Advisory Committee on the Marine Environment

ICES CM 1996/Env:8
Ref.: E + F

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

Gdynia, Poland
22–26 April 1996

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

Palægade 2–4 DK-1261 Copenhagen K Denmark

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

1 OPENING OF THE MEETING AND INTRODUCTION

The 1996 meeting of the ICES Working Group on Introductions and Transfers of Marine Organisms (WGITMO) was held at the Sea Fisheries Institute (Morski Instytut Rybacki or MRI), 1 Kollataja Str., Gdynia, Poland, 22–26 April 1996 and was chaired by Dr J.T. Carlton (USA). This was the second time since 1985 that the Working Group met in Poland. The members of WGITMO were welcomed by Professor Z. Polanski, the Institute Director, and by Dr W. Pelczarski. The objectives of the 1996 meeting were reviewed and the agenda for the meeting was considered and approved. The agenda is attached as Annex 1. At this meeting, there were fourteen WGITMO members representing nine ICES Member Countries, in addition to ten additional members of the Baltic Marine Biologists' (BMB) Nonindigenous Estuarine and Marine Organisms (NEMO) Working Group, as well as three invited guests. A complete list of participants is attached as Annex 2.

2 TERMS OF REFERENCE

The terms of reference for the 1996 meeting of WGITMO (C.Res. 1995/2:14:8) were to:

a) meet with the Working Group on Nonindigenous Estuarine and Marine Organisms (NEMO) of the Baltic Marine Biologists (BMB) association, to consider current critical issues arising from exotic species invasions in the Baltic Sea, and the potential risk of future invasions via shipping and other anthropogenic activities, and to facilitate contacts with Eastern European experts on the issues of introductions and transfers;

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

c) continue to review scientific studies on ballast water issues, including intercalibration of ballast water and sediment sampling techniques, the management of ballast water, on-going studies of control and treatment, and the impacts of ballast water introductions on fisheries (including mariculture) and report on the findings;

d) continue to assess biocontrol activities, research, and the development of risk assessment methods relative to the management of non-indigenous marine organisms and report on the results;

e) assess and report on whether there are disease and ecological implications arising from the introduction and transfer of aquarium (ornamental) marine and estuarine species into ICES Member Countries;

f) assess the potential for coordination of databases on the introductions and transfers of marine organisms that are being created in individual ICES Member Countries and elsewhere;

g) on the basis of an IOC Assembly Resolution, develop a proposal for a group to be cosponsored by ICES, IOC, and IMO on the topic of the implications and management of ships' ballast water and sediments.

Through the auspices of the General Secretary representatives of IOC and IMO will be invited to attend.

3 REPORT OF ICES MEETINGS

Dr J.T. Carlton (Chairman) had attended the 1995 ICES Annual Science Conference (ASC) in Aalborg, Denmark, and presented the 1995 WGITMO Report before the Mariculture Committee. In addition, Dr Carlton and other WGITMO members participated in the "Theme Session on the Ecological and Fisheries Implications of Ballast Water". Seventeen papers and posters from eight countries and IMO were presented at this first international scientific meeting addressing the role of ballast discharge in the introduction of non-native species. Papers in preparation for publication in the ICES Cooperative Research Report (ICES CRR) series are listed below (see item 5).

It was noted that the ACME had included "Introduction and transfer of organisms" as one of the six most important marine environmental issues within the ICES area over the next decade (ICES CRR, No. 212, pp. 77–78).

4 STATUS OF RECOMMENDATIONS FROM 1995 MEETING

The recommendations from the 1995 WGITMO meeting are listed below with their outcome at the 1995 ASC. The original recommendations are summarized here; the full wording of each may be found in ICES CM 1995/ENV:9.

Recommendation 1

That the *1994 Code of Practice on the Introductions and Transfers of Marine Organism* in addition to its publication in the official ICES languages of English and French, should also be available in all of the languages of the ICES Member Countries, and that these translations should be provided by the Member Countries.

became

Approved as C.Res. 1995/4:2

ICES Member Countries are encouraged to prepare translations of the '1994 Code of Practice on the Introductions and Transfers of Marine Organisms', in

addition to its publication in the official ICES languages of English and French, and distribute copies to all relevant persons.

Recommendation 2

That the *Annotated Bibliography on Transplantations and Transfers of Aquatic Organisms* ... by Prof. H. Rosenthal, should be published by ICES.

became

Approved as C.Res. 1995/1:4

*The **Annotated Bibliography on Transplantations and Transfers of Aquatic Organisms and their Implications on Aquaculture and Ecosystems**, edited by Prof. H. Rosenthal (Germany), initiated and motivated by work with the ICES Mariculture Committee and the Working Groups on Introductions and Transfers of Marine Organisms and on Pathology and Diseases of Marine Organisms, and subject to a review of cost implications and possible co-financing, will be published by ICES on CD-ROM, with several copies available on paper. The estimated number of pages is 1200.*

Recommendation 3

That recognizing that species introduced by ballast water and sediments are a critical issue, there should be further strengthening of cooperation on ballast issues between ICES/WGITMO, IMO, and IOC.

became

Approved as C.Res. 1995/2:14:8 (g).

Recommendation 4

That in order to understand the ecological and economic impacts of intentional introductions of marine organisms to ICES Member Countries, a study should be conducted on historical case examples of selected species (e.g., the Japanese oyster, the Manila clam, the Japanese seaweed *Undaria*, and the anadromous salmonid rainbow fish) to provide a foundation for future risk assessments

Endorsed by the ACME in 1995: see ICES CRR., No. 212 (Section 13.2), p. 64.

Recommendation 5

That the Working Group should meet at the Sea Fisheries Institute, Gdynia, Poland, from 22–26 April 1996 with the terms of reference described above.

Approved as C.Res. 1995/2:14

Following discussion of the outcome of these recommendations, and noting the endorsement by ACME relative to item (4), WGITMO agreed that an important endeavor and term of reference would be to undertake historical risk assessments of the ecological and other environmental effects of introductions of commercially important exotic species to ICES Member Countries, retrospective of the events leading to their current development and current ecological status, so that the types of risk can be identified and used as a basis for aiding future management decisions. Species that could be considered in this assessment include the Pacific oyster *Crassostrea gigas*, the Pacific kelp *Undaria pinnatifida*, and the coho salmon *Oncorhynchus kisutch.*

5 STATUS OF ITMO-GENERATED ICES COOPERATIVE RESEARCH REPORTS

Three manuscripts to be published in the ICES Cooperative Research Report sereis are in production or in the final stages of preparation:

1) *Status (1981–1991) of Introductions of Non-Indigenous Marine Species to North Atlantic Waters*, A.L.S. Munro (Editor) and S. Utting and I. Wallentinus (Co-Editors), was submitted to the ICES General Secretary on 6 February 1996.

2) *The ICES Code of Practice on the Introductions and Transfers of Marine Organisms: Guidelines and a Manual of Procedures*, J.T. Carlton (Editor), is near completion and submission to the General Secretary is estimated for June 1996.

3) *Ballast Water: Ecological and Fisheries Implications*, J.T. Carlton (Editor), is also near completion and submission to the General Secretary is estimated for June 1996. The following papers, from the ballast water theme session at the 1995 ASC, will be included:

   J.T. Carlton. *Ballast water: The ecological roulette of marine biological invasions.*

   K. Hayes. *Ecological risk assessment for ballast water introductions.*

   G.M. Ruiz, L.D. Smith, A.H. Hines, J.T. Carlton, and D.W. Coates. *Ballast water and non-indigenous species in U.S. coastal waters.*

   S. Gollasch, M. Dammer, J. Lenz and H.G. Andres. *Non-indigenous organisms introduced via ships into German waters.*

   E.M. Macdonald. *Dinoflagellate resting cysts and ballast water discharges in Scottish ports.*

   I. Laing. *Ballast water discharges into coastal waters of England and Wales.*

   N.C. Eno. *Non-native marine species in British waters: ballast water introductions.*

   D. Minchin and J. Sheehan. *The significance of ballast water in the introduction of exotic marine organisms to Cork Harbour, Ireland.* G.M.

Hallegraeff. *Transport of toxic dinoflagellates via ships' ballast water: an interim review.*

D. C thier and D.A. Steel. *A synopsis of the Cc an situation regarding ship transported b water.*

Hayden. *A New Zealand perspective on ballast ter.*

R.E. Thresher and R.B. Martin. *Reducing the impact of ship-borne marine introductions: focal objectives and development of Australia's new Centre for Research on Introduced Marine Pests (CRIMP).*

H. Gollamudi and A. Randall. *Policy incentives to prevent the introduction of non-indigenous species via shipping.*

R.M. Gaudiosi and L.V. Kabler. *Ballast water management: an integrated approach.*

G. Rigby and A. Taylor. *Ballast water: its impacts can be managed.*

M.K. Nauke. *Provisions for the control and management of ballast water to minimize the transfer of harmful aquatic organisms and pathogens.*

6 THE 1994 ICES CODE OF PRACTICE

The Chairman and the Working Group noted with great pleasure and pride the formal publication by ICES, for the first time in the Working Group's 17-year history, of *the ICES Code of Practice on the Introductions and Transfers of Marine Organisms 1994* (*Code de Conduite du CIEM pour les Introductions et Transferts d'Organismes Marins 1994*). The elegant 12-page bilingual booklet, with a *Preamble* and a *Brief Outline of the ICES Code of Practice* 1994 co-authored by J.T. Carlton and K. Richardson, was made available at the ASC in Aalborg, Denmark, in September 1995.

In addition to the official ICES languages of English and French it was noted that versions are expected to be available in Finnish, Swedish, German and Norwegian this year. In addition a Japanese draft of the Code, from the Fisheries Agency of Japan, was provided to the meeting through correspondence with D. Minchin (Ireland).

It is intended that all available translations of the Code of Practice will be gathered to form a single published volume at a later date.

The Chairman noted that there were changes made to the final version of the Code in Section IV (a) at the request of French representatives. The change was to delete a phrase, "and any other non-indigenous and/or harmful organisms" after the words "introducible pests and disease agents". It was felt that the existing wording ("introducible pests and disease agents") captured a portion of the fundamental essence of the issue. The broader issue of additional transferable species that might not manifest themselves as pest or disease organisms but could have ecological consequences nevertheless should remain open for discussion relative to future revisions of the Code.

In this regard, the Working Group noted that extensive movements of fish and shellfish continue throughout and among ICES Member Countries. These movements may pose risks as secondary introduction sources causing range expansions of species that could have the potential to modify aquaculture practice and/or result in changes in the structure of ecological communities. The continuously expanding range of many invasions in European coastal waters does not speak toward a static issue.

Note was made of C.Res. 1993/3:7 and C.Res. 1994/3:2. The 1993 resolution stated that,

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

The 1994 resolution stated that,

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

Relative to the matter in the Code of Practice noted above, and relative to the issues highlighted in these resolutions, a recommendation was thus formulated, whereby ICES Member Countries would be asked to collect data on the diversity, abundance, and extent of any organisms unintentionally accompanying known (and especially regular) commercial shipments of fish and shellfish transferred between Member Countries, and to present such data at the 1997 WGITMO meeting.

6.1 The Code of Practice in Relation to International Bodies

6.1.1 Oslo and Paris Commissions (OSPAR)

The 1994 ICES Code of Practice was discussed at a meeting of the Environmental Assessment and

Monitoring Committee (ASMO) of OSPAR at a meeting in Vila Franca Do Campo, The Azores, in March 1996. The Code of Practice had been recommended for discussion by the IMPACT Working Group of ASMO, which met in Stockholm 10–13 October 1995. It was highlighted at the meeting that the Code was a voluntary commitment by ICES Member Countries. A draft OSPAR Recommendation to the effect that its Contracting Parties apply the ICES Code of Practice with respect to introductions and transfers of marine organisms to the maritime area was prepared during the meeting. Contracting Parties were asked to send proposed revisions to this draft to Sweden by 30 June 1996. After discussion at ASMO 1997, the text may be forwarded to the Programmes and Measures Committee (PRAM) for further consideration and possible adoption by OSPAR.

At the IMPACT Meeting it was further agreed that Sweden, as Lead Country, should distribute a questionnaire to Contracting Parties, requesting relevant national information on alien species, including, *inter alia*, information on relevant research activities, strategies for the development of monitoring programmes and sampling and measurement techniques. The results from the questionnaires will be presented to IMPACT in 1996, and based on this report and additional information from ICES, the Working Group of ASMO will decide on its strategy involving alien species.

6.1.2 Helsinki Commission (HELCOM)

At the Sixth Meeting of the Environment Committee (EC 6) of HELCOM, the Committee requested the Contracting Parties to take action to reduce the risks associated with the intentional introduction of alien species in the Baltic Sea (for example, relative to aquaculture practices and scientific field experiments) and to follow the 1994 ICES Code of Practice and/or the EIFAC Code of Practice.

7 NATIONAL REPORTS

7.1 Highlights of the National Reports

The National Reports, appended as Annex 3, contain details of new laws and regulations, deliberate releases, accidental introductions and transfers, live imports, and live exports. Highlights are summarized below. Data updating algal invasions are reported in a separate section, below. References cited in the National Reports and elsewhere in this Report are provided in the Bibliography, attached as Annex 4.

7.1.1 Canada

* An "interim amendment" has been proposed for the Canadian Fish Health Protection Regulations (FHPR) which, if approved, will allow facilities with FHPR pathogens to transfer live fish or eggs into the country, or between provinces, providing the recipient facility already has those specific agents. An important aspect of this proposal is the determination of "likeness" of pathogens at the source and recipient facility. Considerations of serotype, genetic makeup, and antibiotic sensitivity/resistance are being discussed as important discriminators to be included.

* Research continues into the use of triploid grass carp *Ctenopharyngodon idella* to control aquatic vegetation in irrigation canals and farm ponds. As this work is nearing the stage of widespread use, a "Non-Native Species Risk Assessment Committee", consisting of Federal and Provincial representatives, has been established for this and related issues.

* Milt from transgenic (growth hormone) Atlantic salmon in Newfoundland is being imported to research facilities in New Brunswick. The use of transgenic fish in commercial aquaculture ventures is on the horizon and the move by Canada to develop a policy on transgenic organisms is seen as timely.

* Native Indian communities in Canada cooperating with each other have initiated approaches to import fronds (blades) of the giant kelp *Macrocystis* from British Columbia to the Gulf of St Lawrence so that herring may lay their eggs upon them, creating a specialized product for export to Japan. It was intended that the fronds be held in suspension in areas where herring spawn naturally or to hold them within enclosures. The application for transfer was refused. Movements of the kelp *Macrocystis* on the west coast of the United States, from California to Oregon, have shown that more that 40 species may be associated with this kelp. These species include bryozoa, hydroids, mollusca and crustacea and some associated parasites, many of which are either encrusting on the blades or so firmly attached as to not be easily dislodged. Such movements will almost certainly involve translocations of unintended species.

The discussion on the potential transport of the kelp *Macrocystis* points out the difficulties in accessing the pertinent literature on transport vectors. In this case, Canadian authorities were not aware of the data from California/Oregon when they made their decisions, although such data would have been of great value. There are few means, however, by which to gather vector-focused data (ballast water being a current exception) as compared to species-focused data.

After some discussion, it was felt that an ICES Cooperative Research Report should be prepared by WGITMO to examine the diversity, nature, and specific roles of those human-mediated vectors known to be important or potentially important in the transportation of exotic marine and brackish water organisms, and to attempt to assign relative degrees

of risk that these vectors may pose in the distribution of non-native species.

The purpose of the ICES CRR would be to supply a reference manual that is vector-based rather than species-based, in order to provide decision-makers with ready access to data sources that may aid in risk assessments, when specific vectors are proposed or come into play that have previously not existed in individual ICES Member Countries or in specific geographical areas thereof.

7.1.2 Finland

* The Gene Technology Act and Decree was put into force in June 1995, specifically requiring all research with GMOs to be reported.

* Two new invasions are noted in coastal Finnish waters in 1995: the zebra mussel *Dreissena polymorpha* and the predatory spiny water flea *Cercopagis pengoi*. The spiny water flea has become an important part of the diet of herring in the northern Baltic Sea.

* The American polychaete worm *Marenzelleria* and the Ponto-Caspian mysid shrimp *Hemimysis* have both expanded their distribution to the Bothnian Sea.

7.1.3 Germany

* The introduced American polychaete worm *Marenzelleria* continues to spread rapidly along the German coast, as highlighted last year.

* An attempt to collect live specimens of the endangered native sturgeon in 1994–1995 resulted in a surprisingly high number of collections of non-native sturgeon in German and Dutch territorial waters of the North Sea, including the Siberian sturgeon, the Caspian sturgeon, the white (Californian) sturgeon, and a number of unidentified hybrids.

7.1.4 Ireland

* The Japanese oyster *Haliotis discus hannai* and the abalone *H. tuberculata* continue to be cultured on Irish coasts, held in netted barrels in the sea.

7.1.5 Norway

* The king crab *Paralithodes camtschatika* was introduced into the Barents Sea (Murmansk) in the 1960s (Kuzmin and Olsen, 1994; Orlov and Ivanov, 1978). Single individuals were occasionally caught, but in 1992 the crab invaded Varangerfjord in Norway and caused problems for the net fishermen in the area. A joint Russian/Norwegian programme was established to monitor the development of the crab stock in the Barents Sea. Recent information (1995) indicates rapid increases in king crab abundance and reproduction, and recruitment has been detected in the Varangerfjord system and in the Murmansk area. Furthermore, a western migration has been observed, and 1995 information suggests that the king crab is curently established in Tanafjord and Kvaenangen. Some large, single individuals have been observed in the Tromsø and Vesteraalen areas. The crab is of high commercial value and there are strong pressures from fishermen to develop a regular fishery and to introduce the crab to additional areas. Portions of a video on the king crab in the Barents Sea were shown to WGITMO.

7.1.6 Poland

* The Ponto-Caspian goby *Neogobious melanostomus* has become increasingly abundant in Gdansk Bay and is occasionally being sold in the market.

* The gammarid amphipod *Gammarus tigrinus* is now reported in the Polish region of the Szczecin Lagoon.

7.1.7 Sweden

* New regulations on the use and release of GMOs came into force 1 July 1995.

* Live cysts of the dinoflagellate *Gymnodinium catenatum* were abundant in the sediments of several fjords in the Bohuslan province in the fall of 1995. No motile cells were found in the plankton.

7.1.8 United Kingdom: England, Wales, and Scotland

* Alleles previously known in French populations of the Pacific oyster *Crassostrea gigas* have been found in British populations of the oysters in the River Teign, indicating that there may have been movements of oysters, possibly of French origin, into this estuary, but when and how this occurred is not known.

* The oyster drill *Urosalpinx cinerea*, initially introduced to the southeast coast of Britain in the 1880s with consignments of American oysters, became established and spread to some neighbouring areas with oyster movements. For most of this century it has caused extensive problems as an oyster predator and has influenced the production of oysters. It does not have a larval stage but has attached egg cases from which juvenile snails are released. The management of oyster movements within dedicated zones within the UK did much to confine the species to restricted regions. However, the last known live records of this species are from 1991 and it may now be absent. It would appear that this species, like all neogastropods, is subject to the effects of organotins which cause sterility, causing their population to decline.

* The Joint Nature Conservation Committee has produced a document (JNCC Report No. 261) reviewing policy and legislation on species translocations (including movements of organisms for ranching, population stocking, aquaculture, sowing, and planting for habitat restoration) as a background for future policy formulations.

7.1.9 United States of America

* The European shore (green) crab *Carcinus maenas* is rapidly spreading out of San Francisco Bay in central California since its discovery there in 1989–1990. It is now present in northern California in Humboldt Bay and has been found south of San Francisco Bay in estuarine sloughs in Monterey Bay. These range extensions are thought to result from natural larval dispersal in coastal currents.

* A new report (Cohen and Carlton, 1995) concludes that San Francisco Bay in central California—with a documented non-indigenous biota of 210 non-native species from many global provinces—is the most heavily invaded aquatic ecosystem known anywhere in the world. Currently invasive rates for this Bay take place at the rate of one new species every six months. San Francisco Bay has salinity values that range from 0 to 30 presenting a wide physical profile to species released in its waters.

* The carnivorous European fish, the ruffe *Gymnocephalus cernuus*, has now spread out of Lake Superior into Lake Huron, probably as a result of ballast water movement in the Great Lakes.

7.1.10 Genetically Modified Organisms (GMOs) and Transgenic Species

In the course of the National Reports (and in further reports on the status of the red algal *Porphyra* culture in America), new experiments and programs with genetically modified organisms (GMOs) were noted. These included,

CANADA
Milt from two transgenic (growth hormone) Atlantic salmon males was transferred from Newfoundland to two research facilities in New Brunswick.

SCOTLAND, UK
The report by MacKenzie (1996) was brought to the WGITMO's attention relative to the growing of genetically altered Atlantic salmon in high-security tanks next to Loch Fyne in Scotland, at the Otter Ferry salmon hatchery. The salmon have been hatched from eggs that were injected with a gene for salmon growth hormone, plus a promoter sequence from the ocean pout fish. This genetic combination has not been approved for commercial trials in North America, but has been licensed by an American company to Otter Ferry and a hatchery in New Zealand. Questions raised now concern in part the future grow-out of such fish in fish farms, and the probability that such fish might escape from net pens.

USA
Discussions are on-going to experiment with the production of transgenic strains of the seaweed *Porphyra yezoensis*.

As GMO developments continue, it was noted that ICES should remain in communication with the EU in Brussels in order to be aware of any plans for the release of transgenic organisms in the ocean. Further, the Working Group felt that it would be useful to remind ICES Member Countries that GMOs are now covered in the Code of Practice and that activity relative to GMOs should be recorded in the National Reports. WGITMO formulated a recommendation to this effect.

8 CURRENT STATUS OF SOME MAJOR ALGAL INVASIONS IN EUROPE

8.1 Green Alga *Caulerpa taxifolia*

Caulerpa taxifolia, an alga introduced to the Mediterranean Sea, was first recorded from the Monaco area in 1984 and now extends to Messina in Italy and to the Balearic Islands (Meinesz *et al.*, 1995). In certain regions it may displace seagrass beds (*Posidonia*) and result in 100% surface cover of the sea floor (Villelle and Verlaque, 1995), which may have a negative impact on diving and tourism (Ribera and Boudouresque, 1995). The plants are all recorded as males and reproduce by fragmentation (Ribera and Boudouresque, 1995). It is thought that transfers within the Mediterranean may take place by boats carrying snared (entangled) algal fragments on anchors and caught in anchor chains. There is now a ban in France and Spain to possess, sell, and transport this species (Ribera and Boudouresque, 1995). The lack of severe nutrient limited productivity may also enhance its ability to outcompete native species (Delgado *et al.*, 1996). *C. taxifolia*, as well as the native species *C. prolifera*, produces toxins, e.g., caulerpenyne, which can vary considerably between plant populations. Recent studies concluding that the *Caulerpa* of the northeast Mediterranean is the same as a Lessepsian *Caulerpa* species that invaded the eastern Mediterranean through the Suez Canal in the 1930s (Chisholm *et al.*, 1995) have been questioned (Patel, 1996). However, other studies have also claimed that *C. taxifolia* and *C. mexicana* to be conspecific. WGITMO especially noted suggestions of using non-native herbivorous snails (seaslugs), a species of *Elysia* from the Caribbean, as possible control agents (see Section 12 on Biological Controls).

8.2 Brown Alga *Undaria pinnatifida*

Undaria pinnatifida, a Japanese kelp, has established itself on the south coast of England (Fletcher and Manfredi, 1995). Its occurrence in June 1994 in the Hamble Estuary in the Solent region where there are many pleasure crafts, strongly suggests that transfer by

recreational vessel traffic from Brittany, the nearest population of *Undaria,* may have been responsible for its establishment in England. In March 1996, a one-year pilot study was started in England to monitor this introduced species with respect to further spread and competition with other species. This is a species that is likely (e.g., through shipping) to extend its range in western Europe and its presence should be investigated. The species has appeared accidentally in Argentina, Tasmania, New Zealand, the Mediterranean (France, Italy), and the Atlantic (Spain). It was intentionally planted in Brittany from previously existing Mediterranean populations in the 1980s (several of the original farms on the Atlantic coast of France now being out of business).

8.3 Brown Alga *Sargassum muticum*

Sargassum muticum continues to extend its range throughout Europe. New range extensions are reported within the Mediterranean Sea; its appearance in the Venice Lagoon (Curiel *et al.*, 1996) may be associated with oyster introductions or shipping. The occurrence in Strangford Lough in Northern Ireland (Boaden, 1995) is associated with oyster cultivation. A stand in the region of the oyster farm was picked, in an attempt to control its expansion, and two metric tonnes of material were collected. Following an extensive survey within the Lough the only further specimens that were found were in the southern region of the Lough near the entrance to the Irish Sea. WGITMO noted the control attempts (including hand harvesting) and await with interest the results of such attempts, being aware, that such attempts in the UK in the 1970s were unsuccessful. Another survey will be carried out in the summer of 1996. It has not yet been recorded from Ireland or the northern UK. In Sweden, attached *Sargassum* plants were found further south in the Goteborg area in the late summer of 1995 while only drifting plants occurred in large amounts along the Kattegat coast. *Sargassum* is also well established in the southern part of Norway, especially along the Skagerrak coast and occurs on the western coast as far north as Hordaland (north of Bergen).

9 STATUS OF ON-GOING INTRODUCTIONS

9.1 Japanese Seaweed (Nori) *Porphyra yezoensis* in the USA

Coastal Plantations International, Inc., based in Eastport, Maine, USA, has cultivar strain U51 of the Japanese red algae *Porphyra yezoensis*, known as nori, under culture. The culture site was set up in 1992, the project was extensively discussed by WGITMO in 1991 and 1992 and visited by the WG in 1994. It was agreed that an annual report would be made to WGITMO to report developments of the project. This report was to include local surveys to evaluate and document any spread of this species from the cultivation site.

Dr I. Levine of Coastal Plantations attended this year's meeting in Gdynia and presented his annual report, attached as Annex 5. Dr Levine stated there was no evidence of conchocelis stages on nearby shells, *in situ* monospore formation occurred only in young gametophytes, and there were no *P. yezoensis* on salmon farming cages or their mooring lines at 600 to 3000 meters away from the cultivation site.

Several new sites have been established or are being considered (one which used leasing of nets, one small pole farming site, and negotiation of the use of a site in Canada). Furthermore, the company has also started to test the use of native *Porphyra* species for farming and has undertaken laboratory experiments with protoplast fusions.

Dr Levine addressed WGITMO on the matter of the strains (cultivars) used as seeding material for farming of *P. yezoensis* in Maine. The original request to ICES as well as the review by WGITMO concerned the use of an axenic strain of U-51 then already existing in the United States (in the State of Washington). That strain had been established in Japan by successive selection of gametophytes from wild populations of northern Japan for cultivation further south, where they were then grown at more sheltered sites and with higher temperatures and in more turbid waters than Maine. Experienced scientists in the USA, China, and Japan confirmed the selection procedure had not altered the temperature requirements for production of the conchocelis stage, i.e., 25–27 °C, temperatures typically more than 10 °C higher than occur in Maine.

Subsequent knowledge gained in Japan in the last several years has yielded information on biomass increases and greater flexibility in farming management by the use of other cultivars of *P. yezoensis.* Dr Levine expressed that he would like WGITMO to consider the approval of the use of such additional strains (see Annex 5). Dr Levine further indicated that these strains were available in axenic cultures and that their temperature and habitat requirements for reproduction were the same as those of cultivar U-51 previously approved for use and releases by State of Maine authorities. Finally, there are discussions now in progress relative to experiments with the production of transgenic strains of *P. yezoensis.*

After extensive discussion, WGITMO made the following conclusions with regards to the continued mariculture operations in the State of Maine on domesticated, cultured strains of the Asian red alga *Porphyra yezoensis*:

a) WGITMO sees no objection to proceeding with culture operations utilizing additional strains of this alga that do not differ in their reproductive requirements (and thus their potential to become established in the wild in the State of Maine) from that strain, i.e., *Porphyra yezoensis* cultivar strain

U-51, previously approved for culture by authorities of the State of Maine;

b) WGITMO urges the continuation of an aggressive monitoring program for plants with monospores or sexual reproduction outside the farm's physical grow-out structures, especially after any new strains are acquired and deployed for grow-out;

c) WGITMO requests the continued reporting of any expanded or new grow-out sites, sites which WGITMO understands to be limited to the State of Maine or to the Province of New Brunswick, Canada, and sites which in turn WGITMO understands are or will be in temperature regimes that do not differ from those of Eastport, Maine (the site of current mariculture operations), and thus sites which the strains of *Porphyra yezoensis* now in use or contemplated for future use, will not and cannot reproduce in the wild; and

d) WGITMO requests the continued reporting of any experimental, quarantined, laboratory development, of any transgenic strains, cultivars, or populations, of *Porphyra yezoensis* in western North Atlantic waters or in any ICES Member Country.

10 STATUS OF INVASIONS IN THE BALTIC SEA

As the first such joint meeting, WGITMO met for part of the week in Gdynia with the Working Group on Nonindigenous Estuarine and Marine Organisms (NEMO) of the Baltic Marine Biologists' (BMB) association in order to consider current critical issues arising from exotic species invasions in the Baltic Sea relative to the overall status of biodiversity in the Baltic Sea, and the concomitant potential risk of future invasions via shipping and other anthropogenic activities.

A series of presentations by BMB NEMO members painted a picture of some of the current and recent concerns for invasions in the Baltic Sea:

* The predaceous water flea *Cercopagis pengoi*, first noted in the Baltic Sea in 1990, has expanded its range throughout much of the middle and southern regions of the Baltic Sea during 1995. This species attains about 10 mm in length. It is morphologically similar to the European carnivorous water flea *Bythotrephes cederstroemi* which invaded the Great Lakes of North America in the 1980s. *Cercopagis* is native to the Caspian and Aral Seas and the Volga River basin and survives in freshwater, brackish, and marine environments. It is expected that this species will continue to expand its range in the Baltic Sea. It now forms a sizable portion of the diet of herring in the northern Baltic Sea.

* The aggressive, large, and carnivorous/omnivorous goby (fish) *Neogobius melanostomus,* first recorded at one site in Poland in 1987, has expanded its population and range within the Gulf of Gdansk and is expected to continue to do so (see Annex 6). It is thought to have arrived via the navigation canal system from either the Black Sea or the Caspian Sea, where it occurs as an indigenous species. Studies on the genetics of this species will be undertaken in 1996 to determine the origin of the Baltic Sea population. The species attains 25 cm in length and is marketed as a food. *Neogobius* has also been introduced by ballast water to the Great Lakes, where it was first reported in 1990, perhaps having been introduced from the Baltic Sea. (Later in the week, on a visit to the Hel Marine Station, WGITMO and BMB NEMO were able to see a video on this fish, presented by Dr K. Skoro).

* Range extensions continue for the very abundant American spionid polychaete *Marenzelleria viridis.* This polychaete can attain high densities, accounting for 97% of the benthic biomass in some regions.

* The eel nematode *Anguillicola crassus* was reported to infest all of the eels sampled in the Elbe River, Germany, and is known from eels imported from Poland and has been found for the first time in Lithuania.

* Mr P. Gruszka gave a detailed account of the distribution of exotic species within the Szczecin Lagoon (which has two associated ports) in Poland. The abundance of exotic species including the amphipod *Corophium* spp. *Pontocaspian Amphipoda,* the worm *Marenzelleria viridis,* and the Chinese mitten crab *Eriocheir sinensis* present within this lagoon was described in detail. The presence of the thermal discharges in this lagoon may also be important features for the distribution of some species.

The following species' profiles have been assembled since the first Klaipeda meeting in 1995 of BMB NEMO, when it was agreed that a series would be produced. These will be edited later in the year by Dr B. Dybern and published in the BMB series:

1) *Cercopagis pengoi* (H. Ojaveer)
2) *Oncorhynchus mykiss* (E. Karasjeva)
3) *Percottus glehni* (E. Karasjeva)
4) *Anguillicola crassus*
5) *Corophium multisetosum* (A. Janta)
6) *Gammarus tigrinus* (P. Gruszka)
7) *Eriocheir sinensis* (S. Gollasch)

The current interest and understanding of exotic species expansions in the Baltic regions are such that predictions

of invasions by some species may now be possible by understanding the role of certain vectors, such as navigation waterways in southern and northern Europe. Thus, the polychaete *Hypania invalida*, for example, is expected to extend its range into the Baltic Sea over the next few years.

Climate change, periodic flushing events, and nutrient inputs may be important features in providing windows of opportunity within the Baltic Sea area. Based on past evidence of invasions within the Baltic Sea it may be expected that further invasions will take place. While most of the current invasive species are not known to be economically "harmful", their establishment may result in significant trophic and other ecological changes in different ecological niches.

The similarities between the Black and Baltic Seas and the close matching of environmental conditions strongly suggest that the Baltic Sea is a candidate for a harmful invasive species at some future time. The costs and consequences of an invasive species are difficult to determine because past experience dictates that the many recent harmful invasive species (such as the comb jellyfish *Mnemiopsis leydii* in the Black Sea) could not have been predetermined with present knowledge as being serious aquatic nuisance species. On the other hand, many taxa are known to be particularly harmful in relation to economic impacts on fishery and aquaculture activities, and the prevention of the introduction of such known taxa should be given priority.

The WGITMO discussed at length some of the main issues regarding introductions in the Baltic Sea:

1) Frequent (and harmful) species invasions will continue. The high frequency of exotic invasive events in the Black Sea demonstrates that it is a vulnerable ecosystem. Experience of areas with similar invasive histories (Great Lakes, San Francisco Bay, Tasmania, Black Sea) would strongly suggest that harmful species invasions to the Baltic Sea are very likely. Forecasting of possible exotic species establishments within the Baltic Sea area should take account of the vectors that are suspected in the transport of previous invasions of exotics.

2) Extraordinary environmental modification by invasive species. The abundance of exotic species is such that in the Baltic Sea they have modified the trophic flow in areas where they exist, thus altering our understanding of the dynamics of the benthic communities in these regions.

3) Detection of invasions at an early stage. Surveys of marine biodiversity in selected areas should be undertaken as part of an overall monitoring programme to determine exotic species establishments at an early stage. An understanding of the current "baseline" of native and cryptogenic (species whose history as a native vs. invader are not clear) fauna in the study areas would aid in the understanding of future changes and in the recognition of new invasions.

4) Public and political bodies should be informed of current changes to the ecosystem. Information needs to be provided in both public and political arenas as to the extent of the ecological and economic impacts of exotic species, and their overall burden within ecosystems and to human interests.

5) Global climate change. It is likely that as a result of global climate change there will be changes in the Baltic Sea that will provide new opportunities for invasive species which may mimic some of the patterns of invasions known for the Black Sea.

6) Conservation issues. Re-establishment of native species which were abundant previously, but which are now either rare or absent. Examples include sturgeon and harbor seals.

7) Vulnerable to secondary inoculations. "Islands" of exotic species may exist in nearby European ports or in thermal plumes from industrial plants. As conditions change or as opportunities arise, these species may expand their ranges; the Baltic Sea.

8) The Baltic Sea as a donor area. Species already established in the Baltic Sea may become transported elsewhere to similar areas. Localities with similar physical properties may be susceptible; such areas once identified should be considered for appropriate measures to prevent their establishment.

It was noted that further topics warranting study include ballast water projects, regional risk assessments, studies on target nonindigenous species, development of a CD-ROM base on non-indigenous species, and the development of a NorFA course on invasion ecology for graduate students.

It was agreed that continued communication between WGITMO and the Baltic Marine Biologists' Working Group on Nonindigenous Estuarine and Marine Organisms (BMB NEMO), which will continue its work for at least the next three to five years, should be maintained by regular correspondence and possibly by meetings between the Chairmen of the two groups, so that issues of importance and information on new developments and new regulatory procedures can be exchanged and to keep abreast of the sources and means of dissemination of information on introduced species (such as the effects and impacts (ecological, economic and social) of introduced species).

It was further noted that members of both WGITMO and BMB NEMO may soon be able to subscribe to an e-mail discussion list on nonindigenous species in the Baltic Sea (this list may initially be established as a subgroup of the BALTSEA discussion group on Baltic research issues).

11 BALLAST WATER AND SEDIMENTS

WGITMO continued its work reviewing scientific studies on ballast water and sediments, the management of ballast water, on-going studies of control and treatment, and the impacts of ballast water introductions on fisheries (including mariculture) .

In addition, at the WGITMO meeting, and under both the Terms of Reference for WGITMO and on the basis of an Intergovernmental Oceanographic Commission (IOC) Assembly Resolution, WGITMO met together with a representative (M. Nauke) of the United Nations International Maritime Organization (IMO) and with a specially appointed representative (D. Minchin) of the IOC, in the absence of a regular IOC staff member. The purpose of this meeting was to develop a proposal for a group, to be co-sponsored by ICES, IOC, and IMO, focusing on the topic of the implications and management of ships' ballast water and sediments. Through the auspices of the General Secretary representatives of IOC and IMO will be invited to attend.

11.1 Ballast Water Research

Ballast water research studies and management regulations in ICES Member Countries were briefly summarized by WGITMO members.

11.1.1 Canada

The 'Voluntary Guidelines for the Control of Ballast Water Discharges from Ships', first implemented in 1989, and which apply to vessels carrying ballast water entering the St Lawrence Seaway from beyond 200 nautical miles from shore and bound for the Seaway and Great Lakes ports, were modified slightly in 1995 to include ports west of 640 °W longitude (formerly 630 °W longitude). These guidelines request that vessels exchange their ballast water on the high seas where depths are greater than 2000 m or, if this is not possible, in a "backup exchange zone" within the Laurentian Channel, to the southeast of 640 °W longitude, in waters deeper than 300 m. Voluntary guidelines for the exchange of ballast water in Lake Superior first implemented in 1993, were continued in 1995. The guidelines, which attempt to minimize the uptake of ballast water when juvenile ruffe are present at ballasting ports, apply to cargo vessels in Lake Superior and are designed to slow the spread of ruffe *Gymnocephalus cernuus* from western Lake Superior to the lower Great Lakes.

A Canadian Coast Guard 'Notice to Mariners', first issued in 1982 and renewed annually, prohibits ships bound for the Grande-Entrée Lagoon of the Îles-de-la-Madeleine, Gulf of St Lawrence, from discharging ballast waters within 10 nautical miles of the Islands unless the ballast was taken on from a specified offshore area.

11.1.2 Finland

According to the Finnish maritime authorities, no new steps have been taken by the maritime or environmental administration in 1995. Regarding to ballast water management.

11.1.3 Germany

The role of ballast water and ships' hull fouling as mechanisms of transport of non-indigenous organisms into Germany is being investigated by S. Gollasch, M. Dammer, J. Lenz, and H.G. Andres as part of a project commissioned by the Federal Environmental Agency (Berlin). The research is a joint project between the Institut für Meereskunde, Kiel, and the University of Hamburg. 211 different vessels calling in German ports have been sampled between 1992 and 1995 yielding 334 samples. To date, about 380 plant and animal taxa have been found in ballast and hull samples, about one-third of which are non-indigenous to the waters of the Baltic and North Seas.

In 1995, the survival of planktonic organisms in ballast water tanks was studied by S. Gollasch and M. Dammer on-board a container vessel during its 23-day voyage from Singapore to Bremerhaven, Germany. A poster was displayed at the WGITMO meeting showing the initial results of this voyage. Harpacticoid copepods and diatoms survived the interoceanic voyage.

11.1.4 Ireland

In 1995, following a study of exotic species introductions and annual increases of ballast water discharges in Cork Harbour, areas of highest risk were deduced from a circular distributed to 30 Irish ports. All ports responded to the questionnaire. From the data provided Shannon Estuary and Cork Harbour were considered to be areas of highest risk, based on estimated ballast discharges and a series of features and physical conditions. Ship sampling began in April 1996. From the results it would appear that ships' fouling should still be considered to be a method of significant introductions of exotic species.

11.1.5 Norway

At present there are no regulations connected with sea transportation and ballast water management. However, there is much interest and discussion on the ballast issue in the aquaculture and shipping industries. There is increased transportation and discharge of ballast water because of increased petroleum traffic, and some of this ballast discharge occurs in areas that are important for salmon farms. There is also interest in identifying risk areas and in determining the actual amounts and sources of arriving ballast water.

11.1.6 Poland

Dr Z. Sobol of the Institute of Maritime and Tropical Medicine, Gdynia, spoke on Polish interests in ballast water transport and release. A primary issue of concern is the human health issue, such as the potential for the transport of cholera bacteria. Considerations have been given to ballast water treatment—for example, should the water be treated before it is discharged? or should it be treated onshore? Chemicals, in general, are not considered a good approach because of environmental dangers. Instead, particular attention has been given to filtration studies. Studies in Poland indicate that normal suspended sediment (exclusive of bottom sediments in ballast tanks) is between 2 and 10 percent of ballast water discharge. Such sediment could be removed with mesh filters in the range of 100 to 200 micrometers. After filtration, the water could be pasteurized by heating to 70 degrees Celsius. They have prepared designs of a thermal filtration system and would like to prepare a prototype of such a unit if funding can be obtained. Cooperative studies are also planned with the Sea Fisheries Institute.

11.1.7 Sweden

A research project is underway at the University of Goteborg (A. Persson, B. Karlson, and I. Wallentinus) on the sampling of ballast water and of sediments from harbors and reference stations, especially for dinoflagellate cysts. As of April 1996, three ships had been sampled, all transporting cars between Japan, the USA, and Europe. These vessels frequently mixed their water, making it impossible to secure exact locations of ballast water intake. Bacteria, small flagellates, ciliates, nematodes, dinoflagellates, diatoms, and chlorophyceaens were among some of the organisms recorded to date. A critical insight has been that a number of species of phytoplankton that were not found in plankton samples appeared after "grow out" in laboratory cultures of the ballast water and sediments.

The Swedish EPA, possibly in conjunction with the Swedish National Marine Board (SNMB), will commission a desk study of patterns and volumes of ballast water imported to and exported from Swedish waters (to be completed in 1996). Implemtation of the IMO Voluntary Guidelines are under the jurisdiction of the SNMB.

11.1.8 England and Wales, UK

A six month desk study (Laing, 1995) was carried out by MAFF to assess how much ballast water was exchanged at ports in England and Wales. Questionnaires were sent to 127 ports of which 87% responded. The main findings were as follows:

* Ballast water is discharged into 49% of ports and it is estimated from the information supplied that there are more than 36,000 ballast water exchange operations per year.

* Ports in England and Wales are net importers of bulk cargoes and approximately 1.6 times more ballast water is loaded than is discharged.

* An estimated 16.8 million tonnes of ballast water are discharged annually into ports, with oil and gas tankers contributing 75% of the total.

* Only 4 ports reported discharge of ballast water originating from outside continental Europe. By volume, ballast water from this origin accounted for about 11% of the total. These results should be treated with caution since accurate information on port of origin was not always available and ballast water may have been loaded at a location other than the last port of call.

* 79% of ports have no policy or regulations on management of ballast water discharge. Only 5 ports request compliance with IMO guidelines.

Following on from the desk study, a 3-year research project will be carried out by the School of Ocean Sciences, Menai Bridge, Bangor (Dr I. Lucas), to further assess the risk of introductions of alien marine organisms to coastal waters of England and Wales. A sampling programme will be carried out to determine the number and type of viable marine organisms transported in ballast water to coastal waters of England and Wales. The strategy for the sampling programme will be based on the results of the questionnaire survey. This research programme will compliment studies underway in Scotland and a UK database on ballast water organisms will be developed.

The project on ballast water treatment using a commercial copper/silver electrode system which was sponsored by the UK Marine Safety Agency was completed. A report was prepared for the Agency.

Relative to other ship-related vectors, Howard (1994) discusses the possibility of long-distance transmission of the oyster parasite *Bonamia* by fouling on boat hulls.

11.1.9 Scotland, UK

The current ballast water research which began in Scotland in 1994 continues through March 1997. To date, approximately 90 ship sampling visits have been carried out in six ports around the Scottish coast. Ballast water has been sampled from oil and gas tankers, bulk carriers, and general cargo vessels ranging in size from 500 dead weight tonnes (dwt) to 350,000 dwt, bringing ballast water to Scotland from countries throughout northern and southern Europe, Scandinavia, the USA, the Gulf of Mexico, Canada, North Africa, the Middle East, and the Pacific. In addition to ballast water loaded in ports, ballast taken on at sea and ballast exchanged at sea, was sampled. "Before" and "after" samples from a shipping company which always exchanges ballast in the North Sea or Irish Sea prior to discharging ballast in port

were collected in order to investigate the efficiency of the exchange process. The sampling programme will continue through this summer and further field work will depend on securing more funding for the study.

Sample analysis is continuing with emphasis on potentially harmful phytoplankton species both in water and sediment samples. Zooplankton samples will be analyzed this year. Zooplankton samples from all vessels were not collected —in many cases, sampling has been carried out through sounding pipes making it impossible to collect net samples. In addition to the biological material samples, information on temperature, salinity, and nutrients in the ballast water and heavy metals in the tank sediments was collated. Some phytoplankton viability experiments are being carried out to investigate whether resting stages will germinate in the laboratory and attempts will be made to establish cultures from hatched cells.

A relational database specifically developed for the UK ballast water research is now established and all results from the Scottish project are currently being input. England and Wales have recently started a similar project on ballast water and their data will feed into the system, resulting in a UK-wide database on planktonic species in ballast water and sediments.

Scottish workers are very interested in setting up sampling with groups from other countries to investigate the change in species composition from loading ballast to discharge. If vessels could be identified as suitable for this type of study, it could work in either direction—that is, loading in Scotland and discharging elsewhere or vice versa. Interested parties can contact Dr E. Macdonald (macdonald@marlab.ac.uk).

A report entitled, Natural Heritage Implications of Ballast Water Discharges (June 1994), and, published as Scottish Natural Heritage Review Series No. 29 (Edinburgh, Scotland; ISSN 1350 3111) was noted. The report examines the literature on ballast and nonindigenous species, and deballasting and monitoring procedures for ballast water discharges with particular relation to the proposed large scale quarry at Lingerbay, Harris.

11.1.10 United States

Public Law 101-646, passed in November 1990 for a 5-year period concluding 1995–1996, is now up for reauthorization by the U.S. Congress. A revised and updated version of the Act was submitted on 29 March 1996 by U.S. Senator John Glenn (Ohio), along with colleagues. The new Act calls for instituting voluntary guidelines for ballast management (encouraging vessels to deballast and reballast on the high seas when it is safe to do so) for all U. S. coast lines, and calls for a good deal of new research on exotic species and on ballast water in particular.

"The Shipping Study" (Carlton *et al.*, 1995), completed in April 1993, was released in the spring of 1995 and was generally available in September 1995. "The Shipping Study" is a U.S. study and monograph on ballast was water and introductions attributed to that vector, with lengthy discussions on selected control and management issues. See Annex 3 (USA National Report) for a partial summary published in the "Aquatic Exotic News".

A Ballast Water Research Laboratory is in operation at the Smithsonian Environmental Research Center (SERC) in Edgewater, Maryland, USA, on the shores of northwestern Chesapeake Bay. Principal scientists involved include Drs G. Ruiz, A. Hines, D. Smith, W. Coates, J. Carlton, M. Wonham, and L. McCann.

11.2 WGITMO Interests in Ballast Water and Sediments: The Impact of Biological Invasions on Fisheries, Mariculture, and the Environment

Dr J. Carlton reviewed the ICES and WGITMO interests in ballast water. Dr Carlton, who presented the Open Lecture in September 1995 at the ASC on "Ballast Water: The Ecological Roulette of Marine Biological Invasions", noted that WGITMO had been discussing ballast water as a mechanism of exotic species transport and release since the 1970s. WGITMO had drafted specific language on the role of ballast water in 1988 just prior to the discovery of the Eurasian zebra mussel *Dreissena polymorpha* in the United States, and in 1990 a special Study Group on ballast water was convened as part of the WGITMO meeting in Halifax, Nova Scotia, and a report was issued. The primary interests of WGITMO in ballast water are the roles that the discharge of ballast water and sediments can and do play in the release and subsequent establishment of exotic species in ICES Member Countries. A particular focus is on those species that may have important environmental ramifications and directly impact mariculture and other fisheries resources. In this regard, the management and treatment of ballast to minimize such releases is considered to be a critical element in the coming years.

11.3 IMO Interests in Ballast Water and Sediments: Regulatory Management of Ballast Water Uptake and Discharge

Dr M. Nauke presented the interests of the United Nations International Maritime Organization (IMO) on the issues of unwanted aquatic organisms in ballast water. It was noted that IMO had indicated concerns with ballast water as a vector of human pathogens and other species as early as 1973 at the first MARPOL convention. Voluntary guidelines for ballast management, focusing on open ocean exchange of ballast water of coastal origin, were adopted in 1991 and again in 1993. Two IMO conventions, SOLAS (Safety of Life at Sea) and MARPOL (Marine Pollution) require consideration when ballast issues are discussed.

Relative to safety issues, the IMO Subcommittee on Ship Design and Equipment met in February 1996 to discuss issues associated with the structural integrity of ships engaged in ballast water exchange. The Subcommittee on Stability and Load Lines and on Fishing Vessels (SLF) will consider the SDE report in September 1996.

Relative to environmental issues, IMO's Marine Environment Protection Committee (MEPC) formed a Ballast Water Working Group, which met for the fourth time in September 1995 at the 38th session of MEPC in London. The Working Group's current efforts are focused on developing language for a possible annex to MARPOL, or for a separate convention connected to MARPOL. The Working Group has developed a draft work schedule, with plans to finalize its work between 1997 and 1999.

Dr Nauke noted that there was interest in developing "certification guidelines for ballast free of unwanted species" and "internationally acceptable standards for ballast certification and analysis". The WGITMO examined this issue at length later in the meeting (Section 11.6).

An important goal of the present joint meeting between ICES, IMO, and IOC was to develop the terms of reference for a joint working group on ballast water and sediments, given the mutual interests of all three of these organizations in this subject.

11.4 IOC Interests in Ballast Water and Sediments: The Role of Ballast in the Dispersal of Phytoplankton

Dr D. Minchin was requested by the Intergovernmental Oceanographic Commission (IOC) of UNESCO to represent IOC interests at the present meeting, as IOC representatives who had planned to attend were unable to at the last moment. Dr Minchin noted that IOC interests focus on the issues of human health relative to ballast water discharge, particularly the matter of the potential dispersal of toxic phytoplankton by ballast water. Last week, the ICES/IOC Working Group on Harmful Algal Bloom Dynamics (Chairman: Dr P. Gentien) formulated several recommendations relative to limiting the introduction of harmful algal species by ballast water at its meeting in Brest 17–20 April 1996. Dr Gentien has kindly and in a very timely manner been able to provide these recommendations for this WGITMO meeting. They are as follows:

1) local algal populations in harbors where ballast water may be pumped should be investigated;

2) the problems of ballasting at sea should be considered not only in terms of safety and cost, but also in terms of effectiveness;

3) the deposition of cysts in ballast sediment should be investigated;

4) physical or chemical treatments commonly envisaged should be listed in order to define their effectiveness in terms of algal cysts; and

5) harmful algae and their resting stages should be added to the list of species for concern.

The IOC/FAO Intergovernmental Panel on Harmful Algal Blooms (IPHAB) formulated a recommendation relative to the Secretariats of IOC, IMO, and ICES considering the possibility of establishing a joint working group on the dissemination of phytoplankton by water discharges from ships at its meeting in 1995. This recommendation was subsequently endorsed by the IOC Assembly in the form of a resolution requesting that the Secretariats consider this possibility. At the ICES ASC in September 1995, H. Enevoldsen (IOC), M. Nauke (IOC) and J. Carlton (ICES) met briefly with H. Dooley (ICES) to discuss this matter further and to provide information for the April 1996 WGITMO meeting.

Dr Minchin then presented an overhead, covering some general matters relevant to ballast water science and management, and relevant to enhanced communication between ballast research groups. Topics addressed covered international co-operation (including the possibility of a newsletter, databases (for algal blooms, invasion hot spots, and so forth), reference collections, expert lists, intercalibration of sampling methods, and annotated species lists for major ports), the control and management of ballast (the need for the development of practical and precautionary methods for ballast management in advance of the scientific solutions), and understanding how invasions take place (including critical population biomass, DNA fingerprinting studies to retrospectively determine invasive routes, taxonomic distinctions and biogeographic species forms, dispersal models for inoculated ballast, behaviour of organisms in darkness (as inside a ballast tank for days and weeks at a time), and relative risk in relation to topographic and hydrographic features).

11.5 Helsinki Commission (HELCOM) Interests

It was noted that at the 21st meeting of the Maritime Committee (MC21) of HELCOM, the Committee encouraged Contracting Parties to apply the IMO Voluntary Guidelines on ballast management and to submit their experiences in their application to the 1996 meeting of the Committee. The MC also decided to further cooperate on this item with IMO.

11.6 Ballast Sampling Issues: Ship and Port Certification

During the course of the joint ICES/IMO/IOC discussions and reviews of tabled materials on ballast management and control, a matter arose regarding ballast sampling and, based on such sampling, what could be

understood about the biological contents of ballast water and sediments and the interpretation of those contents.

M. Nauke (IMO) noted that it had been proposed by various interested parties through IMO that it would be valuable and helpful to ship operators, port authorities, environmental managers, and others, if the contents of ships' ballast water and sediments, once sampled and found to be "free of harmful or unwanted organisms", could be so certified by the issuance of a document to that effect. Similarly, it had been proposed that ports and harbors could also be sampled and, if found to be free of harmful or unwanted organisms, a certificate could also be issued to that effect.

Two related concepts were noted. One, that there are "internationally accepted water quality standards", and that these types of basic standards, or ones similar to them, could be applicable to ballast water analysis and certification. Two, that ship personnel are already familiar with the regular sampling of materials, such as fuel oil, on board vessels. Such samples are then dispatched from the ship in a small prepackaged and pre-addressed container (a "mailer") to an analytical laboratory. The laboratory then provides a timely analysis of the fuel oil, which is telexed or FAXed back to the ship.

The following comments notwithstanding, WGITMO felt it important to emphasize that biological studies of ballast water and sediments were extremely important and useful, as such studies serve to document the diversity and spatial and temporal patterns of the movements of thousands of species of marine organisms around the world. Such studies are worth pursuing and should be encouraged as focused research projects or as part of national monitoring programmes. Relative to extending such research and programmes as bases for certification systems, however, encounters certain obstacles that are discussed below. WGITMO thus offered the following comments on the concepts of the potential certification of ships and/or ports as free of harmful or unwanted organisms.

1) INABILITY TO QUICKLY DETERMINE HARMFUL STATUS

Key summary point: For many if not most animals and plants, it is *not* possible to determine, in a timely fashion, if a specific species in question could be harmful if released in a new environment. Many species are not recognized as harmful or potentially harmful in their native waters, and there is little or no information available concerning the biology or ecology of many species.

Discussion: Many of the transported organisms in ballast water and sediments, even if they could be identified (but see items 3, 4, and 5, below) may be undistinguished and unknown as harmful species in their native environments. This is coupled with the fact that little or no biological or ecological information may be available concerning such species in their native regions. The same species, apparently innocuous in its native environment, may prove extraordinarily harmful once transported and introduced elsewhere. An example is the Asian clam *Potamocorbula*, which is not considered a harmful, nuisance, or pest species in any manner in Asia. After being introduced by ballast water in its planktonic life stages (the larvae would have been identifiable only as "clam larvae") to San Francisco Bay, this seemingly innocuous clam proceeded to dominate the Bay's ecosystem in numbers exceeding 10,000 clams per square meter. Today this Asian clam has displaced many other species, and has also caused a serious depletion of the microscopic plant plankton (phytoplankton) that make up the fundamental base of the Bay's food chain.

The Asian clam *Potamocorbula* could have been an example of a species whose potential survival and, to some extent whose potential impacts in a new environment (such as San Francisco Bay) may have been revealed in a risk assessment study (K. Hayes, personal communication, 1996), were there reasons to examine *Potamocorbula* for such a study (such as by their identification in a ballast water sample).

2) LIMITATIONS OF BALLAST SAMPLING

Key summary point: The large volumes and often numerous compartments holding ballast water coupled with the typical inaccessibility of ballast sediments make adequate sampling a critical issue.

Discussion: Because of the often large volumes of ballast water held in different compartments (to which there is often limited access), and because of the extraordinary difficulties in sampling ballast sediments when ships are in a ballast condition, it is not possible, in most cases, to secure sufficient samples that would guarantee that a vessel is free of harmful or unwanted organisms. For example, it is possible to extensively sample a fully ballasted cargo hold on a bulk cargo vessel and yet not be able to determine if fish are present in that hold.

3) LIMITATIONS OF IDENTIFICATION IN A TIMELY AND ECONOMICALLY FEASIBLE FASHION

Key summary point: Identification in a timely manner of most of the living organisms in ballast water is a costly and time-consuming task.

Discussion: Even if adequate sampling of a vessel were possible (item 2, above), proper identification (at the genus or species level) of most of the living animals and plants in a sample of ballast water or sediment will be a time-consuming and costly task. The time required for analysis of such samples is

likely to almost always exceed the length of even transoceanic voyages, so that undue delays would be unavoidable even if the taxonomic analysis were to be undertaken while the ship is underway (in part, too, because any laboratory so engaged would already have numerous ballast samples waiting for analysis). A global certification program would also require the establishment of a global network of highly specialized taxonomic experts. If suitable laboratories and taxonomic experts were to be engaged, the costs of analysis, including the costs of re-distributing samples to consulting specialists, would still be prohibitive. Therefore, whether many of the organisms in ballast represent harmful or unwanted species cannot be determined because of the limitations of the initial identification steps.

It is important to note that (a) many organisms in ballast water are not identifiable because of the early life stage at which occur in the ballast environment and (b) there is a general lack of availability and scarcity of suitable taxonomic experts. Many of the living animals and often many of the living plants cannot be identified because of the life stages they are in. Eggs, larvae, juveniles, or encysted organisms would require laboratory culture to grow them to stages that would permit identification; for many organisms, however, culture techniques are not known. For culture work, further samples would be required and the organisms therein kept alive for transmittal to laboratories, requiring special techniques, special packing and handling, and special containers to insure that death did not occur. There are far too few laboratories in the world with sufficient expertise to support such a programme. In addition, species (such as certain phytoplankton) may not even be revealed as present in a ballast water or sediment sample until that sample has undergone laboratory culture.

4) VIRUSES AND BACTERIA

Key summary point: Viral and bacterial sampling would be equally challenging under a timely certification programme.

Discussion: The sampling, handling, laboratory culture, and identification of viruses and bacteria in ballast water that are known to be the causes of diseases (including human ones) would require an extensive investment of time and money per individual vessel each time the vessel is ballasted (although it may be possible to establish more streamlined procedures for shipboard sampling and sample handling if dedicated research programs were put to this task). It would be necessary to obtain and keep alive samples for transmittal to laboratories, requiring special techniques, special packing and handling, and special containers. On-shore laboratory and taxonomic support, however, would remain limited and would only be likely to provide analyses in a fashion that would lead to undue delays. In addition, internationally-agreed lists of bacterial and viral agents of concern (in terms of both human and aquatic life (especially fish/shellfish) pathogens) would have to be developed to insure that the correct bacteria and viruses were tested for. These matters aside and notwithstanding, surveys in ballast water and sediments for disease-causing viruses and bacteria have been conducted successfully on a limited, targeted basis.

5) SAMPLING REQUIREMENTS

Key summary point: Accurate, replicated samples of ballast water and sediments are required to determine if a species may be present aboard the ship.

Discussion: It may be possible to state statistically if a given organism is (was) not present on a given vessel based on replicate sampling. However, it must be understood that there is no *guarantee* that a given organism is absent, but rather its absence is based on a statistical degree of confidence dependent on a given sampling strategy. Thus, a minimum of 3 to 5 replicate samples from each individual ballast tank and each individual ballasted hold, would be required with a further demonstration that such samples were taken in a scientifically rigorous and accurate manner relative to a minimum per sample volume (filtered or pumped) and minimum screen mesh size appropriate to the organism(s) in question. In addition, it would be necessary to provide certification that the samples were identified by a professional taxonomist.

6) PORT CERTIFICATION: LIMITATIONS AND COSTLINESS OF PORT SURVEYS

Key summary point: Many port systems are often complex systems with few if any previous biological surveys, and such surveys (even for one or a few target species) are costly, time-consuming, and must be repeated periodically.

Discussion: Many harbors and ports of the world are large, complex systems that are historically not well sampled or known in terms of the diversity, abundance, and distribution of the organisms present in their waters. It may be possible to establish surveys of certain ports to determine the presence, abundance, and local distribution of certain target species, but even surveys targeting a few selected species are typically very costly. Such surveys would further have to be repeated on a periodic (both seasonal and annual) basis to establish if a species (such as a given species of toxic dinoflagellate) was not subsequently introduced by ships, etc., or transported by natural means, after a prior survey was conducted. International fish health regulations that outline the extent in time and space required to establish that given fish populations or geographic regions are free of known parasites or pathogens provide possible

models for such surveys. These matters aside and notwithstanding, surveys for (for example) toxic dinoflagellates, both as cysts and motile cells, have been conducted successfully.

7) PORT-CERTIFICATION: INABILITY TO DETERMINE HARMFUL STATUS OF PORT OR HARBOR-DWELLING ORGANISMS

Key summary point: For many if not most animals and plants, it is not possible to quickly determine if a specific species in a given port in question could be harmful if released in a new environment.

Discussion: Many of the native organisms (if such organisms can be identified as native) in a given harbor or port are not considered to be harmful, nuisance, or pest species in their native environment. The comment under (3) above item can be repeated here: An example is the Asian clam *Potamocorbula*, which is not considered a harmful, nuisance, or pest species in any manner in Asia. After being introduced by ballast water in its planktonic life stages (which larvae would have been identifiable only as "clam larvae") to San Francisco Bay, this innocuous clam proceeded to dominate the Bay's ecosystem in numbers exceeding 10,000 clams per square meter. Today this Asian clam has displaced many other species, and has also caused a serious depletion of the microscopic plant plankton (the phytoplankton) that make up the fundamental base of the Bay's food chain".

WGITMO thus conclude that there appears to be little or no biological or other scientific support for a "ship certification program" or a "port certification programe" that would provide State Port Authorities with a minimal level of assurance that a given vessel or a given port is free of harmful or unwanted organisms at this time. It was also noted that a certification system would require that there is no further ballasting after the final sample has been taken, further restricting the potential needs of the ship for trim, stability, and other purposes.

The general inability to certify a ship or port as free of harmful or unwanted organisms provides further rationale (a) for *as complete ballast water treatment as practicable* (by open sea exchange and/or by other operational or technological methods) so that the risk of introducing unwanted organisms in the ballast water and sediments is minimized, and for further studies to determine the best methods of management and treatment, and (b) for pursuing *quantitative risk assessment studies* of ballast water uptake and release that involve transport of water and sediments both (i) between port systems of similar environmental conditions and (ii) between port systems with fundamentally different environmental conditions (such as between a salt water port (e.g., salinity of 33–35) and a freshwater port (salinity of 0–0.5) noting that there are euryhaline species that can survive and even reproduce in such a range of environments, or between tropical ports (for example, below 10 degrees latitude) and polar ports (for example, above 65 degrees latitude).

WGITMO thanked the IOC and IMO representatives for their time and willingness to discuss these and other issues. WGITMO would like to continue this cooperation to define and refine protocols for ballast sampling and analysis.

11.7 Health and Safety Concerns While Sampling Ships

During the course of discussions at the WGITMO meeting, it became clear that there were a number of human health and safety issues relating to the boarding of ships and the sampling of ballast tanks and ballasted cargo holds. These issues may not be readily apparent to scientists and others who are unfamiliar with vessel conditions. Among the issues noted were the many serious dangers of entering enclosed spaces where the air quality (oxygen content, the presence of additional gases, and so forth) was not known. No such spaces, it was noted, should ever be entered without a prior measure of the amount and content of the gases present in such spaces. Such measurements are routinely made by inspectors and ship personnel. Large ballast tanks, such as aftpeak and forepeak tanks, are often complex structures consisting of a number of levels with passage ways through them. Mud and other slippery materials may make ladders in ballast tanks and the internal areas of the tanks hazardous. In addition, there may be water quality issues, particularly relative to the presence of viruses, bacteria, or other human pathogenic organisms in ships' water and sediments. Ballast sampling personnel should therefore consider the possible sources of ballast water and the concomitant needs for taking the appropriate precautionary medical measures, such as immunization and the wearing of appropriate safety clothing and masks.

It was concluded that any written materials about ballast sampling should always include reference to these and any other human health and safety issues. Health and safety issues involved in sampling any other regions of the ship (the hull, the anchor chain locker, and so forth) should also be carefully addressed in guides to sampling procedures and protocols.

11.8 Standard Questionnaires on Ballast Water

It was noted that most countries and international agencies have developed their own questionnaires relating to ballast water when interviewing shipping agency personnel or when boarding ships. It would thus be of great value to have an *"international standard reporting form"* which ICES Member Countries could use. WGITMO concluded that it should cooperate in

assembling a standard questionnaire form to compliment biological, chemical, or other samples taken from ships in dry dock, in port, or at sea, with a view to developing a general database for ballast within European waters.

11.9 ICES, IMO, and IOC

It was concluded that the discussions between ICES WGITMO, IMO, and IOC members and representatives, on the ecological, environmental, management, sampling, human health and safety, and other issues involved with the burgeoning science of ballast water and sediments, were of great value and that much important information had been exchanged and reviewed.

It was thus concluded that continued cooperation and communication are not only valuable but essential between ICES, IMO, and IOC, relative to the issues of the transportation by ships' ballast water and sediments of invasive exotic species that could cause extensive damage to fisheries and other aquatic resources. Because such cooperation would facilitate an exchange of information and thus be mutually beneficial, to ICES, IMO, and IOC, it was felt that these parties should continue to meet, and that it would be useful to meet in joint session once a year for a period of at least one day, as a "Joint ICES/IMO/IOC Working Group on Ballast Water and Sediments" (WGBWS). This Joint WGBWS would review annual progress on the scientific studies of ballast water and sediments and on technical management approaches, as well as pertinent policy issues and developments. IMO should be represented by the Chair of the IMO Marine Environmental Protection Committee's (MEPC's) "Working Group on Ballast Water", as well as by a second IMO representative. IOC should be represented by the Chair of the IOC "Intergovernmental Panel on Harmful Algal Blooms" (IPHAB), as well as by a second IOC representative. A representative of the International Chamber of Shipping (ICS) could be invited as well, as could a representative of the FAO European Inland Fisheries Advisory Committee (EIFAC), as noted below. ICES should be represented by all WGITMO members attending its annual meeting. The Joint ICES/IMO/IOC WGBWS meeting could be convened during the regular annual meetings of WGITMO, with the provision that either IMO headquarters in London or IOC headquarters in Paris could act as a host venue for one or more of the regular WGITMO meetings. The Joint WGBWS would consider the broad range of scientific, sampling, management, and international cooperation issues relative to ballast water and sediments, as well as additional issues that may be pertinent. Examples of the latter would include, but are not limited to: (a) the dissemination of particular groups of organisms by ballast (for example human health pathogens, phytoplankton, zooplankton, and other plants and animals), (b) proposed control options, (c) understanding the role of ballast inoculations in the subsequent establishment of invasive species, (d) the sharing of data bases, and (e) the contributory role of other ship-associated vectors (such as hull fouling). The Joint WGBWS could meet for a four-year period commencing in 1997 and ending in the year 2000, at which time its usefulness and continuation would be evaluated by all three sponsoring organizations. Since several introduced organisms, especially in the Baltic Sea, appear to originate in inland Eurasian waters and are spread by riverine vessel traffic, ICES should further communicate with representatives of EIFAC to participate in the Joint WGBWS.

12 MARINE BIOCONTROL ACTIVITIES

Dr J. Carlton noted that the control of marine invasive species by means of a secondary introduction of a controlling herbivore or carnivore are actively under consideration in a number of regions throughout the world.

* In the Black Sea the ctenophore (comb jellyfish) *Mnemiopsis leydii*, a predator of copepods, fish larvae and other zooplankton, has been considered to be one of the primary causes for the decline of anchovy and sardine fisheries, with serious economic consequences. Under the auspices of the United Nations Environmental Programme (UNEP), an expert group convened in 1994 and again in 1995 (Chair: P. Wells, Canada) to review the *Mnemiopsis* situation and to consider methods for controlling this species. One method under consideration is the introduction of a potentially commercially useful fish that feeds on gelatinous zooplankton. Research along these lines has been conducted in part at the Woods Hole Oceanographic Institution (USA).

* The European shore crab (known in America as the "green crab") *Carcinus maenas* now occurs, due to introduction by ships and by other means, on the Atlantic coast of North America, South Africa, and Australia (Cohen *et al.*, 1995). In 1989–1990, this crab appeared on the Californian coast, where it is spreading rapidly in large numbers. In 1993, *Carcinus* appeared for the first time in Tasmania, in southern Australia, although it has been present in mainland Australia for over 100 years across the Tasmania Sea. This crab is an avid predator species of molluscs and its presence can extensively impact molluscan aquaculture and fisheries. It has an endoparasite, a rhizocephalan cirripede crustacean *Sacculina carcini* which grows through the crab's body and weakens the crab's feeding capabilities as well as reduces its reproductive output. As the parasite is not known in t non-European areas, its introduction is being considered as a method of controlling green crab abundance.

* The recent expansion of the green invasive alga *Caulerpa* continues to be a cause of concern in the Mediterranean Sea. This invasive species attains sufficient densities that in some regions it can form

100% cover where it is present. Seaslugs (sacoglossan opisthobranch snails) of the genus *Elysia* from the Caribbean Sea that specialize in the genus *Caulerpa* are currently under study by French scientists as a possible biocontrol agent. The sea slug lances the cell wall of the plant, sucking out the chloroplasts. This research is being conducted by Dr A. Meinesz and associates at the University of Nice, France.

WGITMO discussed these cases and considered some of the primary issues involved. In all three cases, and in most biocontrol cases in general, a central concern is whether or not the introduced biocontrol species is capable of preying upon non-target species (other introduced or native species) and to what extent this may occur. The ability of laboratory experiments to fully demonstrate this capability, or the lack thereof, is a further central matter. WGITMO noted that, given increasing worldwide interest in the Black Sea, the Mediterranean, and Australia, that it is inevitable that similar research, and possible proposals for the actual release of a biocontrol species, will be forthcoming in ICES Member Countries.

As one of the primary areas of research in this matter is in France, and as the WGITMO has been invited to La Tremblade for its 1997 meeting, it was concluded that an invitation to Dr A. Meinesz to present his research would be of great value, in order to keep the WGITMO up to date on the scientific and other issues involved in marine biocontrol technology. Although the venue of this research, and the species involved, are (at the moment) outside the geographic purview of ICES, the target species for control, *Caulerpa*, is considered a potential invader of at least the southern ICES region.

WGITMO thus concluded that it would be of value to continue its assessment of potential biocontrol activities and the risks thereof, through the invitation to biocontrol researchers to the 1997 WGITMO meeting, with a further goal, cognisant of recent mechanical efforts to control the seaweed *Sargassum* in Ireland, of formulating a brief review of the efficacy of various other measures (mechanical, chemical, or otherwise) that have been employed to control exotic species invasions.

13 INTRODUCTIONS AND TRANSFERS OF AQUARIUM (ORNAMENTAL) ANIMALS AND PLANTS

Last year WGITMO began to focus on another rapidly increasing global development relative to nonindigenous species, in addition to such matters as GMOs and biocontrol species: the growing trade in the movement of ornamental (aquarium) marine and estuarine invertebrates, fish, plants, seagrasses, and other higher marine and maritime plants (phanerogams in general). These organisms are kept in private and public aquaria, in open saltwater and brackish water ponds and enclosures, and in tourist-oriented coastal seascape settings. While many of these are subtropical and tropical species, there is growing use of temperate species as well to satisfy a vast aquarium hobby and industry. Little or no control is available on the dispersal and release of these many thousands of warmwater and coldwater species currently in the global trade after they are sold to the public.

In addition, disease agents of some warmer water organisms are known to be transferable to cooler water species. These pathogens, or the ornamental organisms themselves if they were to become established, could have negative impacts on native species or natural ecosystems. WGITMO is concerned that, with the increasing and global trade in aquarium organisms, the accidental transfers of fish pathogens that could affect fisheries resources in ICES Member Countries (for example, the potential introduction of epizootic ulcerative syndrome (EUS) through the transfer of fish species from EUS-enzootic (Southeast Asian) countries).

The movements of aquarium species could further pose an ecological risk for the introductions of organisms which may have consequences for native species should they gain access to the environment as a result of aquarium releases. Such releases have been recorded in the literature. In Europe species known to be harmful in some areas of the world may be seen on display in many public facilities (for example, the seaweeds *Caulerpa taxifolia* and *Sargassum muticum*). Although it is understood that that OIE is concerned about world wide trade with aquatic organisms, this concern is largely focused on the dissemination of diseases, and less so with ecological issues.

Different ICES Member Countries have varying abilities to control the importation of aquarium trade species. Some species may be controlled under the CITES Convention, requiring a license for their movements.

Finland and the UK tabled the following information.

13.1 Aquarium fish trade in Finland, January–September 1995

The aquarium fish trade is "free" in Finland, that is, there are no restrictions and no permits are needed.

Imports of fresh water aquarium fish for the first nine months of 1995 were as follows: 12,974 kg (1,831,000 FIM or approximately 400,000 USD) (Singapore 6548 kg, Russia 2245 kg, USA 1422 kg, Germany 623 kg, Denmark 638 kg, Indonesia 280 kg, Israel 168 kg, Sri Lanka 190 kg, Malaysia 331 kg, Thailand 378, Peru 46 kg, Colombia 48 kg, Brazil 16 kg, China 14 kg, Czechoslovakia 26 kg, and Sweden 1 kg)

Imports of marine aquarium fish for the first nine months of 1995 were as follows: 1,100 kg (153, 000 FIM or approximately 33,000 USD) (Indonesia 491 kg, Germany

357 kg, USA 140 kg, Singapore 40 kg, Netherlands 72 kg, Sweden 0.5 kg).

Information concerning invertebrates and aquarium plants is not available. No adverse effects have been reported in Finland related to aquarium fish or plants. Most southern organisms are not able to survive in natural Finnish waters.

13.2 Aquarium/ornamental trade in England and Wales

The ornamental fish industry is a significant one, employing 10,000 people. Imports of ornamental fish in 1995 were worth about 11.5 million pounds, split evenly between imports of coldwater and tropical fish. Imports of all live fish, their eggs, and gametes are controlled by legislation as given in the National Report to prevent the introduction of disease agents. There is legislation for imports coming from EU countries (UK National Report, Appendix 1) and non-EU countries (Appendix 2). This includes ornamentals, coldwater and tropical species. The legislation stipulates that imports must come from an Approved Zone (free of notifiable diseases) in EU countries or must carry health certification if from elsewhere. Additional approval must be granted under the Wildlife and Conservation Act 1981 if imports are for release into the wild or if they could escape into the wild.

WGITMO discussed current knowledge about the extent of the aquarium industry trade, and concluded that much remained to be learned relative to this "back door" mechanism of introductions. Particularly lacking are data on the scale of exotic species dispersal within and between ICES Member Countries. WGITMO concluded that it would be of extraordinary value, relative to basic precautionary principles of biological and ecological management, if ICES Member Countries were to compile basic information on the introductions and transfers of marine and brackish water ornamental organisms (fish, invertebrates, algae, and higher plants (phanerogams)) into their countries. This information could be presented to ICES in time for consideration at the 1997 WGITMO meeting. The purpose of this would be to provide data on which species and which sources of ornamental organisms may present the highest risks of introducing or transferring pathogens and/or establishing self-sustaining populations.

In these efforts, communication with EIFAC would be useful, and such communication could be facilitated by a member serving on both the ICES and EIFAC working groups on introductions. ICES is aware that the Office International des Epizooites (OIE) will share some of the concerns noted, and thus communication with relevant authorities on this matter at OIE should be established.

14 DATABASES ON INTRODUCTIONS AND TRANSFERS

WGITMO discussed at some length the nature of existing databases on the introductions and transfers of marine organisms and the potential for coordination of such information (in addition to such global bibliographic compilations such as that of Dr H. Rosenthal now in preparation. The following existing or contemplated databases were noted as being concerned with introduced species (this list was largely compiled by WGITMO member K. Jansson).

BMB NEMO Working Group
Computerized encyclopedia on "The Baltic Region Non-Indigenous Marine and Estuarine Organisms". (Source: BMB NEMO Working Group discussion.)

EU
At the workshop "Introduced Species in European Coastal Waters'93, Monaco", it was suggested by Dr Frederic Briand, Director General of CIESM, that a European data bank on introduced species and receptive habitats be developed, preferably within an enlarged European CORINE database. (Source: European Commission, Ecosystems Research Report 8, EUR 15309 EN.)

FAO
The FAO database on international introductions and transfers is being expanded to include marine organisms and aquatic plants. The database is incorporated into FISHBASE (a relational database formed under the collaboration of FAO and ICLARM (International Center for Living Aquatic Resource Management) which is being distributed to universities, research institutions, international organizations, and government agencies throughout the world. (Source: Dr D. M. Bartley, Fisheries Department, FAO.)

IRRO
An information sheet from IRRO (Information Resource for the Release of Organisms to the Environment) provides the following information: "RRO is an information network, run on a nonprofit basis, which aims to provide access to all types of information relevant to the release of animals, plants and microorganisms into the environment. ... The decision to establish the IRRO was taken in 1991, under initial impetus from the United Nations Environment Programme (UNEP). .... Information of interest for IRRO might include details of, for example, releases of nonindigenous, novel or genetically modified organisms. It might cover ecological data relevant to receiving environments, information on the regulatory oversight of releases of nonindigenous organisms or genetically

modified organisms. It could include information on the impacts of biodiversity. IRRO is intended to be a network which will facilitate access to existing relevant databases and other information sources located throughout the world. It is envisaged that there will be many types of users of the IRRO with many different interests". IRRO has made an extensive survey of existing databases and information resources relevant to the release of organisms into the environment. Information about the report (Global Survey on Information Resources on Releases of Genetically Modified Organisms (GMOs) and Introductions of Non-Indigenous Organisms into the Environment) and information about IRRO can be obtained from: IRRO Secretariat, c/o MSDN, 63 Wostenholm Rd, Nether Edge, Sheffield S7 1LE, England, UK. E-mail: msdn@sheffield.ac.uk. IRRO also has a listserver. The moderator of the list is Dr M. Segal, EPA-OPPT (7402), 401 M Street S.W., Washington, D.C. 20460, USA (Tel: +1 202 260 3389. e-mail: segal.mark@epamail.epa.gov). To subscribe to the list (by e-mail), type: subscribe irro_L <your e-mail address>

IUCN
The Invasive Species Specialist Group (ISSG) of the IUCN Species Survival Commission will begin compiling a global list of invasive species: ... "known to significantly threaten conservation values, along with their biological characteristics, history, distribution, habitat associations and methods used for control. The database will be designed for use as a predictive tool, to help identify natural ecosystems at risk at risk from invasives and to manage these threats. It will provide information and practical assistance to conservation managers and policy makers; to this end it will also contain a list of key experts on particular species or groups of invasives. The database will be built in a modular fashion, as funds and contributing personnel permit. ... The ISSG hopes to be able to establish the first version of the invasive species database by the end of 1996." (Source: IUCN Bulletin 3/1994.)

UNEP
UNEP maintains a global reference system on information on methods of biological control (risk assessment as well as guidelines). The information is mainly composed of terrestrial species. Information is available on the world wide web.

FISHBASE
This is a database of the world's fishes: annotated accounts, descriptions and plates of many of the world's fishes are present. The project is jointly sponsored by FAD and ICLARM (Manila, The Philippines).

IOC
Database available on the location and extent of harmful algal blooms.

WORLD WIDE WEB
There is a "Seaweed Checklist" for Great Britain, Ireland, and Northern Europe, which includes introduced species. The WWW address for the Seaweed Checklist is: http://seaweed.ucg.ie./seaweed.html.

AUSTRALIA
There is in a nation-wide review of introduced freshwater, brackish water, and marine organisms progress, based at the CSIRO CRIMP laboratories in Hobart, Tasmania.

CANADA
A national register on Introductions and Transfers of Aquatic Organisms is to be developed by the Department of Fisheries and Oceans (DFO). A national register of fish diseases is held at the DFO in Ottawa.

GREAT BRITAIN
A monograph is now in preparation by Dr C. Eno of the Joint Nature Conservation Committee, Peterborough, UK.

SWEDEN
The summary by K. Jansson is now available (K. Jansson. 1994. Alien species in the marine environment: Introductions to the Baltic Sea and the Swedish West Coast. Swedish Environmental Protection Agency, Report No. 4357.)

USA
The U.S. Fish and Wildlife Service (USFWS) offices in Gainesville, Florida, have an expanding database on exotic aquatic organisms in North America (see additional data in National Report for the USA herein).

Regional monographs with extensive bibliographies and detailed discussions of hundreds of exotic freshwater, brackish, and marine plants and animals, are now available for the Great Lakes (Mills *et al.*, 1993) and San Francisco Bay (Cohen and Carlton, 1995) and are in preparation for Chesapeake Bay (G. Ruiz *et al.*, pers. comm., 1996) and for Pearl Harbor, Oahu, the Hawaiian Islands (L. Eldredge, J.T. Carlton, *et al.*, pers. comm., 1996).

15 MEETINGS ON INTRODUCTIONS OF MARINE ORGANISMS

15.1 Bern Convention, May 1996

The Bern Convention of the Council of Europe met in Killarny, Ireland in May 1996. This group discusses conservation issues and up to the present much of their attention has been focused on terrestrial matters. A special session of the meeting was scheduled to focus on species diversity and related management issues. A presentation on the current knowledge of species introductions by means of aquaculture, shipping and other transfers, both intentionally and unintentionally,

was on the agenda. The *1994 ICES Code of Practice* was also to be discussed.

15.2 Technical consultation on the Precautionary Approach to Capture Fisheries, (Lysekil, Sweden, June 1995)

This meeting was run jointly by the Swedish National Board of Fisheries and FAO and was divided under four areas—fishery management, fishery research, fishery technology and species introductions. Dr J. Carlton, who was unable to attend the meeting was represented by Dr D. Minchin. The meeting provided an opportunity to advertise the *1994 ICES Code of Practice*, a special pre-print addition was made available for those attending. Background discussion papers were presented to the meeting, for each of the four disciplines. The paper that related to introductions by Dr D. Bartley and Dr D. Minchin, entitled Precautionary Approach to the Introduction and Transfers of Aquatic Species' gave a background to the relevant matters in aquatic environments and what levels of uncertainty existed and how such uncertainty could be reduced.

Matters arising out of the meeting considered that further communication between ICES, FAO, IMO and ICLARM as well as national and port authorities to coordinate policies and regulations in relation to species introductions was needed. In addition it is necessary for importers and relevant regulatory agencies to consider the development of contingency plans to aid in the control of unexpected situations. It was considered useful to promote education, training and awareness programmes on the effects of harmful species, and to create a general awareness as to what precautionary measures are advised for their control, such as the *1994 ICES Code of Practice* and the IMO *Guidelines for the Introduction of Unwanted Aquatic Organisms and Pathogens from Ships' Ballast Water and Sediment Discharges.*

Many future activities on the management of exotic species will require improved communication between workers and the setting up of networks of specialists, who should consider standardization of sampling methodologies and promotion and development of databases.

The development of effective non-biocidal antifouling applications to reduce risk of introduction from ships' fouling was also encouraged.

15.3 Estuarine and Coastal Sciences Association, September 1995

The 25th Annual Symposium of the Estuarine and Coastal Sciences Association met in Dublin during September 1995. D. Minchin gave a presentation on "The Management of the Introduction and Transfers of Marine Molluscs". This paper covered the risks associated with the transportation of molluscs for culture, in particular, the movements of oysters. These movements also included many unintended species. The range expansions of cultivated molluscs was discussed along with how the application of the *1994 ICES Code of Practice* could reduce further risks.

15.4 Office International des Epizooites (Paris, June 1995)

The Office International des Epizooites (OIE) convened an "International Conference on Preventing Spread of Aquatic Animal Diseases through International Trade" in Paris on 7–9 June 1995. Dr J. Carlton presented a paper on an overview of the ICES/EIFAC Codes of Practice on the Introductions and Transfers of Marine and Freshwater Organisms.

16 ACTION LIST

WGITMO identified the following elements as being on its current list of Action Items. These items are reprinted in Annex 7 and are *in addition* to those elements proposed for action in the Recommendations of the Working Group for its 1997 meeting. WGITMO members and the WGITMO Chairman will:

* undertake efforts to encourage and then assemble translations of the *1994 ICES Code of Practice* to the languages of ICES Member Countries;

* finalize and submit the manuscripts for the two planned ICES Cooperative Research Reports as noted in Section 5;

* continue to assemble information on available databases on nonindigenous marine and brackish water organisms during the course of the year;

* facilitate as far as possible the submission of the "Annotated Bibliography on Transplantations and Transfers of Aquatic Organisms" for publication by ICES in disk and hard copy format (C.Res. 1995/1:4);

* keep abreast of developments at OSPAR relating to the dissemination of the *1994 ICES Code of Practice* and provide further information if requested; and

* work with representatives of IOC (IPHAB) and IMO in advance of the next meeting to define specific areas of mutual interest, concern, and discussion relative to ballast water issues.

17 RECOMMENDATIONS

The following recommendations to the Advisory Committee on the Marine Environment (ACME) were formulated by the WGITMO. The recommendations also appear in Annex 8 of this report.

1) In order to understand the ecological and other environmental effects of commercially important exotic species introductions into ICES Member Countries, an historical risk assessment, retrospective of the events leading to their current development and current ecological status should be undertaken, so that the types of risk can be identified and used as a basis for aiding future management decisions. Species that could be considered include the Pacific oyster *Crassostrea gigas*, the Asian kelp *Undaria pinnatifida,* and the coho salmon *Oncorhynchus kisutch.*

2) An ICES Cooperative Research Report should be prepared by WGITMO to examine the diversity, nature, and specific roles of those human-mediated vectors known to be important or potentially important in the transportation of exotic marine and brackish water organisms, and to attempt to assign relative degrees of risk that these vectors may pose in the distribution of non-native species. The purpose of this CRR is to supply a reference manual that is vector-based rather than species-based, in order to increase awareness of potential "new" vectors and to provide decision-makers with ready access to data sources that may aid in risk assessments, when specific vectors are proposed or come into play that have previously not existed or have not yet been recognized in individual ICES Member Countries or in specific geographical areas thereof.

3) Continued cooperation and communication are not only valuable but essential between ICES, the United Nations International Maritime Organization (IMO) and the United Nations Intergovernmental Oceanographic Commission (IOC) relative to the issues of the transportation by ships' ballast water and sediments, of invasive exotic species that could cause extensive damage to fisheries and other aquatic resources. Because such cooperation would facilitate an exchange of information and thus be mutually beneficial, ICES, IMO, and IOC should meet in joint session once a year for a period of at least one day, as a "Joint ICES/IMO/IOC Working Group on Ballast Water and Sediments" (WGBWS), to review annual progress on the scientific studies of ballast water and sediments and on technical management approaches, as well as pertinent policy issues and developments. IMO should be represented by the Chair of the IMO Marine Environmental Protection Committee's (MEPC's) "Working Group on Ballast Water", as well as by a second IMO representative. IOC should be represented by the Chair of the IOC "Intergovernmental Panel on Harmful Algal Blooms" (IPHAB), as well as by a second IOC representative. A representative of the International Chamber of Shipping (ICS) could be invited as well, as could a representative of the FAO European Inland Fisheries Advisory Committee (EIFAC), as noted below. ICES should be represented by all WGITMO members attending its annual meeting. The Joint ICES/IMO/IOC WGBWS meeting will be convened during the regular annual meetings of WGITMO, with the provision that either IMO headquarters in London or IOC headquarters in Paris could act as a host venue for one or more of the regular WGITMO meetings. The Joint WGBWS would consider the broad range of scientific, sampling, management, and international cooperative issues relative to ballast water and sediments, as well as additional issues that may be pertinent. Examples of the latter include, but are not limited to: (a) the dissemination of particular groups of organisms by ballast (for example human health pathogens, phytoplankton, zooplankton, and other plants and animals), (b) proposed control options, (c) understanding the role of ballast inoculations in the subsequent establishment of invasive species, (d) the sharing of databases, and (e) the contributory role of other ship-associated vectors (such as hull fouling). The Joint WGBWS would meet for a four year period commencing in 1997 and ending in the year 2000, at which time its usefulness and continuance would be evaluated by all three sponsoring organizations. Since several introduced organisms, especially in the Baltic Sea, appear to originate in inland Eurasian waters and are spread by riverine vessel traffic, ICES should further communicate with representatives of EIFAC to participate in the Joint WGBWS.

4) ICES Member Countries are asked to collect data on the diversity, abundance, and extent of any organisms unintentionally accompanying known, and particularly regular, commercial shipments of fish and shellfish transferred between ICES Member Countries, and to present such data to the 1997 WGITMO meeting.

5) ICES Member Countries are requested to compile information on the introductions and transfers of marine and brackish water ornamental organisms (fish, invertebrates, algae, and higher plants (phanerogams)) into their countries. This information should be presented to ICES in time for consideration at the 1997 WGITMO meeting. The purpose of this assessment is to provide data on which species and which sources of ornamental organisms may present the highest risks of introducing or transferring pathogens and/or establishing self-sustaining populations. These pathogens, or the ornamental organisms themselves if they were to become established, could have negative impacts on native species or natural ecosystems. This concern is based on the rapidly increasing interest, in many countries, of keeping ornamental organisms. These organisms are kept in private and public aquaria, in open saltwater and brackish water ponds and enclosures, and in tourist-oriented coastal seascape settings. ICES is concerned that with such increasing and global trade, the accidental transfers of fish pathogens could and will affect fisheries resources in ICES Member Countries (for example, epizootic ulcerative

syndrome (EUS) through the transfer of fish species from EUS-enzootic (Southeast Asian) countries). Both freshwater and marine species are of concern. Pathogens found in either environment may be transferable to the other. Communication with EIFAC would be useful, and such communication could be facilitated by a member serving on both the ICES and EIFAC working groups on introductions. ICES is aware that the Office International des Epizooites (OIE) will share some of the concerns noted, and thus communication with relevant authorities on this matter at OIE should be established.

6) ICES reminds its Member Countries that genetically modified organisms (GMOs) are now included in the *1994 ICES Code of Practice on the Introductions and Transfers of Marine Organisms* (COPITMO). ICES is aware that there is a growing interest in the development of transgenic fish, algae, and other organisms in ICES Member Countries. Activities relative to GMOs, including laboratory experiments that have been initiated or are being planned, should be included in the annual National Reports submitted to WGITMO by ICES Member Countries.

7) Relative to the continued mariculture operations in the State of Maine, USA, on domesticated, cultured strains of the Asian red alga *Porphyra yezoensis*,

   a) ICES sees no objection to proceeding with culture operations utilizing additional strains of this alga that do not differ in their reproductive requirements (and thus their potential to become established in the wild in the State of Maine) from that strain, being *Porphyra yezoensis* cultivar strain U-51, previously approved by State of Maine authorities for culture;

   b) ICES urges the continuation of an aggressive monitoring program for plants with monospores or sexual reproduction outside the farm's physical grow-out structures, especially after any new strains are acquired and deployed for grow-out;

   c) ICES requests the continued reporting to its WGITMO of any expanded or new grow-out sites, sites which WGITMO understands to be limited to the State of Maine or to the Province of New Brunswick, Canada, and sites which in turn WGITMO understands are or would be in temperature regimes that do not differ from those of Eastport, Maine (the site of current mariculture operations) and thus being at sites where the strains of *Porphyra yezoensis* that are now being used or that are being contemplated for future use, will not and cannot reproduce in the wild, and,

   d) ICES requests the continued reporting to its WGITMO of any experimental, quarantined, laboratory development, of any transgenic strains, cultivars, or populations, of *Porphyra yezoensis* in western North Atlantic waters or in any of the ICES Member Countries.

8) Continued communication between the Baltic Marine Biologists' "Working Group on Nonindigenous Estuarine and Marine Organisms" (BMB NEMO) and WGITMO should be maintained by regular correspondence or meetings between the Chairs of the two groups, so that issues of importance and information on new developments and new regulatory procedures can be exchanged and discussed,

9) The Working Group on Introductions and Transfers of Marine Organisms (Chairman: Dr J.T. Carlton, USA) will meet in La Tremblade, France, from 21–25 April 1997 to:

   a) meet in joint session for a period of at least one day with representatives of IMO and IOC relative to current critical developments in ballast water and sediment management and the role of ballast water and sediments in the introduction of alien species to ICES Member Countries and relative to the continued exchange of information;

   b) continue the assessment of potential marine biocontrol activities and the risks thereof, through the invitation to biocontrol researchers to the 1997 WGITMO meeting, as for example researchers working on the control of the invasive seaweed *Caulerpa* or the invasive comb jellyfish *Mnemiopsis*, with a goal of formulating a brief review of the efficacy of various other measures (mechanical, chemical, or otherwise) that have been employed to control exotic species invasions;

   c) continue to assess the disease and ecological implications arising from the introduction and transfer of aquarium (ornamental) marine and estuarine species into ICES Member Countries;

   d) prepare and undertake risk assessment retrospectives for selected case histories of introduced marine plants, invertebrates, and fish in ICES Member Countries, in order to provide a stronger basis for future considerations of newly proposed introductions and transfers;

   e) assemble materials toward an ICES Cooperative Research Report on a "Directory of Vectors Involved in the Introduction and Transfer of Marine and Estuarine Organisms";

   f) report on the current status of fish, shellfish, algal, and other introductions in and between ICES Member Countries, through submission of annual National Reports, and in particular through continued overview of (i) the status of the culture of the marine seaweeds *Porphyra yezoensis* on the Atlantic coast of North America and of Undaria

pinnatifida on the Atlantic coast of Europe, and its subsequent dispersal and establishment in other ICES Member Countries, (ii) the potential and risk of dispersal of the Mediterranean alga *Caulerpa taxifolia* into Atlantic waters, (iii) the increasing expansion and dominance of the American marine worm *Marenzelleria*, (iv) the increasing activities with GMOs in ICES Member Countries, and (v) the continued development and coordination of cooperative data bases on introductions and transfers of marine and brackish water organisms.

Through the auspices of the General Secretary representatives of IMO, IOC, ICS, OIE, and EIFAC will be invited to attend specific sessions pertinent to their interests.

18 CLOSING OF THE MEETING

A final review of the 1996 terms of reference was made and the proposed agenda and actions items for 1997 were considered. FAXes received from Drs P. Goulletquer and H. Grizel inviting the WGITMO to La Tremblade, France, for 1997 were discussed and this offer was accepted. Final draft recommendations were discussed, revised, and approved by WGITMO participants. The Chairman acknowledged the WGITMO members and guests for their dedicated work, Dr D. Minchin for standing in as Acting Rapporteur for WGITMO in the absence of Dr S. Utting, and thanked Dr W. Pelczarski and his colleagues for hosting the meeting in Gdynia at the Sea Fisheries Institute. The Chairman noted that both WGITMO and BMB NEMO working groups much appreciated the opportunity to visit the facilities along the Polish coast at Gdansk University Marine Station at Hel under the direction of Dr K. Skora and the Coastal Landscape Park (Namorski Park Krajobrazowy) at Wladyslawowo under the direction of Mr A. Janta. The Chairman adjourned the meeting at 12.10 hrs on 26 April 1996.

ANNEX 1

AGENDA

MONDAY APRIL 22

[Registration: Sign-In and Name Tags Distribution]

9:00 AM Opening Session

"First Joint WGITMO-NEMO Meeting" begins between ICES WGITMO and the Baltic Marine Biologists (BMB) Working Group: Nonindigenous Marine and Estuarine Organisms (NEMO) in the Baltic Sea

* Welcome from Sea Fisheries Institute — Zygmunt Polanski, Director, SFI
* Logistical Announcements — Wojciech Pelczarski
  Meals, telephones, FAXing, photocopying, transportation, Thursday field trip, etc.
* Personal Introductions — All Participants
* Appointments of Rapporteurs for WGITMO and NEMO
* Review of Week's Agenda — Jim Carlton, Sergej Olenin
  Changes, Corrections, and Additions

10:00 AM BMB/NEMO: Brief History and Goals — Sergej Olenin, Krzysztof Skora

10:15 ICES/WGITMO: Brief History and Goals — Jim Carlton
~ The New ICES Code of Practice

10:30 COFFEE BREAK

11:00 Reconvene

WGITMO / NEMO:
(Begin) National Reports from Baltic Area Countries:

Introduced Species Issues Other than Ballast Water
(see Wednesday:)
Finland Erkki Leppakoski
Germany Stephan Gollasch
Lithuania Sergej Olenin and K. Skora

12:00 LUNCH

1:30 PM Reconvene

(Finish) National Reports from Baltic Area Countries
Norway Knut Jorstad
Poland Wojciech Pelczarski
Sweden Bo Holmberg, Inger Wallentinus, Kristina Jansson

2:15 **The Baltic Sea:** The Major Issues Regarding Biological Invasions (NEMO's) in the Baltic Sea
* Round-Table and Informal Impromptu Presentations from NEMO Members

* Recommendation for HELCOM relative to inclusion of NEMOs in the revised Guidelines for Baltic Monitoring Programme

* Joint NEMO and WGITMO Discussion of Major Issues, Focusing on BMB - ICES Cooperation to Address and Make Progress on Individual Items

3:30 COFFEE BREAK and Group Photo(s)

4:00 Reconvene
* ITMO and NEMO: Plans for continued cooperation, facilitation, and joint work

5:00 PM Adjourn for the Day
Dinner On Your Own or as Arranged with the Group

TUESDAY APRIL 23 ICES WGITMO // BMB NEMO meet separately

9:00 AM
~ Review of Agenda
~ WG Report Deadline: **May 20, 1996**
~ Addenda/Errata for 1995 Kiel Report
~ Status of Recommendations from 1995 Kiel meeting

~ The ICES Code of Practice: Status Relative to OSPAR (Oslo and Paris Commissions) and the HELSINKI COMMISSION.

* OSPAR's Environmental Assessment and Monitoring Committee (ASMO) Meeting, March 1996

~ Status of ITMO In-Progress Cooperative Research Reports:

(1) Status of Introductions: 1990
Submitted to ICES February 1996

(2) Guidebook for Code of Practice
Near Completion: To Be Completed April 1996

(3) Aalborg Ballast Water Symposium
To be submitted to ICES April 1996

~ National Reports (Continued)

Introduced Species Issues Other than Ballast Water
(see Wednesday:)

Canada	Richard Arthur, Dorothee Kieser, Malcolm Campbell
Ireland	Dan Minchin
UK	Sue Utting (in absentia), Clare Eno
USA	Jim Carlton

10:30 AM COFFEE BREAK

11:00	Reconvene: ~ National Reports (Continued, if necessary) ~ Updates on Algal Invasions: *Caulerpa taxifolia* *Undaria pinnatifida* *Sargassum muticum*	
12:00	LUNCH	
1:30 PM	Reconvene	
	~ Presentation of papers and materials from 1995-1996 meetings on introductions and transfers, including stockings, or meetings where papers on introductions and/or ICES Code were presented:	
	(1) Bern Convention meeting, May 1996	Dan Minchin
	(2) Estuarine and Coastal Science Assoc. (ECSA) meeting, Dublin, Sept. 1995	Dan Minchin
	(3) Sweden/FAO fisheries meeting June 1995 "Precautionary Approach to Fisheries"	Dan Minchin
	(4) USA meetings	Jim Carlton
	(5) Other Meetings	All present
	~ Update on Comb-Jelly Invasion (*Mnemiopsis)* in Azov, Black, and Mediterranean Seas: *Mnemiopsis*	Jim Carlton
	~ Marine biocontrol activities utilizing non-native organisms to control nuisance (pest) exotics	All present
3:30	COFFEE BREAK	
4:00	Reconvene	
	~ Data base coordination within and among ICES member countries relative to introductions and transfers	All present
5:00 PM	Adjourn for the Day Dinner On Your Own or as Arranged with the Group	
7:00 PM	Reception at MRI	

WEDNESDAY APRIL 24

9:00 AM	WGITMO and BMB NEMO reconvene for continued discussions
10:30 AM	COFFEE BREAK

BALLAST WATER BIOLOGY AND MANAGEMENT: NATIONAL AND INTERNATIONAL STATUS

11:00 AM Overview:
Ballast Water Biology and Management: 1996 Update Jim Carlton

Proposal for Joint, Cooperative Efforts Between ICES, the United Nations (UN) International Maritime Organization (IMO), and the Intergovernmental Oceanographic Commission (IOC): Develop the terms of reference (TOR) for a joint ICES-IMO-IOC Working Group on Ballast Water, relative to the implications and management of ships' ballast water and sediments, in order to bring together, focus, and streamline the expertise from all of three groups.

Representing IMO: Manfred Nauke
Representing IOC: Dan Minchin
Discussion on Proposal and Draft Terms of Reference

12:00 LUNCH
1:00-2:30 Visit to Gdynia Aquarium

3:00 PM Reconvene
<u>*Updates of ballast water research and management:*</u>

Canada	Lithuania		Sweden
Finland	Norway	UK	
Germany	Poland		USA
Ireland			

3:30 COFFEE BREAK

4:00 Reconvene
<u>Updates (from above, continued)</u>

6:00 PM ~ Viewing of US Coast Guard Video on Ballast Water
~ Viewing of Video on King Crab (K. Jorstad)

6:30PM Adjourn for the Day

Dinner On Your Own or as Arranged with the Group

THURSDAY APRIL 25

AM: WGITMO and NEMO in separate session

9:00 AM ~ Presentation from Dr. I. Levine (USA) on *Porphyra* status update in Gulf of Maine on USA/Canada border

9:45 ~ Status of Case Examples of Incidents where Shipments of Fish or Shellfish from one EU country to another have been found to transport associated organisms that would then be accidentally released as non-indigenous species in recipient country waters (Res. 1994/3:2)

~ Historical Case Examples of Introductions in ICES Member Countries as a Potential TOR (relative also to possible meeting in La Tremblade in 1997)

10:30 COFFEE BREAK

11:00	Reconvene: ~ Issues Associated with the Aquarium (Ornamental) Trade of Marine and Estuarine Organisms, Particularly Relative to Disease and Ecological Implications ~ Review of Proposed Draft Recommendations
12:00	LUNCH
PM:	**FIELD EXCURSION** Laboratory tour (with Dr. K. Skora) - to Hel Marine Station (University of Gdansk Oceanographic Station), on the tip of Hel Peninsula (80 km from Gdynia), and the Fisheries Museum in Hel.

FRIDAY APRIL 26 1996

9:00 AM	WGITMO and NEMO re-convene for a 1-hour joint conference on future joint endeavors
10:30	COFFEE BREAK
11:00	Reconvene WGITMO and NEMO meet in separate final sessions Distribution and Discussion of Final Recommendations Principal Agenda Items for 1997 WG Meeting Place & Time for 1997 Meeting Concluding remarks by Chair; Official Adjournment
12	LUNCH
PM	WGITMO: Report Writing Session
5 PM	End of Meeting

ANNEX 2

LIST OF PARTICIPANTS

Name	Address	Telephone	Fax	E-mail
Arthur, R.	Parasitology Section Department of Fisheries & Oceans Maurice Lamontagne Insitute P.O. Box 1000 Mont-Joli, Quebec, G5H 3Z4 Canada	+1 418 775 0640	+1 418 775 0542	r_arthur@dfo.qc.ca
Campbell, M.	Department of Fisheries and Oceans P.O. Box 5030 Moncton, New Brunswick E1C 9B6 Canada	+1 506 851 6247	+1 506 851 2079	campbellm@gfc.dfo.ca
Carlton, J.T. (Chairman)	Williams College Mystic Seaport P.O. Box 6000 75 Greenmanvill Avenue Mystic, CT 06355 USA	+1 860 572 5359	+ 860 572 5329	james.t.carlton@ williams
Dybern, B.I.*	Institute of Marine Research Box S-453 21 Lysekil Sweden	+46 523 187 00	+46 523 139 77	
Eno, N.C.	Marine Conservation Branch Joint Nature Conservation Committee Monkstone House, City Road Peterborough PE1 1JY United Kingdom	+44 173 386 6833	+44 173 355 5948	
Gollasch, S.*	Zoologisches Institut und Museum Martin-Luther-King-Platz 3 D-2146 Hamburg Germany	+49 40 4123 4226	+49 40 4123 3937	FB5A007@rrz-cip-1.rrz uni-hamburg.de
Gruszka, P.†	Department of Marine Ecology and Environmental Protection University of Agriculture ul. Kazimierza Krolewicsa 4 PL-71-550 Szczecin Poland	+48 91 231 061 ext. 276	+48 91 232 417	
Holmberg, B.	National Board of Fisheries P.O. Box 423 S-401 26 Goteborg Sweden	+46 31 630 329	+46 31 156 577	

* = Also a member of BMB NEMO
† = BMB member
° = Visitor/Guest

Name	Address	Telephone	Fax	E-mail
Jansson, K.*	Swedish Environmental Protection Agency Research & Development Department Marine Section S-106 48 Stockholm Sweden	+46 8 698 1451	+46 8 698 1663	kaj@environ.se
Janta, A.†	Nadmorski Landscape Park Morska 6 PL-84120 Wladyslawowo Poland	+48 58 74 06 85		
Jorstad, K.E.	Department of Aquaculture Institute of Marine Research P.O. Box 1870 N-5011 Nordnes, Bergen Norway	+47 55 23 83 02	+47 55 23 83 33	
Karasiova, E.†	ATLANTNIRO 5 Dmitry Donskoy Street Kaliningrad 23600 Russia	+112 215 645	+112 215 645	root@atlant.koenig.su
Kieser, D.	Department of Fisheries & Oceans Pacific Biological Station 3190 Hammond Bay Road Nanimo BC V9R 5K6 Canada	+1 604 756 7069	+1 604 756 7053	kieserd@pbs.dfo.ca
Leppäkoski, E.*	Department of Biology Åbo Akademi University Bio City FIN-20520 Turku/Åbo Finland	+358 21 265 4355	+358 21 265 4748	eleppakoski@abo.fi
Levine, I.°	Coastal Plantations International, Inc. P.O. Box 209 Poland, Maine 04273 USA	+1 207 998 4909	+1 207 998 4909	ikelevine@aol.com
Minchin, D.	Fisheries Research Centre The Marine Institute Abbotstown, Dublin 15 Ireland	+353 1 8210 111	+353 1 8205 078	minchin@frc.ie

* = Also a member of BMB NEMO
† = BMB member
° = Visitor/Guest

ANNEX 2 (continued)

Name	Address	Telephone	Fax	E-mail
Nauke, M.K.°	Office for the London Convention 1972 Marine Environment Division International Maritime Organization (IMO) 4 Albert Embankment London SE1 7SR United Kingdom	+44 171 587 3124	+44 171 587 3210	
Ojaveer, H.†	Estonian Marine Institute Lai Street 32 EE-0001 Tallinn Estonia	+372 2 601 529	+372 6 313 004	
Olenin, S.†	Centre of System Analysis Klaipeda University Manto 84 LT-5808 Klaipeda Lithuani	+370 6 212 936	+370 6 212 940	serg@samc.ku.lt
Pelczarski, W*	Sea Fisheries Institue ul. Kollataja 1 PL-81-332 Gdynia Poland	+48 58 201 728 ext. 219	+48 58 202 831	wpelczar@miryb.mir.gdynia.pl
Sapota , M.R.†	Institute of Oceanography Department of Marine Biology and Ecology Univeristy of Gdansk Al. Pilsudskiego 46 PL-81 378 Gdynia Poland	+48 58 202 101	+48 58 202 165	ocerns@univ. gda.pl
Schulz, S.†	Lessingstrasse 22 D-18055 Rostock Germany	+49 381 29008	+49 381 29008	
Skora, K.E.	Hel Marine Station University of Gdansk P.O. Box 37 PL-84 150 Hel Poland	+48 58 750 836	+48 58 750 420	
Sobol, Z.°	Insitute of Maritime and Tropical Medicine ul. Powstania Styczniowego 9b PL-81-519 Gdynia Poland	+48 58 223 011	+48 58 223 354	

* = Also a member of BMB NEMO
† = BMB member
° = Visitor/Guest

ANNEX 2 (continued)

Name	Address	Telephone	Fax	E-mail
von Wachenfeldt, T. †	Baltic Laboratory Utovagaen Karlskrona Sweden	+46 455 16579	+46 456 13429	
Wallentinus, I.*	Department of Marine Botany University of Göteborg Carl Skottsbergs Gata 22 S-413 19 Göteborg Sweden	+46 31 773 27 02	+46 31 773 27 27	inger.wallentinus@marbot.gu.se
Wolowicz, M. †	Institute of Oceanography Gdansk University PL-81-378 Gdynia Poland	+48 58 202 101	+48 58 202 165	ocemw@univ.gda.pl

* = Also a member of BMB NEMO
† = BMB member
° = Visitor/Guest

ANNEX 3

NATIONAL REPORTS FROM MEMBER COUNTRIES FOR 1995–1996

NATIONAL REPORT FOR CANADA

1 LAWS AND REGULATIONS

Fish Health Protection Regulations

The Department of Fisheries and Oceans continues to work on amendments to the Fish Health Protection Regulations (FHPR). Realizing that the completion of the major revision is still some time away, the Technical Committee that is preparing the amendments has proposed an 'interim amendment' which is presently under review. If approved this amendment to the existing regulations would embody a 'like-to-like' philosophy whereby facilities with FHPR pathogens may be permitted to transfer fish into the country or to another province providing that the recipient facility already has those specific agents. A second part of the interim amendment proposes that facilities wishing to sell only surface disinfected eggs need only be inspected for the viruses listed in Schedule II of the FHPR.

Work on the development of specific 'shellfish health regulations' is continuing.

Draft Policy on Research with, or Rearing of, Transgenic Aquatic Organisms

The Department of Fisheries and Oceans has as a priority the intention to finalise the draft policy entitled "Transgenic Aquatic Organisms: Policy and Guidelines for Research with, or for Rearing in Natural Aquatic Ecosystems in Canada" which has received extensive review by public and private interests and is in a near-final version. It is the Department's intention that the policy address the needs of both protecting the natural resources and of facilitating and encouraging the potential use of such biotechnology products in aquaculture.

Draft National Policy on Introductions and Transfers of Aquatic Organisms

The Department of Fisheries and Oceans has prepared a draft "National Policy on Introductions and Transfers of Aquatic Organisms" which is presently being distributed for review by public and private interests groups. The purpose of the policy is to establish the criteria for the deliberate introduction and transfer of aquatic organisms into Canada or between provinces. The policy will not cover accidental introductions and transfers nor will it cover 'transgenic' organisms which will be dealt with by the above mentioned 'transgenics policy'.

2) DELIBERATE RELEASES

2.1. FINFISH

Significant numbers of eggs and fish (*Oncorhynchus mykiss, O. tshawytscha, O. nerka, O. kisutch, Salmo salar, S. trutta, Salvelinus alpinus, S. fontinalis, S. namaycush, S. fontinalis X S. namaycush, Esox lucius, Stizostedion vitreum, Micropterus dolomieui, Ictalurus nebulosus*) continue to be transferred into the country, between provinces and intra-provincially in support of aquaculture (not intended to be released to natural environment - but escapes do occur, see section 3.1.) and enhancement programmes (released to natural environment). In general these movements receive rigorous scrutiny by regional/provincial introductions and transfers committees which consider disease, genetic and ecological risks. In addition, all transboundary movements of salmonids must also satisfy the Canadian FHPR. Some points worth mention:

As in previous years, eggs from British Columbia sockeye salmon (*O. nerka*) stocks were moved to an approved Alaska hatchery using a fish-free water supply. After hatching the fry were returned to their native BC system.

Depending on the recipient drainage, and the perceived risks to local stocks, some jurisdictions (e.g. New Brunswick and Newfoundland) are requiring that rainbow trout be reproductivily sterile (generally triploid fish).

Walleye (*S. vitreum*) and northern pike (*Esox lucius*) are stocked in Manitoba to create new self sustaining populations or to replace populations that have been destroyed by winter-kill.

2.2. INVERTEBRATES

Movements of invertebrates also receive rigorous scrutiny by regional/provincial introductions and transfers committees which consider disease, genetic and ecological risks before permission is given. Of note:

In Atlantic Canada, oysters (*Crassostrea virginica* and *Ostrea edulis*), blue mussels (*Mytilus edulis*), soft-shell (*Mya arenaria*), hard-shell (*Mercenaria mercenaria*) and bar clams (*Spisula solidissima*) and giant sea scallops (*Placopecten magellanicus*) were transferred as seedstock throughout the region between May and September, 1995. As in previous years, all official movements of shellfish destined for hatchery-use or for relay in open water are screened for parasites, pests and diseases, prior to transfer. An increase in the number of transfer requests received in 1995 compared with 1990-1994 reflects an increase in research and trials with species diversification for aquaculture in Atlantic Canada [especially hard-shell, soft-shell and bar clams, giant scallops, and European oysters ("new" to New Brunswick and PEI)].

The American oysters transferred from Cape Breton, Nova Scotia, to Prince Edward Island and New Brunswick for research purposes in 1994 continue to be held in closed cages. Mortalities occurred in the Cape Breton oysters, starting in September 1995, and indicate continued virulence of the aetiologic agent of Malpeque disease despite no clinical signs of the disease in local tolerant ("resistant") oysters since the last epizootic in the late 1950s. (Note: This is very relevant for countries designating disease-free periods, usually 2–4 years, in order to re-zone open water areas with specific disease status).

An official request from the Department of Fisheries and Aquaculture, New Brunswick to import hard-shell clams (*Mercenaria mercenaria)* from a South Carolina bivalve hatchery was received in 1994 and reported as a 'planned introduction' last year. The health of the proposed export stock was examined by a shellfish pathologist on site and certified to be free of a list of disease organisms of concern. A permit was issued allowing import into quarantine facilities in New Brunswick in February 1995. The stock was spawned in quarantine and all broodstock were examined for disease agents (histology and thioglycollate culture). The F1 generation (<2mm in diameter) were also examined and found to be heavily fouled by peritrichous ciliates. 100% of the F1 generation died (see 3.2 below).

In British Columbia Manilla clam (*Tapes philippinarum*) and Pacific oyster (*Crassostrea gigas*) seed continue to be imported for beach seeding purposes, from certified sources in the Pacific northwest USA.

3. ACCIDENTAL INTRODUCTIONS AND TRANSFERS

3.1. FINFISH

Ruffe (*Gymnocephalus cernuus*) in the Great Lakes: In 1995, ruffe were captured for the first time at a location outside of Lake Superior. The U.S. Fish and Wildlife Service reported that 3 specimens of ruffe were caught in Lake Huron at Alpena, Michigan in August 1995. Prior to 1995, the distribution of ruffe was restricted Lake Superior. Ruffe were first discovered in Duluth Harbor at the western end of Lake Superior in 1986, and were probably transported via ballast water from a marine vessel. Since 1986, ruffe have gradually extended their range eastward along the south coast of Lake Superior, and now occur as far east as the Ontonagon River, Michigan. On the north shore of Lake Superior, ruffe have been found on two occasions (1991 and 1994) in Thunder Bay, Ontario. Ruffe are continuing to expand their range in the Great Lakes.

Gobiidae: Information presented at the 6th Zebra Mussel Conference indicated that the round goby (*Neogobius melanostomus*) continues to expand its range in the Great Lakes. First found in 1990 in the St. Clair River, the round goby has now been found in Lake Erie, southern Lake Michigan, southern Lake Huron, and Lake Superior. Tubenose gobies (*Proterorhinus marmoratus*) have not spread as far, and have been found only in the St. Clair River, St. Clair Lake and the lower Detroit River.

Two major escapements of rainbow trout (approximately 19,000 and 12,000 fish) occurred in the Bay D'Espoir aquaculture area of Newfoundland in 1995. It is believed that the escapes were triploid fish.

3.2. INVERTEBRATES

Mercenaria mercenaria notata: An 'unofficial' introduction (proponent claimed to have verbal approval from DFO) of hard-shell clams made from Maine to Nova Scotia in 1991 was revealed in September 1995, following the loss of the same species which had been officially introduced into a quarantine at Shippagan, New Brunswick (see 2.2, above). Approximately 35 clams have reportedly survived from the initial 1991 introduction of an unspecified number of

seedstock. The seed originated from a shellfish hatchery in Maine. An October 1995 health check of 8 of the clams revealed the presence of the parasite "QPX" (quahaug parasite X) which is known in *Mercenaria mercenaria* from Atlantic Canada. The origin of the infection appears likely to have been local rather than introduced with the seed. Despite scientific advice to the contrary, approval was given for a portion of the clams to be transferred to Shippagan for use as broodstock. The shellfish grower refused to allow use of all of the clams as broodstock since he did not want them all to be destroyed for health examination. He has maintained a subsample at his site in Nova Scotia. Federal recommendations are that seedstock from the notata broodstock can only be distributed for growout trials following lethal examination of 100% of the broodstock as well as a subsample of the F1 generation. These examinations are scheduled for the end of April 1996.

Dreissena: The zebra mussel (*Dreissena polymorpha*) has slowly expanded its range to inland lakes of Ontario. The species is now found in all lakes of the Trent-Severn Waterway between Lake Ontario and Georgian Bay. Range expansion has also occurred slowly northward to Manitoulin Island, Lake Huron and along the shore of Georgian Bay to Moon River, Parry Sound and Pointe au Baril in water with low Ca levels (27 to 30 mg/L). The Rideau Waterway between eastern Lake Ontario and the Ottawa River has been colonised, with confirmed sightings in the nearby inland lakes, Sharbot and Charleston Lake. These transfers are probably related to recreational boat traffic. No occurrences of the second species, *Dreissena bugensis*, have been reported in Canadian waters upstream of the Detroit River. This species has been found in Lake Erie, Lake Ontario and the St. Lawrence River.

New Zealand Mud Snail: The Hydrobiidae snail *Potamopyrgus antipodarum* was finally identified as the exotic snail found in Lake Ontario by Zaranko et al. (1996) (identification confirmed by Robert Hershler of the Smithsonian, Washington D.C). Specimens were first noticed in Department of Fisheries and Oceans (DFO) samples from Lake Ontario off Wilson, New York during 1993. Examination of samples collected previously by DFO showed that the species first occurred at that site in April 1991; no specimens were present in 1990. A study of several harbours and bays on Lake Ontario by Zaranko et al. (1996) showed populations of *P. antipodarum* were present in two areas of Lake Ontario. At the west end of the lake, the species is present in the vicinity of the Welland Canal and the Niagara River. At the east end of the lake, the snail has been found in the Kingston area, and upper St. Lawrence River at Prescott. The snail has yet to be reported from elsewhere in Lake Ontario or Lake Erie. The snail is 5 to 12 mm long with 7 to 8 whorls in a long attenuated spire. It reproduces rapidly as it is parthenogenic. This species is widespread in Europe (Denmark, Poland, Slovakia) where it is known as *P. jenkinsi.* The suspected mode of introduction in Lake Ontario is ballast water discharge prior to 1991. The only other area in North America where the species occurs is in the Snake River and Box Canyon Creek in Idaho.

3.3. ALGAE AND HIGHER PLANTS

In British Columbia there is some concern about sitings of a type of Sargassum in areas other than Pendrell Sound where it was first seen approximately 15 years ago, and where it is thought to have been introduced with oyster seed from Japan.

Codium fragile was first detected in Nova Scotia three years ago and the belief is that it was introduced with shellfish from the USA. It appears to only be abundant in Mahone Bay, Lunnenburg County (south of Halifax on the Atlantic coast) and, despite evidence of some minor dispersal to adjacent areas, it does not appear to have spread much so far. There is some concern that it could interfere with bottom culture aquaculture but it should not be a problem for suspended culture operations. Although there are concerns about a possible threat to native kelp (*Laminaria*) beds there is no evidence to date that it is pushing native species out.

4. LIVE IMPORTS (RESEARCH/HUMAN CONSUMPTION)

The following organisms were imported into Canada for research or for human consumption. The organisms are held in quarantine or containment facilities, and are either destroyed after research is completed or used as food. Importation of these organisms under the above conditions is not believed to pose a significant risk to Canadian fisheries resources. The list of organisms imported for food is not complete. Recording food organisms is low priority because of the low risk of impact on wild resources.

<u>British Columbia</u>
Species imported for bioassays, live table market or display purposes included: red abalone, spotted cabarilla, giant crab, spiny lobster, spot prawn, kelp rockfish, various species of sand bass, California scorpionfish, sailfin sculpin, California sheepshead, ocean whitefish, Pacific whitefish, blue mussel, eccentric sand dollar, purple sea urchin, inland silversides, white sturgeon, tilapia, and American eels (these eels were brought for immediate transshipping to Asia only).

Alberta
Proponents in the Province of Alberta continue to study the potential use of triploid grass carp (*Ctenopharyngodon idella*) to control aquatic vegetation in irrigation canals and farm dugout ponds. Grass carp have been imported from the United States for research purposes.

Tilapia imported from the USA for an established food fish aquaculture enterprise.

Manitoba
Inconnu (*Stenodus leucichthys*), Arctic charr (*Salvelinus alpinus*), and shovelnose sturgeon (*Scaphirhynchus platorynchus*) are imported for research along with numerous unmonitored imports of species for the aquarium trade (aquarium dealers are advised of the list of prohibited species under the Manitoba Fisheries regulations of 1985).

Ontario
Live species imported for human consumption include: lobster, tilapia, crab (unspecified), oysters (unspecified), striped bass, rock lobster, freshwater bass, clams (unspecified), bighead sucker, scallops (unspecified), conch, cod, blue crab, blackfish, bluefish, butterfish, flounder, squid, eels, herring, mullet, catfish and miscellaneous 'fresh fish'.

New Brunswick
Milt from two transgenic (growth hormone) Atlantic salmon males was transferred from Newfoundland to two research facilities in New Brunswick.

Nova Scotia
Amphipods: *Hyalella azteca* from Ontario; *Rhepoxynius abronius* from Washington State, USA; *Boekosimus affinis* from the Northwest Territories and *Euhaustorius estuarius* from Oregon, USA.

Pacific sea urchin (*Strongylocentrotus purpuratus*) and white sea urchin (*Lytechinus pictus)* and clam (*Macoma nasuta*) from California, USA.

Eccentric sand dollar (*Dendraster excentricus*) from British Columbia

Prince Edward Island
Atlantic salmon from New Brunswick and coho salmon (*O. kisutch*) from British Columbia were imported to research facilities.

Carp (*Cyprinus carpio*) imported to a research facility from California, New Hampshire, Texas, Pennsylvania and North Carolina USA.

Newfoundland
Importation of 3 lots of 5000 amphipods (unspecified) from Seattle, Washington for bioassay purposes.

Importation of 3 lots of 40 sea urchins (unspecified) from California for research.

5. LIVE EXPORTS TO ICES MEMBER COUNTRIES

Canadian aquaculturists continue to ship salmonid eggs and fish (*Salmo salar, Salvelinus alpinus, S. fontinalis* and *Oncorhynchus mykiss*) to the USA subject to US Title 50 fish health conditions. In 1995 an aquaculturist in Quebec also sent shipments of *Salvelinus alpinus* and *S. fontinalis* eggs to France and *S. alpinus* eggs to Germany. A Yukon aquaculturist shipped Arctic charr eggs to Ireland in 1995 and Manitoba exported <500 wild white bass (*Morone chrysops*) to the USA.

6. PLANNED INTRODUCTIONS

6.1. FINFISH

Continued importations and transfers of salmonids for enhancement and aquaculture purposes from other provinces in Canada and from sources in the USA are likely. Importations of various fish species for research and for human consumption will likely continue as well. Of note:-

Proponents in the Province of Alberta continue to investigate the potential use of triploid grass carp *(Ctenopharyngodon idella)* to control aquatic vegetation in irrigation canals and farm dugout ponds. It is intended that grass carp will continue to be imported from the United States for research purposes. A Non-Native Species Risk Assessment Committee, with both federal (Department of Fisheries and Oceans, Central and Arctic Region) and provincial membership, has been established to deal with this issue. The goal of the Committee is to develop a risk assessment protocol, and to use grass carp as a case study.

6.2. INVERTEBRATES

Continued importations and transfers of invertebrates for aquaculture and research purposes from other provinces in Canada and from sources in the USA are likely.

6.3. ALGAE AND HIGHER PLANTS

Pacific kelp (*Macrocystis integrifolia*) from British Columbia to Gulf of St. Lawrence waters off New Brunswick and Nova Scotia for use in a herring roe-on-kelp developmental fishery. Two requests to import Pacific kelp fronds for use as herring roe collectors in the Gulf of St. Lawrence were reviewed by local introductions & transfers committees in 1995. Both requests were denied and the proponents encouraged to use the local *Laminaria* species. The proponents have indicated that they will continue to try to get permission for Pacific kelp use.

7. MEETINGS, CONFERENCES, SYMPOSIA OR WORKSHOPS

The Fifth International Zebra Mussel and Other Nuisance Organisms Conference was held in Toronto, Ontario, 21-24 February, 1995.

Ruffe Control Committee Meeting, April and November 1995, Detroit, Michigan (T. Busiahn, U.S. Fish and Wildlife Service, Chairman).

International Symposium on the Biology and Management of the Eurasian Ruffe (*Gymnocephalus cernuus*), planned for Detroit, MI, March 1997.

British Columbia and Washington State have formed a 'BC/Washington Environmental Cooperation Council under the Puget Sound/Georgia Basin International Task Force to address common environmental problems. One of the working groups under this task force is the 'WG on Minimizing Introductions of Exotic Species'. This WG is interested in both planned and inadvertent introductions and steps to minimize negative impacts. Both Washington State and British Columbia have sub-working groups. The two groups will prepare a joint report to the Council.

Collated by M. Campbell, Department of Fisheries & Oceans, April 1996.

NATIONAL REPORT FOR FINLAND

1.0 LAWS AND REGULATIONS

Gene technology Act and Decree were put into force in Finland in 1 June 1995. The Act monitors the use of gene technology with means of a report system. Every research and development project on GMOs has to be reported to Gene Technology Board, the purpose of which is to assess the environmental risks.

In accordance with the EU's position, all export and import of live farmed fish and gametes are prohibited between the EU and Finland. Imports from countries outside the EU are also prohibited from 1995–1997.

ICES Code of Practice (1994) has been translated into Finnish and Swedish and will be issued in the summer of 1996.

2.0 DELIBERATE RELEASES

Deliberate releases into the Baltic Sea for fisheries management purposes were as follows in 1995:

2.4 mi. salmon (*Salmo salar*) smolts
2.8 mi. salmon parrs
1.1 mi. sea trout (*Salmo trutta m. trutta)* smolts
1.1 mi. sea trout parrs
10 mi. one-summer-old whitefish (*Coregonus lavaretus*)
55 mi. newly-hatched whitefish

As in previous years, veterinary authorities allowed the import of elvers (*Anguilla anguilla*) from England via Swedish quarantine. 200 000 elvers were released into inland waters in southern Finland in 1995.

3.0 ACCIDENTAL INTRODUCTIONS AND TRANSFERS

3.2 Invertebrates

In 1995, two new invertebrate species were first found in Finnish coastal waters in 1995, both of them in the inner part of the Gulf of Finland. The spread of the zebra mussel (*Dreissena polymorpha*) could be linked to its earlier occurrence in the Estonian and Russian parts of the inner Gulf of Finland. A mass occurrence of the predaceous spiny waterflea, *Cercopagis pengoi*, found in the Riga Gulf in the early 90s, was observed in the eastern Gulf of Finland in September, 1995.

The spionid polychaete *Marenzelleria viridis*, and the Ponto-Caspian mysid shrimp *Hemimysis anomala* (both of them found for the first time in Finnish waters in the beginning of the 90s) have expanded their distribution to the Bothnian Sea (Gulf of Bothnia).

4.0 LIVE IMPORTS

4.1 Fish

See 2.0.

4.2 Invertebrates

As in previous years, aquarium shops and some restaurants and stores may import live marine animals such as oysters, lobsters and crabs for sale or consumption without the authorization of the Veterinary Department because it is obvious that they cannot survive in natural Finnish waters.

4.3 Algae or Higher Plants

None apart from aquarium plants.

5.0 LIVE EXPORTS to ICES Member Countries

5.1 Fish

Fertilized eggs of Atlantic salmon have been exported to hatcheries in Russia, Estonia and Denmark. Fertilized eggs and fingerlings (up to two-year-old) of rainbow trout *Oncorhynchus mykiss*) have been exported in Russia (mostly *Karelia*). In addition, Estonia has obtained fertilized eggs of Arctic char (*Thymallus thymallus*) from Finland.

6.0 PLANNED INTRODUCTIONS

6.1 Fish

All export is prohibited for 1995–1997, when the IHN and VHS examinations will be carried out.

Report prepared by R. Rahkonen and E. Leppäkoski.

NATIONAL REPORT FOR FEDERAL REPUBLIC OF GERMANY

3.0 Accidental Introductions

Anguillicola crassa (Nematoda), first recorded in German waters in the 1970s (Koops and Hartmann, 1989) was introduced by imported eels for aquaculture (Williams and Sindermann 1991). It is now in all water sheds of Germany and is increasingly affecting the eel populations up to 100%.

Spread of the Worm, *Marenzelleria viridis*

The introduced American polychaete worm *Marenzelleria viridis* (Verrill, 1873) is spreading rapidly along the German coast. It has been recorded since 1982 in the Ems estuary, North Sea probably introduced by ballast water (Essink and Kleef, 1986; Carlton and Geller, 1993). The first record in the Baltic Sea was in 1985 (Laine, 1995). It now occurs in various brackish waters of the Baltic Sea. The occurrence of *Marenzelleria* has led to a number of studies in German coastal areas and in coastal waters of neighbouring countries. Kirkegaard (1990) reported this species from the Ringkîbing Fjord (Denmark). Zettler (1993) demonstrated its rapid growth and range extension in the Darx-Zingster Bodden Sea. In subsequent studies, Zettler *et al.* (1994, 1995) reported on the regional distribution and spread in Baltic coastal waters as well as on its vertical distribution and life cycle under brackish water conditions. Bochert (1993) describes the reproduction and larval development in the Darx-Zingster Bodden chain. As already reported by Arndt (1991), the biomass of *M. viridis* increased rapidly in the central part of the Bodden area. The author noted wet weights up to 82 g/m² of this species in the Saaler Bodden. Zmudzinsky *et al.* (1993) also describe the spread of this spionid into the south-eastern part of the Baltic Sea. In a recent study Bastrop et al. (1995) investigated the differences between North Sea and Baltic Sea populations. The author noted that the species reproduced at different times in both seas. Enzyme separation by starch gel electrophoresis revealed major differences between specimens from the Baltic Sea and those from the North Sea (collected in 1992 and 1993), but a high degree of homogeneity among populations from the one sea. The identified genetic differences between the two geographically separated populations could be due to environmentally induced selection or genetically different origins of the populations.

Shipworm *Teredo navalis* Linnaeus, 1758 (Bivalvia).

This species is known to occur in coastal waters of the North and Baltic Sea since the beginning of the 1980s probably introduced as fouling organism on ships (Wolff, 1992; Carlton, 1985). The last sampling of wooden installations on the German Baltic coast (Warnemünde) showed that the population of *T. navalis* was not damaged by the extreme heavy winter conditions 1995/96 (Gercken, pers. comm.) like many native species. Nearshore mussel beds of the mussel *Mytilus edulis* and barnacles were eliminated during this extremely cold winter and ice drift. *T. navalis* was well protected inside of its wooden habitat.

Sturgeon

In German coastal areas of the Baltic Sea and North Sea a number of records of non-native sturgeons have been obtained during the past few years. Most of them were reported by fishermen in estuarine and coastal waters. Because of a rescue programme for the native sturgeon (*Acipenser sturio*) which was launched by the society for the protection of this native species, a campaign was started by setting a price for any live specimen that would be reported and delivered to the society during 1994–1995. The first results of this campaign are summarized by Debus (1995 a, b) and Spratte and Rosenthal (1996). A surprisingly high number of records relate to non-native sturgeon species (the location of catch and specification and identification of these specimen are listed in Table 1). In total 79 specimens were found since 1981. Species reported include the Siberian sturgeon (*A. baeri*), the Caspian sturgeon (*A. gÅldenstaedti*), the white sturgeon (*A. transmontanus*, originating from California) and a number of unidentified hybrids. It is believed that most of the records are escapes from earlier imports either for culture in extensive ponds or for grow-out in intensive systems. Most of the fish are imported either as juveniles or eggs. It is believed that the chance to escape from culture facilities is greater for small fish. Although it is assumed that survival conditions for sturgeons in the heavily fished waters of the German Wadden sea is fairly low, it is surprising to see that an increasing number of exotic sturgeons survive until having reached a substantial body weight, indicating that conditions for the native species, once supported by release from a maintained brood stock, may be sufficient to conserve the species. Therefore, the campaign to build a brood stock of native *A. sturio* continues.

Report prepared by Stephan Gollasch and Harald Rosenthal.

Tab. 1 Recorded catches of sturgeons in waters of the German and Dutch North Sea 1981 - 1995.

sample year	area	date	size [m]	weight [kg]	species	source
01 1981	Elbmündung vor Cuxhaven	Mitte November 1981	0,3 Jungstör	?	?	MORAWA 1982
02 1985	Nordsee,Seegebiet von Helgoland	Sommer 1985	2,8	140	A .sturio	ANONYMUS 1985
03 1986	Elbe unterhalb Staustufe Geesthacht	Anfang November 1986	1,1	?	?	EILTS 1987
04 1987 bis 13	Emsmündung	Anfang 1987	ca.0,3 10 Exemplare		A. baeri	ANONYMUS 1987
14 1987	Elbe vor Krautsand	Sommer 1987	0,36	?	?	ANONYMUS 1987
15 1987	Elbe vor Elbhafen Brunsbüttel	Sommer 1987	0,28	?	?	ANONYMUS 1987
16 17 18 19	Deutsche Bucht	Ende 80er Jahre	4 markierte Jungstöre	?	A. sturio A. sturio A. sturio A. sturio	STEINERT1990a, 1990b
20 1989	Deutsche Bucht	Juni 1989	?	?	A. sturio	LAMP 1989, 1990
21 1990	Elbe in Höhe Ostemündung	22.2.1990	0,67	?	?	ANONYMUS 1991
22 1990	Nord-Ostsee-Kanal, Fähre Hochdonn	Mitte Juli 1990	1,02	4,5	?	GORONTZI 1990
23 1992	Merwede, Mündungsarm Rhein in Holland	8.1.1992	0,7	?	A. sturio	VOLZ & DE GROOT 1992
24 1992	„aangevoerd te Scheveningen"	?	0,98	?	A. sturio	TIMMERMANS & MELCHERS 1994
25 1992	Nordsee in Höhe Nordsee Insel Terschelling	25.2.1992	1,35	8,5	A. sturio	STOLZENBURG 1992
26 1992	Schagen-Kolhorn-Kanal	24.4.1992	56	0,69	A. baeri	VOLZ & DE GROOT 1992 TIMMERMANS & MELCHERS 1994
27 1992	Nordsee 15 Meilen westl. von Ijmuiden	4.5.1992	1,25	8	A. sturio	VOLZ & DE GROOT 1992
28 1992	Ketelmeer	4.6.1992	0,27	?	A. ?	VOLZ & DE GROOT 1992
29 1992	nordöstl. Ijsselmeer, Kornwerdersand	23.6.1992	0,2	?	A. gueldenstaedti	TIMMERMANS & MELCHERS 1994
30 1992	Maas bei Belfeld	25.10.1992	0,43	0,25	A. ruthenus	TIMMERMANS & MELCHERS 1994
31 1992	„dak! van garage te Amsterdam"	13.12.1992	0,4	?	A. ?	TIMMERMANS & MELCHERS 1994
32 1992/93 33 34	Elbe	Ende92/Anfang 1993	3 kleinere Störe	?	?	ANONYMUS 1993a
35 1993	„Noordzeekanaal, ADM -haven"	7.2.1993	0,615	?	A. sturio	TIMMERMANS & MELCHERS 1994
36 1993	„1,5 mijl uit kust Kijkduin"	?.5.1992	1,06	9	A. sturio	TIMMERMANS & MELCHERS 1994
37 1993	„tuin! te Dongen"	22.5.1993	0,22	?	A. gueldenstaedti	TIMMERMANS & MELCHERS 1994
38 1993	„Rede van Vlissingen"	2.6.1993	1,35	8,9	A. sturio	TIMMERMANS & MELCHERS 1994
39 1993	„Noordzeekanaal zijkanaal B"	12.6.1993	0,51	?	A. sturio	TIMMERMANS & MELCHERS 1994
40 1993	„tuincentrum 't Oosten Aalsmeer"	?.9.1993	0,35	?	A. sturio	TIMMERMANS & MELCHERS 1994

41	1993	„Balgzandkanaal hengelvangst"	15.9.1993	0,5	?	A. ?	TIMMERMANS & MELCHERS 1994
42	1993	Nordsee südl. von Helgoland	26.10.1993	2,85	142,5	A. sturio	ANONYMUS 1993b, 1993c FRICKE 1994
43	1993	„Amstelmeer"	5.11.1993	0,52	0,5	A. Hybride	TIMMERMANS & MELCHERS 1994
44	1993	„Leeuwen"	12.11.1993	0,64	0,95	A. Hybride	TIMMERMANS & MELCHERS 1994
45	1994	Elbe, Blankenese/ Finkenwerder	27.6.1994	0,66	?	?	ANONYMUS 1994a
46	1994		28.6.1994	40	?	?	ANONYMUS 1994b ANONYMUS 1994c
47	1994	Elbe bei Krautsand	23.5.1994	1,1	?	?	ANONYMUS 1994d
48	1994	Elbe bei Geesthacht	Ende Juni 1994	0,73	?	?	ANONYMUS 1994d
49 50 51	1994	Mittelelbe bei Gorleben	1994	3 Exemplare	?	A. transmontanus	GAUMERT 1995
52	1994	Oste „Hexenbucht"	1994	ca. 1		?	MATTHIES 1995
53 bis 62	1994	deutsche Flußmündungs-gebiete	1994	ca.10 Exemplare	2-3	?	FISCHEREIAMT BREMERHAVEN 1995
63	1995	Elbe , Mühlen-berger Loch	7.6.1995	70-80	?	?	ZEECK 1995
64	1995	Elbe, Mühlenberger Loch	10.6.1995	64	1,35	A. ?	GESELLSCHAFT ZUR RETTUNG DES STÖRS 1995
65	1995	Elbe	1995	?	?	?	ZEECK 1995
66	1995						
67	1995	Elbe unterhalb Geesthacht	Juni 1995	1,2	?	A. baeri	GESELLSCHAFT ZUR RETTUNG DES STÖRS 1995
68	1995	Angelteich bei St. Michaelisdonn	Juni 1995	0,57	0,7	?	GESELLSCHAFT ZUR RETTUNG DES STÖRS 1995
69	1995	Elbe bei Brunsbüttel	15.8.1995	1,05	3,5	Störhybride	GESELLSCHAFT ZUR RETTUNG DES STÖRS 1995
70	1995	Elbe gegenüber Ostemündung	Anfang August 1995	ca.1	?	?	GESELLSCHAFT ZUR RETTUNG DES STÖRS 1995
71	1995	Elbe bei Krautsand	10.9.1995	0,97	3,6	?	GESELLSCHAFT ZUR RETTUNG DES STÖRS 1995
72	1995	Elbe, Stader Sand	Juli 1995	2 kleinere Störe	?	?	LINAU 1995
73							
74	1995	Elbe bei Blankenese	Juli 1995	?	?	?	LINAU 1995
75	1995	untere Hunte	1995	über 1	?	A. baeri	SCHLIE 1995
76	1995	Elbe bei Brunsbüttel	22.12.1995	0,6	?	Störhybride	GESELLSCHAFT ZUR RETTUNG DES STÖRS 1995

NATIONAL REPORT FOR IRELAND

2.0 DELIBERATE RELEASES

2.2 Invertebrates

The abalones *Haliotis discus hannai* and *H. tuberculata* continue to be cultured on west, south-west and south Irish coasts, held in netted barrels in the sea.

The Manila littleneck clam, *Tapes philippinarum*, cultivated from hatchery seed on all Irish coasts. There is no evidence of reproduction.

The oyster *Crassostrea gigas*, all cultivated from hatchery seed imported from Normandy, France and Guernsey. No French oysters from the 1993 importations survive in Ireland.

3.0 ACCIDENTAL INTRODUCTIONS AND TRANSFERS

3.2 Invertebrates

The parasitic copepod *Mytilicola orientalis* established in Dungarvan Bay on the south Irish coast. This species was introduced in Pacific oysters. The copepod reproduced in the bay and infected non-French oysters held in cultivation. In 1995 there was a large mortality (cause unknown) of Pacific oysters in Dungarvan Bay and this is likely to have effects on the population abundance of this gut parasite.

4.0 LIVE IMPORTS

4.1 Fish

Salmon eggs were imported from Denmark (600,000), Norway (350 litres). Tasmania (500,000). Char eggs were imported from Canada (250,000). Juvenile halibut were transferred from the Orkneys (5,000) and juvenile turbot from the Isle of Man (800).

4.2 Invertebrates

Pacific oysters (*Crassostrea gigas)* were imported from the UK (58,450,000) in 84 consignments, from Guernsey (5,686,000) in 22 consignments, from the Orkneys (100,000) one consignment and France (16,000,000) from twelve consignments. Pacific clams (*Tapes japonica)* were imported from the UK (4,460,000) from eight consignments and Guernsey (250,000) three consignments.

Reported prepared by Dan Minchin.

NATIONAL REPORT FOR NORWAY

1.0 Laws and regulations

A proposal for regulation of marine enhancement and ranching has been developed and is now under extensive evaluation. New regulations will be based on a revised version of this proposal and will regulate commercial marine enhancement/ranching in the future.

2.0 Deliberate releases

2.1 Fish

The national programme of coastal salmon (*Salmo salar*) ranching and coastal cod (*Gadus morhua*) enhancement continues, and is now focusing on the collection of reliable recapture information and potential interactions with wild stocks. The programme will be finished in 1997 with an overall evaluation of the future potential for commercial ranching in Norway.

As a part of the programme, small scale release projects using genetically tagged fish (*Salmo salar, Salmo trutta, Gadus morhua*) have been conducted in order to evaluate the potential genetic impact on the wild populations in question.

2.2 Invertebrates

The lobster (*Homarus gammarus*) enhancement project has been carried out as part of the national sea ranching programme. About 30% of legal size lobster catches in the release area (Kvitsoy) is now of hatchery origin. The fraction of released lobster is, however, more than 60% in the under-legal size lobster group, and the catches of hatchery lobster are expected to increase substantially.

The King crab (*Paralithodes camtschatika*) was introduced into the Barent Sea (Murmansk) in 1961–1969 (Kuzmin *et al.*, 1995). Some single individuals were occasionally caught in the fishery, but in 1992 the crab invaded Varangerfjord in northern Norway and caused problems for the net fishermen in the area. A joint Russian/Norwegian investigation programme was established between the Institute of Marine Research (IMR) in Bergen and the Polar Research Institute of Marine Fisheries and Oceanography (PINRO) in Murmansk in order to monitor the development of the King crab stock in the Barents Sea. Initially, the studies were focused on population dynamics and geographic distribution. Fiskeriforsk in Tromso is now studying nutritional aspects and ecological impacts as well.

The recent information available (Kuzmin *et al.*, 1995) is based on a limited commercial trap fishery both in the Russian and Norwegian areas and research surveys conducted be the two institutions. The results indicate rapid increases in King crab abundance and reproduction, and recruitment has been detected in the Varanger fjord system and the Murmansk area. The Barents Sea King crab population seems to be established as a self-sustaining population in the area. Further, there has been observed a western migration, and recent information from 1995 suggests that the King crab is now also established in Tanafjord and Kvaenangen. Some large, single individuals have been observed in the Tromso and Vesteraalen area. The crab is of high commercial value, and there are strong pressure from fishermen to open up a regular fishery, and also to introduce the crab into other areas.

Pacific oysters (*Crassostrea gigas*) were introduced to Norway in 1970 and at present the species is cultivated at only one locality in western Norway.There have been no observations of individuals outside the cultivation facility.

Manila clams (*Tapes philippinarum*) were introduced for cultivation at two localities in 1986. At present, there is no cultivation of this species. At one of the localities, large, mature individuals have been observed in the wild environment. These individual seem to reproduce naturally under wild conditions, but so far no recruitment has been detected.

3.3 Algae and higher plants

Sargassum muticum seem to be established in the southern part of Norway, especially the Skagerak coast. The algae have also been observed on the western coast as north as Hordaland, but the distribution and density of the algae seem to be stabilized.

7.0 Meetings

A NORWAY/UN Conference on Alien Species is being arranged in Trondheim, 1–5 July 1996. The conference will focus on introductions and invited speakers from all over the world will cover different aspects connected with introductions and transfers. The programme so far is dominating by terrestrial examples and the number of participants from each country is limited.

Report prepared by Knut E. Joerstad.

NATIONAL REPORT FOR POLAND

1.0 LAWS AND REGULATIONS

There were no special rules introduced, however, since Poland is preparing for future membership of the EEC the appropriate measures (has to) will be adopted. but the precise date of implementing those EEC standards is still uncertain.

2.0 DELIBERATELY INTRODUCED ANIMALS OR PLANTS

2.1 Fish

467, 000 (1-year) and 658, 000 sea trout smolts also 149, 000 (1-year) and 79, 000 salmon smolts were released into the rivers in northern Poland and the Gdansk Bay.

About 10, 000 whitefish (*Coregonus lavaretus*) fry were released into Szczecin Lagoon and 85, 000 whitefish juveniles origin of Szczecin Lagoon were released into the Puck Bay.

2.2 Invertebrates

None

3.0 ACCIDENTAL INTRODUCTIONS

3.1 Fish

The growing abundance of round goby (*Neogobius melanostomus*) was noted in the Gdansk Bay specially on hard and stone bottom. This fish became more popular among fishermen and anglers. It is sold in commercial quantities in fish market in Gdynia. The fish was probably transferred from the Black Sea (Skora, 1993).

3.2 Invertebrates

The presence of *Gammarus tigrinus* in the Szczecin Lagoon was reported (Gruszka, 1995). This species was found earlier in German part of Szczecin Lagoon and in many canals of the eastern part of Germany.

4.0 LIVE IMPORTS

4.1 Fish

No fish were imported

5.0 LIVE EXPORTS to ICES Member Countries

No species were exported.

6.0 PLANNED INTRODUCTION

6.1 Fish

It is planned further introduction of salmonids and whitefish into Polish coastal waters.

7. MEETINGS, CONFERENCES, SYMPOSIA OR WORKSHOPS

The Polish-Swedish Symposium on Baltic Coastal Fisheries was held in Sea Fisheries Institute in Gdynia aiming among others on issue of eel import and whitefish in Baltic waters.

Symposium on Polish fauna in River Odra estuary was held in the University of Szczecin, September 1995. Poster on *Gammarus tigrinus* (Sexton,1939) Amphipoda, Gammaridae—new species for Polish fauna was presented by J. Gruszka.

Report prepared by W. Pelczarski.

NATIONAL REPORT FOR SWEDEN

1.0 LAWS AND REGULATIONS

GMOs: New regulations concerning the release and use of genetically modified aquatic organisms (FIFS 1995:10) came into force 1 July 1995 [cf. EC Council Directive of April 23, 1990 on the Deliberate Release into the Environment of Genetically Modified Organisms (90/220/EEC)].

Other introductions: In 1994 the Council Directive 91/67/EEC on animal health and aquaculture animals was implemented in regulations from the National Board of Agriculture (SJVFS 1994:94). New regulations on import of aquaculture animals and products thereof (SJVFS 1995:125) came into force in 1995.

According to regulations of the National Board of Fisheries (FIFS 1993:29), concerning the deliberate releases of fish, crayfish and molluscs, and species used in aquaculture, no exotic species or populations thereof may be released or used.

The *1994 ICES Code of Practice* is now being translated into Swedish (in cooperation with Finland).

2.0 DELIBERATE RELEASES

2.1 Fish

Salmon, sea trout; elvers imported from England (Severn)

3.0 ACCIDENTAL INTRODUCTIONS AND TRANSFERS

3.3 Algae and Higher Plants

The Japanese brown alga *Sargassum muticum* was found in 1995 during late summer some kilometers further south in the Göteborg area (Valda Sandö, the northern Kattegat). Along the Swedish Kattegat coast it was also found during the summer of 1995 drifting in large amounts at several localities in the northern and middle part of the province of Halland (I. Wallentinus, personal observation; cf. also Nielsen *et al.* 1995). Still no attached plants were found there, although searched for. A project will be carried out in the summer of 1996, revisiting the localities in Bohuslän, where it was first found in Sweden, to quantify the increase.

Live cysts of the dinoflagellate *Gymnodinium catenatum* occurred abundantly in sediments from several fjords areas in the province of Bohuslän sampled during September 1995, and hatched in laboratory experiments. Still no motile cells have been found in the area. The origin of the cysts is not known (see Persson, 1995; Thorsen *et al.* 1995). Danish studies show that the Scandinavian specimens are not or only slightly toxic in contrast to the PSP- causing blooms in, for example, Spain, Japan and Australia (Ellegard and Oshima, 1996).

3.5 Mammals

Muskrat (*Ondatra zibethica*) were during 1994 found as far south along the Swedish coast of the Gulf of Bothnia as Husum (N Örnsköldsvik) and has during 1995 become established and is spreading further south. (It has also increased in areas around lakes.)

4.0 LIVE IMPORTS

4.1 Fish

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

4.2 Invertebrates

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

4.3 Algae and Higher Plants

None (No information available on imported aquaria plants)

5.0 LIVE EXPORTS To ICES Member Countries

5.1 Fish

Eggs to:

ICES countries		Outside ICES	
Denmark	Salmon	Austria	Arctic charr
Germany	Salmon, Arctic charr	Chile	Rainbow trout
Poland	Trout		

Live eels for consumption to:

Belgium	Hong Kong
Denmark	Japan
Germany	Italy
The Netherlands	

5.2 Invertebrates

Blue mussels (*Mytilus edulis)* to Denmark and The Netherlands

7.0 MEETINGS, Conferences, Symposia or Workshops

International workshop on marine biodiversity 21–25 August 1995, Tjärnö Marine Biological Laboratory, Sweden (arranged by the Swedish Scientific Committee on Biological Diversity)

Norway/UN Conference on Alien Species - The Trondheim Conferences on Biodiversity, 1–5 July 1996.

Report prepared by Bo Holmberg, Kristina Jansson and Inger Wallentinus.

NATIONAL REPORT FOR U.K. ENGLAND AND WALES

1.0 LAWS AND REGULATIONS

Current legislation covering fish and shellfish movement controls is given in the Appendices attached.

2.0 DELIBERATE RELEASES

2.2 Invertebrates

Seed Pacific oysters and Manila clams, from hatcheries in England and Guernsey, were planted out for commercial cultivation. Approximately 500 tonnes of Pacific oysters and 50 tonnes of Manila clams were harvested.

In recent years there has been evidence of light spatfalls of Pacific oysters in British waters (in the estuaries of the Rivers Exe, Teign and Dart, and in the Menai Strait) near to sites of commercial cultivation. Comparisons of their sizes with hatchery oysters suggest that spat settled in 1989 and 1990. The springs and summers of those years were exceptionally warm. There is no evidence that self-sustaining populations have developed, or are likely to in the future (Spencer *et al.*, 1994).

The spat in the River Teign carried three alleles which are not in spat produced by UK commercial hatcheries. However, the alleles are present in French Pacific oysters indicating that there may have been movement of oysters possibly of French origin into this river (Child *et al.*, 1995). When and how this occurred is not known but some possibilities are discussed in the paper.

After reports that the F1 generation of *Crassostrea virginica* reared in France from broodstock introduced from Conwy, UK were infected with *Marteilia* after transfer to the open sea (1995 French National Report), tests were carried out using the few remaining UK stock. No trace of *Marteilia* was found.

3.0 ACCIDENTAL INTRODUCTIONS AND TRANSFERS

3.3 Algae and Higher Plants

Undaria pinnatifida

The presence of attached plants is still confined to the Hamble Estuary in the Solent on the south coast of England (Fletcher and Manfredi, 1995). There is no evidence that it has spread further. In March 1996, a 1-year pilot study was started to monitor this introduced species with respect to further spread, competition with other species, etc. (Fletcher, pers. comm.)

Sargassum muticum

A survey was carried out last year by the Northern Ireland Department of Environment Services to determine the extent of Sargassum in Strangford Lough. Attached plants were found only in the vicinity (within 500 meters) of Pacific oyster trestles on a rocky outcrop that was exposed at low tide. Approximately 2.5 tonnes of *Sargassum* were removed from the shore. However, it was a particularly warm summer and it is possible that further spread may have occurred because it is unlikely that all the plants were removed. Another survey will be carried out in the summer of 1996.

4.0 LIVE IMPORTS

4.1 Fish

Approximately 50 million rainbow trout eggs were imported from disease-free sources, mainly South Africa, Denmark, Northern Ireland, the Isle of Man and Tasmania. Imported eggs were disinfected on arrival. There has been some concern in recent years in maintaining the continuity of supply especially from South Africa and Ireland. The British Trout Industry has been advised to investigate ways for the UK to become self-sufficient in the supply of eggs, e.g. through photoperiod control.

4.2 Invertebrates

Imports of *Crassostrea gigas* came from Southern Ireland (19 imports), Guernsey (5) and Jersey (1). The total weight was 25,647 kg.

5.0 LIVE EXPORTS to ICES Member Countries

5.1 Fish

Approximately 150,000 turbot juveniles were exported for on-growing, principally to Galicia, Spain and around 1,000 halibut juveniles were sent to Scotland for on-growing.

5.2 Invertebrates:

106 consignments of Pacific oyster seed were exported mainly to Southern Ireland (102 consignments) but also to Guernsey (3) and Northern Ireland (1). In addition, there were 6 consignments of Manila clam seed to Southern Ireland and 4 consignments of mussels to Guernsey. The total number of seed animals exported was 107 million.

6.0 PLANNED INTRODUCTIONS

None known

8.0 References Related to Changes to Legislation

a) A Guide to Importing Fish : An explanation of the controls governing the movement of live and dead fish, fish eggs and gametes into and from Great Britain. Ministry of Agriculture, Fisheries and Food, Welsh Office Agriculture Department and Scottish Office Agriculture, Environment and Fisheries Department. October 1995.

b) A Guide to Shellfish Health Controls: An explanation of the controls governing the movement of shellfish, their eggs and gametes into, from and within Great Britain. Ministry of Agriculture, Fisheries and Food, Welsh Office Agriculture Department and Scottish Office Agriculture, Environment and Fisheries Department. February 1996.

Report prepared by S.D.Utting.

LEGISLATION COVERING SHELLFISH MOVEMENT CONTROLS

The legislation governing the controls explained in this booklet is set out below. Copies may be purchased from Her Majesty's Stationery Office or through booksellers.

Movements of live shellfish, eggs and gametes to Great Britain from elsewhere in the EU

The Fish Health Regulations 1992 (SI 1992 No 3300) as amended by
The Fish Health (Amendment) Regulations 1993 (SI 1993 No 2255);
The Fish Health (Amendment) Regulations 1994 (SI 1994 No 1448); and
The Fish Health (Amendment) Regulations 1995 (SI 1995 No 886)

These Regulations implement Council Directive 91/67/EEC and control the movement into Great Britain, from elsewhere in the EU, of all live molluscan shellfish, their eggs and gametes.

They also implement the EU rules on marketing, transport and identification of shellfish and shellfish products (set out in Section 1).

The Animals and Animal Products (Import and Export) Regulations 1995 (SI 1995 No 2428)

These Regulations implement Council Directive 90/425/EEC regarding veterinary inspections of consignments in trade within the EU.

Imports of live shellfish, eggs and gametes into Great Britain from outside the EU

The Shellfish and Specified Fish (Third Country Imports) Order 1992 (SI 1992 No 3301)

This Order controls the import into Great Britain from non-EU countries of all live molluscan and crustacean shellfish and their eggs and gametes.

The Animals and Animal Products (Import and Export) Regulations 1995 (SI 1995 No 2428)

The Products of Animal Origin (Import and Export) Regulations 1992 (SI 1992 No 3298)

These two sets of Regulations implement EU Directives regarding veterinary inspections of consignments.

Controls on deposits of Molluscan Shellfish in Great Britain

The Fish Health Regulations 1992 (SI 1992 No 3300) as amended by
The Fish Health (Amendment) Regulations 1993 (SI 1993 No 2255);
The Fish Health (Amendment) Regulations 1994 (SI 1994 No 1448); and
The Fish Health (Amendment) Regulations 1995 (SI 1995 No 886)

These Regulations require persons to obtain consent before molluscan shellfish, taken from a "Restricted Zone", may be deposited, re-laid or immersed elsewhere in Great Britain.

Controls on deposits of lobsters in Great Britain

The Lobsters (Control of Deposit) Order 1981 (SI 1981 No 994)

This order requires all deposits of lobsters (alive or dead) in coastal zones of Great Britain to be licensed.

The Lobsters (Control of Importation) Order 1981 (SI 1981 No 995)

This order makes it an offence to bring lobsters (alive or dead) into coastal zones of Great Britain if it would be illegal to deposit that lobster in the area concerned.

LEGISLATION COVERING FISH MOVEMENT CONTROLS

e legislation governing the controls explained in s booklet is set out below. Copies may be rchased from Her Majesty's Stationery Office or ·ough booksellers.

'ovements of live fish, eggs and gametes to Great Britain from elsewhere in the EU

ıe **Fish Health Regulations 1992** (SI 1992 No ;00) as amended by·
he **Fish Health (Amendment) Regulations 1993** ·I 1993 No 2255),
he **Fish Health (Amendment) Regulations 1994** ;I 1994 No 1448) and
he **Fish Health (Amendment) Regulations 1995** '' 1995 No 886)

hese Regulations implement Council Directive 1/67/EEC and control the movement into Great ritain, from elsewhere in the EU, of:

- all live fish, their eggs and gametes; and
- certain dead fish

'hey also implement the EU rules on marketing, ·ansport and identification of fish and fish products ·eferred to in Section 1).

'he Animals and Animal Products (Import and :xport) Regulations 1995 (SI 1995 No 2428)

:hese Regulations implement Council Directive 0/425/EEC regarding veterinary inspections of .signments in trade within the EU.

Imports of live fish, eggs and gametes into Great Britain from outside the EU

Γhe Diseases of Fish Act 1937

Γhis Act controls the import into Great Britain, from ıon-EU countries, of live fish of the salmon family, :reshwater fish and eggs of these species.

Γhe Shellfish and Specified Fish (Third Country Imports) Order 1992 (SI 1992 No 3301)

This Order controls the import into Great Britain from non-EU countries of:

- all live fish (other than salmonid and freshwater fish) and their eggs and gametes; and
- the gametes of salmonid and freshwater fish.

The Animals and Animal Products (Import and Export) Regulations 1995 (SI 1995 No 2428)

The Products of Animal Origin (Import and Export) Regulations 1992 (SI 1992 No 3298)

These two sets of Regulations implement EU Directives regarding veterinary inspections of consignments.

Imports into Great Britain of certain dead fish and viscera

The Fish Health Regulations 1992 (SI 1992 No 3300) as amended by:
The Fish Health (Amendment) Regulations 1993 (SI 1993 No 2255),
The Fish Health (Amendment) Regulations 1994 (SI 1994 No 1448) and
The Fish Health (Amendment) Regulations 1995 (SI 1995 No 886)

These Regulations restrict movements of certain dead fish into Great Britain from elsewhere in the EU.

The Importation of Salmonid Viscera Order 1986 (SI 1986 No 2265)

This Order restricts imports of uneviscerated salmonid fish, and their viscera, from non-EU countries.

The Products of Animal Origin (Import and Export) Regulations 1992 (SI 1992 No 3298)

These Regulations implement EU Directives regarding veterinary inspections of consignments.

LEGISLATION COVERING FISH DISEASE CONTROLS

Legislation governing the controls contained in this booklet is set out below. Copies may be purchased from Her Majesty's Stationery Office or through booksellers.

The Fish Health Regulations 1992 (SI 1992 No 3300) as amended by

The Fish Health (Amendment) Regulations 1993 (SI 1993 No 2255) and

The Fish Health (Amendment) Regulations 1994 (SI 1994 No 1448) and

The Fish Health (Amendment) Regulations 1995 (SI 1995 No 886)

These Regulations implement Council Directive 91/67/EEC and Decisions made under it and control the movement into Great Britain from elsewhere in the EU of

- all live fish their eggs and gametes; and
- certain dead fish

They also implement the EU rules on marketing and transport of fish and certain fish products.

Articles 12 and 13 of 91/67/EEC also make provision for Member States to forward programmes for approval to the Commission to prevent the introduction or spread of certain diseases including IPN, BKD, SVC, gyrodactylosis and furunculosis as set out at List III of Annex A of 91/67/EEC. List III diseases are those which are present in the Union, and which may cause financial losses where they occur, but which can be controlled.

The UK has received EU approval to operate additional guarantees for imports to guard against SVC (Commission Decision 93/44/EEC). This Decision was recently extended by Commission Decision 94/865/EEC to cover an additional 8 species susceptible to the disease in the light of scientific evidence which was gained during the outbreak of SVC which occurred in Great Britain in 1994.

The Diseases of Fish (Control) Regulations 1994 (SI 1994 No 1447)

These Regulations implement the disease control measures which are required on an EU-wide basis where suspicion and/or confirmation of the List I disease ISA, and the List II diseases IHN and VHS occurs.

List I diseases are exotic to the Community, and would have severe economic consequences (for farmed and wild fish stocks) were they to occur. List II diseases, which also have severe economic implications, are present in some parts of the European Union but are exotic to others, including

Great Britain which is an approved zone for both VHS and IHN except for the island of Gigha which is now no longer approved for VHS following an outbreak in 1994.

Should a List I or a List II disease be confirmed in Great Britain, the measures in these Regulations would come into effect.

The Diseases of Fish Act 1937 (amended by the Diseases of Fish Act 1983)

Section 4 of this Act requires the notification of any suspicion of the presence of a notifiable disease to the relevant Minister.

Section 6 provides powers for those appointed as Inspectors under this Act to take samples of any fish, eggs of fish or foodstuffs of fish for testing purposes. Where the presence of disease is suspected, a 30-day notice may be placed on the site, and movements of live fish, eggs of fish and foodstuffs of fish either to or from the site may be controlled for the period of time covered by the notice.

Where the presence of disease is suspected or confirmed, a Designated Area Order (DAO) may be made under Section 2 of the Act, and placed on the site. All movements of live fish and eggs of fish both to and from the designated site are then subject to the prior written consent of the Minister. Any person who knowingly moves fish either to or from a site which is subject to a DAO without this written authorisation, shall be guilty of an offence. Section 2a of the Act allows Ministers to require the removal of dead and dying fish from the waters of a designated site.

The Registration of Fish Farming and Shellfish Farming Businesses Order 1985 (made under the Disease of Fish Act 1983) requires anyone who carries on a business of fish farming to register the business with Fisheries Departments and to keep stocking and movement records.

N.B. 30-day notices may only be placed on sites which constitute the waters of a fish farm or other premises used to keep fish with a view to their sale and transfer to other waters. Other inland waters, such as the waters of a fishery, will be subject to a Designated Area Order should the presence of a notifiable disease be suspected.

The Wildlife and Countryside Act 1981

Section 14 of this Act makes it an offence to release or allow to escape into the wild any animal which is not ordinarily resident in or a regular visitor to the UK, or which is established in the wild and listed in Schedule 9 of the Act, without a licence. Licences to release non-native fish or shellfish are issued by the Ministry of Agriculture, Fisheries and Food. English Nature and the National Rivers Authority are consulted on every application for a licence.

Salmon and Freshwater Fisheries Act 1975

Section 30 of this Act makes it an offence to introduce fish into an inland water without first obtaining the written consent of the National Rivers Authority.

IMPORTS OF LIVE FISH, EGGS OR GAMETES FROM NON-EU COUNTRIES

Species	Product	Purpose	Requirement
Fish of the salmon family	Live fish	Any	Absolutely prohibited
	Eggs or gametes	Any	Licence (DOF 8C)* and health certificate
Grayling Whitefish Pike Turbot	Live fish, eggs or gametes	Any	Licence (DOF 8C)* and health certificate
Koi carp Goldfish	Live fish, eggs or gametes	Any	Licence (DOF 8C)* and health certificate
		Stocking ornamental waters	If from a country not listed below*** licence (DOF 8A)** and a health certificate may be used
Tropical fish (freshwater or marine)	Live fish, eggs or gametes of species unable to survive in GB's natural aquatic environment	For keeping in aquaria	Licence (DOF 8T)** and health certificate
Other freshwater fish	Live fish, eggs or gametes	Any	Licence (DOF 8C)* and health certificate
		Human consumption	Licence (DOF 8B)**
Other marine fish	Live fish, eggs or gametes	Any	Licence (DOF 8C)* and health certificate
		Human consumption	Licence (DOF 8B)**

* These licences will be issued only if the source meets strict health and geographical requirements. They will also normally be valid only for a single consignment.

** These licences will normally be valid for 12 months but, where required, separate health certificates must accompany each consignment.

*** Licence DOF 8C must be used for imports of koi carp and goldfish from the following countries: Albania, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Former Yugoslavian Republic of Macedonia, Georgia, Hungary, Latvia, Lithuania, Moldova, Poland, Romania, Russia, Slovakia, Slovenia, Turkey, Ukraine and Yugoslavia.

Scientific names for species of fish are shown in Appendix 4.

Please note: all imports of fish eggs must be disinfected on arrival.

The above rules apply from 1 December 1995. If you wish to import fish before this date and you are unsure of the rules, please contact the appropriate address given in Appendix 3.

MOVEMENTS TO GREAT BRITAIN* FROM OTHER PARTS OF THE EU: REQUIREMENTS FOR MOVEMENT DOCUMENTS BY FISH SPECIES

There are several different movement documents to meet the different certification requirements for different fish species and origins. The rules are summarised below. If you wish to see copies of the movement documents referred to, or for more details about the rules, please contact one of the addresses shown in Appendix 3. The scientific names for the species mentioned are set out in Appendix 4.

TABLE - LIVE FISH

Species	Acceptable Source(s)	Form of Movement Document		Explanatory notes
		Farmed origin	Wild origin	
GROUP 1 **All species of salmon and trout**	VHS and IHN Approved Zone only	Form A	Form A	These species are susceptible to both VHS and IHN and the movement document covers both diseases.
GROUP 2 **Grayling, Whitefishes Turbot**	VHS Approved Zone only	Forms A and E	Forms A and F	These species are susceptible to VHS and can transfer IHN. Two movement documents are required: one (Form A) covers VHS; the other (Form E or F) guards against transferring IHN.
GROUP 3 **Pike(excluding fry)**	VHS Approved Zone only **In addition**, the fish must come from: (i) an area of the EU where satisfactory control arrangements exist for SVC; or (ii) a source in the EU which has a satisfactory history of SVC testing and introductions	Forms A and E and I	Forms A and F and I	These species are susceptible to VHS and spring viraemia of carp (SVC) and can transfer IHN. Three movement documents are required: one (Form A) covers VHS; the second (Form E or F) guards against IHN; and the third (Form I) covers SVC.
GROUP 4 **Pike (fry only)**	VHS and IHN Approved Zone only **In addition**, the fish must come from: (i) an area of the EU where satisfactory control arrangements exist for SVC; or (ii) a source in the EU which has a satisfactory history of SVC testing and introductions	Forms A and I	Forms A and I	These species are susceptible to IHN, VHS and spring viraemia of carp (SVC). Two movement documents are required: one (Form A) covers IHN and VHS; and the second (Form I) guards against the introduction of SVC.
GROUP 5 **Common carp (all variants including koi) Grass carp, Bighead carp, Silver carp Goldfish, Crucian carp Roach, Rudd, Tench Orfe, Wels catfish**	VHS and IHN Approved Zone; or VHS and IHN Approved Farm; or other farm which: (i) does not hold species in Groups 1, 2 , 3 or 4; and (ii) is not connected to any other waters **In addition**, the fish must come from: (i) an area of the EU where satisfactory control arrangements exist for SVC; or (ii) a source in the EU which has a satisfactory history of SVC testing and introductions	Forms E and I	Forms F and I	These requirements guard against the possible introduction of spring viraemia of carp (SVC) to which these species are susceptible. They also guard against transferring VHS or IHN.
GROUP 6 **Tropical warm water fish intended to be kept permanently in aquaria**	Any	None required	None required	No movement documents are required provided the tropical fish will be kept permanently in aquaria. If any other use is intended, they are subject to the controls set out elsewhere in this table.
GROUP 7 **All other fish species**	VHS and IHN Approved Zone; or VHS and IHN Approved Farm; or other farm which (i) does not hold species in Groups 1, 2, 3 or 4; and (ii) is not connected to any other waters	Form E	Form F	These requirements guard against transferring VHS or IHN.

* Great Britain's approved zones for VHS and IHN

TABLE EGGS AND GAMETES

Species	Acceptable Source(s)	Form of Movement Document		Explanatory Notes
		Farmed origin	Wild origin	
GROUP 1 **All species of salmon and trout**	VHS and IHN Approved Zone	Form A	Form A	These species are susceptible to both VHS and IHN and the movement document covers both diseases.
	VHS and IHN Approved Farm	Form B		
GROUP 2 **Grayling** **Whitefishes** **Turbot**	VHS Approved Zone	Forms A and E	Forms A and F	These species are susceptible to VHS and can transfer IHN. Two movement documents are required: one (Form A or B) covers VHS; the other (Form E or F) guards against transferring IHN.
	VHS Approved Farm	Forms B and E		
GROUP 3 **Pike**	VHS Approved Zone	Forms A and E and I	Forms A and F and I	This species is susceptible to both VHS and spring viraemia of carp (SVC) and can transfer IHN. Three movement documents are required: one (Form A or B) covers VHS; the second (Form I) covers SVC ; the third (Form E or F) guards against transferring IHN
	VHS Approved Farm	Forms B and E and I		
	In addition, the eggs or gametes must come from: (i) an area of the EU where satisfactory control arrangements exist for SVC; or (ii) a source in the EU which has a satisfactory history of SVC testing and introductions			
GROUP 4 **Common carp (all variants including koi), Grass carp Bighead carp, Silver carp, Goldfish, Crucian carp, Roach, Rudd, Tench, Orfe, Wels catfish**	VHS and IHN Approved Zone; or VHS and IHN Approved Farm; or other farm which: (i) does not hold species in Groups 1, 2 or 3; and (ii) is not connected to any other waters **In addition**, the eggs or gametes must come from: (i) an area of the EU where satisfactory control arrangements exist for SVC; or (ii) a source in the EU which has a satisfactory history of SVC testing and introductions	Forms E and I	Forms F and I	These requirements guard against the possible introduction of spring viraemia of carp (SVC) to which these species are susceptible. They also guard against transferring VHS or IHN.
GROUP 5 **All other fish species**	VHS and IHN Approved Zone; or VHS and IHN Approved Farm; or other farm which: (i) does not hold species in Groups 1, 2 or 3; and (ii) is not connected to any other waters	Form E	Form F	These requirements guard against transferring VHS or IHN.

JNCC Report

No. 261

Review of information, policy and legislation on species translocation

J.M. Bullock, K.H. Hodder, S.J. Manchester & M.J. Stevenson

Institute of Terrestrial Ecology
Furzebrook Research Station
Wareham, Dorset
BH20 5AS

1995

A report commissioned by the Joint Nature Conservation Committee as a background for future policy formulation

Further copies of this report can be obtained from:

Species Conservation Branch
Joint Nature Conservation Committee
Monkstone House
City Road
Peterborough PE1 1JY

ISSN 0963-8091

EXECUTIVE SUMMARY

- This report reviews the available information concerning translocations, as background for a future policy statement to be drawn up by the statutory UK conservation agencies (the Joint Nature Conservation Committee, English Nature, Scottish Natural Heritage, the Countryside Council for Wales and the Department of the Environment Northern Ireland).

- Translocations of species for conservation reasons in the UK include reintroduction, population supplementation, sowing and planting for habitat restoration, and relocation of populations and of species assemblages.

- Non-conservation translocations for commercial, amenity and aesthetic reasons are carried out using native and non-native species, and genetically modified organisms.

- Precise definitions of the different types of translocation are given, as well as other important terms used in the review.

- Four subject areas are covered in separate chapters: species native to the UK, species not native to the UK, genetically modified organisms, and species assemblages. The types of translocations carried out within the subject area are reviewed and representative case studies are presented.

- A set of definitions of genetic, species and ecosystem biodiversity are determined, and are used as a framework with which to assess the environmental effects of each type of translocation.

- For all types of translocation, the adverse effects on biodiversity are assessed using the case studies. For conservation translocations, the factors affecting the success and benefits of the translocation are determined as well.

- Existing policies and guidelines of UK and international organisations relating to each type of translocation are summarised and assessed in the light of the reviews of case studies.

- UK and European legislation and international conventions relevant to translocations in the UK are also summarised and possible improvements are suggested which would allow better regulation and amelioration of adverse effects on biodiversity.

- While certain types of translocation are well regulated in the UK (e.g. GMO release, release of non-resident alien animals), others poorly covered by legislative controls are translocation of most native species, release of most alien plants or animals resident in the UK and control of problem alien species.

- Some areas require a revision or coordination of the approach to the regulatory process: GMO releases, translocation of species assemblages, release of non-native species.

- Areas requiring further research are highlighted, and these illustrate a need for more coordinated and structured monitoring and databasing of current and future translocations.

- A major aspect of any translocation must be consideration of the maximum benefit to biodiversity and/or the minimum risk of adverse impacts. It is recommended that project planning and risk and 'benefits' assessment procedures should be carried out before any translocation takes place.

- It is recommended that the formulation of new policy and guidelines by the statutory conservation agencies should involve other UK and international organisations involved in carrying out, advising on, or licensing translocations.

NATIONAL REPORT FOR UNITED STATES OF AMERICA

1.0 LAWS AND REGULATIONS

National

Public Law 101-646, passed in November 1990 for a 5-year period concluding 1995–1996, is now "up" for reauthorization by the U.S. Congress. A new, updated version of the Act was submitted on March 29,1996 by U. S. Senator (Ohio) John Glenn, along with colleagues. The new Act calls for instituting voluntary guidelines for ballast management (encouraging vessels to deballast and reballast on the high seas when it is safe to do so) for all U.S. coast lines, and calls for a good deal of new research on exotic species and on ballast water in particular.

2.0 DELIBERATE RELEASES

2.1 Fish

Salmon releases on the Atlantic coast of the United States

The State of New Hampshire has ceased an active Pacific salmon release program, although returns from earlier releases still occur. Since 1992 chinook salmon (*Oncorhynchus tshawytscha*) returns have been:

Year Captured	Age/Size	From Release of
Fall 1992	2 year old (1)	1990 release
Fall 1993	(no captures)	------
Fall 1994	3 year old (1)	1991 release
Fall 1995	1 male, 76 cm	1992 release
	1 male, 81 cm	1992 release

All fish were taken at the initial release site (fish ladder) on the Lamprey River in the Great Bay Estuary, New Hampshire.

2.3 Algae and Higher Plants

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

"Nori," the Japanese red alga (Rhodophyta) *Porphyra yezoensis*, in the form of a cultivar strain, continues to be cultured in northern Maine for aquaculture purposes. An update report from the aquaculture company, Coastal Plantations International, Inc., is scheduled for presentation at the Gdynia 1996 meeting.

3.0 ACCIDENTAL INTRODUCTIONS AND TRANSFERS

3.1 Fish

(A) European Ruffe *Gymnocephalus cernuus* in the Great Lakes

A major new expansion of the ruffe (first found in the North American Great Lakes in 1986) was discovered in August 1995, when specimens were found in Lake Huron, at the mouth of the Thunder Bay River in Alpena, Michigan. Ships in ballast water regularly move between infested regions of Lake Superior (such as the harbors of Duluth-Superior) and Alpena Bay. For the past several years, the Great Lakes shipping industry has had in place regulations to prevent the uptake of ballast water in regions known to have ruffe populations in Lake Superior. Whether the specimens discovered in Lake Huron represent an established population is not yet known.

(B) Eurasian Round Goby *Neogobius melanostomus* in the Great Lakes

First discovered in North America in 1990 in a small river between Lakes Huron and Lake Erie (see Appendix), the Round Goby began making its appearance in other Lakes only in 1993 (Lakes Michigan and Erie) and in 1995 (Lake Superior). This exotic fish (15 cm individuals are common) can compete with native fish. On the other hand, they are avid consumers of the zebra mussel *Dreissena*.

3.2 Invertebrates

(A) Zebra Mussels *Dreissena polymorpha* and *Dreissena bugensis* in the United States

No significant new extensions of the zebra mussel's range have been reported since 1995. The zebra mussel is now recognized as consisting of two different species in North America, *Dreissena polymorpha* and *Dreissena bugensis* (the latter given the common name of "quagga mussel"). The "Sixth International Zebra Mussel and Other Aquatic Nuisance Species Conference" was held in Michigan in March 1996; the 7th such Conference will be held in January 1997 in New Orleans, Louisiana (see Appendix herein: "International Conference Highlights Growing Aquatic Nuisance Species Problem."

Because of the presumption that the zebra mussel will move west and potentially infest the vast water irrigation and urban supply systems of California, a "Western Zebra Mussel Task Force" has been established as a consortium of 13 midwestern and western states and the Canadian province of Manitoba.

The Ohio Sea Grant College Program (Columbus, Ohio) issued in February a booklet, "Sea Grant Zebra Mussel Update: a 1995 Report of Research, Part 1 of 2".

(B) CRAB INVASIONS

Japanese crab *Hemigrapsus sanguineus* on the US Atlantic Coast

New range expansions of this crab are now reported for 1995–1996: it continues to move north and south. The new northern records are north of Cape Cod, but south of Boston (J. McDermott, personal communication, 1995) and new southern records are northern North Carolina (G. Ruiz, personal communication, 1995). Ecological studies are underway at three institutions: the University of Connecticut at Avery Point, the Smithsonian Environmental Research Center in Edgewater, Maryland, and Franklin and Marshall College in Pennsylvania.

European (green) crab *Carcinus maenas* on the US Pacific Coast

The European shore (green) crab *Carcinus* continues to expand its range in California since its arrival on the Pacific coast of North America in 1989-1990. From its initial epicenter in San Francisco Bay, it has now reached Monterey Bay to the south (Elkhorn Slough; T. Grosholz, personal communication, 1995) and Humboldt Bay to the north (T. Smith, personal communication, 1995). There is great concern relative to its eventual and seemingly inevitable arrival in Puget Sound, the site of extensive shellfish operations. These include the Manila Littleneck Clam (*Venerupis philippinarum*, old name *Tapes japonica*), the Pacific Oyster (*Crassostrea gigas*) and edible mussels (*Mytilus trossulus* and *Mytilus galloprovincialis*). Two papers were published in 1995 on the arrival of *Carcinus* in California (Cohen et al., 1995; Grosholz and Ruiz, 1995). See also in the Appendix (attached) the article,"An Endless Invasion? Green Crabs, New England Invaders, Move West".

Chinese Mitten Crab *Eriocheir sinensis* in San Francisco Bay

The Chinese mitten crab was first found in California in 1992 and brought to the attention of the scientific community in late 1994. A paper on the arrival of *Eriocheir* in California is now in press (Cohen and Carlton, 1996). Unlike the European shore crab *Carcinus, Eriocheir* remains restricted to San Francisco Bay. A graduate student at the University of California, K. Halat, is now studying the ecology and reproduction of the Chinese mitten crab in the Bay (see attached abstract by Halat and Resh,1996). Thousands of small crabs have been discovered in the muddy sloughs of the south bay. *Eriocheir* is considered a new, serious nuisance species in North America, given its potential ability to burrow into river banks and dikes, and to interfere with native decapod populations.

7.0 MEETINGS

In addition to the Sixth International Zebra Mussel Conference noted above (section 3.2), two other meetings were convened in early 1996 on introductions and transfers.

Exotic Species Workshop: Issues Relating to Aquaculture and Biodiversity.
This Workshop was sponsored by the Massachusetts Institute of Technology Sea Grant College Program and was held 8 February 1996 in Boston, Massachusetts. A copy of the book of abstracts is on display.

National Forum on Nonindigenous Aquatic Species

A roundtable forum and discussion group was convened in Washington, D.C. on 22 March, 1996, sponsored by members of the U.S. Congress, to present a series of papers summarizing the status of marine, brackish, and freshwater invasions around the United States. Invasion biologists were invited from the Atlantic, Gulf, Pacific, and Hawaiian coasts of the United States: the gathering was the first, and largest, gathering of most of the active marine invasion research biologists in the U.S. The following day, consisted of an additional workshop on invasion biology held at the Smithsonian Environmental Research Center (see "Ballast Update", above).

8.0 REFERENCES

Release of Two New Monographs on Exotic Species Invasions

Two monographs (display copies will be shown) on invasions were released in 1995 and 1996 in the United States. These studies were called for in 1990 federal legislation, "The Nonindigenous Nuisance Species Control and Prevention Act of 1990":

"The Shipping Study"

James T. Carlton, Donald M. Reid, and Henry van Leeuwen. 1995. Shipping Study. The role of shipping in the introduction of non-indigenous aquatic organisms to the coastal waters of the United States (other than the Great Lakes) and an analysis of control options. The National Sea Grant College Program/Connecticut Sea Grant Project R/ES-6. Department of Transportation, United States Coast Guard, Washington, D.C., and Groton, Connecticut. Report Number CG-D-11-95. Government Accession Number AD-A294809. 213 pages + Appendices A-I (122 pages).

A separate flyer (information sheet) will be distributed as to the availability of this work. Completed in April 1993, the Shipping Study was not released until the spring of 1995 and not generally available before September, 1995. The Shipping Study is a monograph on ballast water and introductions attributed to that vector, with lengthy discussions on selected control and management issues. See Appendix (herein) for a partial summary published in the "Aquatic Exotic News".

"The Biological Study: San Francisco Bay"

Andrew N. Cohen and J.T. Carlton. 1995. Biological Study. Nonindigenous Aquatic Species in a United States Estuary: A Case Study of the Biological Invasions of the San Francisco Bay and Delta. A Report for the United States Fish and Wildlife Service, Washington, D.C., and The National Sea Grant College Program, Connecticut Sea Grant (NOAA Grant Number NA36RG0467). 246 pp. + Appendices.

The title page and Executive Summary of this work will be distributed separately. This study is not yet (as of April 1996) generally or easily available; it is in the process of being assigned a so-called "NTIS" so that it can be ordered via the U. S. government. This is a monographic study of estuarine invasions. More than 210 species of introduced animals and plants are now known from the aquatic environments of the San Francisco Bay and the Delta region. In recent years, one new introduction becomes successfully established once ever 24 week: since 1970, more than 50 non-native species have been collected from this estuarine system. The actual number of invasions may be considerably higher and thus critically underestimated: for example, over 120 species, as examples, are listed that are "cryptogenic"—that is, their status as native vs. introduced is now questionable.

Report prepared by J.T. Carlton.

United States Department of Interior
National Biological Service
Southeastern Biological Science Center

Nonindigenous Aquatic Species Geographic Information System

Background

From the earliest times and for a variety of reasons, humans have transported plants and animals from one ecosystem to another. Once a plant or animal species is released beyond its historic geographic range, it becomes a nonindigenous species. This includes species moved from one region or watershed to another within the United States as well as those transferred from other countries. In some cases, nonindigenous species have been called "exotics" or "transplants." In foreign countries, they are often referred to as "alien" species.

Within the United States alone, humans have intentionally or unintentionally introduced more than 4,500 terrestrial and aquatic species to areas outside their historic ranges.[1] Although many terrestrial introductions are believed to have provided economic and social benefits, almost all intentional aquatic introductions have proven to be mixed blessings.[1,2,3]

Environmental Impacts

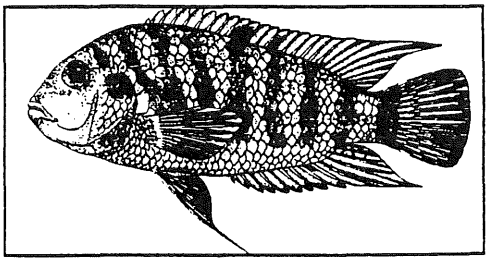
Not surprisingly, many people are unaware of the negative environmental impacts these introductions can produce. For although there has been considerable effort to document beneficial impacts, little has been done to assess the potential for harm, especially at all life stages of the introduced species. To date, no unintentional aquatic introductions have proven to be beneficial.[2] On the contrary, most of them have had detrimental or even catastrophic environmental effects.[1,4]

Through both intentional and unintentional introductions, nonindigenous fishes have become at least temporary residents in nearly every aquatic system in the United States. In many instances, their presence has become permanent. Because complete eradication or exclusion is often neither economically feasible nor socially justifiable,[1] nonindigenous fishes will continue to be components of our nation's aquatic systems. Nevertheless, their interactions within the aquatic community must be monitored and analyzed to ensure that effective, proactive management actions are taken before crisis situations arise.

The Southeastern Biological Science Center

The Southeastern Biological Science Center (SBSC), based in Gainesville, Florida, is part of the National Biological Service (NBS). An agency within the U.S. Department of Interior, the National Biological Service works with others to provide the scientific understanding and technologies needed to support the sound management and conservation of the nation's biological resources.

Since 1978, SBSC has monitored the status and distribution of nonindigenous fish species through reports of nonindigenous fishes taken in open waters of the United States. Information on each introduction is obtained by searching published and unpublished reports; by contacting state and federal agencies, fisheries biologists, ichthyologists, and museum curators; and by searching laboratory and museum collections and computer data bases. To facilitate information transfer, these data are then compiled and entered into an electronic data base.



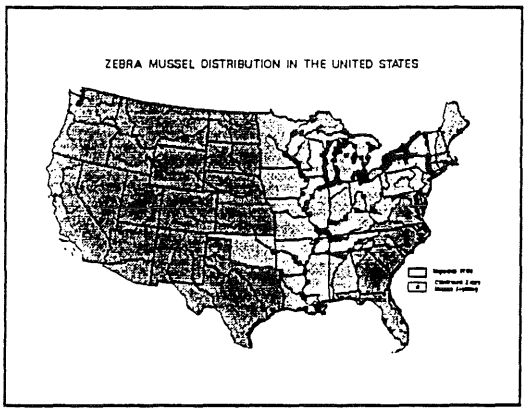
Cichlasoma nigrofasciatum
Convict cichlid

The Data Base for Nonindigenous Fish Species

The data base for nonindigenous fish species includes information on taxonomy, locality, method of collection,

disposition of specimens, and status of the introduction, where known. Each record also includes fields for other pertinent data. Recently, the data base was integrated with Geographic Information System (GIS) technology to facilitate monitoring and mapping of nonindigenous species distributions. Anyone with a computer connected to the Internet may access it.

The current data base contains more than 13,500 records of 454 nonindigenous fish species. This diverse group of 58 families of fishes includes species from every continent except Antarctica. Of the 454 species, 263 (58%) are native to the United States but occur outside their native ranges, while 171 (38%) are native to other countries. Seventy-three of these foreign species have become established.



Additional Data Base Resources

After the 1988 sightings of the pervasive and troublesome zebra mussel in the Great Lakes, NBS was charged with the responsibility for monitoring its distribution. Since 1991, the Southeastern Biological Science Center has included reports that document the dispersal of this nonindigenous aquatic species. The data base now contains information on more than 1,000 spatially referenced zebra mussel locations.

Recently, SBSC has expanded the data base to include distribution records for other mollusk species, amphibians, reptiles, crustaceans, cladocerans, and aquatic plants. With over 30,000 records, this expansion represents another important step in the effective monitoring and control of nonindigenous aquatic species.

Computer Network Services

New technology is being used to distribute this information more effectively. While NBS staff can perform custom queries and provide various types of data products, computer network services facilitate data transfer. Both a World Wide Web server (http://www.nfrcg.gov) and a WAIS wide area information server (192.132.59.1, 1030) are available to anyone with access to the Internet. These servers will accommodate real-time, spatial, and logical data queries. In addition, NBS maintains an archive of standard maps, reports, and data sets, all of which can be retrieved through an anonymous FTP server (ftp.nfrcg.gov).

Literature Cited

1. U.S. Congress, Office of Technology Assessment. Harmful non-indigenous species in the United States. Washington, DC: U.S. Government Printing Office; 1993. OTA-F-565.

2. Steirer FS Jr. Historical perspectives on exotic species. In: DeVoe MR, editor. Introductions and transfers of marine species. South Carolina Sea Grant Consortium; 1992. p 1-4.

3. Courtenay, WR Jr, Williams JD. Dispersal of exotic species from aquaculture sources, with emphasis on freshwater fishes. In: Rosenfield A, Mann R, editors. Dispersal of living organisms into aquatic ecosystems. College Park, MD: Maryland Sea Grant Publication; 1992. p 49-81.

4. Taylor JN, Courtenay WR Jr, McCann JA. Known impacts of exotic fishes in the continental United States. In: Courtenay WR Jr, Stauffer JR Jr, editors. Distribution, biology and management of exotic fishes. Baltimore. MD: The Johns Hopkins University Press; 1984. p 322-373.

For further information regarding nonindigenous aquatic species, contact the National Biological Service, Southeastern Biological Science Center, 7920 NW 71st Street, Gainesville, FL 32653. (904) 378-8181, FAX (904) 378-4956, email nas@nfrcg.gov

Southeastern Biological Science Center - August 1995

Aquatic Exotics News

by the Northeast Sea Grant Network Vol. 2 No. 2 Summer/Fall 1995

National Biological Invasions Shipping Study (NABISS) Published

Marine waters worldwide invaded! Tankers, cargo ships and container ships among culprits! Ballast water contains international mix of aquatic organisms!

The Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 established a "National Ballast Water Control Program," which in turn mandated "Studies on the Introduction of Aquatic Nuisance Species by Vessels." The NABISS was a study sponsored by the U.S. Coast Guard through the Connecticut Sea Grant College Program, to determine the need for controls on vessels entering U.S. waters other than the Great Lakes, to minimize the risk of unintentional introduction and dispersal of aquatic nuisance species in those waters.

This 15-month study, from December 1991 to April 1993, was carried out by Dr. James Carlton, director of the Williams College Maritime Studies Program, based at Mystic Seaport, Mystic, Connecticut, along with two research associates, Donald Reid and Henry van Leeuwen. The researchers assessed ballast patterns in ten major regions of the United States: (1) the Gulf of Maine; (2) the mid Atlantic; (3) the south Atlantic; (4) the eastern Gulf of Mexico; (5) the western Gulf of Mexico; (6) southern California; (7) northern California; (8) the Pacific Northwest; (9) Alaska; and (10) the Hawaiian Islands. They visited 22 ports and boarded vessels in 21 of these. This study involved more than 500 persons in international, national, state, and local agencies, institutions, universities and industry. During the study, the researchers determined actual ballast carried versus ballast capacity, and a wide range of other data on routine ballasting, deballasting, and exchanging operations. They also sought to estimate amounts of ballast water arriving in U.S ports, and its origins.

According to the report, a total of 103 aquatic species have been introduced to or within the United States by ballast water and/or other mechanisms, including 74 foreign species. Sixteen species were introduced into the Great Lakes, and 57 into marine waters. However, since most biological distribution data stems from the 20th century, it is likely that some species considered "native" to certain U.S. waters are, in fact, immigrants of long ago.

Ships are doubly implicated in their role as transporters of aquatic organisms, because organisms can foul the hulls of the ships or be carried in the ballast water used for stabilization. While increase in vessel speed, shorter port calls, use of toxic antifouling paints, and increased frequency of hull clean have all contributed to lessening the role of fouling organisms in invasions, the increased use of ballast water post-World War II has led to an increase of invasions stemming from this vector.

Continued →

Publications Update

Likelihood of invasion of the aquatic exotic zebra mussel, Dreissena polymorpha, into Rhode Island freshwater systems, Publication no. RIU-T-95-002. Rhode Island Sea Grant, University of Rhode Island, Narragansett, RI, 02882

Rhode Island freshwater clams and mussels. Fact sheet no. P-1390, Rhode Island Sea Grant, University of Rhode Island, Narragansett, RI, 02882.

Aquatic Exotic: Sea Grant Resources on Zebra Mussels . Contact Communications Office, UW Sea Grant Institute, 1800 University Avenue, Madison, WI 53705-4094.

The Role of Shipping in the Introduction of Nonindigenous Aquatic Organisms to the Coastal Waters of the United States (other than the Great Lakes) and an Analysis of Control Options. 1995. Carlton, J., D. Reid, and H. van Leeuwen. Available on loan basis from National Sea Grant Depository, Pell Library Building, URI, Narragansett, RI 02882-1197; or through the National Technical Information Service, Springfield, VA 22161. Report No. CG-D-11-95.

• *Connecticut Sea Grant College Program* • *Maine-New Hampshire Joint Sea Grant College Program*
• *Massachusetts Institute of Technology Sea Grant College Program* • *New York Sea Grant Institute*
• *Rhode Island Sea Grant College Program* • *Woods Hole Oceanographic Institution Sea Grant Program*
• *Lake Champlain Basin Program* • *Vermont Department of Environmental Conservation*

Shipping Study *continued...*

A vessel carrying only ballast water is said to be "in ballast." For example, an oil tanker returning to the Persian Gulf from North America may be "in ballast" to the tune of 74 million gallons! A vessel carrying both cargo and ballast water is "with ballast." The amount of ballast water carried can range from 100s of gallons in sailing and fishing vessels to *10s of millions of gallons* in tankers, container and cargo ships.

It gets worse.

Carlton *et al.* have calculated a conservative estimate of the amount of ballast water entering the 226 U.S ports and coastal waters receiving foreign ship traffic, based on 1991 numbers. *How does 21 billion gallons per year strike you?* 58 million gallons per day? 2.4 million gallons per hour? Who says humans don't have a role alongside currents and tides in moving water around globally?

Biological invasions frequently have profound ecological, economic, and social consequences, although not all invasions are "bad." However, it is because of the havoc wrecked by the rotten apples, so to speak—organisms that prey on or compete with native fauna, cause toxic algal blooms, or are parasitic or pathogenic—that there is a pressing need for some controls to be put on ballast water exchange process. Carlton *et al.* note that "the philosophy of ballast water management is similar to the basic philosophy of quarantine science in general: ballast management should seek to prevent the introduction of all organisms; ranging from bacteria and viruses, to higher plants, invertebrates, fish and all other entrained life." They point out though, that no one option or alternative will satisfy this philosophy. It is more likely that a combination of several alternatives will eventually maximize the strength of ballast management.

The researchers examined 32 control alternatives, including prevention of organism uptake (ballasting micromanagement); extermination of organisms upon ballasting; disinfection; microfiltration; ultraviolet, ultrasonics and thermal treatment. Many of these options can be applied to retrofitted or new vessels, but not to existing ones. They propose an **Integrated Ballast Management (IBM)** program as a "stop-gap" management system that incorporates no new technologies, but does incorporate new programs such as the Global Hot Spot Program, establishment of backup exchange zones, and the establishment of biological monitoring laboratories.

Carlton *et al.* summarize by saying that "invasions will continue no matter what type of ballast management system is implemented, now or in the future." However, the goal of a control plan is to reduce the diversity (numbers of species) and abundance (numbers of individuals) of potential colonists; a barometer of its success implementation.

For information on ordering this report, please refer to the Publications Update box on page 1.

Mytilopsis leucophaeata discovered in Connecticut

A population of the dark false mussel was discovered in the Housatonic River, just southwest of the confluence of the Housatonic and Naugatuck Rivers. This euryhaline species, which in its juvenile form resembles zebra mussels, was discovered by Connecticut Department of Environmental Protection scientists conducting a river survey.

Mytilopsis leucophaeata
The "Dark False Mussel"

The small mussels, exhibiting bold striping patterns and byssal threads, were picked up in dredge samples along the western shore of the Housatonic, between O'Sullivan Island and Two Mile Island. This area is tidally -influenced, but salinities generally do not exceed 1-2 parts per thousand. Unlike zebra mussels, this species has limited biofouling tendencies.

After the DEP reported the discovery to Northeast Utilities and Connecticut Sea Grant, the mussels were sent to a number of experts for confirmation of identification, including Chuck O'Neill of New York Sea Grant, Jim Carlton of Williams College, and Doug Smith of University of Massachusetts, Amherst. This is apparently the first live population of the dark false mussel documented in Connecticut, although Smith has found shells of the mussel in the past.

On the Regional Front - Who's Doing What...Where?

Connecticut

It's been pretty quiet on the zebra mussel front in Connecticut this year. The 10-minute video is now being used in 36 states and two Canadian provinces! In addition, it was shown during a southeastern regional teleconference in September, entitled "Zebra Mussels Invade Dixie," downlinked to 120 sites in Florida, Texas, Oklahoma, Arkansas, Tennessee, Louisiana, Mississippi, Alabama, Georgia, and the Carolinas.

Aquatic Exotics. . . .Aquatic Exotics. . . .Aquatic Exotics. . . .

Connecticut Sea Grant contributed information on zebra mussels for an article published in Golf Course News, an industry magazine sent to golf course superintendents across the country.

The Lake Lillinonah Authority, through the efforts of Authority member Len DeJong, now has the voluntary services of six individuals (most of whom are Authority members) to place and inspect zebra mussel samplers throughout the lake next year. Welcome aboard and thank you!

I took part in a western regional zebra mussel conference last May in Denver, giving a talk on introduction and spread prevention policies and serving as co-facilitator of the first western regional task force meeting. The conference, part of the Sea Grant - USDA Zebra Mussel National Training Initiative, drew participants from almost all of the states west of the Mississippi River, indicating their concerns about the potential spread of these mussels. Indeed, during border inspections in California, six boats have been found with clusters of dead zebra mussels on them.

We now have four-color zebra mussel alert cards available, with the infamous "mussel in hand" on the front. If you would like some for distribution in Connecticut, please let me know. (Submitted by Nancy Balcom)

New Hampshire / Maine

Phew! - Another summer has come and gone without any confirmed zebra mussel sightings in New Hampshire or Maine. Meanwhile, outreach efforts plod along. The number of people who can recognize a zebra mussel continues to grow, thanks to the many opportunities to do presentations and display exhibits at teacher workshops, student conservation days, water festivals, and the like. Monitoring was de-emphasized this summer as we reevaluate protocols and strategies. A new batch of STOP the Zebra Mussel brochures and signs arrived hot off the press in early September and are available upon request.

Bob Fawcett of New Hampshire Fish and Game Department continues to spearhead efforts to draft regulations that allow for baitfish import and guard against being a party to introducing zebra mussels into New Hampshire. The draft regulation bans the import of baitfish from states which have water infested with zebra mussels. It allows for the import of baitfish from a hatchery source approved free of zebra mussels except where hatcheries bring in fish from the wild. It bans all imports of baitfish from wild sources not approved zebra mussel free unless there is a treatment process available that is accepted by the scientific community. Whether or not a source is an approved source will be determined by the results of zebra mussel monitoring and/or water chemistry criteria. The heart of the draft regulations are the result of a team effort led by NH Fish and Game Department and include local bait dealers, NH Department of Environmental Services, municipal water suppliers, and UNH Cooperative Extension Sea Grant. Bob anticipates formalizing this regulation in time for next fishing season.

In many ways, the baitfish issue in New Hampshire serves as a model that illustrates the challenges of addressing zebra mussel concerns in a state as yet uninfested. Some might ask why pose any restrictions on local businesses that are only a potential source of a potential problem? I believe the question was best answered during a meeting in June. At the time of an infestation, no one wants to look back and think about what could have been done, yet was not done, to avoid the problem in the first place. Regulation is seldom popular (especially in New Hampshire!), however, when invested parties are involved from the beginning and coming up with a solution that works is the goal, the chances for success increase. NH Fish and Game is committed to do what is within its power to prevent the introduction of zebra mussels to the region. The bait dealers have worked with the agency from the beginning to ensure that any regulations would be reasonable and as unrestrictive to business as possible. UNH Cooperative Extension/Sea Grant provided information about monitoring protocols, water chemistry, treatment research, and strategies from other states. The Department of Environmental Services has agreed to help gather samples for monitoring. Kudos to all involved in the effort! (Submitted by Julia Dahlgren)

Vermont

The Lake Champlain Basin Zebra Mussel Taskforce was formed and met several times already this year. Its members represent concerns in Vermont, New York, Quebec, and Montreal. The co-chairs of the group are Carl Baren, U.S. Fish and Wildlife Service, and Michael Hauser, Vermont Department of Environmental Conservation. At the first meeting in June, the members brain-stormed a list of concerns that included water systems, spread, fishery, economic impacts, ecosystem and biodiversity impacts, endangered species, controls, public perception, funding, and bioaccumulation. From that list, the following general categories were established: funding; public outreach & education; spread prevention; technology development; research; and regulation/recommendations. The taskforce decided that outreach should be the primary focus at this point, especially to raise the awareness of those individuals who stand to be affected immediately. Chuck O'Neill of NY Sea Grant volunteered to hold two workshops on residential intake controls, which drew 245 participants (most from Vermont).

Regional News *continued*

Lake Champlain is still the only water body in New England with zebra mussels. In "South Lake" which is south of Crown Point Bridge, veliger densities range from 35,000 to 110,000 veligers/m^3. Between Thompson's Point and the main lake area west of Burlington, veligers range from 500 to 2,800 veligers/ m3. In the northwest arm between the Gut and Rouses Point, veliger densities increased to 64 to 1,044 veligers/m^3. Veligers have not been found in the northeast arm and Mallett's Bay.

Adult mussels have spread to new areas in the main lake and northwest arm north of Burlington. Adult density surveys will be conducted this fall. (taken from task force minutes provided by Michael Hauser).

New York

The news from New York's marine district is that the public outreach contact, Robert Linck, has left his position to become Associate Director of the Upper Valley Land Trust in Norwich, Vermont, which is a two-state land trust. New York Sea Grant has advertised the position and plans to fill it as soon as possible. We wish Bob the best in his new position, and expect that we'll continue to cross paths in the future.

Aquatic Exotics News

A newsletter to follow the movements of nonindigenous plants and animals, written by and for the Northeastern region of the United States.

Send comments/contributions to:

Nancy Balcom, Editor
Connecticut Sea Grant Marine Advisory Program
University of Connecticut
1084 Shennecossett Rd.
Groton CT 06340-6097

Connecticut Sea Grant Program
Edward C. Monahan, Director
Peg Van Patten, Communications Director
Nancy Balcom, Interim Program Leader
Heather Crawford, Extension Educator
Valerie Cournoyer, Education Coordinator

Sea Grant
Connecticut

Upcoming Conferences

6th International Zebra Mussel Conference, March 5-7, 1996

Michigan Sea Grant will host the 6th International Zebra Mussel and Other Aquatic Nuisance Species Conference in Dearborn, Michigan on March 5-7, 1996. Speakers will discuss the latest field studies and case histories relevant to utilities, industry, agriculture, municipal water treatment facilities, the tourism industry, federal government agencies, and others who rely on waterways that are presently, or at risk of becoming, infected.

For a copy of the preliminary program and a registration form, contact Elizabeth Muckle-Jeffs at 1 -800-868-8776.

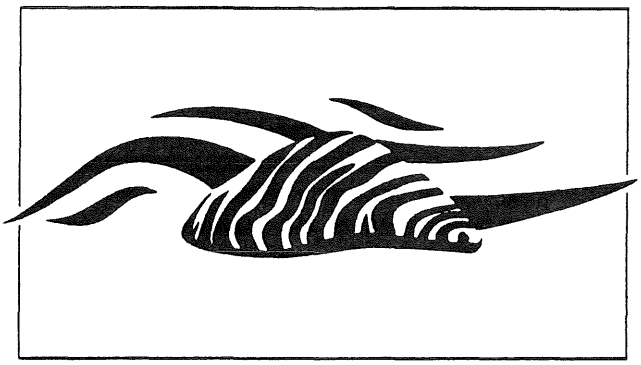
Aquatic Planning Management Society to hold January meeting in Vermont

The Aquatic Plant Management Society, founded in 1961, is an international organization of scientists, educators, students, commercial pesticide applicators, administrators and concerned individuals interested in the study and management of aquatic plants. For the first time in the history of the Society, they will be holding their annual meeting in New England! The meeting will be held at the Radisson Hotel in Burlington, Vermont, from July 14-18, 1996. For more information, contact Holly Crosson, VT DEC, by calling (802) 241-3777.

upwellings
news of the Great Lakes from Michigan Sea Grant College Program
Volume 18 • No. 1 • Winter 1996

International Conference Highlights Growing Aquatic Nuisance Species Problem

Michigan Sea Grant will host over 400 participants at *The Sixth International Zebra Mussel and Other Aquatic Nuisance Species Conference* in Dearborn, Michigan, March 5-7, 1996. Speakers from around the globe will address aquatic nuisance species—what's being done to prevent their spread, problems encountered, educational programs, policy initiatives, and promising research and control methods.



Participants will learn how zebra mussels affect contaminant levels in their environment; what unique methods, such as plant extracts and diaper cream, are being tested for zebra mussel control; and how zebra mussels cause taste and odor problems in drinking water. They will also hear about two new aquatic nuisance fish species in North America—the Eurasian ruffe and round goby; the next freshwater macrofouling mussel that may invade North America; and what the shipping industry is doing to combat future invasions of aquatic nuisance species.

The following is a sampling of over 115 papers to be presented at the conference. Look for the spring issue of *upwellings* to follow up on these and other conference presentations. In addition, a copy of the Conference Final Proceedings will be available in late summer 1996.

Drinking Water Problems

It's not surprising that numerous complaints from residents of Erie County, New York, about the taste and smell of their drinking water coincided with the first infestation of zebra mussels in Lake Erie and the Niagara River. Some scientists believe that the exotic mussel is partly to blame because it contributes to the rapid decomposition of phytoplankton in the drinking water source—increasing production of known odor and taste compounds. Cameron Lange of Acres International will discuss the zebra mussel's role in this process.

Next Mussel to Invade North America?

What will be the next nuisance mussel to hit North America? Anthony Ricciardi, graduate student at McGill University, predicts that the Asian freshwater mollusc *Limnoperna fortunei* (Dunker), known to foul water supply systems in Hong Kong and Thailand, will be arriving here soon. This new species of mussel would likely cause significant economic and ecological impacts if it were introduced into North America. In its native range, *L. fortunei* normally lives at temperatures of 8 to 32 degrees Celsius—limiting its potential range to the southern U.S. While similar to the zebra mussel, *L. fortunei* tolerates slightly lower calcium concentrations and higher temperatures, and thus may invade habitats that provide refuge for endangered native clams. "Like the zebra mussel, this species has a planktonic larval stage, and therefore can spread to other continents in ship ballast water," says Ricciardi. *L. fortunei* recently invaded South America, presumably via shipping traffic between Hong Kong and Argentina.

Mussels Costly Grip on Power Plants

Industries and municipalities have incurred significant damage from zebra mussels and have paid a heavy price for controlling the problem—at least $69 million through 1995. According to two surveys, nuclear power plants have been hardest hit. A Great Lakes Sea Grant Network study reports that 88 percent of such plants in the Great Lakes region have been infested to some degree, while preliminary results of a study conducted by the National Zebra Mussel Clearinghouse indicate that controlling zebra mussel damage at nuclear generating stations in the Great Lakes and Mississippi drainage basin cost an average of $825,000 per plant. Half of the Great Lakes region's industrial process water plants have also been infested. The preliminary cost results will be reported by Charles R. O'Neill of New York Sea Grant. Murari Suvedi of Michigan State University will present the findings on infestation and on the effectiveness of Sea Grant's educational outreach efforts to industries and municipalities.

More Michigan Lakes Have Mussels

Michigan has the dubious distinction of having more inland lakes infested with zebra mussels than any other Great Lakes state. So far, the state has at least 20 known infested lakes compared with seven in Wisconsin and five in Indiana, according to a Sea Grant study conducted by Ladd Johnson of the University of Laval, Quebec, and Clifford Kraft of the University of Wisconsin Sea Grant Institute. Michigan's large number of lakes and rivers close to the initial mussel infestations in Lake Erie and Lake St. Clair and its longer period of exposure are likely reasons, say Jeff Hieb of the University of Wisconsin-Green Bay and Paul Marangelo of the University of Michigan. Hieb and Marangelo will discuss zebra mussels' present and potential patterns of dispersal.

Changes in Contaminant Cycling

Zebra mussels are filter feeders, removing suspended particles from the water column and depositing leftover material into the sediment. This trait enables zebra mussels to transfer contaminants from the water column to their bodies or the sediment. Russell Kreis Jr. of the U.S. EPA studied levels of heavy metals and organic contaminants in zebra mussels from the lower Saginaw Bay in western Lake Huron. Kreis will report how levels of contaminants found in zebra mussels varied depending on levels of contaminants in their surrounding environments—pointing to possible uses of zebra mussels as indicators of environmental quality. Contaminants not absorbed by the mussels are transferred to the sediment. Researcher Chris Marvin of the Ontario Ministry of Environment and Energy studied sediment in eastern Lake Erie, western Lake Ontario, and the Bay of Quinte in the northeast sector of Ontario. Marvin will report changes in nutrients, organic carbon, trace metals, and organic contaminants since zebra mussel colonization.

Baby Bottoms, Boat Bottoms, & Mussels

What could baby bottoms, boat bottoms, and zebra mussels possibly have in common? For several years, European boaters have experimented with diaper cream as a deterrent to keep mussels from attaching to boat hulls. Recent trials in Chesapeake Bay have proven diaper cream is a deterrent to zebra mussel settlement. David Wright and John Magee of the University of Maryland will share their research findings and discuss ongoing efforts to determine the larvicidal properties of the cream.

Plant Extract Tested for Molluscicide

Eino Heitanen, a researcher at the University of Turku in Finland, is testing Endod powder , a natural plant extract, as a possible control for zebra mussels. Tests show that the Endod powder is biologically effective in eliminating zebra mussels in water systems. However, Heitanen says, too few toxicological studies have been conducted to ensure its ecological, occupational and environmental safety over the long term, which prevents Endod from being registered as a molluscicide. He is currently conducting studies using rodents, which show an adverse effect at a dose of Endod lower than required to be effective with zebra mussels.

Gobies Flourish on Diet of Mussels

First discovered in the St. Clair River in 1990, round gobies have made their way through all five of the Great Lakes as freighter stowaways. As large adults, these fish almost exclusively eat mollusks—particularly zebra mussels. As a result, gobies flourish where zebra mussels are abundant. University of Michigan Researcher David Jude will present evidence showing how the ever-expanding goby population may impact native fish species, change food web relationships and other ecological interactions, and how gobies may eventually transfer toxins through the food chain to your dinner plate.

MARYLAND
Research, Education, Outreach
March-April 1996
MARINE NOTES

SPOTLIGHT ON ECOLOGY

AN ENDLESS INVASION?

Green Crabs, New England Intruders, Move West

BY MICHAEL W. FINCHAM

On Martha's Vineyard, the new scallop season opened with high skies, bouncing sunlight and blustery winds but only modest hopes that a good harvest would be had this winter out of the harbors, bays and tidewater ponds of this picturesque island.

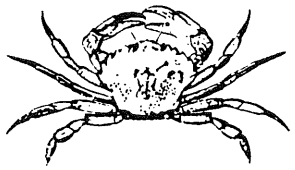
So Mike Picciandra spent this windy first morning fishing for scallops — and in the afternoon he went fishing for green crabs. Picciandra has a daily limit on scallops: as soon as he catches three bushels he has to quit. On a good day he may get $8 a pound for his scallops.

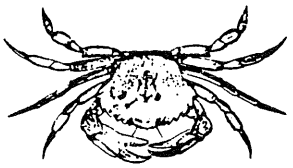
On green crabs, however, he has no season, no limits — just as green crabs have no season, no daily limit on scallops: they keep eating scallops all day, every day. And that's one reason Picciandra goes out after green crabs.

The other reason is money: the green crab is so unpopular up here, it carries a price on its head. "The town puts a bounty on these crabs," he explains, "and I as a bounty hunter, I go out and catch the crabs." He'll only get 40 cents a pound for his green crabs, and most of them will end up on a compost pile, but he reasons that by the end of the day there'll be fewer 40 cent crabs eating up $8 scallops.

Most scallop fishermen think of the green crab as a local pest, but few realize it is actually a transplant from European seas.

Only four years ago, the scallop fleet that motored out of Edgartown harbor on opening day numbered more than 100 boats. This year the winds are so high and the hopes are so low that the "fleet" totals less than 20 boats. For several weeks, Picciandra and other fishermen had been motoring out to Cape Pogue Bay and Edgartown Harbor and Sengekontacket Pond to check on this year's crop, and by opening day the word has gone round the island: another off year for scallops.





An Unwanted Bounty

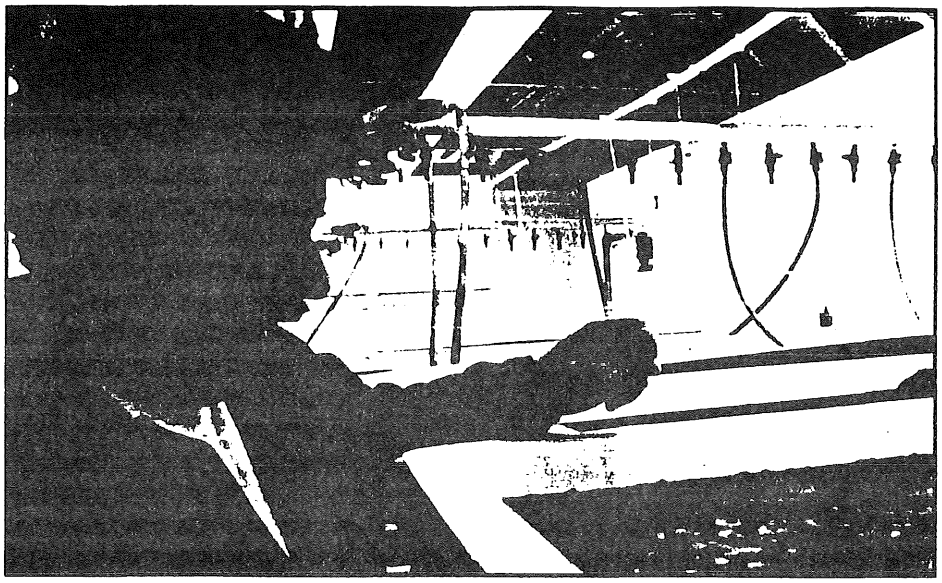
Green crabs are probably not the primary culprit in the scallop decline — but they stand accused as accessories to the crime. Most scallop fishermen think of the green crab as a local pest, but few of them realize this small green predator is an immigrant into these coastal waters, a transplant from European seas like the North Sea and the Baltic.

For marine scientists, green crabs are a prime example of yet another successful invasion of American waters by an exotic species. That makes them an instructive case study for the developing science of "invasion ecology."

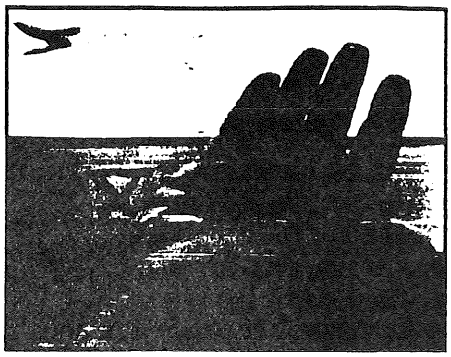
Green crabs may be exotics, but

Continued on page 2

A Maryland Sea Grant Publication



Michael W. Fincham



Michael W. Fincham

Food for crabs or food for people? Paul Bagnall, a shellfish biologist, checks seed scallops at a nursery run by the Martha's Vineyard Shellfish Group. Last year the group planted 600 thousand seed scallops in the harbors, bays and ponds around the island.

Green crabs are probably not the primary culprit in the scallop decline — but they stand accused as accessories to the crime.

Invaders, continued

you catch them much the same way you catch blue crabs, their larger, more popular cousins. Picciandra uses a technique familiar to any Chesapeake Bay waterman: he builds pyramid-shaped wire mesh traps, baits them with fish and sets them in the water attached to crab buoys. Every two or three days, he checks his pots and makes his haul. "I weigh them up, tag them, and then once a week I submit a voucher to the town treasurer and they pay me."

That bounty on the green crab is paid by the town of Edgartown, the scenic village on Martha's Vineyard where Hollywood filmed the blockbuster movie *Jaws* 20 years ago. In that epic, a great white shark slid around eating hapless swimmers and hard-drinking fishermen. In Edgartown today, green crabs are leaving people alone, but they are attacking scallops and other native shellfish.

"Green crabs are a problem in our ponds because they eat soft shell clams, quahogs and oysters — as well as scallops," explains Paul Bagnall, the shellfish biologist for Edgartown and the man responsible for putting a bounty on green crabs. He wants to protect the scallop fishing in Sengekontacket Pond, a two-mile saltwater embayment shared by Edgartown and the neighboring town of Oak Bluffs.

Over the last year, he placed more than a quarter million seed scallops in the pond from the town's small shellfish hatchery. He hopes most of those scallops are caught by fishermen rather than green crabs.

Bounty programs are somewhat controversial as a predator control technique. Proponents like Paul Bagnall make this simple argument: every time you catch a crab, you save a number of scallops, clams and oysters. Opponents to bounties argue that crab populations in a tidewater pond reach a steady state equilibrium. Every time you catch a crab, you simply open up space for another crab to move in. The bounty is wasted money and effort.

The arguments for and against are largely theoretical, the evidence mostly anecdotal. As a result, a number of New England towns have sporadically tried bounties in hopes of protecting their shellfish beds. And most have abandoned them without knowing whether they worked or not.

Good evidence might come from the work of Greg Ruiz, an ecologist who has been setting a lot of traps for green crabs along the Atlantic coastal marshes of Connecticut and along the Pacific coastal bays north of San Francisco. As a graduate student, Ruiz worked with Jim Carlton, one of the country's leading researchers in invasion ecology, and his early research centered on San Francisco Bay, this country's hottest site for invasive exotics. Now with the Smithsonian Environmental Research Center on Maryland's Chesapeake Bay, Ruiz has been studying the history and pattern of green crab immigrations. His question: can we predict the ecological impacts of future invasions?

Claws II

According to Ruiz, there have been two major green crab invasions of American waters: one on the east coast, one on the west coast. The green crabs of Martha's Vineyard are descendants of the first influx that be-

gan more than 150 years ago. Their ancestors reached the Atlantic coast under sail, riding along in the dry ballast of wooden ships or clinging to the mossy crevices of heavily fouled outer hulls.

Those green crabs first found suitable habitat in coastal embayments from New Jersey to Cape Cod. In the early 1900s, they began spreading northwards, ranging up through Maine and the maritime provinces of Canada, all the way to Cape Sable, Nova Scotia. Their arrival in Maine in the 1950s coincided with dramatic declines in the soft clam fishery, setting off an earlier search for predator control strategies.

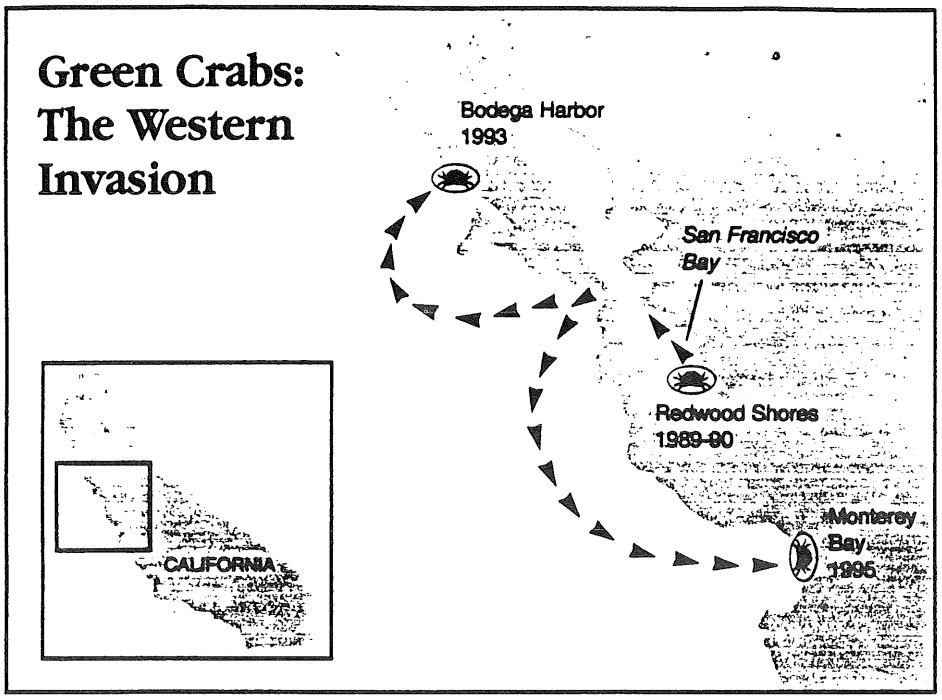
The second great invasion of green crabs was discovered as recently as 1989 in San Francisco Bay. First a fisherman found a large male crab in his gill net. The next summer bait trappers began finding green crabs in lagoons along the west side of the bay. Since scientists were able to track this west coast episode nearly from the start, this second invasion has revealed much more about the green crab's migratory strategy.

These recent immigrants probably arrived as stowaways in the ballast water of big commercial ships hauling televisions, trucks and cars — and the oil to run them. According to Jim Carlton, now an ecologist with Williams College, there are also a number of other less obvious routes. Green crabs, like their ancestors, could also be hanging onto the fouling found in seawater pipes of big ships. Or they could have come west directly from New England, tucked in with the seagrass and kelp used for packing and shipping Maine lobsters and Atlantic bait worms.

On the Western Front

The green crab invasion, according to Ruiz and Carlton, works something like this. Young green crabs thrive best in fairly protected coastal ponds and lagoons and embayments. There they eat molluscs, crustaceans, polychaetes and green algae. Though they have trouble cracking a hard clam, they can dig out soft clams

Continued on page 4



Michael W. Fincham

Mike Picciandra ponders yet another exotic threat. The local name for this immigrant species is Japanese grass, but it is actually an alga (Codium fragile) *that roots itself to the bottom, much like seagrass. It can replace eelgrass beds that scallops like to set on.*

Invaders, continued

buried six inches deep. In these food-rich coves and ponds and marshes they can grow and reproduce in sufficient numbers to create a "beachhead population." On the west coast, green crabs took three years to establish a beachhead in San Francisco Bay.

Their first major foray beyond the Golden Gate came in 1993 when they reached Bodega Harbor 75 miles north. According to Ruiz, it was not grown crabs but crab larvae, offspring of the beachhead crabs, that made the trip, gliding northwards at five miles a day on the current. These excursions probably occurred during short windows of opportunity lasting five to fifteen days when the normal northerly winds die down. Since 1993, green crabs have been building up a new beachhead in Bodega Harbor from where a new crop of larvae can travel north towards Oregon, Washington and Canada.

On the Global Front

As the entire globe becomes a free trade zone and shipping traffic continues to increase, green crabs will invade other estuaries — and so will other species. "What we've seen over the last few decades is really an explosion in the amount of commercial traffic that is bringing in ballast water to different parts of the world," explains Ruiz. "At an any one time, there may be tens of thousands of vessels moving around the world carrying ballast water. The effect has really been to open up a conduit for the transfer of species from one part of the world to another part of the world."

Whether bounty programs work remains an open question. In Edgartown, Paul Bagnall claims his bounty program is helping green crabs, scallops and fishermen coexist. "We have removed over 15,000 pounds of green crabs over the last five months from this pond," he says. "We have reaped the benefit of this by having a scallop harvest up here this year. It isn't the best the pond has ever seen, but there are certainly plenty of nice healthy scallops to be harvested."

Will Edgartown — beset by green crabs and a growing population — ever see great scallop harvests again? Picciandra, for one, says it could happen — but only if the town deals with problems like reseeding, redredging, rising nitrogen levels, spider crabs, green crabs and the influx of yet another non-native species: *Codium fragile*, a bottom-rooting alga that locals call Japanese grass. In many parts of the pond Japanese grass is replacing the eelgrass beds that new scallops like to set on.

Though the threat of more invasions looms large with the approach of every tanker and container ship across the horizon, marine exotics remain a small, nearly invisible blip on the environmental radar screens of most Americans. "Look at the problems it is causing us," laughs Picciandra, the bounty hunter. "I'm killing this green crab for two years, and seeing it all around — and I didn't know that it didn't belong here." ■

SIXTH INTERNATIONAL

Zebra Mussel and Other Aquatic Nuisance Species Conference

Hosted by the Michigan Sea Grant College Program

March 5 to 7, 1996

Hyatt Regency Dearborn, Michigan, USA

The Chinese Mitten Crab *(Eriocheir sinensis)*: Implications for the Freshwater Habitats of the San Francisco Bay and Delta Ecosystem

Kathleen M. Halat and Vincent H. Resh, University of California

The Chinese Mitten crab (*Eriocheir sinensis* H. Milne Edwards) is native to mainland China and coastal areas along the Yellow Sea. It is a catadramous species, living in freshwater for approximately 90% of its life; it returns to the estuaries and ocean only to reproduce and die. The crab has caused numerous problems in Europe where it was introduced in the early 20th century. In Europe, *E. sinensis* has been able to rapidly increase its numbers, and currently occurs at extremely high densities. The burrows that the crabs excavate cause severe destabilization of river banks, leading to accelerated bank erosion. The sharp claws of *E. sinensis* cut up commercial fish nets, increasing operating costs of fishing operations. Because of the severe problems the crab has caused in European waters, *E. sinensis* recently has been listed as a federally injurious species in the United States.

E. sinensis was first captured in shrimping and research trawls in the south portion of San Francisco Bay during the winter of 1993. The number of reproductively active adult *E. sinensis* captured in shrimping trawls has increased steadily since then. For example, over the entire winter of 1993 fewer than 100 *E. sinensis* were collected; in contrast, over 200 individuals were collected in just one trawl taken in late October 1995. Population estimates made in freshwater sloughs of the South Bay during the summer of 1995 indicate that the species has already reached high densities in some area, e.g. as high as 34 burrows/m^2, a level approaching the damage-inducing densities reported from Europe. Accelerated bank erosion caused by crab burrowing is visually evident along a number of sloughs in South San Francisco Bay.

In South Bay freshwater habitats, *E. sinensis* is most common in areas with steep, vegetated banks that are high in clay contents. Burrows are concentrated underneath the root profile of the aquatic macrophytes lining the banks, which mainly consists of *Scirpus*. Analysis of gut contents indicates that the crabs, although omnivorous, mainly eat vegetation. Salinities in the areas where *E. sinensis* has been found range from 0-5 ppt.

We are currently collecting field data to assess the densities and distribution of *E. sinensis* in South San Francisco Bay, along with growth rates and migration patterns of the crab. We have started a series of controlled experiments to determine the effect of burrow placement, burrow density, bank-substrate, and bank-vegetation type on the extent of bank erosion caused by burrows. We plan to model the dynamics of *E. sinensis* populations, incorporating stochastic effects of weather (which influences the amount of freshwater habitat available) and other variables such as burrowing habitat and food resources. Based on the effects of its introduction into European waters, the potential for *E. sinensis* to become a major environmental problem in the freshwater habitats of the San Francisco Bay and Delta is high.

Round gobies invade North America

Produced by the Illinois-Indiana Sea Grant Program in cooperation with the Michigan and Ohio Sea Grant College Programs as IL-IN-SG-95-10.

Authors:
J. E. Marsden
Illinois Natural History Survey
David J. Jude
University of Michigan

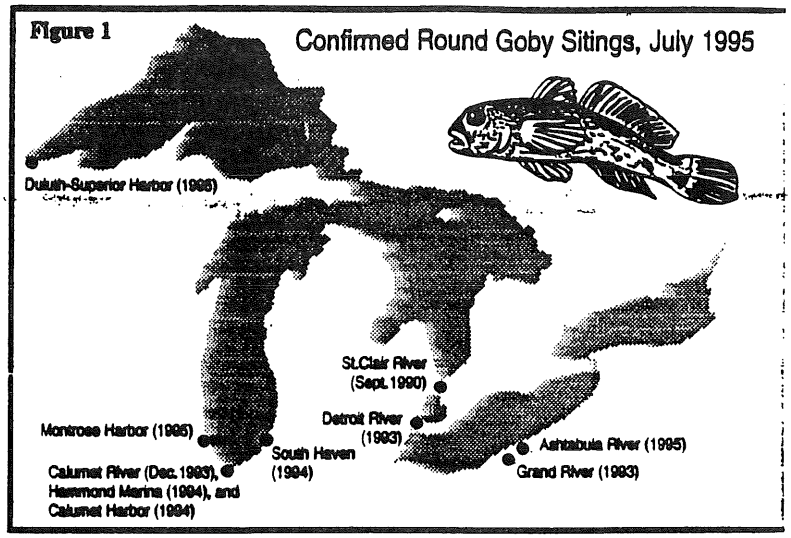
Editors:
Robin G. Goettel
Agnes E. Dillon
Illinois-Indiana Sea Grant

Production and Fulfillment:
Ohio Sea Grant Communications

Reviewers:
Ted Cavender, Museum of Biological Diversity, Columbus, Ohio; Jeff Gunderson, Minnesota Sea Grant, Duluth; Doug Jensen, Minnesota Sea Grant, Duluth; Carey Knight, Ohio Department of Natural Resources, Fairport Harbor; Clifford Kraft, University of Wisconsin Sea Grant Institute, Green Bay; Tom Lauer, Purdue University, W. Lafayette, Indiana; and Dave MacNeill, New York Sea Grant Institute, Brockport.

In the last decade, considerable public and scientific attention has been focused on the zebra mussel, an aquatic invader in the Great Lakes. The zebra mussel actually is a recent addition in a long history of invaders, ranging from rainbow smelt, alewife, and lamprey to the recently introduced ruffe and spiny water flea. Now another foreign species has begun to spread throughout the inland waterways. The round goby *(Neogobius melanostomus)* was discovered in the St. Clair River, the channel connecting Lake Huron and Lake St. Clair, in 1990. This species comes from the same area of the world as the zebra mussel (around the Black and Caspian Seas). Presumably, they arrived the same way as zebra mussels: in ballast water discharged by transoceanic vessels.

Figure 1 Confirmed Round Goby Sitings, July 1995



Although gobies belong to a family of fish with a worldwide distribution in both salt and freshwater, they had not been found in the Great Lakes prior to 1990. A second species, the tubenose goby *(Proterorhinus marmoratus)*, also appeared in the St. Clair River in 1990; but this species, which is endangered in its native habitat, has remained uncommon. The more aggressive, robust round goby underwent a rapid dispersal and population expansion in the St. Clair River and Lake St. Clair. In 1993 it began to spread to other waterways, and the likelihood of its spreading to watersheds such as the Mississippi River drainage system has raised concerns over its potential effects on North American native species and ecosystems.

Exotic species, such as the round goby, have destroyed and disrupted aquatic communities across the nation. The entry of another foreign invader to the already abused Great Lakes environment is an unwelcome addition to the plethora of other problems, including habitat destruction, overfishing, pollution, and loss of native species.

Range and Spread

From 1990 to 1992 round gobies were found only in the areas adjacent to the St. Clair River: Lake St. Clair and in the first 2 km of the upper Detroit River. By 1993 round gobies were found in the Grand River near Cleveland, Ohio (Lake Erie) and in the Grand Calumet River near Chicago, Illinois (Lake Michigan). In August 1994, gobies became well established in the Central Basin of Lake Erie. Also in 1994, gobies were found 12 miles east of the Grand Calumet River at Hammond Marina and at South Haven, Michigan, on the east shore of Lake Michigan. Because the Grand Calumet River is connected to the Mississippi River, round gobies now have access to America's largest watershed. By 1995, they had spread to Duluth-Superior Harbor, in Duluth, Minnesota (Lake Superior), Montrose Harbor north of Chicago (Lake Michigan), and Ashtabula River in Ohio (Lake Erie).

After they reach a new area, gobies are capable of rapid population growth. Densities of gobies in rocky areas at Calumet Harbor already exceed 20 per square meter—equivalent to 20 fish in a space the size of a bathtub. The fish in this harbor range from 12 to 140 mm (0.5 to 5.5 inches) in length, and likely represent two age groups.

Identification

Round gobies are bottom-dwelling fish that perch on rocks and other substrate. They can grow to 250 mm (10 inches) as adults. Gobies have large heads, soft bodies, and dorsal fins lacking spines; they slightly resemble large tadpoles (Figure 1). The gobies' unique feature is their fused pelvic (bottom) fins, which form a suctorial disk. In flowing water habitats, this suction disk aids in anchoring the fish to the substrate. Young round gobies are a solid slate gray; larger individuals have blotches of black and brown over their bodies, and their dorsal fin may be tinged with green.

Round gobies look similar to sculpins, a native, bottom-dwelling fish occasionally caught by anglers. Sculpins *(Cottus bairdi* and *C. cognatus)*, also called muddlers or Miller's thumb, are usually solid brown or mottled. Both sculpins and goby males can appear almost solid black during spawning. Round gobies have a distinctive large black spot on the front dorsal fin; and sculpins often have a dark spot in the same location. Sculpins can most easily be distinguished from gobies by their separate pelvic fins (Figure 2).

Characteristics and Habitat

Round gobies possess four characteristics that make them effective invaders.

1. Round gobies are aggressive, pugnacious fish. They feed voraciously and may eat the eggs and fry of native fish such as sculpins, darters, and logperch. They will aggressively defend spawning sites in rocky habitats, thereby restricting access of native species to prime spawning areas.
2. They have a well-developed sensory system that enhances their ability to detect water movement. This allows them to feed in complete darkness, and gives them a major competitive advantage over native fish in the same habitat.
3. They are robust and are able to survive under degraded water quality conditions. This ability and their propensity to swim into holes and other crevices probably allowed round gobies to enter and survive in the ballast water of ships.
4. Round gobies spawn over a long period during the summer months so they can take advantage of optimal temperature and food conditions. Females mature at 1 to 2 years and males mature at 3 to 4 years. Spawning can occur frequently from April through September. Each female produces from 300 to 5,000 large (4 x 2.2 mm [0.16 x 0.09 inch]) eggs; these eggs are deposited in nests on the tops or undersides of rocks, logs, or cans; they subsequently are guarded by the males.

Round gobies prefer a rocky or gravel habitat; they hide in crevices or actively burrow into gravel when startled. In the Black and Caspian Seas, gobies generally inhabit the nearshore area, although they will migrate to deeper water (up to 60 m [197 feet] depth) in winter. They also are found in rivers and in slightly brackish water. In Europe, the diet of round gobies consists primarily of bivalves (clams and mussels) and large invertebrates, but they also eat fish eggs, small fish, and insect larvae. In the United States, studies have revealed that the diet of round gobies includes insect larvae and zebra mussels.

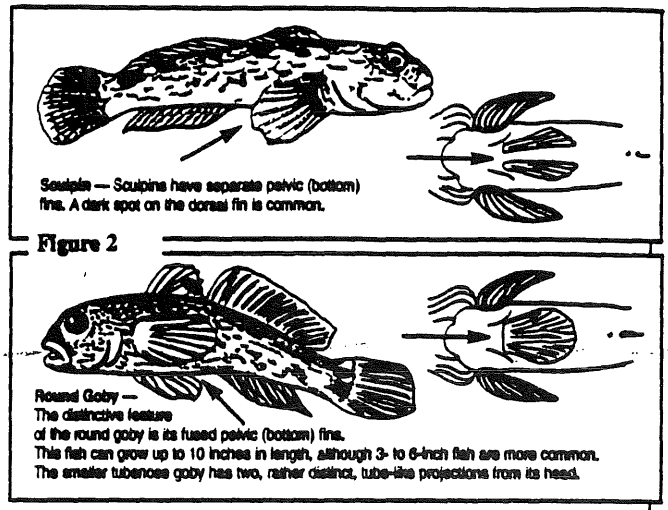


Figure 2

Potential Impacts

Gobies may compete successfully with native benthic fish such as sculpins and darters. Substantial reductions in local populations of sculpins already have been reported from areas in which gobies have become established. Gobies may compete with sculpins for food or drive them from their preferred habitat and spawning area. In laboratory experiments, gobies will eat darters and other small fish. Of perhaps more concern is their predation on the eggs and fry of lake trout, which has been observed in laboratory experiments. The reproduction of the lake trout in the Great Lakes is extremely limited.

On the positive side, round gobies eat large quantities of zebra mussels, an invader that is causing an increasingly large number of problems because of its huge reproductive output. Zebra mussels are an important component of the gobies' diet in their native range; and, in laboratory studies in North America, a single round goby can eat up to 78 zebra mussels a day. However, it is unlikely that gobies alone will have a detectable impact on zebra mussels. The round goby is expected to be one of several species (including ducks, crayfish, diseases, and other fish species) that eventually will reduce the abundance of zebra mussels. Gobies are preyed upon by several sport fish species (e.g., smallmouth and rock bass, walleyes, yellow perch, and brown trout). Because the diet of round gobies consists predominately of zebra mussels, there may be a direct transfer of contaminants from gobies to sport fish.

Gobies affect anglers in several ways. These fish aggressively take bait from hooks. Anglers in the Detroit area have reported that, at times, they can catch only gobies when they are fishing for walleye.

What can be done?

Unfortunately, eliminating a species after it has become established usually is impossible. However, it may be possible to slow the spread of these unwanted species into our waterways. Ballast water exchange is one method of reducing additional introductions of foreign organisms. Ballast dumping regulations within North American waterways may help to prevent the spread of exotic species. Anglers and others can avoid accidentally spreading these species by dumping bait buckets only in areas where they were filled, and by not taking unusual animals home to add to an aquarium. Note: there may be a temptation to take gobies for a home aquarium or home fish pond; however, transportation of gobies or other exotic species across state lines is illegal.

What can you do?

Learn to identify gobies (see illustration that indicates fused pelvic [bottom] fins). To enable biologists to track the spread of round gobies, up-to-date information on new sightings is needed. Your assistance is extremely important. If you catch a round goby outside the areas noted on the map indicating goby range, preserve the fish either in alcohol (grocery store rubbing alcohol is fine) or by freezing it. Then contact your state Sea Grant office, fisheries management agency, or the Illinois Natural History Survey (708/872-8677). Be prepared to describe when and where you caught the fish (the name of the lake or stream, and the nearest town). New sightings can be confirmed only by identification of a captured fish. Verbal reports cannot be used because sculpins can be easily mistaken for gobies.

For other publications, newsletter, conference, and workshop announcements, or for advice from local experts, contact the Sea Grant program or state natural resources-management office nearest you. Phone numbers for the Great Lakes Sea Grant programs follow.

Illinois-Indiana	217/333-9448
Michigan	517/353-9746
Minnesota	218/726-8106
New York	800/285-2285
Ohio	614/292-8949
Wisconsin	608/263-3259

Other Sea Grant programs and other agencies also have information available on this issue.

Publishers and authors can be contacted at the addresses listed here.

Illinois-Indiana Sea Grant Program
Purdue University
1159 Forestry Building
W. Lafayette, IN 47907-1159
Administration
317/494-3573
FAX 317/496-2422
Communications
217/333-9448
FAX 217/333-2614

For large orders of this publication, contact Ohio Sea Grant. Request OHSU-PB-096.

Ohio Sea Grant College Program
The Ohio State University
1314 Kinnear Road
Columbus, OH 43212-1194
614/292-8949
FAX 614/292-4364

Michigan Sea Grant College Program
University of Michigan
2200 Bonisteel Boulevard
Ann Arbor, MI 48109-2099
313/764-1139
FAX 313/747-2748

J. E. Marsden
Illinois Natural History Survey
Lake Michigan Biological Station
400 17th Street
Zion, IL 60099
708/872-8677
FAX 708/872-8679
E-mail:
inhsfish@merle.acns.nwu.edu

David J. Jude
University of Michigan
Center for Great Lakes and Aquatic Sciences
2200 Bonisteel Boulevard
Ann Arbor, MI 48109-2099
313/763-3183
FAX 313/747-2748
E-mail: djude@umich.edu

ANNEX 4

BIBLIOGRAPHY

(Prepared in large part by Dr I. Wallentinus)

Main References

Adlard, R.D. & I. Ernst, 1995. Extended range of the oyster pathogen *Marteilia sydneyi*. Bull. Eur. Ass. Fish Pathol.15: 119-121.

Albaladejo, J.D. & J.R. Arthur, .Some Trichdinids (Protozoa: Ciliophora:Peritrichida) from freshwater fishes imported into the Philippines. Asian Fish. Sci. 3: 1-25.

Ambrose, P., 1996. Mediterranean oysters attacked by US drills. Mar. Poll. Bull. 32:1996.

Andrulewicz, E. & J. Lamp, 1994. Odra/Szczecin Lagoon - spoiled but hopeful green link to the Baltic. WWF Baltic Bulletin 1/94: 29-34

Andrulewicz, E., B.V. Chubarenko & L. Zmudzinski, 1994. Vistula Lagoon - a troubled region with great potential. WWF Baltic Bulletin 1/94: 16-21.

Anonymous. 1995. New Zealand: Importation of marine fish for bait. The Fish Inspector 32:4.

Anonymous. 1995. Deep concern among Baltic marine biologists about NEMOs and GMOs. WWF Baltic Bulletin 4-5/95: 15-17.

Anonymous. 1995. Mediterranean toxic algae growth fears. Fish Farming International 22(2): p. 40.

Anonymous. 1996. Action Plan for Biological Diversity. SEPA Report 4567. Swedish Environmental Protection Agency, Stockholm. 144 pp. ISBN 91-620-4567-9.

Balcom, N., Editor, 1995. Proceedings of the Northeast Conference on Non-Indigenous Aquatic Nuisance Species. Publication Number CT-SG-95-04, Connecticut Sea Grant College Program, University of Connecticut, Groton CT, 89 pp.

Carlton, J. T. 1995. Exotic species update: are ballast water regulations working? Focus (International Joint Commission, Washington, D.C.), 20(1): 8-9.

Bartley, D. & Minchin, D.(1996, in press) Precautionary approach to the introduction and transfer of aquatic species. FAO Technical Rept.

Bastrop, R., M. Rohner, and K. Jurss. 1995. Are there two species of the polychaete genus *Marenzelleria* in Europe? Marine Biology 121: 509-516.

Beukema, J.J. & R. Dekker, 1995. Dynamics and growth of a recent invader into European coastal waters: The American razor clam, *Ensis directus*. J. mar. biol. Ass. U.K. 75: 351-362.

Blanchard, M., 1995. Origine et état de la population de *Crepidula fornicata* (Gastropoda Prosobranchia) sur le littoral français. Haliotis 24: 75-86.

Boudouresque, C.F., Briand, F., Nolan, C. (eds),1994. Introduced species in European Coastal Waters. Europ. Comm. EUR15309. Ecosystems Res. Rep. 8: 1-111.

Buttermore, R.E., E. Turner & M.G. Morrice,1994. The introduced Northern Pacific seastar *Asterias amurensis* in Tasmania. Mem. Queensland Mus. 36: 21 -25.

Carlton, J. T. Carlton. 1995. Marine invasions and the preservation of coastal diversity. Endangered Species Update (School of Natural Resources, The University of Michigan), 12(4/5): 1-3.

Carlton, J. T. 1995. Ballast Water: The Ecological Roulette of Marine Biological Invasions. Open Lecture in the General Assembly, Thursday 21 September 1995, 10.00, International Council for the Exploration of the Sea

(ICES) 1995 Annual Science Conference (83rd Statutory Meeting), Aalborg, Denmark, 7 pp. [Photocopied text of lecture distributed at Conference]

Carlton, J. T. \1995. Exotic species in the sea: Biological invasions and marine biodiversity. UNESCO IMS Newsletter (International Marine Science), Paris, Nos. 75/76: 11-12, 14.

Carlton, J. T. 1995. Four species of marine crabs invade North America. Aliens, No. 2, pp.5-6. Newsletter of the Invasive Species Specialist Group of the IUCN Species Survival Commission]. Centre for Conservation Biology, School of Environmental and Marine Sciences, University of Auckland, Auckland, New Zealand.

Carlton, J. T. 1996. Marine bioinvasions: the alteration of marine ecosystems by nonindigenous species. Oceanography 9(1).

Carlton, J. T. 1996. Pattern, process, and prediction in marine invasion ecology. Biological Conservation, Special Issue, in press.

Carlton, J. T. 1996. Biological invasions and cryptogenic species. Ecology, in press [Fall 1996]

Carlton, J. T. and R. Mann. 1996. Transfers and world-wide introductions, Chapter 20, pp. 687-702, in: Victor S. Kennedy, Roger I.E. Newell, and Albert F. Eble, editors, The Eastern Oyster: Crassostrea virginica. Maryland Sea Grant, College Park, Maryland, 772 pp.

Carlton, J. T., Donald M. Reid, and Henry van Leeuwen. 1995. Shipping Study. The role of shipping in the introduction of non-indigenous aquatic organisms to the coastal waters of the United States (other than the Great Lakes) and an analysis of control options. The National Sea Grant College Program/Connecticut Sea Grant Project R/ES-6. Department of Transportation, United States Coast Guard, Washington, D.C. and Groton, Connecticut. Report Number CG-D-11-95. Government Accession Number AD-A294809. 213 pages and Appendices A-I (122 pages).

Carlton, J.T., G. M. Ruiz, L. D.Smith, and A. Hines. 1995. Ballast water. Aliens, No. 1, pp. 18-19. [Newsletter of the Invasive Species Specialist Group of the IUCN Species Survival Commission]. Centre for Conservation Biology, School of Environmental and Marine Sciences, University of Auckland, Auckland, New Zealand.

Child, A.R., Papageorgiou, P. & Beaumont, A. R., 1995. Pacific oysters *Crassostrea gigas* (Thunberg) of possible French origin in natural spat in the British Isles. Aquatic Conservation: Marine and Freshwater Ecosystems, Vol. 5, 173-177.

Cohen, A. N. and J. T. Carlton. 1995. Biological Study. Nonindigenous Aquatic Species in a United States Estuary: A Case Study of the Biological Invasions of the San Francisco Bay and Delta. A Report for the United States Fish and Wildlife Service, Washington, D.C., and The National Sea Grant College Program, Connecticut Sea Grant (NOAA Grant Number NA36RG0467), 246 pp. + Appendices.

Cohen, A. N., J. T. Carlton, and M. C. Fountain. 1995. Introduction, dispersal and potential impacts of the green crab *Carcinus maenas* in San Francisco Bay, California. Marine Biology 122: 225-237.

Dahl, J.A, D.M Graham, R. Dermott, O.E. Johannsson, E.S. Millard and D.D. Myles. 1995. Lake Erie 1993, western, west central and eastern basins: Change in trophic status, and assessment of the abundance, biomass and production of the lower trophic levels. Can. Tech. Rept. Fish. Aquat. Sci. No. 2070.

Debus, L. 1995. Historic and recent distribution of *Acipenser sturio* in the North Sea and the Baltic Sea. Proc. Int. Sturgeon Symp. VNIRO Publ. pp. 189-203.

De Grave, S., Xie, Q. Casey, D., 1995. The intensity of infestation by the intestinal copepod, *Mytilicola orientalis*, does not affect the condition of Pacific oysters (*Crassostrea gigas*). Bull. Eur. Ass. Fish Pathol., 15: 129 - 131.

Ellegard M. & Y. Oshima, 1995. The dinoflagellate *Gymnodinium catenatum* Graham 1943 (Dinophyceae) from sediments in northern Europe. 7th Intern. Conf. Toxic Phytoplankton, July 12-16, 1995, Sendai Japan. Abstracts p. 63.

Gerasimova, O. and Kuzmin, S. 1995. Some peculiarities of reproduction of King crab *Paralithodes camtschatika* (Til.) in the Barents Sea. Int. Coun. Explor. Sea. C.M. 1995/K:29.

Gollasch, S., and K. Riemann-Zurneck. 1996. Transoceanic dispersal of benthic macrofauna: *Haliplanella luciae* (Verrill, 1898) (Anthozoa: Actiniaria) found on a ship's hull in a shipyard dock in Hamburg Harbour, Germany. Helgolander Meeresuntersuchungen 50: 253-258.

Hellberg, H. 1995. Främmande arter på vift. [Aliens on the move]. Miljöaktuellt 4/95. (In Swedish).

Hägerhäll, B. 1995. Global focus on coastal and marine biodiversity. WWF Baltic Bulletin 4- 5/95: 10-14.

Hedlund, L., Hägerhäll, B., Johannesson, K. (eds.). 1995. Biodiversity and Sustainable Use of Coastal Waters. Report from a workshop 21 - 25 August 1995, Tjärnö Marine Biological Laboratory, Sweden. Swedish Scientific Committee on Biological Diversity, Discussion paper no 2, November 1995. Swedish Museum of Natural History, Stockholm. 47 pp.

Holmes, J.M.C. & Minchin, D., 1995. Two exotic copepods imported into Ireland with the Pacific oyster *Crassostrea gigas* (Thunberg). Ir. Nat. J., 25: 17-20.

Howard, A. E. The possibility of long distance transmission of *Bonamia* by fouling on boat hulls. Eur. Ass. Fish Pathol. 14(6): 212.

Jenkins, P. T. 1996. Free trade and exotic species introductions. Conservation Biology 10: 300-302. (And reply by D. W. Yu: New factors in free traded: reply to Jenkins). CB 10:303-304.

Johnson, L. E. and J. T. Carlton. 1996. Post-establishment spread in large-scale invasions: the relative roles of leading natural and human-mediated dispersal mechanisms of the zebra mussel Dreissena polymorpha. Ecology, in press [Fall 1996]

Kuzmin, S. and S. Olsen. 1994. Barents Sea King Crab (*Paralithodes camtschatica)* : the transplantation experiments were successful. ICES Shellfish Committee C.M.1994/K:12.

Kuzmin, S., Olsen, S. and Gerasimova, O. 1995. Barents Sea King Crab (*Paralithodes camtschatika*): The transplantation were successful. International Symposium, Anchorage, October, 1995.

Landsberg, J.H., K.A. Steidinger & B.A. Blakesley, 1995. Fish-killing dinoflagellates in a tropical marine aquarium. In: Lassus, P., G. Arzul, E.Erard, P. Gentien & C. Marcaillou (eds) Harmful marine algal blooms. Proc 6th Intern. Conf. Toxic Marine Phytoplankton, October 1993, Nantes, France. Technique & Documentation, Lavoisier, pp. 65-70.

Leppäkoski, E. & Rahkonen, R. 1995. Främmande arter i kända vatten [Alien species in well-known waters]. Fiskeritidskrift for Finland 1/1996, p. 22-25. (in Swedish)

Leppäkoski, E. & Rahkonen, R. 1996. Itämeren tulokaslajit - ekologista rulettia? [Introduced species in the Baltic Sea - an ecological roulette?]- Suomen Kalastuslehti 1/1996, p. 4-7. (in Finnish)

Mackenzie, D., 1996. Can we make supersalmon safe? New Scientist. 27 Jan. 1996: 14-15.

Matern, S. A. and K. J. Fleming. 1995. Invasion of a third Asian goby, *Tridentiger bifasiatus*, into California. California Fish and Game 81(2): 71-76.

Minchin, D., (in preparation) Hazard assessment on the introduction of the Japanese scallop *Patinopecten yessoensis* to Irish waters. ICES Co-op. Res. Rept.

Minchin, D., (in press) Management of the introduction and transfers of marine molluscs. 25th Annual Symposium of the Estuarine and Coastal Sciences Association.

Minchin, D., McGrath, D. & Duggan, C.B. 1995. The slipper limpet *Crepidula fornicata* (L.) in Irish waters with a review of its occurrence in the north-east Atlantic. J. Conch., London., 35(5): 297-301.

Minchin, D. & Sheehan, J., 1995. The significance of ballast water in the introduction of exotic marine organisms to Cork Harbour, Ireland. ICES CM 1995/O:1, 15pp.

Montes, J., M.A. Longa & A. Lama, 1996. Prevalence of *Bonamia ostrae* in Galicia (NW Spain) during 1994. Bull.Eur. Ass. Fish Pathol. 16: 27-29.

Morrice, M.G., 1995. The distribution and ecology of the introduced Northern Pacific seastar, *Asterias amurensis* (Lütken), in Tasmania. Final Rep. Austral. Nature Conserv. Agency, Feral Pests Prog. 35. Tasmanian Museum and Art Gallery, 70 pp.Nielsen, R., Aa. Kristiansen, L. Mathiesen & H. Mathiesen (eds), 1995. Distributional index of the benthic macroalgae of the Baltic sea area. Acta Bot. Fennica 155; 1-51.

Norkko, A., M. Enberg & E. Bonsdorff 1995. Occurrence and population dynamics of the polychaete *Marenzelleria viridis* (Verrill) in the Tvärminne area, Gulf of Finland. Tvärminne Studies 6: 41 (Abstract).

Ojaveer, H. and A. Lumberg. 1995. On the role of *Cercopagis (Cercopagis) pengoi* (Ostroumov) in Parnu Bay and the NE part of the Gulf of Riga ecosystem. Proc. Estonian Acad. Sci. Ecol. 5 (1/2): 20-25.

Orlov, Yu. I. and B. G. Ivanov. 1978. On the introduction of the Kamchatka King Crab *Paralithodes camtschatica* (Decapoda: Anomura: Lithodidae) into the Barents Sea. Mar. Biol. 48: 373-375.

Patz, J. A., P. R. Epstein, T. A. Burke, and J. M. Balbus. 1996. Global climate change and emerging infectious diseases. J. American Medical Assoc. 275(3): 217-223.

Persson, A. 1995. Värmetolerans hos dinoflagellatcystor isolerade från svenska västkusten. [Heat tolerance in cysts of dinoflagellates isolated from the Swedish west coast]. M Sc thesis, Dept Marine botany, Göteborg univ., 14 pp.

Radziejewska, T., 1994. Scientific cooperation needed in Pomeranian Bay. WWF Baltic Bulletin 1/94: 40-41.

Ruiz, G. M., A. H. Hines, L. D. Smith, and J. T. Carlton. 1995. An historical perspective on invasions of North American waters by nonindigenous species. ANS (Aquatic Nuisance Species) Digest, 1(1): 1, 11. Published by the Freshwater Foundation, Wayzata, Minnesota.

Salemaa, H. & V. Hietalahti 1195. *Hemimysis anomala* G. O. Sars (Crustacea, Mysidacea) - new mysid species in the northern Baltic Sea. Tvärminne Studies 6: 12-13 (Abstract).

Skóra, K.E., Stolarski, J., 1995. Round goby- a fishy invader. WWF Baltic Bulletin 1/95:

Spencer, B.E., Edwards, D.B. Kaiser, M.J., & C. A. Richardson. 1994. Spatfalls of the non-native Pacific oyster, *Crassostrea gigas*, in British waters. Aquatic conservation: Marine and Freshwater Ecosystems, Vol. 4, 203-217.

Stigzelius, J., A. Laine, J. Rissanen, A.-B. Andersin & E. Ilus 1995. The introduction of the North American polychaete *Marenzelleria viridis* (Verrill) into the Gulf of Finland and the Bothnian Sea. Tvärminne Studies 6: 40-41 (Abstract).

Thorsen, T.A., B. Dale & K. Nordberg,1995. 'Blooms' of the toxic dinoflagellate *Gymnodinium catenatum* as evidence of climatic fluctuations in the late Holocene of southwestern Scandinavia. The Holocene 5: 435-446.

Tømmerås, B.Å. (ed.), 1994. Introductions of alien organisms to Norway. NINA utredning 62:1-1412. Norsk Inst. for Naturforskning, Oslo. (In Norwegian with English summary).

Turkkila, A.-M. & J. Rissanen 1995. The ecology of Polychaeta *Marenzelleria viridis* (Verrill, 1873) in the Tvärminne area. Tvärminne Studies 6: 41-42 (Abstract).

Zaranko, D.T., D.G. Farara, and F.G. Thompson. 1996. Another exotic species in the Great Lakes: the New Zealand Gastropod *Potamopyrgus antipodarum* (Hydrobiidae) in Lake Ontario. Submitted to Can. J. Fish. Aquat. Sci.

Sargassum muticum

Aguilar-Rosas, R., A. Machado-Galindo & L.E.Aguilar-Rosas, 1994. Morphologic and reproductive variation of *Sargassum muticum* (Yendo) Fensholt on the northwestern coast of Baja California, Mexico. Abstracts, Fifth Intern. Phycol. Congr. 26 June to 2 July, 1994, EMBL,Inst. Oceanol., Chin. Acad. Sci., Qingdao, Shandong, P.R. China. p. 35(Abstract)

Arenas, F., C. Fernández, J.M. Ricoo, E.Fernandez & D. Haya, 1995/in press. Growth and reproductive strategies of Sargassum *muticum* (Yendo) Fensholt and *Cystoseira nodicaulis*(Whit.) Roberts. Sci mar.

Boaden, P.J.S., 1995. The adventive seaweed *Sargassum muticum* (Yendo) Fensholt in Strangford Lough, Northern Ireland.Ir. Nat. J. 25: 111-113.

Curiel, D., A. Rismondo, M. Marzocchi & A. Solazzi, 1996. Distribuzione di*Sargassum muticum* (Yendo) Fensholt (Phaeophyta) in Laguna di Venezia.Aqua-Aria 8 (in press).

Viejo, R.M., J. Arrontes & N.L. Andrew, 1995. An experimental evaluation of the effect of wave action on the distribution of Sargassum *muticum* in northern Spain. Bot. mar. 38: 437-441.

Undaria pinnatifida

Casas, G.N. & M.L. Piriz, 1995. Surveys on *Undaria pinnatifida* in Golfo Nuevo, Argentina. Abstracts and Programme,XVth Intern. Seaweed Symp., Valdivia - Chile, January 8-14, 1995, p. 56.(Abstract)

Curiel, D., A. Rismondo, M. Marzocchi & A. Solazzi, 1994. Distribuzione di*Undaria pinnatifida* (Harvey) Suringar (Laminariales, Phaeophyta).Lavori-Soc. Ven. Sc. Nat. 19:121-126.

Fletcher, R.L. & C. Manfredi, 1995. The occurrence of *Undaria pinnatifida* (Phaeophyceae, Laminariales) on the south coast of England. Bot. mar. 38:355-358.

Floc'h, J.Y., 1995. The alien brown alga *Undaria pinnatifida* (Harv.) Sur. 12 years after its introduction into the northeast Atlantic. Abstracts and Programme, XVth Intern. Seaweed Symp.,Valdivia - Chile, January 8-14, 1995, p. 65. (Abstract)

Pirez, M.L. & G. Casas, 1994. Occurrence of *Undaria pinnatifida* in Golfo Nuevo, Argentina. Appl. Phycology Forum 10(3): 4.

Sanderson. C., 1994. Algal utilization in Tasmania, Australia. Appl.Phycology Forum 11 (1-2): 2-3.

***Caulerpa* spp.**

Belsher, T. & A. Meinesz, 1995. Deep-water dispersal of the tropical alga *Caulerpa taxifolia* introduced into the Mediterranean. Aquat. Bot. 51: 16-169.

Chisholm, J.R.M., J.M. Jaubert & G. Giaccone,1995. *Caulerpa taxifolia* in the northwest Mediterranean: introduced species or migrant from the Red Sea? Comptes Rendu Acad. Sci. Paris, Life Sciences 318: 1219-1226.

Delgado, O. C. Rodrigueéz-Prieto, E. Garcia & E. Ballesteros, 1996. Lack of severe nutrient limitation in *Caulerpa taxifolia* (Vahl) C. Agardh,an introduced seaweed spreading over the oligotrophic northwestern Mediterranean. Bot. Mar. 39: 61-67.

Gayol, P., C. Falconetti, J.R.M. Chisholm & J.M. Jaubert, 1995. Metabolic responses of low-temperature-acclimated *Caulerpa taxifolia* (Chlorophyta) to rapidly elevated temperature. Bot. Mar. 38: 61-67.

Gnassia-Barelli, M., R. Lemee, D. Pesando & M.Romeo, 1995. Heavy metal distribution in *Caulerpa taxifolia* from the north-western Mediterranean. Mar. Poll. Bull. 30: 749-755.

Lemée, R., M. Durand-Clément, P. Amade, R.Valls, A. Dubreuil, A. Meinesz, A. Guerriro, F. Pietra & D. Pesando, 1994.Effects of the toxic metabolites from *Caulerpa taxifolia* introduced into the Mediterranean Sea. Abstracts, Fifth Intern. Phycol. Congr. 26 June to 2 July, 1994, EMBL, Inst. Oceanol., Chin. Acad. Sci., Qingdao,Shandong, P.R. China. p. 21 (Abstract)

Meinesz, A. , E. Ballesteros, J. Blachier, F.Cinelli, J.M. Cottalorda, C. Frada'Orestano, T. Komatsu, R. Lemée, H.Molenaar, C. Morucci, S. Pou, R. Sandulli, G. Tripaldi & J. de Vaugelas,1994. Latest news on the spread of *Caulerpa taxifolia* introduced in the Mediterranean. Abstracts, Fifth Intern. Phycol. Congr. 26 June to 2 July, 1994, EMBL, Inst. Oceanol., Chin.Acad. Sci., Qingdao, Shandong, P.R. China. p. 28 (Abstract).

Meinesz, A., L. Benichou, J. Blachier, T.Komatsu, R. Lemée, H. Molenaar & X. Mari, 1995. Variations in the structure, morphology and biomass of *Caulerpa taxifolia* in the Mediterranean Sea. Bot. Mar. 38: 499-508.

Panayotidis, P. & B. Montesanto, 1994. *Caulerpa racemosa* (Chlorophyta) on the Greek coasts. Cryptogamie, Algol.15: 159-161.

Patel, T. 1996. 'Metamorphosis' paper greeted with derision. New Scientists 10 Feb.1996: 6.

Piazzi, L., E. Balestri & F. Cinelli, 1994.Presence of *Caulerpa racemosa* in the north-western Mediterranean.Cryptogamie, Algol. 15: 183-189.

Verlaque, M. & P. Fritayre, 1994. Modifications des communautés algal méditerranéennes en présence de l'algue envahissante *Caulerpa taxifolia* (Vahl) C. Agardh. Oceanol. Acta 17:659-672.

Villèlle, X. de & M. Verlaque, 1995. Changes and degradation in a *Posidonia oceanica* bed invaded by the introduced tropical alga*Caulerpa taxifolia* in the northwestern Mediterranean. Bot. Mar. 38:79-87.

References on Other Seaweeds

Curiel, D., M. Marzocchi & G. Bellemo, 1996.First report of fertile *Antithamnion pectinatum* (Ceramiales,Rhodophyceae) in the North Adriatic Sea (Lagoon of Venice, Italy). Bot. mar. 39: 19-22.

Fletcher, R.I. & Manfredi, C., 1995. The occurrence of *Undaria pinnatifida* (Phaeophyceae, Laminariales) on the South Coast of England. Bot. Mar., 38:355-358.

Haritonidis, S., E. Amoutzopoulou & G.Nikolaidis, 1994. The pathway of a marine plant migrator (*Halophila stipulacea*) to the Greek coasts (Eastern Mediterranean). Abstracts, Fifth Intern.Phycol. Congr. 26 June to 2 July, 1994, EMBL, Inst. Oceanol., Chin. Acad.Sci., Qingdao, Shandong, P.R. China. p. 12 (Abstract)

Kornmann, P. & P-H. Sahling, 1994. Marine algae of Helgoland: Second supplement. Helgoländer Meeresunters. 48: 365-406.(In German with English abstract).

Maggs, C.A., 1996. Introduced marine macroalgae -are they a problem? Abstr. from the BPS Winter meeting 1996. The Phycologists - The Newsletter of the British Phycol. Soc. p. 26(Abstract)

Maggs,C.A. & B.A. Ward, 1996. The genus *Pikea* (Dumontiaceae,Rhodophyta) in England and the North Pacific: Comparative morphological, life history, and molecular studies. J. Phycol. 32: 176-193.

Ribera, M.A. & C.F. Boudouresque, 1995.Introduced marine plants, with special reference to macroalgae: mechanisms and impact. In : Round, F.E. & D.J. Chapman (eds.) Progress in Phycological Research 11, Biopress, pp. 188-268.

Rojas-González, B., J. Afonso-Carillo & C.Ibeas, 1994. New records of Rhodomelaceae (Rhodophyta) from the Canary Islands. Bot. Mar. 37: 133-138.

Rueness, J., 1994. *Polysiphonia harveyi*: Recent spread in Scandinavia. Comparisons and hybridization between isolates from eastern USA and Europe. Abstracts, Fifth Intern. Phycol.Congr. 26 June to 2 July, 1994, EMBL, Inst. Oceanol., Chin. Acad. Sci.,Qingdao, Shandong, P.R. China. p. 36 (Abstract)

Russell, D.J. & G. H. Balazs, 1994. Colonization by the alien marine alga *Hypnea musciformis* (Wulfen) J. Ag.(Rhodophyta: Gigartinales) in the Hawaiian Islands and its utilization by the green turtle, *Chelonia mydas* L. Aquat. Bot. 47: 53-60.

Schaffelke, B., D. Evers & A Wahorn, 1995. Selective grazing of the isopod*Idotea baltica* between *Fucus evanescens* and *F. vesiculosus* from Kiel Fjord (western Baltic). Mar. Biol. 124: 215-218.

Wang, F. & G. Liu, 1994. Studies on the cultivation and application of *Macrocystis pyrifera.* Abstracts, Fifth Intern. Phycol. Congr. 26 June to 2 July, 1994, EMBL,Inst. Oceanol., Chin. Acad. Sci., Qingdao, Shandong, Peoples Republic of China. p. 42 (Abstract)

Additional Ballast references and related topics

(see also Main References, above)

Anon. 1995. Australian port to fund ballast treatment research. Mar. Poll.Bull. 30: 684.

Blanco, J., 1995. A model of the effect of cyst germination on the development of the *Gymnodinium catenatum* populations on the west coast of the Iberian peninsula. In: Lassus, P., G.Arzul, E. Erard, P. Gentien & C. Marcaillou (eds) Harmful marine algal blooms. Proc. 6th Intern. Conf. Toxic Marine Phytoplankton, October 1993,Nantes, France. Technique & Documentation, Lavoisier, pp. 563-566.

Boalch, G.T., 1994. The introduction of non-indigenous marine species to Europe: Planktonic species. In: Boudouresque, C.F., F. Briand, C. Nolan (eds). Introduced species in European Coastal Waters. Europ. Comm. EUR 15309. Ecosystems Res. Rep. 8:28-31.

Burkholder, J.M., H.B. Glasgow Jr & K.A. Steidinger, 1995. Stage transformations in the complex life cycles of an ichthyotoxic"ambush-predator" dinoflagellate. In: Lassus, P., G. Arzul, E. Erard, P.Gentien & C. Marcaillou (eds) Harmful marine algal blooms. Proc. 6th Intern. Conf. Toxic Marine Phytoplankton, October 1993, Nantes,France. Technique & Documentation, Lavoisier, pp. 567-572.

Clapin, G. & D.R. Evan, 1995. The status of the introduced marine fanworm *Sabella spallanzanii* in Western Australia: A preliminary investigation. Centre Res. Introd. Species, CSIRO, Techn. Rep.2, 34 pp.

Costas, E., R. Zardoya, J. Bautista, A. Garrido,C. Rojo & V. López-Rodas, 1995. Morphospecies vs. genospecies in toxic marine dinoflagellates: an analysis of *Gymnodinium catenatum /Gyrodinium impudicum* and *Alexandrium minutum / A. lusitanicum* using antibodies, lectins, and gene sequences. J. Phycol. 31: 801-807.

Ellegard, M., N.F. Christensen & Ø. Moestrup,1994. Dinoflagellate cysts from recent Danish marine sediments. Eur. J.Phycol. 29: 183-194.

Epstein, P.R., 1995. The role of algal blooms in the spread and persistence of human cholera. In: Lassus, P., G. Arzul, E. Erard, P. Gentien & C.Marcaillou (eds) Harmful marine algal blooms. Proc. 6th Intern. Conf. Toxic Marine Phytoplankton, October 1993, Nantes, France. Technique & Documentation, Lavoisier, p. 846.

Figueiras, F.G., E. Gomez, E. Nogueira & M.L.Villarino, 1995. Selection of *Gymnodinium catenatum* under downwelling conditions in the Ria de Vigo. 7th Intern. Conf. Toxic Phytoplankton, July 12-16, 1995, Sendai Japan. Abstracts p. 53.

Fraga, S., 1995. Wintering of of *Gymnodinium catenatum* in Iberian waters. 7th Intern. Conf. Toxic Phytoplankton, July 12-16, 1995, Sendai Japan. Abstracts p. 28.

Fraga, S., I. Bravo, M. Delgado, J.M. Franco &M. Zapata, 1995. Differences between two chainforming athecate, red tide flagellates: *Gymnodinium catenatum* Graham and *Gyrodinium* sp. In: Lassus, P., G. Arzul, E. Erard, P. Gentien & C. Marcaillou (eds) Harmful marine algal blooms. Proc. 6th Intern. Conf. Toxic Marine Phytoplankton, October 1993, Nantes, France. Technique & Documentation,Lavoisier, pp. 39-44.

Gosselin, S., M. Levasseur & D. Gauthier, 1995. Transport and deballasting of toxic dinoflagellates via ships in the Grande Entrée lagoon of the Îles-de-la-Madeleine (Gulf of St. Lawrence, Canada). In: Lassus, P., G. Arzul, E. Erard, P.Gentien & C. Marcaillou (eds) Harmful marine algal blooms. Proc. 6th Intern. Conf. Toxic Marine Phytoplankton, October 1993, Nantes, France.Technique & Documentation, Lavoisier, pp. 591-596.

Hallegraeff, G.M., M.A. McCausland & R.K.Brown, 1995. Early warning of toxic dinoflagellate blooms of *Gymnodinium catenatum* in southern Tasmanian waters. 7th Intern. Conf. Toxic Phytoplankton, July 12-16, 1995, Sendai Japan. Abstracts p. 24. (To be publ. in J. Plankton Research).

Jones, P. 1996. Possible links between algal blooms and cholera outbreaks. Mar. Poll. Bull. 32: 251.

MacKenzie, D. Why cholera blooms in the spring.New Scientist 2013: 6.

McCarthy, S.A. & F.M. Khambaty, 1994.International dissemination of epidemic *Vibrio cholerae* by cargo ship ballast and other nonpotable waters. Appl. Environ. Microbiol. 60:2597-2601.

Montani S., K. Ichimi, S. Meksumpun & T.Okaichi, 1995. The effects of dissolved oxygen and sulphide on germination of the cysts of some different phytoflagellates. In: Lassus, P., G. Arzul, E.Erard, P. Gentien & C. Marcaillou (eds) Harmful marine algal blooms. Proc 6th Intern. Conf. Toxic Marine Phytoplankton, October 1993, Nantes, France.Technique & Documentation, Lavoisier, pp. 627-632.

Nehring, S., 1994. Spatial distribution of dinoflagellate resting cysts in recent sediments of Kiel Bight, Germany.Ophelia 39: 137-158.

Nehring, S. 1995. Dinoflagellate resting cysts as factors in phytoplankton ecology of the North Sea. Helgoländer. Meeresunters. 49: 375-392.

Nehring, S,. K-J. Hesse & U. Tillmann, 1995. The German Wadden Sea: A problem area for nuisance blooms. In: Lassus, P., G. Arzul, E. Erard, P.Gentien & C. Marcaillou (eds) Harmful marine algal blooms. Proc. 6th Intern. Conf. Toxic Marine Phytoplankton, October 1993, Nantes, France. Technique & Documentation, Lavoisier, pp.199-204.

Noga, E.J., L. Khoo, J.B. Stevens, Z. Fan & J.M.Burkholder, 1996. Novel toxic dinoflagellate causes epidemic disease in estuarine fish. Mar. Poll. Bull. 32: 219-224.

Patz, J.A., P.R. Epstein, T.A. Burke & J.M. Balbus, 1996. Global climate change and emerging infectious diseases. J. Amer. Med. Ass.: 275:217-223.

Pazoz, Y., J.C. Maneiro, J. Blanco, A.Moroñio, J. M. Torres, J.M. Cotos, 1995. *Gymnodinium catenatum* (Graham) in the Galician Rias in 1993: Hydrographic conditions nutrient sand associated species. 7th Intern. Conf. Toxic Phytoplankton, July 12-16, 1995, Sendai Japan. Abstracts p. 54.

Peperzak, L. R. Verreusel, K. Zonneveld, W. Zewenboom R. Dijkema, 1995. The spatial and temporal distribution of dinoflagellate cysts in the North Sea with special emphasis on *Alexandrium tamarense* and *Gymnodinium catenatum*.. 7th Intern. Conf. Toxic Phytoplankton, July 12-16, 1995, Sendai Japan.Abstracts p. 62.

Rainer, S.F., 1995. Potential of the introduction and translocation of exotic species by hull fouling: A preliminary assessment. Centre Res. Introd. Species, CSIRO, Techn. Rep. 18 pp.

Rick, H-J. & C-D. Dürselen, 1995. Importance and abundance of the recently established species*Coscinodiscuswailesii* Gran & Angst in the German Bight. Helgoländer. Meeresunters.49: 355-374.

Rigby, G & G, Hallegraeff, 1995. Ballast controls to minimise the translocation and establishment of toxic phytoplankton - What progress have we made and where are we going. 7th Intern. Conf. Toxic Phytoplankton, July 12-16, 1995, Sendai Japan. Abstracts p. 16.

Rigby, G.R., A.H. Taylor, G.M. Hallegraeff & P. Mills, 1995. Progress in research and management of ships' ballast water to minimise the transfer of toxic dinoflagellates. In: Lassus, P.,G. Arzul, E. Erard, P. Gentien & C. Marcaillou (eds) Harmful marine algal blooms. Proc. 6th Intern. Conf. Toxic Marine Phytoplankton, October 1993,Nantes, France. Technique & Documentation, Lavoisier, pp. 821-824.

Sansón, M. J. Reyes, 1995. Morphological and geographical observations on four species of Ceramiaceae (Rhodophyta) new to Canary Islands. Bot. mar. 38: 89-95.

Sousal, I., P. Alvitol, S. Francal, M.A. de M.Sampayo, A.G. Martinez & J.A. Rodriguez-Vasquez, 1995. Data on paralytic shellfish toxins related to recent *Gymnodinium catenatum* blooms in Portugal coastal waters. In: Lassus, P., G. Arzul, E. Erard, P.Gentien & C. Marcaillou (eds) Harmful marine algal blooms. Proc. 6th Intern. Conf. Toxic Marine Phytoplankton, October 1993, Nantes, France.Technique & Documentation, Lavoisier, pp. 825-829.

Steidinger, K.A., J.M. Burkholder, H.B. Glasgow Jr., C.W. Hobbs, J.K. Garett, E.W. Truby, E. J. Noga & S.A. Smith, 1996. *Pfiesteria piscicida* gen. et sp. nov. (Pfiesteriaceae fam. nov.), a new toxic dinoflagellate with a complex life cycle and behaviour. J. Phycol. 32:157-164.

Steidinger, K.A., E.W. Truby, J.K. Garett & J.M. Burkholder, 1995. The morphology and cytology of a newly discovered toxic dinoflagellate. In:Lassus, P., G. Arzul, E. Erard, P. Gentien & C. Marcaillou (eds) Harmful marine algal blooms. Proc. 6th Intern. Conf. Toxic Marine Phytoplankton, October 1993, Nantes, France. Technique & Documentation, Lavoisier, pp. 83-88.

Tognetto, L. S. Bellato, I Moro & C.- Andreoli,1995. Occurrence of *Ostreopsis ovata* (Dinophyceae) in the Tyrrhenian Sea during summer 1994. Bot. mar. 38: 291-295.

Yoshida, M., Y. Fukuyo, T. Murase &T. Ikegami,1995. On- board observations of phytoplankton variability in ships' ballast tanks under critical light and temperature condition. 7th Intern. Conf. Toxic Phytoplankton, July 12-16,1995, Sendai Japan. Abstracts p. 66

ANNEX 5

PORPHYRA YEZOENSIS

April 14, 1996

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

Dear Jim:

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

1. Culture Sites:

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

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

1994: The two Maine lease sites established in 1993 were utilized in 1994. The lease site just north of Goose Island has been shifted approximately 600 feet due west. The lease site east of Goose Island has been shifted approximately 300 feet to the east to establish a 1320 foot buffer zone between CPI cultivation lease sites and the seabird nesting areas on Goose and Spectacle Islands. An additional 80 acre tract, Huckins Ledge, was permitted and utilized as CPI's nursery tract. It is located 4000 yards west south west of Goose Island, just west of Seaward Neck on "Huckins Ledge" in waters off of Lubec, Maine (See Figure 1, "94" delineation)

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

1995: The three 1994 CPI culture lease sites were similarly utilized in 1995. Additionally, as part of a NMFS grant, CPI established a small, 15 net, pole farm for the 1995 growing season. This one year experimental system is not scheduled for deployment in 1996. The farm was located just north of Mathews Island and is designated by "T" in Figure 1.

The company's effort to train displaced fisherman, (CPI offered a Nori Farming Training Seminar and a six month course) has resulted in the formation of the Blue Hill Nori Farming Cooperative. Their efforts have consisted of deploying six nori nets in 1994, and eight nori nets in 1995 in the Blue Hill, Maine area, see Figure 2. They are attempting to obtain a lease site consisting of 30 nets for the 1996 season.

Additional efforts for 1996 include the establishment of a 24 net test polyculture system at one of the salmon farms, and the licensing of a 100 net effort by a fisherman in Grand Manan, New Brunswick.

2. Cultivation/Reproduction:

The Porphyra yezoensis cultivation season is limited by the minimum growing temperatures of 6-7° C. The cultivation season in the waters of Cobscook Bay usually comprises the first week in June to the first week in December. The 1995 season started two weeks earlier than 1994 due to higher temperatures experienced at our Huckins Ledge lease site. The nets deployed were seeded in March 1995 in our newly constructed, artificially heated,indoor seeding and culture tank systems. Monospore production was observed from both our indoor facility in addition to the outdoor nursery site (Huckins Ledge). Evidence of monospore production was observed from June through October during the nursery phase of 1996's seeding process. Successful recruitment was evident upon the seeded nets, cultivation system support ropes and the anchor lines.

Adjacent salmon cages were examined monthly for evidence of successful monospore recruitment. Two sets of salmon cages adjacent to our nori sites consist of 1. 2500 yards south and 2. 3500 yards west, southwest of our Spectacle and Goose Island Sites. Cages 1 and 2 are 6000 yards west and 2000 yards south, respectively, of our Huckins Ledge site. No evidence of Porphyra yezoensis on the cage structure nor mooring lines were observed.

The 1995 cultivation season was adversely affected by the seasonal drought (August through October, zero rain) which

contributed to nitrogen levels approaching zero for nearly ten weeks. Growth rates experienced during this period ranged from 1% to 3%.

Porphyra yezoensis thalli were examined daily and evidence of carpospore production and release was observed from October 1 through December 10, 1995. Water temperatures ranged from 12° C in October to 6° C on December 10, 1995.

During diving operations to collect gear (December 10, through December 24, 1995,) water temperatures were recorded at 6.0-3.0 ° C and a series of transects were established and shells and shell hash were collected from our two production cultivation sites (Goose and Spectacle Islands) and our nursery cultivation site (Huckins Ledge). The shells were rinsed in seawater and examined for evidence of conchocelis populations. Several shells were acid etched to clarify observations. No evidence of Porphyra yezoensis conchocelis populations were identified from these collections. The winter water temperature is significantly lower than the 11 - 25° C experienced by P. yezoensis conchocelis in its native habitat.

Concurrent with CPI's efforts to install the 1996 cultivation floating raft systems, our divers will collect shells and shell fragments in and around our cultivation sites. The shells will be examined in our culture laboratory for the presence of conchocelis filaments. The filaments will be collected and attempts will be made to complete its life history cycle and identify the subsequent cultivar.

3. Recruitment:

Determination of natural or anthropogenic dispersal of Porphyra yezoensis has been accomplished by monthly field surveys. The intertidal zone has been examined by CPI personnel from May, 1995 to January, 1996 for the successful establishment of P. yezoensis from the 1992, 1993, 1994, and 1995 cultivation efforts.

Zero Porphyra yezoensis was recorded from the land masses surrounding the 1992, 1993, 1994, and 1995 cultivation sites. Goose, Spectacle, Mathews Islands and Huckins Ledge were extensively examined. Due to the limited experience at Johnson Cove and the time of year on site (June-July 1992) no follow-up has been attempted. The New Brunswick site was surveyed prior to the assemblage of the CPI cultivation system and each month to July, 1994. Our test farm in New Brunswick was discontinued

due to bureaucratic obstacles from both countries' customs, immigration, and work permit commissions. Our gear was retrieved during the summer of 1994. No new cultures were placed out in Canada during the 1994 cultivation season. Surveys were discontinued at that time and no additional efforts are scheduled.

CPI efforts to monitor the areas surrounding the Goose-Spectacle Island and Huckins Ledge along with adjacent salmon cages and all future cultivation areas will continue unabated. To this affect, CPI has established an independent monitoring program to be administered by Northeastern University, Department of Marine Science's graduate students under the tutelage of Dr. Donald Cheney, Associate Professor of Biology. The program will commence in May 1996 and continue for a minimum of 24 months (see attached).

4. Modification of Original Findings

The January 10, 1994 letter from Emory D. Anderson, General Secretary of International Council for the Exploration of the Sea, to then commissioner of the Maine Department of Marine Resources, William Brennan, responding to Mr. Brennan's request of April 6, 1992 for advice on the proposed release of the Japanese seaweed Porphyra yezoensis into State of Maine waters stated, "On the basis of the consideration of the Working Group on Introductions and Transfers of Marine Organisms on the introduction of the Japanese alga P. yezoensis, strain U-51, by a private party to the State of Maine (USA) and to the Province of New Brunswick (Canada), Member Countries are advised...". We respectfully request the removal of "strain U-51" from the approval for the purpose of permitting CPI to cultivate additional cultivars of P. yezoensis. The company's internal research and external experience (see letter from Dr. John Merrill) and ongoing work in the labs of University of Connecticut and Northeastern University support the contention that the cultivars of P. yezoensis were the result of a 15 year classical blade gametophyte strain selection program which has not altered the conchocelis' high temperature requirements necessary to produce conchospores and thus complete its life history cycle. Therefore, I respectfully request the working group approve this minor adjustment to the agreement in place.

Please feel free to contact my office if you, the working group or ICES have any questions or points of clarification concerning this matter. A letter of confirmation to the present commissioner of the Department of Marine Resources is all that the MDMR requires for CPI to proceed. We appreciate the time

and effort on our behalf and welcome a site inspection by any and all of the members of the ICES working group.

Yours very truly,

Ira A. Levine, Ph.D.
President

IAL:kab
Enclosures

cc: Robin Alden, Commissioner, Maine Dept. Marine Resources
Steve Crawford, V.P. Coastal Plantations International, Inc.

Northeastern University

College of Arts and Sciences
Marine Science Center

To: Ike Levine
President, Coastal Plantations International
From: Donald P. Cheney
Date: April 17, 1996
Re: *Porphyra yezoensis* monitoring project

Dear Ike:

I propose my laboratory conducting the following tasks as a means for monitoring the establishment of the introduced species *Porphyra yezoensis* in Cobscook Bay, specifically the rocky shores in the vicinity of CPI's nori farms. The monitoring project will be conducted by two graduate students from my laboratory, Kathy Watson and Katie Roberts, under my direction. Both students are working with *Porphyra* for their Masters Thesis and are familiar with the identification of both local species of *Porphyra*, as well as P. *yezoensis*. The monitoring project will be initiated in June-July, 1996. Details of the experimental design and tasks involved are as follows:

1).At the beginning and end of the nori farming season, both students will make extensive visits to the farming sites to examine adjacent and distant (eg. "down-current") rocky shores for plants of *P. yezoensis*. Any suspect plants will be brought back to our laboratory for microscopic examination and isoenzyme analysis. We have identified an isoenzyme marker that distinguishes *yezoensis* from the local species.

2. At the beginning of the farming season, "settlement substrates" will be put out to detect the production of *yezoensis* from spores. Specially prepared concrete blocks will be put out at various locations on shores adjacent to the farms, as well as other locations as recommended by local fishermen familiar with currents in the area.

3. At the end of the 1996 farming season, all concrete blocks will be initially examined for *Porphyra* colonization and returned to our laboratory at the Marine Science Center for further culture. At MSC, the blocks will be "cultured" in our running seawater system over the winter and re-examined for *yezoensis* colonization. New settlement blocks will be put out at the end of the farming season to replace those we remove; these will be removed and examined at the beginning of the 1997 farming season during our field examination visit and treated as described above.

Please let me know if you have any comments or suggestions.

Sincerely
Donald P. Cheney

Northeastern University
East Point, Nahant, Massachusetts 01908
617-581-7370 (office)
617-581-6076 (fax)

VIA FAX

Applied Algal Research

Tel/Fax: 517-655-2792
4223 Vanneter Rd.
Williamston, MI 48895 USA

17 April 1996

Ike Levine
Coastal Plantations
PO Box 209
Poland ME 04273

Dear Ike:

As per your request, relayed to me by Mr. Crawford, this letter is to report information concerning the conditions for culturing of several strains of *Porphyra yezoensis*, including:

U-51 (wild-type)
C-13 (wild-type)
H-25 (red-type)
C-12 (green-type)
C-0 (green-type)
ZY-1 (yellow recombinant type)
ZRGW (wild recombinant type)
(all designations according to Prof. A. Miura, Tokyo University of Fisheries)

These strains were used extensively in our laboratory research. This laboratory research required young gametophyte (blade-phase) plants to be readily available. Stock sporophyte (conchocelis) cultures were maintained in the vegetative condition at 18°C, short days, low light. Initiation of fertile branches (conchosporangia) was achieved by a high temperature (25-27°C), low light, long day treatment. Spore release was then achieved by reduction in temperature (<20°C), shortened daylength (10 h light or less) and increased light. All strains were handled by the same methods.

I hope this information is helpful.

Sincerely,

John E. Merrill

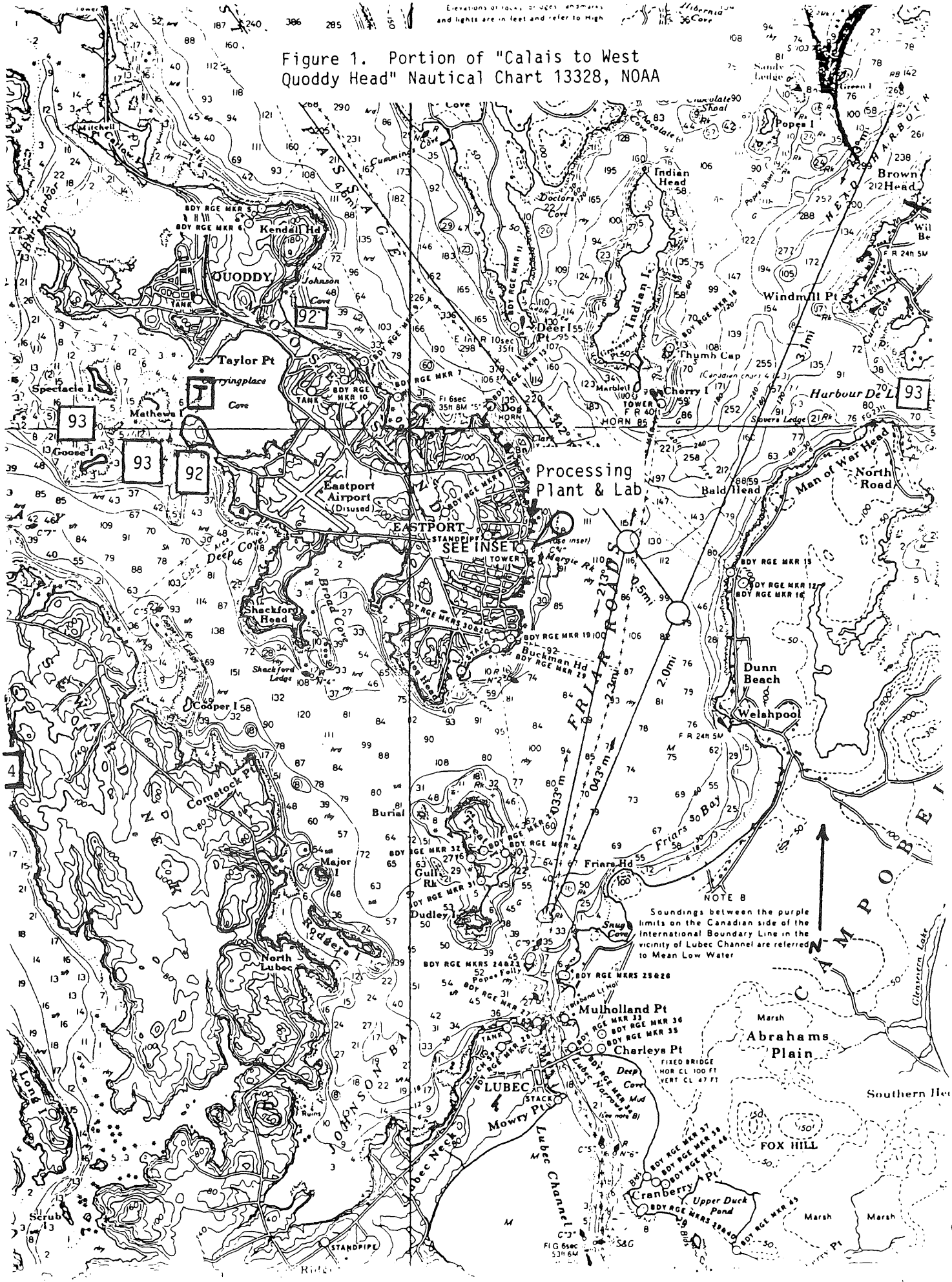


Figure 1. Portion of "Calais to West Quoddy Head" Nautical Chart 13328, NOAA

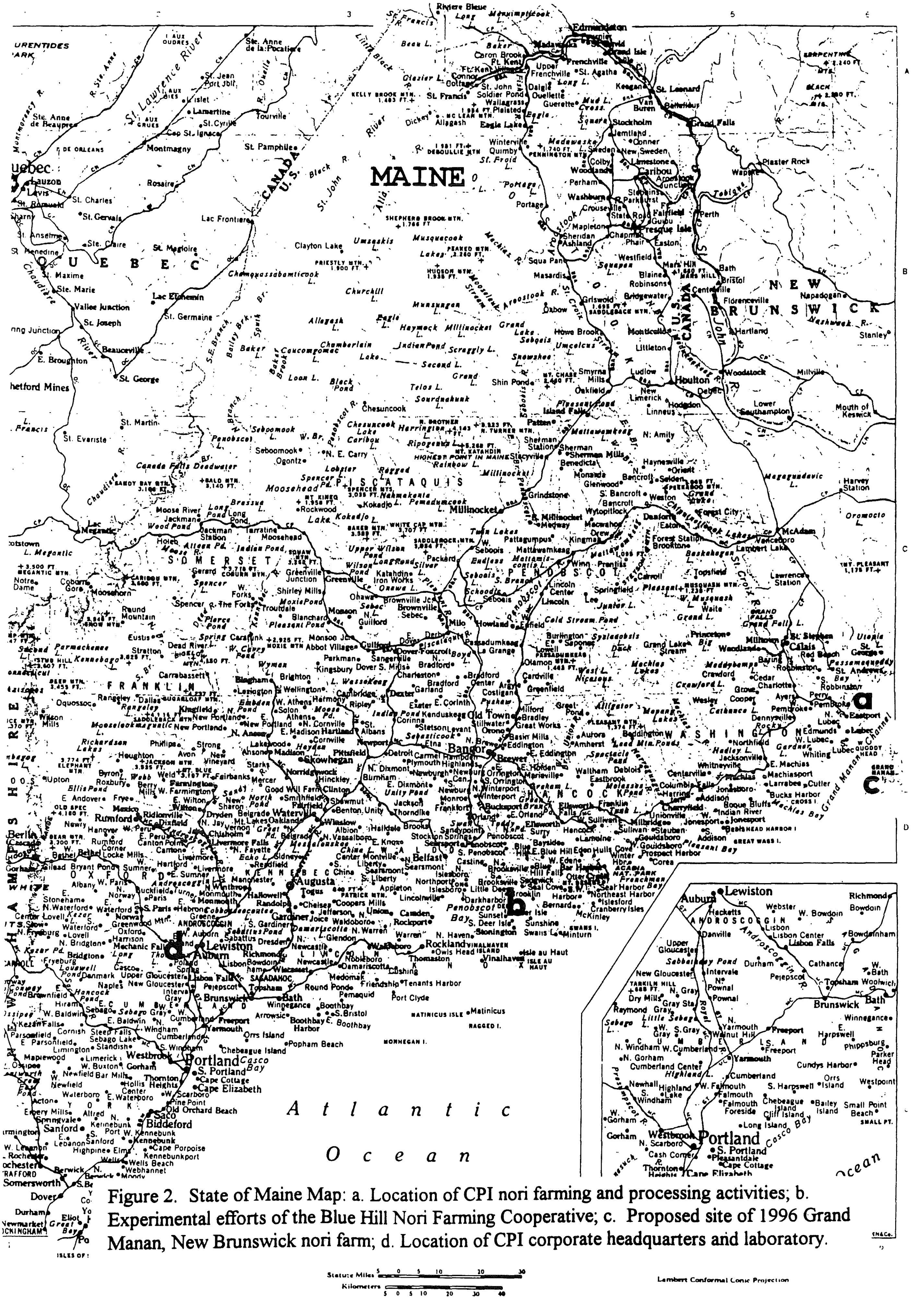


Figure 2. State of Maine Map: a. Location of CPI nori farming and processing activities; b. Experimental efforts of the Blue Hill Nori Farming Cooperative; c. Proposed site of 1996 Grand Manan, New Brunswick nori farm; d. Location of CPI corporate headquarters and laboratory.

ANNEX 6

NEOGOBIUS MELANOSTOMUS

BALTIC MARINE BIOLOGISTS

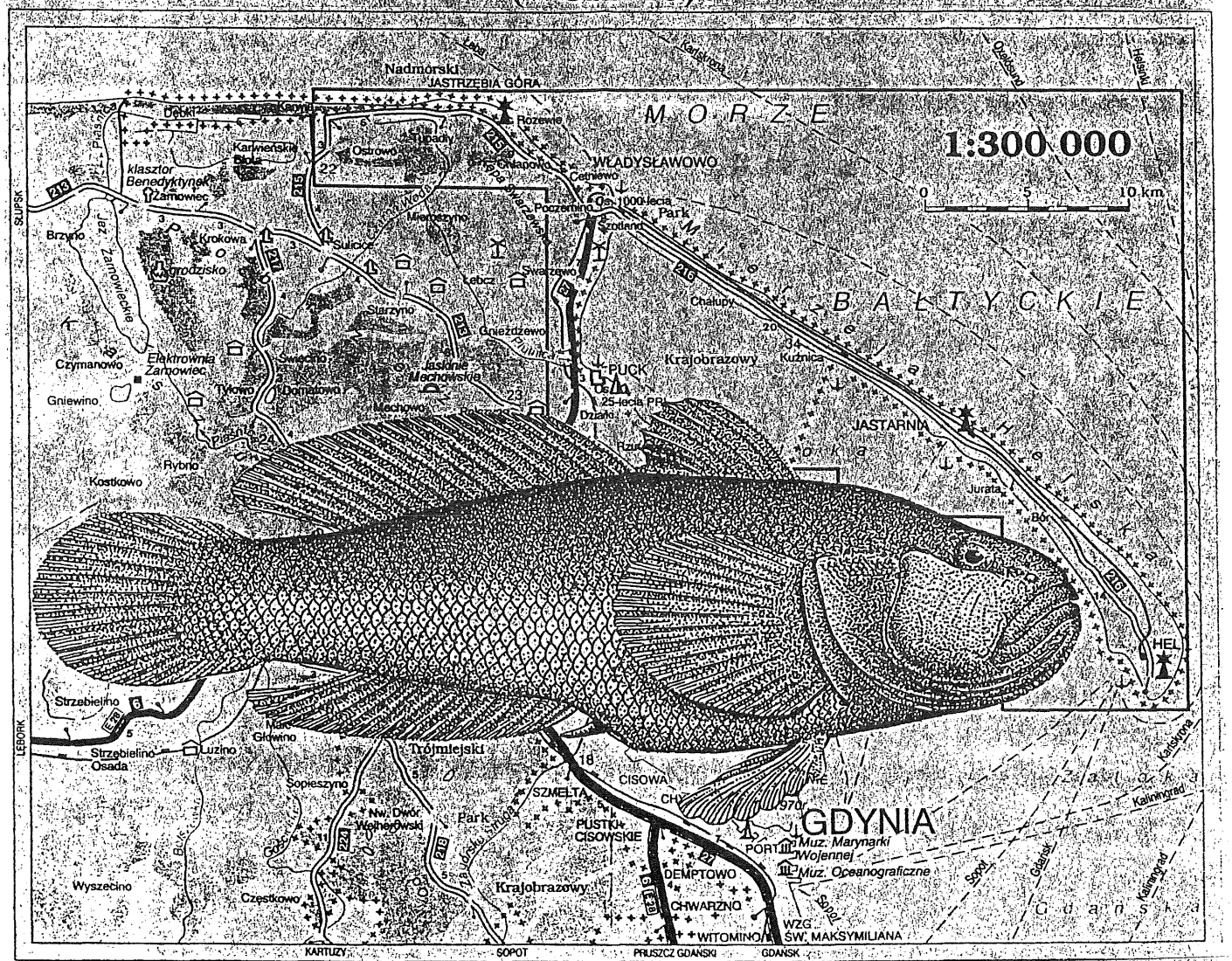
WORKING GROUP NO. 30

NON-INDIGENOUS ESTUARINE AND MARINE ORGANISMS (NEMO) IN THE BALTIC SEA

&

INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA

WORKING GROUP ON INTRODUCTION AND TRANSFERS OF MARINE ORGANISMS (WGITMO)



THE JOINT MEETING IN GDYNIA

April 22-25, 1996

Sea Fisheries Institute,
ul. Kołłątaja 1, 81-332 Gdynia,

Hel Marine Station , University of Gdańsk,
ul Morska 2, 84-150 Hel,

Krzysztof E. Skóra, Hel Marine Station, University of Gdańsk, Poland

Neogobius melanostomus (Pallas 1811)

TAXONOMY

Typus -	Chordata
Subtypus -	Vertebrata
Superclassis -	Gnathostomata
Classis -	Osteichthys
Subclassis -	Actinopterygii
Ordo -	Perciformes
Subordo -	Gobioidei
Familia -	Gobiidae
Genus -	Neogobius
Species -	Neogobius melanostomus (Pallas 1811)

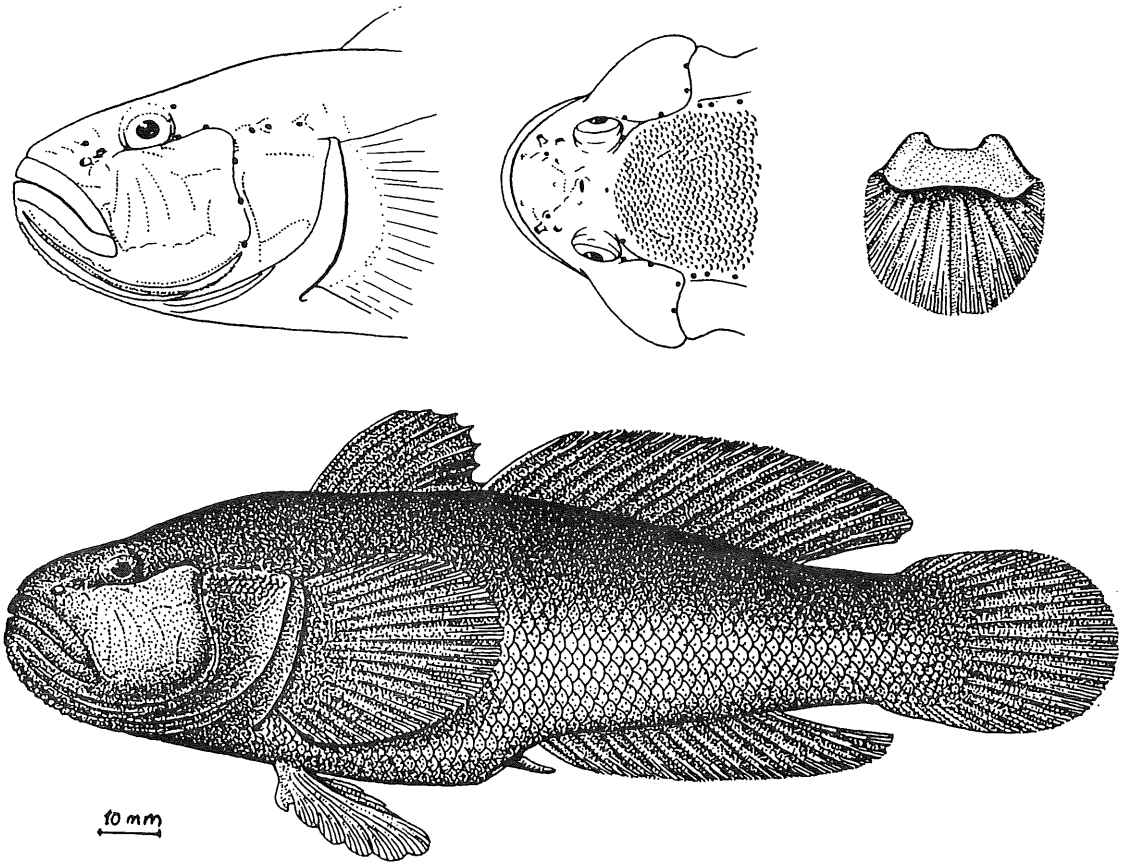
Subspecies (?) in the Caspian Sea -Neogobius melanostomus affinis Eischwald

- **Common synonyms:**
  Gobius melanostomus Pallas 1811,
  Gobius (Apollonia) melanostomus Pallas 1811

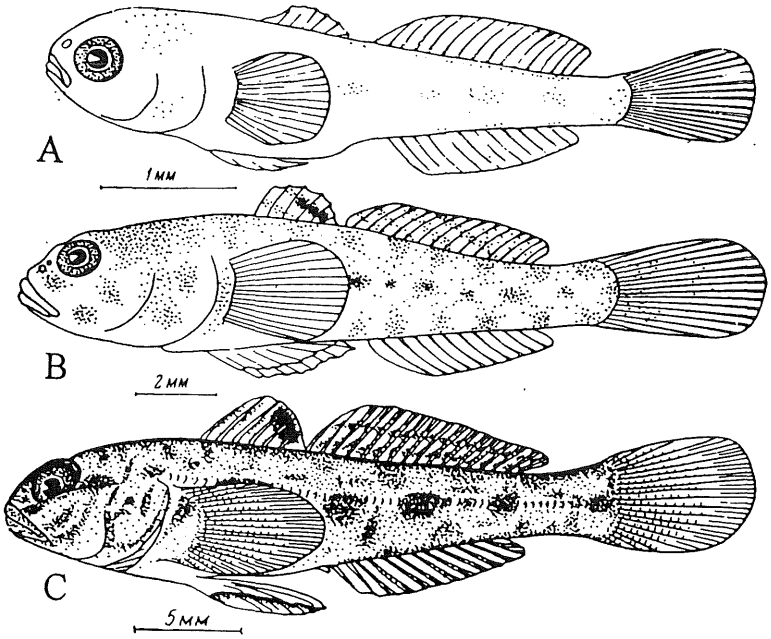
- **Common names:**
  Trevno popche (Bu), Schwarzmundgrundel, Kruglyak-Grundel (D), Round goby, Black spotted goby (En), Gobie á taches noires (Fr), Babka bycha, babka okragla (Pl), Guvid, Stronghil, Babča neagră (Ro), Bychok-kruglyak, Chornorotyj bychok (Ru), Gobio pintato (Sp)

IDENTIFICATION

- **Diagnosis:**
  After Miller (1986) - nape scaled completely, scales cycloid on middle and anterior nape. Head depth 0.9 - 1.2 width. Inter-orbit four-fifths to almost equalling eye diameter. Angle of jaws below anterior quarter of eye. Snout 1.1 - 1.4 orbit. Upper lip narrowing slightly to rear, with about half lateral preorbital area. Pelvic disc 0.6 - 0.8 abdomen length, anterior membrane width very shallow, rounded, lateral lobes, if evident at all. Caudal peduncle depth about two-thirds own length. D1 VI (V-VII); D2 I + 14-16 (13-16); A I + 11-13 (11-14); P 18-19 (17-20). Scales in lateral series 49-55 (45-57). Vertebrae 32-33 (31-34). *Colour*: yellowish-grey, with lateral blotches; first dorsal fin with large black spot in posterior part; breeding males black, with median fins white-edged. *Size*: to 22 cm. (24.6 cm Lt , in Gulf of Gdańsk)

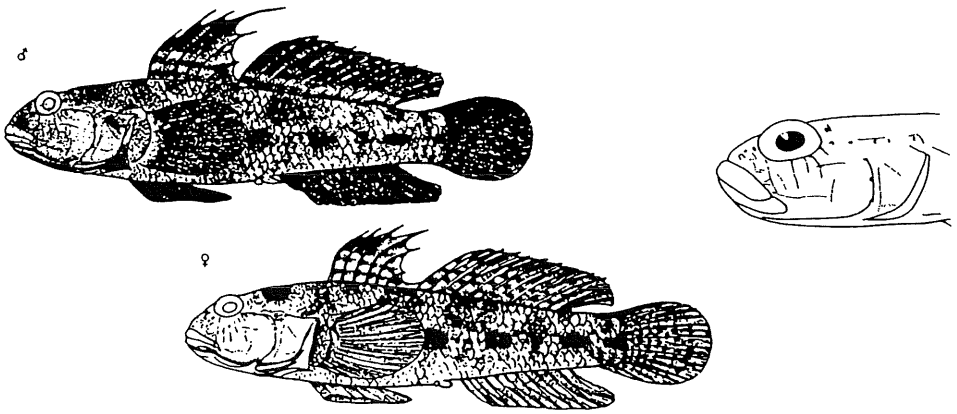


Neogobius melanostomus (Pallas 1811) from the Gulf of Gdańsk (Lt 185 mm)
The figure does not show the changeable colour and pattern of the fish.

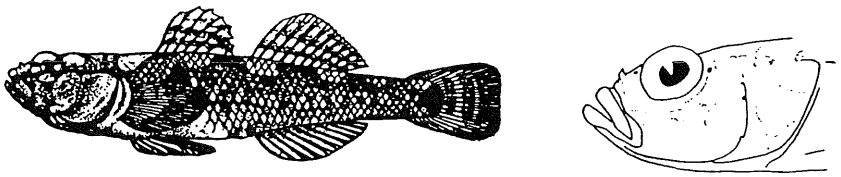


Larvae and juvenile *Neogobius melanostomus affinis* (after Koblickaja 1981)
A - Lt 5,4 mm B - Lt 19,5 mm C - Lt 33,5 mm

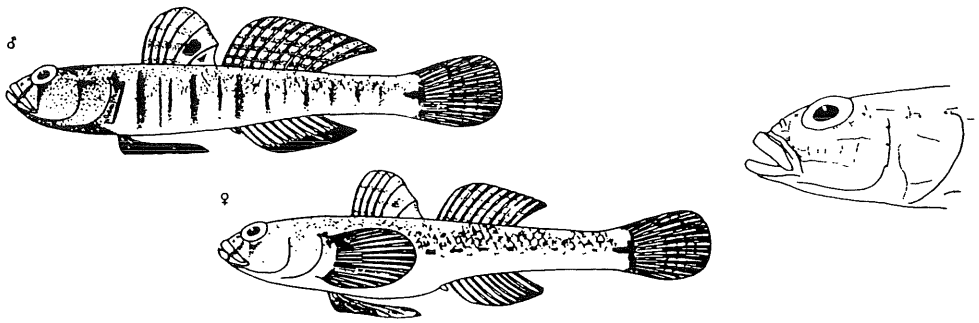
- **Species already present in the Baltic Sea, with which an introducent have similar features, and, therefore may be mixed up**



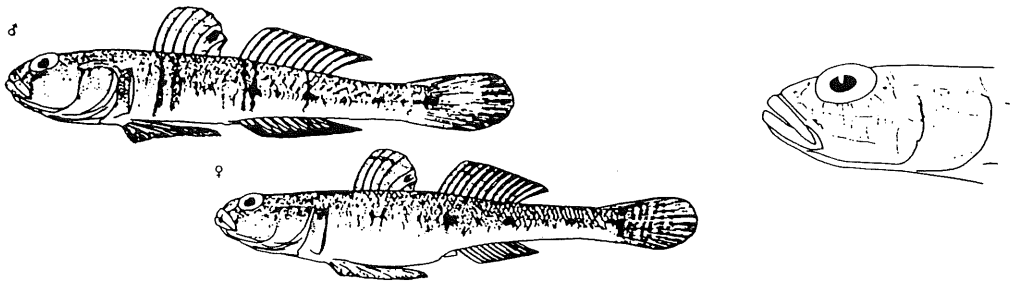
Gobius niger



Gobiusculus flavescens,



Pomatoschistus microps,



Pomatoschistus minutus

INTRODUCTION AND DISTRIBUTION

- **First record from the Baltic Sea (year, area, reference)**

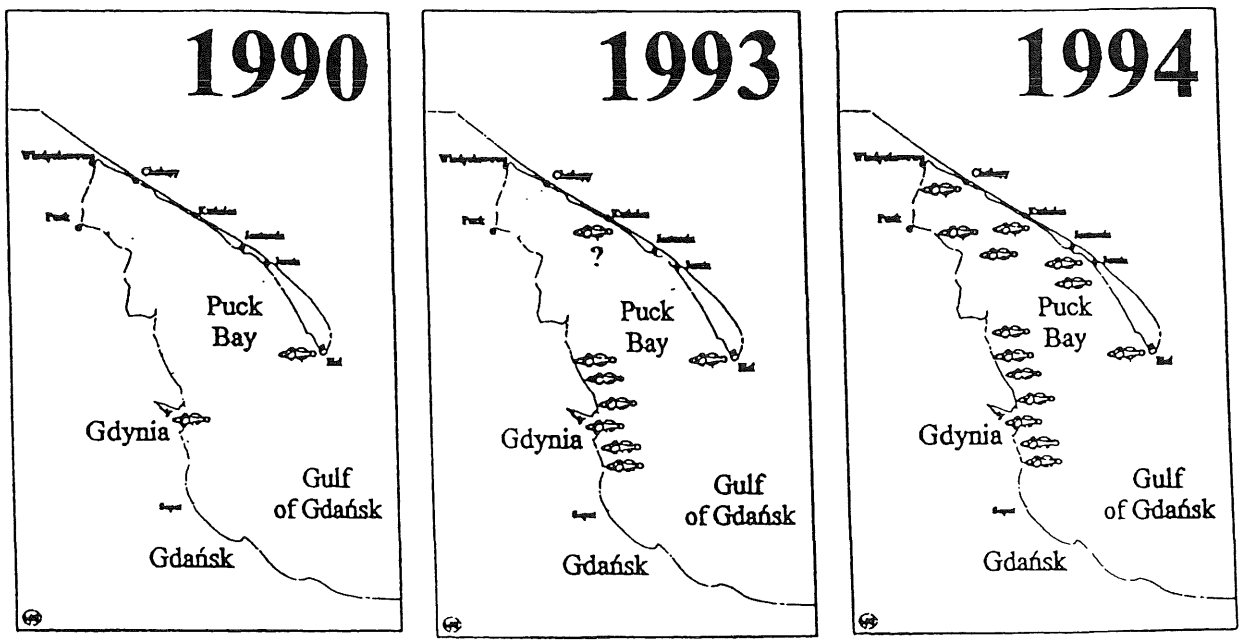
  Year - 1990,
  Area -Gulf of Gdańsk (Hel),
  Reference - Skóra K.E., Stolarski J.1993 „New fish species in the Gulf of Gdansk Neogobius sp [cf. Neogobius melanostomus (Pallas 1811)]", in: Notes Bulletin of the Sea Fisheries Institute 1(128): 83.

- **Established:**
  a) in the entire Baltic Sea - No
  b) in the area of primary introduction - Yes

- **Primary or secondary introduction into the Baltic**

  Primary, probably before 1987, into the harbours or shipyard basins of Gdynia (Gulf of Gdansk) because the first individual of this species, caught in 1990 in Hel, was age 3 or 4 according to scale readings.[1]

- **Secondary/marginal dispersal (to the Baltic): vector dispersal within the Baltic**



[1] At the same time, unintentional introduction has occurred in North America. The first 3 specimens were caught in Sarnia (1990) on the St.Clair River - a connecting chanel between Lake Huron and Lake St.Clair (Ontario, Canada), Jude et al.1991, Crossman et al 1992, Jude et al.1992, Jude et al. (in press).

- **Present distribution in the Baltic**

  In the Gulf of Gdańsk:

  In the entire Puck Bay:

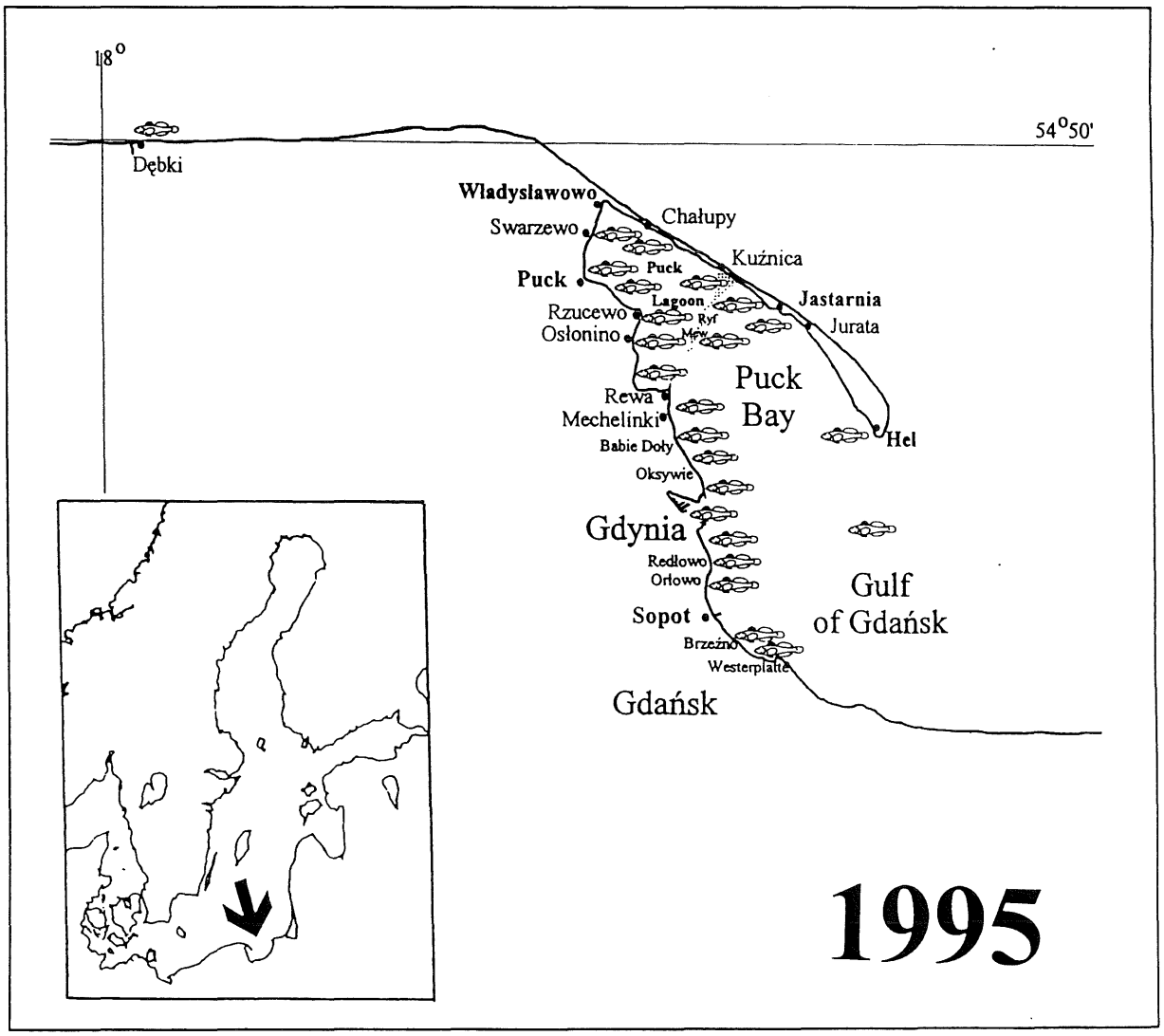
  * in the harbours of: Gdynia, Hel, Jastrania, Puck and out of them (data from Hel Marine Station)
  * in the coastal zone, of thr above harbours, and near the fishery villages: Kuźnica, Chałupy, Swarzewo, Rzucewo, Osłonino, Rewa, Mechelinki, Gdyni-Oksywie, , Gdynia-Orłowo and Gdynia-Redłowo (data from Hel Marine Station),
  * shoal area of Ryf Mew (data from Hel Marine Station)
  * position 54° 31,39 N and 18°50,47 E at depth =31-34 m (data from Sea Fisheries Institute, Gdynia)

  Outside the Puck Bay:

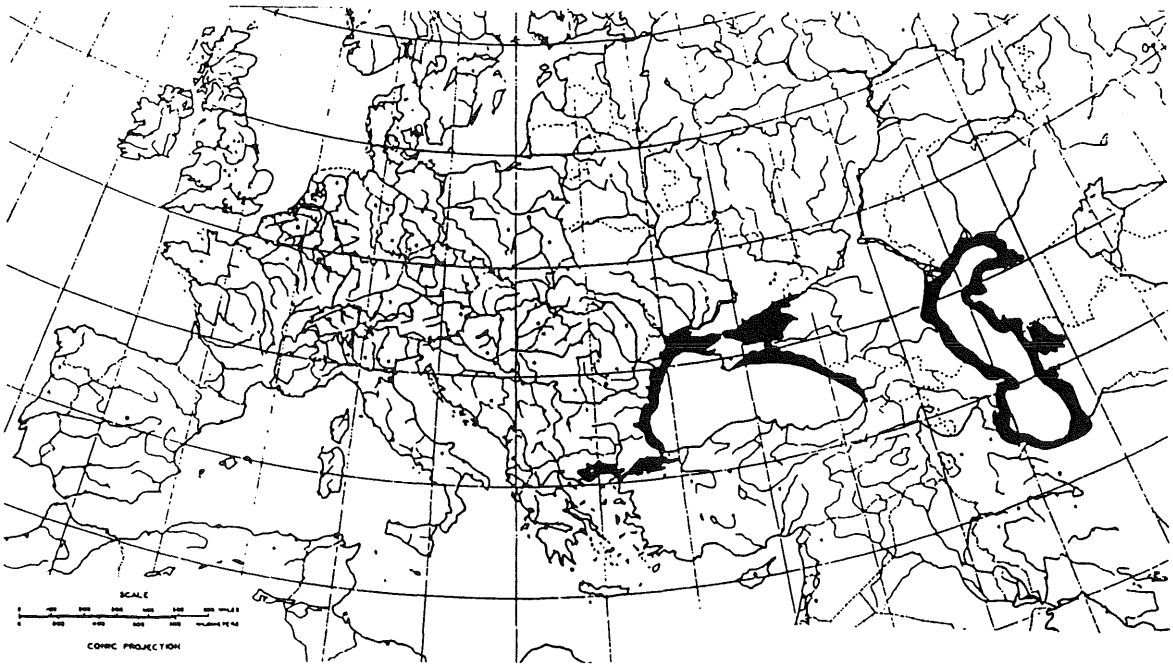
  * in the area of Gdańsk-Brzeźno, Gdańsk-Westerplatte (data from Sea Fisheries Institute and Hel Marine Station)

  Outsie of the Gulf of Gańsk:

  * near Dębki.(data from Sea Fisheries Institute, Gdynia)



- **Area of native biogeographic range.**



Black Sea, Azov Sea, Marmara Sea, Caspian Sea and their tributaries

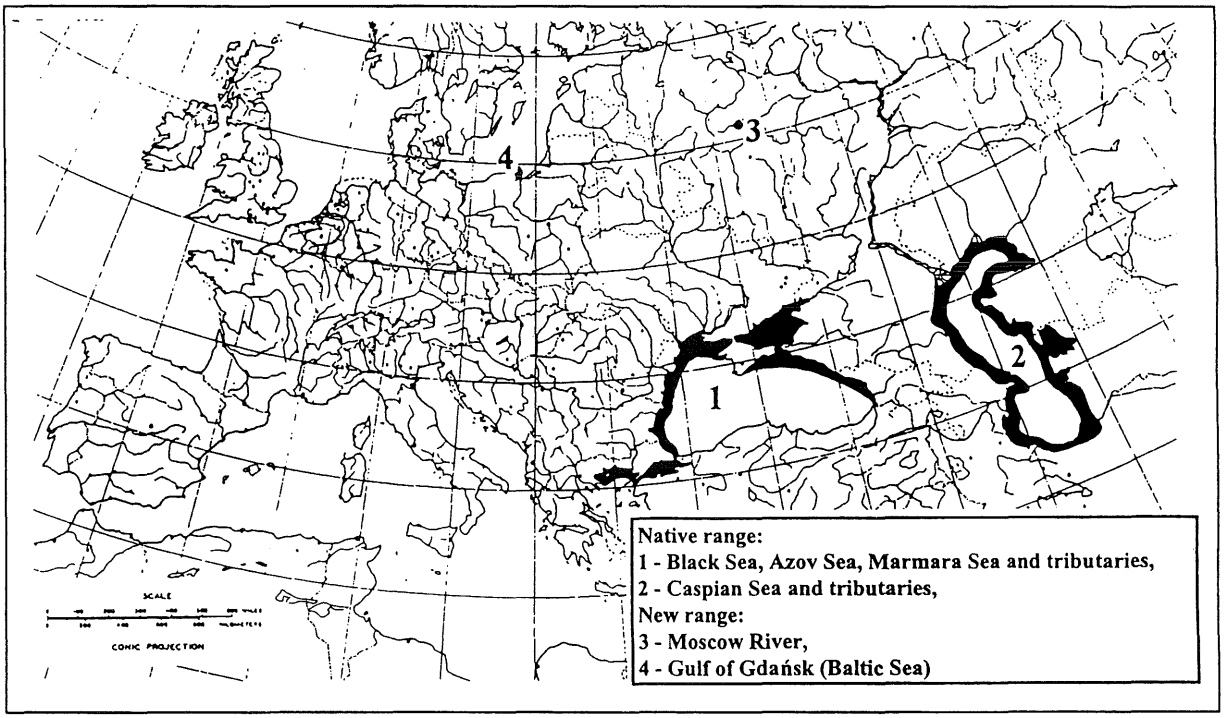
- **Primary introduction (in Europe): a route of introduction.**

The first transfer of this species outside its native biogeographic range occurred in the Aral Sea (Miller 1986). However, the species died out because of increasing salinity in this body of water (A.Neelov, personal comm.)

N. melanostomus could have found its way into the Gulf of Gdansk by means of ballast waters of vessels sailing along the line connecting the Caspian and Black Seas with the Baltic, or directly through rivers: from the Black Sea through the Dnieper, Pripet, Pina, Kanal Krolewski, Bug, and Vistula. It is also possible that they reached the Baltic by a longer route from the Sea of Azov through the Don to the Volga or from the Caspian Sea through the Volga, Rybinskoe Reservoir, the Onega and Ladoga Lakes and the Gulf of Finland. This second longer route seems more likely. This is supported by the fact that *N. melanostomus* was observed in the river Moskva (Sokolov et al. 1989). So far the presence of these fish in other parts of the Baltic has not been observed; the Gulf of Gdansk is their only habitat. Transport of eggs or larvae with ballast waters seems more likely than the migration of fish. This species is not a good "swimmer" and it is difficult to imagine the fish covering such a long distance, leading mostly upstream.

Hypothetical route of *N.melanostomus* transfer from its native habitat into the Gulf of Gdańsk.

- **Present distribution in Europe.**



ABIOTIC PREFERENCES AND BIOLOGY:

In the area of origin

Inshore, on coarse gravel, shelly and sandy bottom, to a depth of 20 m (50-60 m in winter, off Varna, Bulgaria); also lower and middle reaches of rivers, in only slightly brackish to freshwater (Miller 1986).

In the Baltic

In the Gulf of Gdansk: on sandy-stony bottom, among mussel beds, marine structures (piers, wharves), sunken objects. In the Puck Lagoon, which is a part of the Puck Bay, juvenile stages inhabit muddy-sandy humus-containing bottom, overgrown with benthic flora.

- **Reproduction, physiology, feeding strategy, mobility level, etc.**

After Miller (1986) - *Reproduction*: April to end of September (Varna), May-June (Romania), early April to August (Strait of Kerch) but ending by July in Sea of Azov; repeat spawning, up to six times, every 18-20 days in captivity. Eggs ovoid, with sharp apex, about 3.9 x 2.2 mm, deposited under or between stones. Fecundity 328-5221 at 7-13 cm. Sexually mature at 3-4 years (males), 2-3 years (females). *Lifespan*: up to 4 years, but males die after the spawning season. *Food*: chiefly bivalves, crustaceans (corophiid amphipods, decapods) and polychaetes; also, small fish and chironomid larvae

Based on the observations from two years (very warm seasons in 1994 and 1995), it was concluded that the spawning season of *N.melanostomus* in the Gulf of Gdansk extended from the end of April until the end of August/beginning of September. In captivity at water temperatures of 18-19 °C the incubation lasted from 17 to 19 days (Skora, unpublished). Fecundity values, calculated by Kuczynski (1995) for two 15 cm long females were 2700 and 3000 eggs/individual.

- **Effects of introduction**

a) positive and/or negative social and economic effects

The consequences of the growth of this species population in the Gulf of Gdańsk may be commercially favourable for local fishery and anglers because - in a stituation when many of traditionally caught species disappear - it may compensate for their absence.

This species has cobstituted most of gobiid catches in the Sea of Azov, Romanian and Bulgarian waters (Miller 1986).

According to Svietovidow (1964) in the '30s and '40s in the Aral Sea the catches of this species ranged from 2 to 35 thousand tons, while in 1956, they amounted to almost 50 thousand tons. In the northern Black Sea annual catches fluctuated at

the level of 3 to 4 thousand tons. Catch rates vary widely because of the stock size, predation by pike perch and mortality due to the summer oxygen deficiency in water.

It is uncertain whether the stock of *N.mealnostomus* will be that numerous; food resources (abundance of mollusks) and lack of predators are to the species advantage. For a year N. melanostomus has been sold in fish markets at 1.5 PLN/kg (0.6$/kg). By-catch rates of this species during eel-directed catches with traps reach up to 50 kg/day/boat. This fish becomes more and more often the main sporting species, particularly in the Gdynia area.

b) impact on the ecosystem (physical displacement of, or predation on native species; changes in autochtonous communities and food chains; others)

An increase in the number of *N.melanostomus* may bring about far-reaching changes in the ecosystem. This species may become a serious competitor for food with other species of ichthyofauna of coastal zone (especially crustaceans and molluscs feeders). Its hiding places will overlap with those occupied by *Zoarces viviparus* and *Gobius niger*. *N.melanostomus*, being abundant and accessible, will become a new food item for other fish and birds. This will probably result in reduced preying intensity on traditionally consumed major species (sand eels, sprat, large crustaceans).

- **Abundance in study area: quantitative data on density/biomass and comparison to autochtonous species of the same taxonomic/ecological group.**

The abundance of *N.melanostomus* in the Gulf of Gdansk should be considered as high and widespread. In the habitats optimal for this species (among constructions reinforcing the beach, made of rocks) the presence of even several individuals per $1m^2$ od surface area was reported (Redlarski A., Samsel J., *viedeo films*).

The remaining autecological features reveal that this species has found adequate living conditions in the Gulf of Gdansk. Its propagation in our waters is aided by the food base, abundant in molluscs, which are the main food component for this species. In the areas of its natural habitat molluscs constitute from 46 to 98% of its diet (Svetovidov 1969). Not without significance is also its optimum spawning strategy (caring for the eggs, absence of the pelagic phase during the larval stage), protecting embryos and juvenile stages against predation by stickleback, dominant in the coastal zone. Besides, the disappearance of large predators (cod, pike, eel, seals) in the coastal zone nullifies the threat to adult individuals. Another factor, which probably favourably influences the ability of this ponto-caspian species to settle in the Baltic, are symptoms of the global warming.

- **REFERENCES**

1. Crossman, E.J. Holm E., Cholmondeley R., Turininga K. ,1992 First record for Canada of the rudd Scardinus erythrophthalmus, and notes on the introduced round goby, Neogobius melanostomus Can.Field. Nat 106, 2: 206-209.
2. Jude D.J., Reider R.H., Smith G.R 1991 „First evidence of Gobiidae in the Great Lakes basin. Conf. of the Int. Assoc. for great Lakes Res. June 2-6 1991. Program and Abstracts., Ann Arbor MI, USA, IAGLR, Univ. Michigan.
3. Jude D.J., Reider R.H., Smith G.R. 1992 „Establishment of Gobiidae in the Great Lakes Basin" Can. J.Fish. Aquat.Sci.Vol.49, 2:416-421.
4. Jude, D.J. Jamssen J., Crawford G., (*in press*) Ecology distribution and impact of the newly introduced round and tubenose gobies on yhe biota of St.Clir and Detroit Rivers" In M.Munawar, T.Edsall and J.Leach (eds) The lake Huron Ecosystem: Ecology, Fisheries and Management. Ecovision World Monograph Series, S.P.B. Academic Publishing, The Netherlands.
5. Grygiel W. 1995 Występowanie nowego gatunku babki Neogobius melanostomus (Pallas 1811) w polskicj obszarach morskich. Notatka w Zakladzie Biologii i Ochrony Zasobów MIR, Gdynia.
6. P.J.Miller 1986 „Gobiidae" in: „Fishes of the North-eastern Atlantic and the Mediterranen" , Vol III, P..J.P Whitehead at al (ed):1019-1086
7. Müller H. 1983 „Fische Europeas"Neuman Verlag, Leipzig; 320.
8. Koblickaja A.F. 1981 „Opredielitiel molodii priesnowodnyh ryb" Moskva. Legkaja i pischevaja promyslennost. 208
9. Kuczyński J 1995 Babka krągła Neogobius melanostomus (Pallas 1811) - emigrant z Basenu Pontokaspijskiego w Zatoce Gdańskiej. Bull.SFI, Gdynia, 2(135): 68-71
10. Kuzancejev E.N. 1981,„Ryby Kaspijskogo morija" Moskva, Legkaja i pischevaja promyslennost.
11. Skóra K.E., Stolarski J.1993 New fish species in the Gulf of Gdansk Neogobius sp [cf. Neogobius melanostomus (Pallas 1811), in: Notes Bulletin of the Sea Fisheries Institute 1(128): 83.
12. Skóra K.E., Stolarski J.,1993,„Neogobius melanostomus (Pallas 1811) a new immigrant species in the Baltic Sea" Proceedings of Second Estuary Symposium on Biology of Estuarine Species. Gdańsk, Poland Oct.18-22 1993. AMBER (in press)
13. Skóra K.E., Stolarski J. 1994 „Neogobius melanostomus(Pallas 1811) - new fish in the Baltic Sea". Poster, communicat (abstrakt), The VIII European Congress of Ichthyology „Fishes and their environment". Sep 25 - Oct 2, 1994 Oviedo, Spain.
14. Skóra K.E., Stolarski J., 1995 „Round goby - a fishy invader" WWF Baltic Bulletin 1/95, :46-47
15. Sokołov L.I., Sokolova E.L., Gloviatok 1989 „Novyje zhitieli Moskvy-rjeki" Priroda N9: 80-81
16. Svietovidov A.N. 1964 „Ryby Chernovo morija" Acad.Nauk.USSR, Opr. po faunie USSR. Moskva: 552

- **SOURCE**

Krzysztof E. Skóra
Hel Marine Station, University of Gdańsk
PL - 84-150 Hel, Morska 2 P.O.Box 37
Tel +4858 750836
Fax +4858 750420
e-mail: skora@univ.gda.pl

- **COMMENTS**

The Hel Marine Station kindly asks for all new data on the distribution of this species in the Baltic to be sent to its headquarters.

ANNEX 7

ACTION LIST

WGITMO identified the following elements as being on its current list of Action Items. These are *in addition* to those elements proposed for action in the Recommendations of the Working Group for its 1997 meeting. WGITMO members and the WGITMO Chairman will:

* undertake efforts to encourage and then assemble translations of the *1994 ICES Code of Practice* to the languages of ICES Member Countries;

* finalize and submit the manuscripts for the two planned ICES Cooperative Research Reports as noted in Section 5;

* continue to assemble information on available databases on nonindigenous marine and brackish water organisms during the course of the year;

* facilitate as far as possible the submission of the "Annotated Bibliography on Transplantations and Transfers of Aquatic Organisms" for publication by ICES in disk and hard copy format (C.Res. 1995/1:4);

* keep abreast of developments at OSPAR relating to the dissemination of the *1994 ICES Code of Practice* and provide further information if requested; and

* work with representatives of IOC (IPHAB) and IMO in advance of the next meeting to define specific areas of mutual interest, concern, and discussion relative to ballast water issues.

ANNEX 8

RECOMMENDATIONS

The following recommendations were formulated by the Working Group on Introductions and Transfers of Marine Organisms for consideration by the Advisory Committee on the Marine Environment.

1) In order to understand the ecological and other environmental effects of commercially important exotic species introductions into ICES Member Countries, an historical risk assessment, retrospective of the events leading to their current development and current ecological status should be undertaken, so that the types of risk can be identified and used as a basis for aiding future management decisions. Species that could be considered include the Pacific oyster *Crassostrea gigas*, the Asian kelp *Undaria pinnatifida,* and the coho salmon *Oncorhynchus kisutch.*

2) An ICES Cooperative Research Report should be prepared by WGITMO to examine the diversity, nature, and specific roles of those human-mediated vectors known to be important or potentially important in the transportation of exotic marine and brackish water organisms, and to attempt to assign relative degrees of risk that these vectors may pose in the distribution of non-native species. The purpose of this CRR is to supply a reference manual that is vector-based rather than species-based, in order to increase awareness of potential "new" vectors and to provide decision-makers with ready access to data sources that may aid in risk assessments, when specific vectors are proposed or come into play that have previously not existed or have not yet been recognized in individual ICES Member Countries or in specific geographical areas thereof.

3) Continued cooperation and communication are not only valuable but essential between ICES, the United Nations International Maritime Organization (IMO) and the United Nations Intergovernmental Oceanographic Commission (IOC) relative to the issues of the transportation by ships' ballast water and sediments, of invasive exotic species that could cause extensive damage to fisheries and other aquatic resources. Because such cooperation would facilitate an exchange of information and thus be mutually beneficial, ICES, IMO, and IOC should meet in joint session once a year for a period of at least one day, as a "Joint ICES/IMO/IOC Working Group on Ballast Water and Sediments" (WGBWS), to review annual progress on the scientific studies of ballast water and sediments and on technical management approaches, as well as pertinent policy issues and developments. IMO should be represented by the Chair of the IMO Marine Environmental Protection Committee's (MEPC's) "Working Group on Ballast Water", as well as by a second IMO representative. IOC should be represented by the Chair of the IOC "Intergovernmental Panel on Harmful Algal Blooms" (IPHAB), as well as by a second IOC representative. A representative of the International Chamber of Shipping (ICS) could be invited as well, as could a representative of the FAO European Inland Fisheries Advisory Committee (EIFAC), as noted below. ICES should be represented by all WGITMO members attending its annual meeting. The Joint ICES/IMO/IOC WGBWS meeting will be convened during the regular annual meetings of WGITMO, with the provision that either IMO headquarters in London or IOC headquarters in Paris could act as a host venue for one or more of the regular WGITMO meetings. The Joint WGBWS would consider the broad range of scientific, sampling, management, and international cooperative issues relative to ballast water and sediments, as well as additional issues that may be pertinent. Examples of the latter include, but are not limited to: (a) the dissemination of particular groups of organisms by ballast (for example human health pathogens, phytoplankton, zooplankton, and other plants and animals), (b) proposed control options, (c) understanding the role of ballast inoculations in the subsequent establishment of invasive species, (d) the sharing of databases, and (e) the contributory role of other ship-associated vectors (such as hull fouling). The Joint WGBWS would meet for a four year period commencing in 1997 and ending in the year 2000, at which time its usefulness and continuance would be evaluated by all three sponsoring organizations. Since several introduced organisms, especially in the Baltic Sea, appear to originate in inland Eurasian waters and are spread by riverine vessel traffic, ICES should further communicate with representatives of EIFAC to participate in the Joint WGBWS.

4) ICES Member Countries are asked to collect data on the diversity, abundance, and extent of any organisms unintentionally accompanying known, and particularly regular, commercial shipments of fish and shellfish transferred between ICES Member Countries, and to present such data to the 1997 WGITMO meeting.

5) ICES Member Countries are requested to compile information on the introductions and transfers of marine and brackish water ornamental organisms (fish, invertebrates, algae, and higher plants (phanerogams)) into their countries. This information should be presented to ICES in time for consideration at the 1997 WGITMO meeting. The purpose of this assessment is to provide data on which species and which sources of ornamental organisms may present the highest risks of introducing or transferring pathogens and/or establishing self-sustaining populations. These pathogens, or the ornamental organisms themselves if they were to become established, could

have negative impacts on native species or natural ecosystems. This concern is based on the rapidly increasing interest, in many countries, of keeping ornamental organisms. These organisms are kept in private and public aquaria, in open saltwater and brackish water ponds and enclosures, and in tourist-oriented coastal seascape settings. ICES is concerned that with such increasing and global trade, the accidental transfers of fish pathogens could and will affect fisheries resources in ICES Member Countries (for example, epizootic ulcerative syndrome (EUS) through the transfer of fish species from EUS-enzootic (Southeast Asian) countries). Both freshwater and marine species are of concern. Pathogens found in either environment may be transferable to the other. Communication with EIFAC would be useful, and such communication could be facilitated by a member serving on both the ICES and EIFAC working groups on introductions. ICES is aware that the Office International des Epizooites (OIE) will share some of the concerns noted, and thus communication with relevant authorities on this matter at OIE should be established.

6) ICES reminds its Member Countries that genetically modified organisms (GMOs) are now included in the *1994 ICES Code of Practice on the Introductions and Transfers of Marine Organisms* (COPITMO). ICES is aware that there is a growing interest in the development of transgenic fish, algae, and other organisms in ICES Member Countries. Activities relative to GMOs, including laboratory experiments that have been initiated or are being planned, should be included in the annual National Reports submitted to WGITMO by ICES Member Countries.

7) Relative to the continued mariculture operations in the State of Maine, USA, on domesticated, cultured strains of the Asian red alga *Porphyra yezoensis*,

   a) ICES sees no objection to proceeding with culture operations utilizing additional strains of this alga that do not differ in their reproductive requirements (and thus their potential to become established in the wild in the State of Maine) from that strain, being *Porphyra yezoensis* cultivar strain U-51, previously approved by State of Maine authorities for culture;

   b) ICES urges the continuation of an aggressive monitoring program for plants with monospores or sexual reproduction outside the farm's physical grow-out structures, especially after any new strains are acquired and deployed for grow-out;

   c) ICES requests the continued reporting to its WGITMO of any expanded or new grow-out sites, sites which WGITMO understands to be limited to the State of Maine or to the Province of New Brunswick, Canada, and sites which in turn WGITMO understands are or would be in temperature regimes that do not differ from those of Eastport, Maine (the site of current mariculture operations) and thus being at sites where the strains of *Porphyra yezoensis* that are now being used or that are being contemplated for future use, will not and cannot reproduce in the wild, and,

   d) ICES requests the continued reporting to its WGITMO of any experimental, quarantined, laboratory development, of any transgenic strains, cultivars, or populations, of *Porphyra yezoensis* in western North Atlantic waters or in any of the ICES Member Countries.

8) Continued communication between the Baltic Marine Biologists' "Working Group on Nonindigenous Estuarine and Marine Organisms" (BMB NEMO) and WGITMO should be maintained by regular correspondence or meetings between the Chairs of the two groups, so that issues of importance and information on new developments and new regulatory procedures can be exchanged and discussed,

9) The Working Group on Introductions and Transfers of Marine Organisms (Chairman: Dr J.T. Carlton, USA) will meet in La Tremblade, France, from 21–25 April 1997 to:

   a) meet in joint session for a period of at least one day with representatives of IMO and IOC relative to current critical developments in ballast water and sediment management and the role of ballast water and sediments in the introduction of alien species to ICES Member Countries and relative to the continued exchange of information;

   b) continue the assessment of potential marine biocontrol activities and the risks thereof, through the invitation to biocontrol researchers to the 1997 WGITMO meeting, as for example researchers working on the control of the invasive seaweed *Caulerpa* or the invasive comb jellyfish *Mnemiopsis*, with a goal of formulating a brief review of the efficacy of various other measures (mechanical, chemical, or otherwise) that have been employed to control exotic species invasions;

c) continue to assess the disease and ecological implications arising from the introduction and transfer of aquarium (ornamental) marine and estuarine species into ICES Member Countries;

d) prepare and undertake risk assessment retrospectives for selected case histories of introduced marine plants, invertebrates, and fish in ICES Member Countries, in order to provide a stronger basis for future considerations of newly proposed introductions and transfers;

e) assemble materials toward an ICES Cooperative Research Report on a "Directory of Vectors Involved in the Introduction and Transfer of Marine and Estuarine Organisms";

f) report on the current status of fish, shellfish, algal, and other introductions in and between ICES Member Countries, through submission of annual National Reports, and in particular through continued overview of (i) the status of the culture of the marine seaweeds *Porphyra yezoensis* on the Atlantic coast of North America and of Undaria *pinnatifida* on the Atlantic coast of Europe, and its subsequent dispersal and establishment in other ICES Member Countries, (ii) the potential and risk of dispersal of the Mediterranean alga *Caulerpa taxifolia* into Atlantic waters, (iii) the increasing expansion and dominance of the American marine worm *Marenzelleria*, (iv) the increasing activities with GMOs in ICES Member Countries, and (v) the continued development and coordination of cooperative data bases on introductions and transfers of marine and brackish water organisms.

Through the auspices of the General Secretary representatives of IMO, IOC, ICS, OIE, and EIFAC will be invited to attend specific sessions pertinent to their interests.