

SHELLFISH AND BENTHOS COMMITTEE

by F. A. Gibson

1970

MOLLUSCA AND BENTHOS

Belgium

(R. De Clerck)

Mytilus edulis

Research surveys on the formation of mussel beds along the Belgian coast were made in 1970.

Canada

(D.G. Wilder)

Crassostrea gigas, Ostrea edulis and Crassostrea virginica

The exotic species, Crassostrea gigas and Ostrea edulis, and the native Crassostrea virginica were reared in a shellfish hatchery and held in the field under similar conditions. At 18 months the mean whole weight of C. gigas was 54 grammes, over twice that of O. edulis (22 g) and four times that of C. virginica (13 g). The largest C. gigas were over 90 mm long and weighed over 70 grammes.

Electron microscopic examination of tissue from oysters susceptible to Malpeque disease and exposed to the disease-infected area for 1-2 years revealed no viral particles. Longer term studies are in progress.

Placopecten magellanicus

A June survey revealed that small scallops were abundant on the Northern Edge of Georges Bank. Up to 180 kg of 40-80 mm scallops were caught per tow and up to 10 scallops per square meter were seen in bottom photographs. A survey of meat sizes landed showed that many boats were retaining smaller scallops than in previous years.

Gear selection studies showed that in areas of high abundance, the 50% selection point for the back of a scallop drag was 65 mm. Most scallops, however, pass through the belly and are particularly liable to injury as the heavy drag passes over them. Shell shock marks indicate that the greatest probability of damage occurs at a shell diameter of 60 mm.

Studies on growth and condition were started using hanging culture cages developed for use with Japanese scallops.

Prerigor scallop meats, iced, frozen or thawed yield a superior cooked product. In iced meats, texture firms as the meat enters rigor. Meats frozen in rigor or postrigor were objectionably firm and tasteless. The desirable features of prerigor frozen scallops are retained at least 1 1/2 years at -40°C.

### Arctica islandica

In aquaria ocean clams grew only 1.0 to 1.8% in length from May to October. In suspended culture baskets, growth was 50% faster. Canadian stocks are large and widely distributed. A new fishery landing 45 000 kg of whole clams per month is marketing small clams for the raw, half shell trade, and larger clams for chowders and other products.

### Paralytic shellfish poison

Paralytic shellfish poison scores in the Bay of Fundy were unusually high in 1970. Ocean clams were about 20% as toxic as blue and red mussels, excreted poison quickly and were poison-free for long periods. Rough whelks were responsible for 4 deaths. An extensive review of paralytic shellfish poisoning in the Canadian Atlantic has been accepted for publication and is expected to appear in 1971.

### Cephalopoda

For the third successive year squid (Illex illecebrosus) were virtually absent in Newfoundland inshore waters resulting in the failure of the commercial fishery. Few samples were obtained for population studies and a planned tagging programme was postponed.

### Benthos

In assessing the potential of benthic invertebrates as food for groundfish, 200 bottom grab samples were analyzed. Samples from a silt-clay basin were relatively uniform and differed from all others. This basin has been identified as a functional unit. Productivity of the prominent polychaete Pectinaria hyperborea ranged from 0.03 to 7.6 kcal/m<sup>2</sup>/year.

### Denmark

(Sten Munch-Petersen)

### Mya arenaria

A population investigation of the soft clam, using the models described by Beverton & Holt, was undertaken in 1970.

### Mytilus edulis

Mussels from the Limfjord have been tested for their content of lead, mercury, copper, chromium and zinc.

Studies on Mya arenaria will be continued in 1971. The information on heavy metal content in Mytilus edulis will be communicated to the Fisheries Improvement Committee.

### Benthos (Vøgg H. Jacobsen)

The work on the determination of organic matter in the seabottom of the Danish Waddensea has been temporarily stopped after an annual survey has been completed. Instead, similar works have been carried out in shallow waters around Sjælland, where occurrence and accumulation in heavy polluted areas have been studied.

Finland  
(J. Lassig)

Institute of Marine Research

The quantitative study on the bottom fauna in the seas around Finland which was started in 1961 in accordance with a recommendation in Moscow in 1960, was continued in June and July on standard stations. A number of reference stations were visited in the southern Baltic. The number of stations sampled was about 70.

In co-operation with the Finnish IBP-PM, studies on benthic macro-fauna were continued at 5 stations in the archipelago of Tvärminne. The stations were sampled in March, May, June, August and October.

Furthermore, the benthos of polluted Finnish coastal areas was studied at about 100 stations in August. This work is connected with the environmental studies of the Institute.

Tvärminne Zoological Station, University of Helsinki

Items of study : a) Bottom fauna at standard stations (continuation of earlier work), b) Mesidotea entomon (Isopoda) : ecological studies (continuation of earlier work), c) Harmothoe sarsi (Polychaeta) : ecological studies combined with studies on meiofauna (continuation of earlier work), d) Lamellibranchs : studies on the reproductive cycle (continuation of earlier work), e) Oligochaeta : faunistic and ecological studies (continuation of earlier work), f) The tolerance of benthic invertebrates to different concentrations of ferrous sulphate and waste water containing sulphuric acid (these studies are part of investigations on the distribution of some heavy metals in the sea, and on their effects upon the biota), g) The uptake and elimination of methyl-Hg in benthic organisms, especially in Mytilus edulis; the dependence of these processes on temperature and Hg-concentration.

Archipelago Research Institute, University of Turku

Two separate studies on the ecology and abundance of macrobenthos at about 20 stations within each study were carried out in the waters around the Institute (on the Island of Seili/Själö). In the same area, meiobenthos was studied at about 10 stations.

In the southern part of the Archipelago Sea, studies on the biotic consequences of an oil accident in 1969 were followed up.

In co-operation with a water protection organisation, benthic studies were carried out in the polluted area off the cities of Turku and Naantali.

The Water Conservation Laboratory, City Construction Bureau of Helsinki

The bottom fauna at 6 standard stations in the archipelago of Helsinki was sampled twice a month during the open water period, and at irregular intervals in the winter. The studies are connected with a programme on fisheries ecology.

France  
(L. Marteil)

Huîtres

Les mauvaises conditions hydrologiques de l'été 1970 ont gravement perturbé la reproduction d'Ostrea edulis et Crassostrea angulata dans la plupart des centres français.

La croissance de C. gigas importée en 1969 a donné des résultats très satisfaisants. De nouveaux apports ont été faits à la fin de l'année 1970. Aucune mortalité anormale n'a été constatée.

La maladie des branchies chez C. angulata semble en régression; le pourcentage des sujets atteints et la gravité des attaques sont plus faibles que les années précédentes.

Des mortalités massives ont affecté les huîtres C. angulata dans la plupart des secteurs d'élevage au moment de la reproduction et ultérieurement. Les études faites n'ont pas encore permis de déterminer la cause de ces pertes. Aucun organisme parasite n'a pu être décelé jusqu'ici.

Dans un secteur breton et dans le bassin d'Arcachon, les élevages d'O. edulis ont été décimés par une maladie parasitaire. Un organisme a été isolé dans les diverticules de la glande digestive; il est en cours d'identification. Le transfert des huîtres vers d'autres centres d'élevage a été interdit. Les huîtres portugaises et japonaises vivant dans les mêmes biotopes ne sont pas affectées. Par ailleurs, les huîtres plates et japonaises vivant dans les secteurs frappés par les mortalités de portugaises ne sont pas touchées par le phénomène.

Pecten maximus L'inventaire des stocks des côtes bretonnes a été poursuivi. On note une prédominance des groupes d'âge 2 et 3 dans tous les secteurs.

#### Benthos

Algues. Les champs de laminaires des côtes de la Manche ont été cartographiés à l'aide des dragages et de photographies prises d'avion. Laminaria digitata, Saccoriza bulbosa, Halidrys siliquosa prédominent largement dans la partie orientale de cette région où les travaux ont été terminés en 1970.

#### Programme 1971

##### Mollusca

Etude sur la reproduction des huîtres.  
Recherches sur les causes de mortalité.  
Etude d'un gisement de Mercenaria mercenaria.

##### Benthos

Achèvement de l'étude cartographique des champs de laminaires (Manche occidentale) et recherches sur l'espèce Chondrus crispus.

#### Germany

(K. Tiews)

#### Mytilus edulis

Routine investigations on the growth and quality of wild and cultured mussels and on their infection rate with Mytilicola intestinalis, Modiolicola insignis and Cercaria have been continued at the Institute. Experiments on the vertical culture of mussels were continued at the Flensburger Förde in the Western Baltic.

#### Benthos

The Biological Station Heligoland continued its sampling of benthic communities on special stations in the North Sea with the aim to study changes in species distribution and dynamic aspects of the eco-system.

The Institut für Meeresforschung at Bremerhaven has continued its study on the distribution of microbenthos in the Southern North Sea with special emphasis on nematodes, fungi and bacteriae.

The development of benthos communities were studied in a brackish water pond at the Institut für Küsten- und Binnenfischerei. The distribution of benthic food specimens for flat fish were studied off the coast of Lower Saxony.

#### Mytilus edulis

Routine investigations on the growth and quality of wild and cultured mussels and on their infection rate with Mytilicola intestinalis, Modiolicola insignis and Cercaria shall be continued, also experiments on the vertical mussel culture in the Flensburg fjord.

#### Ostrea edulis

Fattening experiments in the Wadden Sea around the Isle of Sylt might be continued.

#### Benthos

The Biological Station of Heligoland and the Institut für Meeresforschung in Bremerhaven will continue their benthos studies.

### Iceland

(U. Skúladóttir)

#### Chlamys islandica

Two exploratory scallop surveys in 1970 showed the existence of stocks of Iceland scallops in Breidafjörður, West Iceland, and Húnaflói, North Iceland. Up to 180 kg of live scallops were obtained per 5 min. haul, averaging 80-100 kg per haul in some areas. During these surveys, a 130 cm wide scallop dredge of an Icelandic design was used. Both these areas are already supporting a commercial scallop fishery.

Studies have shown the Iceland scallop at Northwest Iceland to become sexually mature at a shell height of 40-50 mm and an estimated average age of 5 years. The sexes are separate, with an approximately equal sex-ratio. Spawning is at a peak from the end of June to the middle of July. A 70 mm size limit has been legalized and the landed catch is mostly made up of scallops 8 years of age and older. The size distribution of Iceland scallops appears to vary to some extent according to latitude, depth and bottom substrate, relatively larger individuals being found at lower temperatures, shallower depths and harder substrates. The most favourable habitat appears to be on a bottom with sand, gravel and shells at approximately 10 to 30 fathoms depth.

In 1971 a number of scallop surveys will be carried out off the west, north and east coasts of Iceland.

### Ireland

(F. A. Gibson)

#### Escallops

Pecten maximus. Investigations of the escallop stocks off the east and south coasts of Ireland continued in 1971, regular sampling being made and research vessel cruises were undertaken. Some 700 escallops were tagged and relayed in the area between Bray and Greystone in the Irish Sea. This stock was discovered in May 1969 and has been consistently fished since then. However, recaptures of tagged escallops have been very few to date.

Chlamys opercularis. During the course of scallop stock exploration off the east coast in 1970, large quantities of "queens" were located. In the three months beginning September, 1970, some 130 tons of queens have been landed. At present there is no conservation measure in force to protect these stocks from overfishing. Samples were examined for age and growth, and particular attention was given to maturity with a view to determining a suitable minimum legal size limit designed to ensure the return of recruit queens to the grounds.

Work on both the above species will continue in 1971.

#### Oysters

Investigations of the oyster stocks at Tralee and Clarinbridge were continued. For the first time since 1958, the spatfall at Tralee was negligible in 1970, whilst at Clarinbridge where spatfalls are irregular, there was a small settlement of spat.

Natural spatfalls will continue to be monitored in 1971 and where possible spat will be collected and transferred to suitable growing areas, including the heated effluent waters of a power station. Continued assistance will be afforded to a private oyster fishery in which the economics of fattening Norwegian seed oysters is being studied.

#### Mytilus edulis

Work continued with respect to growth rates of mussels in the chief Irish mussel fishing areas. Mussel culture studies continued using rafts, net-bags and bouchots.

Large concentrations of 0-group mussels settled in the open sea off Co. Wicklow, in the Irish Sea, were located. These averaged 3 000 individuals per kilogramme. Mussels settle annually in this area, but do not survive their first winter in any numbers. About 60 tons were transferred to the commercial fishery in Wexford harbour, where they grew and survived very satisfactorily, after some initial mortality soon after transplantation, due to the complete change of environment.

This work will continue in 1971, and attempts to use the Norwegian system of mussel culture will be made.

#### American hard-shelled clam

Further transplantings of M. mercenaria from the MAFF layings in North Wales, were made in 1970, and equally divided between Cork harbour (successful in the 1970 experiment) and the heated waters of a power station in the estuary of the R. Shannon. The clams laid in Cork harbour again gave satisfactory results, but those laid in the heated waters have shown disappointing results to date. The environment of this heated lagoon will be the subject of a special study in 1971.

#### Italy

No report received.

Netherlands

(P. Korringa)

Oysters

Though the oysterbeds in the Oosterschelde were predominantly populated with relaid flat oysters from Brittany and Portuguese oysters from the Sado Estuary, the native Zeeland stock showed a remarkable come-back. Growth and fattening of the oysters left nothing to be desired and the mortality rate was remarkably low. This is tentatively ascribed to the rather sparse population of the beds and to the closure of the Volkerak, which keeps the Oosterschelde free from intrusion of polluted low-salinity Rhine water.

Gill disease has not been observed in the year 1970 and though it may have been overlooked, growth, fattening and survival were apparently not affected by it.

Mussels

Observations on the incidence of Mytilicola intestinalis in the Dutch Waddenzee revealed a slow, but unmistakable progress in westerly direction. The area south of the Isle of Terschelling is now inhabited by Mytilicola, be it not yet in alarming numbers. If the population increases in that district, there is little hope that the western part of the Waddenzee can be kept free of this noxious parasite.

The technical installation of the experimental mussel station on the Isle of Texel was completed in the year 1970, and in the second part of the year experiments on cleansing and storage of mussels have been carried out on a technical scale. This work is done in relation to the Delta project, which threatens to cut off the Oosterschelde, thereby destroying the present natural cleansing and storage plots near Yerseke. Only by construction of a huge cleansing basin with storage facility can the Dutch mussel-industry, producing almost 100 000 000 kg of marketable mussels per year, hope to continue its existence. The basic data required for projecting an installation through which all mussels produced can pass, are collected by experimenting in the technical installation of the experimental mussel station, backed by small-scale laboratory work.

Norway

(K. Gundersen)

Mytilus edulis

In May, mussels at the south-east coast were examined, but neither Mytilicola intestinalis nor gill disease were recorded.

The experiments with cultivation of mussels were partly ended during the autumn 1970. The results showed that at good growth localities, the mussels reached market size and could be harvested 14 months after the spatfall. During 1970, new types and sizes of net bags were developed.

In the late autumn, unusual cases of food poisoning after consumption of mussels occurred on the south-east coast. The mussels had been collected in the sea presumably free of sewage contamination. At present (1 March 1971) no explanation can be given.

Chlamys islandica

In the Porsanger Fjord in the northern Norway, a commercial fishery for the Iceland scallop took place in 1970. In the Tromsø area, field experiments on the relation between the spawning time and fluctuations in the sea temperature and respiration rate in relation to the tidal cyclus were studied.

### Ostrea edulis

In 1970 experiments on a new type of spat collector were concluded. The old types made from birch twigs have been unsatisfactory.

In Norway six polls for spat production are in use. In 1970 eight tons of spat (one and two years old) were exported, mainly to England and Ireland.

An estimate of the number of consume-oysters produced is 150 000 to 200 000, of which 65 000 were exported to Sweden.

### Cephalopods

Introductory investigations on Todarodes sagittatus and Gonatus fabricii were performed during the autumn.

The research plans for 1971 include continuation of experiments with cultivation of mussels, especially experiments with new sizes of net bags suitable for the different conditions at the Norwegian coast. In the laboratory, experiments on growth of Mytilus edulis related environmental conditions will be performed.

It is planned to continue investigations on cephalopods in the Norwegian Sea, mainly Todarodes sagittatus and Gonatus fabricii. Firstly, one has the intention to investigate occurrence, migrations and eventually the reproductive cycle.

### Poland

(L. Zmudziński)

### Benthos

Thirty control stations in the central places of the West-Baltic Depth and sixty stations in the region of Gdańsk Depth with respect to investigations on the problem of pollution.

### Portugal

No report received.

### Spain

(Hector Quiroga)

### General

The laboratory of the Instituto de Investigaciones Pesqueras at Vigo and the laboratories of the Instituto Español de Oceanografía at Vigo and la Coruña have begun a new programme of research on the biology of molluscs, mainly on Crassostrea angulata.

Mr Pascual of the Instituto de Investigaciones Pesqueras has continued his study of the biology of the Portuguese oyster.

### Solenidae

Mr Cendrero of the Instituto Español de Oceanografía, Santander, has begun studies of the taxonomy and biometrics of members of this family; he has paid special attention to fecundity and to development "in vitro".

### Benthos

Mr Cendrero and his co-workers from the Instituto Español de Oceanografía laboratory at Santander have studied the distribution and abundance of benthic seaweeds, living between 0 and 15 metres along the coast of northern Spain.

Sweden  
(B. I. Dybern)

Benthos

The investigations of the bottom fauna in the open parts of the Baltic have been continued. They have been connected partly with an extensive shallow water programme carried out at the Asko Marine Station about 80 km south of Stockholm. This programme involves both brackish-water plants and animals; their inter-relations and their relations to the physical environment.

Benthic animals and to some extent plants are studied in connection with pollution situations on the Swedish coasts and in areas with existing or planned discharges of heated cooling waters from power stations.

It is expected that the programmes for benthos investigations will be extended during the next few years, especially on the west coast of Sweden, where efforts are being concentrated to combat the effects of coastal pollution.

United Kingdom

1. England and Wales  
(P. R. Walne)

Cardium edule

As a result of increased intensity of fishing in the 3 major areas, the Burry Inlet (South Wales), the Wash and the Thames estuary, particular attention was directed in 1970 to the conservation of these fisheries. In the Burry Inlet monitoring surveys of cockle stocks have continued. The 1970 spatfall was good and represented the fourth highest recruitment during the last 13 years. Heavy depredation by oystercatchers has continued and a high level of catch has been maintained but, as a result of the poor recruitment in 1968 and 1969, it is unlikely that stocks can continue to support the same fishing effort during 1971. Data collected since 1958 has been used in a contribution for the ICES/FAO/ICNAF Symposium on "Stock and Recruitment". Monthly estimates of oystercatchers in this area have been continued. Over the last 5 years the number of oystercatchers overwintering in this area has increased steadily.

Increased fishing effort in the Wash has resulted in the 1970 landings exceeding 5 000 tons but, because of poor recruitment during the last few years, landings are expected to fall in 1971. Investigations are being made to determine the existing stocks and the effect that hydraulic dredging would have if it were introduced. In experiments using the hydraulic cockle dredge, the yields were from 0.6 tons/hour in areas where densities were 80 per m<sup>2</sup> to 2.5 tons/hour where densities were 250/m<sup>2</sup>. Damage to cockles in the catch was not serious.

In the Thames estuary, the 1970 yield of 4 500 tons was approximately the same as in the previous year, but was obtained from a very much reduced stock, due to the use of the hydraulic dredge. Stock surveys have been made during 1970 by sampling the beds at low tide. Losses due to natural mortality were calculated at 35%. There is some suggestion that mortality of young cockles in areas subjected to hydraulic dredging is greater than that in other areas.

### Chlamys opercularis

The efficiency of commercially operated queen dredges was calculated at 53%, when the mean density was 2.95 queens per m<sup>2</sup>. Surveys for queens continued in several areas off the north-east coast. Catches were insignificant in an area which previously supported good commercial landings. Work is continuing to determine whether this is due to over-exploitation or to a change in behaviour.

### Crassostrea angulata

As a result of high mortality in 1969 few Portuguese oysters were imported during 1970. During the year there has been no evidence of significant mortality caused by gill disease.

### Mytilus edulis

The monthly recording of spatfall in Morecambe Bay has been continued. During two and a half years study spatfall has occurred every month at all 3 stations. The monitoring data suggests that this abundant spat resource could be utilised, by means of artificial collectors, to supply spat for distant culture grounds. In some exploratory work pairs of ropes were either staked to the ground or suspended horizontally. After a month's exposure there were 2 000 - 5 000 spat per 30 cm of rope. After hanging from a raft in the Menai Straits for 6 months the fastest growing mussels had obtained a length of 58 mm.

### Ostrea edulis

Spatfall was assessed in the river Fal and in Poole harbour but settlement in both areas was poor. Spatfalls of moderate intensities have occurred in three areas on the east coast. Experimental studies showed that larvae passing through cooling water systems of a power station were not damaged. Investigations to determine the suitability of Norwegian stock for relaying in this country, using trays, have continued; survival has been generally poor. Comparison of performance of Conway and Norwegian oysters, laid in trays at various tidal heights, showed an inverse correlation between growth and exposure at exposure levels only a few centimetres apart.

### Pecten maximus

The 1968 tagging experiment off Brixham has continued and, by the end of October 1970, 133 (6.2%) of the tagged scallops which were released had been returned. Of these approximately one fifth were caught by trawlers working in the sea.

### Venerupis decussata

A study of the growth rate of hatchery reared spat, which was started in 1968, has now been completed. The spat had been planted in mesh-covered frames on the south coast of England and North Wales. The pooled results show that, on average, 10 mm spat take 3 years to reach marketable size of 45-50 mm. Survival over a 2 year period has generally been 50 - 70 per cent.

Monthly sampling of hard clams from Poole harbour has continued to September 1970. During the year individuals from a 1969 spatfall were observed. Physiological investigations were made to determine the oxygen consumption of a bed of hard clams submerged in the outfall from a power station, where water temperatures in winter may range from 2 to 22°C during one tidal cycle. Oxygen uptake increased with temperature and was still increasing at 30°C. There was no evidence of acclimation or of a rhythm in the rate of uptake.

Scotland  
(H.J. Thomas)

Mytilus edulis

Further observations on the growth of mussels cultivated on ropes have been made and the work extended to cover several additional sea lochs on the Scottish west coast.

There was a further outbreak of paralytic shellfish poisoning on the east coast of Scotland but at a lower level.

Bacteriological examination of shellfish from a variety of sites was undertaken.

Mytilicola intestinalis was found to have spread to a hitherto clean area on the west coast.

Cardium edule

Surveys of a number of beaches for exploitable concentrations of cockles were undertaken.

Pecten maximus

Collection of catch effort data was maintained on the established fisheries. Explorations for unexploited grounds were also undertaken by research vessels. Further observations have been made on the growth of young scallops and on newly settled spat.

Chlamys opercularis

Catch effort data were obtained from selected vessels engaged in the newly established fishery for Chlamys opercularis. Catch composition data have also been collected. Experiments have been undertaken into the efficiencies of 3 types of gear in the capture of queens and scallops.

Cephalopoda

Data on the commercial landings of squid were maintained.

Benthos

Food Chain Studies. Long term studies of the food chain leading to juvenile plaice (Pleuronectes platessa) were continued in a sandy bay of a sea loch on the west coast of Scotland. Particular attention was concentrated on determining the time and density of settlement of the young fish and on assessing the fluctuations of the main invertebrate food supply of these fish. Comparable studies of the food chain in a muddy ground in the same loch, begun last year, were continued.

Coastal Survey. Continuing the survey of benthos on grounds round the Scottish coast, and partly to provide data on the fauna of unpolluted grounds, a survey was made of extensive intertidal sandy areas at North Uist in the Outer Hebrides. The macrofauna was studied by digging quadrats on selected transects, and cores were collected for meiofauna and for particle size analysis. Fish populations were also sampled. Physical observations included determination of interstitial water salinity, sand temperature, drainage, water table and beach levels, with limited profile measurements at all sampling stations. The survey showed the importance of beach profiles in relation to flatfish nursery grounds. When the profile is such that a large part of the intertidal area is above the mid-tide line, the area does not support many of the prey-species required by juvenile flatfish.

U.S.S.R.

(A. F. Karpevich)

Under experimental conditions the effect of salinity was determined, as well as the oxygen deficiency and manganese ion on survival and respiration of the bivalves such as Dreissena polymorpha, Mya arenaria and the Crustacean, Mesidothea entomon of the Baltic. The investigation was conducted under the guidance of Prof. Karpevich and Mr Shurin at the experimental laboratory of BaltNIIRKH.

CRUSTACEA

Belgium

(R. De Clerk)

Analyses of consumption shrimp landings were carried out and catch per unit effort data collected.

Regular shrimp surveys along the Belgian coast were also continued.

Canada

(D.G. Wilder)

Homarus americanus

Laboratory experiments show a sex-related, temperature-coupled effect of photoperiod on moulting frequency and growth rate of immature lobsters. The intermolt period for 1/4 kg lobsters is about 2 years at 5°C and 4 months at 15°C.

Lobsters killed by yellow phosphorous showed massive hemolymph coagulation and extensive tissue destruction in the antennal gland and hepatopancreas.

Heavy, toothed rakes are towed to harvest Irish moss (Chondrus crispus) in areas populated by lobsters. Underwater observations showed that most lobsters displaced by the rakes were unharmed. Detailed examination of the rake tracks revealed greater numbers of injured lobsters under rocks. Raking does appreciably more damage to lobsters than was hitherto believed.

Immediate or direct observable effects of Bunker C oil contamination from a wreck were largely restricted to areas above low water mark. In general, the bottom from L.W.M. to 20 metres appeared clean and the biota normal. In one area, oil mixed with sand was found to a depth of 12 metres. Chemical analyses indicate that oil is being ingested by several species. Lobsters liberally smeared with Bunker C oil or given one feeding of oil smeared herring did not become tainted. The meat and hepatopancreas of lobsters held 4 days in sea water containing 1 part per 1000 Bunker C oil acquired an objectionable oily flavour that persisted more than a month.

Surveys showed that serious ecological effects of effluent from a bleached kraft mill were restricted to a relatively small area, lobster larvae and adults occur in areas discoloured by effluent. There is little to suggest that changes in lobster stocks locally and elsewhere are directly related to pulp mill effluent. Experiments to determine whether bleached kraft mill effluent alters the lobster's response to food odours gave contradictory results and will be extended.

The antennules are important sites of olfactory sensitivity, ablation of the medial, lateral or both branches lowering response 10, 20 and 40% respectively. The urine of all lobsters is attractive to mature males and females but the greatest response is by mature males to urine from moulted, mature females.

Legislation limiting the number of lobster traps has resulted in fewer traps set, hauled and lost. The fishing day is now about one third shorter and the rate of exploitation has declined slightly. Fishing costs have been appreciably reduced.

The moulting frequency of lobsters fed fish for 4 3/4 months was not related to feeding rates of 1 1/2, 3 and 6% of body weight/week. Meat yield was maintained only at the highest feeding rate. Survival of moulted lobsters was directly related to feeding rate. A diet supplement of calcium had no obvious effects on survival.

Continuing investigations of lobster blood disease (gaffkemia) show it to be a wasting disease in which death occurs through depletion of body reserves. Experiments indicate that the hemagglutinin principle is separate from the bactericidal principle in lobster blood. Studies of gaffkemia in commercial holding facilities have permitted improved control measures.

Ecdysterone and inokosterone accelerated development of premoult characteristics in lobsters but led to death at moult or late premoult. Ecdysterone was about twice as effective as inokosterone.

#### Chionoecetes opilio

Commercial landings from the new fishery for snow crabs declined from 8 300 metric tons in 1969 to 7 300 tons in 1970, mainly because of less favourable market conditions. In a survey to study distribution and abundance, good catches were made with 3 m diameter lift nets and with Japanese crab traps and about 2 000 good bottom photographs were obtained using a towed camera sled. Crabs were readily identified even when almost buried in the mud.

In the laboratory, ecdysis was completed in 2-9 hours, depending on size. Moulted commercial-sized crabs became hard enough for commercial use in 2-3 months. Male crabs, well below minimum commercial size, mated successfully. Larval survival was poor at 0 and 20°C but improved progressively at 5, 10 and 15°C.

Snow crab muscle is low in lipid (<1%) but rich in phospholipids. Byproduct dry meals marketable for animal feeding have been prepared from crab shell and unused tissues.

#### Geryon quinquedens

Landings of 80 metric tons of deep sea red crabs in 1970 by a single boat give some indication of this species' potential economic importance. Laboratory studies show the red crab to be more tolerant of high temperatures than the snow crab. A temperature of 14°C is acceptable for short-term (1 week) storage but temperatures of 12°C or lower should be used for longer periods.

#### Pandalus borealis

Deep water shrimp grounds discovered off the northwest coast of Newfoundland in 1958 were exploited for the first time in 1970. Landings exceeded 135 metric tons. Studies of the stocks in this area have been initiated.

#### Denmark

(Sten Munch-Petersen)

Investigations of the "by-catch" in the Danish Crangon sp. fishery will be made in 1971. Investigations on the Danish fishery for Pandalus sp. will be carried out in the North Sea and in the Skagerrak.

#### Pandalus borealis (E. Smidt)

Trawling experiments in West Greenland inshore and offshore waters were continued in 1970. Most interest was taken in the offshore experiments in the Davis Strait, where a commercial fishery is under development.

Offshore experimental trawling for Pandalus borealis are planned for 1971 to take place especially off Frederikshaab and west of Store Hellefiske Bank.

Finland

No report received

France

(L. Marteil)

Homards

Dans les zones de repeuplement, le rendement de pêche numérique et pondéral a diminué en 1970 ce qui peut être dû à une dispersion des animaux mais aussi à une pêche frauduleuse.

L'immersion de jeunes individus élevés en laboratoire doit concourir au repeuplement, concurremment avec celle des femelles grainées.

Langoustes

Une colonie de Jasus lalandei s'est développée dans les parages de l'île de Batz après les immersions de 1969.

Programme 1971

Poursuite des expériences de repeuplement en homards par immersion de jeunes individus produits en laboratoire.

Germany

(K. Tiews)

Crangon crangon

The investigations of the Institut für Küsten- und Binnenfischerei to assess the shares of undersized protected fish in the catch of the German shrimp fishery and the fluctuations in the abundance of fish species found on the shrimp fishing grounds were continued. A total of 400 samples (1 967 kg) of unsorted catch of the shrimp fishery were collected in Buxum, Cuxhaven, Neuharlingersiel, Dornumersiel, and analysed as to their species and length composition.

The investigations on the distribution of shrimp larvae along the German coast were continued. Samples were taken also during the winter months at a large scale.

Pandalus sp.

Numerous samples of deep-sea prawn catches made on the occasion of two research cruises of RS "Friedrich Heincke" in Farn Deep area and on the Fladen Ground were taken in March and November and analysed as to their species and length composition at the Institute.

Lobster

Rearing and crossing experiments with lobsters of different origin were continued by the Biological Station of Heligoland as well as stock assessment work on the lobster population of Heligoland.

Programme for 1971

Crangon crangon: Catch assessment work to determine the composition of shrimp catches by species and length and work on the larvae distribution on the German coast shall be continued at the Institut für Küsten- und Binnenfischerei.

Pandalus sp.: Research on the composition of Pandalus catches made by RS "Friedrich Heincke" in the North Sea shall be continued.

Lobster : Rearing and crossing experiments with lobsters of different origin shall be continued at the Biological Station Heligoland as well as stock assessment work on the lobster population of Heligoland.

#### Iceland

(U. Skúladóttir)

##### Nephrops norvegicus

Routine data on the landings of Norway lobsters, catch per unit effort and catch composition of all major fishing areas were maintained. Moreover, two short out of season Nephrops surveys were carried out to investigate various aspects of stock composition. Two exploratory surveys were undertaken with a selective Nephrops-Pandalus trawl, the use of which could become profitable in areas where both species are known to be co-existent.

Apart from routine investigations on Nephrops, the selective Nephrops-Pandalus trawling experiments will be continued in 1971. Moreover, a large scale tagging of Norway lobsters is planned at the end of the fishing season.

##### Pandalus borealis

Several trips were made and experimental fishing was carried out on banks found in 1969 along with efforts to find new banks.

During the summer, fishing on the banks off Reykjanes was started. Here, by-catch contained young fish of commercial value and young Norway lobster.

By-catch containing young fish of commercial value has become a difficult problem for the first time in the prawn fisheries of Iceland. In order to solve this, experiments were carried out on a French type of selective trawl. The two cod-ends were designed firstly to catch prawn and Norway lobster respectively, and secondly, prawn and fish respectively. Of these combined fishing of prawn and Norway lobster was hampered by the small catch of prawns on the Norway lobster grounds at the time of the experiments. Fishing of prawn and fish proved unsuccessful.

Research has been carried out in the same manner as before concerning samples and collecting of catch and effort data.

1971/72 : Research will be carried out along the same lines as before with an emphasis on solving the problem of young fish in the catch. In addition to this, tagging of Pandalus is planned.

#### Ireland

(F.A. Gibson)

##### Hommarus gammarus

Information concerning catch and effort in the lobster fishery continued to be collected. The study of gonadal development in the female lobster entered its third and final year. A detailed description of the results of this work will be published in the Irish Fishery Investigations, in due course.

Studies of the oxygen requirements of lobsters in storage will be undertaken in 1971, in conjunction with similar experiments in respect to crawfish. Catch per effort and other biometrical data will continue to be collected in 1971.

### Palinurus elephas

Studies of the crawfish will be recommenced in 1971. This will include a laboratory study of the requirements of the crawfish in regard to water oxygen concentration and other water quality factors. A study of the planktonic distribution of phyllosomata will be initiated off the south west coast during the early summer of 1971. The development of a chitin destroying disease widespread in crawfish taken from the sea in 1970, will be studied, and attempts to isolate the pathogen will be made.

### Cancer pagurus

Population densities will be studied using a programme of repeated taggings in a relatively unfished population.

### Nephrops

Monthly collection of commercial samples was continued.

Surveys to study variations in numbers and sex and age-composition of the population over different areas of the fishing grounds of the Irish Sea and off the south west coast were made. These included sets of repeated hauls in the same area correlated with measurements of submarine illumination during dawn and dusk.

Six larval survey cruises were carried out during April-June 1970. Samples of larvae were brought back to the laboratory and were maintained in captivity in order to assess stage duration.

Small samples of juvenile and mature Nephrops were held in captivity and under control to observe moulting rates.

### Italy

No report received

### Netherlands

(P. Korringa)

### Brown shrimp

The 1970 investigations on the brown shrimp (Crangon crangon) focussed on three topics :

Statistics: samples of the commercial landings were taken on a monthly basis in all important shrimp ports of the Netherlands. This to obtain accurate data on the size distribution of the landings in the course of the year. These data were completed by statistical records on the number of fishing days and on the catch per day fishing, split up in the categories "Dutch Coastal Waters" and "Sylt area".

Rotating sorting machine: the introduction of this new type of shrimp sieve on the Dutch fleet made good progress during 1970. At the end of the year, 36 of these sorting machines were in operation on the fleet. Experiments with this apparatus were also carried out by the Belgian fishery research, and plans are being made to try the machine out on the Wash Bay in England. Comparative experiments revealed a clear-cut positive influence of this sorting machine on the financial outcome of the shrimp fishery.

Stock: shrimp larvae surveys were regularly made during the year 1970. Taking into consideration the favourable effect of low water temperatures in February and the surprisingly high numbers of larvae caught in the period January/April, the landings of consumption shrimps in the autumn of 1970 were very disappointing indeed. This is probably due to the noteworthy explosion of cod of the 1969 year class in the Dutch coastal waters. Observations on the stomach contents of these codlings led to the tentative conclusion that this large cod population may have been the cause of the disappearance of the shrimps one had hoped to land in autumn.

Norway  
(K. Gundersen)

Homarus gammarus

Tagging experiments on lobster in the field continued mostly in the same way as in the previous years. The material mainly consisted of lobsters up to 24 cm total length. The material for tagging was collected from commercial catches at a lobster pond south of Bergen.

Of the tagged lobsters, 108 were liberated at Glesvær in the neighbourhood of the lobster pond and 97 in Kvernhusosen north of Bergen.

At the same localities fishing experiments were carried out with different types of gear in July, October and November. Catches of tagged lobsters from previous years were controlled for moulting and increase in weight and length and if in fine condition liberated in other areas. The same was done with tagged lobsters caught by fishermen.

To obtain information about the composition of the lobster stock along the west coast of Norway, commercial catches received at the lobster pond mentioned above were controlled. This lobster pond gets catches from Hordaland to Møre and Trøndelag. By very good collaboration with the manager of the pond it has been possible to keep the catches from the different areas separate. This will possibly give information about difference in length composition, maturity and berried females from south to north.

Cancer pagurus

Tagging experiments on Cancer pagurus were continued mostly in the same way as the year before in the Hjeltefjord area.

The suture tagging method of van Engel was used for comparison with the Norwegian method, and 722 and 450 tagged crabs by the two methods respectively were released.

This year also tagging experiments were carried out at Møre in the same way and 578 tagged crabs were released.

The feeding experiment on crabs in basin which started in 1969 was continued in 1970. In addition to the feedings in basin also floating wooden boxes were used.

Pandalus borealis

A cruise was made with M/S "Lyngstuva" and M/S "Sagøy", two 100 feet fishing vessels from 10 March to 11 August to find new fields for commercial fishing grounds in the Barents Sea. The investigations were carried out from 15° to 50°E and from the Norwegian coast to Spitsbergen areas. Several good fishing fields were found. During the summer a substantial commercial fishing took place on these fields.

Because of the great amount of 0-group fish that are destroyed by prawn fishing, the Institute constructed 4 shrimp sorting trawls. Experiments with these trawls were carried out with M/S "Bjarne" from 1 October to 31 October on the fishing grounds near Nordcap.

Poland

No report received

Portugal

No report received

Spain

(Hector Quiroga)

A study of the distribution of Decapoda around the Canary Island was carried out by Mr Garcia Cabrera and his co-workers from the Instituto Español de Oceanografía laboratory at Santa Cruz de Tenerife.

Mr Massuti from the Laboratory in Palma de Mallorca is studying the taxonomy and biometrics on Nantantia living on the Posydonia grounds of the Palma Bay.

Sweden

(B. I. Dybern)

Cancer pagurus

The studies of migrations, population densities, stomach contents and behaviour of crabs has been continued.

To date, 4 000 crabs have been tagged at 4 main areas of the Swedish west coast. About 1 200 recaptures have been made. The distances travelled by recaptured crabs vary very much, but are generally much longer than those for lobsters. Two crabs were recaptured about 110 km (straight line calculation) from the point of release. According to results of studies of the feeding behaviour and stomach contents, sea urchins, hermit crabs and different mussels seem to play a dominant role as food for crabs.

The collection of statistics concerning the yields per fishing effort has also been continued. In most places the crab catches decreased during 1970.

The crab investigations will be continued during 1971. During subsequent years they are expected to be less extensive.

Homarus gammarus

Taggings have been carried out in the Skagerak area during the last five years. These experiments have now been completed. The results show that the distances travelled by recaptured lobsters are generally short or up to some 6 km (straight line calculation). There is no typical movement of lobsters towards the sea during the winter months. When the water temperatures are low, lobsters lie in deep hollows between stones or crevices, where they appear to be able to survive without intake of food for 3 - 4 months.

Statistics show that increased fishing effort has resulted in diminished catches. The reasons for this are not yet fully understood, but an increasing fishery by summer guests and other part-time fishermen may be one of the more important causes.

The main field investigations will be concentrated on the lobster stocks of the Kattegat, during 1971.

United Kingdom

1. England and Wales

(P. R. Walne)

Cancer pagurus

Suture tagging experiments to determine growth and migration were continued off Devon and Cornwall in 1970. Of the 3 448 tagged crabs released in 1968 and 1969, 17% have been recaptured. Of these 13% had moulted. There is some evidence of movement in certain parts of the fishery, but at the present time this cannot be correlated with breeding activity. During 1970 small crabs were tagged to obtain additional growth data and, even after a few months, a high proportion of returned crabs had moulted. From preliminary results the growth increment and moult frequency of crabs from the south-west and east coasts appeared to be similar. Crabs from the south-west coast of about 152 mm carapace width moult on average about once every two years, while larger crabs appear to moult not more than about once in 5 years.

Catch and effort data is being gathered from the Norfolk and Yorkshire fisheries.

Crangon crangon

Population studies are being undertaken to understand recruitment in the Wash and in the river Crouch. Crangon was found to be present in greater numbers in the Wash than in the river Crouch. No berried females were found in samples taken from both areas in October.

Homarus vulgaris

Trials have been initiated to test the persistence of tags during the moult on lobsters in tanks. In one trial 7 lobsters marked with the sphyryon tag have moulted successfully and without tag loss.

Nephrops norvegicus

Limited sampling of North Sea fishery has been undertaken during 1970. Successful trials were carried out in the Irish Sea with the 2-mesh trawl, and separation of Nephrops from saleable whiting was good with over 50 per cent of the undersized whiting having escaped.

Palinurus vulgaris

In July 1970, 444 crawfish were tagged and released on the Cornish coast. Either an arrow tag or a disc tag wired to the base of an antenna, of both types of tag together were used. Shortly afterwards two "double-tagged" crawfish were returned without their arrow tag showing that such a tag can be lost.

Pandalus borealis

A survey was made of the north-east coast Pandalus borealis fishery in November/December. The volume of prawns caught exceeded the maximum catch observed in the same area during the 1969 survey. A more accurate chart of depth soundings has been produced for the area following earlier work which suggested that those given on the Admiralty Chart were not detailed enough. A more detailed distribution of bottom sediments was also recorded. Basic conclusions on the distribution of Pandalus and depth and type of bottom, reached on the earlier cruises, remained unchanged.

Pandalus montagui

The improvement noted in the Wash fishery in 1969 has continued during 1970 and landings are expected to be greater than the previous year. The large number of 0-group individuals seen in October should provide a substantial fishery during 1971. Examination of data collected during recent years suggests that the catch per unit effort was reduced during the extremes of water temperature. The relationship between the variation in catches and the high fat content of shrimps during the summer is being examined. During the year the traditional method of cooking shrimp in boilers heated by solid fuel has been replaced by more economical oil-fired boilers.

2. Scotland

(H. J. Thomas)

Crangon, Pandalus

Collection of catch effort data for the Crangon fishery was continued. Research vessel cruises have investigated the distribution, abundance and catch composition of pink shrimps, the biology of which has been studied.

Cancer pagurus

Sampling of the catch of edible crabs and collection of catch effort data from the main fishing areas have been maintained. A comparative fishing experiment using Scottish creels and parlour traps was undertaken.

Homarus vulgaris

Catch composition data covering all the main lobster fishing areas and catch effort data have been collected.

An analysis was made of the seasonal variation in the development stages of the external eggs of berried lobsters and the relative catchability of berried with non-berried females.

U.S.S.R.

No report received.