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International Council for the
Exploration of the Sea

C.M. 1993/F:3

REPORT OF THE WORKING GROUP ON

INTRODUCTIONS AND TRANSFERS OF MARINE ORGANISMS

Aberdeen, 26 - 28 April 1993

This document is a report of a Working Group of the International Council for the Exploration of the Sea and does not necessarily represent the views of the Council. Therefore, it should not be quoted without consultation with the General Secretary.

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1993 HIGHLIGHTS

The Working Group:

* **Completed and prepared for submission the revised "1993 CODE OF PRACTICE", and proposed that it be submitted for Council approval.**
  > *See pp. 3 - 4 and C.M. 1993/F:18*

* **Acted upon a request received by ICES from the State of Maine relative to the proposed introduction of the Japanese red seaweed *Porphyra yezoensis* into the Gulf of Maine. The WG prepared a recommendation for Committee and Council approval on this introduction. The WG does not oppose the development of open sea aquaculture programs with this seaweed subject to the conditions set forth in the WG's Report and recommendation.**
  > *See pp. 15 - 17 and Recommendation No. 2, pp. 21 - 22 and Appendix IV.*

* **Acted upon a request received by ICES from France relative to the proposed introduction of the American bay scallop *Argopecten irradians* into France. The WG prepared a recommendation for Committee and Council approval on this introduction. The WG does not oppose the development of culture programs with this scallop subject to the conditions set forth in the WG's Report and recommendation.**
  > *See pp. 17 - 18 and Recommendation No. 3, p. 22 and Appendix V.*

* **Noted that a number of non-native species, including parasitic copepods, mollusks, worms, and dinoflagellates, were released into Irish waters from France in shipments of half-grown Pacific oysters, shipments now permitted under EC Council Directive 91/67 EEC. The WG voiced concern over this, and recommended that ICES should consider establishing a dialogue with international agencies, such as the European Commission, relative to the increasing movements through new trade agreements of aquatic organisms, to insure that potential ecological and genetic impacts of such movements are taken into consideration, not just the prevention of the spread of disease agents.**
  > *See pp. 14 - 15 and Recommendation No. 4, p. 22*

* **Reviewed the rapidly growing international concerns over the continued spread of exotic organisms by ships' ballast water, and new International Maritime Organization, Canadian, United States, and other guidelines to address this issue. The WG noted with great concern the introduction of the American comb jelly *Mnemiopsis leidyi* to the Azov, Black, and Mediterranean Seas by ballast water in the 1980s, and the resulting devastation of the Azov Sea anchovy fishery. The potential for the spread of this species by ballast water around Europe has been noted by FAO and other organizations. The WG reviewed management developments and new ballast water - mediated invasions in ICES member countries.**
  > *See pp. 8 -9 (Mnemiopsis), 10 - 14, and Appendix III*

* **Further found that,**

  - Harmful algal blooms (HABs), some of which may be due to species transported by ballast water, continue to spread at alarming rates, and supports the UNESCO/IOC recommendation that ICES should be an active participant in an HAB international program, with the WG contributing to relevant parts of this effort.

  - The WG should cooperate and work with FAO in the development of a "User's Guide" to the ICES/EIFAC Code of Practice.

  - The development of guidelines for research to evaluate the ecological effects of the release of genetically modified organisms (GMOs), and the review of risk evaluation models for introduced organisms, should continue.

WORKING GROUP ON INTRODUCTIONS AND TRANSFERS OF MARINE ORGANISMS

Report of a meeting held 26 - 28 April 1993 in the Scottish Office Agriculture and Fisheries Department (SOAFD), Marine Laboratory, Aberdeen, Scotland.

INTRODUCTION

The 1993 meeting of the ICES Working Group on Introductions and Transfers of Marine Organisms (hereafter WG) was held at the Scottish Office Agriculture and Fisheries Department, Aberdeen, Scotland from April 26 to April 28 1993. At this meeting, which was the 15th Anniversary meeting of the WG, there were 19 participants representing 8 member countries:

J. Carlton	USA	(Chairman)
T. Carey	Canada	
M. Campbell	Canada	
R. Randall	Canada	
H. Grizel	France	
S. Gollasch	Germany	
M. Dammer	Germany	
D. Minchin	Ireland	
S. Tilseth	Norway	
B. Dybern	Sweden	
B. Holmberg	Sweden	
I. Wallentinus	Sweden	
A. Munro	UK (Scotland)	
A. McVicar	UK (Scotland)	
J. Side	UK (Scotland)	
D. McGillivary	UK (Scotland)	
D. Frazer	UK (Scotland)	
S. Utting	UK (England and Wales)	(Rapporteur)
I. Levine	USA	

National reports were received by mail from Denmark (S. Mellergaard), Finland (R. Rahkonen), Poland (J. Wiktor, W. Pelczarski, Z. S. Karnicki) and Spain (J. Cremades). The members of the WG were welcomed by Dr Alan Munro of SOAFD. The Chairman then reviewed the objectives of the WG's 1993 meeting; the agenda for the meeting was considered and approved (Appendix I).

The 1992 Handbook, which contains the history of the WG, the venues of the meetings, a statement of the WG's purpose (terms of reference and operating principles), the Code of Practice for introductions, a list of WG publications and a synopsis of Council resolutions from the WG (1969-1991) was also reviewed.

STATUS OF WORKING GROUP RECOMMENDATIONS FOR 1992

The Chairman reviewed the status of the recommendations formulated at the last meeting of the WG in Lisbon, Portugal in April 1992 (1992 Report, C.M. 1992/POLL:3) and submitted for consideration at the Statutory Meeting of ICES in Rostock-Warnemunde, 24 September- 2 October 1992:

Recommendation 1
That the principal parent of the WG on ITMO should be the Mariculture Committee, but that all advice emanating from the Group should be channelled through ACME.

> See ICES Annual Report, 80th Statutory Meeting 1992:

page 30: Report of Delegates Meeting, Agenda Item 17, "Report and Recommendations of Consultative Committee",item (l), "Recommendations by Advisory and Subject/Area Committees"

page 55: Report of Consultative Committee, Agenda Item 15, "Recommendations by Advisory and Subject/Area Committees"

pages 86-7: Mariculture Committee, Committee Business

The WGITMO is transferred back to the Mariculture Committee, but all issues of an advisory nature must be channeled through ACME for thorough review before the advice could be provided.

Recommendation 2
That the WG should consult EIFAC (since EIFAC had adopted the ICES Code of Practice) prior to the publication of the *ICES Cooperative Research Report* entitled "A Code of Practice to Reduce the Risks of Adverse Effects Arising from the Introduction and Transfer of Marine Organisms: Guidelines and a Manual of Procedures", which would be an extension of the older CRRs 130 and 159 and which would also include a model procedure, the ICES Code of Practice in all member state languages, and a brief summary of other international codes.

> See ICES Annual Report, 80th Statutory Meeting 1992, pages 86-87. EIFAC should be so consulted.

Recommendation 3
That the "Revised 1992 Code of Practice to Reduce the Risks of Adverse Effects Arising from the Introductions and Transfers of Marine Organisms, Including the Release of Genetically Modified Organisms" (as set forth in ACMP 1992/7.3), after consultation with the respective EIFAC Party on Introductions, will be presented to the Council for adoption.

> C. Res. 1992/4:10

Recommendation 4
That the WG meet at the Marine Laboratory (SOAFD) Aberdeen, Scotland from 26 - 28 April in 1993 to consider and report on the proposed introduction of the American bay scallop (*Argopecten irradians*) to France; further consider and report on the release of the Japanese red alga *Porphyra*

yezoensis on the Atlantic coast of the USA and its potential for spread into Canada and into southern waters; begin the preparation of a new *ICES Cooperative Research Report* entitled 'A Code of Practice to Reduce the Risks of Adverse Effects Arising from the Introduction and Transfer of Marine Organisms: Guidelines and a Manual of Procedures'; develop guidelines for research to evaluate the ecological effects of the release of genetically modified organisms in marine environments; consider and report on progress in ICES Member Countries on methods to reduce the risk of introductions of marine organisms in ships' ballast water and sediments; and to report on the current status of salmonid fish, algal, shellfish and other introductions in and between ICES Member Countries.

> C. Res. 1992/2:44

STATUS OF 1993 CODE OF PRACTICE TO REDUCE THE RISKS OF ADVERSE EFFECTS ARISING FROM INTRODUCTIONS AND TRANSFERS OF MARINE SPECIES, *INCLUDING THE RELEASE OF GENETICALLY MODIFIED ORGANISMS*

In 1991 the WG met in Helsinki with the ICES WG on Genetics. As a result, a section on genetically modified organisms (GMOs) was proposed for addition to the Revised Code of Practice. This "Revised 1991 Code" was submitted to the Council, but not adopted because a definition of GMO had been omitted (Reference: C.M. 1991/F:47). In 1992 the WG met in Lisbon. After considerable discussion, a definition of GMO was adopted, based upon that given in EC Directive 90/220. This "Revised 1992 Code" was submitted to the Council, but not adopted because of the need to consult and coordinate with FAO/EIFAC, which had previously adopted the ICES Revised Code as well, with modest changes (References: ACMP 1992/7.3, C. Res. 1992/4:10).

Dr J. Carlton entered into correspondence with Drs R. Welcomme and D. Bartley of FAO (Rome) on this matter, and with Dr B Steinmetz, Co-Chair, EIFAC Working Party on Introductions. The EIFAC Working Party is not active at this time. At the 16th Session of EIFAC in 1990, Drs B. Steinmetz and Mr. Fijan were appointed co-conveners. At the 17th Session of EIFAC in 1992, no further action was taken relative to the Working Party.

Dr Steinmetz has informed Dr Carlton that it would be appropriate to now note "that EIFAC plans to take up this matter at its next session in 1994", and that this could so be noted in the 1993 ICES CODE, that is, the new ICES Code could be produced without waiting for EIFAC. Dr Steinmetz has consulted on this matter with the EIFAC Chairman as well.

After considerable discussion, the WG concluded that,

(a) No further delays in producing the new Code of Practice were necessary, and that EIFAC has been informed of and provided copies of the new proposed sections on GMOs, and that Dr Steinmetz, in representing the Working Party, has indicated that EIFAC has now been so informed,

(b) That the word "Revised" be dropped from the title of the Code, but replaced with the *year* of the Code instead,

and therefore,

(c) In accordance with C. Res. 1992/4:10, that the "**1993 CODE OF PRACTICE TO REDUCE THE RISKS OF ADVERSE EFFECTS ARISING FROM INTRODUCTIONS AND TRANSFERS OF MARINE SPECIES, INCLUDING THE RELEASE OF GENETICALLY MODIFIED ORGANISMS**" be presented to the Council for adoption.

The 1993 CODE is presented in a separate document, C.M. 1993/F:18, for Council action.

STATUS OF THE NEW ICES COOPERATIVE RESEARCH REPORT 'A CODE OF PRACTICE TO REDUCE THE RISKS OF ADVERSE EFFECTS ARISING FROM THE INTRODUCTION AND TRANSFER OF MARINE ORGANISMS: GUIDELINES AND A MANUAL OF PROCEDURES.'

Organization and writing assignments on this CRR continue. Dr J. Carlton is the Editor. The potential for the application of this new CRR on a global scale was recognized. Contents of the CRR will include:

1. ***The Principles of Disease Spread Prevention:*** The principles that should be adhered to, in order to prevent the spread of disease agents, when making introductions, with references to literature that covers diagnostic methodologies. The CRR would not seek to compete with or reproduce pathological protocols that have been published or adopted already. Dr Alastair McVicar, Chairman of the WG PDMO, spoke of the lack of standardization between diagnostic techniques that are used in different countries. There is the potential for ICES to take the lead towards their standardization.

2. ***Ecological Risk Assessment:*** An outline of how to carry out an ecological risk assessment prior to making an introduction.

3. ***Genetic Considerations:*** Genetic factors that need to be considered both in general terms and in the realm of genetically modified organisms (GMOs).

4. ***Case Examples: History of ICES Decisions:*** Case examples of introductions that have been proposed and/or subsequently made into ICES countries. This would be beneficial in cases where there were good reasons for and against an introduction. A list of species that had previously been accepted or rejected by the ICES WGITMO would be compiled giving reasons for ICES acceptance/rejection of the proposal.

5. ***Model Proposal:*** A full model of how a proposal for an introduction should be presented for submission to ICES for consideration. To this end Dan Minchin outlined the progress he has made in putting a case example together outlining the steps that were followed for the introduction of *Patinopecten yessoensis* to Ireland.

6. ***Outcomes of Introductions:*** The outcome of a number of case introductions eg. the Japanese scallop *Patinopecten*, the Japanese seaweed *Undaria* and coho salmon into France, and pink salmon into northern Norway.

STATUS OF THE NEW ICES COOPERATIVE RESEARCH REPORT "TEN YEAR REVIEW"

Dr Alan Munro reported that the preparation of the report was virtually complete and will be ready for publication this year.

WORKSHOP TO CREATE A USER MANUAL TO FACILITATE IMPLEMENTATION OF THE ICES/EIFAC CODES - FAO

FAO has recognized that developing countries and even FAO field projects have difficulties in satisfying the conditions of the ICES/EIFAC Codes of Practice. Toward that end, a workshop will be held in July 1993 in Manila, supported by IDRC, FAO and ICLARM. The purpose of the workshop will be to create a 'User Manual to Facilitate Implementation of the ICES/EIFAC Codes of Practice and Manual of Procedures for Consideration of Introductions and Transfers of Marine and Freshwater Organisms'. A small group of experts, which is likely to include a fishery ecologist, geneticist, aquaculturist, pathologist, and an expert familiar with applying the Code, will be invited to the workshop. Dr J. Carlton had received an invitation to attend. The WG recommends that ICES be represented at this workshop, and that one or more members of the WG ITMO should attend FAO Workshops on this topic.

NATIONAL REPORTS - (Appendix II)

A total of 12 national reports were received this year, a record number in the 15 year history of the Working Group. Reports were received from Canada, Denmark, Finland, France, Ireland, Norway, Poland, Spain, Sweden, UK: Scotland, UK: England and Wales, and the USA. No reports were received from Belgium, Germany, Portugal, or the Netherlands. Iceland and Russia are not represented on the Working Group.

Highlights of the National Reports (please see Appendix II) and special Status Reports (see below) are as follows. *Ballast water activities are reported in a special section below.*

Canada

> Amendments to the Fish Health Regulations, to cover all species of finfish and shellfish, and a policy on introductions of genetically modified organisms, have been drafted.

> To insure genetic protection of local salmonid stocks, transfers of salmonids are becoming more localized, especially on the east coast of Canada

> Extensive research continues on the invasion of the Eurasian zebra mussel *Dreissena polymorpha* in Canada. A second species of the invasive zebra mussel *Dreissena* has been identified.

Denmark

> Imported eels are examined for viruses and swimbladder nematodes; contaminated shipments are abandoned and not released.

> The invasive Japanese brown seaweed *Sargassum muticum* continues to spread in the Kattegat.

Finland

> Revised regulations on the transfer of live fish, fertilized roe, and milt to prevent the spread of viral and bacterial fish diseases to Finland will come into force in the spring of 1993.

France

> No coho salmon were imported in 1992.

> An official request to begin studies on the introduction of the American bay scallop *Argopecten irradians* was submitted to ICES in time for the WGITMO 1993 meeting.

> Culture of the Japanese kelp *Undaria pinnatifida* continues at several locations; only at Aber Wrach has there been a good harvest.

Ireland

> A number of non-native species, including the oyster parasitic copepods *Mytilicola orientalis* and *Myicola orientalis*, and dinoflagellate cysts, have been released into Irish waters from France in shipments of half-grown Pacific oysters.

> The Japanese scallop *Patinopecten yessoensis* continues to be held in lantern nets off the southeast coast of Ireland.

Norway

> The Kamchatka king crab, *Paralithodes camtschatica*, originally introduced into Russian waters by VNIRO, is established in Norway.

> The Japanese brown alga *Sargassum muticum* continues to spread northwards.

Poland

> In 1993, whitefish (*Coregonus lavaretus*) stocks in Gdansk Bay will be enhanced by a planned release of about 200,000 fry originating from eggs from spawners from the Gulf of Szczecin.

Spain

> Studies continue on the invasive seaweeds in Spain, with experiments being carried out on the introduced Japanese kelp *Undaria pinnatifida* in Galicia, and with meetings and control efforts of the introduced green seaweed *Caulerpa taxifolia*. New populations of the Japanese seaweed *Lomentaria hakodatensis* were detected in Galicia.

UK

> In England and Wales in recent warm summers, there has been natural recruitment of the Pacific oyster *Crassostrea gigas*.

> In Scotland, applications to import sturgeon from Hungary were rejected on health grounds.

USA

> An interagency federal "Aquatic Nuisance Species Task Force" is carrying out the numerous mandates of the major piece of U.S. legislation on nonindigenous exotic species (passed in 1990). Extensive work on the distribution, biology, ecology, dispersal mechanisms, and control of the zebra mussel *Dreissena polymorpha* continues throughout the United States. The zebra mussel has now spread east to New York, south to Louisiana, and west to Oklahoma.

> Chinook salmon (*Oncorhynchus tshawytscha*) will not be released in New Jersey, according to a final decision by that state government.

> Chinook salmon (*Oncorhynchus tshawytscha*) continue to be released in New Hampshire, with a five-year release program ending in the fall of 1993.

> Another exotic sea squirt (ascidian tunicate), *Ascidiella aspersa*, a native of Europe, has been recognized in New England.

> Several thousand of the Pacific white shrimp *Penaeus vannamei* have been found in commercial shrimp hauls off South Carolina, having escaped from aquaculture facilities.

> A private company proposal to undertake open sea aquaculture of the Japanese seaweed *Porphyra yezoensis* in the Gulf of Maine will be considered at this meeting of the WG.

STATUS REPORTS

Japanese scallop, *Patinopecten yessoensis*, in Ireland

Japanese scallops that survived their importation into Ireland were introduced to a quarantine facility during April 1990. Following spawnings, all broodstock were destroyed. The surviving F_1 generation, which cleared quarantine in September 1990, were expected to spawn in the spring of 1993. It would appear that spawning will now take place during spring 1994. The surviving 75 scallops are held in lantern nets off the southeast coast of Ireland near Wexford. There were no importations of broodstock in 1992 and none are planned for 1993 or 1994.

Invasion of the green seaweed *Caulerpa taxifolia* in the Mediterranean

Since 1984 when *Caulerpa taxifolia* was first found near Monaco, natural spread from that area to new sites has been rapid. Also, anthropogenic methods of dissemination have occurred to sites which are more than 5 km from Monaco. Colonies have appeared at the more distant sites over the last three years. Spread of the alga is very seasonal, from June to November. In terms of the number of sites occupied, in the area covered and in the length of coastline affected, there has been an exponential rate of spread. It is estimated that the area occupied by *Caulerpa* is increasing by a factor of six each year. This rate of invasion is comparable with that of many other algal invasions, such as *Sargassum muticum.*

Under favorable conditions, the rate of spread along the shore can reach 200 m per year. In areas with little shallow water or where the substrate is unsuitable (e.g. areas with wide expanses of mobile sediment between depths of 0 -10 m), progress is much slower. The species has, however, colonized deep water and enclosed bays on either sand or mud. In sites exposed to wave action, *Caulerpa* occurs only at depths in excess of 2-3 m while in sheltered sites it grows up to the surface of the water. The greatest depth at which the alga has been found is 52 m. Although all types of substrate can be colonized, rock or dead seagrass (*Posidonia oceanica*) beds are preferred. *Caulerpa* competes with seagrass, particularly in areas where the seagrass beds are less dense.

The wide diversity of biotopes affected by the invasion of *Caulerpa*, the permanence of the *Caulerpa* colonization as a result of its extremely dense growth, and the lack of fauna that graze on the alga are giving cause for concern.

A video on *Caulerpa taxifolia* in the Mediterranean was shown to the WG.

The North American comb jelly (*Mnemiopsis leidyi*) invasion in the Black Sea and the Mediterranean

The American comb jelly (ctenophore) *Mnemiopsis leidyi* was first observed in the Black Sea in 1982, having been transported from the Americas by ballast water (references cited in previous WG reports, and Harbison, 1993). *Mnemiopsis* is a omnivorous-carnivorous species that consumes vast amounts of zooplankton, including copepods and larval fish. Standing stocks in the Black and Azov Seas have been estimated at over 100 million metric tons per year. It become abundant in 1987, and by 1988 it had virtually eliminated the anchovy fishery in the Azov Sea. By 1992 it had spread into the

Mediterranean, forming large concentrations in the Sea of Maramara and also near Mesin, Turkey (Harbison, 1993).

In January 1993 the FAO issued an international advisory, directed to the United Nations' "International Maritime Organization" (IMO), on the invasion of this species and concerns for its transport by shipping activities to other regions of Europe, particularly to the Baltic Sea. This advisory is reproduced here as Appendix III (A).

In January 1993 also Dr S. P. Volovik, director of research for Russia's Azov Sea Research Institute of Fishery Problems, visited laboratories on the Atlantic coast of the United States to discuss the invasion of *Mnemiopsis* with American scientists. Under consideration are possible methods of biological control. Possible predators that could be introduced would be carnivorous species of ctenophores (such as *Beroe*) and ctenophore-eating fish (Harbison, 1993), but no decisions have yet been made, and no introductions of predators have yet taken place.

The Working Group considers the invasion of *Mnemiopsis* into Eurasian and European waters to be of the utmost concern for all ICES member states, and concurs with the suggestions in the FAO letter (Appendix III) that attempts should be made to reduce the spread of this species to western and northern European waters by ballast water.

Japanese kelp, *Undaria pinnatifida*, in France

Culture of *Undaria* is taking place on an experimental scale at several locations on the French coast. In 1991, plantules were put into the water at Ile d'Ouessant, Aber Wrach, Conquet, Ile de Groix, Ile d'Oleron and Ile de Brehat. Only at the Aber Wrach site has there been a good harvest. No harvesting has occurred at the other sites for a number of technical reasons (e.g. the plantules were too small when they were put into the water, contamination of the water by zinc oxide).

The harvest in 1991 was less than 50 tonnes. In the Etang de Thau, *Undaria* has been parasitized by an ascomycete and by September 1992 culture of *Undaria* was concentrated around Aber Wrach and Conquet.

There is little evidence of an ecological impact caused by the alga but the density of *Undaria* is low at 10 plants per meter, and *Sacchoriza bulbosa* is also grown on the ropes with *Undaria*. With the exception of the St. Malo area, there has been no sign that the alga has become permanently established. Some natural localized spread has occurred but plants that have appeared outside the cultivation area disappear once cultivation is stopped.

Undaria pinnatifida has been found in Galicia, Spain following the transfer of oysters from the Etang de Thau.

In response to C. Res. 1989/4:4, France must present a summary of annual records, including ecological considerations and environmental impacts of *Undaria* culture, to ICES in 1994.

Relative to other exotic algae, the abundance of *Laminaria japonica* in the Etang de Thau is declining; in 1992, it was impossible to find fertile plants. By contrast, *Porphyra yezoensis* and *Grateloupia doryphora* have spread to open waters.

BALLAST WATER AND SEDIMENTS: REGULATIONS AND PROCEDURES IN ICES MEMBER COUNTRIES

The WG, aware of the role of ballast water and sediments in the introduction of non-indigenous aquatic organisms, including the spread of toxic marine phytoplankton (Harmful Algal Blooms - HABs), reviewed the status of ballast water regulations and procedures in ICES member countries. It became apparent that the implementation of international guidelines (e.g. those of the International Maritime Organization [IMO]) and research on the role of ballast in the introduction of non-indigenous species varied greatly between countries. Australia had circulated questionnaires worldwide to IMO member countries to obtain information on ballast water procedures and regulations and delegates were encouraged to obtain copies of the completed questionnaires from their member country. An example of a completed questionnaire was available to the WG, provided by the Swedish representatives.

Appendix III includes several ballast water documents tabled at the meeting, as noted below.

Canada

Canada has been very active in the area of ballast water management. The Canadian Coast Guard has proposed new guidelines for ballast water exchange to reduce accidental introductions of exotic organisms into the Great Lakes and the St. Lawrence River. Ships bound for ports west of 63°W longitude (Anticosti Island) must exchange their ballast water while at sea. Previous guidelines required only those ships bound for areas west of Quebec City to exchange their ballast. Although compliance with the guidelines was high, foreign organisms were still being released into fresh and brackish waters of the St. Lawrence River. Transport Canada is planning to change the new guidelines to regulations by the 1994 shipping season. A fuller account of Canada's current ballast water program is provided in Appendix III - B.

Denmark

Danish legislation dealing with ballast water is in agreement with the recommendations in the IMO MARPOL Convention, which relates only to oil or other harmful chemicals. Recently, a revision of the legislation has been initiated. However, this revision would not involve special considerations on the risks of introduction and transfer of marine organisms unless this is recommended from appropriate international bodies.

Finland

Since 30 March 1993, a brochure on IMO Guidelines has been distributed widely in the field of navigation. The introduction to this brochure is presented in Appendix III-C.

Germany

A major research project is underway, entitled "Invasion of Non-Indigenous Marine Species into the North and Baltic Sea via Ships Ballast Water: Investigations of the Ecological Threat". Samples of ballast have been taken from ships arriving in Germany from ports worldwide. Most of the phytoplankton identified in ballast water consisted of diatoms. However, cysts of *Alexandrium* and *Protoperidinium* have been found in sediment from ballast tanks. There were several technical

difficulties in taking samples from ballast tanks. Also, when taking ballast samples from Argentinian ships, individuals were faced with a health hazard from chloramines (which are carcinogenic) because hypochlorous acid had been added to ballast water. An introduction to the German ballast water project is provided in Appendix III-D.

Norway

Log books are checked but no samples of ballast water are taken. In 1991, the phytoplankter *Dinophysis acuta* was found in Norwegian waters, with concentrations reaching more than 40,000 cells/liter. In 1992 concentrations were 1.3 million cells per liter. It is speculated that pollution problems may stimulate blooms of local species.

Poland

There are no special rules on discharging ballast water in the Polish EEZ, unless the waters contain oil or harmful chemicals. Several governmental bodies are concerned with this issue and an appropriate bill project was sent to the Polish parliament (Sejm) some time ago. The concept of "Particularly Sensitive Sea Areas" in relation to the Baltic Sea under MARPOL standards was discussed. An "International Survey of IMO Member States Relating to Ballast Water" was circulated among Polish shipping, maritime and harbour authorities to obtain the necessary opinions.

Sweden

The Swedish Environmental Protection Agency is proposing to begin studies to identify the potential problems arising from discharge of ballast in Swedish waters in order to decide on the appropriate course of action to take. There is a plan to introduce ballast water management practices and letters about ballast discharge guidelines have been sent to the Shipowners Association.

A copy of the Swedish response to the Australian/IMO Survey on Ballast Water is presented in Appendix III-E.

UK

Controls on ballast discharge apply only to regulations (Marpol) for oil and chemical discharges. Several government bodies (Dept. of Transport, Dept. of Environment, MAFF, SOAFD) are in discussions over the implementation of IMO Guidelines and funds are currently available for research to assess whether there is a potential problem from the discharge of ballast in UK waters.

United States

Extensive activity continues in the United States on ballast water and sediment management. In the meantime, new invasions continue to be newly discovered, recorded, and/or announced:

* The Japanese crab *Hemigrapsus sanguineus*, noted in earlier U.S. Annual Reports, was first discovered in the 1980s in New Jersey, and has now (1993) spread north to Cape Cod.

* A second species of zebra mussel (called in Canada and the U.S. the "quagga" mussel), *Dreissena* sp., has now been recognized in North America.

* Two small southern USA fish, a blenny and a goby, have been found in the Hudson River, New York.

* The Japanese seaweed *Antithamnion nipponicum*, earlier also known from the Mediterranean, has been discovered in Long Island Sound, Connecticut/New York, in the 1980s,

* The Asian copepod *Pseudodiaptomus inopinus* has been discovered in the Columbia River, Oregon/Washington, where it is now one of the most abundant species (Cordell et al., 1992).

* Two new opossum shrimp (mysids) have been discovered in San Francisco Bay, both probably from Asia via ballast water.

* The green crab *Carcinus maenas* of the Atlantic Ocean has appeared in San Francisco Bay by the tens of thousands

* A Philippines goby, *Mugiligobius* sp., has been newly found on Oahu, Hawaiian Islands

* A Venezuelan mussel, *Perna perna*, has become established on the Texas coast.

In addition, a host of new phytoplankton blooms have appeared in the U.S. (and around the world), which some researchers believe may be linked to ballast water release. These include,

* The "brown tides" of 1985-1986 of the U.S. Atlantic coast, involving the chloromonad (Raphidophyceae) *Aureococcus anophagefferens* (if introduced, origin unknown)

* The diatom *Pseudonitzschia australis*, which produces domoic acid, and is of great concern now on the U.S. Pacific coast (if introduced, origin may be Asia or South America)

* The "phantom dinoflagellate" of North Carolina and the Chesapeake Bay system.

The 1990 Nonindigenous Species Act put into place voluntary guidelines to control the release of ballast water in the Great Lakes. These guidelines become law on May 8, 1993: vessels coming into the Great Lakes ***must have exchanged their water in the open ocean and in so doing achieved a minimum salinity of 30 ppt.*** A new 1992 law extends these guidelines to the Hudson River (the "back door" to the Great Lakes), which guidelines similarly become law in 1994.

For the rest of the United States coastlines -- Atlantic, Gulf, Pacific, Alaskan, and Hawaiian -- ballast water management has not yet taken the form of regulations. In December 1991 the U.S. Coast Guard, following the appearance of South American cholera released by ballast water in Mobile Bay, Alabama, published the IMO Guidelines in the *United States Federal Register*. In order to address the issue of ballast water management for waters other than the Great Lakes, the U.S. Congress called for three studies in the Nonindigenous Species Act: a Ballast Exchange Study (BES), a

Biological Study (BIO-S), and a Shipping Study (SS). These studies were initially due in June, 1992.

The BES addresses the impact of the release of exchanged water on the coastal zone and identifies "back up sites", other than the open ocean, where ballast water could be released without danger of introducing nonindigenous species.

The BIO-S addresses the biological, ecological, and other impacts of ship-introduced organisms around the United States.

The SS addresses the role of shipping in introducing exotic species, control options, and the relative need for regional versus national regulations.

Neither the BES nor the BIO-S were funded in 1991-1992 or 1992-1993, but funds are now being assembled to address these studies in 1993-1994 or 1994-1995. The SS began in December 1991 and the first phase was completed in December 1992. This 380 page document, produced in the laboratory of Dr J. Carlton, Maritime Studies Program, Williams College - Mystic Seaport, Mystic, Connecticut, reviews in detail the phenomenon of ships as transport vectors ("biological islands") for aquatic life. The SS places extensive emphasis on the role of ballast water and sediments, explores in detail what ballast water is and why it is used, and examines 32 options for the control and management of ballast water. The document is planned for release by the U.S. government in June or July 1993. The U.S. Coast Guard will present some of the findings of the SS at the IMO's "Marine Environmental Protection Committee" (MEPC) meeting in London in July 1993.

In independent moves, the States of California, Alaska, Washington, and Hawaii have each considered in their state legislatures the issue of ballast water. California passed legislation in late 1992 relative to reporting requirements of ships; Alaska issued a "Resolution", the Washington legislation failed to survive due to concerns about monitoring and research coasts, and legislation is now being considered in Hawaii.

In another independent move, the Lake Carriers' Association of the Great Lakes has issued plans to reduce the spread of exotic species, in particular the European fish the ruffe (*Gymnocephalus cernuus*), introduced by ballast water to Lake Superior in the 1980s, around the Great Lakes (see Appendix III-F).

Brochures on ballast water have been distributed in the Great Lakes region. A video, prepared by the United States Coast Guard, is also available and this was shown to WG delegates.

HARMFUL ALGAL BLOOMS - (HABs)

Dr Bernt Dybern gave an account of some of the research on HABs that is being carried out internationally. This has recently been studied by the Intergovernmental Oceanographic Commission (IOC) of UNESCO in cooperation with FAO owing to the fact that HABs are becoming increasingly important as nuisance organisms in many parts of the world causing harm to human health, resources and ecosystems. An Intergovernmental Panel on HABs (IPHAB) has been set up to coordinate and advise on HAB studies. This HAB program is a very extensive undertaking and will be one of the main activities of IOC. ICES is one of the many organizations participating in this program.

Dr Dybern referred to some suggestions made in ICES circles, namely to transfer the present Study Groups on the Dynamics of Algal Blooms to a Working Group on the Dynamics of Harmful Algal Blooms. It has been suggested that this Group would act as the forum for ICES activities related to HABs and to the global work coordinated by IPHAB. The WG ITMO supported the suggestions and referred to its discussions on ballast water and sediments at the present meeting which had a bearing on HABs.

It was agreed that the spread of harmful algal species might have occurred, and may still occur, through discharge of ballast water from ships. Algal cysts, and other life stages, might be spread with introductions of shellfish and other marine organisms. In this context, the work within the IMO on ballast water problems was mentioned.

The WG recommends that ICES take an active part in the global HAB program and set up an internal organization suited to both national and international work. The WG ITMO (and its Parent Committee) should be involved in relevant parts of this work.

At its next meeting, the WG will prepare a review of 1994 and proposed 1995 activities relative to the prevention of the release of non-indigenous marine organisms by ballast water and sediments between ICES member countries, and identify areas where greater cooperation and communication could facilitate such prevention.

SPECIAL REPORT FROM IRELAND

Introductions of exotic species with Pacific oyster transfers

EC Council Directive 91/67/EEC, which facilitates the trade in live fish and shellfish within the EC, was implemented in all EC countries on 1 January 1993. This Directive permits the free movement of live fish and shellfish between farms and zones of equivalent health status, transfers which previously Irish legislation had controlled.

Importations of half-grown Pacific oysters from France into Ireland have taken place since 1 January 1993. All importations were certified as being free from *Bonamia* and *Marteilia* and also free from other species. However, samples taken from consignments on arrival in Ireland revealed the presence of the parasitic copepods *Mytilicola orientalis* and *Myicola ostrea*, the slipper limpet *Crepidula fornicata* and the flat oyster *Ostrea edulis*. Although it is a species native to Ireland, there is concern that *O. edulis* spat in shipments of Pacific oysters may act as vectors of *Bonamia* and *Marteilia*. Other organisms, associated as shell epifauna, have yet to be identified.

The biomass of the importations and the frequency of *M. orientalis* and *M. ostrea* in these consignments suggest that these species may become established in areas of Irish waters where Pacific oysters are relaid. Also of great concern was the occurrence of dinoflagellate cysts in sediment associated with the imported Pacific oysters. It is not yet confirmed, but they may be cysts of a species of *Alexandrium*.

At this point in the meeting, reference was made to an ICES paper on the potential risks of introducing toxic algae with shellfish transfers (Dijkema, 1992).

As a measure to prevent further introductions of unwanted exotic flora and fauna, the Irish shellfish industry has been advised to cease the importation of seed and half-grown Pacific oysters. However, this is contrary to the terms of the Directive which is concerned primarily with disease issues.

It is extremely likely that the situation that has arisen in Ireland will be repeated in other EC countries, wherever the free trade in shellfish takes place. There may be opportunities in the future for the EC Directive 91/67/EEC to be modified but at present it is not possible to control such importations as have taken place into Ireland on disease grounds. It was noted by the WG that there is a clause within EC Directive 91/67/EEC whereby member countries might control introductions. This is Article 1, part of which states -- "This Directive shall apply without prejudice to Community or national provisions on the conservation of species." In another EC Directive 92/43/EEC, on the conservation of natural habitats and of wild fauna and flora, Article 22 (b) states that Member States shall "ensure that the deliberate introduction into the wild of any species which is not native to their territory is regulated so as not to prejudice natural habitats within their natural range or the wild native fauna and flora and, if they consider it necessary, prohibit such introduction. The results of the assessment undertaken shall be forwarded to the committee for information."

The majority of WG delegates were very concerned about the implications of an increase in free trade of live aquatic species, in respect of the co-introduction of non-target species, both within the EC and on a global scale. The WG recommends that ICES should be aware of the potential ecological impacts that may arise and that ICES should establish a dialogue with appropriate international agencies on this matter at an early stage.

PLANNED INTRODUCTIONS

Japanese seaweed, *Porphyra yezoensis*, (Maine, USA) (Appendix IV)

The WGITMO informally began examining the proposed introduction of the commercially-farmed Japanese seaweed (nori) *Porphyra yezoensis* (variety U-51) in Maine, USA, at its meeting in Helsinki in 1991. ICES received a formal request in 1992 from the State of Maine to comment on this proposal.

A private company has proposed to establish aquaculture operations in the northern State of Maine and in southern New Brunswick, Canada, with open-sea culture of this Pacific Ocean seaweed. Extensive documentation was provided to the WG in 1992. Additional documentation was independently provided by Dr I. Wallentinus (Sweden), the WG's expert phycologist.

In 1992 the WG concluded that, before advise could be offered, more information needed to be provided on the reproductive potential of this species in the Gulf of Maine, and in waters further south, and on the potential of this species to spread along the Canadian and U.S. coastlines. The WG also requested documentation that the proposed cultures of this alga were fungal-free and of any observed establishment of natural populations of this species in other culture areas outside of Japan. This advise was provided to the State of Maine through the ACMP and through the General Secretary's office.

In response to these requests, Dr I. Levine, of Coastal Plantations International, Inc., (CPI) Poland, Maine, representing the private interests involved in this introduction, presented to the WG in

Aberdeen a detailed outline of the commercial nori project, including addressing concerns raised by the WG at its 1992 meeting. Dr Levine provided for the WG's files numerous documents on *Porphyra* biology and ecology and on nori commercial operations. A statement of CPI's activities, as provided by Dr Levine, a letter from N. A. Bellefontaine of Fisheries and Oceans Canada, a letter regarding the fungal-free status of the *Porphyra* cultures, and other materials on the status of this alga in the State of Washington, and on water temperatures and currents in the Atlantic regions of concern, are presented in Appendix IV, herein. Dr Levine also showed a video of nori biology and commercial culture.

In response to the WG's questions, CPI responded as follows:

> *"Can Porphyra yezoensis escape cultivation and establish itself as a reproductively independent organism in Maine and the Canadian coastal waters?"*

Response:

"The temperature and photoperiod requirements of conchosporangial development and conchospore release are not realized in the coastal conditions of the outplant areas. Similar issues were raised in Washington State and British Columbia where Dr Sandra Lindstrom of the University of British Columbia stated that P. *yezoensis* has not escaped cultivation in Washington State nor British Columbia even though it has been cultivated on and off for nearly ten years."

> *"Considering potential modes of transport (currents, shells, ships, birds, man, and marine mammals) where could Porphyra yezoensis successfully escape cultivation and establish itself as a reproductively independent organism?"*

Response:

"Humm (1969) established phytogeographical zones along the U. S. east coast as a function of water temperature. The major transition or boundary delineations are Cape Cod, Massachusetts, Beaufort Harbor, North Carolina, and Cape Kennedy, Florida. The summer maximum temperatures of Maine and Atlantic Canada (17.5° C maximum) are significantly less than the 25 to 28 ° C necessary to induce the development of mature conchosporangia. The waters of Cape Cod approach the temperature regime necessary during the summer maximums but the photoperiod of 15+ hours would inhibit the conchosporangial development. Although the Labrador Current and southward-flowing inshore counter current might assist the transport to southern waters, the Gulf Stream and its influence would inhibit the migration south of Cape Hatteras to waters with appropriate temperatures, substrates, and photoperiod."

The WG thanked Dr Levine for his presentations and continued in private chambers for further discussion. Several members noted that under extreme or unusual conditions at the proposed sites, or at sites to where this alga could be transported, conditions for the natural establishment of *Porphyra* could nonetheless occur. These appear to be quite rare, and, even under situations where this might occur, abundances would be predicted to be low. There appears to be no evidence of

negative interactions between the cultivars of this commercial alga and other seaweeds (in Asia, Washington, France, or elsewhere). It was noted that certain exotic species requiring specific thermal regimes do at times become established in power plant thermal effluents. It was further noted that other species of introduced algae (such as the Japanese green seaweed *Codium fragile tomentosoides*) have been observed to form previously unknown physiological races adapted to temperature conditions not previously thought to be within the range of the species. These too are rare occurrences, and no ecological consequences are yet noted.

On the basis of Dr Levine's presentation, and on the basis of the discussions noted, the WG proposed to submit to the Mariculture Committee and ACME the following as proposed advise:

a) the Council does not oppose the continued development of Japanese algal (nori) culture in the State of Maine and the Province of New Brunswick, subject to continued adherence to the ICES Code of Practice, and under the culture and grow-out conditions presented to the Council.

b) the Council advises that, upon careful examination of the available scientific evidence, commercial-scale development of *Porphyra yezoensis* populations in the open sea in the Gulf of Maine may lead to rare natural reproduction. However, there appears to be limited ecological risk relative to the establishment of this species in Maine and New Brunswick.

c) the Council requests that the Working Group on Introductions and Transfers of Marine Organisms be provided with annual reports on the culture sites of this alga, on any observed reproduction in natural waters, and on any dispersal, natural or anthropogenic, that may occur.

American bay scallop, *Argopecten irradians*, in France (Appendix V)

An official request had been received by ICES from France for the introduction of the American bay scallop, *Argopecten irradians*.

Dr H. Grizel presented the case for the introduction of this bivalve. Supporting information is presented in Appendix V.

The reasons for the introduction of this species are as follows. The native scallop (*Pecten maximus*) fishery is insufficient to support market demand and 40,000 tonnes of scallop meats are imported into France each year. Also, the recently introduced Japanese scallop, *Patinopecten yessoensis*, appears to be unsuitable for commercial culture. To satisfy the demand for scallop meats and to diversify from the monoculture of oysters in France, *Argopecten* will be assessed for its potential for commercial cultivation.

Argopecten has a temperature range of 5-30° C. Gonad development occurs at temperatures above 10° C, and spawning at 15-20° C. Salinities of 21-33 ppt are suitable for growth although the optimum is 30 ppt. The growth rate is rapid, since it takes only 12-18 months for this scallop to reach 60-90 mm. Growth is best subtidally at depths of 1.5 -10 m, but this species will grow in deeper water in hanging culture. The preferred substrate for the American bay scallop in its native habitat is areas

of eelgrass *Zostera* beds. There is no threat from this species spawning and crossing with the other commercial scallop species in France, i.e. *Pecten maximus* and *Aequipecten opercularis,* because chromosome numbers are different.

Broodstock scallops will be imported from Canada or the USA into quarantine at La Tremblade and seed will be reared at the Argenton hatchery, following the ICES Code of Practice. Once the F_1 generation has been diagnosed free of diseases, etc., seed will be planted out at experimental sites.

However, the ecological risks of the introduction could not be assessed fully by the WG from the information that was available.

On the basis of Dr Grizel's presentation, and on the basis of the discussions following, the WG proposed to submit to the Mariculture Committee and ACME the following as proposed advise:

a) the Council does not oppose the continued development of Atlantic bay scallop culture in France subject to continued adherence to the ICES Code of Practice, and in the form of the importation of brood stock (based upon site visits to the USA and Canada) into quarantine and the development of F_1 generation in hatcheries.

b) the Council however recommends that further investigations be carried out relative to the potential ecological impact of the establishment of wild populations of this species in the Mediterranean and in Atlantic Europe, and relative to more precise predictions of the geographic range that this species could attain if it were to become established, and requests that such information be provided to the Working Group prior to the open sea release of this species.

In conclusion, France was requested to provide additional information for the 1994 WG meeting. This information should include an assessment of the interspecific competition between *Argopecten* and other species in the Mediterranean Sea and Atlantic waters in the event that *Argopecten* was to establish self-sustaining populations and spread along French or other coasts of ICES member states. Also, distribution maps of *Zostera* beds were to be provided since this is the preferred substrate of the American bay scallop in its native habitat.

PROJECT PREFIX: PRODUCTION AND RISK EVALUATION FOR INTRODUCED ORGANISMS

Dr Jon Side (Heriot-Watt University, Orkney) described the technique of Quantitative Risk Assessment (QRA) that is used in the field of industry for safety assessment. With modifications, he proposed that QRA might be applicable for carrying out environmental risk assessments relative to introductions and transfers of aquatic species.

Compared to the situation in industry, damage to the environment with introductions of exotic organisms is much harder to assess. Quantitative methods are difficult to apply since there are a large number of unknowns in the marine environment, but some form of numerical ranking might be used. It is extremely important to be clear about what the acceptance criteria are before any risk assessment is carried out and these criteria must include public conceptions of the proposed introduction. Project PREFIX ("Production and Risk Evaluation for Introduced Organisms", the latter being the

unknown entity X) is a program of research which aims to develop a predictive methodology for establishing environmental risks associated with marine restocking and the introduction of novel or alien organisms into marine environments.

The WG considers that there are a number of different models that have been developed and which might be applicable for evaluating proposed introductions and transfers of aquatic species. Indeed, the WG developed a risk assessment model several years ago. It is proposed that the WG will review these models at its next meeting.

GUIDELINES FOR RESEARCH TO EVALUATE THE ECOLOGICAL EFFECTS OF THE RELEASE OF GENETICALLY MODIFIED ORGANISMS (GMOs)

Doreen McGillivary, a microbial geneticist working at the SOAFD Marine Laboratory, was invited to give a short presentation on EC Directive 90/220/EEC on the deliberate release into the environment of genetically modified organisms which became effective in EC member countries on 1 February 1993. Within the requirements of this Directive, strict procedures must be followed when working with genetically modified organisms (GMOs), including carrying out a risk assessment before any release to the wild is made. Aspects that have to be considered include the potential for the transfer of genetic material from the GMO to other organisms, the phenotypic and genotypic stability of the GMO, and the GMOs potential for survival and spread, and its potential negative impacts on other organisms. Assessments have to be made of the GMOs biological and environmental requirements, and any behavioral changes compared to the unaltered organism.

Rapid advances in the field of biotechnology may soon lead to a request for the release of a GMO into the *marine* environment. A new section has been proposed for addition to the ICES Code of Practice to include the release of GMOs. The WG aims to develop guidelines for research to evaluate the ecological effects of the release of GMOs in marine environments. The WG considered that the release of a GMO would be less acceptable to the public than the release of an exotic species. For this reason the potential advantages of the GMO compared with the unmodified organism must be clearly defined and validated. Before any release is contemplated a risk assessment would have to be carried out and this would include clearly defined acceptance criteria for allowing/rejecting the release. Some form of quantitative model (e.g. Project PREFIX) might be the most suitable, with low/medium/high risk given numerical scores. Research would be essential to gather information to be entered into the predictive model.

The WG considered that guidelines for research on the release of GMOs into the marine environment should include the following:

1. Assess whether the GMO could hybridize with the unmodified organism or other species. Using triploids, wherever possible, might be considered.

2. Assess whether there are changes in the biological and ecological requirements of the GMO compared to the unmodified organism. This might include studies of food preference, food requirements, temperature range, salinity range, oxygen utilization, the reproductive cycle, life span and disease susceptibility. These studies should be carried out from small laboratory scale through to field trials, in containment at all stages. If adverse changes are detected then the trial should be abandoned or modifications made to earlier steps of the procedure.

3. Assess the benefits/risks to human health/economy/social structure/recreation and quantify human perception of the release of the GMO.

4. Characterize the environmental conditions of the release site as far as is practical (for example, measurements of biodiversity and physicochemical factors). Monitoring should continue after introduction of the GMO has taken place.

5. Assess and validate methods for controlling/eradicating the GMO prior to its release.

The WG propose to continue to develop the guidelines at its next meeting, with the intent to incorporate them in the new *Cooperative Research Report* on the 'Code of Practice'.

RECENT MEETINGS ON INTRODUCTIONS AND TRANSFERS

"EC-CIESM Workshop on Introduced Species in European Coastal Waters" in Monaco, March 2-3, 1993.

Dr Inger Wallentinus and Dr Henri Grizel had attended this meeting, the purposes of which were to review the research being carried out primarily in the Mediterranean (although other waters were included), to formulate ideas for further research, and to identify research priorities.

Introductions into the Mediterranean have occurred through the Suez Canal, through aquaculture and in ballast water. Other than the species that are of economic value, it is difficult to assess the impact that these introduced species have had. The areas of research that are being developed include listing the flora and fauna in aquaculture sites, characterizing the genetic structure of wild and cultivated populations using genetic markers, developing techniques to use species that have attained a high biomass but which at present have no commercial value, identifying ballast water introductions, and studies on the biology (morphology, physiology, genetics) of introduced species growing in the Mediterranean compared with their biology in the native habitat.

It was of great concern to the WG to hear from Dr Wallentinus that there were individuals at this workshop who were unaware of the WG ITMO or its work. It has been proposed that the profile of ICES and its role in the field of introduced species should be raised through the publication of an information booklet on the background, activities, and interests of the WG, with a copy of the 1993 Code of Practice appended, for general distribution to ICES member countries, and other interested states, and in particular to other groups involved in introductions and transfers of marine species.

"National Oceanic and Atmospheric Administration (NOAA) Nonindigenous Estuarine and Marine Organisms (NEMO) Workshop", in Seattle, April 20-22, 1993. (Appendix VI)

Dr Jim Carlton gave a report of this meeting. Although most of the 26 people at this workshop were from the US, there were representatives from Canada, Finland, Australia and Belgium. A very broad program was covered. One paper outlined a proposed study on the release of a parasitic barnacle to control the green crab *Carcinus maenas* invasion of San Francisco Bay, California, USA, but even the study has met with considerable resistance, and there are no plans for this release to proceed at

present. A general conclusion from the meeting was that good education and communication between Governments, the scientific community and the public are more effective than legislation for controlling introductions and transfers.

"OECD Workshop on the impacts on the aquatic environment arising from the introduction or escape of aquatic organisms which have been derived from modern biotechnology", Trondheim, June 9-11, 1993.

The purpose of this meeting is described in the title above, and the intention is to cover finfish, shellfish, plants and microorganisms. WG delegates, Snorre Tilseth and Sue Utting, will be attending this meeting.

Examples of studies that are underway in Norway, following the rapid expansion of fish farming in the 1980s when it was recognized that there was a lack of information on the genetic and ecological interactions between cultivated and wild organisms, were given to the WG by S. Tilseth ('Genetic and ecological interactions of cultivated and wild populations; some ongoing projects at the Institute of Marine Research, Bergen, Norway.', Appendix VII). The genetic population structure and taxonomy of marine species is being studied using genetic markers. Details of these research areas will be covered at this meeting.

Two other meetings are also being held in Norway this year:

"Sea ranching of cod and other marine fish species", June 15-18, 1993.

"Strains of Atlantic salmon", in Trondheim, October 25-27, 1993.

RECOMMENDATIONS

The following recommendations to the parent committee were formulated by the WGITMO:

1. That the "1993 Code of Practice to Reduce the Risks of Adverse Effects Arising from Introductions and Transfers of Marine Species, Including the Release of Genetically Modified Organisms" (as set forth in C.M. 1993/F:18) be presented to the Council for adoption.

2. That on the basis of the considerations of the Working Group on Introductions and Transfers of Marine Organisms on the introduction of the Japanese alga *Porphyra yezoensis*, strain U-51, by a private party to the State of Maine (USA) and to the Province of New Brunswick (Canada), member countries are advised that:

    a) the Council does not oppose the continued development of Japanese algal (nori) culture in the State of Maine and the Province of New Brunswick, subject to continued adherence to the ICES Code of Practice, and under the culture and grow-out conditions presented to the Council.

b) the Council advises that, upon careful examination of the available scientific evidence, commercial-scale development of *Porphyra yezoensis* populations in the open sea in the Gulf of Maine may lead to rare natural reproduction. However, there appears to be limited ecological risk relative to the establishment of this species in Maine and New Brunswick.

c) the Council requests that the Working Group on Introductions and Transfers of Marine Organisms be provided with annual reports on the culture sites of this alga, on any observed reproduction in natural waters, and on any dispersal, natural or anthropogenic, that may occur.

3. That on the basis of the considerations of the Working Group on Introductions and Transfers of Marine Organisms on the introduction of the North American Atlantic bay scallop *Argopecten irradians* to France, member countries are advised that:

a) the Council does not oppose the continued development of Atlantic bay scallop culture in France subject to continued adherence to the ICES Code of Practice, and in the form of the importation of brood stock (based upon site visits to the USA and Canada) into quarantine and the development of F_1 generation in hatcheries.

b) the Council however recommends that further investigations be carried out relative to the potential ecological impact of the establishment of wild populations of this species in the Mediterranean and in Atlantic Europe, and relative to more precise predictions of the geographic range that this species could attain if it were to become established, and requests that such information be provided to the Working Group prior to the open sea release of this species.

4) That ICES should be an active participant, as recommended by UNESCO/IOC, in the IOC's international program of research on harmful algal blooms (HABs), and that the WGITMO should contribute to the relevant parts of this study, particularly with reference to the role of the transportation of ballast water and sediments and the movement of shellfish stocks in the spread of phytoplankton species causing HABs.

5) That ICES should consider establishing a dialogue with international agencies, such as the European Commission, relative to the increasing movements through new trade agreements of aquatic organisms and their products, to insure that potential ecological and genetic impacts of such movements are taken into consideration, not just the prevention of the spread of disease agents.

6) That the WGITMO cooperate and work with FAO, which is planning the development of a "User's Guide" to the EIFAC/ICES Code of Practice, for use in developing countries, and that, in response to requests received from FAO, one or more members of the WGITMO attend FAO workshops on this topic.

7) That the WG on Introductions and Transfers of Marine Organisms should meet at the Williams College - Mystic Seaport Maritime Studies Program, Mystic, Connecticut, from April 20 - April 22, 1994, to,

a) complete work on a new *Cooperative Research Report* on, "A Code of Practice to Reduce the Risks of Adverse Effects Arising from the Introduction and Transfer of Marine Organisms: Guidelines and a Manual of Procedures"

b) prepare a review of 1994 and proposed 1995 activities relative to the prevention of the release of nonindigenous marine organisms (such as phytoplankton species causing harmful algal blooms, but including other algae, invertebrates, and fish) by ballast water and ballast sediments to and between ICES member countries, and to identify areas where greater cooperation and communication could facilitate such prevention

c) prepare a condensed information booklet, apart from a Cooperative Research Report, for general distribution to ICES member countries, and particularly to other groups involved in the introductions and transfers of marine species, on the background, activities, and interests of the WGITMO, with a copy of the 1993 Code of Practice appended, to respond to increasing requests for information about ICES activities in this field

d) to continue to develop guidelines to evaluate the ecological effects of the release of genetically modified organisms (GMOs) in marine environments, with the intent to incorporate such guidelines in the new *Cooperative Research Report* on the "Code of Practice"

e) to prepare a review in the form of detailed case histories, tracing the initiation, discussions, and subsequent developments, of major WG deliberations on intentional introductions and transfers, in order to provide an overview of the role of ICES in such deliberations and to provide guidance for those contemplating future introductions and transfers

f) to begin a review of different models (risk assessments, decision pathways, and other systems) which have been developed for evaluating proposed and contemplated introductions and transfers

g) to consider the progress on WG activities relative to cooperation with FAO on the development of a "User's Guide to the Code of Practice" in developing countries

h) to consider the summary report from France on the introduction of the Japanese kelp Undaria pinnatifida, including ecological considerations and environmental impacts, as called for reporting in 1994 by C. Res. 1989/4:4:d

i) to report on the current status of fish, shellfish, algal, and other introductions in and between ICES Member Countries

BIBLIOGRAPHY

The combined bibliographies for the main body of the Report and for all of the National Reports are found at the end of Appendix II.

APPENDIX I.

ICES Working Group on Introductions and Transfers of Marine Organisms
Aberdeen, Scotland, April 26 - 28, 1993

FIFTEENTH ANNIVERSARY MEETING

Scottish Office Agriculture and Fisheries Department
Marine Laboratory, Victoria Rd., Aberdeen

AGENDA

26 April 1993 Monday — 9:00

Opening Session

~ Welcoming Comments by Chair

~ Introduction of Participants

~ Welcoming Comments by Representatives of the Marine Labora

~ Review of Agenda

* WG Report Deadline: **May 17, 1993**

~ Review of 1992 WGITMO Handbook

~ Addenda/Errata for 1992 Lisbon Report

~ Recommendations from 1992 Lisbon meeting:
Reference: Blue-covered "Extracts from ICES Annual Report 1992"

(1) Decision regarding WG's Parent Committee
Dr B. Dybern

(2) Revised **1993** Code of Practice (addition of "Genetically Modified Organisms" section and other changes)
> Update on co-ordination with FAO/EIFAC
Dr J. Carlton

(3) New *Cooperative Research Report*, "A Code of Practice to Reduce the Risks....." Reference: Lisbon Report, p
Dr J. Carlton (Editor)
Dr D. Minchin (Model Example)
Dr A. Munro (Finfish Pathology)
Dr H. Grizel (Invertebrate Pathology)
Dr I. Wallentinus (Algal Pathology)
Dr R. Saunders (Genetics)

~ "1990 Summary of Introductions and Transfers in ICES Member Countries", a new *Cooperative Research Report*

Dr A. Munro (Editor)

~ "Workshop to Create a User Manual to Facilitate Implementation of the ICES/EIFAC Codes...": FAO, Manila, Philippines, 12-16 July 1993
Dr J. Carlton

26 April 1993
Monday

~ NATIONAL REPORTS and Literature Dissemination (Begin)
Please note:

> Ballast Water Reports are at 4:00 PM today.
> Special Status Reports are at 2:00 PM today.

Canada	Norway
Denmark (*)	Poland (*)
Finland (*)	Spain (*)
France	Sweden
Germany	U.K.
Ireland	U.S.A.

(* = Report provided by Mail)

10:30 Coffee Break

11:00 Reconvene Morning Session

~ NATIONAL REPORTS (Continue)

12:00 Lunch

2:00 Convene Afternoon Session

~ NATIONAL REPORTS (Continue if necessary)

Special Status Reports: (15 minutes each)

~ Ireland: Japanese Scallop Patinopecten
Dr D. Minchin

~ Mediterranean Europe: Invasion of the Alga *Caulerpa taxifolia* **VIDEO PRESENTATION**
Dr I. Wallentinus

~ Black Sea and Mediterranean: Invasion of the North American Atlantic Comb Jelly *Mnemiopsis leidyi*, and concerns for invasion into the Baltic Sea
Dr J. Carlton

~ France: Introduction of Japanese Kelp *Undaria pinnatifida*
Dr H. Grizel

3:30 Coffee Break

26 April 1993
Monday

4:00 Reconvene Afternoon Session

BALLAST WATER REGULATIONS AND PROCEDURES

General Introduction: Ballast Water and Sediments and the Introduction of Non-Indigenous Aquatic Organisms, Including the Role of Ballast Water Discharge in the Spread of Toxic Marine Phytoplankton (Harmful Algal Blooms [HAB's])
Dr J. Carlton, Dr B. Dybern

Canada
Canadian Ballast Water Studies: Pollutech Report and Update on Ballast Water Exchange Reports (BWERs)
Dr R. Randall

Finland
Report provided by mail
Ms. R. Rahkonen

Germany
Invasion of Non-Indigenous Marine Species into the North and Baltic Sea via Ships Ballast Water: Investigations on the Ecological Threat
Drs. S. Gollasch and M. Dammer

Ireland
Dr D. Minchin

Norway
Dr S. Tilseth

Poland
Report provided by mail
Drs J. Wiktor and W. Pelczarski

Sweden
Drs B Dybern and B. Holmberg

U.K.
Ballast Water -- Current Procedures and Research Proposals
Dr S. Utting

U.S.A.
The National Biological Invasions Shipping Study (NABISS), and Other Ballast Water Activities in the U.S. **VIDEO PRESENTATION**
Dr J. Carlton

5:30 Adjourn

Dinner

27 April 1993
Tuesday

9:00 Convene Morning Session

~ Discussion of Place & Time for 1994 Meeting

~ *Special Report from Ireland*
Introductions of Exotic Species Associated with Pacific Oyster Transfers from France to Ireland (a paper by D. Minchin, C. B. Duggan and J.M.C.Holmes)
Dr D. Minchin

10:30 Coffee break
GROUP PHOTO for the *ICES/CIEM Information Newsletter* to note the occasion of the 15th Anniversary Meeting of the Working Group

11:00 Reconvene Morning Session

~ The Proposed Introduction of the American Bay Scallop Argopecten irradians to France
Dr H. Grizel

Questions, Answers, and Comments session

~ The Proposed Introduction of the Japanese Red Seaweed (Nori) *Porphyra yezoensis* to the Atlantic coast of North America **VIDEO PRESENTATION**
Dr I. Levine (Coastal Plantations International, Maine)

~ Questions, Answers, and Comments session

12:00 Lunch

2:00 Convene Afternoon Session

~ PROJECT PREFIX: Production and Risk Evaluation for Introduced Organisms
Dr J. Side (Heriot-Watt University, Orkney)

~ On the Release of Genetically Modified Organisms
Dr D. McGillivary (Aberdeen)

3:30 Coffee Break

4:00 Reconvene Afternoon Session (*next page please*)

Recent Meetings on Introductions and Transfers:

~ "EC-CIESM Workshop on Introduced Species in European Coastal Waters": Monaco, March 2-3, 1993
Dr I. Wallentinus, Dr H. Grizel

		~ "National Oceanic and Atmospheric Administration (NOAA) Nonindigenous Estuarine and Marine Organisms (NEMO) Workshop": Seattle, April 20-22, 1993 **Dr J. Carlton**
		~ "OECD Workshop on the impacts on the aquatic environment arising from the introduction or escape of aquatic organisms which have been derived through modern biotechnology": Trondheim, June 9 - 11, 1993 **Dr S. Tilseth**
		~ Other meetings
	5:45	Adjourn
	7:30	Reception (Dr A. Munro)
28 April Wednesday	9:00	Convene Morning Session
		~ Develop guidelines for research to evaluate the ecological effects of the release of genetically modified organisms in marine environments Break into two discussion groups to meet simultaneously for one hour each
		~ Reports of Discussion Groups and Group Discussion
		~ Conclude Any Remaining Business
		~ Presentation and Discussion of Recommendations
	10:30	Coffee break (15 minutes)
	10:45	Reconvene Morning Session ~ Distribution of Draft Recommendations ~ Principal agenda items for 1994 WG meeting ~ Time and place for 1994 WG meeting
	11:45	Concluding remarks by Chair
	12:00	**ADJOURN**

APPENDIX II.

NATIONAL REPORTS

ICES WORKING GROUP ON INTRODUCTIONS
AND TRANSFERS OF MARINE ORGANISMS

Aberdeen - 26-28 April 1993

Annual Report for **CANADA**

1.0 LAWS AND REGULATIONS

Fish Health Protection Regulations

Drafting of amendments to the Fish Health Protection Regulations and the Manual of Compliance is nearing completion. The Regulations will provide the powers needed to ensure protection of fish health (eg. requirement for notification of diseases, and powers to inspect and test fish, impose quarantine and isolation, and prohibit imports because of disease emergencies in certain areas of Canada or other countries). The present regulations will also be expanded to cover all finfish (not only salmonids) and shellfish (molluscs and crustaceans).

The Manual of Compliance for Finfish will have new sections describing national and regional fish disease monitoring and protection programs, quarantine and isolation procedures, emergency fish disease control and eradication procedures, and guidelines for quality control and quality assurance in diagnostic laboratories. The Manual of Compliance for Shellfish is still in the drafting stage, but will closely parallel the Manual for Finfish.

It is expected that the amended Regulations, as they apply to finfish, will be implemented in 1994.

Draft Policy on Introductions of Genetically Modified Organisms

The Department of Fisheries and Oceans (DFO) has prepared a draft document entitled "Transgenic (Genetically Modified) Aquatic Organisms: Policy and Guidelines for Research with, or Use in Natural Ecosystems in Canada". The policy was prepared because of concerns that transgenic aquatic organisms released to the wild could have an impact on fisheries resources. Appendices to the policy specify the information required in proposals to conduct research with or release transgenic aquatic organisms, guidelines for containment of transgenic organisms in research facilities, and protocols for the review and approval of proposals dealing with transgenics.

DFO is now consulting with other government agencies and interested parties (universities, hospitals, aquaculture associations, and sport and commercial fishing associations) on the contents of the policy. The policy should be finalized and implemented in 1994.

Ontario Regulation - River Ruffe

In 1992, a new regulation was proposed under the Ontario Fishery Regulations (which come under the federal Fisheries Act). The purpose of the regulation is to prohibit the possession of ruffe, *Gymnocephalus cernuus*, except for the purpose of submitting specimens to Ministry of Natural Resources offices. This regulation has yet to come into effect.

Procedure for Range Extensions - Ontario

A procedure was developed by the Ministry of Natural Resources in Ontario to minimize the impacts of range extensions (i.e. stocking of fish which are present in Ontario, but not in the receiving waterbody).

The procedure, which is a supplement to Ontario's evaluation requirements under the Environmental Assessment Act, stipulates that other jurisdictions potentially affected by a proposed range extension must be consulted prior to proceeding with the stocking program.

National Introductions and Transfers Policy

A National Working Group on Introductions and Transfers of Aquatic Organisms has been established by DFO to develop a national policy on introductions and transfers. The first meeting of the Working Group will be held in Ottawa on 6-7 July, 1993.

The intention is to finalize the national policy by 1994, and then incorporate the policy into a regulation.

2.0. DELIBERATE RELEASES

2.1 Fish

Table 1. Deliberate introductions and releases of fish in Canada in 1992. These fish were used for stocking and for aquaculture.

Species/Receiving Province	No. of eggs/fish	Source
Rainbow Trout (*Oncorhynchus mykiss*)		
Prince Edward Island	75,000 eggs	Quebec
Prince Edward Island	20,000 fish	New Brunswick
Prince Edward Island	25,000 fish	Prince Edward Island
New Brunswick	100,000 eggs	Ontario
New Brunswick (all female)	25,000 eggs	Prince Edward Island
New Brunswick (all female)	85,000 eggs	Quebec
Nova Scotia	200,000 eggs	Ontario
Nova Scotia (all female)	525,000 eggs	Ontario
Nova Scotia (all female)	10,000 fish	New Brunswick
Nova Scotia (triploid)	150,000 eggs	Quebec
Nova Scotia (triploid)	100,000 eggs	Saskatchewan

Newfoundland	218,500 eggs	Ontario
Newfoundland	150,000 eggs	Quebec
Newfoundland	6,700 fish	Quebec
Newfoundland	59,500 fish	Prince Edward Island
Arctic Charr (*Salvelinus alpinus*)		
Prince Edward Island	35,000 eggs	New Brunswick
New Brunswick	51,000 eggs	Manitoba
Nova Scotia	10,000 eggs	Prince Edward Island
Nova Scotia	30,000 fish	New Brunswick
Newfoundland	120,400 eggs	Manitoba
Ontario	30,000 eggs	Manitoba
Brook Trout (*Salvelinus fontinalis*)		
Prince Edward Island	21,000 fish	Prince Edward Island
New Brunswick	105,000 eggs	Prince Edward Island
New Brunswick	485,000 eggs	Quebec
New Brunswick	110,000 eggs	Maine, USA
New Brunswick	230,500 fish	Prince Edward Island
New Brunswick	20,000 fish	Quebec
Nova Scotia	10,000 eggs	Prince Edward Island
Nova Scotia	50,000 eggs	Quebec
Atlantic Salmon (*Salmo salar*)		
Prince Edward Island	30,000 eggs	New Brunswick
Prince Edward Island	243,239 fish	Prince Edward Island
New Brunswick	10,500 eggs	New Brunswick
New Brunswick	1,134,539 fish	New Brunswick
New Brunswick	385,000 fish	Maine, USA
Nova Scotia	450,000 eggs	New Brunswick
Nova Scotia	198,100 fish	Nova Scotia
Newfoundland	250,000 eggs	New Brunswick
Newfoundland	80,000 fish	New Brunswick
Ontario	60,000 eggs	Nova Scotia
Lake Trout (*Salvelinus namaycush*)		
Ontario	70,000 eggs	New York, USA

New Brunswick regularly stocks brook trout, sea trout, lake trout, landlocked salmon and splake. Some of the brook trout are imported from Maine.

2.2 Invertebrates

Oysters were transferred from Prince Edward Island to Nova Scotia and from New Brunswick to Prince Edward Island. Seed oysters were transferred from Nova Scotia to Prince Edward Island and

blue mussels were shipped from Prince Edward Island to New Brunswick for experimental grow out. Giant sea scallops (*Placopecten magellanicus*) from Newfoundland were moved as seedstock (spat) to Nova Scotia (2.9 million), New Brunswick and Quebec for experimental aquaculture and growout.

3.0 ACCIDENTAL INTRODUCTIONS AND TRANSFERS

3.1 Fish

Ruffe, *Gymnocephalus cernuus*

The ruffe was introduced into North America during the 1980s, probably through the ballast water of a seagoing vessel. This species has no value as a recreational fish and is often considered a pest or a serious problem because it can become abundant and impact on native species. In Canadian waters, seven specimens were captured at Thunder Bay, Ontario, in 1991. None have been found in 1992 during surveillance surveys and none have been found in the lower Great Lakes.

Canada is represented on the United States Ruffe Control Committee, and a draft ruffe control program has been prepared. The program includes range reduction, ballast water management, population investigation, surveillance, predator evaluation and public education.

3.2 Invertebrates

Update on the Zebra Mussel, *Dreissena polymorpha*

Unlike its range expansion into the United States, the zebra mussel has had a limited expansion north from the Great Lakes into adjacent Canadian watersheds. However, populations now occur in all sections of the Trent-Severn canal which links Lake Ontario and Georgian Bay (adjacent to Lake Huron). The Trent-Severn system includes the Kawartha Lakes and Lake Simcoe.

The Ontario Ministry of Natural Resources (OMNR) is the lead agency in the Ontario Zebra Mussel Program. The program emphasis is on communications, research and impact assessment.

Communications are aimed at increasing public awareness of the problem and procedures to reduce the spread of zebra mussels. Impact assessment focuses on the effects of zebra mussels on walleye (*Stizostedion vitreum*) spawning in Lake Erie and lake whitefish (*Coregonus clupeaformis*) spawning in Lake Ontario. Researchers are investigating the use of traditional spawning grounds, egg deposition, survival rate, and feeding inter-relationships between young fish and zebra mussels. Distribution and abundance of zebra mussels are being monitored to determine their impact on fish communities.

Eight projects to study control of zebra mussels are underway. There is a catalogue of research projects being done on zebra mussels in Ontario, with a list of contacts.

The federal Department of Fisheries and Oceans is conducting research on the ecological impacts of zebra mussels in the Great Lakes ecosystem. Research during 1992 included:

(a) Studies on the interactions of zebra mussels with zooplankton food webs in Lakes Erie and

Ontario.

(b) Benthic community shifts on nearshore shoals and midlake soft bottom habitats.

(c) Modelling of nutrient shifts due zebra mussel invasions of nearshore bays.

(d) Projected population sizes in the inland Kawartha lakes and spawning selection.

(e) Egg survival of walleye and lake trout on mussel-colonized shoals.

A New Invasive Species of Mussel in the Great Lakes

A dreissenid mussel, genetically different from the zebra mussel, has been found in the Great Lakes. This "quagga" mussel is common in Lake Erie, Lake Ontario and the St. Lawrence River. The identity of the "quagga" is unresolved, but it is likely from the Black/Caspian Sea region. It is more tolerant of cooler and deeper water than the zebra mussel.

4.0 LIVE IMPORTS

4.1 Fish

Table 2. Live imports of fish into Canada during 1992, for research or for human consumption.

Species/Receiving Province	No./wt. of eggs/fish	Source
Carp (*Cyprinus carpio*)		
Ontario	100,223 kg	USA
Brown Bullhead (*Ictalurus nebulosus*)		
Ontario	3,175 kg	USA
Pacu (*Piaractus brachypoma*)		
Ontario	454 kg	USA
Tilapia (*Tilapia* sp.)		
Ontario	45 kg	USA
Rainbow Trout (*Oncorhynchus mykiss*)		
New Brunswick	12,000 eggs	Manitoba
New Brunswick	2,000 fish	Ontario
Nova Scotia	13,000 fish	Ontario
Arctic Charr (*Salvelinus alpinus*)		
Ontario	500 fish	New Brunswick

4.2 Invertebrates

Blue mussels (*Mytilus edulis*) were imported from Ireland for processing evaluation on Prince Edward Island. The mussels were held in quarantine until processed. A health check revealed the presence of four parasites previously unrecorded in Canadian mussels (*Mytilicola*-like copepod; *Steinhausia mytilovum*, a microsporidian of mussel ova; *Nematopsis*-like gregarine cysts and a *Proctoeces*-like digenean flatworm) were found. All of the mussels were processed and waste was disposed of

according to guidelines set by the Prince Edward Island Introductions and Transfers Committee.

Adult sea urchins were imported by the federal Department of Environment to Nova Scotia from California, USA, to provide gametes for bioassays. The organisms were held in quarantine. Transfers of the following species were requested:

Pacific Purple Sea Urchin (*Strongylocentrotus purpuratus*)	110 adults
Green Sea Urchin (*Strongylocentrotus droebachiensis*)	60 adults
White Sea Urchin (*Lytechinus pictus*)	30 adults

5.0 LIVE EXPORTS

No live aquatic organisms were reported as exported from eastern Canada to other ICES member countries.

6.0 PLANNED INTRODUCTIONS

6.1. Fish

Prince Edward Island plans to continue importing rainbow trout and Arctic char from other provinces in Canada for use in commercial aquaculture.

Newfoundland plans to import all-female triploid rainbow trout and Atlantic salmon eggs in 1993.

6.2 Invertebrates

The use of bay scallops (*Argopecten irradians*) should increase in the Maritime Provinces now that a moratorium on their culture in open waters around Prince Edward Island has been lifted. The moratorium was lifted because studies showed that bay scallop parasites are not transmitted to five commercially important native bivalve species. Bay scallops are presently cultured along the Atlantic and Gulf of St. Lawrence coasts of Nova Scotia. In 1993, New Brunswick will introduce bay scallops into its Gulf of St. Lawrence waters for aquaculture. Commercial facilities in the Maritimes should satisfy all of the region's requirements for bay scallop spat.

7.0 MEETINGS

Canadian scientists participated in the following meetings and conferences:

Ruffe Control Committee meeting, Superior, Wisconsin, September, 1992

Third International Zebra Mussel Conference, Toronto, Ontario, February 1993.

US Aquatic Nuisance Species Task Force, Great Lakes Region Meeting, Ann Arbor, November, 1992

US Aquatic Nuisance Species Task Force, National Meeting, Ann Arbor, November, 1992

Report Prepared by: T. Carey, M. I. Campbell, and R. Randall

ICES WORKING GROUP ON INTRODUCTIONS
AND TRANSFERS OF MARINE ORGANISMS

Aberdeen - 26-28 April 1993

Annual report for **DENMARK**

1.0 LAWS AND REGULATIONS

During 1992, Danish legislation has been revised in order to comply with the EEC Council Directive 91/67 on marketing of aquaculture animals and products and import of these from third countries.

2.0 DELIBERATE RELEASES

2.1 Fish

The following numbers of fish have been released for restocking purposes in marine waters:

700,000 brown trout (*Salmo trutta*), 3.8 million eel (*Anguilla anguilla*), 19,000 cod (*Gadus morhua*), 150,000 turbot (*Scophthalmus maximus*) and 217,000 plaice (*Pleuronectes platessa*).

The eels were imported as elvers from France and the United Kingdom and reared in eel farms with recirculation systems until they reached 5-10g. Before release, a subsample of the eel stock was examined for the presence of detectable viruses (e.g., EVEX, EVA, VHS) and for swimbladder nematodes (*Anguillicola* sp.). If any of these agents were isolated the release was abandoned. Eels were released into fresh- and marine waters.

For mariculture, 2 million rainbow trout (*Oncorhynchus mykiss*) were transferred from freshwater farms to net cages at sea.

3.0 ACCIDENTAL INTRODUCTIONS

3.3 Algae and Higher Plants

Further spread of *Sargassum* has occurred in the Kattegat area.

4.0 LIVE IMPORTS

4.1 Fish

Eggs from turbot and sea bass (*Dicentrarchus labrax*) were imported from France for hatching and farming purposes.

In addition, elvers (approximately 8 tonnes) were imported from France and the UK mainly for farming purposes. Some of these were released for restocking purposes, as mentioned above. All eel farming in Denmark takes place in recirculation systems.

For the production of turbot for restocking, eggs originating from the North Sea turbot stock were imported from Norway.

Sturgeon hybrids (*Acipenser* sp.) eggs, larvae (10,000) and fingerlings (20,000) were imported from Russia for farming in recirculation systems.

Salmon smolts were imported from Sweden for restocking.

5.0 LIVE EXPORTS

5.1 Fish

Turbot juveniles were exported to Spain for aquaculture purposes.

Seed eels for farming purposes were exported to Germany and the Netherlands.

6.0 PLANNED INTRODUCTIONS

6.1 Fish

Import of elvers from France and the UK for eel farming purposes.

Report prepared by: S. Mellergaard

ICES WORKING GROUP ON INTRODUCTIONS AND TRANSFERS OF MARINE ORGANISMS

Aberdeen, Scotland 26-28 April 1993

Annual Report for **FINLAND**

1.0 LAWS AND REGULATIONS

To prevent the spread of the monogenean *Gyrodactylus salaris* to Atlantic salmon stocks, the transfer of live fish to the water systems flowing into the Arctic Ocean from other parts of the Finland has been permitted only with the authorization of the Veterinary Department since 1987. The latest decision is from 1990 (Decision of Ministry of Agriculture and Forestry No 470/1990), and it is now under revision. Also the transfer of live fish, fertilized roe and milt from the water systems flowing into the Atlantic Ocean and the Arctic Ocean to other water systems in Finland will be authorized to prevent the spread of the virus and bacterial diseases to Finland. The revised decision will come into force in spring 1993.

2.0 DELIBERATE RELEASES

2.1 Fish

As in 1991, the veterinary authorities allowed the import of elvers (113 000) from Swedish quarantine. The elvers have been released into inland waters in southern Finland.

As in 1991, the eggs of signal crayfish (*Pacifastacus leniusculus* Dana) have been imported from Sweden during 1992 and have been released as one summer old young into inland waters in southern Finland.

4.0 LIVE IMPORTS

4.1 Fish

None apart from aquarium fish.

4.2 Invertebrates

As in previous years, aquarium shops and some restaurants and stores import live marine animals such as oysters, lobsters and crabs for sale or consumption and this is permitted without the authorization of the Veterinary Department, because it is obvious that they do not survive in natural Finnish waters. Authorization is needed for imports of live freshwater crayfish. Crayfish are mainly imported from the Soviet Union and USA, and they have to be cooked before sale for consumption (soon after arriving in the country).

4.3 Algae and Higher Plants

None apart from aquarium plants.

5.0 LIVE EXPORTS

5.1 Fish

Fertilized eggs of rainbow trout have been exported to hatcheries in Russia (Karelia, Kola Peninsula) and Chile. Live rainbow trout fingerlings have been exported to hatcheries in inland waters in Karelian Russia. Fertilized eggs of the grayling (*Thymallus thymallus* (L.)) have been exported to France.

6.0 PLANNED INTRODUCTIONS

6.1 Fish

The eel is one of the Finland's native fish species, but without stocking it will disappear, because of dams at the river mouths. It is planned to import eel fry annually from quarantine in Sweden.

No action has been taken on last year's report on plans to import fertilized roe of rainbow trout for the selective breeding program and neither to import of sheatfish (*Silurus glanis* L.) from Sweden or Russia.

6.2 Invertebrates

As in 1991 and 1992, fertilized eggs of signal crayfish are needed for stocking purposes from Sweden. No action has been taken on last year's report on plans to import some new stocks from the northern USA for improvement and experimental stocking.

Report prepared by: R. Rahkonen

ICES WORKING GROUP ON INTRODUCTIONS
AND TRANSFERS OF MARINE ORGANISMS

Aberdeen, Scotland 26-28 April 1993

Annual Report for **FRANCE**

1.0 LAWS AND REGULATIONS

The EC Directive 91/67 relative to the transfer of aquaculture animals came into effect on 1 January 1993. One important point to note is that exchange of *Crassostrea gigas* from non-approved areas to approved areas is allowed. The agreement is based on the absence of two protozoan diseases, *Marteilia refrigens* and *Bonamia ostreae*, of the flat oyster, *Ostrea edulis*.

The ICES recommendations are well known in France and are applied more and more. Application from the Mediterranean countries could be possible (discussion with CIESM).

2.0 DELIBERATE RELEASES

2.1 Fish

Salmo salar smolts were imported from Norway (200,000) and from Ireland (100,000) by one farm.

No importation of coho salmon occurred in 1992. Exchanges of white fish (sea bass and sea bream) have increased from France to Greece, Italy and North African countries. There was increased interest in turbot with exports from France to Galicia, Spain and imports to France from the Isle of Man.

4.0 LIVE IMPORTS

4.1 Fish: (see above)

5.0 LIVE EXPORTS

5.1 Fish: (see above)

6.0 PLANNED INTRODUCTIONS

6.2 Invertebrates

Oysters (*Crassostrea virginica*): As indicated last year, an experimental introduction of broodstock (provided by S. Utting from the Fisheries Laboratory, Conwy, UK) was carried out. Broodstock went into quarantine. After checking for diseases, 4 male and 4 female oysters produced 1,830,000 D-larvae. After 41 days of rearing in the micronursery, 640,000 juveniles were transferred in September to the nursery in Bouin. In December, the average size was 7 mm (87% of the population). Growth stopped below 13° C. The experiment continues.

Scallops (*Argopecten irradians*): An official request to introduce this species into France was submitted to ICES Headquarters in time for the WGITMO annual (1993) meeting.

Report prepared by: H. Grizel

ICES WORKING GROUP ON INTRODUCTIONS
AND TRANSFERS OF MARINE ORGANISMS

Aberdeen, Scotland 26-28 April 1993

Annual Report for **IRELAND**

1.0 LAWS AND REGULATIONS

EC Directive 91/67 came into effect 1 January 1993.

2.0 DELIBERATE RELEASES

2.1 Fish

Rainbow trout eggs from Northern Ireland (4,055,000), Isle of Man (120,000), and Denmark (1,000,000). Atlantic salmon eggs from Scotland (2,880,000), Northern Ireland (800,000). Arctic charr eggs from Sweden (140,000).

Turbot juveniles from the Isle of Man (22,500), and Scotland (12,000). Rainbow trout fingerlings and fry (290,000) and Atlantic salmon fry and parr (250,000) from Northern Ireland.

2.2 Invertebrates

Abalone *Haliotis discus hannai*: No importations in 1992. F1 individuals have been distributed to hatcheries on the south and west coasts. An F2 generation was produced at the Shellfish Research Laboratory, Carna in 1992. Adults are ongrown within mesh containers in the sea or in raceways.

Abalone *Haliotis tuberculata*: No importations in 1992. These have been in cultivation for some years, with several generations having been produced. They are being ongrown at the same locations as *H. discus hannai.*

Abalone are currently ongrown in Carna, Newquay, Clifden, Westport on the west coast of Ireland and Bere and Clear Islands on the south coast.

Manila Clam *Ruditapes semidecussata (= Tapes philippinarum)*: This species is presently cultivated on all Irish coasts. Seed was produced in Irish hatcheries and supplemented with importations from Guernsey (100,500), UK (910,000) and Norway (12 million).

Oyster *Crassostrea gigas*: Cultivation takes place on all Irish coasts and production exceeds that of the native oyster. Seed is produced by Irish hatcheries but a significant amount was imported from Guernsey (23 million), UK (52 million) and Norway (4 million).

Japanese Scallop *Patinopecten yessoensis*: 75 are in longline culture off the SE Irish coast.

3.0 ACCIDENTAL INTRODUCTIONS AND TRANSFERS

3.2 Invertebrates

The slipper limpet *Crepidula fornicata*, the parasitic copepods *Myicola orientalis* and *Mytilicola orientalis* and the polychaete worm *Terebella lapidaria* have been released into Irish waters with half-grown Pacific oysters from France; in addition an anthozoan and a serpulid polychaete worm which were not known previously in Irish waters were released.

3.3 Algae and Higher Plants

Dinoflagellate cysts were found with sediments associated with introduced half-grown French Pacific oysters.

3.4 Parasites, Pathogens and Other Disease Agents - (please see 3.2)

5.0 LIVE EXPORTS

5.2 Invertebrates:

Native oysters (*Ostrea edulis*) and Pacific oysters are exported for direct consumption, the majority to France. Abalone, *Haliotis tuberculata*, were exported to Guernsey, Channel Islands for part of a re-stocking programme and to Israel for experimental purposes.

Lobsters (*Homarus*), velvet crabs (*Macropipus puber*) and green crabs (*Carcinus maenas*) were exported to continental Europe.

Small numbers of sea urchins were exported to France by air.

Report prepared by: D. Minchin

ICES WORKING GROUP ON INTRODUCTIONS
AND TRANSFERS OF MARINE ORGANISMS

Aberdeen - 26-28 April 1993

Annual report for **NORWAY**

1.0 LAWS AND REGULATIONS

A law on "genetechnology" passed parliament in 1992.

2.0 DELIBERATE RELEASES

2.1 Fish

The stock enhancement program on cod continued in 1992 in the counties Hordaland 5000 fry released, Trøndelag 13000 fry released, Nordland 40000 fry released and Troms 40000 fry released. The fry were vaccinated and tagged prior to release.

A sea ranching program on arctic char started in the county of Finnmark where 52000 hatchery reared smolts were released in the river Hals and in the county of Troms where 3000 smolts were released in the River Møkkeland.

Hatchery reared salmon smolts were released for sea ranching purposes. In the river Opløy, 140000 smolts of the Namsen stock were released. On the island Vega 92300 smolts of the river Vefsna stock were released. Both in Nordland county. On the island Sotra in Hordaland county a total 39000 smolts of the rivers Vosso, Dahle and Lohne stocks were released.

2.2 Invertebrates.

The stock enhancement program on lobster was continued in the area of Kvitsøy, Rogaland county, 38000 lobster fry were hatchery produced, tagged and released.

In 1961 to 1969 the All-Union Research Institute of Marine Fisheries and Oceanography (VNIRO); Moscow USSR, released 2500 5 to 15 year specimens of the Kamchatka king crab *Paralithodes camtschatica* and 10,000 juveniles 1 to 3 years old in the Barents Sea. In 1992 more than 200 specimens were reported in gillnet catches in the Varangerfjord in Finnmark county. One specimen weighed 5 kilos. Some of the specimens were egg-bearing females. One specimen was positively identified as a Kamchatka king crab as far west on the Finnmark coast as Honningsvåg. This crab was also found in the 1980s in fewer numbers.

3.0 ACCIDENTAL INTRODUCTIONS AND TRANSFERS

3.3 Algae and Higher Plants.

Sargassum muticum has now established itself on the West Coast of Norway. Attached specimens have been identified in Skogsvåg on the island of Sotra west of Bergen. (T. Lein, Univ., of Bergen,

pers. comm.).

4.0 LIVE IMPORTS

4.1 Fish.

Sea bass, 5,5 mill eggs from France.
Tilapia, 1000 juveniles from Scotland for research purposes.

4.2 Invertebrates.

Live import of 5.0 ton lobsters from Scotland and 16.1 ton from Shetland for direct consumption. 6.5 ton lobster imported from Scotland and 20 ton from Orkney stored in sea water for later consumption.

Crassostrea gigas from France, numbers not known.

5.0 LIVE EXPORTS

Spats of *Crassostrea gigas* and *Ostrea edulis*, numbers not known.
Sea urchins *Strongylocentrotus droebachiensis*, 500,000 specimens.
Turbot fry to Spain, numbers not known.
Sea bass to France, numbers not known.

7.0 MEETINGS

OECD Workshop on the impacts on the aquatic environment arising from the introduction or escape of aquatic organisms which have been derived through modern biotechnology. Trondheim, Norway, June 9-11, 1993.

Report prepared by: S. Tilseth

ICES WORKING GROUP ON INTRODUCTIONS
AND TRANSFERS OF MARINE ORGANISMS

Aberdeen - 26-28 April 1993

Annual report for **POLAND**

1.0 LAWS AND REGULATIONS

There are no special regulations or laws concerning the introduction and transfer of marine organisms.

2.0 DELIBERATE RELEASE

2.1 FISH

524,200 sea trout smolts, cultured from eggs of wild sea trout, have been released into the Gdansk Bay and 358,000 salmon fry were released into the rivers of northern poland (mainly the Slupia River). Salmon eggs came from broodstock kept in sea cages in Puck Bay.

4.0 LIVE IMPORTS

4.1 Fish

1,000 kg of eel (montee) were imported for release into Vistula Lagoon (500 kg) and the Gulf of Szczecin (500 kg).

6.0 PLANNED INTRODUCTIONS

6.1 Fish

In 1993, the Sea Fisheries Institute is planning to release about 200,000 whitefish (*Coregonus lavaretus*) fry into the Gdansk Bay as an enhancement of whitefish stock which is almost extinct there at the present. The whitefish eggs came from spawners caught in the Gulf of Szczecin. Also, 945,000 sea trout smolts will be released into the Polish EEZ.

7.0 MEETINGS

A poster showing progress with salmon introduction in the Polish EEZ was presented in the Session of Polish Hydrobiology Committee held in Gdansk in 1992.

Report prepared by: J. Wiktor and W. Pelczarski and provided by Z. S. Karnicki

ICES WORKING GROUP ON INTRODUCTIONS
AND TRANSFERS OF MARINE ORGANISMS

Aberdeen - 26-28 April 1993

Annual report for **SPAIN**

2.0 DELIBERATE RELEASES

2.3 Algae and Higher Plants

Experiments are being carried out in relation to the farming productivity of the introduced Japanese kelp *Undaria pinnatifida* in open waters of a few Galician localities (northwest region of the Iberian Peninsula). These studies are being financed by the local government and different universities, and different universities and the Instituto Espanol de Oceanografia are collaborating with them.

3.0 ACCIDENTAL INTRODUCTIONS AND TRANSFERS

The situation with the numerous species of allochthonous benthic seaweeds recently introduced into Spain is stationary, with the exception of a slight increase, both in extension and biomass, of the established populations of the Japanese kelp *Undaria pinnatifida* and the detection of new populations of the alga *Lomentaria hakodatensis* in Galicia (La Coruna bay).

In relation to *Caulerpa taxifolia*, some populations were localized, as was to be expected, in the Spanish Mediterranean (Balearic Islands). These populations were then mechanically eliminated.

7.0 MEETINGS

The Annual Meeting of the Spanish Society of Phycology (S.E.F.) was held in Alicante on 27 - 28 June 1992. At this meeting a round table was convened dealing with the problems of the introduction of the seaweed *Caulerpa taxifolia* in the Spanish Mediterranean, and a report was also presented with regard to the problems of the numerous species of introduced seaweeds in Galicia (northwest region of the Iberian Peninsula).

Additions and Corrections to the 1992 National Report Presented at Lisbon
Reference: C.M. 1992/POLL:3, pp. 66-67:

* The references for the occurrence of the introduced algae *Codium fragile tomentosoides* and *Grateloupia filicina luxurians* in Galicia are Perez-Cirera et al. (1989) and Lopez Rodriquez et al. (1991) respectively.
* The report last year of the alga *Pikea californica* in Galicia is erroneous. This report is in fact based on specimens of the indigenous species *Schimmelmannia schousboei* (J. Agardh) J. Agardh.
* On page 66, *Cystoseiba* should read *Cystoseira*
  On page 66, *Sacchoria* should read *Sacchorhiza*
  On page 67, *faxifolia* should read *taxifolia*

Report prepared by: J. Cremades

ICES WORKING GROUP ON INTRODUCTIONS
AND TRANSFERS OF MARINE ORGANISMS

Aberdeen, Scotland 26-28 April 1993

Annual Report for **SWEDEN**

2.0 DELIBERATE RELEASES

2.1 Fish

Salmon, Sea trout, Cod, and elvers imported from England (Severn).

4.0 LIVE IMPORTS

4.1 Fish

Elvers from England (Severn). Quarantine regulations are followed.

4.2 Invertebrates

Lobsters from USA and Canada.

5.0 LIVE EXPORTS

5.1 Fish

Eggs:

Denmark - salmon
Germany - salmon, grayling and Arctic charr
Spain - rainbow trout
Portugal - rainbow trout
Greece - rainbow trout
Ireland - Arctic charr
Israel - rainbow trout
USA - rainbow trout

Salmon smolts to Denmark (Bornholm) for release.

5.2 Invertebrates

Blue mussels to Denmark.

Report prepared by B. Holmberg

ICES WORKING GROUP ON INTRODUCTIONS AND TRANSFERS OF MARINE ORGANISMS

Aberdeen, Scotland 26-28 April 1993

Annual Report for **U.K.: ENGLAND AND WALES**

1.0 LAWS AND REGULATIONS

New legislation was implemented on 1 January 1993:

Council Directive 91/67/EEC facilitates the trade in live fish and shellfish within the EEC while ensuring that they are free of disease. It allows the free movement of live fish and shellfish between farms and zones of equivalent health status. The legislation which incorporates this Directive is under The Fish Health Regulations 1992.

Council Directive 91/492/EEC lays down health conditions for the production and placing on the market of live bivalve molluscs.

2.0 DELIBERATE RELEASES

2.2 Invertebrates

Seed of *Crassostrea gigas* and *Tapes philippinarum (= Ruditapes semidecussata)* were planted out for commercial cultivation. Although these species are not released for the purpose of establishing self-sustaining populations, there is evidence that in recent warm summers natural settlement of *C. gigas* has occurred in the R. Teign and in the Menai Strait area of North Wales. Numbers of naturally-settled seed are low.

3.0 ACCIDENTAL INTRODUCTIONS AND TRANSFERS

3.2 Invertebrates

None known. However, there was an article in the *London Times* newspaper (26/8/92) about giant Japanese whelks (*Rapana venosa*) that were said to have been brought up in a lobster pot from the bed of the North Sea, south of Dogger Bank and about 20 miles out. It was speculated that the whelks could have been carried as eggs from the Black Sea on the hull of a ship. (Apparently it was introduced into the Black Sea in the early 1950's from the Far East with the Japanese oyster. Mussel beds in the Black Sea were devastated. The Japanese whelk has also been found in the Adriatic, near Venice.) The most recent information is that the find was in fact a hoax.

4.0 LIVE IMPORTS

4.1 Fish

Eels (*Anguilla* spp.) primarily from New Zealand and Ireland but also from Canada and Australia.

Saltwater ornamental fish from at least 23 countries worldwide but the imports were from countries with much higher sea water temperatures than found in the UK and it is unlikely that they would survive in open waters.

A total of 51 million rainbow trout eggs from South Africa (30 million), Denmark, Tasmania and Northern Ireland.

4.2 Invertebrates

(Some of the available data did not differentiate between live and fresh/chilled)

Lobsters (*Homarus* spp.) mainly from Canada and the USA.

Oysters from Ireland, Denmark, France, the Netherlands, Chile, Japan, China and Hong Kong. Scallops (*Pecten*, *Chlamys*, *Placopecten*) from France, China and the USA, and in smaller quantities from the Netherlands, Spain, and Ireland.

Mussels (*Mytilus*) from Ireland and the Netherlands.

Some *C. gigas* and *T. philippinarum* seed were imported from Guernsey for cultivation, but the industry relied mainly on seed produced in England.

Squid (*Loligo* spp., *Omnastrephes sagittatus*) from France.

5.0 LIVE EXPORTS

5.1 Fish

Approximately 250,000 turbot juveniles primarily to Galicia, Spain.

Saltwater ornamental fish to Germany, USA and Italy. Other saltwater fish to France, Ireland, Spain, the Netherlands, Germany, Italy and the USA.

Eels (*Anguilla* spp.) to the Netherlands, Belgium/Luxembourg, Germany, Denmark, Spain, Norway, Sweden, former USSR and Eastern Europe (Czechoslovakia and Hungary).

5.2 Invertebrates

Lobsters (*Homarus* spp.) to France, Spain, Norway, the Netherlands, Belgium/Luxembourg, Germany, Italy, Ireland, Denmark, Greece and Sweden.

Oysters to France, Spain, Norway, the Netherlands, Belgium/Luxembourg, Germany, Italy, Ireland, Denmark, Greece and Sweden. At least 30 million *C. gigas* seed to Spain, Ireland and the Channel Islands, and *Ostrea edulis* seed (25,000) to Italy.

Scallops to France, Spain,Norway, the Netherlands, Belgium/Luxembourg, Germany, Italy, Ireland, Greece, Sweden, the USA and former USSR.

Mussels to France, Spain,Norway, the Netherlands, Belgium/Luxembourg and Ireland.

Cuttlefish (*Sepia officinalis*, *Rossia macrosoma*, *Sepiola* spp.), octopus and squid (*Loligo* spp., *Omnastrephes sagittatus*) to France, Spain, the Netherlands, Italy, Ireland and Greece.

7.0 MEETINGS

"Introduction of Alien Species and Harmful Organisms to UK Coastal Waters" - Seminar organized by the Marine Forum (for Environmental Issues), London, 24 February 1993.

Report prepared by S. Utting

ICES WORKING GROUP ON INTRODUCTIONS AND TRANSFERS OF MARINE ORGANISMS

Aberdeen, Scotland 26-28 April 1993

Annual Report for **UK: SCOTLAND**

1.0 LAWS AND REGULATIONS

Under the UK European Communities Act 1972(b) the following Statutory Instruments in compliance with Community Directives have been implemented.

a) The Fish Health Regulations 1992, No 3300 (complying with Directive 91/67/EEC).

b) The Shellfish and Specified Fish (Third Country Imports) Order 1992, No 3301.

c) The Animals and Animal Products (Import and Export) Regulations 1992, No 3295 (complying with Directives 90/425/EEC and 91/496/EEC).

d) The Products of Animal Origin (Import and Export) Regulations 1992, No 3298 (complying with Directives 89/662/EEC and 90/675/EEC).

e) The Products of Animal Origin (Third Country Imports) (Charges) Regulations 1992, No 3299 (complying with Directives 90/675/EEC).

2.0 DELIBERATE RELEASES

2.1 Fish

The Scottish Office Agriculture and Fisheries Department (SOAFD) issued 56 licences for imports during 1992 under the Diseases of Fish Act 1937 and 1983.

Species	No of licences granted	Amount licensed	Origin
Rainbow trout eggs	24 (8) (15) (1)	2,180,000 5,900,000 200,000	Northern Ireland Denmark Isle of Man
Rainbow trout milt	2	750 cl and 50 ml	Northern Ireland
Brown trout eggs	1	100,000	Denmark
Rainbow trout fingerlings	2	41,000	Northern Ireland

Rainbow trout	1	6,000	Northern Ireland
Salmon ova	1	59,000	Tasmania
Arctic charr	4	160,000	Canada
Assorted tropicals (fish)	18	9,804,575	Various
Assorted tropicals (eggs)	2^{+}	600	Various
Cichlids*	1	1,000	-
Blue gill sunfish	1	2,000	USA
Egg laying toothcarp*	1	1,000	-
European eel	1	450	Holland

*Same licence; $^{+}$within fish licences

2.2 Invertebrates

The following licences were issued under the Molluscan Shellfish (Control of Deposit) Order 1978.

Species	No of licences granted	Amount licensed	Consigner
Crassostrea gigas	5	30,750 kg	Herm Island Oysters
Crassostrea gigas	5	3,300 kg + (20 individuals)	Guernsey
Crassostrea gigas	2	2,000 kg + 30,000 (individuals)	Seasalter Shellfish
Crassostrea gigas	2	20 (individuals)	Guernsey
Haliotis tuberculata	1	1,000 of each	EIRE
Haliotis hannai			

Licences issued under Article 7 of the Lobsters (Control of Deposit) Order 1981 - there were 6 licences issued under this Act.

Licences issued under the W&C Act 1981 Section 16(4) - there were 2 licences issued under this Act.

5.0 LIVE EXPORTS

5.1 Fish

Atlantic salmon ova from farmed and wild stocks to several European countries and to Chile.

5.2 Invertebrates

Native lobsters and crabs to several European countries.

6.0 PLANNED INTRODUCTIONS

6.1 Fish

The proposal to culture Beluga sturgeon (*Huso huso*) fails to meet health requirements and remains under discussion.

Reported prepared by: A. L. S. Munro

ICES WORKING GROUP ON INTRODUCTIONS AND TRANSFERS OF MARINE ORGANISMS

Aberdeen, Scotland 26-28 April 1993

Annual Report for **UNITED STATES OF AMERICA**

1.0 LAWS AND REGULATIONS

Nonindigenous Aquatic Species Act

Extensive work continues throughout various branches of the federal government carrying out the new mandates of Public Law 101-646, the "Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990" was signed on November 29, 1990. The Act defines "nonindigenous species" as "any species or other viable biological material that enters an ecosystem beyond its historic range, including any such organism transferred from one country to another". In brief, the Act focuses on the prevention of future invasions *due to ballast water release* and on research, education, and management activities relative to the European zebra mussel *Dreissena polymorpha*. The "Aquatic Nuisance Species Task Force" (see "NEMO" Abstracts, page 1), made up of representatives from NOAA (National Oceanic and Atmospheric Administration, Office of the Chief Scientist), USFWS (U.S. Fish and Wildlife Service), EPA (Environmental Protection Agency), USCG (U.S. Coast Guard), the USACE (U.S. Army Corps of Engineers), APHIS (the U.S. Department of Agriculture, Animal and Plant Health Inspection Service), and the Department of State. The Task Force meets on an irregular basis to review progress on the Act's mandates. Public meetings were held around the country in 1992.

The Task Force has produced a draft document (September 1992) on the "Aquatic Nuisance Species Program".

2.0 DELIBERATE RELEASES

2.1 Fish

Salmon releases on the Atlantic coast of the United States

The State of New Hampshire continues with a Pacific salmonid program on the U.S. Atlantic coast. This year (1993) is the final year of its current "five year plan" (1989 - 1993) which calls for the release of chinook salmon (*Oncorhynchus tshawytscha*) from the New York State Salmon Falls Hatchery, each year into the Lamprey River (New Hampshire). The Program is operated by the state's Department of Fish and Game. Reports of these releases are also contained in the NASCO reports. In the fall (September - October) of 1992, 495,000 smolts were released. One (1) chinook salmon was captured this past year, believed to be from the 1989 release of approximately 400,000 smolts. They are now waiting for more returns, and these fish will be aged to confirm if they are from the 1989 releases. This fall will be the final releases under the current program. The Salmonid Program will then be re-evaluated later this year

3.0 ACCIDENTAL INTRODUCTIONS

3.2 Invertebrates

Introduction of the Zebra Mussel *Dreissena polymorpha* to the United States: Update

As noted in the National Reports of the U.S. and Canada over the past several years, the European zebra mussel *Dreissena polymorpha* was discovered by biologists in the Great Lakes, North America, in June 1988 in Lake St. Clair. It is now known that it was earlier observed by a fisherman in December 1987 in Lake Erie. It is believed to have been introduced about 1985 - 1986. The zebra mussel is thus entering at least its eighth year in North America. The zebra mussel has rapidly spread down the major U.S. river system. The attached map shows the spread of the mussel as of February 28, 1993. The zebra mussel is now in the major river drainages leading out of the Great Lakes, including the Mississippi, Illinois, Ohio, Tennessee, Arkansas, Hudson, and Susquehanna River systems. In the "first 1000 days" since its escape from the Great Lakes, it has entered 18 U.S. states. In January 1993 it was first detected in eastern Oklahoma.

The "Third International Zebra Mussel Conference '93" was held in Toronto, Canada from February 23-26 1993. Approximately 700 attended the Conference. A major new book on zebra mussels (Nalepa and Schloesser, 1993) appeared in December 1992. The "Fourth International Zebra Mussel Conference" will be held March 13-16, 1994, in Madison, Wisconsin. Co-incident with this level of interest have been numerous meetings, publications, videos, posters, and so forth.

As part of Public Law 101-646, the "Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990", draft regulatory procedures, to be used by scientists when moving mussels to their laboratories, have been completed. These are known as the "Zebra Mussel Containment Protocols".

Yet Another Exotic Seasquirt on the USA Atlantic Coast: Now Identified

As noted in last year's report, another exotic species of seasquirt has been recognized in New England. It was tentatively identified last year as "a species of *Ascidia* ?". It is common to abundant in fouling communities in Connecticut. It was first noted sometime between 1986 and 1988. It has now been identified as the common European fouling sea squirt *Ascidiella aspersa*. While this introduction would have previously been unquestionably recognized as due to fouling on a ship's hull, the discovery of the tadpole larvae of seasquirts in ballast water makes the exact mode of introduction now uncertain.

Occurrence of the Pacific White Shrimp *Penaeus vannamei* off South Carolina

Wenner and Knott (1992) report that several thousand of these Pacific shrimp have been taken in commercial shrimp hauls off South Carolina. All are believed to result from aquaculture facility escapes, and the establishment of reproducing populations has not yet been demonstrated, although a sexually mature male was collected.

Additional New Invasions

Several additional new invasions are noted under the "Ballast Water and Sediment" special section

in the main text of the WG Report. It is widely held that these likely represent the "tip of the iceberg" in terms of the actual presence of newly introduced exotic species, particularly among smaller invertebrate and algal groups.

6.0 PLANNED INTRODUCTIONS

6.1 Fish

Proposed Introduction of Chinook Salmon to New Jersey

In 1992 the State of New Jersey completed a "Draft Environmental Impact Statement" on the proposed "Introduction of Pacific salmonids into the Delaware River Watershed". The issue of releasing Pacific salmon into New Jersey (specifically in the Delaware River) began over 15 years ago. A public 90 day review period (including public hearings) ended on June 5, 1992.

On July 2, 1993, the New Jersey Department of Environmental Protection's "Division of Fish, Game, and Wildlife" released the following statement (in part):

> "Department of Environmental Protection and Energy Commissioner Scott Weiner announced today that the department has decided not to pursue a proposal to stock Pacific Salmon in the Delaware River watershed, thereby allowing the department to devote resources to warmwater fisheries. Weiner said the 'No Action' decision was based on the findings of an Environmental Impact Statement completed earlier this year and in consideration of public comment on the proposal. 'After considering the study and public comments, it is clear that the state should be devoting its resources to the Warmwater Fisheries Program,' Commissioner Weiner said. The department was considering introducing the salmon to the area in an effort to generate additional recreational opportunities and its accompanying economic benefits along the Delaware River. In 1989, the U.S. Fish and Wildlife Service requested that the department have an Environmental Impact Study conducted to determine the feasibility of the project. The study, which was conducted by Versar Inc. of Maryland and completed this year, found that the introduction of the salmon would not have a great environmental impact on the region. However, it also found that a very limited number of salmon would return to the region and, therefore, the project wold not justify the necessary expenditures."

6.2 Invertebrates

Proposed Introduction of Japanese Oysters to US Atlantic Coast (Chesapeake Bay)

There has been no further progress on the proposed introduction of the Japanese (Pacific) oyster *Crassostrea gigas* to Chesapeake Bay. The issue has, however, not been abandoned. As noted last year, the stated purpose of the introduction would be to re-vitalize the declining native oyster industry (the Atlantic oyster *Crassostrea virginica*). Native oyster populations have been reduced by over-harvesting for many decades and by severe disease problems, particularly MSX (or "Delaware Bay Disease", caused by the protozoan *Haplosporidium costale*).

6.3 Algae and Higher Plants

Introduction of Japanese Seaweed *Porphyra yezoensis* to the Gulf of Maine

The ICES Working Group on Introductions and Transfers of Marine Organisms considered this proposed introduction at its April 1992 meeting in Lisbon. In July 1992 the ICES General Secretary advised the State of Maine Department of Marine Resources of the WG's conclusions, which were as follows:

"(1) It was necessary to receive from the private company and the State of Maine a fuller analysis of the potential for this species to spread to more southern and western waters, where, according to the reports provided, suitable temperatures for reproduction could be found. An analysis of the potential transport mechanisms and of the ecological impacts of the establishment of this species in more southern waters would be of value.

(2) An indication of the fungal-free status of the imported culture stocks be provided.

(3) More information and correspondence from Canadian officials, if available, on this proposed release would be of great value.

(4) An update on 1992 activities be provided along with (1), (2), and (3)"

Dr I. Levine, of Coastal Plantations International, Inc., in Poland, Maine, attended the WG meeting in Aberdeen in April 1993 to present details of the introduction of *Porphyra* to Maine, and to address the above questions and issues.

7.0 MEETINGS

A symposium, entitled "A Workshop on Nonindigenous Estuarine and Marine Organisms" (NEMO), was held April 20 - 22, 1993, in Seattle, Washington. It was sponsored by NOAA (the National Oceanic and Atmospheric Administration), Office of the Chief Scientist. There were 26 presentations. The Agenda is presented in Appendix VI.

More than 20 regional and local meetings were held throughout the eastern and southern United States on the biology, ecology, and control strategies of the zebra mussel.

Report prepared by J. T. Carlton

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APPENDIX III - A

联合国粮食及农业组织

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

ORGANISATION DES NATIONS UNIES POUR L'ALIMENTATION ET L'AGRICULTURE

ORGANIZACION DE LAS NACIONES UNIDAS PARA LA AGRICULTURA Y LA ALIMENTACION

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14 JAN 1993

Dear Mr Khanimonov,

You may be aware of the disastrous events that have occurred in the fisheries of the Black Sea over the last few decades. These have culminated in the collapse of the last major fishery, for anchovies, from a figure of some 800 000 t landed in the mid-late 1980s, to a provisional 1992 figure that is believed to be below 100 000 t. The consequences of this disaster on the fisheries and fishing industry of the Black Sea at this time of dramatic political change, are easy to imagine, and the true scope of the disaster remains to be economically evaluated. Such an evaluation will likely be a significant component of the GEF programme now being developed for the Black Sea by UNDP and the World Bank.

It would appear that nutrient enrichment of the Black Sea, Azov and Marmara, has resulted in biological productivity which, while having some short-term positive effects on overall production of pelagic fish, has led to anoxia of shallow shelf environments with disastrous repercussions on demersal finfish, shellfish and probably also, migratory pelagic fish. In addition to the effects of nutrient enrichment, the collapse of the anchovy fishery referred to above seem to have been accelerated through introduction of an exotic species, Mnemiopsis leydei, a comb jelly or ctenophore (similar to a jellyfish). This species originates from the Western Central Atlantic where it is common, for example, in Chesapeake Bay. It has found a congenial habitat in the Azov and Black Seas, and shows an extremely high rate of population growth in the summer months. Russian estimates suggest that, each season, it can reach population biomasses of over 100 million tons. Under these circumstances, it effectively consumes not only food for anchovy and their larvae, but the fish larvae themselves.

...../

Mr. O.N. Khanimonov
Director
International Environment Division
International Maritime Organization
Thames Embankment
London
UNITED KINGDOM

Information copies to:
Dr. A. Lindquist, Lysekil
Mr. Kees Wijnen, New York
Dr.A.Kullenberg,IOC,Paris
General Secretary, ICES,

From what we have been able to gather from the Russian literature, the species was introduced to the Black Sea in or before the mid 1970s. It has rapidly gained a dominant position in the pelagic ecosystem, with the disastrous results described above. No final evidence exists, but the best hypothesis is that it was introduced to the Black Sea through pumping ballast water off a ship following a trans-Atlantic crossing.

The purpose of this letter is to draw your attention to the potential implications of this event with respect to other important semi-enclosed seas, in particular, the Baltic Sea. The situation there has been one of growing nutrient enrichment, a growth of small pelagic fish (sardines and herring), and a decline of demersals (Baltic cod is threatened with virtual population collapse at this time). These roughly parallel events in the Black Sea in the 1970s and 1980s.

We are not aware of any scientific investigation in the Baltic Sea to monitor abundance of gelatinous predators such as Mnemiopsis, but as far as we know, it has not yet been introduced into the Baltic. It would seem important to reduce the risk of introductions of this species into other semi-enclosed seas such as the Baltic Sea, and to consider possible measures to delay or prevent the transfer of this dangerous species to the extent possible to areas with important fisheries. For example, ships leaving the Black Sea for ports in the Mediterranean and Baltic Seas should be aware of the provisions of MARPOL; especially IMO Resolution MEPC 50(31). Furthermore, a step should be taken to ensure that untreated ballast water taken in the Black Sea is not discharged in transit through the Mediterranean Sea. We would be happy to advise further on any initiatives you might wish to take on this matter.

Yours sincerely,

W. Krone
Assistant Director-General a.i.
(Fisheries Department)

APPENDIX III - B

UPDATE ON CANADIAN GUIDELINES FOR BALLAST WATER CONTROL IN THE GREAT LAKES

BACKGROUND

Since the 1800s, over 130 exotic species (plants, algae, invertebrates and fish) have invaded the Great Lakes basin. The rate of invasions has increased over time (Fig. 1): an average of one organism per year has invaded the Great Lakes over the past 15 years (Mills et al. 1993a). Increased shipping activities, improved water and habitat quality and climate warming may all increase the vulnerability of the Great Lakes to invasions by exotic species in future.

About 10% of all invading species, and about 50% of invading fish species, have had significant impacts (ecological and economical) on the aquatic ecosystems (Mills et al. 1993b). For example, sea lamprey (*Petromyzon marinus*), a parasitic species, had a significant negative impact on lake trout (*Salvelinus namaycush*) and other native species when it invaded the upper Great Lakes. The potential impact of abundant populations of alewife (*Alosa pseudoharengus*) and white perch (*Morone americana*) on yellow perch (*Perca flavescens*) and other native species has always been a concern. Carp (*Cyprinus carpio*) uprooted plants and caused increased turbidity in the near shore habitats used by more favourable fish species and waterfowl. Further details of exotic fish introductions and their impacts in the Great Lakes are given by Emery (1985), Crossman (1991), and Mills et al. (1993a and b).

Recent invaders include zebra mussels (*Dreissena polymorpha*), the spiny water flea (*Bythotrephes cederstroemi*), and three fish species: tubenose goby (*Proterorhinus marmoratus*), round goby (*Neogobius melanostomus*) and ruffe (*Gymnocephalus cernuss*). The impact of these species on aquatic ecosystems in the Great Lakes is still being investigated.

Exotic species of fish and other aquatic organisms are introduced to the Great Lakes through a number of vectors, including ballast water, fish stocking programs, the bait fish industry and the aquarium industry. A high proportion of the non-native organisms entering the Great Lakes since the opening of the St. Lawrence seaway in 1959 have been associated with shipping (Mills et al. 1993b). Both the Canadian and American governments, through the international Great Lakes Fishery Commission, recognized the need to regulate and control ballast-water discharge, and other potential vectors of exotic organisms, in the Great Lakes basin (Dochoda 1991; Mills et al. 1993a).

CANADA'S BALLAST WATER GUIDELINES PRIOR TO 1993.

On 1 May 1989, guidelines were set into place by the Canadian Coast Guard requesting voluntary exchange of ballast water by upbound ocean-going vessels in the open sea prior to arrival at the St. Lawrence Seaway. All ships bound for Great Lakes locations west of Montreal (Fig. 2) were required to exchange their ballast. Ships unable to exchange ballast water in mid-ocean could exchange ballast water within the Laurentian Channel, east of longitude 64°W, in water depths exceeding 340 metres. The rationale of the ballast water control program was that freshwater and coastal organisms would be flushed out or killed by high salinity water.

During 1990, a study was conducted to determine the effectiveness of the mid-ocean exchange for controlling ballast water (Locke et al. 1991). The study found that the ballast water control practices in effect at that time were 'achieving high compliance and effectiveness rates'. Compliance of vessels with

the guidelines was 95% (all vessels) or 89% (excluding vessels not carrying ballast water). However, the control was not perfect. Some risk of invasions still existed, as some ships did not comply with the guidelines, and some live freshwater organisms still existed within the ballasts after the mid-ocean exchanges. In addition, Locke et al. (1991) reported that 27 vessels discharged their ballast in fresh and brackish parts of the St. Lawrence River, which supply much of the ballast water released in the Great Lakes.

BALLAST CONTROL GUIDELINES FOR 1993

The Canadian Coast Guard proposed that new tougher guidelines for ballast water exchange be applied during the 1993 shipping season in the Great Lakes. The new guidelines require that all ships bound for the St. Lawrence River and Great Lakes ports west of 63° W longitude (Fig. 2) exchange their ballast water while at sea. Extending ballast discharge restrictions to 63° (Anticosti Island) will prohibit exchanges of foreign ballast water in the fresh and brackish waters of the St. Lawrence River. The revised guidelines will substantially reduce the risk of accidental introductions of exotic organisms like the zebra mussel in the Great Lakes or St. Lawrence River.

We understand Transport Canada is examining the efficacy of changing the revised guidelines to regulations, similar to those introduced by the United States in 1992.

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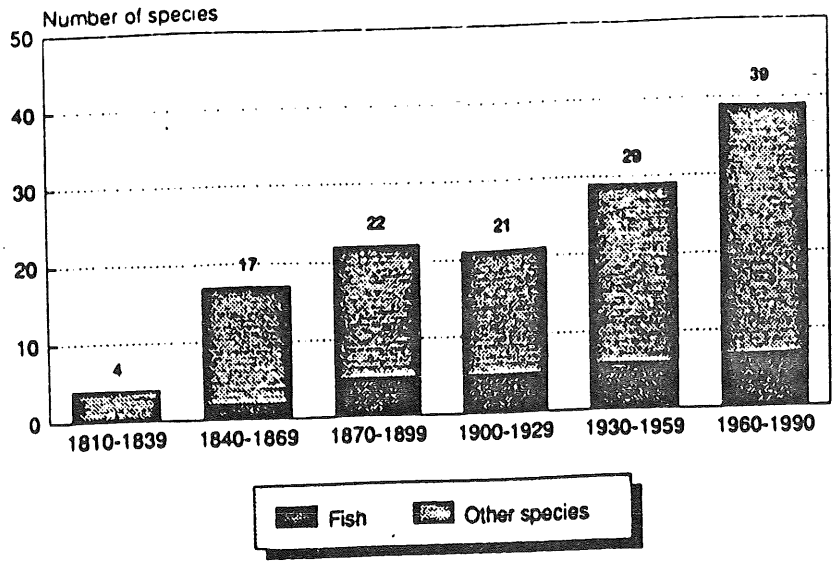

Figure 1. Number of species introduced into the Great Lakes, 1810 to 1990. The number of species introduced during each time period is indicated above each bar (total N = 132). Other species include plants, algae and invertebrates. Figure redrawn from Mills et al. 1993a.

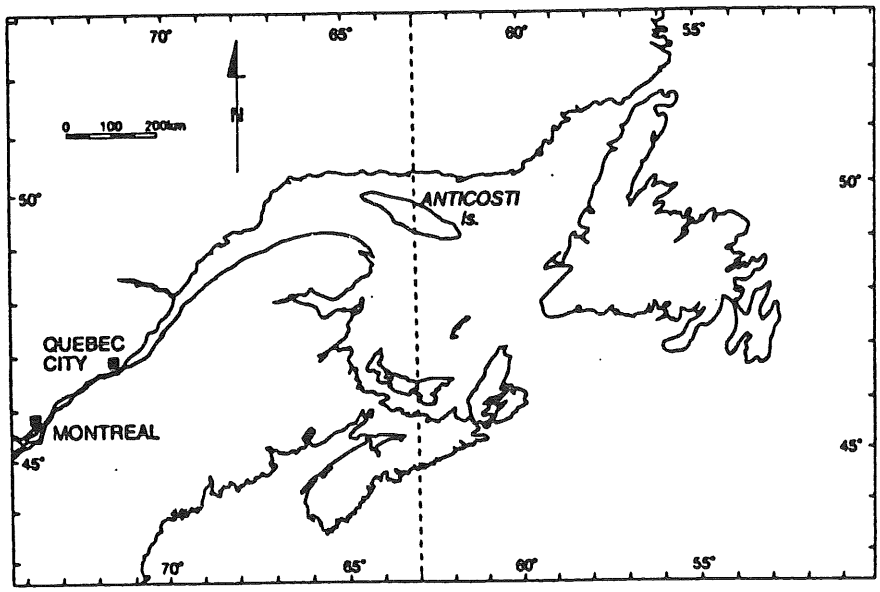

Figure 2. Map of eastern Canada. An amendment to Canada's Guidelines For the Control of Ballast Water Discharges (proposed for 1993) will require that all ships bound for river or Great Lakes ports west of 63°W (dashed line) exchange their ballast while at sea.

Merenkulkuhallitus

TIEDOTUSLEHTI NRO 5/30.3.1993

ALUSTEN PAINOLASTIVESIPÄÄSTÖJÄ KOSKEVA SUOSITUS

Kansainvälisen merenkulkujärjestön IMO:n Meriympäristön suojelukomitea on 4.7.1991 antanut alusten painolastivesipäästöjä koskevan päätöslauselman Resolution MEPC. 50(31). Päätöslauselma sisältää suosituksen, jonka mukaan sekä satamavaltiot että satamaviranomaiset voivat asettaa erityisehtoja alusten painolastitankkien täyttämiselle tai tyhjentämiselle.

Päätöslauselmassa todetaan, että alusten painolastivesipäästöjen seurauksena eräille merialueille on ilmestynyt niille vieraita kasveja ja eläimiä sekä tauteja aiheuttavia eliöitä, jotka häiritsevät merialueiden ekologista tasapainoa. Tämän vuoksi IMO on päätöslauselmassaan pyytänyt tietoja niistä merialueista, joilla alusten painolastivedet todistetusti ovat aiheuttaneet ongelmia.

Päätöslauselmassa satamaviranomaisille annetaan mahdollisuus määrätä, että esimerkiksi tietyn tyyppisten alusten on vaihdettava painolastivetensä avomerellä tai että painolastivedet on tyhjennettävä satamien vastaanottolaitteisiin. Määräysten valvonnassa voidaan käyttää päätöslauselman liitteenä olevaa mallikaavaketta. Satamaviranomaisten antamien määräysten rikkomisesta voidaan antaa sakkoa. Satamaviranomaisten määräykset eivät kuitenkaan saa aiheuttaa vaaraa aluksen henkilökunnalle.

Oheisena julkaistaan päätöslauselma englanninkielisenä.

Merenkulkuosaston päällikkö
merenkulkuneuvos — Heikki Valkonen

Toimistopäällikkö — Aapo Latvalahti

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Dnro 3/30/93
ISSN 0430-5345

APPENDIX III - D

International Council for the Exploration of the Sea (ICES)

Working Group on Introductions and Transfers of Marine Organisms

Meeting 1993, April 26 - April 28 1993; Aberdeen, Scotland

Introduction to the German Project

Research project of the Umweltbundesamt, Berlin:
INVASION OF NON-INDIGENOUS MARINE SPECIES INTO THE NORTH AND BALTIC SEA VIA SHIPS BALLAST WATER: INVESTIGATIONS ON THE ECOLOGICAL THREAT.

Project leaders: Prof. Dr. J. Lenz — Prof. Dr. G. Hartmann / Dr. H.-G. Andres

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The above mentioned project shall characterize the importance of ships as vector for the transport of non-indigenous organisms into German waters. Subject of investigation are planktonic and benthic organisms.

Sampling of plankton organisms:

- The ballast water extraction at the ballast water pump system: the construction of some ships allowed to open a small tap (diameter 0.5 - 1.0 cm) and get a few liters of ballast water filtering through a small sized plankton net (meshsize 10 µm).
- If ballast water operations are not possible we try to find a short plumbing pipe connected to a usefull tank. Through this pipe we pushed a hosepipe and started filtering the water through a plankton net by a manual pump.

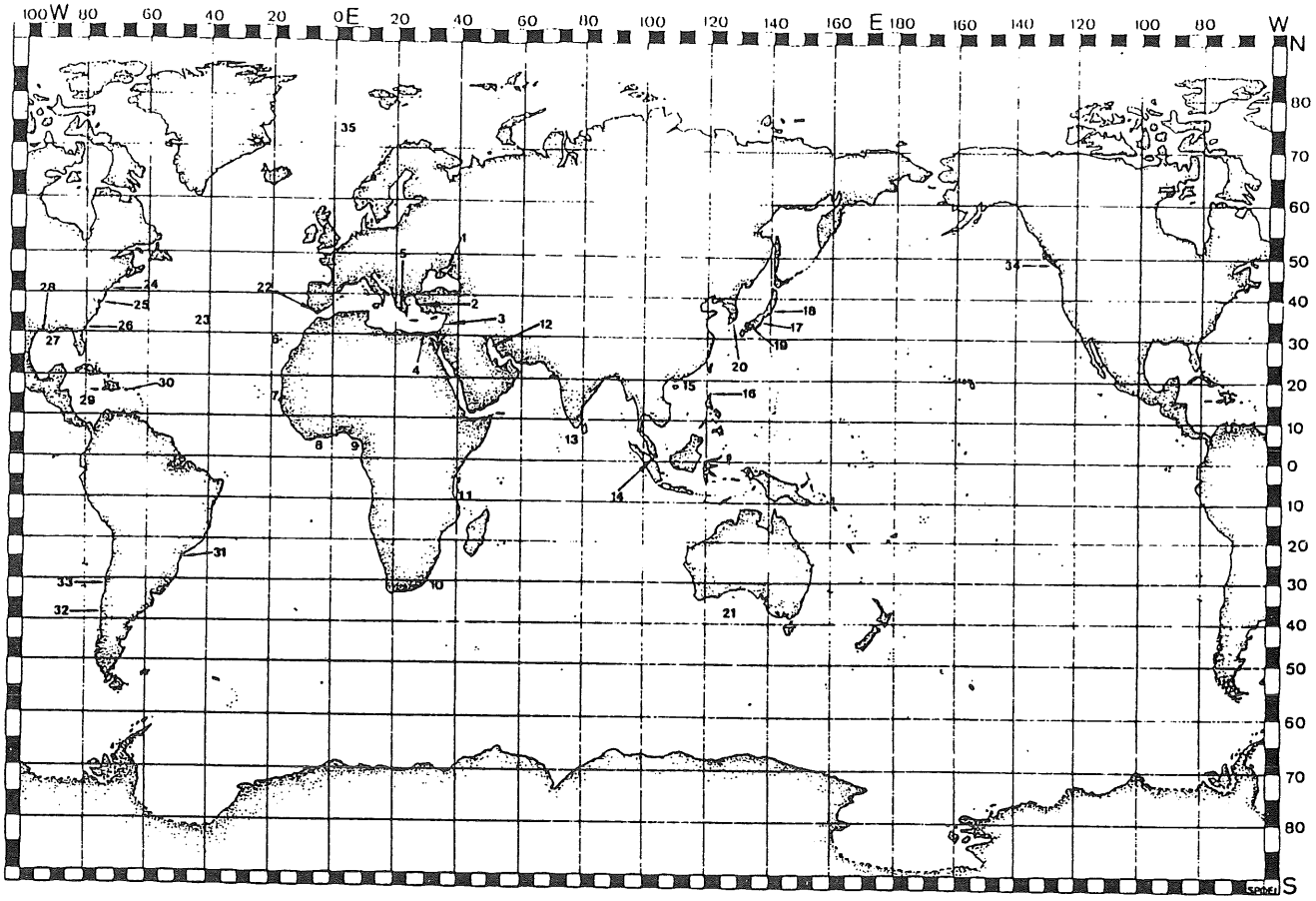
Sampling of benthic and settled Organisms:

- The only way to get benthic and settled organisms is to sample nearly empty ballast water tanks through an opened manhole. In the tank we were sampling with a hand fishing net (meshsize 500 µm).
- Additionally we tried to get hull samples of ships from outside in shipyard docks.

A statistic was made showing the favourite trading routes of international sea traffic. This allowes specific samples of the most frequent shipping routes to German ports (Fig 2 & 3).

We compiled a bibliography of papers discussing this subject, with assistance of questionnäires sent to more than 200 scientists in Germany.

Fig 1

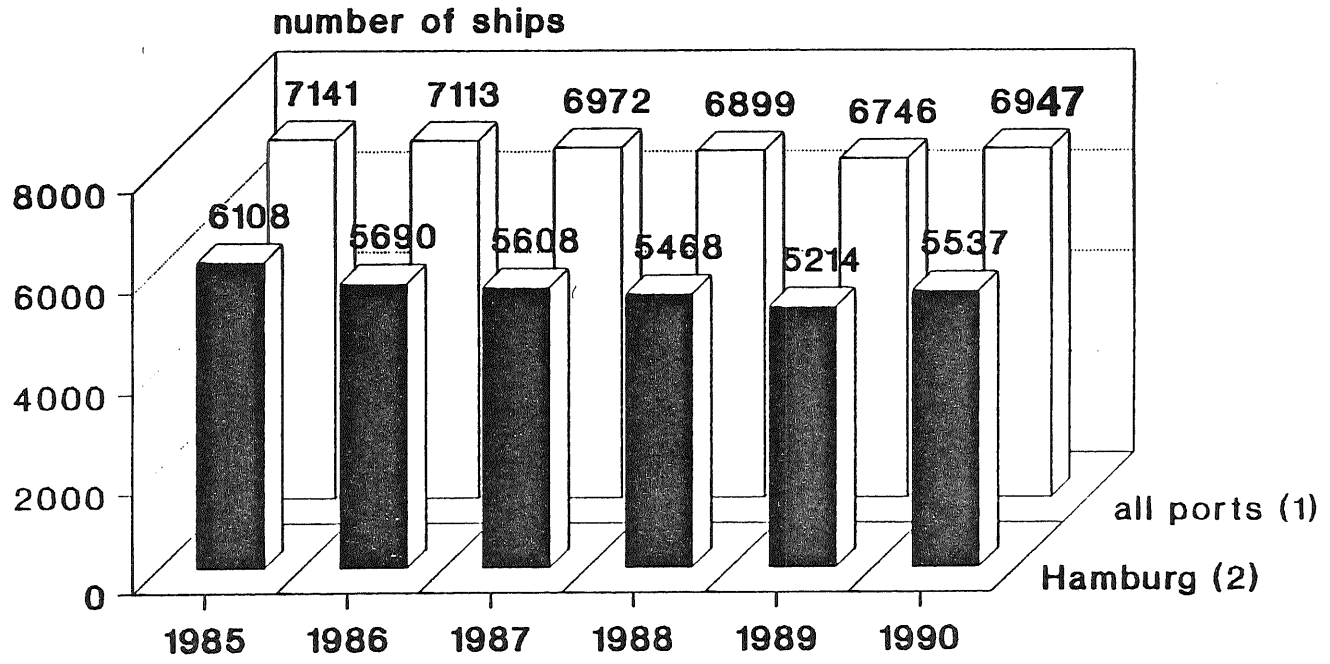


Worldmap, origin of sampled ships.

1. Azovskoye Sea (Black Sea)
2. Turkey
3. Lybia
4. Egypt
5. Greece
6. Canary Islands, Spain
7. Senegal
8. Ivory Coast
9. Nigeria
10. Rep. of South Africa
11. Tanzania
12. Persian Gulf
13. India
14. Singapore, Malaysia
15. Hongkong, China
16. Keelung, Taiwan
17. Nagoya, Japan
18. Tokyo, Japan
19. Kobe, Japan
20. Pusan, Korea
21. Australia
22. Algeciras, Spain
23. centre Atlantic
24. New York, USA
25. Norfolk, USA
26. Savannah, USA
27. New Orleans, USA
28. Houston, USA
29. Caribbean Sea
30. Puerto Ric .o, USA
31. Santos, Brasil
32. Valdivia, Chile
33. Valparaiso, Chile
34. Vancouver, Canada
35. Greenland Sea

Fig 2

International Sea Traffic 1985-1990
Arrival of Ships in German Ports
(without inner european Traffic)



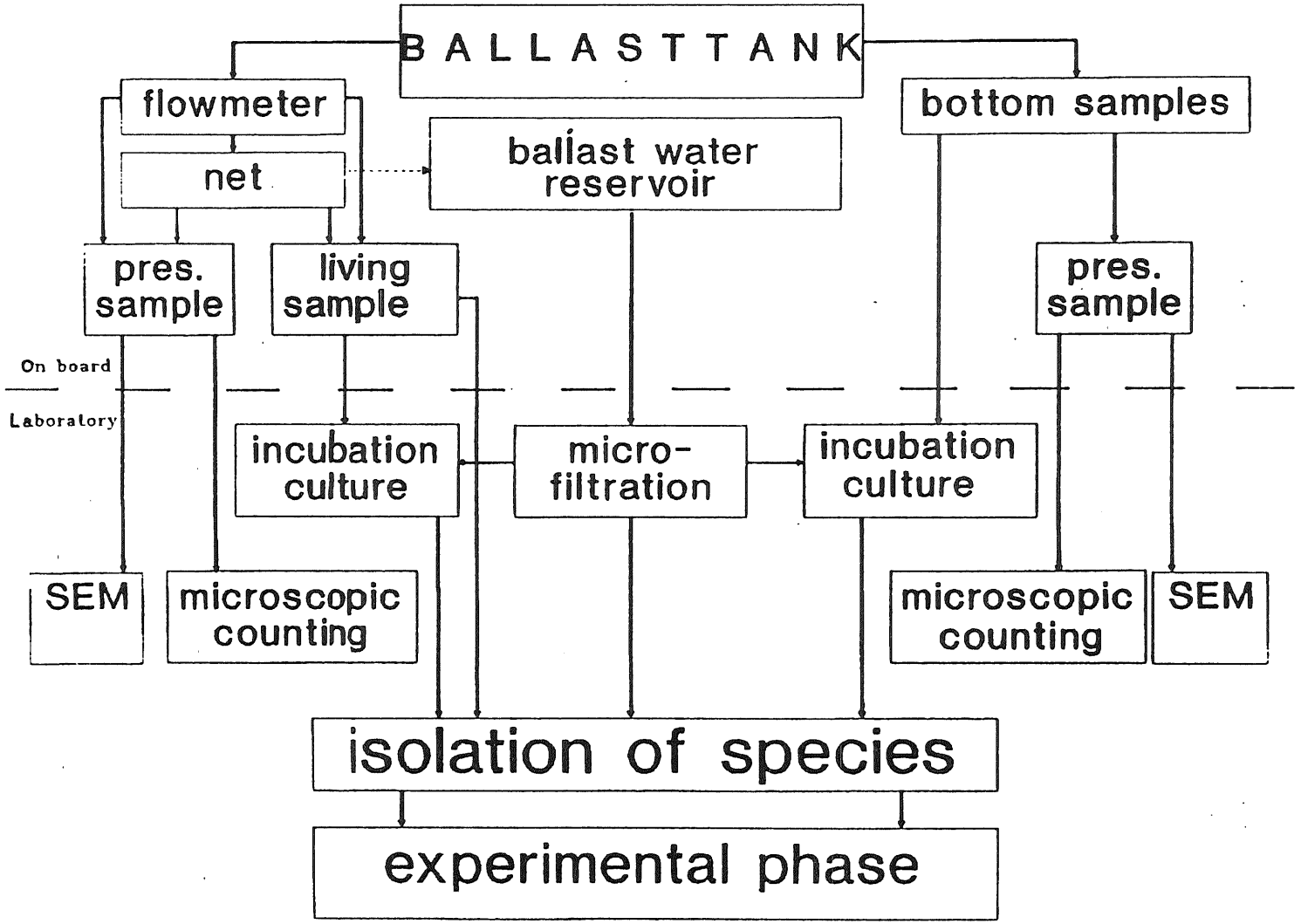
Source:
(1) Statistisches Bundesamt
(2) Statist. Landesamt Hamburg

Fig 3

Statistic of Sea Traffic 1985-1990
arriving ships of all German ports

region of origin	1985 ships	%	1986 ships	%	1987 ships	%	1988 ships	%	1989 ships	%	1990 ships	%
South Europe, Mediterranean *	243	3,4	221	3,1	239	3,4	227	3,3	213	3,2	249	3,6
South East Europe, Mediterranean *	357	5,0	388	5,5	417	6,0	344	5,0	320	4,7	376	5,4
North Africa, Mediterranean *	450	6,3	454	6,4	358	5,1	383	5,6	326	4,8	336	4,8
North Africa, Atlantic	217	3,0	216	3,0	195	2,8	238	3,4	233	3,5	140	2,0
West Africa	528	7,4	505	7,1	500	7,2	494	7,2	512	7,6	546	7,9
South Africa	229	3,2	204	2,9	198	2,8	181	2,6	159	2,4	198	2,9
East Africa	126	1,8	147	2,1	148	2,1	137	2,0	113	1,7	145	2,1
Africa, Gulf of Aden	62	0,9	54	0,8	53	0,8	51	0,7	63	0,9	55	0,8
North America, Atlanktic	811	11,4	892	12,5	875	12,6	793	11,5	736	10,9	699	10,1
Gulf of Mexico, Caribbean	931	13,0	921	12,9	931	13,4	926	13,4	909	13,5	950	13,6
South America, Atlantic	547	7,7	467	6,6	451	6,5	439	6,4	434	6,4	506	7,3
North America, Pacific	160	2,2	180	2,5	162	2,3	176	2,6	169	2,5	182	2,6
Central America, Pacific	53	0,7	47	0,7	50	0,7	63	0,9	39	0,6	57	0,8
South America, Pacific	246	3,4	248	3,5	249	3,6	223	3,2	251	3,7	264	3,8
eastern Mediterranean *	219	3,1	208	2,9	178	2,6	216	3,1	182	2,7	134	1,9
Persian Gulf + Gulf of Oman	230	3,2	223	3,1	154	2,2	137	2,0	133	2,0	133	1,9
Middle East	331	4,6	351	4,9	382	5,5	340	4,9	373	5,5	373	5,4
southern Far East	131	1,8	103	1,4	103	1,5	69	1,0	63	0,9	68	1,0
northern Far East	1014	14,3	1064	15,0	1110	15,8	1214	17,6	1316	19,5	1331	19,1
Australia + Oceania	256	3,6	219	3,1	219	3,1	248	3,0	202	3,0	205	3,0
polar region	0	0,0	1	0,0	0	0,0	0	0,0	0	0,0	0	0,0
total	7141	100,0	7113	100,0	6972	100,0	6899	100,0	6746	100,0	6947	100,0
only Hamburg	6108	85,5	5690	79,9	5608	80,4	5468	79,3	5214	77,3	5537	79,7
Mediterranean total *	1269	17,8	1271	17,9	1192	17,1	1170	17,0	1041	15,4	1095	15,8

Fig 4


BALLASTTANK
flowmeter
net
ballast water reservoir
bottom samples
pres. sample
living sample
pres. sample
On board
Laboratory
incubation culture
micro-filtration
incubation culture
SEM
microscopic counting
microscopic counting
SEM
isolation of species
experimental phase

Questionnaire to the Research project of the Umweltbundesamt, Berlin:
INVASION OF NON-INDIGENOUS MARINE SPECIES INTO THE NORTH AND BALTIC SEA VIA SHIPS BALLAST WATER: INVESTIGATIONS ON THE ECOLOGICAL THREAT.

species:
origin:
invasion of (region, country):
invasion by (ballast water, ship's hull):
date of the first record:
ecological threat, influence on indigenous species :

Literature, Author:
Source:

---

species:
origin:
invasion of (region, country):
invasion by (ballast water, ship's hull):
date of the first record:
ecological threat, influence on indigenous species :

Literature, Author:
Source:

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species:
origin:
invasion of (region, country):
invasion by (ballast water, ship's hull):
date of the first record:
ecological threat, influence on indigenous species :

Literature, Author:
Source:

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species:
origin:
invasion of (region, country):
invasion by (ballast water, ship's hull):
date of the first record:
ecological threat, influence on indigenous species :

Literature, Author:
Source:

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species:
origin:
invasion of (region, country):
invasion by (ballast water, ship's hull):
date of the first record:
ecological threat, influence on indigenous species :

Literature, Author:
Source:

Please send questionnäire to:

Dipl. Biol. Stephan Gollasch
Universität Hamburg
Zoologisches Institut u. Museum
Martin-Luther-King-Platz 3
W-2000 Hamburg 13
Germany

APPENDIX III - E

NATIONAL MARITIME ADMINISTRATION

Date
1993-02-15
Your date

Our reference

Your reference

International secretariatvag

Mr. Denis Paterson
Assistant Director
Australian Quarantine & Inspection Service
GPO BOX 858
CANBERRA ACT 2601
AUSTRALIA

Dear Sir,

1. Reference is made to MEPC/Circ.264, from 6 January 1993, the questionaire of which is attached hereto.

The Swedish Maritime Administration is presently dealing with various environmental topics emanating from the marine sector and consequently also is striving actively in order to solve related problems in various fields.

For some years ballast water has been identified to constitute a potential risk for the introduction of aquatic organisms of exotic origin into Swedish waters.

A number of recently identified species might have been introduced by ballast water, which is, however, to be further investigated. So far no drastic economical or ecological damages have been found.

The situation in Sweden, in respect of ballast water, is complex and similar to our neighbouring countries which surround the Baltic. The Baltic Sea is a brackish-water sea. Shipping also takes place on internal waterways in rivers as well as on the lakes Mälaren and Vänern which constitute huge fresh-water sources for the major cities in Sweden.

The Swedish west coast from the Norwegian border down to Öresund has a more representative marine environment from an international point of view, since there the salt content corresponds to the Atlantic.

The risk of an unwanted introduction of exotic species into Swedish waters is increased by the dense shipping traffic from internal waterways on the European continent and Russia, since these waterways are connected to other brackish waters such as the Black Sea and probably the Caspian Sea through the rivers and canals used for transportation.

Our Administration has comprehensively discussed the problem and found that there is a need for a 'technical fix' since most of the available solutions either can not exclude the possibility of introducing such organisms only by the application of operational measures or are not acceptable from an environmental point of view.

An idea of solution might be to use an alternating current (potential-free from the ship's hull) from a centre electrode in the pipe inlet to the ballast system providing an amplitude and frequency that interacts with the nerve system of plankton and the cilia of bacteria. After a certain exposure, the survival capability of such organisms in the ballast water would be eliminated. The unit should only be activated during ballast operations.

There might be reasons to investigate this possibility more closely since also fresh water contains enough salt for maintaining the electrical field. Such a procedure could therefore be used to provide sterilized ballast water with no environmental implications.

If successful, the use of such a procedure and equipment could be made mandatory on a global level, since chemical solutions result in other environmental implications, and therefore should be avoided.

Due to somewhat complex situation in respect of ballast water management in Sweden there might be a need for the application of more than only the operational measures presented in the Guidelines contained in Resolution MEPC 50(31).

Biological investigations are being carried out by the Swedish Environmental Protection Agency and the results will constitute the base for any additional measures to be taken by the Swedish Maritime Administration.

Sweden is prepared to forward the results from the national investigations, as soon as they are available, to the correspondence group in order to promote the international co-operation in solving the problems related to ballast-water discharges.

Yours faithfully,

Stefan Lemieszewski

NTERNATIONAL MARITIME ORGANIZATION
ALBERT EMBANKMENT
ONDON SE1 7SR
elephone: 071-735 7611
elegrams: INTERMAR-LONDON SE1
elex: 23588
elefax: 071-587 3210

IMO

MEPC/Circ.264
6 January 1993

Ref. T5/1.01

INTERNATIONAL SURVEY OF IMO MEMBER STATES
RELATING TO BALLAST WATER

INTRODUCTION

. MEPC 33 (October 1992) considered the issue of ships ballast water and the potential for it to be a means of spreading organisms, sea creatures and sea life which could be detrimental to some nations.

. MEPC accepted the report of an (informal) working group which, in part, concluded as follows:

"The uncontrolled discharge of contaminated ballast water remains an international problem of yet undetermined proportions and an issue of significance to public health and the marine environment. All Member States, through MEPC, should therefore continue their diligent efforts towards improving ballast water management practices and the conduct of necessary research.

In support of conclusion 1, and in the absence of a cost effective, practical, safe and environmentally acceptable treatment process, emphasis should continue to be placed on :

(i) application of the MEPC 50(31) Guidelines ("International Guidelines for Preventing the Introduction of Unwanted Aquatic Organisms and Pathogens from Ships' Ballast Water and Sediment Discharges");

(ii) conduct by Member States of research and international sharing of results of that research;

(iii) in accordance with the MEPC Guidelines, Member States reporting to IMO and the Secretariat arranging for circulation of all submitted information and research on the problem; and

(iv) any information or technology, which could be of benefit in resolving this matter and which comes to any Member States' notice (in addition to 2.2 (iii) above), be given wide circulation to other Member States.

To further assist in this matter, the Group resolved that an intersessional correspondence group, comprising the United States, Canada, the United Kingdom, New Zealand and Japan with Australia offering to be the lead country, supported by the other representatives listed at annex, would undertake to develop and circulate a survey of all Member States and co-ordinate the resulting information for the benefit of MEPC and all Member States. This survey, to be undertaken before MEPC 34, will concentrate on the following areas:

(i) application of the MEPC Guidelines

(ii) research

(iii) information availability and dissemination; and

(iv) technology"

PURPOSE

- In accordance with the MEPC conclusion to endorse these findings of the (informal) working group the attached questionaire has been prepared and is now being circulated to all MEPC member states.

- It is intended that the resuls of the questionaire will be consolidated by the lead nation, Australia, and that they will report the results to all countries and present them to MEPC 34 in July 1993.

TIMING

- To enable completion of the survey and submission of the paper to IMO Secretariat by the due date, Australia requires the completed questionaire by 15 February 1993.

- To enable the most complete report possible to be prepared the assistance of all member states in completing the attached questionaire and returning it to Australia by the due date, would be greatly appreciated. Any queries should be directed to the contacts listed below.

PLEASE COMPLETE ATTACHED QUESTIONAIRE AND SEND IT :

TO: MR DENIS PATERSON
ASSISTANT DIRECTOR
AUSTRALIAN QUARANTINE & INSPECTION SERVICE
GPO BOX 858
CANBERRA ACT 2601
AUSTRALIA BY 15 FEBRUARY 1993

TELEPHONE:	MR DENIS PATERSON	(06) 272 5365	OR
	MR PETER MILLS	(06) 272 4523	
FACSIMILE:	(06) 272 4873 OR	(06) 272 3276	

International Maritime Organisation, Marine Environment Protection Committee

Ballast Water Survey

(being conducted by the Australian Quarantine and Inspection Service)

1 Country and Contact Details

1.1 Member State (country) SWEDEN

1.2 Name and address of contact officer

Stefan Lemieszewski
National Maritime Administration
601 78 NORRKÖPING - SWEDEN
Telephone: (46)11 191377 Facsimile: (46) 11 239934

2 General Shipping/Ballast Water Information

2.1 Estimated number of visits of ships from other countries to your ports each year 1991: 416,070

2.2 Estimated amount of ballast water discharged in your ports each year by ships from other countries: ??

2.3 What are the 2 major countries these ships come from: Germany; Finland

2.4 Number of ports in your country which receive ballast water from other countries: > 50

3 Ballast Water Management Practices

3.1 In your country, what is the status of ballast water management practices to minimise the risk of spreading exotic species and/or diseases (tick the appropriate box):

- ☐ No ballast water management practices in place, and no intention to introduce such practices.
- ☒ Intend to introduce ballast water management practices.
- ☐ IMO Ballast Water Guidelines* in place.
- ☐ Other ballast water management practices (please specify)

* "International Guidelines for Preventing the Introduction of Unwanted Aquatic Organisms and Pathogens from Ships' Ballast Water and Sediment Discharges"

3.2 If IMO Guidelines are in place in your country do you consider them
- ☐ Satisfactory
- ☒ Unsatisfactory
- ☐ No opinion

3.3 If unsatisfactory, what do you consider to be the problem

Control, stability during discharge of ballast, technical and economical implications involved in the practice if it is intended to solve the problems by operational means.

3.4 If ballast water management practices are in place in your country are they: ☐ compulsory ☐ voluntary

3.5 Do you undertake any testing of ships' ballast water? ☐ YES ☒ NO

3.6 If YES, what organisms/species are being tested for

Investigations are being carried out within the Swedish Environmental Protection Agency.

3.7 Has your country identified introduced exotic marine organisms? ☒ YES ☐ NO

3.8 If YES, what are their effects so far?

Toxic algae blooms, fish diseases, fish parasites, seaweed, mussels, crabs, etc.of exotic origin have been found in Swedish waters, which may emanate from ballast water discharges. Investigations are going on. So far no drastic influence has been identified.

3.9 If ballast water management arrangements are in place does your program include testing ports? ☐ YES ☐ NO

3.10 If YES, what have been the findings?

4 Research

4.1 Has your country conducted to date any research into ballast water management and/or matters relating to it? ☐ YES ☒ NO

4.2 If YES, detail nature of research (if insufficient space please attach details)

4.3 Proposed areas of future research (next 12 months)

Problem identification.

5 Information Availability and Dissemination

5.1 Is your country prepared to share with other IMO members research and other relevant information? ☒ YES ☐ NO

5.2 If YES, what is the pretered way to do this?

☒ All information supplied to IMO Secretariat and they disseminate it

OR

☐ information supplied on request from other countries

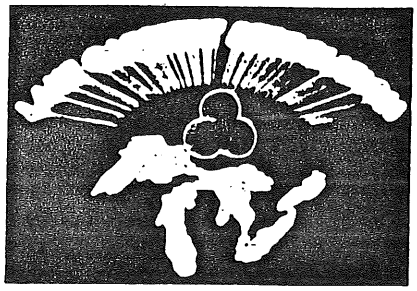
5.3 The IMO Ballast Water Guidelines ("International Guidelines for Preventing the Introduction of Unwanted Aquatic Organisms and Pathogens from Ships' Ballast Water and Sediment Discharges") at page 2 item 4 and page 6 items 5.5, 5.6, 5.7 require reports by Member States to MEPC Secretariat

are these requirements reasonable?	☒ YES	☐ NO
has your country been complying with them?	☐ YES	☒ NO
does your country intend to comply with them in future?	☒ YES	☐ NO

6 MEPC Role

6.1 What role do you believe MEPC should play in the ballast water managment issue in the future?

conduct research itself	☐ YES	☒ NO
act as a co-ordinating point for member states	☒ YES	☐ NO
establish a sub group to concentrate on the matter	☒ YES	☐ NO
other (please specify)	☐ YES	☐ NO



APRIL 7, 1993

For further information, contact:
Glen Nekvasil, Communications Director
(216) 621-1107

NEWS RELEASE

GREAT LAKES SHIPPING INDUSTRY MOVES TO HALT SPREAD OF NON-INDIGENOUS SPECIES

CLEVELAND—Great Lakes vessel and port interests have joined together in a landmark effort to control the spread of a non-indigenous species of fish in the Great Lakes. During the 1993 navigation season, U.S., Canadian and salt water ships calling on Duluth/Superior and Thunder Bay have voluntarily agreed to a Ballast Water Management Plan to prevent further diffusion of the Ruffe, a nuisance fish. The effectiveness of the voluntary undertaking will be monitored by the U.S. Fish and Wildlife Service. Ballast Water Records will be available for review by the United States or Canadian Coast Guards.

The Ballast Water Management Plan was jointly developed by Lake Carriers' Association, Canadian Shipowners Association, the Ports of Duluth/Superior and Thunder Bay, The Shipping Federation of Canada, and the U.S. Great Lakes Shipping Association in cooperation with Fish and Wildlife and the Ruffe Control Committee, an inter-agency group convened by the U.S. Government.

Fish and Wildlife officials have praised the Ballast Water Management Plan. "Lake Carriers' Association is the first maritime association in North America to propose a voluntary ballast water management strategy," said Gary B. Edwards, Assistant Director of Fish and Wildlife Service. "We commend the Great Lakes shipping industry for its leadership on this initiative. Ballast water transport of non-indigenous species is a serious problem worldwide."

-Continued-

"This plan is on the cutting edge of ballast water management to prevent the spread of nuisance species." said Thomas R. Busiahn, Chairman of Fish and Wildlife's Ruffe Control Committee.

When not carrying cargo, vessels must fill their ballast tanks with water to maintain stability. Under the terms of the plan, vessel Captains have been instructed by their owners to refrain from taking any ballast water from Duluth/Superior during a 4-month period (May 15 - September 15). During these months, young Ruffe are small enough to pass through screens fitted on ballast line intakes. Vessels not fitted with screens have been directed to take no ballast from Duluth/Superior at any time during the year.

If for reasons of stability or trim, some water must be taken onboard, then the Captains have been instructed to exchange this water with clean Lake Superior water while west of a Ballast Demarcation Line between Ontonagon, Michigan, and Grand Portage, Minnesota. Although no evidence of Ruffe colonization was found in Thunder Bay, Ontario, in 1991, precautions will be taken in that harbor until it can confirmed that Ruffe have not established colonies. Captains of vessels leaving Thunder Bay must exchange the ballast in western Lake Superior -- but only in waters at least 240-feet deep and 15 miles from shore. It is expected that any Ruffe exchanged in deep waters that distance from shore will be unable to feed or colonize.

Speaking for the owners of U.S.-flag Great Lakes vessels, George J. Ryan, president of Lake Carriers' Association, expressed pleasure with the scope of acceptance for the Ballast Water Management Plan. "We recognize that we have a responsibility to operate our ships in an environmentally-sound manner and have voluntarily developed this plan. We believe our coalition will be able to ensure that vessels of all flags will participate and thus stem, to the degree possible, further spread of the ruffe in Lake Superior and the other Great Lakes and rivers."

GREAT LAKES MARITIME INDUSTRY
VOLUNTARY BALLAST WATER MANAGEMENT PLAN
FOR THE CONTROL OF RUFFE IN LAKE SUPERIOR PORTS
1993

Owners and operators of vessels in the domestic and international trade on the Great Lakes recognize their role in assisting the governments of the United States and Canada in controlling the introduction and spread of non-indigenous fish species. We recognize that control must be on many fronts, including ballast water management, chemical control, predatory fish control, and other mechanisms. Vessels must use ballast water for safety purposes to provide adequate stability, trim, propulsion, maneuverability, and hull stress control. Recognizing these constraints, the marine industry will do everything within its power, consistent with safety and stability, to decrease the spread of known unwanted non-indigenous species. The introduction of new species from outside the system is under the control of the U. S. and Canadian Coast Guards through ballast water exchange regulations prior to entry into the system. This plan deals with the control of the spread of the European Ruffe from Western Lake Superior ports, in particular, Duluth/Superior or other harbors where Ruffe colonies are documented.

FOR VESSELS DEPARTING LAKE SUPERIOR PORTS *WEST* OF BALLAST DEMARCATION LINE:

1) Operators of vessels pumping ballast water onboard in the above harbors, with ballast line intakes equipped with screens fitted with holes larger than ½" in diameter, are restricted at all times of the year in their pumping out of ballast water from these harbors into the Great Lakes or their Connecting Channels or harbors. This ballast water should be pumped out west of a ballast demarcation line between Ontonagon, Michigan and Grand Portage, Minnesota. Ballast water from these harbors must not be pumped out within 5 miles of the south shore of Lake Superior while west of the ballast demarcation line. Ballast exchange should take place in water at least 20 fathoms (120 feet) deep.

2) Operators of vessels pumping ballast water onboard in the above harbors, with ballast line intakes equipped with screens fitted with holes ½" in diameter or less, are restricted only during the period between May 15 and September 15 in their pumping out of ballast water from these harbors into the Great Lakes or their Connecting Channels or harbors. During this 4-month period, these vessels should pump out the harbor ballast water west of a ballast demarcation line between Ontonagon, Michigan and Grand Portage, Minnesota. Harbor ballast water must not be pumped out within 5 miles of the south shore of Lake Superior while west of the ballast demarcation line. Ballast exchange should take place in water at least 20 fathoms (120 feet) deep.

3) If ballast exchange is not completed at the time the vessel reaches the demarcation line, exchange may continue in Lake Superior, but only in waters at least 40 fathoms (240 feet deep) and 15 miles from shore. In all cases, exchange must stop before proceeding east of 86° west.

FOR VESSELS DEPARTING LAKE SUPERIOR PORTS *EAST* OF BALLAST DEMARCATION LINE:

4) Vessels departing Thunder Bay should limit pumping ballast onboard as in paragraphs 1) and 2) above. These vessels may exchange ballast in Lake Superior, but only in waters at least 40 fathoms (240 feet deep) and 15 miles from shore. In all cases, exchange must stop before proceeding east of 86° west.

FOR *ALL* VESSELS DEPARTING LAKE SUPERIOR PORTS:

5) Operators of vessels pumping in ballast water from the above harbors and leaving the harbor with that water will maintain a record showing the amount of ballast water taken, the means of control, if any, and the location where the treated or untreated harbor ballast water was pumped out.

6) The ballast water records will be available for review by U.S. or Canadian Coast Guard personnel.

7) The above requirements will be waived for vessels which attest by means of a log entry that the harbor ballast water from the above harbors will not be pumped out within the Great Lakes/St. Lawrence Seaway System (at least until reaching salt water). Masters of these vessels recognize that ballast water from the above harbors must not be pumped out in any other fresh or brackish water port and thus should exchange ballast with salt water.

VOLUNTARY BALLAST WATER MANAGEMENT PLAN CO-SPONSORED BY:

- Canadian Shipowners Association
- Lake Carriers' Association
- The Thunder Bay Harbour Commission
- Seaway Port Authority of Duluth
- Shipping Federation of Canada
- U.S. Great Lakes Shipping Association

04/02/93

APPENDIX IV.

Coastal Plantations International, Inc.
P.O. Box 209
Poland, Maine 04273

Coastal Plantations International, Inc. (CPI) has for the past 36 months attempted to establish Porphyra (nori) cultivation and processing to Cobscook Bay, Maine, America and Passamaquoddy Bay, New Brunswick, Canada. We have assembled a complete nori culture laboratory, conchocelis shell culture nursery and a nori sheet processing facility in Eastport, Maine. The onshore facilities combined with the ability to lease the coastal waters provide an excellent opportunity to culture commercially viable Porphyra. CPI's team of experienced phycologists and aquaculturists are dedicated to the successfull development of a North American nori industry.

In response to our initial efforts and research we were granted a conditional permit by the Maine Department of Marine Resources (MDMR) on August 28, 1991 to import into Maine coastal waters Porphyra yezoensis variety U-51 as free conchocelis from the Washington State Department of Natural Resources. The cultures were certified axenic by Dr. Dean M. Jacobson, Curator of the Provasoli-Guillard Center for Culture of Marine Phytoplankton at the Bigelow Laboratory for Ocean Sciences, West Boothbay Harbor, Maine (see attached letter).

August of 1992, we placed our first seeded nets out into two subleased aquacultural sites in Johnson Cove and Mathews Island Eastport, Maine. The production system in Johnson Cove was removed within 60 days due to siting conflicts and the Mathews Island system remained in the water until the end of the growing season in November, 1992. The seeded nets from Mathews Island exhibited growth rates up to 8% per day as measured by dimensional analysis.

CPI's permit was renewed by MDMR on October 5, 1992. Presently, we are four months into the conchocelis cultures and anticipate the seeding of the nets between May 15 and June 15 dependent upon the local coastal water conditions.

There have been concerns raised by the ICES Working Group on Introductions and Transfer of Marine Organisms concerning the introduction of exotic species of Porphyra into Maine's coastal waters. The introduction of exotic species of Porphyra must be put into historical and phytogeographical perspective. Washington State initiated nori cultivation research in 1980. There were 17 described species of Porphyra in Washington State (Conway, et al., 1975) and 21 species in British Columbia (Scagel et al., 1989) but none were of both commercial quality and capable of commercial scale cultivation. Therefore two species (P. yezoensis varieties Inayoshi "X", Susabi #10, Aka-1, Blue

Bud, Green Bud, U-51 & P. tenera variety Izumi) (Mumford, 1987) were imported to Washington State. Subsequently, permits were issued to import Japanese frozen nori nets (with live Porphyra plants) into Washington State and British Columbia by nori farmers in the 1980's. The nori cultivation industry ultimately failed due to socioeconomic and not biological difficulties.

Can Porphyra yezoensis escape cultivation and establish itself as a reproductively independent organism in Maine and the Canadian coastal waters? The temperature and photoperiod requirements of conchosporangial development and conchospore release are not realized in the coastal conditions of the outplant areas. Similar issues were raised in Washington State and British Columbia where Dr. Sandra Lindstrom of the University of British Columbia stated that P. yezoensis has not escaped cultivation in Washington State nor British Columbia even though it has been cultivated on and off for nearly ten years (Lindstrom and Cole, 1992 and attached letter).

Considering potential modes of transport (currents, shells, ships, birds, man, and marine mammals) where could Porphyra yezoensis successfully escape cultivation and establish itself as a reproductively independent organism? Humm (1969) established phytogeographical zones along the U.S. east coast as a function of water temperature. The major transition or boundary delineations are Cape Cod, Massachusetts, Beaufort Harbor, North Carolina, and Cape Kennedy, Florida. The summer water temperatures of Maine and Atlantic Canada (17.5 C maximum) are significantly less than the 25 to 28 C (Urano per. comm.) necessary to induce the development of mature conchosporangia. The waters of Cape Cod approach the temperature regime necessary during the summer maximums but the photoperiod of 15+ hours would inhibit the conchosporangial development (Kurogi, 1959). Although the Labrador Current and southward-flowing inshore counter current might assist the transport to southern waters, the Gulf Stream and its influence would inhibit the migration south of Cape Hatteras to waters with appropriate temperatures, substrates, and photoperiod.

What is the Canadian Government's position concerning the introduction of Porphyra yezoensis into Maine's coastal waters? In 1991, an application was submitted to the Canadian government requesting permitting for the introduction and cultivation of Japanese red alga P. yezoensis to Passamaquoddy Bay and the western part of the Bay of Fundy. No action was taken on the initial submission therefore the application was resubmitted in late 1992 at the request of Canadian officials and the Department of Fisheries and Oceans Regional Director-General, Neil A. Bellefontaine, authorized the importation of nori nets seeded with P. yezoensis into New Brunswick, Canada (see attached letter).

CPI has received a great deal of support and assistance from U.S. and Maine government departments and private concerns as well as the New Brunswick Provincial Government and the Federal Government Departments. The political, biological, and socioeconomic concerns of nori cultivation have been examined at length by six United States federal, state, and local departments as well as three Canadian governmental agencies all of which have voiced support for this project.

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Fisheries and Oceans
Pêches et Océans
P.O. Box 550
Halifax, N.S.
B3J 2S7

Telex 01931552

Your file Votre référence

APR - 8 1993

Our file Notre référence

Dr. Ira A. Levine
President
Coastal Plantations International, Inc.
P.O. Box 209
Poland Municipal Center
Route 26
Poland, Maine 04273
U.S.A.

Dear Dr. Levine:

This letter is a response to yours of January 21, 1993, in which you re-activated a proposal to introduce the red alga, Porphyra yezoensis, to the coastal waters of New Brunswick. I understand you are seeking a response that your American representative can take to the ICES Working Group on Introductions and Transfers of Marine Organisms in April. My staff have reviewed the extensive material you provided as well as have benefited from telephone conversations with you in order to develop the Canadian position.

I understand the red alga has been cultured in the international boundary environment and, if the marine plant can survive in that environment, the red alga may already be a member of the local ecology. Our approval of a fait accompli is not necessary.

My Department is interested in promoting the aquaculture industry, and it appears that nori production may have considerable potential to that end. Therefore I will be authorizing your importation of nori nets for trials at the two grow-out sites in 1993. The documentation is being prepared and will be forwarded to you shortly.

Yours sincerely,

Neil A. Bellefontaine
Regional Director-General
Scotia-Fundy Region

Canada

Bigelow Laboratory for Ocean Sciences
P.O. Box 475, McKown Point, West Boothbay Harbor, Maine 04575-0475 207-633-2173
Telex 333024 (Bigelow)

19 February 1993

Greetings:

Upon the request of Steven Crawford of IMR, I have conducted tests upon a strain of *Porphyra* provided by Mr. Crawford to determine whether any contaminating organisms where present with the algae. Based on microscopic examination and on the negative results of 6 bacteria and fungal test media (including peptone and malt solutions) which had been inoculated with *Porphyra* filament fragments, I conclude that this culture is free of either bacteria or fungi.

Sincerely,

Dean Jacobson

Dean M. Jacobson, PhD,
curator, Provasoli-Guillard Center for Culture of Marine Phytoplankton.

13965 64th Avenue
Surrey, British Columbia
Canada V3W 1Y7
12 April 1992

Mr. Steve Crawford
IMR - Rte 1, Box 97
Eastport, Maine 04631

Dear Mr. Crawford:

I am writing you to confirm our conversation of April 10 in which you asked me whether Porphyra yezoensis had escaped cultivation in Washington or British Columbia. As I stated then, to my knowledge it has not. In the manuscript I submitted to the Canadian Journal of Botany on revision of Porphyra in British Columbia and adjacent waters, I state:

> Although the possibility exists that one or more of the species of Porphyra discussed above is introduced (Lindstrom 1991), we have not been able to confirm the identity of any local species with an exotic species. In particular, we did not obtain any zymograms resembling those of P. yezoensis Ueda, which is the putative name of the species that has been cultivated intermittently in local waters for the past decade (Lindstrom 1989, 1990; Merrill 1990).

Enclosed with this letter is a list of recent published and not-yet-published papers on my work on Porphyra. I also include the references for the papers cited above.

Please let me know if I can be of further help.

Sincerely,

Sandra Lindstrom

Sandra C. Lindstrom, Ph. D.

THE UNIVERSITY OF BRITISH COLUMBIA

Department of Botany
#3529 - 6270 University Boulevard
Vancouver, B.C. Canada V6T 1Z4
Tel: (604) 822-2133
Fax: (604) 822-6089

17 February 1993

Mr. Steve Crawford
Coastal Plantations
11 Madison Street
Eastport, Maine 04631

Dear Steve:

I am sending reprints of two papers with this correspondence. The first, by Seibin Arasaki, from the Proceedings of the 8th International Seaweed Symposium, states on p. 276 that Japanese species of Porphyra, including P. yezoensis, have an upper lethal temperature of 25 C. In Japan, nets seeded with spores of P. yezoensis are not put into the ocean until the seawater temperature has dropped below 23 C so I assume that the upper lethal temperature for the thallose phase of P. yezoensis actually falls somewhere between 23 and 25 C.

In the second paper, by myself and Dr. Cole, we state at the very end that there is no evidence that P. yezoensis has escaped cultivation in British Columbia or northern Washington based on our field surveys.

Please don't hesitate to contact me if I can provide you with further information.

Sincerely,

Sandra Lindstrom

Sandra Lindstrom, Ph. D.

AVERAGE WEEKLY WATER TEMPERATURES FOR 1989-1992

Blacks Harbour, New Brunswick Canada

DATE	1989	1990	1991	1992	
JAN	3.0	1.6	4.3	4.1	
	2.9	2.2	2.7	2.9	
	2.2	2.2	2.3	2.2	
FEB	1.7	1.3	3.0	1.2	
	1.2	1.3	3.0	0.4	(-0.2 LOW)
	0.8	0.9	2.7	1.5	
MAR	0.6	0.9	2.9	1.2	
	0.8	1.7	3.6	1.2	
	1.3	1.9	3.9	1.4	
APR	2.0	1.8	4.5	2.1	
	2.3	3.2	4.8	2.2	
	3.3	4.0	5.4	2.9	
MAY	4.5	4.8	5.6	3.5	
	6.9	6.1	5.7	4.5	
	7.4	5.8	6.3	5.8	
JUNE	7.2	7.0	6.8	6.5	
	8.4	8.3	7.6	7.4	
	9.5	8.2	7.5	8.6	
JULY	9.9	10.2	10.6	8.7	
	10.7	10.7	10.4	9.3	
	11.1	11.2	11.8	10.1	
AUG	11.9	12.6	12.2	9.8	
	12.6	13.2	12.5	11.2	
	12.1	11.9	12.6	10.9	
SEPT	12.4	13.6	12.0	11.2	
	13.1	12.1	12.1	11.2	
	11.8	11.9	11.5	11.1	
OCT	10.7	11.7	11.3	10.1	
	10.2	11.1	10.9	10.1	
	10.4	10.0	10.2	9.4	
NOV	ERR	9.1	9.4	8.3	
	ERR	7.4	8.2	7.7	
	6.6	7.1	8.1	7.2	
DEC	4.9	6.7	6.7	6.1	
	3.6	5.5	5.4	5.7	
	2.0	5.3	4.1	4.6	

Seawater temperatures throughout the year on the continental shelf of the northeastern US. GOM = Gulf of Maine; CC = Cape (latitude 39° 15 N); CH = Cape Hatteras (latitude 37° 15 N).

	January	April	July	October
Surface				
GOM	2.0-7.0	4.0-6.0	10.0-17.5	11.0-14.0
CC	2.5-12.5	5.0-10.0	17.5-25.0	15.0-17.5
CH	7.5-12.5	7.5-10.0	22.5-25.0	20.0-22.5
Bottom				
GOM[a]	5.0-7.0	4.0-5.0	5.5-8.0	8.0-11.0
CC	2.5-12.5	5.0-11.0	12.5-25.0	12.5-15.0
CH	7.5-12.5	7.5-12.5	10.0-17.5	12.5-20.0

[a] Depth of 50 m.

Note: Temperatures in the Bay of Biscay (near latitude 46° 20 N) are similar to those near Cape Cod (39° 15 N).

Sources:

Colton, J.B., and R.R. Stoddard. 1972. Average monthly sea-water temperatures Nova Scotia to Long Island 1940-1959. Serial Atlas of the Marine Environment. Folio 21. American Geographical Society.

Fuglister, F.C. 1960. Temperature and salinity profiles and data from the International Geophysical Year of 1957-1958. Woods Hole Oceanographic Institute.

Walford, L.A., and R.I. Wicklund. 1968. Monthly sea temperature structure from the Florida Keys to Cape Cod. Serial Atlas of the Marine Environment. Folio 15. American Geographical Society.

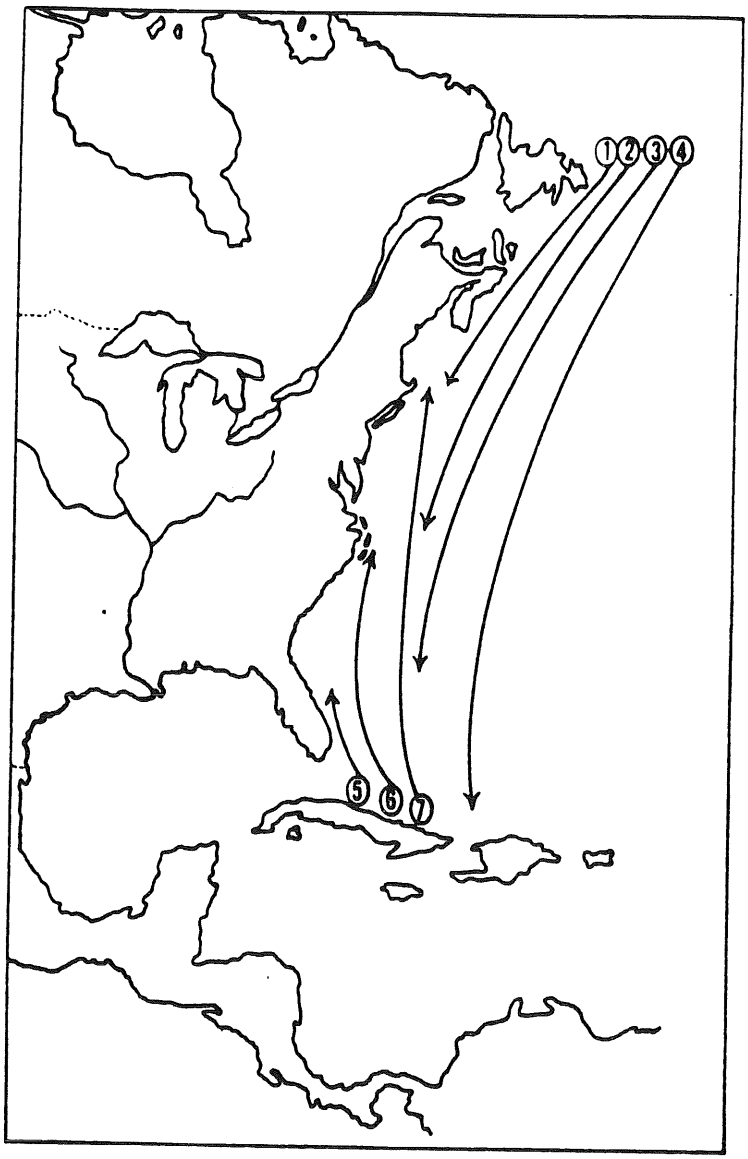
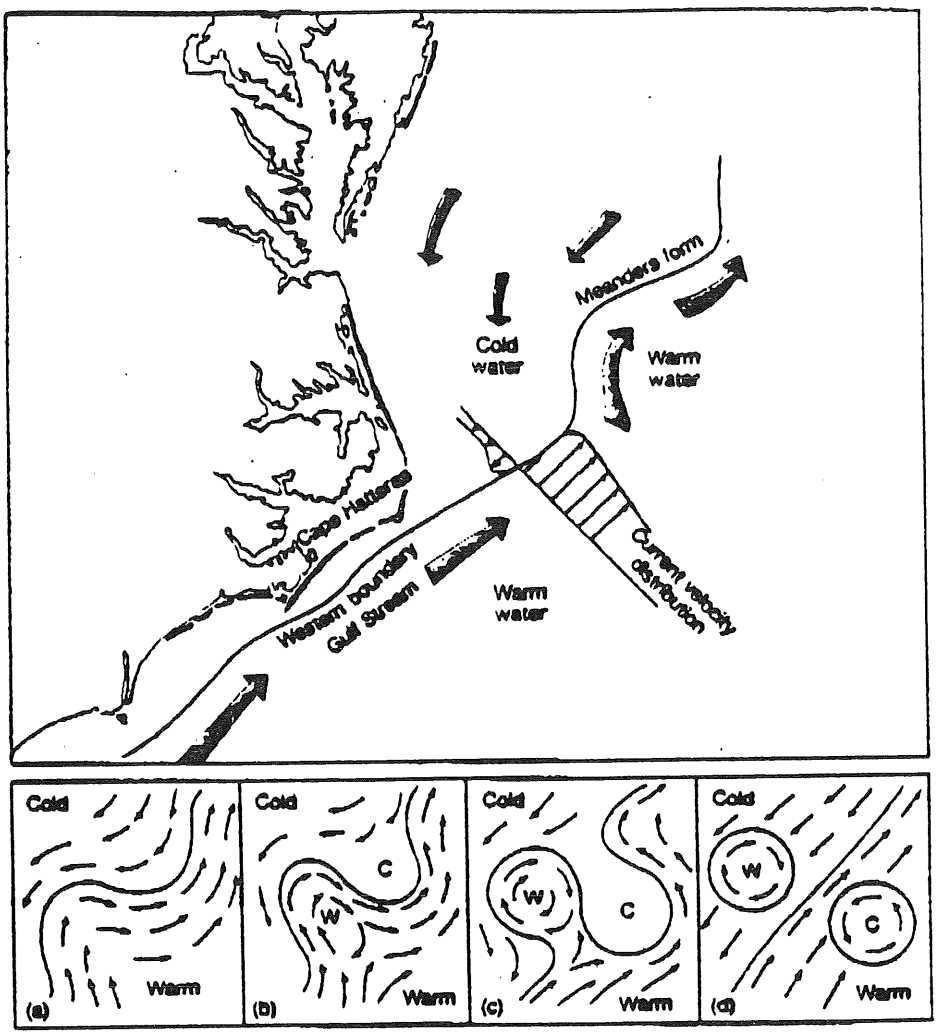


Fig. 1. Diagrammatic representation of the distribution of the inshore marine algae of the Atlantic coast of North America in which seven distributional groups are recognized. The algae of the Atlantic coast of North America are divisible into two floras, one centered in tropical waters, the other in cold waters north of Cape Cod. Species that occupy the coastal waters between Cape Cod and Cape Kennedy are representatives of the more eurythermal elements of the two floras.

(Humm, 1969)



(Duxbury and Duxbury, 1989)

APPENDIX V.

INTRODUCTION DU PETONCLE AMERICAIN *Argopecten irradians* EN FRANCE

DAO J.C., J. BARRET, J.C. COCHARD et S. LE BOUQUIN

RESUME

Il faut rechercher des espèces nouvelles qui présentent les avantages de répondre à la demande française et pouvoir constituer une alternative à la conchyliculture actuelle très vulnérable.

Argopecten irradians a été identifiée comme une espèce répondant aux deux critères énoncés précédemment. Elle vit dans des biotopes analogues à ceux rencontrés sur les côtes atlantiques et méditerrannéennes et s'élève avec des techniques proches de la conchyliculture traditionnelle.

Il est donc proposé d'introduire l'espèce pour réaliser les premiers tests biologiques démontrant son intérêt. Ce type de programme a déjà été conduit au Canada et en Chine où il a développé dans ce dernier pays une production de 50 000 tonnes/an en quelques années.

Les conditions d'introduction de cette espèce satisferont aux normes définies par le Groupe de Travail CIEM sur "l'Introduction et le Transfert des Organismes Marins".

TERMES DE REFERENCE

1 - Introduire l'espèce américaine de pectinidés, *Argopecten irradians*, appelée "bay-scallop", en France dans les conditions requises par le groupe de travail ad-hoc du CIEM.

2 - Réaliser les examens préventifs et placer les reproducteurs introduits sous élevage en quarantaine totale.

3 - Détruire les reproducteurs introduits dès l'obtention d'élevages larvaires de bonne qualité pouvant constituer la base d'une première génération.

4 - Suivre les performances des juvéniles et les effets secondaires éventuels consécutifs à l'introduction des F1 dans les écosystèmes français.

JUSTIFICATION

L'introduction d'*Argopecten irradians* correspond à un besoin de diversification des espèces cultivées en mariculture. La production française est en effet une monoculture de *Crassostrea gigas* et tout agent pathogène nouveau serait une catastrophe pour l'activité économique et sociale.

Par ailleurs, la France est un grand consommateur de pectinidés, et plusieurs espèces sont exploitées. La coquille St Jacques, *Pecten maximus*, fait l'objet d'une pêche intensive insuffisante pour la satisfaction du marché français. Les importations sont très importantes : plus de 45 000 tonnes par rapport à la production de 5 à 10 000 tonnes (équivalent produit frais avec la coquille). Le prix est élevé, près de 5 F/coquille payé au pêcheur. D'autres pectinidés occupent des créneaux de marché concurrents des huitres comme le pétoncle noir *Chlamys varia*, mais les volumes sont très limités et les perspectives réduites.

La coquille St Jacques, *Pecten maximus*, a fait l'objet de programmes intensifs de recherche depuis 15 ans en France, autant en halieutique qu'en aquaculture du fait de son importance socio-économique. Il a été mis en évidence que la ressource est extrèmement fluctuante, et qu'il était possible de valoriser les gisements naturels par apport de juvéniles. Mais cette technique ne concerne que les élevages sub-tidaux en culture sur le fond. Ce type de culture répond très mal aux demandes de la conchyliculture.

La présente demande d'introduction doit répondre au double critère de constituer une alternative - partielle - à la monoculture conchylicole actuelle et à l'importation systématique de chair de pectinidés. Elle reprend le protocole défini en 1986 pour l'importation de *Patinopecten yessoensis* (Annexe 3).

Les élevages ont démontrés que les cultures suspendues de coquille St Jacques sont difficilement compétitives sur le plan économique du fait des critères comportementaux de l'animal. C'est pourquoi une espèce apparemment plus adaptée mérite d'être testée.

INTERET D'*Argopecten irradians* POUR LA CONCHYLICULTURE (Annexe 1)

Le développement de l'espèce se fait dans des conditions très variées de température et de salinité, respectivement de 5 à 30°C et de 14 à 33 %°,avec une forte tolérance aux variations rapides de ces deux facteurs. L'espèce est présente en eau peu profonde et colonise les zones d'herbiers.

Ces conditions se retrouvent dans les zones conchylicoles françaises, dont les zones estuariennes, les étangs littoraux, les marais et claires constituent des surfaces potentielles d'élevage.

La vitesse de développement de l'animal (cycle d'élevage en 12 à 18 mois) rend ce pétoncle particulièrement compétitif des autres bivalves élevés.

Les techniques d'élevage en écloserie sont identiques à celles utilisées pour les autres espèces de pectinidés et particulièrement le pétoncle noir *Chlamys varia*, et la coquille japonaise *Patinopecten yessoensis*.

L'introduction de cette espèce offre donc les meilleures probabilités de réussite biotechnique, au moins pour la zone entre le Sud de la Bretagne et la Méditerrannée.

MESURES PREVENTIVES AVANT TRANSFERT (Annexe 3)

A. irradians regroupe en fait trois sous-espèces qui se distribuent sur la côte atlantique des Etats Unis entre les lattitudes 26 et 42° Nord. La première opération consistera en une enquête sur place pour comparer les différentes populations. Le choix dépend de deux critères :

1 - performances zootechniques des animaux dans différentes conditions d'élevage.

2 - qualités zoosanitaires du cheptel disponible.

Pour ce second critère, un échantillon de 30 individus pour chaque sous-population sélectionnée sera réalisé et envoyé en France pour étude histologique au laboratoire IFREMER de pathologie des mollusques.

Un échantillon, après examen macroscopique sur la présence de parasites ou de lésions, est composé de deux fractions : un morceau de la glande digestive et un fragment de branchies fixé au glutaraldéhyde en présence de tampon de cacodylate de sodium pour des observations au microscope électronique. La seconde fraction est composée de tissus provenant du manteau, du muscle adducteur et de la gonade fixée dans du Davidson pour examen histologique en microscopie photonique après coloration au trichrome de Masson et/ou à l'hémalum-éosine.

TRANSFERT ET CONDITIONNEMENT DES REPRODUCTEURS (Annexes 2 et 3)

Après sélection de la sous-population le transfert portera sur 200 adultes en boite isotherme maintenue à 4°C. Le laboratoire de réception en France est celui de pathologie des mollusques à la station IFREMER de La Tremblade, qui est équipé d'une installation d'élevage en quarantaine. Les animaux séjourneront un mois pour observations.

La salle de quarantaine comporte des bacs d'élevage de 800 litres et des raceways, ce qui permet de suivre plusieurs conditions de stabulation. L'eau est recyclée sur filtre biologique avec un apport additionnel permettant un renouvellement complêt par 24 heures. Le bac d'évacuation comporte un bromostat qui assure la destruction complète de la matière organique. L'alimentation est assurée par une distribution en continu d'un mélange de microalgues.

Les animaux seront par la suite transférés à l'écloserie expérimentale d'Argenton près de Brest ou des précautions équivalentes seront maintenues durant le conditionnement des géniteurs.

Deux bacs de 700 litres avec filtre biologique seront utilisés. Les arrivées d'eau permettent un renouvellement complet au rythme de 3 fois par semaine. La température sera ajustée aux besoins de la souche utilisée en accord avec les normes appliquées dans les écloseries américaines. Le conditionnement sera réalisé dans une pièce à accès limité au personnel qualifié et les effluents collectés dans un bassin de quarantaine de 10 m3 où ils seront traités au chlore.

Les géniteurs seront détruits après la production de larves de bonne qualité.

PROGRAMME PREVISIONNEL D'ELEVAGE (Annexe 2)

Le programme reprend celui qui a été développé pour l'espèce voisine *Chlamys varia*, qui nécessite des structures d'élevage identiques, mais qui a présenté des performances zootechniques insuffisantes pour que le développement aquacole fasse suite rapidement.

La première année consistera à assurer une production à l'écloserie d'Argenton de larves et de postlarves (2 à 5 mm), en suivant les protocoles d'élevage couramment appliqués sur les espèces françaises (*P. maximus*, *C. varia*) mais aussi japonaise (*P. yessoensis*). Arrivés à ce stade, les juvéniles seront placés en mer en structures immergées, dans des casiers à petit maillage, sur la station sous-marine du Centre IFREMER de Brest.

Au-delà de 10 mm, les survivants seront distribués aux stations IFREMER de La Trinité/mer, Bouin, La Tremblade et Palavas pour des essais comparés de grossissement en poches ostréicoles. Les animaux feront l'objet d'un suivi zoo-sanitaire selon un protocole encore à définir avec le laboratoire de pathologie.

Le cycle d'élevage d'un an est satisfaisant pour cette espèce dont la croissance est particulièrement rapide. Il permet de tester le développement dans les différentes conditions climatiques de l'année et sur différents sites, et d'analyser au printemps le début de la maturation lors de la reprise du réchauffement de l'eau de mer.

Les expériences IFREMER feront l'objet d'un bilan au terme des 12 mois d'exercice, avant l'utilisation de la première génération comme géniteurs à Argenton.

CONSEQUENCES ULTERIEURES DE L'INTRODUCTION *A. irradians*

L'application d'un protocole d'élevage limité à un an est une garantie de non-dissémination de l'espèce au cours du programme d'introduction puisqu'il est prévu retirer les animaux avant leur première ponte.

Toutefois la question des conséquences écologiques de l'introduction mérite d'être posée pour le développement ultérieur du programme si les bons résultats attendus se vérifient :

- performances en écloserie et en grossissement (croissance, survie, facilité de manutention)
- taille du muscle et développement de la gonade pour le marché français
- bonnes réactions des consommateurs français devant un produit nouveau.

En cas d'insuffisance des résultats, le protocole de la première année pourrait être reconduit et appliqué à la seconde génération.

L'élevage d'*A. irradians* dans un stade ultérieur pourrait faire l'objet de cultures suspendues avec le contrôle du cheptel et la vente étalée sur la deuxième année (durée de vie de l'animal). On ne peut exclure qu'il y ait reproduction dans le milieu naturel puis interactions avec la faune indigène. L'hybridation naturelle est cependant exclue puisque les espèces de la même famille ont un nombre différent de paires de chromosomes.

La gestion à long terme d'*A. irradians* ne se posera qu'en fin du programme d'introduction s'il s'avère intéressant de passer à l'échelle commerciale. Il est certain que l'on retrouvera tous les problèmes généraux de la conchyliculture face au développement d'une espèce. Mais ce pétoncle semble pouvoir se reproduire facilement en écloserie et l'intervalle entre les générations est très court. C'est donc en restant très exigeant pour l'application d'une politique de quarantaine et de production en écloserie qu'on apportera les meilleures garanties d'importation d'espèces indésirables (parasites, pathogènes, prédateurs, mais aussi épibiontes ou spores de dinoflagellés).

DOCUMENTS EN ANNEXE

1 - Synthèse des connaissances sur *A. irradians*
2 - Techniques d'élevage d'*A. irradians*
3 - Rapport sur l'introduction de la coquille japonaise *Patinopecten yessoensis*.
4 - Bibliographie sur *A. irradians* (1978-1992)

APPENDIX VI.

A workshop on

NONINDIGENOUS ESTUARINE & MARINE ORGANISMS

Seattle, Washington
April 20-22, 1993

Edgewater Inn

AGENDA

Monday, April 19th

3:00-6:00 pm **Registration**

Tuesday, April 20th

7:30-8:00 am **Registration - *Rainier Room***

8:00 am **Welcome and Opening Remarks** *David Cottingham*
White House Office of Environmental Policy,
co-chair Aquatic Nuisance Species Task Force

Aquatic Nuisance Species Task Force Activities
Gary B. Edwards, U.S. Fish and Wildlife Service,
co-chair Aquatic Nuisance Species Task Force

Keynote Address: Biological Invasions in the Sea - *James Carlton*, Maritime Studies Program, Williams College and Chairman, ICES Working Group on Introductions of Marine Organisms

9:10 am ***SESSION I Presence, Distribution and Effects***
Chair: *John W. Chapman*, Oregon State University

Biological Invasions - *James Drake*, University of Tennessee

Are We Underestimating the Number of Introduced Species? - *John W. Chapman*, Oregon State University

9:55 am **Break**

European Problems and Concerns - *Canice Nolan*, Commission of the European Communities, Environment Research Program, Belgium

The Invasion of the Black Sea and the Mediterranean by the American Comb Jelly Mnemiopsis - *Richard Harbison*, Woods Hole Oceanographic Institution

The Baltic and the Black Sea - Seriously Contaminated by Nonindigenous Species? - *Erkki J. Leppäkoski*, Åbo Akademi University, Finland

11:15 am Break into Working Groups Facilitators: Chapman, Gottingham and Nolan

12:15 pm Lunch (on your own)

1:30 pm ***SESSION II Pathways of Introduction and Dispersal Mechanisms***
Chair: *Elliott Norse*, Center for Marine Conservation

Global Dispersal Mechanisms - *James Carlton*, Williams College

Nonanthropogenic Dispersals and Colonization in the Sea *Joel Hedgpeth*, Santa Rosa, California

Ballast Water as a Vector for the Dispersal of Toxic Dinoflagellates - *Christopher J. S. Bolch*, CSIRO Division of Fisheries, Tasmania

The Aquarium Industry: Volume of Fish Species Being Introduced and the Variety of Organisms Associated with Them - *Marshall Meyers*, Pet Industry Joint Advisory Council

Real and Perceived Risks From Aquaculture - *Ralph Elston*, Battelle Marine Sciences Laboratory

3:00 pm Break into Working Groups (Coffee and cookies during working group session) Facilitators: Bolch, Edwards and Norse

4:10 pm Discussion and Group Reports

6:30 pm **Welcome Reception and Dinner** in *Olympic Room*

8:00 pm **After Dinner Speaker**, *Joel Hedgpeth*, Santa Rosa, California

Wednesday, April 21st

8:30 am ***SESSION III Research - Monitoring, Strategies and Control***
Chair: *Michael Crosby*, National Ocean Service

Opportunities for Research: Monitoring in Sanctuaries and Reserves - *Michael Crosby*

Status of Australian Ballast Water Research Program - *Geoff Rigby*, BHP Research Newcastle Laboratories, Australia

Current Protocol on Research Strategies - *James A. McCann*, National Fisheries Research Center

Research Strategies and Protocols Established for International Shellfish Introductions - *Fred Kern*, National Marine Fisheries Service

9:50 am Break

International Maritime Guidelines on Ballast Water Discharge, *Darrell Brown*, Environmental Protection Agency

Utilization of Alien Algal Species by Sea Turtles - *Dennis J. Russell*, Everett Community College

10:50 am Group Discussion: Comments from the Floor

11:10 am Introduction to Field Trip

11:20 am Lunch (on your own)

12:45 pm **Field Trip** - Board Bus at Entrance to *Edgewater Inn* Depart for Port of Tacoma Facilities Tour and Visit to Mariculture Facility and to float fouling communities

8:45 pm Arrive at the *Edgewater Inn*

Thursday, April 22nd

8:30 am *SESSION IV Mitigation and Response Strategies*
Chair: *Ralph Elston*, Battelle Marine Sciences Laboratory

Potential Uses for Biological Control of Alien Marine Species - *Kevin D. Lafferty*, University of California at Santa Barbara

Model Plan for West Coast Shellfish Transfers - *Ralph Elston*, Battelle Marine Sciences Laboratory

Policies, Legislation, and Other Activities Related to Nonindigenous Marine Organisms in the State of Hawaii - *Bruce C. Mundy*, National Marine Fisheries Service

Best Management Practices in Aquaculture - *Michael Rubino*, Bluewaters Inc. and Palmetto Aquaculture

9:50 am Break

A Risk Assessment Process for Evaluating Nonindigenous Organisms - *Richard L. Orr*, Animal and Plant Health Inspection Service

A Safe Minimum Standard Approach to Exotic Invasions - *Michael H. Thomas*, Ohio State University

Pathways for Education Activities for Marine Nonindigenous Species - *Jack Whetstone*, South Carolina Marine Extension Program

11:05 am Group Discussion: Comments from the Floor

11:30 am Closing Remarks: James Carlton and David Cottingham

12:00 pm Adjourn

APPENDIX VII.

Genetic and ecological interactions of cultivated and wild populations; some ongoing projects at The Institute of Marine Research, Bergen, Norway

Following the rapid expansion in Norwegian fish farming during the 1980's, there was a recognition of a lack of scientific knowledge about the genetic and ecological interactions between cultivated and wild organisms. Gradually, one has realized that the category "cultivated" is not restricted to farmed fish, but may also contain ocean ranched fish as well as transgenic organisms. Furthermore, many of the questions associated with genetic and ecological effects of mixing cultivated and wild populations are also associated with interactions between genetically distinct wild populations. Such interactions between wild populations is a common natural and dynamic phenomenon. However, as a consequence of induced climatic and environmental changes, a change in the geographical distribution of many species and populations is expected to result in an increase in the number and intensity of genetic and ecological interactions between species and populations. To be able to distinguish between serious consequences (ie. exclusion, extinction etc.) and fiction, and to enable a prediction of effects, it is more than ever important to vitalize research on genetic and ecological interactions between populations, be they wild or cultivated.

The population genetic research on marine populations that was initiated at the Institute of Marine Research about 1960, constituted a foundation for the recent research on genetic population structure and taxonomy of marine species, and on genetic and ecological interaction between wild and cultivated populations. Through a collaboration with Andrew Ferguson and his group at the Queens University of Belfast, DNA fingerprinting methods have been incorporated in the research on genetic variability. Genetic marking plays an important part in several of the projects.

Genetic impact of introduced fish; brown trout (Salmo trutta L.) as a model

This experiment was initiated in 1986 by a screening for genetic markers in brown trout. In autumn 1989 genetically marked spawners reared at the Institute of Marine Research were released into the spawning areas of two wild trout populations in River Øyreselv. Thee was a transfer of genetic material from introduced reared trout into both of the wild populations although the spawning success of reared spawners were significantly lower than that of wild trout. The genetic and ecological characteristics of the populations and the 1990 year-class that received the gene pulse from introduced trout are still recorded and compared to the pre-manipulated condidions. The frequency of the introduced genetic material has been declining during 1991 and 1992.

Genetic impact on wild salmon (*Salmo salar* L.) stocks from ocean ranching

Wild and farmed populatinos of Atlantic salmon have been screened for genetic markers in 1990, 1991 and 1992. Genetically marked smolts have been released in a small stream with a wild salmon stock to study genetic and ecological effects of ocean ranching. DNA fingerprinting methods including single locus probes are incorporated in the project. Released genetically marked salmon will return in 1993 and 1994. The spawners will be counted and classified as wild or ocean ranched, genotyped and released back in the river. Frequencies of alleles and distribution of genotypes will be recorded in the F1 generation.

Fitness and selection coefficients for the various categories will be calculated, and the degree of species hybridization between salmon and trout as a result of ocean ranching will be recorded.

Genetic contribution of released cod (*Gadus morhua*) to wild stock

A genetically marked strain of cod has been reared at the institute for various experimental studies. In 1990 and 1991 a large number of fry was released in the Masfjorden area where there is a wild cod population. Released individuals have been detected in catches, and after the maturation and spwning in 1993, spawning success and genetic contibution of released cod to the wild population will be estimated. This is a joint project between the Institute of Marine Research and the Institute of Fisheries and Marine Biology at the University of Bergen.

Population genetics and stock enhancement in lobster (*Homarus gammarus*)

For several decades lobster of Scottish and Norwegian stocks has been released along the coast of Norway for commersial purposes. In 1992 a study on the genetic population structure of Norwegian lobster was initiated in areas with releases as well as in areas without introductions. Both isozyme variability and DNA fingerprinting is emploied to obtain information about the possible genetic effects of introduced Scottish lobster in Norway.

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