

SHELLFISH COMMITTEE

by

J. Audouin

1978

MOLLUSCA

Belgium

(Reporting on Crustacea only)

Canada

(G.P. Ennis)

Crassostrea virginica

Caraquet Bay is the most important oyster producing area of New Brunswick. In 1978, the natural oyster spatfall was monitored and the larval set was successfully predicted for the benefit of the oyster culturists of the area. The experimental bottom cleaning and brood stock relaying conducted in 1977 were repeated in 1978 because the poor 1977 set in the experimental areas did not provide any meaningful conclusions. Preliminary indications are that a good set was obtained in 1978; analysis of the data should determine the effectiveness of man-induced population expansion in the Public Fishing Area of the Bay.

A study was completed and a report published on the oyster leasehold industry of Caraquet Bay, New Brunswick, since its beginning in 1946. In 1977, the industry involved 230 leases covering 211 hectares (521 acres). The industry's theoretical potential was estimated at over 4 000 metric tons of oysters per year.

Preliminary studies were continued in North St Simon River, New Brunswick, to assess the feasibility of rehabilitating the former public oyster beds. During the years of inactivity which followed their destruction by the Malpeque diseases in 1956, the beds were gradually invaded by eelgrass (Zostrea marina) and the natural cultch was covered by siltation. Preliminary studies have indicated that oyster reproduction would be successful within the area of the old beds if clean cultch were available at the time of the set. An operation aimed at controlling the eelgrass and removing the silt to expose the natural cultch prior to spatfall is planned for 1979.

Work continued on Labyrinthomyxa sp. regarded as a possible cause of the oyster disease known as Malpeque Disease. Development of this organism in the oyster is consistent with the general pattern of Malpeque Disease development. An extra-cellular proteinase has been detected in culture filtrates of this organism; the relationship of this to the pathogenicity of the Labyrinthomyxa sp. is being investigated. Studies of mussel mortalities showed that a Labyrinthomyxa sp. appeared to be related to the mortalities.

Mya arenaria

Continued emphasis was placed on the assessment of underutilised soft-shell clam (Mya arenaria) stocks in P.E.I. to determine their potential for hydraulic harvesting. Approximately ten acres were assessed through a cooperative effort with the province of Prince Edward Island Department of Fisheries, in which they provided the survey crews, and the Shellfish Section carried out the analysis of the data.

Studies initiated in 1976 to provide fisheries and biological data for use in the future management of hydraulic harvesting activities were continued. The project to study the short- and long-term effects of hydraulic harvesting on soft-shell clam populations, other benthic organisms and their habitat was also continued in Fortune Bay, P.E.I. This study involves repeated sampling of harvested areas to indicate recruitment changes, changes in the benthos, and changes in the nature of sediments.

The Eel River Cove (N.B.) clam population was surveyed for the fourth time since 1963. The Cove is slowly converting to a salt marsh and the clam producing grounds have considerably diminished in size.

Placopecten magellanicus

Georges Bank

1978 scallop landings were 10% less than in 1977 (1978, 11 802 MT; 1977, 12 910 MT), indicating that the above average abundance of the 1972 year class is almost terminated. A resource survey indicated that two-year old scallops were relatively abundant on the northeastern part of the Bank, in contrast to 1977, although the lack of a comparable data base makes it difficult to estimate the relative magnitude of this age class and its potential effect on future landings. Landings are expected to continue to decline in the short term and hence, the management regulations imposed in 1977 were extended into 1978.

Studies of both offshore scallop distributions derived from log data and of scallop growth are continuing.

Bay of Fundy and Browns Bank

Landings of shucked meat in this fishery declined 5% to 458 MT, a catch still well above the long-term average of 325 MT. The inshore area, although closed by regulation during the summer to provide for winter fishing, again experienced variable exploitation throughout the year. Vessels were permitted to exploit Georges Bank scallop stocks, although their catch was restricted to less than 2.9% of the previous year's total Canadian Georges Bank catch. In fact, only about 2% of the 1977 catch was landed in 1978.

The Browns Bank landing in 1978 was 27 MT total from both the inshore and offshore scallop fleets.

Southern Gulf of St Lawrence

Landings of shucked meat continued to decline in this fishery, declining to 167 MT in 1978. As a result of the drastic decline in landings in 1977, a licence freeze and a two-month scallop closure from mid-July and mid-September were imposed. This, no doubt, had some influence on the reduced landings; but with active participants in the scallop fishery in 1978, sufficient capability still existed to over-exploit the resource.

As a result of the unilateral imposition by government of regulations in 1978, a Northumberland Strait Scallop Advisory Committee was formed to develop a management programme for the 1979 fishery season. This has been done, and in addition to closure periods, a 50 meat count per pound and fishery log system have been put into regulation. Further licence negotiations were also recommended.

Chlamys islandicus

There was not active fishery for this species in 1978 and research has been confined to investigating its breeding cycle.

Illex illecebrosus

There was rapid expansion of the offshore and inshore squid fisheries in the last few years and catches reached unprecedented proportions in 1978. In addition, Canada's increased management responsibilities resulting from the 200-mile fishing zone have lent urgency to the understanding of the biology and distribution of this species. Studies undertaken in 1977 to develop information on growth, maturation, distribution, migration, and other biological factors necessary for stock assessments were continued in 1978. Research requirements identified at the STACRES meeting on squid in Cuba 1978 were undertaken in a comprehensive programme which included data collection in the field from research and commercial vessels and cooperative laboratory studies with Dalhousie University staff and students. An attempt was made to introduce a standardisation to the biological data collection on squid by recommending standardisation of morphometric and maturation criteria.

Laboratory studies resulted in successfully breeding Illex in captivity and descriptions of mature males and females, egg masses, and larvae were made available for the first time. Descriptions of food, feeding and food conversion provided new considerations for management. Maturation stages were more closely monitored to provide a better understanding of the life cycle, growth, and maturation. These biological data were studied in relation to distributional patterns.

A cooperative research programme undertaken with Japan consisted of a mesh selection study and a pre-season and late-season biological and distributional survey on the Scotian Shelf. Selection information for Illex was presented in the context of developing management regimes suitable for Illex as well as other commercial species and by-catch species.

A starting data for the fishery was recommended for 1978 using size at recruitment as a criterion. Since large numbers of squid were removed per unit biomass early in the fishing season, June 15 was established as an appropriate date for the opening of the fishery.

A workshop on the biology of Illex and the Northwest Atlantic Fishery was successfully co-sponsored with Dalhousie University.

The Newfoundland inshore fishery landed 39 122 tons (up from 29 678 tons in 1977). The increased landings in 1978 compared to 1977 may reflect greater effort and availability of additional processing facilities rather than an increase in the actual abundance of squid.

Biological sampling of commercial inshore and offshore catches continued. Information on effort and CPUE for the inshore commercial fishery was collected for the first time. The influence of environmental factors on fluctuations in CPUE was studied. An attempt to validate the ageing of squid using stratoliths was initiated.

Depuration studies

An amphibian virus and fish cell tissue culture was used for viral depuration studies. E. coli and Violet Red Bile agar were used for bacterial depuration studies. The highest uptake rate for oysters and soft shell clams was observed following 12 hours exposure to the contaminants, viral or bacterial. The final concentration of the contaminants in the shellfish tissue appears to depend largely on the concentration of the organism or virus in the experimentally contaminated seawater. Over 90% of the contaminants in the shellfish can be released within 24 hours after transfer to running seawater at 20°C. However, the residual contaminants were not completely eliminated in the 96 hour experimental period.

Feeding with unicellular algae or corn starch during uptake or depuration process appears to have little effect on the rate of depuration. Low salinity seawater appeared to have stress effects on the experimental shellfish thereby reducing the rate of depuration.

Toxicology Studies

A study of lethality of heavy metals to marine invertebrates was continued by testing Mya against Cu, Cd and Zn.

The potential for marine clams (Mya), mussels (Mytilus) and freshwater bivalves (Anodonta) to accumulate and excrete fenitrothion was investigated. Relatively low uptake rate constants and relatively high excretion rate constants result in low accumulation coefficients (about 10 to 80). This indicates little or no danger to shellfish contamination from a normal application of fenitrothion.

Denmark

(Reporting on Crustacea only)

France

(J. Audouin)

Ostrea edulis

La maladie de l'huître plate due au parasite Marteilia refringens semble regresser dans les zones de Morlaix, Penzé, Crach, Arcachon et Marennes-Oléron. Aucun secteur nouveau n'a été affecté par l'épizootie.

La contamination des huîtres a lieu uniquement pendant les mois de juillet et août.

La récolte de naissain est inférieure aux années précédentes (200 à 250t). Des essais de collecteurs originaux ont été effectués en Baie de Quiberon.

Crassostrea angulata.

La technique de microscopie en fluorescence a permis de mettre en évidence la nature ADN, du virus trouvé dans les lésions branchiales et dans les cellules conjonctives de Crassostrea angulata.

Crassostrea gigas.

Des anomalies de croissance, modifiant la qualité des huîtres, ont été notées dans plusieurs bassins ostréicoles.

Des études de croissance en milieux ouverts et semi-fermés (claires) sont en cours.

Des essais de dévasement de parc à huîtres sont effectués à Fouras.

Le captage a été perturbé par les basses températures. Les résultats les meilleurs ont été obtenus dans les rivières. (Seudre, Gironde).

Des évaluations ponctuelles de stocks ont été réalisées notamment en Normandie, par photos aériennes et en Seudre par prospections sur le terrain.

Des techniques de RMN ont été appliquées pour étudier la structure des chromosomes.

Mytilus edulis.

L'envasement des zones de bouchots a été étudié en baie de l'Aiguillon et en Vilaine.

Pecten maximus

L'étude des stocks de coquilles Saint-Jacques a été poursuivie sur les principaux gisements du littoral français : Manche orientale, Gisement du Nerput, Baies de Saint-Brieuc, Lannion, Morlaix, Camaret et Courreau de Belle Ile (Institut des Pêches Maritimes).

25000 collecteurs ont été immergés en baie de St Brieuc. La fixation a été tardive et le rendement du captage a été compris entre 10 et 30 par collecteur. 2000 collecteurs ont été placés en Rade de Brest et Baie de Camaret : il n'y a pas eu de fixation. Lors d'une opération de repeuplement on a observé un taux de survie de 50%, 15 mois après le semis. Les expériences ont été effectuées par le CNEOX en collaboration avec les organismes professionnels locaux.

Chlamys varia et Chlamys opercularis.

3000 collecteurs ont été immergés en Baie de Quiberon (ISTPM). Les résultats du captage ont été faibles, comme l'année précédente. Le naissain obtenu, destiné à être immergé dans le secteur de Ré-Oléron a été placé en prégrossissement dans des "lanternes japonaises".

En Rade de Brest, 3000 collecteurs ont été utilisés. On a observé deux fixations principales, la première a donné 500 à 700 Chlamys varia par collecteur, la seconde 3000 (Comité Local des Pêches Maritimes et CNEOX).

Algues

En vue d'établir la cartographie des peuplements algaux, des prospections ont été effectuées (ISTPM) entre l'Ile de Bréhat et l'Ile Tomé. Cette zone porte des peuplements en laminaires au moins aussi fournis que ceux du Nord-Finistère.

L'étude des possibilités de culture en bassins de l'algue rouge Chondrus crispus a été poursuivie en 1978 et une comparaison des résultats obtenus en circuits ouvert et semi-fermé a été faite.

Un programme d'étude des possibilités de culture de l'algue rouge Eucheuma spinosum a été mis sur pied aux Antilles. (ISTPM).

Federal Republic of Germany
(K. Tiews)

Cockles :

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 coasts of Niedersachsen and of Schleswig-Holstein.

Program 1979 :

Cockles

Survey work on the size of cockle populations along the German North Sea coast shall be continued at the Institut für Küsten- und Binnenfischerei.

Iceland
(U. Skúladóttir-H. Eiriksson).

Chlamys islandica

Five scallop surveys were carried out during the year in which new scallop beds were discovered off the west, north-west and east coasts of Iceland.

The total catch of scallops in 1978 reached an alltime high of approx. 8 800 tons and the catch per unit effort was even higher than in previous years or up to 800 - 1000 kg. per fishing hour in some areas.

As before the fisheries were managed by catch quotas and closed areas and some 11 000 scallops were sampled during the year.

In 1979 surveys of exploited grounds will be extended somewhat in connection with the increased effort. Moreover exploratory surveys are planned off the west and north-east coast.

Ireland
No report received.

Netherlands
(A.C. Drinkwaard)

Ostrea edulis L.

The Dutch oyster industry still struggling with a critical production gap of the original Zeeland oyster, imported nearly all types of the European flat oyster and U.S.A. nursery stuff.

The 1977 spat of the interbred Southern types showed a higher rate of mortality than the isolated Zeeland tank bred spat after an artificial winter period at the Texel experimental station. The 1978 natural spatfall was not worth mentioning, due to the very low sea water temperatures during the normal spawning season.

For the re-establishment of a Zeeland parent stock in the Oosterschelde some Crown-land plots are brought under control of the Molluscan Shellfish Department of the Netherlands Institute for Fishery Investigations. They will be planted with the native oyster only.

The spat collection experiment in the Lake Grevelingen has been advanced by the use of lime coated plastic grill collectors, both suspended and situated on the bottom. Late in the season some spat has settled down, not larger than 5-10mm in November.

At the end of the year 1976 oysters were allocated to planting in the Oosterschelde in the coming spring.

In 1979 the 1978 surveys will be continued : The spatfall distribution over the whole ~~area~~ and the progress of growth, both related to differences in location and differences in distances to bottom and surface.

The intended area for sowing of mussel shell-collectors has been enlarged to 50 hectares, but for the most part the program of action has been cancelled because of the low expectations, caused by the decreasing sea water temperature in July.

For salinity control the influx of North Sea water, up to 100 m³ per second, became possible through a new floodgate in the Western dam.

The water temperature during June, July and August in the basins of the Experimental station Texel have been too low for any results in the tank breeding experiment. The first collectors have been set out in the beginning of July at the first swarming of larvae with ample 1000 per 100 litre in 4000 m³ sea water.

Now we are on the look-out for other artificially enclosed sea water basins with sufficient depth in the neighbourhood and the Southern Delta area.

Notwithstanding the low sea water temperatures down to around 14°C in the middle of July and already 10°C during a week in the beginning of October, the 2-3mm spat nursery experiments at the Experimental station became a success. At the end of the 4½ months period, from 20 June till 5 November, the average rate of mortality amounted to only 15%.

More than a quarter of over 300 000 young oysters, larger than 27 mm (3 gram) has been sown on a natural Yerseke Bank plot in November. Three quarters, smaller than 27 mm were wintering in an oyster pit at Yerseke. Fouling problems appeared to be preventible. The batches will be followed during the next years.

This Zeeland seed was born in a French hatchery, using both parent oysters from the Oosterschelde (very old ones) and lake Grevelingen. Concerning the vitality

of the larvae and early young stages this hatchery noted : "Il est intéressant de noter déjà que les larves et les naissains produits par ces géniteurs (Zélandaises) sont très vigoureux!"

Mytilus edulis L.

Much the same situation as in 1977. The co-operation with the Laboratory of Chemical Animal Physiology (State University of Utrecht) has been continued in studying the seasonal changes in biochemical composition of mussels, related to the reproductive cycle.

Within the framework of dike renovation at Yerseke the re-establishment of seven mussel shipment plants will be combined with provisions for sea water-circulating de-sanding systems. In these basins the mussels from the natural rewatering plots can be stored for some hours in the fresh market divisions and up to a week-end for the preserving factories. This means that part of the buffer stock of high quality mussels can be brought nearer to the processing plants and consumers, while the working conditions become better. While building the new factories attention will be paid to ways of avoiding mussel stress and distress symptoms induced by mechanical handling, making use of the most well balanced machineries for transport, declustering, cleaning and packing.

Cerastoderma edulis L.

The oyster branch may be in an offensive period and the mussel branch may be in a defensive period, either in relation to the reducing of the Oosterschelde tides in 1985; the cockle branch is now coming to a necessary period of stabilization with a thirty licences and a growing number of well equipped shallow draught dredgers.

The thoughts are heading in the direction of a better shift-system of the exploitable grounds, for which new surveys may be expected, in which also nature management research will take part. This means an extension of the applied benthic productivity research. The cockle dredging may be counter-productive for birds etc., but a regular harvest of cockles may also produce a positive effect with regard to the seed settlement and in consequence to the overall availability of young cockles.

Only the hand-picked cockles were suited to the fresh market abroad. The frozen meat production has to be restricted to the available market, especially in Spain.

Diseases

Research on diseases in shellfish was carried out on oysters. Concerning the oysters most attention was paid to the control of the importations of the European flat oysters (Ostrea edulis) originating from France and Greece. For 1978

no infections could be observed in these imported lots which would have led to a disease and threat for the dutch oyster culture. On this point the importations can be qualified as rather safe, and in contrast with the character of importations of former years.

Norway
(K.R. Gundersen)

Cephalopods

Todarodes sagittatus

On the west coast of Norway the fishery continued in some fjords from the autumn of 1977 until April-May 1978. In March the mean mantle lengths increased to 39 cm for females and to 34 cm for males, the mean total weight to 1.500g. Single squid weighing about 3.000g were caught in May. The fishing season autumn 1977-spring 1978 yielded about 350 tons.

In 1978 a new immigration of squid started in September at the coast of northern Norway. In October the mean mantle length was 32-34 cm, mean weight 800g. At the west coast a few small squid were taken in November with mean mantle length 27 cm and weight 400 g.

The autumn fishery yielded about 250 tons.

Gonatus fabricii

Material was collected in 1978 and earlier years during surveys for post-larval and 0-group fish in the Norwegian Sea and adjacent areas, and from stomach contents of bottlenose whales and hooded seals caught for investigation. Mostly larval and juvenile Gonatus were taken, larger squid being found only in the stomach contents.

G. fabricii is very abundant in the Norwegian Sea and may represent a possible fishing resource. Further investigations are needed in order to study the biology and locate areas of maximum abundance, especially of larger squid.

Poland

No report received.

Portugal

No report received.

Spain

No report received.

Sweden

(Nothing to report)

United Kingdom

England and Wales : E. Edwards

Scotland : J. Mason

England and Wales

Pecten maximus and Chlamys opercularis

Fisheries information was obtained from visits to all the ports where scalloping was carried out. Fishing is still essentially carried out in the English Channel. Record landings of scallops (£2.5 million) were made in 1978 by a fishing fleet of around 110 vessels.

A three year underwater television survey was completed of scallop and queen beds off the Devon and Cornwall coasts. A total of 29 000m² of sea bed were examined; mean pectinid densities found were 0.15/m² for Pecten and 0.5/m² for Chlamys. Surveys by dredging and diving were carried out in other Channel areas.

Artificial pectinid spat collectors were laid in Start Bay, Lulworth and Holyhead. Settlement of both Pecten and Chlamys was poor in 1978, although interesting data was obtained on the variation of spat settlement with depth. Checks will be made to see if the collector results are indicative of limited recruitment to the natural stock in 1978.

A study on the seasonal variation in meat yield/gonad condition of Pecten off Newhaven was completed. Results indicated that the gonad condition generally fell over the summer months but, as far as yield was concerned, this was largely compensated for by an increase in the muscle weight. Work was also carried out to appraise the validity of traditional gonad staging.

Cardium edule

Routine surveys were carried out on a number of cockle beds. The 1978 spat-fall appears good, but adult stocks seem to be at a low level in most fisheries

Introduced Shellfish pests

Checks were continued on the distribution of Urosalpinx cinerea, the American oyster drill, using tile-traps. No new records were obtained.

The immigrant Japanese seaweed Sargassum muticum has continued to spread along the south coast of England. Deleterious effects have been reported with respect to amenity beaches, harbours and small-boat navigation. The effect on fishe-

ries remains uncertain, interference with trawling and dredging being reportedly compensated for by increased catches taken within the strands of weed. Research continues on effective control measures.

Further field experiments were carried out in 1978 on the natural infection of seed oysters, both Ostrea edulis and Crassostrea gigas with Mytilicola, by exposing uninfected, ex-hatchery stocks from North Wales to infection in SW England. During September-December, all sizes of seed in the range 17-45mm length rapidly became infected. In both species, numbers of copepodite and juvenile parasites showed high positive correlations with body size of oyster. The overwintering survival to maturity of Mytilicola will be assessed in Spring 1979.

Oysters

Oyster landings of (Ostrea edulis) the native oyster have continued to improve, over 1000 tons being produced in 1977 worth about £1.1 million. Both the major producing areas, the Solent and River Fal (Cornwall) are being fished heavily and the major part of the catches continue to be exported to Europe for final marketing.

Development of the Pacific Oyster (Crassostrea gigas) fisheries continues to be slow with production of marketable stocks at about 140 tons in 1977, worth about £0.11 million. To date no large market outlets have been developed in the UK in order to stimulate larger scale production of this species. However, many hatchery produced seed oysters are in demand widely overseas for introducing disease free stocks into developing fishery projects.

Work has been concentrated on monitoring stock levels in the naturally producing areas, investigating the effects of predators and examining techniques of working grounds to prevent damage and maximise output.

Considerable attention is given to the control of importation of molluscs and movement within the UK to minimise the risks of spreading pests and diseases.

Scotland :

Pecten maximus and Chlamys oerularis

Monitoring of changes in stock composition, catch and effort in the principal fisheries was maintained in 1978 and will be continued in 1979. Studies of the settlement and early life history were continued.

An investigation of the effect of an increase in dredge mesh, ring size and tooth spacing on catches was started. Further studies were made on the survival of scallops which escape the dredge or are captured and returned to the sea.

An investigation was started into the use of underwater television for studying scallop distribution and density. This will be extended and compared with other methods.

Oyster

A comparison was made of the growth rate and flesh condition of Crassostrea gigas kept in trays suspended from a raft and in stacks of trays at various heights on the shore.

Collection of statistics of landings of Ostrea edulis in the Loch Ryan fishery was maintained. A further survey of the beds was made.

No change was noted in the distribution of pests and parasites. Samples of oysters for export and import were examined to ensure freedom from pests and diseases.

Loligo forbesi

The composition of landings from Scottish inshore grounds was studied, together with the biology and distribution of the species. Length-weight relationships were calculated.

U.S.A.

(S.H. Clark¹⁾ and M. Castagna²⁾)

The following report summarizes research and other activities on commercially important mollusk and crustacean species during 1978 by USA agencies including the Northeast Fisheries Center (NEFC) and Southeast Fisheries Center (SEFC) of the National Marine Fisheries Service (NMFS), state marine research organizations, and academic and private institutions. NMFS personnel participated in a variety of research vessel surveys in which biological data were obtained for shellfish species (Table 1) and also sampled commercial catches (Table 2). Activity summaries by species and agency are as follows :

American oyster (Crassostrea virginica)

New Jersey Department of Environmental Protection (DEP) personnel have continued surveys to determine extent of the available resource and prevalence and intensity of Minchinia nelsoni (MSX) disease as well as research to assess the importance of various environmental and biological factors contributing to

1) National Marine Fisheries Service, Northeast Fisheries Center, Woods Hole, MA

2) Virginia Institute of Marine Science, Eastern Shore Laboratory, Wachapeaque, VA.

incidence of MSX. Delaware Bay oyster seed beds are also being continually monitored to assess trends in recruitment, growth and mortality. Louisiana Wildlife and Fisheries Commission (WLFC) personnel have continued studies of oyster drill (Urosalpinx cinerea) distribution and density on oyster seed grounds. University of Maryland researchers studied factors influencing distribution and success of oyster spat settlement; the State University of New York surveyed abundance in New York waters, and University of South Carolina workers continued modeling of oyster communities.

Sea scallop (Placopecten magellanicus)

NEFC personnel completed research vessel surveys (including participation in Canadian surveys) of all major scallop grounds in the Georges Bank-Middle Atlantic areas and also completed stock assessments. Results indicate population declines in many areas and with the exception of the northeast peak area recent catch levels do not appear sustainable without increases in fishing mortality. Maine Department of Marine Resources (DMR) personnel continued development of tagging methods, evaluation of ageing techniques and growth studies; the New Hampshire Fish and Game Department continued resource monitoring and collection of biological data for assessment purposes. Old Dominion University and the College of William and Mary surveyed scallop resources off Virginia.

Bay scallop (Argopecten irradians)

North Carolina Department of Natural and Economic Resources personnel studied factors affecting abundance and continued collection of data for assessment purposes. Rhode Island Department of Natural Resources (DNR) personnel conducted biological studies and evaluation of population size; a comprehensive management plan is currently being developed.

Calico scallop (Argopecten gibbus)

SEFC personnel completed studies of growth, maturation, spawning and sub-tropical faunal zonation and analyses of trends in abundance. Resulting reports and manuscripts will be used to prepare a fishery management plan. The South Carolina Wildlife and Marine Resources Department (WMRD) also conducted stock assessment work on this species.

Soft-shelled clam (Mya arenaria)

The Maine DMR implemented and coordinated a state-wide plan to develop a public management program and conducted assessments to evaluate biomass levels and the impact of various harvest levels on the resource. Other Maine DMR work included

monitoring of pollution levels and bioassays to determine the potential impact of oil pollution. Massachusetts DNR personnel conducted surveys to determine biomass levels. University of Maine and University of New Hampshire researchers are currently engaged in a variety of ecological studies including evaluation of chemical factors effecting recruitment and the role of dissolved organics in nutrition and distribution; studies are also being conducted on biological aspects (e.g., maturation) and impact of commercial harvest.

Hard clam (*Mercenaria mercenaria*)

The New York Department of Environmental Conservation (DEC) continued studies of Great South Bay, Long Island to determine resource size and to assess mortality and recruitment levels and completed recreational fishery surveys. South Carolina WMRD personnel conducted assessment work and natural history studies. State University of New York researchers continued population dynamics studies and compilation of an extensive bibliography; genetic studies are also in progress at the Virginia Institute of Marine Science.

Ocean quahog (*Arctica islandica*)

The USA offshore fishery is currently regulated under a management plan restricting annual landings to 3 million bushels (about 13,600 metric tons). Management regulations were implemented in view of rapid expansion in effort and landings, uncertainty relative to growth, mortality, and age at maturity and high dredge-induced mortality to unharvested quahogs.

NEFC personnel engaged in a variety of quahog research projects in 1978. Work included research vessel surveys, stock assessments, and marking studies to evaluate growth; evaluation of maturation and seasonal changes in the condition factor are also in progress. Massachusetts and Rhode Island DNR personnel conducted surveys to estimate biomass levels. Studies of reproduction, growth, and larval distribution are continuing at the Woods Hole Oceanographic Institution; researchers at Yale University conducted studies of growth line and structure formation to provide a basis for ageing techniques, and growth rate, age composition and mortality studies were conducted at Princeton University.

Surf clam (*Spisula solidissima*)

NEFC work during 1978 included research vessel surveys and assessment analyses. Other work in 1978 included Massachusetts DNR studies to compare catch and shell damage rates in hydraulic and "dry" commercial dredging operations and growth, mortality, and recruitment studies by the New Jersey DEP. These states also completed surveys to evaluate biomass levels. Workers at Princeton University continued studies

Table 1. Research vessel surveys involving collection of shellfish data by USA and foreign nationals, 1978.

Vessel	Dates	No. of stations	Area	Type of gear	Purpose
DELAWARE II (USA)	1/5 - 2/11	346	Nantucket Shoals to Cape Hatteras	Hydraulic dredge/48" knife dredge	Shellfish assessment
ALBATROSS IV (USA)	1/18- 1/27	10	Hudson Canyon to Cape May	#41 Yankee trawl	Herring distribution and relative abundance
ARGUS (USSR)	1/28- 3/2	89	Cape Hatteras	Hake 815	Squid, mackerel, hake survey
ANTON DOIRM (FRG)	2/25- 3/23	120	S. New England to Gulf of Maine	180' herring	Herring, groundfish bottom trawl
WIECZNO (Poland)	3/11- 3/20	35	S. New England to Mass. Bay	90' herring	Herring survey
ALBATROSS IV	3/20- 5/23	331	Nova Scotia to Cape Hatteras	#41 Yankee	Spring bottom trawl survey
ALBATROSS IV	3/24- 4/10	72	Block Island to Cape Hatteras	#41 Yankee	Spring bottom trawl survey (inshore)
STATE ARROW/ RSD DIAPIUS (USA)	7/9 - 7/18	N/A	Wilmington, Baltimore and Washington Canyons	Submersible	Megabenthic crustacean study
KYMA (USA)	7/25- 8/5	11	Rockaway Beach, Long Island	Air-lift clam sampler	Surf clam - ocean quahog survey
M/V DIANE MARIA (USA)	7/25- 8/5	12	Long Island Coast	Hydraulic clam dredge	Ocean quahog marking project
DELAWARE II	7/25- 8/20	168	Gulf of Maine to Cape Hatteras	#36 Yankee	Summer bottom trawl survey
DELAWARE II	7/28- 7/31	21	Cape Hatteras to Cape Fear	#36 Yankee	Summer bottom trawl survey
ALBATROSS IV	8/1 - 8/14	105	Gulf of Maine to Cape Hatteras	#36 Yankee	Summer bottom trawl survey (inshore)
DELAWARE II	8/15- 8/20	51	Southern New England	#36 Yankee	Scallop dredge comparison survey
ALBATROSS IV	8/15- 9/1	327	Great South Channel and Western Georges Bank to Cape Hatteras	10' scallop dredge	Sea scallop survey
DELAWARE II	9/5 -11/22	443	Gulf of Maine to Cape Hatteras	#36 Yankee	Fall bottom trawl survey
DELAWARE II	9/8 - 9/11	45	Cape Hatteras to Cape Fear	#36 Yankee	Fall bottom trawl survey (inshore)
DELAWARE II	9/11- 9/21	77	Gulf of Maine to Cape Hatteras	#36 Yankee	Fall Bottom trawl survey (inshore)
ALBATROSS IV	9/19-10/9	204	Cape May to Delaware Bay	Smith-McIntyre grab	Environmental Monitoring (Ocean Pulse)
LULU/ALVIN (USA)	9/21- 9/30	9	Oceanographer Canyon	Submersible	Offshore canyons study
DELAWARE II	12/2 -12/21	163	Montauk Point to Cape Charles	Hydraulic clam dredge/48" knife	Shellfish assessment

Table 2 Summary of USA commercial landings sampling activities
for mollusc and crustacean species, 1978.

Species	No. of ^{a)} commerical samples
Sea scallop	104 (218) ^{b)}
Squid	12
Surf clam	372
Ocean quahog	110
Lobster	3

a) Number per sample varies according to species.

b) Number of age determinations.

on growth rates, age composition and natural mortality; Rutgers University experimented with establishment of refuge areas as a means of rebuilding depleted stocks. University of Maryland (Eastern Shore) scientists continued ageing studies.

Squid (*Loligo pealei* and *Illex illecebrosus*)

NEFC personnel completed a joint cooperative survey with the USSR to investigate maturity, feeding, and diel migration patterns; other work included assessment updates and determination of dorsal mantle length-total weight relationships by area and season. Recent survey data indicate declines in abundance for both species although abundance of Illex remains high compared to the 1967-1976 average.

U.S.S.R
(A.Neyman)

In May and June 1978, the survey of the shelf and continental slope of the Atlantic coast off Morocco was conducted.

Larval Cephalopoda selected from 2 600 plankton samples were examined. The samples contained the larvae of 4 squid species of the family Enoploteuthidae. From morphological analyses of the larvae by growth stage the conclusion was drawn that subfamilies Abraliinae and Pyroteuthinae differ considerably beginning from early life stages. The subfamily Pyroteuthinae may be regarded as the more specialized one since its representatives possess better armed manual apparatus and internal photophores.

Genetic-biochemical studies of intra-specific differentiation in Sthenoteuthis pteropus from various areas of the tropical Atlantic indicated the presence of polymorphism in mantle esterases, the genetic nature of which is not quite clear.

From the samples of squids taken in different parts of the tropical Atlantic 3 groups may be singled out by the frequency of esterase phenotype and length-sex composition. Tentatively, two groups are late maturing and the third is an early maturing group. The reliability of such classification needs further verification.

CRUSTACEA

Belgium (F. Redant)

Crangon crangon :

A quantitative consumption-production-model, describing the most important population-dynamic parameters of the shrimp-stock in the Belgian coastal water, was formulated. This model includes estimates of total abundance and biomass of the population, consumption of food, production of eggs and larvae, production by growth, mortality during the embryonic phase, predation-mortality due to demersal fishes and fishing-mortality. The results of this study will be published in the near future.

The monthly analyses of the shrimp stock and of the by-catch of experimental shrimp fishing were continued in 1978 in order to evaluate long-term changes in the abundance of the shrimp-stock and long-term interactions between the shrimp-population and its predators (demersal fishes, demersal invertebrates and fisheries).

Nephrops norvegicus : The catch of Nephrops was sampled on board of commercial vessels in the North Sea during the period June-September 1978. The total volume of Nephrops in each haul was determined and the individual total lengths from a sample were measured. The by-catch of commercial fishes was also analysed. A semi-quantitative analysis of the non-commercial by-catch was carried out.

Canada (G.P. Ennis)

Homarus americanus

A Canada-U.S. lobster Workshop (one participants from U.K.) was held at St Andrews, N.B. The over-riding conclusions were that lobsters in all areas are fished too heavily and that minimum legal size is too low. In Canada, the legal size in most places is below 50% female maturity (based on berried females). The papers presented will be published as an FRB Technical Report.

Commercial catches were sampled in all Maritimes lobster areas to provide data on CPUE, size frequency, by-catch, egg condition, and moult stage. Discussions and calculations were carried out to evaluate the potential effect of increasing minimum legal size. A Maritimes-wide voluntary license buy-back scheme was inaugurated by the Minister's office. A fishermen-participation effort to reduce illegal lobster fishing was successfully implemented by the Area Manager's office in Prince Edward Island.

In the Gulf of St Lawrence and eastern Nova Scotia, growth-maturity-mortality studies were conducted utilising short-term sequential sampling and tag re-capture techniques. Yield/recruit and stock recruitment models for lobsters were developed. Minimum legal size limit is at or below size of first maturity, total annual mortalities range from 50% in collapsed areas with much reduced effort, to over 95% in fall fishing area. Fishery is seen to be growth overfished in all inshore areas, recruitment overfished in some areas.

In southwestern Nova Scotia and the Bay of Fundy, routine sampling of commercial catches was expanded and is continuing on a regular basis. Historical data of sampling since the early 1940's are being analysed. Total annual mortality estimates of lobster populations for southwestern Nova Scotia and the Bay of Fundy from the 1940's to present range from 70 to 89%.

A lobster larval survey was, for the second year, done from inshore south-western Nova Scotia out to beyond Browns Bank - July to September, with five cruises to about 30 offshore stations and ten cruises to about 30 stations within 2 miles offshore. As a result of the larval surveys, results of previous tagging studies, data on surface currents, and analysis of at-sea lobster data, a hypothesis was developed that off southwestern Nova Scotia the inshore and offshore lobster stocks are independent. The degree of independence is not known.

Field and laboratory studies undertaken in Prince Edward Island provided preliminary data on the ecology, distribution, and behaviour of juvenile lobsters. Field studies on the effect of scallop dragging showed lobsters to be a significant by-catch. Laboratory studies on lobster feeding behaviour, with mussels, sea urchins and sea scallops as prey provided data on predation mechanisms, feeding rates, prey preferences, prey size selectivity, and foraging strategy.

The polysaccharide capsular material prepared from the lobster pathogen, Aerococcus viridans (var.) homari proved to be non-toxic when injected into lobsters at levels up to 25 mg/kg body weight. Unfortunately, its use in the form of a vaccine did not provide protection or induce a significant degree of resistance in lobsters as shown by subsequent challenge with a virulent strain of A. viridans (var.) homari. To date complete protection has only been possible with live vaccines.

Additional work on the defense mechanisms of the lobster have been devoted to a study of the process of phagocytosis which seems to be central to resistance in the lobster.

Studies on the nutritional requirements of the lobster were continued. Work with juvenile lobsters during the past year showed that they required $\omega 3$ fatty acids in the diet for maximum growth and survival. Growth and survival, as well as lipid metabolism patterns, suggest that $\omega 6$ fatty acids may also be essential in the diet of lobster but at a much lower level.

Long-term monitoring of the lobster fishery and studies of various aspects of lobster population biology and dynamics were continued in five localities around the coast of Newfoundland. This included commercial catch sampling, obtaining logs from individual fishermen, collecting tags from previous year's tagging operations, carrying out additional tagging and shell condition sampling and collecting larvae from the plankton. The first yield per recruit assessments were completed for Newfoundland lobsters and these clearly demonstrated the need to increase the size limit and reduce exploitation rates.

The tag-recapture study of an unfished lobster population around a small island in Placentia Bay, Newfoundland, continued for the third consecutive year. Detailed analysis of the data to arrive at estimates of various population parameters was initiated.

Chionoecetes opilio

In the Maritimes region biological sampling of commercial snow crab catches, at sea and at landing sites is continuing in northern New Brunswick and in Cape Breton Island, N.S. Backlog and recent catch/effort statistics from these two areas have been collected and analysed. A tagging study in northwestern Cape Breton has yielded data on stock size, exploitation, and recruitment to the fishery. Effect of soak time on trap catches has been analysed.

Catch and /catch/effort data were obtained for the various segments of the Newfoundland fishery on this species. A series of cruises was conducted to study the seasonal depth distribution, shell conditions, etc. of C. opilio and two species of Hyas in Conception Bay, Newfoundland.

Work with snow crab Chionoecetes opilio defence factors of serum agglutinine, hemocytes and bactericidins illustrated a number of differences in comparison with the lobster. Lower hemocyte levels, lower agglutinin levels but very high bactericidal levels were demonstrated. The bactericidin was not inducible with Pseudomonas perolens, as is the case with the lobster. The limited comparisons made to date using crab data show considerable differences between the operation of the lobster defences and those of the crab.

Cancer irroratus

Laboratory studies documented rock crab burrowing and mating behaviour. Laboratory feeding experiments on mussels, sea urchins, and sea scallops as prey yielded data on feeding rates, prey size selectivity, predation mechanisms and prey preferences. Results indicate that rock crabs and lobsters have an extensive dietary overlap and would compete for limited prey species.

Carianus maenas

Green crab were sampled in May and August at Port Hebert, N.S., to determine relative abundance, population structure, and diet. There was no evidence from stomach analyses of green crab predating on lobsters, although laboratory experiments showed green crabs to be capable of feeding on juvenile lobsters.

Pandalus borealis

In the Maritimes area shrimp sampling was initiated in 1978. Most landings come from the Gulf of St Lawrence north off Anticosti Island. A shrimp survey was completed off eastern Nova Scotia. The estimated minimum biomass for that area (845 miles²) is 8 000 metric tons. Detailed catch/effort data are being collected by means of log books for the shrimp fishery throughout the Maritimes. A study of fecundity was initiated.

The shrimp fishery of the Northern Gulf of St Lawrence was monitored through commercial sampling at Port au Choix. In addition, a biomass survey covering the whole Gulf area was conducted. The Labrador shrimp fishery, under quota control for 1978, was sampled on a monthly basis providing details of catch and catch per unit effort. A research survey in the Labrador areas was carried out in the early fall. A contract was undertaken to assess pink shrimp potential in the Davis Strait area during August. Additional information for this area was collected on an exploratory cruise for shrimp in September.

Toxicology Studies

Lethalities of 8 chlorinated hydrocarbons to Crangon in spiked sediments were determined and compared with similar data from water exposures. Lethality in sediment exposures is related mainly to the compound concentration in the aqueous phase of the tests.

The lethality of creosote to larval and adult lobsters (Homarus americanus) and to Crangon was determined. As well creosote concentration in lobster hepatopancreas was followed, it increased both with exposure time and exposure concentrations.

The lethalities of 50, mostly aromatic compounds to Crangon and Mya were determined to assess structure-activity relationships.

Study of the combined lethality of mixtures of two organophosphate insecticides (phosphamidon and methidathion) to adult lobsters (H. americanus) was completed and greater than additive lethality was found.

Study of uptake and excretion of PCBs (Aroclor 1254) by Crangon at the polychaete Nereis virens showed that the amount accumulated/unit wt depended on exposure time, animal size, and on exposure concentration. Equilibrium concentrations were not indicated within the 24 and 32 days of the tests. Accumulation factors were low ranging from 2 to 5 times depending on species and on animal size. Lobsters fed mussels spiked with PCB for 6 weeks accumulated PCB in the hepatopancreas, initial values being obtained within 6 weeks when fed with unspiked mussels.

Study of uptake of cadmium from sediment by Pandalus and Crangon was initiated for comparison with similar data for Nereis. With Nereis, the amount of cadmium accumulated/unit wt depends on exposure time, animal size and sediment concentration. No equilibrium concentration was indicated by 24 days. Excretion of Cd was negligible during 75 days. Comparison with data on uptake from water indicates that Cd uptake from sediment is mainly from that released to the aqueous phase.

Lethality tests showed that Crangon is as sensitive to fenitrothion as lobster larvae and adults (H. americanus) (96-h LC50's of about 1 ppb). Marine bivalves (clams and scallops) are much less sensitive, not being killed in 96 hrs by 300 ppb, the highest concentration tested.

A study of lethality of heavy metals to marine invertebrates was continued by testing Crangon against Cu, Cd and Zn.

Denmark

(Home waters : S. Munch-Petersen)

Greenland waters : E. Smidt)

Carcinus maenas.

Investigations on the density of the shore crab, Carcinus maenas, in Kattegat by means of marking experiments were continued in 1978.

Crangon crangon.

Investigations on the Crangon fishery in the Danish Wadden Sea has been carried out during 1978.

Pandalus borealis

Research on distribution and density of shrimp stocks was made in the offshore West Greenland area by bottom photography and by trawl survey on standard trawl stations in July-August. Further, standard trawl stations in Disko Bay were operated in

October-November. Catch-effort data were obtained from offshore trawlers and from inshore cutter landings. Commercial catches were sampled for year-class analyses.

Investigations in 1979 will be made along the same lines as in 1978. Further, information on vertical diurnal migrations of shrimps will be obtained from offshore trawl catches.

Chionoecetes opilio

Inshore fishing experiments with crab traps were continued in Godthåb district.

France

(J. Audouin)

Langoustine (Nephrops norvegicus)

Travaux du CNEKO-COB.

Une fois par mois, 2000 langoustines sont mesurées (par une technique photographique) dans les ports de Guilvinec, Loctudy et Lesconil) et des chalutages expérimentaux sont effectués à l'aide d'un chalut (maille de 5mm) en région Sud-Bretagne. En 1978, une étude de la dispersion spatiale des terriers à langoustines a été effectuée : elle a donné lieu au dépouillement de 4500 photos.

Des recherches ont été entreprises sur le rythme des mues, la fécondité des langoustines. Une étude économique (relations entre prix et quantité débarquées) a été entreprise.

Travaux de l'ISTPM.

L'essentiel de la recherche a porté sur l'étude de la sélectivité des chaluts dans la pêche de la langoustine. Au cours des quatres campagnes sur le Plateau Celtique (une avec le NO "Roselys II" et 3 à bord de chalutiers de Guilvinec) neuf maillages en polyamide et en polyéthylène ont été essayés sur trois types de chaluts. Les résultats sont très consistants et une relation entre le poids de la pêche accessoire et le facteur de sélectivité a été mise en évidence. La valeur moyenne du facteur de sélectivité pour les chaluts français en polyamide est de 0,5 ce qui correspond à une pêche accessoire de 70kg.

Echantillonnage année 1978.

Région VIIla :	-sur bateaux commerciaux.....	10 500
Région VIIg :	-sur bateaux commerciaux.....	20 400
	-sur bateaux scientifiques.....	15 000
	-sous la halle à marée.....	9 000

Homard (*Homarus gammarus*)

Les opérations de repeuplement des zones côtières par l'immersion de post-larves produites en écloserie ont été poursuivies (120 000 provenant de l'Ecloserie de l'Ile d'Yeu, 35 000 de celle de Houat et 30 000 de celle de l'Ile de Sein.)

Des échantillonnages ont été réalisés lors des prospections faites à bord d'un bateau de pêche dans le secteur de l'Ile d'Yeu en mai 1978 (N= 419). Le contrôle des apports a été poursuivi dans différents secteurs. 4000 homards en provenance du Conquet ont été mesurés et 3300 en provenance de l'Ile d'Yeu.

Des prospections ont été faites sur le cantonnement de Portsall non loin de l'épave de l'"Amoco Cadiz". Les rendements obtenus ont été bons. (ISTPM).

La mise au point d'un modèle de simulation des rendements par recrue s'est poursuivie (CNEXO-COB).

Langoustes :

Le stock de langoustes Panulirus argus et Panulirus guttatus a été étudié en Martinique. Des marquages ont été effectués et une étude biométrique a été entreprise (ISTPM).

Crevettes :

En 1978, la biologie et la distribution de la crevette côtière Xiphopenaeus kroyeri ont été étudiées en Guyane. Une diminution marquée des apports a été enregistrée depuis plusieurs années.

Deux campagnes de pêche à bord de bateaux de pêche (Mars et Novembre-Décembre) ont permis de recueillir des données sur Penaeus aztecus et Penaeus brasiliensis du plateau guyanais. On constate une augmentation des apports liée à un accroissement de l'effort de pêche.

Araignée de mer (*Maia squinado*)

Une campagne a été faite en février 1978 à bord d'un bateau de pêche, dans le Golfe normano-breton. Le taux d'exploitation de ce crustacé croît régulièrement. Il atteint un niveau très élevé. Des données ont été recueillies en vue de déterminer la croissance de l'araignée (ISTPM).

Federal Republic of Germany

(K. Tiews)

Crangon crangon :

Investigations of the Institut für Küsten-und Binnenfisherei 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 263 samples (= 1 810 kg) of unsorted catch of the shrimp fishery were collected in Büsum, Cuxhaven, Norddeich and Husum, and analysed as to their species and length composition. The prey-predator relationship in the Crangon fishery has been studied.

Program 1979 :

Crangon crangon

Catch assessment work to determine the composition of shrimp catches by species and length shall be continued at the Institut für Küsten- und Binnenfisherei.

Iceland

(U. Skúladóttir- H. Eiriksson)

Nephrops norvegicus

Two research vessel surveys were made during the fishing season (May-August).

Routine sampling was continued as in previous years with some 30 000 Nephrops being studied from various fishing areas.

Work was also continued on landings and catch per effort. As a result of a somewhat smaller catch quota for the total fishery as well as increasing stock size in some areas the average catch per effort rose from 36 kg/hour in 1977 to 40 kg/hour in 1978.

VPA work was continued and computer work involving various factors affecting catch per effort was initiated.

Work will continue along similar lines in 1979 with some added emphasis however on by-catch data.

Pandalus borealis

During the year two new offshore fishing grounds were found. Research was similar as before. An effort was made to evolve methods for distinguishing between populations. For this purpose counting of eggs in samples, taken at the same time in many areas, was carried out. This seemed to be inconclusive as the samples were not taken early enough in the winter, where as other biological factors such as the occurrence and pattern of strong and weak year-classes, growth rate, and age and length at first spawning seemed to be useful criteria. Larval collection will be continued

but the connection between occurrence of larvae and year-class strength has not yet been demonstrated. Management of the fishery will be by quotas as before.

Ireland

No report received.

Netherlands

(R. Boddeke)

Stock assessment

Fishing mortality

Estimations of the fishing mortality rates of Crangon crangon were carried out again on basis of Leslie's method adapted by Becker for this case.

A complication in these calculations was, that fluctuations in the number of fishing days are coupled with two other phenomena. a shift in fishing area and fluctuations in the mean motor power of ships involved in shrimp fishing. Especially in Den Oever, a relevant decrease in the number of fishing days mainly takes place if multipurpose cutters with strong engines and operating on open sea choose for another type of fishing. For this reason a study was made about the influence of the motorpower on the catch per fishing day and of the fished rectangles.

Stock-recruitment relation

During the second half of 1978, a remarkable recovery of the shrimp stock in Dutch coastal waters took place. This improvement could be explained on basis of the relation between the number of ripe eggs in the months January-September and the number of consumption shrimps four months later, which relation already exists since 1970 for the fishing area of Den Oever.

Calculations showed a very favourable ratio between the number of ripe eggs present in the period January-May 1978 and the number of consumption shrimps in the corresponding months. In January-May the intensity of the fishing for brown shrimps in the fishing area of Den Oever was very low (only 31% of the number of fishing days of this period in 1977); the mean motor power of the ships involved decreased from 225 to 155 HP and the fishing was concentrated in inshore waters, where in January-April females with ripe eggs were much less abundant than the sea.

For these reasons the mortality among berried females has been much lower in the spring of 1978 than in other years, resulting in a higher yield expressed by recruitment of the ripe eggs carried by these females.

Biological cycle of Crangon crangon

Investigations on the copulation process of Crangon crangon have proved

that, in this species similar to other Decapod crustaceans, sperma is stored in the oviducts. The question whether the male brings the sperma directly into the oviduct or if it is deposited in the near vicinity of the opening of the oviduct and brought inside by action of the female is a matter of investigations in the first months of 1979. During this work, films have been made of the copulation process, revealing many interesting details on orientation by the male and position of the couple during the copulation.

Diseases

A study has been started on the occurrence of the milk or cotton disease in the brown shrimp of the Dutch coastal waters. Infected brown shrimps are observed in some local areas in the Oosterschelde and Waddenzee. The subject is still in study to estimate the rate of infection and to determine the causative agents. Some indications are found that probably two microsporidian protozoans are involved, namely Pleistophora sp. and Thelohania sp. both penetrating the muscle tissue of shrimps.

Surveys

Extensive surveys to estimate the abundance of brown shrimps along the entire coast of the Netherlands and adjacent regions, were carried out as usual in April and October, in cooperation with fisheries research stations in Belgium and the Federal Republic of Germany. In other months of the year, smaller surveys covered the Zeeland and estuaries and the Western Waddensea.

The so called tidal flat programme in which tidal flats are fished during high water to estimate their importance as feeding areas for brown shrimps (and flatfish), were carried out in May and September. On several spots along the western coast of the Netherlands, a line of stations perpendicular to the beach, was fished six times during 1978. Both last mentioned surveys, were carried out with a rubberboat.

Norway

(K.R. Gundersen)

Homarus gammarus

Fishing experiments, in order to obtain recaptures of tagged lobsters, were carried out in the tagging areas north and south of Bergen.

Because of some outbreak of Gaffkemia in a few lobster ponds on the west coast during the autumn 1977, the spring fishery for lobster were closed during 1978, and therefore no data of the commercial spring fishery were obtained.

Experiments with growing lobsters from larvae to market size were continued in the laboratory.

Cancer pagurus

Investigations of unexploited stocks of crabs were continued in northern Norway from August to October. Also fishing experiments for crabs in a small area in the harbour of Bergen were continued.

Nephrops norvegicus

Fishing experiments with different types of pots were made on localities south of Bergen, where type of bottom is unsuitable for trawling. Only small catches are obtained. At the same place, tagging experiments on Nephrops are carried out in small-scale. A minitype of the Norwegian lobster tag is used.

Poland

No report received.

Portugal

No report received.

Spain

No report received.

Sweden

(B.I. Dybern)

Homarus vulgaris

An investigation has been devoted to the lobster stock in the southern part of the Swedish distribution area. Migrations, frequency of males and females, under-sized and full-sized lobsters, berried females, etc. have been registered. Experiments have been carried out with different escape opening on creels used in the area.

Cancer pagurus

Continued collection of catch data and some diving observations have been performed.

Nephrops norvegicus

Continued compilation of data from the commercial fishery.

Pandalus borealis

Two surveys at sea were performed for the collection of data regarding quantities, sizes and sex.

United Kingdom

(England and Wales : E. Edwards)
Scotland : J. Mason)

England and Wales

Lobsters, crabs and crawfish

The programme consists of three main areas : 1) monitoring of catch-effort and population structure, 2) population modelling, and 3) population biology. Most

of our research efforts have been directed at lobsters.

Growth data from tagging, together with population structure data, were used in cohort analysis and in a yield per recruit model to predict the effects of raising the minimum landing size of lobsters. A consultative document was issued which recommended an increase in minimum landing size to 85 mm carapace length, improved enforcement, and a survey of fishing effort.

Certain aspects of the biology of lobsters have been studied to aid the interpretation of results and formulation of management proposals. Water currents and bottom types have been shown to influence lobster distribution and population structure. Parlour pots have been found to be on average 2.4 times more effective than standard creels. The effectiveness of escape gaps in releasing undersized lobsters and crabs has been demonstrated.

The crab (Cancer) and crawfish fisheries have been monitored, with attention being paid to the inshore crab fishery along the south coast. Should our recommendations for increases in minimum sizes along the Channel coast be reconsidered we can provide additional data on immediate short term losses.

A survey was also made of the spider crab (Maia squinado) stocks in the English Channel. The study included population modelling and migration studies using a claw tag.

Nephrops norvegicus

Cod are a major predator of Nephrops in the northeast coast fishery and observations were made to relate the size of cod predators to the size of Nephrops prey. Cod of all sizes up to 100 cm total length took small Nephrops, but very large Nephrops were found in cod stomachs. 90% of all Nephrops prey were smaller than 35mm carapace length.

In two tag-recapture experiments off the northeast coast, a total of 26 Nephrops (0.9%) were returned from a release of 3003. Results are open to several interpretations; Nephrops were recaptured in the release area after several months, others moved 12-25 miles in a general westerly direction. Large Nephrops were recaptured up to 110 weeks after tagging. Movement of tagged individuals was calculated to be approximately 0.2 miles per week.

Experiments were conducted aboard a commercial vessel to determine damage and mortalities to Nephrops caused by trawling and sorting the catch. A comparison was made of damage and mortalities from short (1 hour) hauls and long (up to 5 hour) hauls. Claw loss was the major source of physical damage.

Pandalus borealis

The 1978 year classes were not particularly strong and fishery landings amounted to only 98 tonnes, worth £57 700 for the whole northeast coast. There was no requirement for biological studies.

Scotland

Homarus gammarus

Commercial landings of lobsters were sampled in the main fishing areas and catch and effort data were obtained from selected fishermen. A preliminary yield assessment based on a cohort analysis on length composition data suggested means by which yield per recruit in the south-east Scottish fishery could be increased.

During 1978 more than 1 200 toggle tagged lobsters were released on the offshore grounds west of the Outer Hebrides and a further 330 were released off the south-east coast. Further tagging experiments are planned for 1979.

Exploratory fishing has failed to reveal any deep water stock of lobsters on the continental slope west of Scotland, though considerable numbers of Geryon affinis were found in depths of 500-600 m on the rough eastern edge of Rockall Bank. Many Cancer pagurus but no lobsters were found around the Rockall islet.

Cancer pagurus

Catch composition and fishing effort data were collected from the main fishing areas. The meat yield of crabs from west of the Outer Hebrides was studied in collaboration with scientists at Torry Research Station.

The preliminary results of a study of the diet of crabs in lower Loch Torridon (north-west Scotland) suggest that much of the food is obtained by digging deep into sandy substrata.

Nephrops norvegicus

Sampling of commercial catches of Norway lobsters was continued in the Firth of Forth and the Firth of Clyde. The rate of discarding of Nephrops and fish by-catch was studied and experiments were conducted on the survival of discarded Nephrops held in cages on the sea bed. Tagged Nephrops were released for growth studies. A mid-water trawl was used to sample post-larval Nephrops.

Further comparative fishing experiments were undertaken to compare size selection of Norway lobsters by 50, 70 and 90 mm mesh trawls and cod-ends.

Observations were made of the predation of Nephrops by cod.

Pandalus borealis

Sampling of commercial catches from the Fladen fishery and collection of catch per unit effort data were continued. Studies of the discarded fish by-catch were made. Preliminary trials were done with underwater television and still cameras to observe the behaviour and distribution of Pandalus on the Fladen and Farn Deep grounds.

Crangon crangon

Collection of catch composition and effort data from the Solway Firth fishery was continued.

U.S.A.

(S.H. Clark-M. Castagna)

Northern shrimp (*Pandalus borealis*)

Northern Shrimp Scientific Committee³ completed a draft management plan for the Gulf of Maine fishery as well as an assessment indicating that stock abundance has recently stabilized at a low level. Maine DMR personnel initiated an extended research vessel survey program and continued studies to further evaluate temperature influences. Results to date suggest that even during unusually warm years water temperature levels in the Gulf of Maine would not be sufficiently high to cause direct mortality, although the incubation period may be significantly reduced.

White and brown shrimp (*Penaeus setiferus* and *P. aztecus*)

SEFC personnel conducted stock assessment work for both species and also participated in mark-recapture studies in cooperation with the Louisiana WLFC, Louisiana State University, the Texas Parks and Wildlife Department (PWD), and Texas A & M University (data collection and analyses are continuing). Other activities included investigation of potential remote sensing applications, gear research, shrimp fleet discard surveys (in cooperation with Texas A & M University) and development of an economic model of the fishery. The South Carolina WNRD, the Georgia DNR, the Alabama Department of Conservation and Natural Resources and the Gulf Coast Research Laboratory (Mississippi) engaged in resource assessment and monitoring activities. Louisiana State University researchers continued socioeconomic studies and development of a shrimp fishery management plan.

Spiny lobster (*Panulirus argus*)

SEFC personnel conducted underwater television observations in the Gulf of Mexico-Antilles areas. Nova University conducted studies of larval distribution patterns in the Florida Keys; the Florida DNR, the University of Florida and the University of Miami continued stock assessment work in the south Florida-Caribbean area. This work indicates extremely high fishing mortality upon attainment of legal size.

American Lobster (*Homarus americanus*)

The Northern Lobster Scientific Committee³ completed Yield per recruit assessment and related analyses for incorporation into the Lobster Management Plan (completed in October). NEFC personnel continued assessment work on offshore populations. Results of all assessments to date indicate that fishing mortality is much too high (and current age at entry much too low) to maximize yield per recruit. Maine DMR personnel continued stock assessment work and evaluated use of escape vents; the Massa-

³) The Northern Shrimp and Lobster Scientific Committees each consist of state and Federal scientists whose activities are coordinated by the NMFS Fisheries Management Operations Branch.

chusetts DNR conducted spatio-temporal studies of larval distribution as well as an evaluation of the influence of nuclear power plant effluents on commercial catch rates. Work by Rhode Island DNR personnel included design and implementation of a statistical reporting system for collection of refined catch: effort data, evaluation of otter-trawl damage, and larval distribution studies. The New York DEC initiated tagging studies to evaluate movement, growth, and mortality and continued catch sampling to determine size composition, sex ratio, and size at maturity in Long Island Sound. The New Jersey DEP continued tagging studies to evaluate growth and movement and monitored commercial size composition and catch-effort trends.

Blue crab (*Callinectes sapidus*)

The SEFC continued studies on abundance and movement patterns of female blue crabs in Biscayne Bay; University of Maryland researchers studied growth, larval behavior, and genetic variation as indicators of larval exchange among estuarine systems, and the University of Delaware and Old Dominion University continued studies of larval distribution and recruitment into inshore areas.

Red crab (*Geryon quinquedens*)

NEFC biologists completed stock assessment work; University of Maryland workers studied growth, development, and dispersal characteristics of larval and postlarval stages, and College of William and Mary researchers conducted natural history studies.

U.S.S.R.

(A. Neyman)

In May and June 1978 the survey of the shelf and continental slope of the Atlantic coast off Morocco was conducted. The shrimp species composition data indicated that 41 species of shrimps occur in this area, 5 of which were not found off Morocco before. 4 shrimp communities were distinguished with regard to peculiarities of their vertical distribution with the habitat boundaries specified by vertical structure of the waters in the area studied.

In the Barents and Norwegian Seas Soviet investigations of commercial invertebrates were continued. There were six cruises. The following vessels conducted research expeditions: "Medvezhy", "Tuna", "Odissey", "Yuksporit".

As a result of this research, commercial concentrations of Pandalus borealis were found; Soviet and Norwegian vessels then fished successfully. Provisional biomass of these concentrations was assessed by trawling surveys and underwater photography. Dense concentrations of shrimp were observed with bottom temperatures of $-0,2^{\circ}$, $-0,4^{\circ}$ and depths of 240-280 m. It was revealed that shrimp larvae drifted with the Nordkap and Norwegian currents towards shrimp banks of the Barent Sea. Reproductive potential of shrimp concentrations in the open areas of the sea, especially in the eastern and north-eastern

parts of the sea was at least three times lower than the reproductive capacity of the Murman coastal concentrations. Visual observations on distribution and behaviour of shrimps were conducted from a self-propelled inhabited underwater apparatus.

In winter, the density of shrimp at the bottom and the efficiency of fishing were lower than in summer. In December, bottom concentrations consisted mainly of females with eggs, which orientated their bodies along the current.

The main feeding object of northern shrimps in the Barents Sea was Polychaeta and Euphausiacea.

The bulk of shrimps moulted in May-June.

In the coastal zone of the Kola peninsula the results of long-term introduction of king crab into the Barents Sea were studied.

ADMINISTRATIVE REPORT - IRELAND

(C B Duggan)

Pecten maximus

The research programme on spat settlement and related hydrographic parameters continued in Lough Ine, a sea lough on the south coast of Ireland. Spatfall was much less abundant than in 1977.

Oysters

The University of Galway's Shellfish Research Laboratory, Carna, Co. Galway, expanded their work on a low-cost mollusc hatchery using plastic tunnel greenhouses.

A commercial firm constructed 21 outdoor ponds, approximately 8 m x 8 m x 3 m deep for spat collection. Another firm began construction of a large oyster hatchery.

Mussels

Raft cultivation of mussels increased and bouchot trials were begun.

Nephrops

Trials were conducted using trawls of 70 mm mesh overall and the traditional net of 55 mm in the wings and 45 mm elsewhere.

