

SHELLFISH AND BENTHOS COMMITTEE

by H. J. Thomas

1974

MOLLUSCA AND BENTHOS

Canada

(J. E. Stewart)

Ostrea edulis

Transplanted oysters in St Mary's Bay and Conception Bay, Newfoundland, suffered over-winter mortalities (1973-1974) of 7 and 3 per cent. Eight and 10 per cent, respectively, of the remaining oysters died during May to November. Shell growth was slight (< 0.5 cm) in St Mary's Bay and nil in Conception Bay.

Crassostrea virginica

Population surveys and stock assessments were carried out in major public fishing areas of the Maritimes region. The most significant changes were:

- 1) In Caraquet Bay, New Brunswick, the standing crop of marketable oysters doubled since 1972 and the area occupied has increased 10%; this is attributed, in part, to the intensified fishing effort which has had the effect of cleaning the beds and exposing clean shell surfaces for increased spat settlement.
- 2) At Dunk River, Prince Edward Island, the average density of oysters has dropped from 53.1 m<sup>-2</sup> to 35.5 m<sup>-2</sup> and the area occupied by oysters has decreased by 21%. High winter mortalities in recent years have been attributed to severe ice conditions and heavy siltation. The standing crop of market size oysters has decreased by about 60% since 1972.

The five year spatfall monitoring program, designed to define a number of commercially reliable oyster spat collection areas, was continued for the fourth year. The 1974 spatfall was one of the best, in most of the areas sampled, since the program was started in 1971.

Studies of shellstring oysters showed that in the more densely set strings mussels and crowding gave rise to a heavy loss, considerable variation in size, and a high percentage of poorly shaped oysters. Experiments were conducted to develop better techniques for bottom rearing of oysters removed from shellstrings.

A study of viral purification in oysters was pursued. Preliminary results indicated that the oyster reached its maximum uptake of viral particles during the first 24 hours of exposure in circulating seawater (20°C). The effect of the oyster upon the stability of the virus and the factors affecting the clearance rates were studied.

Transplantations of "susceptible" oysters from Bras d'Or Lake to Malpeque Bay were continued as part of a study of Malpeque oyster disease. The

younger or smaller oysters (one-year class) had a significantly lower mortality rate in Malpeque Bay water than older larger oysters (two-year class). Apparently the younger oysters were better able to cope with the disease or conditions than the older, larger, oysters.

A research program concerned with shellfish genetics was begun at Dalhousie University. A considerable part of the effort was devoted to oyster genetics.

Development work on better methods for rearing oysters on a more intensive commercial basis was continued in the Bras d'Or Lakes. This work included a number of government sponsored as well as private ventures.

#### Mytilus edulis

A report on all activities in Eastern Canada on the mussel, Mytilus edulis, was commenced, summarizing all available literature pertinent to mussel culture and indicating the status of mussel culture and research in Canada.

#### Placopecten magellanicus

A spatial model for an exploited shellfish population was developed, exploring the repercussions of different fishing strategies on a population showing contiguous distribution. This was developed for the Georges Bank scallop population where historic data are available by 10' statistical units of latitude and longitude. It has been generalized to consider repercussions of closed areas on overall yield for sedentary species.

#### Chlamys islandicus

Studies on the population dynamics of Iceland scallops in the north-east Gulf of St Lawrence continued. A dredge survey was conducted, including experiments on gear selection. A first approximation of natural mortality was made.

#### Mya arenaria

A survey, initiated in 1971, to assess the distribution and abundance of intertidal clams at Newfoundland was continued in May to August 1974. The area surveyed comprised Notre Dame Bay, Trinity Bay and Conception Bay. Total standing stocks on all beaches were found to be small, from a few hundreds to a few thousands of kilograms.

Stock assessment surveys on soft-shelled clam populations in two areas outside Newfoundland, closed to harvesting because of bacteriological contamination, indicated a potential yield of 18 000 bushels, enough to warrant the continuation of work to develop purification on a commercial scale. A pilot plant purification operation was carried out with limited success.

Expansion of the pilot testing in the Annapolis Basin area will be continued in 1975.

#### Illex illecebrosus

Total failure of the Newfoundland inshore fishery again hampered research efforts. Lower bounds on annual production estimates were derived

from estimates of stock size and consumption estimates by a major predator, Globicephala melaena.

#### Shellfish Growth, Productivity

In 1974 a program was commenced at Luke Island in St Margaret's Bay to study growth, mortality and productivity of three edible mollusc species. This program, an extension of investigations of benthic productivity begun several years ago, is a continuation of the study of potentially exploitable local shellfish species. A section on the blue mussel (Mytilus edulis) was completed. The additional species were the soft-shell clam (Mya arenaria) and the razor clam (Ensis directus). To date work has nearly been completed on the design and installation of containers and support systems for these two.

#### Benthic Community Dynamics

Resuspension of bottom sediments by tidal or other currents resulted in higher rates of benthic metabolism, more efficient oxidation of deposited organic matter and higher biomass of bottom fauna. Studies of sedimentation in St Margaret's Bay, N.S. in shallow and deep water quantified some of these inter-relations. In both deep (65 m) and shallow (15 m) areas, bottom sediments had much lower organic content than material caught in sediment traps. Integrated figures for organic deposition were  $118 \text{ g C m}^{-2} \text{ yr}^{-1}$  at the deep station and  $134 \text{ g C m}^{-2} \text{ yr}^{-1}$  at the shallow site. Material was probably derived from dense beds of macrophytes in shallow water. When corrected for possible bacterial consumption approximately  $60 - 70 \text{ g C m}^{-2} \text{ yr}^{-1}$  (equivalent to  $600 - 700 \text{ kcal m}^{-2} \text{ yr}^{-1}$ ) remained available to benthic macro-invertebrates to serve as a food resource for fish. The amount of this potential food supply transferred to higher trophic levels was unknown.

Soft sediments from St Margaret's Bay, allowed to settle after stirring in aerated water, rapidly formed an oxidized mud-water interface to a depth similar to that observed in freshly taken undisturbed cores. Measurements of oxygen uptake, an index of total community metabolism, were initially high during restratification due to chemical oxidation. Biological respiration due to bacterial colonization rapidly replaced chemical oxidative processes and achieved equilibrium levels within two weeks. The experimental manipulation of bottom sediments may lead to an understanding of controlling processes leading to the formation and maintenance of bottom fauna biomass.

#### Benthic Studies and Pollution

Methods were being developed to recognize temporal changes at a single benthic sampling station from the cumulative plot of species against individuals taken in serial samples. This may be used as a measure of the resistance of a community to possible pollution stress and hence will be of use for predictive purposes.

#### Effects of Dredging on the Sea Bed

An investigation into the impact of inshore scallop dragging on lobsters in the Pictou area was less than conclusive because of the

seriously depleted state of the lobster stocks. Nevertheless, underwater examination of drag performance suggests that on a rough or mixed ground, which in normal circumstances would support a lobster population, drags will cause significant damage. This can be avoided by exclusive use of sweep chain drags, which will not operate on rough bottom, or prohibition of dragging in the close inshore zone.

### Finland

(J. Lassig)

#### Benthos

Quantitative studies on the bottom fauna in the northern Baltic were continued at the Institute of Marine Research in May, June, July, August and November. A number of reference stations were visited in the central and southern parts of the Baltic. Studies on benthic macrofauna were continued, in co-operation with Tvärminne Zoological Station, in May and August in the archipelago of Tvärminne. As part of the "Joint benthic macro- and meiofauna sampling program for the whole Baltic" 12 stations were visited in the Gulf of Finland and the Gulf of Bothnia.

Macrofauna studies were continued by the Tvärminne Zoological Station of the University of Helsinki at 14 stations in the vicinity of an iron mill near the research station.

Studies on the effects of organic pollution on soft-bottom macrobenthos were carried out off Rauma in the Bothnian Sea, by the Archipelago Research Institute of the University of Turku. Additionally, the effects of oil pollution on macrobenthos were studied off Naantali and Porvoo. Within the framework of the "Joint sampling programme" (see above) 20 stations were sampled in the Archipelago Sea.

Macrobenthos was studied at 20 standard stations in the sea around Åland, by the Husö Biological Station of Åbo Akademi.

Studies on benthic macrofauna were continued in the Bay of Liminka, by the University of Oulu. As part of the "Joint sampling programme" 10 stations were visited in the Bothnian Bay.

Macrobenthos studies were continued at 3 standard stations, by the Water Conservation Laboratory of Helsinki City. Additionally, 5 stations were visited within the framework of the "Joint sampling programme". All the stations were situated in the coastal waters off Helsinki.

These projects will be continued during 1975.

France

(L. Marteil)

Ostrea edulis, Crassostrea gigas

L'évolution des larves d'O. edulis et surtout de C. gigas a été fortement perturbée par les médiocres conditions climatiques de 1974; les fixations ont doc été moins abondantes qu'en 1973. De même, la croissance et l'engraissement des huîtres dites japonaises ont été moins satisfaisants qu'ils ne l'avaient été l'année précédente.

L'épizootie de l'huître plate s'est poursuivie. Il y a eu apparition du parasitisme dans de nouveaux secteurs mais il n'y a pas eu généralisation de la mortalité qui est restée limitée à quelques endroits. L'évolution du parasite semble être influencée par les conditions locales.

Pecten maximus

En plus des études sur l'état des stocks et leur évolution, des essais de captage de coquilles St Jacques ont été tentés par le laboratoire de La Trinité.

En 1974, le programme du Centre océanologique de Bretagne était axé sur les essais de collecte de naissain de Pectinidés en milieu naturel. A cette fin, deux gisements ont été suivis en Bretagne en vue de suivre le cycle de vie des coquilles St Jacques et déterminer les périodes de ponte et de fixation des larves.

Le modèle de RICKER a été appliqué sur les données collectées (les modèles de production sont ininterprétables en raison des fluctuations naturelles importantes, on ne se trouve pas en situation d'équilibre). Les réglementations en vigueur, qui limitent la taille minimale des captures, la saison de pêche, le nombre des bateaux qui opèrent, sont, en première approximation, satisfaisantes. On peut néanmoins espérer un accroissement de la production en élevant la taille à la première capture ou en décalant la saison de pêche. Mais les incidences resteraient marginales.

Sur la collecte de naissain, la population de géniteurs a été suivie tout au long de la saison et les données sur l'évolution de la maturation ont été obtenues: la ponte a eu lieu début juillet en baie de St Brieuc et à plusieurs reprises entre mai et août en rade de Brest et a déterminé les dates de pose des collecteurs.

Les densités de larves planctoniques trouvées (quelques individus par m<sup>3</sup>) sont tout à fait anormales, bien que la méthodologie employée (filet à plancton, maille de 200µ, traits de surface) soit à revoir.

Les résultats de 1973 (fixations de 10 à 50 coquilles St Jacques, de 100 à 5000 Chlamys par collecteur) n'ont pu être retrouvés, en raison du mauvais temps incessant qui a régné en Bretagne nord: la quasi absence de fixation peut être due à l'action mécanique de la houle sur les structures de collecte mais pourrait aussi signifier un défaut dans le recrutement.

Chlamys opercularis, C. varia

Parallelement aux essais de captage de P. maximus, les experiences ont porte sur C. opercularis et C. varia dont les fixations ont ete plus intenses que celles de coquilles St Jacques.

Venus decussata, V. semi-decussata

L'elevage en casiers surélevés de naissains de V. decussata et V. semi-decussata est en cours dans les differentes regions conchylicoles.

Federal Republic of Germany

(K. Tiews)

Crassostrea gigas

Raft culture experiments with Crassostrea gigas were continued in the Wadden Sea, off the isle of Sylt, and in the western Baltic at the Institut für Küsten- und Binnenfischerei.

These studies will be continued in 1975.

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 were concluded at the Institut für Küsten- und Binnenfischerei. Experiments on the raft culture of mussels were continued in the western Baltic (Flensburger Förde) at the Institut für Küsten- und Binnenfischerei.

These studies will be continued in 1975.

Cerastoderma edule

Cockle beds along the coast of Niedersachsen and Schleswig-Holstein were again surveyed by the Institut für Küsten- und Binnenfischerei. A commercial fishery which started in 1973 was continued off the coast of Niedersachsen.

These studies will be continued in 1975.

Benthos

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

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

Studies on the development of benthos communities were continued in a brackish water pound at the Institut für Küsten- und Binnenfischerei.

The Institut für Meereskunde continued its studies on the availability of benthic food specimens in relation to its utilization by fish in the Kiel Bight.

These studies will be continued in 1975.

Iceland

(U. Skúladóttir, H. Eiríksson)

Mytilus edulis

Experimental rope culture showed an O-group growth between 5 and 10 mm. However, improvements regarding rafts and mooring have to be made to combat the adverse weather conditions.

Chlamys islandica

Sampling was continued, as previously, together with data on landings and effort. 4200 Iceland scallops were tagged in the Breidafjörður area. On the whole recapture rates were low with the exception of one area where 22% were recaptured within 4 months of being tagged.

Landings continued to fall, largely owing to unfavourable prices and decreased effort. Landings may be expected to rise again following increased mechanization of the industry.

Arctica islandica

Surveys scheduled to start in 1974 had to be postponed until 1975 owing to a delay in the delivery of clam dredges.

Two or three surveys are planned in 1975.

Ireland

(F. A. Gibson)

Ostrea edulis

A large-scale experiment on the settlement of naturally produced Ostrea edulis spat, on collectors of French design and constructed from polythene in the Tralee Bay area was planned for 1974. By mid-June, the sea temperature had, however, not exceeded 17°C, and thereafter fell to remain below this level. By mid-August, when larvae should have been most abundant, it was only 15°C. Oyster larvae were found in many parts of the Bay, but no settlement of consequence was noted. The collectors were, therefore, not installed in position. This was only the second occasion since 1965 when natural spatfall virtually failed in Tralee Bay.

The oyster spat collection experiment, postponed because of unsuitable climatic conditions, will be undertaken during the summer of 1975. If it proves to be successful it is intended to instruct local oyster interests fully in the techniques and outcome of oyster research in this area during the past decade, so that the industry may capitalise on this and, hopefully, manage this natural oyster stock.

A single specimen of the Australian Barnacle, Elminius modestus, was discovered in the inner part of Tralee Bay. This is the first record of a non-indigenous species in this area, and it may have been introduced by ships plying between the continent and the port of Fenit at the head of the Bay.

## Shellfish Surveys

General shellfish surveys of a number of Bays and River Estuaries from Wexford on the south-east to Bantry Bay on the south-west, were undertaken. Both commercial and non-commercial species were quantified.

### Netherlands

(P. Korringa)

#### Ostrea edulis

Though the stock of oysters born in the Oosterschelde continued to increase, the Zeeland oyster farmers still found it necessary to import a fair quantity of oysters from Brittany to supplement their stocks. A mysterious disease raged among the flat oysters in several sections of the coastline of Brittany. Strict instructions were given to avoid purchase of oysters grown in well-defined coastal sections, in addition to the action of the French authorities who did everything within their power to guarantee that only healthy oysters left the country. It was virtually impossible nevertheless to exclude oysters bearing the early phases of this disease from consignments. Many samples were analysed for symptoms of the disease. It was feared that with the advance of summer some mortality would occur. Fortunately this did not happen. The oysters grew well and developed a good quality of the edible parts; the losses were again minimal. Parasitological studies were continued to acquire more insight into the true nature and the etiology of this disease.

The sanitary control of oysters, both on the plots of the Yerseke Bank, and in the storage basins at Yerseke, was continued. The sanitary conditions appeared to be satisfactory throughout the season.

#### Mytilus edulis

Studies on laboratory and commercial scale dealing with cleansing and storage of marketable mussels were continued at the Mussel Experimental Station on the Isle of Texel. It is certainly possible to free mussels completely from intervalvular sand in a well-designed tank and to keep them in good condition for some time prior to marketing. These experiments led to the design of large plants capable of handling all the mussels produced in the Netherlands. Should enclosure of the Oosterschelde lead to destruction of the natural cleansing plots near Yerseke, such a plant would be required. Towards the end of the year the Dutch Parliament reconsidered the enclosure of the Oosterschelde. Though no definite decision has yet been taken, there seems to be a reasonable possibility that the cleansing plots near Yerseke will be maintained in use.

One experiment was successful in cleansing of mussels horizontally. Further experiments demonstrated that it was possible to clean mussels by water passing them in vertical direction. This indicates that it might be possible to free mussels from sand and silt in the intervalvular space in a specially designed ship. Prolonged storage seemed, however, not feasible in such a ship.

The quality of the consumption mussels was again exceptionally good in the season 1974-1975. Sanitary control was continued and gave no reason for concern in the year 1974. Phytoplankton control was continued in the



Oosterschelde and in the Dutch coastal water throughout the year. Fortunately no unfavourable development was observed. It was presumably the unstable weather situation during the summer which did not favour the development of dinoflagellate blooms. In the month of August frustules of Prorocentrum micans were found in the intestinal tract of mussels in the Oosterschelde, but careful tests for shellfish toxicity, carried out with laboratory rats during this period, gave only negative results.

#### Norway

(K. R. Gundersen, B. Böhle, K. F. Wiborg)

#### Ostrea edulis

Experiments have started on oysters in connection with projects on combined culture of shellfish and fish in sea water.

Experiments have started, in co-operation with the Society for the promotion of the Norwegian fisheries, Bergen, on the culture of oysters combined with marine culture of rainbow trout and salmon. The theory is that the oysters may profit either directly, by filtering surplus food particles, or indirectly, from the increased primary production induced by organic and inorganic waste material from the fish farms.

Oyster seed and one year olds were placed in baskets suspended from buoys near four fish farms in Western Norway. The results so far seemed promising, the oysters exhibiting good growth.

These experiments will be continued.

#### Mytilus edulis

The experiments on cultivation of mussels by the use of net bags were concluded in 1974. Although the experiments were successful, very few commercial cultivation plants have been established. This is mainly due to marketing problems.

Experiments on cultivation in Northern Norway were only partly successful. The plant suffered from unauthorised interference.

In laboratory experiments in a 15 week period, unfed mussels and mussels with very low algal concentration decreased in dry weight at 24°C while fed mussels increased their weight "normally".

#### Cephalopods

No immigration of Todarodes sagittatus occurred in 1974.

#### Poland

(L. Zmudzinski)

#### Benthos

Control research on biocenotic changes of distribution of benthic fauna in the Southern Baltic, already pursued over many years, was continued in 1974. Production of two selected species, Pontoporeia affinis and Macoma baltica, was also studied.

Portugal

(M. J. de Figueiredo)

Crassostrea angulata

Experiments on improving the quality of Crassostrea angulata by transplantation to improvement areas within the estuary of the River Sado were continued. The results obtained by the end of 1974 were promising and will be published.

Murex spp.

A study of the stock composition of Murex brandaris and Murex trunculus was started in order to establish conditions for their commercial exploitation.

Contamination

In consequence of the outbreak of cholera during April, molluscs of the south coast (Algarve), which were supposed to be the most important vehicle of that disease, were intensively analysed. A heavy pollution by the V. cholerae was found in all species: oysters, Tapes, oockles and mussels. Analysis of the sea waters also showed strongly positive results. The epidemic outbreak was finished by July.

Experiments were carried out on Tapes decussatus in order to establish regulations for the purification of these molluscs.

Spain

(H. H. Quiroga)

Ostrea edulis

Studies on the growth, reproduction, larval settlement and condition index have been undertaken at different places on the Galicia coast. Growth was studied not only in oysters born in Spain but also in those imported from France.

Crassostrea spp.

Sexual maturity was achieved for C. angulata and C. virginica in laboratory conditions but larval development was not completed.

Plastic collectors were monitored in the Guadalquivir River.

Oyster mortality investigations were undertaken on the southwest coast of Spain.

Mytilus edulis

Specific differences between cultivated and natural mussels were studied, as were sexual development and spawning in cultivated mussels.

Venerupis decussata

Studies on the production of Venerupis decussata were undertaken at different bays off the Spanish coast. Temperature influence on the growth, weight and mortality was studied. Experiments on artificial feeding of clams maintained in captivity were initiated.

Benthos

New investigations of the red seaweed beds, Gelidium sesquipedale, off the Cantabric coast and studies of the possibility of attaching the plants to artificial substrata were pursued.

Ecological studies, with special attention to the structural variations and population dynamics of the intertidal seaweeds, some of which, e.g. Chondrus crispus, have commercial importance, were undertaken.

The biomass of Ascophyllum nodosum in the Ria of Vigo was evaluated.

Sweden

(B. I. Dybern)

Ostrea edulis

A survey of the oyster beds at the northern part of the west coast was started.

Mytilus edulis

Investigations on the content of parasites and commensals in Mytilus were started. So far there was no evidence of an occurrence of Mytilicola in Swedish waters.

Benthos

The survey of the population of benthos animals in the Baltic was continued. Benthic organisms were studied in connection with several pollution investigations along the Swedish coasts.

United Kingdom

(P. R. Walne - England and Wales  
H. J. Thomas - Scotland)

Ostrea edulis

In 1974 natural recruitment of stocks on English oyster grounds was not good, although stocks from the previous year were substantial. Production of marketable oysters from traditional oyster growing fisheries has increased considerably as a result of restocking with seed oysters from the Solent fishery; quantities of seed from this area have also been exported to France.

Crassostrea gigas

The economic aspects of growing hatchery-reared small seed was further examined, at the English and Welsh laboratories, in 1974. It has been found that costs of growing the seed can be reduced by improved husbandry methods which reduce losses and improve growth rates. At present the economic handling of seed of 2 mm to 15 mm is the major remaining problem to be solved in the development of hatchery culture methods.

Mytilus edulis

English and Welsh experiments on the exploitation of seed stocks are concentrating on measuring the effect of predation by Carcinus in relation to tidal level and size of mussels. Trials of fences with crab guards are in progress.

Cerastoderma edule

Research has been carried out in the three main English and Welsh fisheries. In the Wash reports have been prepared on the likely effects of proposed intertidal water storage reservoirs; an additional project has been the long-term effect of a method of fishing which utilises the propellers of fishing vessels to "blow" cockles out of the sand. In the Thames Estuary a special effort has been made to survey offshore and sublittoral stocks and special gear has been constructed for effective large-scale sampling. Stock surveys in the South Wales fishery have indicated that the present decline, due in part to topographical changes in the Burry Inlet, is likely to continue for some years.

Cockles transplanted from the upper to the lower shore on Traigh Mhor, Barra, Scotland, in May 1965 were examined in August 1973. Survival had been good and a mean size of more than 2 in (51 mm) attained.

Pecten maximus and Chlamys opercularis

Tagged scallops continue to be returned from the Devon (West Channel) fishery and results indicate that in this area the growth of scallops in their fifth year is poor. A detailed study is being made of the queen scallop (Chlamys) stock off the south-west coast of England. Regular samples are being taken for shell growth, meat yield and gonad condition analysis. Many queen spat have been found associated with hydroid/bryozoan colonies; the growth of these is being studied in cages. Various techniques have been tried to obtain accurate assessments of queen stock composition, including the use of modified dredges and diving. Studies are being made of the growth of Pecten spat kept in suspended trays.

Scottish landings of scallops (Pecten maximus) declined in 1973, largely because of a switch of emphasis to the queen (Chlamys opercularis). Studies of the principal stocks of both species continued. Recent recruitment of scallops has been good in the Clyde and catch per unit effort there was much higher than in the late 1960s. West of Kintyre and off the north-west, where the stocks have been exploited for only a few years, the catch composition has now come to resemble that in the Clyde, where fishing has gone on for 35-40 years, and catch per unit effort has now increased after falling steadily since fishing began. The mean length has generally shown little change. Comparative fishing experiments showed that dredge tooth

spacing and ring-mesh size have a selective effect on the catch. A dredge with 2 in. (51 mm) spacing and  $2\frac{1}{4}$  in. (57 mm) ring-mesh caught most small scallops. Comparative fishing experiments showed that commercial dredge efficiency is low, especially for scallops smaller than 80 mm (3%) and only averaged 27% for larger scallops. Dredge-caught scallops returned to the sea showed significant mortalities when taken in long hauls. The density of scallops on a commercial bed in Kilbrennan Sound was one per 10 m<sup>2</sup>.

The Scottish queen fishery off the south-west continued to thrive and landings increased greatly. Catch per unit effort increased in the Solway Firth, Morecambe Bay and at Shetland, but fell in the Clyde and off the Isle of Man. Catch per unit effort falls during the late winter and spring and rises again from the late summer to early winter as 2-ring queens achieve commercial size.

#### Loligo forbesi

Observations on the Scottish catch, landings composition and catch effort, of squid were maintained. At Rockall both total catch and catch per 100 hr fishing were at a lower level in 1974 than in 1973.

#### Shellfish Pests and Diseases

New legislation was introduced in 1974 to strengthen the controls designed to prevent the introduction of new molluscan shellfish pests and diseases into England and Wales. It also improved control of the movement of shellfish stocks nationally. Mytilicola has extended its range in Morecambe Bay.

Molluscan shellfish for relaying may only be introduced into England and Wales under licence, which is also required for certain movements within the country.

No extension of the known Scottish distribution of mollusc pests, parasites and diseases was noted. Observations on the flatworm Notoplana atomata found living on cultivated C. gigas yielded no evidence of harm to the oysters.

#### Bivalve Culture

Hatchery reared seed of native (Ostrea edulis) and Pacific (Crassostrea gigas) oysters and natural spat of scallops and queens were grown on under a variety of conditions in five Scottish west coast lochs. Oysters grew and fattened well in Loch Ardvar and especially in Linne Mhuirich, where C. gigas attained commercial size in 16 months. Queens attained commercial size in 2 years, but scallops, after growing well in their first year, grew poorly in their second.

#### Benthos

A Working Group has been formed in southern England to try to eradicate the immigrant seaweed Sargassum muticum. Approximately 12 tonnes of the weed have been removed by hand-gathering; other control methods are being studied.

Research has been carried out on the fisheries for whiteweed (Sertularia argentia) and bait-worms (Nereis virens and Arenicola marina)

in the Thames estuary.

As part of a Scottish programme of food chain studies on sand and mud bottoms involving various commercially important species of fish and shellfish, an investigation was made of the energy flow to a mud community on the bottom of a sea loch on the Scottish west coast. This investigation included the use of experimental chambers of 3 m diameter placed on the bottom and serviced by divers who made weekly measurements of oxygen consumption, nutrient release, redox, ATP and C/N profiles.

On sand ecosystems, the field work on the food web of the flatfish nursery ground at Firemore (Loch Ewe) has now been largely completed, but some final processing and assessment of recent data is under way, and limited monitoring of fish and benthos populations will continue.

The programme of benthos studies in the larger flatfish grounds of the Clyde sea area is still in progress.

U.S.A.

(R. L. Wigley)

#### Loligo pealei

In January-February 1974 the National Marine Fisheries Service in Gloucester, Mass. chartered a 100-foot commercial stern trawler to explore the potential for a squid fishery in winter off southern New England. Four trips, about one week each, were made. The squid caught (mostly Loligo pealei) and the incidental finfish were marketed to see whether directed effort for squid could support a fishery. The total marketed catch for the four trips was 76.7 metric tons of squid and 7.4 tons of finfish. The ex-vessel value was \$29,800 (U.S.). This was less than the trawler could have expected to earn fishing for groundfish, and it was determined that the market demand and price of squid would need to be somewhat higher than at present for a directed fishery for squid to be feasible. (Details of this study are published in Marine Fisheries Review, December 1974).

#### Contamination

A study concerning the effects of acute exposure of various bivalve molluscs to silver was completed. The first phase of a similar study utilizing chronically exposed bivalves was also completed. Data were processed from oysters (Crassostrea virginica) and hard clams (Mercenaria mercenaria) exposed to silver for 30 and 90 days, as well as a 30-day exposure followed by 30 days of clean water recovery. At the end of each exposure period, gill tissue respiration was measured. In every test respiration was elevated, a finding similar to that noted after 96-hr acute testing.

Some important marine contaminants, such as heavy metals and certain pesticides, were found to be mutagenic, that is, capable of inducing genetic damage. Such damage may lead to reduced fecundity, defective gametes, abnormally developed eggs, dead larvae, and reduced recruitment of any season's spawn into the fisheries. Earlier work

reported last year showed four heavy metals to have general genetic effects on dividing cells almost invariably associated with direct damage to the chromosomes and genes. Subsequent work showed nearly absolute genetic arrest of egg maturation in the coot clam, Mulinia lateralis, by 0.5 ppm lead. The chromosome damaging effect of cadmium for the commercial American oyster, Crassostrea virginica, extends below 1.0 ppm. For silver this effect extends below 0.003 ppm in the oyster. American oysters given chronic low-dose exposure to low parts per billion silver produced well-developed gonads on schedule. Eggs had, however, severe genetic damage.

In 1975, experimental and field-orientated studies on the potential mutagenicity of widespread marine contaminants are being extended to groundfish and crustaceans. First samples of tuna and some marine mammals will soon be examined.

A study concerning the sublethal physiological effects of acute exposure of surf clams, Spisula solidissima, to silver neared completion. Larval, juvenile and adult respiration were monitored after 96-hr exposures to silver. In each case the oxygen consumption values were elevated, indicating increased metabolic activity under silver stress. In addition, valve closure and heart-rate studies were conducted on adult clams.

#### Aquaculture

As a result of a changing emphasis in the National Marine Fisheries Service fisheries research programs the Milford (Connecticut) laboratory, Middle Atlantic Coastal Fisheries Center, has had a significant portion of experimental research directed back to molluscan aquaculture starting March 1, 1975. This follows a five-year period during which the laboratory was exclusively concerned with environmental pollution studies, particularly the effects of heavy metals on marine organisms - physiologically, biochemically, genetically, and on the phytoplankton at the base of the food chain. A good deal of this contaminants research will continue, while the new aquaculture research will emphasize selective and hybrid breeding, nutrition of larval and juvenile molluscs, and larval rearing and hatchery methodology - programs that had been initiated in the late 1960s with the completion of construction of a new laboratory building. Larval and juvenile disease studies are also to be undertaken through the Oxford (Maryland) laboratory, MACFC, with research personnel based at Milford. Consequently, contacts will be re-established with European laboratories involved in aquaculture research and it is anticipated that co-operative work and training for visiting scientists and technicians will resume as in the past. Further information can be obtained by writing to Dr James E. Hanks, Director of Investigations, Milford, Connecticut, 06460.

U.S.S.R.

(B. G. Ivanov)

#### Nuculana pernula

Three year long investigations on the biology of bivalve mollusc Nuculana (= Leda) pernula conducted by VNIRO in the White Sea were terminated. These investigations were conducted as this species became of

commercial importance in the Far East. The habitat of the White Sea population is similar to that of the Far Eastern population, allowing study there, under more favourable conditions, of the biology of this species.

Growth of N. pernula was investigated. The size-age composition of N. pernula population was analysed by Harding's (1949) method. The maximum age was 10-12 years and 6-7 year old specimens made up the bulk of the population. The molluscs matured when their shell was 5-6 mm high at the age of 2-3 years. The data on distribution of N. pernula by depths and types of bottom were obtained.

#### Loligo forbesi, Sepia officinalis, Ommastrephidae

In 1974 the Atlantic Research Institute of Marine Fisheries and Oceanography (AtlantNIRO) conducted investigations on the distribution and biology of the common squid (Loligo forbesi) and the cuttlefish (Sepia officinalis). The data on cuttlefish were obtained from 560 trawl catches. 1 280 specimens of cuttlefish were measured. A biological analysis of 360 specimens was made, as well as 860 morphometric measurements. Stomach fullness of 306 specimens was analysed. The data on common squids were obtained from 360 hauls. 3 000 specimens were measured; the biological analysis of 586 specimens was made.

Cuttlefish do not form large and stable concentrations. Their distribution is patchy and subject to frequent changes in space and time. As a rule, these are spawning rather than feeding concentrations. The population structure is complex and there are probably groups differing in maturation rates and seasons of reproduction.

The cuttlefish are predators which lie in wait for their food organisms. The main food items are fish and crabs, while gastropods and cephalopods make up an additional diet. The importance of fish in feeding increases with age.

There are summer and winter spawning populations of squid which differ in size composition and state of the reproductive organs. The squid's migrations are seasonal. In summer, winter-spawning populations perform feeding migrations and summer-spawning populations perform spawning migrations and in winter vice versa.

A monographic review on systematics, biology and distribution of squid of Ommastrephidae of the World Ocean was completed at the All-Union Research Institute of Marine Fisheries and Oceanography (VNIRO).

#### Benthos

The Polar Research Institute of Marine Fisheries and Oceanography (PINRO) has completed studies on systematics of Amphipoda, and studies of Bivalvia from bottom samples collected in 1968-1970 were continued. It was found that the distribution range of boreal species was curtailed and their abundance decreased as compared with the 1930s.

VNIRO made investigations on the biology of Fucus vesiculosus and Ascophyllum nodosum on the Barents Sea coast. Observations of the algae



in experimental areas and of labelled plants in natural conditions were carried out. The laboratory data on size-weight relationship of these species have been obtained. Ten thousand specimens of F. vesiculosus and 5 000 specimens of A. nodosum were examined. A bed of Fucus was composed of 1-9 year old plants. The bulk of breeding plants were 4-5 years of age. The annual mortality of one generation was estimated to be 60-90%. The length<sub>2</sub> of Fucus thallus reached up to 50 cm, the average biomass being 7.9 kg/m<sup>2</sup>, production 3.6 kg/m<sup>2</sup> per year.

1-13 year old plants occurred in the bed of A. nodosum, most of the breeding plants were 5-7 years of age. The annual mortality of one year-class was believed to be 40-75%. The length of A. nodosum thallus was up to 100 cm, the average biomass being 9.4 kg/m<sup>2</sup>; production was 11.5 kg/m<sup>2</sup>. Two peaks of germination were observed, in autumn and spring.

In the White Sea investigations on the distribution and stock of algae were conducted by the Northern Branch of PINRO. Studies on the prospects of agar algae cultivation were initiated.

In the Baltic Sea near the coast of Latvia and Estonia 500 samples of algae were collected by SCUBA divers by the Baltic Research Institute of Fisheries (BaltNIIRKR). The species composition, vertical and horizontal distribution of algae were studied, phytocenosis, biomass and productivity of algae in some areas were investigated.

VNIRO continued the treatment of data on growth rates and productivity of Furcellaria fastigiata. 289 samples were treated from 764 samples placed in cages in 1972-1973.

F. fastigiata from the Gulf of Riga increase in weight during the whole year, with the most intensive growth being observed from April to October (especially in June-August). The relative production (P/B - coefficient) varied from 1.5 to 0.5.

## CRUSTACEA

### Belgium

(R. de Clerck)

#### Crangon crangon

Monthly analyses of the shrimp stock and of the by-catch in experimental shrimp fishing, started in April 1973, on 14 fixed stations on three different areas along the Belgian coast, were continued in 1974. The objectives of this study are to obtain a detailed picture of the evolution of the population of C. crangon along the Belgian coast over an extended period and to evaluate the possible competitive and predatory interactions between the population of C. crangon and the populations of the other species in the shallow water community. Within the framework of this latter study stomach analyses on Gadus luscus and on juvenile G. merlangus were started in order to evaluate the importance of post-larval Caridean shrimps in the food of these fishes.

These studies will be continued in 1975 and analyses will be extended to other predatory fish as for instance Callionymus, Agonus, Liparis and Onos.

Canada

(J. E. Stewart)

Homarus americanus

Concern over the state of the lobster fishery led to the formation of a 14-man Task Force to review the situation, obtain the views of the industry and government officials, and recommend corrective procedures. Public meetings attended by over 1 000 fishermen and processors covered fishing seasons, size limits, districts, enforcement, financial assistance, restricted licensing and trap limits. A report will be produced soon.

Monitoring of the fishery in selected Newfoundland areas was continued. This included catch sampling and collection of catch/effort data throughout the fishing season and estimates of total traps in use during the peak fishing period. Tagging was carried out to provide estimates of stock sizes and rates of exploitation of legal size lobsters. Growth studies were continued in order to obtain more data on moult increment and the frequency of moulting in nature.

An experimental study of responses of pre-settling larvae to pressure changes and a study of the effect of wind on the distribution of larvae in a near-shore area were carried out.

Nutrition. Studies on the nutritional requirements of the adult lobsters showed that the animals fed casein require a minimum of 40% protein while the optimum level was 60% based on growth and survival measurements. Cod liver oil was markedly better than corn oil or coconut oil with the optimum achieved with 5% cod oil. Cholesterol was required by adult animals. The optimum level of cholesterol for juvenile lobsters was 0.5%. Betacarotene and glucosamine had essentially no effect on pigmentation or growth of juveniles; a dietary mineral source was required (3% Bernhardt-Tomelli mineral mix was optimal).

Continuing work is focused on the requirements for fat soluble vitamins, amino acids and the dietary quality of different protein sources.

Lobster culture. A pilot scale lobster culture facility is being constructed at St Andrews to evaluate the economic feasibility of lobster culture. The plant, scaled to annual production of one thousand pounds of lobster, will incorporate research facilities and a small shellfish culture unit to evaluate the potential for multiple culture.

Lobster reproduction and endocrinology. Work on the reproductive cycle of the female lobster indicated the traditional concept of moult and egg laying in alternate years was only partially correct. One size class predictably moults and lays eggs in the same summer, and these females are valuable for culture purposes because offspring of planned matings may be obtained in a short time.

A single dose of ecdysterone (moult hormone) induces rapid pre-moult development, but the animals die during ecdysis. Such lobsters at ecdysis showed high blood lactic acid levels suggestive of anoxia and stress; the defective gill development observed in these lobsters was suspected as the basic cause of these conditions and the animals' deaths.

Diseases of lobsters. The ciliate blood parasite that was associated with lobster deaths at St Andrews between 1971 and 1973 has not been detected in samples over the past two winters. It now appears this was an isolated example of facultative parasitism and this ciliate is not developing into a major problem.

Studies of the bacterial disease, gaffkemia, were continued. Surveys showed that over the past two years the freshly captured lobsters have been free of the pathogen. Scattered outbreaks have occurred in holding units over the same period suggesting that much of the problem probably resides in the holding units. The intrinsic defence mechanisms against disease generally (agglutinins, bactericidins, phagocytic capacity etc.) are being examined with a view to manipulating these so as to provide resistance to the disease. A combination of the live pathogen, Aerococcus viridans (var.) homari and the antibiotic vancomycin has been successful in producing a high degree of resistance immunity in treated lobsters. Work on these aspects is continuing.

#### Cancer irroratus

Research in the Gulf of St Lawrence in 1974 tested a new trap design. The new traps - modified lobster traps with rectangular entrance on top of the trap - caught more crabs than unmodified traps, and no lobsters.

A rapid tagging technique was devised using Floy anchor tags inserted by a tagging gun postero-laterally through the epimeral line. The tag was retained through the moult and tagged crabs held in the laboratory for 3 months showed no increased mortality over untagged animals.

Landings of Cancer irroratus in Nova Scotia contained about 25% meat. Despite the hard exoskeleton, mechanized meat extraction was possible and resulted in a good yield (21-23%) not excessively contaminated with shell debris.

Preliminary investigation of postmortem metabolic processes in rock crab (Cancer irroratus) muscle indicated that significant differences exist between this species and queen crab previously studied. For example, in leg muscle of freshly killed rock crab, quaternary ammonium compounds were major constituents of the acid-soluble fraction, with nucleotide concentrations being relatively low, about half those found in queen crab muscle. On the other hand, glycogen → lactate breakdown patterns appear similar in both species. The effects of various processing techniques on rate and extent of these metabolic changes associated with flavour and textural properties is under way.

#### Chionoecetes opilio

Bottom photography was found to be a more accurate census method for the commercial spider crab, Chionoecetes opilio, than trawling or sight

counts from a submersible. Males larger than 40 mm carapace width approached a random distribution and abundance estimates for 4 study areas ranged from 5.2 to 9.2 crabs/500 m<sup>2</sup> and from 2.2 to 4.2 kg live weight/500 m<sup>2</sup>. Mature female crabs and immature crabs of both sexes had highly aggregated distributions. To permit catches from commercial crab traps to be converted to crab density, traps were calibrated for effective area fished. This calibration averaged 4100 m<sup>2</sup>/trap over 4 study areas.

#### Pandalus borealis

A minimal amount of shrimp research was carried out in 1974. The small local fishery centred on Port aux Choix in the northeastern part of the Gulf of St Lawrence suffered from labour unrest and strikes but in spite of this, 500 metric tons was landed. Monitoring of this fishery continued.

#### Denmark

(Home waters - S. Munch-Petersen

Greenland waters - E. Smidt)

#### Pandalus borealis

Collecting of catch and effort data from the commercial shrimp fishery was started, around Greenland, in the Disko Bay and in offshore areas. Biological material for carapace measuring was taken from research vessel catches and from commercial landings.

The research work is continuing in 1975.

#### Chionoecetes opilio

Inshore trap fishing experiments for crabs were made in the Greenland districts of Godthåb and Sukkertoppen and in Disko Bay.

The experiments will be continued in 1975.

#### Nephrops norvegicus

Four cruises, on grounds fished by Danish vessels, were made during 1974 by research vessels using the Danish commercial Nephrops trawl with the purpose of investigating

- 1) The activity of Nephrops relative to (a) day and night; (b) current velocity; (c) oxygen content just above the bottom.
- 2) The composition of the by-catch.

France

(L. Marteil)

Homarus vulgaris

Poursuite des opérations de repeuplement des zones côtières par l'immersion de post-larves produites en écloseries. Les résultats obtenus à l'écloserie expérimentale de l'Ile d'Yeu sous la direction du laboratoire de l'Institut des Pêches de Roscoff montrent en particulier un doublement de la production de ces post-larves en 1974 par rapport à 1973.

Palaemon serratus

Etude de la reproduction chez les crevettes capturées et des déplacements par marquage des individus par injection de colorants.

Maia squinado

Etude de la reproduction par histologie des gonades.

Pathologie des crustacés

Poursuite des recherches sur Gaffkya homari; essais de traitement des homards par antibiotiques et expériences de traitement de l'eau de mer par U.V. Ascophrys et Pseudonionas sp. parasitent les tourteaux (C. pagurus) morts ou moribonds présents dans les viviers commerciaux; Gaffkya a également été trouvé dans le sang d'un de ces crustacés. Le cilié Ascophrysrodor a été étudié chez P. serratus.

Nephrops norvegicus

Travaux a la mer: Des échantillonnages mensuels ont été effectués dans le nord du golfe de Gascogne. De janvier à août, ils ont eu lieu simultanément dans trois secteurs. A partir d'octobre, ils ont été réalisés bi-mensuellement dans une zone centrée sur 47°30'N et 4°W. Une expérience préliminaire d'étude de la sélectivité des chaluts utilisés pour la pêche de la langoustine dans le golfe de Gascogne s'est déroulée en mai à bord d'un bateau commercial dans les conditions normales de pêche.

Travail en laboratoire: La biologie de la langoustine et plus particulièrement sa croissance a été étudiée à l'aide des échantillons prélevés dans le golfe de Gascogne. Des relevés statistiques des apports français ont été commencés ainsi que des mensurations sur des captures commerciales provenant du nord du 48° parallèle.

Echantillonnages: Le programme de 1975 prévoit la poursuite des échantillonnages mensuels à bord des bateaux commerciaux et de l'étude des stocks du golfe de Gascogne et du nord du 48° parallèle.

région	Nombre d'échantillons		Nombre de langoustines mesurées
	bateaux commerciaux	marché	
Golfe Gascogne	18	2	27 018 455
Nord du 48°N mer d'Irlande		9	1 814

Une campagne sera consacrée au printemps à l'étude de la sélectivité des diverses parties du chalut. En automne une seconde mission est prévue pour l'étude des populations du Plateau Celtique.

La croissance et le cycle de vie de la langoustine (Nephrops norvegicus) dans la région nord Gascogne ont été étudiés à partir de données de distributions de fréquence de taille et de fréquence de mue collectées entre avril 1970 et avril 1971.

#### Centre océanologique de Bretagne

Il a été établi que 5 classes d'âge (Ages II, III, IV, V et VI) constituaient la partie la plus importante des captures. L'âge II était incomplètement recruté, tandis que les classes plus âgées que l'âge VI apparaissaient seulement occasionnellement et ne représentaient jamais plus de 5% des mâles ou 3% des femelles capturées. Il est suggéré que les langoustines, durant la période de leur vie qui est soumise à la pêche, muent une ou deux fois l'an; les individus des deux sexes meeraient au printemps; plus tard en automne, seuls le feraient à nouveau les mâles et les femelles d'âge II. Les mâles et les femelles deviennent apparemment matures à la fin de l'âge II; les femelles pondraient ensuite tous les ans et échapperaient à la mue d'automne alors qu'elles incuberaient leurs oeufs.

Les classes modales des distributions de taille des carapaces, observées aux différentes périodes de l'année, ont été portées sur un graphe de croissance en les rapportant à une échelle de temps correspondant à la fin des périodes de mue de printemps et d'automne. Les équations des courbes de von Bertalanffy ajustées à ces données ont été obtenues par la méthode des moindres carrés; elles sont de  $L = 116,9135 (1 - \exp(-0,00771 (t+0,4382)))$  pour les mâles et de  $L = 56,0387 (1 - \exp(-0,1785 (t+0,4353)))$  pour les femelles;  $L$  étant la longueur de la carapace en millimètres et  $t$  l'âge en années. Les équations de régression du poids en grammes en fonction de la taille en millimètres ont été calculées séparément pour les mâles ( $W = 0,0003920 L^{3,18415}$ ) et pour les femelles ( $W = 0,00080664 L^{2,97303}$ ). Un modèle de simulation de la croissance a été réalisé sur ordinateur, il permet de suivre l'évolution du poids moyen et de la taille moyenne des individus d'un groupe d'âge, durant une ou plusieurs années; dans ce modèle il est tenu compte de la distribution des fréquences de mues durant l'année et de la croissance relative durant chacune des mues. Une méthode a été mise au point pour intégrer la croissance en poids dans un modèle de rendement du stock de langoustines étudié.

Federal Republic of Germany

(K. Tiews)

Crangon crangon

Investigations at the Institut für Küsten- und Binnenfischerei to assess the proportions 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 409 samples (= 2 045 kg) of unsorted catch from the shrimp fishery were collected in Büsum, Cuxhaven, Neuharlingersiel, Dornumersiel, and analysed as to their species and length composition. Experimental work at the Institut für Küsten- und Binnenfischerei with Crangon crangon have been continued to establish whether this shrimp changes sex.

Experimental studies on the movement of Crangon crangon in tanks were carried out at the Institut für Hydrobiologie und Fischereiwissenschaft of the University of Hamburg.

Studies on the survival rate of by-catch flat fish of the German shrimp fishery were performed at the Institut für Hydrobiologie und Fischereiwissenschaft.

In 1975 catch assessment work to determine the composition of shrimp catches by species and length will be continued at the Institut für Küsten- und Binnenfischerei.

Pandalus spp

Samples of deep sea prawn catches, made during research cruises of RS "Friedrich Heintke" in the Farn Deep area and on the Fladen Ground, were analysed as to their species and length composition at the Institut für Küsten- und Binnenfischerei. A study on the stomach content of Pandalus borealis and on the rearing of this species was continued at the Institut für Hydrobiologie und Fischereiwissenschaft of the University of Hamburg.

In 1975 research on the composition of Pandalus spp. catches in the North Sea and food investigations will be continued.

Iceland

(U. Skúladóttir H. Eiríksson)

Pandalus borealis

Several exploratory surveys were carried out in which commercial quantities of shrimps were located in one new area.

Sorting of undersized shrimps alive in sorting machines has become popular among fishermen in Húnaflói where about 28% of the total catch of shrimp are caught.

Research similar to that in former years was continued. Approximately 132 000 shrimps were measured to the nearest mm. A small proportion of these was analysed further with regard to sex composition, maturation, spawning and hatching. Fishermen furnish reports from which catch per unit effort can be calculated. Estimations based on the method of Gulland, used on fish in 1961, are now being tried again. Accordingly a catch quota has been decided for the best known fishing areas.

In 1975 research on Pandalus will be carried out along the same lines with the addition of the collection of pandalid larvae.

#### Nephrops norvegicus

Routine collection of data on Norway lobster landings, catch effort and catch composition were continued.

Four research vessel surveys were undertaken including the tagging of 2 080 animals. Nephrops larvae were sampled and surveys made of previously unexploited areas.

A total catch quota of 2 000 metric tons operated during the 1974 season as well as a 100 GRT and/or 400 HP size limit for Nephrops trawlers. The average catch/hour rose by approximately 26% from the previous year or from 31 kg in 1973 to 39 kg in 1974.

It is forecast that an increase in the 1975 catch quota up to 3 000 tons may sustain a further increase in average catch/hour to approximately 45 kg. This is considered of paramount importance in order to increase the financial returns of the fishery.

#### Ireland

(F. A. Gibson)

#### Homarus gammarus

In October 1974, 1 000 lobsters, of all size groups common to the fishery, were heat branded and released off the south east coast of Ireland in the general area of the Saltee Islands. The purposes of this experiment are to study stock density, annual growth, fishing mortality and migration. A reward of £1 sterling is being offered for each live recaptured lobster, which will also be purchased at the current market price, so that it can be released again to the fishery. Those recaptures made in October 1975 will be the most valuable for the measurement of annual growth.

A lobster trap census which has been carried out since 1968 was continued, and in 1974 showed a slight increase in the number and weight of lobster caught per trap in comparison to previous years. There was also a slight drop in the number of boats and traps engaged in the fishery.

Examination of the lobster catch was continued and about 2 500 (in addition to the liberations reported above) individuals were examined for the usual characteristics.



The poor response by fishermen to the voluntary catch and effort scheme, continued.

In 1975 this programme will be continued and developed in the light of the discussion of the Lobster Working Group.

#### Palinurus elephas

At the Fisheries Field Station at Dunmore East, Co. Waterford, experiments on the physiological requirements of Palinurus elephas led to the construction of specially designed storage pounds, capable of being operated successfully at or away from a source of renewable sea water.

#### Nephrops norvegicus

The mark-recapture programme begun in 1973 was continued in 1975. This work involves the use of SCUBA divers, locating and catching prawns in small discrete populations, and after telson punch code marking, and release, their recapture one year later. In July 1974 divers searched for the 130 liberations made in July 1973, and at the same time code punched a further 300 specimens. Recaptures showed annual growth increments of carapace length 1.5 mm in females and variable growth in males, up to 4.5 mm.

In 1975 the Nephrops investigation will be continued and experiments with escapements undertaken.

#### Netherlands

(P. Korringa)

#### Crangon crangon

In 1974 emphasis was laid on studying the biological cycle of the brown shrimp, especially regarding distribution patterns and migrations. Owing to the extended facilities for a mathematical approach data collected in previous years were worked in greater detail. The technique developed for distinguishing different groups of migrating shrimps by means of the relation between body length and surface area of given parts of the carapace (the dorso-lateral shields of the first three tail segments) could also be used for establishing a practically complete lack of migration in the western Waddenzee during the abnormally mild month of December. A paper on the autumn migration in the brown shrimp was presented at the marine biological symposium held in Oban (Scotland) from 2 to 8 October 1974.

It was predicted that the total landings of brown shrimp for the Netherlands would amount to at least 6 million kg with financial proceeds of at least Hfl 18 million. These figures held good: the actual landings amounted to 6 054 733 kg whereas the proceeds were Hfl 18 724 863.--. For the year 1975 the prediction is considerably less favourable: from the Dutch coastal waters only 4.5 million kg against 5.4 million kg in 1974. This decline will probably be largely compensated for by an increase from 0.6 million kg to 1.3 million kg in the landings from the German Bight. The financial proceeds of the total landings will not differ appreciably from the 1974 figure.

A new step forward to the total protection of undersized shrimps was the construction of a prototype of a mechanical transporter to lead the catch gradually to the rotating shrimp sieve. With this automatic transporter the undersized shrimps (and also the undersized flat fishes) keep moist and cool during their entire passage on board. The mortality due to handling on board being thereby reduced to a minimum. The transporter was thoroughly tested on board a commercial vessel. It will come into practical use in 1975.

#### Norway

(K. R. Gunderson, B. Bøhle, P. Øynes)

#### Homarus gammarus

The lobster investigations at sea were carried out mainly in the same way, but on a smaller scale, than previous years. The tagging locality in the Hjeltefjord north of Bergen was visited in May, June and October, and fishing experiments were carried out with lobster pots. The tagging locality at Busepollen south of Bergen was visited only in July.

As in previous years commercial catches of lobster from special parts along the west coast of Norway were investigated at a lobster pond south of Bergen. Carapace length, sex and berried females were observed. During the last 10 years considerably more length data on tagged lobster in aquaria were obtained. To investigate whether the tagging operation affects the growth of the lobster, experiments on untagged lobster in aquaria, under the same conditions as the tagged, started in the middle of 1974.

Studies of the growth of juvenile lobsters in temperatures 5-22°C were initiated in the autumn 1974 in the laboratory. The study will continue for 3-4 years. The growth rates have shown considerable differences. High temperature resulting in high growth rate.

Some of the larvae from the hatching experiments are now under study. Though high mortality was sustained at stage 1, some larvae have been observed to go through pelagic stages 2 and 3. If the pelagic stages can be controlled the larval ecology, which as yet has been almost unknown, may be investigated.

#### Cancer pagurus

The crab investigations at Møre, which started in 1972, continued in 1974 on the same scale. The investigations in this area covered fishing- and tagging experiments, composition of the stock and catch per unit of effort analysis.

#### Pandalus borealis

The Institute worked with the prawn sorting trawl which mainly catches prawns and allows fish to escape. A report on the results of these experiments was published.

The investigations on discovering new prawn fields were mainly carried out in the north east Barents Sea where extensive and dense fields were found. A report of the investigations was published.

Mesh selection experiments with prawn trawls were carried out in Norwegian coastal waters.

In laboratory experiments the mortality in heated sea water was investigated. In a 10 days period, at 18°C 50% of the prawns acclimatized to 6.8°C died after 3 hrs, at 15.5°C 50% of the prawns died after 7 days. Below 12°C the mortality from temperature was very low. Prawns acclimatized to 9°C showed somewhat higher resistance to heated sea water.

During the autumn 1974 a laboratory study on development and hatching of eggs from mature females at different temperatures (7-11°C) was initiated. Though the investigation was not concluded, it showed that temperature influenced both development rate and hatching measured as numbers of larvae obtained at each temperature. This study will continue until April 1975 and be repeated next season.

In 1975 the transformation from male to female, and rate of moulting will be studied at different temperatures.

#### Portugal

(M. J. Figueirido)

##### Palaemon serratus

Experiments on post-larval rearing of Palaemon serratus, started in 1973, were continued.

##### Nephrops norvegicus

The sampling programme started in 1972 for the study of the stock composition of Nephrops norvegicus was continued in 1974.

Experiments on artificial rearing of Nephrops were carried out and the growth of early larval stages followed under laboratory conditions.

#### Spain

(H. H. Quiroga)

##### Carcinus maenas

Investigations of the biological cycle, and the effects of Sacculina carcini on the Carcinus maenas population of the Santander Bay were undertaken.

##### Palaemon serratus

Shrimps hatched in December 1973 were reared to the adult stage. Some reached a size of 7 cm in the first year of life. Fertilized females were found with developed gonads. Two kinds of food were investigated. The yield was better with natural than with artificial food.

##### Penaeus kerathurus

Feeding studies on the larval stages of this species were continued. The zoea stage showed better survival on Skeletonema costatum than on other

diatoms such as Thalassiosira decipiens, Chaetoceros sp., Coscinodiscus sp. and Asterionella japonica. It was found that the most important point is the stage at which the diatom culture is given to the animals. Experiments performed with Skeletonema costatum demonstrated that the proliferation rate notably improved if the phosphorus concentration in the f/2 Guillard and Ryther media is doubled or trebled. Experiments on zooplankton culture were performed. The species cultivated were: Artemia salina, Tisbe sp. and Brachionus plicatilis.

A thousand young prawns were released off the Mediterranean coast. Prawn sizes varied from 5 cm to 7 cm.

#### Nephrops norvegicus

Studies of this species were initiated during 1974. The catch, capture composition, fleet, effort, catch per unit effort and fishing areas were investigated. During the year, populations off the northwest coast of Spain and west of Ireland were investigated.

#### Sweden

(B. I. Dybern)

#### Homarus gammarus

The results of the Swedish lobster fishery still show very low landings. The decline is somewhat bigger in the northern parts of the west coast than in the south. Investigations were carried out, in the diving programme for in situ studies, on the behaviour of the lobster.

#### Cancer pagurus

The results of the crab fishery showed a small improvement during 1974 and an unusually high number of small crabs was observed in several places. The investigations on the fishery, biology and etiology of crabs were continued on a small scale, and the compilation of 5 years' studies started.

#### Pandalus spp

The catches in the commercial fishery for Pandalus were still relatively poor and rather uneven (fluctuating) during the year. The stocks seemed to be utilized to the maximum. A selected number of fishing boats reported on the shrimps and bycatch in their daily catch.

#### Nephrops norvegicus

The landings of the fishery were stable. A number of boats reported to the Fishery Board on their daily catches, including data on bycatch of fish.

United Kingdom

(P. R. Walne - England and Wales)  
(H. J. Thomas - Scotland)

Homarus gammarus

The information collected from the extensive 1972-73 survey of the England and Wales lobster stocks has been examined and recommendations made for the future management of the fishery. Conservation problems in certain areas require further intensive studies of recruitment, growth, movements, natural and fishing mortalities. The availability of a tagging method which persists through the moult is essential to these studies and laboratory and field trials were commenced to evaluate the available methods and, if possible, to develop others. The collection of catch-effort information and population structure data has continued.

Studies on the culture of juveniles have concentrated on temperature-salinity interaction and different presentations of processed diets.

Sampling of the commercial landings of lobsters in Scotland was undertaken for all the main fishing areas and catch/effort data compiled from observations made by fishermen observers. These data in 1974 were generally similar to those of the previous year. In some areas there was a slight improvement in catch per 100 trap hauls. Fishing remains very intensive on the east coast and to a less extent around Orkney and on the grounds worked by the Mallaig fleet.

Palinurus elephas

269 tagged crawfish were released during July off the coast of Cornwall. Within four months 22 (8.2%) had been returned.

Cancer pagurus

Using a yield assessment model, incorporating estimates of the main population parameters studied, proposals have been made for the management of the crab fishery off south-west England. Monitoring of the population structure and collection of catch-effort information has continued. A preliminary survey of the potential of crab stocks off Wales was completed.

Releases of suture-tagged crabs on the offshore English Channel grounds have been completed. Further recaptures are expected in 1975 when the data will be analysed to determine stock relationships and migratory patterns.

Landings of crabs in Scotland showed a considerable increase over those of 1972. On the east coast catch per 100 trap hauls has generally increased, but there is little change in mean carapace width. Crabs claw-tagged west of Orkney in May-June 1974 showed an overall recapture of 26% up to November 1974.

Nephrops norvegicus

Combined Nephrops/Pandalus cruises obtained data on both species in the Farn Deeps off north-east England during April and October. The Nephrops data

gathered were added to those of previous years and examined in relation to physical parameters. An interpretation was begun of Nephrops results obtained during research cruises since 1959.

Scottish landings of Norway lobster, were reduced in 1974 as compared with 1973 in part attributable to the poor markets in which smaller categories were sometimes unacceptable. The mean size of Norway lobster caught by commercial vessels was in general little changed being about 4.0 in (101 mm) overall length. Of the catch about 33% by number, and in some areas over 50%, were rejected being unacceptably small. The available data show the catch per 100 hours fishing to be considerably better in 1974 than in 1973. The effects of codend lifting covers on the catch of Norway lobsters were assessed. A comparison was also made of the catch using a trawl fitted with 70 mm and 50 mm cod ends. Further investigations were made on the behaviour of Norway lobsters particularly in relation to their burrowing habit and their response to light intensity.

#### Pandalus borealis

Further research cruises were carried out on the stock of P. borealis in the Farn Deep. Shrimps were present in maximum concentrations of 15 kg/h and 38 kg/h. As recommended by ICES Pandalus Working Group, mesh selection results were obtained. Data collected during a comparison of the Gulf of Mexico trawl and the 16 m prawn trawl during 1972/3 were presented to the Statutory meeting (CM 1974/B:6).

Sampling of the Scottish fishery for Pandalus borealis on the Fladen ground was continued. Landings fell slightly in 1973 but increased greatly in 1974. Catch per unit effort increased from 0.068 tonnes/hour in 1972 to 0.150 tonnes/hour in 1974, and the mean carapace length also increased. The retained by-catch in 1973, mainly cod for human consumption, accounted for 11-18% of the total catch by weight; a few Norway pout were landed for industrial purposes. The discarded by-catch, mainly Norway pout and undersized haddock, accounted for 30-47% of the total catch by weight. Tests showed the unsuitability of a Dutch machine for sorting pink shrimps.

#### Pandalus montagui

As predicted from studies undertaken to relate the yield of the fishery to the water temperatures during the previous year, stock density in the Wash fishery for P. montagui continued at a satisfactory level. At the major port of King's Lynn annual landings for the past two years have been:-

1973	426 060 kg
1974	396 600 kg

#### Crangon crangon

The fishery for C. crangon in the Thames estuary declined during the last decade and to determine present stocks research surveys were timed to coincide with Spring and Autumn peak landings. Crangon was found in fishable concentrations in rivers and creeks around the estuary.

U.S.A.

(R. L. Wigley)

Homarus americanus

Most of the U.S. research effort on lobster in 1974 was conducted under the guidelines of the State-Federal Lobster Program, which includes input from coastal states from Virginia to Maine. In addition, some lobster research was conducted at several universities. Research activities by the National Marine Fisheries Service pertained previously to the offshore fishery located off Southern New England and Georges Bank. Research by the states pertained to both the offshore and inshore fisheries.

Lobster research activities in 1974 dealt with: migration, growth, maturity, indices of abundance, evaluation of catch-effort statistics, economics of the fishery, mortality, and yield.

Several states attempted to implement lobster fishery regulations in 1974 in order to carry out State-Federal management goals.

Cancer irroratus

Testing of enzyme activity in the tissues of marine animals exposed to heavy metals has shown that transaminases in heart and liver reflect in vivo metal stress. Baseline studies are in progress to determine normal patterns of transaminase activity (AAT) in the rock crab, Cancer irroratus, by which to determine the biochemical effects of environmental stress during spawning and moulting. Final testing was completed for acute exposure of rock crabs to cadmium salts and testing for chronic exposures is in progress, as scheduled. The extreme sensitivity of rock crabs to cadmium, as compared to blue crabs, was borne out by AAT data, which showed depressed activity in cadmium-exposed rock crabs and little change in cadmium-exposed blue crabs. Preliminary work with AAT properties in both of these animals, however, indicated that exposure to cadmium in vivo effects changed at the molecular level. There was no in vitro cadmium effect. The nature of the anion in the cadmium salt markedly affected the nature and degree of the change in AAT activity. Serum haemocyanins were examined electrophoretically for changes in state of aggregation and for peroxidatic activity, but no significant difference was found between the cadmium-exposed crabs and the controls.

Geryon quinquedens

A survey of the Deep Sea Red Crab, Geryon quinquedens, was conducted in continental slope waters off the northeastern U.S. from offshore Maryland northeastward to the eastern part of Georges Bank. This work was conducted June-July 1974 from the research vessel, Albatross IV. Water depths sampled ranged from 125 to 900 fathoms. The distribution and estimates of the population size in numbers of crabs were determined from in situ photographs of the sea bottom taken with a sled-mounted underwater camera on selected sections and expanded to the entire region. A 70-millimetre deep-sea camera, which was synchronized with a stroboscopic light, was mounted on a 1.2-ton steel sled. Operational procedure was to tow the sled at slow speed ( $1\frac{1}{2}$  to 2 knots) along the bottom for about 1 hour. The camera was programmed to take a picture every 10 seconds, permitting several hundred photographs per set. Approximately 8 000 photographs were analyzed for information on crab density and distribution. In addition to the photo-sled, a 16-foot Semi-Balloon Otter Trawl was used. Collections with this trawl were taken at 43 locations, and the samples of crabs provided information on distribution, relative abundance, size, sex, and spawning condition.

Pandalus borealis

Assessments of the abundance of northern shrimp in the Gulf of Maine were conducted in 1974 and revealed that the population declined about 50 per cent from 1972 to 1975. Recruitment has steadily declined since 1969, and fishing mortality has probably been in excess of 1.5 since 1970.

Mesh selection studies in 1974 resulted in the establishment of a mesh regulation. The basic provision of this regulation stipulates that mesh size, in both the body and cod-end, of nets used for catching shrimp must be 1 3/4 inches (stretched measure) or larger. Major purpose of this regulation is to reduce the mortality of small shrimp.

Methods of reducing fishing mortality of this species will be further explored in 1975.

U.S.S.R.

(B. G. Ivanov)

Pandalus borealis

In 1974 studies on the distribution and biology of deep-water prawn, Pandalus borealis, were conducted by the Polar Research Institute of Marine Fisheries and Oceanography (PINRO). In autumn and winter 235 hauls were made with a two codend shrimp trawl. Studies of P. borealis stocks have been conducted in the north-western part of the Barents Sea. Data on the optimal season for fisheries were obtained.





