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Administrative Report

FISHERIES IMPROVEMENT COMMITTEE

by Grim Berge

1972

Belgium

(R. De Clerck)

Research was continued on the disposal of industrial waste water by ships off the Belgian coast. The density of the fish and shrimp stocks was measured on a monthly basis by means of research vessel catches. The occurring fauna was also qualitatively determined.

Research was continued on the determination of heavy metals, PCB's and pesticides in fish and shrimps. The samples were taken both during regular surveys off the Belgian coast on shrimps, plaice, sole, cod and whiting, and during the market research which for plaice concerned three fishing grounds, viz. the North Sea, the Bristol Channel and the Irish Sea.

Canada

(D.C. Gordon jr.)

Pollution

Efforts were directed towards determining whether mercury contamination has destroyed the Atlantic swordfish industry and assessing the possibility of preparing FPC from mercury contaminated fish. Recent studies indicate a potential for the reclamation of mercury contaminated proteinaceous food by an extraction procedure very similar to that employed in making fish protein concentrate.

A study of mercury contamination in the east coast swordfish fishery has been carried out in an attempt to determine the source and extent of mercury contamination in this fishery. Total mercury and methyl mercury analyses have been completed on specimens and tissues from seven cruises in different locations. Mercury analyses on the stomach contents of swordfish from four cruises have also been completed. It is hoped that the stomach content analyses will indicate the source of mercury contamination.

A study of the distribution of toal and methyl mercury throughout the tissues of several swordfish was carried out in order to have a better understanding of mercury contamination in this species. It was found that mercury concentrations varied considerably in the internal organs and tissues but was uniform in the edible part of the fish.

The concentration of total mercury in seawater has been measured along the Halifax-Bermuda section. All analytical work has been done on shipboard. concentrations are very uniform with both distance from the coast and depth, averaging about 0.2 µg/l. Geochemical calculations indicate that most of this mercury is natural in origin.

A study on the total mercury and methyl mercury concentrations in Nova Scotian eels (Anguilla rostrata) has shown that the mean total mercury concentration was 0.72 ppm and only 50% of the total mercury was methyl mercury. This finding is particularly significant inasmuch as the general consensus has been that practically all mercury in fish is in the methyl form.

Studies on east coast seals have shown that they are highly contaminated with mercury; yet they appear to tolerate it. It is suspected that seals may, in fact, demethylate the mercury contained in their food since high levels of mercury in seal liver are not in the form of methyl mercury.

In work on the development of a bioassay method it has been shown that at high levels of mercuric chloride (5 ppm) cellular enzymes were inhibited while at lower levels cellular respiration was unaffected but cell multiplication was inhibited. The evidence available suggests that mercuric mercury may interact with cellular genetic material and prevent cell division at particular stages. The bioassay method is being refined and described further and appears to hold promise for replacing, in specified circumstances, live animals used now for bioassay purposes. This tissue culture bioassay system offers the triple advantages of rapidity, sensitivity and reproducibility.

Cadmium levels in several fish have been determined. Cadmium is known to cause infertility in man and toxaemia of pregnancy in women; therefore a study of this metal on the reproductive behaviour of fish was carried out. It was found that this metal at very low concentrations (ppb levels) was very toxic (also lethal) to salmonids and interfered with their reproduction process.

Increased levels of PCB were detected in hatchery-reared Atlantic salmon. The source of this contamination was an anti-fouling paint used in the hatchery tanks. Oral uptake of PCB by fish results in lower whole-body residues of PCB than uptake from water. Feeding experiments with isometrically pure chlorobiphenyls indicate that fish do not metabolize these compounds. Components of one peak of the commercial PCB preparation, Aroclor 1254, are disappearing faster than components of the other peaks after the feeding of fish with PCB-contaminated diet had been discontinued.

It is known that sub-lethal concentrations of PCB's interfere with steroidogenesis and reproduction in birds who eat fish contaminated with PCB's. A study was performed to determine the effects of this universal pollutant on reproduction in salmonids. Preliminary results from short time exposure of salmonids to sub-lethal concentrations of this contaminant have indicated that they are able to reproduce; however, less than 5% of eggs from both controls and PCB treated fish hatched when incubated in water containing a concentration of PCB not lethal to fish. None of the hatched salmonids survived more than a few days in this contaminated water. This study is being continued.

Studies on the ability of marine organisms to metabolize and transport DDT and PCB components are under way. Following intravenous administration to skate (Raja radiata), DDT was deposited in fatty tissues, principally liver. Metabolic clearance rate from blood was approximately 150/200 ml/hr. Metabolism of DDT was not detected, even over prolonged periods. After five weeks, approximately 80% of the administered dose could be recovered from the fish, indicating that excretion from the animal was slow. The transport of 2-, 3-, and 4-chlorobiphenyl has also been studied in the skate. Following intravenous administration, the 2- and 4- isomers are deposited in fatty tissue (liver) but the 3- isomer appears to be either preferably metabolized or excreted. Both skate and trout can metabolize biphenyl to its 4- hydroxy derivative; small amounts of 2-hydroxy biphenyl are also formed.

Blubber samples from harp seals taken near the Saguenay River in the Gulf of St Lawrence were analyzed for DDT metabolites, PCB and dieldrin. The concentration of total DDT and metabolites (ΣDDT) ranged from 3.1 to 22.6 ppm, PCB (as Aroclor (R)1254) from 2.4 to 22.2 ppm and dieldrin from 0.1 to 0.3 ppm of blubber. Residue level was positively correlated with age.

Analyses of plankton ranging from 73 to 2000 microns in diameter collected from the Gulf of St Lawrence just north of Prince Edward Island, indicate a clear inverse relation between particle size and PCB (matched to Aroclor 1254) tissue concentrations. On a wet weight basis, small plankters (73 to 102 microns) contained in the order of 7 ppm PCB, whereas larger plankters (760-1050 microns) contained about 0.10 to 0.08 ppm. Only traces of DDT and derivatives have been detected.

Chlorinated dibenzofurans, possible impurities in commercial PCB preparations, are much more orally toxic than PCB to juvenile Atlantic salmon. Only octachlorodibenzofuran was detectable in dead fish and the fate of the less chlorinated dibenzofurans is not known. The present analytical method may not be sensitive enough to detect sublethal levels of di- tri- and tetrachlorodibenzofurans in fish. Analyses of yellow perch, herring, and exchange samples for PCB and chlorinated hydrocarbon pesticides for the OECD "Toxic Chemicals in the Environment 1972-1974" programme have been completed.

A method for the determination of phthalates in biological samples was developed. Dibutyl and di-2-ethylhexyl phthalate, used as plasticizers and additives in a variety of products, were detected in eggs of double-crested cormorants and herring gulls, in the blubber of a common seal (Phoca vitulina) pup, in commercial fish food and in hatchery-reared Atlantic salmon.

A survey of hydrocarbons in seawater along the Halifax-Bermuda section indicates that concentrations drop markedly between Halifax Harbour (1-70 ppb) and the northwest Sargasso Sea around Bermuda (1-3 ppb). Concentrations over the Scotian Shelf are intermediate (1-10 ppb). Except in Halifax Harbour, these concentrations apparently have no adverse effect on the photosynthetic activity of phytoplankton. Laboratory experiments designed to study the accommodation of oil in seawater indicate that oil concentrations up to about 1000 ppb can occur in seawater, most oil entering seawater is in particulate form, the concentrations of oil appearing in seawater are inversely related to temperature, and most oil particles are smaller than 10 microns in diameter.

Fish Transplantation and Cultivation

The devastating effects of lobster disease are well known. Many of the factors have been defined and current work centers around means of treating diseased lobsters and understanding the natural defence mechanisms of the lobster against invading disease organisms.

Studies are continuing on the use of antibiotics to control gaffkemia in lobster. Vancomycin pretreatment of healthy lobsters was still completely effective in preventing the development of gaffkemia as far as 15 days after antibiotic administration. Studies to determine the end point of efficacity have been completed.

In the studies of the defense mechanisms of crustaceans the bactericidin which can be induced in the hemolymph of the lobster by the use of vaccines has been shown to be a product of hemocyte : plasma interaction. The induced bactericidin, however, has not conferred protection against Gaffkya homari.

Live and formalized vaccines prepared from avirulent strains of G. homari were injected into groups of lobsters to determine if bactericidal activity was induced or increased. Bactericidal activity tests showed there was no induced activity when the avirulent strains were used as test organisms but there was increased activity using Ps. perolens as the test organism. In vivo tests to determine whether the host's resistance was enhanced showed a limited form of resistance.

Synthetic or artificial diets of known composition have been developed for use in oyster and lobster nutrition studies. Preliminary nutrition studies have been completed with oysters at Ellerslie and lobsters at Halifax. In trial studies, lobsters receiving diets where corn oil was the only source of lipid, had a very high mortality rate immediately after molting. In contrast lobsters on diets with cod liver oil as the sole lipid source showed a low mortality rate and good growth. Casein or fish protein concentrate was satisfactory as a suitable protein source; no difference was observed between glucose or corn starch as a carbohydrate source. From these initial studies control diets for maintenance and growth promotion are now available for future experiments with both lobsters and oysters.

Based on growth, glycogen content and condition index data, cod liver oil is a better lipid than corn oil for oyster feeding. Diets with 18% of either lipid resulted in greater meat production and earlier sexual maturation than those with only 5% lipid. Oysters from the same initial stock held in floating trays in Malpeque Bay and feeding on natural diets grew 5-10 times as large as any of the oysters on artificial diets over the 12 week period indicating the extent of work required to formulate a comparable synthetic diet.

A survey of the microflora of two oyster production areas in the Maritimes indicated that vibrio incidence was consistently higher in the specimens from Malpeque Bay area than in those from Bras d'Or Lake area (an area not affected at the moment by Malpeque disease). The relationship of these organisms to weaken the oyster before occurrences of epidemics of Malpeque Disease is being studied.

Oysters transferred from Bras d'Or Lake to Malpeque Bay have suffered over 90% mortality after 2-year exposure. The diseased oysters generally exhibit a poor condition factor, shell recession and yellow pustules. These specimens are being processed for pathological examination and are invaluable for our oyster disease investigation.

Returns from natural spawning pink salmon (Oncorhynchus gorbuscha) were low in 1971, 468 to North Harbour River (the home river) plus 154 to the commercial fishery and other rivers from 1 116 spawning adults in 1969. Returns during 1972 were even more disappointing. There were only 58 returns to the river plus 59 from the commercial fishery and other rivers from approximately 1 400 spawning adults in 1970. One of the reasons for the low return in 1972 is probably because of predation on the fry by cod and haddock which were present in unusually large numbers in the estuary of North Harbour River during the fry run in the spring of 1971.

Second generation oysters (Ostrea edulis) bred under quarantine at Ellerslie, Prince Edward Island were shipped to Newfoundland and set on August 29, 1972 in trays suspended 1 metre below the surface in two locations, one in Conception Bay (350 specimens) and one in St Mary's Bay (227 specimens) on the Avalon Peninsula. By November 7 mean length increments added were 7 and 14 mm on an initial length of 38 mm. The only mortality observed was due to breakage in handling. The trays were moored on bottom late in November in 10 fathoms in Conception Bay and 3-4 fathoms in St Mary's Bay.

The oyster spatfall monitoring project initiated in 1971 was continued in 1972. This project designed to determine commercially-reliable spat collection areas will continue for at least three more seasons. Spatfall results in most areas were poorer in 1972 than in 1971, but a number of stations did collect well, indicating some reliability.

Estuarine resource inventories were carried out in two areas of New Brunswick, Buctouche Bay and Caraquet Bay. These inventories are designed to determine the potential of Maritime estuaries for aquacultural development and to provide an information base for management of the shellfish resource.

A new oyster leasing policy was implemented in the three Maritime Provinces in June 1972. This policy relieves the oyster culturist of unnecessary lease acreage restrictions, while at the same time it discourages the non-productive and speculative type of leasing which prevailed under the old policy. Lease administration functions have also been consolidated to increase the Branch's efficiency in servicing the oyster industry.

The development and assessment of aquacultural techniques for off-bottom rearing of the American oyster was continued in 1972. Results to date indicate that a high quality, half-shell oyster cannot be produced solely by shell-string rearing, and that the best strategy would be to remove oysters from shell-strings at approximately 22 months and to rear them on-bottom for two or more seasons. Greater emphasis is now being directed to manipulation of the shell-string produced seed oyster to improve shell and meat quality for marketing.

Studies will be initiated in 1973 to test the economic feasibility of hydraulic harvesting in conjunction with depuration as a means of utilizing soft-shell clams (Mya aremaria) from contaminated waters. It is felt that the savings in harvest cost will balance the extra costs of depuration, while at the same time control of digging will be facilitated and public health hazards reduced.

A 2-year saltwater rearing project, using rainbow trout and Atlantic salmon, was initiated in 1972 to determine the technical feasibility of raising these species to commercially marketable sizes in relatively low-cost floating enclosures. The project is located on the southeast coast of Cape Breton, Nova Scotia. In the first winter, total mortality of both salmon and trout occurred when temperatures approached 0°C. However, rainbow trout growth data obtained in 1972 indicated that a $\frac{1}{2}$ pound marketable size could be achieved within 6 months of their conversion to saltwater, prior to the onset of lethal temperatures.

Denmark

(Vagn Olsen)

The cultivation experiments with plaice and sole have been expanded. Experiments with hatching and rearing the hybrids of plaice and flounder have been carried out.

The toxicity of different industrial waste on sticklebacks and on plaice larvae have been examined.

Federal Republic of Germany

(H. Mann)

The basic programme on littoral research and pollution studies of coastal waters, which is supported and coordinated by the Deutsche Forschungsgemeinschaft, were continued. This work was done by many institutes in close collaboration. As in previous years, the essential problems are the effect of pesticides and heavy metals on the organisms of the sea. The content, uptake, biological and chemical decomposition of pesticides in marine organisms, such as commercially important fish, mussels and shrimps were studied. The concentration of DDT and metabolites, dieldrin and endrin were determined in many of the fish samples from the Baltic and the North Sea. In connection with these investigations the content of pesticides in fish oil was determined.

Furthermore, investigations were carried out on the influence of pesticides on the development of fish eggs.

Another problem is the effect of cadmium and EDTA on the development of eggs of the herring. These investigations show the uptake of cadmium in organs of the developing egg and on the other hand the influence of EDTA on this process.

The regular studies of the content of heavy metals (strontium, zinc, manganese, iron, cobalt, chromium and mercury) in the coastal water, rivers, plankton and fish are continued.

The salts of heavy metals ($CuSO_4$, $HgBr_2$ and $ZnCl_2$) have been examined concerning their metabolic and neuro-physiological effect on eel, plaice and sole.

The chemical, physical and biological studies on the effect of red mud on fish, plankton and benthos organisms were continued and summarised in a general report.

The Bundesforschungsanstalt für Fischerei prepared a report on the situation regarding the mercury content in fish and their preparation.

Investigations were carried out on the toxicity of non-ionogenic densities for different animal species in fresh- and seawater. The studies on the effect of proteolytic enzymes as additives to washing compounds were completed by investigations of the influence on the development of fish eggs.

Fish Cultivation

It was attempted to rear the larvae of the common sole (*Solea solea* L.) in small containers and in high density under laboratory conditions. Investigations are in progress to induce the spawning of the turbot (*Rhombus maximus* L.) by injection of hypophysical suspensions.

Finland

(A. Voipio)

Pollution

The continued pollution studies are mainly directed to the following parameters :

- The survey of the contents of certain nutrients and of other hydrographic or chemical properties outside the Finnish coast. These observations show, among others, a clear increase of total phosphorus in the Gulf of Finland in 1972 which is evidently caused by a new mobilisation of the Baltic deep waters.

- The measurement of primary production(*in situ*) used in the monitoring of eutrophication. Observations have been performed in three localities in the Gulf of Finland and in one in the Bothnian Sea.

- The production in the open sea areas has been studied by chlorophyll measurements.

- Studies on the distribution of the benthic animals in and outside the polluted areas have been carried out since 1966.

- The long-term study of the macrofauna of the sea areas around Finland was started in 1961 by the Institute of Marine Research in Helsinki, in accordance with a recommendation of ICES in Moscow in 1960. In 1965 the project was extended to cover typical areas of the whole Baltic. The main purpose of this study is to follow the long-term fluctuation of the macrofauna resulting from hydrographical and man-made changes in the environment.

- A long-term study on coastal zooplankton was started by the Institute of Marine Research in 1966, and is now carried out at five stations : Krunnit and Valsörana in the Gulf of Bothnia, Själö/Seili in the Archipelago Sea, and Tvärminne and Orrengrund in the Gulf of Finland.

- Activities of the Working Group on the Pollution of the Gulf of Finland. The Working Group was established within the frame-work of the agreement concerning scientific and technical cooperation between Finland and the Soviet Union. The primary purposes of the cooperation have been the development of mutually acceptable criteria for the evaluation of the effects of waste waters in the marine environment, and the exchange of information on the study of waste water treatment. Three symposia have been held on these related topics, and several excursions have been made by small groups.

  An analogous Working Group on the Pollution of the Gulf of Bothnia was established at the end of 1972 by the Finnish and Swedish authorities.

France

(L. Marteil)

Pollution

Les travaux effectués par l'Institut des Pêches maritimes, ontporté sur quatre catégories de polluants : les pesticides, les détergents, les métaux lourds, les hydrocarbures.

Pesticides - Les organochlorés et les organophosphorés habituellement employés ont été principalement recherchés dans l'eau de deux grandes régions conchylicoles. Les organochlorés d'origine agricole ont été les plus fréquemment décelés. La contamination actuelle reste cependant très faible. En outre, le DDT et ses dérivés ainsi que des biphénylpolychlorés (PCB) ont été trouvés, à des taux relativement élevés, dans les organes d'une vingtaine de cétacés échoués sur les côtes.

Les démoustiquants sont employés abondamment dans les marais bordant la côte atlantique. Des expériences ont été effectuées en liaison avec l'Office de démoustication sur 3 esters thiophosphoriques (Abâte, Fénitrothion, Dursban). Dans les conditions d'emploi, l'Abâte est complètement dégradé en 4 jours. Ce produit, testé en laboratoire, sur 18 organismes marins, est assez bien supporté même par les crustacés; suivant les espèces, la dose létale (DL 50 96h) est de 7 à 300 fois la dose mortelle pour les larves de moustiques.

Détergents anioniques - L'étude menée, sur contrat CNEXO, en 5 points du littoral a montré qu'en dehors de la baie de la Seine et de la rade de Marseille, la contamination est faible. Des essais de toxicité ont été menés sur 16 espèces marines avec 5 produits dont 4 biodégradables; les poissons paraissent plus sensibles que les autres organismes testés.

Métaux lourds - Mercure, cuivre, cadmium, plomb et zinc ont été recherchés. Les teneurs en mercure ont été mesurées sur 62 espèces receuillies par les navires océanographiques et sur des moules récoltées en 32 points du littoral, tous les trois mois, pendant un an. Des valeurs supérieures à 0.5 mg/kg ont été trouvées chez des poissons carnivores comme le thon et les sélaciens, alors que les teneurs se situent habituellement entre 0.02 et 0.30 mg/kg chez les poissons à vie brève ou phytoplanctonophages. Chez les moules, la moyenne est de 0.066 sur la côte atlantique, les moules d'élevage ayant des teneurs toujours nettement inférieures à celles des mollusques trouvés dans les eaux souillées.

Hydrocarbures - La pollution par les hydrocarbures est étudiée désormais en utilisant, comme révélateur, des coquillages. Les tests effectués jusqu'ici révèlent la présence d'un grand nombre de substances comparables aux hydrocarbures.

Bactériologie des eaux et coquillages - Des études de salubrité faites, en coopération avec d'autres organismes, en diverses régions ont porté sur la recherche des germes tests de contamination fécale; elles ont montré que les écoulements d'eaux polluées, venant de terre, influent sensiblement sur la salubrité des eaux.

Des travaux ont été, en outre, effectués pour mieux connaître les conditions d'épuration des coquillages, principalement de Cardium edule qui, du fait de son habitat, est souvent fortement contaminé et s'épure plus difficilement que les huîtres et les moules.

Elevage de Poissons

Les recherches sur le bar (D. labrax) et le turbot, entreprises depuis 1971 sous l'égide du CNEXO par le Centre Océanologique de Bretagne, portent sur l'approvisionnement en géniteurs, la reproduction artificielle, le développement des oeufs fécondés et la survie larvaire. Des pontes de turbot ont été obtenues; quatre incubations ont réussi fournissant, au total, un peu plus de 100 000 larves nouvellement nées dont on a essayé d'en nourrir près de 20 000.

Une technique de nutrition a été mise au point, basée sur la succession de deux norritures vivantes, le rotifère Brachionus plicatilis et Artemia salina donnant jusqu'à 20% de survie au vingtième jour à 21° environ. Toutefois, pour des raisons diverses, la métamorphose n'a pas donné tous les résultats escomptés. La reproduction du loup a également été réalisée en Mediterranée.

Des élevages de truites de mer sont en cours, à une échelle significative sur le plan commercial, en divers points des côtes françaises de la Manche, de l'Atlantique et de la Méditerranée; ils bénéficient du soutien scientifique, technique et parfois financier de divers organismes (CNEXO, ISTPM, etc...).

La reproduction contrôlée des daurades (A. aurata) et le développement des larves jusqu'au stade de l'alevin ont été réussis en Méditerranée à la suite de travaux menés conjointement par une Société privée et l'Université du Languedoc, sous contrat CNEXO.

Algues

L'essai préliminaire d'acclimatation de l'algue chilienne Macrocystis pirifera dans le nord-Bretagne a pris fin après que l'algue ait atteint en 7 mois une longueur de 13 mètres. l'expérience été réalisée par le laboratoire d'algologie de l'Institut des Pêches.

Iceland

(I. Hallgrímsson)

Samples were obtained from major fishery harbours and their vicinity in order to investigate possible nutrient input.

Ireland

No report received.

Netherlands

(P. Korringa)

The sanitary control of shellfish grown and stored in the water of the Oosterschelde and of theWaddenzee created no problems during 1972. Tests on coliform bacteria showed the oyster basins and the mussel cleansing plots on the Yersche Bank to be free from faecal pollution throughout the year. Although large numbers of the suspect dinoflagellate Prorocentrum micans were occasionally found during summer, all biological and chemical tests on the presence of shellfish toxins gave negative results.

No significant change could be detected in 1972 in the general situation of the pollution of the Dutch environment with mercury. Both the total amount of used-up mercury (ca. 100 ton) and the amount of mercury entering the Netherlands by the great border-crossing rivers (80-140 ton) remained more or less the same. In order to estimate the degree of pollution of the Dutch coastal waters, the mercury content of several species of fish and shellfish were studied. All fish and shellfish samples contained levels well below 0.5 ppm of mercury except for Twaite Shad (Alosa fallax) in which mercury levels exceeding 1 ppm were found regularly. Since this fish sojourns in fresh water bodies (like the river Rhine) during part of the year, the high amount of mercury found in this fish might rather reflect the degree of pollution of the inland waters than that of the coastal waters. As no indication of mercury pollution could be found in fish and shellfish samples from the coastal waters, except in some very localised places at outfalls,

one wonders whether a major part of the mercury introduced into the Dutch environment does reach the coastal area at all, and is not spread about over larger areas by atmospheric transport of mercury vapours.

The determination of PCB's and pesticides in fish and shellfish from the Dutch coastal waters revealed high levels of PCB's (an average of about 20ppm on fat basis) as compared with the other chlorinated aromatic hydrocarbons present. The alarming situation with respect to PCB's has so far resulted in a voluntary restriction in the use of these compounds by some Dutch industries.

Phytoplankton surveys in the Dutch coastal area were made regularly in search of phytoplankton blooms as possible effects of the strong eutrophication of these waters. Such blooms did occur, consisting mainly of diatoms. At the end of June, a very intensive bloom of the diatom Coscinodiscus concinnus was observed along the coastline between IJmuiden and Den Helder. The stench of the disintegrating diatoms on the beaches, strongly reminding of cow-dung, was reason for many complaints from the recreation sector. A change in the atmospheric condition made the adverse effects disappear. Since little is known on the possible role of phosphorus, nitrogen and silicon in creating a diatom bloom, it is not clear whether this bloom of Coscinodiscus concinnus should be considered as a purely natural phenomenon (a comparable bloom of this type, spreading the same stench was reported as early as 1849!) or must be considered as an effect of the eutrophication of the coastal waters.

In 1972 too herring samples were analysed to estimate the infection rate with the herring worm(Anisakis larvae). The present excellent control system makes it less urgent to continue such regular sampling. All herring for raw consumption passes the deep freezer. As compared with the 1971 data, there was no change in the average number (16) of Anisakis larvae per 3 and 4 year old.

Special attention was paid to the occurrence of parasites in herring larvae to study the mortality of fish larvae due to injury by infection. Attention was also paid to the occurrence of parasites in zooplankton organisms as source of infection of fish larvae.

Investigations on lymphocystis and Glugea stephani infection in plaice were continued, as was collecting of data on nematode infections of mackerel in search of a biological tag.

Several cases of parasitological and pathological infections were met in both marine and fresh water material sent by fishermen and institutes. Most of the infections were caused by parasitic protozoans, helminths and copepods.

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Norway

(G. Berge)

Pollution

The investigation of the conditions of polluted fjords continued. Observations were made in the Hardangerfjord, where several laboratories cooperate in the work on distribution of heavy metals in biota and sediments. The pollution originates in the metallurgic industries in the inner part of Sørfjord branch of the Hardangerfjord. In addition, extensive fruit farming and its use of pesticides may be the source of the raised levels of DDT and metabolites in stationary organisms. (The results are made available to the Institute of Marine Research.)

Several pollution studies are being carried out in fjords by the Norwegian Institute for Water Research. The studies include the quantity and quality of the receiving waters, waste water discharges and the mixing processes giving background information to municipal and industrial corporations. An algae assay is applied in describing the condition of a brackish area, Frierfjord in Southern Norway (Norwegian Institute for Water Research).

A study of the biological aspects of a planned nuclear power plant in southeastern Norway continued. The study is jointly undertaken by biologists from several research laboratories and are aimed at enlightening the problems connected with cooling-water discharges, thermal, radioactive and other pollution aspects.

A monitoring programme on the occurrence of hydrocarbons from oil in seawater was continued. Gas-chromatographic analysis of monthly samples in depths of 0-10 and 50 m from a permanent section between Norway and Shetland have been continued. Only two samples have revealed oil pollution indications. (Institute of Marine Research).

In order to comply with international qualifications such as maximum levels for mercury and other heavy metals, stocks of all commercial fish are analysed regularly in a programme organised by the Director of Fisheries. The results are made available to the Institute of Marine Research.

Samples of Shellfish, crustaceans and fish for the North Sea base-line studies were analysed. The samples were collected along the Skagerak and North Sea coast of Norway. The organic pollutants (PCB's, DDT and metabolites) were measured at the Institute of Marine Research, heavy metal analyses were carried out at the Institute of Marine Biology, University of Oslo. Several other national laboratories took part in the intercalibration exercise.

The problem of industrial waste in containers irregularly captured from the North Sea bed and near shore waters, was accentuated as the presence of PCB as well as several chlorinated hydrocarbons were established, using gaschromatographic-masspectrometric methods. Resulting from these observations, regulations have been made as to how the fishing fleet shall tackle the problem of such findings.

An investigation of the sub-lethal effects of chlorinated hydrocarbons on fertilisation, egg development and larvae survival were concluded and the results published. Routine toxicity tests (LC_{50}) were carried out on fish, phytoplankton and algae, with pollutants of current interest. Effects of 1,2-dichloropropane and monochlorobenzene from North Sea oils together with industrial spill water, such as from the Grinsted Works, and ortho-polyester production were bioassayed (Institute of Marine Research). Effects of sub-lethal concentrations of heavy metals, expressed in anatomic, histological and physiological changes in organisms as well as in the behaviour of organisms were studied (Institute of Marine Biology, University of Oslo).

A comparison of different chemical methods for sewage treatment was made as to their effect on removing heavy metals. (Institute of Marine Biology, University of Oslo).

Distribution of heavy metals in different species of zooplankton, mussels, shrimps (Pandalus borealis), flounder, sprat and herring form the Oslofjord were studied (Institute of Marine Biology, University of Oslo).

The effects of municipal sewage on the primary production of a landlocked fjord (poll) is being studied. Twice a month samples are measured on nutrients, O_2, pH, alkalinity, chlorophyll and primary production. The programme is part of a cooperative study of ecosystem dynamics. (Biological Station Espegrend, University of Bergen).

Aquaculture

A noticeable expansion has taken place in the activities concerning cultivation. At the Institute of Marine Research a group of scientists in March 1972 established a research team, their main activities concentrating on: Environmental factors:determining appropriate locations for fish-farming; Hatching: the consequences of hard/soft water on the various species (Norwegian/Canadian project) and the effect of concentrations and variations of salinity on juveniles ; Physiology - growth tests under controlled conditions, metabolism; Pathology - Vibriose; Nutrition - feeding, water content of dry food, vitamins and astaxantine addition.

In Matredal, on the west coast of Norway, the Institute of Marine Research has established a considerable fish-farming construction with access to seawater and to heated water from a hydroelectric plant. The work in Matredal is mainly concerned with genetics.

Growth tests on hybrids of flatfish (Pleuronectus platessa and P. flesus) are in progress. Further investigations were made into optimal conditions, particularly temperature,for the earliest stage of the juveniles (Institute of Marine Research).

The experiments with cultivation of mussels (Mytilus edulis) using the net bags has been continued and the method was successfully used by several farmers. The outlook for this form of cultivation is promising. No case food poisoning has been reported this year. (Institute of Marine Research).

Lobster

Growth tests with lobsters in heated seawater continue and indications are that lobsters kept under constant temperature of 15-16°C reach commercial size in 3½ years. (Institute of Marine Research, Biological Station of Flødevigen.

Investigations on the rate of molting of lobster larvae in relation to temperature, nutrition and light are in progress. (Institute of Marine Research).

Poland

(W. Mańkowski)

In Poland, two cruises were made in 1972 covering the area from the Skagerak through to the Danish Sounds, the southern and central Baltic up to the Åland Islands, including the Gulf of Finland. One cruise was made in spring (May-July), the other in summer (August/September).

During each cruise samples of plankton and bottom fauna were taken and hydrographical observations were made (t°, S‰, O_2). The material is being worked up with a view to prove the effect of pollution on the Baltic plankton and bottom fauna.

Portugal

(J. de Ataíde)

During 1972 the Instituto de Biologia Marítima carried out the following work on aquaculture :

Field Work - A programme has been initiated in the south of the country (Ria de Faro-Olhão) for the knowledge of the water quality, regarding the biology and chemistry, for the purpose of the culture of fish and crustacea.

Laboratory Work - a) Development of the experiments on the artificial culture of the Norway lobster (Nephrops norvegicus) and shrimp (Penaeus kerathurus)from the egg.

b) Study of the culture of marine organisms (Palaemonetes varians and Tisbe spp.) as food for the larvae and post larvae of fish and crustacea.

Sweden

(B.I. Dybern)

Baltic Sea

The investigations of the local and off-shore physical-chemical, biological and toxological factors as listed in the 1971 Administrative Report have been continued. Most of them are carried out within a national cooperative research programme for the Baltic. The efforts to produce a model for the Baltic have been continued and computer simulations of hydrochemical and biological processes have been started and some preliminary results have been published (S. Sjöberg et al. : Computer simulations of hydrochemical and biological processes in the Baltic. - Contributions from the Askö Laboratory, University of Stockholm, Sweden, No.1/1972).

Southern Sweden, including Øresund

Several local investigations in polluted areas or areas expected to be polluted have been carried out by the semi-official organisation "South-Coast Investigations" (SKU). The investigations have mainly been concerned with basic hydrographical parameters and plankton and benthos composition. SKU produces a series of reports "Studier över Sydlänens kustvatten" (Studies of the waters of the southern counties).

West Coast

The local investigations in some parts of the coast have been continued. The investigations in the heavily polluted Byfjord have made considerable progress and attempts are made to construct a working model for the fjord.

The investigations in the Idefjord at the Norwegian border have been finished as a whole, but follow-ups will be made later on. Preliminary results have been published (B.I. Dybern: The Idefjord - a destroyed marine environment. - Fauna och Flora 2/1972; in Swedish).

Relatively large-scale hydrographical and biological investigations have been started in the Brofjord north of Lysekil where a refinery is being built. The investigations are a base-line study of the conditions before the refinery starts operation.

During 1972 the results were published of a comprehensive study of the metal content in the sediments from a number of stations in the Kattegat, Skagerak and west coast inshore waters. For many of the stations the results also show the depth distribution in the sediment of the metals. (E. Olausson, Sediment investigations on the west coast, changes and stability - Meddelande från Maringeologiska laboratoriet, Göteborg, No. 4, in Swedish.)

Sweden took part in the 1972 ICES North Sea Pollution Base-Line Study.

United Kingdom

1. England and Wales

(H. A. Cole)

1. Fish Cultivation - Fisheries Laboratory, Lowestoft

The objective of this work is to establish techniques for the cultivation of marine fish and to develop these towards standards acceptable in commercial fish farming.

Turbot larvae were successfully reared through metamorphosis for the first time in 1972. The techniques employed included the use of rotifers (Brachionus plicatilis) for first feeding and the provision of culture conditions which ensured an adequate supply of oxygen to the larvae. The latter condition was imposed since it was felt that the failures in previous spawning seasons may have been caused by faulty development of the swim-bladder in turbot larvae. This theory will be examined further in the 1973 programme and additional information will be sought on optimum densities for larvae and food organisms.

Work is proceeding on the rearing of 0-group turbot to marketable size and sexual maturity. These trials have been running for over two years. Sufficient information on growth rates and food conversion efficiency have been obtained to form the basis of preliminary assessment of the economics of turbot farming. Present indications are that the turbot in question will mature in this, their third, year of life, after $2\frac{1}{2}$ years in captivity.

Further information is being obtained on growth efficiency on various diets and particularly on the efficiency of conversion of protein in the presence and absence of lipids. Further data on temperature and salinity optima for food conversion efficiency are also being obtained.

Research on the genetic development of fish stocks has been concerned mostly with plaice, but the recent successes with turbot may justify a switch to this fish in the near future.

Techniques have been developed for an accelerated system of inbreeding using a form of parthenogenesis in which eggs are activated by genetically inert spermatozoa. Recent work with halibut x plaice hybrids suggests that halibut sperm is "inert" in plaice eggs - a similar situation probably exists also

for plaice sperm in flounder eggs. These "false hybrids" are more viable than the parthenogenetic fish produced after fertilisation of eggs with radiation de-activated sperm.

Triploid plaice have been produced to assess the possible value of sterile fish in fish culture. Food conversion trials have so far shown no distinct differences between diploid and triploid females, but the ovaries of the former are very full and a fall in net efficiency can be expected in the diploids if the eggs are shed. Attempts to induce triploidy in salmonids have so far failed.

Formal genetic analysis is being done in plaice for genes which control enzyme systems. The analysis will involve the identification of parental and offspring genotypes within conventional matings and after parthenogenetic and triploid development. It is hoped that these analyses will supply information on the genetics of the enzyme systems and on the frequency of crossing-over in plaice chromosomes.

2. Fish Cultivation - Fisheries Laboratory, Port Erin

Turbot

In the rearing of turbot only one treatment proved successful and in this 46 larvae reached metamorphosis giving a survival of 10% from day 7 after hatching. A small number of Brill/Turbot hybrids were also reared and the post-metamorphosis growth of the best of these fish is being compared with that of the best of the turbot. At seven months after metamorphosis the mean weights of the best ten hybrids and the best five turbot were 110 g and 73 g respectively, food conversion efficiencies for this last month expressed as wet weight of food to wet weight of fish were 2.69:1 and 2.64:1. The food consisted of minced white fish muscle bound with a vitamin and mineral supplement.

Dover Sole

Tests on the suitability of mollusc flesh as a food for small juvenile fish showed that while fresh mussel (Mytilus) gonad produced the best growth, fresh and frozen whole mussel were also satisfactory. Frozen slipper limpet (Crepidula)was found to give better growth than Mytilus and trials will continue with this food with the aim of improving the presentation to avoid wastage caused by the breaking up of the bound pellet.

Investigations on the growth of sole at a range of dissolved ammonia and carbon dioxide concentrations have shown that the ability of sole to tolerate without loss of growth concentrations of unionised ammonia up to 0.1mg per litre is not affected by elevated carbon dioxide levels depressing pH down to 7.0.

The relationship between temperature and the rate of development of the eggs and larvae of dover sole has been studied and information obtained for a wide range of temperatures. Additional information has been obtained on temperature tolerance, and the growth of juvenile fish is being studied in relation to data obtained from investigations into their activity patterns and basic metabolism.

Lemon Sole

Survival to metamorphosis in a batch of larvae hatched from eggs spawned by freshly caught wild fish was greater than 50%, but although the juveniles were successfully transferred to a diet of live Lumbricillus their subsequent growth was poor.

Disease

Isolation of the bacterial flora associated with skin lesions has revealed the presence of Pseudomonas and Vibrio species. On the basis of biochemical tests a range of Vibrio types have been identified none of which conform to the

stated characteristics of V. anguillarum. The use of an antibiotic compound, FURANACE, produced in Japan and shown by work there to be particularly effective against Vibrio species is at present under investigation. Assays on blood taken from dover sole exposed to low concentration baths indicate that it is rapidly absorbed to produce probable therapeutic levels in this tissue.

Tests with the biodegradable organophosphate insecticide, MASOTEN, have so far shown it to be effective against leeches (Piscicola) and Entobdella on dover sole, and Lepiopthirus on brill.

3. Marine Pollution - Fisheries Laboratory, Burnham-on-Crouch

a) Monitoring

During the year, the national programme for the chemical monitoring of commercial species of fish and shellfish landed in England and Wales continued. Samples of fish were taken from coastal fisheries at six monthly intervals, and examined for organo-chlorine pesticide residues, PCB's and six metals. In addition, special investigations involving over 1 500 samples of fish and shellfish have been made to determine the concentrations of lead and cadmium in commercial species, particularly in those coastal regions which are likely to be polluted. Generally, levels of lead in fish and shellfish were low, but higher values, where they occurred, could be attributed either to lead of geological origin, or to industrial sources. This element is concentrated by certain shellfish, highest values being found in periwinkles (Littorina littorea) and limpets (Patella vulgaris) adjacent to an industrialised area. A report describing the distribution of lead in commercial species has been published. The survey of cadmium has been completed and the results will be published shortly. A re-survey of the distribution of mercury in fish and shellfish showed that since 1971 levels have remained the same, except in one polluted area where a substantial reduction has occurred as a result of effluent treatment. The monitoring programme has been extended to incorporate samples required for the ICES Cooperative North Sea Base-Line Study and the more limited OECD coastal study.

b) Toxicology

Toxicological studies have been made of a wide range of industrial wastes prior to disposal at sea through pipelines or by dumping from vessels. Over 150 effluents were tested in 1972. Brown shrimps (Crangon crangon) and armed bullheads (Agonus cataphractus) were exposed to varying concentrations of each waste for several days and the median lethal threshold concentration for each species is determined. For the majority of the wastes, the threshold concentration was reached within 4 days, but was not evident with 10% of the wastes, even after 8 days. Very few wastes had threshold values below 100 parts/10^6 and only two below 10 parts/10^6. Generally tests with Crangon and Agonus gave similar results. The effects of an effluent on the distribution of benthic organisms and on caged animals have been studied to relate laboratory tests to field conditions.

Experiments to assess the effect of long-term exposure of shrimps to mercury have shown that total body residues of mercury at death are largely independent of the exposure level reaching about 40 parts/10^6 for Crangon and 10 parts/10^6 for Pandalus montagui Obvious symptoms of sub-lethal toxication were not evident.

c) Ecology

Studies have continued to assess the distribution and effects of sludge disposal into the Thames estuary. Considerable effort was made to assess the movement of the liquid and solid phases of sludge by means of tracers (rhodamin and radioactive substances). There was some evidence that the solid phase was deposited on the sides of the channel in which the sludge

was released. It is not clear whether this material is then buried by sand, or more widely dispersed. Benthic studies have continued in order to relate the distribution of organisms to sediment type and sludge distribution.

Several sites used for the extraction of marine gravel have been examined. Detailed measurements of the distribution and shape of dredged banks and their subsequent change have been made using an advanced scanning sonar. In areas subject to anchor dredging little change has been found to occur over a period of one year; re-colonisation has taken place by fauna typical of fine deposits.

Investigations have been made to assess the distribution of diseased fish in the Irish Sea and in the Channel. Lymphocystis and ulceration were found in several species, with flounders most heavily infected. The incidence of infection was higher in the Irish Sea, probably as a results of different hydrographic features.

d) Oil

The toxicity of newly developed oil dispersants has been tested using standard techniques. Those tested include the newer non-aromatic based ones of relatively low toxicity and the traditional kerosene based dispersants. At the present time two dispersants of low toxicity have been approved for use in shallow water. Experiments have been carried out to assess the toxicity of mixtures of low-toxicity dispersant with oil; dispersed oil is now more toxic than the low-toxicity dispersants.

The effects on Crangon of oil sunk by the use of amine-treated sand have been determined. The toxicity of the material seems to depend on the volatile content of the oil. Feeding experiments showed that sunken oil is eaten by edible crabs, lobsters and brown shrimp, and retained in the gut of the latter until moulting takes place; thus sunken oil is likely to taint shrimps and other crustaceans and possibly predatory fish living on them.

In cooperation with the Torry Research Station, experiments have been undertaken to determine the uptake and elimination of oil fractions (n-alkanes) by plaice tissues. Samples of plaice were taken for analysis after they had been fed 10 mg oil/day for 10 days and held in clean flowing seawater; the results of the analysis are expected shortly. In cooperation with the Marine Laboratory, Aberdeen and the Torry Research Station, a survey has been made of hydrocarbons at 10 sites in the United Kingdom, chosen to represent different levels of oil and of other pollution. Samples have been taken of water from the surface, middle depth and bottom, the surface film, sediments, plankton, benthos and fish. The results of analyses are not yet available.

e) Microbiology

Investigations have continued in the Laboratory and the field to solve problems related to the sewage pollution of molluscan shellfish. Field surveys have been made in a number of areas to overcome local pollution problems. The tracer bacterium Serratia marcescens has been found to be useful for following the distribution of sewage.

Experiments with a high density purification unit have successfully removed faecal bacteria from hard clams (Mercenaria mercenaria), and experiments are now being made with Crassostrea gigas. Technical improvements in the methods of determining E. coli in shell fish have been made, and the use of the membrane filter for the examination of polluted seawater has been developed. Experiments have started to assess the value of coliphage as an indicator of faecal virus in seawater and shellfish. The bacterial flora of shellfish has been examined in detail.

Qualitative aspects are being assessed by Adansonian techniques and it is hoped to identify those organisms of particular value in qualitative studies. Investigations have continued to establish whether or not a commensal flora exists in shellfish.

2. Scotland

(A.D. McIntyre)

Food Chain Investigations

The studies of the food chain leading to juvenile flatfish, initiated some years ago in Loch Ewe, on the west coast of Scotland, were extended to the Firth of Clyde in 1972, when a pilot survey was made of this food chain in polluted and non-polluted parts of the Firth. Depending on the results of the pilot survey, it is planned to extend this work in 1973. The equivalent work in the sand eco-system in Loch Ewe has been reduced to routine monitoring of the main prey and predator stocks, but studies of the mud eco-system (the food chain leading to Nephrops) are being continued.

Shellfish

Mollusca - Experimental cultivation of mussels (Mytilus edulis) in sea lochs on the west coast of Scotland, and studies of transplantation methods, were successfully concluded in 1972 and the results are being assessed. Following these experiments, attention is being turned to other species of bivalve molluscs. The growth and fattening of the seed of the scallop (Pecten maximus), the queen (Chlamys opercularis) and two species of oyster (Ostrea edulis and Crassostrea gigas) will be studied in a number of areas.

Crustacea - In April-May 1972 broken concrete slabs were laid as four reefs on a bottom of smooth rock south of Aberdeen in an attempt to improve the ground as a habitat for lobsters by providing hides. It is too early to assess the success of the experiment, though the reefs have acquired a characteristic flora and fauna.

Fish Farming - Disease and Parasite Studies

Extensive outbreaks of Infectious Pancreatic Necrosis (IPN) virus disease previously unrecorded in UK before 1971 have been diagnosed in all major Scottish trout farms this year. The disease has caused mortalities ranging from 10-80% in fry of Salmo gairdneri and Salmo salar. All but one of the outbreaks has been traced to a single source of imported rainbow trout eggs. An investigation of the properties of the strain of IPN virus has commenced as well as a survey of the possible spread of the virus into wild stocks of salmonids.

Parasitological studies of farmed marine flat fish have continued in cooperation with the WFA at Hunterston and Ardtoe and marked seasonal variations in infection by several parasites have been recorded. Protozoans belonging to the genera Glugea and Myxidium are known to be serious fish pathogens and one species of each which appeared in plaice and turbot was selected for experimental study. The risk of transporting parasites to new localities or of exposing fish to new parasitic infections has been highlighted by this study.

An investigation of the protective mechanisms against disease in the plaice with particular emphasis on the immune response, has shown that despite the limited and different distribution of lymphopoetic tissues the cellular architecture and the fat of foreign materials is very similar to the well studied mammalian systems. Current studies are aimed at characterising the lymphoid cells responsible for antibody production.

Pollution

Shellfish and public health

The laboratory has provided analysis of shellfish and water for indicators of faecal pollution to ensure a safe product and also to ensure that exploitation is not hampered by unfounded fears of contamination.

Advice on purification has been provided.

Facilities for the detection of toxins typical of Paralytic Shellfish Poisoning are maintained, so that checks can be made immediately reports of toxins are received from regions adjacent to the areas subject to our surveillance.

Firth of Clyde

In an overall study of the Clyde in relation to pollution, interim assessments have been made of the salt balance and the associated dilution of nutrient rich inputs. In addition, a tentative budget has been produced of metals, including the inputs and distributions in water and plankton. For the latter, the use of a double plankton net has enabled a separation to be made into macro- and micro-zooplankton and where possible sub-samples have been made of individual species. This has provided a much more detailed picture of the distribution of metals in the pelagic phase.

In 1973 it is planned to fill gaps in the budget by suitable sampling.

Base-line and other surveys

A substantial effort was directed by the Marine and Freshwater Fisheries Laboratories to the collection and analysis of fish, shellfish and plankton samples for various metals as a contribution to three major surveys of pollutants in the marine environment and its exploited resources : viz, a national survey on metals on food stuffs, the ICES base-line survey, and the USA's IDOE pollution survey and other surveys. The laboratories have participated in a number of intercalibration exercises in connection with these.

Collections of water were also made from selected sites round the Scottish coast for analysis of oil components.

Experimental work

The programme of experimental studies of the effects of sub-lethal concentrations of pollutants on the bivalve/flatfish food chain in outdoor tanks was continued. Copper and mercury were added to the same system but combined with enrichment by phosphate and nitrate so that the synergistic effect could be examined. The same food chain was used to study the effects of Aroclor (PCB) compounds.

In another series of experiments the effects of various concentrations of copper on the survival and hatching of herring eggs and of the growth and development of the larvae were studied. The effects of copper on copepod mortality and grazing were also examined in a further series of experiments, and it was shown that the feeding rate was affected by levels about one order of magnitude less than the 48 hour LC 50 level.

In 1972 experiments were begun by the Marine Laboratory, Aberdeen and the Torry Research Station on the effects of soluble components of oil and of oil in water, on fish and shellfish. The study is planned to allow for a six month exposure to oil followed by a six month period

when the disappearance of contamination from the tissues will be followed. Studies of the effect of changes in the physiological status of fish on the transport of ingested doses of organochlorine pollutants from "safe" fat stores to sensitive brain sites have been continued. It has been found that during starvation of the rainbow trout, the proportion of the total body burden of DDT localised in brain tissues was more than twice that observed in fed, control fish. Lesser rises were observed in liver and muscle. Administration of physiological doses of adrenalin caused an increase in the concentration of DDT in the blood plasma reflecting the movement of plasma fluid to extravascular compartments. Administration of cortisol or ACTH resulted in larger increases in plasma DDT concentrations by effecting, additionally, a mobilisation of the polluted depot lipids. These experiments provide a rationale for the suspicion that stress and starvation greatly increase the toxicity of fat soluble pollutants. Parallel studies of PCB transport are in progress.

Investigations of the pollution induced hepatic metabolism of oestradiol and testosterane, which may be expected to affect reproduction in fish are being extended.

Studies of the rates and routes of metabolism and clearance of DDT and PCBs have been carried out on the plaice (Pleuronectes platessa) and on Tellina and plankton species.

Physiological investigations

Investigations of the physiological changes in fish which must be expected to be induced by stress and fright have been continued. Capture and tank adaptation in the trout (Salmo gairdneri) and plaice (Pleuronectes platessa) has been shown to result in a rapid drop in plasma thyroxine levels which is sustained for at least 60 days and which appears to be the sequel to a reduction in the activity of the pituitary gland.

Further analysis of the concentrations of thyroid hormone levels in the plasma of plaice and of the rainbow trout have revealed a clear seasonal cycle, maximum levels being attained during October-November, coinciding with the minimum catch per unit fishing effort in the north-western North Sea and minimum levels being recorded during May, synchronously with the maximum catch per unit effort.

At the Freshwater Fisheries Laboratory, Pitlochry, analysis of rain water for organochlorine residues have been made on samples collected at four sites in Scotland, in an attempt to assess the extent to which this mode of transport may be involved in the contamination of freshwaters and the ocean. Analytical facilities peculiar to this type of sample have been largely overcome and the concentrations of total DDT and PCB found have been mainly below 20 PPT less than the DDT values reported in earlier literature.

Analysis of seals, porpoises and whales from the coasts of the UK and other areas of the north Atlantic have been continued, both organochlorines and heavy metals being determined. The organochlorine residues are used to assess the extent to which the areas from which the samples are obtained are contaminated by local discharges, or reflect the more general level of contamination of the oceans. The residues of lead, cadmium, copper and zinc in seal liver samples, while much higher than in the fish taken as food, seem to be unrelated to both. Mercury concentrations of seal liver seem to increase with age, but in brain tissue the level appears in almost all specimens to be too low to have any toxic effect.

Investigations of the distribution of organochlorines in plankton samples from the Clyde and eastern Atlantic were continued, the Clyde samples showing consistently higher levels of contamination. With reduction of PCB concentrations and sewage sludge discharged to the Clyde estuary, observations on PCB levels and plankton and fish in the area will be continued to follow the expected decline.

U.S.S.R.

(A.S. Bogdanov)

In 1972 some research institutes carried out investigations aimed at a study of the effect of some toxic substances (oil and its by-products, pesticides and so on) on water organisms.

These investigations will be continued in 1973.
