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the Exploration of the Sea

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Mariculture Committee

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

Edinburgh, Scotland, May 31 - June 3, 1988

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SUMMARY
and
1988 HIGHLIGHTS OF IMPORTANT ADVISORY INFORMATION ON INTRODUCTIONS

* **The release of seawater and freshwater ballast by ships, and the intercountry movement of bait, can and does result in critical accidental introductions of exotic species**

The continued release of foreign ballast water by ocean-going vessels is now a major mechanism of transoceanic and intercontinental accidental transportation of marine and aquatic organisms, as witnessed by the recent appearance of the European river ruffe Gymnocephalus cernua and the water flea Bythotrephes in the USA Great Lakes, and by growing concerns over the accidental inoculation of toxic-bloom causing phytoplankton (dinoflagellates). The movement of aquatic and marine organisms for bait, and their intentional and accidental release over wide regions, are also major causes for concern relative to unrestricted movements. International and national control measures should be studied.

* **North Atlantic wild salmon stock genetic integrity may be threatened by the rapidly growing releases and movements (introductions and transfers) of cultured salmon**

Rapid expansions of sea cage culture of Atlantic salmon (Salmo salar) throughout the North Atlantic, using fish farm stock and other potentially inbred genotypes, have led to the widespread accidental and/or intentional releases of these fish, causing serious concern over the genetic integrity of natural (wild) salmon populations with which these cultured fish may interbreed. A joint meeting of the ICES Working Group on Introductions and Transfers and representatives of the North Atlantic Salmon Conservation Organization (NASCO) addressed these and related concerns in a one-day session. Genetic studies attempting to establish inter- and intra-population genetic identification of salmon stocks are now in progress in the U.K. Modification of natural genomes may result in potential modifications in the biological and ecological adaptations of the Atlantic salmon.

* **The coho salmon Oncorhynchus kisutch has established a resident reproducing population in the Cornwallis River, near Halifax, Nova Scotia, apparently as a result of releases of this species in the USA**

It has now been established that coho salmon have apparently been reproducing in Nova Scotia every year since 1978 (with the exception of 1983 and 1985). As native Atlantic salmon also reproduce in this same river, further studies by Canadian officials are encouraged to closely monitor this overlap of native and exotic salmon species.

* **The Japanese brown alga Undaria pinnatifida is reproducing naturally on the Atlantic coast of France**

  The Japanese brown kelp Undaria pinnatifida, outplanted at the Ile d'Ouessant on the Brittany Peninsula for experimental studies on growth and culture, was found in the summer of 1987 to be naturally reproducing at this site. Two separate studies are now in progress to assess the extent and potential of this natural reproduction, and to provide a foundation for ICES recommendations relative to future cultivation of this alga on the Atlantic coast of France.

* **The Japanese brown alga Sargassum muticum has now reached Scandinavia (Sweden)**

  The Japanese brown seaweed Sargassum muticum was discovered to be growing and established in 1987 on the Swedish coast, the furthest north this invasive species has been recorded since its appearance in western Europe in the early 1970s.

* **Two symposia (1988 and 1990) are planned to review the biological, ecological, pathological, and practical (applied) concerns relative to the introductions and transfers of marine and aquatic organisms in ICES member countries**

  A minisymposium in October 1988 and a major symposium in 1990 are planned to address in detail theoretical and practical issues relative to pressing concerns over biological invasions in marine and aquatic waters, accidental and intentional, in ICES member countries. The extent and range of such invasions, from seaweeds to invertebrates to fish, continue to increase in some regions in an unbated fashion. These symposia are focused on reviewing in detail case histories of such introductions to lay the groundwork for more sophisticated predictions and control measures relative to introductions and transfers.

WORKING GROUP ON INTRODUCTIONS AND TRANSFERS OF MARINE ORGANISMS
Report of a meeting, held May 31 - June 3 1988 at Edinburgh, Scotland

Introduction

The 1988 meeting of the ICES Working Group on Introductions and Transfers of Marine Organisms was held at the Headquarters of the North Atlantic Salmon Conservation Organization (NASCO) in Edinburgh, Scotland, from May 31 to June 3 1988. Nine participants representing 8 member countries were present:

C. Sindermann	United States of America	(Chairman)
J. Carlton	United States of America	(Rapporteur)
R. Cutting	Canada	
V. Jacobsen	Denmark	
H. Grizel	France	
S. de Groot	Netherlands	
E. Egidius	Norway	
V. Bye	UK (England and Wales)	
A. Munro	UK (Scotland)	

In addition, reports were received from Ireland (D. McCarthy). Also present during part of the meeting were Drs. M. Windsor and P. Hutchinson (NASCO) and A. Youngson (Marine Laboratory, Aberdeen). Communications were also received from B. Dybern (Sweden), H. Quiroga (Spain), and H. Rosenthal (FRG).

The members of the WG were welcomed by Dr. Malcolm Windsor, Secretary of NASCO. The Chairman thanked NASCO for coordinating and hosting the meeting and for providing its facilities, and then reviewed the purposes and goals of the Working Group's 1988 meeting, including a one-day joint session with NASCO to discuss mutual overlapping interests and to broaden the communication network relative to introductions and transfers of salmonid fishes. The AGENDA for the meeting was considered and with revisions approved (Appendix I).

STATUS OF WORKING GROUP RECOMMENDATIONS FOR 1987

The Chairman reviewed the status of recommendations formulated at the last meeting of the Working Group in Brest, France in June 1987 (1987 Report, C.M.1987/F:35, pp. 24-25) and submitted for consideration at the 75th Statutory Meeting of ICES in Copenhagen in October 1987:

Recommendation 1
That the report, "Code of Practice and Manual of Procedures for Consideration of the Introduction and Transfer of Freshwater and Marine Organisms" be published in the ICES Cooperative Research Reports series.

> C. Res. 1987/1:9: The report will be published in the CRR series. Status: The "Manual" (G. Turner, Canada, Editor) is in final draft and about to be submitted for publication.

Recommendation 2
That a symposium be convened, entitled "Case Histories of the Effects of Introductions and Transfers on Marine and Aquatic Resources and

Recommendation 2 (continued)
Ecosystems" in cooperation with FAO/EIFAC prior to the 1990 Statutory meeting, with Dr. C. J. Sindermann and Prof. K. Tiews as co-convenors.

> The Mariculture Committee (Proces-Verbal de la Reunion for 1987, p. 78) supported this proposal. See Recommendation No. 3 for 1988, herein.

Recommendation 3
That continuing concern be expressed over the trans-Atlantic and other transfers of Atlantic salmon relative to the genetic and ecological implications of stock mixing, and urges that studies be encouraged by ICES member countries to determine means of stock identification and to examine the effects of these movements.

> C. Res. 1987/2:42a: a one-day joint meeting be convened with NASCO these matters

Recommendation 4
That a permanent computerized record of the introductions and transfers of marine organisms in and between ICES member countries be established.

> C. Res. 1987/2:42c: this proposal should be considered, in consultation with the Secretariat, at the 1988 WG meeting

Recommendation 5
That NASCO, including its Bilateral Scientific Working Group on Salmonid Introductions and Transfers, be invited to meet in a one day joint session with the ICES Working Group.

> See Recommendation 3 (above)

Recommendation 6
That the WG meet in Edinburgh, Scotland, in May-June 1988 to continue the work before it (and so listed)

> C. Res. 1987/2:42: passed

NATIONAL SUMMARIES OF INTRODUCTIONS AND TRANSFERS

1.0 Relevant laws and regulations

Canada

Canada's "Fish Health Protection Regulations" were amended in November 1987. The amendment involved the transfer of BKD (bacterial kidney disease, Renibacterium salmoninarum) from Schedule II ("Certifiable" Diseases or Disease Agents) to Schedule IV ("Notifiable" Diseases or Disease Agents).

The Province of Manitoba introduced a regulation (Part III(5)) as follows: "No person shall bring into Manitoba for use as bait any live fish, crayfish, leeches, or salamanders."

1.0 Relevant laws and regulations (continued)

Canada (continued)

A new impetus is directed toward development of a nation-wide set of federal regulations to address import or export, interprovincial and intraprovincial introductions and transfers of all aquatic organisms having potential impacts including fish health, genetics, or ecology for implementation within two years.

Netherlands

There are new 1988 regulations by the Fisheries Directory relative to the importation of live finfish (freshwater and marine) based on Article 2(b) of the Fisheries Law of 1963; a copy was submitted of "Advies 'Importregeling Levende Vis'". The new regulations prohibit the importation of live sperm, eggs, or fish (exceptions are for human consumption, ornamental fish, garden fish, restocking, or as part of normal and ongoing trade). Definitions and permit issuing authorities are detailed. Requirements for exceptions include a health certificate from country of origin, the specifics of importation methods and crossing stations, and 24 hour pre-notice. Imports can be banned from entire regions effected by a disease agent.

UK

A summary of current legislation controlling imports and transfers was submitted (this will be included in a proposed document summarizing national laws and regulations of ICES member countries concerning introductions and transfers of marine organisms). There have been no changes in legislation during 1987. Representatives of the water industry and fish farmers supported by conservation organizations are pressing government to improve the controls over the imports of fish and other aquatic organisms. They are particularly concerned that no health certification is required for ornamental freshwater fish and that there are no constraints on the import of marine species. The government is currently reviewing its controls.

2.0 Other procedures concerning introduced species

Canada

Development of a policy and procedure has been underway for ensuring adequate broodstock for the salmon aquaculture industry especially in the Maritime Provinces. A federal/provincial government and industry committee has completed a plan to provide broodstock in New Brunswick. Test movements with quarantine facilities have been tried to determine efficacy of moving salmon eggs from cage-reared salmon between provinces.

Prince Edward Island has established a Fish Transfer Committee of federal/provincial representatives to consider introductions of non-indigenous species other than Fish Health Protection Regulations certified rainbow trout (*Salmo gairdneri*) or brook trout (*Salvelinus fontinalis*).

UK

The non-indigenous Atlantic salmon parasite, *Gyrodactylus salaris*, was added to the list of notifiable diseases in March 1988 under the Diseases of Fisheries Act.

2.0 Other procedures concerning introduced species (continued)

ICES Revised Code of Practice

Dissemination of the code continues to be emphasized by the Working Group. V. Bye (UK England and Wales WG representative) has published the code in the MAFF publication, "Trout News" (No. 5) for March 1988; a copy was submitted. H. Grizel (French WG representative) has prepared a translation of the Code and of ICES Cooperative Research Report No. 130; a copy was submitted.

3.0 Deliberately introduced animal or plant species
3.1.2 Deliberately introduced fish: mariculture

A summary of releases and transfers of eggs and juveniles of salmonid fishes is given in Tables 1 and 2, and the footnotes therein.

Denmark

500 kg of elvers (Anguilla anguilla) were imported from Bristol Channel, UK and released after quarantine in the Gudena. 84,000 specimens meant for stocking were released at four points in Denmark (80% originated from elvers imported from the UK and 20% from France).

U.S.A.

Salmon Releases in New Hampshire, Massachusetts, and New Jersey

MASSACHUSETTS resumed releases of coho salmon (none were released in 1987). Eggs stripped from returns of prior releases (now fifth and sixth generation fish stemming from original introductions from Pacific coast) were raised in the hatchery to provide some of the release stock. Additional fish, obtained as fingerlings, were air-freighted from a Lake Michigan hatchery. There are no major diseases associated with these Great Lakes fish being released into Massachusetts. (They do not obtain stock from the Pacific coast of North America because of disease problems there). Massachusetts is planning upon releasing Lake Ontario (New York State) coho salmon as well (fry in May 1988; parr in fall 1988; more in spring, 1989). There were no reported returns of coho salmon in the fall of 1987. State fishery agents attribute this to the low numbers of released fish in prior years.

NEW HAMPSHIRE continued releases of coho, chinook, and steelhead. An outbreak of BKD (bacterial kidney disease) in their hatchery this year caused an approximately 20% loss in the coho yearling stock. (Salt was added to the water to relieve stress). Returns from prior releases were very low; less than ten coho salmon were reported caught in the summer and fall of 1987 (from 1986 releases).

THE NEW JERSEY Division of Fish, Game and Wildlife began in December 1987 stocking small numbers of chinook salmon (Oncorhynchus tshawytscha) and steelhead trout (Salmo gairdneri), a migratory strain of rainbow trout, in the Raritan River, which empties into the Atlantic just south of New York City. Eggs of the chinook salmon were obtained from a

(continued on text page 9)

Table 1.

RELEASES AND TRANSFERS OF JUVENILE SALMONID FISH IN 1987
(summarized from National Reports)

Key:
K = thousands, m = millions
sm = smolts; f = fry; fg = fingerlings; juv = juveniles
(n) = see notes, below

Species	From	To	Action
Atlantic salmon *Salmo salar*	Iceland	Norway (1)	924K sm
		Ireland	juv (2)
	France	Netherlands	4K sm from R.Meuse
	Sweden	Norway	236K sm
	Finland	Norway	124K sm
	Maritimes	Nova Scotia	1K sm and 1/4m fry
		New Brunswick	171K sm and 130K f
	New Brunswick	Maine	sm (3)
	U.K.	various	(4)
	Various	Ontario	(5)
Rainbow trout (Steelhead) *Salmo gairdneri*	Northern Ireland	Scotland	100K (age?)
		Ireland	470K juv (1986)
			520K fry (1987)
	Denmark	Ireland	143K juv (1987)
	Dnmk hatcheries	Isefjord,Dmk	4K tagged
	Iceland	Ireland	200K fry (1986)
	New York State	New Jersey	1.2K (1988) (6)
	Lake Michigan	New Hampshire	37.1K (1988) (6)
	Alberta	Manitoba	300K fg
	Various	Canada	(note 7)
Arctic char *Salvelinus alpinus*	Various	Manitoba	to establish viable poplation
	New Brunswick	Bay D'Espoir hatchery	100 fg from marine lab
Coho salmon *Oncorhynchus kisutch*	Lake Michigan	Massachusetts	20.1K (1988); 1K (1987)
		New Hampshire	151.3K (1988)
	Mass.returns	Massachusetts	21.4 (1988) (8)
Chinook salmon *Oncorhynchus tshawytscha*	New York State	New Jersey	50K (1987), 88K (1988) (9)
	New York State	New Hampshire	40K (1988)

Table 1.
RELEASES AND TRANSFERS OF JUVENILE SALMONID FISH IN 1987
(continued)

Table Notes:
(1) **NORWAY** imports were more than 2m < than salmon smolt imports in 1986 the imported fish shown went mainly to the three northernmost provinces
(2) **IRELAND** imports of juveniles: number not legible in 1987 report
(3) **NEW BRUNSWICK** (Canada) smolts exported, as in 1986, from a private hatchery to an affiliated commercial rearing facility in Maine (USA).
(4) **U.K.**:
Atlantic salmon hatcheries: There are 39 hatcheries producing parr and smolts for fishery enhancement or for on-growing at commercial marine sites. Approximately 1m smolts will be produced in 1987. The eggs for these hatcheries were obtained either from natural local populations or from natural and cultivated broodstocks in Scotland. Regional Water Authorities run 13 of these hatcheries primarily for restocking their own waters for fishery enhancement. The remaining 26 privately run hatcheries produce smolts for on-growing in commercial cage salmon farms (mostly in Scotland, and a few in England and Wales). Several large salmon hatcheries are planned or under construction.
Saltwater farms: There are 4 operating sea sites which will produce approximately 500 tons of salmon in 1988. One farm is a pump-ashore site on the northeast coast of England, the others are cage sites, two on the south coast of England and one in an estuary in southwest Wales. A pump ashore site in Wales is expected to produce salmon in 1989 and a small cage unit in an east coast estuary is believed to be rearing small quantities of salmon.
(5) **ONTARIO** (Canada) continues its program of importing Atlantic salmon to support the provincial aquaculture industry with sufficient biomass for self-sufficiency in broodstock.
(6) **UNITED STATES**: Juvenile fish from Salmon Falls Hatchery, on the Salmon River, New York State (at Altmar) released into the Raritan River, New Jersey by New Jersey Division of Fish and Game; juvenile fish from Lake Michigan released into the Great Bay Estuary, New Hampshire, by the State of New Hampshire.
(7) **CANADA**: fingerlings introduced from Ontario, Quebec, and Prince Edward Island (one facility each) to six facilities in New Brunswick, one in Nova Scotia, and three in Prince Edward Island for use in aquaculture production. Juveniles were introduced from two Ontario faciliites to university and government facilities for research or bioassay purposes (and ultimate destruction). Rainbow trout in general continue to be spread by private fish growers into private waters.
(8) **UNITED STATES:** Coho are released by Massachusetts into the Indian Head River, a tributary of North River and by New Hampshire into the Great Bay Estuary. "Massachusetts returns" = hatchery reared juveniles from eggs stripped from returns of prior releases
(9) **UNITED STATES:** Chinook are released by New Jersey in the Raritan River and by New Hampshire in the Great Bay Estuary; stock is derived from the Salmon Falls Hatchery (see note 6, above).

Table 2.

TRANSFERS OF SALMONID FISH EGGS (OVA) IN 1987

Key:
K, thousands; m, millions

Species	From	To	Numbers
Rainbow trout *Salmo gairdneri*	Denmark	England,Wales (1)	19m
		Scotland (2)	12.5m
		Ireland	3.4m (1986)
			250K (1987)
	Finland	Ireland	340K (1986)
	Iceland	Ireland	200K (1986)
	USA	England and Wales	10m
		Scotland	10K
	Australia	England and Wales	12m
	Tasmania	Ireland	1.1m (1986)
			850K (1987)
	Canada	Scotland	40K
	South Africa	England and Wales	400K
	Isle of Man	England and Wales	small nos.
	Northern Ireland	England and Wales	small nos.
		Ireland	400K (1986)
			575K (1987)
		Scotland	1.35m
	U.K.	Ireland	400K (1986)
	West Virginia	Nova Scotia	---
		Prince Edw.Is.	---
	Washington State	Maritimes	---
	Indiana	Ontario (L.Huron)	--- (note 6)
	Ontario	Quebec	---
Atlantic salmon *Salmo salar*	USA	Wales	70K (3)
	Norway	Scotland	600K
		Ireland	1.08m (1986)
			4.7 m (1987)
	Finland	Scotland	600K
	Scotland	Ireland	1.08m (1986)
			5.34m (1987)
	Ireland	Spain	500K (1986)
			500K (1987)
	N. Ireland	Ireland	100K
	Iceland	Ireland	(note 4)
	Nova Scotia	Ontario	48.5K (5)
	New Brunswick	Ontario	15K (5)
	Maine	Ontario	50K (5)
	Various	Canada	(note 8)
Arctic char *Salvelinus alpinus*	Labrador (Fraser River)	Newfoundland	(note 7)
	Manitoba	Newfoundland	5K
	Labrador	Nova Scotia, Prince Edward Is.	---
Coho salmon *Oncorhynchus kisutch*	Washington and Oregon	France	17m (note 9)
Brown trout *Salmo trutta*	Scotland (Howietoun)	Chile	50K (note 10)

Table 2.
TRANSFER OF SALMONID FISH EGGS (OVA) IN 1987
(continued)

Table Notes:

(1) **ENGLAND AND WALES**: Although there are several large brood stock farms in England and Wales which supply at least half of the UK demand for eyed ova, substantial numbers are still imported from overseas. During 1987 48 licenses were issued for the import of up to 42m eyed ova of rainbow trout; the majority were used for freshwater culture of trout (for the table or restocking), but at least 500K were used for seawater farming of large trout. Imports of eyed trout ova for the first 4 months of 1988 ran at an even higher level than in 1987. July imports are to cover a period when UK eggs are not easily available; this also applies to a lesser extent in April-May. Danish imports are preferred because of superior quality, availability, production performance and price. UK broodstock farms are attempting to increase quality, quantity and seasonal availability of trout eggs in order to reduce imports. One UK producer exports >15m eyed ova/year "to many parts of the world"; most are female-only or sterile, female-only triploids.
(2) **SCOTLAND**: 33 licenses were issued in 1987 for rainbow trout ova importation
(3) **WALES**: In 1987 a Welsh farm imported 20K eyed ova of landlocked Atlantic salmon from the USA for use in freshwater recreational facilities; 500K more eyes came from the same source in February 1988.
(4) **IRELAND** imports of ova: number not legible in 1987 report
(5) **CANADA**: 48,457 eggs from LaHave River, NS, a 15K egg lot from Saint John River, NB, and 50K from Union River, Maine, USA were introduced in an attempt to establish a breeding population and angling recreational fishery in Credit River and Wilmot Creek, tributaries of Lake Ontario
(6) **CANADA**: eggs of steelhead strain were imported from Indiana USA for establishing a population in a Lake Huron tributary
(7) **CANADA**: Eyed arctic char eggs from Labrador were destroyed when enteric redmouth disease (ERM) and kidney disease (BKD) were found in the broodstock. Eggs from Iceland (and fingerlings from New Brunswick) were brought to university facilities in Ontario for research purposes.
(8) **CANADA**: Rainbow trout eggs were introduced from four facilities in Ontario and one each in Quebec, Washington, and Prince Edward Is. to eight facilities in New Brunswick, three in Nova Scotia, and four in Prince Edward Island for use in aquaculture production
(9) **FRANCE**: Seventeen million coho salmon eggs were imported from Washington and Oregon. These importations have permitted the commercialization of 330 tons of coho of which 80 tons have been raised in the sea. The expected production in 1988 will be 900 tons of which 130 tons will be raised in the sea. Selling of the fish occurs 12 to 18 months after growing, the weight being between 400 and 1500 g.
(10) **SCOTLAND to CHILE**: fingerlings subsequently released in wild.

3.1.2 Deliberately introduced fish: mariculture (continued)

U.S.A. (continued from text page 4)

Salmon Releases in New Hampshire, Massachusetts, and New Jersey hatchery on the Salmon River in New York State which empties into Lake Ontario. Fish were reared in New Jersey prior to release; numbers of smolt released were 50,000 in 1987 and 88,000 in 1988. Also in 1988 a smaller number (1,200) of steelhead was released. New Jersey has conducted a review and has concluded that the introduced fish will not conflict with existing species (in particular brown trout, Salmo trutta). It is expected that future stocks will be derived from hatchery production and would not be self-sustaining.

3.1.3 Deliberately introduced fish: live storage prior to sale

Canada

Tropical fishes are imported to Canada for the aquarium trade, but no attempt has been made to formalize record-keeping.

UK: England and Wales

Almost 900 licenses were issued for the importation of living ornamental and tropical fish (and for salmonid eggs). Some of the ornamental and tropical fish were marine species intended for public and private aquaria. The numbers of live fish are not recorded but they are estimated as several million.

3.1.5 Deliberately introduced fish: captures of introductions originally made in neighboring countries

Denmark

Nielsen (1988) reports that the big-head carp (Cyprinidae: Aristichthys nobilis) was caught in a net in September 1987 near Klintholm Harbour, Mon., on the border of the Baltic Sea. It is an Asian species imported by the Russians, Polish, and Germans for freshwater culture. Nielsen also reported the capture of the marine fish Pagellus acarne (Sparidae) near Tjaereborg, in the North Sea, in August 1987. It is known from England, the Mediterranean, and Senegal.

3.1.6 Deliberately introduced fish: research purposes

Canada

Sailfin mollies (Poecilla latipina) from Florida (n = 450) and winter flounder (Pseudopleuronectes americanus) from New Brunswick (n = 24) were brought to the Memorial University's Marine Sciences Research Laboratory in Newfoundland for research purposes.

UK: England and Wales

Black sea turbot (Scophthalmus maeoticus maximus) caught in the Black

3.1.6 Deliberately introduced fish: research purposes (continued)
UK: England and Wales (continued)
Sea have been imported for rearing trials and are being grown onto maturity for use as broodstock. They are presently contained in an indoor rearing system. (There is also a report that Black Sea turbot at approximately 500g were transferred to on-shore marine tanks in Scotland, probably in 1987)

Several Tilapia species are in use in a variety of research projects in university departments. Other marine species may have been imported by university departments and other organisations for research projects but details are difficult to obtain since no licensing is required.

It is known that at least one aquaculture company is experimenting with the culture of clown fish (Amphiprion percula) with a view to supplying the UK aquarium market.

3.2.1 Deliberately introduced invertebrates: fishery enhancement

U.K.: England and Wales

Refer to discussion of the Manila clam, Tapes philippinarum, at section 6.0 (species introduced for hatchery rearing).

3.2.2 Deliberately introduced invertebrates: mariculture

Denmark

Experiments on introducing the Japanese scallop Patinopecten yessoensis into Danish waters has continued. No new releases have been performed. It is expected that spat from adult specimens near Laeso will be reared and subsequently replaced. These experiments will be supervised by the Danish Aquaculture Institute.

France

A brood stock lot of the Japanese scallop Patinopecten yessoensis was brought in from Japan and placed in quarantine at Arcachon. Zoosanitary measures revealed the presence of ricksettsia infections and the presence of parasites similar to rhizocephalans. Difficulties may be encountered in disseminating such information when the stock suppliers are sensitive about concerns over pathological or parasitological problems.

These animals have been raised in vats the effluent water of which is treated with chlorine. As of this date 85 thousand juveniles (2mm) have been obtained which will be put on hanging culture into the Mediterranean (50 thousand) and Brittany (35 thousand) for rearing. The brood stock has been destroyed. (IFREMER reviewed some of this work at the Sixth International Pectinid Workshop at Menai Bridge, Wales in April 1987; earlier mention is also found in the WG 1987 Report, page 14).

Ireland

A total of 18 million Pacific oyster spat (Crassostrea gigas) were imported from the UK and Northern Ireland.

Netherlands

Flat oysters (Ostrea edulis) are imported from Maine (USA) (they belong to the original strain of Zeeland oysters transported to the States in the 1950s). This activity may harbor the risk of importing unwanted marine organisms. The decline of the original Zeeland oyster in

3.2.2 Deliberately introduced invertebrates: mariculture

Netherlands (continued)

the Netherlands gave rise to this activity. Imported spat have been examined and no evidence of haplosporidians was found.

Norway

Lobsters (Homarus) from Scotland are imported in August-September for ongrowth and re-exported around Christmas.

Manila clams (Ruditapes semidecussata (= Tapes philippinarum) are imported as brood animals from Scotland. They are held in quarantine and destroyed after spawning.

3.2.3 Deliberately introduced invertebrates: Live storage prior to sale

France

Principal importations of shellfish destined for direct consumption after passage through a quarantine station were: (in tons)

From	Ostrea edulis (flat oyster)	Mytilus edulis (mussels)
Ireland	39.5	4,200
United Kingdom	53	3,300
Spain	---	8,120
RFA	---	308

UK:

A few (4) American lobsters (Homarus americanus) were imported and held prior to sale in Scotland. American lobsters are imported live to England and Wales both for consumption in the UK and for exporting to Europe. Strict quarantine controls are in force (see 1987 Report, p. 8).

3.2.4 Deliberately introduced invertebrates: Improvement of food supplies for other species

U.K.: Scotland and England

Large quantities of vacuum packed dried eggs of the brine shrimp Artemia salina are imported from several sources around the world to provide live food for ornamental fish and for juvenile fish in aquaculture and research systems.

3.2.5 Deliberately introduced invertebrates: Research purposes

U.K.: Scotland and England

Relatively large numbers of non-indigenous penaeid prawns were imported as live adults or nauplii, primarily for research but also to establish broodstocks for the production of juveniles for on-growing in closed recirculation systems in the UK or in a variety of closed and natural systems in the tropics. All were imported under quarantine conditions and rearing water was disinfected before disposal. Several importations developed disease. Species, sources, and status are:

3.2.5 Deliberately introduced invertebrates: Research purposes (continued)
U.K.: Scotland and England (continued)

Species and Sources of Penaeid Prawns Imported into UK

Penaeus monodon
(1) Hong Kong/Singapore: 500 thousand nauplii from ablated females; larvae reared to adult in some cases and ultimately destroyed for research purposes. Now (May 1988) holding about 100 post-larvae (Welsh University); Hull University and Findon Research Centre (Aberdeen) supplied with 20 each.
(2) Australia: adults imported by aquaculture consulting company for research and to establish a broodstock; recirculation system with disinfection.
(3) Source not stated: 50 female broodstock, used only for research, not for breeding (Commercial mariculture company)
(4) Philippines: 6000 postlarvae imported for research on intensive culture in recirculating system (all water disinfected before disposal) (University Dept., Scotland)

Penaeus japonicus
(1) Pemares, Spain: About 20 animals maintained at present in Aberdeen, grown from nauplii from ablated females (Welsh University)

Penaeus merguiensis
(1) Singapore: 70 postlarvae used for experimenation and now destroyed

Macrobrachium rosenbergii (freshwater prawn)
(1) Hawaii: 12 adults found to be infected with black shell disease; these were destroyed (Welsh University). Welsh University is currently (May 1988) holding about 100 breeding adults from Stirling University.

Welsh University is doing research into larval nutrition, functional morphology of larvae and adults, and maturation of adults and energetic studies aimed at supporting development of UK industry; animals are also used for teaching purposes. All animals are held in recirculation system and waste water chlorination before disposal into Menai Bridge rainwater drainage system. No animals, water, etc., have been allowed to come into contact with UK seawater systems at any time; all effluent is chlorinated for 24 hours. Two outbreaks of disease occurred: both were attributable to high ammonia and nitrite levels in the recirculating water system. Infective agent in both cases was identified by MAFF Pathology Laboratory as a common UK coastal water strain of Vibrio. (Malachite green was ineffective as a control; no antibiotics were used except in dip baths. All disease water chlorinated before returning to sewage/drainage system).

4.0 Species introduced accidentally with deliberate introductions

Status of the eel parasite (swimbladder nematode) Anguillicola crassa:

Netherlands
A special study was undertaken to investigate the effects of the

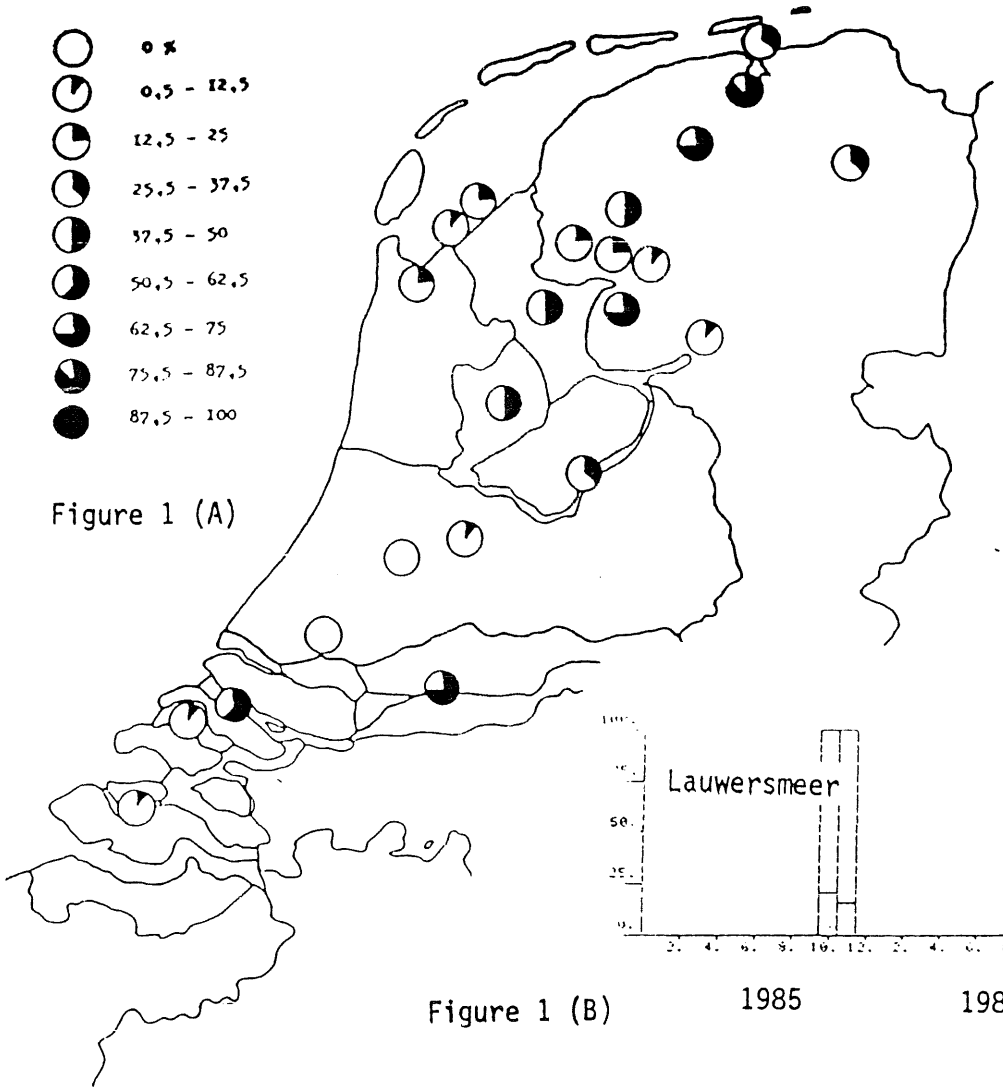


Figure 1 (A)

Figure 1 (B)

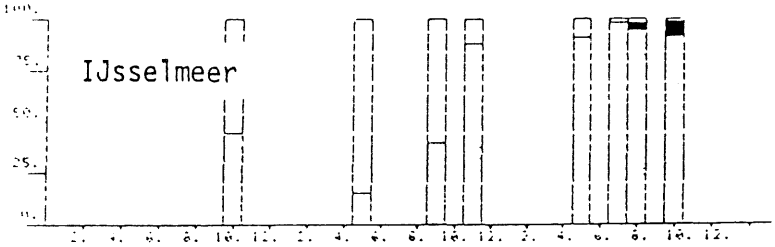


Figure 1 (C)

(A): Distribution of Anquillicola crassa in the **Netherlands** (from Dekker and van Willigen, 1987)
(B) and (C): Percentage of infected commercial eel in **Lauwersmeer** and in **Yssel Lake** (**Ijsselmeer**) per month per year: White: non-infected; Dotted: infected with living parasites; Black: no infection, thickening of the swimbladder wall

Figure 1.

4.0 Species introduced accidentally with deliberate introductions (continued)

Status of the eel parasite (swimbladder nematode) Anguillicola crassa: (continued)

Netherlands (continued)
presence of this parasite in young eel (6-15 cm group). The infection with the eel parasite is now widespread in the Netherlands (Dekker and van Willigen, 1987). The distribution is rather patchy (Figure 1 herein). Eel become infected in the freshwater phase; fish from seawater or estuarine (brackish) water show a lower infection rate. in 1987 it was observed that the swimbladder of young eel was affected in most cases due to more or less serious infection reactions, resulting in thickening of the swimbladder wall and deposit of connective tissue. The swimbladder condition restricts the survival and reproducing capacities of the nematode. The consequence of the ruptured swimbladder for the return of the eel to their spawning ground may be less than initially thought. In the end the situation of the European eel may be comparable to those of the Japanese eel, the species as a whole seeming "to cope" with the parasite.

U.K.: England and Wales
This parasite has been identified in eels in freshwater in East Anglia and the River Trent during a survey by MAFF throughout England and Wales in the autumn of 1987. Another major survey will be mounted in the autumn of 1988. Mode of introduction not known. Some heavily infected eels were taken from a power station seawater intake screen on the east coast of England. The infection had caused the swim bladders to burst making deep water migration impossible.

Dr. M. Koie, of the Marine Biological Laboratory, Helsingor, University of Copenhagen, will be presenting a paper at the special symposium on introduced species in Bergen in October 1988, on the introduced nematodes Anguillicola crassa (which has spread throughout most of northern Europe) and A. novaezelandiae (which is found in Italy), as well as the introduced monogene trematodes Pseudodactylogyrus anguillae and P. bini, Asian parasites that are also now spreading through the European eel populations. The former monogene is pathogenic to eels and is apparently the only one of the four introduced endoparasites that is able to reproduce in seawater (Dr. M. Koie, in litt., May 1988).

Other accidental introductions:

Denmark
It was noted that sportfishermen from Germany have been found to dispose of their live bait in Denmark. See discussion at Netherlands, below.

Ireland
There was an outbreak of the commercial oyster pathogen Bonamia ostreae in Cork harbour in 1987. It also now occurs in Clew Bay on the west coast of Ireland.

4.0 Species introduced accidentally with deliberate introductions (continued)

Netherlands

For shellfish no new commercial plantings of flat oysters (Ostrea edulis) was carried out in the bonamiasis infected area of Yerseke Bank. Therefore only remains of formerly planted oysters could be examined for Bonamia in the spring season (the other season samples showed no bonamiasis). The oyster area of Lake Grevelingen showed no bonamiasis infection, as has also been observed in former years.

It is to be noted that for angling purposes a great variety of marine polychaete annelid worms, particularly of the family Nereidae, are imported for either direct sale or rearing. Neither the traders (importers) nor the culturists seem to know the correct species names of the nereid worms imported. Countries of origin named included Korea (either via France or directly), USA (near Boston), and even more vaguely Africa. It was admitted that also shellfish are imported for the same purpose! The trade is completely unaware of the risks of the possible impact of importing unwanted species, disease problems, etc. Government agencies seem also unaware of this problem.

Norway

The salmon parasite Gyrodactylus salaris is in 28 out of 29 freshwater salmon (Salmo salar) rivers in Norway. A paper will be presented on this introduced parasite at the special symposium in Bergen in October 1988. In one small river, rotenone was used successfully, such that the salmon are back again but the parasite has been eradicated. It is thought that Gyrodactylus came from Sweden with imported smolts for fish farming.

U.K.: England and Wales

Spring Viraemia of carp (SVC) appeared in England in spring 1988 and is now a substantial problem in carp farms, fisheries and retail units for ornamental fish with at least 30 positive sites identified to date. The virus is thought to have entered in a legal shipment of live ornamental cyprinid fish and spread to non-ornamental cyprinids because of the increasingly common practice of maintaining both types on the same farms. Sites with positive identification are advised to kill all of their fish stocks but there are no compulsory slaughter powers.

U.S.A.

Haplosporidium nelsoni, a protozoan parasite of American oysters (Crassostrea virginica) has had severe effects on oyster production in the middle Atlantic states since the late 1950s. Recent surveys by E. J. Lewis and F. G. Kern of the Oxford (Maryland) laboratory of the National Marine Fisheries Service and by S. W. Sherburne and L. L. Bean of the Maine Department of Marine Resources have disclosed an extension of the pathogen's distribution northward to include Maine and southward to include South Carolina and Georgia. Prevalences of H. nelsoni in samples of Crassostrea virginica from these states were low, but the presence of the disease organism should be considered in any decisions about oyster movements.

5.0 Completely accidental introductions

Denmark

The Japanese algae Sargassum muticum, discovered growing in the Limfjord in June 1984 has been seen drifting in the Skagerrak in 1985. At some localities in the Limfjord it is now the dominating species.

The Australian acorn barnacle Elminius modestus which since 1963 has been seen in Danish waters appears to be very sensitive to severe winter conditions. When noticed it is a dominant species (up to 73% of barnacles counted in some regions).

The occurrence of the Chinese mitten crab Eriocheir sinensis in Denmark has been reviewed by Rasmussen (1987). Rasmussen believes that since the salinity in the Skaw is too low for the crab to reproduce, it will never be a pest in Denmark as is the case elsewhere in Europe.

Ireland

The crayfish fungal plague Aphanomyces astaci (introduced over a century ago into Europe from North America) was discovered by Dr. J. Reynolds of Trinity College (Dublin) in native crayfish stocks following heavy mortalities in the midland lakes. It is thought that the fungus was imported on crayfish pots or angling gear in 1985.

Netherlands

A new paper by den Hartog et al. (1987) reviews plant and animal invasions in the coastal, brackish, and fresh waters of the Netherlands.

Sweden

Karlsson (1988) reports that the Japanese brown alga Sargassum muticum was found for the first time in Sweden in the summer of 1987 at two separate localities, and in the spring of 1988 at a third locality. It now appears to be a permanent member of the Swedish algal flora. A review of Sargassum in Europe will be presented by G. Boalch (UK) at the special minisymposium on introduced species in Bergen in October 1988.

U.S.A.

Introduction of European River Ruffe to North America and Ballast Water Mediated Dispersal of Aquatic and Marine Organisms

The river ruffe Gymnocephalus cernua (Percidae) has dramatically appeared in the St. Louis River, in Duluth Harbor, in Lake Superior (Wisconsin) (see Figures 2 and 3). It was first found in July 1987, at which time at least three year classes (1985, 1986, and 1987) were present. Increasing numbers of specimens with a wider distribution have been found since (more than 400 taken in 1988 as of May), but only four specimens have been taken in the Lake proper (outside of the river).

The river ruffe is a northern and wester European percid inhabiting rivers and lakes and entering brackish water. It is fast growing for the first two years; after that, it slowly achieves a maximum length of 8-10 inches. The mean maximum age is about 7 years; a high mortality rate in the young is compensated for by the attainment of maturity at the age of 2 or 3 years (Lind, 1977). It is edible but is not actively sought by anglers or commercial fishermen.

The ruffe is known to consume whitefish (Coregonus lavaretus) eggs in Russia (Sterligova and Pavlovsky, 1984). It also feeds on a wide variety of benthic invertebrates, including amphipods and insect larvae

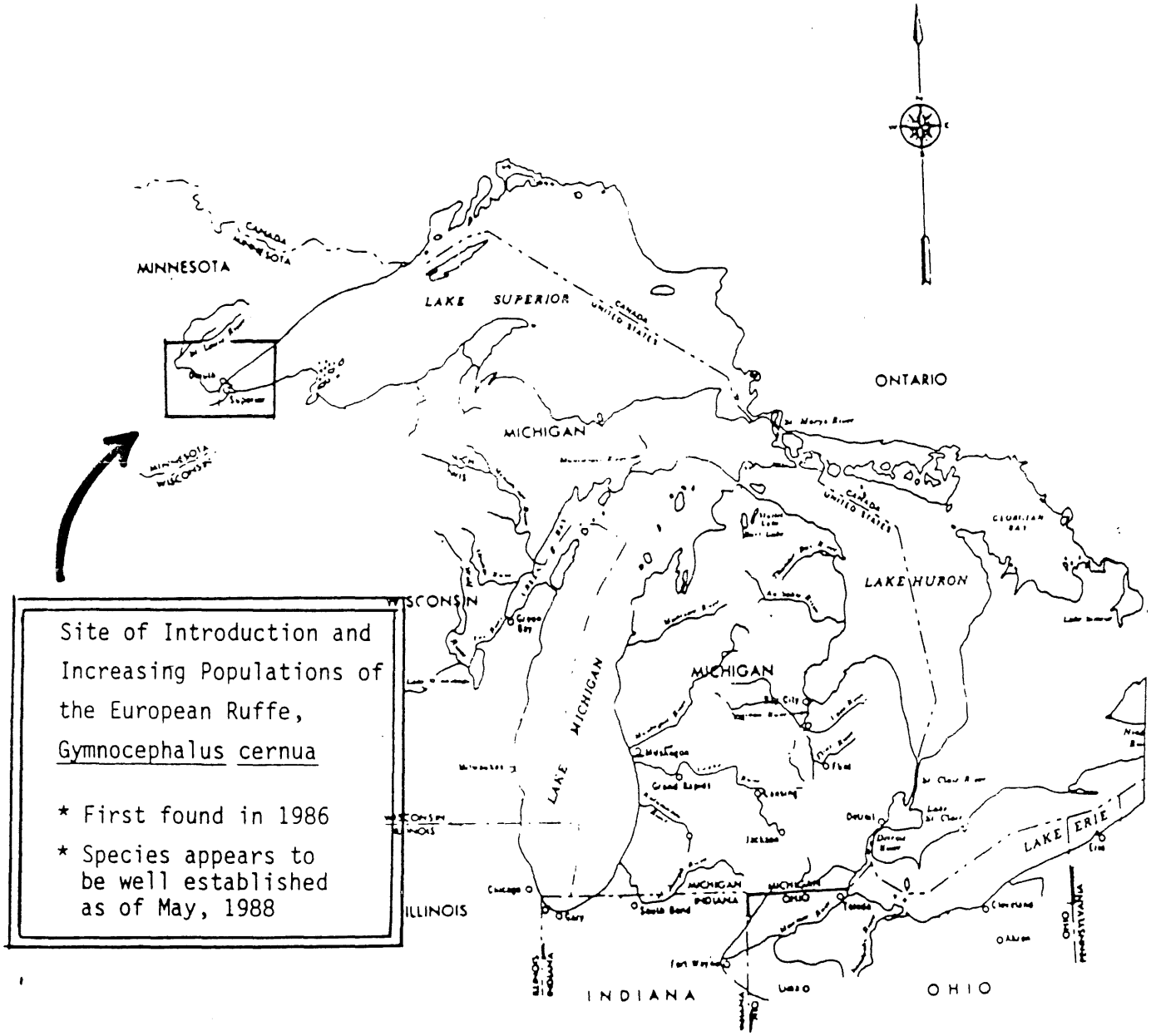
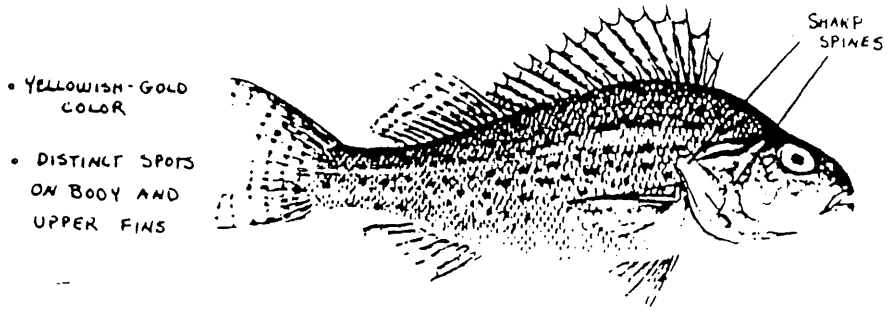


Figure 2.

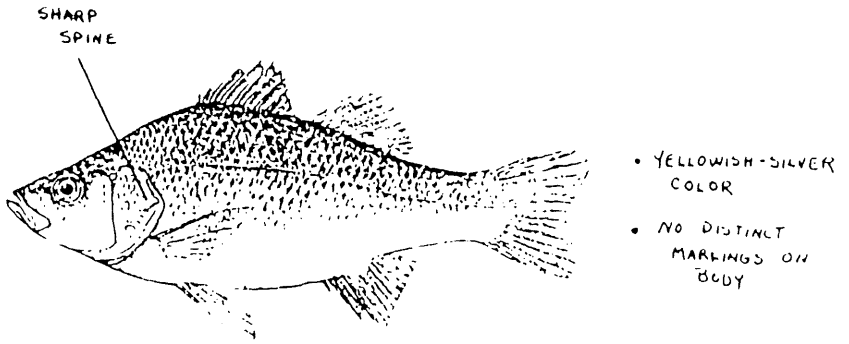
The European River Ruffe (Fish) Gymnocephalus cernua in the Great Lakes (1986-1988)

ATTENTION
EXOTIC FISH

THE FISH SHOWN BELOW HAVE BEEN FOUND IN THE ST. LOUIS RIVER BY DULUTH/SUPERIOR. THE WISCONSIN AND MINNESOTA DNR'S ARE LOOKING FOR THESE FISH. IF FOUND, TURN IN TO YOUR LOCAL DNR OFFICE OR DESTROY IMMEDIATELY. DO NOT TRANSPORT!



RUFF



WHITE PERCH

Figure 3

Popular poster announcing presence of European River Ruffe Gymnocephalus cernua in Lake Superior, Great Lakes, USA

5.0 Completely accidental introductions
(continued)
USA (continued)

(Willemsen, 1977). The ruffe, historically absent from Scotland, Wales, and Ireland, is not widely distributed in Britain (Bagenal, 1970), but was discovered in 1982 to be present in Loch Lomond, Scotland, where it has undergone a dramatic and enormous increase (Maitland, 1987). The ruffe can hybridize with perch and other fish, and became a dominant fish after it colonized the Zuiderzee.

The appearance of this exotic fish in the Great Lakes is greatly concerning fisheries biologists and managers. It was a major focus of attention at the Annual Meeting of the "Great Lakes Fishery Commission" in May 1988 in Toledo, Ohio. Whether the fish can be eliminated at this time by any control measures is not known. A primary concern is the potential effect of the ruffe on smelt, whitefish, and walleye.

Ballast Water Dispersal

The ruffe is thought to have been introduced by means of fresh or brackish water ballast discharged in Duluth Harbor from inbound cargo ships arriving from Western European ports. Other fish (the European flounder, Platichthys flesus) and invertebrates (the Chinese mitten crab, Eriocheir sinensis, and the water flea Bythotrephes [below]) are known to have been released into the Great Lakes by ballast water as well.

There is a rapidly growing concern in the United States for control of ballast water releases by cargo ships. Ballast water is now known to be an increasingly viable and critical mechanism for the intercontinental (transoceanic) accidental dispersal of many marine, brackish and freshwater organisms (Carlton 1985; Williams et al., 1988). In San Francisco Bay, in central California, USA, a Chinese or Japanese species of small marine clam (bivalve mollusk) [Potamocorbula amurensis] appeared in 1986, apparently as a result of ballast water release of larvae, and now (1988) occurs by the tens of thousands/square meter on the floor of the Bay.

The Great Lakes Fishery Commission is in the process of proposing that Canada and the United States institute regulations that would prevent further introductions of exotic fish and invertebrates into the Great Lakes. One regulation under consideration is that ships replace their river- and coastal-derived ballast water with oceanic water on the high seas. Open ocean water contains relatively fewer organisms and, more importantly, few or no species that would survive when released into bays, harbors, estuaries, rivers, or lakes.

In addition, the white perch (Morone americana), previously known to have invaded Lakes Ontario and Erie (Busch et al., 1977), has also now appeared in the Duluth-Superior region (see copy of attached poster issued jointly by the States of Wisconsin and Minnesota (Departments of Natural Resources). It is probable that it, too, has arrived in the region with ballast water transported up to Lake Superior in cargo ships that move around the Great Lakes.

Appearance of the European Water Flea (Cladoceran)
Bythotrephes cederstroemi in the Great Lakes

A European zooplankter has also appeared recently in North America,

5.0 Completely accidental introductions
(continued)
USA (continued)

probably introduced with ballast water released by cargo ships. It was first found in 1984 in Lake Huron; by 1987, it had appeared in all of the Great Lakes. The following information is based upon Bur et al. (1986), Lange and Cap (1986), and upon detailed data provided by Dr. J. Stanley of the U.S.Fish and Wildlife Service, Ann Arbor, Michigan (and presented at the Great Lakes Fishery Commission Annual Meeting in Toledo, Ohio, May 3-4 1988).

Bythotrephes has already become very important in the Great Lakes trophic dynamics in a short period of time. In Lake Erie, it is eaten by yellow perch, white bass, walleye, and white perch; by 1987, it had become the most important food item for yellow perch and white bass! In Lake Superior, it is the prey of coho salmon and brown trout. The appearance of this species has the potential for causing significant changes in the Great Lakes. It is a relatively large predator (as well as a prey item!), which preys on native Lakes zooplankton; it has been suggested by John Lehman (University of Michigan) that it caused a 10- to 50-fold drop in the abundance of the native water flea (cladoceran) Daphnia (whose loss, in turn, could affect fish that feed on this latter species).

6.0 Species introduced for hatchery rearing

A summary of releases and transfers of eggs and juveniles of salmonid fishes is given in Tables 1 and 2, and the footnotes therein.

6.2 Stock relaid in small quantities under controlled conditions

U.K.: England and Wales

Evaluations of the environmental impact of the Manila clam, Tapes philippinarum, originally introduced in 1980, continue with research centered on the MAFF Fisheries Laboratory, Conwy. Histological assessments of the reproductive potential of the clams in trial layings around the coast of England and Wales show little cause for concern. Although the clams mature gametes during the late summer there is no evidence of spawning during summer but a suggestion of minor spawning activity in the autumn in response to falling sea temperatures in some areas. Such activity at that time of year is unlikely to result in recruitment but surveys for wild sapt in the vicinity of lays will be undertaken in association with the Nature Conservancy Council in summer 1988. A number of commercial growers are showing interest in the species but involvement is small scale. Yields of up to 20 kg per square meter have been achieved in two growing seasons in MAFF trials in mesh protected ground lays.

The evaluation of the culture potential of the re-introduced American oyster Crassostrea virginica continues but research input is at present low-key due to the scarcity of seed.

7.0 Planned Introductions

U.K.: England and Wales

In 1987 a request was made to the Sea Fisheries Commission of

7.0 Planned Introductions (continued
U.K.: England and Wales (continued)

Guernsey, Channel Isles to permit the import of the Japanese brown kelp Undaria pinnatifida for culture in local waters. Following consultation with MAFF and Nature Conservancy Council the application was refused.

A proposal to import the non-indigenous annelid (polychaete worm) Arenicola cristata for release into British waters was declined primaril because of the risk of introducing disease or parasites.

U.K.: Scotland

Requests were received to import live codling (cod) from Norway and live sturgeon (Acipenser mediorostris) from the Columbia River, Washington, USA, but were denied.

8.0 Live Exports for Consumption

These data are not usually reported as the species involved are held only for immediate human consumption and not for release. Examples are:

Species	From	To
Homarus americanus	USA, Canada	Norway
American Lobster	Canada (all five eastern provinces)	Various countries
Homarus gammarus	Scotland	European countries
European lobster	U.K.	Europe and North America
Pecten maximus	Scotland	European countries
Scallop		
Scallops, various spp.	U.K.	European countries
Ostrea edulis	Norway	Germany
Flat oyster, as spat	U.K.	European countries
Crassostrea gigas	U.K.	European countries
Pacific oyster		
Mytilus edulis	U.K.	European countries
Mussel		
Cephalopods, alive (squid, cuttlefish, octopus)	U.K.	European countries
Crabs (Hyas and other species)	U.K.	European countries
Eels	U.K.	Holland and W. Germany
Turbot	Norway	Spain

9.0 Live exports for purposes other than direct consumption

A summary of releases and transfers of eggs and juveniles of salmonid fishes is given in Tables 1 and 2, and the footnotes therein.

Norway

Bass (Dicentrarchus labrax) are imported as juveniles from the Aquaculture Institute in Denmark, originating from Yugoslavia. They are kept in quarantine in land-based tanks for farming in heated effluent water.

Sea caught young eel (Anguilla anguilla) are imported for ongrowth from Denmark.

9.0 Live exports for purposes other than direct consumption
U.K. (continued)

U.K.

* Hatcheries in Britain and the Channel Islands exported about 30millior Crassostrea gigas and 80 million Tapes philippinarum seed to European on-growers, principally in Spain, France and Italy. In addition, large seed of C. gigas were exported by nursery growers to Ireland and Germany for final grow out to market size.

* Small numbers of juvenile paeneid prawns from UK research hatcheries were exported to research units in Europe and in the tropics for trial ongrowing.

* Live elvers (at least 12- 15 tons) were exported to Holland, Germany, Poland, Spain and other European countries for stocking natural waters and for on-growing in intensive culture facilities. The trade in live elvers to Japan for aquaculture has declined considerably because of the susceptibility of Anguilla anquilla to diseases in Japan.

* Live juvenile turbot reared in hatcheries are exported to the Atlantic coast of France and Spain and into the Mediterranean for on-growing in sea cages. Approximately 150,000 were exported in 1987. (Juvenile turbot from Scotland are also sent to Sweden, Spain, Portugal, Greece, and other countries)

* Future exports may include juveniles of the Black Sea turbot (Scophthalmus maeoticus) and its hybrids with S. maximus.

* Plans to produce juveniles of sea bass (Dicentrarchus labrax) and gilthead sea bream (Sparus aurata) for on-growing in the Mediterranean have been suspended.

CURRENT STATUS OF PROPOSED OR ACTUAL INTRODUCTIONS

The Introduction and Cultivation of the Japanese Brown Alga Undaria on the Atlantic coast of France

Background

The history of this proposed introduction and detailed references to its consideration by the WG are given on pp.16-21 of the 1987 WG Report (C.M. 1987/F:35). A two year ecological study by Dr. J.-Y. Floc'h of this seaweed commenced in January 1987. At its 1987 meeting the WG requested that IFREMER provide to ICES a copy of Dr. Floc'h's conclusions so that the WG may return to this question and formulate more precise and definitive advice and recommendations at its 1989 meeting. It was also suggested that Dr. I. Wallentinus of Sweden remain in her capacity as expert consultant and be invited to the WG meeting in 1989 to consider the French report on Undaria outgrowth at Ouessant. In the meantime, a proposal to the Sea Fisheries Commission of Guernsey to introduce this alga to the Channel Isles was denied.

Update

Experimental plantings of Undaria at Ouessant since 1983 have lead its reproduction there, with wild-set sporophytes found to be growing vigorously in 1987 on immersed hard substrates (Floc'h, Pajot, and Wallentinus, 1988). As a result of this discovery, additional new studies are now underway (April 1988 -- April 1989) by IFREMER, in

addition to those of Dr. Floc'h's, on its reproduction in this bay. A special paper on Undaria is to be presented at the October 1988 special symposium on introduced species in Bergen.

WG Action in 1989

The WG, which first considered this question in Halifax in 1984, will consider the question of the cultivation of Undaria again at length at its meeting in 1989 in order to prepare final recommendations.

JOINT MEETING OF THE ICES WORKING GROUP ON INTRODUCTIONS AND TRANSFERS OF MARINE ORGANISMS and Representatives of the NORTH ATLANTIC SALMON CONSERVATION ORGANIZATION (NASCO)

The Working Group met in joint session with representatives of NASCO at NASCO Headquarters in Edinburgh on June 2 1988. Representing NASCO were Dr. P. Hutchinson and R. Cutting (also representing Canada on the ICES Working Group). Dr. A. Youngson of the Marine Laboratory, Aberdeen, attended this session as an invited expert.

Background of NASCO/NAC and Interest in Salmon Movements

Dr. Hutchinson outlined the background of NASCO's concerns and interests relative to the introductions and transfers of salmonid fishes in the North Atlantic Ocean. NASCO (founded in 1984) consists of several commissions of different geographical purviews; in addition, there is an Annual Council Meeting. The question of introductions and transfers was addressed in 1984 at NASCO's North American Commission (NAC) meeting, and a "Bilateral Scientific Working Group of the North American Commission on Salmonid Introductions and Transfers" was established in 1985 and began work in June 1986 (hereafter, BI/SIT). The Northeast Atlantic Commission may also address in the future the question of impacts of salmonid movements. The Council will consider this year at its June 1988 Reykjavik meeting the potential impacts of aquaculture on wild salmonid stocks.

The NAC Bilateral Working Group on Introductions and Transfers

Dr. Cutting distributed copies of the NASCO document, "Report of the Activities of the Bilateral Scientific Working Group of the North Atlantic Commission on Salmonid Introductions and Transfers 1987" (Annex 13 to the Report of the Fourth Annual Meeting of NAC (87) 20) (72 pp.). Dr. Cutting reported that progress had been fairly rapid, based on the consensus that introductions and transfers were an area of concern.

The Group was quickly organized, terms of reference defined, and early priorities were established as follows:

(1) inventory the extent of movements of salmonids in the North Atlantic Ocean,

(2) formulate protocols, and

(3) meet with the ICES Working Group to set up a joint liaison.

Relative to (1), this inventory has begun. Relative to (2), three subgroups of specialists have been set up relative to (a) fish health,

(b) genetics, and (c) ecological concerns. The first two have been organized and terms of references for these special interest subgroups defined; the third group, concerned with matters for which there are fewer data bases, is being organized. Relative to (3), the present joint session addresses this priority.

The charge of each of the subgroups of BI/SIT is to develop protocols or model programs, to protect North Atlantic salmon from any harmful effects resulting from introductions and transfers. There has been, for example, a dramatic increase of sea cage activity in the northeast Unite States and in Atlantic Canada (New Brunswick). The subgroups first met last December, and draft protocols and progress reports are due by September 1988, with final drafts due December 31, 1988.

Based upon these protocols, the interest subgroups will merge togethe by March 1989 and prepare a final document for NASCO by June 1989. The goal is to set a tone of what should be done versus what not to do relative to introductions and transfers of salmon populations. That is, the protocols should provide minimal guidance on how to move salmon safely and yet still protect and reduce the risks to natural wild North Atlantic salmon populations. It is hoped that the protocols will provid a foundation for "good stewardship" through "state of the art" ("state o the science") biological guidance.

NAC/BI/SIT is deriving concepts and ideas from its members and from the American Fisheries Society (AFS), EIFAC, ICES, the Great Lakes Fishery Commission, and other sources.

NAC/BI/SIT and the ICES Working Group

After concluding his review of NAC/BI/SIT, Dr. Cutting put two questions before the ICES WG, relative to the establishment of protocols

(1) Is there a means for the ICES WG on Introductions and Transfers to examine the BI/SIT protocols?

and,

(2) What is the most efficient and productive method of continuing a working liaison between the ICES WG and NAC/BI/SIT?

Relative to (1), Chairman Sindermann responded that BI/SIT could send copies of their draft protocols to the individual members of the WG (an address list is provided) for their individual comments. Relative to (2), it was agreed that there was a clear need to maintain a close and continuing association between the two groups. Dr. Cutting could act as a general liaison, since he is a member of both BI/SIT and the ICES WG. In terms of any actions that may need more rapid response and addressing the ICES WG Chairman could contact the BI/SIT Chairman directly and immediately.

ICES Interest in Salmonid Movements in the North Atlantic Ocean

Chairman Sindermann, with contributions from H. Grizel, A. Munro, R. Cutting, and V. Bye, next reviewed the ICES Working Group's involvement

and concern with introductions and transfers of salmonids in the North Atlantic Ocean. The WG has had continuing interests in these matters since the Group's reconvening in 1979. A Council Resolution of that yea (C.R. 1979/4:6) reads,

> "It was decided that the Council should encourage member countries to conduct feasibility and environmental impact studies for all species of Oncorhynchus prior to any further introductions into North Atlantic waters and adjacent seas."

When the ICES Group first reconvened in 1979, introductions by the **USSR** of pink (humpback) salmon, Oncorhynchus gorbuscha, were coming to a end. For twenty years the Russians had been releasing the pink salmon from a hatchery on the **Kola Peninsula**; many of these salmon migrated up and spawned in **Norwegian** rivers (see review by D. Solomon, "Pacific pink salmon in northwest Russia," in the 1983 WG Report (C.M. 1983/F:27), pages 40-42). No natural runs were ever verified. In **Poland, Latvia** an **Estonia** there were many cage trials with as many as four differnt Oncorhynchus species in the **Baltic Sea.**

At about the same time, the **UK** was studying proposals to introduce brood stock of the pink salmon (O. gorbuscha) to **Britain**, and Dr. D. Solomon presented progress reports to the WG at meetings from 1979 to 1983. (This proposal is on "inactive status" in the UK according to Dr. Bye). **Scotland** held coho salmon (Oncorhynchus kisutch) in quarantine, where they were raised to an F1 generation, but the decision was made no to release these fish and all were destroyed. Proposals in the **UK** for steelhead (rainbow trout) (Salmo gairdneri) ranching in the **North Sea** ar also on "inactive status"; there are no active proposals at this time in the UK relative to introductions and transfers of salmonid fish.

The Group was also concerned in 1980-1981 with the question of coho salmon (O. kisutch) open sea ranching in **France**, and in May 1981 conducted a field trip lead by Dr. Y. Harache to the Centre Oceanologiqu de Bretagne (COB) and the hatchery and experimental rearing site at Trevabu, 20 km from COB (near Brest). As a result, a series of recommendations were made to ICES. No coho ranching project is now in operation in France.

The Group has also been concerned with the release by individual **northeastern states of the USA** of Pacific salmon, and their appearance i **Canadian** waters. The matter of these introductions is largely under the jurisdiction and purview of individual states, and the federal governmen of the United States has little control; it is difficult to prevent a state from releases of Pacific salmon. In 1987-1988, three states, **New Hampshire, Massachusetts,** and **New Jersey**, are releasing coho salmon (O. kisutch) and chinook salmon (Oncorhynchus tshawytscha) into Atlantic coastal waters (see report herein).

It is clear from these histories that interest in the movements of salmonid stocks transoceanically and interoceanically has been and continues to be a major potential force in the economy, biology, ecology, and genetic history of North Atlantic salmon populations.

Studies in Scotland on Genetic Questions of Atlantic Salmon Aquaculture

Dr. A. Youngson of the Marine Laboratory, Aberdeen, reviewed for ICES

and NASCO current studies in Scotland. In Scotland there is extensive aquaculture interest in Atlantic salmon; given the future sizes (numbers of potential releases, it is important to ask what the effects will be o indigenous Atlantic salmon. Will large scale releases (escapes) of salmon derived from other geographic regions disrupt the genetic structure of natural wild stocks? Will that be detrimental? The question is difficult to approach.

Collections of scales of Atlantic salmon in Scotland waters have and are being made; the scale records the part of the animal's life spent in culture (the pattern of freshwater growth on the scale is distinctive). There are small numbers (less than 10 percent) of "wild caught" salmon that come originally from culture operations. These latter are interpreted as either accidental hatchery releases (losses, from broken nets or sunken well boats [large numbers of smolts are moved long distances in "well boats"]) or intentional hatchery releases of older smolts (released into freshwater supplying the hatchery). Eighty freshwater hatcheries (with 200 sea farming sites) -- 90 percent of these are on the west coast of Scotland --put into the sea 20 million smolts i 1988. The wild catch of salmon is mostly on the east coast. Aquacultur began in the early 1970s, and production now outstrips the wild fishery take.

Genetic studies include the description of tissue protein variation (via electrophoresis) to detect patterns of natural geographic variation. There is now very little hard data to go on. Much more data are needed to test questions and ideas in the field relative to what effects increasing aquaculture practices will have on the existing wild fishery and in the maintenance of stock genetic integrity. Three questions can be asked in this regard:

(1) Do native wild fish and "introduced" fish differ in "performance" in any measurable way?

(2) If these fish grow to adults and return, do native and introduced fish hybridize as adults?

(3) Do hybrid fish differ in any way from wild stocks?

The type of stock introduced may of course influence the outcome of any experiments designed to answer these questions, but any stock type used would demonstrate the principles involved in potential genetic crossing questions. One way to perform the experiments necessary to answer these questions is to use a genetic tag (based on proteins), using, for example, one variable enyzme (ME) in muscle tissue whose frequency of occurrence is quite high. It is thus possible to take a biopsy sample and potentially look at whether wild stocks and introduced stocks have bred together. The enzyme concerned may have important effects on some life history stages. The effects of genetic hybridization could be quite subtle and take a long time to be manifested. Other genetic techniques may include mitochondrial DNA markers.

Impact of Fish Farming and Restocking on Natural Populations of Salmonids in the UK

Dr. V. Bye of MAFF, Lowestoft, submitted the following statement pertinent to the questions being addressed by this joint meeting:

The rapid expansion of salmonid farming in Europe, particularly of Atlantic salmon, has substantially increased the number of farmed fish being accidentally and deliberately released into the wild. An estimate European production of Atlantic salmon of 70,000 tons in 1987 probably involved the escape of at least one million smolts and larger fish into the sea. Accidents, predator damage to nets, storm damage, etc., all allows fish escapes; for example during the storms of October 1987 a single English farm lost 37,000 salmon of around 500g mean weight. In addition the production from salmon hatcheries is beginning to exceed th demand from fish farms and the excess production of parr and particularl of S2 smolts is being made available at low cost for enhancement and mitigation or are deliberately dumped into natural waters to avoid disposal costs.

Although the survival rate of the released fish is probably poor and return rates as mature fish low, they are almost invariably non-local stocks, usually from semi-domesticated farm broodstocks. The eventual contribution they make to the production of natural salmon stocks and th impact they have on the genetic constitution and viability of the stocks cannot at present be calculated. In Norwegian coastal fisheries 10 percent of the salmon captured are of fish farm origin.

Research programs have been established in Scotland (DAFS) and in England and Wales (MAFF) to develop techniques for the genetic identification of salmonid stocks and to apply them to natural populations to assess what level of genetic discrimination is possible. It may be that the 100 years of restocking and enhancement in the UK have swamped the original stock distinctions except in a few isolated areas, although the relatively low viability of stocked fish may limit their contribution to gene pools. It is hoped that the effect of fish farm escapees can be monitored.

Regional water authorities and riparian owners have become increasingly aware of the potentially adverse effects of restocking with "alien" genotypes and many have, or are developing, codes of practice which take into account genetic factors. Legislation is available under the Salmon and Freshwater Fisheries Act 1975 and the Salmon Act 1986 which allows water authorities and river fishery boards to prevent deliberate stocking with salmonids of non-local origin.

Other Atlantic salmon hatcheries and interests in Europe

It was noted by the Group that there are many salmon hatcheries throughout Europe from which fish can and do escape. Many hatcheries also continue to move eggs, parr and smolt on large scales. Dr. E. Egidius commented that in Norway there was also rapidly increasing aquaculture interest; here, hatcheries also date back 100 years. There is interest (attempts) to select certain rivers for aquaculture operations and not others. Dr. Egidius will be presenting a paper in Bergen in October at the introduced species minisymposium on the mutual impact of wild and cultured salmon in Norway.

It was noted that there are also salmon hatcheries in northern Spain producing fish. In Germany there is interest in re-establishing (restocking) the Atlantic salmon in the Rhine (which is polluted in large parts). The Rhine, once the largest salmon river in Europe, had ceased producing salmon by the 1930s.

A survey of the member countries present at the Joint Meeting revealed

over 500 hatcheries in Canada, the Netherlands, Norway, the U.K. and the USA alone (Table 3).

It was noted that the Institute of Aquaculture of the University of Stirling has prepared a report for the Nature Conservancy Council entitled, "The Reduction of the Impact of Fish Farming on the Natural Marine Environment". Phillips et al. (1985) and Gowen and Bradbury (1987), all from Stirling, have further considered the ecological and environmental impacts of salmonid farming on coastal waters and inland fisheries.

Status of Introductions of Pacific Salmon in North Atlantic

In brief, the current status of Pacific salmon culture and releases in the North Atlantic is as follows (Dr. Y. Harache will be presenting a paper in Bergen in October on Pacific salmon in Atlantic waters):

France: there is one operating farm raising coho salmon (Oncorhynchus kisutch) on the Jaudy River at Treguier, Brittany run by SODAB and IFREMER; see review and description in the ICES 1987 WG Report (C.M. 1987/F:35, pp. 38-39 (Appendix V))

United States of America: private operations which were releasing pink salmon (Oncorhynchus gorbuscha) and chum salmon (Oncorhynchus keta) in Maine ceased in 1983 (pink) and in 1986 (chum). The states of New Hampshire, Massachusetts, and New Jersey now release coho salmon (Oncorhynchus kisutch) and chinook salmon (Oncorhynchus tshawytscha) (see 1988 Report, herein).

Canada: coho salmon, derived from USA releases, still survive in the Cornwallis River, near Halifax, in Nova Scotia. Juveniles were first found here in 1978 (adults in 1976) and coho have successfully reproduced in the River in all years except 1983 and 1985 (study by Dr. S. Barbour; see NASCO/NAC/BI/SIT 1987 report, page 6); the population appears to be self-sustaining. Two mature chinook salmon were captured in the Annapolis River, Bay of Fundy, Nova Scotia in 1986. Dr. S. Barbour recently concluded a two year study on the coho Cornwallis River population. Both coho and Atlantic salmon thus breed in this same river.

Conclusions, recommendations, and directions

It was felt by ICES participants that the present Joint Meeting was a useful exchange of information. Dr. Cutting also found that the contact between the Bilateral Group and ICES had been most useful.

It was further agreed that,

(1) There should be a continuing interchange of communication between the two groups, particularly between the two Chairmen of the Groups,

(2) That Dr. R. Cutting could act as a general liaison relative to communication and information flow between the two Groups,

and

(3) That consideration should be given at the 1989 WG meeting for another joint session with the NAC Bilateral Working Group in 1990 in Halifax.

On the basis of the extensive discussions and information presented a this Joint Meeting today, the WG formulated two recommendations relative to further Canadian studies on the introduced population of coho salmon in Nova Scotia, and relative to further evaluating the effects of releases of introduced and transfered salmonids on the genetic integrity of wild Atlantic salmonid stocks, by holding a special session on this question at its 1989 WG meeting, to which national experts on the geneti identity of salmonid stocks should be invited to attend.

International Union for Conservation of Nature and Natural Resources (IUCN): Interest in Translocation of Living Organisms

It was brought before the attention of the WG that the IUCN (Avenue du Mont-Blanc, CH-1196, Gland, Switzerland), has an "Introductions Specialist Group" of its Species Survival Commission. The Group is chaired by Dr. P. Munton. Copies of "The IUCN Position Statement on Translocation of Living Organisms: Introductions, Re-Introductions, and Re-Stocking" (as approved at the 22nd Meeting of the IUCN Council, 4 September 1987) were shown.

A meeting, "Introduced Species: European Policy and Practice at Home and Abroad", is being convened for September 6-8 1988 at the Imperial College, London, sponsored by IUCN, "to bring specialists together to identify major actual and potential invasive species of plants and animals and to consider the implications of introduced species for wildlife and habitat management in the countries of the Council of Europe and other countries where introductions are made by European development or other agencies for any reason, but especially in connection with biological control."

Table 3.

EXAMPLES OF NUMBER OF HATCHERIES AND SALMON IMPORTATION REGULATIONS IN SOME ICES MEMBER COUNTRIES

[For Atlantic salmon (Saumon atlantique) Salmo salar]

Country	Approx.No.Hatcheries Private	Government	Importation of live salmon (as eggs, parr, smolt and/or brood stock) from other countries:
CANADA	12	11	Under permit only
DENMARK	None	None	No. But after consultation with the Fisheries Institute exceptions are possible
FRANCE	None	None	Yes (ova certainly) under permit only
NETHERLANDS	1	None	Yes, at present (but refer to draft regulations, 1988)
NORWAY	>300	3	No, but exceptions are given in view of smolt shortage
UK: ENGLAND	26 (*)	13 (**)	Ova:under license with appropriate health certificate. Fish: only from N. Ireland. Water authorities can regulate release of salmonids into natural waters under their control
UK: SCOTLAND	130	2	Ova: under license; Fish: no
USA	?	6	Yes, under individual state control

(*) plus several under construction
(**) Regional Water Authorities, not national government

The 1988 Mini-Symposium on "Case Histories of Effects of Introductions and Transfers on Marine Ecosystems"

A minisymposium on introductions and transfers is planned for the October 1988 76th Statutory Meeting of ICES in Bergen, with Dr. C. J. Sindermann as Convenor.

The symposium consists of the following case histories:

INTRODUCED MARINE PARASITES:

(1) The swim-bladder nematodes Anguillicola spp. and the gill monogenes Pseudodactylogyrus in European eels
By: M. Koie (Denmark)

(2) The trematode parasite Gyrodactylus salaris in Atlantic salmon in Scandinavia
By: (Norway)

INTRODUCED MARINE FISH:

(3) Pacific salmon in Atlantic waters
By: Y. Harache (France)

(4) Mutual impact of wild and cultured salmon in Norway
By: E. Egidius (Norway)

INTRODUCED MARINE INVERTEBRATES:

(5) The introduction of the Pacific oyster Crassostrea gigas in France
By: H. Grizel (France)

INTRODUCED MARINE PLANTS:

(6) The Japanese brown kelp Undaria pinnatifida on the coast of France
By: J.-Y. Floc'h (France), R. Pajot (France), and I. Wallentinus (Sweden)

(7) The Japanese brown alga Sargassum muticum in European waters
By: G. Boalch (UK)

In addition, C. Sindermann (USA) and A. Munro (UK) will present the "Introduction" and "Conclusions and Summary", respectively. The case histories will focus on the broad picture of both the ecological implications and practical impacts of the introductions under examination. It is intended that these papers will be published together as a group (the target journal to be selected at a later date).

The 1990 Symposium on "Case Histories of the Effects of Introductions and Transfers on Aquatic Resources and Ecosystems"

An international Symposium on introduced and transferred species is planned for 1990. It was proposed that this two day Symposium be held in June 1990 in Halifax, adjunct to the World Aquaculture Society's (WAS) meeting, "Aquaculture: The Global Perspective". The Symposium would be co-sponsored by ICES, EIFAC, and the WAS. with Drs. C. J. Sindermann (ICES), Prof. K. Tiews (EIFAC) and J. Castell (WAS) to be asked to be co-convenors. A joint meeting with EIFAC would be appropriate at this time, and convening the meeting in Halifax would address one of the important target groups (aquaculturists) relative to concerns about exotic species movements.

The 1990 Symposium on "Case Histories of the Effects of Introductions and Transfers on Aquatic Resources and Ecosystems" (continued)

A tentative outline consisting of four major theme sessions was proposed

Topic	Possible (Co-)Conveners
GENERAL SESSION: ISSUES AND THEORETICAL CONCEPTS ON THE GLOBAL MOVEMENTS BY MAN OF MARINE AND FRESHWATER SPECIES Special Keynote Papers: * The Intentional and Accidental Transportation of Marine and Aquatic Organisms by Man (J. Carlton) * The Laws and Regulations Governing the Movement of Marine and Aquatic Organisms by Man (Speaker to be Chosen) * Genetic Engineering and the Introductions and Transfers of Genetically Modified Organisms (Speaker to be Chosen)	C. Sindermann (ICES), K. Tiews (FAO), J. Castell (WAS)
FISH INTRODUCTIONS & TRANSFERS * Overview Paper * Special Case History Papers	A. Munro (ICES), (EIFAC)
INVERTEBRATE (ESPECIALLY MOLLUSKS AND CRUSTACEANS) INTRODUCTIONS AND TRANSFERS * Overview Paper * Special Case History Papers	H. Grizel and J. Carlton (ICES), J. Stewart (EIFAC)
PLANT INTRODUCTIONS & TRANSFERS * Overview Paper * Special Case History Papers	I. Wallentinus, G. Boalch, and Others (freshwater representative)

The Symposium would consist of the General Session on the first morning, followed by the three thematic sessions over the next one and a half days. Both freshwater (aquatic) and marine species would be covered, with particular questions of diseases (quarantine), ecological concerns, genetic problems, and so forth, being covered under each of the special themes. The sessions would also consist of contributed papers (15 minute presentations) presented as part of each thematic session or in concurrent sessions.

It was decided that the WG propose this Symposium with this location, timetable, and general framework.

Update of Cooperative Research Report 116 (1982):
"Status (1980) of Introductions and Transfers of Non-Indigenous Marine Species in North Atlantic Waters"

It was decided that this valuable document should be updated after the 1988 and 1990 symposia on introductions and transfers. Eleven years of information and data contained in the Working Group annual reports of meetings would also be incorporated. WG members will be asked to begin to prepare special materials and syntheses for this revision.

The Laws and Regulations Concerning Introductions and Transfers of Marin and Aquatic Organisms in ICES Member Countries

The WG has accumulated for ten years information on the laws and regulations concerning the introductions and transfers of marine and aquatic organisms in ICES member countries. These laws and regulations are often difficult to locate. It was decided that a summary (list) of all known laws and regulations that have been presented to the WG betwee 1979 and 1987 should be prepared by the Rapporteur in draft form, along with information on how to locate and obtain copies (and possibly translations) of the documents cited. The Rapporteur was asked to have this document ready for the 1989 WG meeting.

A great deal of careful thinking and preparation has gone into the drafting of these many regulations in ICES countries over the decades, and it is believed that making these more widely available would further a global understanding of the concerns and problems associated with the movement of exotic species.

Computerized Inventory and Bibliography of Introductions and Transfers

The WG has considered the needs for these data bases over the past several years, but time, funds, and personnel to devote to these tasks have been limited. In the meantime, Dr. H. Rosenthal (Federal Republic of Germany) has produced what the WG noted is a valuable and useful bibliography on introductions and transfers (Rosenthal, in press). Proofs pages of Dr. Rosenthal's bibliography were passed out at the WG meeting for the WG members to examine. Discussions focused on the continual updating of such a bibliography and the need for wide availability.

It was decided to consider further discussions and consultations with the ICES Secretariat relative to a specific focus on the development of a computerized record of introductions and transfers of marine organisms in ICES member countries (the establishment, format, and implementation of such a record perhaps to coincide with the revision of CRR 116).

RECOMMENDATIONS

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

(1)
That attention be drawn to the dangers resulting from the increasing international movement of water as ballast in cargo vessels, and the subsequent accidental introduction of exotic fishes and zooplankton (as in the North American Great Lakes) and the potential accidental introduction of exotic phytoplankton (such as species that may cause toxic blooms) and ICES member countries be urged to examine this critical problem, to determine the scale of this activity in their countries, and to consider control measures (such as the exchange of harbor (port, estuarine, bay) water for ocean water on the high seas),

(2)
That great concern be expressed about the increasing cross-border transport of live bait organisms (fish, annelids, mollusks, crustaceans, and so forth) which are frequently subsequently released in new areas, and urges ICES member countries to examine this critical problem, to determine the scale of this activity in their countries, and to consider control measures,

(3)
That, being made aware of general examples of pathogens of commercial fish and shellfish being discovered, or the existence ignored and/or not reported, ICES member countries are urged to carefully consider importations when commercial interests may influence subsequent or concurrent publication of scientific findings of the species involved,

(4)
That, in light of the occurrence in the North Atlantic Ocean of populations of introduced coho salmon and Atlantic salmon breeding in the same river in Nova Scotia, Canada be urged to establish a continuing program of surveillance and documentation of these co-occurring species, relative in particular to successful reproduction and microhabitat utilization of salmonids in this river,

(5)
That an international symposium entitled, "Case Histories of the Effects of Introductions and Transfers on Aquatic Resources and Ecosystems" be convened for two days in separate session during the annual meeting of the World Aquaculture Society (WAS), between June 9 and 16, 1990, in Halifrax, and to be co-sponsored by ICES, FAO/EIFAC and WAS; and that Dr. C. J. Sindermann (ICES), Prof. K. Tiews (EIFAC) and Dr. J. Castell (WAS) be asked to be co-conveners. Said Symposium would consist of invited and contributed papers that would be presented in sessions devoted to general issues and theoretical concepts, fish and fisheries, shellfish and other invertebrates, and plants,

(6)
That the Working Group on Introductions and Transfers of Marine Organisms (Chairman: Dr. C. J. Sindermann) meet at the Department of Fisheries and Forestry in Dublin from May 23 - May 26 1989 in order to,

(a) evaluate the effects of the releases of introduced and foreign salmonids on the genetic integrity of wild Atlantic salmonid stocks, to which session national experts on the genetic identity of salmonid stocks should be invited to attend;

(b) prepare definitive advice and final recommendations relative to the introduction and cultivation of the Japanese brown alga Undaria on the Atlantic coast of France, the WG to have been provided the reports of studies on the matter scheduled to be completed before June 1989, and with National Experts Drs. J. Floc'h (France) and I. Wallentinus (Sweden) to be invited to this WG meeting in 1989;

(c) make detailed plans for the international symposium, "Case Historeis of the Effects of Introductions and Transfers on Aquatic Resources and

Ecosystems," proposed to be held in Halifax in June, 1990;

(d) complete preparation of a document, "National Laws and Regulations o ICES Member Countries Concerning Introductions and Transfers of Marine Organisms," for proposed publication in the ICES Cooperative Research Report series;

(e) continue the overview of the status of proposed, new, and on-going introductions and transfers and their biological and ecological effects, relative to finfish, shellfish, and other invertebrates, and algae in an between ICES member countries.

ACKNOWLEDGEMENTS

At the conclusion of its deliberations the Working Group extended their thanks to Secretary Malcolm Windsor and his staff of NASCO Headquarters in Edinburgh for their gracious hospitality, and to Dr. A. Munro (Marine Laboratory, Aberdeen) and NASCO for inviting the Working Group to Scotland for its 1988 meeting; to Dr. R. Roberts and his staff of the Institute of Aquaculture of the University of Stirling for an informative and detailed review and site visit of the Institute's work, and to the Edinburgh City Administration for their gracious hospitality.

Appendix I

AGENDA

ICES Working Group on Introductions and Transfers of Marine Organisms
Edinburgh, Scotland, May 31 - June 3 1988

31 May 1988
Tuesday

9:00 AM	* Opening Session of Working Group Welcome by M. Windsor, Secretary, NASCO Comments by WG Chairman * Review of agenda * Status of recommendations -- 1987 meeting * National Reports
12:00	Lunch
1:00 PM	* National Reports (continued) * Status of Introductions and Transfers: Brown alga Undaria pinnatifida in France * 1988 Minisymposium on Introductions and Transfers (Bergen): Brown alga Undaria pinnatifida Pacific oyster Crassostrea gigas Brown alga Sargassum muticum Eel parasites Coho and other Pacific salmon Atlantic salmon Gyrodactylus in Scandinavia
5:00 PM	Adjourn
5:30 PM	Reception (City Chambers, Edinburgh City Administration)

1 June 1988
Wednesday

9:00 AM	* Continue discussion of plans for 1988 Minisymposium on Introductions and Transfers of Marine and Aquatic Organisms * Plans for 1990 World Symposium on Introductions and Transfers of Marine and Aquatic Organisms
12:00	Lunch
1:30 - 5:00	* Site Visit and Field Trip: Institute of Aquaculture at the University of Stirling

Appendix I
(continued)

AGENDA

2 June 1988
Thursday

9:00 AM * Convene joint session of ICES Working Group and NASCO representatives
> Review of NASCO activities related to transfers and introductions
> Review of ICES activities related to transfers and introductions
> Review of Atlantic salmon transfers (status, pathology, genetics, ecology)
> Review of Pacific salmon introductions (status, pathology, genetics, ecology)

12:00 Lunch

1:30 - 5:00 * Reconvene Joint Session
> Review codes of practice, protocols, other documents
> Discussion of possible joint activities
> Preparation of joint statement: Conclusions, recommendations, and directions

5:00 Adjourn

5:30 Reception (NASCO Headquarters)

3 June 1988
Friday

9:00 AM * Update of Cooperative Research Report 116
* Publication of Summary of National Laws concerning introductions and transfers
* Discussion of establishment, format and implementation of a computerized record of introductions and transfers in ICES countries
* Discussion of establishing an international bibliography of introductions and transfers of aquatic organisms
* Other international activities relative to introductions and transfers: IUCN, SCOPE
* Discussion of recommendations to parent committee
* Time, place, and principal agenda items for 1989 meeting

12:00 Adjourn

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APPENDIX III.

Working Group Site Visit: 1988 Meeting

On June 1 1988 members of the Working Group visited the Institute of Aquaculture of the University of Stirling. The group was greeted by Institute Director Professor Ron Roberts and other members of his staff, who provided a detailed introduction and background to the Institute's history and current research programmes.

The group was set up in 1971 (and attained Institute status in 1978) to address problems of fish diseases, with the idea of bringing together biological and veterinary expertise. By the mid-1970s, the Institute's interests were expanded to other areas of aquaculture, including fish genetics, fish nutrition, and environmental considerations relative to aquaculture. The Institute initially took over an old trout farm starte by Sir James Maitland (famous for his salmonid work at Howietoun), and now owns seven farms.

Today the Institute has a staff of about 90 and is part of the postgraduate curriculum of the School of Biological Sciences of the University. It is anticipated that in two years there will be offerings at the undergraduate (bachelor's) level. A major emphasis of the Institute is the teaching of postgraduate researchers from around the world (through the EEC, the Overseas Development Administration, and the Research Council). The budget of the Institute is about 2.3 million pounds per year, about 300,000 of which is from the University and the rest from external funding sources. Major emphases today of the Institute are questions focused on disease, genetics, and nutrition, especially relative to biotechnology. As an example, the Institute's work lead to the founding of an independent company (Stirling Diagnostics) as an international fish disease diagnostics centre (on a commercial paying basis).

The Working Group toured the laboratories and fish holding and experimental facilities of the Institute at length, and discussed with the staff problems of introductions and transfers internationally:

* The Institute's genetics program focuses on genetic analyses (including mitochondrial DNA) of tropical species (especially Tilapia) to determine species origins and the maintenance of pure species stocks (that came out of Africa in the mid 1970s); genetic engineering to produce up to 1000 fish per brood per month (with females maturing at 6 mos of age), and applications to commercial practices, and genetic cryopreservation of Tilapia gametes (holding genetic diversity in a milt gene library).

* The Institute's diseases program focuses on the histopathology, biology, pathophysiology, epidemiology, and pathogenesis of fish pathogens and parasites, including viral and bacterial diseases; an additional focus is on aquatic vaccines and immune systems (e.g., the control of virunculosis). A particular concern has been the Southeast Asia epizootic rhabdovirus study (with FAO and ODA joint funding): annual outbreaks of a severe, ulcerative disease with ver high mortalities of wild and pond cultured freshwater fishes have

APPENDIX III.

Working Group Site Visit: 1988 Meeting

(continued)

occurred throughout Southeast Asia since 1980, causing multimillion of dollars in fish loss. It is now widespread and spreading throug the tropics (see the work of the Institute's G. Frerichs et al., published in Nature in 1986).

* The Institute's nutrition program focuses on questions relative to Atlantic salmon stocks and freshwater prawns (three viruses are now spread around the world and are either directly pathogenic or lower the animal's overall disease resistance).

Information about the Stirling University Aquaculture Institute is contained in their Annual Report, in their Aquaculture News, and in numerous research, teaching, and advisory publications (c/o Professor Ro Roberts, Director, Institute of Aquaculture, University of Stirling, Stirling FK9 4LA, United Kingdom).