#### This report not to be quoted without prior reference to the Council\*

International Council for the Exploration of the Sea

C.M.1992/POLL:3

Ref.: F

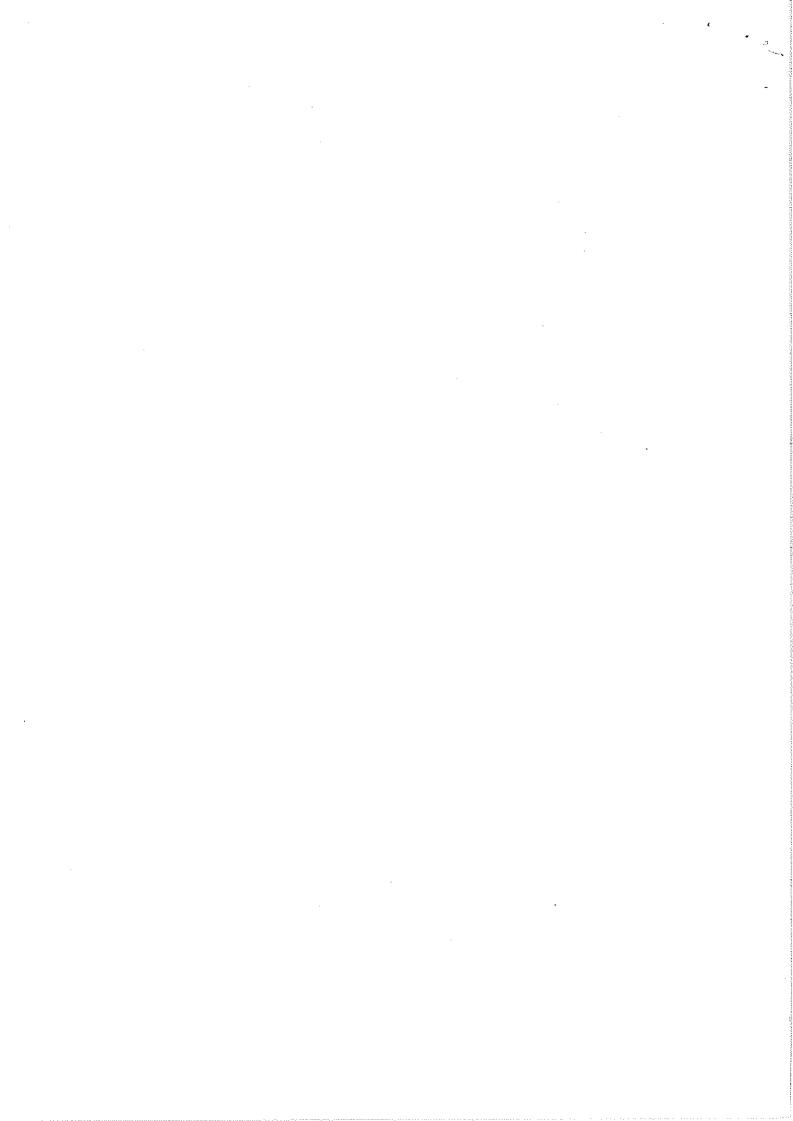
Sess. O

# REPORT OF THE WORKING GROUP ON INTRODUCTION AND TRANSFERS OF MARINE ORGANISMS

Lisbon, 14 - 17 April 1992

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.

\*General Secretary ICES Palægade 2-4 DK-1261 Copenhagen K DENMARK



### TABLE OF CONTENTS

1992 HIGHLIGHTS	i
INTRODUCTION	1
STATUS OF WG RECOMMENDATIONS FOR 1991	<b></b> 1
THE 1992 HANDBOOK	2
ACMP AS THE WG'S NEW PARENT COMMITTEE	2
RESULTS FROM THE JOINT MEETING WITH THE WG ON GENETICS, 1991	3
RESULTS FROM THE STUDY GROUP ON THE RISKS OF INTRODUCTIONS OF NON-INDIGENOUS SPECIES BY BALLAST WATER, 1991	
CURRENT STATUS OF THE ICES CRR TEN YEAR REVIEW	
REVIEW OF THE LAWS AND REGULATIONS Governing Introductions and Transfers of Marine Organisms in ICES Member Countries: A Proposed Document	. 4
NATIONAL REPORTS: Highlights	4
(In full, Appendix IV)	••
Errata to WGITMO 1991 Report, Helsinki	
Revised Guidelines for National Reports(Appendix V)	(
STATUS REPORTS	6
Japanese brown alga, Undaria pinnatifida, in Spain	
Japanese scallop, Patinopecten yessoensis, in Ireland	
Green alga, Caulerpa taxifolia, in the Mediterranean	
Japanese brown alga, Sargassum muticum, in Europe	
Zebra mussel, Dreissena polymorpha, in the USA and Canada	
PLANNED INTRODUCTIONS	;
Japanese seaweed, Porphyra yezoensis, to Maine, USA	
Pacific chinook salmon, Oncorhynchus tshawytscha, to New Jersey, USA	
Japanese oysters, Crassostrea gigas, to New Jersey, USA	
American bay scallop, Argopecten irradians, to France	
MODIFICATIONS TO THE CODE OF PRACTICE	
Modifications suggested by WGPDMO	
Modifications based on 1991 Joint Meeting with the Working Group on Genetics	
Additional modifications to the 1000 Code of Practice	

NEW ICES COOPERATIVE RESEARCH REPORT	14
ANNOTATED BIBLIOGRAPHY ON TRANSPLANTATIONS AND TRANSFERS OF AQUATIC ORGANISMS	14
RECOMMENDATIONS	15
BIBLIOGRAPHY	16
APPENDIX I. Agenda of the Meeting	
APPENDIX II. The Dispersal of Sargassum in ICES countries (By Inger Wallentinus)	
APPENDIX III.  Documents on the Proposed Introduction of the Japanese red alga <i>Porphyra</i> to the Atlantic coast of the United States	
APPENDIX IV. National Reports Note on Report Format	
APPENDIX V. Revised Guidelines for Preparation of "National Reports"	

#### 1992 HIGHLIGHTS

#### The Working Group:

\* Voiced concern that the changing of its parent committee from Mariculture to ACMP would inadvertently indicate that ICES regards the introduction and transfer of marine organisms as a form of "pollution", a conclusion of possible detriment to aquaculture and mariculture interests. The WG recommended that ICES consider reinstatement of Mariculture as its parent committee.

> See pages 2 - 3

Completed work on the "Revised 1992 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 ACMP 1992/7.3), and recommended that its adoption.

> See page 11-14

Completed work on the "Status (1990) of Introductions of Non-Indigenous Marine Species to North Atlantic Waters", for a <u>Cooperative Research Report</u>, as set forth in C. Res. 1989/1:1.

> See page 4

\* Acted upon a request received by ICES from the State of Maine and considered the proposed introduction of the Japanese red alga *Porphyra yezoensis* to the Gulf of Maine. The WG found that insufficient information was provided relative to the potential spread of this species, especially to more southern waters, and requested that such information be provided by the parties involved.

> See pages 8-9

Proposed that a major new document be prepared as a CRR, to be 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", being an extensive revision of CRRs 130 and 159, with the new CRR to also include a model procedure, the ICES Code of Practice in all ICES languages, and a brief summary of other international codes.

> See page 14

#### Found that,

- the zebra mussel *Dreissena*, introduced from Europe to North America by ballast water, continues to be a major economic and ecological problem; extensive studies are underway in the United States, Australia, and elsewhere on preventing future introductions by ballast water and sediments
- ~ the toxic tropical alga Caulerpa taxifolia is spreading west through the Mediterranean
- the Japanese alga Sargassum muticum continues to spread along the Swedish and Portuguese coasts
- the Japanese scallop Patinopecten yessoensis remains in small quantities in hanging culture in Ireland and are expected to come into spawning condition, while the French propose to introduce the American bay scallop (Argopecten irradians) its potential for aquaculture.
- an exceptional bloom of the dinoflagellate *Dinophysis acuta* was reported in February 1992 in Norway; it is believed to be a ballast water introduction from Britain.
- the release of Pacific chinook salmon in New Jersey U.S.A. is under study,
- the proposed introduction of the Japanese oyster Crassostrea gigas, remains a matter of heated debate on the Atlantic coast

#### WORKING GROUP ON INTRODUCTIONS AND TRANSFERS OF MARINE ORGANISMS

Report of a meeting held 14 April - 17 April 1992 in Lisbon, Portugal.

#### INTRODUCTION

The 1992 meeting of the ICES Working Group on Introductions and Transfers of Marine Organisms (hereafter WG) was held at the Instituto Nacional de Investigação das Pescas (INIP), Lisbon from April 14 to April 17 1992. Fifteen participants representing 8 member countries were present:

J. Carlton USA (Chairman) T. Carey Canada Canada R. Dermott R. Rahkonen Finland H. Grizel France D. Minchin Ireland G. Cabecadat Portugal M. Figueiredo Portugal M. Brogueira Portugal F. Ruano Portugal B. Dybern Sweden B. Holmberg Sweden I. Wallentinus Sweden A. Munro UK S. Utting UK (Rapporteur)

National reports were received by FAX from Spain and Norway. The members of the WG were welcomed by Maria Figueiredo and Nelson Duarte of INIP. The Chairman thanked the officials of INIP for coordinating and hosting the meeting and for providing its facilities. The Chairman then reviewed the objectives of the WG's 1992 meeting; the agenda for the meeting was considered and approved (Appendix I).

#### STATUS OF WORKING GROUP RECOMMENDATIONS FOR 1991

The Chairman reviewed the status of the recommendations formulated at the last meeting of the WG in Helsinki, Finland in June 1991 (1991 Report, C.M. 1991/F:44) and submitted for consideration at the Statutory Meeting of ICES in La Rochelle in October 1991:

#### Recommendation 1

That the recommendations from the Study Group to Assess the Risks of Introductions of Non-indigenous Species by Ballast Water (C.M. 1991/F:46) be adopted.

#### Recommendation 2

That the "Revised 1991 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" (C.M. 1991/F:47) be adopted.

#### Recommendation 3

That the Council encourages all ICES member states to have scientific representation on international and national councils which make decisions on whether or not to release GMOs to the natural environment.

#### Recommendation 4

That the recommendations from the Study Group on Genetic Risks to Atlantic Salmon Stocks (C.M. 1991/M:3) be considered by the Council.

> Rec. 1-4 not adopted as Resolutions

#### Recommendation 5

That a special "Theme Session on Stock Enhancement" be held.

> Council recommended that this session be held during the 1993 Statutory Meeting in Dublin. The convener will be Josianne Stottrup, Danish Institute for Fisheries and Marine Research.

#### Recommendation 6

That the WG meet in 1992 in Portugal to consider extensive modifications to the Code of Practice proposed by the WG on Pathology and Diseases of Marine Organisms; to consider modifications, revisions, and additions to the Guidelines for Implementing the Code and the Manual of Procedures as a result of proposals by the WG on Pathology and Diseases of Marine Organisms and as a result of the new EEC regulations and subsequent legislation; to prepare material for "1992 Summary of the Laws and Regulations Governing the Introductions and Transfers of Marine Species in ICES Member States"; to assess the status of introductions and transfers in Portugal and Spain; to consider the release of the Asian red alga *Porphyra* on the Atlantic coast of the USA; to review the structure, formulation and submission of annual National Reports; and to continue to review and assess the status of salmonid fish, algal, shellfish and other introductions in and between ICES member countries.

> C. Res. 1991/2:32:11

# INTRODUCTION OF THE 1992 HANDBOOK OF THE WG ON INTRODUCTIONS AND TRANSFERS OF MARINE ORGANISMS

The first Handbook was produced in 1990 for the meeting in Halifax. This second edition contains the history of the WG, the venues of the meetings, a statement of the Wgs purpose (terms of reference and operating principles), the Code of Practice for introductions, WG publications and a synopsis of Council resolutions from the WG (1969-1991). The handbook served as a reference document throughout the 1992 meeting, and sets an example that other ICES Working Groups might follow. It may be necessary to update the handbook every two years.

#### ACMP AS THE WG's NEW PARENT COMMITTEE

The WG noted that ACMP, through action by the Consultative Committee and decision by the Council, was the new parent committee of the WG. The WG was unclear as to the reason(s) for this change since the WG throughout its history has dealt with items not directly related to pollution. During discussions that ensued the WG noted several concerns relative to this new action.

In particular, the WG noted that ICES, by issuing its advice through the Advisory Committee on Marine Pollution, may inadvertently be creating the impression that it considers the movement of species for aquaculture purposes to be in the realm of pollution. While there are many examples of introduced species that have demonstrably caused biological and ecological problems in their new environments, even these phenomena have rarely been considered as examples of marine pollution per se. The WG was concerned that there would be those who would be lead to interpret that ICES viewed all introductions as a form of pollution, and that this interpretation would be extremely detrimental to aquaculture interests.

The advice that the WG gives is relevant to a wide range of fisheries and ecological issues, rather than to the issue of marine pollution per se. For example, critical items on the WG's agenda have concerned the release of genetically modified organisms into the environment, the control of ballast water introductions relative to the impact of such introductions on fisheries resources, special legislative items in relation to introductions and transfers of marine organisms, and issues concerned with the introduction of specific species of mollusks and seaweeds into ICES member countries. Relative to the latter, for example, the WG has considered at length the proposed introductions of the Japanese seaweed *Undaria* into France, the coho salmon into Western Europe and the Japanese scallop *Patinopecten* into Ireland, none of which concerned pollution issues.

The WG has worked closely over the past 14 years with Groups not mainly concerned with marine pollution issues, in particular the Pathology & Diseases of Marine Organisms and Genetics Working Groups, and the Mariculture, Shellfish, and ANACAT Committees.

For these reasons, the WG requested that this matter be reconsidered by both the ACMP and the Mariculture Committee for discussion and review. The WG felt that the best of course of action was to reinstatement Mariculture as its parent committee.

# RESULTS FROM THE "JOINT MEETING OF THE WG ON GENETICS AND THE WG ON INTRODUCTIONS AND TRANSFERS OF MARINE ORGANISMS" (HELSINKI, 1991)

This meeting was held in 1991 in Helsinki to discuss concerns over the release of GMOs (genetically modified organisms). To date, releases have not been on a particularly large scale (and virtually none have occurred in the marine environment), but for the future the WG will need to be in the position of being able to provide advice on the release of GMOs.

At the Statutory Meeting in La Rochelle, 1991, there was a lack of discussion on recommendations from the Joint Meeting of the two WGs because no definition of GMO was given in the report (C.M. 1991/F:47). The WG will modify the document as referred from the 1991 Helsinki meeting, using the EC definition of GMO for resubmission to the WGs new Parent Committee, ACMP.

The Mariculture Committee was aware, however, of the need for information on the genetic, ecological, and other effects of the release of GMOs into the natural environment and for the development of regulatory measures. The WG was requested to monitor and report on any future releases of GMOs into marine and freshwater environments including a risk assessment of the effects of such releases. The WG was requested to develop guidelines for research to assess ecological effects of the release of GMOs. The WG will address this request at its 1993 meeting, as this request did not become one of the WG's terms of reference for its Lisbon meeting.

## RESULTS FROM THE "STUDY GROUP ON THE RISKS OF INTRODUCTIONS OF NON-INDIGENOUS SPECIES BY BALLAST WATER"

At the 1991 Statutory meeting in La Rochelle it was decided that the serious problem of transportation and release of dinoflagellates should be addressed by the WG on "Phytoplankton and the Management of their Effects". It was apparent from correspondence between the Chairmen of the WGs on "Introductions and Transfers of Marine Organisms" and "Phytoplankton and the Management of their Effects" that the latter WG had not been requested by ICES to take up this topic. The matter would be raised again in 1992 at the Statutory Meeting.

#### CURRENT STATUS OF THE ICES COOPERATIVE RESEARCH REPORT, TEN YEAR REVIEW

Dr A. Munro, Dr S. Utting and Prof I. Wallentinus had revised the sections in the Report on Fishes, Invertebrates and Marine Algae and asked for final amendments to the manuscripts to be returned to the respective authors by 1 May 1992. A general introduction, discussion, bibliography and index were to be prepared and attached. Once complete, the report would be ready for publication, hopefully in 1992.

### REVIEW OF THE LAWS AND REGULATIONS GOVERNING INTRODUCTIONS AND TRANSFERS OF MARINE ORGANISMS IN ICES MEMBER COUNTRIES: A PROPOSED DOCUMENT

Although it was agreed that such a document would be invaluable, it was decided to again defer preparation of this review. In the EC countries and Canada many changes are currently being made to the legislation. The WG will reconsider this topic at the 1993 meeting.

#### NATIONAL REPORTS - (Appendix IV)

National reports were received from Canada, Finland, Ireland, Norway (by FAX), Portugal, Spain (by FAX), Sweden, UK and USA. These are reproduced as submitted (but including minor corrections tabled at the meeting) in Appendix IV.

#### Highlights of the National Reports are as follows:

#### \* Canada and the USA:

There is considerable concern over the introduction of the zebra mussel *Dreissena* into the Great Lakes in ballast water (see Status Reports, below). For vessels entering the Great Lakes, voluntary exchange of ballast occurs before vessels enter the St. Lawrence River, and this action is logged. This voluntary exchange becomes law in November 1992 in the United States.

#### \* France:

The French propose to introduce the American bay scallop (Argopecten irradians) into France to assess its potential for aquaculture.

#### \* Ireland:

The Japanese scallop *Patinopecten yessoensis* remains in small quantities in hanging culture and are expected to come into spawning condition in March 1993 (see Status Reports, below).

#### \* Norway:

An exceptional bloom of the dinoflagellate *Dinophysis acuta* was reported in February 1992; it is believed to be a ballast water introduction from Britain.

#### \* Portugal:

The Japanese alga Sargassum muticum continues to move south along the Portuguese coast, now being found on the shores of Minho Province, north of Oporto.

#### \* Spain:

The Japanese alga *Undaria pinnatifida* has become firmly established in the Ria de Arosa, northwest Spain.

#### \* Sweden:

The Japanese alga Sargassum muticum continues to spread along the Swedish west coast. In the late summer of 1991 it was first found attached in the northern Kattegat.

#### \* United States:

An Environmental Impact Report for the proposed release of Pacific chinook salmon on the Atlantic coast (New Jersey) has been completed and is under review (see Planned Introductions, below).

The introduction of the Japanese alga *Porphyra yezoensis* in the State of Maine is in its final planning stages (see Planned Introductions, below).

The European oyster Ostrea edulis is apparently reproducing in the State of Rhode Island, south of Cape Cod.

The proposed introduction of the Japanese oyster Crassostrea gigas, remains a matter of heated debate on the Atlantic coast (see Planned Introductions and USA National Report).

#### Errata to WGITMO 1991 (Helsinki) Report

II-18 [Report from Finland] Right hand marginalia reads: "released in the Soviet Union"

#### II-32 [report from Spain] Bottom annotation reads:

"commercial culture imported as ova from Oregon/Washington (also by French)"

Appendix II: Note there are two (2) sets of pages each numbered A43 and A44.

#### Revised Guidelines for Preparations of National Reports - Appendix V

The National Report format was considered to be outdated because some information requested annually is no longer relevant or is impossible to obtain in many ICES countries. No longer to be reported, for example, are species imported solely for research purposes and held under complete quarantine conditions, except as this work relates to planned introductions. A new shorter version of the National Report format was prepared. This may encourage regular returns of National Reports from more of the ICES countries. For future meetings copies of National Reports will be requested on computer disk.

#### -STATUS REPORTS

#### Japanese brown alga, Undaria pinnatifida, in Spain

Undaria was first seen in June 1990 in the Ria de Arosa (northwest Spain), an area renowned for its mussel culture. The alga is relatively common in the Ria de Arosa, occurring from low tide mark down to a depth of 2 to 3 meters. It is also found on the mussel rafts and in the drainage channels from purification plants. So far the alga has not spread into areas beyond the Ria de Arosa. The environmental impact appears to have been less than that from the invasion of Sargassum muticum, although no studies are cited.

#### Japanese scallop, Patinopecten yessoensis, in Ireland

The introduction of the Japanese scallop to Ireland took place in April 1990. This followed discussions about its intended importation at the Dublin WG meeting in June 1989. Discussions continued at the Halifax WG meeting in June 1990 where it was agreed that limited quantities of the filial generation could be cultivated in the sea provided that their health status was good.

Three introductions of adult broodstock were brought into quarantine under the supervision of the Department of the Marine. Scallops were released from quarantine in September 1990 and were held in hanging culture near Carnsore Point on the Irish south-east coast alongside native scallops (*Pecten maximus*). Of this year class, 118 remain, ranging in size from 15-52mm. The largest of these are expected to reach spawning condition in March 1993. Samples of these animals taken in April did not show any pathological condition or parasite loading.

In March 1991 the quarantine facility was re-opened in advance of receiving 20 male and 51 female broodstock. The adult scallops came from Utatsu Bay in Miyagi Prefecture, Japan - the same source as the 1990 introduction. There were five spawnings over a twenty day period during March and April. All adults, after spawnings, were destroyed. Settlement of larvae took place 20-28 days after spawnings. In June there were noticeable mortalities of spat following strong south-easterly winds that caused large amounts of algal debris to accumulate on the beach close to the sea water intake. At this time scallop mortalities were high and the rate of growth declined. There was a *Vibrio* infection of the mantle margin and all spat were then destroyed. On no occasion did scallops from the 1991 year class leave quarantine.

There will be no importations of broodstock in 1992.

#### Green Alga, Caulerpa taxifolia, in the Mediterranean

This tropical alga was first found in 1984 outside the Oceanographic Museum, Monaco from where it may have escaped (Meinesz and Hesse, 1991, Hughes, 1992). It has since spread 3 km eastwards and 150 km westwards of Monaco. It can grow down to depths of 35 m and can completely cover the substrate. Caulerpa taxifolia shows a great deal of morphological plasticity (there is some question, for example, as to whether C. taxifolia is the same as C. mexicana, known from the Caribbean, and reported from Syria, Israel, and the Canary Islands). The "Laboratoire Environnement Marin Littoral" of the Universite de Nice-Sophia Antipolis, along with the Conseil General des Alpes Maritimes and the Conseil Regional Provence Alpes-Cote d'Azur, have set up a program to monitor the progress of this algae.

There is some evidence that this alga is toxic to grazing fish and this toxicity can be passed up the food chain to humans, causing diarrhetic and neurological problems.

Potentially, Caulerpa taxifolia could spread along the Mediterranean coast to Spain and Portugal. It is less likely to spread to the UK and northwards because it overwinters at 11°C.

#### Brown alga, Sargassum muticum, in Europe

(Appendix II)

Dr Inger Wallentinus (Sweden) presented a brief review of the history of Sargassum muticum in Europe. Sargassum muticum first appeared in Europe on the south coast of the UK as drift plants in 1971. It was found on the Atlantic coast of France in 1972 and in Belgium in 1972/3. The invasion throughout Europe continued, to the Netherlands (1977), the North Sea coast of Germany (1981), Denmark (1984), the southern coast of Norway (1984), the west coast of Sweden (1985), the Atlantic coast of Spain (1985) and to Portugal (1989?/90). There are no records of Sargassum in the Baltic Sea. Neither have any plants been found in Ireland. The alga was transferred to the Mediterranean Sea (French coasts only), it is believed with transfers of oysters. To date, it has not spread westwards in the Mediterranean, i.e. to the coast of Spain, nor to countries to the east of France.

#### Zebra mussel, Dreissena polymorpha, in the USA and Canada

The explosive spread of *Dreissena* in the Great Lakes, after its introduction in 1988, started much of the worldwide interest in preventing further release of ballast water as a means for accidentally introducing non-indigenous species. Many people, groups, and government agencies in the USA and Canada are monitoring the progress of the invasion of the zebra mussel. Money from Federal and private sources fund research into studies of this species. The greatest impact of this introduction has been on the industrial companies as a result of the fouling of water intake pipes. The most effective treatment to control the growth of the mussel in water intake pipes is disinfection to prevent the settlement of larvae.

If the mussel were to exploit to its full potential, it could invade two thirds of the North American water systems. The mussel has an upper salinity tolerance of 10-13 ppt. Temperatures above 12°C are required for reproduction and the upper limit for growth is 28°C. (In Europe, from where it was introduced, the tolerance limit is 25°C.) Temperatures above 30°C are lethal.

It is possible that there are two species of *Dreissena* in North America and not just *D. polymorpha* as previously thought. In Lake Erie, the site of the initial introduction, there are signs that numbers of mussels are declining.

#### PLANNED INTRODUCTIONS

#### Japanese seaweed, Porphyra yezoensis, to Maine, USA

(Appendix III)

The State of Maine requested ICES to comment on the proposed introduction of the edible Japanese seaweed, *Porphyra yezoensis*, variety U-51 (Japanese name: Narawa susabi) for culture of "nori". The site of the release, Cobscook Bay, Maine, is near the US/Canadian border. The WGITMO was provided with documents regarding this proposed release. Some of these are presented in Appendix III.

Two hundred "seeded" nori nets, each 200m x 1.5m, are planned to be placed in the Bay in July 1992. According to reports from the private company involved in this enterprise, this alga requires temperatures of 6-14°C to produce harvestable blades and 22-25°C to reproduce sexually. Porphyra yezoensis and Porphyra tenera have been previously cultivated in the State of Washington where, according to the reports submitted, "none of the introduced species have escaped from the algal farms", because of "improper water temperature and perhaps other local environmental factors". Japanese workers have further reported that the cultivar (domesticated) strains of P. yezoensis "do not even escape in Japanese waters, possibly because they are so inbred that they are poor competitors". "Because the water temperature of Maine rarely reaches such high temperatures, and only in shallow estuaries or tidal flats for short periods of time, the chances of the Japanese species to escape would appear slight here as well," according to the reports (Appendix III).

The WG also examined literature provided to it by Prof. I. Wallentinus (Sweden), a member of the Working Group. Blunden (1989), for example, commented that, "The *Porphyra* farming activity in British Columbia had been preceded by a questionnaire circulated to American phycologists, asking their opinion of the possible effect of introducing Japanese *Porphyra* species into Puget Sound. The general consensus was that the effect would be negligible." Additional papers reviewed were those of Kurogi and Akiyama (1966), Li Shi (1984), Merrill (1989) and Mumford (1990).

The WG reviewed these documents and commented as follows:

The WG found no discussion in the Maine documents of the potential for this species to spread to more southern waters, where suitable temperatures presumably could be found for sexual reproduction (according to the data provided). The WG noted that Canada had been consulted (Appendix III), but inquired if states to the south had been made aware of this planned introduction and comment sought. Is there a potential for drift nets to become dislodged, carried out of Cobscook Bay, and be carried by currents to the south and west? Can the asexually-produced spores settle on substrates other than the culture nets, substrates that might be susceptible to transport or movement? The WG noted, by way of comparison to other non-indigenous species, that the introduced Japanese alga Codium fragile tomentosoides had spread from Long Island Sound to Maine, and that the European oyster Ostrea edulis, once restricted to Maine, had recently been discovered to be reproducing in Rhode Island. Would it be possible for Porphyra yezoensis to reproduce sexually in the waters of Massachusetts, Long Island Sound, or further to the south, and what would be the ecological implications if it did so? Merrill (1989, p. 102), for example, noted that "Once established, rapid Porphyra growth tends to exclude other things." The WG noted that Porphyra yezoensis has, it is believed, in fact become established outside of cultivation in southern France, to where it apparently was accidentally introduced with Japanese oysters, and suggested that there may be ecological information from that region available.

The transport of this alga to Maine from source populations in the State of Washington had been in axenic culture, diagnosed free of bacterial and algal contamination, according to a document dated 2 October 1991. However, the WG noted that no precise information was provided on whether these stocks were free of fungal contamination (although this was implied by the statement, "axenic [culture]"). A reference to the potential importation of fungi with *Porphyra* was made by Dr. J. N. C. Whyte in correspondence to Mr. W. Culp of 29 April 1981, in the documents provided. Further reference to fungi is made in the original "Proposal for Application of Permit" (revised January 31 and February 8, 1991), page 4, paragraph 3.

The WG had before it two documents from Canada, being official letters of the dates of 16 May 1991 and 5 December 1991 (Appendix III). These were insufficient to determine Canada's official position on this question. It was noted that it would be of value if the private parties involved could provide more information and correspondence from Canada.

The WG finally noted that it would appreciate receiving copies of the information requested on 28 August 1991 by the State of Maine from the private parties involved, including (a) the current bibliography and translations of reports relating to the ecology and physiology of the species with special attention to the photoperiod and temperature requirements of *P. yezoensis* and the variety U-51 and (b) a report of current observations relative to any effects of introduced *Porphyra* culture or establishment (escape) in the waters of Puget Sound, British Columbia, or other North American waters where they may be cultured.

#### The WG concluded that,

- (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).

The WG was pleased to be able to comment on this introduction, and thanked the State of Maine and the private parties involved for their willingness and cooperation in providing details and documentation. The WG will be pleased to receive the information requested, and proceed with an analysis of this proposed introduction. It was suggested that this information be provided directly to the WG Chair, Dr. J. Carlton.

#### Pacific chinook salmon Oncorhynchus tshawytscha, to New Jersey, USA

(refer to USA National Report)

The State of New Jersey completed in February 1992 a "Draft Environmental Impact Statement" (EIS) on the proposed "Introduction of Pacific Salmonids into the Delaware River Watershed". The proposal is for the annual

release of 300,000 chinook salmon smolts for a period of five years to assess whether a fall sport fishery could be created. The smolts would be raised from disease-free eggs imported from New York State hatcheries. The EIS concluded that each release of 300,000 fish would yield a maximum return of only 240 fish. The other alternatives considered were the introduction of coho salmon, the introduction of steelhead trout, and a "no action" plan. Draft documents have been sent to Canada and NASCO for comment. A public 90 day review period ends on June 5, 1992.

#### Japanese oysters, Crassostrea gigas, to New Jersey, USA

(refer to USA National Report)

The heated debate in the USA continues over the proposed introduction of Japanese oysters into Chesapeake Bay, to re-vitalize the native oyster (*C. virginica*) industry. Recent developments include plans to hold 600 triploid (sterile) juvenile Japanese oysters in Chesapeake Bay to assess their susceptibility to the disease MSX which has severely affected the native oyster population. MSX susceptibility cannot be adequately tested in the laboratory. The planting of these juveniles, which would be disease-free F2 stock, may proceed in 1992. The suggestion was made that an effort should be made by local authorities to sample some of the thousands of Japanese oysters (for MSX) said to have been illegally placed in Chesapeake Bay by private parties.

#### American bay scallop, Argopecten irradians to France

It was brought to the attention of the WG during the meeting in Lisbon that the introduction of Argopecten into France was proposed for 1994. Results from the trials with Patinopecten yessoensis had shown that species to be unsuitable for commercial culture in France. The native scallop (Pecten maximus) fishery is insufficient to support market demand. Each year 40,000 tons of scallop meats are imported. As a result it is proposed that Argopecten will be assessed for commercial culture in France.

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 21-33ppt are suitable for growth although the optimum is 30ppt. The growth rate is rapid, since it takes only 12-18 months for this scallop to reach 60-90mm. Growth is best subtidally at depths of 1.5-10m, but this species will grow in deeper water in hanging culture.

Argopecten was introduced into China. The industry, which is reliant on hatchery-produced seed and natural settlement, produces 50,000 tons per year, although this is expected to rise to 100,000 tons.

The WG was informed that France will formally request ICES to comment on this proposed introduction, and that once this request has been made, France will submit the appropriate documents to ICES for consideration by the WGITMO at its 1993 meeting.

#### MODIFICATIONS TO THE CODE OF PRACTICE

#### Modifications suggested by the WG on Pathology and Diseases of Marine Organisms

Recommendations on changes to the Code had been received from the WG on Pathology and Diseases of Marine Organisms. The WG decided that comments and modifications should be incorporated into the Cooperative Research Reports that elaborate and explain the Code. Extensive modifications were not required in the Code itself (see next section, below).

Extensive changes to "Guidelines for Implementing the ICES Code Of Practice Concerning Introductions and Transfers of Marine Species" in **Cooperative Research Report 130** were not considered to be necessary as a result of the WGPDMO's suggestions, but it was noted that the text of this document will be 10 years old next year, and that many changes have occurred in the past decade.

In order to ensure adequate control of diseases, changes were considered necessary in the "Codes of Practice and Manual of Procedures for Consideration of Introductions and Transfers of Marine and Freshwater Organisms" in Cooperative Research Report 159. EEC and OIE guidelines would be adopted as reference. Protocols would be clarified for the introduction of new species and protocols for transfer of species of current commercial practice. The many suggestions of the WGPDMO would be incorporated throughout the revised text.

The recommendations from the WG on Pathology and Diseases of Marine Organisms had been considered by A. Munro, T. Carey and H. Grizel of the WGITMO. H. Grizel attended the 1992 meeting of WGPDMO immediately prior to the present meeting of the WGITMO. Since further modifications and changes could be made by correspondence with WGPDMO, the WGITMO considered it unnecessary for a joint meeting of the two WGs to be held in 1993. The WG was aware, however, that this is one of the recommendations from the 1992 meeting of the WG on Pathology and Diseases of Marine Organisms.

#### Modifications based on 1991 Joint Meeting with the Working Group on Genetics

At the 1991 Statutory Meeting in La Rochelle, the Working Group on Introductions and Transfers of Marine Organisms (WGITMO) proposed (C.M. 1991/F:47) the addition of a new section concerning the release of genetically modified organisms (GMOs) to the ICES "Revised Code of Practice to Reduce the Risks of Adverse Effects Arising from the Introductions and Transfers of Marine Organisms". This proposal was the result of work conducted during a joint session of the WGITMO and the Working Group on Genetics, held to review the Code of Practice relative to genetically modified organisms (GMOs) with a view to developing an extension of the Code.

This proposal was considered at the Statutory Meeting (Mariculture Committee, item 9: ICES Annual Report for 1991 (1992), page 83), with the following comments offered:

"The question of what constituted a genetically-modified organism (GMO) was raised. A definition of GMO was required. Notwithstanding, there was a requirement for information on the genetic, ecological, and other effects on the release of genetically-modified organisms into the natural environment to serve as a basis for the development of regulatory measures."

The WGITMO suggested adopting the definition of a GMO given in Article 2(2) of EC Directive 90/220, "On the deliberate release into the environment of genetically modified organisms":

"'genetically modified organism (GMO)' means an organism in which the genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination."

Within the terms of this definition, the EC directive lists some of the techniques used in genetic modification (EEC/90/220, Annex I A, Part 1). Document C.M. 1991/F:47 suggested that ICES member states should notify the Council of an impending release of a GMO at "an early stage", i.e., well before any release, and that such notice includes a risk assessment of the effects of the release. It was anticipated that significant details of the nature of the GMO would be included (such as the types of information listed in EEC/90/220, Annex II, "Information required in the Notification").

#### Additional modifications to the 1990 Code of Practice - (ACMP 1992/7.3)

The WG reviewed the "Revised 1990 Code of Practice to Reduce the Risks for Adverse Effects Arising from Introductions and Transfers of Marine Species" taking into account,

- (a) the comments received from the WG on Pathology and Diseases of Marine Organisms (above)
- (b) the comments received from the Mariculture Committee at the 1991 Statutory Meeting in La Rochelle on the proposed addition of a section on the consideration of the release of genetically modified organisms (GMOs) (above)
- (c) the need for awareness of the genetic implications of introductions and transfers of marine organisms.

After extensive discussion, the following changes were proposed, in addition to those proposed in C.M. 1991/F:47 (changes and modifications are shown in BOLD FACE). The entire proposed Revised 1992 Code of Practice is set forth in a companion document, ACMP 1992/7.3.

1. The title be changed to,

"REVISED 1992 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"

2. Section I(a) be changed to read as follows:

Member countries contemplating any new introduction should be requested to present to the Council at an early stage information on the species, stage in the life cycle, area of origin, proposed plan of introduction and objectives, with such information on its habitat, epifauna, associated organisms, potential competition to species in the new environment, **genetic implications**, etc., as is available. The Council should then consider the possible outcome of the introduction, and offer advice on the acceptability of the choice.

3. Section IV to be changed to read as follows:

procedure in the title to read procedures

- (a) Periodic inspection (including microscopic examination) of material prior to exportation to confirm freedom from introducible pests and diseases. If inspection reveals any undesirable development, importation must be immediately discontinued. Findings and remedial actions should be reported to the International Council for the Exploration of the Sea.
- [(b) is deleted]
- [old (c) becomes (b) and is changed to read:]
- and/or (b)

Quarantining, inspection, and control, whenever possible and where appropriate.

[new subsection 'c' is added:]

- (c) Consider and/or monitor the genetic impact that introductions or transfers have on indigenous species, in order to reduce or prevent detrimental changes to genetic diversity.
- [(d) is deleted]

[The final statement to be part of IV and not V and be changed to read:]

It is appreciated that countries will have different requirements toward the selection of the place of inspection and control of the consignment, either in the country of origin or in the country of receipt.

ADD to the DEFINITIONS section the following:

#### Genetic diversity

All of the genetic variation in an individual, population, or species.

This definition is from ICES CRR 159: 42.

#### **Genetically modified organism** (GMO)

An organism in which the genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination.

This definition is from Article 2(2) of EC Directive 90/220, "On the deliberate release into the environment of genetically modified organisms". This directive offers further details relative to the techniques involved in genetic modification.

It was felt by the WG that there is no rapid means by which to disseminate changes to the Code of Practice. The WG should be more aggressive in distributing the Code and ensure that the most recent version is followed. National representatives on the WG should include the Code in their publications whenever and wherever appropriate. It was also felt that there was a need to ensure that the ICES Code of Practice is easily available in the languages of all of its member countries (see proposed new ICES CRR, below).

It was agreed to recommend to our parent committee ACMP and to the Council that the Revised 1992 Code be adopted.

#### NEW ICES COOPERATIVE RESEARCH REPORT

In view of,

- (1) the recommended changes to Cooperative Research Report (CRR) 159 (above)
- (2) the need to revise and update CRR 130
- (3) the modification of the Code of Practice to include genetically modified organisms, and the need to present procedural guidelines to be followed,
- (4) the additional changes made in the Code of Practice since 1988,
- (5) the need to provide a clear, thorough Model Proposal for future submissions to ICES and its WGITMO,
- (6) the need to ensure that the ICES Code of Practice is easily available in the languages of all of its member countries,

the WG proposed that a new CRR be prepared for publication, to be 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".

It is suggested that Dr J. Carlton revise CRR 130 (with the help of additional WG members) and be the Editor of the new CRR. CRR 159 will be revised by Dr A. Munro (finfish pathology), Dr H. Grizel (shellfish and other invertebrate pathology), Dr I. Wallentinus (algal pathology). Dr R. Saunders (Canadian delegate on Genetics WG) will be asked to write a section on genetic implications of introductions and transfers, including the use of GMOs. The new CRR will include a bibliography, and the following Appendices:

- I A model document (in the form desirable to be submitted to the ICES WGITMO) for proposing the introduction of non-native (exotic) species, to be written by Dr D. Minchin, based on the experience of the introduction of *Patinopecten yessoensis* into Ireland.
- II The Code of Practice in all ICES languages.
- III A summary of other international codes.

#### ANNOTATED BIBLIOGRAPHY ON TRANSPLANTATIONS AND TRANSFERS OF AQUATIC ORGANISMS

The WG was kindly informed by Dr H. Rosenthal of the anticipated publication of his "Annotated Bibliography on Transplantations and Transfers of Aquatic Organisms and their Implications on Aquaculture and Ecosystems" (see Bibliography, page 17, herein). This bibliography includes 7000 references from 1849 to 1991, with about 65% of the references accompanied by an abstract that focuses on those aspects of introductions and transfers contained in the paper cited. The Bibliography includes a chapter summarizing a number of well-documented case histories of aquatic introductions. Species and geographic indices are included. The printed bibliography is expected to about approximately 1,200 pages and is scheduled to appear in 1992.

#### RECOMMENDATIONS

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

- 1. That the Mariculture Committee be re-instated as the Parent Committee for the Working Group on Introductions and Transfers of Marine Organisms.
- 2. That the "Revised 1992 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 ACMP 1992/7.3) be presented to the Council for adoption.
- 3. That the WG on Introductions and Transfers of Marine Organisms prepare for publication as a 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", being an extensive revision of the older CRRs 130 and 159, and the new CRR to also include a model procedure, the ICES Code of Practice in all ICES languages, and a brief summary of other international codes.
- 4. That the WG on Introductions and Transfers of Marine Organisms should meet at the Marine Laboratory (SOAFD) Aberdeen, Scotland, from April 26 to April 28 1993 to:
  - a. consider the proposed introduction of the American bay scallop (Argopecten irradians) to France.
  - b. continue the consideration of 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.
  - c. prepare materials for the proposed new CRR, "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".
  - d. develop guidelines for research to evaluate the ecological effects of the release of GMOs in marine environments (as requested by the Mariculture Committee, ICES Annual Report 1991, p. 83), in order to incorporate such materials in the proposed new CRR,
  - e. consider progress in ICES member countries on methods to reduce the risk of introductions of marine organisms in ships' ballast water and sediments,
  - e. continue the review of the status of salmonid fish, algal, shellfish and other introductions in and between ICES member countries

#### **BIBLIOGRAPHY**

Blunden, G. 1989. The future for outdoor seaweed cultivation, pp. 116-117, in: <u>Outdoor Seaweed Cultivation</u>, Proceedings of the Second Workshop of COST 48 Subgroup 1, Port Erin, Isle of Man, British Isles, 21-23 April 1989. Eds. J. M. Kain, J. W. Andrews and B. J. McGregor. COST 48, Commission of the European Communities, Brussels.

Flaasch, J.P. & Leborgne, Y., 1992. Introduction in Europe, from 1972 to 1980, of the Japanese Manila clam, *Tapes philippinarum*, and the effects on aquaculture production and natural settlement. ICES mar. Sci. Symp., 194: (in press).

Grizel, H., 1992. Introduction et transfert de mollusques marins, 26pp. (Paper presented at European Aquaculture Conference (Exhibition), Bordeaux, France, 25-28 March.). [Contact author at IFREMER, B. P. 133, 17390 La Tremblade, France]

Hallerman, E.M. & Kapuscinski, A.R., 1992. Ecological implications of using transgenic fishes in aquaculture. ICES mar. Sci. Symp., 194: (in press).

Harache, Y., 1992. Pacific salmon in Atlantic waters. ICES mar. Sci. Symp., 194: (in press).

Howarth, W., 1992. Regulating the introduction of freshwater fish: the United Kingdom, the European community, and beyond. ICES mar. Sci. Symp., 194: (in press).

Hughes, S. 1992. 'Escaped' algae threatens Mediterranean ecosystem. New Scientist, 7 March 1992, p. 11.

Iwama, G.K., McGeer, J.C. & Bernier, N.J., 1992. The effects of stock and rearing history on the stress response in iuvenile coho salmon, *Oncorhynchus kisutch*. ICES mar. Sci. Symp., 194: (in press).

Joyce, J.C., 1992. Impact of Eichhornia and Hydrilla in the United States. ICES mar. Sci. Symp., 194: (in press).

Kohler, C.C., 1992. Environmental risk management of introduced aquatic organisms in aquaculture. ICES mar. Sci. Symp., 194: (in press).

Kurogi, M. and K. Akiyama. 1966. Effects of water temperature on the growth and maturation of *Conchocelis*-thalli in several species of *Porphyra*. Bull. Tohoku Regional Fish. Res. Lab. 26: 77-89.

Li Shi, Y. 1984. The ecological characteristics of monospores of *Porphyra yezoensis* Ueda and their use in cultivation. Hydrobiologia 116/117: 255 - 258.

Lightener, D.V., Williams, R.R., Bell, T.A., Redman, R.M. & Perez, L.A., 1992. A collection of case histories documenting the introduction and spread of the virus disease IHNN in penaeid shrimp culture facilities in northwestern Mexico. ICES mar. Sci. Symp., 194: (in press).

Locke, A., Reid, D.M., Sprules, W.G., Carlton, J.T. & van Leeuwen, H.C., 1991. Effectiveness of mid-ocean exchange in controlling freshwater and coastal zooplankton in ballast water. Can. Tech. Report of Fish. Aquat. Sci., No. 1822, 93pp.

MacEachen, C., Timmins, C. & Dermott, R., 1992. Distribution of zebra mussels on navigation buoys from Lake

Ontario and upper St. Lawrence River in December 1991. Great Lakes Laboratory for Fisheries and Aquatic Services [Report], 17pp.

Meinesz, A. and Hesse, B., 1991. Introduction et invasion de l'algue tropicale *Caulerpa taxifolia* en Mediterranee nord-occidentale. Oceanologica Acta 14: 415 - 426.

Merrill, J. E. 1989. Commercial nori (*Porphyra*) sea farming in Washington State, pp. 90 - 103, in: <u>Outdoor Seaweed Cultivation</u>, Proceedings of the Second Workshop of COST 48 Subgroup 1, Port Erin, Isle of Man, British Isles, 21-23 April 1989. Eds. J. M. Kain, J. W. Andrews and B. J. McGregor. COST 48, Commission of the European Communities, Brussels.

Mongeau, F. & Jacquaz, B., 1991. Abondance et distribution des moules zebrees (*Dreissena polymorpha*) dans le fleuve Saint-Laurent. Plan d'action Saint-Laurent, Centre Saint-Laurent, 39pp.

Mumford, T. F. 1990. Nori cultivation in North America: growth of the industry. Hydrobiologia 204/205: 89 - 98.

Rosenfield, A. & Mann, R., (editors), 1992. Dispersal of living organisms into aquatic ecosystems. University of Maryland and Maryland Sea Grant College System, College Park, Maryland, USA, 436pp.

Rosenthal, H., 1992. Annotated bibliography on transplantations and transfers of aquatic organisms and their implications on aquaculture and ecosystems. In preparation. (Contact author at Institut fur Meereskunde, Universitat Kiel, 23 Kiel, Dusternbrooker Weg 20, Germany).

Russell, D.J., 1992. The ecological invasion of Hawaiian reefs by two marine red algae, *Acanthophora spicifera* (Vahl) Berg and *Hypnea musciformis* (Wulfen) J.Ag., and their association with two native species, *Laurencia nidifica* J.Ag. and *Hypnea cervicornis* J.Ag. ICES mar. Sci. Symp., 194: (in press).

Stewart, J.E., 1991. Approaches to problems of disease in aquaculture. ICES mar. Sci. Symp., 192: 206-210.

Stewart, J.E., 1991. Introductions as factors in diseases of fish and aquatic invertebrates. Can. J. Fish. Aquat. Sci., 48 (Suppl. 1): 110-117.

Utting, S.D. & Spencer, B.E., 1992. Introductions of marine bivalve molluscs into the United Kingdom for commercial culture - case histories. ICES mar. Sci. Symp., 194: (in press).

Van den brink, F.W.B., Van der Velde, G., and A. b. de Vaate, 1991. Amphipod invasion on the Rhine. Nature 352: 576.

Welcomme, R.L., 1991. International introductions of freshwater fish species into Europe. Finnish Fish. Res., 12: 11-18.

Welcomme, R.L., 1992. A history of international introductions of inland water species. ICES mar. Sci. Symp., 194: (in press).

### Appendix I.

ICES Working Group on Introductions and Transfers of Marine Organisms
Lisbon, Portugal, April 14 - 17, 1992
Instituto Nacional de Investigação das Pescas

#### **AGENDA**

14 April 1992 9:00

Opening Session

Tuesday		Appointment of Rapporteur Introduction of Participants
		Welcoming Comments by representatives of INIP
		<ul> <li>Comments by WG Chairman</li> </ul>
		Review and Approval of proposed Agenda
		<ul> <li>Change of WG's Parent Committee (Mariculture Comm. to ACMP, Advisory Committee on Marine Pollution) (Bernt Dybern)</li> </ul>
		<ul> <li>"Introduction" of 1992 Handbook</li> <li>* Contents review</li> <li>* Review of WG "Statement of Purpose"</li> <li>* Review of attendance history</li> </ul>
•	·-	~ Addenda/Erratá for 1991 Helsinki Report
		<ul> <li>Status of recommendations from 1991 Helsinki meeting and from previous meetings</li> </ul>
		* Status of "Theme Session on Stock Enhancement"
		<ul> <li>Results from the "Joint Meeting of the Working Group on Genetics and the Working Group on Introductions and Transfers of Marine Organisms" (Helsinki, 1991)</li> </ul>
		~ Results from the "Study Group on the Risks of Introduction of Non-Indigenous Species by Ballast Water" (Helsinki, 1991)
	10:30	Coffee Break
	11:00	Reconvene: Continue Morning Session
		<ul> <li>Status of "1990 Summary of Introductions and Transfers in ICES Member Countries", an ICES Cooperative Research Report (Alan Munro)</li> </ul>

document (Jim Carlton)

Status of "Review of the Laws and Regulations Governing Introductions and Transfers of Marine Organisms in ICES Member Countries", a proposed

Finland Spain Ireland Sweden U.K. Norway 1:00 Lunch 3:00 Convene Afternoon Session Continue NATIONAL REPORTS Status Reports: Ireland: Update on Japanese Scallop Patinopecten (Dan Minchin) 5:30 Adjourn Working Group Reception 6:00 9:00 15 April Convene Morning Session Wednesday Continue Status Reports Europe: Status of the Brown Alga Sargassum (Inger Wallentinus) Canada and U.S.A.: Update on Zebra Mussel Dreissena (Ron Dermott and Jim Carlton) U.S.A.: Chinook salmon (New Jersey) (Jim Carlton, Tim Carey) U.S.A.: Japanese oysters (Chesapeake Bay) (Jim Carlton) Further discussion of ACMP Parent Committee issue Discussion of Revision of Format for NATIONAL REPORTS 1:00 Working Group Site Visits to Fisheries Facilities 16 April 9:00 Convene Morning Session Thursday Continue Status Reports Mediterranean Europe: Status of the Invasion of the Alga Caulerpa taxifolia, and

NATIONAL REPORTS

Portugal

U.S.A.

Canada

Prospects for the Invasion of Western Europe (Inger Wallentinus)

#### Code of Practice

- ~ Review of Status of "Revised Code(s)" (1990, 1991 Proposal)
- Consideration of suggested changes/additions offered by Working Group on Pathology & Diseases of Marine Organisms (Henri Grizel)
- Revisions and changes to CRR 130 & 159
- 10:30 Coffee break
- 11:00 Reconvene Morning Session

Code of Practice: Discussions continued

- 1:00 Lunch
- 3:00 Convene Afternoon Session

New Proposed Releases

- USA Atlantic coast: Japanese seaweed <u>Porphyra</u> (Maine)
   Inger Wallentinus, Jim Carlton
- France: American scallop <u>Argopecten</u> (Henri Grizel)

"1992 Summary of Laws and Regulations Governing the Introductions and Transfers of Marine Species in ICES Member States"

5:30 Adjourn

#### April 17 Friday

9:00 Convene Final Session

Review of proposal for a new CRR Further discussion of ACMP Parent Committee issue Promotion, publicity, and dissemination of The Code

- 10:30 Coffee break
- 10:45 Reconvene Final Session
  Discussion of Draft Recommendations
  Principal agenda items for 1993 WG meeting
  Time and place for 1993 WG meeting
  Concluding remarks by Chair
- 11:30 Adjourn

### Appendix II.

#### The dispersal of Sargassum muticum in the ICES countries

Inger Wallentinus Department of Marine Botany, University of Göteborg Carl Skottsbergs gata 22, S-413 19 Göteborg, Sweden

This is a summary of the dispersal of the the Japanese brown alga *Sargassum muticum* being based on information included in the Status 1990 report on introductions and transfers of plants. The summary is organized according to the times for the first records along the Atlantic, the Mediterranean and the Pacific coasts.

#### The Atlantic coasts

In the Atlantic, Sargassum muticum was first reported as attached on the Isle of Wight and at Portsmouth, UK in 1973, while a drift plant was found in that area in 1971 (Southsea; Farnham 1980). The population at Bembridge has been suggested to be at least 2 years old (Farnham 1980, Critchley et al. 1983). The dispersal of the species has been extensively followed ever since its first discovery and has been described in a large number of studies (for references see Critchley et al. 1990a). During the late 1970s, the population densities increased in several areas along the S coast - mainly on free substrate - and especially drifting plants caused nuisance to navigation (e.g. Critchley 1983). The attempts to eradicate the populations during the early years of colonization did not succeed and were abandoned (e.g. Farnham 1980, Critchley et al. 1986).

In the beginning of the 1980s the species was found along 360 km of the S coast of UK (Eastborne to Plymouth), but, only once, it has been found on the SE coast (Norfolk) and not recovered (Critchley et al. 1983). Farnham (1980) predicted it to have a potential distribution all around the British Isles. However, despite the many records from other northern European countries, surprisingly, there have been no reports during the 1980s of attached plants from other parts of the UK apart from the S coast, where it has been expanding in the west to the Scilly Isles and Looe, E Cornwall (S. Utting pers. comm.).

In France, Sargassum muticum was quoted in the previous status report (Anon. 1982) as first recorded in 1973. However, most references in literature quote the first French record of attached plants to be from the coast of Normandie in 1976, being probably an accidental introduction via imported oysters (Gruet 1976, Belsher et al. 1984, Belsher and Pommellec 1988). Druehl (1973) also predicted its establishment after the imports of oysters to France. In the northernmost part (Gris Nez) the first drift plant was found in 1972, and the first attached one in 1978 (Coppejans et al. 1980). According to some scientists, France might also have been the initial site for its introduction in Europe, a question, however, still being discussed (for references see Critchley et al. 1990a).

After 1976 the species spread rapidly and was sighted all along the French Atlantic coast already before 1983 (Belsher et al. 1984, Belsher and Pommellec 1988). In many areas, including slightly brackish estuaries, it is growing vigourously. The plants reach sizes up to 10 m and create nuisance to navigation and mariculture, as well as outrival the native algal flora (Belsher et al. 1984, Belsher and Pommellec 1988). The latter also reported a regression of the populations in some areas SE of Cherbourg in the mid 1980s.

In Belgium, a drift plant of Sargassum muticum was first recorded as early as in 1972 or 1973 (Coppejans et al. 1980) and, during the 1980s, plants were often found in huge quantitaties after storms. However, the species has never been found attached until 1990, not even in harbour areas (E. Coppejans pers. comm.).

In the Netherlands, the first accidental introduction of drift plants of Sargassum muticum was recorded in 1977 and the first attached ones were found at the island of Texel, in Lake Grevlingen and in two other areas in 1980 (Prud'homme van Reine and Nienhuis1982). The subsequent dispersal is described in several papers (for a review see Critchley et al. 1987 and Critchley et al. 1990 b). The species has been especially successful in establishing extensive populations in the non-tidal, cut off brackish lakes.

In the Lake Grevlingen, the maximum was reached in 1985 and, after that, the populations were stable, since all potential sites were occupied and only minor changes were noted through the late 1980s (Critchley et al. 1990 b). Critchley et al. (1987) reported sometimes up to 10 m wide belts of Sargassum, and an almost 100% cover of the surface. The western parts of the Eastern Scheldt were colonized in 1980. The species spread between 1982 and 1985, after which only a slow progress towards the eastern part occurred with four new localities recorded between 1985 and 1988 (Critchley et al. 1987, 1990 b). Later they also found Sargassum in the heavily eutrophicated brackish lake Veere. However, the final success of the plants in such brackish conditions (23 ‰) is not known. Critchley et al. (1987) reported that the abundances of several other macroalgal species had been reduced and that Codium fragile ssp. tomentosoides had decreased or almost disappeared in the Lake Grelingen from 1982 to 1986 as a result of the colonization of Sargassum. Only small germlings were seen among the bases of the Sargassum plants.

In Germany, drift specimens of *Sargassum muticum* were seen already in 1981 and 1982 at several of the East Frisian Islands, respectively in 1982 at an island in the German Bight (Kremer et al. 1983). However, there is no information available of any attached specimens from those areas.

Sargassum muticum was found attached on the island of Helgoland (Südhafen) for the first time in 1988 and was seen again at the same place in 1990 at 1 m depth (K. Lüning pers. comm.). In the future, the species may reach also the SW Baltic.

In Limfjorden, Denmark, Sargassum muticum was first found as drift plants in the winter of 1984 and in the summer of 1984 attached plants were seen along 2 km of the shores (Christensen 1984). During the late 1980s it spread considerably in the Limfjorden, and in 1990 it was growing along most shores in dense belts. At some locations in the Limfjorden area there have been problems for small boats with outboard engines (ICES 1989). In 1990 it was recorded growing in the harbour of Hirtshals, NW Jutland (R. Nielsen pers. comm.).

However, although being looked for, it has not been found attached on the coasts of the Kattegat, the Baltic nor of the North Sea (L. Mathiesen pers. comm.) although it can frequently be seen drifting also in the outer Kattegat.

In the south of Norway, Sargassum muticum was first found as drift plants in 1984 and in 1988 the first attached ones were found (Rueness 1989 and references there). During 1989 it was found attached at several new localities along the Norwegian coast of Skagerrak, from W of the mouth of the Oslofjord in the east, to as far west as Mandal. Drift plants were found as far north as W of Stavanger, occurring partly in large quantities and reaching sizes of 1-2 m (Rueness 1990). He stated that it mainly occupies areas where other species of the Fucales are less well developed, but that it can be a nuisance in marinas and recreation areas.

Rueness also predicted its further dispersal north and east along the Norwegian coast, including into the inner Oslofjord, where so far only drift plants have been found. During 1990 - spring 1991 the species had about the same distribution as in 1989 (J. Rueness pers. comm.).

In Sweden, the first drift plants of Sargassum muticum, probably arriving by drift from Denmark, were recorded in 1985. Two years later, i.e. in 1987, it was found attached at two localities in the northern part of the province of Bohuslän (Karlsson 1988). In 1989, 38 sites were known in the E Skagerrak. In 1990 it was reported growing at altogether 65 localities along the shores of the Skagerrak, from the island of Orust and northwards to the Norwegian border, about 150 km. At some places it existed in belts occurring maximally down to a depth of 8 m. However, so far it is neither outcompeting native species nor is it reported as a nuisance (J. Karlsson pers. comm.).

Although found as a drift plant in the N and S Kattegat (Karlsson 1988, ICES 1990) no attached plants were recorded in the Kattegat until late summer of 1991, when Sargassum was found growing in the S archipelago of Göteborg, the N Kattegat (B. Karlson pers. comm.). However, it has not been found attached further south along the Swedish Kattegat coast, where several sites in that area have been closely surveyed for algal vegetation during the late 1980s (T. Wennberg and M. Pedersén pers. comm.). It has not been possible to verify the report of drift plants in Sweden as early as in 1982 (ICES 1982), although it is not fully unrealistic.

The tolerance for low salinity, down to about 7 ‰ shown in laboratory experiments (Hales and Fletcher 1989), as well as its occurrence in brackish water in other European countries at least down to about 20 ‰, would make it possible for the species to finally disperse to at least the Öresund. Eventually it might also reach the southern Baltic proper, where the salinities normally exceed 6 ‰ (cf. discussion in Hales and Fletcher 1989).

The first appearance of Sargassum muticum in Spain was recorded in 1985 in the Basque province (at Guetaria) (Casares Pascual et al. 1987). In 1987 (Pérez-Cirera et al. 1989, Santiago Caamaño et al. 1990) it was found in the NW of Spain (Ria de Arosa, at Grove). During 1988 to 1989 it was recorded for the first times (Fernández et al. 1990) at three other localities along the Austrian coast in N Spain (at Aramar, Bañugues, Cudillero). In these areas it was first found growing in rock pools and later, when going through a very rapid phase of expansion, it had expanded into the intertidal and subtidal. It was found growing faster, reaching a maximum size of 2.7 m, in areas without large macrophytes and with low desiccation stress (Fernández et al. 1990).

In Portugal, Sargassum muticum was found as drift plants on the W coast, N of Lisbon in 1990, probably carried by the water currents from Galaecia, NW Spain (J. C. Oliviera pers. comm.). Judging from the pattern of its accidental introduction in other European countries, an attached

population might be developed in a few years of time after the first drift to the area.

#### The Mediterranean Sea

In France, Sargassum was first recorded in l'Étang de Thau in 1980, probably introduced with oysters (Belsher et al. 1984, Knoepffler-Peguy et al. 1985). During the mid 1980s it was growing there in dense populations with up to 3-4 m long plants. On natural substrates it had substituted native species at depths between 0 to about 2 m and also was growing at the uppermost parts of mariculture structures (e.g. Boudouresque et al. 1985). In 1985 it was first found outside the lagoon, south as far as Port la Nouvelle (probably 1-2 years old populations) and east to Grau du Roi, mainly on artificial substrates down to 1.2 m and suggested to have been spread also with small boats (Knoepffler-Peguy et al. 1985). In 1987 it was sighted as far west as at Banyul (Belsher and Pommellec 1988).

So far there are no reports available of any occurrence along the Mediterranean coast of Spain, although it is growing in several areas along the French Mediterranean coast as far west as Banyul (see above). As far as known there are no records published in the Mediterranean from east of France.

#### The Pacific coasts

Scagel (1956) reported Sargassum muticum - accidentally introduced with oysters to the W coast of Canada - to have been abundant in the S Strait of Georgia, British Columbia before 1941 (first verified samples from 1944) and widely spread in 1945. However, it did not occur there during the first decades of the century. In many cases plants were found close to areas with imported Japanese oysters. However, it was not recorded from the early periods of oyster imports. During the 1970s the species had been established also on the W coast of Vancouver Island (Norton 1981), having reached the northern point of the Island before 1980 (DeWreede 1980) and later spread all through the N part of the British Columbia (Scagel et al. 1989). Young plants of Sargassum have been transferred from San Diego, California to Bamfield, British Columbia for ecological experiments (Deysher 1984).

On the Pacific US coast, the first record of Sargassum muticum, due to import of oysters, dates from 1947 in Oregon, while it was probably introduced earlier, since oyster imports were common during several decades of the early 20th century (Scagel 1956). In the early 1950s the same author reported it as common and growing in masses in the N part of the state of Washington.

The first progress to the south was slow. It finally covered most of the US Pacific coast in the early 1970s (Norton 1981). At the end of the 1980s, the southern border was in the middle part of the Pacific Mexican coast (Espinoza 1990), having been first recorded south of the US border in 1973. In the north it has been found in the southern SE Alaska, having reached that area before 1977 (Scagel et al. 1989).

#### Non-known records of Sargassum muticum

Areas where the species, as far as known, has not been recorded encompass:

1) The Atlantic: The coasts of Ireland, western, northern and most of the east coast of UK including Scotland, the islands of Ork y, Sheltland and the Hebrides, the Faroe Islands, the Danish North Sea coast, the Norwegian west and north coasts, Iceland, Greenland and the

Atlantic coasts of Canada and USA.

- 2) The Baltic Sea: The coasts of Poland, former USSR, Lithuania, Latvia, Estland, Finland and the Baltic coasts of Denmark, Germany and Sweden.
- 3) The Mediterranean Sea: The coasts of Spain and the countries east of France.

#### References

- Anon., 1982. Status (1980) of introductions of non-indigenous marine species to north Atlantic waters. Coop. Res. Rep., ICES 116:1-87.
- Belsher, T. & S. Pommellec, 1988. Expansion de l'algue d'origine japonaise Sargassum muticum (Yendo) Fensholt, sur les côtes françaises, de 1983 à 1987. Cah. Biol. Mar. 29:221-231.
- Belsher, T., T. Bailly de Bois & N. Salou, 1984. Expansion de l'algue d'origine japonaise, Sargassum muticum (Yendo) Fensholt, sur les côtes françaises, de 1983 à 1984. Cah. Biol. Mar. 25:449-455.
- Boudouresque, C.F., T. Belsher, P. David, M. Lauret, R. Riouall & M. Pellegrini, 1985. Donnes preliminaires sur les peuplement a *Sargassum muticum* (Phaeophyceae) de l'Étang de Thau (France). Rapp. Comm. int. Mer Médit. 29:57-60.
- Casares Pascual, C., A. Gomez Garreta, M.A. Ribera Siguan & J.A. Seone Camba, 1987. Sargassum muticum (Yendo) Fensholt, nueva cita para la Peninsula Ibérica. Collect. Bot. (Barcelona) 17:151.
- Christensen, T. 1984. Sargassotang, en ny algeslækt i Danmark. Urt 1984:99-104.
- Coppejans, E., G. Rappe, N. Podoor & M. Asperges, 1980. Sargassum muticum (Yendo) Fensholt ook langs de Belgische kust aangespoeld. Dumortiera 16:7-13.
- Critchely, A.T., W.F. Farnham & S.L. Morrell, 1983. A chronology of new European sites of attachment for the invasive brown alga, *Sargassum muticum*, 1973-1981. J. mar. biol. Ass. U.K. 63:799-811.
- Critchley, A.T., W.F. Farnham & S.L. Morrell, 1986. An account of the attempted control of an introduced marine alga, *Sargassum muticum*, in southern England. Biol. Conserv. 35:313-332.
- Critchley, A.T., P.H. Nienhuis & K. Verschuure, 1987. Presence and development of populations of the introduced brown alga *Sargassum muticum* in the southwest Netherlands. Hydrobiologia 151/152: 245-255.
- Critchley, A.T., W.F. Farnham, T. Yoshida, & T.A. Norton, 1990a. A bibliography of the invasive alga *Sargassum muticum* (Yendo) Fensholt (Fucales; Sargassaceae). Bot. marina 33:551-562.
- Critchley, A.T., P.R.M. De Visscher & P.H. Nienhuis, 1990 b. Canopy characteristics of the brown alga *Sargassum muticum* (Fucales, Phaeophyta) in Lake Grevlingen, southwest Netherlands. Hydrobiologia 204/205:211-217.
- DeWreede, R.E., 1980. The effect of some physical and biological factors on a *Sargassum muticum* community, and their implication for commercial utilization. *In*: Abott, I.A., M.S. Foster & L.F. Eklund (eds): Pacific seaweed aquaculture California Sea Grant College Program, La Jolla, pp. 32-44.
- Deysher, L.E., 1984. Reproductive phenology of newly introduced populations of the brown alga, *Sargassum muticum* (Yendo) Fensholt. Hydrobiologia 116/117:403-407.
- Druehl, L.D., 1973. Marine transplantations. Science 179:12.
- Espinoza, J., 1990. The southern limit of Sargassum muticum (Yendo) Fensholt (Phaeophyta, Fucales) in the Mexican Pacific. Bot. marina 33:193-196.

- Farnham, W.F., 1980. Studies on aliens in the marine flora of southern England. *In*: Price, J.H., D.E.G. Irvine & W.F. Farnaham (eds): The shore environment, Vol. 2: Ecosystems, Academic Press, London, p. 875-914.
- Fernández, C., L.M. Guteérrez & J. M. Rico, 1990. Ecology of *Sargassum muticum* on the north coast of Spain. Preliminary observations. Bot. marina 33:423-428.
- Gruet, Y., 1976. Présence de l'algue japonaise Sargassum muticum (Yendo) Fensholt sur la côte française de Normandie. Bull. Soc. Sci. nat Ouest Fr. 74:101-104.
- Hales, J.M. & R.L. Fletcher, 1989. Studies on the recently introduced brown alga Sargassum muticum (Yendo) Fensholt. IV. The effect of temperature, irradiance and salinity on germling growth. Bot. marina 32:167-176.
- ICES, 1982. Report of the Working Group on Introductions and Transfers of marine organisms, La Coruna, Spain; 4-7 May 1982. C.M. 1982/F:37.
- ICES, 1989. Report of the Working Group on Introductions and Transfers of Marine Organisms, Dublin, Ireland, May 23-26, 1989. C.M. 1989/F:16.
- ICES, 1990. Report of the Working Group on Introductions and Transfers of Marine Organisms, Halifax, Canada, June 6-8, 1990. C.M. 1990/F:14.
- Karlsson, J., 1988. Sargassum muticum, a new member of the algal flora of the Swedish west coast. Svensk Bot. Tidskr. 82:199-205. (In Swedish with English abstract).
- Knoepffler-Peguy, M., T. Belsher, C.F. Boudouresque & M. Lauret, 1985. Sargassum muticum begins to invade the Mediterranean. Aquat. Bot. 23:291-295.
- Kremer, B.P., H. Kuhbier & H. Michaelis, 1983. Die Ausbreitung des Brauntanges Sargassum muticum in der Nordsee Ein Reise um die Welt. Natur und Museum 113:125-130.
- Norton, T.A., 1981. Sargassum muticum on the Pacific coast of North America. In: Fogg, G.E. & E. Jones (eds): Proc 8 Int. Seaweed Symp. Bangor, North Wales, 18-23 August 1974, p. 449-456.
- Pérez-Cirera, J.L., J. Cremades & I. Bárbara, 1989. Systematic and synecologic comments about some new seaweed records for Galicia or for the Atlantic coasts of the Iberian Peninsula. Anales Jard. Bot. Madrid 46:35-45. (In Spanish with English abstract).
- Prud'homme van Reine, W.F. & P. H. Nienhuis, 1982. Occurrence of the brown alga Sargassum muticum (Yendo) Fensholt in the Netherlands. Bot. marina 25:37-39.
- Rueness, J. 1989. Sargassum muticum and other introduced Japanese macroalgae: Biological pollution of European coasts. Mar. Biol. 20:173-176.
- Rueness, J., 1990. Spredning av japansk drivtang (Sargassum muticum) langs Skagerrakkysten. Blyttia 48:19.
- Santiago Caamaño, J., C. Duran Neira & R. Acuña Castroviejo, 1990. Aparicion de *Undaria pinnatifida* en la costas de Galicia (Espana). Un nuevo caso en la problematica de introduccion de especies foraneas. Informes Técnicos del Centro de Investigaciones Submarinas (CIS) 3 (1990). 45 pp.
- Scagel, R.F., 1956. Introduction of a Japanese alga, Sargassum muticum, into the northeast Pacific. Fish. Res. Pap. Wash. Dept Fish. 1:49-59.
- Scagel, R.F., P.W. Gabrielson, D.J. Garbary, L. Golden, M.W. Hawkes, S.C. Lindström, J.C. Oliviera & T.B. Widdowson, 1989. A synopsis of the marine algae of British Columbia, southeast Alaska, Washington and Oregon. Dept Bot., Univ British Columbia, Phycol. Contrib. 3:1-532.

### APPENDIX III.

Documents on the Proposed Introduction of the

Japanese Red Alga <u>Porphyra</u> to the

Atlantic Coast of the United States



John R. McKernan, Jr.
Governor

William J. Breonan
Commissioner

#### DEPARTMENT OF MARINE RESOURCES

Telephone (207) 624-6550 FAX (207) 289-5758

April 6, 1992

Dr. Emory D. Anderson General Secretary International Council for the Exploration of the Sea Palaegade 2-4 DK-1261 Copenhagen K DENMARK

FAX: 011-44-33-93-42-15

Dear Dr. Anderson:

Dr. James T. Carlton, Chair, of ICES Working Group on Introductions and Transfers of Marine Organisms, has provided me with information on the procedures we should use to request the Council's advice on a proposed release of a Japanese species of seaweed into State of Maine waters.

Our Department has provided a conditional permit to a private party in Maine to begin cultivation of the edible Japanese seaweed Porphyra yezoensis. Our Department, and the private entrepreneur involved, have provided Dr. Carlton with extensive materials on this release. Dr. Carlton's Working Group briefly discussed this species at their meeting last year in Helsinki, and as a result it became one of their terms-of-reference for their meeting in Lisbon next week. We have also regularly provided information on this release to the Canadian Department of Fisheries & Oceans and they are aware of this issue. Furthermore, I am informed by Dr. Carlton that the marine algae expert of his WG, Dr. Inger Wallentinus of Sweden, discussed this matter with Canadian phycologists at the Phycological Congress in North Carolina last fall.

Dr. Carlton informs me, however, that it would be appropriate at this time for the State of Maine to formally request the Council's advice on this introduction which, by this letter, I am so doing. We would appreciate ICES, through its Working Group in Introductions and Transfers of Marine Organisms, examining this introduction and provide to the Council its advice on this matter.

Dr. Emory D. Anderson April 6, 1992 Page 2

Toward that end, by letter of 2 March 1992, the private party involved has provided Dr. Carlton with an update of this planned introduction accompanied by supporting materials. Dr. Carlton has told me that he is prepared to carry these materials before his WG in Lisbon next week. He was concerned, however, that his WG would take this matter on in the absence of a formal request from us, and thus from you to his WG, to do so.

Our thanks for your attention to this matter.

Sincerely

William J. Brennan

Commissioner

WJB/db

PROPOSAL FOR APPLICATION OF PERMIT FOR INTRODUCING THE RED ALGA <u>Porphyra vezoensis</u> FROM WASHINGTON TO THE MAINE COAST FOR COMMERCIAL CULTIVATION (Revised Jan 31,1991) [Fd. 8,191]

#### INTRODUCTION:

During the public hearing on importation of the red alga Porphyra vezoensis from Washington to Maine held at Eastport, Maine on Jan. 29, 1991, it was determined that the methodology of importing frozen seeded nets of P. vezoensis was too risky in possibly importing extraneous diseases and/or organisms on the nets. This revised proposal describes a much safer method for establishing a culture for a pilot study on possible commercial cultivation of the valuable resource in Maine waters.

The economic value of <u>P. vezoensis</u> when prepared as nori is discussed in the first proposal for the introduction of <u>P. vezoensis</u> in Aug. 1990 and is detailed in Kramer et al (1982). The U.S. imported approximately \$25 million worth of nori in 1990. The largest markets in the U.S. for nori are Boston, New York City, San Fransisco, and Hawaii (Kramer et al, 1990). A medium to high quality nori sheet would be readily entered into the existing market pipeline. Small farms of 16 - 24 acres (only 1/12th of which is utilized by nets (P.E.I.S. 1987, appendix A) might yield as much as 2 - 3 million sheets each, realizing a net profit of \$40 - 70,000, and not influencing the total market of 230 million sheets imported last year.

#### DANGERS OF IMPORTATION OF P. vezcensis.

Two basic risks were discussed at the public hearing and in the first proposal for importation: (1) escapement, and: (2) importing other organisms or diseases with the seed materials. These are discussed in detail below. There are a number of P. vezoensis cultivars (Table 1), all highly domesticated and inbred to produce high quality nori at rapid growth. All are poor competitors, requiring strict.

#### 1). Escapement.

Dr. Tom Mumford Jr, instrumental in importing P. Vezoensis from Japan to Washington, studied this risk exhaustively and presents his findings in the P.E.I.S., 1987, Appendix A. To summarize, because P. Vezoensis requires a water temperature of 23 - 25 degrees C. coupled with a photoperiod of 10 hours daylength and 14 hours of dark to reproduce, it is not likely to do so in our waters. As was discussed at the public hearing by Jay McKowen, biologist for Maine DMR, such water temperatures do occur in Cobscook Bay at various shallow water areas during July and August. However, the photoperici P. Vezoensis requires to sexually reproduce occurs in Maine in October, when the

water temperature does not reach the required level. Furthermore, appended to the P.E.I.S. (appendix A) is the correspondance of 12 national and international algalogists that further supports the contention that <u>P. vezoensis</u> is unlikely to escape and impair the local environment. One interesting observation made by Dr. Hitoshi Kito, Seikai Regional Fisheries Research Lab, Japan, was that <u>P. vezoensis</u> strains are so highly domesticated they do not even escape into the native Japanese waters.

### 2). Importing other organisms or disease.

This is considered to be the highest danger in importing this alga. While standard culture practices require extreme care in keeping the nets uncontaminated from other organisms, such contamination can occur. The freshly seeded nets are frozen at -20 degrees C. for at least 2 weeks to further purify the nets, but some bacteria, viruses, fungi, and meiofauna can survive this treatment.

There are two techniques in ensuring uncontaminated seed stock for importation to Maine. As outlined in the life history of P. vezoensis, (Figure 1), adult blades give off male and female germ cells which unite to form enchorage, which grow into conchocelis. Under proper water temperatures and photoperiod, the conchocelis grows into the oyster shell, and after 5 - 7 months forms reproductive buds or shell, and after 5 - 7 months forms reproductive buds or grow into harvestable blades.

Free conchocelis can be obtained from the Division of Natural Resources, EX-12, Dept. of Natural Resources, Marin Research Center, Olympia, WA. 98504. They can be tested as Areka uni-algal or axenic, depending on Maine Dept. of Marine Resources requirements, by a certified microbiology lab. The tested conchocelis would then be cultured on oyster shells purchased or obtained from a local shellish processor in Maine. The shells are scrubbed thoroughly, treated with chlorine solution, and dried before use. Melvin et al, 1986, describes the technique required to innoculate the shells with the conchocelis. The filaments must be broken up into fragments about 200 microns long and contain no more than 6 intact cells. This is done with a household blender and considerable practice is required to determine proper speed and duration. The fragments are then sprinkled over the shells covered by 1" of culture water. Under proper culture conditions the fragments will begin to penetrate the surface of the shells in 5 - 10 days.

Alternatively, the conchocelis of <u>P. vezoensis</u> can be purchased from American Sea Vegetables, Seattle, Washington, already innoculated on the shells. These would be cultured in Washington after innoculation of the conchocelis for 3 - 4 weeks in closed system tanks to become well-established in the shells and to determine that no other organisms might have infected the culture. The shells can be carefully packaged in insulation and vapor barriers and flown to Maine. Immediately upon arrival they will be bathed in sodium hypochlorite to sterilize the outside of the shells.

International Marine Resources, Calais, Me., working with North Atlantic Aquaculture, Eastport and Skybird Ltd., Lubec, and in cooperation with the Marine Trade Center, Washington County Technbical College, Eastport, propose to attempt to grow out a total of 60 5 x 60 nori nets, of divided between the sites. Since 4 innoculated shells are the needed to seed one net, 250 shells would be required, either already innoculated from Washington, or if free conchocelis is required, from a local shellfish processor.

The conchocelis in the oyster shells are cultivated in tanks in small greenhouses, in which temperature and light can be carefully controlled. We propose to use 2 types of tanks for culturing the conchocelis, as described in Melvin et al, 1986. One type is the use of totes used for handling 50 lb wet salmon feed. This tote measures 15" x 24" x 12". Each tote can hold 20 oyster shells. We would use 5 totes to grow 100 oyster shells. The remaining shells would be placed in 2 xactics, measuring 46" x 42" x 30". These shells would be suspended by strings from poles laid across the top of the xactic. The advantage of using the totes is that their management would increase our skills in conchocelis culturing and would limit the damage of any disease outbreaks. The disadvantages are that with the small volume of water involved it is difficult to control temperature because the whole greenhouse must be heated or cooled, and due to evaporation salinity is difficult to control. The xactics can be heated with a 1000 watt emmersion heater, and with the larger volume of water salinity would be easier to control. Thermal stratification would occur in these tanks and can be obviated by using an aquarium air pump and air stone.

During the culturing period of 5 - 7 months, a total volume of only 3 water changes would be needed to sustain the cultures. The culture water would be pumped from 60' below the surface at a location off of Shackford Head with a gasoline water pump into 2 xactics. The lids will be securely fastened and the water stored for at least 2 months

before use. Distilled fresh water will be used to replace water lost through evaporation. To maintain nutrient levels, liguid fertilizer similar to New Norimax (Figure 2) will be added. Figure 3 outlines the water changes, fertilizer schedules, water temperature, and photoperiod for  $\underline{P}$ , vezoensis  $\underline{U}$  – 51.

The growth of the conchocelis will be carefully monitored on a daily basis with the use of a 100x microscope. The conchocelis becomes visible to the naked eye 20 - 25 days after innoculation and its growth pattern is indicative of good health or problems. Fouling by diatoms is common, as they are airborne near the coast. The shells must be carefully brushed periodically to remove the fouling.

Diseases most often occur due to poor culture conditions such as wrong pH, incorrect temp. or salinities. Bacterial problems can be solved using sodium hypochlorite. Some fungi can be controlled by lowering the water temp. below 16 degrees C., which also inhibits the growth of the conchocelis.

After several months reproductive spores will be seen on the conchocelis. Careful culture techniques will determine the success of spore release onto the culture nets. Microscopic examination is required daily to determine when a heavy spore release occurs. When it does occur, the shells are transferred to plastic buckets with enough culture water to cover them, and placed in the seeding equipment to seed the nets.

Seeding the nets.

We will follow the techniques of seeding the nets described by Byer, et al, 1984. Roughly outlined, a seeding framework made of 2" PVC pipe 62' x 6' is constructed, essentially looking like a large ladder with rungs approximately 3' apart (Figure 4.). It will be made in 6 sections that can be put together at the aquaculture sitye. A "seedbag" made of 2 pieces of vexar car-cover type plastic netting 58' x 4' with 1" bar mesh is tied onto the frame. A tarp 61' x 5' is stretched under the seedbag. The shells are placed in the seedbag on the tarp (Figure 4). All 60 nets 5' x 60', are placed on top of the structure, which is gently awash, and seeding takes place in 1-2 days.

Nursery culture.

The seeded nets are then stretched in stacks of 5-10 on floating structures called ikada. They are made of a

series of U - shaped pipe strung together and rising about 1.5' above the water (Figure 5). This allows the nets to be raised out of the water for short periods of time to allow dessication to kill fouling organisms and disease. After 2 - 4 weeks the plants should be about 1" long. They may be thoroughly dried and frozen at this time and used several months or more later, or used immediately. Since the length of the growing season is not known for this area, 30 nets will be used immediately, and 30 frozen to be grown out at later times in the year.

### Growout.

The cultivated nets are usually stretched tightly just beneath the surface on the aquaculture site. Some areas stretch the nets  $3^{\circ}$  -  $6^{\circ}$  below the surface to allow debris to wash over the top. After 10-30 days, the plants should be 15-20 cm, and can be harvested. Up to 6 harvests from each net might be made at 7-10 day intervals. When the net stops producing, it will be pulled, dried, sterilized, and replaced with another frozen net. This will continue until growth no longer occurs.

Because this is a demonstration study, after the plants reach harvestable size an expert from Washington or Japan will come and sample the raw crop for quality and taste for making nori. We will harvest the plants and monitor production to determine if commercial quantities can be produced. Harvested material will be dried and sold locally as laver. After the growth has slowed or stopped, the nets will be pulled from the water, dried, and stored for possible reseeding the following year.

If production approaches that of other areas of the world, then attempts will be made the following year to obtain the proper permitting to expand the operation to several hundred nets and to procur a processing machine to make the nori.

A Proposal to Research Growth of <u>Porphyra yezoensis</u>
cultivar "U - **5**;" Conchocelis from Washington
In Cobscook Bay, Maine

Submitted to the Maine Aquaculture Innovation Center by:

Stephen Crawford International Marine Resources Route 1, Box 97 Eastport, Maine 04631

Ira Levine, Ph.D.
Biological Services, Inc.
RFD 1, Box 625
Empire Road
Poland, Maine 04273

### INTRODUCTION:

Nori is a food product made from certain species of the red algal genus Porphyra. Used as a wrapper in Japanese sushi and as a condiment and seasoning, its global market exceeds \$2 billion/yr. The U.S. market is one of the fastest growing of all food imports, at a rate of 12 - 15%/yr on current sales of \$25 million (1990). It is riding the crest of popularity of the fast-growing Japanese cuisine. The U.S. market is largely in 4 locations: San Francisco, Boston-New York, Honolulu, and Seattle. All product is imported from the Far East, where it is cultivated in Japan and Korea.

Nori is made by finely chopping the alga and washing in fresh water, and forming a water/alga slurry. This slurry is pressed and dried under very specific conditions of heat and humidity to form a paper sheet cut to standard 18 x 20cm size. Acceptable nori is a green-black color with no impurities and of uniform thickness. Taste is critical and there must be proper sweetness and a certain "nori" flavor.

Only a few species make acceptable nori. Japan's predominant species for nori are certain cultivars of <u>Porphyra vezoensis</u>, a cold-water species, and <u>P. tenera</u>, a warm-water species. A couple of others are cultivated in Korea and China. Virtually all nori is cultivated, with cultivars being cultured and developed for several hundred years.

There are several factors that have attracted nori to aquaculturists in North America. One is that several species of Porphyra grow in North American waters. Another is that The Nori Institute of Japan, a Japanese government sponsored marketing coop, targeted the U.S. market in the 1980's as one of great potential, and felt that developing a U.S. nori farm industry would be beneficial to all. Local production would increase consumer awareness and market growth, and eventually provide new markets for Japanese product. Their scientists predicted that the Pacific Northwest and the Northeast from North Carolina to Maine had great potential for culturing Japanese Porphyra. Further incentive was that because of worsening water pollution in Japan, quality product is decreasing, and the Nori Institute is looking for other habitats to produce the nori. The Pacific Northwest potential has been proven, with production rates 4 to 10 times that of Japan's (Mumford 1987). No trials have been made on the East Coast.

Of obvious concern in culturing an alga from Japan is its effects on the local environment. After intense

scrutiny, scientists decided to risk possible detrimental effects and introduced several cultivars of  $\underline{P}$ .  $\underline{yezoensis}$  and  $\underline{P}$ .  $\underline{tenera}$  to the Northwest. Because of improper water temperature and perhaps other local environmental factors, none of the introduced species have escaped from the algal P. yezoensis requires temperatures of 6 - 14 farms. degrees C. to produce the harvestable blade, and 22 - 25 degrees C. to reproduce sexually. Because the water temperature of Maine rarely reaches such high temperatures, and only in shallow estuaries or tidal flats for short periods of time, the chances of the Japanese species to escape would appear slight here as well. written testimony presented at a recent public hearing in Eastport, Maine on introducing P. yezoensis, a Japanese scientists reported that the cultivars used in Japan do not even escape in Japanese waters, possibly because they are so inbred that they are poor competitors.

The advantages of using an exotic Porphyra are that the culturing techniques are widely known, the resulting product is commercially viable, and if production is high enough an industry could be established in just a few months. The blade of the alga takes only 10 weeks of growth to reach harvestable size, and then it can be cut every 5 to 10 days for repeated harvests through the growing season.

### **OBJECTIVE:**

This study would research the growth of the imported alga P. yezoensis cultivar U = 51", in Maine waters to help determine if the species can be commercially cultivated. The conchocelis stage is the filamentous stage of the life cycle of Porphyra, when it lives on calcareous shells. After several months of growth, it releases asexual spores which can attach to net material, from which it will grow the harvestable blade. If this conchocelis growth is successful and nets are seeded, the next step is to stretch the nets out at grow-out sites in Cobscook Bay and monitor the algal growth until harvest. Because the grow-out of the thallus stage occurs at 6 - 14 degrees C., or from June to December, in Maine, the seeded nets will be frozen at -20 degrees C. until the proper temperatures are met. This second step will be funded separately from the proposal.

Permission has been granted by Hank Stence, owner of Skybird Ltd. Salmon Farm, Lubec, and Dick Klyver, North Atlantic Aquaculture Inc. Eastport, to provide grow-out space at their lease sites for this second step.

Results of this study will be presented to all aquaculture lease site holders in Maine and to all interested State agencies and personnel. There is

interested State agencies and personnel. there is potential that nori net could be successfully cultured on existing finfish lease site areas not being leased for culture, such as between mooring floats and between cages, and provide great value-added resources to existing sites.

### References Cited:

Chen, L.C-M., I. McCracken and M.A. Ragon, 1990. Biotechnology potential for hoshi-nori production. World Aquaculture 21 (3): 106-107.

Mumford, T.F. Jr. 1987, commercialization strategy for nori culture in Puget Sound, WA. In Seaweed cultivation for renewable resources. K.T. Bird (Ed.) Elsevier, Amsterdam, 351-369.



John R. McKernan, Jr.

William J. Brennan Commissioner

### DEPARTMENT OF MARINE RESOURCES

Telephone (207) 289-6550 FAX (207) 289-5758

August 28, 1991

Stephen E. Crawford International Marine Resources Rt. 1, Box 97 Kendalls Head Eastport, ME 04631

Dear Mr. Crawford:

In response to your request to introduce the red agla <u>Porphyra yezoensis</u> from the State of Washington to the Maine Coast, as revised February 8, 1991, I hereby grant you this conditional permit under DMR Regulations Chapter 24.

This permit is renewable on the anniversary of this date.

Under this permit you may:

Import for introduction into Maine coastal waters <u>P. yezoensis</u> variety "U-51" as free conchocoelis from the Washington Department of Natural Resources delivered to the Provasoli-Guillard Center for Culture of Marine Phytoplankton, Bigelow Laboratory, Boothbay Harbor.

To receive the culture when it has been determined to be axenic by Bigelow Laboratory and a report of Bigelow Laboratory's methods and determination has been sent to the Commissioner.

To present as substrate clean Maine oyster shell (or other Maine molluscan shell) to the culture released by Bigelow Laboratory.

To culture the alga in closed systems in cooperation with the Marine Trades Center, WCTC, Eastport. Mr. Stephen E. Crawford Page 2 August 28, 1991

Before inoculated nets are introduced into Maine's coastal waters, you must provide the commissioner:

A current bibliography and translations of reports published or unpublished, relating to the ecology and physiology of the species with special attention given to references to photoperiod and temperature requirements for <u>P. yezoensis</u> and the variety U-51 including those cited in the application; AND

A report of current observations relative to any effects of  $\underline{P}$ .  $\underline{\text{yezoensis}}$  or  $\underline{P}$ .  $\underline{\text{tenera}}$  culture or establishment (escape) of those species in the waters of Puget Sound, British Columbia, or other North American waters where they may be cultured.

You must advise me of the sites and size of introductions into Maine coastal waters that are made of any form of the species.

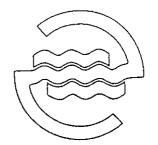
We would appreciate your assistance in the preparation of an application for permission to introduce <u>P. yezoensis</u> into the Northwest Atlantic to be submitted to The Working Group on Introductions and Transfers of Marine and Freshwater Organisms of the International Council for the Exploration of the Sea for its consideration at its regular meeting in 1992.

Sincerely

VILLIAM J. BRENNAN

Commissioner

rr



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

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

Mr. Steve Crawford IMR Route 1 Box 97 Eastport, ME 04631

2 October 1991

Steve:

I've concluded the tests designed to detect bacterial or algal contamination of *Porphyra yezoensis*. All eight tests were negative for any such contamination over a period of eight weeks. By all our methods of detection, including differential interference microscopy, your *Porphyra yezoensis* culture is monoalgal and axenic. I am prepared to maintain the culture here at the CCMP as a non-circulating, private holding for as long as you see fit. We charge \$200 per year for this service, which allows you to repeatedly request subcultures, but does not include the cost of shipping. (Our normal charge for a single "public" culture is \$90 for each successful shipment. Should a culture die in transit we reship, charging for postage only.) However, I will include a year of maintenance of the culture (Oct 1991 to Oct 1992) as a private holding as part of the contamination analysis service, the fee for which we had proposed earlier this year.

Sincerely,

Dean Jacobson, PhD

Dr. J.T. Carlton Maritime Studies Program Williams College Mystic. Conn. 06355

Stephen E. Crawford International Marine Resources Rt. 1, Box 97 Eastport, ME 04631 (207) 853-0982

Mar. 2, 1992

Dear Dr. Carlton:

Enclosed is information on the progress of research on the importation of the Japanese red alga <u>Porphyra vezoensis</u> variety U-51 for possible cultivation and production of nori in Cobscook Bay, Maine. I have included a copy of the correspondance from Maine Department of Marine Resources, 2 grant proposals accepted by Maine Aquaculture Innovation Center, a progress report submitted to the MAIC, and correspondance received from Department of Fisheries and Aquaculture, New Brunswick.

If all goes according to plan, seeding of 200 60' x 5' norinets will take place around July 1, 1992 and the nets will be placed at 2 sites in Cobscook Bay. Cultivation techniques will be as described by Noda and Iwata, 1978, A Guide to the Improvement of Nori Products, National Federation of Nori and Shellfish Fisheries Cooperative Associations, 234 pp., and Byce et al, Equipment for Nori Farming in Washington State, 1984, Wash. Dept. of Natural Res. 154 pp. and consultation with Dr. John Merrill, Applied Algal Research, Seattle, WA. Raw product will be processed in Eastport, ME. into nori sheets and marketed through Maine Coast Sea Vegetables, Franklin, Maine. The growing season is expected to be from June to Nov.

I will be most happy to provide you with additional information in this project. I do not consider any results of my efforts to be proprietory and am very willing to share information with any interested party.

Sincerely,

Stephen E. Crawford

### PROGRESS REPORT

CULTIVATION OF CONCHOCELIS OF PORPHYRA YEZOENSIS, VAR. U -51 FOR SEEDING NORI NETS FOR PRODUCTION IN COBSCOOK BAY, MAINE SEPTEMBER 1, 1991 TO MARCH 1, 1992

This six - month progress report briefly summarizes activities and results in culturing conchocelis filaments of <u>Porphyra vezoensis</u> var. U-51 in Eastport, Maine to prepare for seeding of nets for nori production in Cobscook Bay, Maine. This report is required per Contract # UM-S199, with Maine Aquaculture Innovation Center, and the University of Maine System.

Facilities and Equipment.

Storage tanks with a total capacity of 2500 l. were obtained to store and age sea water for cultivation of the conchocelis. Three culture tanks of 4' x 4' x 1' were constructed, and 6 - 1.5' x 1' x 1' plastic tanks were purchased for culture tanks. A wet lab of 12' x 12' was constructed at International Marine Resources office in Eastport. A bank of fluorescent lights wired to timers provides proper light and photoperiod. Electric water heaters of 100 W maintain temp. 500 scallop shells (Placopectin magellenicus) were obtained from Cooper Island Salmon Farm, Lubec, located in Cobscook Bay, for substrate for the conchocelis. These shells were washed and prepared for culture use, and provide approx. 130 sq. ft. of substrate. This should be sufficient for seeding 200 60' x 5' nori nets.

Testing equipment, glassware, and microscope have been acquired for daily monitoring of temp., salinity, pH, and growth of the filaments. Additional containers and brushes have been purchased to facilitate periodic washing of the culture shells to remove fouling diatoms.

As of March 1, 1992, free conchocelis filaments have been attached to 500 scallop shells and are being grown in 9 tanks. Four concentrations of filament attachment have been used, with the highest concentrations in the smallest growout tanks to observe potential problems with disease and altered growth due to high density. All tanks are under 14 hours of light, 10 hours of dark, at a temp of 18 - 20 degrees C. Temp. will slowly be raised during March to 22 - 24 degrees C., and in April the photoperiod will be changed to 10 hours of light, 14 of dark to induce sporangial growth.

Several types of diatoms and a filamentous green alga have been observed on the substrate, and have been easily removed by washing in fresh water and gently rubbing with a nylon paint brush. The shells must be washed every 10 - 12 days.

No diseases have been observed. Differential morphology has been observed in the filaments growing on the areas of the shell where the adductor muscle once attached, with these filaments being very short with numerous branching, reduced growth rates, and a very sharp delinization at the edge of the filaments which contrasts with fuzzy edges of the other filaments:

One third of the culture water in each tank is changed monthly, and each tank is fertilized with F/2 algae food once per month at the rate of 2 ml each of A and B solution per gallon of culture water.

A summary of the budget is attached.

\*

Fisheries Pêches and Oceans et Océans P.O. Box 550 Halifax, N.S. B3J 287

Your e Votra référence

May 16, 1991

Our 1.4 Notice reference
1152-N1

Mr. Walter Foster, Director Industry Services Division Department of Marine Resources State House Station 21 Augusta, Maine 04333-0021 U.S.A.

Dear Walter:

This letter is a follow-up to my re-acquaintance phone call of May 16, 1991, in which we discussed the proposed introduction of the red alga, <u>Porphyra yezoensis</u>, to the area of Eastport, Maine. Ordinarily the Department of Fisheries and Oceans has the legislative authority for controlling the movement of aquatic organisms into Canadian waters but, at this time, there are regulations only for harvesting marine plants and none for controlling the introduction of marine plants. In other words, if the proposal were to introduce porphyra into the Canadian side of Passamaquoddy Bay, DFO would not issue a written permission to do so because of lack of legislative authority.

However, Canada and the U.S.A. are members of the International Council for the Exploration of the Sea (ICES) which provides scientific advice to the member counties. ICES Working Group on the Introduction and Transfer of Marine Organisms was tasked with developing documentation on advice where movement of aquatic species is being considered. Working Group developed a Codes of Practice and Manual of Procedures for Consideration of Introductions and Transfers of Marine and Freshwater Organisms. The document was printed as ICES Cooperative Research Report 159, August 1988, 44 pages, jointly on ICES and the European Inland Fisheries Advisory Commission which subscribed to the content of the codes and The document, essentially, recommends the collection of all known information about the proposed introductory species in its donor site, about the native stocks in the receiving site, and advice and experience from scientists and industry before making a positive decision. Once the decision is made for the introduction, the youngest stage possible is transferred into quarantine where periodic testing determines whether any other organism or disease has been moved with the introduced organism. At any point, of course, the introduction can be terminated for cause. If no problems develop, then  $F_1$  organisms are placed into the receiving site on a pilot scale. If results are

.../2

Mr. Walter Foster



May 16, 1991

favourable, then the clean new organism is ready for commercial scale usage.

In summary, due to the proximity of your Porphyra receiving site to Canadian waters, DFO would like to see appropriate precautionary measures in place so that our natural resources are not affected deleteriously.

Nice to talk with you again, Walter.

Very truly yours,

R.E. Cutting Chairman, Non-Indigenous Species Introductions Committee

Scotla-Fundy Region

REC/dj

Encl.

cc: D. Scarratt

C. Bird

# Nouveau Brunswick

December 5, 1991

Mr.Stephen Crawford Coastal Plantations International Inc. Rt. 1, Box 97 Eastport, Me. 04631

Dear Mr. Crawford:

This letter knowledges receipt of your submission regarding the introduction and cultivation of the Japanese red alga <u>Porphyra yezoensis</u> to Passamaquoddy Bay and the western part of the Bay of Fundy.

As you may be aware, the introduction of a non-indigenous species such as the one noted above is subject to approval from the federal Department of Fisheries and Oceans. Based on the aforementioned your submission has been forwarded to the noted agency for review. Although the introduction is subject to approval from Fisheries and Oceans Canada, the cultivation of aquatic species in New Brunswick is subject to approval under the Aquaculture Act which is administered by this Department. Prior to consideration being given to the cultivation, an application must be submitted for evaluation. It is suggested that Mr. Hugh Madill our Aquaculture Coordinator for the Bay of Fundy Region be contacted at 466-3928 to discuss your plans for cultivation prior to the submission of an application.

In the event you are no longer interested in pursuing this matter please advise myself or Mr. Madill. Should you have any questions in respect to the above-noted please feel free to contact me at (506) 453-2253.

Sincerely,

R. Russell Henry

Registrar of Aquaculture

CC

Hugh Madill - Department of Fisheries & Aquaculture Gary Turner - Department of Fisheries & Oceans Robert Rioux - Department of Fisheries & Aquaculture

### APPENDIX IV.

### **NATIONAL REPORTS**

### Note on Report Format:

The following National Reports are printed as submitted by the individual countries. While most Reports follow the standard suggested subject areas, they are submitted in a wide variety of type faces and subformats. It is hoped that future submissions will be on computer disks and that these Reports can then be presented in a uniform fashion.

In addition, certain species may appear under more than one name because of continuing taxonomic problems. The Japanese Clam <u>Venerupis philippinarum</u>, for example, appears in the following reports as <u>Ruditapes semidecussata</u>, <u>Ruditapes philippinarum</u> (sic), <u>Tapes philippinarum</u>, and <u>Tapes japonica</u>.

NATIONAL REPORT FOR CANADA ON INTRODUCTION AND TRANSFER OF AQUATIC ORGANISMS: 1991-1992

### 1.0 RELEVANT LAWS AND REGULATIONS IN ICES MEMBER COUNTRIES

### FISHERIES ACT OF CANADA

Legislation governing introductions and transfers of fish and fish products to the provinces and territories of Canada comes under the Fisheries Act of Canada, which covers both coastal and inland fisheries. The Department of Fisheries and Oceans is responsible for the administration of the Fisheries Act. The Fish Health Protection Regulations and the Provincial Fisheries Regulations are promulgated under the Fisheries Act.

### Fish Health Protection Regulations

<u>Present</u>: Canada's Fish Health Protection Regulations (FHPR) for salmonids came into effect in 1977. These regulations control the movements of salmonids between provinces and their importation into Canada, and require health certification of sources of stocks before transfer permits are issued.

<u>Proposed</u>: An amendment to the regulations to exclude dead, eviscerated fish is expected to become effective in May, 1992. Draft revisions of the FHPR and the Manual of Compliance are well under way and it is planned that they will be implemented in mid-1993. Significant changes expected include the expansion of the Regulations to cover other species of finfish (the existing regulations only cover the family Salmonidae) and shellfish, and the use of the concept of zoning.

### **Provincial Fishery Regulations**

Each province/territory has regulations under the Fisheries Act that are designed to meet local needs. The Provincial Fishery Regulations for each of the Atlantic provinces (Newfoundland, Prince Edward Island, New Brunswick and Nova Scotia) require that, with the exception of various shellfish 'exemption' subsections, a permit be obtained to introduce or transfer fish. The regulations are variously worded but those for Nova Scotia and Newfoundland are the most comprehensive (see Appendix I.)

### Fisheries (General) Regulations (Proposed)

The Provincial Fisheries Regulations contain sections which are common to all provinces. In an effort to consolidate and harmonize regulations, the Department of Fisheries and Oceans is proposing to combine common sections of the Provincial Regulations into the Fishery (General) Regulations. Part VII of the proposed Fishery (General) Regulations, dealing with "Release of Live Fish into Fish Habitat and Transfer of Live Fish to a Fish Rearing Facility" (see Appendix II), is intended to replace sections in the existing provincial regulations applicable to introductions and transfers. The Fishery (General) Regulations will apply only in provinces administered by the Department of Fisheries and Oceans and it is planned that they will be in place by the summer of 1992.

### Maritime Provinces Fishery Regulations (Proposed)

The Department of Fisheries and Oceans has also proposed further consolidation of regulations that apply specifically to the three Maritime Provinces (Prince Edward Island, New Brunswick and Nova Scotia). These will be called the Maritime Provinces Fishery Regulations, and will contain sections dealing with the introduction, transfer and use of live baitfish (see Appendix III).

### PROVINCE OF QUEBEC

The Wildlife Conservation and Development Act under the Quebec provincial government is used as a guideline for establishing the conditions under which imports and transfers of non-salmonid fish are permitted. In 1992, these conditions are expected to be incorporated into regulations.

### 2.0 OTHER PROCEDURES CONCERNING INTRODUCED SPECIES

A policy for introductions and transfers into the Province of Prince Edward Island is being developed and is currently being reviewed by aquaculture industry and government agencies. Although both 'finfish' and 'shellfish' are considered in the policy, the emphasis is on shellfish.

An interim policy similar to the American Fisheries Society Environmental Policy Statement on the Introduction of Aquatic Species is currently under development in Saskatchewan.

The Department of Fisheries and Oceans has prepared a "Policy for the Importation of Atlantic Salmon into British Columbia" (Appendix IV). Atlantic salmon are not indigenous to the Pacific coast, but it has become an important species for aquaculture. Importation of Atlantic salmon seedstock is being facilitated under this Policy, but conditions are applied (including a requirement for quarantine holding) which minimize the risks of transfer of disease agents of concern.

Voluntary guidelines for the control of ballast water discharge from ships proceeding via the St. Lawrence Seaway to the Great Lakes are now in effect. These guidelines, together with the US regulations are intended to protect the Great Lakes from the introduction in ships' ballast of non-native fish and other aquatic organisms (Appendix V).

### DELIBERATE INTRODUCTIONS

### 3.0 DELIBERATELY INTRODUCED ANIMAL OR PLANT SPECIES

### 3.1.1 FISHERY ENHANCEMENT (ESTABLISHMENT OF NEW BREEDING POPULATIONS)

Table 1:	1991 transfers and introductions of salmonids for enhancement purposes.

Species/ Receiving Province	No. of fish (shipments)	Source
Atlantic Salmon (Salmo salar	·)	
New Brunswick	565,000 eggs (2)	New Brunswick
New Brunswick	38,000 fry	New Brunswick
New Brunswick	440,500 parr (2)	New Brunswick
New Brunswick	40,083 smolt	New Brunswick
Nova Scotia	136,000 parr	Nova Scotia
Nova Scotia	53,300 smolt	Nova Scotia
Prince Edward Island	129,161 parr	Prince Edward Island
Prince Edward Island	55,309 smolt	Prince Edward Island
Ontario	60,000 eggs (1)	Nova Scotia
Rainbow Trout (Oncorhynchi	ıs mykiss)	
Prince Edward Island	32,675 fry	Prince Edward Island
Brook Trout (Salvelinus fonti	inalis)	
Prince Edward Island	33,293 fry	Prince Edward Island
New Brunswick	12,200 fry	New Brunswick

### 3.1.2 MARICULTURE (GROWTH AND FATTENING)

This category of introductions and transfers resulted in the greatest movement of organisms, primarily between provinces.

Table 2:	A summary	of fish transfers	for aquaculture	purposes in 1991.
----------	-----------	-------------------	-----------------	-------------------

	Species/	No. of fish (shipments)	Source
	Receiving Province	, , =,	
•	Atlantic Salmon (Salmo salar		
•	Newfoundland	100,000 eggs (1)	New Brunswick
	Rainbow Trout		
	(Oncorhynchus mykiss)		
	Newfoundland	2,000 fry (1)	Ontario
	Newfoundland	3,500 fry (1)	Prince Edward Island
	Newfoundland	450,000 eggs (2)	Ontario
	Prince Edward Island	75,000 eggs (2)	Quebec
	New Brunswick	360,000 eggs (5)	Quebec
	New Brunswick	18,300 fry (4)	Prince Edward Island
	New Brunswick	2,000 fry (2)	Ontario
	New Brunswick	20,000 fry (1)	Quebec
	Nova Scotia	460,000 eggs (6)	Ontario
	Nova Scotia	250,000 eggs (1)	Maine, USA
	Nova Scotia	39,600 fry (4)	Prince Edward Island
1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	Nova Scotia	2,000 fry (1)	Ontario
•	Nova Scotia	150,000 fry (1)	Quebec
	Brook Trout (Salvelinus fontion	nalis)	
	Newfoundland	10,000 fry (1)	Prince Edward Island
1	Newfoundland	40,000 eggs (1)	Quebec
	Nova Scotia	400 fry (1)	New Brunswick
	New Brunswick	445,000 eggs (6)	Ouebec
	New Brunswick	120,000 eggs (2)	Prince Edward Island
	New Brunswick	270,000 eggs (2)	Maine, USA
	New Brunswick	20,000 fry (1)	Quebec
	New Brunswick	20,000 fry (1)	Prince Edward Island
	Arctic Charr (Salvelinus alpin	nus)	
	Newfoundland	41,000 fry (2)	Prince Edward Island
	Newfoundland	350,000 eggs (2)	Prince Edward Island
	Newfoundland	30,000 eggs (3)	Manitoba
	New Brunswick	14,500 fry (2)	Prince Edward Island
	Nova Scotia	4,500 fry (1)	Prince Edward Island
	-1 WVVVIII	.,200 115 (1)	* TITLE TO LL MICH TRIMITA

### 3.1.3 LIVE STORAGE PRIOR TO SALE

### **Province of Ontario**

Although fish products brought into Ontario are inspected, records do not distinguish between 'live' and 'fresh' products. Imported species include the indigenous catfish (*Ictalurus punctatus*) and buffalo fish (*Ictiobus* sp.) as well as the common carp (*Cyprinus carpio*) and the bighead carp (*Hypophthalmichthys nobilis*). In 1991, over 350 tonnes were imported, of which 97% were carp, from Missouri and Arkansas.

### 3.1.4 RECREATIONAL PURPOSES

### Province of Quebec

Bait fish are imported into Quebec in unknown quantities from the United States, primarily during the winter ice fishing season.

### 3.1.6 RESEARCH PURPOSES (EXCLUDING USE IN HATCHERIES)

Two facilities on Prince Edward Island have quarantine units and have imported fish for research purposes. Most fish are brought into Prince Edward Island under Section 4 of the Fisheries Act, which facilitates importation of fish for research. An important condition of these importations for research is that the fish be destroyed at the completion of the research.

University, government, and industrial laboratories import many species of fish, invertebrates and algae into Ontario for research purposes. No accurate records exist on the numbers and types of organisms being used.

Table 3: 1991 Fish transfers for research purposes in Canada.

Species/		No. of fish (shipments)	Source
Receiving Pr	ovince		
Coho Salmor	(Oncorhynchus	kisutch)	
Prince Edv	vard Island	40,000 eggs	British Columbia
Atlantic Saln	non (Salmo salar)	)	
Prince Edv	vard Island	700 smolt (2)	New Brunswick
Prince Edv	vard Island	60 adults (1)	New Brunswick
- Prince Edv	vard Island	40,000 eggs (1)	New Brunswick
Prince Edv	vard Island	6,600 fish (2)	New Brunswick
Prince Edv	vard Island	20,000 eggs (1)	Nova Scotia
Prince Edv	vard Island	8,500 fish (2)	Maine, USA
Prince Edv	vard Island	30,000 eggs (1)	New Brunswick
Prince Edv	vard Island	25,000 eggs (1)	New Hampshire, USA
Ontario		40,000 eggs (1)	New Brunswick
Nova Scoti	a	450 adults (2)	Quebec
Rainbow Tro	ut (Oncorhynchu	s mykiss)	
Prince Edv	ard Island	5,500 fry (2)	New Brunswick
Prince Edw	ard Island	10,000 fry (1)	Quebec
Prince Edv	ard Island	20,000 eggs (1)	Washington, USA
Quebec		2,000 fry (2)	Ontario
Newfoundl	and	6,000 fry (1)	Ontario
Newfoundl	and	5,000 fry (1)	Prince Edward Island
Newfoundl	and	1,000 eggs (1)	Ontario
Nova Scoti	a	5,000 eggs (1)	Ontario
Arctic Charr	(Salvelinus alpin	us)	
Ouebec	` .	13,000 eggs	Manitoba

### 3.2 INVERTEBRATES

### 3.2.2 MARICULTURE (GROWTH AND FATTENING)

Table 4: 1991 imports of invertebrates for mariculture purposes.

Species/	No. of fish (shipments)	Source
Receiving Province		
Giant Scallop (Placopecten n	nagellanicus)	
New Brunswick	? juvenile	Newfoundland
Nova Scotia	? juvenile	Newfoundland
Nova Scotia	950,000 seed	Newfoundland
Quebec	? juvenile	Newfoundland
Eastern Oyster (Crassostrea	virginica)	
Nova Scotia	? juvenile	Prince Edward Island
Nova Scotia	? adult	Prince Edward Island
Quahog (Mercenaria mercena	ıria)	
Nova Scotia	? adult	Prince Edward Island
Blue Mussel (Mytilus edulis)		
Nova Scotia	1,000,000 seed (1)	New Brunswick

### Province of Manitoba

One shipment of young live lobsters were transferred from New Brunswick or Nova Scotia to Manitoba in the fall of 1991. The lobsters were to be grown out for local sales opportunities, but success was limited due to high mortalities during transit.

### 3.2.3 LIVE STORAGE PRIOR TO SALE

### Province of Prince Edward Island

Adult blue mussels (Mytilus edulis) were transferred from two sites on the east coast of Newfoundland to Prince Edward Island for processing, following histopathology and thioglycollate analysis of 50 mussels from each Newfoundland site.

Oysters (Crassostrea virginica) were transferred from Nova Scotia to PEI for market purposes, following a health inspection.

During the year, there were after-the-fact reports of mussels being imported from Newfoundland and Maine, USA. These mussels were reported to have been packed and shipped without notice being given to anyone in authority. Closer control is now in place to ensure all processing companies are kept informed of the rules.

### **Province of Ontario**

Live marine crustaceans, primarily *Homarus americanus*, and molluscs (*Mytilus edulis* and others) are imported for the food industry and the restaurant trade. Some species of leeches may be imported for bait from the USA.

### 3.2.5 RESEARCH PURPOSES (EXCLUDING USE IN HATCHERIES)

Table 5: 1991 transfers and imports of invertebrates for research purposes.

Species/ Receiving Province	No. of fish (shipments)	Source
Sea Scallop (Placopecten magellan	nicus)	
Newfoundland	1200 ?	Nova Scotia
Chilean Oysters (Ostrea chilensis)		
Newfoundland	50 adults (1)	?
Sea Urchins (Strongylocentrotus pa	urpuratus)	•
Newfoundland	200 adults (1)	?
Bay Scallop (Argopecten irradians Prince Edward Island	) 250 seed (1)	Nova Scotia
Icelandic Scallop (Chlamys icelana Nova Scotia	lica) ??	Quebec
Quahog (Mercenaria mercenaria) New Brunswick	? ?	Prince Edward Island
Surf Clam (Spisula solidissima) New Brunswick	? ?	Nova Scotia
Horseshoe Crab (Limulus polyphen		
New Brunswick	9 adults (1)	Maine, USA

### Province of New Brunswick

Broodstock quahog (*Mercenaria mercenaria*) were examined following transfer from Pictou, Nova Scotia to an experimental shellfish hatchery in Shippagan, New Brunswick. The examination was requested prior to release of the spat generation (i.e.  $F_1$ ) from the hatchery.

Adult surf clam (Spisula solidissima) and quahog (M. mercenaria) were transferred to the shellfish hatchery at Shippagan, New Brunswick, for experimental purposes, following histopathological and thioglycollate analyses of sub-samples of the broodstock.

### ACCIDENTAL INTRODUCTIONS

### 5.0 COMPLETELY ACCIDENTAL INTRODUCTIONS

A recent report (Mills, E.L., J.H. Leach, J.T. Carlton & C.L. Secor, 1991. Exotic Species in the Great Lakes: A History of Biotic Crises) showed that unintentional release and release from ships accounted for over 60% of introductions of aquatic organisms into the Great Lakes. Over 1/3 of these have occurred in the last 30 years, since the St. Lawrence Seaway was opened into the Great Lakes in 1959. Approximately 10% of the introduced, non-indigenous species have had a significant influence on the Great Lakes ecosystem.

The red-bellied piranha (Serrasalmas nattereri), a tropical South American fish was collected in Ontario, probably released from aquaria.

In North America, the ruffe, Gynmocephalus cernuus, was first discovered in 1986 in Minnesota, USA, probably introduced in ballast water from Europe. It was found in Lake Superior, Ontario, in 1991, probably introduced through ballast water from Minnesota.

The sucker-mouth catfish, Hypostomus plecostomus, was tentatively identified in Lake Erie, probably imported from the southern USA and released by an aquarist.

### HATCHERY INTRODUCTIONS

#### 6.0 SPECIES INTRODUCED FOR HATCHERY REARING

#### 6.1 STOCK NOT SUBSEQUENTLY PLANTED OUTSIDE THE HATCHERY

### Province of British Columbia

F<sub>1</sub> Japanese scallop, Patinopecten yessoensis, were introduced into a BC hatchery in 1991, and subsequently transferred to growout facilities. These came from imported Japanese broodstock that are still being held in quarantine.

#### STOCK SUPPLIED IN LARGER QUANTITIES TO THE INDUSTRY OR SOME OTHER 6.3 **ORGANIZATION**

Table 6: Egg imports in 199	I for hatchery rearing in support	of the aquaculture industry.
Species/	No. of fish (shipments)	Source
Receiving Province		
Atlantic Salmon (Salmo salar)		

оростозі	rot or non (simplifolity)	Domino	
Receiving Province			
 Atlantic Salmon (Salmo salar)	)		
Quebec	60,000 eggs	New Brunswick	
Newfoundland	100,000 eggs (1)	New Brunswick	
Rainbow Trout			
(Oncorhynchus mykiss)			
Newfoundland	565,000 eggs (1)	Ontario	
Ontario	70,000 eggs (1)	Washington, USA	
Arctic Charr (Salvelinus alpin	eus)		
Quebec	18,000 eggs (2)	New Brunswick	
Ontario	68,000 eggs (1)	Manitoba	

### PLANNED INTRODUCTIONS

#### 7.0 PLANNED INTRODUCTIONS

### Province of Newfoundland

Permission to import eggs will be requested for aquaculture purposes in 1992. The numbers are unknown and will depend on available funding. There are also plans to introduce all-female triploid rainbow trout eggs and juvenile rainbow trout for research purposes.

### **Province of Ontario**

Planned introductions for 1992 include 70,000 lake trout (Salvelinus namaycush) eggs from New York and 60,000 Atlantic salmon (Salmo salar) eggs from Nova Scotia for fishery enhancement. 40,000 arctic charr (Salvelinus alpinus) eggs from Manitoba and 60,000 rainbow trout (Oncorhynchus mykiss) eggs from an undetermined source will be imported for hatchery rearing.

### Finland

# ICES WORKING GROUP ON INTRODUCTIONS AND TRANSFERS OF MARINE ORGANISMS Lisbon April 14.-17.1992

# INTRODUCTIONS AND TRANSFERS OF MARINE ORGANISMS IN FINLAND IN 1991

Compiled by Riitta Rahkonen

Finnish Game and Fisheries Research Institute, Aquaculture Division P.O. Box 202, SF-00151 Helsinki, Finland

- 1.0 RELEVANT LAWS AND REGULATIONS IN FINLAND None.
- 2.0 OTHER PROCEDURES CONCERNING INTRODUCED SPECIES None.
- 3.0 DELIBERATELY INTRODUCED ANIMAL OR PLANT SPECIES
- 3.1 Fish
  - 3.1.1 Fishery enhancement (management)
    During 1991 the veterinary authorities have allowed the import of
    118 000 eels from Swedish quarantine. The eels have been kept in
    quarantine for some weeks in Finland as well. The eels have been
    stocked in southern Finland.
  - 3,1.2 Mariculture None.
  - 3.1.3 Live storage prior to sale None apart from aquarium fish.
  - 3.1.4 Recreational purposes None.
  - 3.1.5 Captures of introductions originally made in neighbouring countries None known in 1991.
  - 3.1.6 Research purposes

    An experiment has be carried out in 1:

An experiment has be carried out in 1991 in which Atlantic cod (*Gadus morhua* L.) fry from the island of Gotland (Sweden) were transferred to the Bothnian Sea.

### 3.2 Invertebrates

### 3.2.1 Fishery enhancement

Deliberately introduced invertebrates do not occur in Finnish coastal waters.

The eggs of signal crayfish (*Pacifastacus leniusculus* Dana) have been imported from Sweden during 1991 to be stocked as one summer old young into inland waters in southern Finland.

### 3.2.2 Mariculture

The cold brackish water makes the import of, for example molluscs and crustaceans for mariculture impossible.

### 3.2.3 Live storage prior to sale

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).

### 3.2.4 Improvement of food supplies for other species None.

### 3.2.5 Research purposes None.

### 3.3 Plants

Deliberately imported plants do not occur in Finnish coastal waters.

## 4.0 SPECIES INTRODUCED ACCIDENTALLY WITH DELIBERATE INTRODUCTIONS None known during 1991.

### 5.0 COMPLETELY ACCIDENTAL INTRODUCTIONS None known during 1991.

### 6.0 SPECIES INTRODUCED FOR HATCHERY REARING

- 6.1 Stock not subsequently planted outside the hatchery None.
- 6.2 Stock relaid in small quantities under controlled experimental conditions None.
- 6.3 Stock supplied in larger quantities to the industry or to some other organization

  None.

### 7.0 PLANNED INTRODUCTIONS

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.

A program for improving rainbow trout stocks will start in Finland in 1992. Fertilized eggs will then be needed from rainbow trout stocks improved in Sweden at least for the sake of comparison.

Because of the small number of brood signal crayfish in Finland, fertilized eggs are needed for stocking purposes from Sweden in some years. Researchers would also like to import some new stocks from the northern USA for improvement and experimental stocking, but so far this has been prohibited by the veterinarian authorities.

The sheatfish (Silurus glanis L.) disappeared from Finnish waters at the beginning of the 1900s, but there is now a growing interest in getting it back, mainly for recreational fishery purposes. The sheatfish occurs in Finlands neighbouring countries, the USSR and Sweden.

### 8.0 LIVE EXPORTS FOR CONSUMPTION

8.1 Molluscs None.

8.2 Crustaceans and Sea Urchins None.

8.3 Fish None.

### 9.0 LIVE EXPORTS FOR PURPOSES OTHER THAN DIRECT CONSUMPTION

9.1 Molluscs None.

9.2 Crustaceans and Fish (Ner Fertilized eggs of Neva Salmon and rainbow trout, as well as live rainbow trout

Of the freshwater fishes, fertilized eggs of the grayling (Thymallus thymallus (L.)) have been exported to France.

ICES Working Group on Introductions and Transfers of Marine
Organisms

### Lisbon 13-17 April 1992

### NATIONAL REPORT FOR IRELAND

#### T.AWS

- 1.0 Relevant laws and regulations in ICES member countries. None
- 2.0 Other procedures concerning introduced species. None

### DELIBERATE INTRODUCTIONS

- 3.0 Delibrately introduced animal or plant species.
- 3.1 FISHES
- 3.1.1 Fishery enhancement (Establishment of new breeding populations)

### None

3.1.2 Mariculture (growth and fattening)

Salmon smolts following hatchery rearing, see section 6.0.

- 3.1.3 Live storage prior to sale None
- 3.1.4 Recreational purposes None
- 3.1.5 Captures of introductions originally made in neighbouring countries.

### None

- 3.1.6 Research purposes (excluding use in hatcheries) None
- 3.2 INVERTEBRATES
- 3.2.1 Fishery enhancement (Establishment of new breeding populations)

### None

3.2.2 Mariculture (growth and fattening)

Haliotus discus hannai: No importations in 1991. F1 (400.500) individuals have been distributed to hatcheries on the south and west coasts. It is intended to produce an F2 generation this spring. Adults are ongrown within mesh containers in the sea or in raceways.

<u>Haliotus tuberculata</u>: No importations in 1991. these are also in cultivation for some years and are being ongrown at the same localities as for H. discus hannai.

Abalone are currently in The Shellfish Research Laboratory, Carna, Redbank Shellfish Ltd, Newquay, Boet Mor Ltd, Clifden, John Hensey, Westport on the west coast of Ireland and in Clear Island on the south coast. There are plans for the building of an abalone hatchery on Bere Island in Bantry Bay on the Irish south-west coast.

Ruditapes semidecussata: No importations in 1991. Produced 460mt for final sale in 1990 from cultivation in clam parks. This species is presently cultivated on all Irish coasts and all seed is produced in Irish hatcheries.

Crassostrea gigas: Cultivation takes place on all Irish coasts and production exceeds that of the native oyster.

Patinopecten yessoensis: Seventy-one adults were imported from Miyagi Prefecture in Japan. These were held in quarantine and following spawning were destroyed. Their F1 generation were all destroyed during the summer due to a vibrio infection which is thought to have arisen from poor water quality due to a storm in June. All spat were held in quarantine.

Scallops raised from the 1990 year class and released from quarantine in that year, have been ongrown in longlines and are confined to one site near Wexford, on the Irish southeast coast. These have not matured, and eighty three remain.

- 3.2.3 Live storage prior to sale None
- 3.2.4 Improvement of food supplies for other species Imported brine shrimp eggs are used by aquarists.
- 3.2.5 Research purposes (excluding use in hatcheries) None
- 3.3 PLANTS None

### ACCIDENTAL INTRODUCTIONS

4.0 Species introduced accidentally with deliberate introductions

### None

5.0 Completely accidental introductions

No recent introductions known

### HATCHERY INTRODUCTIONS

6.0 Species introduced for hatchery rearing

Rainbow Trout eggs from Northern Ireland 1,400,000
Denmark 505,000
Rainbow trout milt from Isle of Man 250mls
Atlantic salmon eggs from Scotland 2,080,000
Sweden 100,000
Arctic charr eggs from Sweden 50,000

- 6.1 Stock not subsequently planted outside the hatchery
- 6.2 Stock relaid in small quantities under controlled experimental conditions.
- 6.3 Stock supplied in larger quantities to the industry or to some other organisation.

  Turbot (young) from The Isle of Man 8,000

Rainbow Trout fingerlings from Northern Ireland, 310,000

Native oyster spat from England 6,650,000
Guernsey 9,810,000
Norway 6,000,000

Pacific oyster spat from England 7,475,000
Guernsey 10,410,000
Norway 6,001,000

PLANNED INTRODUCTIONS
7.0 Planned Introductions
None

### LIVE EXPORTS

8.0 Live exports for consumption

8.1 Molluscs

Native oysters and Pacific oysters are exported for direct consuption, the majority of the production is exported. Production in 1990 was as follows:

Native oysters..... 420mt

Pacific clams..... 460mt

### 8.2 Crustacea

Lobsters, Velvet crabs and green crabs are exported to continental Europe.

### 8.3 Sea urchins

Small numbers are exported to France by air.

# ICES WORKING GROUP ON INTRODUCTION AND TRANSFERS OF MARINE ORGANISMS Norway

Lisbon 14,-17, April 1992

### National Report for Norway

### Laws

### 1.0 Relevant laws and regulations in ICES member countries

A law on "Gene-technology" has been proposed, but has not yet passed Parliament.

Regulations related to "Certification on construction of fish farms" is on hearing and is expected to be passed in 1992.

### 3.1.1 Fishery enhancement

310.000 Gadus morhuu juveniles were produced, vaccinated, tagged and released in Hordaland county western Norway. 6000 were accordingly produced and released in Nord Trøndelag county. 55.000 Salmo salar smolts originating from three different local stocks from Hordaland county, reared in a diseasefree hatchery, were tagged and released. 80.000 Salmo salar smolts were produced from the river Namsen stock tagged and released from the river of Opløy. 10 000 Salmo salar smolts were produced from Vefsna stock and released on the island of Vega Nordland county. All releases were controlled by the Veterinary authorities according to national regulations. The stocks were selected according to recommendations established by the Ministry of Environment and the Ministry of Fisheries.

### 3.1.2 <u>Mariculture</u>

A few hundred thousand Scophtalamus maximus juveniles were exported to Spain.

### 3.1.6 Research purpose (excluding use in hatcheries)

Fundulus juveniles have been imported from eastern Canada for experimental purpose. The juveniles have been placed in a Veterinary certified laboratory.

### 3.2 Invertebrates

### 3.2.1 <u>Fisheries enhancement</u>

A total of 50.000 *Homarus gammarus* juveniles produced from local stocks in a diseasefree hatchery were tagged and released on three different localities on the Norwegian south, south-western and western coast.

### 5.0 <u>Completely accidental introduction</u>

Sargassum muticum has established itself on the Norwegian Skagerrak coast (southern Norway).

Gyrodactylus salaris is reported from 35 Norwegian salmon rivers.

An exceptional bloom of *Dinophysis acuta* was reported from Sørfjorden at the industrial site of Odda, western Norway in February 1992. The densities in the upper 2 m of the water volume were measured to 40.000 cells/l. Previous maximum concentration in the fjord system has been measured to 1500 cells/l. The dinoflagellat originated from dumping of ballast water by a ship from Hull in England.



### MINISTÉRIO DO MAR SECRETARIA DE ESTADO DAS PESCAS





# ICES WORKING GROUP ON INTRODUCTIONS AND TRANSFERS OF MARINE ORGANISMS

**Portugal** 

### PORTUGAL

### NATIONAL REPORT

### 1990-1991

#### LAWS

- 1. The Executive Law NQ261/89 from 89.29.17, ruled by the Administrative Rule NQ982—A/89 from 89.11.14, establishes, on its articles 11 and 15, respectively the rules for the importation of live animals and for the introduction of non indigenous species at any portuguese aquaculture facilities.
- 2. The appointment of ICES Code of Practice was proposed.

### DELIBERATE INTRODUCTIONS

- 3.1. FISH
- 3.1.3. Ornamental fishes are imported regularly from Far East Asia and Caribbean countries.
- 3.1.6. Sturgeon hybrids (<u>Acipenser ruthenus</u> x <u>A.baeri</u>) triploids, imported from Russia.
- 3.2. INVERTEBRATES
- 3.2.2. Import from spain the seed of <u>Ruditapes philipinnarum</u> and <u>Crassostrea</u> <u>qiqas</u>. The operations was executed illegally, without official knowledge.

  Pecten maximus seed is imported from Scotland until 1990.
- Seed of <u>Ostrea edulis</u> from south of France and south of Spain is also regularly imported for stocking long lines facilities, located near Sagres (south of Portuguese coast).

  \*\*For direct consumption\*\*
- 3.2.3. Crustacean species are imported regularly from UK and France:

  <u>Cancer pagurus, Maja squinado, Panullirus guttatus, Jasus lalandi</u> and <u>H.ameri-</u>
  canus

### ACCIDENTAL INTRODUCTIONS

5. Completely accidental introductions

The american crayfish, <u>Procambarus clarckii</u>, was introduced in Portugal through Guadiana river, and comming from Spain. The specie is now spread all over the country, including the upper parts of some important estuaries. However In the traditional areas of <u>Austropomatobius pallipes</u>, located on the northern part of the country, there are no notice of the presence of red crayfish.

### MINISTÉRIO DO MAR



SECRETARIA DE ESTADO DAS PESCAS



### INSTITUTO NACIONAL DE INVESTIGAÇÃO DAS PESCAS

2

After the information supplied on Nov. 90 on the occurrence of drift plants of Sargassum muticum on the portuguese west coast, north of Lisbon, this species was observed in May 91 invading and colonizing large sand tidal pools limited by external reefs on the shores of Minho Province, north of Oporto.

The plants were found fertile, attached to stones or mainly embedded in sand, reaching a maximum length of 3.5m. and covering the surface with their floating thallus. Upon inquiry, local fishermen informed that they saw the species, for first time, 3 years ago and noted its progression since them. 5. muticum was certainly carried by water currents from Galicia, NW Spain.

### HATCHERY INTRODUCTIONS

6.2. Although some national hatcheries starts its production, importation of Penaeus japonicus, post-larvae continues to be a current practice.

### PLANED INTRODUCTIONS

7. The triploid hybrids of sturgeons referred ahead will be proceeded surveying pathogens and epibionts as well as it was done for the first introduction.

### LIVE EXPORTS

- 8. For consumption
- 8.1. The groved shell clam, Ruditapes decussatus, is regularly exported to Spain.
- 8.2. Sea urchins, the species <u>Paracentrotus lividus</u>, are exported to France.
- 8.3. Elvers are exported regularly to Spain.
- 9. For purposes other than direct consumption
- 9.2. Elvers are exported to Spain, Netherlands, Sweeden and Japan, for eel culture.

\* until 1989

Lisbon, 13 April 1992

Jaime Menezes

Francisco Ruano

José Carlos de Oliveira



# INSTITUTO ESPAÑOL DE OCEANOGRAFIA CENTRO COSTERO DE VIGO Cabo Estay · Carido Apartado 1.562 3000.0150

Spain

In relation to the information you ask me about the alga <u>Caulerpa taxifolia</u> I've been gathering references about it, and although it is expected to appear at any moment in the northeast coast of Spain (Costa Brava), it hasn't been detected yet, but in the way it is moving through the French coast it will probably appear during the next months.

In relation to the presente of <u>Sargassum muticum</u>, about what we had informed you before, the invasion seems to have reduced, so at present, after the initial bloom, its expansion has become stabilized as the number of founded algae has considerably decreased.

In relation to the presence to <u>Undaria pinnatifida</u> about what we had also informed you before, it was detected in the Ria de Arosa (Northwest Spain) in June 1990. The impact produced by the invasion of this alga has been much lower than the Sargassum one. At present its presence has only been detected in the Ria de Arosa, that is invaded along the whole coast between the low tide and depth of 2 or 3 metres (infralitoral area); it can be easily found also in the mussel-rafts and in the drainages of the purifier plants.

This alga lives together with Laminaria saccharina, Laminaria ochrolenca and Sacchoria polyschides, and a smaller amount with Cystoseika spp. and Sargassum muticum. Algae of as much as 1.5-2.0 metres can be found, and an unbalance with the other species doesn't seem to exist.

The introduction vector has been clearly the import of Crassostrea through the purifier plants. In fact, it can be found in high densities in the drainge areas of these plants.



#### INSTITUTO ESPAÑOL DE OCEANOGRAFIA CENTRO COSTERO DE VIGO Cabo Estay - Canido Apartado 1.552 36080-VIGO

Besides the algae aforementioned, the presence of the following species have been detected in Galicia recently:

- <u>Codium fragile</u> subsp. <u>tomentosoides</u> (Van Goor) Silva, detected in many places of Galicia in 1986; its origen is Japanese.
- <u>Grateloupia filicina</u> var. <u>luxurians</u>, detected in Galicia (Ria de Arosa) in 1990. The probable penetration way in Europa has been the oyster culture. Origen: Pacific Ocean.
- Grateloupia doryphora (Montagne) Howe, detected in the Ria de Arosa in 1990 and probably introduced in Europe through the oyster culture. Origen: Pacific Ocean.
- <u>Pikea californica</u> Harvey, detected in Galicia (Ría de Vigo) in 1991. Airships have probably been the penetration way.
- Lomentaria hakodatensis Yendo, detected in Galicia (Ría de Arosa) in 1992. Penetration way: oyster culture. Origen: Japan, Korea, South of California.

Although these species have been deteted during the last years, they don't seem to have developed in an alarming way.

There are also some species, as <u>Caulerpa faxifolia</u>, that are expected to be detected in our coasts in a short time. These species are:

- Chrysymenia wrightii (Harvey) Yamada
- Laminaria japonica Areschoug
- Sphaerotrichia divaricata (C. Agardh) Kylin
- Antithamnion nipponicum Yamada and Inagaki.

## Sweden

ICES Working Group on Introductions and Transfers of Marine Organisms, April 14-17, 1992

National Report for Sweden 1991-92.

## 1. Relevant laws and regulations

According to the Fisheries Ordinance (SFS 1982:126) fish may not be released or transferred from one water body to another without permission from the Board of Fisheries. Regulations and guidelines with effect from 1989 say that live fish for stocking or farming can only be transferred if the fish is free from diseases and the fish farm is in the Fish Health Control.

Stocking of fish will not be permitted if "valuable" fish populations can be damaged, so releasing of salmon in a river system is only permitted if the fish originates from that strain.

## 2. Other procedures concerning introduced species

## Risk for introductions of non-indigenous species by ballast water

The Swedish Environmental Protection Agency will have the formal responsibility for environmental effects of discharged ballast water. The Agency is informed of the activities and the report from the ICES WG meeting in Helsinki, Finland 1991. However, until now no official policy has been decided upon. The question will be raised during 1992. So far it has been considered to adapt the "Australian" rather strict position as to risks with discharged ballast water.

## Genetically modified organisms

A parliamentary commission is working on risks and ecological hazards following the release of transgenic organisms (GMOs), expected to finish work by 1993 and resulting in rules and restrictions/recommendations for introductions of GMOs.

Applications so far are referred to several governmental and scientific bodies for considerations, such as the Swedish Environmental Protection Agency, the Swedish Board of Agriculture, the Swedish Fishery Board, universities and the Natural Science Research Council.

So far, no aquatic GMOs have been suggested for release.

Pilot studies for ecological evaluations have been allowed for terrestrial, commercial plants such as potatoes (1991, 1992) and rape (1992).

- 3. Deliberately introduced animal or plant species
  - 3.1 Fish
  - 3.1.2 Elvers have been imported from England (Severn) for stocking and aquaculture. Quarantine regulations are followed
  - 3.2 Invertebrates
  - 3.2.3 Live storage prior to sale. Lobster from USA and Canada. Oysters from France.
  - 3.3 Plants

None.

- Species introduced accidentally with deliberate introductions
   None.
- 5. Completely accidental introductions

The Japaneses brown alga Sargassum muticum has continued to spread along the Swedish west coast. In the late summer of 1991 it was for the first time found attached in the N Kattegatt, the SW archipelago of Göteborg (Karlsson et al. 1992). As far as known it has not been found attached further south along the Swedish Kattegat coast. It now occurs along the whole Swedish Skagerrak coast, from the Norwegian border down to Göteborg. Locally it has started to be a nuisance to fishery but is not a major problem and so far it has not outcompeted native algal species (Karlsson et al. 1992).

## Reference:

Karlsson, J., M. Kuylenstierna & P. Aberg, 1992. Contributions to the seaweed flora of Sweden: New or otherwise interesting records from the west coast - Acta F以Jogeogr. Suec. 78:49-63.

6. Species introduced for hatchery rearing

See 3.1.2.

7. Planned introductions

None.

- 8. Live exports for consumption
  - 8.1 Molluscs
    Blue mussels to Holland and Denmark
- 9. Live exports for purposes other than direct consumption
  - 9.2 Salmon eggs to Denmark, Ireland and Germany Salmon smolts to Denmark Arctic char eggs to Germany and Ireland Rainbow trout eggs to USA and Chile

## **England & Wales**

## ICES Working Group on Introductions and Transfers of Marine Organisms

## Lisbon, Portugal - 13-17 April 1992

### Annual Report for England and Wales

#### 1.0 Relevant laws and regulations in ICES member countries

Council Directive 91/67/EEC facilitates the trade in live fish and shellfish within the EEC while ensuring that they are free of disease.

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

### 2.0 Other procedures concerning introduced species

The North Atlantic Salmon Conservation Organisation (NASCO) have produced "Guidelines to minimise the threats to wild salmon stocks from salmon aquaculture" in which a section is included on "Measures to minimise the possible adverse effects from introductions and transfers".

#### 3.0 Deliberately introduced animal or plant species

#### **3.1 FISH**

## 3.1.2 Mariculture (growth and fattening)

A total of 63 million rainbow trout eggs were imported during 1991 from South Africa (24 million), Denmark (19 million), Tasmania (12 million) and Northern Ireland (8 million).

250, 000 American striped bass (*Morone saxatilis*) fry (1 g) were imported by air for growing on in the effluent water of a power station in Cheshire. (These importations of bass fry occur annually.) After 12-18 months when they are approximately 1 kg, the bass are sold to the Chinese restaurant trade.

#### 3.1.3 Live storage prior to sale (\*)

Live eels (195.4 mt) were imported from the Irish Republic, Canada, USA and New Zealand. Atlantic salmon (9.7 mt) were imported from the Irish Republic. An additional 60.3 mt of other saltwater fish (unspecified species) were imported from Europe, USA and Australia.

#### 3.1.4 Recreational purposes (\*)

Saltwater ornamental fish (141.6 mt) were imported live from worldwide sources (France, Netherlands, Denmark, USA, Costa Rica, Brazil, Barbados, Egypt, Saudi Arabia, Dubai, Kenya, Australia, Singapore, Thailand, Maldives, Sri Lanka, Philippines, Indonesia, Fiji and the Cook Islands.)

### 3.1.6 Research purposes (excluding use in hatcheries)

Regular consignments of sea bream fingerlings were transported by air from Mediterranean areas (eg 1000 fingerlings from Cephalonia (Fish Farmer, 1992, Vol.15(1)) for research into sea bream nutrition at Polytechnic South West, Plymouth.

### 3.2 INVERTEBRATES

## 3.2.2 Mariculture (growth and fattening)

The shellfish industry is based on annual transfers of seed from other areas within the UK. The following figures represent only those deposits for which a special licence was obtained, many more deposits would have been made under general licences. *Mytilus edulis* (1,456 mt at 30-60 mm) were transferred from natural beds in Scotland and Northern Ireland to the Exe estuary, the Wash and Poole Harbour. *Pecten maximus* (23,000 individuals at 50-65 mm) were transferred from Scotland to Dorset and Devon. *Ostrea edulis* (1,000 individuals at 70 mm) were transferred from Scotland to the east coast of England.

The remaining transfers were of seed bivalves produced by the hatcheries in England and the Channel Islands. Approximately 50 million *Crassostrea gigas* seed were produced by the hatcheries. *Tapes decussatus* (10 million seed at 3 mm) and *Mercenaria mercenaria* (5 million seed at 3 mm) were deposited in Poole Harbour. Several million *Crassostrea gigas* seed were planted at sites around the coastline.

## 3.2.3 Live storage prior to sale (\*)

Homarus sp. were imported from France, Canada and the Irish Republic.

## 3.2.5 Research purposes (excluding use in hatcheries)

Crassostrea gigas (20 at 10 cm) were imported from Guernsey into quarantine at Hayling Island Laboratory.

Dept. of

Nucella lapillus (300 at 2.5 cm) were imported into the Plymouth Marine Laboratory from the Plant Biology University, Maine, USA.

## 6.0 Species introduced for hatchery rearing

## 6.2 Stock relaid in small quantities under controlled conditions

Only 200 Crassostrea virginica (F1 and F2 produced from broodstock introduced from the USA in 1984) remain alive. There has been no interest shown by the UK shellfish industry in the commercial culture of this oyster species but small numbers of animals were being held by the Ministry of Agriculture, Fisheries and Food at a field site on Anglesey, North Wales. Large mortalities have occurred within this population, probably as the result of adverse environmental conditions.

### 8.0 Live exports for consumption (\*)

#### 8.2 Crustaceans and sea urchins

Homarus sp. (1697.4 mt) were exported to Europe (France, Belgium, Luxembourg, Netherlands, Germany, Italy, Irish Republic, Denmark, Portugal, Spain, Norway, Switzerland, Gibraltar) and Sri Lanka.

#### 8.3 Fish

Live eels (386.5 mt total) were exported to Europe (Belgium, Luxembourg, Netherlands, Germany, Irish Republic, Denmark, Greece, Norway, Sweden, Israel) and Hong Kong. Atlantic salmon (13.2 mt total) were exported to the Netherlands and Spain. Other saltwater fish (unspecified species) were exported (84.4 mt) to Europe (France, Belgium, Luxembourg, Netherlands, Irish Republic, Spain), Chile, Ghana and New Zealand.

## 9.0 Live exports for purposes other than direct consumption

#### 9.1 Molluses

Crassostrea gigas seed were exported to Spain, South Africa, Irish Republic, Scotland and the Channel Islands. Ostrea edulis and Tapes philippinarum were exported to Southern Ireland and Tapes decussatus seed were exported to Italy.

#### 9.2 Crustaceans and fish

Saltwater ornamental fish (259.9 mt) were exported to the Netherlands, Germany, Irish Republic, Portugal, Spain and Israel.

Trout eggs were exported from trout hatcheries to Turkey, Mexico and South America (Fish Farmer, 1992, Vol. 15(1)).

Salmon (eggs / adults for consumption?) were exported to Chile, Brazil and Europe (Fish Farmer, 1992, Vol. 15(1)).

Approximately 250,000 turbot juveniles were exported from the Isle of Man, primarily to Galicia, Spain.

S.D.Utting

<sup>\*</sup> Export/import data used to compile report did not define exact purpose of exports/imports.

## Scotland

# REPORT TO THE ICES WORKING GROUP ON INTRODUCTIONS AND TRANSFERS FROM SCOTLAND - 1991

## 1. Laws

UK regulations under the Environmental Protection and the Health and Safety Acts are being amended to take account of the recent EC Directives 90/219 and 90/220 which deal with the contained use of GMOs and the deliberate release into the environment of GMOs respectively.

UK regulations under the Diseases of Fish Act 1937 and 1983 are to be amended to take account of the recent EC Directive 91/67 which deals with the placing on the market of aquaculture animals and products. (This directive will in effect act to control the spread of infectious diseases both within and into the Community).

## 3. Deliberately Introduced Animal or Plant Species

For fish there were <u>50</u> licences granted under the Diseases of Fish Act 1937 and 1983 Section 1 during 1991 ie

Species	No of licences granted	Amount licensed	Origin
Rainbow trout eggs	23 (8) (15)	920,000 6,735,000	Northern Ireland Denmark
Rainbow trout milt	2 (1) (1)	-	Isle of Man Northern Ireland
Brown trout eggs	1	30,000	Denmark
Assorted tropical fish/eggs	22	6,452,100	Various
Chichlid	1	34	Holland
Tropical tooth carp	1	200	Holland
Blue gill sunfish	1	2,000	USA

For shellfish licences issued under the Molluscan Shellfish (Control of Deposit) (Scotland) Order 1978

Species	No of licences granted	Amount licensed	Consigner
Crassostrea gigas	5	15,250 kg + 200,000 (individuals)	Herm Island Oysters
Crassostrea gigas	7	15,000 kg + 150,010 (individuals)	Guersey Sea Farms
Crassostrea gigas	3	200 kg + 50,000 (individuals)	Seasalter Shellfish
IN TOTAL	15	licences were granted under the above Act	

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

## 7. Planned Introductions

No action taken on last year's report on enquiries to import sturgeon.

## 8. Live Exports for Consumption

- 8.2 Native lobsters and crabs to several European countries.
- 8.3 Atlantic salmon ova from farmed and wild stocks to Spain, Ireland, France and Chile.

A L S Munro 10 April 1992

#### USA NATIONAL REPORT

#### 1.0 Relevant laws and regulations

#### NONINDIGENOUS AQUATIC SPECIES ACT

The most significant piece of federal legislation in over 50 years in the USA on the introduction of exotic marine organisms, Public Law 101-646, the "Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990" was signed on November 29, 1990. The purposes of this Act were reviewed in last year's report. 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 <u>Dreissena polymorpha</u>.

Funds were made available through the legislation to NOAA/Sea Grant to support zebra mussel research in the Great Lakes and associated regions. The U.S. Coast Guard also made available funds, as a result of the legislation, to support a study on national patterns of ballast water release. This study is now being conducted in the laboratory of Dr. James T. Carlton, Maritime Studies Program, Williams College - Mystic Seaport, Connecticut. Entitled the "National Biological Invasions Shipping Study" (NABISS), this research program focuses on the "Shipping Study" called for by Congress to assess the role of shipping in the introduction of exotic species, methods of control, and the needs for regional versus national implementation of control measures. (Dr. Carlton will present a brief slide show on the NABISS project).

## 3.0 Deliberately introduced animal or plant species 3.1 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. The state is operating under a "five year plan" (1989 - 1993) which calls for the release of chinook salmon, from the New York State Salmon Falls Hatchery, each year into the Lamprey River (NH). 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 (Sept-Oct) of 1991, 551,000 smolts were released. New Hampshire officials are also expecting to see the first returns this fall (1992) from the release of approximately 400,000 chinook in 1989.

#### 5.0 ACCIDENTAL INTRODUCTIONS

## (A) Introduction of the Zebra Mussel Dreissena polymorpha to the United States and Canada: Update

The European zebra mussel <u>Dreissena polymorpha</u> was discovered in the Great Lakes, North America, in 1988. This discovery catalyzed the greatest interest in marine and freshwater invasions in the USA in many years, and resulted in the legislation noted in last year's report and in section 1.0 herein. Without going into detail, it may be stated that the zebra mussel is now the subject of many workshops, conferences, and meetings, that the Canadian/U.S. literature is rapidly growing on the species, and that many dozens of scientists are now engaged in zebra mussel research on a full-time basis.

In the past four years, the zebra mussel has cost industry, government, and the public several \$100 millions in damage. It is a major fouling organism, blocking water intake pipes and screens, covering boat bottoms, mooring buoys, and virtually all other hard substrates. It is a major consumer of phytoplankton, and the zebra mussel is believed to have led to vastly increased water clarity in large regions of the Great Lakes. It may be a competitor for space, and it is known to settle upon and kill native unionid freshwater mussels, some of which are rare and endangered species. It covers formerly clean, sandy beaches with many tons of dead shells. It is regarded as a major invasion of North America.

The zebra mussel is now rapidly spreading down the major U.S. river systems. Biologists estimate that it can occupy over two-thirds of North America. Figure 1 shows the spread of the mussel as of November 1991. It is now in the major river drainages leading out of the Great Lakes, including the Mississippi, Illinois, Hudson, and Susequehanna River systems. The Susequehanna River drainage leads into Chesapeake Bay. There is concern about the extent to which the zebra mussel may be able to live in brackish (estuarine) waters along the Atlantic coastal drainage. European records report some zebra mussel populations in salinities of over 10 ppt, but whether these are adult mussels that settled while the river at those sites was fresh water is not known, nor is the capacity of the mussels to reproduce in salt water known.

There are perhaps over 50 research projects now devoted to zebra mussels in the U.S. and Canada, funded by industry and government. Several newsletters, both in the U.S. and Canada, actively report new observations and ongoing studies. A major new revelation is the discovery of a second species of <u>Dreissena</u> in addition to <u>Dreissena</u> polymorpha.

### (B) Introduction of two eastern Mediterranean goby fishes

Jude et al. (1992) have now published their paper on the introduction of the tubenose goby <u>Proterorhinus</u> marmoratus and the roundnose goby <u>Neogobius melanostomus</u> from Europe to North America. The fish were first found in 1990; to date they remain known only from the St. Clair River - Lake St. Clair region of Lakes Huron and Erie.

### (C) Discovery of the European oyster Ostrea edulis in Rhode Island

An unexpected and surprising discovery of adults of the European oyster Ostrea edulis on shallow rocks in the state of Rhode Island marks the first record of this species in southern New England and, indeed, adjacent to the waters of Long Island Sound. Established populations of Ostrea edulis exist in the State of Maine, to where the species was intentionally introduced in the 1940s. Mari/aquaculture facilities all along the Canadian and U.S. coasts have experimented with, or actively grow, Ostrea edulis. In March 1992 one adult oyster, 10 cm in diameter, was collected alive attached to natural substrates in Rhode Island. It is not yet known whether this represents (a) an extension of the Maine populations to the south, (b) an accidental release of (a few?) larvae from an aquaculture facility or (c) a novel introduction (perhaps in ballast water) from Europe. Plans are being made to do a more extended survey of Rhode Island harbors and embayments this summer to determine the size (if any) of this population.

## (D) Yet Another Exotic Seasquirt on the USA Atlantic Coast

Another exotic species of seasquirt (a species of <u>Ascidia</u>?) has been recognized in New England. This relatively large (3.0 cm + long) ascidian has become a common member of fouling communities in Connecticut. It was first noted sometime between 1986 and 1988. It March 1992 the species was found to be common amongst the other two exotic tunicates, the Asian <u>Styela clava</u> and the Californian <u>Botrylloides</u> <u>diegensis</u>, in eastern Long Island

SITINGS

## 2(6): 10 [Nov/Dec 1991]

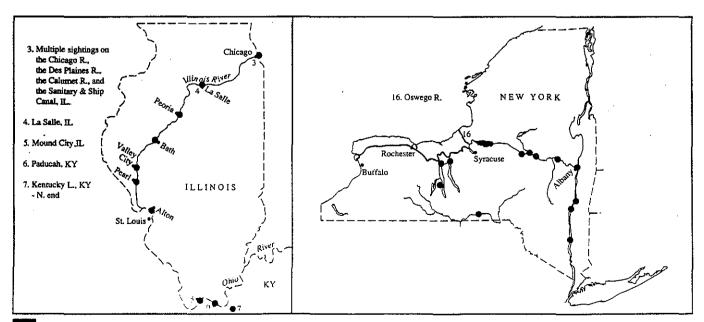
# North American Range of the Zebra Mussel as of 26 November 1991

© Copyright 1991, New York Sea Grant

Compiled by New York Sea Grant with information from: Empire State Electric Energy Research Corp.. Fisheries and Oceans Canada, Illinois-Indiana Sea Grant, Michigan Sea Grant, Minnesota Sea Grant, Ohio Sea Grant, Ontario Hydro, Ontario Ministry of Natural Resources, US Army Corps of Engineers, US Fish & Wildlife Service, Wisconsin Sea Grant

Note: The Kenosha (WI); Cheboygan (MI); Indian Lake (OH); and Ottawa (ONT) sitings were all on "movable substrates" (boats, barges, driftwood, etc.) and do not indicate colonization at this time.





Sound (J.T. Carlton, field observations). It may be a ship-bottom fouling introduction. It does appear to be one of the European <u>Ascidia</u> species (Dr. R. Whittaker, Marine Biological Laboratory, Woods Hole, personal communication, 1991), although the species has not yet been identified.

## (E) New Record of (Catadromous) Chinese Mitten Crab Eriocheir sinensis in North America

Chinese mitten crabs have been collected intermittently in the Lake Erie region of Canada-U.S. between 1965 and 1984. The crab is not regarded as established; rather, the individuals captured are believed to be ballast water releases (probably as larvae) from Europe. In November 1991 another crab was discovered in the western basin of Lake Erie by a private fisherman (J. Leach, Ontario Ministry of Natural Resources, personal communication, December 1991). The locality may have been in Canadian waters. It was described as female, with an estimated carapace width of 100 mm and a length of 75 mm; the specimen apparently was lost in the fisherman's backyard. This discovery is of interest because ballast water discharge into the Great Lakes is believed to have declined dramatically since Canadian guidelines went into place in May 1989. The 1991 crab may have arrived in the Great Lakes before May 1989.

#### 7.0 PLANNED INTRODUCTIONS

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

The proposed introduction of the Japanese (Pacific) oyster <u>Crassostrea gigas</u> still remains a matter of heated debate in the United States. The stated purpose of the introduction would be to re-vitalize the declining native oyster industry (the Atlantic oyster <u>Crassostrea virginica</u>). Native oyster populations have been reduced by overharvesting for many decades and by severe disease problems, particularly MSX (or "Delaware Bay Disease", caused by the protozoan <u>Haplosporidium costale</u>).

1991-2 developments include plans to plant 600 triploid (sterile) juvenile Japanese oysters into Chesapeake Bay to determine their susceptibility to MSX. MSX susceptibility cannot be adequately tested in the laboratory. These oysters would be disease-free F-2 stock derived from laboratory culture. Experiments may proceed in 1992, although no final decisions have been made.

#### Proposed Introduction of Chinook Salmon to New Jersey

The State of New Jersey (through a hired environmental consulting firm) completed in February 1992 a "Draft Environmental Impact Statement" (EIS) on the proposed "Introduction of Pacific salmonids into the Delaware River Watershed"

The issue of releasing Pacific salmon into New Jersey (specifically the Delaware River) began over 15 years ago. While current officials of the NJ Division of Fish, Game & Wildlife are not strongly supportive of this plan, officials in the NJ Department of Commerce are interested in learning whether a fall sport fishery could be created through this program. The proposed project is an experimental program to determine the feasibility of a hatchery-supported fall/winter recreational fishery in New Jersey waters. Four alternatives were considered in the draft EIS, with the proposed action being the stocking of 300,000 chinook salmon smolts per year for five years with monitoring. Other alternatives evaluated were the introduction of coho salmon, the introduction of steelhead trout, and a "no action" alternative. Fish would be raised from disease-free eggs obtained from New York State hatcheries. The EIS concludes that a release of 300,000 fish would yield a maximum return of only 240 fish. The EIS also

concludes that the probability of chinook salmon becoming established on the Atlantic coast, straying significant distances, or having an ecological impact on Atlantic salmon, are extremely low.

A public, 90 day review period ends on June 5, 1992. Public hearings are scheduled for April 23 in New York and April 24 in New Jersey. The U.S. Fish & Wildlife Service has not taken a position on this proposal as of April 1992, but they are required to state their position in the final EIS, due out in July or August of this year. Since the State of New Jersey proposes to use federal funds for this introduction, the approval of the USFWS Regional Director (in this case in Massachusetts) is required. Without this approval, no federal funds would be made available. Thus while there are no federal (national) laws preventing New Jersey from releasing Pacific salmon on the Atlantic coast, the federal government can withhold federal funding.

Draft documents have been sent to Canada and NASCO for comment. A local regional commission, the Delaware River Fish & Management Cooperative, could also in theory comment upon the proposal.

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

The State of Maine has approved the experimental release and culture of "nori", the Japanese red alga <u>Porphyra vezoensis</u>, variety U-51, into Cobscook Bay, Maine, near the US/Canadian border. Two hundred "seeded" nori nets, 20 meters x 1.5 meters in size, will be placed in the Bay in July 1992. The growing season is expected to last until November. According to reports received from the private company involved in this endeavor, this alga requires temperatures of 6 to 14 degrees C to produce harvestable blades, and 22 to 25 degrees C to reproduce sexually. Because these latter temperatures are rarely reached in Maine, the chances of this Japanese species establishing wild populations is believed to be "slight". In addition, Japanese workers report that cultivar strains of this alga (such as will be used in Maine) do not appear to escape into Japanese open waters, "possibly because they are so inbred that they are poor competitors."

\*

## Symposium

A symposium, entitled "Introductions and Transfers of Marine Species: Achieving a Balance Between Economic Development and Resource Protection", was held October 30 - November 2, 1991, at Hilton Head Island, South Carolina. It was sponsored by the South Carolina Sea Grant Program. Approximately 32 papers were presented.

#### USA NATIONAL REPORT

#### REFERENCES

- D. Jude, R. H. Reider, and G. R. Smith. 1992. Establishment of Gobiidae in the Great Lakes Basin. Canadian Journal of Fisheries and Aquatic Sciences 49: 416-421.
- J. J. McDermott. 1991. A breeding population of the western Pacific crab <u>Hemigrapsus sanguineus</u> (Crustacea: Decapoda: Grapsidae) established on the Atlantic coast of North America. Biological Bulletin 181: 195-198.
- Meng, L. and J.J. Orsi. 1991. Selective predation by larval striped bass on native and introduced copepods. Trans. Amer. Fisheries Society 120: 187-192.
- Orsi, J. J. and T. C. Walter. 1991. <u>Pseudodiaptomus forbesi</u> and <u>P. marinus</u> (Copepoda: Calanoida), the latest copepod immigrants to California's Sacramento San Joaquin estuary. Proc. Fourth Intern. Conference on Copepoda. Bull. Plankton Soc. Japan, Special volume (1991): 553 562.

Rosenfield, A. and R. Mann. Editors. 1992. <u>Dispersal of living organisms into aquatic ecosystems</u>. Maryland Sea Grant, University of Maryland, College Park, Maryland. [In press as of this writing]

Bibliography of <u>Dreissena polymorpha</u> in North America (Chronological, 1989 - 1992)

#### J. T. Carlton

### NOTE

Not included here are Sea Grant newsletters, fact sheets and pamphlets, nor numerous popular articles (with the exception of Roberts 1991). The most recent Sea Grant publication is the Coastal Resources Fact Sheet of November 1991, "The Zebra Mussel (<u>Dreissena polymorpha</u>): an unwelcome North American invader", by Charles R. O'Neill and David B. MacNeill, available from New York Sea Grant, Hartwell Hall, SUNY College at Brockport, Brockport NY 14420-2928 (716-395-2638).

#### 1989

Griffiths, Ronald W. 1989. Introduction of zebra mussels into the Great Lakes: truth and consequences. Monthly Newsletter No. 45, Ontario Ministry of the Environment, London, Ontario, 1 page.

Griffiths, Ronald W., William P. Kovalak, and Donald W. Schloesser. 1989. The zebra mussel, <u>Dreissena polymorpha</u> (Pallas, 1771), in North America: impact on raw water users, pp. 11-27, in: Proceedings, EPRI Service Water System Reliability Improvement Seminar. Electric Power Research Institute, Palo Alto, CA

Hebert, P. D. N., B. W. Muncaster and G. L. Mackie. 1989. Ecological and genetic studies of <u>Dreissena</u> polymorpha (Pallas): a new mollusc in the Great Lakes. Canadian Journal of Fisheries and Aquatic Science 46: 1587-1591.

LePage, Wilfred L. and L. Joseph Bollyky. 1989. The impact of <u>Dreissena polymorpha</u> on water works operations at Monroe, Michigan (USA). Manuscript, 18 pp. Paper presented at the "Second International Conference on the Zebra Mussel (<u>Dreissena polymorpha</u>) in the Great Lakes, Rochester, New York.

\* Note LePage, 1991 (below)
[Available from: Zebra Mussel Information Clearinghouse, New York Sea Grant Extension, 250 Hartwell Hall, SUNY College at Brockport NY 14420-2928]

Mackie, George L., W. N. Gibbons, B. W. Muncaster, and I. M. Gray. 1989. The zebra mussel, <u>Dreissena polymorpha</u>: a synthesis of European experiences and a preview for North America. Report prepared for Water Resources Branch, Great Lakes Section, Ontario Ministry of the Environment, 76 pp. + unpaginated appendices. Queens' Printer for Ontario. ISBN 0-7729-5647-2

Walz, Norbert. 1989. Spreading of <u>Dreissena polymorpha</u> (Pallas) to Northern America. Heldia 1(5/6):196.

#### 1990

Hopkins, Gordon J. 1990. The zebra mussel, <u>Dreissena polymorpha</u>: a photographic guide to the identification of microscopic veligers. Water Resources Branch, Limnology Section, Ontario Ministry of the Environment, 8 pp. + 7 unpaginated figures. Queens' Printer for Ontario. ISBN 0-7729-6349-5

International Zebra Mussel Research Conference. 1990. Conference Proceedings Abstracts]. Great Lakes Sea Grant Network. Published by The Ohio Sea Grant College Program. 27 pp.

Mackie, George L. 1990. Early biological and life history attributes of the zebra mussel, <u>Dreissena polymorpha</u> (Bivalvia: Dreissenidae), and impacts on native bivalves in Lake St. Clair. <u>In</u>: Environmental Research: 1990 Technology Transfer Conference. Environment Ontario (Toronto), Volume 1: 215 - 231.

McMahon, Robert F. and J. L. Tsou. 1990. Impact of European zebra mussel infestation to the electric power industry. Proceedings of the American Power Conference 38: 471 - 482.

Raeihle, D. 1990. Summer update on the zebra mussels. New York Shell Club Notes No. 316: 10-11.

Schloesser, Donald W. and William P. Kovalak. 1990. Infestation of native unionids by <u>Dreissena polymorpha</u> in a power plant canal in Lake Erie. Bulletin of the North American Benthological Society 7: 107.

Sinclair, Mason. 1990. Zebra mussels and water supplies. American Water Works Association, 19 pp.
[Available from: Zebra Mussel Information Clearinghouse, New York Sea Grant Extension, 250 Hartwell Hall, SUNY College at Brockport NY 14420-2928]

U.S. Congress. 1990. Zebra mussels and exotic species: hearings before the Subcommittee on Oceanography and Great Lakes, the Subcommittee on Fisheries and Wildlife Conservation and the Environment, and the Subcommittee on Coast Guard and Navigation of the Committee on Merchant Marine and Fisheries, House of

Representatives. One Hundred First Congress, second session, on H.R. 4214, a bill to help eliminate the growing threat of the zebra mussel and other exotic species to the Great Lakes region. June 14, 1990. Serial No. 101-95. GPO Item No. 1021-B, 1021-C, Superintendent of Documents, Washington, D.C., iii + 222 pp.

- U. S. Congress. 1990. The Nonindigenous Aquatic Nuisance Act of 1990: hearing before the Subcommittee on Environmental Protection of the Committee on Environment and Public Works, United States Senate. One Hundred First Congress, second session, on S. 2244, a bill to prevent and control infestations of the coastal and inland waters of the United States by the zebra mussel, and other nonindigenous aquatic nuisance species. June 19, 1990. Senate Hearing 101-805. Superintendent of Documents, Washington, D.C., iii + 114 pp.
- U. S. Congress. 1990. The problem of zebra mussel infestation: Hearings before the Subcommittee on Water Resources, Transportation, and Infrastructure of the Committee on Environment and Public Works, United States Senate, One Hundred First Congress, second session, May 19, 1990 Alexandria Bay, NY; June 23, 1990 Dunkirk, NY. Senate Hearing 101-811. GPO Item No. 1045-A, 1045-B, Superintendent of Documents, Washington, D.C., iii + 107 pp.
- U. S. Congress. 1990. An Act to Prevent and Control Infestations of the Coastal Inland Waters of the United States by the Zebra Mussel and other Nonindigenous Aquatic Nuisance Species, to Reauthorize the National Sea Grant College Program, and for other Purposes. Public Law 101-646, 101st Congress, November 29, 1990. 104 Stat. 4761. GPO Item No. 575, Stock No. 869-010-00406-1, Superintendent of Documents, Washington, D.C., [28 pp.].

Legislative History: H.R. 5390, S.2244

1991

Cooley, John M. 1991. Zebra mussels. Journal of Great Lakes Research 17(1):1-2.

Fisher, S. W. and D. O. Bernard. 1991. Methods for evaluating zebra mussel control products in laboratory and field studies. Journal of Shellfish Research 10: 367-371.

Garton, David W. and Wendell R. Haag. 1991. Heterozygosity, shell length and metabolism in the European mussel, <u>Dreissena polymorpha</u>, from a recently established population in Lake Erie. Comparative Biochemistry and Physiology 99A(1/2): 45-48.

Griffiths, Ronald W., Donald W. Schloesser, Joseph H. Leach, and William P. Kovalak. 1991. Distribution and dispersal of the zebra mussel (<u>Dreissena polymorpha</u>) in the Great Lakes region. Canadian Journal of Fisheries and Aquatic Sciences 48: 1381 - 1388.

Haag, W. R., and David W. Garton. 1991. Synchronous spawning in a recently established population of the European zebra mussel, <u>Dreissena polymorpha</u>, in western Lake Erie. Hydrobiologia.

Hebert, P. D. N., C. C. Wilson, M. H. Murdoch, and R. Lazar. 1991. Demography and ecological impacts of the invading mollusc <u>Dreissena polymorpha</u>. Canadian Journal of Zoology 69: 405-409.

LePage, W. L. 1991. The impact of <u>Dreissena polymorpha</u> on water works operations at Monroe, MI (II). 24 pp.

\* Note LePage and Bollyky, 1989 [Available from: Zebra Mussel Information Clearinghouse, New York Sea Grant Extension, 250 Hartwell Hall, SUNY College at Brockport NY 14420-2928]

Lemma, A., L. et al. 1991. Endod is lethal to zebra mussels and inhibits their attachment. Journal of Shellfish Research 10: 361-365.

MacIsaac, Hugh J., W. Gary Sprules, and J. H. Leach. 1991. Ingestion of small-bodied zooplankton by zebra mussels (<u>Dreissena polymorpha</u>): can cannibalism on larvae influence population dynamics. Canadian Journal of Fisheries and Aquatic Sciences 48: 2051 - 2060.

Mackie, G. L. 1991. Biology of the exotic zebra mussel, <u>Dreissena polymorpha</u>, in relation to native bivalves and its potential impact in Lake St. Clair. Hydrobiologia 219: 251 - 268.

Marsden, Ellen J. 1991. Standard Protocols for Monitoring and Sampling Zebra Mussels. DRAFT. Center for Aquatic Ecology, Illinois Natural History Survey, Aquatic Ecology Technical Report 91/4, 34 pp.

Roberts, Leslie. 1991. Zebra mussel invasion threatens U. S. waters. Science 249: 1370 - 1372.

Second International Zebra Mussel Research Conference. Conference Proceedings [Abstracts]. Rochester, New York. November 19-22, 1991. Great Lakes Sea Grant Network, Environment Canada, and Fisheries and Oceans Canada. Published by New York Sea Grant, 52 pp.

Sly, P. G. 1991. The effects of land use and cultural development on the Lake Ontario ecosystem since 1750. Hydrobiologia 213: 1 -75. [p. 25, mention; p. 30, brief discussion]

Strayer, David L. 1991. Projected distribution of the zebra mussel, <u>Dreissena polymorpha</u>, in North America. Canadian Journal of Fisheries and Aquatic Sciences 48: 1389 - 1395.

[Note availability of primary data and sources from author or from Depository of Unpublished Data (Ottawa)]

Wu, Lin and David A. Culver. 1991. Zooplankton grazing and phytoplankton abundance: an assessment before and after invasion of <u>Dreissena polymorpha</u>. Journal of Great Lakes Research

Yount, J. David, ed., 1991. Ecology and management of the zebra mussel and other introduced aquatic nuisance species. U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C., EPA/600/3-91/003, 45 pp. + 52 variously numbered pages in Appendix.

## Appendix V.

## REVISED GUIDELINES FOR PREPARATION OF NATIONAL REPORTS

- 1.0 LAWS AND REGULATIONS: New, revised, or amended laws, regulations, or guidelines on introductions and transfers of marine organisms
- 2.0 DELIBERATE RELEASES: Species deliberately released or held in open waters

#### To be included here are:

- (1) releases with the expressed intent of establishing new populations
- (2) hatchery-reared species that are subsequently placed out into open waters for grow-out, by government agencies or industry, under conditions such that the species could reproduce and release gametes, larvae, or postlarval juveniles into the open environment
- (3) releases with the intent of experimental evaluation, but under conditions such that the species could reproduce and release gametes, larvae, or postlarval juveniles into the open environment
- 2.1 Fish
- 2.2 Invertebrates
- 2.3 Algae and Higher Plants
- 3.0 ACCIDENTAL INTRODUCTIONS AND TRANSFERS
  - 3.1 Fish
  - 3.2 Invertebrates
  - 3.3 Algae and Higher Plants
  - 3.4 Parasites, Pathogens, and Other Disease Agents
- 4.0 LIVE IMPORTS

#### To be included here are:

- (1) species held in open waters prior to use but without the intention of establishing the species in the importing country
- (2) species imported directly for consumption (not held in open waters prior to use), but which, through the activities of industry or the public, could be released into the open waters of the importing country
- 4.1 Fish
- 4.2 Invertebrates
- 4.3 Algae and Higher Plants
- 5.0 LIVE EXPORTS to ICES Member Countries
  - 5.1 Fish
  - 5.2 Invertebrates
  - 5.3 Algae and Higher Plants
- 6.0 PLANNED INTRODUCTIONS
  - 6.1 Fish
  - 6.2 Invertebrates
  - 6.3 Algae and Higher Plants
- 7.0 MEETINGS, Conferences, Symposia or Workshops on Introductions and Transfers
- 8.0 BIBLIOGRAPHY

	<del></del> -
r	
	Total and the second
	Tanakan
	1

