International Council for
the Exploration of the Sea

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Mariculture Committee

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

Brest, France, June 10 - June 12 1987

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* General Secretary
ICES
Palaegade 2-4,
DK-1261 Copenhagen K
DENMARK

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SUMMARY
and
1987 HIGHLIGHTS OF IMPORTANT ADVISORY INFORMATION ON INTRODUCTIONS

*** The introduced Asian parasitic eel nematode Anguillicola continues to spread northward in Europe**

Introductions of eels from Asia have resulted in the accidental introduction of the dangerous parasitic swimbladder nematode Anguillicola to Europe. It occurs now in Italy, the Netherlands, Denmark, northern Germany (Baltic), perhaps in Poland, and appears to be spreading northward and eastward. Given the widespread and difficult to control movements of eels throughout Europe, a high level of probability now exists that this parasite will spread beyond its current area. Sweden is considering new importation and quarantine rules for eels.

*** IHN (Infectious Haematopoietic Necrosis) has been reported in rainbow trout in France**

IHN has been reported from two rainbow trout (Salmo gairdneri) farms in France in 1987; published reports will be forthcoming. Up until this time, the IHN virus has not been isolated in Europe. Mulcahy and Wood (1986) report the first natural infection of introduced stocks of Atlantic salmon (Salmo salar) by IHN virus in the State of Washington, U.S.A.

*** The protist oyster parasite Bonamia has been reported in Ireland**

There was an outbreak of the disease-causing oyster parasite Bonamia in Cork, Ireland; this organism has caused extensive mortalities in the flat oyster Ostrea edulis elsewhere in Europe. Reports of Bonamia in Ireland in 1983 [see WG Bergen report, C.M. 1983/F:27, page 19] were based upon oysters relaid from France. Now, however, Bonamia is in an oyster farm in Cork from which spat have already been widely spread. Ireland is investigating the importation of "Bonamia-resistant" oyster strains.

*** The North Atlantic Salmon Conservation Organization (NASCO) has formed a working group on salmonid introductions and transfers**

NASCO is turning its attention to current and future problems relative to the widespread movements of salmonid stocks within and between continents and oceans, and has suggested establishing contact with the ICES Working Group on Introductions and Transfers in order to better coordinate scientific review efforts.

* **Salmonid movements** (continued)

The WG considered at length the increasing intercontinental, intracontinental, and transhemispheric movements of salmonids, especially relative to the genetic and ecological implications of stock mixing, and the critical need for stock identification to quantitatively assess this mixing (see Recommendation, herein).

* **The cultivation of the Japanese brown alga Undaria on the Atlantic coast of France is now the subject of an intensive investigation**

Studies are now in progress by Dr. J.-Y. Floc'h, of the Laboratory of Plant Physiology, Universite de Bretagne Occidentale, on the cultivation of the introduced alga Undaria on the island of Ouessant off the Brittany coast, in order to determine its biology, ecology, and life history at this sole site of planting. These studies are directed toward determining whether or not Undaria can reproduce or is reproducing naturally at the release site. Undaria plants have been found in areas (Groix) or on substrates (mussels, Ouessant) where they were not planted, but in both cases either anthropogenic dispersal on mussels (from Ouessant to Groix) or drifting from planted beds (plantules on lines carried to adjacent mussels) may be involved. The WG urged the undertaking of field experimental studies in addition to those studies already in progress by Dr. Floc'h and his associates. The studies will be completed in December 1988.

* **The "Manual of Procedures for Consideration of Introductions and Transfers" has been completed as a joint ICES/EIFAC document**

A "Code of Practice and Manual of Procedure for Consideration of Introductions and Transfers of Marine and Freshwater Organisms" has been finalized, and it is proposed that it be published as an ICES Cooperative Report Series (see Recommendation herein).

WORKING GROUP ON INTRODUCTIONS AND TRANSFERS OF MARINE ORGANISMS
Report of a meeting, held June 10 - June 12 1987 at Brest, France

Introduction

The 1987 meeting of the ICES Working Group on Introductions and Transfers of Marine Organisms was held at the Institut Francais de Recherche pour l'Exploitation de la Mer (IFREMER), Brest, France, from June 10 to June 12 1987. The meeting was preceeded by a one day site visit to Ile d'Ouessant on June 9 to the Cooperative Aquicole d'Ouessant (COA) to study the experimental cultivation of the introduced alga Undaria. Eleven participants representing 8 member countries were present:

C. Sindermann	USA	(Chairman)
J. Carlton	USA	(Rapporteur)
G. Turner	Canada	
H. Grizel	France	
Y. Harache	France	
D. McCarthy	Ireland	
E. Egidius	Norway	
J. Oliveira	Portugal	
B. Dybern	Sweden	
V. Bye	UK	
A. Munro	UK	

In addition, Professor I. Wallentinus, of the University of Goteborg, attended as an Invited Expert from Sweden. A national report from Denmark (V. Jacobsen) had been received and was presented by the Chairman.

The members of the WG were welcomed during the meeting on behalf of IFREMER by Dr. Y. Harache, Dr. J. Querellou, and by the Director, M. J. Vicariot. The Chairman thanked IFREMER for hosting the meeting and providing its facilities, and then reviewed the purposes and goals of the Working Group's 1987 meeting. The AGENDA for the meeting was considered and with modifications approved (Appendix I).

STATUS OF WORKING GROUP RECOMMENDATIONS FOR 1986

The Chairman reviewed the status of recommendations formulated at the last meeting of the Working Group in Gdynia, Poland, in June 1986 (1986 report, C.M. 1986/F:51, pages 11-12) and submitted for consideration at the 74th Statutory Meeting of ICES in Copenhagen in October 1986:

Recommendation 1
That a pilot study of the introduced Japanese alga Undaria, prior to its commercial development in France, be encouraged, and that Dr. I. Wallentinus prepare an additional report based upon a spring site visit for the 1987 meeting.

* C. Res. 1986/2:35, 2a: the WG should complete consideration of the Undaria introduction, including a visit to the trial sea site, and consideration of the report by Dr. Wallentinus arising from her proposed site visit in the spring of 1987

Recommendation 2
That additional research into the ecological effects of Pacific salmonid introductions to eastern North America be encouraged.

* C. Res. 1986/2:35, 2f: the WG should continue the consideration of additional said research.

Recommendation 3
That a Permanent Advisory Group on Introduced Species be established.

* C. Res. 1986/2:35, 1: The general terms of reference of the WG are amended as follows:
"The Working Group will assume the long-term responsibility for producing continuing advice to the Council on all matters relating to introductions and transfers."

Recommendation 4
That a symposium be convened in 1988, possibly in cooperation with FAO/EIFAC, on case histories of introductions and transfers.

* Refer to C. Res. 1985/2:36(g), which earlier supported convening a symposium in 1986 or 1987. The Symposium has not yet been scheduled [see Recommendation 2 of the present meeting]

Recommendation 5
That the WG meet in Brest, France in June 1987 to continue the work before it (and so listed).

* C. Res. 1986/2:35, 2, passed.

1. NATIONAL SUMMARIES OF INTRODUCTIONS AND TRANSFERS

1.0 Relevant laws and regulations

Canada
The new Federal-Provincial Policy for the Importation of Live Salmonids into British Columbia has been adopted and is attached here (Appendix III).

Denmark
The Danish Salt Water Fisheries Act (Lov om saltvandsfiskeri; Ov nr 306 af 4. juni 1986) states in article 32 that any introduction or transfer of fishes, crustaceans and mollusks and eggs or juvenile specimens hereof is prohibited unless a special permit is granted by the Secretary for Fisheries after consultation with the fishermen's organizations and the Danish Institute for Fisheries and Marine Research.

Portugal
The only legislation in force concerns sanitary control measures and the movement of animals within interior waters. This legislation is in the

NATIONAL SUMMARIES (continued)

1.0 Relevant laws and regulations (continued)

Portugal [continued]
process of revision. The development of laws regulating mariculture, which anticipates the control of introductions and transfers of exotic species, contributes to the lessening of inherent risks, but does not replace the necessity of adopting more extensive legal procedures, notably those proposed by ICES and EIFAC. This legislation is urgently needed as there exist increasing pressures for the importation of exotic species through the aquaculture and aquarium trades.

U.K.
Information on movements of shellfish into and out of farms, including the origin or destination of the stock, will be facilitated by the Registration of Shellfish Farms (Diseases of Fish Order Act, 1985).

2.0 Other procedures concerning introduced species

Canada
The Federal/Provincial Transplant Committee for the Province of British Columbia reviews all applications for import of fish and aquatic invertebrates, except those covered by the Fish Health Protection Regulations. Ontario has decided that all imports of Atlantic salmon eggs must come from certified sources. All imports will be quarantined for three months post first feeding. The quarantine facility is at the Normandale provincial hatchery and is operated by the Ministry of Natural Resources staff. Quarantine includes injection of 10ppm chlorine gas into the effluent with a contact time of approximately 30 minutes. Ontario anticipates continuing their program of importing foreign Atlantic salmon until the provincial aquaculture industry has sufficient biomass to continue with their own broodstock.

A federal/provincial government and industry committee has been struck to look at the need for and possible development of a policy on brood stock requirements for Atlantic salmon for the aquaculture industry in the Maritimes. It will consider disease, genetic and ecological aspects relative to the wild stocks of the region as well as the aquaculture stocks.

Canada and the United States are members of a Bilaterial Scientific Working Group on Salmonid Introductions and Transfers of NASCO (The North Atlantic Salmon Concervation Organisation). This WG has prepared a draft report discussing the possible implications of introductions and transfers of salmonids on the east coast of North America and have prepared some mechanisms for dealing with these movements.

Ireland
A proposed introduction of "Bonamia-resistant" flat oysters (Ostrea edulis) from the State of Washington to Cork has led to the development of a draft license with detailed conditions of importation relative to shipment, handling, quarantine, and production of brood stocks. A copy of this draft license is appended herein (Appendix III).

NATIONAL SUMMARIES (continued)

2.0 Other procedures concerning introduced species (continued)

Norway

There is an enormous interest in marine culture in Norway today, as well as for warmwater species that can be raised in the heated industrial effluent water. For non-indigenous species the ICES Code of Practice is applied and permission for import will only be given when adequate quarantine facilities are provided. The question of import of indigenous species like halibut and turbot mostly for breeding purposes is more difficult to handle. Health certificates cannot be obtained, and there always is a chance that the fish are carriers of unknown diseases and parasites specific for the species.

In early 1986 it was agreed with the shellfish farmers association to stop all imports of oysters, as local production of spats of both the flat oyster Ostrea edulis and the Japanese oyster Crassostrea gigas was large enough to be self-containing.

Sweden

The regulations for introductions and transfers of fish have been sharpened:

> Fish must not be moved from coastal areas and inland,
> Import of fish is in principal prohibited and can occur only for stock enhancement programs (with some exceptions for eel),
> Regulations especially designed for introduction of fish/shellfish for immediate consumption (which may be held alive in aquaria and other containers) are being worked out,
> The Swedish fish health control system is being reconsidered, as well as the rules for transport and storage.

Rules for importation of eels (elvers) to Sweden have been developed, and are appended here (Appendix III).

U.S.A.

In October 1986 the Atlantic coast states, through the Atlantic States Marine Fisheries Commission, signed a "cooperative agreement" to control the interstate movement and shipments of living shellfish (mollusks). A major aim of this control is to limit the spreads of diseases and pathogens. Toward this end, a "Shellfish Management Plan" with a target date of October 1987 is being prepared, to implement these controls.

3.1.2 Deliberately introduced fish: mariculture

A summary of releases and transfers of juvenile and adult salmonid fish by Canada, USA, Denmark, U.K., and Norway is given in Table 1.

Denmark

Elvers (Anguilla anguilla) have been imported for experiments in net cages and subsequent release (200 kg) while further imports were intended for release only (500 kg). 15,000 specimens menat for stocking were also imported. All imports originated from the U.K. (certified) and the consignments were kept in quarantine before the experiments or releases were performed.

Table 1

RELEASES AND TRANSFERS OF JUVENILE AND ADULT SALMONID FISH IN 1986

Species	From	To	Action
Rainbow trout (Steelhead) *Salmo gairdneri*	USA (White Sulphur Springs, West Virginia)	Canada (Nova Scotia)	Imported to hatcheries
	Great Lakes	New Hampshire	37,133 smolts released
	Ireland	England	2 tons
	Danish hatchery	Isefjord	8000 tagged released
	Danish hatchery	Limfjord	4000 tagged released
Atlantic salmon (*) *Salmo salar*	USA (Maine)	Wales	dwarf land-locked strain: 20K for stocking angling waters without connection to natural waterways
	Sweden	Norway	"considerable import of smolts"
Coho salmon *Oncorhynchus kisutch*	Stock from eggs from returns of prior releases	New Hampshire (Great Bay tributaries)	151,993 smolts April/May 1987
Chinook salmon *Oncorhynchus tshawytscha*	Great Lakes	New Hampshire (Great Bay tributaries)	40,000 smolts April/May 1987
Brown trout *Salmo trutta*	Danish hatchery	Limfjord	5500 released
	Danish hatchery	Als fjord	378 released

* France:
"Aucune importation de smolts n'a eu lieu en 1986. En 1987 ou 1988 devrait être réalisé un projet de développement d'élevage de saumon atlantique avec des smolts importés de Norvège et d'Islande."

NATIONAL SUMMARIES (continued)

3.1.2 Deliberately introduced fish: mariculture (continued)

Norway

In spite of the unfortunate experience of import of Atlantic salmon smolts from Scotland carrying furunculosis, a disease that had not been present in Norway, in spring 1985, there was a considerable import of smolts to Norway also in 1986. Imports were mostly from Sweden under the condition that the fish was directly transferred to seawater to avoid further introduction of the parasite Gyrodactylis salaris. Norwegian production of Atlantic salmon smolts is increasing rapidly with the aim of becoming self-contained as soon as possible.

Sweden

Import of eels (elvers, Anquilla anquilla) to Sweden is made for stock enhancement and culture purposes. Current practices in eel transfers are as follows:

Eels come from England (River Severn) and France (Ile de Re); they are delivered directly to a quarantine facility. No eels are stored in open waters. Imported and quarantined elvers are stocked only in coastal waters in the southern part of the Baltic. There are five quarantine facilities and 5-10 eelfarms (landbased with recirculating water). IPN and Rhabdovirus anquilla have been found in eel quarantine; outbreaks of fish diseases related to importation include IPN, VHS, and furunculosis.

U.S.A.

Salmon Releases in Maine, New Hampshire, and Massachusetts

State fisheries agencies in New Hampshire and Massachusetts, on the Atlantic New England coast, continue their interest in releasing salmonids for sport fisheries purposes. Released fish represent (1) pen-raised smolts, derived from eggs stripped from returning females and (2) importations from the Great Lakes. Because of disease problems, no fish are imported from the Pacific coast of North America. Fisheries biologists regard river conditions in these states as not suitable for salmonid establishment. In 1986-1987 returns of coho in New Hampshire and Massachusetts were particularly low, although the reasons are not known.

NEW HAMPSHIRE released both coho salmon and chinook salmon in 1987 (see Table 1). Spring 1985 releases were 97, 931 fish; returns were very low, with only 27 returning adults reported in 1986-1987. (See 1986 Gydnia report for summary of 1986 releases). Chinook and rainbow trout eggs are imported from the Great Lakes and reared in pens. A current problem is a 50% (fifty percent) loss rate of these eggs due to a condition called "roll-over disease", which is believed to be result from metal contamination in the Great Lake watershed. Dr. S. Sower at the University of New Hampshire is continuing her studies on the relationship between rearing densities of coho and their eventual survival. She is also looking at the frequency of sexually precocious and of intersex fish in the coho populations. This work is federally funded by Sea Grant (NOAA).

MASSACHUSETTS continues to have hatchery problems and released no salmonids this year. They believe the problem may be in copper contamination in the hatchery water supply. Returns of previously released

NATIONAL SUMMARIES (continued)

3.1.2 Deliberately introduced fish: mariculture (continued)

U.S.A. (continued)

coho salmon were variable: In the fall of 1985, returns were 1.44% of released fish (considered good by Massachusetts officials), but in the fall of 1986 [in concert with the rest of the Atlantic states], returns fell to 0.06%.

MAINE, in the form of a private company, released no salmonids this year. The large project involving experimental releases of chum salmon (and, originally, pink salmon) has ended. In the 1986-1987 fall/winter season, six male chum salmon returned to the release site, all of which were originally Japanese fish, before the river froze. There were a few, unverified reports from fishermen. Any future releases will be based upon eggs stripped from returning females; no new importations of Pacific fish are planned. The company is now turning its attention to Phase I of a new project on land-locked Atlantic salmon rearing.

Summary: USA Salmonid Releases

Species	Current Status
Coho Salmon (*Oncorhynchus kisutch*)	Currently released from returning stocks in New Hampshire (1987) and Massachusetts (1986, none in 1987, see Table)
Chinook Salmon (*Oncorhynchus tshawytscha*)	Currently released in New Hampshire from stock from Great Lakes (1987)
Chum Salmon (*Oncorhynchus keta*)	No longer released; last releases were in Maine in 1986 (see Gdynia report)
Pink Salmon (*Oncorhynchus gorbuscha*)	No longer released; last releases were in Maine in 1983

3.1.6 Deliberately introduced fish: Research purposes

U.K.

Licenses have been issued under the Molluscan Shellfish (Control of Deposit) Order to permit small-scale introductions of the oyster *Crassostrea virginica* (from the Virginia Institute of Marine Sciences) and the bivalves *Pinctada* spp. (from Bahrain) for scientific purposes in research establishments with closed quarantine facilities inspected by MAFF. No introductions have been made or are envisaged in the forseeable future for fisheries enhancement or mariculture purposes.

NATIONAL SUMMARIES (continued)

3.2.2 Deliberately introduced invertebrates: mariculture

Ireland

6000 kilos of adult oysters (Ostrea edulis) were reimported from Holland to Ireland, but rejected on quality grounds.

U.K. (Scotland)

850,000 seed and 35 tonnes of oyster seed (Crassostrea gigas) were imported from Guernsey and N. Ireland respectively.

3.2.3. Live storage prior to sale

France

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

Country of origin	Ostrea edulis (flat oyster)	Mytilus edulis (mussels)
Ireland	12	3,507
U.K.	100	4,209
Spain	---	7,564

U.K.

Live lobsters (Homarus americanus) continued to be imported under Control of Disease License from North America and were associated with an outbreak of Gaffkaemia in an east coast lobster storage facility. This outbreak resulted in mortalities of European lobsters held in the same facility. MAFF guidelines on the management of lobster storage tanks as required under the Lobster (Control of Deposit) Order are currently being updated.

3.2.5. Deliberate introductions of invertebrates: Research purposes

U.K.

Tropical penaeid prawns (including Penaeus monodon) are being held for research purposes in closed systems by a University Department in Wales. There have been no introductions of marine crustaceans for fisheries enhancement or mariculture purposes during the report period.

4.0 Species introduced accidentally with deliberate introductions

The European nematode eel situation:

Introductions of eels from Asia have resulted in the accidental introduction of the dangerous parasitic swimbladder nematode Anguillicola to Europe. It occurs now in Italy, the Netherlands, Denmark, northern Germany (Baltic), perhaps in Poland, and appears to be spreading northward and eastward. Given the widespread and difficult to control movements of

NATIONAL SUMMARIES (continued)

4.0 Species introduced accidentally with deliberate introductins (continued)

eels throughout Europe, a high level of probability now exists that this parasite will spread beyond its current area. Sweden is considering new importation and quarantine rules for eels.

France

IHN (infectious haematopoietic necrosis) has been reported from two rainbow trout (Salmo gairdneri) farms in France in 1987 (E. Egidius, Norway); published reports will be forthcoming. Up until this time, the IHN virus has not been isolated in Europe. [Mulcahy and Wood (1986) report the first natural infection of introduced stocks of Atlantic salmon (Salmo salar) by IHN virus in the State of Washington, U.S.A. While the fry of these fish had come from specific-pathogen-free eggs imported from Norway, the source of infection in this case is considered probably to be from the local Lake Washington, from which the hatchery water supply is derived, and in which the sockeye salmon (Oncorhynchus nerka) is known to have a high prevalence of the IHN virus in spawning adults and frequent epizootics in fry.]

Ireland

There was a Bonamia outbreak in Cork in March 1987, causing the first regulations to be issued to limit transfers of oysters, but unfortunately oyster spat from this oyster farm have already been widely spread. A proposed introduction of a "Bonamia-resistant" strain of the flat oyster Ostrea edulis from the State of Washington (USA) has lead to the development of a draft license (see 2.0 [above] and Appendix III herein).

Sweden

During recent times there have been several outbreaks of diseases in Swedish marine aquaculture installations, such as IPN in rainbow trout and eel cultivations and BKD and furunculosis in rainbow trout. Rhabdovirus anguilla has been found in eel quarantines. Installations in both the southern and northern parts of the country have been hurt. An extensive sanitation program has been set in.

The eel parasitic nematode, Anguillicola which has been spread from Asian to European waters has, so far, not reached Sweden, but has been established in Danish as well as northern German (Baltic) waters. A special group of scientists has been designated to watch for this parasite.

U.K.

There have been no further extensions in the range of Bonamia within the report period.

U.S.A.

Elston, Farley, and and Kent (1986) report the occurrence of the protozoan parasite Bonamia ostreae in the flat oyster Ostrea edulis oysters on the Pacific coast of North America, in the states of Washington and

NATIONAL SUMMARIES (continued)

4.0 Species introduced accidentally with deliberate introductins (continued)

California. Bonamia has caused extensive oyster moralities in France, the United Kingdom, The Netherlands, Spain, and DEnmark. They suggest that Elkhorn Slough, on Monterey Bay, in central California, may have been one of the original sources of this parasite. Oysters from Elkhorn Slough were transported to the State of Washington, and also in large quantities to France in the 1970s, prior to the detection of the disease in either locality. The source of the Bonamia in California is uncertain, but may eventually be traced back to the Atlantic coast of the United States, which was the original source of Ostrea edulis for California.

5.0 Completely Accidental Introductions: Invertebrates

U.S.A.

Introduced Tunicates Spreading on Atlantic Coast

Two species of introduced ascidians (tunicates, "sea squirts") continue to spread along the Atlantic coast and recent attention has now turned to their interaction with native oyster culture. These species are the encrusting compound ascidian Botrylloides leachii (from California, released intentionally, and unfortunately, by an experimental biologist at Woods Hole) and the solitary stalked ascidian Styela clava (native of Asia, but introduced via Europe, via ship fouling). Both first appeared in the 1970s. The brightly colored Botrylloides grows rapidly in large, flat, gelatinous sheets, spreading over many square meters in a matter of weeks. Very few other animals grow on it. The brown Styela grows to 6 inches (15 cm) to 8 inches (20.5 cm) in height, often in dense aggregations; it often becomes encrusted (covered) with many other small fouling organisms. Botrylloides often grows on the (also introduced) green algae Codium fragile tomentosoides, and is apparently spreading by this means: Codium often tears loose, and plants with Botrylloides are often observed floating along the coast. Both seasquirts are also transported by ships.

Biologists at the University of Connecticut (Professor R. Whitlatch) and the Benedict Estuarine Research Laboratory of the Academy of Natural Sciences of Philadelphia (Dr. R. Osman) are now beginning studies on the relationship between these fouling ascidians, which are spreading south and west into Long Island Sound, and oyster populations (Crassostrea virginica). Concerns focus on competition, predation, and indirect effects. Botrylloides may be directly affecting oyster larval settlement; Styela may be consuming the oyster larvae directly. Oyster growers are also reporting that dense aggregations of these ascidians are weighting down and fouling oyster grow-out cages. Earlier reports (J. T. Carlton) recorded areas where Styela may have replaced Mytilus edulis populations in Rhode Island.

Appearance of Atlantic Blue Crab in California

A great deal of popular media attention accompanied the discovery of a number of living Atlantic blue crabs, Callinectes sapidus, in early 1987 in San Francisco Bay, California, and in a small open marine bay (Halfmoon Bay) just to the south of San Francisco. These were large adult male and

NATIONAL SUMMARIES (continued)

5.0 Completely Accidental Introductions: Invertebrates

U.S.A. [continued]
female crabs, and at least one individual had been in the ocean long enough to have native Californian barnacles on it. It is generally believed that these crabs were released by private individuals. It is popular in the United States to purchase living Atlantic lobsters at airports (such as New York and Boston), and return to the Pacific coast with them as gifts for one's family! Both Chesapeake Bay blue crabs (Callinectes) and green crabs (Carcinus maenas) can be obtained by the same means from fisheries dealers. Although Callinectes is being transported from the Atlantic coast of the United States to Europe as larvae in ballast water, it is believed that this is not a likely means for transport to central California (although not entirely impossible if a ship were to come directly from the Gulf of Mexico in water ballast through the Panama Canal to San Francisco Bay).

The San Francisco Bay area is regarded as too cold for the successful reproduction of this crab (which, however, would find conditions suitable in southern California).

6.1 Species introduced for hatchery rearing: not planted outside hatchery

Norway
Broodstock of the clam Venerupis semidecussata [= Tapes philippinarum elsewhere in this report] was imported from Scotland and kept in quarantine in accordance with the ICES Code of Practice. The broodstock was destroyed after spawning. The F1 generation seems to do very well.

U.K.
At least three University departments maintain broodstocks of the fish Tilapia and are evaluating their potential for aquaculture.

U.S.A.
The shrimp Penaeus vanamei is currently raised in seawater ponds in South Carolina. Penaeid culture began in 1952 in that state using native species, with experimentation with introduced shrimp beginning in the mid to late 1970s. In the past several years the interest in this culture has increased considerably. Penaeids have been imported from Texas and Central America (Panama).

Approximately one million shrimp (individuals less than one gram in weight each) are now held in the Waddell Mariculture Center of the State Marine Resources Department. The water is pumped from local estuaries and the effluent water is returned to these estuaries. State officials regard these shrimp populations as disease-free, and only disease-free shrimp are permitted to be imported into the State. Penaeus stylirostris, which is infected by the IHHN virus in Hawaii, Mexico, and elsewhere, is no longer imported into South Carolina, and no culture work with this species is now going on there.

Examination of these shrimp for viruses is currently in progress at the University of Mississippi. Both native and exotic viruses are being looked

NATIONAL SUMMARIES (continued)

6.1 Species introduced for hatchery rearing: not planted outside hatchery (continued)

U.S.A. [continued]
for. This involves assay work, infecting susceptible individuals and doing tissue culture and immunological studies. No results of these studies are yet available.

6.2 Species introduced for hatchery rearing: stock relaid in small quantities under controlled experimental conditions

U.K.

American oysters (Crassostrea virginica): seed have been produced from imported stock held in quarantine at the MAFF Fisheries Laboratory, Conwy. Spat released from quarantine, following frequent histopathological examinations on samples by the MAFF Fish Diseases Laboratory, Weymouth, have been used for on-growing performance comparisons with Pacific oyster seed (Crassostrea gigas) at six locations in England and Wales. American oysters grew equally as well as the Pacifics during spring and summer at all sites but annual growth was better in the latter species because of its ability to grow well in autumn and early winter. Growth of C. virginica was particularly good in the Essex rivers on the east coast of England and was unaffected by concentrations of TBT which severely stunted the growth of the Pacific oysters at West Mersea. Juveniles have been supplied to commercial hatcheries as a source of future breeding stock. Future commercial culture of this species will need to comply with the provisions of the Wildlife and Countryside Act, 1981 as well as licensing procedures under the Molluscan Shellfish (Control of Deposit) Order, 1974 as varied in 1983.

6.3 Species introduced for hatchery rearing: stock supplied in larger quantities to the industry

Transfers of salmonid eggs (ova) in 1987 to Scotland, France, Ireland, Britain, and Canada are shown in Table 2.

France

Eggs of turbot and bass are transferred between Brittany, Spain, Great Britain, and the Mediterreanean.

U.K.

The hatchery production of Manila clam seed (Tapes philippinarum) is now well established but few British growers are involved in culturing the species to market size. There is the requirement to contain effectively the clams under secure mesh covers or in mesh bags or trays to prevent their escape into the wild to comply with the Wildlife and Countryside Act of 1981.

Research by MAFF shows that the species will grow to 20-25 grams live

Table 2.
TRANSFER OF SALMONID FISH EGGS (OVA) IN 1986

Species	From	To	Number (m, millions K, thousands)
Rainbow trout (Truites arc en ciel)			
Salmo gairdneri	Denmark	Scotland	9.25m
	USA	France	--
	Norway	France	--
	Denmark	France	--
	N. Ireland	Ireland	400K
	U.K.	Ireland	400K
	Denmark	Ireland	2.0m
	Denmark	U.K.	21.5m (Feb-May)
	USA	U.K.	21.0m (*)
	Tasmania	U.K.	2.0m (July)
	Ireland/Isle of Man	U.K.	5.0m
Atlantic salmon (Saumon atlantique)			
Salmo salar	Norway	Scotland	2.4m
	Sweden	Scotland	2.4m
	Norway	France	30K
	Scotland	Ireland	3.5m
	England	Ireland	220K
	Norway	Ireland	100K
	USA (New York, Maine)	Canada (Ontario)	53K (**)
	Scotland	Canada (Ontario)	30K (***)
Coho salmon (Saumon Coho)			
Oncorhynchus kisutch	USA (Washington, Oregon)	France	4.5m (****)

* Eggs from USA: June (6m), September (3m), October (6m), December (4m), January (2m). Trout ova are imported because UK eggs are not available or are not in adequate supply (particularly April-July), or because foreign eggs are cheaper and said to be of better quality.

** To be released in 1987 into tributaries of Lake Ontario

*** Juveniles to be distributed to private growers in 1987 for producing market fish

**** Coho salmon eggs imported from USA to France in prior years were (millions of eggs): 1983, 0.6; 1984, 2.2; 1985, 3.4. Coho salmon production in freshwater was (in tons): 1985 (30), 1986 (150) and 1987 (250 anticipated); production in seawater was: 1984 (60); 1985 (60), 1986 (70) and 1987 (90 anticipated).

NATIONAL SUMMARIES (continued)

6.3 Species introduced for hatchery rearing: stock supplied in larger quantities to the industry (continued)

U.K. [continued]
weight in 2/3 years in mesh protected ground lays in favored areas with better than 70% overall survival. The European palourde (clam) Venerupis decussata required at least an extra year to reach the same size. Semi-commercial scale on-growing trials are in progress involving collaboration between MAFF and local authorities/fishermen's associations. Although spawning can be anticipated in warm summers the probability of significant recruitment is considered to be very low since the clams mature late in the summer when water temperatures are falling.

7.0 Planned Introductions

France

Acclimatization experiments with the bivalve Patinopecten yessoensis have been planned for 1987-1988. The introduction will be made according to the ICES Code of Practice, as follows:

> Introduction of brood stocks in the quarantine installations at La Tremblade
> Experiments to obtain an F1 stock in the hatchery at Argenton
> Grow out and rearing in the Mediterranean in suspended culture installations
> Zoosanitary control at all stages

The experimental introduction and acclimatization of the shrimp Penaeus stylirostris have been deferred.

8.0 Live exports for consumption

Canada: Atlantic coast

Nova Scotia exported in 1986 American oysters (Crassostrea virginica), blue mussels (Mytilus edulis), and possibly also soft-shell clam (Mya arenaria), European flat oyster (Ostrea edulis) and the quahaug clam (Mercenaria mercenaria).

U.K.

Exports to continental Europe from the whole of the U.K. in 1986 included 543 tons of oysters (mainly Ostrea edulis from the Solent) and 1,261 tons of mussels (Mytilus edulis). In the case of mussels an unknown proportion of the total was processed products. In addition, unknown quantities of winkles, cockles, razor clams, other clams of various species, and scallops are being exported live by vivier transport to France and northern Spain.

Canada: Atlantic coast

Prince Edward Island (Maritimes) exported in 1986 2,500 tons of lobsters and crabs (approximately twenty percent of landings).

NATIONAL SUMMARIES (continued)

8.0 Live exports for consumption (continued)

U.K.

The vivier transport of live crustaceans to continental Europe for consumption is a rapidly expanding trade. Principal species involved are the European lobster (Homarus gammarus), the brown crab (Cancer pagurus), the spider crab (Maia squinado), the velvet crab (Liocarcinus puber) and the green crab (Carcinus meanas). No accurate figures on volumes are available but the total trade is thought to have been in excess of 5,000 tons in 1986 (SIFA information). While much of the volume is directed to the Rungis market large quantities are re-distributed to merchants elsewhere in France and in Spain where they may be held in storage systems. A new and developing trade in vivier air transport of the lobster Nephrops norvegicus to northern Spain. Other markets for live crustaceans include Holland, Belgium, Italy, and Germany.

9.0 Live Exports for purposes other than direct consumption

U.K.

Overseas trade in bivalve seed was buoyant mainly centering on Manila clams (Tapes philippinarum) and Pacific oysters (Crassostrea gigas) produced by commercial hatcheries in England and the Channel Islands (Guernsey). During the report period 42.5 million Manila clam seed were exported to France, Spain and Italy and 25.7 million Pacific oysters, mainly to Ireland, Germany, Spain and South Africa. Included in the Pacific oyster total was more than 6 tons of half-grown oysters for final grow-out in Germany. All animals exported were for mariculture.

Canada: Atlantic coast

Atlantic salmon smolts were exported in 1986 from a Nova Scotia private hatchery to a private commercial rearing facility in Maine.

U.K.

A single farm on the Isle of Man claims to have exported 25 million rainbow trout eyed ova (almost entirely sterile triploid and female only) to Europe, North and South America and Asia. Chilled milt was also exported by the same farm in significant quantities. Another English farm exported less than 100,000 triploid female ova to the USA.

2. CURRENT STATUS OF PROPOSED OR ACTUAL INTRODUCTIONS

A.
THE INTRODUCTION AND CULTIVATION OF THE JAPANESE BROWN ALGA *UNDARIA* ON THE ATLANTIC COAST OF FRANCE.

Working Group Background (Summary)

In 1984 (Halifax) the WG first considered the matter of *Undaria* introductions on the Atlantic coast of France, hearing reports by H. Grizel (France) and J. Craigie (Canada). In 1984-1985 two reports, by G. Boalch (England) and by IFREMER (France), were submitted for consideration. The WG was requested at this time to consider these documents and prepare a formal, separate report. The WG met in special session on 29 May 1985 in Goteborg to undertake this request, and heard reports by two invited phycologists, G. Boalch (England) and I. Wallentinus (Sweden). A detailed report was prepared as a result of this meeting (C.M. 1985/F:60 (Appendix)). Council Resolution 1985/2:35 was passed, stating,

> "Any commercial cultivation and expansion of the existing pilot project of *Undaria* be held in abeyance. Also that an extensive study and risk assessment be undertaken of *Undaria* in the likelihood of escape."

C. Res. 1985/2:36(b) further advised that the monitoring and study of the introduction of *Undaria* should be continued. Dr. I. Wallentinus of the University of Goteburg was asked to prepare a special independent report and evaluation relative to the possible establishment of this Japanese alga on the European Atlantic coast.

The WG met in 1986 in Gdynia to hear a report on the status of French activities by A. Michel (IFREMER), to receive Dr. Wallentinus' report, and to formulate further recommendations. Dr. Michel reported that development of field tests on the feasibility of cultivation were continuing, that the test sites had been reduced from three to one (at Ouessant), and that no natural establishment of young thalli has been observed. Dr. Wallentinus reported, on the basis of an extensive evaluation of published physiological and ecological data, that "a large part of the European Atlantic coast could be a potential area for growth of *Undaria pinnatifida*." On the basis of these reports, the WG supported the French proposal for a more extensive ecological and behavioral study to be undertaken prior to commercial farming of *Undaria*, and that, in the interim, Dr. Wallentinus would visit the *Undaria* site in early 1987.

Under C. Res. 1986/2:35a, the WG was thus requested to complete consideration of the introduction of the brown seaweed *Undaria* to the Atlantic coast of France, and met to do so in 1987 at its Brest meeting.

Summary of *Undaria* Considerations by Working Group

Meeting		Documentary Material
Halifax	1984	C.M. 1984/F:35, pages 33 - 37
Goteborg	1985	C.M. 1985/F:60, pages 25 - 26
		C.M. 1985/F:60 (Appendix): 13 pages + 6 subappendices
Gdynia	1986	C.M. 1986/F:51, pages 3-4, and Appendix V, pages 48 - 58, report by I. Wallentinus
Brest	1987	C.M. 1987/F:35, (herein)

UNDARIA (continued)

1987 Undaria Working Group Activities

On June 9 1987, eight members of the WG (D. McCarthy, Ireland; E. Egidius (Norway); J. C. Oliveira (Portugal); B. Dybern (Sweden); I. Wallentinus (Sweden); A. Munro (UK); C. Sindermann (USA) and J. Carlton (USA)) visited the site of experimental culture of Undaria at Ouessant, one of the Ponant Islands, 20 km from the Brittany Peninsula. Dr. Wallentinus had been unable to make an earlier site visit as planned. Also present at Ouessant were:

Dr. J.-Y. Floc'h, Universite de Bretagne Occidentale, Brest
M. R. Pajot, Assistant to Dr. Floc'h
Dr. O. Barbaroux, IFREMER-Nantes
M. Guermeur, President, Cooperative Aquicole d'Ouessant (CAO)
M. J.-Y. Moigne, CAO, Operations Manager at Ouessant

Presentations to the WG included a videotape, slides, written and oral reports, and a site tour. The WG met separately later during the week at IFREMER facilities at Brest to consider these presentations and findings. Dr. Wallentinus was present at these meetings as well. On June 11, Dr. R. Kass made an additional short presentation to the WG, and presented copies of an IFREMER report on the Undaria culture project.

Background

In early 1971 Undaria was discovered to have been accidentally introduced with oysters from Japan in the l'etang de Thau, Sete, on the French Mediterranean coast. Ten years later, in 1981, it was discovered growing outside of the lagoon. Its spread since then has been limited (Boudouresque et al., 1985; see Figure 1, herein).

In 1983, Drs. R. Perez and R. Kass, of the Laboratory of Applied Algology of IFREMER, worked out a culture technique which led to field tests of plantings that fall at three sites on the French Atlantic coast: Ile de Groix, Ile d'Ouessant, and St. Malo, on the Rance estuary. Work at Groix and St. Malo was abandoned and the only current Atlantic site of Undaria culture is Ouessant. At the moment, no culture of Undaria is allowed anywhere on Atlantic France except at Ouessant. (The reports of Undaria at Roscoff and at Paimpol are in error [C.M. 1985/F: 60 (Appendix), page 2, Table 1]).

Ile d'Ouessant

The site of Undaria experiments on Ouessant is Lampaul Bay, on the southwest side of the island. The experimental plot is 100 m x 200 m, with floating lines held up by large floats and anchored with 2.5 ton cement blocks, 5 to 10 m below the surface. Ten kilometers of 4.8 cm line are in this plot. The Undaria plantules, from the hatchery at Nantes (raised according to a modified Korean cultivation method, A. Michel, Gdynia 1986 report, p. 3) are first suspended from floats in the hatchery trays themselves, to acclimate the young plants, and then later tied onto lines hanging one meter below the surface. The mortality (loss rate) of plantules at Ouessant is not yet known, but literature reports in Asia record losses as high as 80 percent. Plans are underway to condition the young sporophytes of Undaria in the laboratory before plant-out to decrease field mortality.

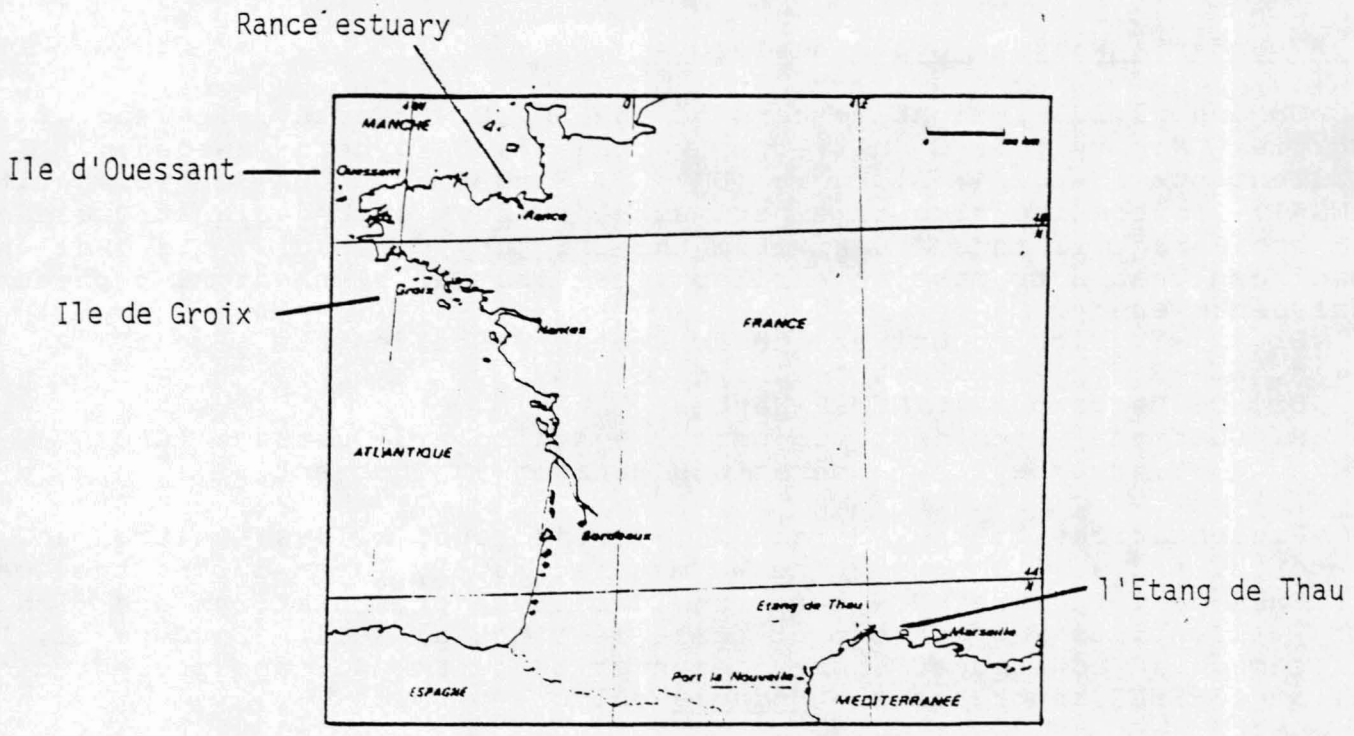
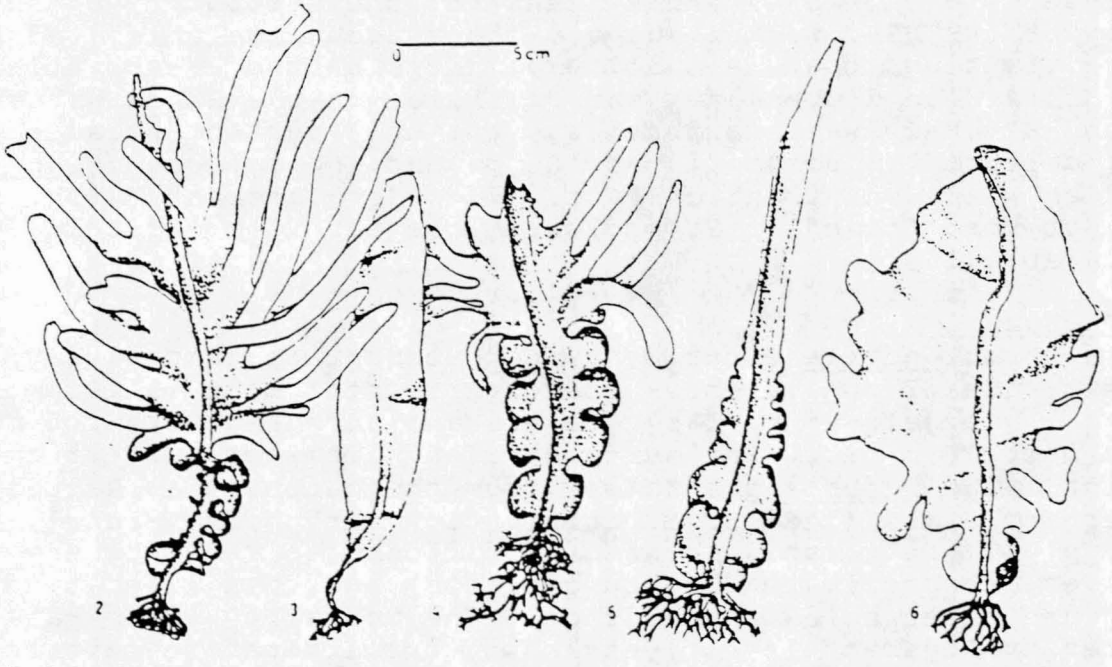


Fig. 1. Carte des côtes méditerranéennes et atlantiques de France et emplacement des stations d'*Undaria pinnatifida*.



Figs 2-6. Aspect général de quelques spécimens d'*Undaria pinnatifida* récoltés à Port-la-Nouvelle; début septembre 1982 (Figs 3 et 6) et fin juillet 1984 (Figs 2, 4 et 5).

Figure 1.

(from Boudouresque, Gerbal, and Knoepffler=Peguy, 1985)

UNDARIA (continued)

At Ouessant, Undaria grows to a depth of 5 m, but most Undaria occur at 2 m or less. (In Asia, Undaria grows to a depth of 15 m). Mullet are known to eat Undaria at Ouessant, and bryozoan epiphytes are common. (The WG members also observed grazing scars of small crustaceans (the isopod Idotea and gammarid amphipods) on the Undaria here, and observed that the blades also supported abundant populations of hydroids (hydrozoans)). There are no known disease problems of cultivated Undaria here.

The long-term plan of IFREMER and the CAO is to have two hectares under production by 1989. The history of plantings of Undaria here is shown in Table 3.

Table 3.

Undaria pinnatifida at Ouessant, Brittany, France
1983 - 1986

Year	Planted	Harvested	Source of Plantules	Remarks
1	Fall 1983	Spring 1984	Sete	"les resultats spectaculaires" -- maximum 2.5 m in 4 months
2	Fall 1984	Spring 1985	hatchery	also excellent results
3	Spring 1985	---	hatchery	experiments to see what would happen to plants if they were planted in spring. Results: plantules were overgrown by bryozoans and certain algae (including Asparagopsis armata [also an introduced species], and other species)
4	Fall 1986 (*) [no plantules were available for a fall 1985 planting]	---	hatchery	a storm in October destroyed the plantules, mostly by stripping the plantules off newly-hung hatchery trays; a few trays were lost, and some of these were found on the bottom of the bay
5	[Fall 1987]		(hatchery)	(new plantings planned for fall 1987)

The studies of Dr. J.-Y. Floc'h

Dr. Floc'h, who had done detailed phycological studies in the Ponant archipelago, was asked by IFREMER to study the ecology of Undaria in Lampaul Bay, Ouessant. He was asked to determine if Undaria could or is

UNDARIA (continued)

reproducing there, if it could establish itself naturally even if it did reproduce, and if there were any escapes (does it occur outside of the cultivated sites?).

Dr. Floc'h outlined his three primary tasks:

1) to visit Asia (Japan, Korea, and China) and study Undaria culture there; to visit the Mediterranean sites of Undaria;
2) to contact and visit Asian experts on Undaria;
3) to conduct a detailed survey in Lampaul Bay -- qualitative, quantitative, and experimental studies.

Dr. Floc'h has visited Asia, but has not yet visited the Mediterranean sites. He has made extensive contacts with foreign experts. His studies at Ouessant, aided by biologist-diver M. R. Pajot, were started in January 1987.

Visits to Korea, Japan, and China

Dr. Floc'h presented a slide show of his Asian visits, showing field sites, harvesting, and processing (preparation) techniques in all three countries -- Pusan (Korea), Sendai (Japan) and Ching'tao (China). In particular, a detailed view of the preparation of "wet salted wakame" in Korea was presented. The extraordinary clean and meticulous methods of Japan in wakame preparation were also noted. At most sites, several species of algae (Undaria, Laminaria spp., Porphyra) and mussels (Mytilus) are grown in the same bay. (At Ouessant, mussels and oysters are also grown in extensive hanging culture at Lampaul Bay)

Highlights of particular importance relative to Dr. Floc'h's Ouessant studies are as follows:

> The work of Dr. K. Akiyama in Japan. Dr. Akiyama's experimental work on the effects of temperature and light on growth and reproduction of Undaria are very important. His results suggest that Undaria "will probably be able to reproduce at Ouessant" (J.-Y. Floc'h) -- that is, it appears to be able to reproduce, although there is no evidence of this at Ouessant at the present time. Dr. Akiyama's studies are especially applicable since it appears that the original French oysters brought to l'etang de Thau (where Undaria was first discovered in France) may have come from the same Prefecture where Dr. Akiyama did his studies (Dr. Floc'h is looking into this possibility).

> Current work in China includes studies on two major forms of Undaria: form typica and form distans. Which form is at Ouessant? Are these forms ecological or genetic? It is very important to answer these questions, since there may be fundamental reproductive and ecological differences between these two forms (microscopic studies are required for identification).

Ouessant Studies: Design and Work Accomplished So Far

A detailed survey of Lampaul Bay is now in progress. The survey consists

UNDARIA (continued)

of looking for Undaria in 80 square meter plots on the bottom of the bay from +1.5 m to -5.0 m in depth. So far (January to May 1987) 45 sites have been surveyed. Experimental work has not yet started.

Since the work has just begun, no formal results are available. Some observations to date, however, include:

> As of May-June 1987, Undaria growing at Ouessant ranged in size (length) from 20 to 170 cm. Sporophytes cut in May were found to be mature -- very ripe, packed with spores. It is not known if these spores are actually released and/or settle.

> As of May-June 1987, no Undaria have been found on the bottom on rocks or other benthic hard substrates anywhere in the Bay. However, it has been known for two years that Undaria is growing on hanging mussel (Mytilus) culture where it was not planted -- but near to areas where plantules have been put out. It appears that the plantules were washed off trays and ropes and drifted onto (and attached to) the mussels. (The WG observed that loose plantules would likely pass through these mussel beds on receding (ebbing) tides). Undaria grows on the Mytilus here along with Laminaria, Saccorhiza, Asparagopsis, and other algal species.

> Two plants of Undaria, about 30 cm long, were found growing on mussel ropes at Ile de Groix in May 1987 by Dr. R. Kass. Undaria was cultured here from September 1983 to 1985. It is not yet known whether Undaria may be reproducing here or whether its presence in 1987 at Groix is due to the factg that mussels are transferred from Ouessant to Groix.

Recommendations

The Working Group,

(1) Noted with pleasure that a two year ecological study of Undaria at Ouessant was started in January 1987 by Dr. J.-Y. Floc'h, and encouraged the continuation and completion of this important research,

(2) Urged, in particular, the implementation of experimental manipulative studies focusing on the competitive abilities of Undaria, and its potential for interactions with native algae or with other hard-substrate organisms. These studies could include the use of artificial substrates (ropes, panels, or other materials) set at various distances from the culture sites to look for reproduction and settlement; transplants of Undaria to test survival, and so on.

(3) Urged further exploration for Undaria at Ile de Groix (relative to the discovery of its growing at the former cultivation site) and checking of the previous cultivation area at La Rance estuary, and requested that it be kept advised of the occurrence of any escaped plants outside of Lampaul Bay; of the occurrence of natural reproduction or spreading of Undaria at Ouessant, Groix, or other areas, or of any cultivation attempts outside of Lampaul Bay

UNDARIA (continued)

(4) Requested that IFREMER provide to ICES, as soon as practical and possible, Dr. Floc'h's preliminary or final report, after the completion of his study in December 1988, so that the WG may study this report, and formulate more precise and definitive advice and recommendations at its spring 1989 meeting,

(5) Requested that Dr. I. Wallentinus remain in her capacity as expert consultant and be invited to the WG meeting in 1989 to consider the French report on Undaria at Ouessant.

B.
TRANSATLANTIC TRANSFERS OF ATLANTIC SALMON EGGS AND JUVENILES

The WG discussed aspects of the current status of certain intercontinental, intracontinental, and transhemispheric movements of salmonid stocks. G. Turner (Canada) brought to the attention of the group the current work of the Bilateral Scientific Working Group on Salmonid Introductions and Transfers of the North American Commission (NAC) of the North Atlantic Salmon Conservation Organization (NASCO). NASCO-NAC has suggested (1987) that it establish a liaison with the ICES WG to consider matters of joint interest. NASCO is formulating recommendations relative to a number of salmonid movements, including USA activities on the Atlantic coast of North America.

Discussions included the need for,

* techniques to distinguish different stocks of Atlantic salmon (and other salmonids), especially relative to genetic studies

* the need to learn of the activities of multinational companies in the current movement of eggs and smolts from one continent to another, relative to the potential for disease movement, gene pool mixing, and ecological ramifications

* studies of escapes from fish pens: what is the fate of these fish? do they return to spawn? what is their ecological impact?

The WG expressed continuing concern over the trans-Atlantic and other transfers of Atlantic salmon (Salmo salar) relative to the genetic and ecological implications of stock mixing, and formulated a recommendation urging that studies be encouraged by member countries to determine means of stock identification and to examine the effects of these movements.

3. JOINT MEETING OF THE EIFAC "WORKING PARTY ON INTRODUCTIONS" AND THE ICES WORKING GROUP

On June 10-11 1987 the ICES Working Group met in joint half-day sessions with the EIFAC Working Party on Introductions. The Report of this Joint Meeting are presented herein in Appendix II. The sessions were chaired by Dr. K. Tiews (EIFAC) and Dr. C. Sindermann (ICES).

Highlights of the joint meeting are as follows:

* "Code of Practice and Manual of Procedures for Consideration of Introductions and Transfers of Marine and Freshwater Organisms" should be published by ICES (in its Cooperative Report Series) and by EIFAC (in its Technical Paper Series).

  > The joint meeting discussed this document at length relative to both specific details of content and more general matters of international distribution (see Appendix II).

  > It was decided to also include the flow charts for proposal processing; the ICES WG flow chart will be modified to show that decision proceed from the ICES General Secretary directly to ICES Delegates Meeting.

* The utility of a "decision model" for considering introductions (see Working Group Report of the 1985 Goteborg meeting, pp. 29-30) was again considered by the review of prepared case histories of risk assessment (one on Japanese oysters (by H. Grizel) and the other on rainbow trout (by B. Stout)). The model is a useful tool for discussions and for being part of a decision-making process in concert with other mechanisms and steps.

* The two Chairmen of the Working Groups/Parties will keep each other informed of the respective activities of their committees in order to minimize duplication of effort.

* A joint EIFAC/ICES symposium on the impact of introductions and transfers and individual species case histories is considered desirable, and such a symposium will be proposed.

* The concept and utility of joint meetings was viewed as extremely useful and essential, and it was agreed that the working groups/parties should continue to meet in the future as the need arose.

4. MANUAL OF PROCEDURES, COMPUTERIZED INVENTORY/BIBLIOGRAPHY

A.

Manual of Procedures

One of the tasks of this WG meeting was (C. Res. 1986/2:35b) to complete the production of the The "Manual of Procedures" (also known as the "Protocols"). This manual has been completed with G. Turner (Canada) as

General Editor and considered for finalization and publication at the joint ICES/EIFAC meeting convened during this WG session (see above, and Appendix II).

A1.
Code of Practice to be published in Manual of Procedures

The Code of Practice will be published in the newly-completed Manual of Procedures. WG members were also urged to include the Code in their publications in their native language. Known translations of the Code include English, Dutch, Spanish, and Norwegian.

B.
Computerized Inventory of Introductions and Transfers

G. Turner (Canada) has prepared an example of a computerized inventory of introductions and transfers of marine and freshwater organisms. (One of the tasks of this WG meeting was (C. Res. 1986/2:35d) to "consider the use, value and development of data base programs for the storage and collaboration with EIFAC during a one-day joint meeting"). The data base includes species, life cycle stage, stock origin, release site, original receiving facility, and type of introduction. It was agreed that computerized access to background and historical data on species movements would be of extreme valuable in aiding the WG in its advisory role on introductions and transfers. A computerized data base on salmonid introductions has been started for NASCO. G. Turner will prepare a working draft of a data form (which could be filled out each year by ICES member countries) based upon comments he receives from WG members ouf a draft format that he submitted. Simultaneously, B. Dybern (Sweden) will discuss the feasibility of such a computerized project with the ICES Data Center.

C.
Computerized Bibliography of Introductions and Transfers

H. Rosenthal (FRG) has prepared a computerized bibliogrpahy of over six thousand literature entries concerning introductions and transfers of marine and freshwater organisms. This is an extremely valuable compilation which should be added to and to which member countries could contribute important citations. It was felt that member countries would be particularly instrumental in providing citations to or copies of the so-called "gray literature" -- government reports, environmental impact assessments, etc. -- which often contain otherwise unpublished valuable data sets. The WG agreed that it would like to learn in detail of the progress of Dr. Rosenthal's bibliography and plans for publication.

5. RECOMMENDATIONS

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

(1)
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 COOPERATIVE RESEARCH REPORT series as soon as possible;

(2)
A symposium be convened, entitled, "Case Histories of the Effects of Introductions and Transfers on Marine and ~~Aquatic~~ Resources and Ecosystems", in cooperation with FAO/EIFAC, in 1989 or 1990, at which scientific papers by invited experts would be presented and subsequently published, and that Drs. C. J. Sindermann and K. Tiews be asked to be co-convenors.

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

(4)
Because of the very important need of the Working Group on Introductions and Transfers of Marine Organisms, in its advisory role, to have immediate access to background and historical data on species movements, ICES establish a permanent computerized record of the introductions and transfers of marine organisms in and between ICES member countries. Data for this record can be obtained from a form to be filled out each year by each member country.

(5)
The North Atlantic Salmon Conservation Organisation (NASCO), including its Bilateral Scientific Working Group on Salmonid Introductions and Transfers, should be invited to a one-day joint meeting with the ICES Working Group on Introductions and Transfers of Marine Organisms, in order to consider, coordinate, and evaluate matters concerning the status, genetics, ecology, and pathology of salmonid introductions and transfers in the North Atlantic Ocean.

(6)
The Working Group should meet in Edinborough, Scotland, from May 31 - June 3, 1988, under the chairmanship of Dr. C. Sindermann, to,

(a) make detailed preparations for the symposium on case histories of the introductions and transfers of finfish, shellfish, and other marine organisms,

(b) consider the progress and status of the proposed computerized record of introductions and transfers of marine organisms,

RECOMMENDATIONS
(continued)

(c) consider international response and comment on the publication of the Code of Practice and Manual of Procedures,

(d) consider the proposed bibliography of introductions and transfers of marine and freshwater organisms,

(e) consider methods of expediting considerations and deliberations of proposals for introductions and transfers,

(f) consider and coordinate concerns over salmonid introductions and transfers in the North Atlantic in the proposed one day joint meeting with NASCO, and,

(g) continue its overview of the status of new and ongoing introductions and transfers and their biological and ecological effects, relative to shellfish, finfish, and algae, in and between ICES member countries.

6. ACKNOWLEDGEMENTS

At the conclusion of its deliberations the Working Group extended their thanks to Director M. J. Vicariot, Drs. H. Grizel, Y. Harache and J. Querellou, and the staff of IFREMER for the use of their excellent meeting facilities and secretarial services (in particular Mrs. Badia-Villato), and for inviting the Working Group to France for the 1987 meeting; to the EIFAC Working Party (in particular its Chairman Drs. K. Tiews, Secretary D. Charbonnier, and Rapporteur R. Welcomme) for the organization of and cooperation in a joint session; and to the authorities of the Cooperative Aquicole d'Ouessant, at Lampaul Bay, on Ile d'Ouessant, Brittany, and to the authorities of the Societe de Developpement de l'Aquaculture de Bretagne, on the Jaudy River, Treguier, Brittany, for their cooperation in site visits to their respective facilities. The Working Group further extended their appreciation to Drs. R. Kass and O. Barbaroux for taking the time to come from Nantes to present further information on Undaria culture activities.

Appendix I

AGENDA

ICES Working Group on Introductions and Transfers of Marine Organisms
Brest, France, June 9 - June 12 1987

9 June 1987 Tuesday
* WG site visit to Lampaul Bay, Ouessant, Brittany: "Cooperative Aquicole d'Ouessant" and IFREMER: Experimental cultivation of Japanese alga Undaria

10 June 1987 Wednesday

9:00 AM
* Opening Session of Working Group
Welcome by Dr. Y. Harache, IRFEMER
* Review of agenda
* Status of recommendations -- 1986 meeting
* National Reports
* Discussion of Undaria advisory report

12:00 Lunch

1:00 PM
* Joint session with EIFAC Working Party on Introductions
Dr. K. Tiews, Chair
Welcome by Dr. J. Querellou, IFREMER
> Adoption of the agenda
> Introduction of members
> Election of rapporteur
> Preliminary comments of chairmen
> Executive Committee
> Case studies of risk assessment
> Protocols (Manual of Procedures) (G. Turner)
> Future joint activities
> Conclusions and report of the Joint Meeting
> Closing of the Meeting

3:30 PM
* Discussion of Undaria advisory report (continued)
* Discussion of publication of Manual of Procedures

11 June 1987 Thursday

9:00 AM
* Joint session with EIFAC Working Party on Introductions (continued)
Dr. C. Sindermann, Chair
> Preparation of Joint Meeting
> Review of the Joint Meeting
> National plans for introductions
> Further activities
> Other business
> Conclusions and report of the Meeting
> Closing of the Meeting

12:00 Lunch

Appendix I
(continued)

AGENDA

11 June 1987
Thursday
(continued)

12:45 PM * Discussion of Undaria advisory report (concluded)

1:30 PM * ICES/EIFAC joint site visit to the fish farm facility of the Societe de Developpement de l'Aquaculture de Bretagne (SODAB) in Treguier

12 June 1987
Friday

9:00 AM * Discussion and preparation of recommendations concerning trans-Atlantic transfers of Atlantic salmon eggs and juveniles
* Discussion of NASCO activities on salmonid introductions and transfers
* Computerized inventory of introductions and transfers (G. Turner)

12:00 * Welcome by M. J. Vicariot, IFREMER Director
Lunch

1:30 PM * Discussion and approval of minutes from joint ICES-EIFAC meeting
* Discussion of proposed computerized bibliography on introductions and transfers by Dr. H. Rosenthal
* Structure of decision procedures (flow-chart) of proposed introductions and transfers
* Review of Aquaculture Glossary
* Discussion of recommendations to parent committee
* Time, place, and principal agenda items for 1988 meeting

4:00 PM * Adjourn

JOINT MEETING OF THE EIFAC WORKING PARTY ON INTRODUCTIONS WITH THE ICES WORKING GROUP ON INTRODUCTIONS AND TRANSFER OF MARINE ORGANISMS

I. Opening of Meeting

The joint meeting was Chaired by Dr K. Tiews on behalf of EIFAC and by Dr C. Sinderman on behalf of ICES. Drs J. Carlton and R.L. Welcomme were nominated Rapporteurs. Dr Querellou welcomed the participants on behalf of the Director of IFREMER, Brest.

II. Executive Committee

The joint meeting recognized the possibility of the two Working Parties being requested to consider the same proposal for introduction. This would lead to a duplication of effort and the potential giving of conflicting opinions. It was not, however, felt necessary to set up a specific committee to deal with this at this stage as it was considered sufficient for the two Chairmen to keep each other informed as to the respective activities of their Working Parties. Should a case be presented requiring action by both Working Parties, as in the case of a proposal to introduce an anadromous or catadromous species, a more definitive mechanism would have to be set up to handle it.

III. Case Studies of Risk Assessment

As suggested at the First Joint Meeting of the two Working Parties (Göteborg, 1985), an evaluation of the decision model adopted by EIFAC was made by considering Salmo gairdnerii and Crassostrea gigas introductions. In both cases the model had proved useful for discussion and was therefore considered to be a functional tool which should be used wherever feasible along with other mechanisms for reaching a final decision.

IV. Protocol Document

The joint meeting discussed the draft protocol document which was presented by Dr G. Turner. It was agreed that this document be published under the title: "Code of Practice and Manual of Procedures for Consideration of Introductions and Transfers of Marine and Freshwater Organisms", and sub-titled: "Prepared by the 'Working Group on Introductions and Transfers of Marine Organisms' of the International Council for the Exploration of the Sea, and by the 'Working Party on Introductions' of FAO, European Inland Fisheries Advisory Commission".

Any modification of content and organization should be transmitted to Dr G. Turner by 31 July, in time to provide for the submission of the Draft Document to the October 1987 ICES Statutory Meeting for review by the Mariculture Committee and approval by the ICES Delegates. The final draft would be tansmitted to the EIFAC Secretariat for approval by FAO following its procedures.

It was recommended that ICES publish the Protocol document in English in its Cooperative Research Report Series and that FAO publish it, when financially possible, in the EIFAC Technical Paper Series. As EIFAC was currently limited by shortage of funds, Dr K. Tiews and Dr B.I. Dybern should approach the General Secretary of ICES to see whether sufficient supplementary copies could be printed for EIFAC's immediate use. The extra print run could be paid for by one or more of the EIFAC member countries. The EIFAC Secretariat would provide for the translation of the Manual into French and possibly Spanish.

It was recognized that, because of its importance the document should be given maximum circulation at government, scientific and public levels. It should also be transmitted officially to interested international organizations, such as the Office international des épizooties (OIE), International Union for the Conservation of Nature (IUCN), the Council of Europe and the American Fisheries Society. The EIFAC Secretariat was requested to enquire if this transmission could be made at high level from the Director-General of FAO to the Ministers responsible for inland fisheries and the environment of EIFAC countries, as well as to the heads of other appropriate organizations. The ICES Secretariat should also distribute copies of the report to its Member Governments at the highest possible levels.

The following changes were agreed to the format and content of the document:

- that the Code of Practice be included in the body of the text;
- that the decision model be included in annex;
- that the work of authors originating the material presented be acknowledged in an appropriate section;
- that the Annex containing specific examples of Protocols be retained with an explanatory passage. Dr H. Grizel agreed to expand the mollusc section of this Annex and Dr B.I. Dybern agreed to contact Swedish workers to expand on the eel protocol;
- that the addresses of the Secretariats of the Working Parties be included as contact addresses, and
- that the flow charts for the processing of proposals by the two parties be included.

V. Future Joint Activities

Symposium

The joint meeting agreed that it would be desirable to hold a joint ICES/EIFAC Symposium to discuss the status and impact of introductions and transfers, and consider individual case studies. This would most appropriately be organized by ICES, and Dr Sinderman agreed to propose such a Symposium to the ICES Statutory meeting. The meeting suggested that the Chairmen of the two Working Parties act as Co-conveners.

Further Meetings

It was agreed that the two joint meetings held so far had accomplished much in the way of producing compatible Codes of Practice and an agreed set of protocols. In principle, such meetings should continue to be held, but the date and place would depend on future needs.

CANADA

Federal-Provincial Policy for the Importation of Live Salmonids into British Columbia

In recognition of the commercial and recreational value of wild and cultured native salmonid stocks in British Columbia and the Yukon Territory, it is essential to protect their genetic integrity and freedom from exotic diseases.

Therefore, no importations of fish belonging to the family Salmonidae will be authorized by Federal or Provincial fisheries management agencies which are not in compliance with this policy, effective on date of signing.

General:

1. Approved importation of live salmonids must comply with the Canadian Fish Health Protection Regulations (CFHPR).
2. Only surface-disinfected, fertilized eggs will be imported. No live fish or unfertilized eggs or milt will be allowed.
3. Only Atlantic salmon (Salmo salar) and non-anadromous rainbow trout (Salmo gairdneri) will be considered for importation.
4. Importation of rainbow trout will be considered only from brood stock that was hatched and reared in Canada and continental U.S.A.

Atlantic Salmon:

5. As of April 1, 1987, egg imports will be limited to 300,000 eggs/year/licence and allowed only from brood stock that has been held at the source facility (hatchery and sea pen), separate from other stocks, for one full generation. This means that consideration could be given to F_2 Atlantic salmon from Canada and the U.S.
6. No direct importation of Atlantic salmon eggs will be permitted from continental Europe, from the southern hemisphere, or from countries in which viral hemorrhagic septicemia (VHS) is known or suspected to occur. Importation will be considered only from sites that (i) a Canadian Local Fish Health Officer has approved after a site inspection; (ii) can demonstrate a thorough record of disease history to the satisfaction of a Canadian Local Fish Health Officer; (iii) can document and demonstrate disease-free water supply system; and (iv) can document and demonstrate the capability of the physical plant to isolate stocks and prevent disease transfer between stocks.
7. Importation of Atlantic salmon eggs will be for the purpose of developing aquaculture brood stocks in British Columbia. Importers must propose a number or percent of fish to be held to maturity for reproduction and collection of sex products and demonstrate progress and intent to establish brood stocks.
8. Consideration for import will be given particularly to stocks that are demonstrably adapted for commercial aquaculture pen rearing, assuming that all other conditions are met.
9. After March 31, 1989, no further shipments of Atlantic salmon will be permitted.
10. All Atlantic salmon must be held under strict quarantine (as outlined below).

All Live Salmonids.

11. Notwithstanding sections 2,3,5,6,8 and 9, exceptions may be permitted for limited numbers of eggs or small volumes of milt for such activities as research or brood stock development and improvement when work is to be conducted under strict supervision of government fisheries agencies. Approval for exceptions must be obtained from the Director General, Pacific Region, Department of Fisheries and Oceans and the Director, Fisheries Branch, British Columbia Ministry of Environment and Parks.

Atlantic Salmon Quarantine Conditions:

12. Prior to the arrival of any eggs, a quarantine facility must be inspected and approved by designated government personnel according to the following conditions as judged by the designated Fish Health Officer.
    The quarantine facility must:
    a) be an adequately enclosed area, physically separated from any other hatchery operation;
    b) have restricted access;
    c) have approved facilities for disinfection of effluent.
13. All eggs and resultant fish must be held in quarantine for a minimum of 12 months after arrival.
14. All stocks in the initial year and thereafter all stock kept for brood stock must be inspected and sampled according to the CFHPR Manual of Compliance. Fish must be sampled 3 times in their quarantine year and once just after transfer to salt water. Brood stock must be sampled at maturity.
15. Diseased stocks:
    a) shall be destroyed if VHS, IPN, or whirling disease is detected, and
    b) may be ordered destroyed or treated if any disease listed in Schedule II of the CFHPR is detected.
    Also, detection of any other disease designated by Federal and Provincial fisheries management agencies may lead to the same requirement for stock destruction or to further quarantine of the stock.

16. Failure to comply with importation or quarantine conditions will result in suspension of the Commercial Fish Farm Licence of the facility.

Marine Rearing of Atlantic Salmon.

17. All movements of Atlantic salmon from hatchery to salt water will be by Federal-Provincial Transplant Committee approval only.

The precautions taken in 1 to 17 above are designed to minimize the risk of introducing exotic fish diseases and to maximize the chances for detection of any exotic fish diseases that may be carried by introduced stock.

Procedures:

18. All requests for permission to import live salmonids are to be addressed to the Canada-British Columbia Transplant Committee, c/o Local Fish Health Officer, Pacific Biological Station, Hammond Bay Road, Nanaimo, British Columbia, V9R 5K6.
19. In recognition of the importance of managing fish disease upon the orderly development of aquaculture in British Columbia, and recognizing the lead role of the Ministry of Agriculture and Fisheries in aquaculture; the Department of Fisheries and Oceans and the Ministry of Environment and Parks will confer with the Ministry of Agriculture and Fisheries:
    a) prior to any decision being made by the parties regarding items 5 and 11 requests;
    b) prior to any amendments to the policy under item 20;
    c) at least semi-annually regarding the nature and status of requests to the Canada-British Columbia Transplant Committee to import live salmonids to British Columbia.

Amendment:

20. This policy may be amended by mutual consent of the signatories.

APPROVED:

Peter Meyboom, Deputy Minister Department of Fisheries & Oceans	B. E. Marr, Deputy Minister B.C. Ministry of Environment and [illegible]
Date	Date

Draft licence to import O.edulis from USA to Cork

Conditions:

1. Usual conditions of date limits, quantity, supplier, point of entry, etc.

2. Competent authorities [to be named] in the USA to certify that:

a. The following parasites and diseases are absent from a sample of not less than 150 oysters.

[list to be inserted here]

b. No known blooms of dinoflagellates which are responsible for the production of biotoxins have occurred in the waters in which the oysters for consignment have been produced.

c. Any dinoflagellates and/or their cysts which are responsible for the production of biotoxins are absent from a sample of not less than 150 oysters. This check is to be carried out using chemical and biological assay.

d. Immediately prior to packing:

(i) Every oyster in the consignment has been cleaned of all external macrofauna and flora.

(ii) All the oysters have then been dipped in a saturated brine solution for 30 seconds, and allowed to stand for 1 hour in air.

(iii) Following the brine dip and air drying, all the oysters have been immersed for 1 hour in a chlorine solution containing not less than 20 parts per million of sodium hypochlorite.

(iv) The oysters may then be rinsed in clean drinking water (not seawater).

(v) The oysters must not be packed in seaweed or any other plant material, but only in synthetic packing and /or paper.

3. The oysters must not be placed in seawater at any time en route to the premises of Atlantic Shellfish Ltd.

4. On arrival at the premises of Atlantic Shellfish Ltd.:

a. The oysters are to be held indefinitely in quarantine as described below. Any oyster mortalities, on arrival or subsequently, are to be immediately recorded and reported to the Fisheries Research Centre and their instructions followed.

b. Under the supervision of Fisheries Research Centre staff:

(i) All the imported oysters are to be unpacked on the premises of Atlantic Shellfish Ltd.

(ii) No containers or packing materials are to be allowed to come into contact with any of the oyster farm equipment or water supply. All containers and packing equipment must be destroyed by incineration immediately after the oysters have been unpacked.

(iii) A sample of not less than 150 oysters from the consignment is to be taken immediately for histological examination.

(iv) The remaining oysters may be refreshed in ultra-violet-treated seawater in recirculating tanks. When the oysters have been removed, sodium hypochlorite is to be added to the water to a concentration of not less than 50 parts per million. The water is not to be released until at least 24 hours after the addition of the sodium hypochlorite.

(v) All surviving oysters are to be thoroughly cleaned externally and held for at least 3 days in ultra-violet treated water in recirculating tanks, or until such time as the results of the histological examination of the sample of oysters taken at 3.b (ii) are available.

(vi) On removal from the ultra-violet treated water in the recirculating tanks, the oysters are to be dipped in brine, dried and immersed in chlorine solution as at 2.d (i)-(iii) above.

(vii) Before release to the sea, the water in the ultra-violet tanks, and the brine dip, is to be sterilised by the addition of sodium hypochlorite to a concentration of not less than 50 parts per million, followed by thorough

mixing. The water is not to be released until at least 24 hours after the addition of the sodium hypochlorite.

(viii) The imported oysters are to be distributed in not more than 4 ponds until spatfall, following which they are to be destroyed.

c. When it is necessary to remove spat from any broodpond, the water is to be transferred to an adjacent empty pond, in which it will be sterilised by the addition of sodium hypochlorite to a concentration of not less than 50 parts per million. The water is not to be released until at least 24 hours after the addition of the sodium hypochlorite.

d. Ponds containing the imported oysters must be physically and clearly identified as such, and treated as quarantine areas. Maximum hygiene standards are to be maintained at all times. Separate equipment (boots, sample bottles, thermometers, etc.) must be used, in order to minimise the risk of contact and possible contamination between the ponds of imported and domestic oyster stocks.

e. No spat produced by the imported oysters are to be removed from the pond system without prior approval in writing from the Minister for the Marine.

f. In addition to whatever conditions the Minister may attach to such removals, all spat for removal from the pond system are to be dipped in saturated brine solution for 30 seconds, followed by 30 minutes standing in air.

g. When the progeny of the imported oysters have reached a size at which they are fit to be put out, Atlantic Shellfish Ltd.(or any future company to which the ownership of the imported oysters or their progeny may be transferred) shall make available each year to other domestic oyster producers in Bonamia affected areas, not less than 5% (in number) of the annual production of the imported oyster progeny, at prices not exceeding those pertaining in 1986, indexed for inflation.

Summary of oyster treatment procedures:

Before leaving USA:

1. Examined for dinoflagellates/cysts.
2. Cleaned externally.
3. Dipped in brine.
4. Allowed to stand in air for 1 hour.
5. Immersed in 20 ppm chlorine solution, 1 hour.
6. Optional rinse in drinking water (not seawater).
7. Packed and consigned to Atlantic Shellfish Ltd.

On arrival:

1. Unpacked. Packing materials etc destroyed.
2. Sample taken for histology.
3. Optional refreshment in u-v seawater in recirculating tank.
4. Cleaned externally.
5. Held in u-v seawater in recirculating tanks. Not released to ponds until clearance given following histological examination of sample taken at (2) above.
6. Dipped in brine.
7. Allowed to stand in air for 1 hour.
8. Immersed in 20 ppm chlorine solution, 1 hour.
9. Released to ponds.

Water from steps 3, 5, 6, 8, 9 is not to be released until treated with 50 ppm chlorine solution for 24 hours.

RULES FOR IMPORTATION OF ELVERS TO SWEDEN

The Board of Agriculture consider an application for importation of live fish and set rules for the quarantine.

The installation must be made in such a way that no infections can come out into the open waters (closed system). The discharged water must be disinfected, mostly by increasing the pH to higher than 10. A tank for testfish is included in the system. Special rules are set up for the operation of the quarantine.

The imported elvers must be taken directly to the quarantine without changing of waters. After the delivery, the equipment must be disinfected or reexported.

In a quarantine with warm water, the elvers must be kept for 6 weeks. In an installation with cold water (unheated), the period is 4 weeks followed by 2 months "storing" (prohibition of dispersing).

The elvers and the testfish are analysed for virus (RTG - 2 cells).

After the quarantine, the elvers can be used for stocking or farming with due permission from The Board of Fisheries.

APPENDIX IV.

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APPENDIX V.

Working Group Site Visits: 1987 Meeting

(A)
On June 9 1987 eight members of the WG visited the site of experimental culture of the introduced Japanese brown alga Undaria pinnatifida at Ile d'Ouessant, Brittany, France. The results of this visit are presented in the text.

(B)
On June 11, 1987, the joint EIFAC and ICES introduction groups visited the culture site of the introduced coho salmon Oncorhynchus kisutch, sea-run rainbow trout (Salmo gairdneri) and native turbot (a more recent addition), at the Societe de Developpement de l'Aquaculture de Bretagne (S.O.D.A.B.), M. P. Le Roux, Director, located on the Jaudy River at Treguier, Brittany. SODAB is managed as a private company with IFREMER as a major partner; it is becoming economically more self-sufficient each year (1986 sales: 17m F). The work of the company has, up until now, been largely experimental, but they are now ready for commercial development to increase aquaculture in Brittany.

Coho salmon

The eggs are received in December from Oregon, USA. The salmon complete their entire life cycle here. They go into seawater in October at 200 gm, and are harvested at 800 gm - 1.5 kilos. The estuary here is ideal for salmonid culture (depth over 10m; temperatures from 8 to 14 deg Celsius), yielding cost-effective operations. The growth cycle of coho here is much shorter than elsewhere -- half that of northern Europe, for example. There is also a high market demand for small ("family-size") fish (coho are now bringing 36F/kilo).

SODAB is now attempting to develop their own broodstock (several 1000 fish are at the site now). At this time, there is no known natural reproduction of coho salmon in France, although Pacific salmonids were known to be established in some French rivers in the 19th century. Coho salmon have been worked with here for 13 years, underscoring the length of time necessary to develop the right culture methods. At the start, there was an attempt to first transfer the salmon to seawater during the second spring, but these all died. Later, the second fall was tried, and then the first fall was tried (at 10 months).

There is a 5% escape rate. They are designing an electronic net which would alert for ruptures in the system. Predators include various birds (cormorants, gulls, and herons, all of which are protected species), while theft also happens. Escape, predators, and theft are all small but increasing problems as the size of the SODAB increases. Diseases here include furunculosis (in freshwater) and BKD and vibriosis (in seawater).

Relative to the survival rate, the problem here focuses on the transfer between freshwater and seawater. There is only a one to two percent loss when this is done properly, but there can be up to a 25% loss when the fish are two years old. The overall mortality after transfer is about 10 to 15 percent, with two peaks: one, when temperatures start to rise and two, during the summer. The optimal stocking rate of fish is 15 kilo/cubic meter.

Appendix V
(continued)

Rainbow trout

These come originally from a freshwater fish farm in Brittany. They are transferred to seawater at the beginning of November (200 gm), and raised at sea until June/July (when they are now one to two kilos in size). They are thus 10 months in freshwater and 8 months in seawater, reaching up to two kilos in 18 months. Production is 350 tons/year; rainbow trout currently bring about 25F/kilo at the market. They are stocked optimally at 20-25 kilo/cubic meter.