International Council for the Exploration of the Sea

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REPORT OF THE WORKING GROUP ON INTRODUCTIONS AND TRANSFERS OF MARINE ORGANISMS

Mystic, Connecticut, 20–22 April 1994

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1 OPENING OF THE MEETING AND INTRODUCTION

The 1994 meeting of the ICES Working Group on Introductions and Transfers of Marine Organisms (WGITMO) was held at the Williams College–Mystic Seaport Maritime Studies Program, Mystic, Connecticut, USA, from 20 to 22 April 1994. The members of WGITMO were welcomed by the Chairman, Dr J.T. Carlton, who then reviewed the objectives of the 1994 meeting; the agenda for the meeting was considered and approved (Annex 1).

Twelve members representing eight countries were present at the meeting. Eight invited guests also participated. A list of meeting participants is attached as Annex 2.

2 TERMS OF REFERENCE

Terms of reference (C.Res.1993/2:7:10) for the Working Group on Introductions and Transfers of Marine Organisms (Chairman: Dr J.T. Carlton, USA), which will meet in Mystic, Connecticut, USA from 20–22 April 1994, are to:

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

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

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

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

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

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

g) consider the summary report from France on the introduction of the Japanese kelp, *Undaria pinnatifida*, including ecological considerations and environmental impacts, to be provided in 1994 as specified in C. Res. 1989/4.4;

h) consider a request from the State of New Jersey (USA) to evaluate the appropriateness and risk of the use of sterile triploid Japanese oysters *Crassostrea gigas* in open field trials to evaluate MSX- and Dermo-Disease Resistance in such oysters;

i) prepare, if time permits, a condensed information booklet, apart from a *Cooperative Research Report*, for general distribution to ICES Member Countries, and particularly to other groups involved in the introductions and transfers of marine species on the background, activities, and interests of the Working Group, with a copy of the 1993 Code of Practice appended, to respond to increasing requests for information about ICES activities in this field;

j) commence, if time permits, a review of different models (risk assessments, decision pathways, and other systems) which have been developed for evaluating proposed and contemplated introductions and transfers;

k) report (prior to the ACME meeting) on the issues and problems associated with the ecological impact (including changes in genetic attributes) associated with introductions, transfers and enhancements of marine organisms, with a view to giving future Council advice;

l) consider a request from Ireland to examine a proposal from a private party, Aquafuture Inc. (Turner Falls, Massachusetts, USA) to develop a high intensity, land-based contained culture system for the striped bass, *Morone saxatilis*, the white bass, *Morone chrysops*, and their hybrids on the south coast of Ireland [this item was added at the request of D. de G. Griffith].

3 REPORT OF THE MEETING

The 1994 Working Group Handbook (Third Edition), containing the history of the Working Group, the venues of the meetings, a statement of the Working Group's purpose (terms of reference and operating principles), and the 1990 Code of Practice was presented.

4 STATUS OF RECOMMENDATIONS FROM 1993 ABERDEEN MEETING

Recommendation 1

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

Approved as C.Res.1993/3:7

Recommendation 2

On the basis of the considerations of the Working Group on Introductions and Transfers of Marine Organisms on the introduction of the North American Atlantic bay scallop *Argopecten irradians* to France, Member Countries are advised that:

a) the Council does not oppose the continued development of Atlantic bay scallop culture in France, subject to continued adherence to the ICES Code of Practice, and in the form of the importation of broodstock (based upon site visits to the USA and Canada) into quarantine and the development of F1 generation in hatcheries:

b) the Council, however, recommends that further investigations be carried out relative to the potential ecological impact of the establishment of wild populations of this species in the Mediterranean and European waters of the Atlantic, that more precise predictions of the geographic range of this species should be obtained if it were to become established, and that such information be provided to the working group prior to the open sea release of this species.

Approved as C.Res.1993/4.7

Recommendation 3

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

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

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

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

Approved as C.Res. 1993/4.8

Recommendation 4

That the Working Group on Introductions and Transfers of Marine Organisms (Chairman: Dr J.T. Carlton, USA) will meet in Mystic, Connecticut, USA, from 20–22 April 1994 with the terms of reference described above.

Approved as C.Res. 1993/2:7:10

5 STATUS OF THE NEW ICES COOPERATIVE RESEARCH REPORT: TEN YEAR REVIEW

The manuscript for this *ICES Cooperative Research Report* (edited by A. Munro) is in the final stages of preparation. It is anticipated that the report should be ready for submission to ICES early in the summer of 1994.

6 1993 ICES DUBLIN MEETING: ACME AND THE WORKING GROUP

WGITMO noted with interest the discussions held at the 1993 Statutory Meeting in Dublin relative to ICES' involvement with introductions and transfers of marine organisms in ICES Member Countries, and the role of WGITMO.

Since 1973 ICES Member Countries have been asked to voluntarily participate in a Code of Practice relative to introductions and transfers of marine organisms into and between Member Countries, in order "to reduce the risks of adverse effects arising from introduction by non-indigenous marine species." The first Code of Practice was adopted by the Council on October 10, 1973. Modifications proposed by the then-named Working Group on Marine Pathology and Diseases in March 1978 and by the newly reconvened and then-named Working Group on the Introduction of Non-Indigenous Marine Organisms in 1979 led to the publication of a "Revised Code" adopted by ICES in October 1979.

Member Countries contemplating the importation of a new species are asked to share their plans with the Council, which, through its Working Group on Introductions and Transfers of Marine Organisms, considers such importations and the acceptability of the plan. Member countries contact the General Secretary of ICES directly, never WGITMO itself, who then if appropriate may enter the request upon the Working Group's terms of reference for consideration. These considerations normally focus on any concerns of neighboring and distant countries should the target species become successfully established and expand its range. Focus is also placed upon any potential disease agents that could be introduced with the target species, as well as any species capable of being accidentally co-transported with the target species. Ecological, biological, disease, and other concerns are examined relative to each proposal, with particular emphasis often being placed upon the ecological and overall environmental implications of the introduction. In reviewing any particular case or case history, WGITMO gathers data from a broad suite of resources, with frequent emphasis on local knowledge. In recent years, WGITMO has worked with invited experts on formal ecological risk assessment pathways, and continues this approach in what is hoped will be a very fruitful avenue of thinking.

Until 1992 WGITMO passed its advice on a given matter to the Mariculture Committee. While the Mariculture Committee continues to also consider the advice of WGITMO, WGITMO now passes its deliberations and advice directly to ACME. If the advice is approved by ACME and subsequently by the Council, the General Secretary advises the Member Countries of the suggestions and recommendations of ICES. Such suggestions and recommendations are not binding, but rather reflect the co-operative spirit of neighboring countries relative to the implications of the potential alteration of biodiversity in confluent waters. ICES, through WGITMO, has served as the sole international forum for over 20 years for mutual discussions among Member Countries relative to the use of non-native species for new and enhanced aquaculture (mariculture) operations, and has thus provided an invaluable and unique "sounding board" for many Member Countries. The forum that ICES provides is now known internationally and regarded as a striking model for international cooperation relative to introduced and transferred species. ICES' concerns with introductions and transfers have meant that individual countries no longer undertake private actions without discussion but rather can participate in a multinational forum.

WGITMO typically reviews only one or two requests for advice per year (in addition to its many other responsibilities), and sees no signs of that number increasing. Indeed, as increasingly stricter protocols are passed by Member Countries, it is probable that fewer and fewer countries will wish to experiment with exotic species versus enhancing natural (native) and previously introduced resources.

WGITMO noted ACME's suggestion to add "enhancements" to its overview of introductions and transfers, and agreed that enhancements were a critical issue, and were very much part of the larger picture of the modification of species populations due to the human-mediated movement of living organisms. However, WGITMO felt that it would be better to discuss with ACME and with other working groups the extent to which WGITMO should absorb the large number of questions associated with enhancements (such as were raised at the 1993 Theme Session on Implications of Stock Enhancement of Marine Organisms), since other ICES working groups had been and were extensively working on this issue relative to species stocking, stock enhancement, salmonid population alterations, salmonid genetics, and genetic issues in general. Future coordination between WGITMO and these other working and study groups was viewed as worthwhile.

WGITMO very much welcomed the concerns of ACME relative to the very complex ecological issues involved in the consideration of intentional introductions. As a result, WGITMO considered an extensive modification to the Code of Practice to underscore the ecological concerns of ICES, well beyond disease issues alone, relative to introductions and transfers. These concerns, and proposed modifications to the Code of Practice, are summarized below.

7 ACME NEW PROCEDURES

To improve communication between WGITMO and the ACME, a primary contact person (Jacqueline Doyle) and two secondary contact persons (Robert Cook and Thomas Osborn) have been appointed as liaison by the ACME.

8 REPORT TO THE ACME ON THE ISSUES AND PROBLEMS ASSOCIATED WITH THE ECOLOGICAL IMPACT (INCLUDING CHANGES IN GENETIC ATTRIBUTES) ASSOCIATED WITH INTRODUCTIONS AND TRANSFERS OF MARINE ORGANISMS

The subject of the ecological impacts of introduced species has been addressed in the scientific literature for over 150 years, and has received renewed attention in the past 15 years. In the 1980s introduced species (biological invasions) became a special programme of the United Nations Scientific Committee on Problems in the Environment (SCOPE), resulting in more than 6,000 pages of published monographs on invasion ecology. However, only a small fraction of the SCOPE work was devoted to the marine environment.

The ecological impacts and consequences of the invasion of an exotic species into a novel ecosystem are potentially numerous and complex, and frequently poorly understood. Nevertheless, a great deal has been learned from the thousands of case histories of introductions, and some predictions can be made in species-specific cases. As noted above, the following discussion will be limited to the movements of species (by introduction or transfer) into ecosystems where they did not previously exist, and not include (at this time) concerns associated with population enhancement by the inoculation of potentially different genetic stocks of a species into populations of the same species.

A partial understanding of the potential ecological role of a new invasion can be gained from a detailed examination of the biology and ecology of the species within its native range. However, the introduced range (the novel ecosystem) almost always challenges the species with a novel set of physical, chemical, and biological conditions, setting the stage for phenological alterations (such as an expanded or reduced reproductive season), biological changes (shifts in realized versus fundamental niche dimensions), and ecological modifications (interactions with species with which the introduced species has not evolved).

Thus, an assessment of the potential role of an introduced species in a novel environment can be gained in part by one or more of three methods:

1) a thorough documentation of the physical, chemical, and biological environment in the target (novel) ecosystem, including theoretical and empirical considerations of (a) whether and how the biology (including physiology) of the introduced species could change in the new environment, and (b) the potential species with which the introduced species could interact;

2) an examination of the biology and ecology of the species where it may have been previously introduced elsewhere; and

3) an examination of the biology and ecology of similar species (particularly congeners) previously introduced elsewhere.

In summary form, the following are the main (but not the only) considerations relative to the potential ecological ramifications of the successful insertion (whether intentional or accidental) of a non-native species into an ecosystem:

1) interactions with species already present in the ecosystem (competition; predator-prey dynamics; disturbance; disease agents; co-introduction of species other than disease agents; changes in genetic attributes); and

2) novel interactions with the environment (ecological; geological).

Interactions with Species Already Present in the Ecosystem

An invading species may interact with previously established species (PES)—either native or previously introduced species—in the environment. These interactions may take several forms:

Competition

The introduced species may compete with PES for spatial, trophic, and other resources. Simple spatial examples include direct or indirect competition for sites for reproduction (mating, egg-deposition, etc.) while trophic examples include the use of the same or similar food sources. Competition could result in local changes of abundance of the PES or complete elimination of the PES from a given site. Resulting changes in PES abundance may thus have reverberations through the ecosystem through indirect effects. For example, if Introduced Species A altered the abundance of Native Species B, then competitors, predators, and prey of B (Native Species C...n) may be altered as well. Species extinction due to invasions in the marine environment through competition are not known.

Predator-prey dynamics

Introduced species may alter predator-prey dynamics in an ecosystem. Examples of three interactions include:

- an introduced predator may consume native prey;
- an introduced predator may consume introduced prey;
- a native predator may consume introduced prey.

As a result of these interactions, local changes in abundance of both predator and prey may occur. As with competitive axes, altered predator-prey dynamics could result in local changes of abundance of the PES or complete elimination of the PES from a given site, with similar potential reverberations as described above under Competition. Introduced predators may alter their diets and their feeding strategies. Species extinction due to invasions in the marine environment through predation are also not known.

Disturbance

A species can alter the distribution and abundance of other species through the indirect effects of disturbance resulting in habitat modification. Common marine examples include those organisms:

- that burrow into soft substrates (bioturbators), burrowing polychaete worms, clams, thalassinid crustaceans, and so forth, can significantly modify surface sediments up to one meter in depth;
- such as grazing herbivorous molluscs (limpets) that create bare patches on hard substrates; and
- such as boring sphaeromatid isopods that burrow into living substrates such as mangroves.

Disease agents

A great deal has been written about the introduction and impact of disease agents. Diseases may have an impact on:

- the introduced species itself (if a mariculture species, potentially resulting in lowered culture potential);
- PES; and
- human society, either directly (in the form of the introduction of cholera via ballast water, for example) or more commonly indirectly (in the form of resulting in contaminated food stocks).

Co-introduction of species other than disease agents

A common result of the intentional release of species has been the co-introduction of associated species. Examples include the many scores of species that can be found on the back of a single oyster shell, the planktonic organisms found in the water transporting fish, and even boring organisms in the wooden crates once commonly used to move oysters around the world. Sediments associated with the transport of shellfish, seaweeds, and fish may contain the cysts of dinoflagellates that could cause harmful algal blooms (in the 1990s, dinoflagellate cysts are most commonly globally transported in ballast sediments).

Changes in genetic attributes

Understanding is limited relative to the changes in the genetic attributes of introduced species following their introduction and of the genetic impacts upon PES. Important issues focus upon hybridization potential between exotic and native species, and the novel presence of closely related species acting as a "gamete sink" or "trap" of the reproductive products of native taxa.

Novel Interactions with the Environment

Ecological

Introduced species may colonize environments where few or no previous species have existed. Examples include new volcanic soils, artificially human-created habitats, and geologically young estuarine habitats. In these cases, invasions will have novel interactions with the environment, such interactions being primarily relative to other colonizers.

Geological

Boring species may burrow into substrates and modify shoreline and river embankments. Well known examples include the burrowing activities of the Chinese mitten crab (*Eriocheir sinensis*) in western European estuaries, and the burrowing activities of the New Zealand sphaeromatid isopod crustacean *Sphaeroma quoyanum* in California. In San Francisco Bay, this isopod has been said to be responsible for landward erosion of some shorelines by up to several centimeters per year since the beginning of the 20th century.

These ecological and general environmental concerns and issues relative to biological invasions provide a working foundation for the range of information that Member Countries contemplating new introductions and transfers should consider. The WGITMO decided to expand and rewrite Section I of the "Code of Practice" to reflect this broader foundation.

9 1994 ICES CODE OF PRACTICE ON INTRODUCTIONS AND TRANSFERS OF MARINE ORGANISMS

WGITMO discussed at length proposed and new modifications to the ICES Code of Practice. As a result of discussions with ACME and between ACME and WGITMO, and as a result of further discussions at the present meeting, it was felt that an expanded ecological emphasis in Section I of the Code was necessary. In addition, WGITMO addressed several other changes, as discussed below. The new "1994 Code of Practice" is presented presented for Council consideration as ICES C.M.1994/ENV:11.

WGITMO also discussed the title of the Code, which has become somewhat long and cumbersome. It was decided to shorten the title to simply,

> *1994 Code of Practice on the Introductions and Transfers of Marine Organisms*

(changing "species" to "organisms", and bringing a phrase of the old title, "to reduce the risks of adverse effects arising from..." into the Preamble, below).

The Addition of a Preamble to the Code

ACME suggested the insertion of a preambulatory statement at the beginning of the Code, and suggested the following wording:

> "The introduction or transfer of marine species carries the risk of introducing pests and disease, establishing undesirable ecological effects in relation to existing species in the new environment, and, where the introduction is a genetically modified organism, of affecting existing genotypes. This Code of Practice provides recommendations dealing with these issues for new introductions, and also recommends procedures for species which are part of existing commercial practice."

WGITMO discussed this at length, and concluded that a preambulatory statement should be broader in scope, capturing ecological concerns about organisms other than pests and disease agents, and referring to non-ecological impacts as well. WGITMO proposed the following preamble:

> "The introduction and/or transfer of marine organisms, including genetically modified organisms, carries the risk of introducing not only pests and disease agents but also many other species. Both intentional and unintentional introductions may have undesirable ecological and genetic effects in the receiving ecosystem, as well as potential economic impacts. This Code of Practice provides recommendations for dealing with new intentional introductions, and also recommends procedures for species which are part of existing commercial practice, in order to reduce the risks of adverse effects that could arise from such movements."

Revisions to Section I

The following revision to Section I was formulated by WGITMO:

I. Recommended procedure for all species prior to reaching a decision regarding new introductions (A..... Section V).

a) Member Countries contemplating any new introduction should be requested to present to the Council at an early stage a detailed prospectus on the proposed new introduction(s) for evaluation and comment.

b) The prospectus should include the purpose and objectives of the introduction, the stage(s) in the life cycle proposed for introduction, the area of origin and the target area(s) of release, and a review of the biology and ecology of the species as these pertain to the introduction (such as the physical, chemical, and biological requirements for reproduction and growth, and natural and human-mediated dispersal mechanisms).

c) The prospectus should also include a detailed analysis of the potential impacts on the aquatic ecosystem of the proposed introduction. This analysis should include a thorough review of:

i) the ecological, genetic and disease impacts and relationships of the proposed introduction in its natural range and environment

ii) the potential ecological, genetic and disease impacts and relationships of the proposed introduction in the proposed release site and environment. These aspects should include but not necessarily be limited to:

> potential habitat breadth,
>
> prey (including the potential for altered diets and feeding strategies),
>
> predators,
>
> competitors,

hybridization potential and changes in any other genetic attributes,

the role played by disease agents and associated organisms and epibiota.

Potential predation upon, competition with, disturbance of, and genetic impacts upon, native and previously introduced species should receive the utmost attention. The potential for the proposed introduction and associated disease agents and other organisms to spread beyond the release site and interact with species in other regions should be addressed. The effects of any previous intentional or accidental introductions of the same or similar species in other regions should be carefully evaluated.

d) The prospectus should conclude with an overall assessment of the issues, problems, and benefits associated with the proposed introduction. Quantitative risk assessments, as far as reasonably practicable could be included.

e) The Council should then consider the possible outcome of the proposed introduction, and offer advice on the acceptability of the choice.

Revised Definition of "Disease"

It was proposed to replace the word "disease" in the Code with the words "disease agent", and the definition be changed accordingly, as follows:

Disease Agent
For the purpose of the Code, "disease agent" is understood to mean all organisms, including parasites, that cause disease. (A list of.....).

WGITMO agreed that these changes should be combined with those earlier proposed for the "Revised 1993" Code of Practice, which incorporated a new proposed section (V) on genetically modified organisms. WGITMO agreed that, (1) the "1994 Code of Practice" should be submitted to the Council for adoption, (2) once adopted by the Council, the Code, along with a brief history of it and of WGITMO, should be published as soon as possible as an *ICES Cooperative Research Report* (*CRR*), such a Report to serve both as an accessible source of the Code of Practice, and as a general information source about WGITMO and ICES activities in general in this field, and (3) that the Code of Practice and a brief history of WGITMO/ICES activities relative to introductions and transfers, should also be published in one or more additional international scientific journals, to insure the widest possible dissemination of the Code. These three proposals will be submitted as Recommendations to the Council. The new proposed *CRR* would serve in the capacity of the information booklet called for under WGITMO's 1993 terms of reference, item (i).

10 NEW COOPERATIVE RESEARCH REPORT ON 'A CODE OF PRACTICE'

For several years WGITMO has been working on the concept of a new Cooperative Research Report that would combine and update ICES CRR 130, "Guidelines for Implementing the ICES Code of Practice..." (1984) and ICES CRR 159, "Codes of Practice and Manual of Procedures..." (1988). Given the new changes to the Code of Practice proposed in 1994, and given the other growing and related issues that the WGITMO has been assigned, it was decided to combine the following Terms of Reference for 1994: (b), (c), (d), and (e), into one unified effort, and to make this a major goal of the 1995 WGITMO meeting.

11 NATIONAL REPORTS (ANNEX 4)

National reports were received from Canada, Finland, France (by FAX), Germany, Ireland, Norway, Sweden, the UK (England and Wales), the UK (Scotland) (by FAX), and the USA.

11.1 Highlights of National Reports

Please refer to the National Reports for the details of new Laws and Regulations, Deliberate Releases, Accidental Introductions and Transfers, Live Imports, Live Exports, Planned Introductions, and Meetings.

CANADA AND THE USA

Cooperative Ballast Water Invasions and Issues

Zebra mussels, quagga mussels, and the European ruffe *Gymnocephalus cernuus* continue to expand in the Great Lakes waters in 1993 and 1994. Extensive management and education programmes are focused upon these ballast-mediated invasions. In May 1993 U.S. law came into effect for the Great Lakes to regulate the discharge of ballast water. Both Canada and the USA continue with a series of ballast water studies. Surprisingly, a living specimen of the Chinese mitten crab *Eriocheir sinensis* was collected on the Canadian side of Lake Erie in April 1994; age estimates are in progress. Since ballast water management has been in place for the Great Lakes since May 1989, the presence of this crab, if less than five years old, could indicate that some original fresh water ballast from Europe (or Asia) is still entering the lakes.

FINLAND

Two new invertebrates were reported in the Gulf of Finland in 1993: an American polychaete worm and a Caspian mysid shrimp. Both may have originally been ballast water releases in northern Europe.

FRANCE

Experimental work with the American oyster *Crassostrea gigas* has ceased, and the American bay scallop *Argopecten irradians* remains in quarantine.

GERMANY

Extensive ballast water studies are underway, as reported elsewhere in this report. The Pacific oyster *Crassostrea gigas* has been recently discovered in small numbers on mussel beds in the German Wadden Sea. An Asian seasquirt has been discovered in the oyster beds at Sylt Island, possibly as the result of oyster imports from Ireland.

IRELAND

As per National Report.

NORWAY

Investigations continue on the distribution of the introduced Kamchatka king crab (see Annex 5).

SWEDEN

The situation with the potential PSP-producing dinoflagellate *Gymnodinium catenatum* in the Sound between Denmark and Sweden, where live cysts have been discovered in abundance in the sediments, is being monitored.

UNITED KINGDOM: ENGLAND, WALES, SCOTLAND

As per National Reports. Living specimens of the South American mussel *Aulacomya ater* were surprisingly discovered in the Moray Firth in 1994.

UNITED STATES OF AMERICA

Ballast Water (see above under Canada)

The federal Aquatic Nuisances Species Task Force has been active relative to the formulation of regulations, the oversight of invasion studies, the application of risk assessment processes, and other matters. 1993 was the final year of chinook salmon (*Oncorhynchus tshawytscha*) releases in New Hampshire. Culture of Japanese red algae (nori) continues in the Gulf of Maine in contiguous waters of Maine and Canada. The Japanese crab *Hemigrapsus sanguineus* continues to spread along the American Atlantic coast. New invasions continue to be reported from San Francisco Bay, the most spectacular of these being the aggressive, omnivorous European green crab *Carcinus maenas* and the bivalve-eating New Zealand sea slug *Philine auriformis*.

12 UPDATE ON PROJECT PREFIX: PRODUCTION AND RISK EVALUATION FOR INTRODUCED ORGANISMS

Dr Keith Hayes (Heriot-Watt University, Orkney) gave an update of Project PREFIX, a programme of research that aimed to develop a predictive methodology for establishing environmental risks associated with the introduction of novel or alien organisms into marine environments. This project has not received funding and there are plans to reformulate and restructure it. (See also 1993 Working Group Report, C.M. 1993/F:3, pp. 18–19).

A discussion ensued relative to the potential suite of different models for evaluating proposed introductions and transfers. These include decision pathways (such as those used by groups such as the American Fisheries Society and EIFAC) and formal risk assessments (such as used by PREFIX, and by the USA Task Force on non-indigenous aquatic introductions). WGITMO decided that while there was no time during the present meeting to adequately pursue this topic, it would be worthwhile to discuss with Dr Hayes and colleagues the preparation of a discussion document on the different models that could be applied toward the evaluation of the potential ecological and genetic risks that might arise from invasions, whether intentional or unintentional. This goal has been proposed as a target for the next WGITMO meeting and as one of the WGITMO's "Action Items".

13 SPECIAL REPORT ON THE COMBJELLY *MNEMIOPSIS* INVASION IN EUROPE

Dr Richard Harbison of the Woods Hole Oceanographic Institution gave a presentation on the invasion of the carnivorous ctenophore *Mnemiopsis* in the Black/Azov Seas and the Mediterranean. This ctenophore was first seen in the Black Sea in 1982, although it was not identified as *Mnemiopsis* until 1987. Its natural range is the east coast of the Americas, from Woods Hole in the north to Argentina in the south. The environmental requirements are 3-35°C but it needs temperatures above 20°C to reproduce prolifically. The salinity range is also impressive, 3–70 parts per thousand.

This plankton-eating ctenophore has devastated anchovy fisheries, which have fallen in some regions from hundreds to tens of thousands of tonnes.
The introduction of *Mnemiopsis* into the Black Sea was believed to have been via ballast water although the exact geographic source of the introduction is unknown. It has since spread to the Mediterranean. This invasion demonstrates how ballast water introductions can have major implications on large ecosystems, signals the need for ballast water control, and has raised the issue of marine biocontrol. A proposal has been forwarded to the UN for the potential biological control of *Mnemiopsis* in the Black Sea, as for example through the introduction of a fish species (such as a stromateid) that preys on the ctenophore.

The main steps within the proposal are to:

1) identify fish species that feed on *Mnemiopsis*;

2) determine rates of feeding and electivity;

3) identify possible deleterious impacts on other organisms in the Black Sea;

4) secure consent of the Black Sea riparian countries for release;

5) establish culture methods and develop techniques to transport the fish to the Black Sea;

6) transport and begin to culture fish in Black Sea riparian countries;

7) begin a release programme and then monitor the abundance of the fish and of *Mnemiopsis*.

Of concern to ICES Member Countries is the potential invasion by this species of many other areas in Europe, for example, the Baltic Sea, through existing and new lines of shipping traffic. WGITMO considered that western and northern European member states should pay particular attention to ballast water coming from the Black Sea region.

In addition, the potential introduction of marine species as biocontrol agents is an area that is relatively new but that falls within the scope of WGITMO. The invasion of the Black Sea by *Mnemiopsis*, the invasion of the green crab *Carcinus* into San Francisco Bay, and other recent invasions have prompted discussion about the possibility of introduced predators or parasites as control agents. WGITMO considered that any use of additional exotic species to control other exotic species should be approached with great caution, but nevertheless required discussion, consultation, and careful deliberation among and between all impacted parties. WGITMO felt that the growing number of ballast-mediated invasions would inevitably lead to greater and greater interest in the potential of marine biocontrol, and felt that this topic needed to be addressed more thoroughly. It was proposed to consider this topic in greater detail at the next WGITMO meeting.

14 BALLAST WATER MANAGEMENT IN ICES MEMBER COUNTRIES

Special presentations were given by Stephan Gollasch and by an invited guest, David Smith (Smithsonian Environmental Research Centre), on the ballast water research projects being carried out respectively in Germany and Chesapeake Bay (USA). Details of the projects and results from the German project are given in Annex 6.

In Germany, a total of 357 samples have been collected from 274 ships since the start of the project in 1992. Most samples were not taken directly from ballast tanks but from ducts through which the water was pumped from the ballast tanks. Sediment samples were taken after water had been drained from the tanks. Several fish had been found lying on the surface of the sediment. A significant number of plant and animal genera have been found (see Annex 6). The project is funded until December 1994, although it may be extended for another 6–8 months.

A meeting on ballast water control and prevention of the introduction of unwanted organisms by ships was organized with an Australian scientist Dr G. Rigby on October 13, 1993, at Essen, Germany. Dr Rigby's company, the Broken Hill Propriety Co. Ltd. (BHP) has a shipbuilding section. The main point of interest is to find out the relations between ships (or shipbuilding) and the environment. Several methods of the prevention of unwanted organisms introduced by ships' ballast water. The most practicable solution might be the heating of the ballast water by the exhaust of the engine.

The USA project, which is one of several, is funded by the US Coast Guard and the Sea Grant Programme. Norfolk and Baltimore are two major ports in Chesapeake Bay, receiving 10 million and 4-5 million metric tonnes, respectively, of ballast water per year. Compared to other areas in the USA, there have been only approximately 14 species introduced. (For comparison, there have been 137 species in the Great Lakes, 150 in San Francisco Bay, and 82 in Coos Bay, Oregon.) In the project, ballast water and sediments are being sampled and an examination of the samples made as soon as possible to identify species that remain alive after transport. Data are collected from the ships' captain and questionnaires completed (see Annex 6—wherein "NAA" refers to "North American Atlantic"). Around 38% of ships sampled are from north-east Atlantic waters, 34%

from the Mediterranean and the remainder from various sources world-wide. More than 90% of the vessels sampled had live organisms present in the ballast. Data showed that ballast water organisms can remain viable for at least 20 days and some even longer.

The rapidly growing global interest in ballast invasions continues to move this issue forward in discussions of introductions of marine organisms. The continual new appearance of novel species of potentially bloom-causing dinoflagellates in many countries, the appearance of the Japanese seastar (starfish) *Asteria amurensis* in southern Australia and its impact on native abalone beds, and the appearance of new invasions in San Francisco Bay, along with the dramatic demonstration of the impacts of a single species—the American comb jelly *Mnemiopsis* in the Black and Azov Seas—focuses increasing attention on this problem, as does the potential for ballast water and sediments to carry problem species such as the fish-killing phantom dinoflagellate discussed below. The United Nations International Maritime Organization (IMO), through its Marine Environmental Protection Committee, is very active in the international arena.

The concern about ballast water and sediments, and their role in the accidental release of exotic species, has led ICES to consider a special session on Ballast Water for its 1995 Statutory Meeting. The Mariculture Committee has proposed a special theme, "Ballast Water and Accidental Introductions". The WGITMO is pleased to be able to take the lead in organizing this very important session, and identifying a convener, speakers, and the programme. WGITMO has added this theme to its current "Action List".

Threat of Ballast Transport of the Fish-Killing "Phantom" Dinoflagellate *Pfiesteria*

D. Minchin (Ireland) reported upon a new and soon to be described polymorphic dinoflagellate *Pfiesteria piscimorte* (Steidinger and Burkholder) known from the east coast of the USA. There are real possibilities that this species could become transferred in ballast water, particularly to ICES Member Countries.

This species requires the presence of live fish or their excreta before their cysts, present in the sediment, hatch. Following hatching a neurotoxic-like substance is released which results in the death of the fish. Large schools of fish can be destroyed. The dinoflagellate feeds on some of the fish material before re-encysting. The following key points emerge from Burkholder *et al.* (1992) and from Dr Jacqueline O'Mahoney (Fisheries Research Centre, Dublin), through her attendance at dinoflagellate working meetings:

1) Outbreaks are known in the USA from Pamlico River, Neuse River, Taylor's Creek, and the Newport River.

2) Several species of fish and shellfish (crabs) are known to be killed by the presence of dinoflagellate blooms of *P. piscimorte*. These include: striped bass, southern flounder, menhaden, eel, and blue crabs.

3) Shellfish, such as blue crab and bay scallop, do not induce excystment but when placed within an aquarium with dying fish, die within minutes (scallops) to hours or days (crabs).

4) Aquaculture facilities rearing hybrid bass have had bloom outbreaks resulting in fish death. Trials using hybrid bass under laboratory conditions have had the same result.

5) The dinoflagellate tolerates temperatures 4° to 28°C, and salinities of 0–35.

6) Cysts can be destroyed in dilute bleach solutions but treatments of concentrated sulfuric acid or ammonium hydroxide, 35 days of desiccation, or two years of dormancy are insufficient to destroy them or result in non-viability.

7) The toxin produced resembles a neurotoxin which is *also toxic to humans*, resulting in vomiting, short-term memory loss, total disorientation and asthmatic symptoms.

8) There are at least 15 stages in the life cycle of this organism, mostly as an array of amoebae. 300 cells/ml of the toxic stage are sufficient to cause toxicity.

9) Blooms develop rapidly in the presence of fish. Following the excystment of the dinoflagellate, fish move spasmodically, become disoriented, then become lethargic, suffocate and die. Although the algae have not been observed to attack the fish directly, they rapidly increase fish swimming and attach directly to sloughed fish tissue and digest it. Within hours of the fish's death, toxic vegetative cells encyst. All non-encysted stages have been found to be toxic.

This species has major implications for aquaculture and fisheries in freshwater, estuarine, and marine conditions throughout the world. It is critical that the development of research and the expanding knowledge on this species be followed. There would appear to be a strong probability that this organism could be transported in ballast water and/or sediments.

15 STATUS REPORTS

15.1 Japanese scallop, *Patinopecten yezoensis*, in Ireland

The Japanese scallop *Patinopecten yezoensis* cultivation in Ireland was terminated as a result of the loss of the longline holding the broodstock. This longline was later recovered and all scallops were dead.

15.2 American bay scallop, *Argopecten irradians*, in France

Nothing further has been done since the 1993 report (see French national report, Annex 5).

15.3 The Japanese brown alga (kelp) *Undaria pinnatifida* in France

In response to ICES C.Res. 1989/4.4, WGITMO received a written report from France on the status of the *Undaria pinnatifida* along the French coast (Annex 7) and also considered two published papers adding further information (Castric-Fey *et al.*, 1993; Hay and Villouta, 1993). Eight sites are listed as farming areas after 1990, with a production of 40 to 75 tonnes (fresh weight) per year, and two sites as abandoned (Annex 7). The French report concluded that, several years after its introduction to Atlantic France, *Undaria* has only colonized some areas close to the farming sites, mainly at St. Malo and Charente Maritime, while on other sites small and fluctuating populations have developed. Furthermore, it was stated that no negative impact on the ecosystem had occurred and that the alga mainly coexisted with the native brown alga *Himanthalia elongata* and is grazed by above all the native limpet *Patina pellucida* and other small gastropods and isopods.

Castric-Fey *et al.* (1993) made diving surveys on two sites outside the farming area in the Rance estuary, where *Undaria* has been cultivated since 1983, and mapped its distribution and that of co-occurring species. Large populations were seen in 1992, covering almost all available substrata; however, plants were already seen there in 1986. They found up to 20 plants per m^2 with fewer and smaller plants deeper down, but occurring as deep as 12 m, and populations comprising both young and old plants, indicating that the species is present all year round and has a long period of fertility. In relation to other kelps it was found growing in spaces not occupied by the perennial *Laminaria* species, but it may compete for space with the annual *Sacchorhiza polyschides*. The outcome of this, according to the authors, will depend on both the timing, duration and efficiency of the sexual reproduction as well as on the attractiveness to potential grazers of these two annual species. Since the occurrence of *S. polyschides* differs along the coasts of Atlantic France, being more common in the parts south of Brittany, *Undaria* may be less competitive there, but also fewer farming sites exist in that area. As a whole, despite the large populations found in some areas, these authors also consider *Undaria* not to have a detrimental impact on the environment. They also speculated on what the outcome would be, should the alga colonize the southern British shores, which seems plausible to them.

At the site at Iles d'Ouessant, where *Undaria* was first observed growing wild, no large amounts were seen among beach-cast kelps in 1992, apparently being distributed mainly in the bay of the farming (Hay and Villouta, 1993), in contrast to the huge amounts seen on the shores of St Malo. From studies of the populations accidentally introduced into New Zealand, these authors have measured biomasses there in excess of 10 kg per m^2, with the main densities between 1 and 3 m, but occurring as deep as 18 m. Although spreading into new habitats in some areas there, it has so far not been seen to replace other species, but may constitute an ecological change to areas where seaweed vegetation naturally is sparse.

WGITMO noted that *Undaria* has spread from the farming sites, as anticipated earlier, but that its effects on the ecosystem so far do not seem to be detrimental, although large populations may develop. A further spread in Europe also seems likely, considering it has occurred since 1990 in Spain too.

15.4 Japanese seaweed (Nori), *Porphyra yezoensis*, in the USA and Canada

Steve Crawford (Coastal Plantations International, Inc.) gave a presentation at the meeting which followed an initial annual report that had been sent by post to the Chairman of the Working Group (Annex 8). The project appears to be going well although there was an initial 10–20% loss of production because the nets could not be raised from the water sufficiently to allow the nori to receive the appropriate level of air-exposure. This has been overcome with modifications to the equipment that is used to raise the nets.

It was stated that there had been no loss of nets or gear from the sites although loss of plant fragments occurred during harvest which was carried out from a barge on site.

On Saturday 23 April, six of the WGITMO members were invited to the cultivation site in Maine. Although there were no nets to be seen (they have not yet been deployed) the group was taken out by boat to the sites. It was suggested by Dr Wallentinus that the ropes that were seen along some of the salmon cages in the same area might be studied for any spread of the *Porphyra* from the cultivation site. The land-based processing unit was also visited.

15.5 Invasion of the tropical alga *Caulerpa taxifolia* in the Mediterranean

Professor A. Meinesz in Nice believes that 'the material (of *Caulerpa taxifolia*) growing in the Mediterranean is quite different from that which grows naturally in the Tropics, and that it probably represents a strain created artificially by man under aquarium conditions. It seems not to reproduce successfully by sexual means, but spreads by fragmentation. It is still spreading, and, for instance, is now in Elba and Sicily. The Mediterranean strain can survive temperatures as low as 7°C and can grow from 13°C upwards.'

The potential spread of this species to many other European areas has to be considered.

According to Jenkinson (1993), new centers have been reported at the Spanish port of Palma de Mallorca and at the Italian port of Livorno. Additional information is given in the bibliography.

16 NEW PROPOSED INTRODUCTIONS

16.1 The Movement of Bass from the USA to Ireland

At the request of Ireland, WGITMO examined a proposal by Aquafuture Inc. (Turners Falls, Massachusetts, USA) to develop a high intensity, land-based contained culture system for the striped bass *Morone saxatilis*, the white bass *Morone chrysops*, and their hybrids on the south coast of Ireland. The stock is to be completely contained within the production facilities with multiple barriers to fish escape. Initially Aquafuture intends to import 480,000 hybrid fingerlings twice yearly. It is intended that the operation will become self-sufficient using on-site broodstocks. Two WGITMO members visited the USA-based aquaculture facility and the proponents, Aquafuture, Inc., presented themselves to the meeting to clarify several matters and to respond to questions raised in relation to the ICES Code of Practice (Annex 9).

WGITMO acknowledges that either species or their hybrids proposed for importation have the potential to become established and to compete with native species should a release occur. However, it is the opinion of WGITMO that the basic proposal satisfactorily addresses the risk of potential release within proposed operational parameters by virtue of the strict containment. Therefore, a full assessment of the ecological implications of such a release is not warranted.

WGITMO does not oppose the movement of bass to Ireland as proposed here, subject to the following conditions:

1) *An assessment will be carried out* which addresses the operational and environmental aspects of the disposal of all waste products, including dead fish, waste water, and liquid manure. (The disposal of these products is to meet with the requirements of the relevant Irish authorities.)

2) *The facility will be constructed* so that in the event of complete tank(s) failure all fish and water would be physically contained within the facility.

3) *A contingency plan will be prepared* that addresses any and all identifiable potential accidental events that could lead to fish escape (such as the loss of fingerlings during transfer from the port of entry to the culture facility).

4) *Breeding stocks will be established* within the culture facility as soon as possible by importing surface-disinfected (if practicable) eggs from parents that have been lethally sampled for bacteria, viruses, and other potentially vertically transmitted organisms. These breeding stocks should be maintained within the site in isolation from fingerlings in culture.

5) *No live fish or viable gametes will leave the security of the site.*

16.2 The Use of Triploid Pacific Oysters (*Crassostrea gigas*) in Field Experiments When Introduction of the Oysters is Not a Desired Outcome

At the request of the State of New Jersey and the State of Delaware, USA (Annex 10), WGITMO addressed the question of whether the use of triploid oysters in open water experiments would be considered, under the Code of Practice, to be a technique sufficiently safe such that it would not result in the unintentional, accidental introduction of the species involved as required by state authorities.

In the present case, hatchery-raised, purportedly disease-free, F_4, triploid Pacific (Japanese) oysters (*Crassostrea gigas*) had been held in trays in open waters in Delaware and Chesapeake Bays, USA, to test the susceptibility and resistance of the oysters to "MSX" disease (caused by the sporozoan *Haplosporidium nelsoni*). Dr S. Allen of Rutgers University, New Jersey, along with Mr J. Joseph of the New Jersey Division of Fish, Game, and

Wildlife, and Mr J. Tinsman, of the Delaware Division of Fish and Wildlife, presented themselves to the meeting to give the background and history of the development of the research project and the deployment of triploid oysters in Delaware and/or Chesapeake Bays.

Information was presented that indicated that all of the oysters placed in the experimental trays in Delaware and Chesapeake Bays had been individually tested by flow cytometry methodology and found to be triploids (as a check on this method, chromosome numbers of a subsample of oysters were examined, and these were verified to be triploids).

Following more than 6 months' exposure, and the detection of a mosaic individual, all oysters were retrieved from the deployment sites. Of 83 oysters examined from the York River, Virginia, in Chesapeake Bay, 61 (73.5%) were found to still be triploid, 17 (20.5%) were found to be mosaics in their genetic make-up (that is, possessing both triploid and diploid cells), and 5 (6%) were found to be diploid (that is, possessing almost entirely diploid cells with a trace of triploid cells). Reversion from a triploid to a diploid state for some oysters thus appears to have occurred. Dr Allen stated that he had not expected this reversion to occur, and that there were no previous reports of reversion in the literature for bivalve molluscs. Both mosaic and the largely diploid oysters are now considered to have the potential to return to reproductive capacity.

Given these findings, WGITMO concluded that the question posed to the Council had already been answered by Dr Allen and that this information had already been supplied to the States of New Jersey, Delaware, Virginia, and Maryland. However, WGITMO urged further consideration by ICES of the broader issues of sterilization techniques of test organisms (such as triploidy), when there is a desire to conduct field trials and experiments, but when actual introduction of the test species is not a desired outcome, and particularly concerning the risks involved relative to reversion to a reproductive state. WGITMO suggested that the Working Group on Applications of Genetics in Fisheries and Mariculture (WGAG) take this question under further consideration.

WGITMO noted that the ICES definition of an "introduced" species (= non-indigenous, = exotic species) is: "Any species intentionally or accidentally transported and released by humans into an environment outside its present range." The definition does not specify any particular genetic status of the species or population. In the case of organisms that are transported and that upon release are, or after release become, potentially capable of sexual reproduction (possessing diploid cells) or asexual reproduction (such as by budding or fragmentation), such species could potentially colonize and become established in a new environment.

WGITMO concluded that,

1) The holding in the open waters of Delaware Bay and Chesapeake Bay of non-indigenous oysters (including triploid oysters) would constitute an introduction under the ICES Code of Practice. WGITMO further noted the need, as demonstrated in the Delaware and Chesapeake Bay non-indigenous species oyster program, for post-deployment monitoring of organisms (populations and/or individuals) placed in open waters as triploids to determine if any reversion has occurred;

2) The ICES Working Group on Applications of Genetics in Fisheries and Mariculture should take this question under further consideration, relative to the techniques of sterilization of test organisms (such as triploidy) for field experiments, the efficacy of and justification for these techniques, and the risks involved relative to reversion to a reproductive state.

16.3 FAO Meeting in Manila, Philippines to produce a User Manual to facilitate implementation of the ICES/EIFAC Codes of Practice and Manual of Procedures for consideration of Introduction and Transfers of Marine and Freshwater Organisms

D. Minchin (Ireland) of WGITMO attended this meeting, held in November 1993. A planned document, "Guidelines for the responsible introduction and transfer of aquatic organisms" which will include sections on ecological interactions, socio-economics, quarantine and genetics, was discussed. Appendices would be provided to explain clearly how the required procedures might be achieved. While this document was in preparation, a circular/information leaflet to advertise its contents in advance of its publication is to be circulated as it is intended to widely circulate these Guidelines once completed.

It was concluded that much text that related to ecological matters which appears in the ICES/EIFAC Code could be used in the manual but that those sections that relate to quarantine would need to consider the special conditions of sub-tropical and tropical areas. With this in mind, it is intended that Dr Modh Shariffand, an FAO fish disease specialist, will hold a meeting in Malaya during 1994. The group recommended that the genetic protocols in the ICES Code should be modified and simplified in the Guidelines and would be referred to in the manual as Genetic Resources. The section on socio-economics does not appear in the ICES/EIFAC Code and because of this was outside the expertise of the attendants and would require the involvement of and the attendance of relevant experts at a future meeting.

An advisory group, consisting of local organizations including GIFT (Genetic Improvement of Farmed Tilapia) and FAO, is to be formed as a multidisciplinary panel of experts to assist resource managers with the introduction and transfer of aquatic organisms.

WGITMO plans to keep in close touch with FAO and ICLARM relative to the development and evolution of this document, and to contribute expertise (such as D. Minchin's participation) to this effort as requested. WGITMO was extremely pleased to learn of the continuing work on the development of user's guides to the Code of Practice in developing countries. WGITMO further noted the need to make sure that other users are provided with the latest version (1994) of the Code of Practice.

17 OECD WORKSHOP ON THE IMPACTS ON THE AQUATIC ENVIRONMENT ARISING FROM THE INTRODUCTION OR ESCAPE OF AQUATIC ORGANISMS WHICH HAVE BEEN DERIVED THROUGH MODERN BIOTECHNOLOGY, TRONDHEIM, JUNE 9-11, 1993

A report of this meeting was given by Dr Sue Utting who had attended the meeting and presented a paper. During the meeting she had also been requested to give a brief account of the ICES Code of Practice, since the introductions of non-indigenous species and GMOs had some common elements.

The meeting was attended by 73 participants representing fourteen OECD countries. Presentations and case histories covered a full range of aquatic organisms. Topics covered in the presentations were wide ranging and included methods of producing transgenic organisms, methods of producing triploids and the use of triploid fish and shellfish, risk assessment models that could potentially be used for the release of GMOs, and biotechnology as used for the production of microalgae.

Of interest to ICES were some of the points that came out of a final day of discussion, that:

1) the aquatic organisms derived from modern biotechnology that are of most concern are GMOs,

2) the impacts that might arise from the commercial culture of GMOs are likely to be difficult to predict,

3) there is little precise information on the likely environmental impacts of GMOs and there are a number of information gaps, for example, relative to fitness, selective advantage, and genetic effects such as connectivity and introgression.

18 ACTION LIST (ANNEX 3)

WGITMO identified the following elements as being on its current list of Action Items. These are *in addition to* those elements proposed for action in the Recommendation of the Working Group for its 1995 meeting:

* Complete the '1990 Summary of introductions and transfers in ICES Member Countries', being a new *ICES Cooperative Research Report.* This document should be ready for submission to ICES by June, 1994.

* Prepare a discussion paper on Environmental Impact Assessment Models for Biological Invasions in time for its consideration at the 1995 Working Group meeting. This document will be prepared in cooperation with Drs J Side, K Hayes, and others.

* Begin preparation of a paper for publication in a scientific journal on the '1994 ICES Code of Practice on Introductions and Transfers of Marine Organisms' along with a brief history of the Code and the Working Group on Introductions and Transfers of Marine Organisms. This work will commence following the 1994 ICES Statutory Meeting, and it is hoped will bring greater international attention to ICES' work in this important field.

* Arrange a Special Theme Session on 'Ballast water and accidental introductions' to be held under the auspices of the Mariculture Committee during the 1995 Statutory Meeting.

* Continue to work with FAO, including EIFAC, on disseminating, harmonizing, and putting into use the ICES Code of Practice.

19 RECOMMENDATIONS TO COUNCIL (ANNEX 11)

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

As a result of extensive discussions starting several years ago and highlighted in 1993 at the Dublin meeting, and as a result of similarly extensive discussions within WGITMO at its 1994 Mystic meeting, WGITMO deliberated at length the incorporation of a greater ecological and environmental framework relative to discussions on introductions and transfers of marine organisms. These deliberations included a discussion of the ecological and environmental ramifications of invasions, and an extensive revision of the ecological

portions of the Code of Practice. Recommendations 1, 2, and 3 are a result of these discussions:

1) That the '1994 ICES Code of Practice on Introductions and Transfers of Marine Organisms', which has been modified to take account of the problems associated with the ecological and genetic impacts associated with introductions and transfers of marine organisms, and genetically modified organisms, be presented to the Council for adoption.

2) That the '1994 ICES Code of Practice on Introductions and Transfers of Marine Organisms', once adopted by the Council, along with a brief history of the Code and of the Working Group on Introductions and Transfers of Marine Organisms, be published as an *ICES Cooperative Research Report*, this Report to serve both as an accessible source of the Code of Practice, and as a general information source about the Working Group on Introductions and Transfers of Marine Organisms and ICES activities in general in this field.

3) That the '1994 ICES Code of Practice on Introductions and Transfers of Marine Organisms', along with a brief history of the Code and the Working Group on Introductions and Transfers of Marine Organisms, be published in one or more additional international scientific journals, by the Working Group, to insure the widest possible dissemination.

WGITMO considered the matter of importing American bass, as stem species and/or hybrid stock to Ireland in entirely contained culture systems. WGITMO heard presentations from the working group member from Ireland and from the private company involved in the possible exportation of bass from the USA to Ireland. On the basis of this discussion, the following recommendation is made:

4) That on the basis of the considerations of WGITMO on the importation of bass from the USA to Ireland by a private party, Member countries are advised that the Council does not oppose the importation subject to adherence to the ICES Code of Practice, and under the land-based, completely contained culture conditions presented to the Council, and subject to the following conditions:

   a) *An assessment will be carried out* which addresses the operational and environmental aspects of the disposal of all waste products, including dead fish, waste water, and liquid manure. (The disposal of these products is to meet with the requirements of the relevant Irish authorities).

   b) *The facility will be constructed* so that in the event of complete tank(s) failure all fish and water would be physically contained within the facility.

   c) *A contingency plan will be prepared* that addresses any and all identifiable potential accidental events that could lead to fish escape (such as the loss of fingerlings during transfer from the port of entry to the culture facility).

   d) *Breeding stocks be established* within the culture facility as soon as possible by importing surface-disinfected (if practicable) eggs from parents that have been lethally sampled for bacteria, viruses, and other potentially vertically transmitted organisms. These breeding stocks should be maintained within the site in isolation from fingerlings in culture.

   e) *No live fish or viable gametes will leave the security of the site.*

WGITMO considered the matter of the use of triploid Pacific oysters in field experiments on the USA Atlantic coast, when actual introduction of the oysters was not a desired outcome. WGITMO heard from representatives from Rutgers University (the source of the triploid oysters) and the States of New Jersey and Delaware. On the basis of this discussion, the following recommendation is made:

5) That the Council finds that the holding in the open waters of Delaware Bay and Chesapeake Bay of non-indigenous oysters (including triploid oysters) would constitute an introduction under the ICES Code of Practice. WGITMO further noted the need, as demonstrated in the Delaware and Chesapeake Bay non-indigenous species oyster program, for post-deployment monitoring of organisms (populations and/or individuals) placed in open waters as triploids to determine if any reversion has occurred. The techniques of sterilization of test organisms (such as triploidy) for field experiments, the efficacy of and justification for these techniques, and the risks involved relative to reversion to a reproductive state, should be discussed by the ICES Working Group on Applications of Genetics in Fisheries and Mariculture.

WGITMO noted the approval of C.Res.1993/3:7, relative to the possible co-importation of associated species

with trade products, resulting from WGITMO's 1993 discussions on the importation of living oysters from France to Ireland. WGITMO continues to strongly support the need for dialogue on this issue, and recommended the following resolution:

6) That in reference to C.Res.1993/3:7, ICES should identify an official avenue in the European Commission (EC) to establish a dialogue between ICES member countries and the EC relative to the ecological and genetic impacts of increasing movements through trade of aquatic organisms and their products, and not just relative to the prevention of the spread of disease agents. The Working Group on Introductions and Transfers of Marine Organisms could serve within ICES to provide the technical and scientific expertise relative to this issue.

WGITMO discussed increasing concerns about, and increased evidence for, the role of ballast water and ballast sediments in the transportation and release of exotic species. As a result of these discussions, WGITMO formulated the following resolution for Council consideration:

7) That member countries, but especially European countries, should be encouraged to develop ballast water and sediment management practices, particularly in the light of the potential further spread of the highly invasive ctenophore *Mnemiopsis* in Europe, in light of the discovery of the "phantom" fish-killing dinoflagellate *Pfiesteria piscimorte*, and in light of increasing global invasions of exotic species.

WGITMO reviewed its work relative to its 1993 terms of reference and relative to new issues, and proposed the following recommendation:

8) That WGITMO should meet at the University of Kiel, Kiel, Germany from 10 to 13 April 1995, to,

   a) report on the current status of fish, shellfish, algal, and other introductions in and between ICES member countries, including the annual report on the status of *Porphyra* in the Gulf of Maine,

   b) prepare a discussion document on different models that could be applied for evaluating the potential ecological and genetic risks that might arise from proposed introductions and transfers,

   c) begin to consider the implications of introducing marine organisms into the environment as potential agents for biological control,

   d) continue work on the new *ICES Cooperative Research Report* on "The ICES Code of Practice on Introductions and Transfers of Marine Organisms: Guidelines and a Manual of Procedures," incorporating a history of the usage of the Code, an example of a prospectus relative to proposing new introductions, guidelines for evaluating the ecological effects of the release of GMOs (in consultation with the Working Group on Applications of Genetics in Fisheries and Mariculture), and a review of case histories and decisions reached on introductions and transfers by the Council,

   e) finalize plans for the 1995 Theme Session, "Ballast Water and Accidental Introductions" to be held during the 83rd Statutory Meeting in Copenhagen.

20 CLOSING OF THE MEETING

The meeting was closed on Friday morning 22 April, following a final review of the terms of reference assigned to WGITMO for 1994, and a consideration of the proposed agenda and action items for 1995. Drs S. Gollasch and H. Rosenthal (in absentia) kindly offered to host the 1995 WGITMO meeting at the University of Kiel, and this invitation was accepted pending the working out of mutually acceptable meeting dates. Final draft recommendations were discussed, finalized, and approved by WGITMO. The Chairman adjourned the meeting at 13.00 hrs, Friday, April 22.

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ANNEX 1

Working Group on Introductions and Transfers of Marine Organisms

AGENDA

20 April 1994
Wednesday

9:00 Opening Session
~ Welcoming and Introductory Comments by Chair
~ Introduction of Participants
~ Review of Agenda: WG Report Deadline: **May 6 1994**
~ Presentation of the 1994 WG HANDBOOK (Third Edition)
~ Addenda/Errata for 1993 Aberdeen Report

~ Status of Recommendations from 1993 Aberdeen meeting:
C.Res. 1993/3.7: ICES/EC Dialogue Relative to Shellfish Movements
C.Res. 1993/4.7: American *Argopecten* in France
C.Res. 1993/4.8: Japanese *Porphyra* in USA
Reference: Yellow-covered "Extracts from ICES Annual Report 1993"

~ The 1993 ICES Dublin Meeting: ACME and the Working Group
* The Chair to go to ACME Copenhagen meeting, May 1994
~ ACME New Procedures

10:30 Coffee Break

11:00 ~ Revised **1994** Code of Practice: Discussion of Proposed ACME Changes to Code of Practice
~ Status of "1990 Summary of Introductions and Transfers in ICES Member Countries", a new *Cooperative Research Report*
A. Munro (Editor) (S. Utting)

12:00 Special Luncheon with Maritime Studies Program students

1:30 Reconvene
~ **NEW PROPOSED INTRODUCTIONS (I)**
Introduction of Hybrid Bass *Morone saxatilis x M. chrysops* to Ireland
Overview from **D. Minchin**
Presentation by **J. Goldman** (Aquafuture, Turners Falls, Massachusetts USA)
2:30 Discussion in Executive Session

3:00 (Begin) **NATIONAL REPORTS** and Literature Dissemination

3:30 Coffee Break

3:45 **NATIONAL REPORTS** (Continued)
5:00 Adjourn
6:30 Working Group Reception @ Mystic Seaport
8:00 Dinner

21 April 1994
Thursday

8:30 Review of Previous Day and Agenda
Other Business
NATIONAL REPORTS (Concluded)

9:30 Special Report on the *Mnemiopsis* Invasion of Black/Azov Seas, Mediterranean, and Potentially of Europe in General (and a Review of the January 1994 UNEP Meeting in Geneva) **R. Harbison**

10:30 Coffee Break

10:45 Ballast Water Management in ICES Member Countries: 1993 to 1995 Activities *including* consideration of the spread of the phantom dinoflagellate *Pfiesteria piscimorte*: Canada, Finland, Germany, Ireland, Norway, Sweden, U.K., U.S.A.

Special Presentations: Research Project Updates:

~ German Ballast Water Research Project **S. Gollasch**

~ USA Ballast Water Research Project **D. Smith, J. Carlton, G. Ruiz**

12:00 Group Photo at the Seaport

Lunch (on your own or as arranged by consensus)

1:30 Reconvene

Status Reports:

* Ireland: Japanese Scallop *Patinopecten*
  D. Minchin
* France: American Scallop *Argopecten*
* France: Japanese Kelp *Undaria*
* USA: Japanese Seaweed (Nori) *Porphyra*
  S. Crawford
* Europe: Invasion of the Alga *Caulerpa*
  I. Wallentinus

3:00 Coffee Break

3:30 ~ **NEW PROPOSED INTRODUCTIONS (II)**

Use of Triploid Japanese Oysters *Crassostrea gigas* to Test for Disease Resistance in the Field on the US Atlantic Coast

Overview by J. Carlton

Presentations by:

S. Allen (Rutgers University)

J. Tinsman (Delaware Fish & Game)

4:30 Discussion in Executive Session

5:00 Update on PROJECT PREFIX: Production and Risk Evaluation for Introduced Organisms

K. Hayes (Heriot-Watt University, Orkney)

Followed by Discussion: Possible directions for preparing a review of different models (risk assessments, decision pathways, and other systems) which have been developed for evaluating introductions and transfers

6:00 Adjourn

7:30 Dinner

8:00 Reconvene for Evening Working Session

11:00 Adjourn

22 April 1994
Friday

8:30 Review of Previous Day and Agenda

Presentation and Discussion of Draft Recommendations

Report on ICLARM Meeting, Manila, The Philippines, November 1993 on a User Manual to Facilitate Implementation of the ICES/EIFAC Code of Practice and Manual of Procedures, including Discussion concerning EUS (Epizootic Ulcerative Syndrome)

D. Minchin

Status of New *Coop Research Report*, "A Code of Practice to Reduce the Risks....."

J. Carlton (Editor)

D. Minchin (Model Example)

A. Munro (Finfish Pathology)

H. Grizel (Invertebrate Pathology)
I. Wallentinus (Algal Pathology)

Report to the ACME on the Issues and Problems Associated with the Ecological Impact (including Changes in Genetic Attributes) Associated with Introductions, Transfers, and Enhancements of Marine Organisms
J. Carlton

Review of "OECD Workshop on the impacts on the aquatic environment arising from the introduction or escape of aquatic organisms which have been derived through modern biotechnology": Trondheim, June 9–11, 1993
S. Utting
Followed by Discussion: Directions for developing guidelines for research to evaluate the ecological effects of the release of genetically modified organisms in marine environments

Distribution of Final Recommendations
Principal Agenda Items for 1995 WG Meeting
Date/Venue for 1995 Meeting

Concluding remarks by Chairman

ADJOURN

ANNEX 2

ICES Working Group on Introductions and Transfers of Marine Organisms
April 20-23 1994 Mystic Connecticut USA

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ANNEX 3

ACTION LIST

The Working Group identifies the following elements as being on its current list of Action Items. These are *in addition to* those items proposed for action in the *Recommendations* of the Working Group for its 1995 meeting:

* Complete the '1990 Summary of introductions and transfers in ICES Member Countries', being a new *Cooperative Research Report*. This document should be ready for submission to ICES by June, 1994.

  See page 4 of present report

* Begin preparation of a paper for publication in a scientific journal on the '1994 ICES Code of Practice on Introductions and Transfers of Marine Organisms' along with a brief history of the Code and the Working Group on Introductions and Transfers of Marine Organisms. This work will commence following the ICES 1994 Statutory Meeting, and it is hoped will bring greater international attention to ICES' work in this important field.

  See page 11 of present report

* Prepare discussion paper on Environmental Impact Assessment Models for Biological Invasions in times for its for 1995 Working Group meeting. This document will be prepared in cooperation with Drs J. Side, K. Hayes, and others.

  See page 13 of present report

* Arrange a Special Theme Session on 'Ballast water and accidental introductions' to be held under the auspices of Mariculture Committee during the 1995 Statutory Meeting.

  See page 15 of present report

* Continue to work with FAO, including EIFAC, on disseminating, harmonizing, and putting into use the ICES Code of Practice.

  See page 21 of present report

ANNEX 4

NATIONAL REPORTS FROM MEMBER COUNTRIES FOR 1993-1994

ICES Working Group on Introductions and Transfers of Marine Organisms
Mystic, Connecticut USA 20-22 April 1994

NATIONAL REPORT FOR CANADA

1. LAWS AND REGULATIONS

Ballast Water Controls for the Great Lakes

The United States Coast Guard put into effect new ballast water regulations that apply to all vessels entering the St. Lawrence seaway at Massena, New York. The regulations were implemented in May, 1993. USA and Canada are working cooperatively to ensure compliance. Canada has ballast water guidelines which require that all vessels entering the Saint Lawrence River exchange their ballast water while at sea. Transport Canada has indicated their intention to change these guidelines to regulations in the future. Details on the current guidelines are available in the 1993 Report of the Working Group on Introductions and Transfers of Marine Organisms (C.M. 1993/F:3).

In April, 1993, the Canadian and USA shipping industries implemented voluntary ballast water exchange guidelines to help stop the spread of European ruffe (*Gymnocephalus cernuus*) out of western Lake Superior. The program calls for ballast exchange in deep water for any ships that have taken on ballast in the ports of Duluth, MINN, Two Harbours, and Thunder Bay, ONT. The ports of Ashland, WI, and Ontanogan, MI, have been added in 1994.

Ruffe Regulation

Amendments to the Ontario Fisheries Regulations (under the Canada Fisheries Act), to prohibit the possession of ruffe, have been submitted to Department of Fisheries and Oceans for approval. It is hoped the regulation will be approved and gazetted in May, 1994.

Fish Health Protection Regulations

Amendments to the Fish Health Protection Regulations and Manual of Compliance are still in preparation. Draft amendments were distributed to government agencies and industry in Canada, and to governments in other countries, for comment in January, 1994. The Technical Committee responsible for preparing amendments will meet in May, 1994 to consider all comments received. The revised Regulations and Manual of Compliance are now targeted for implementation in 1995.

The Fishery (General) Regulations

The Fishery (General) Regulations promulgated under the Fisheries Act were approved in February, 1993. They presently apply in the provinces of British Columbia, New Brunswick, Prince Edward Island, Nova Scotia, and Newfoundland. The other provinces, which have delegated authority for administration of freshwater fisheries, may opt to use these Regulations if they choose. Part VIII of the Regulations covers the release of live fish into fish habitat, and transfer of live fish to a fish rearing facility. The purpose of Part VIII is to minimize fish health, genetic and ecological impacts of fish releases into waters of a province or transfers to hatcheries. These Regulations do not replace the Fish Health protection Regulations referred to above.

Pacific Fishery Regulation

The Pacific Fishery Regulation, 1993, Section 5 and Part VIII, lists species prohibited from importation into British Columbia. The species named are considered a potential threat to wild fish populations.

Draft Policy on Introductions of Genetically Modified Organisms

The Department of Fisheries and Oceans draft policy entitled "Transgenic Aquatic Organisms: Policy and Guidelines for Research with, or Use in Natural Aquatic Ecosystems in Canada" has been revised following review by governments, universities and industry. The revised draft has again been sent out for public comment. Target date for implementation of the policy is late 1994 or early 1995.

National Policy on Introductions and Transfers

A meeting of a national working group, organized by Department of Fisheries and Oceans, was held in July, 1993, to discuss proposals for a national policy on introductions and transfers of aquatic organisms. The working group comprised representatives from federal and provincial agencies, the aquaculture and fishing industries, and related associations. Consensus was reached on the basis for the policy, which will apply to intentional (not accidental) introductions and transfers. A draft policy is being prepared for public consultation.

Ontario Non-indigenous Species Action Plan

The Ontario Ministry of Natural Resources is developing an Action Plan to address issues associated with intentional and non-intentional introductions in terrestrial and aquatic ecosystems.

Ontario Aquaculture Task Force

The Ontario Ministry of Natural Resources has formed an Aquaculture Task Force with the intent of developing policies that will allow for a diversified and competitive aquaculture industry while protecting wild ecosystems in a province. The Ontario Ministry of Agriculture and Food, and the Ontario Aquaculture Association are also represented on the Task Force.

2. DELIBERATE RELEASES

The summary below includes introductions and transfers of aquatic organisms for the purposes of stocking or for aquaculture. Even though cultured organisms are usually contained, they can escape to the wild. There were no new introductions of aquatic organisms, and all importations were either between provinces, or from sources in USA.

2.1 Fish

Rainbow Trout (*Oncorhynchus mykiss*)
Nova Scotia - Imported rainbow trout eggs and juveniles (including sterile and triploid forms) from

Ontario and Quebec.

New Brunswick - Imported rainbow trout eggs and juveniles from Ontario.

Prince Edward Island - Imported rainbow trout eggs and juveniles from Ontario, Quebec and Washington State, USA.

Quebec - Imported rainbow trout from western USA.

Arctic charr *(Salvelinus alpinus)*
Nova Scotia - Imported Arctic charr eggs from Prince Edward Island
New Brunswick - Imported Arctic charr eggs from Manitoba

Brook trout *(Salvelinus fontinalis)*

Nova Scotia - Imported brook trout juveniles from Prince Edward Island.

New Brunswick - Imported brook trout eggs and fish from Prince Edward Island, Quebec and Maine, USA.

Atlantic salmon *(Salmo salar)*

New Brunswick - Imported juveniles from Prince Edward Island and Maine, USA. Stocked landlocked x anadromous cross in Long Lake experiment.

Nova Scotia - Imported Atlantic salmon eggs from New Brunswick

Prince Edward Island - Imported Atlantic salmon eggs from New Brunswick

Quebec - Imported brook trout juveniles from western USA.

Ontario - Imported Atlantic salmon eggs from Nova Scotia.

British Columbia - Imported Atlantic salmon eggs from New Brunswick, Washington State, USA, and Ireland, UK.

Lake Trout *(Salvelinus namaycush)*
Ontario - Imported lake trout eggs from Seneca Lake, New York, USA.

Black Bullhead
Ontario - Imported black bullhead fingerlings from Brockport, New York, USA.

Yellow Perch *(Perca flavescens)*
Ontario - Imported perch juveniles from Brockport, New York, USA.

Lake Sturgeon *(Acipenser fulvescens)*
Ontario - Imported lake sturgeon fingerlings from Minnesota, USA

Sockeye Salmon (*Oncorhynchus nerka*)
British Columbia - Sockeye salmon eggs taken in Canadian waters were transferred to an isolation unit in Alaska, and will be out-planted in the river systems from which they originated.

Chinook Salmon (*Oncorhynchus tshawwyscha*)
British Columbia - Imported chinook salmon eggs from Yukon Territory.

Coho Salmon (*Oncorhynchus kisutch*)
British Columbia - Imported coho salmon eggs from Pacific coast, USA.

2.2 Invertebrates

Giant Sea Scallop (*Placopecten magellanicus*)
New Brunswick - Imported giant sea scallop juveniles from Newfoundland and Prince Edward Island.

Prince Edward Island - Imported giant sea scallop juveniles from Newfoundland.

Eastern oysters (*Crassostrea virginica*)
Prince Edward Island - Imported eastern oysters from Nova Scotia for depuration and processing.

Hard-shell Clam (*Mercenaria mercenaria*)
Prince Edward Island - Imported hard-shell clams from Nova Scotia for depuration and processing.

Blue Mussels (*Mytilus edulis*)
New Brunswick - Imported blue mussels from Quebec.
British Columbia - Imported blue mussel seedstock from Prince Edward Island.

Manila Clams (*Tapes philippinarum*)
British Columbia - Imported Manila clam seedstock from Pacific coast, USA.

Pacific Oyster (*Crassostrea gigas*)
British Columbia - Imported Japanese oyster seedstock from Pacific coast, USA.

Japanese Scallop (*Placopecten yessoensis*)
British Columbia - Imported adult Japanese scallop into quarantine from Japan. Only the F_1 generation will be out-planted into coastal waters.

3. ACCIDENTAL INTRODUCTIONS AND TRANSFERS

3.1 Fish

Two species of Eurasian fishes were collected in Ontario waters in 1990. The rudd (*Scardinius erythrophthalmus*), collected in the St. Lawrence River was likely introduced there through its use as a baitfish. The second species, the round goby (*Neogobius melanostomus*) was collected in the St. Clair river. This species was likely introduced via ballast water discharged from ocean-going vessels. Another introduced goby, the tubenose goby (*Proterorhinus marmoratus*), which is present on the USA side of the St. Clair River, has yet to be collected from Canadian waters. To this time, neither the round goby or the rudd have been collected outside the areas where they were first discovered.

The impacts of both species on native fauna are not known at this time.

The margined madtom (*Noturus insignis*) was introduced into Lake Muskoka and Lake Rousseau, Ontario in 1989, probably as a result of a bait-bucket transfer from the USA.

Ruffe have continued to expand their range in Lake Superior. During 1993, ruffe were found as far east as the Bad River, which is 156 km. east of Duluth Harbour, where ruffe were first discovered in 1986. Over the past seven years, ruffe have expanded their range by an average of about 29 km. of shoreline each year. No ruffe were found in Canadian waters in 1994. Canada has a surveillance and education program, and has participated in the ballast water management program in Lake Superior. Canadian biologists met in March, 1994 to discuss the ruffe issue.

3.2 Invertebrates

In 1993, the zebra mussel (*Dreissena polymorpha*) continued to expand its range in Ontario. New areas of colonization include the Rideau Canal system, Collingwood in Georgian Bay, and Warp Bay in Lake Superior.

Canadian biologists are monitoring changes in the abundance of zebra mussels and changes in the plankton and benthic communities in Lake Erie and Lake Ontario. Several agencies are investigating the impact of zebra mussels on the structure and dynamics of the aquatic community in Lake Erie.

The quagga mussel has been genetically identified as *Dreissena bugensis* Andrusov, which is native to the Dnieper River drainage in the Ukraine. In the Great Lakes, this second species of *Dreissena* is common in Lake Erie, Lake Ontario and the St. Lawrence River, and is found in deeper water than the zebra mussel. There are no reports of its occurrence elsewhere in Canada.

The spiny waterflea (*Bythotrephes cederstroemi*), which invaded each of the Great Lakes in the 1980s, has spread to several inland lakes in Ontario including the Muskoka lakes (1990 and 1991), Lake Temagami (1991) and two lakes north of Minden (1993). These introductions were likely related to recreational boat traffic.

One specimen of *Eriocheir sinensis* (Chinese mitten crab) was collected from Lake Erie, approx. 7 km. ESE of Wheatley, Ontario, in April, 1994.

The rusty crayfish (*Orconectes rusticus*), which is now present in central and northwestern Ontario, is slowly spreading via bait-bucket transfers and natural invasive migrations.

At the Maurice Lamontaigne Institute, PQ, the Department of Fisheries and Oceans is undertaking an assessment of the risk of introduction of unwanted aquatic organisms from exchange or discharge ballast waters and sediments in the estuary and gulf of the St. Lawrence River. Specific goals of the project are to: (a) Determine which marine organisms and ports of origin pose a threat to marine waters of the St. Lawrence; (b) Describe the practices used to discharge ballast waters and sediments in the estuary and gulf of the St. Lawrence River; (c) Assess the part played by anchor-chain pits and ballast tanks in transporting harmful marine organisms, and effectiveness of water exchange in controlling the transfer of organisms; and (d) Assess the risk of introducing these organisms to Canadian waters. Work in the first two years (1993/94 and 1994/95) will include analyses of the

Canadian Coast Guard DADS and ECAREG databases, literature surveys, and obtaining information through ships surveys of ballast discharge practices. Field work will be conducted in 1995/96 to sample ballast waters and ships reservoirs.

A notice was put out to shellfish growers in Atlantic Canada by Department of Fisheries and Oceans following unconfirmed reports of unlicensed importations of European oysters (*Ostrea edulis*) from Maine, USA to Nova Scotia.

Department of Fisheries and Oceans has received a report that a yet-unidentified mussel was introduced on the hull of a ship stationed in a harbour on the west coast of Vancouver Island, BC. This mussel is reported to be reproducing in local waters.

3.3 Algae and Higher Plants

Scientists from Department of Fisheries and Oceans, in collaboration with University of Toronto and Williams College (Mystic, CT), conducted a study in 1990 and 1991 on phytoplankton in ships ballast. Ballast water was analyzed from 86 foreign vessels that visited the Laurentian Great Lakes and upper St. Lawrence River. A total of 102 taxa belonging to seven groups were recognized. Samples contained 69 diatoms and 30 dinoflagellates, several new to Canadian Atlantic waters. Most of the algae were in good condition, and contained chloroplasts. Cultures were also established from live samples. There were 21 potentially bloom-forming, red tide, and/or toxigenic algal species in these ballast waters.

The green macroalga, *Codium fragile ssp. tomentosoides* was collected for the first time in Atlantic Canada at Graves Shoal, Mahone Bay, Nova Scotia in December, 1991. The evidently rapid dispersal, large size of plants, and abundant production of gametangia indicate that the local environment is favorable to the alga. It was probably transported to Nova Scotia from New England by boat traffic or tidal flow.

4. LIVE IMPORTS

The following aquatic organisms were imported into Canada for research or for human consumption. The organisms imported for these purposes are not believed to pose a risk to Canadian fisheries resources.

Ontario
Lake trout (*Salvelinus namaycush*)
Lake sturgeon (*Acipenser fulvescens*)
Carp (*Cyprinus carpio*)
Bass (unspecified)
Tilapia (unspecified)
Sucker (unspecified)
Pacu (*Piaractus brachypoma*)
Brown bullhead (*Ictalurus nebulosus*)
Catfish (unspecified)

British Columbia
Abalone (unspecified)
Geoduck (*Panope abrupta*)
Lobster (unspecified)
Green mussels (*Mytilus smaragdinus)*
Blue mussels (*Mytilus edulis*)
Giant sea scallop (*Placopecten magellanicus)*
Sea urchins (*Strongylocentrotus spp.*)
Whelk (unspecified)
Shrimp (unspecified)
Eohaustorius estuarius
Rhepoxynius abronius
Dendraster sp.
Neanthes arenaceodentata
Scylla serrata

5. LIVE EXPORTS TO ICES MEMBER COUNTRIES

Canada does not have a reliable mechanism for recording exports of live aquatic organisms to other countries.

6. PLANNED INTRODUCTIONS

6.1 Fish

Prince Edward Island - Continued importations of rainbow trout and Arctic charr from other provinces are likely.

New Brunswick - Importing hybrid brook trout eggs from Maine.

Ontario - The province is considering the importation of rainbow trout eggs from Quebec in 1994. The Ministry of Natural Resources is intending to import lake trout eggs from Seneca lake and Atlantic salmon eggs from Nova Scotia again in 1994.

British Columbia - It is anticipated that introductions for 1994 will be very similar to those in 1993.

6.2 Invertebrates

New Brunswick - Consideration is being given to culture of bay scallops (*Argopecten irradians*) and European oyster for the first time in the Gulf of St. Lawrence waters of New Brunswick. These two species are already cultured in Prince Edward Island and Nova Scotia. Commercial hatcheries in the Maritimes provinces should be able to satisfy all of the region's requirements for bay scallops.

7.0 MEETINGS, CONFERENCES, SYMPOSIA OR WORKSHOPS

In New Brunswick, the Southeast New Brunswick Professional Association held a meeting with federal and provincial agencies to discuss the implications of importing the European oyster. The Gulf Fisheries Centre hosted a clam workshop to discuss the best methodology to enhance the development of clam culture in Atlantic Canada, including importation of proven stocks from Rhode Island or South Carolina, USA. Alternatives such as development of native stocks or other native clam species were discussed.

Scientists from the Department of Fisheries and Oceans Laboratory, Burlington, and Ontario Ministry of Natural Resources were involved in the following meetings and conferences:

Third Provincial Conference on Zebra Mussels, Quebec, PQ, in March, 1994.

Ruffe Control Committee and Ballast Water Meeting, Chicago, IL in July, 1933.

Ruffe Control Committee Meeting, Duluth, MN, in January, 1994.

Ruffe Meeting, Burlington, ON, in March 1994.

Canadian Marine Advisory Council Meeting, Toronto, ON, in December, 1993.

Fourth International Zebra Mussel Conference, Madison, WI, in March 1994.

U.S. Aquatic Nuisances Species Task Force, Great Lakes Region Meeting, Toronto, ON, in February, 1993

Staff from the Pacific Biological Station attended the USA NOAA workshop on Non-Indigenous Estuarine and marine Organisms held in Seattle, WA, in April, 1993.

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Reported prepared and collated by:
Aquaculture and Habitat Science Branch, Department of Fisheries and Oceans, Ottawa

ICES Working Group on Introductions and Transfers of Marine Organisms
Mystic, Connecticut USA 20-22 April 1994

NATIONAL REPORT FOR FINLAND

1.0 LAWS AND REGULATIONS

Referring to the previous report, the revised decision concerning the transfer of live fish to and from water systems flowing into the Arctic Ocean did not come into force in 1993. The decision will be enforced after veterinary authorities from Finland and Norway have reached an agreement on the terms of the preventative measures against monogenean *Gyrodactylus salaris* concerning those water systems.

2.0 DELIBERATE RELEASES

Management of fisheries has included a great number of deliberate releases into the Baltic. About 2 million smolt (1-2 years old), 1.1 million two-year-old sea trout, 10.7 million one-summer-old and 38.4 million newly-hatched whitefish (*Coregonus lavaretus*) were released last year.

As in previous years, veterinary authorities allowed the import of elvers from Swedish quarantine. As many as 122,300 elvers with a mean weight of 0.73 g were released into inland waters in southern Finland in 1993.

The eggs of signal crayfish (*Pacifastacus leniusculus* Dana) were imported from Sweden in 1993 and were released as one-summer-old young into inland waters in southern Finland.

3.0 ACCIDENTAL INTRODUCTIONS AND TRANSFERS

3.2 Invertebrates

Two new invertebrates in the Gulf of Finland were reported in 1993. Specimens of the North American spionid polychaete *Marenzelleria viridis* (Verrill) were collected from samples taken by SCUBA divers in the Tvarminne area of the Gulf of Finland in June 1993. It is suggested by Norkko et al. (1993) that this species may have been transferred by currents from southern parts of the Baltic Sea where it was first reported in 1985.

Hemimysis anomala G.O. Sars (Crustacea: Mysidacea), originally an endemic Pontocaspian mysid, was found at two locations in the coastal waters of SW Finland in late summer 1992. According to Salemaa and Hietalahti (1993), "Because eurytopic crustacean populations have been introduced since the 50s from Pontocaspian estuaries into fresh-water reservoirs of the river Dnieper, the Volga, and also into the Baltic basin, *H. anomala* seems to be a young anthropochorous neoimmigrant distributed via man-made water routes, instead of being a real glacial relict, not previously observed. The possibility of abrupt migration in the ballast water of ships along Volgo-Baltic water routes is not, however, to be excluded."

4.0 LIVE IMPORTS

4.2 Invertebrates

See 2.0. As in previous years, aquarium shops and some restaurants and stores import live marine animals such as oysters, lobsters, and crabs for sale or consumption and this is permitted without the authorization of the Veterinary Department, because it is obvious that they cannot 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).

5.0 LIVE EXPORTS TO ICES MEMBER COUNTRIES

5.1 Fish

The fertilized eggs of rainbow trout have been exported to hatcheries in Russia (Karelia, Kola Peninsula), Chile, Portugal, Scotland, and Greece. Live rainbow trout fingerlings (0-2 years old) have been exported to hatcheries in inland waters in Karelian Russia. As well, 6,900 one-summer-old whitefish have been exported to Estonia to be released into the Baltic Sea.

6.0 PLANNED INTRODUCTIONS

6.1 Fish

It is planned to import elvers annually from quarantine in Sweden.

No action has been taken on plans to import the fertilized roe of rainbow trout for a selective breeding program, nor on plans to import sheatfish (*Siluris glanis* L.) from Sweden or Russia.

One of the state fish farms has received permission to import the fertilized eggs of Arctic char (*Salvelinus alpinus*) from the River Koutajoki water system (flowing into the White Sea) in Russia to the same water system in Finland. The import will be carried out in autumn 1994.

6.2 Invertebrates

As in previous years, fertilized eggs from signal crayfish from Sweden are needed for stocking purposes. No action has been taken on plans to import new stocks from the northern US for improvement and experimental stocking.

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Report prepared by R. Rahkonen

ICES Working Group on Introductions and Transfers of Marine Organisms
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NATIONAL REPORT FOR FRANCE

1.0 LAWS AND REGULATIONS

Nothing new. The status of mussels as carriers of pathogens is under examination for both spat and adults. A list of non-carriers should be established soon.

Other procedures concerning introduced species:

During the WGPDMO meeting in Moncton sample size and protocols for shellfish were discussed. Regarding the EU and OIE regulations, the appropriate sample size seems to be 150 units. Until now the best diagnostic method remains histological techniques for all pathogens of molluscs, but some other methods such as thioglycollate are also appropriate for specific pathogens such as Perkinsus sp.

2.0 DELIBERATE RELEASES

2.1 Fish

No more coho salmon have been imported to France.

Juveniles of sea bream and sea bass have been transferred from France to Spain, Greece, and Italy.

6.0 PLANNED INTRODUCTIONS OF NEW SPECIES

6.2 Invertebrates

American oyster Crassostrea virginica:
The experiment with C. virginica has been stopped for one major reason -- very bad growth compared to the Pacific oyster C. gigas reared in the same conditions. Moreover the diagnosis in just one oyster of young stages of Marteilia sp. in the stomach epithelium, and the presence of abnormal quantities of calcium (coloration Van Kausa positive) in the gill epithelia and in the mantle have enforced our decision to stop the experiments.

American bay scallop Argopecten irradians:
No more scientific information is available. Until now nothing has been done, and France has previously reported upon the importation of this species into quarantine.

Report prepared by H. Grizel

ICES Working Group on Introductions and Transfers of Marine Organisms
Mystic, Connecticut USA 20-22 April 1994

NATIONAL REPORT FOR GERMANY

1.0 LAWS AND REGULATIONS

After unification, several "Länder" have adjusted their regulations to the rules applying in former West Germany, considering also the changes in EC health regulations effective after January 1993. These regulations will be available after regional discussion (approximately early 1995).

3.0 ACCIDENTAL INTRODUCTIONS AND TRANSFERS

Import of quarantined seed oysters from hatcheries in the UK was routinely undertaken during the past decade to supply a grow-out unit at the shores of Sylt Island. Because of technical problems and changing demands, the farm imported in later years half-grown (1 year) oysters from Ireland which also originate from the same UK hatchery. Because long-term holding of these oysters in onshore tanks is not economically feasible, the half-growns are relayed for a certain period in nearshore waters and thereafter shipped to Germany. During the growing season of 1993, and ascidian species, possibly of Korean origin, was discovered in the Sylt oyster racks. These must have been accidentally transferred with the regularly transferred half-grown oysters. So far, the distribution of the new arrival is limited to the oyster racks and the preliminary identification of the species has not yet been confirmed. A study will shortly be initiated to follow the possible range extension of this epifaunal species.

Furthermore, the cultured oyster, *Crassostrea gigas*, has recently been discovered in small numbers on several local mussel beds of the German Wadden Sea.

4.0 LIVE IMPORTS

During 1993, several imports of sturgeon species (e.g. *Acipenser baeri* from Russia and *Acipenser transmontanus* from Italy and western USA) were imported for commercial purposes.

7.0 MEETINGS

Conference on "Biodiversity and Production in the Ocean"

The Euroconference, sponsored by the European Science Foundation (ESF) in conjunction with the European Committee on Ocean and Polar Sciences (ECOPS), organizes a conference on "Biodiversity and Production in the Ocean" which will be held on May 4-8 1994 at San Feliu de Guixolls, Spain. A full day is dedicated to manmade influences on biodiversity including introductions. The main subjects include the effects of accidentally and deliberately introduced species, transferred via ballast water and introductions of mariculture species with native fauna (fisheries!). The conference intends to conclude the presented review paper by a synthesis and a set of recommendations to advise administrators on national and interregional level (EC wide).

Report prepared by S. Gollasch and H. Rosenthal

ICES Working Group on Introductions and Transfers of Marine Organisms
Mystic, Connecticut USA 20-22 April 1994

NATIONAL REPORT FOR IRELAND

2.0 DELIBERATE RELEASES

2.2 Invertebrates

Haliotis discus hannai and *H. tuberculata*, post quarantine hatchery reared juveniles released on the west and south-west coasts.

Tapes philippinarum, cultivated from hatchery seed on all Irish coasts. Ten million seed imported from Guernsey.

Crassostrea gigas, cultivated from hatchery seed. Introductions of seed also from Normandy, France and Guernsey. Half grown oysters were introduced from France and relaid in Carlingford, Dungarvan, Cork Harbour and Oysterhaven.

3.0 ACCIDENTAL INTRODUCTIONS AND TRANSFERS

3.2 Invertebrates

Crepidula fornicata, Myicola ostreae. Mytilicola orientalis, Terebella lapidaria have been introduced with half-grown Pacific oysters from France. An anthozoan and a serpulid were also introduced and have not been identified. Dinoflagellate cysts were found within sediments associated with the oysters.

4.0 LIVE IMPORTS

4.1 Fish

Rainbow trout fry and fingerlings were introduced from Northern Ireland.
Arctic charr eggs were introduced from Iceland and Canada but were destroyed due to disease in the receiving hatchery.
Turbot juveniles, 200,000 introduced from Scotland.

5.0 LIVE EXPORTS TO ICES MEMBER COUNTRIES

5.1 Fish

Salmon, eggs were exported to the following countries: Austria (15,000), Belgium (55,000), Chile, (12 million), Denmark (200,000), France (22,000), Germany (900,000), Luxembourg (20,000), Scotland (6 million), Spain (800,000) and Turkey. 205,000 eggs were exported to England from the Parteen hatchery on the Shannon River for restocking of the Thames.

5.2 Invertebrates

Half-grown oysters were exported to Germany.

7.0 MEETINGS

1994: 10th International Pectinid Workshop, Cork (26 April - 2 May). For inquiries: Telefax 353-

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Report prepared by D. Minchin

ICES Working Group on Introductions and Transfers of Marine Organisms
Mystic, Connecticut USA 20-22 April 1994

NATIONAL REPORT FOR NORWAY

2.0 DELIBERATE RELEASES
2.1 Fish

The Norwegian enhancement and sea ranching research program was continued in 1993. In the counties of Hordaland, Trøndelag, Nordland and Troms the following number of cod fry were released 27.800, 4.500, 18.000 and 80.000 respectively.

A total of 41.000 smolts of Atlantic salmon were released from a net pen in a bay on the island of Sotra Hordaland County. In the river Opløy, Trøndelag county 100.000 smolts produced from the river Namsen were released and 130.000 smolts from the river Vefsna were released in a small river on the island of Vega in Nordland county.

The release experiments with Arctic charr were only continued in the river of Hals where 40.000 smolts were released.

2.2 Invertebrates

The releases of hatchery reared lobster fry continued in the area off the island of Kvitsøy in Rogaland county and 24.000 lobster were released.

The investigations on the distribution of the Kamchatka king crab *Paralithodes camtschatica* continued in 1993 in a joint fishing experiment with Norwegian and Russian scientists. The report is presented here in the Working Group's **Annex 4** as the "Joint Report on Investigations of the Barents Sea King Crab *(Paralithodes camtschatica)*", by B. Berenboim (PINRO) and S. Olsen (IMR).

3.0 ACCIDENTAL INTRODUCTION AND TRANSFERS
3.3. Algae and Higher Plants

Attached specimens of *Sargassum muticum* has been observed on several locations off the island of Sotra west of Bergen. Drifting specimens have been observed north of this site and it is expected it will continue its distribution northwards along the Norwegian coastal current.

4.0 LIVE IMPORTS
4.1 Fish

Sea bass, *Dicentrarchus labrax* eggs from Italy.

Report prepared by S. Tilseth

ICES Working Group on Introductions and Transfers of Marine Organisms
Mystic, Connecticut USA 20-22 April 1994

NATIONAL REPORT FOR SWEDEN

1.0 LAWS AND REGULATIONS

As a consequence of the Swedish agreement with EU, new regulations will be implemented during 1994, as well as a proposal of a new law for GMOs.

2.0 DELIBERATE RELEASES

2.1 Fish

Salmon, sea trout, cod
Elvers imported from England (Severn)

3.0 ACCIDENTAL INTRODUCTIONS AND TRANSFERS

3.2 Invertebrates

The polychaete *Marenzelleria viridis*, was first encountered on the Swedish south coast (eastern part of Blekinge) in 1990 (Persson 1991), and was found also in 1991 to 1993 along that coast and the southern part of the Swedish east coast (Kalmarsund).

3.3 Algae and higher plants

The Japanese brown alga *Sargassum muticum* has still not been found attached south of the archipelago of Goteborg, Swedish west coast, although searched for.

In autumn 1992 there was a considerable bloom of the dinoflagellate *Prorocentrum minimum* in the northwestern part of the Baltic proper, where it was first observed in 1984. Laboratory experiments showed the species to grow well at low salinities, thus indicating a potential to penetrate further into the Baltic Sea (Edler et al. 1993).

In the Sound, between Denmark and Sweden, live cysts (hypnozygots) of the potential PSP-producing dinoflagellate *Gymnodinium catenatum* have been found in the upper sediments, and it was possible in the laboratory after germination to produce one strain of motile cells, which, how ever did not form long chains as in other areas, but occurred as single cells or in pairs (Ellegaard et al. 1993a, 1993b). Since the motile cells have not been reported from northern Europe before, the possibility of a recent introduction by ballast water or currents was discussed, as was the relation to the large amounts of subfossil cysts found in old sediments (around 300-500 years old) in the Kattegat. Also for the German Bight and the Kiel Bight the same kind of observations have been made, the author considering currents from the North Sea and the saltwater intrusion to the Baltic in 1993 to be the vector (Nehring 1993).

4.0 LIVE IMPORTS

4.1 Fish

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

4.2 Invertebrates

Lobsters from U.S.A and Canada

5.0 LIVE EXPORTS

5.1 Fish

Eggs to:

Denmark:	Salmon
Germany:	Salmon, grayling and Arctic charr
Ireland:	Arctic charr
Chile:	Rainbow trout

Salmon smolts to:
Denmark (Bornholm) for release

Elvers to:
Finland (6 week quarantine checked for IPN and rhabdovirus)

Live eels to:
Denmark, Germany, The Netherlands,Russia, Japan

5.2 Invertebrates

Blue mussels to Denmark

Report prepared by Bo Holmberg and Inger Wallentinus

ICES Working Group on Introductions and Transfers of Marine Organisms
Mystic, Connecticut USA 20-22 April 1994

NATIONAL REPORT FOR THE U.K.: ENGLAND AND WALES

1.0 LAWS AND REGULATIONS

None. However, the European Commission will be issuing guidance during 1994 on Aquaculture/Environment Interactions. This will include ICES/EIFAC Code of Practice. Every EC activity concerning introductions will be expected to abide by the Code.

2.0 DELIBERATE RELEASES

2.2 Invertebrates

Approximately 300 tonnes of Pacific oysters and 50 tonnes of Manila clams were harvested. Seed Pacific oysters and Manila clams were planted out for commercial cultivation. All seed were from hatcheries in England and Guernsey.

4.0 LIVE IMPORTS

4.1 Fish

Approximately 50 million rainbow trout eggs were imported from disease-free sources. Consignments came from South Africa, Denmark, Northern Ireland, the Isle of Man and Tasmania. Imported eggs were disinfected on arrival.

Table 1 (Other fish imports)

Species	Non-EC*	EC*
Saltwater ornamentals	118,942	3,370
Eels	55,128	526
Salmon	0	22,130
Other saltwater fish	0	156,385

*Figures given in this and subsequent tables are in kg. Figures are for total trade and not just ICES countries. Non-EC import figures are for country of origin, EC import figures are for country of despatch.

ICES countries involved in import/export trade are likely to be similar to those given in 1993 WG report.

4.2 Invertebrates:

Seed Pacific oysters (19 consignments) and Manila clams (2 consignments) were imported from Guernsey for on-growing.

Table 2 (Other invertebrate imports)

Species	Non-EC*	EC*
Lobsters	748,096	0
Flat oysters	0	724
Other oysters	41,807	151,991
Scallops	14,952	357
Mussels (*Mytilus*)	0	272,949
Mussels (*Perna*)	13,821	12,394
Cuttlefish	0	4,531

Table 2 (Other invertebrate imports) [continued]

Species	Non-EC*	EC*
Squid (*Loligo*)	63,078	684
Other squid	2,605	112,745
Octopus	0	1,542
Other molluscs	833,404	13,670

5.0 LIVE EXPORTS to ICES Member Countries

5.1 Fish

Approximately 245,000 turbot juveniles were exported for on-growing in intensive farms principally in Galicia, Spain.

Table 3 (Other fish exports)

Species	Non-EC*	EC*
Saltwater ornamentals	1,355	4,595
Eels	20,898	635,995
Salmon	194	22,174
Other saltwater fish	9,002	6,931

5.2 Invertebrates:

Pacific oyster seed was exported to Southern Ireland (70 consignments), Northern Ireland (3 consignments), Jersey (2 consignments) and Guernsey (2 consignments); Manila clam seed was exported to Guernsey (1 consignment).

Table 4 (Other invertebrate exports)

Species	Non-EC*	EC*
Lobsters	9,555	667,798
Flat oysters	0	231,545
Other oysters	16,772	381,383
Scallops	37,155	1,436,690
Mussels (*Mytilus*)	2,778	3,633,754
Mussels (*Perna*)	435	1,512
Cuttlefish	59,184	500,563
Squid (*Loligo*)	0	434,529
Other squid	45,430	66,898
Octopus	0	41,348
Other molluscs	0	2,588,353

6.0 PLANNED INTRODUCTIONS

6.2 Invertebrates

Industry has expressed an interest in re-introducing Pacific oysters through quarantine to boost the gene pool of UK broodstocks. The source of broodstock is likely to be the Pacific coast of the US.

Report prepared by S.D.Utting

ICES Working Group on Introductions and Transfers of Marine Organisms
Mystic, Connecticut USA 20-22 April 1994

NATIONAL REPORT FOR THE U.K.: SCOTLAND

1.0 LAWS AND REGULATIONS

As for England and Wales.

2.0 DELIBERATELY INTRODUCED ANIMALS OR PLANTS

2.1 Fish

Source	Ova	Gametes	Fish
Atlantic Salmon			
N Ireland	1,350,000	265 ml	8,550
Eire	3,089,000		
Tasmania	470,000		
TOTAL	4,909,000	265 ml	8,550

Rainbow Trout	
N Ireland	7,250,000
Isle of Man	2,352,000
Denmark	5,200,000
South Africa	4,960,000
TOTAL	19,762,000

Brown Trout	
Denmark	70,000

2.2 Invertebrates

Oysters, *Crassostrea gigas*, from Guernsey: 2,681,000 juveniles
Lobsters, from Canada, 7,300 (average mean weight: > 1 kg)

3.0 ACCIDENTAL INTRODUCTIONS

Living specimens of the Magellan mussels (*Aulacomya ater*) were collected from the Moray Firth in 1994, but how these arrived from southern South America is not known.

5.0 LIVE EXPORTS TO ICES MEMBER COUNTRIES

For consumption:

Species	Destination	Tonnes
Mollusks		
Mussels	Europe	1,200
Periwinkles	Europe	1,700
Razor shells	Europe	75
Scallops (*P.maximus*)	Europe	27
Crustaceans		
Lobsters (European)	Europe	400
Brown crab	Europe	2,000
Velvet crab	Europe	2,300

For other purposes:

Species	Destination	Numbers
Mollusks:		
Oysters (*C. gigas*)	N Ireland	100,000
Scallops (*P. maximus*)	Denmark	4,000

Species	Destination	Ova	Fish	Milt
Fish:				
Atlantic Salmon	N Ireland	3,040,000		
	Denmark	250,000		
	Spain	685,000		
	Chile	7,987,000		
	Morocco	40,000		
Brown Trout	Jersey	30,000		
Halibut	Isle of Man	83,750	6	50 ml
Turbot	N Ireland		4	

Report prepared by A. Munro

ICES Working Group on Introductions and Transfers of Marine Organisms
Mystic, Connecticut USA 20-22 April 1994

NATIONAL REPORT FOR THE UNITED STATES OF AMERICA

1.0 LAWS AND REGULATIONS

National

Fish Health Legislation

Section 16.3 of Title 50 of the Federal Regulations relative to revised fish health legislation when into effect on December 6, 1993.

Ballast Water

Ballast Control Act:
A "Ballast Water Control Act" is now before the U. S. Congress. This legislation follows a path established by the "Nonindigenous Species Act" of 1990. The ballast control act calls for the exploration, development, and demonstration of technologies beyond exchanging water at sea that would control the intake, transport, and release of living organisms in ballast water and sediments. These technologies could include, for example, microfiltration, thermal treatment and chemical treatment.

Great Lakes Control:
In May 1993 it became illegal, under the 1990 act, to discharge into the Great Lakes ballast water that had not been exchanged at sea and that was less than 30 o/oo (ppt, parts per thousand). The U.S. Coast Guard is mandated with enforcing this law, through a Marine Safety Detachment established at Massena, New York. Vessels with incoming ballast water from a foreign port are boarded at Massena as they are in transit through the St. Lawrence Seaway System. Two vessels were stopped in 1993: one, with brackish water (as low as 22 o/oo) from France, was delayed for 4 days while the Coast Guard and the shipping company explored options. The Coast Guard eventually permitted the vessel, on a one-time only and not policy-setting basis, to add sufficient salt (sodium chloride) to the ship's water to bring it up to 30 o/oo. The second vessel was a new chemical tanker, also with brackish water, capable of carrying high heat liquid cargos (for example, liquid asphalt). This vessel volunteered to pump its ballast water into its cargo holds and heat the water to > 30 Celsius. The CG again permitted this action, on a one-time only and not policy-setting basis.

Chesapeake Bay Studies:
Under the aegis of the "Shipping Study" of the Nonindigenous Species Act, the National Biological Invasions Shipping Study (NABISS) was established in 1991. The "Shipping Study" has been completed and is expected to be issued in late spring or early summer 1994 by the U. S. Coast Guard. This 400 page report documents the role of ballast water in transporting exotic species to the U.S. and examines 30 different control options.

Field work on ballast water invasions in the United States continues with an extensive program now established at the Smithsonian Environmental Research Center (SERC) by Dr. James T. Carlton and Dr. Gregory Ruiz through U. S. Coast Guard and Sea Grant funding. Under this program Dr. David Smith is leading a team of biologists studying the diversity of marine animals and plants arriving in Chesapeake Bay from around the world, with a focus on the role of ballast exchange in reducing the diversity and abundance of coastal organisms in ballast, on ballast sediments, on long-distance transport, and on transport from "hot spots" (other global regions of known invasions). In addition, the Chesapeake Bay ballast program includes extensive experimental studies on the survival of transported organisms. Dr. D. Smith is scheduled to present a report on this U.S. Program at the Mystic meeting.

Other Activities

ANS Activities:

The Aquatic Nuisance Species (ANS) Task Force, established by the 1990 law, issued in 1993 its draft report to Congress regarding intentional introductions of non-native species to U.S. waterbodies. An overview and critiques of the report are in the April 1994 issue of Fisheries (volume 19, no. 4).

"Zebra-Mussel-Specific Containment Protocols" were issued on December 29, 1993 by the ANS Task Force Research Protocol Committee as an "Approved Species-Specific Protocol" (ASSP). The report was prepared and issued by the Great Lakes Environmental Research Laboratory, 2205 Commonwealth Blvd., Ann Arbor MI 48105. Copies are available from Dr. David F. Reid. The Protocols serve as a potential model system for the quarantined transport, handling, and disposal of species utilized in research activities.

The ANS Task Force's Risk Assessment and Management Committee (RAM) has completed a draft document, now under review, entitled "Generic Non-Indigenous Pest Risk Assessment Process ('The Generic Process') For Estimating Pest Risk Associated with the Introduction of Non-Indigenous Organisms". The Contact for the RAM Committee is Dr. Richard L. Orr, USDA APHIS PPD, 6505 Belcrest Road, Room 810, Hyattsville, Maryland 20782.

Regional

Ballast Water

The Chesapeake Bay Commission is preparing a document on the "Ballast Water Invasions of Chesapeake Bay: Strategies to Decrease the Risks to Fisheries and the Management of Living Resources". This document will contain proposed avenues of state-level legislation to regulate incoming ballast water and sediments.

The "Great Lakes Maritime Industry Voluntary Ballast Water Management Plan for the Control of Ruffe in Lake Superior Ports 1994" was issued January 25, 1994. The plan is an attempt to decrease the possibility of ballast water transporting the European ruffe (Gymnocephalus cernuus) out of Lake Superior to other Great Lakes, and calls for the exchange of Lake Superior harbor water in the open portions of the Lake west of a demarcation line near Ontanogan, Michigan.

Other Activities

A final version of the "Chesapeake Bay Policy for the Introduction of Non-Indigenous Aquatic Species" was issued in December 1993 (copies distributed). This document sets forth policies on "intentional first-time" and "unintentional" introductions.

A "Fact Sheet" dated November 1993 was issued by the University of Hawaii Sea Grant Extension Service on "Importing Live Organisms to Hawaii: Procedures and Permitting". The procedures include a 20-point checklist of topics that must be covered in a profile of any new species proposed for importation.

Many western, mid-western, and eastern states have not implemented a wide variety of regulations to control the accidental movement of zebra mussels by such means as recreational boat traffic and bait movement. Non-local recreational vessels have been banned from many lakes and reservoirs unless they have undergone a cleaning program. Bait control programs have also been implemented. For example, the New Hampshire Fish & Game Department has issued regulations stating that only bait fish from waters certified as mussel-free can be imported into the state. Traditionally, state bait dealers have imported fish from Quebec, Ontario, Arkansas, and Vermont -- all of which have now been invaded by zebra mussels.

2.0 DELIBERATE RELEASES

2.1 Fish

Salmon releases on the Atlantic coast of the United States

The **State of New Hampshire** continues with a Pacific salmonid program on the U.S. Atlantic coast. Last year (1993) was the final year of its current "five year plan" (1989 - 1993) which calls for the release of chinook salmon (Oncorhynchus tshawytscha) from the New York State Salmon Falls Hatchery, each year into the Lamprey River (New Hampshire). The Program is operated by the state's Department of Fish and Game. Reports of these releases are also contained in the NASCO reports. In the fall of 1993, approximately 400,000 smolts were released. There have been no reported returns to date of the 1989-1990 releases, the youngest returning fish to be expected at this time. No more releases will be made until the program has been fully reevaluated.

2.3 Algae and Higher Plants

Introduction of Japanese Seaweed Porphyra yezoensis to the Gulf of Maine

"Nori," the Japanese red alga (Rhodophyta) Porphyra yezoensis, in the form of a cultivar strain, has been seeded in northern Maine for aquaculture purposes. As of April 1994, no plants outside the cultivation area had been detected. A full update report from the aquaculture company, Coastal Plantations International, Inc., is expected to be presented at the 1994 WG meeting.

3.0 ACCIDENTAL INTRODUCTIONS AND TRANSFERS

3.2 Invertebrates

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

The zebra mussel has now spread west to Oklahoma, south to Louisiana, northeast to Vermont, and east to the lower Hudson River. It is not yet in the Chesapeake Bay system, nor in southern New England (Massachusetts - Rhode Island - Connecticut), nor in the southeastern most U.S. (Georgia, Florida). It is, however, expected to fill in these gaps in the next few years. The zebra mussel is also expected to inevitably head to Western North America, with vast potential economic impact in the California water systems. In November 1993 the California Department of Agriculture intercepted a small recreational boat at the California border, coming from the Great Lakes, with zebra mussels in a water intake. The boat had spent several weeks out of the water in Colorado between the Great Lakes and California; however, such a discovery clearly illustrates that such transport is possible, and that a boat moved directly between eastern infested regions and California could likely successfully transport live mussels (which can remain out of the water for 10 days or more).

The distribution of the quagga mussel Dreissena bugensis is not as well known as that of D. polymorpha. At the moment, the quagga mussel appears to be restricted to the northeastern U.S.

and Canada, and there are no records of its having spread throughout the East. It is believed that this is in part due to confusion between the two species.

The "Fourth International Zebra Mussel Conference" was held in Madison, Wisconsin, from March 6-10 1994. Approximately 450 attended the Conference.

(B) Japanese crab Hemigrapsus sanguineus on the US Atlantic Coast
It is believed that this ballast-introduced crab, first found in New Jersey in 1988, continues to spread along the coast, but reports are few. As of the end of the summer of 1993, it had been reported from Cape Cod (Buzzards Bay, on the south side of the Cape) to near Chesapeake Bay. Large specimens have a carapace width of 3.0 cm or slightly more.

(C) European (green) crab Carcinus maenas on the US Pacific Coast
The aggressive and omnivorous green crab Carcinus, first detected in San Francisco Bay in the summer of 1990, continues to spread along the California coast, with increasing concern by regional biologists and ecologists. It now occurs not only in San Francisco Bay in great abundance, but by 1993 was found in four bays immediately to the north (Bolinas Lagoon, Drakes Estero, Tomales Bay, and Bodega Harbor). The green crab has a diet that ranges from infaunal invertebrates (clams and worms) to epifaunal organisms (barnacles, mussels, oysters) to seaweeds and even marsh grasses. The movement of green crabs north of Cape Cod and their increased abundance by the 1950s was linked to the demise of the softshell clam industry (Mya arenaria) in Maine. Two papers have been submitted to Marine Biology on the California green crab invasion (J. T. Carlton, A. Cohen, and M. Fountain on the invasion of San Francisco Bay, and E. Grosholz and G. Ruiz on the invasion of the four bays to the north).

(D) More new invasions of San Francisco Bay
In the summer of 1993, two Black Sea hydromedusae, Maeotias inexspectata and Blackfordia virginica and the New Zealand carnivorous sea slug Philine auriformis, were discovered in abundance in San Francisco Bay. All are believed to be ballast water introductions.

(E) The New Zealand mussel Perna viridis established in the Caribbean
Preliminary and apparently yet unpublished reports indicate that the New Zealand mussel Perna viridis has become established in the lower Caribbean in Trinidad and Tobago. They are apparently becoming abundant in the mangrove ecosystems.

6.0 PLANNED INTRODUCTIONS OF NEW SPECIES

6.1 Invertebrates

Outplanting of Triploid Japanese Oysters on the US Atlantic Coast (Chesapeake Bay) for the study of disease resistance
Triploid Japanese oysters placed in the water in 1992-3 to study their resistance to disease infection (particularly MSX, or "Delaware Bay Disease", caused by the protozoan Haplosporidium costale), have been removed. Some of the specimens are reported to have reverted to diploidy. A separate agenda item at this meeting deals with this experiment.

Report prepared by J. T. Carlton and F. Kern

ANNEX 5

JOINT REPORT ON

INVESTIGATIONS OF THE BARENTS SEA KING CRAB (*Paralithodes camtschatica*)

By

Boris Berenboim (PINRO) and Steinar Olsen (IMR)

The Mixed Russian-Norwegian Fisheries Commission at their 21st meeting in November 1992 prolonged the prohibition of commercial fishing for king crab and agreed that both countries would intensify and coordinate their king crab investigations with the aim of providing advise to the Commission at its next meeting in November 1993 about the management of this new common fishery resource.

Accordingly, the Institute of Marine Research (IMR) in 1993 started investigations of the biology, population structure, distribution, and abundacne of king crab in the Barents Sea. Plans for these investigations were discussed at a meeting in March in Murmansk between PINRO and IMR scientists.

Trial fishing with traps has been conducted each month in the South-Varanger area, and in July a three weeks king crab cruise was carried out in the Varangerfjord area with R/V "Fjordfangst", with participation by a Russian scientist.

PINRO has continued the king crab investigations started in 1992 with a cruise during the period 17 Aug-28 Sept, covering the Russian area of crab distribution. A Norwegian scientist was scheduled to take part in this cruise, but Russian authorities did not sanction this visit.

The Norwegian and Russian king crab data have been analysed during a meeting in Bergen 5-8 Nov, and a brief summary report with tentative conclusions about future harvesting of this common resource has been prepared.

DISTRIBUTION AND ABUNDANCE

The presently known distribution of king crab in the Barents Sea is indicated on the map of Figure 1 and last (1992) year's crab distribution is demonstrated on that of Figure 2. No observation suggests that king crabs are numerous offshore, but dense concentrations of mature male and female crabs are common along the southern coast and tributaries of the Varangerfjord, both in Norwegian and Russion territorial waters, in Motovsky Bay and at the eastern part of the Murman coast. The king crabs evidently make speedy horizontal migrations and quick changes in depth according to season, and males and females are partly separated in distribution. This makes density estimates from survey catches very difficult and unreliable before detailed insight into the migratory patterns has been established.

Young, immature king crabs are known to be quite stationary until they reach ca. 60 mm in carapace width. Accordingly, large amounts of young crabs, 60-90 mm c.p.w., located in Malaya Volokovaya, Dolgay and Ura inlets; as well as dense concentrations of young crabs, 60-80 mm c.p.w., observed in Bugøyfjord in August-September, document successful reproduction of king crab. The main reproduction potential appears to be situated in Varangerfjord (within both REZ and NEZ) and in the Motovsky Bay.

During the Norwegian survey cruise in July, 573 crabs were caught, ranging in size from 96-240 mm c.p.w. and 600-7000 g in weight. Catch rates upto 75 crabs in one trap was obtained. The 541 crabs caught during the Russian survey ranged from 64 - 270 mm c.p.w. and 110-7570 g in weight. The size distribution is thus quite comparable to that of the Pacific area.

In the absence of more extensive data, very tentative assessments of the king crab stock in REZ and NEZ have been made on the basis of the survey results, using the formula:

$$N = \sum_{k=1}^{n} \frac{S \cdot a}{b}$$

where S is the size of a sub-area where king crabs are present; a is the mean catch per trap in that sub-area; b is the effective catching area per trap; and n is the number of sub-areas covering the total distribution of crabs

While S, a, and n are calculated on the basis of the present survey data, the value of b applied is that of other crab assessments derived from comparisons between trap and trawl catches.

A total number of 211,800 crabs was estimated, with a biomass of 347,000 kg. Not less than 74,700 mature males estimated to inhabit REZ and NEZ. Assuming a maximum exploitation rate of 30%, about 22,400 males above 130 mm c.p.w. may be fished without damaging the reproduction potential of the population.

The structure of the king crab stock in the Barents Sea appearing from the joint Russian and Norwegian research data corresponds well to the structure of natural populations of king crab in the Pacific area. While the present tentative assessments suggest that a limited harvest might be possible without damaging the reproduction potential, full scale commercial exploitation is clearly premature.

To make more reliable stock assessments and corresponding TAC-s, the king crab investigations have to be continued and expanded. A limited, well controlled and documented trial fishery would greatly enhance these investigations by providing supplementary information on biology, seasonal migrations and catch and effort statistics.

CONCLUSIONS

The stock of king crab in the Barents Sea is now established with successful reproduction both in REZ and NEZ. Dense concentrations of sexually mature king crab have been located along the southern coast of the Varangerfjord on both sides of the national border, in Motovsky Bay and at the eastern part of the Murman coast. Young crabs, which in REZ concentrate in large amounts in Malaya Volokovaya, Dolgaya and Ura inlets, have also been located in high densities in the tributary fjords of Varanger within NEZ.

The limited observations so far do not indicate a marked deviation of the Barents Sea king crab stock, as compared with those of the Pacific area, with regard to size distribution, sex proportions, seasonal migrations, and changes in depth distribution for the two sexes.

Available data are insufficient for reliable abundance assessments, but very tentative estimates based on mean trap catches during the research cruises carried out by both countries, estimated areas of crab distribution, and calculations from other crab investigations regarding effective catching area of a trap, give a total number of king crabs within REZ of 212,200 equaling close to 347 tons. Of these not less than 75,000 are mature males. To safeguard the reproduction potential any fishing mortality of males should not exceed 30%, corresponding to a catch of 22,400 male crabs.

These assessments might be biased in both directions, primarily because of the uneven distribution of the king crab which greatly increases the variance of the calculated mean trap catches, and it is concluded that full scale commercial exploitation of king crab in the Barents Sea is premature. This does not preclude, however, the start of a strictly limited and carefully monitored trial fishery, which would provide supplementary information on biology, seasonal migrations, as well as catch and effort statistics required for stock assessments; and which may assist in curbing the uncontrolled, non-reported black market fishery, which presently probably occurs in both countries. It is proposed that a TAC for such a fishery should be 22,000. The fishery should be carried out with traps only, be restricted to males above 130 mm carapace width, and be closed during the hatching and moulting period which may occur in the months of March, April and May. Bycatches of king crab in other fisheries are to be included in these TAC-s. In areas/locations where immature king crabs are numerous, special measures should be introduced to prevent high bycatch mortality of young crabs.

Investigations and assessments of the Barents Sea king crab resource should be intensified by both countries and coordinated by exchange of research data and meetings of scientists to prepare joint reports of their findings and plans for future investigations. Exchange of research personnel during survey cruises would greatly enhance such coordination.

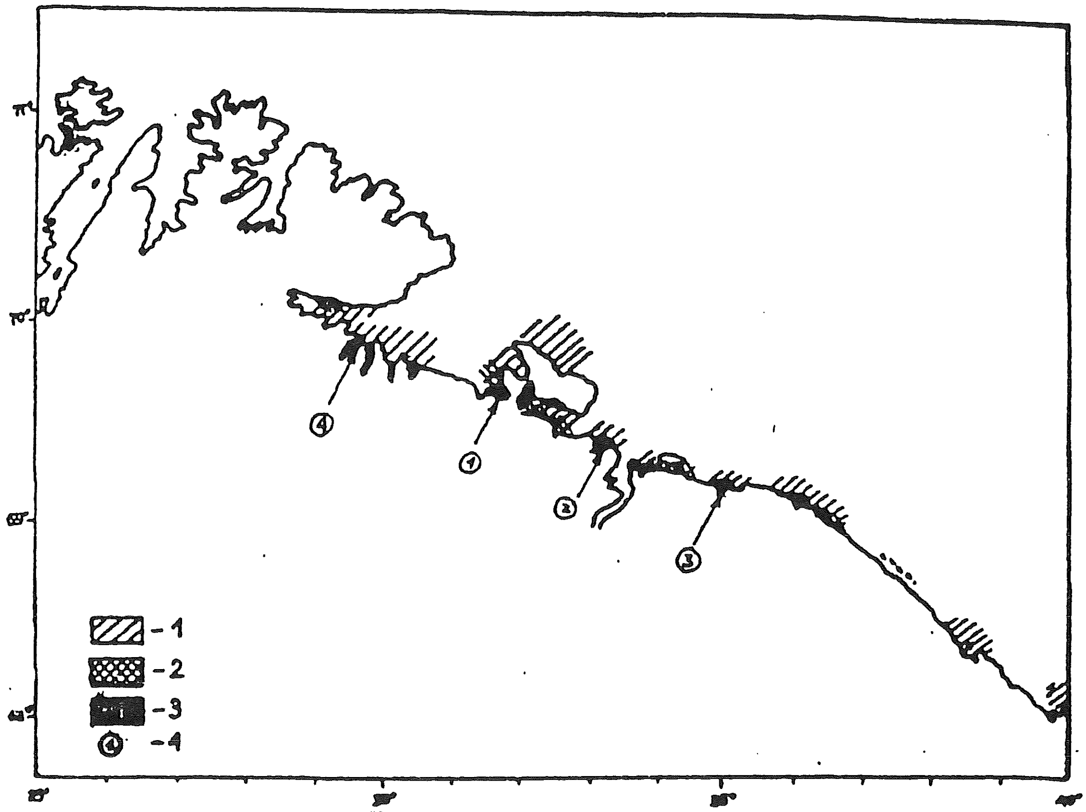


Figure 1. Scheme of king crab investigations in July-September 1993. 1: Investigated area, 2: Dispersed concentrations, 3: dense concentrations, 4: places of young crabs inhabit ((1) Malaya Volokovaya, (2) Ura, (3) Dolgaya, (4) Bugøyfjord).

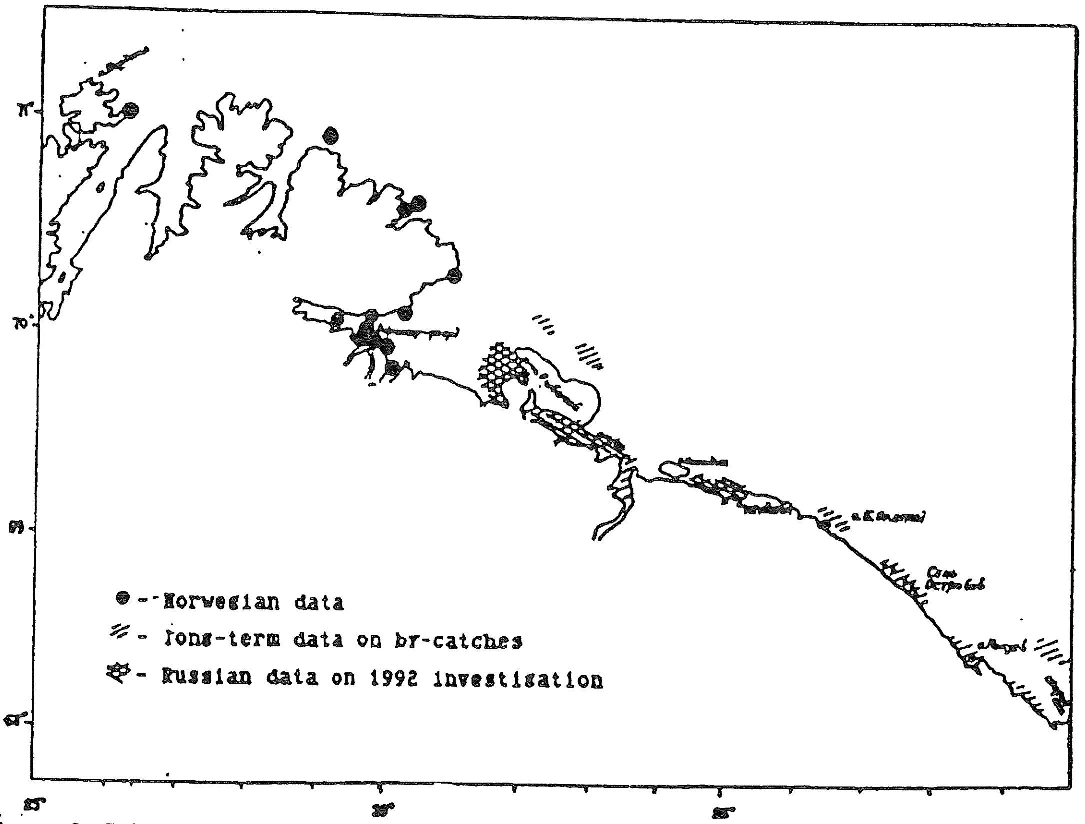


Figure 2. Scheme of king crab investigations and known places of inhabit in 1992.

ANNEX 6

The German Research Project

INVASION OF NON-INDIGENOUS MARINE SPECIES INTO THE NORTH AND BALTIC SEAS VIA SHIPS' BALLAST WATER: INVESTIGATIONS ON THE ECOLOGICAL THREAT

This project characterizes the importance of ships as vectors for the transport of non-indigenous organisms into German waters. The subjects of this investigation are planktonic and benthic organisms (see appendix of the 1993 Report of the Working Group on Introduction and Transfers of Marine Organisms).

1. FIRST RESULTS

We have taken 357 samples in 274 ships since the beginning of the project in 1992 (Figure 1). There were 92 different geographical origins from 36 countries (Figure 2). More than 80% of the plankton samples contained organisms. These consisted mostly of adults of Copepoda and larval stages of Copepoda, Cirripedia, and Mollusca. Every hull sample offers a high number of individuals and species: these mostly belong to the Cirripedia, Polychaeta, Bivalvia, Gastropoda, and Cnidaria.

2. INTERNATIONAL COOPERATION

Dr J.T. Carlton founded a research project at the Smithsonian Environmental Research Center (SERC) as part of the earlier-established National Biological Invasions Shipping Study (NABISS). As part of this project, a cooperative effort has been established between the German and the U.S. research programs. The idea of cooperation is that one research team samples a ship at departure and the other team samples the same ship on arrival, and vice-versa. In this way we can find out:

1) which species can survive the ship's journey between the east coast of USA and Germany;

2) if the voluntary guidelines of the IMO (ballast water exchange in the open sea) were carried out; and

3) the effectiveness of the ballast water exchange in relation to the prevention of an introduction of non-indigenous species.

The first ships were sampled, but it was not possible to realize the full bi-directional program. It is hoped that bi-directional ships will be sampled in 1994. In addition, we would like to find more partners, in particular in China, New Zealand, and Australia, for a cooperative research program as mentioned.

LIST OF ZOOLOGICAL SPECIES FOUND IN BALLAST WATER SAMPLES

Foraminiferida
Cnidaria:
- *Haliplanella sp.*

Tentaculata
Bryozoa:
- *Conopeum sp.*
- *Membranipora sp.*
- *Schizoporella sp.*
- *Thalamoporella sp.*

Platyhelminthes
Turbellaria
Aschelminthes
Rotifera
Nematoda
Mollusca
Gastropoda:
- *Aporrhais sp.*
- *Atlanta sp.*
- *Barleeia sp.*
- Buccinidae
- Cerithiimorpha
- *Clio sp.*
- Chaenogastropoda
- *Crepidula sp.*
- Hydrobiidae
- *Limacina sp.*
- Littorinimorpha
- *Marginella sp.*
- *Nassarius sp.*
- *Natica sp.*
- Neogastropoda
- *Odostomia sp.*

Nudibranchia
Bivalvia:
- *Anadara sp.*
- *Anomia sp.*
- *Argopecten sp.*
- *Astarte sp.*
- *Cerastoderma sp.*
- *Chama sp.*
- *Chione sp.*
- *Corbula sp.*
- *Crassostrea sp.*
- *Cryptomya sp.*
- *Dreissena sp.*
- *Erodona sp.*
- *Macoma sp.*
- *Macoma sp.*
- *Mactra sp.*
- *Modiolus sp.*
- *Mulinira sp.*
- *Musculus sp.*
- *Mya sp.*
- *Mytilus sp.*
- *Ostrea sp.*
- *Parvicardium sp.*
- *Placamen sp.*
- *Senilia sp.*
- *Spisula sp.*
- *Telemactra sp.*
- *Tellina sp.*
- *Venus sp.*

Scaphopoda:
- *Pseudantalis sp.*

Annelida
Polychaeta:
- *Capitella sp.*
- *Ficopomatus sp.*
- Nephthyidae
- *Nereis sp.*
- *Polydora sp.*
- Serpulidae
- Spionidae

Oligochaeta:
- Naididae
- *Nais sp.*

Chelicerata
Pantopoda/Pycnogonida:
- *Nymphon sp.*

Crustacea
Ostracoda:
- *Argilloecia sp.*
- *Aurilia sp.*
- *Cypria sp.*
- *Cyprideis sp.*
- *Cypridida sp.*
- Paracypridinae
- *Paradoxostoma sp.*
- *Urocythereis sp.*

Copepoda:
- *Acartia sp.*
- *Centropages sp.*
- *Corycaeus sp.*
- *Eurytemora sp.*
- *Euterpina sp.*
- *Lubbockia sp.*
- *Microsetella sp.*
- *Oithona sp.*
- *Oncaea sp.*
- *Paracalanus sp.*
- *Pseudocalanus sp.*
- *Sapphirella sp.*
- *Temora sp.*

Cirripedia:
- *Acasta sp.*
- *Balanus sp.*
- *Elminius sp.*
- *Octomeris sp.*
- *Tetraclita sp.*
- *Conchoderma sp.*
- *Lepas sp.*

Decapoda:
- *Eriocheir sp.*

Crangonidae
Cladocera:
- *Bosmina sp.*
- *Chydorus sp.*

Mysidacea:
- *Mesodopsis sp.*
- *Paramysis sp.*

Isopoda:
- *Cymodoce sp.*
- *Dynamene sp.*
- *Sphaeroma sp.*

Amphipoda:
- Caprellidae
- Corophiidae
- Gammaridae

Pisces:
- *Ammodytes sp.*
- *Anguilla sp.*
- *Gasterosteus sp.*
- *Osmerus sp.*
- *Pomatoschistus sp.*
- *Sprattus sp.*
- *Syngnathus sp.*

Cyclostomata:
- *Petromyzon sp.*

LIST OF PHYTOPLANKTON GENERA FOUND IN BALLAST WATER SAMPLES

Diatomophycea

Achnanthes
Actinoptychus
Amphora
Asterionella
Bacteriastrum
Biddulphia
Caloneis
Chaetoceros
Climacosphenia
Coscinodiscus
Cyclotella
Dactyliosolen
Diatoma
Dimeregramma
Dimeregrammopsis
Diploneis
Ditylum
Eucampia
Fragilaria
Gyrosigma
Hemiaulus
Lauderia
Leptocylindrus
Licmorpha
Melosira
Navicula
Nitzschia
Odontella
Paralia
Pinnularia
Pleurosigma
Podocystis
Rhabdonema
Rhaphoneis
Rhizosolenia
Skeletonema
Stauroneis
Streptotheca
Suriella
Synedra
Thalassionema
Thalassiosira
Trigonium

Dinophycia

Ceratium
Dinophysis
Gonyaulax
Mesoporos
Prorocentrum
Scrippsiella

Chlorophycia

Chodatella
Pediastrum
Scenedesmus
Sorastrum
Tetrastrum

Euglenophycea

Euglena

Prymnesiophycea

Euglena

Prymnesiophycia

Phaeocystis

Cyanobacteria

Oscillatoria

Div. Chrysophyceae

Figure 1.

Number of vessels and samples (total, plankton, hull, sediment, and unsuccessful) in the German research project on "Invasion of Non-Indigenous Marine Species into the North and Baltic Sea via Ships Ballast Water"

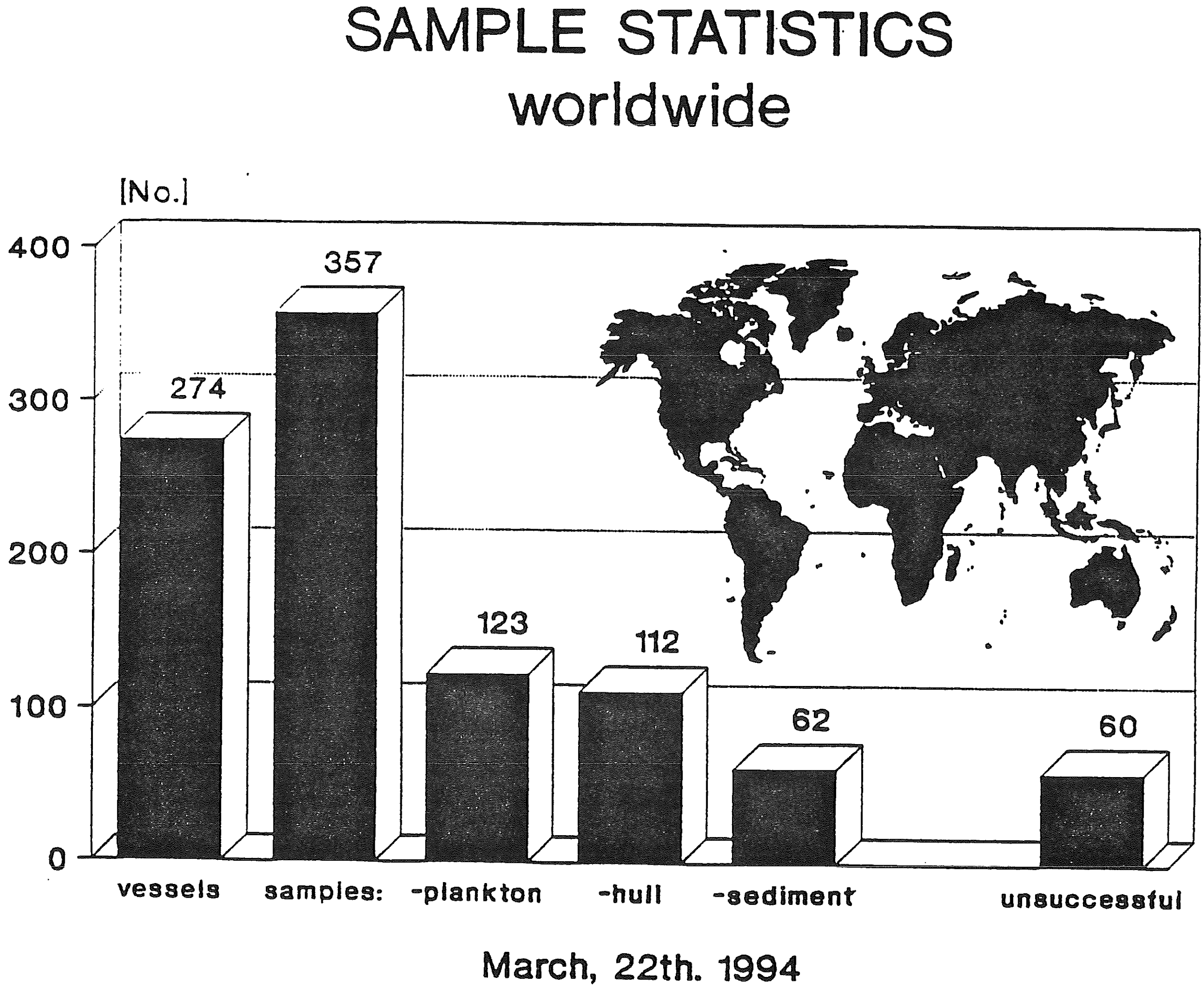
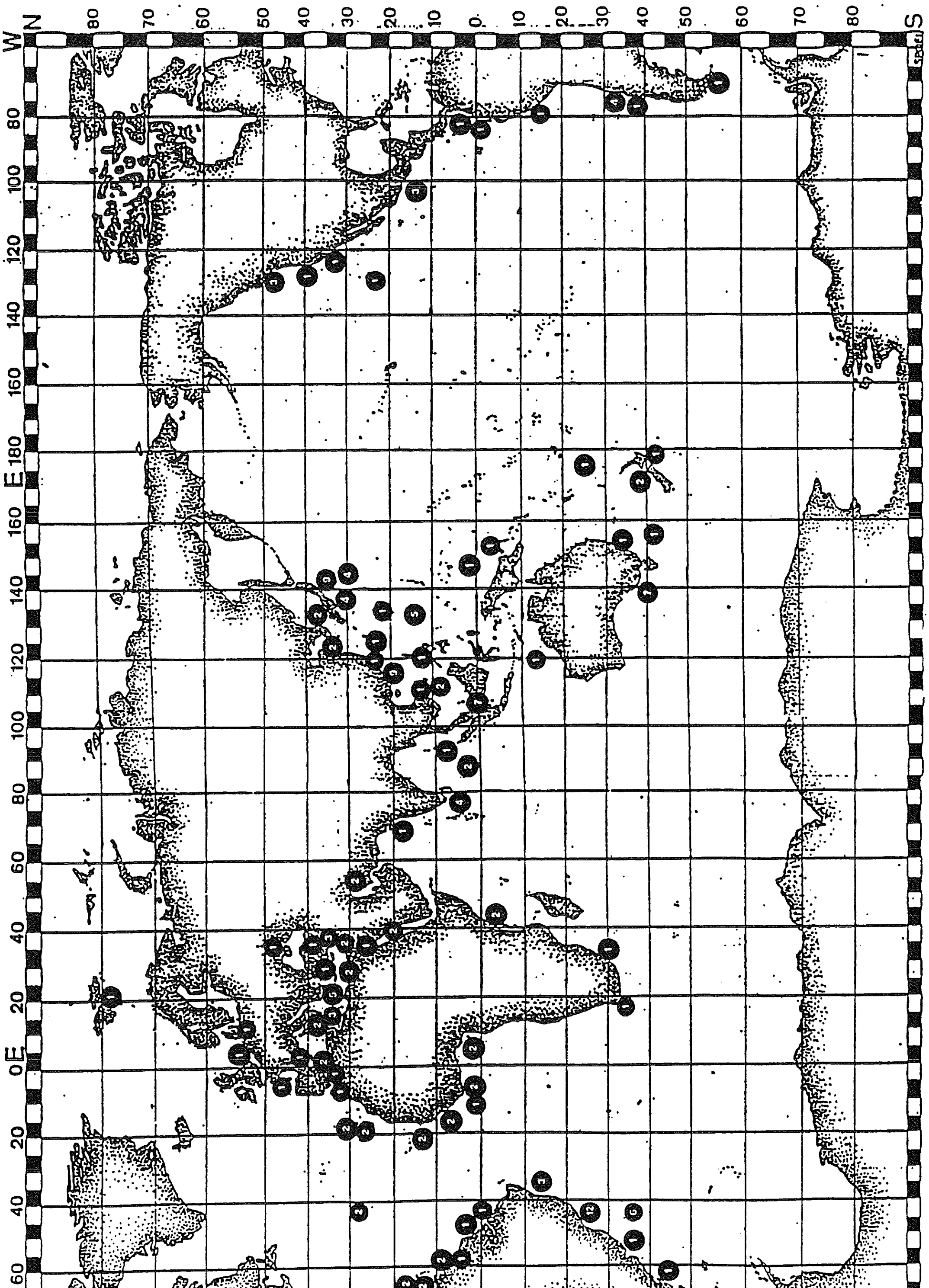


Figure 2.

Origin of the sampled ships (marked by black spots) of the German research project. The spot number represents the number of sampled ships from that region.



SMITHSONIAN ENVIRONMENTAL RESEARCH CENTER
P.O. Box 28, Edgewater, MD 21037-0028

MARITIME STUDIES PROGRAM
WILLIAMS COLLEGE - MYSTIC SEAPORT
P.O. Box 6000, Mystic, CT 06355-0990

[Example of Information Sheet Provided to Vessels Upon Boarding:]

SCIENTIFIC STUDY OF BALLAST WATER

** We are studying the aquatic salt and freshwater life in ballast water and sediments. This U.S. Coast Guard sponsored study was requested by the United States Congress. Your participation in this program is voluntary. The purpose of our study is to determine what kinds of organisms are taken up in ballast and what kinds of organisms survive voyages from port to port.

** This study is not an inspection or examination. We are not studying water pollution. This is a scientific study on the transport of living organisms into U.S. waters by ballast water.

** We sample the living organisms in ballast water. We normally collect these organisms from the ballast water **by lowering a net through a deck hatch or manhole cover**. Your cooperation in gaining access to the water is appreciated.

** This is a cooperative research program between scientists from Williams College-Mystic Seaport (WCMS) and the Smithsonian Environmental Research Center (SERC); the program is based locally at SERC.

** If you have any questions, please do not hesitate to contact us at the SERC numbers listed below. Again, we thank you for your time and cooperation in this important study.

Sincerely,

Dr. David Smith (WCMS)
Ms. Linda McCann (WCMS)
Ms. Marjorie Wonham (WCMS)

Dr. Gregory Ruiz (SERC)
Dr. Anson Hines (SERC)

Baltimore Area - Phone: 410-269-1412 Washington Area - Phone: 301-261-4190 Annapolis Area - Phone: 410-798-4424

Date/Time: ____________

Field Party: ____________

BALLAST DATA SHEET

NAA- ____

VESSEL INFORMATION:

Vessel name: ____________

Registry:		Type:	GRT:
Agency:	Officers & crew:		
Arrival port:	Berth:	LPOC:	
Arrival date:	Time:	LFPOC:	
Departure date:	Next Ports:		

BALLAST WATER INFORMATION: Specify units: m3, MT, LT, ST

Total BW on board:			
Total BW capacity:			
DEBALLASTING	Here	Y / N	
(when, where,	Later	Y / N	
BW sources?)	Earlier	Y / N	

BW SOURCES:

Dates	Locations	Tanks	Ballasted / Pressed up

BW EXCHANGED: Y / N (specify quantities, locations, dates, reasons)

SAMPLING:

			Tank 1 (blue)						Tank 2 (orange)				
Tank/hold (number, name)													
BW capacity of tank													
BW quantity in tank													
BW source(s)													
Date(s) ballasted													
Sample	Net	Diam:			Mesh:			Diam:			Mesh:		
method		Water depth in tank:						Water depth in tank:					
		jar	tow ht	Q?	jar	tow ht	Q?	jar	tow ht	Q?	jar	tow ht	Q?
		1-1			1-4			2-1			2-4		
		1-2			1-5			2-2			2-5		
		1-3			1-6			2-3			2-6		
	Pump (volume / rate)												
Dip net? (write details on back)													
Salinity (o/oo)													
Temp (oC)													
Water colour, other notes													
Deballasting during sampling?		Y / N	depth water dropped:					Y / N	depth water dropped				

SHIPSIDE SAMPLE:	Salinity (o/oo)	Temp (oC)	
PHOTOGRAPHS:	Vessel Panorama	Ballast Tank	Sampling procedures

VERTICAL PROFILES

Tank 1 (blue)

Salinity Meter			DO Meter		
Depth (m)	Temp (oC)	Salinity (o/oo)	Depth (m)	Temp (oC)	DO (mg/l)

Tank 2 (orange)

Salinity Meter			DO Meter		
Depth (m)	Temp (oC)	Salinity (o/oo)	Depth (m)	Temp (oC)	DO (mg/l)

SHIPSIDE

Salinity Meter			DO Meter		
Depth (m)	Temp (oC)	Salinity (o/oo)	Depth (m)	Temp (oC)	DO (mg/l)

NOTES:

HANDLING, QUARANTINE, AND DISPOSAL PROTOCOLS FOR NON-INDIGENOUS SPECIES AT THE SMITHSONIAN ENVIRONMENTAL RESEARCH CENTER (SERC)

October 1993

Project Specific Research Containment Protocol for: The National Biological Invasion Shipping Study (NABISS): Biological Invasions by Nonindigenous Species in United States Waters: Quantifying the Role of Ballast Water and Sediments

The NABISS Project at SERC involves the collection of living plankton and benthos from the ballast water and sediments of foreign vessels arriving in Chesapeake Bay, and the transportation of these organisms back to specific and authorized laboratories at SERC. The following handling, quarantine, disposal, and termination protocols will be observed for this project. Some of these procedures are adopted in part from "Zebra Mussel Containment Protocols", by D. P. Reid et al. (1993).

Definition of "Specific and Authorized Laboratory Sites"

Specific and authorized laboratory sites means those locations within the SERC complex that Center authorities have identified and designated as sites within which research may be conducted on living and preserved materials of non-indigenous organisms. A site map will indicate these authorized locations. In the following document, "the laboratory" or "laboratory" means these specifically authorized locations within SERC.

HANDLING AND QUARANTINE

Facility Containment Protocol

1. Samples with living ballast organisms brought to SERC will be held in specifically designated rooms with lockable doors. These rooms will be designated as "Restricted Areas" and be so posted. Doors are to be locked when responsible personnel are absent for extended periods of time (such as evenings, weekends, and holidays). These laboratory rooms will be used for (a) the examination of living and preserved samples of ballast organisms and (b) the culture of organisms derived from the ballast. Appendix (A) herein details the wording of this notice.

2. In no case will non-indigenous organisms be held in flowing water systems which do or could drain to the outside environment.

3. All research and staff personnel with involvement in the NABISS project and/or have key access to the designated laboratory sites will be briefed about the project and will indicate that they understand that living non-indigenous organisms are in the laboratory and may not be removed from the laboratory. All personnel will sign a documentation sheet indicating that they have been so briefed and that they understand these protocols.

Field Equipment Use Protocol

4. Nets, plankton bottles, and any other equipment used in the collection of plankton from ballast tanks will not be used in any other field work.

Equipment Cleaning and Disinfectant Protocol

5. All equipment, apparatus, or other devices used in the collecting, handling and processing of ballast water plankton (including but not limited to nets, field containers, buckets, glassware, plasticware, and examination tools) will be rinsed and washed in sinks or other washing areas whose drainage leads solely to septic systems. Chlorine baths will be available for the dipping and rinsing of laboratory and collecting equipment.

ACCIDENTAL SPILLS PROTOCOL

1. A spill of specimens of non-indigenous organisms will be considered an emergency situation.

2. A procedure to handle such spills shall be posted conspicuously in all non-indigenous organisms work areas. Appendix (B) herein details the wording of this notice.

NORMAL TERMINATION PROTOCOL

1. All living ballast plankton brought to SERC will be preserved after examination, after culturing, or after experimental work.

2. The sole exception to (1) will be the hand carrying of, or express mail shipment of, living specimens to consulting systematists (taxonomists) for identification, with the understanding that these specimens will subsequently be preserved. A log will be maintained of the organisms (species) and numbers of all living specimens provided to consulting systematists, the methods of conveyance, and to whom and when they were carried or sent.

3. The sole exception to (2) will be when the consulting systematist finds it necessary to maintain the organisms in question alive for observation, culturing, or for other purposes. In this case it is the responsibility of NABISS personnel to inform the consulting laboratory of the minimum handling, quarantine, and disposal protocols recommended when non-indigenous organisms are involved in research programs. A copy of these protocols must be provided to the consulting laboratory.

PROJECT TERMINATION PROTOCOL

1. Upon final completion of the NABISS project (and/or related ballast research projects), all equipment, apparatus, supplies, and other materials which may or could be reused in future research projects must be sterilized by chlorination, autoclaving, freezing, acid bath, or other suitable means.

2. All other equipment, apparatus, supplies, and other materials for which there are no plans for future use must be destroyed.

EMERGENCY TERMINATION PROTOCOL

1. If the integrity of the research facility at SERC is threatened by imminent and confirmed destruction by hurricanes, flood, or other event, and if time allows (without threat to personnel safety), all living non-indigenous organisms (species) cultures and experiments shall be either (a) transported off-site in sealed and labeled containers to a suitable secure facility, or (b) terminated by adding chlorine bleach to all pertinent systems at a volume:volume ratio of 1:50 (1 part bleach for every 50 parts water).

ANNEX 7

1994 Annual Report on the Status of the Brown Alga (Kelp) Undaria pinnatifida on the coasts of France

Statut d'Undaria pinnatifida le long des cotes francaises

par Raymond Kass

1 - Situation des élevages

L'algue brune *Undaria pinnatifida* fut introduite en France au début des années 70 L'hypothèse la plus probable concernant son introduction est relative à l'importation de *C. gigas* en provenance du Japon. Il est fort probable qu'un seul échange ou des échanges effectués avec un expéditeur déterminé soit la cause de l'apparition des espèces nippones dans l'étang. Dans le cas contraire on aurait du assister à la prolifération de ces algues au niveau de tous les sites ostréicoles français qui ont procédé à des échanges avec le Japon.

A partir de 1976 les ostréiculteurs de l'étang de Thau firent part aux autorités de l'apparition, sur les tables de culture, d'algues dont les dimensions étonnaient avant d'inquiéter. Perez (1978) détermina que cette algue était une laminariale du genre *Undaria* et de l'espèce *pinnatifida*. Elle est très commune au Japon, appréciée et consommée couramment par l'ensemble de la population.

Après avoir suivi le cycle biologique de cette laminaire pendant un an, qui montra notamment le faible impact sur la production ostréicole, le laboratoire d'Algogie appliquée de l'ISTPM envisagea la possibilité de valoriser cette espèce. Les premières tentatives de valorisation de l'algue en tant qu'aliment montèrent l'inadéquation du site originel pour une telle entreprise. La qualité de l'algue varie en fonction de son stade de développement et de la température du milieu. L'optimum du rapport qualité/poids se situe dans un laps de temps très restreint (1er au 15 mai environ) Au-delà la rapide montée de la température entraîne une rapide dégradation du thalle. Une telle contrainte ne pouvant permettre le développement d'une culture rentable, des sites plus favorables furent recherchés. Les eaux bretonnes avec des maxima n'exédant pas 18°C semblaient fort bien convenir aux essais. Le succès des premières expériences montra les possibilités que pouvaient offrir ces sites pour la culture de cette espèce. Les premiers essais furent entrepris au niveau des sites de l'île de Groix, de l'île d'Ouessant et de la Rance en amont de la centrale marée-motrice.

Suite à une demande émanant du CIEM concernant l'introduction d'espèce non indigène le nombre de sites expérimentaux fut réduit et ramené à un seul. Des études complémentaires sur les possibilités d'extensions des peuplements d'*Undaria* furent menés par le laboratoire de l'Université de Bretagne Occidentale du Professeur J-Y Floch. L'étude montra la relative inocuité de l'espèce vis-à-vis des espèces indigènes ce qui amena les Affaires Maritimes à autoriser la culture d'*Undaria* en différents endroits du littoral breton puis charentais.

Depuis 1990 des cultures ont été tentées dans les sites de :

- La Rance, St Malo, Pleubian, L'Aber Wrach', Le Conquet, L'île d'Ouessant, Le Guilvinec, Marennes Oléron.

Les îles de Groix et de Sein qui furent un temps le siège d'une production sont actuellement abandonnées.

Les productions en tonnes humides depuis 1990 sont reportées ci-après :

Année	1990	1991	1992	1993
Récolte (Tonnes humides)	40	70	75	60

La production, comme le démontre le tableau ci-dessus, est loin d'atteindre les résultats escomptés au moment du lancement des programmes de recherche sur ce sujet. Les raisons de ces résultats sont multiples, conjoncture économique peu favorable ces dernières années pour la création d'entreprise, mise sur le marché de produits de qualité médiocre entraînant une dégradation de l'image de marque de produit, problèmes d'autorisation de mise en vente des produits (CSHP). Il ressort de l'analyse du fonctionnement des différentes sociétés existant encore sur le marché que seules ont survécues les sociétés ayant opté pour les cultures mixtes, algues-moules ou algues-huîtres A l'heure actuelle les sites de la Rance et de St Malo vont prochainement être abandonnés.

2 - Modifications du biotope

Concernant la diffusion d'*Undaria* dans le biotope, il est à noter qu'un peuplement s'est développé sur le site de St Malo. L'origine de ce peuplement est semble-t-il à mettre sur le compte d'un certain nombre de dépradations occasionnées aux structures de culture d'une part, et à la mauvaise tenue à la mer de certaines de ces structures. Il en a résulté la perte d'un certain nombre de lignes de cultures qui ont pu ensemencer le milieu. Des raisons analogues ont prévalu en Charente Maritime où *Undaria* s'est également installé en quantité. De petits oasis se sont également dévelopés dans d'autres sites, mais leur importance fluctue en fonction des années.

La baie de Lampaul qui représente l'aire la plus ancienne en terme de présence *d'Undaria* n'a pour l'instant pas connu de phénomène de colonisation intense des substrats naturels en dépit d'ensemencement régulier des cordages de cultures.

L'observation des plants se développant en dehors des structures artificielles permet de constater l'attirance particulière que cette espèce provoque au niveau des herbivores principalement *Patina pellucida*, petit gastéropode brouteur que l'on retrouve en grande quantité sur les plants. Des poissons herbivores doivent également consommer ce végétal car des traces très distinctes de broutage sont observables au niveau des frondes. L'implantation d'*Undaria* se situe dans la frange occupée par *Himanthalia elongata* avec qui elle semble cohabiter sans problèmes.

3 - Prédation des algues

Concernant les cultures proprement dites un certain nombre de prédateurs sont apparus tel, *P. pellucida* déjà mentionné précédemment ainsi qu'un isopode de grande taille qui peut ravager des lignes entières ensemencées en algues. Il est fort possible que la prédation féroce dont ces algues font l'objet obère leur pérénisation à un endroit donné. Cette remarque est confortée par les observations effectuées dans les sites où des réensemencements n'ont pas eu lieu. En effet, dans ceux-ci *Undaria* représente pour le moment de faibles peuplements qui ne se propagent plus.

CONCLUSIONS

Plusieurs années après l'introduction *d'Undaria pinnatifida* sur les côtes atlantiques et de la Manche, cette algue n'a colonisé que de faibles espaces dans les sites où elle a été expérimentalement implantée. Elle ne s'est pas propagée sur de longues parties de côte et ne semble pas avoir induit d'impact négatif dans les biotopes où elle s'est installée. Sur le plan économique, les productions restent encore faibles mais un développement plus important peut encore avoir lieu avec une meilleure prise de conscience des nécessaires efforts à fournir en phytotechnie.

April 7, 1994

Dr. James T. Carlton
Chair, ICES Working Group on Introductions
and Transfers of Marine Organisms
Maritime Studies Program
Williams College - Mystic Seaport
50 Greenmanville Avenue
P.O. Box 6000
Mystic, CT 06355-0990

Dear Jim:

As per the letter dated January 10, 1994 from Emory D. Anderson, General Secretary of ICES to Mr. William Brennan, Commissioner of the Maine Department of Marine Resources, the following is Coastal Plantations International's initial annual report to the Working Group on Introductions and Transfers of Marine Organisms.

1. Culture Sites:

1992: Two culture sites were established; Johnson Cove and Mathews Island (See Figure 1, "92" delineations). In Johnson Cove a 24 net system was assembled. The system was removed within 60 days of assemblage due to regulatory restraints. A 30 net system was established just off of Mathews Island which was maintained from July - December, 1992.

1993: Three culture sites were established. Two in waters off of Eastport, Maine USA and one site in Harbour de Lute, Campobello Island, New Brunswick Canada (See Figure 1, "93" delineations). The Eastport sites, just east and north of Goose Island, were established in June and removed in December, 1993. The Canadian effort was established in late September 1993 on the aquaculture lease site of Mr. John Mallack.

1994: The lease sites established in 1993 will be utilized in 1994. The lease site just north of Goose Island has been shifted approximately 600 feet due west. The lease site east of Goose Island has been shifted approximately 300 feet to the east to establish a 1320 foot buffer zone between CPI cultivation lease sites and the seabird nesting areas on Goose and Spectacle Islands. One additional 80

COASTAL PLANTATIONS INTERNATIONAL, INC.
FACILITY: 11 MADISON STREET ■ EASTPORT, MAINE 04631 ■ 207-853-6238
OFFICE: P O BOX 209 ■ ROUTE 26, POLAND CENTER ■ POLAND, MAINE 04273 ■ 207 998-4909

acre tract is in its final stages of permitting and is anticipated to be utilized in 1994. It is located 4000 yards west south west of Goose Island, just west of Seaward Neck on "Huckins Ledge" in waters off of Lubec, Maine (See Figure 1, "94" delineation)

2. Reproduction:

The Porphyra yezoensis cultivation season is limited by the minimum growing temperatures of 6-7^{o} C. The season in the waters of Cobscook Bay comprises the first week in June to the first week in December. P. yezoensis thalli were examined daily and evidence of carpospore production and release was observed from October 6 through November 10, 1993. Water temperatures ranged from 11^{o} C in October to 8^{o} C on November 10, 1993.

No data on the fate of the 1993 carpospore release has been ascertained to date The potential of successful carpospore recruitment is low. Water temperatures decreased to a season minimum of - 0.7^{o} C, significantly lower than the 11 - 25^{o} C experienced by Porphyra yezoensis conchocelis in its native habitat.

Concurrent with CPI's efforts to install the 1994 cultivation floating raft systems, our divers will collect shells and shell fragments in and around our cultivation sites. The shells will be examined in our culture laboratory for the presence of conchocelis filaments. The filaments will be collected and attempts will be made to complete its life history cycle and identify the subsequent cultivar.

3. Dispersal:

Determination of natural or anthropogenic dispersal of Porphyra yezoensis has been accomplished by monthly field surveys. The intertidal zone has been examined by CPI personnel from April 1993 to the present date for the successful establishment of P. yezoensis from the 1992 and 1993 cultivation efforts.

No Porphyra yezoensis was recorded from the land masses surrounding the 1992 or 1993 cultivation sites. Goose, Spectacle, and Mathews Islands were extensively examined. Due to the limited experience at Johnson Cove and the time of year on site (June-July 1992) no follow-up has been

Dr. J. Carlton, ICES
CPI Annual Report
April 13, 1994
Page Three

attempted. The New Brunswick site was surveyed prior to the assemblage of the CPI cultivation system and each month thereafter.

CPI efforts to monitor the areas surrounding the Goose-Spectacle Island and Harbour de Lute lease sites and all future cultivation areas will continue unabated.

Please feel free to contact my office if you, the working group or ICES has any questions or points of clarification concerning this matter. We appreciate the time and effort on our behalf and welcome a site inspection by any and all of the members of the ICES working group.

Yours very truly,

Ira A. Levine, Ph.D.
President

IAL/mr

cc: William Brennan
Steve Crawford

ANNEX 9

AquaFuture INC.

Response to ICES Code of Practice

April, 1994

AquaFuture, Inc. • P.O. Box 783 Turners Falls, MA 01376 USA • (413) 863-8905 Fax: (413) 863-3575

AquaFuture INC.

Response to ICES Code of Practice

1.0 Introduction

AquaFuture is seeking to establish a recirculating production system in Ireland for the culture of hybrid striped bass *(Morone saxtilis X Morone chrysops)*. The proposed system has been designed to create an entirely fail-safe quarantine environment. The system virtually eliminates the risk of accidental release of the cultured fish or any associated pathogens into the environment. On this basis, AquaFuture requests permission to import HSB fingerlings for production. It is anticipated that the company will, in the future, seek permission to establish resident broodstock for an indigenous domestic breeding program, in accordance with the ICES recommendations.

2.0 Species Background

Striped bass is a member of the Moronidae family which consists of both freshwater and anadromous species. The original range of the striped bass extends along much of the East coasts of the United States, from the St. Lawrence River in Canada to northern Florida. Over the past twenty years, striped bass populations have undergone a precipitous decline in several major estuaries on both coasts. Large scale coastal enhancement efforts are underway and are projected to extend through the 1990's. There are currently 17 state and federal hatcheries stocking 40 million fingerlings annually into 450 reservoirs and 15 inland streams in 36 states. Extensive study since the early 1970's had produced little or no evidence of species displacement associated with introductions of striped bass.

White bass are a primarily fresh water species and are seldom found in estuarine environments. White bass are much smaller than striped bass and are generally more abundant for broodstock. The spawning temperature for white bass is somewhat lower then that of striped bass. Both species normally begin spawning runs when water temperatures reach 55-60°F. Peak spawning of the white bass usually occurs 2-3 weeks before that of striped bass in the same area.

3.0 Hybrid Striped Bass

Hybrid striped bass are produced by crossing either gender of the striped or white bass. The predominant method for producing hybrid striped bass fingerlings uses outdoor ponds in which natural zooplankton provide the majority of the food for the larval fish. Tank-based fingerling production is also practiced on a smaller scale. Despite years of stocking into natural environments, there are no self sustaining populations of hybrid striped bass.

4.0 AquaFuture's Fingerling Production method
AquaFuture uses a combination of in-house produced and externally soured fingerlings. The externally sourced fingerlings are supplied by two hatcheries in the Southern U.S. AquaFuture places stringent quality requirements on its fingerling suppliers. For example, the hatchery's are required to hold the fish in a flow-through vat system to facilitate inspection (by a certified fish health laboratory) and treatment for ectoparasites, prior to loading for transport. The fish health laboratory report all findings but are instructed to specifically check for the presence of the following:

1. Bacteriology: *Edwardsiella tarda, Flexibacter columnaris, Aeromonas hydrophilla, Vibrio anguillarum, Pseudomonas fluorescens, Pasteurllosis piscicida, Streptococcus spp., Mycobacterium marinum*

2. Virology: *IPNV is routinely tested by a U.S. Federal fish health laboratory as per Massachusetts requirements., and has never been detected in more than 9 samplings Striped bass are not carriers of IHN or VHS (see enclosed letter).*

3. Parasites: *Costia, tricodina, tetrahymena pyriformis, Heteropolaria colisarum (Epistylis) Ichthyophthirius multifilis, Dactylogrus, Gyrodactylus.*

5.0 Overview of Relevant Aspects of the Proposed Project
The ICES code of practices guards against the risks of direct introduction of non-native or genetically modified species into the marine environment. With this in mind, the code specifies the screening for disease prior to importation of broodstock, introduction of the broodstock into a quarantine system, a period of further testing while the broodstock are maintained in the quarantine system and then breeding to produce F1 progeny which may be released directly into the environment.

AquaFuture's proposal does not envision direct introduction of non-native or genetically modified species into the environment. Rather, the premise of the entire system concept is based on the ability to maintain an effective quarantine within the production environment. This is achieved through a broad range of measures which are described in section 6.0, below.

6.0 Key Biological Security Features
AquaFuture proposes to incorporate the following physical and management control measures into the facility.

1. Screening Prior to Fingerling/Broodstock Introduction:

- Fingerlings would be produced by AquaFuture's current suppliers. They will be held in clean well water and treated with 150 mg/l formaldehyde prior to shipment.

- A representative subsample (typically 60 fish per lot of 80,000) of the population for any proposed fingerling introduction would be screened in the U.S. by a qualified fish health lab for target pathogens. Presence of any target pathogen would be grounds for canceling that shipment.

2. Physical Containment:

- AquaFuture's tanks are equipped with non-removable integral standpipes. These eliminate the possibility of accidental draining of the culture tanks. The only mean of draining the tanks is through the removal of a deliberately undersized drain valve. Any water leaving the tanks is collected in a central drain system

- Multiple, redundant physical barriers to escape. All exit points from the individual production tanks will be equipped with screens. From there, all water must pass through a secondary screening system which is part of the on-site discharge treatment system (see drawling) that system also includes, a centrifugal pump, heat exchanger and sterilization system, each of which provides further barriers to escape.

- If required, the building could be constructed so that the concrete foundation would serve as a permanent physical containment area in the event of a complete tank(s) failure.

3) Continuous Sterilization of Discharge Water:

- All discharge leaves only through a pumped, non-by-passable, discharge treatment and sterilization system. Discharge pump interlocks with sterilization system such that a failure of the sterilization system immediately interrupts discharge flow. There will be no gravity driven means for water to leave the facility.

- Redundant sterilization utilization a combination of ozone and UV irradiation. Ozone treatment would be designed for a target of 0.1 mg/l residual after ten minuets. This would create a minimum 5 log reduction in bacterial levels. Water would then be subject to UV irradiation. The combination of Ozone and UV creates and instantaneous and exponential increase in free radical production which significantly enhances kill rates. The proposed UV system would be designed to achieve a dose of 60,000 $\mu ws/cm^2$. This fully redundant system is expected to create a high degree of reliably. Ozone residual levels would be continuously monitored; failure to achieve target residuals would cause an automatic shunting of the discharge to a holding tank until the target residuals are achieved.

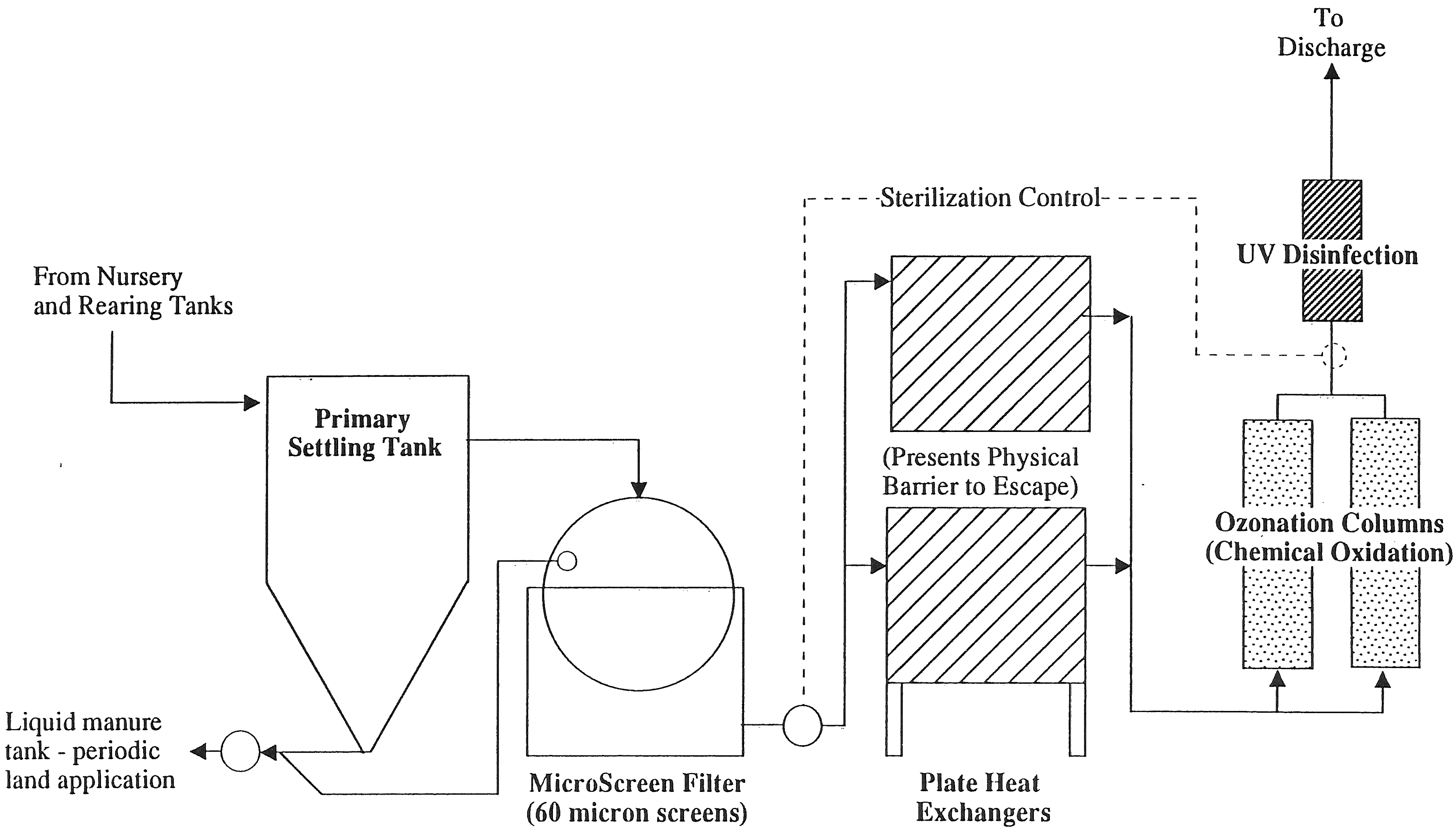
4) Additional Control Measures:

- Dedicated clothing and footwear will be provided to all production personal for on-site use only.

- Use of foot and hand sterilization for all personal entering/exiting any production areas within the facility.

- Detailed written operating procedures, initial and follow-up staff training and around the clock staffing.

Proposed On-Site Discharge Treatment System



United States Department of the Interior

FISH AND WILDLIFE SERVICE

FISH FARMING EXPERIMENTAL LABORATORY
POST OFFICE BOX 860
STUTTGART, ARKANSAS 72160-0860

(501) 673-4483
Fax (501) 673-7710

November 29, 1993

Scott Lindell
AquaFuture
P. O. Box 783
Turners Fall, MA 01376

Dear Mr. Lindell:

The following statements are given in regard to the potential for transfer of IHNV and VHSV infected hybrid striped bass (STBH) from AquaFuture in Massachusetts to Ireland. There is little to no reason to believe that shipments of STBH from this aquaculture facility would be infected by either of the above mentioned viruses. This is because neither virus has ever been found in any fish in Massachusetts or in Mississippi and Arkansas (the two states that supply AquaFuture with fingerling bass). Also, to our knowledge, there has never been an isolation of either of these viruses from STBH anywhere in the world. Inspections of STBH for these two viruses would be impractical and a waste of resource and time.

Sincerely,

Andrew J. Mitchell

Andrew J. Mitchell
Fish Pathologist AFS/FHS

Review of Safety Features

Captive "Disease-Free" Broodstock

↓

Laboratory Health Test Prior to Shipment

↓

Treatment for Ectoparasites Prior to Shipment

↓

Quarantine Upon Receipt

↓

Multiple Physical Barriers to Escape

↓

Permanant Physical Containment

↓

Redundant Sterilization Systems

↓

Dedicated Clothing & Footwear

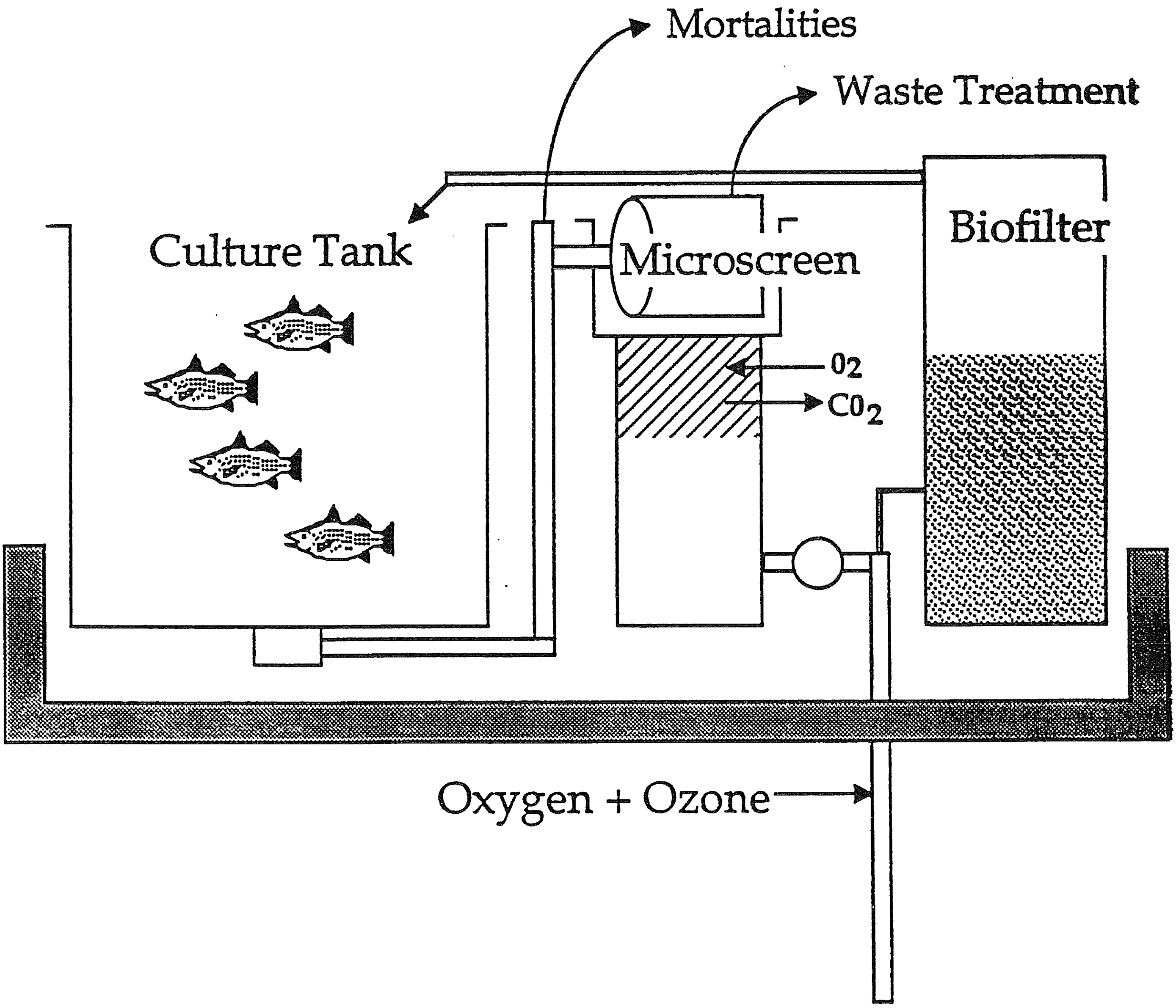
↓

Ongoing Staff Training

No IHNV/VHS
No Self-Sustaining Populations

AquaFuture.

Culture System Overview



AquaFuture.

Production Overview

Hatchery — U.S.

- Captively reared brood stock
- Intensive/extensive culture using live & dry diets
- Held in well or city water prior to shipment
- Treated for external parasites prior to loading
- Laboratory health inspection prior to export

Nursery — Ireland

- Quarantine / receiving system
- 80,000 moved to nursery production every month
- Spend 15 weeks in nursery

Growout — Ireland

- 24 week grow-out cycle
- Harvest at 0.85 kg - i.e. not sexually mature

Processing — Ireland

- Chill-killed
- On-site packing & processing

AquaFuture.

ANNEX 10

State of New Jersey
Department of Environmental Protection and Energy
Division of Fish, Game and Wildlife
CN 400
Trenton, NJ 08625-0400
Tel. # 609-292-2965
Fax. # 609-984-1414

Scott A. Weiner
Commissioner

Robert McDowell
Director

August 5, 1993

Dr. Emory Anderson, General Secretary
International Council for the Exploration of the Sea
PALAEGADE 2-4
DK-1261
Copenhagen, Denmark

Dear Dr. Anderson:

The state of New Jersey is in the process of reviewing a proposal by Dr. Standish Allen of Rutgers University (New Brunswick, New Jersey) and is seeking ICES input in making a final decision regarding project approval.

The proposal, entitled Evaluation of MSX- and Dermo-Disease Resistance in Crassostrea gigas Using "Rutgers Sterile Triploids", has been modified several times since originally proposed in 1989. The modifications were made in response to concerns expressed regarding genetically-transmitted disease and assurance of using sterile, triploid oysters. Some states, notably Virginia and Maryland, were originally opposed to an identical proposal for Virginia waters. However, given the project modifications, these states have endorsed the proposal and have, in fact, recently placed Rutgers sterile triploid C. gigas in Virginia waters.

Comments were solicited from Dr. James Carlton, Chairman of the ICES Working Group on Introduction and Transfers of Marine Organisms (ICES/WGITMO) and in a letter to Dr. Allen (June 1993) stated his support of the current proposal. However, in order to solicit ICES/WGITMO comments, Dr. Carlton stated that an official request from a State agency must be made directly to the ICES General Secretary in Copenhagen. Dr. Carlton stated that the WGITMO could officially review the matter at its next meeting in April 1994.

Given that this proposal has been discussed since 1989 and the fact that Virginia has initiated a similar project, New Jersey is eager to make a final recommendation on this project. To this end, I request an expedited review by ICES/WGITMO as suggested by Dr. Carlton. This review will help resolve the issues raised by some states and, assuming ultimate approval and completion of the project, will finally answer the question of MSX and Dermo resistance in C. gigas.

Thank you for your consideration in this matter.

Sincerely,

Robert McDowell
Director

JWJ:nl:bd
Enclosure

STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES
& ENVIRONMENTAL CONTROL
DIVISION OF FISH AND WILDLIFE
89 KINGS HIGHWAY
P O BOX 1401
DOVER, DELAWARE 19903

OFFICE OF THE
DIRECTOR

December 17, 1993

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

Dear Secretary Anderson,

I have been in contact with Dr. James T. Carlton several times since last summer about the possibility of petitioning the ICES Working Group on Introductions and Transfers of Marine Organisms for technical advice on questions relating to the safety of in situ experimentation with triploid exotic bivalves. Specifically, the State of Delaware is concerned that research deployment of triploid C. gigas by the State of New Jersey may lead to unintentional introduction of this species in Delaware Bay and surrounding areas. Dr. Carlton has informed me that the State of New Jersey has officially petitioned the committee requesting advice on the research proposal in question, which they have already permitted without ICES consideration. Dr. Carlton has provided me with copies of pertinent correspondence on this issue and has encouraged me to express to you the desire of the State of Delaware to be recognized as an official co-petitioner on this issue. We feel that this would facilitate a thorough discussion and consideration of both sides of the issue.

A brief history of this debate will provide the committee with a context in which to consider our questions:

1) New Jersey has been proposing in situ research with C. gigas since 1989. During 1989 in situ testing was conducted in Delaware Bay with diploid C. gigas, over our objections. Despite the good intentions of the researcher, histological examination, after exposure, indicated that some spawning had occurred.

2) A series of critical international issues forums on the ecology of C. gigas, suggested that C. gigas if established would

compete effectively with C. virginica (it spawns at a lower temperature, grows faster and often sets densely).

3) The Atlantic States Marine Fisheries Commission, Interjuridictional Shellfish Transport Committee and the Chesapeake Bay Program, Exotic Species Working Group have developed policies in opposition to introductions of C. gigas without formal environmental assessment and risk benefit analysis.

4) The socio-political decision to introduce an exotic oyster species has not been made by any jurisdiction along the Atlantic Coast. No state presently favors this introduction and some vigorously oppose it.

5) Procedurally, New Jersey has failed to provide data for objective peer review by mutually agree upon third party reviewers. They have permitted several in situ experiments in opposition to ASMFC policy and the expressed concerns of neighboring states. They have avoided NEPA requirements (National Environmental Protection Act, 1970) and any other formal and thorough environmental assessment. In 1993, Dr. Allen provided us with a list of 14 "peer reviewers" of his proposal. Of the four geneticists contacted, to field our technical questions about triploidy, none had reviewed the proposal.

Interjurisdictional problems are expected if C. gigas becomes established along the Atlantic Coast:

1) The fishery for the native oyster, though depressed, is still on-going in many east coast states. A mixed population of C. gigas and C. virginica would be of limited value (i.e. could not be shipped as shellstock) due to the tendency of C. gigas to gape after several days.

2) Actions by one Atlantic Coast state to introduce an exotic species or the unintentional escape of an exotic species will surely have regional ecological impacts.

3) No one knows how many highly successful larvae of C. gigas are necessary to result in the irreversible introduction of the species, but the fecundity of C. gigas is known to be very high.

It is in this somewhat contentious atmosphere that the State of Delaware would like to pose the following technical and procedural questions:

1) Triploidy is not synonymous with sterility. While reproductive capacity is diminished, gametes are produced and larvae can result. Dr. Allen reportedly attempted unsuccessfully to rear batches of larvae in the laboratory. This data has not been made available to us. Are these data adequate to indicate that larvae would not result in situ, resulting in the introduction of C. gigas?

2) When triploids are created, the process is imperfect, requiring individual testing to select triploid test organisms. From each batch of larvae, some will be diploid, some triploid and some mosaic. Mosaics are "checkerboard" individuals having both diploid and triploid tissues. The state of our knowledge about triploidy in animal systems appears to be undergoing rapid expansion. Several years ago New Jersey researchers indicated that mosaic individuals did not exist in *C. gigas*. Now they acknowledge that five percent can be mosaic individuals. *In situ* deployment several years ago might have been disasterous, resulting in establishment of the exotic. Do we know enough about mosaics, today, to allow field deployment? Do we know that all tissues are mosaic in the mosaic individual? For example, if blood cells (which are used for individual testing of ploidy) are triploid, but the gonad/gametes are mosaic, then oysters with significant reproductive potential would erroneously be certified triploid.

3) There are indications of a tendency in biological systems to revert from the induced triploid state to the normal diploid state with growth (mitosis) and sexual maturation (meiosis). New Jersey researchers indicate that this may occur, but do not know at what rate it occurs in triploid *C. gigas* under field conditions. Field exposure in this experiment is prolonged (two growing seasons) and during this period, test organisms should grow from small juveniles to mature adults. If reversion occurs, significant production of viable diploid gametes would occur. If reversion to diploid occurs this situation would then become the "worst case" basis for figuring the risk of establishent of the exotic, making Dr. Allen's larval survival test irrelevant. Do we know enough about reversion to the diploid state under field conditions to permit *in situ* experimentation without risk of escape of the exotic?

4) Are there other factors, such as machine error (Flow cytometer) which could cause misidentification of certified triploids?

5) If the committee feels it is within its purview, the State of Delaware would appreciate comment on the proper procedure to be used by a jurisdiction prior to permitting this type of research over the objections of a neighboring jurisdiction (i.e. making data available, peer review, abiding by interstate agreements environmental assessment/risk benefit analysis, etc.)

In summary, the State of Delaware feels that because of the high reproductive potential of bivalves and our imperfect understanding of how triploidy works, we can not estimate with any certainty whether this research will result in the unwanted establishment of an exotic oyster in Delaware Bay and surrounding areas. While the research, as proposed, has far more safeguards that it did in 1989, when diploids were placed in Delaware Bay, we feel it should not be permitted just because it makes use of the best available technology. It is incumbent on the researcher to be able to quantify the risk of introduction and to show a thorough understanding of how proposed safeguards (tripoidy) work in the test organism. Without this information, it is the responsibility of fisheries managers to err on the side of protecting the native species.

Please advise me as to how the committee will address this request. I thank you for your consideration of this matter.

Sincerely,

Jeff Tinsman
Fisheries Biologist

JT:as

Enclosure

cc: Christopher A. G. Tulou, Secretary
Delaware Dept. of Natural Resources and Environmental Control

Andrew T. Manus, Director
Delaware DNREC, Division of Fish and Wilflife

Robert McDowell, Director
New Jersey Dept. of Environmental Protection, Division of Fish, Game and Wildlife

Gordon Colvin, Director
New York Dept. of Environmental Conservation Division of Marine Resources

Ernest E. Beckwith, Jr., Director
State of Connecticut Fisheries

cgigasi.ces

CHESAPEAKE BAY POLICY
FOR THE INTRODUCTION OF
NON-INDIGENOUS AQUATIC SPECIES

Prepared by the
Exotic Species Workgroup
of the Living Resources Subcommittee

DRAFT 11-22-93

ADOPTION STATEMENT

We, the undersigned, adopt the following policy statement regarding the Chesapeake Bay Policy for the Introduction of Non-Indigenous Aquatic Species:

> "It shall be the policy of the jurisdictions in the Chesapeake Bay basin to oppose the first-time introduction of any non-indigenous aquatic species into the unconfined waters of the Chesapeake Bay and its tributaries for any reason unless environmental and economic evaluations are conducted and reviewed in order to ensure that the risks associated with the first-time introduction are acceptably low. The signatories to this Adoption Statement are committed to sharing information and to [carefully] assessing through a joint review process all proposed first-time introductions of non-indigenous aquatic species in the Chesapeake Bay Basin. The signatories to this Adoption Statement are also committed to working together to prevent unintentional introductions of non-indigenous aquatic species and to minimizing the negative effects of undesired aquatic species within the Chesapeake Bay ecosystem."

DRAFT POSITION STATEMENT

ASMFC Interjurisdictional Shellfish Transport Committee

Both C. virginica and C. gigas have similar environmental requirements and life history characteristics. Growth rate of C. gigas is known to be greater than C. virginica reaching a three-inch marketable size in about eighteen months in temperate climates. Placement of C. gigas in open waters during conditions that are conducive to successful spawning constitutes a species introduction. Spawning of C. gigas is suppressed by temperatures below 10° C and salinity less than 15 ppt. These conditions are not optimum for C. gigas growth and not an environment which sustains infections by MSX and Dermo diseases. There appears to be no compelling reason for overboard exposure.

The Committee affirms its position that no open water testing of C. gigas be conducted until a sociopolitical decision is made to accept the introduction of C. gigas to the East Coast of the United States. The workshop on Ecology and Management of C. gigas identified the potential of this species to replace C. virginica in East Coast estuaries.

This decision requires a technically complete environmental impact statement and an economic risk assessment based on a plan for introduction and commercial use. These documents are to be reviewed by the ASMFC Interjurisdictional Shellfish Transport committee, ASMFC Advisory Committee, and approved by ASMFC by vote.

The Committee's recommendation for testing of C. gigas is that...all testing of C. gigas be conducted in closed systems, hatcheries with no discharge to the environment, in microcosms, and through the use of pumped ambient water with subsequent disinfection and no discharge to the natural environment. An ASMFC Shellfish Transport Committee member should be involved in the experimental studies and all facilities and experimental study plans should be reviewed and approved by the Committee.

10/30/91

isfmp:sf9158shell

EVALUATION OF MSX- AND DERMO-DISEASE RESISTANCE IN *Crassostrea gigas* USING "RUTGERS STERILE TRIPLOIDS"

Standish K. Allen, Jr.
Susan E. Ford
Haskin Shellfish Research Laboratory
Institute of Marine and Coastal Sciences
Rutgers University
Port Norris, NJ

OBJECTIVE

Our objective is to determine whether the Pacific oyster, *Crassostrea gigas* is resistant to *Haplosporidium nelsoni*, causative agent of MSX-disease, and to verify laboratory results that this species is resistant to Dermo-disease.

RATIONALE

The Pacific oyster has certain biological features that are generally considered desirable by oyster culturists, such as rapid growth, hardiness, and possibly resistance to disease(s). For example, in studies run at the Haskin Shellfish Research Laboratory in the summer of 1989, field plantings of *C. gigas* did not become infected by *Haplosporidium nelsoni* the parasite that causes MSX-disease, whereas 10% of control eastern oysters, *C. virginica*, were infected. Infection pressure was particularly low in 1989, so these results are not definitive. Similar results were obtained by the Maryland Department of Natural Resources and National Marine Fisheries Service (Oxford, MD). Approximately 65% of *C. virginica* in a flow-through system inside the Deal Island, MD hatchery were infected with *Haplosporidium nelsoni* and <u>all</u> were infected with *Perkinsus marinus*, causative agent of Dermo. Adult *C. gigas* held in the same system were not infected by either parasite

(Dr. George Krantz, MD. Dept. Nat. Resources and Mr. Austin Farley, National Marine Fisheries Service, Oxford, MD). However, because MSX was not found in oysters held immediately outside the hatchery, or in other nearby areas, this study remains equivocal also. Researchers at VIMS have demonstrated that *C. gigas* is resistant to Dermo-disease in the lab; verification of these results in the field is an appropriate next step.

Because of the problems with oyster diseases on the east coast, there is a renewed interest in *C. gigas* as an alternative species or in using it in breeding schemes. The culture of this exotic species on the East coast is complicated not only because of the possible concomitant introduction of undesirable foreign species and diseases but also because *C. virginica* oyster populations still survive. Under favorable environmental circumstances *C. virginica* populations may rebound. It is important that while evaluating the new species as an option, we not compromise the recuperative potential of the old.

There are many aspects of the ecology of *C. gigas* in east coast estuaries that are unknown, e.g. salinity tolerance, reproductive range, resistance to pests/ predators, but until the question of resistance to pathogens now afflicting native oysters is answered, it is probably pointless to worry about its ecological effects. If *C. gigas* does not survive disease challenges by MSX, ecological questions are moot. Recent laboratory challenges at the Virginia Institute of Marine Science has demonstrated that *C. gigas* is resistant to Dermo, one of the two major pathogens. Our study is designed to address the question of resistance to MSX and verify the lab results with Dermo. Our design carefully mitigates the risks associated with exotic introductions: a) inadvertent pest or disease transferal and b) genetic contamination.

BACKGROUND

A. Mitigation of pest and disease transferal

Guidelines for controlling the hazards associated with the introduction of non-native species have been established by the International Council for Exploration of the Seas (ICES) "Working Group on Introductions and Transfers of Marine and Freshwater Organisms." With reference to diseases, this procedure recommends importation and holding broodstock under quarantine conditions. Only progeny from these imports can be used for introductions, or for this study -- testing.

In the summer of 1988, *C. gigas* broodstock were imported to the College of Marine Studies (CMS). Here, Drs. Pat Gaffney (CMS) and Allen spawned and reared F_1 progeny under the strict quarantine conditions available at this facility. These progeny were examined for presence of diseases in Spring, 1989 by Dr. Ralph Elston (Battelle Marine Research Laboratory, Sequim, WA) and none were found. In the summer of 1989, the state of New Jersey endorsed a project conducted at the Cape Shore facility of the Haskin Shellfish Research Laboratory to test *C. gigas* for MSX-disease resistance. During this same summer, juvenile F_1 progeny were spawned to produce an F_2 generation. These progeny groups represent the rudiments of a domesticated east coast population of *C. gigas* that will be increasingly important as more work is proposed using this species. The F_4 *C. gigas* progeny represent a broodstock that, following ICES guidelines, no longer have to be quarantined for disease purposes. Therefore the major deterrent to field testing *C. gigas* in Delaware Bay is one of uncontrollable reproduction.

B. Mitigation of genetic contamination

Induced triploidy is a genetic manipulation that has a proven track record for oyster production, but only for *C. gigas* on the west coast. The west coast oyster industry produced approximately 15 billion eyed triploid larvae last year. Triploid oysters are commercially valuable because they are reproductively sterile . In *C. gigas*, sterility enhances growth and market qualities in the adult oyster.

For this proposal, we are not concerned with the energetic advantage associated with reproductive sterility in triploids, but rather the sterility itself. Relative to diploids, gametogenesis in triploid *C. gigas* is severely retarded. However, both male and female triploids produce some gonad, and the quantity of the gametes varies widely among individuals.

In 1992, Allen's lab conducted two projects bearing on the question of reproductive potential of triploid *C. gigas*. (*i*) We examined the process of gametogenesis in diploid and triploid *C. gigas* and compared these observations with data from diploid and triploid *C. virginica* and (*ii*) we mated triploids to triploids, as well as triploids to diploids. The full details of this work are being prepared for publication and are summarized in Appendix I.

It is clear from this work that triploidy is a formidable reproductive impediment, but not an absolute barrier. However, our data now indicate that the successful development of larvae from triploid x triploid crosses is extraordinarily low. And it is now apparent that survivors would most likely themselves be triploid.

Triploids represent the most viable option for inhibiting reproduction, while still maintaining normal phenotypic characters of the oyster. The elements of risk are as low as biologically achievable.

APPROACH

Source and use of *C. gigas*

In summer 1992, the genetics program at the Haskin Shellfish Research Laboratory program has produced F_4 *C. gigas* that are about 60% triploid. For this study, we will "certify" every individual from this population for ploidy and remove all diploids. Certification will be accomplished at the Fluorescence Activated Cell Sorting and Flow Cytometry (FACS/FCM) Laboratory at HSRL using a Partec CA-II flow cytometer. THUS ALL *C. gigas* IN THIS STUDY WILL BE TRIPLOID and reproductively incapacitated. These oysters will be designated **Rutgers Sterile Triploids** (RSTs).

For certification of DNA content, a small hole or notch will be drilled in each oyster shell near the adductor muscle. A 1 cc syringe will be inserted into the adductor muscle sinus and hemocytes will be withdrawn. Cells will be stained in the DNA fluorochrome 4',6-diamidino-2- phenylindole (DAPI) and filtered through a 25 μm screen before analysis of DNA content on the flow cytometer. Diploid oysters will be discarded and triploids kept for deployment.

<u>Deployment of oysters</u>

RSTs and control *C. virginica* will be exposed in open waters in New Jersey in May 1993. Oysters will be deployed at the lower Delaware Bay Cape Shore site in the intertidal zone. Lab personnel are present at this site 24 hours/day in summer and 8-12 hours/day at other times. MSX-disease pressure here is more intense and consistent than at any other known location. RSTs will be held in plastic mesh ADPI bags, which themselves will be placed inside metal trays pinned to the bottom with iron reinforcing bars.

Before the study begins, RSTs and controls will be sampled for prevalence and intensity of disease. Prevalence and intensity of MSX and Dermo (*Perkinsus marinus*) will be determined using tissue-section histology and fluid thioglycollate culture by Ford. For the study, we will place 2 replicates of about 150 triploid *C. gigas* (total 300) and 4 replicates of 150 *C. virginica* (controls) of about the same age at Cape Shore. The controls will come from a cultivated population in the Damariscotta River, ME and range from 1.5 - 2", about the same mass as our experimental triploids. Control oysters are extremely susceptible to both MSX- and Dermo-disease and will indicate the prevalence of these diseases in the Bay. In addition, 2 trays containing larger susceptible *C. virginica* (obtained from Martha's Vineyard, MA) will be deployed at Cape Shore. These larger oysters will enable sampling of hemolymph for disease diagnosis, thereby serving as sentinels for disease onset. When hemolymph smears from sentinel oysters show about 50% systemic infection of MSX-disease, the first sample of experimental oysters will be taken. Sampling will be destructive and consist of randomly choosing 30 RSTs and 15 *C. virginica* from each replicate (total of 60 oysters of each species). In 1993, two more samples will be taken: one month after the first and in late October when prevalence of MSX- and Dermo diseases in Delaware Bay oysters typically peaks. The final sampling will occur in late spring, 1994 when potential sub-patent infections have bloomed. This sampling is necessary because occasionally MSX infections are acquired late in the summer or early fall, but cannot develop because of low water temperatures. Infections are detectable by the following spring, however, when water temperatures rise. Throughout the exposure, dead oysters will be removed and recorded. If soft tissues are still present, they will be examined for MSX and Dermo. Cumulative mortality will be calculated. The time course of the study is May 1, 1993 through June 30, 1994 (14 months).

At the conclusion of the study, we will have prevalence and intensity data for both MSX and Dermo in both oyster species at four times during the year. We will have ample data for assessing the incidence, extent, and fate of infections because (1) collection times are designed to intersect known prevalence peaks in the MSX and Dermo infection cycles and (2) we will be examining 60 oysters of each species at each collection at each site. Infection levels in the control, susceptible *C. virginica* will provide an index to the intensity of MSX and Dermo infection pressure. (In most years susceptible oysters become 100% infected.)

PLANS FOR USE OF INFORMATION AFTER THE EXPERIMENT

Use of *C. gigas* genes

We first need to know if *C. gigas* is resistant to MSX-disease and, at the same time, to verify that it is resistant to Dermo in a natural system. This would demonstrate the usefulness of genes belonging to this species. If resistant, as suspected, our long term plans are to develop procedures to hybridize *C. gigas* with our native species, *C. virginica*. (Initial attempts using straight forward approaches were unsuccessful. But it might be possible using more circuitous approaches.) Successful hybridization is essential to the most rapid approach to building a "new" species. Hybridization can lead to two courses: back crossing or triploid hybrids.

Back crossing. We could cross the hybrid back to native *C. virginica*. Through continuous selection of this cross, eventually (several generations) we would expect the resistant genes to be integrated into the native oyster.

Triploid hybrids. The course that the genetics program at HSRL prefers is to produce triploid hybrids because progress to a usable product, the "new" oyster, will be faster. A triploid hybrid is a hybrid of *C. gigas* and *C. virginica*, with an extra set of genes from the latter. The probable qualities of the triploid hybrid are (1) close resemblance to our native oyster in taste and appearance, (2) robustness and, hopefully, growth rates of *C. gigas*, and (3) sterility, since it will be a triploid. Sterility is important for several reasons. First sterile (neutered oysters) will grow faster and maintain market quality throughout the summer (as triploids do in Washington). Second, and equally important, they will not reproduce and "threaten" the native populations. Remember that a hybrid would still be part *C. gigas* and even if it is exceptional, there may be objection to its half-breed (or in this case, third-breed) nature. Third, from a commercial perspective, whoever owns the technology to produce triploid hybrids controls the market because they cannot be bred (analogous to the hybrid seed situation for many crops and flowers).

Transformation, not introduction

What we are really talking about, and our long term objective for *C. gigas*, is a transformation of the commercial oyster from a wild product to a cultured, genetically designed one. It is our conviction that this "new" species will spur the partial restoration and stabilization of the oyster industry through intensive and extensive aquaculture, with hatcheries forming the essential link between specialized genetic techniques to develop disease resistant stocks and the grower. Introduction of *C. gigas* per se is NOT part of this scenario, nor is the not-so-tenable notion of altering all native, resident oysters in Delaware Bay.

APPENDIX I:

Data on reproductive capability of triploids from summer 1992 research

In 1992, Allen's lab conducted two projects bearing on the question of reproductive potential of triploid *C. gigas*. (*i*) We examined the process of gametogenesis in diploid and triploid *C. gigas* and compared these observations with data from diploid and triploid *C. virginica* and (*ii*) we mated triploids to triploids, as well as triploids to diploids.

(*i*) Confirmation of gonadal development in triploid *C. gigas*.

Gametogenesis of triploid *C. gigas* was compared to diploids from the same spawn with both flow cytometric and histological techniques; triploid *C. virginica* were also examined as an outside reference to sterility in *C. gigas*. A total of 131 *C. gigas* and 118 *C. virginica* were sampled from May through August, 1992, at bi-weekly intervals.

No haploid sperm were detected in any male triploid, but all males were capable of producing 1.5n aneuploid sperm. Gonad development of triploid *C. gigas*, as measured by the area of the gonad relative to the total body area, ranged from 0.45 - 0.75 of the diploid mean. Gamete production in triploid *C. gigas*, as measured by the proportion of fully reduced spermatocytes -- 1n for diploids and 1.5n for triploids, ranged from 0.37 - 0.39 of the diploid mean. The overall reproductive potential of triploid *C. gigas*, as measured by the product of gonad development x gamete production, was about 0.27 of the diploid reproductive potential. In addition the triploids "matured" about 3 weeks after the diploids.

In summary, triploid *C. gigas* appear to have about ¼ of the potential for gamete production as diploids, irrespective of the quality of the gametes, which will determine the viability of progeny. We also examined this.

ANNEX 11

RECOMMENDATIONS TO COUNCIL

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

1) That the '1994 ICES Code of Practice on Introductions and Transfers of Marine Organisms', which has been modified to take account of the problems associated with the ecological and genetic impacts associated with introductions and transfers of marine organisms, and genetically modified organisms, be presented to the Council for adoption.

2) That the 1994 ICES Code of Practice on Introductions and Transfers of Marine Organisms', once adopted by the Council, along with a brief history of the Code and of the Working Group on Introductions and Transfers of Marine Organisms, be published as an *ICES Cooperative Research Report*, this Report to serve both as an accessible source of the Code of Practice, and as a general information source about the Working Group on Introductions and Transfers of Marine Organisms and ICES activities in general in this field.

3) That the 1994 ICES Code of Practice on Introductions and Transfers of Marine Organisms', along with a brief history of the Code and the Working Group on Introductions and Transfers of Marine Organisms, be published in one or more additional international scientific journals, by the Working Group, to insure the widest possible dissemination.

4) That on the basis of the considerations of the WGITMO on the importation of bass from the USA to Ireland by a private party, Member Countries are advised that the Council does not oppose the importation subject to adherence to the ICES Code of Practice, and under the land-based, completely contained culture conditions presented to the Council, and subject to the following conditions:

   a) *An assessment will be carried out* which addresses the operational and environmental aspects of the disposal of all waste products, including [illegible]d fish, waste water, and liquid manure. (The disposal of these products is to meet with the requirements of the relevant Irish authorities).

   b) *The facility will be constructed* so that in the event of complete tank(s) failure all fish and water would be physically contained within the facility.

   c) *A contingency plan will be prepared* that addresses any and all identifiable potential accidental events that could lead to fish escape (such as the loss of fingerlings during transfer from the port of entry to the culture facility).

   d) *Breeding stocks will be established* within the culture facility as soon as possible by importing surface-disinfected (if practicable) eggs from parents that have been lethally sampled for bacteria, viruses, and other potentially vertically transmitted organisms. These breeding stocks should be maintained within the site in isolation from fingerlings in culture.

   e) *No live fish or viable gametes will leave the security of the site.*

5) That the Council finds that the holding in the open waters of Delaware Bay and Chesapeake Bay of non-indigenous oysters (including triploid oysters) would constitute an introduction under the ICES Code of Practice. The WG further noted the need, as demonstrated in the Delaware and Chesapeake Bay non-indigenous species oyster program, for post-deployment monitoring of organisms (populations and/or individuals) placed in open waters as triploids to determine if any reversion has occurred. The techniques of sterilization of test organisms (such as triploidy) for field experiments, the efficacy of and justification for these techniques, and the risks involved relative to reversion to a reproductive state, should be discussed by the ICES Working Group on Applications of Genetics in Fisheries and Mariculture.

6) That in reference to Res. 1993/3:7, ICES should identify an official avenue in the European Commission (EC) to establish a dialogue between ICES Member Countries and the EC relative to the ecological and genetic impacts of increasing movements through trade of aquatic organisms and their products, and not just relative to the prevention of the spread of disease agents. The Working Group on Introductions and Transfers of Marine Organisms could serve within ICES to provide the technical and scientific expertise relative to this issue.

7) That Member Countries, but especially European countries, should be encouraged to develop ballast water and sediment management practices, particularly in the light of the potential further spread of the highly invasive ctenophore *Mnemiopsis* in Europe, in light of the discovery of the "phantom" fish-killing dinoflagellate *Pfiesteria piscimorte*, and in light of increasing global invasions of exotic species.

8) That the WGITMO should meet at the University of Kiel, Kiel, Germany from 10 to 13 April 1995, to:

   a) report on the current status of fish, shellfish, algal, and other introductions in and between ICES Member Countries, including the annual report on the status of *Porphyra* in the Gulf of Maine;

   b) prepare a discussion document on different models that could be applied for evaluating the potential ecological and genetic risks that might arise from proposed introductions and transfers;

   c) begin to consider the implications of introducing marine organisms into the environment as potential agents for biological control;

   d) continue work on the new *ICES Cooperative Research Report* on "The ICES Code of Practice on Introductions and Transfers of Marine Organisms: Guidelines and a Manual of Procedures," incorporating a history of the usage of the Code, an example of a prospectus relative to proposing new introductions, guidelines for evaluating the ecological effects of the release of GMOs (in consultation with the Working Group on Applications of Genetics in Fisheries and Mariculture), and a review of case histories and decisions reached on introductions and transfers by the Council;

   e) finalize plans for the 1995 Theme Session, "Ballast Water and Accidental Introductions" to be held during the 83rd Statutory Meeting in Denmark.