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International Council
for the Exploration
of the Sea

C.M. 1990/F:14
Mariculture Committee

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

Halifax, Canada, June 6 - June 8, 1990

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**SUMMARY
and**

1990 HIGHLIGHTS OF IMPORTANT ADVISORY INFORMATION ON INTRODUCTIONS

* **Working Group Offers Final Advice on Introduction of Japanese Scallops to Ireland**

The Working Group formulated advice on the introduction of the Japanese scallop to IRELAND. The WG does not oppose the continued development of Japanese scallop culture, in the form of field trials that would assess survival, growth, and gametogenesis in open waters; finds that establishment of wild populations is very likely; urges the monitoring of wild populations if such become established, and ecological relationships, if any, with native biota (particularly native scallops)

>> See pages 21-23 and 31-32

* **Growing International Concern of the Introduction of Exotic Species by Ballast Water**

The Working Group reviewed the mounting evidence that world-wide invasions are increasing as a result of ballast-water releases from ocean-going vessels. CANADA and AUSTRALIA have issued international advisories and guidelines for ballast water control; legislation is pending in the UNITED STATES. The invasion of the zebra mussel Dreissena in North America is a major biological alteration of North America. Red-tide dinoflagellates from Japan have invaded Australia; American jelly-fish have invaded the Black Sea; Chinese clams have invaded California's San Francisco Bay, among scores of cases. The WG proposes the formation of a Study Group to examine this issue and formulate advice for ICES member countries.

>> See pages 25-26 and 32

* **Transgenic and Other Genetically Altered Species as Introduced Species**

The Working Group began formal discussions on consideration of transgenic and other genetically altered organisms as introduced species, and the upcoming need to revise the Code of Practice to accomodate genetic engineering.

>> See pages 24-25 and 32

* **A 1990 Revised Code of Practice**

An interim revised code was formulated (at this time without reference to transgenic species) to accomodate much needed changes in advice on brood stock and quarantine management.

>> See pages 26-27, 32, and Document F:37

* **Chair Retires....**Dr. Carl J. Sindermann announced that he is resigning as Chairman of the Working Group, after 12 years in this position, upon the occasion of his retirement from the National Marine Fisheries Service.

>> See pages 1 and 33

WORKING GROUP ON INTRODUCTIONS AND TRANSFERS OF MARINE ORGANISMS
Report of a meeting, held June 6 - June 8 1990 at Halifax, Canada

INTRODUCTION

The 1990 meeting of the ICES Working Group on Introductions and Transfers of Marine Organisms (hereafter, WG) was held at the Halifax Laboratory of Fisheries and Oceans Canada from June 6 to June 8. Fifteen participants representing 7 member countries were present:

C. Sindermann	United States of America (Chairman)
J. Carlton	United States of America (Rapporteur)
M. Campbell	Canada
R. Cutting	Canada
R. Porter	Canada
R. Saunders	Canada
H. Grizel	France
J. Doyle	Ireland
J. McArdle	Ireland
D. Minchin	Ireland
S. Tilseth	Norway
B. Holmberg	Sweden
I. Wallentinus	Sweden
A. Munro	UK (Scotland)
S. Utting	UK (England and Wales)

Present during parts of the meeting, and representing Fisheries and Oceans Canada, were J. Ritter, M. Sinclair and D. Scarratt. Dr. Porter is also a NASCO member, and Dr. Saunders is also a member of the ICES Genetics Working Group. Both were present to participate in the WG's discussion on genetically engineered organisms.

The members of the WG were welcomed by Dr. David Scarratt, Director of the Halifax Laboratory. The Chairman thanked Fisheries and Oceans Canada for coordinating and hosting the meeting and for providing its facilities. The Chair then reviewed the goals of the WG's 1990 meeting; the Agenda for the meeting was considered and with revisions approved (Appendix I).

During the meeting Dr. Sindermann announced that upon the occasion of his upcoming retirement from the National Marine Fisheries Service, he would also be stepping down as Chairman of the Working Group, after serving 12 years in this position. The Group unanimously expressed their regrets at Dr. Sindermann's departure, and wished him the best of luck in his future endeavors.

After the meeting, representatives of the WG toured the Mountain Island Shellfish Hatchery, Blandford, Lunenburg County, on the shores of Mahone Bay. Dr. M. Helm hosted the Group. The hatchery currently produces the American oyster Crassostrea virginica, the European (Belon) oyster Ostrea edulis, the bay scallop Argopecten irradians, and the American hard shell clam (quahog) Mercenaria mercenaria.

STATUS OF WORKING GROUP RECOMMENDATIONS FOR 1989

The Chairman reviewed the status of recommendations formulated at the last meeting of the WG in Dublin, Ireland in May 1989 (1989 Report, C.M. 1989/F:16, pp. 21-22) and submitted for consideration at the Statutory Meeting of ICES in Copenhagen in October 1989:

Recommendation 1

That a study group be formed to review, consolidate, and report on the current status of techniques to detect genetic changes in Atlantic salmon stocks which could be caused through hybridization of wild and cultured populations; the proposed group to report to this WG and to the Genetics Working Group.

- > C. Res. 1989/2:35: A "Study Group on the Genetic Risks to Atlantic Salmon Stocks" will be established, to work by correspondence in 1990 and meet in 1991, and report progress to the Mariculture Committee at the 1990 Statutory Meeting

Recommendation 2

That an updated status report on introductions and transfers in ICES member countries be prepared for publication as a Cooperative Research Report

- > C. Res. 1989/1:1: The report will be published following review by the Mariculture Committee

Recommendation 3

That the laws and regulations concerning introductions and transfers of marine organisms in ICES member countries be prepared as a summary volume and deposited at ICES headquarters

- > C. Res. 1989/2:36c: That this be undertaken as part of the WG's 1990 meeting [ref also: C. Res. 1988/2:46d]

Recommendation 4

That the General Secretary of ICES should query member countries relative to their actions and experience with the Japanese scallop Patinopecten yessoensis

- > C. Res. 1989/4:5: Such action to be undertaken, and that such summaries be provided by May 1990 (E. Anderson sent such queries on February 2, 1990).

Recommendation 5

That the WG supports further work and collaboration to define potentially growing problems (relative to possible adverse effects and environmental impacts) of genetic transfers and manipulations in marine organisms

- > C. Res. 1989/2:36e: That this be undertaken as part of the WG's 1990 meeting, as a review of the Code of Practice concerning genetically modified organisms, with a view to developing an extension of the Code

Recommendation 6

That the WG meet in Halifax, Canada, in June 1990 to continue the work before it (and so listed)

- > C. Res. 1989/2:36: so indicated

ADDITIONAL 1989 COUNCIL RESOLUTIONS RELATIVE TO WORKING GROUP CONSIDERATIONS

In addition to the Resolutions noted above, the following Resolutions were passed at the 1989 Statutory Meeting:

- > C. Res. 1989/4:4: On advise to member countries relative to the introduction of the Japanese brown alga Undaria pinnatifida [ref: previous WG reports, including C. M. 1989/F:16: pp. 18-19]
- > C. Res. 1989/4:14, as follows:

"The Council will bring to the attention of the EC the experience of the Working Group on Introductions and Transfers of Marine Organisms."

HANDBOOK FOR THE WORKING GROUP

The Rapporteur distributed copies of a "Handbook" (54 pp.) for the Working Group. The Handbook summarizes the history of the Working Group since 1969, the meetings of the Working Group (four meetings from 1970 to 1974 under the Chair of H. A. Cole, and twelve meetings from 1979 to 1990 under the Chair of C. J. Sindermann), the WG's Statement of Purpose (1984), the detailed history of the Code of Practice, copies of the Revised Code in English and French, a list of Publications of the WG with Errata for Cooperative Research Report 130, a checklist and synopsis of Council Resolutions pertaining to the WG from 1969 to 1989, and four appendices. It was proposed by the WG that the Handbook be revised as necessary for the 1991 meeting, and be submitted for review by the WG for consideration for submission to ICES as an F: document of the Mariculture Committee.

NATIONAL SUMMARIES OF INTRODUCTIONS AND TRANSFERS

1.0 Relevant laws and regulations

Canada

Canada's Fish Health Protection Regulations came into force in 1977. These impact the movement of salmonids between provinces and importations to Canada. Currently the FHPR are being opened for their first major review and opportunity for adjustments, although minor prior adjustment of schedules has occurred. Interest exists for expanding regulations to affect all finfish, among other changes.

In 1990, the Province of Ontario will be reviewing regulations (Game and Fish Act) regarding the (intraprovincial) possession and movement of live bait fishes.

Norway

The Fish Diseases Act has been amended in 1990 and includes marine organisms in addition to salmonid fishes. The laws concerning introductions and transfers are under the control of three different ministries, Agriculture (for disease, for example), Environment (for wild salmonid stocks, for example), and Fisheries, making overall coordination difficult at times.

Sweden

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

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

United Kingdom

As of 25 December 1989, the importation of dead, ungutted salmon and trout from Norway was prohibited. This was in order to safeguard British salmon stocks against the introduction of infectious Laxanaemia, a highly infectious [viral?] disease which has caused heavy mortalities in some Norwegian farms and for which there is no known effective treatment.

United States

Legislation is now before both the United States Senate and the House of Representatives that calls for the regulation of ballast water discharge on the Atlantic and Pacific coasts and in the Great Lakes. This proposed legislation is coupled with proposals to control and study zebra mussel invasions in North America. The legislation calls for incoming vessels to exchange their original ballast water in the open ocean, before arriving in coastal or Lakes waters.

2.0 Other procedures concerning introduced species

Canada

The North American Commission (NASCO) is developing a set of protocols addressing fish health, genetic and ecological effects on Atlantic salmon resulting from introductions and transfers of salmonids. A draft discussion document has been prepared and it is now being reviewed by responsible political entities in eastern Canada and the USA.

In Prince Edward Island (PEI), a Federal-Provincial Introductions and Transfers Committee has been established. The Committee reviews all requests to introduce finfish, shellfish, or marine plants to PEI and all requests for transfers within the province.

A draft "Policy for Introductions and Transfers of Salmonids in the Province of Newfoundland-Labrador" has been prepared with expectation of implementation in 1990.

The Canadian Coast Guard has developed the "Voluntary Guidelines for the Control of Ballast Water Discharges from Ships Proceeding via the St. Lawrence Seaway to the Great Lakes." These guidelines were developed to prevent the further introduction of non-native freshwater and brackish-water invertebrates, fish, and algae in the Great Lakes as a result of ballast water discharges.

Experimentation and testing have continued in order to determine the appropriate quarantine period for Atlantic salmon eggs, and subsequent juvenile fish, when eggs are taken from broodfish in marine cages and are destined for other provinces.

United States

The Atlantic States Marine Fisheries Commission issued its Fisheries Management Report No. 13 in October, 1989, entitled "A procedural plan to control interjurisdictional transfers and introductions of shellfish". This plan addresses problems concerned with introductions and transfers of shellfish (mollusks and crustaceans) on the east coast of North America. The plan focuses on disease components and secondarily on ecological and genetic issues. At present, severe epizootics are occurring in oysters and clams in parts of their east coast range. "The proposed plan includes a review of the disease status of important east coast shellfish, an examination of existing management jurisdictions and regulations, recommendations for management of transfers of shellfish among jurisdictions, a proposed organizational structure, and proposed mechanisms for communication and interaction."

3.0 Deliberately introduced animal or plant species

3.1 FISH

The scientific names of the species referred to below are as follows:

Arctic char	<u>Salvelinus alpinus</u>
Brook trout	<u>Salvelinus fontinalis</u>
Atlantic salmon	<u>Salmo salar</u>
Rainbow trout (steelhead)	<u>Oncorhynchus mykiss</u> (= <u>Salmo gairdneri</u>)
Coho salmon	<u>Oncorhynchus kisutch</u>
Chinook salmon	<u>Oncorhynchus tshawytscha</u>
Channel catfish	<u>Ictalurus punctatus</u>

3.1.1. Fishery Enhancement (establishment of new breeding populations)

Canada

All imported salmonid eggs enter Ontario via a quarantine system:

Species	Introduced		Quantity	Notes
	From	To		
Arctic char	---	New Brunswick lakes	---	(1)
Tiger trout (brown trout x brook trout hybrids)	---	New Brunswick surface coal mine ponds	---	(1)
Atlantic salmon	---	New Brunswick lakes	---	(1)
	LaHave River, N.S.	Lake Ontario	60,000 eyed eggs	(2)
	Maine	Ontario	Green eggs, eyed eggs/2 shipments	(3)
	New Brunswick	Prince Edward Island	70,000 eggs	(4)
Rainbow trout (Skamania strain)	Indiana	Georgian Bay, Lake Huron	Green eggs	(5)

-
- (1) for establishment of recreational fisheries
 - (2) as year 3 of a 5-year plan to establish a breeding population for recreational purposes in two Lake Ontario tributaries
 - (3) to evaluate the feasibility of establishing self-sustaining populations
 - (4) for stock enhancement programs
 - (5) for stocking at yearling stage to improve the nearshore summer fishing and to establish "runs" of Skamania steelhead (and eggs for hatchery rearing)

Norway

A research and development program has been proposed by the Ministry of Fisheries on stock enhancement of Atlantic cod, Atlantic salmon, and Arctic char. Establishment of breeding populations is under study.

United Kingdom

Rainbow trout ova are imported into Scotland.

United States

Massachusetts released both chinook and coho salmon in the fall of 1989. As of January 1 1990, however, Massachusetts has closed down its chinook salmon program. A combination of budget considerations and poor returns (three poor years of returns (only 19 fish reported caught last fall in the Indian River)) lead to this decision.

New Hampshire has closed down its coho salmon release program. They report

that adequate supplies of hatchery fish are no longer available. The State continues its chinook salmon program (see table, next page).

New Jersey's Pacific salmonid program remains "on hold", as it has since 1988. "Environmental impact" reports on proposed releases are still being prepared. The state has no plans to release fish at this time.

Species	Stock from	Numbers Released and Date	Release Point	Agency (see footnotes)
Coho salmon	New York State and New Hampshire hatcheries	34,856 parr Fall 1989	Indian Head River Massachusetts	MASS: MF
	New York State	200,295 Fall 1989	Lamprey River New Hampshire	NH:FG
Chinook salmon	New York State	631,000 parr Fall 1989	Lamprey River New Hampshire	NH:FG
		400,000 planned for Fall 1990	Lamprey River New Hampshire	NH:FG
	New York State	76,880 parr late Nov/ early Dec 1989	Indian Head Massachusetts	MASS: MF

MASS = Massachusetts; NH = New Hampshire
MF = Marine Fisheries; FG = Fish and Game (Departments)

New York State hatchery is the Salmon Falls Hatchery. The New Hampshire hatchery is located at Milford, NH. Indian Head River is a tributary of North River in Massachusetts.

3.1.2 Mariculture (growth and fattening)

Canada

Eggs and fingerlings of Atlantic salmon, rainbow trout, and Arctic char are moved between the Provinces of Newfoundland, New Brunswick, Nova Scotia, Manitoba, Prince Edward Island, and Ontario [data available]. Rainbow trout eggs are imported from Washington to Nova Scotia. In 1989 and 1990, eyed eggs of Arctic char of Northwest Territories and Labrador stocks were imported from the federal Rockwood Hatchery in Manitoba for a six-month quarantine at the University of Guelph for intended release to the aquaculture industry for development of hatchery broodstock. Eyed eggs of landlocked Atlantic salmon were imported from Maine with the same procedure for the same purpose.

France

250,000 smolts of Atlantic salmon were imported from Norway. One-half million eggs of coho salmon were imported from the U.S.A.

Ireland

In 1989 licenses were issued for the importation of approximately nine million salmonid ova for fish farming purposes. The bulk of the ova were salmon and originated from Scotland. Rainbow trout ova were mainly imported from Northern Ireland and to a lesser extent from Denmark.

Norway

Dicentrarchus labrax were imported from Denmark in 1988. The fish are reared commercially in closed landlocked seawater recirculating systems.

Sweden

Cod fry are transferred within Sweden. Elvers have been imported from England (Severn) for stocking and aquaculture. Quarantine regulations are followed.

United Kingdom

A total of 47.375 million rainbow trout eggs were imported, under license, mainly from South Africa, Denmark, and Northern Ireland. Smaller importations (included in the total) were imported from the U.S.A., Australia, and the Isle of Man.

3.1.4. Recreational Purposes

Canada

35K eggs of landlocked Atlantic salmon were imported from Maine to New Brunswick in support of recreational fisheries, particularly in the border St. Croix River basin. About 250,000K eyed eggs of rainbow trout were imported from West Virginia to Nova Scotia for rearing and stocking for recreational fisheries enhancement. 50,000K eggs of landlocked Atlantic salmon were imported from Maine to Nova Scotia for similar purposes.

3.1.6. Research Purposes

Canada

Atlantic salmon, coho salmon, Arctic char and rainbow trout were moved for research purposes between certain Canadian provinces (data available). In addition, Atlantic salmon eggs were imported to Prince Edward Island (PEI) from Scotland and Norway. Channel catfish fingerlings and eggs were imported from the U.S.A. to PEI. Importations are into approved quarantine units under Fish Health Protection Regulations.

3.2 INVERTEBRATES

3.2.1. Fishery Enhancement

Ireland

Adults and larvae of the Japanese scallop, Patinopecten yessoensis, were imported in April 1990 under quarantine. The importation of this species

into Ireland is considered in detail in another section of this Report.

Ormer (abalone) importations to Ireland have been as follows:

In 1974-5 the case was argued and accepted that the abalone or ormer (Haliotis) was missing from the Irish fauna only as a result of the glacial and post-glacial history of western Europe. As the ice sheet retreated during the post-glacial warm-up, the rising sea level cut off first Ireland and later Britain, from the continental land mass. Haliotis had not recolonized before this happened, and its short larval life prevented it from doing so once Ireland and Britain became islands. Here, its ecological niche is occupied by genera such as the sea urchin Echinus and the snail (gastropod) Gibbula.

The European abalone Haliotis tuberculata was introduced to Ireland in 1976 from Guernsey, Channel Islands and put straight into quarantine. This abalone feeds best on green algae (especially Ulva) but also on red algae (particularly Palmaria). It grows to minimum marketable size (62 mm) in about four years. Following quarantine, progeny of the original H. tuberculata have been in enclosed cultivation in the sea since about 1979. No evidence of independent wild colonies has yet been found. The cultivated abalone are easily recognizable because of the distinctive green/red bands on the shell. This is used as a biological marker and is achieved by feeding them on green and red algae alternatively.

The Japanese abalone Haliotis discus hannai were introduced to Ireland in 1985 from Japan, and put straight into quarantine (ICES WG Report for 1985, C.M. 1985/F:60, page 13). This abalone feeds on the kelp Laminaria; it grows to minimum marketable size in two to three years. Thirty certified disease-free adults were imported and successfully spawned. The F1 generation has been screened regularly for parasites and diseases and has been found to be clear. About 3,000 are now in an open circulation system in the Shellfish Research Laboratory and the intention is to move them to containers in the open sea for planting out for on-growing studies during the summer of 1990; they are unlikely to spawn before 1992.

Both the European abalone and the Japanese abalone will probably spawn in Ireland, but for reasons explained above it has been accepted that this will not have any negative ecological impact. In the evaluation of prospective candidates for possible importation to quarantine as a faster-growing and cheaper alternative to Haliotis tuberculata, about 15 species were considered before deciding on the Japanese species. Scientists in the United Kingdom, especially David Alderman, gave extensive and very helpful advice during this process. The UK imported the red abalone Haliotis rufescens from California around 1982, and had already imported H. tuberculata.

Norway

A research and development program has been proposed by the Ministry of Fisheries on stock enhancement of European lobster. Establishment of breeding populations is under study.

United States

Giant Clams (Tridacna) Reported Growing in Florida (and Caribbean):

Of increasing concern is the intentional introduction of the giant clam Tridacna for aquaculture (mariculture) purposes to the Caribbean and Florida, USA. Dr. Ernest H. Williams (Department of Marine Sciences, University of Puerto Rico) reports that living giant clams have been shipped from Palau (Micronesia) and are now in cultivation in Bonaire (Netherlands Antilles), Guadeloupe, and in south Florida.

The immediate concern is that these clams have apparently not been screened for diseases or parasites. "We hope to cooperate with the culture projects and with clam experts in the Pacific to prevent any diseases or parasites from being transmitted into the Caribbean...We believe there is urgent need to avoid introducing pathogens which may harm the conduct and reputation of aquaculture or damage Caribbean fisheries" (E. H. Williams).

There is a rapidly growing interest in tridacnid clam mariculture in much of the tropical world. Heslinga and Fitt (1987) reviewed the "domestication" and "farming" of giant clams. Munro and Nash (1985) reviewed the literature on Tridacna, in particular relative to mariculture considerations.

3.2.2. Mariculture

Canada

Bay scallops (Argopecten irradians), European oysters (Ostrea edulis), sea scallops (Placopecten magellanicus), and Iceland cockles (Clinocardium ciliatum) are moved between certain Canadian provinces (data available). Movements are for rearing, for growth and marketing, and in the case of the cockles (Magdalen Islands to Nova Scotia) to begin assessment of feasibility as an aquaculture species.

France

Experiments with the Japanese scallop Patinopecten yessoensis did not give promising results at the Mediterranean study sites (Port-Vendres). After two years of rearing, survival was between 15 and 20 percent (40,000 individuals initially) and the average length was 70mm. For the same period of growth in Japan scallops are 5 cm larger. A brood stock has been kept to raise an F2 generation under improved zootechnical conditions and to test growth at other sites.

Ireland

84M spat of the Japanese oyster Crassostrea gigas and 16M spat of the Manila clam Tapes philippinarum were imported from England and Guernsey, Channel Islands.

Norway

Broodstocks of Crassostrea gigas and Tapes philippinarum were imported from the UK in 1988. F1 progeny have been established according to the Code of Practice. Spat production is commercialized.

United Kingdom

All introductions were made from areas certified as disease-free, and licensed under the Control of Deposit Order.

Imports of indigenous species were made to supplement shortfalls in natural recruitment. 1,180 mt of the mussel Mytilus edulis ranging in size from 12 to 60 mm were obtained from Ireland (North and South) and Scotland and planted at Poole. 7mt of the oyster Ostrea edulis, from 12 to 80 g, were brought in from Northern Ireland and Spain.

Of non-indigenous species, 15 mt of Crassostrea gigas (65 to 90 g) were obtained from Scotland and Jersey. 3 million C. gigas seed (2 to 25 mm) and 3.3 million Tapes philippinarum seed (5 to 10 mm) were imported from Guernsey. Crassostrea gigas are also imported from the Channel Islands to Scotland.

3.2.3. Live storage prior to sale

Canada

Up to 100,000 lbs of blue mussels (Mytilus edulis) have been approved for movement during 1990 from the Magdalen Islands, Quebec, to Prince Edward Island.

France

Flat oysters (Ostrea edulis) were imported in 1989 from the Netherlands, Italy, U.K., Ireland, and Spain; Pacific oysters (Crassostrea gigas) were imported from the Netherlands, U.K., Ireland, Spain, Gabon, and New Zealand.

Mussels (Mytilus edulis) were imported from Belgium-Luxembourg, the Netherlands, Federal Republic of Germany, U.K., Ireland, Denmark, Spain, Sweden, Turkey, Canada, and South Korea. Scallops are imported from Belgium-Luxembourg, the Netherlands, Italy, U.K., Ireland, Denmark, Spain, Tunisia, U.S.A., Canada, and Chile.

Sweden

Lobsters (Homarus americanus) are imported from U.S.A. and Canada. Oysters are imported from France.

United Kingdom

615 mt live lobsters were imported for consumption. 856 mt of crabs, 479 mt of oysters, and 343 mt of scallops were also imported for consumption but the proportion of live animals is unknown.

3.2.4. Improvements of food supplies for other species

United Kingdom

Dried brine shrimp eggs (Artemia salina) were imported in large quantities from several world-wide sources to provide live food for fish in aquaculture and research systems.

Large quantities of live polychaete worms (Nereis virens and Arenicola marina) are imported from Holland both as food for fish species and for angling. Imports of live "ragworm" (species unknown) have also been made from Korea.

3.2.5. Research Purposes

United Kingdom

Small numbers of oyster (Ostrea edulis and Crassostrea gigas) seed (2cm) were brought in from Scotland for experimental field trials.

Small quantities of the bivalves Perna perna, Brachidontes emarginatus, Barbatia obliquata, Saccostrea spp., Meretrix casta, and M. lusoria from Sri Lanka, Mytilus galloprovincialis from the French Mediterranean coast, Mytilus edulis from Holland, and Pinctada radiata from Bahrain were introduced into quarantine and then destroyed at the end of the research period.

3.3. Plants

France

The experimental culture of the Japanese brown alga Undaria pinnatifida has been extended to the iles de Sein. In January 1990, production at Ouessant was 120 tons and at Sein, 5 tons. The production at Ouessant is 60T/ha, all of which was based upon gametophytes raised in the laboratory. There are no new data on potential competition between indigenous algae and the introduced species.

Sweden

Small amounts of the brown alga Hormosira banksii from southern Australia have been brought to the Kristineberg Marine Biological Station for physiological research. They are kept under strict quarantine laboratory conditions, the water being discharged into the urban discharge (chlorinated freshwater) passing through the sewage treatment plant.

Small amounts of the North Atlantic algae Pelvetia canaliculata, Himantalia elongata, and Alaria esculenta have been brought from Norway for research purposes also; they are kept in running seawater in the laboratory. The species do not occur in Sweden as attached plants, but can be found in drift (especially Himantalia, which is often found drifting in masses on the Swedish coast). In addition, a large number of other marine algae (mostly small red algae of the order Ceramiales), from Norway, the U.S.A. Pacific coast, the Mediterranean, southern Australia, and South Korea, are kept under strict laboratory conditions in the Department of Marine Botany, University of Goteborg. They are in vials with culture media which when changed is discharged into the urban sewage system.

4.0 Species Introduced with Deliberate Introductions

United Kingdom

Surveys continued by MAFF to monitor the occurrence of the American oyster

drill Urosalpinx cinerea. There has been no further spread.

United States

The Hawaiian-based Oceanic Institute reports that a disease-free population of the shrimp Penaeus vannamei has been developed in their hatcheries on Oahu, Hawaii. The Institute's program, in cooperation with Dr. Donald Lightner (University of Arizona), was in response to global concerns over the spread of IHNV (infectious hypodermal and hematopoietic virus) and Baculovirus penaei. The original disease-free stock came from southern Mexico.

5.0 Completely Accidental Introductions

Canada

Capture at the Mactaquac Dam fish collection facility on the Saint John River confirmed the introduction of the muskellunge, Esox masquinongy, to New Brunswick. The fish arose from the introduction of the species to a Saint John River headwater lake in Quebec by that province several years ago.

The European rudd, Scardinius erythrophthalmus, was found in 1989 in Lake Ontario. Source of the introduction may have been the Hudson River area of New York where these cyprinids are used as bait for striped bass, or from ballast water.

The tube-nosed goby, Proterorhinus marmoratus, was found in the St. Clair River, Great Lakes. The species is native to the Caspian and Black Seas. It is believed to have been introduced by ballast water.

The "volunteer" populations of coho salmon in the Cornwallis River have not been seen for two years; they thus may have died out. One hypothesis for their demise is that the springs are too warm in the summer for the juveniles in the Maritimes. A research report by a postdoctoral investigator has been completed on this population.

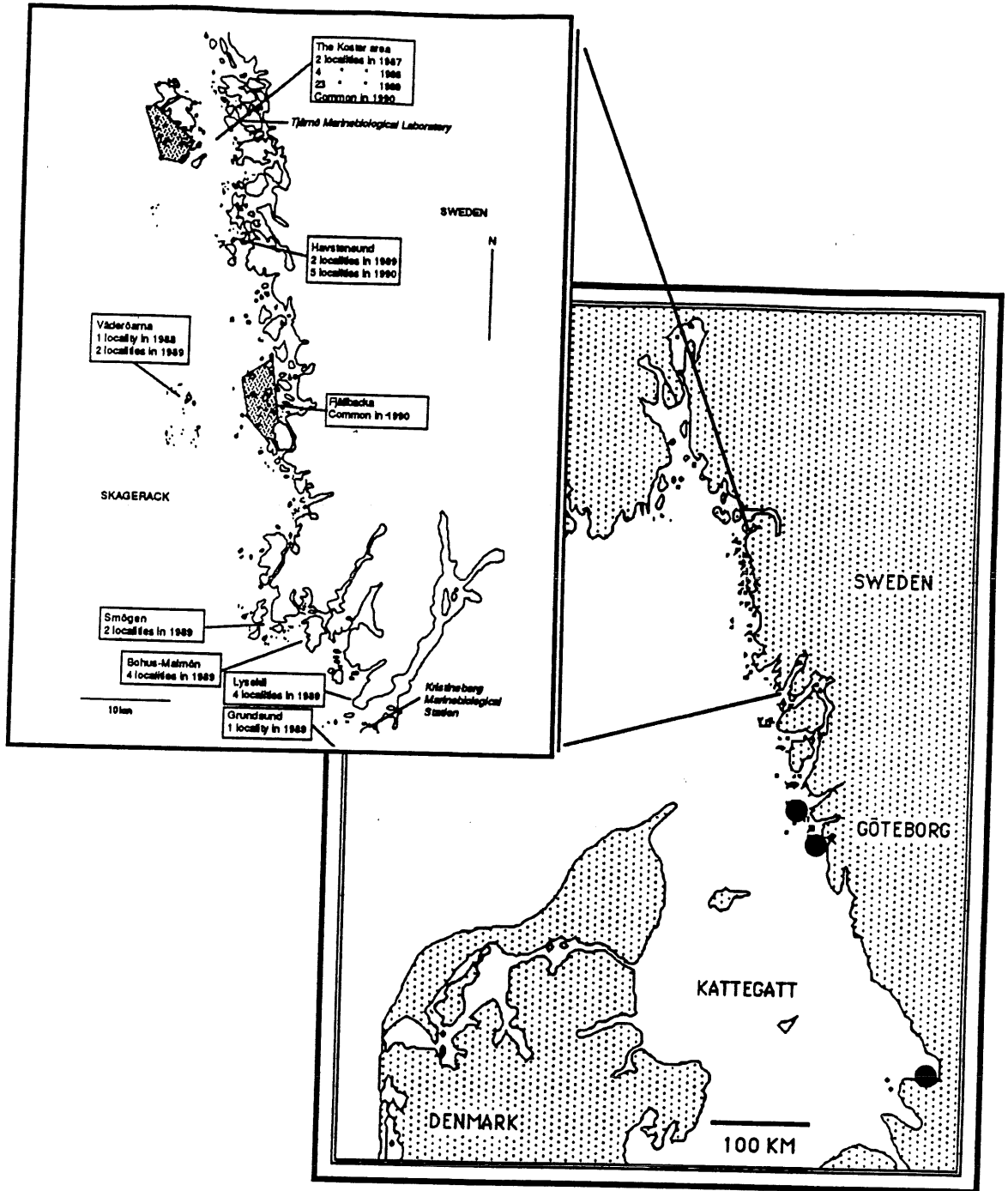
Norway

The alga Sargassum muticum has established itself along the south coast of Norway as far west as County Vest-Agder in 1988 (Rueness, 1989).

Sweden

The occurrence of the alga Sargassum muticum in Sweden (report provided by J. Karlsson):

The brown alga Sargassum muticum has for the last five years regularly been found on the Swedish west coast, mainly in the northern part. No attached plants have been reported south of the fjord Gullmaren in the Skagerrak, nor in the Swedish part of the Kattegat, although this might be due to less intensive searching in those southern areas. It does not occur in a well-studied area in the southern part of the Laholm Bay, Kattegat.



Sargassum muticum in Sweden

● Drift records

During 1989 it occurred on a total of 38 sites in the East Skagerrak, ranging from one plant up to much more than 5,000 (not counted if above) plants per locality. Drift material was frequently found in the whole area from March to September. The winter of 1989/90 was again mild with high water temperatures and no ice. During spring the plants have been frequently found in many parts in the previously reported area (see 1989 report). It does not occur in more sheltered positions, but in more exposed areas, and frequently enough to turn up in randomized diving transects. The maximum depth encountered has been about 8 meters. In the two archipelagos of Koster and Fjallbacka, the East Skagerrak, the species also has colonized open bays and basins. Altogether 65 localities are known from the Swedish west coast.

Other algal species:

During spring 1990 unusually high abundances of the introduced Pacific alga Colpomenia peregrina have been found in the Koster area, north Swedish west coast. The plants were up to about 20 cm in diameter and mainly attached to mussels (J. Karlsson).

Invertebrates:

The American razor clam Ensis directus has been found in Bohuslan, and East Skagerrak, in densities of 5-10 individuals per square meter on sandy and silt sediments from 0 to about 10-15 m depth. It is supposed to have arrived in 1981 or 1982 and probably the species is commonly spread along the Swedish west coast (Lundalv, 1989). It was originally first reported in Europe from Germany, to where it is believed to have been introduced by ballast water.

United Kingdom

A second specimen of the shrimp Penaeus japonicus was caught in February 1990 at a depth of 70 m off the coast of Cornwall by a local trawler. It was 100-130 cm in length and was sent to France for positive identification. The first specimen, of similar length, was caught in January 1989 at 50 m again off the Cornish coast. It is thought that both may have escaped from a culture site in France.

United States

VHS Re-appears in Salmonid Fishes in State of Washington:

In December 1989 viral hemorrhagic septicemia (VHS) was re-discovered in coho salmon in the State of Washington (see attached newspaper article of 16 January 1990, from Seattle Times). Over two and one-half million coho salmon eggs were destroyed in a hatchery after this discovery; it may be possible to recover from this loss by obtaining eggs from other hatcheries.

The mechanism by which VHS arrived on the Pacific coast of North America remains a heated issue between native Indians, fishery biologists, aquaculture officials and shipping industry officials. Some workers believe that imported salmon eggs from Europe introduced the virus. However it is believed that sterilization, quarantine, and pathogen testing programs in place are (were) sufficient to make this an unlikely transport mechanism. Others believe that the virus may have been released in the

Carlton

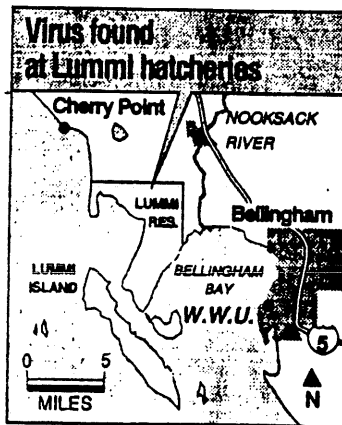
Hatchery forced to destroy eggs

Dietrich
staff reporter

Lummi Indian tribe has destroyed 2.7 million coho salmon eggs after the rediscovery in this state of a deadly European fish virus called VHS.

"That is a horrible thing," was the reaction of Arthur Whiteley, a professor emeritus of zoology at the University of Washington, to news that the virus has resurfaced here.

Viral hemorrhagic septicemia, deadly to trout and carried by salmon, was first identified a year ago at the Makah hatchery on the Olympic Peninsula and at the state's Glenwood Springs Hatch-



ery on Orcas Island.

Some 3.8 million salmon eggs were destroyed then in an attempt to contain the virus.

The virus has killed up to 90 percent of the fish at trout farms in Europe. Last year was the first time it had been detected in North America.

Authorities hoped they had VHS contained after tests on thousands of fish around the state did not turn up any more virus. But scientists such as Whiteley had doubts all along.

"We were predicting it would appear again this time this year."

Please see **LUMMI** on B 2

Coho eggs dumped to block infection

LUMMI

continued from B 1

he said, because VHS thrives in cold water.

The Lummis found the virus in ovarian fluid taken Dec. 11, in just one of 15 groups of tested salmon at their hatchery near Bellingham. As a precaution, all remaining coho stocks at the Lummi Bay and Skookum Creek hatcheries were destroyed over the past week to prevent release of young salmon carrying the virus.

The eggs represented salmon worth \$2.5 million in 1993, when they were expected to return as adults, said Chuck Bendel, spokesman for the Northwest Indian Fisheries Commission.

"It's definitely a blow," Bendel said. "It amounts to 45 percent of the tribe's coho production. But better safe than sorry."

The Makah tribe managed to make up much of its loss by obtaining eggs from other hatcheries, Bendel said, and the Lummi

may be able to do the same.

Although the virus has been detected, no Washington fish have actually been diseased, and no fish have died.

Diseased fish will not harm humans who eat them. But a widespread VHS outbreak could disrupt hatchery production, produce a quarantine on export of Washington salmon or trout eggs, and potentially devastate trout and steelhead fishing.

The source of the virus is a mystery, with authorities differing on whether the most likely origin is visiting ships or imported Atlantic salmon.

The virus lives in diseased fish and is shed on the surface of fish eggs or feces.

Because the outbreaks have been near shipping lanes, Bendel said, tribes and state officials suspect that "this virus is somehow being transferred from European waters by tankers and other shipping."

Empty ships sometimes take on ballast water to keep themselves low enough in the water to operate

water itself, or fish sucked into and pumped out of holds, are transporting the disease.

Robert Levine, senior marine architect for Arco, said such a source is theoretically possible. In the case of tankers, he said, ballast water is sucked through a 1-by-3-inch mesh. "I've personally never seen fish in ballast tanks, but I've seen crab and marine life," he said. Other crewmen have seen small fish in double-bottomed tankers, he said.

Weighing against that theory, Levine cautioned, is that live fish might be pulverized by pumps on discharge. And he could think of no instance of an empty oil tanker coming straight from Europe to Puget Sound, although grain ships might make that trip.

Whiteley, however, said he believes a shipping source is improbable, citing studies that show the virus is unlikely to survive by itself in water, or on boots or similar gear.

He and other aquaculture critics remain suspicious that Atlantic salmon eggs imported from Eu-

farms are the virus source.

State fisheries officials last year discounted aquaculture as a VHS source, noting that eggs are sterilized with iodine and quarantined.

But Whiteley said, "We can't close down the concept of fish farming as the containing source. Somehow, a moratorium on these things has to be instituted. Maybe it's already too late."

He said the state's three-month quarantine of imported European eggs may be inadequate, because the virus can remain dormant on an egg up to 18 months.

"Investigators concluded the source is unlikely to be the aquaculture industry," responded John Forster, president of the Washington Fish Growers Association. "All farms were tested and sampled intensively (in 1989) and no virus was found."

More recently, he said, local farms tested their brood stock this winter and again found no VHS virus.

The Lummis said they will lead an effort to establish a research facility to figure out where VHS is

ballast water of ships coming from western Europe to Puget Sound. However, little is known about this latter mechanism as a transport mode for fish viruses. Some data appear to indicate that the virus cannot live "by itself" in water.

Introduction of the Zebra Mussel *Dreissena polymorpha* to the United States and Canada

What will undoubtedly be recognized as one of the most striking invasions of North America, ranking with the starling (bird) and gypsy moth (insect) introductions on land, has now occurred. As briefly noted in last year's report, the European zebra mussel, *Dreissena polymorpha*, was discovered in Lake St. Clair, between Lake Huron and Lake Erie, in the summer of 1988. Now, in the summer of 1990, there are uncountable hundreds of millions of zebra mussels in the Great Lakes.

It is believed that the zebra mussel, along with other organisms, was introduced to North America as veliger larvae in the ballast water of ocean-going vessels arriving from Europe. While other ballast-water introductions were known prior to the arrival of the zebra mussel, the introduction of this bivalve has been sufficiently disturbing that legislation has, for the first time, been introduced to Congress to control further releases of exotic species by discharged ballast water. Ballast water is also an issue of concern for other governments; for example, Australia has issued a ballast water advisory (see attached example).

The nature of the impact of the zebra mussel in North America, as noted in the attached newspaper stories (there has to date been only one published North American article, by Hebert et al., 1989), revolves around a number of major concerns which focus on the role of the zebra mussel,

- (1) as a fouling organism,
- (2) as a consumer of phytoplankton,
- (3) as a competitor for space,
- (4) as a nuisance organism on public beaches

and

- (5) as a new and "unknown" element in the overall ecosystem and trophodynamics of the Great Lakes.

The zebra mussel blocks water pipes to the extent that water flow is drastically comprised (to the point of being completely prevented in some cases). The mussel attaches with marine mussel-like byssal threads. It consumes an unknown amount of phytoplankton in the water column, converting this plankton to energy and to pseudofeces detritus deposited on the bottom, and sufficient to cause many people familiar with Lake Erie waters to remark on the (now) remarkable clarity of the water! Of immediate concern is that this food (phytoplankton) also appears to be the basis of larval fish diets in the Great Lakes.

The zebra mussel now covers vast areas of previously unoccupied space on the lake floor, including once-bare rocks, as well as on artificial pilings, docks, buoys, etc. Some of these spaces were (and in some cases still are) utilized by the more abundant fish for egg deposition.

Carsten

Heldia 1 (5-6): 196 [1989]

Spreading of Dreissena polymorpha (PALLAS) to Northern America.

In September 1988, I received a message from DAVID B. MACNEILL, Sea Grant Program, Brookport N. Y., that an "exotic mollusk" Dreissena polymorpha was identified in Lake Erie in June 1988. According to Dr. PAUL HERBERT, University of Windsor, Ontario, this freshwater species was introduced as a result of ballast dumping from freighters traveling from European ports. Because of some dangerous characteristics of Dreissena Americans fear that they are now facing problems as serious as those of the Europeans in the past.

Features of Dreissena that supported its spreading over the whole of Europe are likewise responsible for troubles in drinking water and non-potable water works: First, mussels affix by means of byssus threads on all kinds of hard substrates: stones, rocks, boats, nets, but also on concrete and inside walls of pipes. Second, they spread by free-swimming larvae, which are sucked into water pipes. Clogging of mains often poses a severe problem for drinking water facilities in Europe.

Spreading of Dreissena would have never been so successful without the process of eutrophication, now higher algae concentrations being available than mussels maintenance requires. Starting from a refugium zone in the Aralo-Kaspian region, where it had drawn back during glacial periods, Dreissena expanded in the first half of the last century over great parts of Middle and Western Europe, the Danubian region and Great Britain. This was made possible by opening canals for shipping traffic. Former oligotrophic and isolated pre-alpine lakes and lakes south of the Alps were first infested in a second step of expansion as late as the 60ies of this century. Growth of tourism and transfer of tourist boats from lake to lake are responsible for the revival of spreading - and mussels found good conditions in eutrophicated lakes. A remarkable exception is Balkan Lake Ohrid, an old tectonic lake (as Lake Baikal), where Dreissena has been established since earlier times. Due to other morphological and biological characteristics it seems to have evolved another species, not polymorpha.

Occurrence of Dreissena in Northern America shows that spreading hasn't come to an end. In spite of the fact that extension is highly supported by man, one has no practical possibilities to defeat it under the present sociopolitical conditions. One can only support some natural enemies like water birds and invest in technical installations like chlorination of tap-water. But it will never be possible to eradicate it. Immigrants usually show a mass development of individuals. In case of Dreissena invasion is stopped after a few years by proliferation of water birds eliminating all bigger mussels (> 1 year) down to 5 m depth every winter. But there is no doubt Dreissena will become an established member of water fauna in Northern America, as the American Eloidea canadensis did in the water flora in Europe in the last century. Dreissena as a late European "revenge"?

→ NORBERT WALZ. WALZ
Zoologisches Institut der Universität München,
Seidestraße 25, 8000 München 2.

Finally, the zebra mussel, as a now extraordinarily abundant species, is covering rocks and leaving shells and shell fragments in recreational areas, resulting in (previously popular) bathing beaches now having considerable populations of live mollusks and shell debris.

The full role of the zebra mussel, as predator (of plankton), as prey (of diving ducks, for example), as a competitor and disturber, cannot as yet be determined. In economic terms the federal United States Fish and Wildlife Service has estimated that the current costs of the zebra mussel (in terms of its fouling capabilities and in potentially reducing finfish stocks in the lakes) may be approximately \$400,000,000 (four hundred million dollars) each year for the next 10 years. This figure will increase greatly as it invades the rest of North America.

Since their discovery in Lake Erie in 1988, the zebra mussels have now spread to Lake Ontario and Lake Michigan; it is predicted that it will be in all five of the Great Lakes by the end of 1990. Physiological considerations indicate that the zebra mussel has the capability to invade and be successful in two-thirds of North America. Major corridors include the Mississippi and Missouri River systems. Over fifteen different transport mechanisms may now be available to the zebra mussel to affect its spread rapidly across North America (J. T. Carlton, unpublished manuscript).

Other Introduced Aquatic Species in the Great Lakes

The European ruffe, Gymnocephalus cernua, continues to spread relatively slowly (compared to the zebra mussel) across Lake Superior. The population is now estimated to be in excess of over 1,000,000 (one million) fish. The ecological impacts of this invasion are not known. However, State of Wisconsin fishery officials are sufficiently alarmed about the ruffe that a major predatory-fish (walleye) stocking program in the Duluth Harbor, Lake Superior, area is planned. The European water-flea (cladoceran) Bythotrephes cederstroemi, is now found in all five Great Lakes. The role of this water flea in the Lakes' trophodynamics is under considerable debate. Both the water-flea and the ruffe are ballast water introductions. A single specimen of the Mediterranean tube-nosed goby, Proterorhinus marmoratus, was discovered in 1990 in St. Clair River (see Canadian report).

Asian Crab in New Jersey

A specimen of the common Japanese crab Hemigrapsus sanguineus was collected in September 1988 in marine waters of a small inlet in southern New Jersey (Williams and McDermott, 1990). The crab, over 3.5 cm in width, was an ovigerous female. Its native range is from Sakhalin, Korea and north China to Hong Kong, and all of the Japanese coast. Interoceanic shipping is suspected as the probable agent of dispersal. Ballast water release by cargo vessels from Korea, China, Russia, or Japan, inbound to United States ports, and with entrained crab zoea or megalops, may be the primary mechanism.

Introduced Tunicates (Sea Squirts) on the USA Atlantic Coast

The two introduced tunicates (ascidians), the European-Asian stalked

Foreign shellfish threatens Ontario lakes

European zebra clams spread quickly

WINDSOR, Ont. (CP) — A tiny European mollusc is reproducing so rapidly in Lake St. Clair it is clogging water pipes, affecting drinking water and threatening to change the ecosystem of some Ontario lakes, researchers say.

It's only been one year since zebra clams were found breeding in Lake St. Clair, but biologists say they have formed a patchy living carpet on the bottom of the lake, nestled between Lake Huron and Lake Erie where the creatures have also been found.

There were none of the black-and-white striped creatures in the lakes in 1983. This summer about 160,000 per square metre have been found in some areas.

"The little critters are taking over the world," says Wilfred LePage, who runs a water treatment plant in Monroe, Mich., 16 kilometres inland from a Lake Erie intake.

The clams have invaded the system's water lines, cutting pumping capacity by 25 per cent, he says.

"It's damn frustrating," says LePage, who explained the clam's habit of plugging water intakes could boost operating costs.

The clams have also been blamed for killing freshwater clams and causing problems with drinking water in Windsor.

The zebra clam, a native of the Caspian Sea, is believed to have entered the Great Lakes in the ballast of a European freighter.

"Its abundance has increased beyond anything we thought could be possible," says Paul Hebert, director of the Great Lakes Institute at the University of Windsor.

And they are wiping out freshwater clams, Hebert says.



The invading zebra clams are smothering native freshwater clams

— CP photo

"You can't even see the big clams anymore. They are just covered with a mass of these creatures. In terms of native species being wiped out, it's kind of tragic."

He says the clams may also be altering the taste of Windsor's

drinking water because of blooms in amounts of Lake St. Clair algae, which Hebert calls a side effect of the clam's presence.

But the worst is yet to come say researchers, who predict the clams will probably travel on boat hulls to infest Ontario's in-

land lakes within a decade.

But LePage says he has some advice for coping with these aquatic immigrants: "It looks like there is no way to get rid of them. We're going to have to learn to live with them, like they do in Europe."

(The Ottawa Citizen Sept 8 1989 Chomah) ←

CSO to GE

Tiny mussel threatens industry on Lakes

By MICHAEL LEVY
News Staff Reporter

ROCHESTER — Industry, power companies and municipal water plants are bracing for the sting of the zebra mussel, a tiny shellfish that in two years has spread from Lake St. Clair near Detroit to Port Weller on Lake Ontario, causing costly damage along its route.

Over the next 10 years, the U.S. Fish & Wildlife Service estimates, the tiny shellfish could cut the value of commercial and sport fisheries in half — and could cost taxpayers, ratepayers and consumers an additional \$2.3 billion in construction and maintenance costs.

Some 200 scientists and engineers are ending a two-day international conference today that was organized by Sea Grant. Conference participants are sharing experiences and ideas for coping with this recently introduced menace to the Great lakes.

"It was first spotted in June of 1988 in Lake St. Clair," said biologist Ronald Griffis of the Ontario Ministry of Natural Resources, "and last week reached Lake Ontario. It is coming to a pipeline near you."

In September, the mussel was discovered in the intakes of the Niagara Mohawk generating plant at Dunkirk. The Dunkirk municipal water plant fears its lines, too, may be infested.

Arriving in water ballast from European freighters, the tiny shellfish spread rapidly, building thick colonies on anything to which they can attach.

Last summer, mussel colonies affected manufacturing plants, "ruined scientific instruments, sank marker buoys and choked the raw-water intake lines at municipal water treatment plants," Griffis said.

"One small town near Windsor (Ont.) will

"I thought, after 35 years ... I'd lived through every pestilence possible. I was wrong."

Wilfred LePaige
Water plant manager

spend \$3 million to rebuild a water plant that serves 8,000 people," he added.

The Monroe, Mich., water plant saw its intake capacity shrink by half, from 18 million gallons per day to 9 million over three months last summer.

"We almost lost the plant — pumps sucking air, cavitating, pressure dropping," plant man-

ager Wilfred LePaige said.

"I thought, after 35 years in the water-supply business I'd lived through every pestilence possible. I was wrong."

The plant cleansed itself by pretreating all incoming water with heavy doses of chlorine to kill the animals.

"That caused a deluge of dead mussel tissue," a gooey mess that had to be strained. Truckloads of shells were bailed out by hand in buckets, LePaige said. He spent at least \$50,000 in parts and repairs, and has not yet calculated the labor costs.

A complete pipeline cleaning will cost the community \$72,000 and the costs of its new raw-water intake — planned for construction, anyway — may be doubled by a permanent pretreatment scheme, LePaige said.

The Detroit Edison plant nearby saw a 15 percent reduction in generating capacity because of mussel-clogged lines. "That meant a loss of \$500,000 in power sales," plant manager William Kovalak said.

Today, the conference will hear from speakers experienced in shellfish control, including Henk A. Jenner of Holland's KEMA, the research arm of that country's power industry. Europeans have dealt with this fast-colonizing pest for more than a century.

State court rules against Ford in Lemon Law case

By DAVID BAUDER
Associated Press

ALBANY — The Ford Motor Co. violated the state's Lemon Law for new cars by charging consumers a \$100 deductible for repairs made during an extended

period that would cost the company up to \$5.3 million.

The decision could also affect owners of General Motors and Chrysler cars, Abrams said. Those companies also charged the deductible between 1983, when the

years or 18,000 miles.

Ford's warranty offered free repairs during the vehicle's first year or 12,000 miles, whichever came first. For repairs beyond that term and up to the Lemon Law's

Although the companies were known to charge the deductibles, only Ford had been challenged in court, said Abrams spokeswoman Nancy Connell. She said he hopes the other

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And in the Williamsburg section of Brooklyn, an elderly woman ushered Miguel Barreto, a census worker, into her apartment, but not before keeping him knocking for minutes.

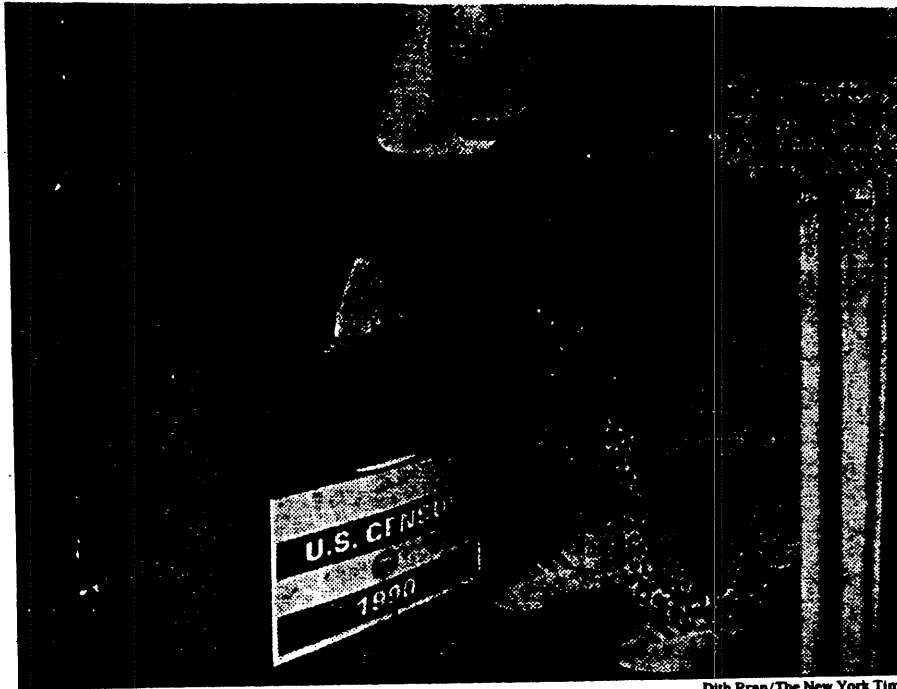
"I almost didn't get up," she said. "I thought it was the Jehovah's Witnesses."

A Force of 200,000

So goes the day for the census counters, a force of more than 200,000 temporary workers who are combing apartment buildings and houses throughout New York City and nationwide to elicit information from households that failed to return questionnaires by last month's deadline.

The count is crucial for areas with low mall-back rates like New York City, not only in determining accurate population numbers but also influencing the local share of Federal aid and representation in state legislatures and Congress.

But despite its importance, the job is fraught with frustration and tedium, and a turnover rate of up to 100 percent. For each counter hired, the bureau keeps at least seven replacements ready to take over, recruited mostly from the neighborhoods where they are needed. This candidate pool stands at some 69,000 people in New York City, and about 1.4 million nationwide, but



Dith Pran/The New York Times

"A lot of people don't expect the job to be so hard," said Virginia Pei, a census counter in Chinatown. She put a census form under the door of a Mott Street resident.

Continued on Page B7

England and banks. F.D. Rich, a closely held family-run firm, is four months behind on \$2.7 million it owes in city property-tax payments; it may have liens placed on some of its properties if payments are not made by May 31.

And last month, the cash-hungry company announced that it had joined with one of the nation's largest real-estate concerns, the JMB Realty Corporation of Chicago, in what appears to be a merger or a partial sale, but which officials at Rich will only call "a preliminary, non-binding agreement concerning the recapitalization and reorganization of F. D. Rich."

Officials of F. D. Rich and JMB refused any further discussion of their deal, which must be approved by the company's lenders, or of other aspects of the companies.

"This is one of the risks of being a large-scale developer," said Charles T. Lee, chairman of the city's Urban Redevelopment Commission. "You have to sink so much up front it's hard to hold on long enough to get your return, and you're terribly vulnerable to market downturns."

The company's troubles are typical of the financial struggles now facing many commercial developers in New England and other parts of the Northeast. "The real-estate

Continued on Page B2

NEW YORK TIMES 14 MAY 1990

Shellfish Is Tiny, but Problems It Could Cause Are Huge

By HAROLD FABER

Special to The New York Times

ALBANY, May 10 — The zebra mussel, an aquatic invader from Europe, is rapidly advancing into New York State, threatening to become a major pest in the Hudson, Delaware and Susquehanna Rivers, marine biologists say.

It is moving into New York by a circuitous route, from the west rather than the east, after having been deposited in the Great Lakes in ballast waters of oceangoing ships traveling up the St. Lawrence River from European ports.

In only three years, the mussel and its

fast-swimming larvae have spread from Lake St. Clair, near Detroit, west into Lake Michigan and east into Lakes Erie and Ontario in western New York.

\$4 Billion in the Next 10 Years

Already a major environmental problem, the small inedible shellfish, which reproduces prolifically, is dangerous in two ways: it clogs the pipes of power plants and it devours microscopic plants at the bottom of the food chain eaten by native fresh-water fish.

So far it has been found in the intake pipes of power-generating stations at Dunkirk on the east end of Lake Erie, at

the Niagara Power Project on the Niagara River just north of Niagara Falls, and at some Canadian projects on Lake Ontario as well as in some midwestern states.

Its economic impact on industry and commercial and recreational fishing will be substantial, said Robert Lange, supervisor of the Great Lakes fisheries program for the New York Department of Environmental Conservation.

"We estimate that it will cost \$4 billion in the next 10 years in the Great Lakes area alone," said Margaret Dochoda, a biologist for the Great Lakes Fishery Commission in Ann Arbor, Mich.

The costs will be borne by businesses, in changing intake pipes to keep the mussels out and in cleaning pipes already clogged; by ship owners and boat owners, in cleaning their hulls, and by the commercial fishing, sports fishing and tourist industries, in lower catches.

'Worse Than the Oil Spill in Alaska'

"This is a very serious problem," she said. "We say it is worse than the oil spill in Alaska because these exotic introductions are permanent and spreading. They can't be cleaned up like the oil spill. In a

Continued on Page B6

NY Times Monday May 14 1990

Tiny Shellfish Could Cause Huge Problems

Continued From Page B1

hundred years, they will be all over America, while the oil spill will have been cleaned up."

To monitor the spread of the mussels into New York, a research program began last month to find out how far they have penetrated into the state.

Twenty monitoring stations were set up in the Erie Canal and the Hudson, Delaware and Susquehanna Rivers by Acres International Corporation under contract with the Empire State Electric Energy Research Corporation, an arm of the state's electric industry. The results are not yet known.

Another sign of mounting concern is that Maurice D. Hinchey, an Ulster County Democrat and chairman of the State Assembly's Environmental Conservation Committee, has called a pub-

lic hearing on the threat of the zebra mussel for May 24 in Niagara Falls.

"What makes these guys bad is that they have an affinity for pipes, which affects municipal water plants, power plants and industry," Mr. Lange said. "They proliferate to the point where they gum up the works, even stopping the flow of the water."

Zebra mussels, so named because of dark brown stripes on their light tannish shells, are native to the Black and Caspian Seas. Without any natural predators to hamper their growth and expansion, they found a new and congenial home here.

They attached themselves to navigational buoys, docks and ladders and even plastic bottles in addition to water intake pipes. The shells of dead mussels have already piled up on beaches,

causing some bathers in Lakes Erie and St. Clair to wear footgear to prevent cuts, according to a recent report.

Adult zebra mussels grow to an inch to an inch and a half. Colonies can grow quickly from 30,000 to 40,000 mussels a square yard. They prefer moving water, which is why they are so dangerous in industrial water intakes, biologists say.

Studying Ways of Control

By depleting the fish food supply, the zebra mussel could cause a decline in the important walleye fishing industry of Lake Erie, in the major whitefish fishery of Lake Superior and, if it reaches the Mississippi River, in the edible mussel industry, as well as in other fishing, the biologists said.

In their native habitat, zebra mussels are kept under control by drying ducks, by systematic repeated flushing of water systems with heated water and by chemical controls like copper sulfate and chlorine.

In the United States, both chemical and thermal controls are being studied. At the Niagara Power Project, for example, John Malinchock, the environmental supervisor, said the project was preparing to use chlorine to eliminate them.

Bills have been introduced in Congress to spend \$4 million a year for five years on prevention programs and an equal amount on eradication. But marine biologists expressed skepticism about proposed controls.

"There's really nothing that anyone knows right now to prevent them from spreading," said Mr. Lange.



BY LOIS BOHOVESKY

WALL STREET TO GRAND CENTRAL: 11 MINUTES.

4 5

The Subway at Midday.
Trains every 3 to 5 minutes.
10 a.m. - 3 p.m. weekdays.

ne

Smoky Muffins Force Jet With 69 to Land

A pan of corn muffins on a USAir flight caught fire yesterday, sending smoke into the passenger cabin and the jetliner back to La Guardia Airport for an emergency landing. No one was hurt.

The small fire broke out soon after Flight 1402, a Boeing 727 bound for Pittsburgh, took off. A flight attendant put out the fire with an extinguisher. "As a precaution, the pilot elected to return to La Guardia," said a USAir spokeswoman, Susan J. Young.

The plane, which had 69 passengers aboard, was met by a firefighter and Sgt. Dominic Lorenzino of the Port Authority Police, who inspected the oven. The muffins were inedible, he reported — "they were burned all over the top."

An hour later the plane was on its way again, and the passengers were finally served breakfast, with their

seasquirt Styela clava, and the Californian orange compound seasquirt Botrylloides diegensis, continue to spread and become very abundant members of fouling and benthic communities. Of concern is the presence of both in large numbers around, on, and amongst commercial oyster growing facilities. The stalked seasquirt reaches 15 or more centimeters in length; the orange, gelatinous seasquirt can reach tens of centimeters in diameter.

Styela was first detected on the Atlantic coast in the early 1970s and is believed to have been introduced as a fouling organism on boat bottoms (or possibly as tadpole larvae in ballast water) from western Europe (the species is originally native to Asia). Botrylloides was first found to have become established on the Atlantic coast in the mid-1970s; it is believed to have been released by an experimental biologist.

New records for Styela include inlets in southern New Jersey, possibly as early as 1986, but with confirmed records in 1988 and 1989 (John McDermott, Franklin and Marshall College, Lancaster PA, personal community April 1990). This is a substantial southern range expansion.

6.0 Species Introduced for Hatchery Rearing

6.2 Stock Relaid in Small Quantities Under Controlled Conditions

United Kingdom

Field trials with the clam Tapes philippinarum continue and include triploid animals.

6.3 Stock supplied in larger quantities to industry

Canada

Atlantic salmon, rainbow trout, and Arctic char were imported as eggs or juveniles from Ontario, New Brunswick, Manitoba, and Washington, into Prince Edward Island. Quebec introduced stocks for rearing of rainbow trout, brook trout, and Arctic char.

United Kingdom

Interest by industry in the culture of Tapes philippinarum is slowly increasing. One million seed were transferred to Poole Harbour from the Whitstable hatchery for on-growing. 1.3 million Crassostrea gigas seed were also transferred within England and Wales for on-growing.

7.0 Planned Introductions

Canada

Ontario is concerned about introduction activity in adjacent jurisdictions, including planned introductions of the grass carp into southern Alberta and the zander (Stizostedion lucioperca) into North Dakota, USA, and rumor of Tilapia spp. introductions into Saskatchewan.

United States:

Proposed Introduction of Japanese Oysters to Atlantic Coast:

A matter of considerable debate in the mid-Atlantic region (New Jersey, Delaware, Maryland, Virginia) is the proposed re-vitalization of the waning

Atlantic oyster industries (once largely based upon Crassostrea virginica) by the introduction of the Japanese (Pacific) oyster Crassostrea gigas.

Native oyster populations have been reduced by over-harvesting for many decades and by severe disease problems (Hargis and Haven, 1988). Because disease-resistance (to MSX) by the Pacific oyster (in Chesapeake Bay, for example) is not known, Crassostrea gigas experiments were proposed in the field (open waters). MSX, or "Delaware Bay Disease", is caused by the protozoan Haplosporidium costale; it is highly infectious, but the method of transmission is unknown, and thus it has not been possible to test for the disease-resistance of Pacific oysters solely in the laboratory.

Some fisheries biologists, environmentalists, and oystermen were concerned that open release of the Pacific oyster in Chesapeake Bay waters might lead to the oyster's reproduction and establishment on the Atlantic coast, with unknown ramifications for the ecosystem and for the competitive survival of the native Atlantic oyster. (Crassostrea gigas has been planted (released) a number of times since the 1940s and 1950s on the Atlantic and Gulf coasts of the United States, but there are no records of reproduction). Others believe that introduction of a non-native oyster may be the only hope for saving the oyster industries of the Atlantic coast. Other issues concern the economic, social, and political implications of the potential establishment of a non-native oyster.

In April 1990 the Virginia Marine Resources Committee rejected a proposal for open field testing of Japanese oysters in Virginian waters. Decisions by other states (Maryland and Delaware) may be forthcoming. No official releases of Japanese oysters have yet been approved.

8.0 Live Exports for Consumption

Norway

Lobsters are exported to Europe.

Sweden

Mussels (Mytilus edulis) are exported to Holland and France.

United Kingdom

4,245 mt of live Mytilus, 662 mt of oysters (Ostrea and Crassostrea) and 4,811 mt of scallops (Pecten maximus, Chlamys opercularis) were exported, but it is not clear from the data how much of this was alive. In addition, 2,096 mt of live squid and cuttlefish, 11,026 mt of live lobsters, and 11,866 mt of crabs were exported (but proportion of live for the latter is not known).

9.0 Live Exports for Purposes other than Direct Consumption

Norway

Several million Tapes philippinarum spat were exported to Europe; spats of both Crassostrea and Ostrea were also exported to Europe. 240,000 turbot juveniles were exported to southern Europe; several million Atlantic salmon ova were exported world-wide.

Sweden

Salmon eggs are sent to Denmark, Chile and Japan. Elvers from England are exported to Finland after quarantine.

United Kingdom

0.4 million Crassostrea seed (from Guernsey and Cumbria), tested and found pathogen- and disease-free, were exported to South Africa and 0.272 million seed were exported to Southern Ireland for mariculture.

Approximately 15mt (45 million individuals) of wild-caught elvers were exported to Sweden, Norway, Denmark, Germany, and Eastern European countries. These were mainly for farming although some were used for restocking.

Spider crabs were sent from Scotland to Spain. Also exported from Scotland were 250,000 turbot juveniles (to a number of southern European countries as well as Chile), and several million Atlantic salmon ova are shipped worldwide.

CURRENT STATUS OF PROPOSED OR ACTUAL INTRODUCTIONS

Eel nematode *Anguillicola crassa*

This "swimbladder nematode" is now widespread in northern Europe and remains of great concern in the eel fisheries. While it continues to spread in the southern UK, it is not yet in Ireland. It is in Sweden on west coast as far up as Goteborg and on the east coast south of Stockholm in the Baltic. Swedish biologists are looking to see if it has spread into freshwater lakes as a result of inland plantings. [See WG 1988 Report, C.M. 1988/F:20, pp. 12-14]

Salmon parasite *Gyrodactylus salaris*

Sweden (B. Holmberg) reports that a 1988-1989 study on both wild populations and hatchery populations of salmonids has found that Gyrodactylus is spread all over Sweden but in very low numbers. It occurs in at least two fish farms and in one wild population in the middle of Sweden, as well as in fish in a river on the Swedish west coast near Goteborg. Studies on Gyrodactylus will be appearing in a special issue of Aquaculture. It is not clear why this parasite is so dangerous to Norwegian salmon but not to other salmon populations; genetic differences in salmon populations may play a role.

Salmonid Fish Movements Among ICES Member Countries

The transfers and introductions of salmonid fishes (Arctic char, Salvelinus alpinus; Brook trout, Salvelinus fontinalis; Atlantic salmon, Salmo salar; Rainbow trout (steelhead), Oncorhynchus mykiss (= Salmo gairdneri), Coho salmon, Oncorhynchus kisutch, and Chinook salmon, Oncorhynchus tshawytscha) are reviewed above in the National Reports.

In addition, it was noted and recorded that the movement of salmonid eggs continues in certain patterns that may still permit the unintentional transfer and introduction of salmonid diseases. For example, rainbow trout are moved from Finland to Maine, and Scottish eggs of Atlantic salmon are

brought to Maine. Rainbow trout from the west coast of the U.S.A. are still moved by private companies to Maine; NASCO would like to see this practiced stopped immediately because of the presence of VHS (viral hemorrhagic septicemia) on the Pacific coast of the U.S.A. The Inland Fisheries Department of Maine permits salmonid eggs to enter the state, and the Marine Division then permits them to be out-planted in the ocean.

The coho population established in the Cornwallis River in Nova Scotia as a result of releases initially in the United States (see ICES WG report for 1985, C.M. 1985/F:60, pages 23-25) appears to have disappeared.

The pink salmon populations reported in Norway as a result of releases initially in the U.S.S.R. appear to have disappeared also. It was suggested that pink salmon may still be present in the White Sea, however.

Japanese Brown Alga Undaria in France

The status of the on-going culture of this species is reviewed under the National Reports, above (section 3.3). H. Grizel summarized his earlier statement by noting that two sites in Brittany are under production, at Ouessant and Sein; interest in commercial production in France continues to be strong. Gametophytes are raised only in the laboratory; these are then out-planted for growth. No ecological effects of the introduction of Undaria have been noted to date. As noted in the WG's 1989 report, and in C. Res. 1989/4:4d, a summary report is to be presented to ICES in 1994.

I. Wallentinus (Sweden) noted that in 1989 Undaria was reported in the Mediterranean as only 10 km from the Spanish border, and queried whether or not it had yet entered Spain. No new information appears to be available.

Japanese Brown Alga Sargassum in Europe

New populations of Sargassum are reported above (section 5.0) by Norway (see also Rueness, 1989) and by Sweden. I. Wallentinus (Sweden) believed there may be reports in Spain at this time. S. Utting (UK) noted that it continues to spread slowly in Britain.

The Manila (Japanese) cockle Tapes philippinarum

This clam continues to be widely used in Europe and North America and interest in increased mariculture and out-planting is growing. H. Grizel (France) reports there do appear to be natural hybrids between Tapes philippinarum and the native cockle Tapes decussata in France, but there is no formal study looking at this. S. Utting (UK) reports that Tapes philippinarum is not reproducing in the U.K.

The Japanese scallop Patinopecten yessoensis in Europe

France

See section 3.2.2 under National Reports, above. The WG 1989 report indicated that 10,000 spat were placed at St. Anne du Portzec (Brest Road) on the French Atlantic coast. However, these were not placed in the open sea; they are in controlled quarantine conditions at the St. Anne installation (H. Grizel).

Ireland

The introduction of the Japanese scallop to Ireland was discussed at length in the 1989 WG meeting (C.M. 1989/F:16, pp. 19-20), and preliminary advice formulated at that time. This advice, summarized, was that,

- (1) The dominant issue was one of natural reproduction in European waters and subsequent ecological impact as a result of competition with native species,
- (2) Significant effort is required to prevent disease introductions,
- (3) If a broodstock is to be developed, adult scallops should be held in quarantine following the Code of Practice, and all scallops, including the F1, be held in quarantine pending definitive advice,
- (4) The introduction of eyed scallop larvae is not supported unless they are only for use as broodstock and held in quarantine,
- (5) The Secretary General of ICES should query all member countries relative to their experience in the past, present, and future with Japanese scallops, such information and summaries to be provided by May 1990.

At the present meeting, D. Minchin, J. F. McArdle, and J. Doyle, of the Fisheries Research Centre, Dublin, presented a detailed report before the WG on the importation of Japanese scallops to Ireland, on the quarantine arrangements, pathological examination, and certification of these scallops, and on the ecology and biology of this mollusk in Japan and on its probable ecological and reproductive adaptations in Ireland. Their presentation and documents addressed those concerns discussed in 1989, as well as other matters.

The following documents were tabled,

- * Report on the quarantine arrangements, pathological examination and certification of Japanese scallops (P. yessoensis) imported into Ireland. J. F. McArdle.
- * Importation of live Japanese scallops (P. yessoensis) to Ireland.
- * Introduction of the Japanese scallop to Irish waters. D. Minchin.
- * The introduction of Patinopecten yessoensis to Irish waters. D. Minchin.

The first three of these are here reproduced as Appendix II. The fourth, a longer document on the culture of scallops in Japan, on the genetic risk of introduction of Japanese scallops relative to native European scallops, on competition with Japanese and European species, and physiological (spawning and growth) expectations in Irish waters, is available from the Fisheries Research Centre.

D. Minchin presented a detailed color slide presentation of Japanese scallop commercial production. J. Doyle presented comments noting that the Code of Practice does not specify where the cited quarantine facility is,

or should be, located, thus opening up the potential for ambiguities in the intent of the Code. In addition, the Code refers specifically only to fish eggs and larvae.

Responses by other countries, as called for in the Preliminary Advice, and as sought by the Secretary General, were reviewed. France continues experimental work on the Mediterranean coast (see NATIONAL REPORTS, section 3.2.2). Canada has no current plans to work with this species in Eastern Canada, but there is an ongoing program in British Columbia, on the Pacific coast (work by N. Bourne and colleagues). A commercial company is developing a hatchery there for F1's and for outplanting. Some outplanting of earlier experimental stocks took place. The species is not known to have become naturally established in British Columbia because of these earlier releases.

During the course of these reviews, it was noted that private companies in Denmark (i.e., not a governmental activity) had also experimented earlier with Patinopecten yessoensis. The WG's Reports for 1985 (F:60, p. 11) and for 1986 (F:51, p. 26) refer to the outplanting of Japanese scallops in Danish waters. For example, the 1985 report reads,

"...a commercial firm imported 5,000 Patinopecten yessoensis by air from wild stocks in Japan and immediately (within five hours from arrival) placed the shipment in the sea at the island of Laeso in the Kattegat. A few days later all except 400 were dead, and it has not been possible to get exact information as to the fate of the dead animals."

At the time, Danish law only controlled the importation of oysters.

Considerable discussion followed throughout the morning. Deliberations focused on disease control (such as Rickettsia), ecological considerations, particularly competition, the reproductive biology of Japanese scallops in Asia and potentially in Europe, and the potential for wild populations to develop.

Based upon these discussions and opinions, advice was formulated, reviewed by the entire WG, and revised.

This advise is as follows:

(1)

On the basis of considerations by the Working Group on the introduction of Japanese scallops (Patinopecten yessoensis) by the Department of Marine, Ireland (wherein the Working Group has found that the steps outlined in the ICES Revised Code of Practice have been followed meticulously), member countries are advised that,

- a) the Working Group does not oppose the continued development of Japanese scallop culture in Ireland, in the form of field trials that would assess survival, growth, and gametogenesis in open waters (in particular in comparison with the native species Pecten maximus), subject to

verification of pathogen-free hatchery stock (F1 progeny) including the stock destined for open release;

- b) the Working Group finds that upon careful examination of available scientific evidence assembled by Ireland, commercial-scale development of Patinopecten yessoensis populations in the open sea will very likely lead to the establishment of natural (wild) populations and possibly their eventual (albeit slow) spread;
- c) the Working Group urges that Ireland provide to the Council annual records of release sites, dates, and numbers as part of their national report, and carefully monitor the health of the releases; also the occurrence, extent, and microhabitats of wild populations if such become established, and their concomitant ecological relationships, if any, with native biota (with a particular focus on any competitive interactions with native scallops);
- d) the Working Group asks that other countries in which introductions of Patinopecten yessoensis have occurred or will occur provide any new ecological or biological information as those experimental or commercial projects develop.

CONSIDERATION OF TRANSGENIC AND OTHER GENETICALLY ENGINEERED SPECIES AS INTRODUCED SPECIES, AND FUTURE NECESSARY MODIFICATIONS IN THE ICES CODE OF PRACTICE

The WG considered at length the question of genetically modified organisms and their proposed release into natural environments, and how such organisms and releases relate to the current Code of Practice.

WG members reviewed the papers by Eric Hallerman of the Virginia Polytechnic Institute and by Anne Kapuscinski of the University of Minnesota (Hallerman and Kapuscinski, 1990a and b; Kapuscinski and Hallerman, 1990), a paper tabled by Richard Saunders of Fisheries and Oceans Canada, and a working document by the Council of the European Communities on a proposal for a CEE directive on the deliberate release into the environment of genetically modified organisms. The paper by Ferguson (1990) came to the attention of the WG after the meeting.

The COE document defines genetically modified organisms (GMOs) as, "an organism in which the genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination." Environmental risk assessment is defined in the same document as, "the evaluation of the risk to humans, plants, animals and the environment connected with the release of GMOs or products containing GMOs."

Kapuscinski and Hallerman (1990) note that "The transfer of novel DNA constructs into fishes introduces a number of contentious issues into public policy debate among fisheries scientists". In their work Kapuscinski and Hallerman conclude that "Transgenic fishes may be considered a special case of introduced fish". They further note that the "utility of the introduced fish concept for predicting the ecosystem impacts of transgenic fish will depend on the degree of phenotypic alteration." Kapuscinski and Hallerman note a "continuum of analogies" between transgenic and introduced fish, ranging from a species with only minor alterations (in this case perhaps analogous to the introduction of a different genotype within a known genetic stock of a species) to a species with major alterations (in this case perhaps analogous to the introduction of a non-native species).

The WG, and additional members present, including Drs. R. Saunders and J. Ritter, discussed at length potential problems related to the interbreeding of farmed, altered salmonid stocks with native, wild salmonid populations. A considerable literature has developed reviewing these concerns, coupled with a great deal of experimental work now in progress on the development of transgenic fish and other organisms. Serious questions arise relative to the restocking of river systems: where does the "new stock" come from? Should genetically altered stocks (modified for production purposes) be introduced?

The WG discussed the extent to which species would still be recognized as "species" relative to the amount of genetic alteration imposed upon any given taxon. Further discussion centered around the concepts of transgenic stocks (the manipulation of one gene at a time, which can be controlled),

hybridization (the combination of many genes, very difficult to control), and introgression. Additional discussion focused on recommendations that released transgenic species should be sterile (e.g., monosex triploids).

It was concluded that it was urgently necessary that the Working Group on Introductions and Transfers meet with the Working Group on Genetics for a joint one-day meeting, to consider those matters that are relevant to both groups, and to consider those revisions that may be necessary to modify the ICES Code of Practice in light of the genetic developments of the 1980s.

BALLAST WATER TRANSPORT OF LIVING AQUATIC ORGANISMS: GROWING INTERNATIONAL CONCERN

Throughout the course of the National Reports, and during the rest of the WG meeting, the increased international concern for the growing number of accidental introductions of marine and freshwater organisms, apparently as a result of the release of ballast (not bilge) water, was noted.

It was noted for example that in the 1980s alone,

- * That fish, crustaceans, and mollusks from Europe have invaded the the North American Great Lakes, having been released by ballast water in ocean-going freighters; these include the ruffe Gymnocephalus and the zebra mussel Dreissena. As a result, the Canadian government has instituted voluntary guidelines relative to the control of discharge of ballast water from Europe into the Great Lakes, and calling for the exchange of ballast water on the high seas before entering the St. Lawrence River system,
- * That the American Atlantic razor clam Ensis, originally introduced in ballast water to Germany, continues to spread on the European coasts,
- * That the American Atlantic comb jelly fish Mnemiopsis has been introduced by ballast water to the Black Sea, where it is now extraordinarily abundant,
- * That red-tide causing dinoflagellates were introduced from Japan to Australia, causing great impact upon coastal shellfisheries in certain areas, and leading the Australian government to institute regulations regarding the release of ballast water from other nations,
- * That San Francisco Bay, California, has been invaded by the Chinese brackish-water clam Potamocorbula amurensis, where, having first appeared in 1986, it now occupies large areas of the Bay, in densities of tens of thousands per square meter.

It was noted that there are in fact a great many other cases of introductions of dinoflagellates, algae, invertebrates, and fish, around the world, that now appear to have been mediated by ballast water



Australian Quarantine and Inspection Service
Department of Primary Industries and Energy

Future Action

AQIS welcomes the continuing co-operation of ships' masters in ensuring the success of the above guidelines. Their effectiveness, and compliance with them, will be monitored by AQIS staff and the results will influence future action.

The proposals concentrate mainly on controlling the discharge of sediment. However, ballast water itself has introduced many new marine species worldwide. AQIS will be researching the type and number of exotic species and the likelihood and frequency of their introduction to determine what the risks are and whether additional controls on ballast water need to be introduced. The effectiveness of the current controls, and the possibility of additional or revised control approaches, is also being researched.

Contact Numbers for Further Information

Ask for the Chief Quarantine Inspector (General) or Regional Co-ordinator on the following numbers:

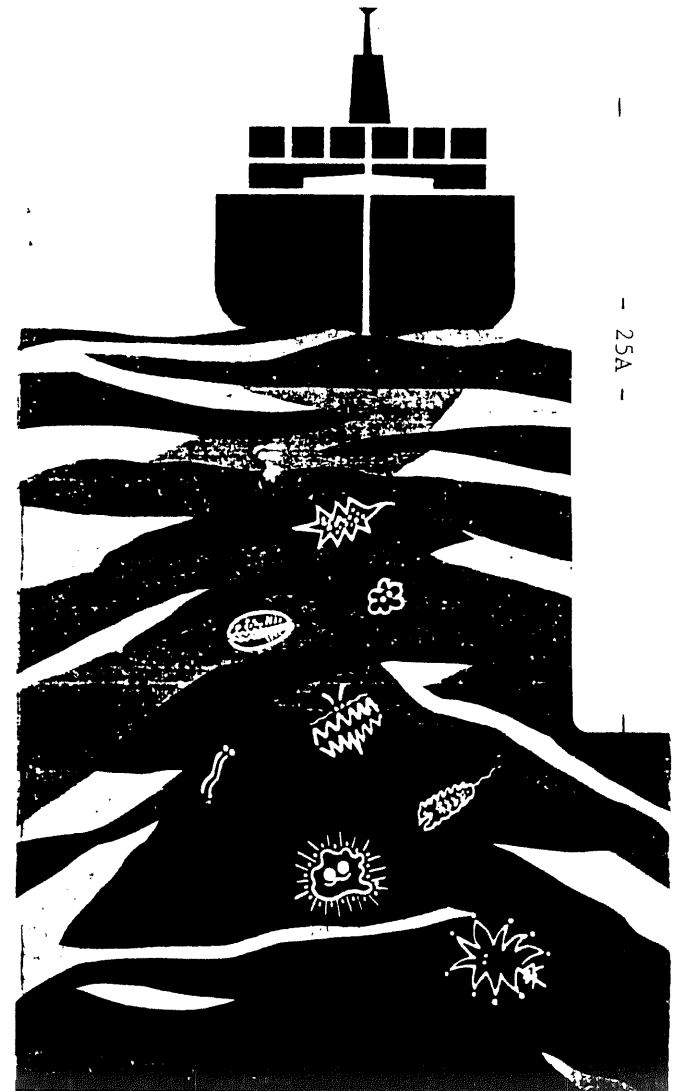
Sydney	(02) 271448
Melbourne	(03) 6293176
Brisbane	(07) 2238738
Adelaide	(08) 2377003
Darwin	(089) 811211
Perth	(09) 4304830
Hobart	(002) 205509

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Ballast Water

a serious quarantine problem



Ballast Water — A Serious Quarantine Problem

Every day, vast quantities of water and sediment from the world's ports and harbours are transported across the oceans as ballast in merchant ships and discharged into foreign waters. Around 60 million tonnes are released in Australian waters each year.

A range of molluscs, crustaceans, worms and seaweeds have been translocated internationally in this way. Recent scientific studies have shown that toxic and harmful organisms can be involved.

Quarantine, Health, Marine and Fisheries authorities, in Australia and overseas, are becoming increasingly concerned at the associated dangers for human health, aquaculture and the environment.

The Australian Situation

Tasmanian authorities have been forced to implement expensive monitoring controls, and to close down shellfish harvesting in the Huon River several times in recent years due to the presence of toxic species of algae known as dinoflagellates in south-eastern Tasmanian waters.

Scientists of the Commonwealth Scientific and Industrial Research Organisation have linked introduction of the organism to ballast water and sediment discharged from overseas vessels. Similar harmful organisms have been found in Victoria and South Australia. While the organism introduced into Tasmania has only a limited

world-wide distribution, those found in Victoria and South Australia are much more widespread.

The dinoflagellates in question are taken into ships when ballast water is loaded and settle in a dormant stage in ballast tank sediment. When released with ballast on arrival in Australia the organisms settle on the sea floor until conditions are ripe for them to hatch; they then enter the water table and become part of the shellfish feeding cycle. They produce toxins which can cause paralysis and sometimes death in humans who eat affected shellfish. (The medical condition is commonly known as paralytic shellfish poisoning.)

Management

To prevent dinoflagellates and other organisms from spreading, the Australian Quarantine and Inspection Service (AQIS) is suggesting a range of voluntary guidelines for ships entering Australian waters. The arrangements are for adoption by vessels from all overseas ports. The emphasis in the guidelines is to minimise the discharge of water and sediment, which could be infested with exotic organisms, from ballast tanks and holds used to carry ballast.

The guidelines are

- measures at the ballasting port, including a certificate from a relevant authority that water and bottom sediment in the area is free from toxic organisms (Shellfish Sanitation authorities are a possible contact point);

- measures on route including re-ballasting at sea, or in-hold water treatment (proposed treatments should be cleared beforehand with AQIS)
- measures on arrival including a commitment not to discharge ballast, on-shore ballast water treatment (subject to AQIS approval) and discharge of sediment into approved areas (check with AQIS)

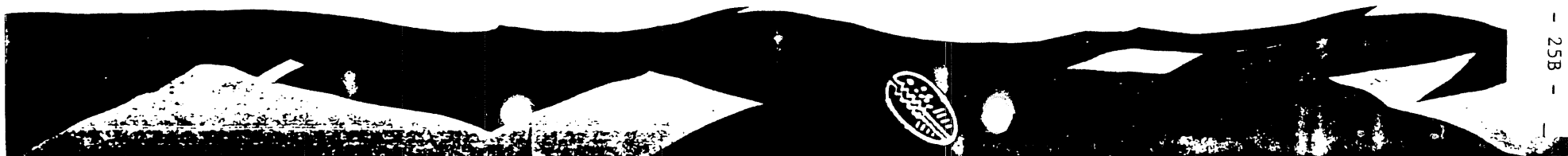
Ships' masters may use one or a combination of these measures.

In addition, ships' masters should make every effort to minimise sediment discharge when ballast is released. This can be helped by

- ensuring wherever possible that ballast taken on is free of sediment
- ensuring ballast tanks and any holds used for ballasting are kept clean
- avoiding or minimising ballasting in shallow water where sediment uptake is more likely
- avoiding ballasting when toxic dinoflagellate hatches are occurring (as above, Shellfish Sanitation authorities are a possible point of contact)

Clean water control can be used as an alternative to the guidelines under certain agreed arrangements. Details of these, known as compliance arrangements, are available from any of the contact numbers listed over.

The control guidelines and options are covered in more detail in a Notice issued by AQIS. Masters of all vessels entering Australian territory should become familiar with the provisions of the Notice.



transport. Carlton (1990) provides a review of some of these introductions.

A need was expressed by the WG to inform all ICES member countries of the growing and potential risk of the release of exotic ballast water by ships, and the organisms therein, and alert member countries as to the reasons for concern. The concerns in the North Atlantic, and lessons learned from other countries in the world, should be of special focus. It was proposed that a Study Group be formed, to assess the risks of introduction of non-indigenous species by ballast" with Dr. J. T. Carlton as Chair and with member nations to designate representatives to the Group, to discuss the magnitude, scale, and implications of this problem in ICES member countries, to review laws, regulations, and control measures available in ICES and other countries, to formulate advice and recommendations, and to report to the Working Group.

REVISIONS TO THE ICES CODE OF PRACTICE

Discussion ensued throughout the three days of the meeting relative to modifications and revisions to the ICES Revised Code of Practice. While noting that a future Code will reflect considerations relative to genetically modified organisms, it was felt that there were revisions that were sufficiently important that necessitated the production of a new revision at this time. In addition, small modifications in wording have been added to the Code over the past decade, resulting in the existence of slightly different versions having been published in different contexts.

WG discussion focused on clarification and expansion of Section II, relative to recommended actions if a decision is taken to proceed with an introduction. A good deal of deliberation was devoted to where and how disease and parasite review should be undertaken and where quarantine stations should exist -- that is, in the country of origin or the country of receipt.

As a result of these discussions, the following six changes were proposed:

(1)
The title be changed to, "The Revised 1990 Code of Practice..."

(2)
Section II (a) be changed to read as follows,

"(a) A brood stock should be established in a quarantine situation approved by the country of receipt, in sufficient time to allow adequate evaluation of its health status. The first generation progeny of the introduced species can be transplanted to the natural environment if no diseases or parasites become evident in the F1 progeny, but not the original import. In the case of fish, brood stock should be developed from stocks imported as eggs or juveniles, to allow sufficient time for observation in quarantine."

(3)

A new paragraph (b) be added to Section II to read as follows,

"(b) The F1 progeny should be placed on a limited scale into open waters to assess potential ecological interactions with native species."

(4)

Old paragraph (b) of Section II becomes paragraph (c), with the words "in recipient countries" to be added, so that it reads as follows,

"(c) "...for quarantine purposes in recipient countries..."

(5)

Old paragraph (c) of Section II becomes paragraph (d)

(6)

The final paragraph, beginning, "It is appreciated that countries..." would become a new Section V.

It was decided that it be proposed that a document be prepared, entitled "Proposed Revisions to the ICES Code of Practice", and submitted for consideration as an F: document of the Mariculture Committee at the Statutory Meeting in October 1991. [This is now document F:37]

REVISION OF WG STATEMENT OF PURPOSE (1984)

In 1984, based upon preliminary discussions and Council resolutions, the WG wrote a "Statement of Purpose" that has served to guide the Group's deliberations and discussions over the past seven years. At each meeting of the WG the Statement of Purpose is often discussed, and certain modifications proposed.

The Chair proposed that, in the 1990s, the WG assume an expanded perspective on matters relative to introductions and transfers of marine organisms in ICES member countries, and that the WG assume a greater initiative to ensure that scientific participation and oversight are part of the transfers and introductions process.

At the conclusion of the meeting, the WG unanimously agreed that statements 12 and 13 be changed to read as follows:

Former versions:

- (12) The WG will not initiate proposals, but will study proposals submitted to the Council, and offer scientific opinions based upon the best available data.
- (13) The WG may, as perceived necessary, initiate special studies of topical problems concerned with introductions and transfers of marine organisms

Revised versions:

- (12) The WG will study proposals submitted to the Council, and offer scientific opinions based upon the best available data.
- (13) The WG will, as perceived necessary, initiate special studies of topical problems concerned with introductions and transfers of marine organisms.

1990 SUMMARY OF INTRODUCTIONS AND TRANSFERS OF MARINE ORGANISMS IN ICES MEMBER COUNTRIES

As reviewed in the WG's report last year, and as directed by C. Res. 1989/1:1, the WG is proceeding to gather together the extensive documentation on the introductions and transfers of marine (and some freshwater) organisms in ICES member countries for a major summary and publication as a Cooperative Research Report. Two national reports have been completed: documents were submitted by Great Britain (by S. Utting) and by Ireland (by D. Minchin). Other national reports were stated to be in progress.

The format of the 1990 Summary was discussed at length. Discussion focused on whether data on introduced species should be presented by category (for example, "Accidental Introductions", as in the National Reports), geographically by country (with sectional subdivisions in each), by species, or by some other arrangement. It was decided that the final decision on how the submitted data were to be presented would be made when all of the national reports have been submitted and the amount and quality of the data assessed.

It was requested that each member country submit a brief (two or three page, single-space) statement summarizing the current status of introductions and transfers of exotic species in their country, and incorporating overviews of major events and phenomena. The actual data should be submitted in tabular form as much as possible.

Placing all of the submitted information on a computerized data base that would permit rapid sorting by country, by species, and by other designated categories was discussed.

Dr. A. Munro (Scotland) was selected to become Editor of this report, with assistance from other WG members. The editorial committee will include Dr. S. Utting (Wales) for invertebrates, Dr. I. Wallentinus (Sweden) for plants, and Dr. D. Scarratt (Canada) for looking into computerization of the data base. The group will work by correspondence in 1990 and 1991, and have a draft document ready for the WG meeting in the spring or early summer of 1991. The target submission/completion date is the October 1991 Statutory Meeting.

SUMMARY OF LAWS AND REGULATIONS PERTAINING TO INTRODUCTIONS AND TRANSFERS OF MARINE ORGANISMS IN ICES MEMBER COUNTRIES

The last summary of pertinent laws and regulations relative to the introduction and transfer of non-native organisms within and between ICES member countries was in 1981. New laws/regulations have been submitted over the past ten years at WG meetings. In 1988 the WG elected to prepare a document entitled, "National Laws and Regulations of ICES Member Countries Concerning Introductions and Transfers of Marine Organisms" (noted in C. Res. 1988/2:46d as a proposed publication in the ICES Cooperative Research Report series). A goal of the present (1990) meeting was "to review, select, and assemble national summaries of laws and regulations concerning introductions of marine organisms," with such a document "to be deposited as a bound volume at ICES Headquarters" (C. Res. 1989/2:36c). The earlier summary was also deposited as a bound volume at ICES Headquarters in 1982.

The U.K. submitted a document entitled, "Legislation Controlling the Introduction and Transfer of Marine Organisms in Great Britain" (authored by Dr. S. Utting), as a model document upon which to base the proposed national summaries. The WG decided that this contribution by the U.K. should be used as a guide for the remaining national summaries, and that the latter should be completed and sent to the Rapporteur before the time of the 1991 WG meeting.

In line with earlier discussions by the WG, and with the ICES C. Res. of 1988, it was concluded that the broadest possible use of these national summaries would be achieved if they were presented as an edited volume for publication in the Cooperative Research Report series, either as a separate document, or to be incorporated as an Appendix in the 1990 Summary of Introductions and Transfers, the latter also proposed for the CRR series.

ERRATA AND ADDENDA TO COOPERATIVE RESEARCH REPORTS

Cooperative Research Report 130 (1984), "Guidelines for Implementing the ICES Code of Practice Concerning Introductions and Transfers of Marine Species"

A one-page errata sheet to CRR 130 has been available within WG meetings for some years, and was included again in the "Handbook" noted on page 3 herein. It was decided that this errata sheet should be submitted by the Rapporteur to ICES for insertion in the remaining copies as distribution proceeds, and, if possible, be made available to those who already have copies.

Cooperative Research Report 159 (1988), "Codes of Practice and Manual of Procedures for Consideration of Introductions and Transfers of Marine and Freshwater Organisms"

Errata and addenda to CRR 159 have been noted by WG members. A particular

and important change is necessary on page 25, section 2.2, subsection (d), wherein the phrase "at special isolated sites" should be replaced with, "in quarantine situations only", such that it would properly read,

"(d) After spawning and successful production of an F1 generation, the broodstock should be destroyed or utilized to study interactions with indigenous species in quarantine situations only."

It was decided that an errata sheet should be prepared and submitted by the Rapporteur to ICES for insertion in the remaining copies as distribution proceeds, and, if possible, be made available to those who already have copies.

Addition of Revised 1990 Code of Practice to CRR 130 and CRR 159

It was also decided that the Rapporteur should submit to ICES the Revised 1990 Code of Practice, to be inserted as possible into copies of CRR 130 and CRR 159 as they are now distributed, and thus be available for immediate and widespread dissemination.

STATUS OF 1988 MINISYMPOSIUM ON INTRODUCTIONS AND TRANSFERS OF MARINE ORGANISMS (held at Statutory Meeting)

Papers presented at this Symposium are now in preparation for publication in the Journal du Conseil (R. Beverton, editor).

STATUS OF 1990 WORLD SYMPOSIUM: INTERNATIONAL SYMPOSIUM ON INTRODUCTIONS AND TRANSFERS (to be held in Halifax, June 10-14 1990)

A two day symposium, the "International Symposium on the Effects of Introductions and Transfers of Aquatic Species on Resources and Ecosystems" is planned for the upcoming World Aquaculture Society (WAS) meetings in Halifax, immediately following the present WG meeting. This symposium is co-sponsored by ICES (co-chair, C. Sindermann), FAO/EIFAC (co-chair, B. Steinmetz), and WAS/Aquaculture Association of Canada (co-chair, W. Hershberger). Over twenty papers are scheduled for presentation.

In addition, the Keynote Address of the meeting, presented by Professor K. Chew (University of Washington), is on "Global Bivalve Shellfish Introductions -- Implications for Sustaining a Fishery or Strong Potential for Economic Gains?" ("Introductions d'Espèces de Coquillages Bivalves à l'Echelle Mondiale -- Implications pour Soutenir une Pêche ou Fort Potentiel Economique?").

OTHER SYMPOSIA ON INTRODUCED SPECIES

A number of meetings and symposia have been held in the United States in 1989 on biological invasions (introduced species). These include,

Introductions and Transfers of Mollusks: Risk Considerations and Implications

National Shellfisheries Association Annual Meeting, Williamsburg, Virginia (symposium on April 4 1990)

Introduced Marine Organisms in the Northeast Pacific Ocean

Western Society of Naturalists Annual Meeting, Tacoma, Washington (symposium on December 29 1989)

Human Influences on the Dispersal of Living Organisms and Genetic Materials into Aquatic Ecosystems

Aquaculture '89, Los Angeles California (symposium on February 15-16 1989)

In addition, there have been many meetings and symposia on the Zebra Mussel Invasion of North America, and on ballast water as a means of introduction of exotic species.

RECOMMENDATIONS

During the course of the meeting, recommendations to the parent committee were formulated by the Working Group. These recommendations are,

(1)

That on the basis of considerations by the Working Group on the introduction of Japanese scallops (Patinopecten yessoensis) by the Department of Marine, Ireland (wherein the Working Group has found that the steps outlined in the ICES Revised Code of Practice have been followed meticulously), member countries are advised that,

- a) the Working Group does not oppose the continued development of Japanese scallop culture in Ireland, in the form of field trials that would assess survival, growth, and gametogenesis in open waters (in particular in comparison with the native species Pecten maximus), subject to verification of pathogen-free hatchery stock (F1 progeny) including the stock destined for open release;
- b) the Working Group finds that upon careful examination of available scientific evidence assembled by Ireland, commercial-scale development of Patinopecten yessoensis populations in the open sea will very likely lead to the establishment of natural (wild) populations and possibly their eventual (albeit slow) spread;
- c) the Working Group urges that Ireland provide to the Council annual records of release sites, dates, and numbers as part of their national report, and carefully monitor the health of the releases; also the occurrence, extent, and microhabitats of wild populations if such become established, and their concomitant ecological relationships, if any, with native biota (with a particular focus on any competitive interactions with native scallops);

d) the Working Group asks that other countries in which introductions of Patinopecten yessoensis have occurred or will occur provide any new ecological or biological information as those experimental or commercial projects develop.

(2)

That the amendments to the Revised Code of Practice discussed at the 1990 meeting of the Working Group be incorporated into the original code and published as an F: document to the Mariculture Committee, and be presented to the Council for adoption as an interim updated Code of Practice (entitled the "REVISED 1990 CODE OF PRACTICE") pending the planned extension and revision of the Code in accordance with C. Res. 1989/2:36e (to review the Code of Practice concerning genetically modified organisms).

(3)

That research universities and colleges involved in the experimentation, holding, and/or release of non-native marine organisms should make every effort to acquaint community members of their responsibilities under the ICES Code of Practice.

(4)

That in accordance with C. Res. 1971/2:7 (wherein the Working Group takes responsibility for advising the Council on all questions relating to the introduction of new species), and C. Res. 1986/2:35 (wherein the Working Group assumes the long-term responsibility for producing continuing advice to the Council on all matters relating to introductions and transfers), the Working Group should take a greater role in bringing to the attention of ICES proposed or actual introductions and in ensuring that the ICES Code of Practice is part of the introduction process.

(5)

That a "Study Group to Assess the Risks of Introduction of Non-Indigenous Species by Ballast" be formed (with Dr. J. T. Carlton as Chair and with member nations to designate representatives to the Group) to discuss the magnitude, scale, and implications of this problem in ICES member countries, to review laws, regulations, and control measures available in ICES and other countries, to formulate advice and recommendations, and to report to the Working Group.

(6)

That the Working Group on Introductions and Transfers of Marine Organisms should meet in Tvarminne Station, Finland, for three days in 1991, to:

- a) meet jointly for one day with the Working Group on Genetics to consider the matter of transgenic and other genetically modified species, in order to develop an ICES position on the recognition of such species as introduced organisms, and to incorporate this position into a revised Code of Practice as called for in C. Res. 1989/2:36e,
- b) complete its consideration of the laws and regulations governing introductions and transfers of marine species in ICES member countries, and the preparation of a document summarizing these,

for inclusion in the CRR noted in (c), below, or for publication as a separate CRR,

- c) complete a Cooperative Research Report on the 1990 Summary of Introductions and Transfers in ICES Member Countries (Dr. A. Munro, Editor),
- d) receive the report of the Study Group on ballast water, and to review its implications for ICES member countries,
- e) to actively encourage participation and to open closer relationships with Baltic countries, and to assess the current status of introductions and transfers in these countries,
- f) continue the review of the status of salmonid fish, algal, shellfish, and other introductions in and between ICES member countries.

Acknowledgments

The Working Group extends his sincerest thanks to Director D. Scarratt and his staff of the Halifax Laboratory, Fisheries and Oceans Canada, for their extensive logistical support before, during, and immediately after the Group's meeting. Dr. R. Cutting arranged for the Group's visit and saw to many administrative and housing details. We thank Drs. Saunders and Porter for their willingness to participate in genetic discussions with the WG. Dr. M. Helm kindly led the Group on a tour of a mariculture facility south of Halifax.

A Special Acknowledgment to Chairman Sindermann

The Group took special note at the end of the meeting to acknowledge Dr. Carl Sindermann's twelve years of work and guidance. Carl chaired the first re-vitalized meeting of the Group in 1979 in Conwy, Wales, and oversaw through the decade to follow the entire modern-day growth and evolution of the Group's international role and activities on the introductions and transfers of marine organisms. It is Carl's spirit, foresight, leadership, diplomacy, and good humor that carried scores of WG members through the 1980s and through many complex and difficult deliberations. The Group was unanimous in their dismay at Carl's decision to resign from the Chairmanship, and wished him the best of luck in his future endeavors.

REFERENCES

- Carlton, J. T.
1989: Man's role in changing the face of the ocean: biological invasions and implications for conservation of near-shore environments. *Conservation Biology* 3: 265-273.
- Ferguson, M. M.
1989: The genetic impact of introduced fishes on native species. *Canadian Journal of Zoology* 68: 1053-1057.
- Gjedrem, T.
1990: Genetics in Aquaculture III. Proceedings of the Third International Symposium on Genetics in Aquaculture, held at Trondheim, Norway, 20-24 June 1988. *Aquaculture*, vol. 85, Reprinted Elsevier Science, Amsterdam, 350 pp.
- Hallerman, E. M. and A. R. Kapuscinski
1990: Transgenic fish and public policy: regulatory concerns. *Fisheries* 15: 12-20.
- Hallerman, E. M. and A. R. Kapuscinski
1990: Transgenic fish and public policy: patenting of transgenic fish. *Fisheries* 15: 21-24.
- Hargis, W. J. and D. S. Haven
1988: Rehabilitation of the troubled oyster industry of the lower Chesapeake Bay. *Journal of Shellfish Research* 7: 271-279.
- Hebert, P.D.N., et al.
1989: Ecological and genetic studies on *Dreissena polymorpha* (Pallas): a new mollusc in the Great Lakes. *Canadian Journal of Fisheries and Aquatic Sciences* 46: 1587-1591.
- Heslinga, G. A. and W. K. Fitt
1987: The domestication of reef-dwelling clams. *BioScience* 37: 332-
- Kapuscinski, A. R. and E. M. Hallerman
1990: Transgenic fish and public policy: anticipating environmental impacts of transgenic fish. *Fisheries* 15: 2-11.
- Lundalv, T.
1989: Smakligt nytillskott till svensk marin fauna. *Vasterhavet* March 1989, 2 pp.
- Munro, J. L. and W. J. Nash
1985: A bibliography of the giant clams (Bivalvia: Tridacnidae). *ICLARM Bibliographies* 5: 1 - 26.

Rueness, J.

1989: Sargassum muticum and other introduced Japanese macroalgae:

biological pollution of European coasts. Marine Pollution
Bulletin 20(4): 173-176.

Williams, A. B. and J. J. McDermott

1990: An Eastern United States record for the Western Indo-Pacific
crab, Hemigrapsus sanguineus (Crustacea: Decapoda: Grapsidae).
Proceedings of the Biological Society of Washington 103: 108-109.

Appendix I

AGENDA

ICES Working Group on Introductions and Transfers of Marine Organisms
Halifax, Canada, June 6 - June 8 1990

- 6 June 1990**
Wednesday
9:00 AM
- Opening Session of Working Group Meeting
Comments by representatives of Fisheries and Oceans Canada
Comments by WG Chairman
Introduction of participants
Introduction of Handbook for WG
Review of proposed Agenda
Status of recommendations from 1989 meeting and from previous meetings
Status of 1988 Minisymposium papers
Status of 1990 World Symposium on Introductions and Transfers of Aquatic Organisms
National Reports
- 12:00 Noon Lunch
- 1:30 - 5:00 PM Reconvene
Continue National Reports
Status of: Japanese brown alga Undaria pinnatifida
Pacific oyster Crassostrea gigas
Japanese brown alga Sargassum muticum
Coho and other Pacific salmon
Eel nematodes
Gyrodactylus in Baltic salmon
- 5:00 PM Adjourn
- 7:00 - 8:00 PM WG Reception (hosted by Fisheries & Oceans Canada)
- 7 June 1990**
Thursday
9:00 AM
- Reconvene
Collate and review national material for Cooperative Research Report on Status (1990) of Introductions
Begin consideration of request from Ireland concerning introduction of the Japanese scallop Patinopecten yessoensis
* Presentation from Ireland
* Review preliminary WG advice
* Examine statement from ICES member countries
* Discussion of options and risks
* Develop draft recommendations to the Council
- 12:00 Noon Lunch

Appendix I (continued)

- 1:30 - 5:00 PM Reconvene
Status of Study Group on Genetic Risks to Atlantic Salmon Stocks
Discussion of the role of the WG in considerations of genetically engineered organisms
* Information from the WG on Genetics
* Position statement by other organizations
* Discussion of options and risks
* Develop draft position statement and possible addendum to ICES Code of Practice
Discussion of decision procedures for introductions and transfers
New WG initiatives
Review WG Statement of Purpose
- 7:00 PM Reception and Dinner
- 8 June 1990** Reconvene
Friday
9:00 AM Prepare final draft of recommendations to the Council on Japanese scallop introductions
Assignment of editing responsibilities for Cooperative Research Report on Status of Introductions (1990)
Collate and review national updates of laws and regulations for reference volume to be deposited at ICES headquarters
- 12:00 Noon Lunch
- 1:30 - 5:00 PM Discussion of recommendations to parent committee
Principal agenda items for 1991 WG meeting
Time and place by 1991 WG meeting
Concluding remarks by WG chairman
- 5:00 PM Adjourn
- 9 June 1990** Field trip to Mountain Island Shellfish Hatchery,
Saturday Blandford
-
- 11 June 1990** Opening session of the WORLD AQUACULTURE SOCIETY Meeting
Monday
- 12-13 June 1990** INTERNATIONAL SYMPOSIUM ON EFFECTS OF INTRODUCTIONS AND
Tuesday TRANSFERS OF AQUATIC SPECIES
Wednesday Symposium jointly sponsored by ICES, EIFAC, and WAS
- 14 June 1990** WORLD AQUACULTURE SOCIETY Meeting concludes
Thursday

APPENDIX II

Submitted documents on the Japanese scallop in Ireland

- * Report on the quarantine arrangements, pathological examination and certification of Japanese scallops (P. yessoensis) imported into Ireland

- * Importation of live Japanese scallops (P. yessoensis) to Ireland

- * Introduction of the Japanese scallop to Irish waters

ICES Working Group on Introductions and Transfers of Marine Organisms. Halifax, Canada, June 1990

Report on the quarantine arrangements, pathological examination and certification of Japanese scallops (*P.yessoensis*) imported into Ireland

John F. McArdle
Fisheries Research Centre
Abbotstown, Castleknock
Dublin 15, Ireland

Quarantine

Water supply:

The quarantine was established on the east coast at Carne about 10 miles from Wexford (see map). The quarantine building is close to the shore which consists of a remote rocky beach. The quarantine consists of a hatchery part and a laboratory/algal culture unit. The laboratory is well equipped. The water supply is obtained by pumping from the sea through a pipe passing under the beach and extending 40 metres from the shore into the sea. The pipe lies at a minimum depth of 3m at the lowest spring tide. The system is capable of pumping of 20 gallons/minute into the hatchery but the routine operational pumping rate is 5 gallons/minute. The intake water is first pumped into a series of 20u, 10u and 5u sandfilters before being sterilised by UV radiation. All waste water from the hatchery, laboratory and from two footbaths drain into one single 4 inch pipe which takes it to the pre-chlorination 600 gallon tank.

Chlorination system:

Chlorination is achieved using a liquid chlorination system based on the use of a solution of sodium hypochlorite. When the volume of waste water in the pre-chlorination tanks reaches 300 gallons a mercury tilt switch activates a water pump set to deliver 32 gallons/min and a hypochlorite pump set to deliver 0.074 gallons/minute. These two liquids are then mixed by a T-piece into the same pipe which flows into tank 2. At these proportions the free chlorine in tank 2 is approximately 250mg/litre. This remains constant provided that the flows are not adjusted or the concentration of available chlorine (14-15%) in the sodium hypochlorite solution is not changed. Given that the volume of effluent water will reach a maximum of 8 gals/minute the system will have no problem in dealing with such volumes. During chlorination the level in tank 1 drops to approximately 100 gallons at which the mercury tilt switch cuts off the two pumps i.e. the residual volume in tank 1 (untreated effluent) is 100 gallons. From tank 2 (600 gals) the chlorinated effluent flows into a 2 500 gallon tank (tank 3) and finally into a 5 000 gallon tank (tank 4). Tank 4 has its outlet half way down its side, giving it an effective capacity

of 2 500 gallons.

The residence time within the chlorination system is as follows:

At 5 gallons/minute	- 19 hours
" 10 " "	- 9 hours
" 20 " "	- 5 hours

Attached to the outlet valve of tank 4 is an automatic shut down valve which is activated by a number of possible emergency causes such as failure of the chlorination system, flooding in the hatchery, power failures etc. When this valve is closed it gives the system an extra 2 500 gallons storage capacity which is adequate to store all the water in the hatchery. In the case of a flood from the hatchery a second tilt switch in tank I is activated when the level reaches 500 gallons. This shuts down the intake pump to the hatchery and the automatic outlet valve in tank 4. If this switch should fail the level in tank 1 will continue to rise to 550 gallons and then start to flow through a 4 inch pipe into tank 2. In this case, as the effluent water is bypassing the chlorination system, this connecting 4 inch pipe has a switch which when wet will also shut down the intake pump and close the outlet valve. In the case of power failure the generator starts up after 15 seconds which trips the safety switches which then have to be reset manually.

The quarantine is surrounded by a bund with a capacity of 500 gallons to contain any water which may leak from the quarantine. Sufficient sodium hypochlorite is available at all times to chlorinate any water in the bund. The whole quarantine building is surrounded by a wire fence.

Operation of the quarantine.

The operational procedures laid down are those in the ICES manual with some modifications. The operation of the quarantine is under the control of an officer of the Department of the Marine. This person is based in the quarantine on a full time basis and reports directly to an officer at the Department's Fisheries Research Centre in Dublin. The officer in charge of the quarantine has access to all parts of the quarantine at all times. This officer writes a daily report on all the activities of the quarantine and is in regular contact with the designated officer in Dublin. Access to the quarantine is strictly limited with only certain named persons being allowed in.

Quarantine requirements and procedures for Japanese scallops

The following conditions were applied prior to importation;

1. All materials in contact with the imported larvae during shipment should be destroyed or sterilised and not allowed into the holding area of the quarantine unit.
2. Intake and effluent water is sterilised in an approved manner. For intake water sand filtration and U/V treatment is used. For effluent water chlorination is used. Effectiveness of the procedures is regularly monitored by the Department.
3. The quarantine unit shall be designed to provide environmental conditions similar to those found in the area where the imported stock will be stocked on release.
4. Water quality in the holding facilities of the quarantine unit shall be monitored at regular intervals. Environmental factors that should be monitored are temperature, salinity, pH, oxygen, total ammonia and nitrite. Other water quality criteria can be checked if considered appropriate. Monitoring will ensure that water quality standards are kept within the optimum range for the species.
5. Records of operational procedures and conditions shall be kept and made available for inspection by Department personnel on request.
6. Any suspended solids or dead specimens removed from the quarantine unit shall be disinfected and disposed of by burial in lime.
7. No equipment shall enter or leave the quarantine without disinfection. If more than one species are kept in quarantine separate equipment must be available for each group.
8. Personnel operating the quarantine unit shall be supervised by staff qualified to ensure all biological and operating concerns are appropriately taken care of.
9. Personnel shall enter and leave the quarantine unit through a disinfection station which should be regularly serviced to guarantee continued effectiveness.
10. Outer clothing and boots must be provided for each person working in the quarantine facility and will remain in the quarantine at all times, except when being cleaned.

11. The quarantine shall have adjacent but physically isolated laboratory facilities for inspection and preparation of material for pathology tests.
12. Should the quarantine unit experience a disease outbreak the Department of Marine shall be immediately notified and diseased stocks destroyed if requested.

Certification

Certification was provided by Professor Tokuo Sano of the Tokyo Fisheries University. Professor Sano is one of the most eminent fish pathologists working in Japan and has taught many of the personnel of the regional prefecture laboratories and is very familiar with the current disease status of most species being cultivated in Japan. Visits to Japan by officials of the Irish Department of the Marine were made to the site of origin of the imported scallops and discussions were held with Prof. Sano re disease problems in Japanese scallops. Discussions revealed that there was no history of disease in scallops from the area of origin.

To validate this information it was a further requirement that approximately 150 adult scallops from the area of origin be examined prior to importation both macroscopically and microscopically for the presence of disease. This examination was carried out monthly at the Tokyo Fisheries laboratory by Prof. Sano from October 1989 to March 1990. The organisms specifically examined for were as follows:

Polydora spp
Pectinophilus ornatus
Chlamydia sp
Microsporea
Stellatosporea

Other potential pathogens were also looked for on the histological examination.

In the case of Polydora a gross examination was carried out, and the for Pectinophilus ornatus both a gross and histological examination was made. For detection of the other pathogens histological examination was carried out supplemented in the case of Chlamydia detection with culture using McCoy cells. The scallops examined were intensively cultured animals cultured by the hanging method from derived natural settlement of scallop spat in the area of origin. The animals ranged in size from 9.6 cms to 11.8cms with an average of 10.6cms in shell length. On macroscopic examination of these animals all appeared healthy.

Following gross examination and examination of wet mount preparations, tissues were fixed in 10% formalin for histological examination. Sections were stained with H and E and Toluidene blue and examined.

Attempted isolation of Chlamydia was carried out by inoculation of fresh digestive diverticula tissue on to McCoy cells and incubated at 35 C for 72 hours.

The pathology results showed that one kind of macroparasite, Pectinophilus ornatus was consistently found on the gills of the Japanese scallop with a prevalence ranging from 20-50% in November and February. No other microparasites (such as Microsporea and Stellatoporea) were found in the digestive diverticula or gills of all fish examined. Attempts at isolation of Chlamydia proved negative. The polychaete Polydora was found in one sample in October at a prevalence of 15%.

Importation of Japanese scallops

The imported scallops were obtained from Miyagi prefecture at Utatsu bay (see map). Two consignments of D-veliger larvae spawned in sterile conditions were imported and two consignments of adults. The larval consignments consisted of 1 million and 250 000 larvae in each consignment and were imported on the 9/4/90 and 14/4/90 respectively. 2 consignments of adults were also received consisting of 102 (72 F + 30M) in the first consignment received on 9/4/90 and 75 (55F + 20m) in the second received on the 24/4/90. Both consignments of larvae died. The first batch died within 24 hours due to excessive residual levels of chlorine in the rearing bins following treatment by the hatchery staff. The cause of mortality in the second group is not clear, but its acuteness and totality would suggest adverse environmental conditions. Bearing in mind that this second batch of larvae had been stored at low temperatures in Japan for some days, and had then spent 35 hours in transit to Ireland, it is likely that the transportation of such organisms for a prolonged period at a critical stage of their development is more than they can withstand.

Procedures following importation of Japanese scallops

The adult scallops were removed from their packing, their shells brushed and cleaned and placed in the quarantine facility. All packing material was burned outside the quarantine.

The larvae were checked for viability under the microscope. Those examined were free-swimming D-veligers.

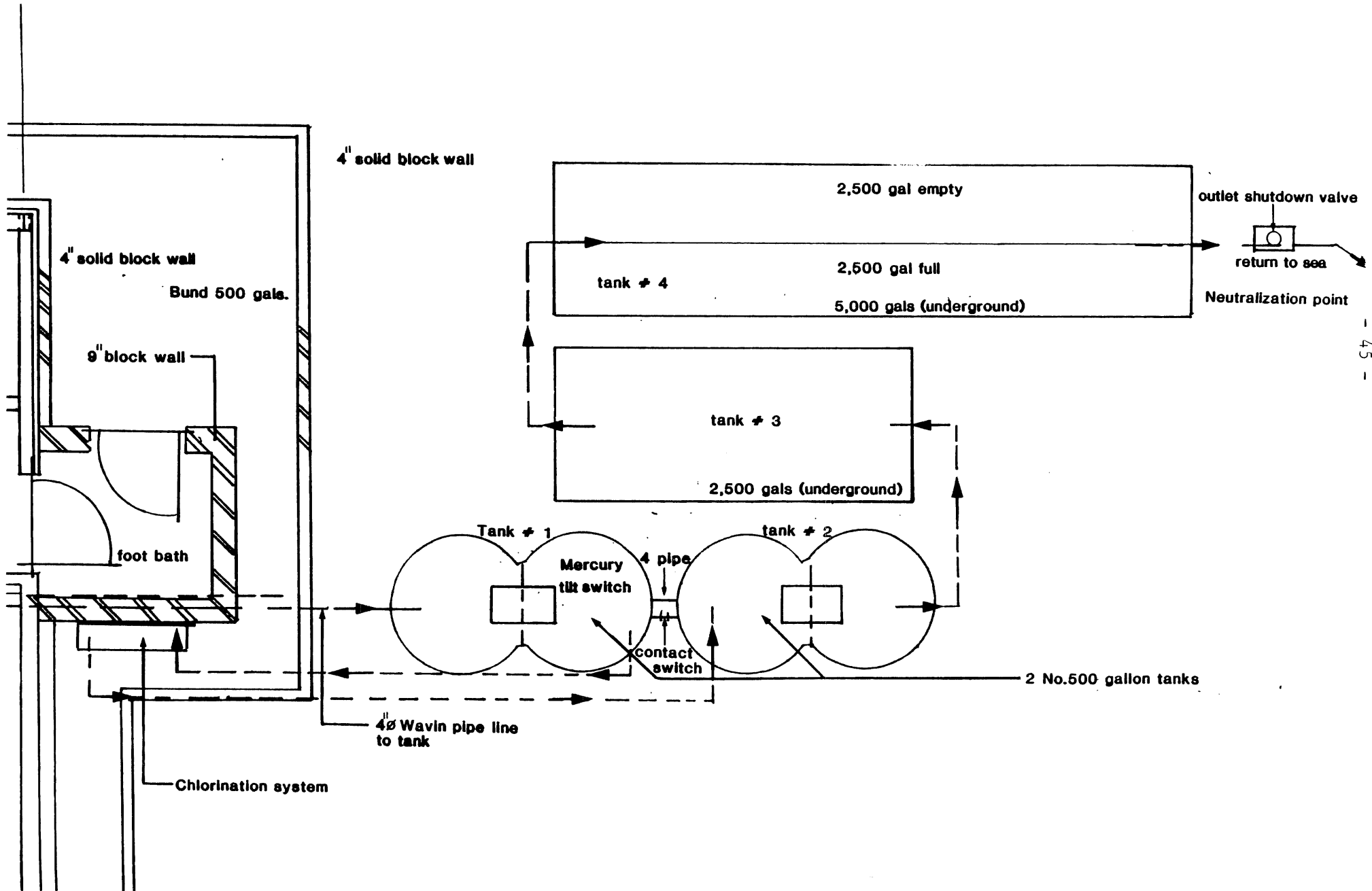
In the immediate post introduction period 75 (66F, 9m) of the 102 adult scallops imported in the first consignment died. These animals were fixed and examined histologically. Out of these mortalities one animal showed the presence of a very few small bodies in the interstitial tissue of the digestive gland which appeared to resemble protozoan parasites. Slides were sent to Dr. Susan Bower, Fisheries and Oceans Dept., Canada for an opinion and results are awaited. In the second consignment 51 (36F, 15M) out of the 75 animals died and were fixed and

examined histologically. Results were negative.

A further 25 animals surplus to breeding requirements were sacrificed and fixed for histological examination. Examination of this group has revealed evidence of the presence of Rickettsia - like organisms on the gills of some animals. Slides have been submitted to IFREMER for confirmation.

Four spawnings have been carried out in quarantine, three of which have been successful. Spat settlement has taken place. Because of their small size as yet pathological examination has not been carried out on this F1 generation.

Chlorination system at Carne Quarantine Co. Wexford.





BROOKSTOCK LOCATIC

MIYAGI LABORATOR

MIYAGI

BANDA

BUKUSHIMA

H

Niigata

ONIGATA

JOSHIN

TOHOKU

AKI

Nakaminato

Hitachi

Hitachi

Hitachi

ICES Working groups on
Introductions and Transfers of Marine Organisms

Halifax, Canada, June 1990

Importation of live Japanese scallops (*P. yessoensis*) to Ireland

1. Quarantine
 - 1.1 The quarantine was established at Carne, Co. Wexford (see map). The quarantine building consists of a converted building a few hundred metres from a rocky beach about 10 miles from Wexford town.
 - 1.2 The incoming water is drawn from a pipe going from the quarantine under the beach and extending 40 yards from the shore at the lowest spring tide. The pipe lies on the seabed at a minimum depth of 3m at lowest spring tide. Pumping of up to 20 gals/minute into the hatchery is possible but it is estimated that about 8 gals/minute would be the maximum sea water requirement. The pumped water is sand filtered through a series of 20um, 10um and 5um sand filters and UV treated prior to entry into the quarantine.
 - 1.3 All effluent water used in the hatchery quarantine is sterilised by liquid chlorination using a solution of sodium hypochlorite. The effluent water pumped from an initial 600 gal collecting tank to the chlorination system and the chlorinated waste water flows into 2 further tanks of 2 500 and 5 000 gallon capacity. The final tank has a number of automatic shut down valve activated by a number of possible emergency causes such as failure of chlorination system, flooding in the hatchery, power failures etc.
 - 1.4 The quarantine has a surrounding bunds to contain any water which may leak from the hatchery with a capacity of 500 gallons. Sufficient sodium hypochlorite is available to chlorinate any water in the bunds.
 - 1.5 The quarantine building is surrounded by a wire fence.
2. Operation of quarantine
 - 2.1 The quarantine is operated according to the recommendations laid down by ICES.
 - 2.2 The operation of the quarantine is under the control of an employee of the Department who is based full time in the installation.
 - 2.3 A daily report is maintained of the activities of the hatchery
 - 2.4 Only named personnel are allowed admittance to the

quarantine.

3. Importation of Japanese scallops
- 3.1 Japanese scallops were obtained from the Miyagi prefecture of Japan (see map).
- 3.2 2 batches of adult scallops, obtained from hanging rope culture at Miyagi prefecture were imported and two batches 1m and 300 000 respectively D stage larvae were also imported. All packing etc. was destroyed by burning before admittance into the hatchery. (102 + 75)
- 3.3 Certification was provided by Dr. Sano, Tokyo Fisheries University and based on a 2 year disease free history of shellfish diseases in the area of origin together with a monthly pathological examination of scallop samples from the area of origin for six months prior to importation. The imported larvae were spawned from a small number of parents held in filtered and sterilised water at the Miyagi Prefecture Fisheries laboratory. Following spawning the parents were sacrificed and examined pathologically. The only pathogen detected in examination of adult scallops from Miyagi was Pectinophilus sp. which is readily detectable on scallops in Japan being a large macroscopic parasite of the gills. However there is no evidence of serious losses occurring due to this parasite. A Department of the Marine Fish Pathologist visited Japan, inspected scallops at the place of origin, visited the local fisheries laboratory and had detailed discussions with Dr. Sano prior to the importation.
- 3.4 Both consignments of scallop larvae died shortly after arrival. The first consignment died because of excessive chlorination of holding tanks. The cause of mortality in the second consignment is not absolutely clear but its acutenesses and scale would suggest some adverse environmental parameters. The transportation of these animals for prolonged periods at a critical stage is their development may also be an important factor in their demise.
- 3.5 Successful spawning of the adult scallops has been achieved and the F1 generation are growing well up to this time. Pathological examination is being carried out on the broodstock.
- 3.6 Scallops are being fed on algal cultures obtained from existing hatcheries in Ireland supplemented with commercially produced algal cultures from the UK.

INTRODUCTION OF THE JAPANESE SCALLOP TO IRISH WATERS.

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SUMMARY

The ultimate objective of introducing the scallop *Patinopecten yessoensis* to Irish waters is to develop commercial hanging culture. Initially its survival and growth will be compared with that of *Pecten maximus*, the main pectinid native to Ireland, to assess its suitability.

Sites on the south and west coasts have been selected for possible on-growing. *P. yessoensis* has been introduced to a quarantine facility on the SE coast of Ireland, under the supervision of the Department of the Marine.

Larvae introduced from Japan did not survive, but imported adults were spawned and an F1 generation has been settled. At this time all scallops remain in quarantine.

An attempt has been made to address questions raised at the last meeting of the Working Group on Introductions and Transfers of Marine Organisms, held in Dublin in 1989. This has included studies of the literature, visits to Japan (where discussions with biologists, oceanographers,

pathologists and fishermen) and correspondence with internationally recognized scallop biologists. The Working Group, and subsequently the Mariculture Committee had expressed some concern over:

1. MASS MORTALITIES OF JAPANESE SCALLOPS IN CULTURE.

There is no evidence of any pathological implication in scallop mortalities in Japan. Causes appear to be one or more of the following, most of which stem from over-intensive cultivation:

- a) Physiological stress arising from premature development or high sea temperatures,
- b) Wave action, causing tissue damage from shell overlapping,
- c) Oxygen depletion.

2. POSSIBLE GENETIC RISK.

In Japanese waters there are no known examples of hybridization of *P. yessoensis* with any other pectinids with overlapping ranges. This scallop is morphologically different, and has a different chromosome number from all European scallop species. It also differs from European commercial scallop species as in that it is dioecious. Any possibility of hybridization should be further reduced by the fact that *P. yessoensis* spawns at lower temperatures (in the early spring) than *Pecten maximus*, which spawns from May to August. *Chlamys opercularis* has three periods of spawning - a small peak in January/February (in the Irish Sea), summer and autumn. For these reasons we conclude that there is no genetic risk.

3. POSSIBLE COMPETITION WITH OTHER SCALLOP SPECIES.

Although there is some overlap with the ranges of other species in Japanese waters there is no apparent competition. *P. albicans*, which resembles *P. maximus*, has a geographical range overlapping that of *P. yessoensis*, but has a preference for a different sediment. It can be deduced from the Japanese literature that the larvae or settled spat of Japanese scallops are unlikely to compete with those of Irish pectinids, because of the spawning patterns described above. There may be competition as juveniles or adults, but this is not seen in Japan, where the distribution of *P.yessoensis* overlaps with that of other pectinid species.

4. POSSIBLE INTRODUCTION OF OTHER ORGANISMS.

Prior to introduction, *P. yessoensis* were selected by size and condition, and their shells were scrubbed. All scallops and their remaining epibionts were introduced to quarantine. Waste water is treated by chlorination at 250 ppm with a minimum treatment time of 4.5 hours. Following spawning all eggs are sieved and washed and kept separate from adults and their water. This procedure is considered to be sufficient to destroy any epibionts.

5. THAT JAPANESE SCALLOPS ARE UNLIKELY TO THRIVE IN IRISH CONDITIONS.

All indications are that conditions in Ireland are favorable, sea temperature ranges fall within the optimum range for the species, and all likely cultivation areas have appropriate salinities.

6. THAT THIS SPECIES COULD BECOME ESTABLISHED OUTSIDE IRISH WATERS.

It is probable that a large source population is required before the establishment of a population becomes likely. The critical size of the source population required is not known, and is likely to be dependent on local conditions. In Japan the establishment of cultivation in new areas is thought to have produced some recruitment to the natural populations in nearby regions, but this has not been quantified. Larval numbers will clearly be dependent on population size, and in Mutsu Bay a direct relationship has been found to exist between larval abundance and subsequent settlement. Annual settlements are known to be highly variable in most scallop species, however.