coast was studied.

4) Sociedad Cultural de Investigación Submarina, San Sebastián:

- Quantitative studies on intertidal and subtidal macrophytobenthos on several embayments along the Bask coast (East Cantabric Sea) are being carried out.

- The infauna of the Oria, Urola and Urumea estuaries is being investigated.

- Ecology and systematics of amphipods, molluscs, coelenterates, polychaetes, harpacticoid copepods in the bask coast, as well as the ecology and systematics of the genus Patella is being studied.

- Investigations on heavy metal pollution on benthic organisms are being carried out.

5) Centro de Investigaciones Acuáticas de Asturias, Gijón:

- Studied on benthic population dynamics and sedimentology of Ría de Ribadesella (Cantabric Sea).

6) Universidad de Oviedo, Zoology and Ecology Departments:

- Systematics of macrofaunal benthos, mainly nudibranchs, bryozoans, hydrozoans and sponges.

- Studies on intertidal communities and biology of key-species (dominant algae and herbivores) on Fucus vesiculosus, Corallina elongata, Gelidium latifolium and Chondrus crispus beds.

D) MICROBIOLOGY

Bacterial abundance and ^3H -Thymidine uptake in the water column of the Ría de Arosa (NW Spain) were measured during 1983. Both parameters were higher in the inner Ría, and decrease gradually towards the open sea, both in surface and bottom water.

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Sweden

(R. Rosenberg)

I have no new report from Sweden to the Biological Oceanography Committee. The reports from the two previous years are still valid.

UNITED KINGDOM

1. England

(J. D. Riley)

MAFF Fisheries Laboratory, Lowestoft

1. Sole egg data from surveys in the north sea and eastern channel in 1971, were analysed in order to help in planning the 1984 international sole egg surveys. The 1971 surveys showed the three known spawning centres in the Dover Strait, off the Belgian coast and off Texel, and one previously unknown centre over the Norfolk Banks.

2. Two mackerel egg surveys west of Britain were made, one in March/April and one in May/June as part of the ICES coordinated stock assessment programme for the western mackerel stock. The samples have been analysed for mackerel and horse mackerel eggs, and production estimates have been calculated for consideration at the egg survey working group in February 1984. The new 53 cm sampler with 20 cm diameter aperture, conical nose core was used on these surveys. This sampler has a modified 'Guildline' CTD unit to transmit information on temperature, salinity, flow and depth to the surface via a multiplexing system.

3. Some plankton samples and CTD profiles were taken in the vicinity of the north east coast of England 'front' in July. Fish egg and larvae abundances were examined in relation to the temperature structure in the area. Four deployments of the 'Benthos' plankton camera independent of a concentrating net, were made to examine vertical distribution of plankters.

4. Plankton samples were taken in the Southern Bight of the North Sea plaice egg patch in January. Abundance of recently produced plaice eggs was used to identify spawning concentrations of adults on which behavioural studies could be done.

Institute for Marine Environmental Research, Plymouth

1. The Continuous Plankton Recorder Survey

The survey by the Continuous Plankton Recorder (CPR) was continued on the same basis as in previous years. Recorders were towed at a depth of 10 m at monthly intervals, where possible, along the standard routes

shown in Figure 1. During 1983 Recorders were towed 75,250 miles by 17 ships of eight nations (Denmark, Eire, Iceland, France, Netherlands, Norway, Panama and the United Kingdom). 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, UK. Details of data processing procedures are given by J. M. Colebrook in Bull. mar. Ecol., 8, 133-142.

Legend to Figure 1. The Continuous Plankton Recorder Survey, 1983. The figures denote the number of tows along each route in 1983.

2. Fish eggs and larvae

IMER collaborated with MAFF to study the distribution and abundance of eggs and larvae of the mackerel in the south-western approaches in relation to their physical and biological environment as part of the International Mackerel Egg Survey.

3. Undulating Oceanographic Recorder (UOR)

The UOR was towed during three cruises in the Celtic Sea. The UOR contains instrumentation to sample plankton and to measure chlorophyll, temperature, salinity, radiant energy and depth over a range of 70 m in the upper layer of the sea.

4. Celtic Sea

Investigations of the pelagic ecosystem in the Celtic Sea were continued with four cruises in 1983.

Institute of Oceanographic Sciences, Wormley

Benthic studies

The long-term programme to investigate the benthic ecology of the Porcupine Seabight region has continued. This included the use of the multicorer to collect a series of samples from 1320 m in a study of the vertical and horizontal distribution of meiofauna. Photographic transects at 800-1300 m showed densities of the sponge *Pheronema*, of over 5 m^{-2} equivalent to a wet weight standing crop of 800 g.m^{-2} . The vertical limits of its distribution are well defined.

A taxonomic study of the Actinaria sampled in the Seabight since 1977 is planned.

The deployment of a 'pop-up' time lapse camera (Bathysnap) has produced useful observations on a hormathiid anemone and vermiform organisms, probably echiuroids.

The study of the bathymetric distribution of benthic decapods, including detailed work on the galatheid genus *Munida*, has continued, for

comparison with the data already available for echinoderms and fish.

Midwater studies

The distribution of the phyto and zooplankton in relation to the oceanic front to the southwest of the Azores continues to be studied chiefly by the analysis of data collected in earlier years. This front appears to be a permanent feature in the area and may mark the edge of one of the return flows of the Gulf Stream in the eastern north Atlantic.

Analysis of the plankton and micronekton standing crops showed a general decline from eastern Atlantic water to western Atlantic water. In addition there was a decline in the quantities of animals migrating up to the surface 200 m at night so reducing nutrient recycling in the western Atlantic water. Most planktonic Ostracods occurred on both sides of the front, *Conchoecia concentrica* however occurred only in WAW. The analysis of data on fish feeding emphasized the degree of prey selection based on size and taxa.

The vertical distribution of mysids, decapods and euphausiids have been described at 42°N, 17°W.

Modelling

A study was made of the application of flow analysis to the modelling of marine ecosystems including their use on the effect of planktobacteria and protozoa on the recycling of dissolved carbon and hydrogen. The preliminary results are encouraging.

Flux of organic material through deep water columns

Work has concentrated this year on the analysis of data and material collected in 1982 and on the measurement of the onset of phytodetritus at 4000 m in the Porcupine Seabight for comparison with 1982.

Gear development

Work has continued on the development or improvement of, the 'pop-up' corer, the multi-power release system, plankton and benthic sieving systems, sediment and amphipod traps.

Marine Biological Association, Plymouth

Sampling and experimental work was carried out on cruises in May, July and August, 1983.

Following sea trials in March, the 15 cm pump system, giving an output of $2.7 \text{ m}^3 \text{ min}^{-1}$, was used in May for the first time to investigate the fine scale distribution of larval fish and larger zooplankton in relation to the developing thermocline and the vertical distribution of phytoplankton. A total of 264 paired fish and microzooplankton samples were collected from the pump over a 3-day period. Preliminary analysis has shown that the condition of the preserved plankton is good and densities of fish are equivalent or greater than from conventional net

sampling techniques. This comprehensive data set is being used to test hypotheses concerning the co-variability of larval and post-larval fish, in particular clupeoids, and their potential food organisms. Further observations were made on phytoplankton blooms in the shelf-break frontal system, both in May when in situ measurements of reflectance were made within a coccolithophore population to calibrate satellite data in July when the relationships between species composition, chlorophyll concentration and light transmission in surface waters were investigated. Also a detailed study was made of internal waves and their possible significance in terms of phytoplankton growth.

During the August cruise, the effects of soluble zooplankton excretion products on phytoplankton growth were investigated following observations on earlier cruises of the stimulation of photosynthesis by simultaneous additions of ammonium ($2 \mu\text{M}$) and phosphate ($0.5 \mu\text{M}$). This year the phytoplankton at all stations in mixed, frontal and stratified water was predominantly $< 10 \mu\text{m}$ in diameter and failed to respond to the nutrient additions. The nature of nutrient supply to the nanophytoplankton remains uncertain.

The long-term chemical and biological observations at Stations E1 and L5 were collected respectively on monthly and weekly day trips from Plymouth.

Marine Science Laboratories, Menai Bridge: Department of Biology

Work on the front in the western Irish Sea continued during 1983. Principally, the mass of data accumulated in the 1981 and 1982 seasons was evaluated and prepared for publication. Following up the earlier studies of microbiological activity at the front, a collaborative programme with the Institut für Meereskunde of the University of Kiel, on the heterotrophic utilisation of different fractions of dissolved organic matter was begun with the support of NATO.

A survey of the distribution of picoplanktonic cyanobacteria in the same area has shown that these organisms are ubiquitous throughout the year, more abundant in inshore than offshore waters, and often form a substantial proportion of the total phytoplankton. A strain isolated in pure culture was found to be adapted to grow at low light intensities and not to fix molecular nitrogen. Studies on the physiological ecology of Phaeocystis in Liverpool Bay have continued.

The distribution of various species of sea-birds in northern Irish Sea has been found to be related to fronts, probably because the distribution of their food organisms is determined by the fronts.

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 and tank experiments

In 1983 the Loch Ewe enclosures were used to investigate two problems associated with primary production:

- a) the efficiency with which soluble organics, such as glucose, are passed up the food web to the larger zooplankton. This was investigated by dosing a 300 m³ bag containing a natural plankton population with C¹⁴ glucose and measuring the size compartmentalisation of the label (<0.2 μ ; 0.2-1 μ ; 1-3 μ ; 5-12 μ ; 12-68 μ and >68 μ) over a period of 50 days.
- b) the sources of supply of nutrients for primary production after the initial spring bloom. For this investigation, the primary productivity of two bags was compared. One of them was connected by a tube to a tank of sediment and thus was receiving nutrients recycled through the sediment, whilst the other was isolated and relied upon recycling of nutrient within the water column.
- c) detailed analyses of zooplankton and of larval gut contents from previous bag experiments were completed during 1983. Field work was restricted to the collection of spawning stocks of cod and haddock for rearing in tanks at Loch Ewe along with a feasibility study on the rearing of eggs and larvae of the lesser sandeel.

Theoretical studies of energy flow through food webs

Further work has been done on the simulation of primary production and of nutrient recycling in simple food webs.

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

Deep-sea studies on the Rockall Trough and Porcupine Sea Bight.

The seasonal sampling of the demersal fish populations at deep stations in the Rockall Trough and the Porcupine Sea Bight continued during 1983. A detailed study of the trophic ecology of the pelagic and demersal fish was completed. The macro- and megabenthos at the SMBA permanent stations was again sampled with the main emphasis being on the growth and reproduction of echinoderms and bivalves.

U.S.A.

(K. Sherman and G. D. Grice)

Fisheries Ecosystem Investigation

National Marine Fisheries Service (NMFS) Laboratory, Sandy Hook, NJ: Six shelf-wide mesoscale surveys of fish eggs and larvae were completed in 1983. This activity represents the seventh consecutive year of MARMAP plankton surveys in the 260,000 km² shelf area between Cape Hatteras, North Carolina, and Cape Sable, Nova Scotia. The time-series of surveys is part of a comprehensive initiative to provide measures of seasonal and annual variability in the structure, function and rates of change of the biological and environmental components of the shelf ecosystem, with the principal focus on fish production. Sand lance larvae continued to numerically dominate the larval fish community in winter. Abundance estimates in 1983 increased over 1982 levels and approached the record estimates of 1978 and 1979. The center of larval abundance was off Southern New England, as it has been since 1977, but a dramatic increase was observed in the number of larvae on Georges Bank, the area where the first evidence of the population explosion that occurred in 1976 was discovered. For the fourth consecutive year, Atlantic herring larvae were absent over the once productive spawning beds on eastern Georges Bank. Survey information on the distribution of haddock larvae was used to derive fishery-independent estimates of the adult spawning biomass for haddock on Georges Bank. Results showed an increase in size of the adult population from 1977 through 1979, followed by a significant decrease between 1980 and 1982.

NMFS Laboratory, Sandy Hook, NJ, Benthos Studies: The sixth consecutive year of semiannual monitoring of benthic macrofauna communities on the northeastern United States shelf was completed. More intensive surveys of the benthos of the New York Bight were carried out for the fourth straight summer. Results indicate that portions of the inner Bight continue to be the most heavily impacted by man's activities. Effects of the various dumping and non-point inputs to the Bight cannot be clearly separated, but greatest alterations to the benthic community are in a ~15 km² area adjacent to the sewage sludge dumpsite. An additional ~240 km² in the inner Bight have apparently undergone lesser changes, such as reduction in crustacean densities and enhancement of populations of several molluscs and polychaetes which are favored by organic enrichment. There is preliminary evidence that overall biomass and secondary production in the inner Bight are not reduced by pollution; efforts are continuing to quantify production and also use of the benthos as fish forage, to determine whether the observed benthic alterations have negative effects on fisheries. According to a number of variables (sediment carbon, metals and fecal coliform bacteria as well as the benthic macrofauna), there has been little change in the condition of the inner Bight over the past decade. The offshore monitoring has similarly revealed little change in the benthos over the periods for which data are available. Field experiments with trays containing various sediment types and contaminant

concentrations have been conducted the past two summers to establish which of these variables are critical to recruitment success for surf clams (Spisula solidissima) and other benthic invertebrates.

NMFS Laboratory, Narragansett, RI:

Laboratory studies of the factors controlling growth and survival of larval fish were continued with mackerel, sand lance, and summer flounder. Recent growth of haddock larvae collected at three sites on the southern flank of Georges Bank was estimated from water temperature and larval RNA-DNA ratio. Growth ranged from 7% per day in shoaler well-mixed waters to 12% per day in the deeper thermally stratified sites to the south. The higher growth rates of larvae in the stratified waters was consistent with the relatively higher concentration of zooplankton food organisms found in the area.

NMFS Laboratory, Woods Hole, MA:

Sample processing and analysis of data continued from the spring, process-oriented larval fish trophodynamics study cruises which began in 1980. Well-defined concentrations of haddock and cod eggs and larvae were observed along the southern flank of Georges Bank as they drifted southwest from the northeast spawning grounds. Larvae and their prey tended to be concentrated at middepth near the seasonal thermocline by May, but wind stress frequently disrupted the stratification process. Short-term growth (2-4 days) of larvae, based on RNA/DNA ratios, has been correlated with the density of suitable food organisms and water temperature in the field. Long-term, average growth curves of cod and haddock during their first two months of life have been derived from studies of their otolith microstructure. Stimulated feeding, growth, and survival of larvae at observed prey densities predict reasonable levels of population survival. During our May 1983 cruise we were able to quantitatively collect post-larvae and pelagic juveniles (15-50 mm SL) of cod and haddock using the 10-m MOCNESS. In 1984 our research emphasis will extend to the juveniles and the significance of predation at this stage.

Energy budget calculations for Georges Bank were refined and augmented to include production of pre-recruit fish and consumption of fish by apex predators (large pelagic sharks and fishes, and marine birds and mammals). Total consumption of fish as prey by all predators (excluding man) is roughly the same order of magnitude as total production of fish on Georges Bank, which suggests that natural predation must be a major factor limiting overall fish yield and implying that fishery control of key fish predators could influence long-term average structure and yield of fish biomass. Studies were continued on multispecies predator-prey models with particular focus on refining estimates of natural mortality for fishes in their first year of life. Estimates of mortality in juvenile stages appears to be high as in larval stages, which together with empirical evidence of high consumption of juveniles vs. production rate of juveniles, implies that juvenile predation may represent principal cause of recruitment variability.

Developed a nitrogen budget for Georges Bank, describing the magnitude of various sources to account for the high primary production on the Bank. Observations were made in the Atlantic sector of the Antarctic

ice-edge zone to determine the effect of the ice edge and its retreat on the local biological productivity.

NMFS Laboratory, Beaufort, NC:

The Beaufort Laboratory continued its ichthyoplankton research in the northern Gulf of Mexico during 1983 in cooperation with NOAA's Atlantic Oceanographic and Meteorological Laboratories, Miami, Florida. Operations were concentrated on the interactions between Mississippi River Plume water and waters of the Gulf of Mexico.

Previous studies showed that densities of larval gulf menhaden (Brevoortia patronus) and spot (Leiostomus xanthurus), collected off Southwest Pass, Louisiana, in the vicinity of the Mississippi Plume, were higher than found in other areas of the Gulf. Horizontally and vertically discrete ichthyoplankton sampling along the edge of the Mississippi River Plume utilizing a multiple opening and closing environmental sensing system (MOGNESS) resulted in surprisingly high densities of the larvae of these two species. These exceptional densities, an order of magnitude higher than average densities of these larvae in the vicinity of the Mississippi River Delta, were encountered over two spawning seasons. High gut content of larvae from the plume edge indicates that these larvae may take advantage of high density zooplankton patches that occur at the plume/shelf water interface.

Recent results indicate that waters associated with the plume are nutrient rich and a highly productive habitat for marine plankton including heterotrophic bacteria. In situ rates of egg production by common shelf copepods show that although areas in the Mississippi River Plume are not always of high quality, they are generally better than non-plume areas. In laboratory experiments in which a dinoflagellate, a tintinnid and a nauplii stage of a copepod were used as food items, gulf menhaden larvae (3.9-4.2 mm) ate the dinoflagellate and tintinnid but not the nauplii. This result is consistent with our results at sea where it was found that small gulf menhaden frequently ate large numbers of dinoflagellates and tintinnids. Our laboratory work on the effects of delayed feeding on the survival and morphology of spot larvae has been completed. Results indicate that if food is deprived even for a short time (1-3 days) during the early larval period, the ability to capture food and avoid predation may be severely reduced. We will use the techniques developed in this work to examine the nutritional state of spot caught in our Gulf of Mexico cruises. We continue to analyze our data on the growth of larval gulf menhaden in relation to environmental factors. Age and growth of larvae are being obtained from growth increments on their otoliths. On a population basis, larvae from the northern Gulf grew from 2.9 mm SL at hatching to 20.9 mm at age 62 days. Among individual data sets there were statistically significant differences in larval growth rates. The ecological significance of these differences in growth rates are examined as they relate to concurrently measured abiotic and biotic factors.

Research on juvenile fish in the estuaries of the Ten Thousand Island region of South Florida was completed. Numerical abundance of fishes was substantially lower in a bay receiving channelized freshwater inflow than in adjacent bays, but fish biomass and species composition did not

differ appreciably. Laboratory and field research also is being continued on the rates of detrital decomposition and its nutritional quality relative to utilization by fishery organisms.

Plankton Ecology Investigations

Bigelow Laboratory for Ocean Sciences:

Research on plankton stresses a strong interaction between observations made in the field and experimental facilities within the laboratory. In the latter case, the laboratory has featured the combined use of a very extensive culture collection of marine microorganisms, in concert with the single cell analysis and sorting capability of flow cytometry. The approach has been to select representatives of special groupings of phytoplankton algae and study them on a single cell basis, looking at physiological properties such as cell growth, membrane potential, photosynthetic and respiration capabilities, and general morphological changes under various environmental conditions. The field observations have consisted primarily of assessing the relative importance of extremely small (picoplankton) eucaryotes and procaryotes. This research is carried out primarily using fluorescent techniques, both microscopic and highly sensitive spectrofluorometers. The environmental physiological approach in the study of these groups has featured the effects of light and nutrients and has attempted to assess the optimal light and nutrient conditions for these microorganisms.

The studies of micro- and macrozooplankton have involved analysis of the rate of production of ammonia during grazing. These studies have focused principally on the vertical distribution of zooplankton throughout the water column, and particularly in the role this vertical distribution plays in the formation of the chlorophyll maximum in the water. Research on zooplankton and ichthyoplankton has involved utilization of standard oceanographic practices in conjunction with rapid sampling of micro- and macrozooplankton and ichthyoplankton. These studies have focused on fronts and have been involved in trying to ascertain why larval ichthyoplankton tend to concentrate in strong physical frontal conditions in the Gulf of Maine.

Woods Hole Oceanographic Institution:

Continuing research on the biology of gelatinous plankton included field investigations of the feeding rates and selectivity of oceanic ctenophores, and the grazing impact of salp populations. Development continues on aquarium systems for laboratory culture of salps. Experiments are beginning on comparative metabolism and life history of salp species. Studies on the feeding strategies, reproduction and systematics of oceanic ctenophores were made. Using the submersible, JOHNSON SEA-LINK, several new species of ctenophores, two representing new genera, were observed, collected and photographed. Experimental work was conducted on the effect of food concentration of the feeding mechanism of the salp, Pegea confoederata, and field observations made on the feeding of the cosmatozous pteropods.

Work continues on the ecological and evolutionary significance of dormant egg production by marine copepods. A three-year study of the calanoid copepod Labidocera aestiva compared the diapause response of

geographically distant populations. The results indicate genetic divergence of the populations. Studies are being initiated on the extent of heritable variation for diapause and other life history traits (e.g., fecundity, development time, survival) by analyzing offspring of controlled matings. Such data will be used for formulating population growth models.

University of Rhode Island:

Plankton investigations include work on bacterioplankton, phytoplankton, and zooplankton and their interactions with each other and higher trophic levels. The biomass, division rates, and metabolic rates of bacterioplankton including cyanobacteria have been studied at sea, in Narragansett Bay, and in the Marine Ecosystems Research Laboratory (MERL). The relationship of bacterial biomass and division rates to the production of dissolved and particulate carbon, and to the grazing rates of dinoflagellates, ciliates, and small flagellates is being investigated. Work on the patterns and causes of the phytoplankton succession in Narragansett Bay is continuing into its twenty-first year based on a weekly sampling program and extensive experimental work. The work at MERL simulating the Narragansett Bay environment has studied the effects and fates of pollutants as well as the effects of enrichment due to inorganic nutrients. The growth rates and division rates of dinoflagellates from "red tide" and open ocean environments has continued. Sampling now includes regions in the Norwegian sea, the Gulf Stream Drift, and the Sargasso Sea. Dinoflagellates have also been investigated in terms of many factors influencing their population dynamics; toxins, heterotrophic and phagotrophic abilities, nutrient requirements, and their bioluminescence. The biology of diatom resting spores has continued. A net plankton survey of the warm core rings is in progress. The relationships between the rates of benthic nutrient recycling and phytoplankton production has been investigated at MERL, in Narragansett Bay, and in coastal lagoons. A center for studies of plankton and nekton behavior has been established based on a video-interactive computer system. The occurrence and the physiology and ecology of bioluminescence in marine plankton is being studied. The distribution of benthopelagic plankton in the deep sea are being surveyed, and feeding studies with them are being initiated.

Brookhaven National Laboratory:

Plankton research was devoted primarily to the development of new fluorometers that will be moored with current meters and transmissometers in the New York Bight. Vertical and lateral transport of particles derived from phytoplankton are measured. Fluxes of particles out of the euphotic zone, arising primarily from the grazing activities of zooplankton and sinking of cells, are quantified with floating sediment traps, moored sediment traps, and field observations of stocks and rates. In the laboratory, rates of egg production and development of major crustacean herbivores as a function of temperature and type of food are being studied. The population dynamics and growth of zooplankton in other highly productive areas, such as the upwelling off Point Conception, California, the Bering Sea and the marginal ice-zone of the East Greenland Sea, are being investigated. Variability in metabolism, growth and life cycle of zooplankton in undisturbed, high latitude seas with brief, annual periods of production show adaptations

found in some, but not all, upwelling areas. Research on phytoplankton is attempting to quantify the environmental regulation of growth and light utilization efficiency of phytoplankton in coastal areas of the New York Bight.

Lamont-Doherty Geological Observatory:

Phytoplankton distribution is being studied in the Middle Atlantic Bight, analysis of chlorophyll *a* data, physical parameters and nutrients from the shelf edge front are being used to establish the degree to which physical phenomena at fronts control the distribution of phytoplankton. Over the continental shelf, the emphasis is on the fate of primary production and the implications of grazing, fecal pellet production and particle decomposition have on overall transport and transfer rates of particulate material. A separate project is now characterizing benthopelagic zooplankton communities in selected submarine canyons off the eastern seaboard and comparing these communities to those found over the adjacent continental slope. Other zooplankton studies include projects on the physiology, life history, and general ecology of the radiolaria, with emphasis on their symbiotic relationships with dinoflagellates and one on planktonic foraminifera with emphasis on environmental factors influencing shell composition, morphology, and the role of symbionts in shell deposition and reproduction. Microbiological research is concentrated on documenting bacterial abundance, biomass and production in estuaries, river plumes and the continental shelf of the Middle Atlantic Bight, and also in Warm Core Gulf Stream Rings. Emphasis is on specifying relative distributions of free versus attached bacterial cells and their respective activities.

Chesapeake Bay Institute:

Photoadaptive response of the dinoflagellate, Prorocentrum mariaelebouriae, are being studied during its seasonal transport sequence in the Chesapeake. The emphasis of this work is to describe the combination of physiological and compositional changes that cells undergo during prolonged exposure to low light in the subpycnocline water mass. A concurrent project concerns the distributions of phytoplanktonic rates in the Chesapeake Bay, Delaware Bay, and Hudson River estuaries. The work focuses on measuring carbon and nitrogen productivity and the allocation of these elements into biochemical constituents of phytoplankton cells along gradients in salinity, turbidity and nutrients. Zooplankton studies are presently focused on refining techniques for determining the growth rates of populations of planktonic ciliates by means of measuring the proportion of dividing individuals in a given sample. Defining the duration of the recognizable division stages, and the factors which influence or control that duration, is the present emphasis in this work.

Marine Sciences Research Center, State University of New York:

Current research involves a study of the relationships between nutrients, bacteria and bacteriovores in Long Island coastal waters. This includes an ongoing seasonal study of biomass and activities of bacteria and heterotrophic flagellates, an isotope dilution study of release and uptake of dissolved free amino acids, and direct measurements of grazing on bacteria. Other research on bacteria

involves measurements of nitrification and denitrification and the significance of marine bacteria as a source of dissolved hydrogen (H_2) in seawater, measurements of the distribution and density of various strains of chroococcoid cyanobacteria in the open ocean, and coastal waters as well as measurements of their growth rates.

Phytoplankton studies involve investigations on the ecology of the toxic dinoflagellate Gonyaulax tamarensis in Long Island waters. Other research concerns the resistance of phytoplankton to PCB's as well as an investigation of the viability of diatoms found in surface sediments of the New York Bight. Other phytoplankton research involves the factors involved in the formation and maintenance of blooms of the dinoflagellate Gyrodinium aureolum.

The importance of macrozooplankton as sources of regenerated nitrogen in local waters is being studied. The activity of the enzyme Glutamate Dehydrogenase is being used to estimate excretion of ammonium. The population dynamics of Temora longicornis are being investigated, and in particular this involves the effects of phytoplankton on Temora fecundity and importance of sand lance predation on Temora survivorship. The age and growth of juvenile sand lance is being studied through an investigation of their otoliths. The effects of water temperature on sex determination in Menidia is also being studied.

Rosenstiel School of Marine and Atmospheric Science:

Research is being conducted on the physiology and ecology of phytoplankton and gelatinous zooplankton. Temporal variations in protein synthesis and its relationship to overall growth in phytoplankton is being examined in detail. The relative importance of trace metal micronutrients compared to macronutrients is being examined in a large number of phytoplankton species to re-evaluate ideas concerning the most important nutrients in marine ecosystems. The nutrition and the role of food patchiness for ctenophores is being examined in the laboratory. Research is also being conducted on chaetognaths in both the field and the laboratory.

U.S.S.R.

(S. A. Studenetsky)

The Barents Sea.

In 1983 the euphausiid stock in the Barents Sea in winter was assessed to estimate the food supply for commercial fishes; peculiarities of the zooplankton growth and distribution in spring-summer were characterized; the most productive feeding areas for capelin, polar cod and blue whiting in the Norwegian and Barents Seas were investigated. Based on the data collected for many years (1972-1982) charts of the phytoplankton abundance in the Barents Sea area were made. Charts of

distribution and tables showing the abundance of deepwater shrimp along the branches of currents were made. Yearly changes in the index of fullness and condition factor as well as other biological indices for capelin of different age groups were analysed.

98 phytoplankton samples, 2190 those of zooplankton and 220 ones of euphausiids, taken with a trawl-attached net, were collected, 3527 larval shrimp were measured and stages of development determined, a quantitative-weight analysis of feeding was made for 200 capelin and 20 blue whiting.

In 1984 the researches on plankton in the Barents and Norwegian Seas will be conducted according to the previously adopted programme (PINRO).

The White Sea.

Much attention was paid to raising the productivity and rational exploitation of biological resources of the White Sea. Complex investigations of production and destruction processes, vegetable pigments, organic substances and biogenic elements were conducted. Nowadays the tendency to the increase of organic substance abundance is observed in the White Sea (VINRO). Spatial and vertical distribution of productive phytoplankton and bioproductive parameters of bacteria were studied. It was revealed that the Kandalakshsky Bay was the most productive area (Murmansk Marine Biological Institute).

The results of studies on interseasonal and spatial variations of zooplankton in the Kandalakshsky Bay were summed up. Reliable assessment methods of total zooplankton abundance in the area in question were found. Biology and life cycles of plankton organisms were studied (Zoological Institute, Moscow State University).

Much attention was paid to investigations of benthos. Bottom biocenoses were distinguished and peculiarities of their distribution in the bays of Kandalakshsky and Dvinsky were studied. New data were obtained in favour of the assumption of the existence of three layers in the biological structure of the White Sea and the attraction of some benthic species to definite water masses and types of sediments (Moscow State University). Distribution abundance and prospects of the utilization of mussels from natural settlements were investigated.

The analysis of food supply of benthos-eating fishes resulted in the scheme of the distribution of food benthos biomass in the Kandalakshsky Bay (Moscow State University).

The Baltic Sea.

Zooplankton. Zooplankton surveys in areas 25, 26, 28 and 29 of the Baltic Sea were conducted in February, August, October-November and according to the partial programme - in April, June, July and September. In the Gulf of Riga sampling was done monthly in February and in April-November; in the Gulf of Finland sampling was done in May, August and October-November. 451 samples were taken in the Baltic Sea, 231 samples - in Gulf of Riga, 182 samples - in the Gulf of Finland.

Samples were taken by Juday net 37/50 with mesh size 0.09-0.16 mm in the filtering cone.

Ichthyoplankton. Ichthyoplankton surveys were collected monthly in areas 25, 26, 28, 29 and 32 of the Baltic Sea from March to May and in July. 274 samples were taken by X-80 net.

Nektobenthos. Nektobenthos surveys were conducted in areas 26 and 28 of the Baltic Sea in January, March, May and September. 138 trawlings were carried out with Isaacs Kidd trawl (10 feet model). In the Gulf of Riga 33 trawlings were done with Rass trawl in June-August.

Zoobenthos. Zoobenthos surveys were carried out in June, July, September and October in areas 25, 26, 28, 29 of the Baltic Sea, in the Gulf of Finland surveys were also carried out in May. 360 samples were taken. Fishing gear was Van-Veen bottom dredge with the covering of 0.1 m².

Fish feeding. Data on feeding of herring and sprat were collected in areas 26 and 28 of the Baltic Sea in January, March, May, July and September. 3.2 thou. stomachs were collected. In the Gulf of Finland samples were taken in April and May. 0.5 thou. digestion tracts were collected.

List of Publications - 1983

- Grauman, G. B. Ichthyoplankton. In: Ecosystem and its components, iss. I Gidrometizdat, Leningrad.
- Grauman, G. B. Long-term dynamics of ichthyoplankton abundance in the Baltic Sea. All-Union conference on problems of early ontogenesis of fish. Abstracts, Kaliningrad.
- Koptev, A. V., Nesterova, V. N. Peculiarities of the latitudinal distribution of summer plankton in the eastern Barents Sea. In: Investigations of the biology and physiology of hydrobionts. Academy of Sciences, Apatity.
- Kostrichkina, E. M. Zooplankton (open sea areas). In: Ecosystem and its components, iss. I, Gidrometizdat, Leningrad.
- Kotta, I., Simm, M. Biology and production of *Mysis mixta* in the north-east Baltic. Scientific conference on the problems of utilization of Pribaltic and Belorussian waters. Abstracts, iss. I, Pskov.
- Line, R. Ya. Characteristics of weight changes of mass zooplankton species from the Gulf of Riga (*Eurytemora hirundoides* and *Arctia bifilosa*). In: Fisheries investigations in the Baltic Sea. Riga, iss. 18.
- Pshenichny, B. P., et al. Problems of artificial upwelling. J. Rybnoe khozyaistvo, No. 5.

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