Status of Irish Aquaculture 2005

An information report on Irish Aquaculture

Marine Institute, Bord Iascaigh Mhara and Taighde Mara Teo.

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Photographs courtesy of BIM, R. Browne and B. Deegan

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Cover image of mussel lines in Killary Harbour (Ronan Browne) and sea cage for Atlantic salmon (Bryan Deegan)

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1. INTRODUCTION / RÉAMHFHOCAL

Micheál Ó Cinnéide, Mark Norman, Terence O'Carroll agus Ronan Browne

Is fiú ós cionn €100 milliún sa bhliain tionscail an fheirmeoireacht éisc do phobail cois cósta, furmhór de lonnaithe in iarthar agus deisceart na hÉireann. Is ionann é seo agus an triú cuid de thionscail éisc na hÉireann. Tá dlúth bhainnt ag eagraisí stait - Bord Iascaigh Mhara, Foras na Mara, Údarás na Gaeltachta agus Taighde Mara Teo - le dul chun cinn agus forbairt maidir le feirmeoireacht éisc.

Don triú bliain as a chéile, tugann an tuairisc seo ós na heagraisí stáit, cúntas neamhspleách ar an dtionscail, ó thaoibh táirgíocht, fostaíocht, cúrsaí timpeallachta, sabháilteacht bidh agus taighde.

Tá súil againn go mbainfear leas an an dtuairisc seo chun na fíricí faoin tionscail a chur ar fáil do lucht gnó, do lucht polasaí agus don bpobal.
Ár mbuíochas dóibh siúd go léir a chuidigh leis an t eolas seo a chur le chéile. Bail ó Dhia ar an obair.

Aim and Scope of Report

This is the third annual report on the status of Irish aquaculture (see Parsons *et al*., 2003, Parsons *et al*., 2004). As with the previous reports it has been produced in collaboration with the three main State agencies that provide support services in the areas of research and development to the industry – Bord Iascaigh Mhara (BIM), the Marine Institute (MI) and Taighde Mara Teo (TMT).

The objectives of this report are:

- To provide a useful, objective and comprehensive source of information on the status of Irish aquaculture in the year 2005;
- To show trends in the production, employment, export and market statistics for the Irish industry in 2005;
- To summarise the current licensing activity, which is the responsibility of the Department of Communications, Marine and Natural Resources;
- To present the results of the wide range of monitoring programmes for farmed shellfish and finfish, which are carried out primarily by the Marine Institute, in accordance with Irish and EU food safety and environmental requirements;
- To highlight the various research and development initiatives in the area of aquaculture that are underway in the various State agencies and third-level institutions; and
- To report on issues/events/initiatives that occurred during the year 2005.

The overall aim of the report is to provide useful reference material for the industry, trade customers, investors, researchers and interested parties.

Overview of Irish Aquaculture Industry Production in 2005

Modern Irish aquaculture began its development in the early 1970's. Since that time the aquaculture industry has become an important contributor to rural economies and the national exchequer. Aquaculture generates income in many areas where there is little other primary wealth creation activities. Over the last three decades there has been an increase in diversity of species being cultured, sites utilised and more recently in the technologies employed in their cultivation. There have also been significant advances made in ensuring that the quality of Irish Aquaculture production reaches the highest standards for the market place at home and abroad.

The Aquaculture Industry production value had grown in output from €37.2 million (26,573 tonnes) in 1990 to a peak in 2002 of €125.2 million (60,984 tonnes). Since the year 2002 the industry has experienced significant production and marketing challenges and in the year 2005 the total Irish Aquaculture output was valued at €109.3 million (60,050 tonnes), with 1,635 employed in the industry. The Aquaculture sector represents some 30% of the total value of Irish seafood produce.

When comparing 2005 with 2004, overall production volumes in the shellfish sector increased marginally by 3.6% to 44,666 tonnes. However, gross production of the finfish industry remained relatively stable at 15,384 tonnes (+0.7%). A more detailed analysis of these figures shows that:

- In the shellfish sector there were increases in bottom mussel and *Crassostrea gigas* oyster production. Rope mussel culture was affected by biotoxin closures and harvest volumes remained static. There was a decrease in the quantities of native oysters, clams and scallops harvested.

- In the finfish sector salmon farming had undergone a significant decline in both 2003 and 2004. In 2005 salmon volumes were down 2.1% on the previous year. Disease problems, primarily Pancreas Disease (PD) continued to adversely affect the dominant salmon sector. However, there was an improvement on the marketing side of the industry with the introduction of "Minimum Import Price" in Europe. In 2005 there was a 150% increase in sea-reared trout production. Harvests of freshwater trout remained static and the production of turbot had ceased. There was significant progress made in the production of freshwater fish, such as char and perch. Cultivation of cod commenced in sea cages.

During the year 2005, the shellfish sector experienced prolonged biotoxin related closures. There was also a protracted intense bloom of *Karenia mikimotoi* which impacted on shellfish stocks.

The locations of salmon, oyster (*C. gigas* and native), blue mussel (*Mytilus edulis*) and scallop Aquaculture Licences are shown in Figure 1.

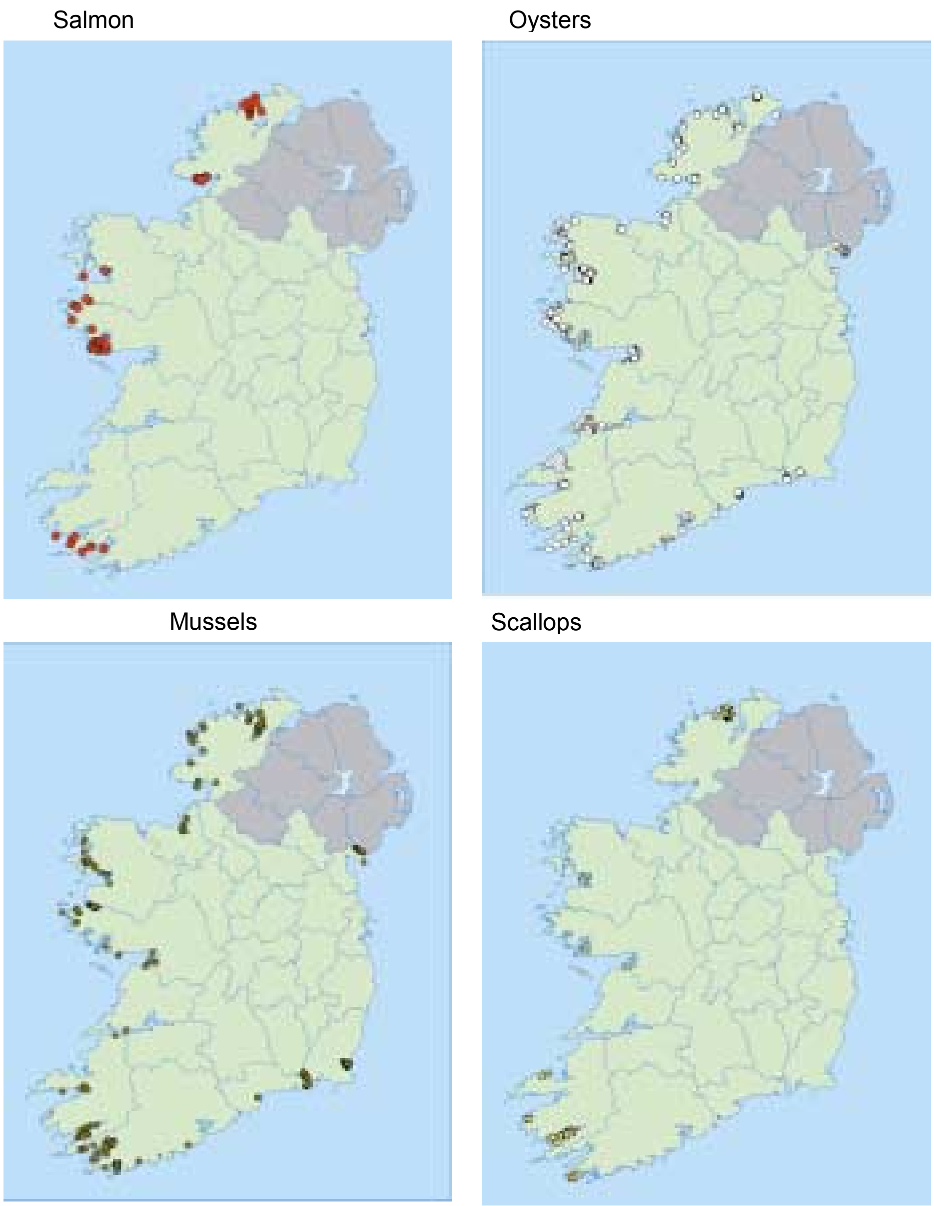


Figure 1: Location of Aquaculture Licences for the Principal Shellfish and Finfish species. Hatched areas in oyster figure are areas subject to native oyster orders (e.g. Clew Bay) (Courtesy BIM).

The sites of new or novel aquaculture species such as cod, abalone, perch, urchins and seahorses are shown in Figure 2.

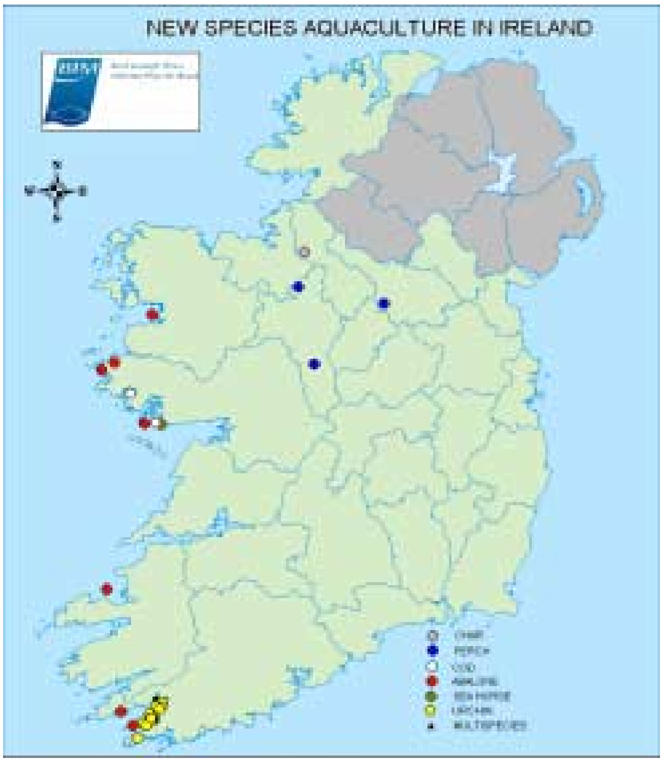


Figure 2: New aquaculture species in Ireland (Courtesy BIM).

Seaweed aquaculture remains in a pilot phase and licences have been issued for counties Cork and Galway. There are a number of species suitable for cultivation in Ireland (e.g. *Alaria esculenta, Palmaria palmata, Asparagopsis armata, Chondrus crispus* and *Laminaria saccharina*).

2. PRODUCTION AND EMPLOYMENT SUMMARY

Overview

BIM is the agency responsible for annually gathering data on production volumes and value, directly from aquaculture operators. BIM also conducts an annual employment survey.

In 2005, the overall total production volume in both the shellfish and finfish sector was 60,050 tonnes, a 2.9% increase compared with that of 2004. The greatest increase of note was in the bottom mussel harvest (Appendix I and Table 1). The combined value of all shellfish harvested was €47.75 million and €61.55 million for the finfish sector (Appendix I). In 2005, the total value of production in the aquaculture sector was €109.3 million compared with €100.5 million in 2004 (an 8.7% increase).

Table 1. Aquaculture production (volume and value) in 2004 and 2005 (Source BIM).

	Volume (tonnes)		Value (€ '000)	
Species	**2004**	**2005**	**2004**	**2005**
Rope Mussel	8,755	8,755	6,871	6,579
Bottom Mussel	28,560	29,510	21,014	25,718
C. gigas Oyster	5,103	5,811	12,204	12,089
native/ *O. edulis* Oyster	390	342	1,636	1,708
Clam	181	161	711	849
Scallop	103	87	437	425
Other (marine algivores)			727	380
Total shellfish	**43,092**	**44,666**	**43,600**	**47,748**
Salmon ova/smolt			2,337	2,500
Salmon	14,067	13,764	51,289	55,042
Sea reared Trout	282	717	860	1,568
Freshwater Trout	889	897	2,116	2,379
Others	25	6	300	62
Total Finfish	**15,263**	**15,384**	**56,902**	**61,551**
Total Aquaculture	**58,355**	**60,050**	**100,502**	**109,299**

The number employed in the aquaculture sector during 2005 on a full-time, part-time and casual basis was 731, 540 and 364, respectively (Table 2). There were a total of 1,635 employed in 2005 compared with 1,936 in 2004, a 15.5% decline. There was a significant increase in the numbers employed in the bottom mussel culture sector. However, as witnessed previously in 2004 many sectors experienced reductions in the numbers employed. The largest decrease being recorded in the native oyster sector, arising out of a decision not to harvest stock and the re-classification of the numbers of fishermen versus aquaculture employees.

Shellfish Production 2005

Overall shellfish production showed a 4% increase in volume, from 43,092 tonnes in 2004 to 44,666 tonnes in 2005. Market value also increased by almost 10% to € 47.7 million. Bottom mussel production dominated shellfish volume with a 66% share of the market, the same as recorded for 2004. The overall market value of dredged bottom mussels increased by 7% (bottom mussels comprise 54% of total shellfish market value) as a result of the increase in its value per tonne. The percentage market share of rope mussel volume was 20%, the same as 2004, but the value had decreased by 14%.

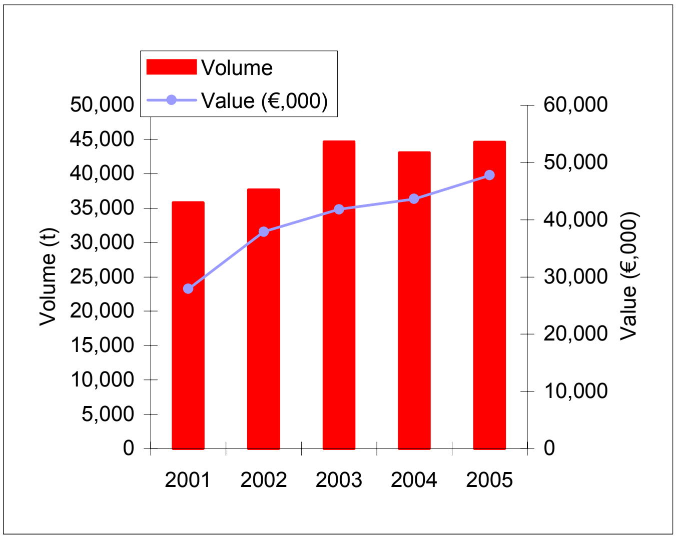


Figure 3: Total Volume and Value of Shellfish Aquaculture in Ireland from 2001 to 2005 (BIM).

Crassostrea gigas oyster production composed 13% of the total volume of shellfish produced in 2005 and 25% by value. The remaining shellfish species, which includes; native oysters, clams, scallops and other shellfish combined to generate a 1.5% volume share and a 7% by value. A detailed species breakdown is shown in Figure 4.

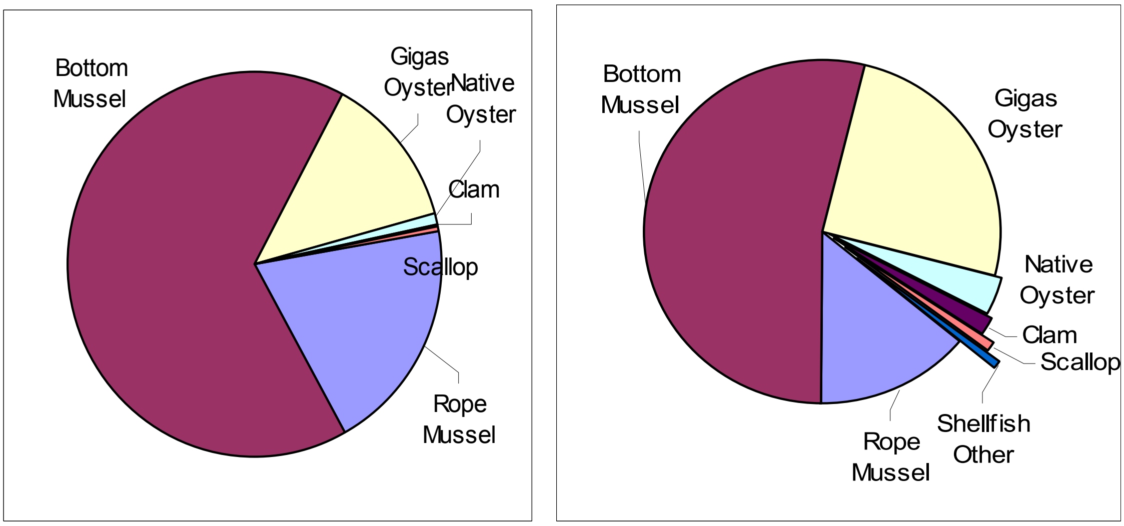


Figure 4: Market Share by Volume (tonnes) and Value (€) (BIM).

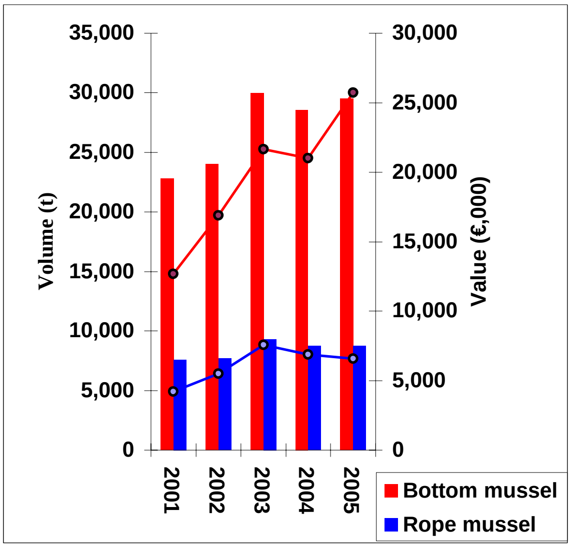
Mussels
Bottom mussel
The bottom grown mussel harvest value increased by 22% to €25.7 million in 2005 (Figure 5). Bottom mussels in 2005 were worth on average €871 per tonne and the national harvested volume increased by 3% to 29,510 tonnes.

In 2005, only relatively small settlements of bottom seed mussels were recorded around the coast, specifically in the Irish Sea, where in previous years beds of several thousand tonnes were normally encountered. The total amount of seed relayed for ongrowing in 2005 was approximately 18,500 tonnes. This was less than 60% of what had been relayed annually for the previous two years. As a result of this poor settlement many bottom mussel producers withheld stock which normally would have been harvested in the year 2005. It is therefore expected that the bottom harvest figure could decrease in 2006.

In 2005, the combination of poor mussel bottom spat settlement and prolonged closures of rope mussel farms due to biotoxins in the southwest initiated a venture between both sectors of the mussel industry. This involved a number of rope mussel producers spreading their mature mussel stock on licensed bottom mussel sites. This exercise was to investigate the potential for boosting bottom mussel harvests in future years and to minimise rope farm losses resulting from slippage. Approximately 3,000 tonnes was relayed to various bottom mussel bays.

The impact of six new mussel dredgers in 2005 was reduced as most of the older dredgers were not permitted to fish due to their inability to achieve certificates of compliance in accordance with the terms of the Torremolinos Protocol (www.imo.org).

Rope mussel
Total rope mussel production for market was static when compared with that of 2004 at 8,755 tonnes. This production could have been greater had it not been for the exceptional biotoxin closures experienced in the southwest (N.B. approximately 3,000 tonnes relayed). The nationwide rope mussel harvest value decreased by 4%, to €6.6 million. This decline was as a result of a drop in the average price paid per tonne, down to an average of €751 (Figure 5). In 2005, for the first time, the average value of bottom mussels exceeded that of rope mussels (Figure 5).



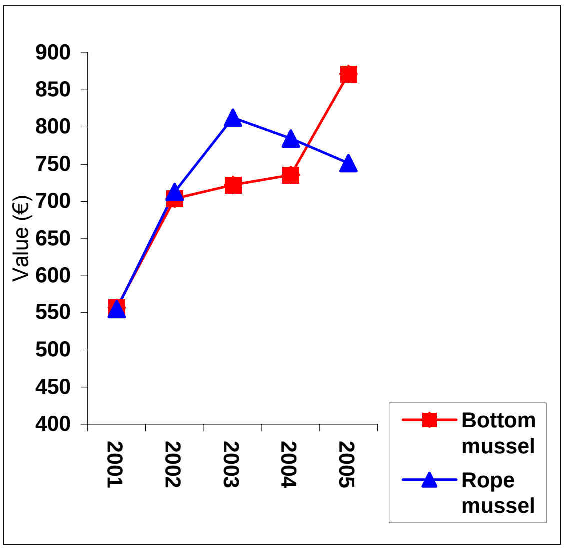


Figure 5: (Left) Rope and Bottom mussel Volume (t -Bars) and Value (€ - Lines). (Right) A comparison of Average Price paid Per Tonne of Rope and Bottom mussels 2001 to 2005 (BIM).

In September 2005, BIM in conjunction with Enterprise Ireland commissioned Price Waterhouse Coopers (PWC) to undertake a review of the Irish rope mussel industry (Completion and publication of the report in 2006).

In 2005, three rope mussel farms were assisted by BIM in adopting novel New Zealand technology, giving the benefits of reduced labour costs and waste disposal. New Norwegian technology was also industry tested to determine its suitability in offshore exposed locations. Further descriptions of these technologies are provided in the technical development section of this report.

***Crassostrea gigas* (Gigas oyster)**
In 2005, the production of *C. gigas* oysters increased by 14% to a total of 5,811 tonnes. However, the annual value of the harvest decreased marginally by €100,000 to €12.1 million compared with 2004 (Figure 6). This was as a result of the average price per tonne decreasing from €2,391 (2004) to €2,080 (2005).

The exceptional algal bloom of *Karenia mikimotoi* experienced in 2005 induced losses of *C. gigas* seed in oyster-growing bays, which is expected to have detrimental consequences for future oyster production (see section 5 Biotoxin).

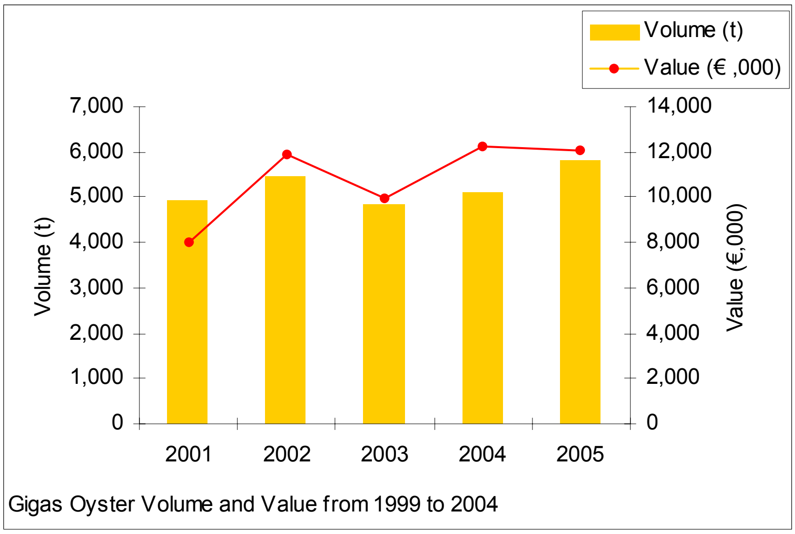


Figure 6: *C. gigas* Oyster volume and value from 2001 to 2005 (BIM).

Figure 7 shows the domination of companies producing larger tonnages of oysters over companies producing lower volumes in this sector. The number of companies selling lower tonnages (e.g. <10 tonnes) continued to decrease while the number of companies producing more than 200 tonnes increased. In 2005 there were several companies exceeding 400 tonnes of production.

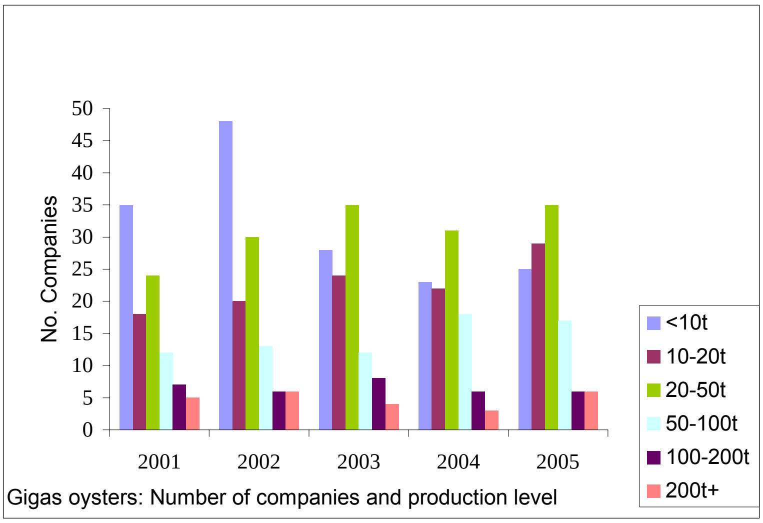


Figure 7: Number of companies and their production (tonnes) from 2001 to 2005 (BIM).

Cultured Native Oyster, Clam and Scallop

The native oyster harvest decreased to 342 tonnes, down 12% on the previous year, but the value increased by 4% to €1.7 million (Figure 8). The decrease in production was related to a decision not to harvest in some areas of the country due to unstable market demand. As a result of this decision in 2005, it is expected that there should be an increase in national harvest in the 2006.

Clam production suffered a decline and younger stock was adversely affected by the *K. mikimotoi* bloom. This is expected to have a negative effect on future harvests. In 2005, clam volume harvest decreased to 161 tonnes (-11%). However, the value increased by 20% to €0.8 million. The farmed Scallop harvest declined by 15% to 87 tonnes, but the value decreased by only 3% to €0.4 million.

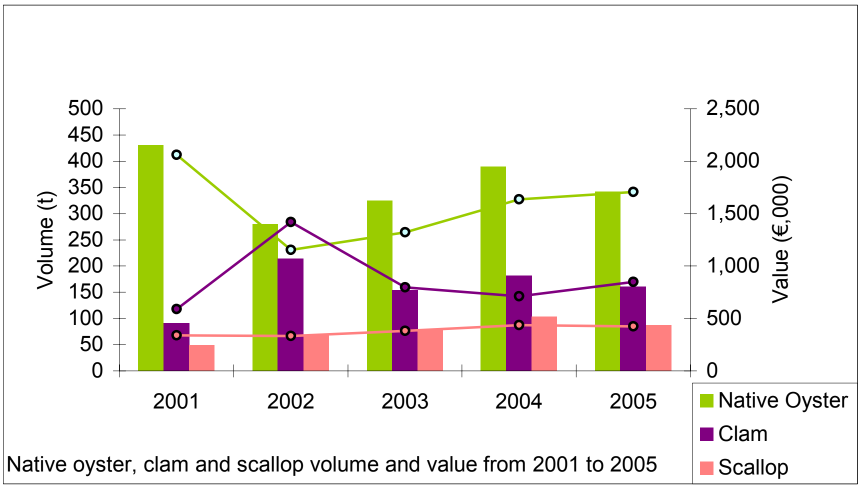


Figure 8: Cultured native oyster, clam and scallop volume (t-Bars) and value (€-lines) from 2001 to 2005 (BIM).

Novel shellfish

This includes sales of sea urchins, abalone and the spat of clams and *C. gigas* oysters. In 2005 the combined value of novel shellfish sales decreased by 48% to €0.4 million. Figure 9 illustrates the irregular reported value for these sectors. It is thought that this pattern will stabilise when full production cycles begin to run concurrently.

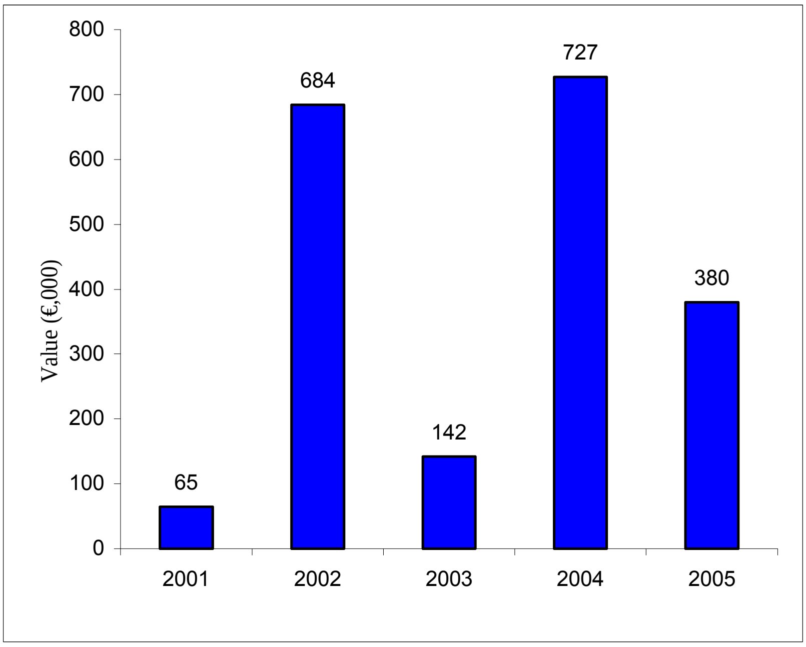


Figure 9: Novel Shellfish Value from 2001 to 2005 (BIM).

Finfish Production 2005

Finfish production had reached a nine-year low in 2004. In 2005 multiple disease outbreaks and the *Karenia mikimotoi* bloom along the west coast caused mortalities in finfish. However, finfish volume increased slightly to 15,384 tonnes. Such an increase in volume has not been observed since 2001 when finfish production peaked at 25,082 tonnes (Figure 10). In 2005 the total value increased to €61.6 million up 8% on the 2004 figure. This was due mainly to increases in sea-reared trout and increased salmon value.

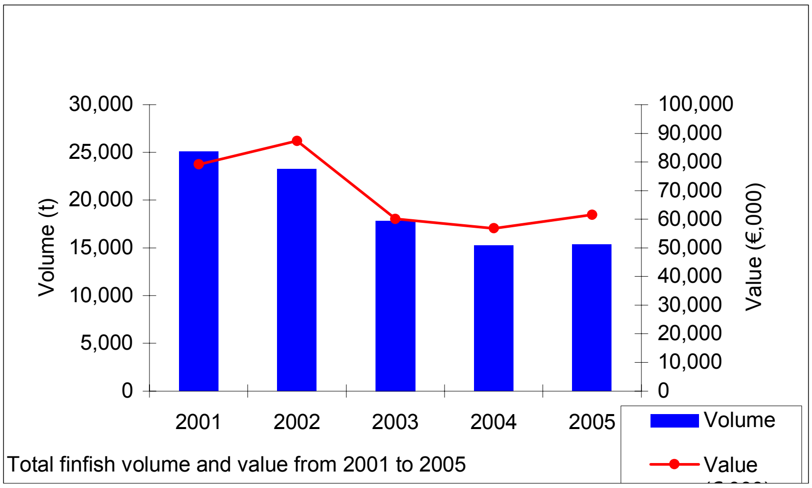


Figure 10: Total Finfish Volume and Value from 2001 to 2005 (BIM).

Salmon dominated the market share of the finfish sector, with approximately 90% of the volume and value (Table 1). The volume of sea-reared trout increased from the previous year to 717 tonnes (+150%). Freshwater trout made up much of the remaining volume at 6% with a value share of 4%. The remaining value shares consist of exported salmon smolts at 4% and novel finfish, which include commercial production of arctic char and juvenile perch.

Atlantic salmon

The salmon sector in Ireland has faced a series of challenges in recent years, this trend continued into 2005 with further outbreak of disease. The future however appears brighter as conditions in the market place improved dramatically. The value of salmon per tonne reached significantly higher values than those recorded in most of 2004 (Figure 11). During 2005 the average price per kilo processed never dipped below €4.20/kg.

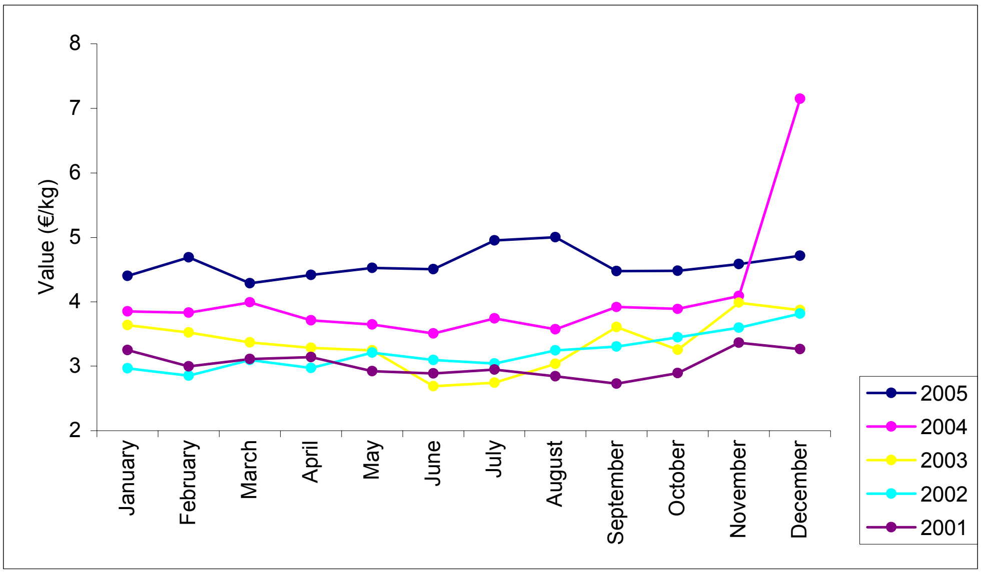


Figure 11: Average Monthly Value of Salmon harvest 2001 to 2005 (BIM).

The harvest value of salmon for each month of 2005 is shown in Figure 11. In 2005, monthly production did not exceed 1,000 tonnes until September. The price per tonne is negatively correlated with the total harvested tonnage for that month (Figure 12). Therefore when production is high the value per tonne is lower and vice versa.

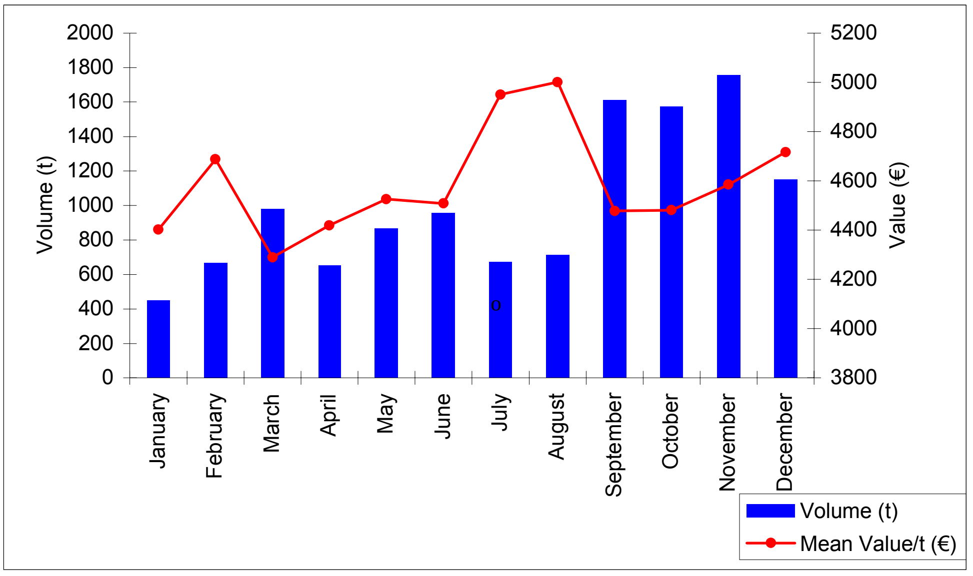


Figure 12: Monthly Processed Salmon Volume and Mean Value per tonne 2005 (BIM).

Despite a four year decline in volume resulting in a harvest weight of 13,764 tonnes the value of salmon in 2005 exceeded €55 million due to the high price achieved post processing (Figure 13). The post harvest value of salmon has increased incrementally for several years, due to the array of post harvest processing techniques as well as the introduction of the Minimum Import Price (MIP). In 2003, salmon processing was dominated by gutted fish (77%), which adds little value to the product. Coupled with fillets at less than 1% and organic at a mere 5%, the value post harvest was little more than that obtained by the farmer. In 2004, gutted fish as a product dominated the monthly processed salmon sector (74%). However, fillets had increased to 4% and organic to 16%. The trend continued into 2005 with gutted fish still in the majority but down to 68%. The fillet quantity remained relatively stable at 4%. Organic product (see section 9 Organic Finfish) increased to 24% of volume and had a value exceeding €18.1 million.

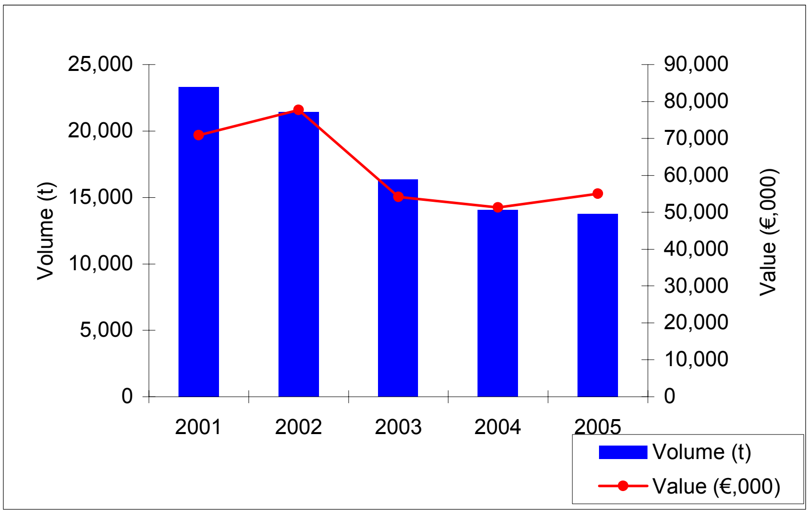


Figure 13: Atlantic salmon volume and value 2001 to 2005 (BIM).

In December 2005, Ministerial and Departmental approval was secured for implementing a technical and environmental support programme for marine salmonid farms with a budget of €2 million. This will be funded from EU and Exchequer sources and implemented in 2006 (BIM) (see Commercial Development section of this report).

Salmon smolts
The value of salmon smolts for export increased to €2.5 million. Values of smolts sold internally are not added to the value of the sector.

Freshwater and sea-reared trout
Total trout production volume increased 38% to 1,614 tonnes and had a value of €3.9 million, up 32% on the 2004. Figure 14 illustrates that the volume of freshwater trout produced was 897 tonnes (an increase of 8 tonnes) and the value increased by 12% to €2.4 million.

Producers of sea-reared trout availed of market opportunities and production in the sector rose sharply to 717 tonnes, an increase of 435 tonnes on 2004. The value of the sea-reared trout also increased to a value of €1.6 million, an increase of 82%.

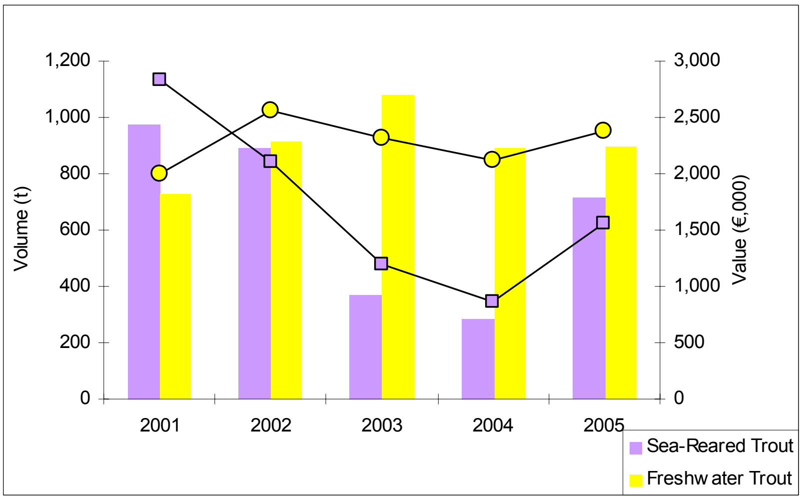


Figure 14: Freshwater and Sea-reared Trout Volume (tonnes - bars) and Value (€,000 - lines) 2001 to 2005 (BIM).

Novel finfish
In 2005, there were a number of new species in development such as cod and commercial sales of Arctic char. The sale of perch juveniles for ongrowing commenced in 2005. Additional value was added to the sector with sales of ornamental finfish such as *Koi and* Seahorses. However without turbot production the nominal value of the sector decreased to less than €0.1 million.

Seaweed Aquaculture
The hatchery production of *Alaria esculenta* established in 2004 continued and the techniques for producing *Palmaria palmata* were successfully adopted.

Employment 2005

In 2005, employment in the shellfish sector was reduced and the total number of employees decreased by 15% to a total of 1,225. There was a loss of 56 full-time equivalent (FTE) (See base of Table 2 for definition of FTE) jobs or 7% of this sector and this illustrates a continuing trend with previous years, where it has become more difficult to employ part-time and casual employees. These positions are being filled by a lesser number of full-time staff.

Table 2. Employment in the Aquaculture Industry 2005 (Source – BIM).

Species	Full-time	Part-time[1]	Casual[2]	Total Staff	FTE[3]
Salmon	181	82	18	281	225
Sea reared Trout	17	9	9	35	23
Freshwater Trout	11	5	0	16	13.5
Smolt	34	18	17	69	45.8
Finfish Others	4	2	3	9	6
Total Finfish	**247**	**116**	**47**	**410**	**312.8**
Bottom Mussel	154	85	42	281	203.5
Rope Mussel	115	104	78	297	180
Native Oyster	3	10	24	37	12
Gigas Oyster	186	197	160	543	311
Clam	10	11	9	30	17
Scallop	6	11	3	20	12
Shellfish Other	10	6	1	17	13
Total Shellfish	**484**	**424**	**317**	**1225**	**748.8**
Seaweed	*NA*	*NA*	*NA*	*NA*	*NA*
Total Aquaculture	**731**	**540**	**364**	**1635**	**1061.6**

1: 10-30 hrs/week throughout the year or 13-39 weeks of working 40 hrs/week.
2: <10 hrs/week throughout the year or <13 weeks of working 40 hrs/week.
3: FTE - Full-Time Equivalent – (1 Full-time = 1FTE; 1 Part-time = 0.5 FTE; 1 Casual = 0.1667 FTE)

Bottom mussel
The total number of employees involved in bottom mussel production increased by 38% to 281 individuals. This resulted in an increase of 49 FTE staff giving a total of 204 FTE for 2005. Employment in the rope mussel sector declined by 26%, leaving 297 employed which equates to 180 FTE.

Crassostrea gigas
The total number of staff employed in the Gigas oyster sector increased marginally on the previous year to 543, this related to 311 FTE. This is a 10% increase on the 2004 figures and an indication of increasing numbers of full time employees working in this sector compared with part-time and casual labour.

Other shellfish
The non-harvest of native oysters in 2005 resulted in declines of number employed, dropping 89% to 37 in total and 12 FTE. Full time equivalent employment for the clam sector remained stable at 17 for the year. The number of persons employed in the scallop sector was reduced from 13 FTE to 12 FTE.

Finfish
Overall finfish production employment suffered a small decline of 10% FTE, leaving 410 employees in total. Employment in the Salmon sector decreased by 17% and there were 281 employees equating to 225 FTE. The levels of employment in salmon smolt production remained static at 45 FTE. This employment includes those in the Regional Fisheries Boards (RFB) and who may be involved in activities additional to smolt production. Many of the RFB's will be involved in stock enhancement of brown and rainbow trout. In 2005, employment in the trout sector decreased by 7 FTE, leaving 14 FTE positions. As a result of higher production in the sea-reared trout sector the employment numbers increased accordingly to 35, equating to 23 FTE an increase of 19 FTE.

3. EXPORT AND MARKET SUMMARY

Finfish

Salmon

Negotiations were undertaken at EU level in the latter months of 2005 in respect to imposing a Minimum Import Price (MIP) for salmon. This appeared to stabilise the market towards the end of the year in conjunction with the normal price increases near Christmas.

Also in 2005, Marine Harvest Ireland decided to develop its own marketing strategy and separate from the Irish Seafood Producers Group (ISPG). This has led to this company processing, marketing and branding their own fish. Therefore the critical mass of fish that the ISPG handles (with the reduced production harvests in recent years) has been further reduced by over 20% in 2005.

Mean salmon prices varied from €4.29 per kg in March to just over €5.00 per kg in August (Figure 15). (These mean figures are obtained by grouping all volumes of salmon processed in the month and dividing this figure into the combined value. See Figure 16 for Salmon production categories and Appendix II Weight conversion rates for salmon).

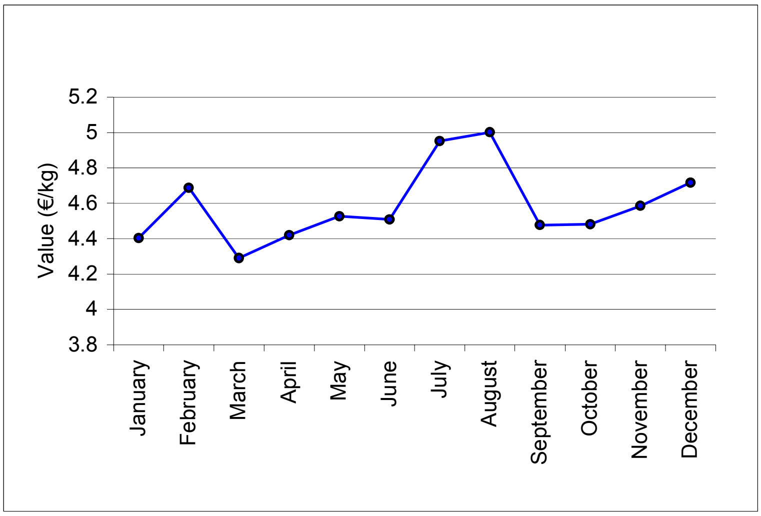


Figure 15: Mean Monthly Price (€/kg) for Farmed Irish Salmon 2005 (BIM).

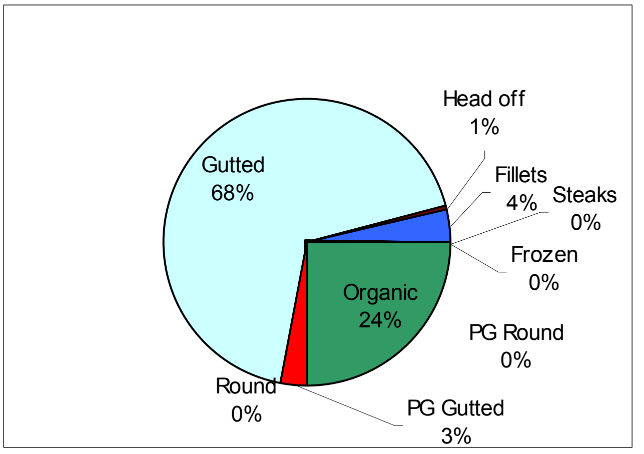


Figure 16: Atlantic Salmon Production Categories % 2005 (BIM).

The average price paid per kilo for each of the main production categories is shown in Figure 17 below. The post harvest processing of salmon contributes significantly to the value as can be observed for fillet prices, which varied from €5.65 to €7.43 per kg. The production of organic salmon resulted in a premium price being paid, with an average of €6.23 and a range of €5.64 to €6.79 per kg. The mean gutted price in 2005 is higher than the average price for salmon in 2004 but is lower than the types of products described above, averaging €3.86 per kg. Prices ranged from €3.59 to €4.11 per kg in 2005.

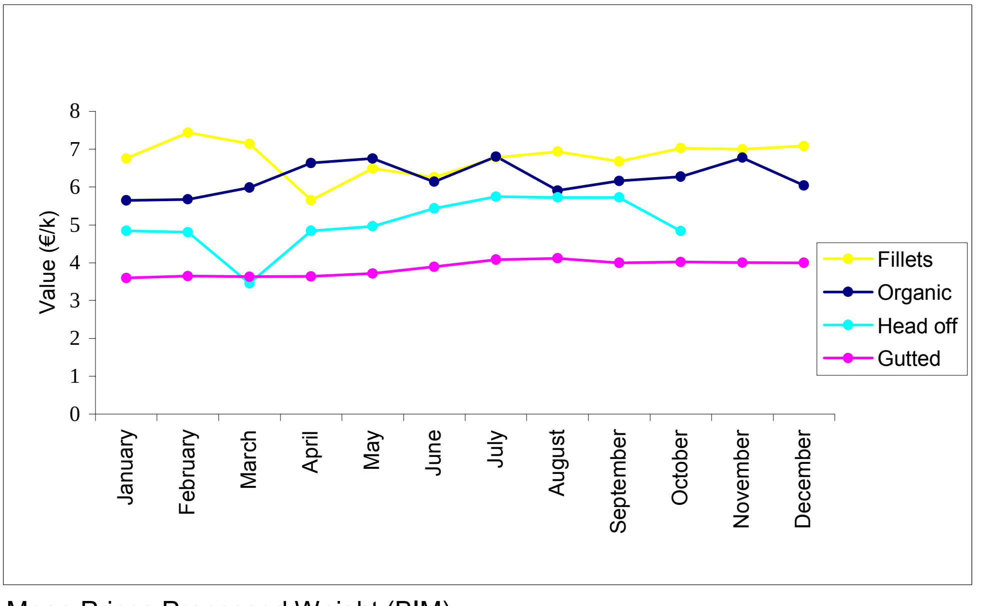


Figure 17: Mean Prices Processed Weight (BIM).

When the values of the various processed products are extrapolated back to Round Weight Equivalents (RWE) (Figure 18, Appendix II), it can be seen that organic salmon achieves the highest price. Filleting adds approximately €1/kg to the value of the gutted product. The costs of filleting and market demand are the deciding factors on how the product is processed and sold. The predominant size of salmon harvested in 2005 was 4 kg to 5kg, as can be seen from Figure 19.

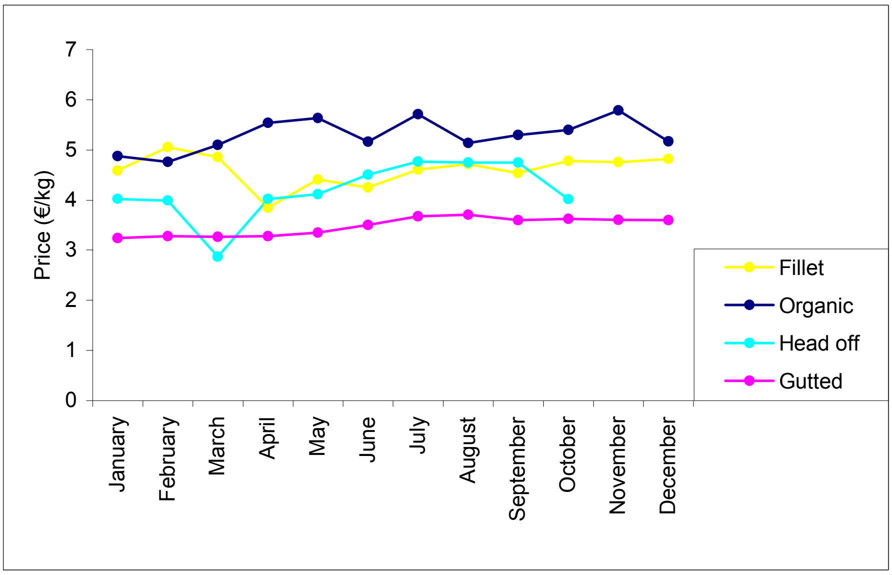


Figure 18: Mean prices in Round Weight Equivalent (BIM).

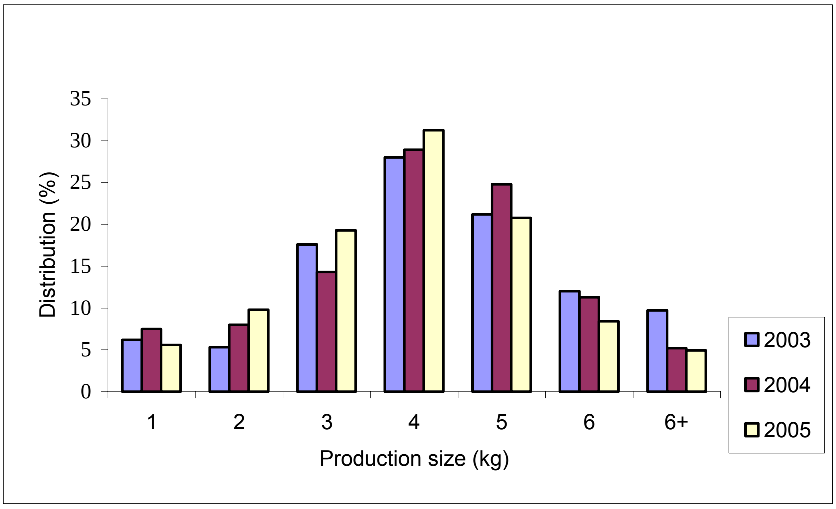


Figure 19: Size Class Distribution for 2003, 2004 and 2005 (BIM).

The price obtained per size class (RWE) (Figure 20) was highest for smaller fish (size class 1). This was because a high proportion of these fish went for filleting. But when filleting costs and production costs are factored in, the best value for the farmer was in the 5 to 6 kg fish.

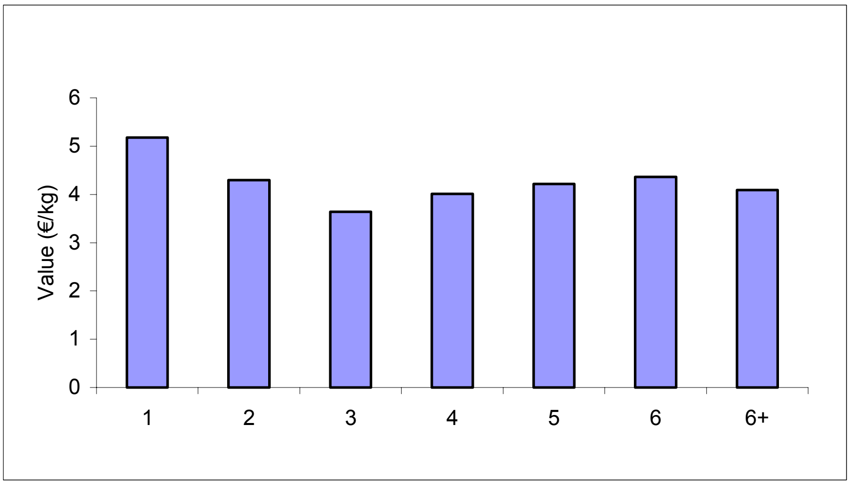


Figure 20: Price per kg for Size Classes (Round Weight Equivalent) (BIM).

As described earlier in the report gutted fish constitute the major share of sales at 68% with organic production comprising 24% of sales. These organic fish are mainly gutted but also include a small amount of fillets.

Trout

The value of freshwater trout in 2005 ranged from €2.30 per kg to €3.33 per kg with a mean price of €2.65, indicating that the majority of fish harvested are valued at the lower end of the spectrum. In 2005, in an effort to consolidate trout sales and production in Ireland the Irish Trout Producers Group (ITPG) was established on a commercial footing. Despite the fact that two of the larger trout farmers (north and south) were contracted to a UK supplier, the other farmers coordinated to supply key Irish markets. At a more local level, several of the farms continued to deal with their traditional customers. The establishment of the ITPG enabled the growers to work as a group in respect of fish handling, marketing and distribution. Approximately 50 tonnes of trout production was sold for further ongrowing at sea. The average price for the sea reared rainbow trout in 2005 was €2,186 per tonne.

Shellfish

Mussels

The total bottom mussel harvest was 29,510 tonnes. From industry returns, over 50% was sold to Holland, a further 25% was sent to France. Of the remaining tonnage 4% was sold within Ireland and the balance was not specified. The price per tonne of bottom mussel produced in Ireland ranged from €400 to €1,250 and the mean price per tonne was €871. Over 80% of the bottom mussels were sold on the fresh market (this includes live MAP).

The primary market for rope mussel production is within Ireland and it is estimated that over 80% goes to the processors and the remainder is mainly sold on the fresh market in France. The average price per tonne of rope mussels was €762 per tonne (paid by processors), but up to €850 can be achieved on the fresh market. In addition almost 3,000 tonnes of rope mussel were re-laid in 2005, as a result of prolonged closures of several bays in the southwest. There has been increased competition from the Chilean industry who have supplied a vacuum packed product at a very competitive price to the EU. This competition is putting pressure on the Irish processors to diversify their product range into higher value niche products.

Oysters

The French market remained the main destination of Gigas oysters and accounted for over 70% of Irish production. Around 5% of oysters sold remained in Ireland with just under 2% being sold to the UK. The destination of the remaining tonnage was not specified though it is likely that the majority of these would also go to France. The average price dropped from 2,392/ tonne in 2004 to €2,080 /tonne in 2005. In 2005 the price ranged from €1,000 /tonne for large oysters (110 g +) up to €3,000 /tonne for some of the smaller classes.

4. AQUACULTURE LICENCES AND APPEALS

Extant Licences

There were 549 aquaculture licences around the coast of Ireland in the year 2005 and approximately 145 licences that were lapsed or due for renewal by 2005 (total 694 licenses). Many of the latter may still be in operation pending decisions on renewal applications. The distribution of aquaculture licences are shown in Table 3 below. The majority of the licences are for shellfish farming with a breakdown of 42% and 30% for oysters and mussels respectively. 59% of the licences were held in counties Donegal, Galway and Cork. The aquaculture licences are issued in thirteen coastal and eight inland counties. Counties Mayo and Kerry accounted for a further 20% of licences in 2005.

Table 3. Distribution of Aquaculture Licences by County for the principal aquaculture species (Source: DCMNR). N.B. Lapsed licences are indicated in (brackets).

	Salmon	Trout (FW & Marine)	Other Finfish	Oysters	Mussels	Clams	Scallops	Other Shellfish	Algae	Total
Louth	-	1	-	15 (4)	14	-	-	-	-	30 (4)
Wexford	2	-	-	6 (2)	10 (1)	-	-	-	-	18 (3)
Waterford	1	-	-	7 (30)	5	-	-	-	1	13 (30)
Cork	6	3	1	18 (7)	48 (13)	1	4	14 (1)	(1)	95 (22)
Kerry	3 (1)	2	-	22 (2)	11 (9)	3 (1)	3	-	-	44 (13)
Limerick	-	-	-	1	-	-	-	-	-	1
Clare	(1)	1	-	13 (2)	2	1	1	-	-	18 (3)
Galway	26 (8)	(1)	1	44 (4)	41 (9)	2	-	5	2	121 (22)
Mayo	7 (1)	1	2	40 (23)	6 (1)	2 (3)	4	4	-	66 (28)
Sligo	-	-	1	5	2	11	-	1	-	20
Donegal	12 (6)	1	-	61 (3)	23 (4)	5 (2)	4 (3)	(1)	-	106 (19)
Kildare	1	-	-	-	-	-	-	-	-	1
Leitrim	1	-	-	-	-	-	-	-	-	1
Tipperary	(1)	3	-	-	-	-	-	-	-	3 (1)
Westmeath	-	2	-	-	-	-	-	-	-	2
Carlow	-	1	-	-	-	-	-	-	-	1
Cavan	-	-	1	-	-	-	-	-	-	1
Offaly	-	-	1	-	-	-	-	-	-	1
Kilkenny	-	1	-	-	-	-	-	-	-	1
Wicklow	1	2	-	-	-	-	-	-	-	3
Roscommon	-	-	3	-	-	-	-	-	-	3
Total	**60 (18)**	**18 (1)**	**10**	**232 (77)**	**162 (37)**	**25 (6)**	**16 (3)**	**24 (2)**	**2 (1)**	**549 (145)**

Notes: i) There may be multiple sites associated with one licence.
ii) Lapsed licences are included as they may still be active.
iii) Other shellfish includes abalone and sea urchins.

Licence Applications and Decisions

Applications

All aquaculture operations must be licensed under the Fisheries (Amendment) Act 1997. Licences are issued by the Minister for the Department of Communications, Marine and Natural Resources (DCMNR). During 2005, there were 63 applications submitted for new shellfish aquaculture licences and ten for finfish operations. Fourteen licence renewal applications for existing licences (eight shellfish and six finfish) were also submitted. In 2005 there was a significant increase in the number of applications for review of aquaculture licences with a total of 17 (thirteen shellfish and four finfish) compared with four in 2004 (a review or amendment can include change of boundary, species or method of production).

Decisions

Ministerial decisions on aquaculture licenses during the year 2005 are summarised in Table 4.

Table 4. Aquaculture Licence Decisions by DCMNR during 2005.

Type Of Decision	Number
Decision to grant	7
Refusal to grant licence	1
Renewals granted	16
Refusal to renew licence	2
Licence amended	1
Reassignment of licence	9
Total Decisions	**36**

Aquaculture Licence Appeals Board (ALAB)

A total of 17 appeals were received by the Board in 2005 (Table 5). These were in relation to the decision by the Minister to grant licences to four applicants. These were appeals made against one scallop, one mussel and two Gigas oyster licenses. In addition, there were three appeals were carried over from 2004, and were determined by the Board in 2005. These were in relation to decisions by the Minister to grant a rainbow trout licence and a Gigas oyster license.

The Board made a total of five determinations in 2005. One appeal was carried over into 2006. This resulted in the granting of four aquaculture licences with revised conditions. One was in relation to rainbow trout, one for the cultivation of scallops and two for Gigas oyster farming. In 2005 there were no appeals in relation to the cultivation of salmon. The Board also upheld two appeals by refusing to grant an aquaculture licence for the cultivation of oysters.

Box 1. Aquaculture Licence Appeals Board (ALAB)

Following the decision by the Minister for Communications, Marine and Natural Resources to grant, refuse, revoke or amend an aquaculture licence, an appeal can be lodged to the Aquaculture Licences Appeals Board (ALAB). ALAB was established in 1998 under Section 22 of the Fisheries (Amendment) Act, 1997. Its function is to provide an independent authority for the determination of appeals against decisions of the Minister for Communications, Marine and Natural Resources on aquaculture licence applications. A person aggrieved by a decision of the Minister on an aquaculture licence application, or by the revocation or amendment of an aquaculture licence, may make an appeal within one month of publication (in the case of a decision) or notification (in the case of revocation/amendment).

The Board, in determining appeals, has the option of:

a) Confirming the decision of the Minister to grant or refuse a licence; or
b) Determining and issuing its own aquaculture licence as if the application for the licence had been made to the Board in the first instance.

Additionally, the Board may alter the terms or conditions of a licence decision granted by the Minister by issuing its own licence with additional or altered terms and conditions.

Table 5. Aquaculture Licence Appeals Received and Board Determinations by the Aquaculture Licences Appeals Board 1999-2005. (Source – ALAB).

	Appeals Received	Withdrawn/ Invalid	Board Determinations	Licences Granted	Confirmed Minister's Decision	Appeals Upheld
1999	88	2	25	16	7	0
2000	38	2	83	37	5	2
2001	76	31	38	14	1	1
2002	13	5	29	24	0	2
2003	7	0	16	2	1	6
2004	22	5	14	12	1	1
2005	17	0	5	4	0	2

N.B. The number of Board determinations in a given year is not necessarily the sum of the last three columns (licences granted, confirmation of ministerial decision and appeals upheld). For example, several appeals may be received against one ministerial decision, with the board having to make a determination on all appeals. This would result in just one of the three possible outcomes.

5. AQUACULTURE MONITORING – SHELLFISH

Ireland has built up a comprehensive system of food safety and environmental monitoring for both the shellfish and finfish sectors, to meet EU regulations and market demands. The key monitoring results in these programmes are set out below.

Biotoxin and Phytoplankton Monitoring

There are a number of naturally occurring microalgal species that produce toxins which under certain conditions may become concentrated in shellfish and pose a risk to human health, if they are consumed. For this reason, samples of seawater and shellfish are regularly tested by microscopy, bioassay and chemical methods for the presence of toxic algal species and biotoxins. The analysis of shellfish is undertaken in accordance with EU Directives and these monitoring schemes are intended to detect toxicity prior to harvest and to provide the necessary information for the control of shellfish destined for human consumption. The National Marine Biotoxin Monitoring Programme for shellfish is co-ordinated by the Marine Institute's National Marine Biotoxin Reference Laboratories based in Galway and Dublin (both facilities relocated to new premises in Galway from March 2006). Details of the National Marine Biotoxin Monitoring Programme are shown in Box 2.

Box 2. National Marine Biotoxin Monitoring Programme

Ireland is obliged under European legislation (Council Directive 91/492/EEC - new food regulations coming into force in 2006) to have a National Marine Biotoxin Monitoring Programme to monitor shellfish harvesting areas for the presence of toxins produced by several different species of phytoplankton. The objectives of the programme are:

a) To protect consumers of Irish shellfish by promoting food safety in the sector;
b) To work with industry partners in the development of the industry; and
c) To develop a harmonious biotoxin management system that provides for industry requirements in line with consumer safety.

Details of the Biotoxin Monitoring Programme are outlined in a Code of Practice produced by the Food Safety Authority of Ireland (FSAI) - available at http://www.fsai.ie/sfma/about_cop.asp. It includes information on how shellfish samples are to be collected and analysed; reporting procedures; and the procedures for opening and closing shellfish production areas. The Department of Communications Marine and Natural Resources (DCMNR), under a Service Contract with the FSAI, implements aspects of the Biotoxin Monitoring Programme in Ireland. The Marine Institute carries out marine biotoxin testing, also under a Service Contract with the FSAI. The four main toxin groups (and their causative agents) covered under the monitoring programme are:

1. Diarrhetic Shellfish Poisoning (DSP) → *Dinophysis* species / *Prorocentrum lima*
2. Paralytic Shellfish Poisoning (PSP) → *Alexandrium* species
3. Azaspiracid Poisoning (AZP) → *Protoperidinium* species (suspected causative organism)
4. Amnesic Shellfish Poisoning (ASP) → *Pseudo-nitzschia* species

If toxins are detected at levels that are unsafe for human consumption, the harvesting and sale of shellfish from the production area in question is prohibited. The ban on harvesting and sale is lifted only after thorough scientific analysis of samples shows that the product is safe for human consumption. Before harvesting from any production area, two samples, taken a minimum of 48 hours apart, must have levels of biotoxins below the regulatory limit. With the first of these two clear samples the area is assigned a "Closed Pending" status and with the second the area is assigned an "Open" status. If a result is positive for biotoxins then the area in question is assigned a "Closed" status and the area will need two clear results, from samples taken a minimum of 48 hours apart, to return to an "Open" status. The minimum frequency of testing is laid down for each species and this may have a seasonal variation. If samples are not provided for testing at the minimum frequency the area can lose its "Open" status.

The results for the biotoxin monitoring programme are available on the websites of the Marine Institute (www.marine.ie/habs) and the FSAI (www.fsai.ie/sfma/default.asp).

On an annual basis the findings of the biotoxin and phytoplankton monitoring programmes are presented at the Shellfish Safety Workshop (the proceedings of which are published annually and available from the MI website (www.marine.ie)

Shellfish production area closures and algal bloom events in 2005

In 2005 there were extended toxicity periods, resulting in prolonged closures in many sites, with some sites being closed for several months, resulting in economic losses for producers and processors. There were three major separate toxic events during the year 2005, which led to closures;

1. ASP toxins (Domoic and Epi-domoic acid) from April – May (in mussel and oyster samples in the southwest).
2. Okadaic acid (OA) and DTX-2 (as well as esters of OA and DTX-2) from June to September (in samples from the west, northwest and southwest).
3. Azaspiracids from September to December (in samples from the west, northwest and southwest).

Of the 36 areas where closures occurred, 20 were in the southwest (see details in Appendix III). While some production areas were closed for extended periods during 2005, closure duration alone does not represent an accurate picture of the potential impact on the industry. For example in 2005, 3,000 tonnes of rope mussels were transferred to bottom culture in an effort to avoid their slippage from ropes and loss.

In addition to these closures, there was also a protracted bloom of *Karenia mikimotoi* which occurred predominantly along the northern half of the western Irish coastline which resulted in widespread mortalities of marine organisms.

Management Cell Decisions for 2005

A group of representatives, from the DCMNR, FSAI (Chair), ISA and MI, form the Management Cell and are responsible for making decisions if the following situations occur:

- Borderline or out of character biotoxin results, where results maybe inconsistent with local/national trends e.g. a single, unexpected negative or positive result occurs.
- When a discrepancy occurs between bioassay and chemistry results
- If prolonged borderline toxicity occurs then these borderline biotoxin results need consideration.Sampling continuity has been interrupted.
- Monitoring equipment LCMS breakdown.

To proactively manage a risk situation the Management Cell considers the following factors when assigning a status to an area:

- Species (e.g. mussel, oyster, scallop or clam).
- Bioassay Results (number dead and time of death)
- Chemical Results (OA, DTX-2, AZA's, Okadaic Acid Esters).
- Time of the year.
- Results of analysis from adjacent areas.
- Phytoplankton Results (numbers of associated toxic species present).
- Previous history of results from the area in question.
- Any other associated data.

The following options are available to the management cell:

- Change a production area's status (open, closed, closed pending).
- Recommend a voluntary closure to producers.
- Close adjacent areas within the same bay.
- Increase sampling frequency.
- Reduce sample frequency based on bay profile and season.
- Other action as appropriate.

For the year 2005 (from January – early December), a total of 89 Management Cell Decisions were taken into account. This is an increase in the number of decisions made when compared with 2004 and was primarily due to the increase in the toxicity periods and type of events observed in 2005. Table 6 shows a breakdown on Management Cells decisions taken in 2005.

Table 6. Management Cell Decisions in 2005 (MI).

Original Decision	MC Decision	Frequency
Open	Closed	3
Open	Closed Pending	4
Closed	Open	14
Closed	Closed Pending	5
Closed Pending	Open	15
Closed Pending	Closed	15
No Change in status		31
Precautionary advice		0
Issuing status advice prior to chem		1
Change in sampling frequency		1
Total Management cells		**89**

DSP in 2005

During 2005, 2,549 samples were submitted for DSP/AZP bioassay and chemical confirmatory analysis compared to 2,262 during 2004. The increase (12%) in the number of samples submitted for 2005 was primarily due to the increased toxicity observed in samples nationally. The breakdown of shellfish samples taken are shown in Figure 21.

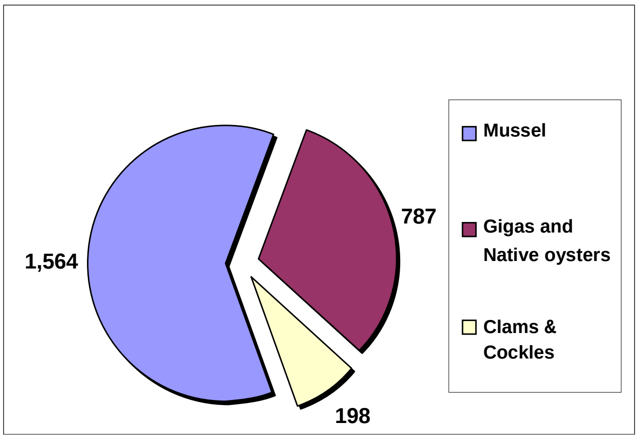


Figure 21: Number of Samples Tested for DSP in 2005 (MI).

Mussel samples were submitted fortnightly from January – April and weekly thereafter. *C. gigas* and native oysters were submitted on a monthly basis during January - April and on a fortnightly basis during the rest of the year. Samples of Clams, Razor Clams and Cockles were submitted on a monthly basis during January - April and on a fortnightly basis during the summer months, reverting back to monthly from October.

Overall, 16% of samples (407) tested positive in the year 2005 for DSP/AZP bioassay for both DSP (primarily June – September) and AZP (September – December), however when the number of closures is taken into account (including those detected with ASP chemical analysis) the inclusive total rises to 17.5% (447 samples). Figure 22 compares the findings of 2005 with the previous four years. It shows that there was a significant increase in positive results over the previous three years but that the findings in 2005 were similar to those recorded in 2001 (17.6%).

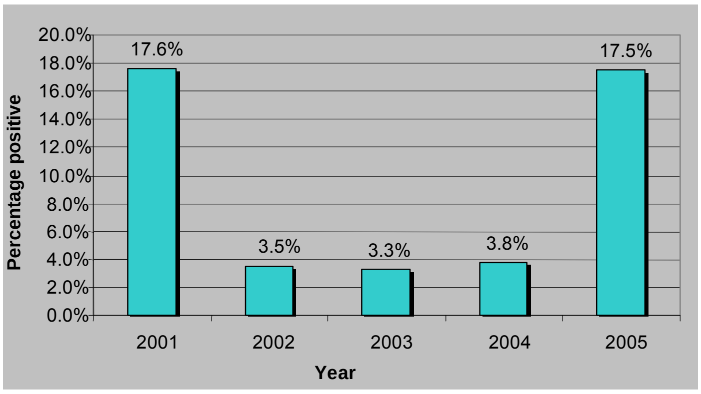


Figure 22: Percentage Positive Results for Shellfish Sampled 2001 to 2005 (MI).

For the first time, DSP toxicity (total concentration present in the form of OA esters) was detected in samples of Clams (*Spisula solida, Tapes philipinarium*) from Galway and Sligo in July. The highest concentration observed was 0.27µg/g total tissue (post hydrolysis) where corresponding positive bioassays were also observed.

AZP in 2005

A widespread AZP intoxification event was observed nationally in samples from September 2005, affecting the southwest, west and northwest. A total of 204 samples submitted were above the regulatory limit of 0.16µg/g total tissue (195 mussel samples, 9 oyster samples).

PSP in 2005

In total, 242 samples of shellfish were analysed for PSP toxins using immunoassay analysis as a negative screening method and bioassay analysis as a confirmatory method, following detection of *Alexandrium* spp. in the water column. The number of tests undertaken in 2005 was 77% higher than tested in 2004 (136 samples). In June of 2005, two samples of mussels tested positive via immunoassay for the presence of PSP toxins from Cork Harbour. Confirmatory analysis via bioassay revealed highest levels of PSP toxin at 66 µg/100g. Since the introduction of the immunoassay, the number of PSP bioassays performed has been reduced by 93%. All other samples analysed tested negative for the presence of PSP toxins.

ASP in 2005

In 2005, 460 analyses for ASP (Domoic and Epi-Domoic Acid (DA)) were conducted on scallop tissues (*Pecten maximus and Aequipecten opercularis*), typically gonad and adductor muscle tissues for *P. maximus*, where the levels observed on adductor muscle tissues (202 analyses) were all below the regulatory limit. Of the 206 gonad tissues analysed 31 were observed to be > 20 µg/g. The highest level observed was 123.8 µg/g in May from Portmagee Channel.

For the first time in Ireland, a major ASP event was recorded in samples of mussels and *C. gigas* from the southwest, where levels were observed above the regulatory limit. Previously, there had only been one recorded incident of ASP levels slightly above the regulatory limit in a sample of mussels in 2002 from Co. Donegal.

From August to September, dramatic increases in *Pseudo-nitzschia* spp. were observed in Bantry and Kenmare, where cell counts were observed to be >1,000,000 cells/litre. Samples of *M. edulis* from these areas were analysed during this period and levels of Domoic acid typically observed were <LOD (limit of detection). From mid September to October, there was a dramatic decrease in the numbers and distribution of *Pseudo-nitzschia spp*., where very low levels were observed.

Phytoplankton Monitoring

In addition to specific biotoxin monitoring using chemical and bioassay methods, the Marine Institute also has an ongoing phytoplankton monitoring programme. The aims of the programme are to identify and quantify the presence of potentially toxic species in shellfish production areas. The phytoplankton targeted include:

- *Dinophysis* species, which are associated with DSP toxins.
- *Alexandrium* species, which are associated with PSP toxins.
- *Pseudo-nitzchia* species, which are associated with ASP toxins.
- *Protoperidium* species, which are suspected to be associated with AZP toxins.

During 2005, 1,621 samples were reported for the National Monitoring Programme from shellfish and finfish sites. Of these, 630 (39%) samples contained toxic species.

Table 7. Location and date of the highest cell counts (cells/litre) for the main toxin producing phytoplankton species in Irish waters for 2005 (MI).

Highest cell counts			**Cells/litre**
Species	**Location**	**Date**	
Alexandrium spp.	Banc Fluich, Castlemaine Harbour	30 Aug 2005	49,680
D. acuminata	Sheephaven, Donegal	07 Jul 2005	82,547
D. acuta	Kealincha-Inishfarnard, Kenmare Bay	02 Aug 2005	2,680
P. delicatissima group	Sealax, Bertraghboy Bay	12 Jul 2005	2,179,980
P. seriata group	Hawks Nest, Mannin Bay	25 Jul 2005	2,304,272

A protracted bloom of *Karenia mikimotoi* was present in summer 2005 along the northern half of the western Irish coastline which lasted from late May / early June and into July. It was succeeded by a bloom of the same species in the southwest in late July. The bloom was very intense and resulted in discolouration of seawater and foaming in coastal embayments. Major mortalities of benthic and pelagic marine organisms were observed and a complete decimation of marine faunal communities, including bivalve molluscs at aquaculture production sites was reported and observed in several locations. While there have been several instances of *Karenia mikimotoi* blooms reported in Ireland over the past 30 years, the scale of mortality associated with the 2005 bloom was not previously observed.

A detailed report on this exceptionally harmful algal event has been published by the Marine Institute (Silke *et al*., 2005). *Karenia mikimotoi*: An exceptional dinoflagellate bloom in western Irish Waters, Summer 2005. This is available on-line at:
http://www.marine.ie/home/publicationsdata/publications/MEHS.htm

Phytoplankton monitoring results can be accessed through the Marine Institute's website: (www.marine.ie/habs).

Sample Turnaround
Speedy turnaround of samples submitted for biotoxin analysis and issuing of reports of test results is essential for the industry, regulatory authorities and the consumer. The results of all sample analyses are issued by fax, e-mail and SMS text messages and are also published on the Marine Institute's web site (www.marine.ie/habs). During 2005, results for 89% of the 2,549 samples analysed for DSP/AZP and PSP bioassay were available within three working days of sample receipt. This compares with 85.6% turnaround within three days in 2004.

Quality System
The full suite of Biotoxin and Phytoplankton Test Methods conducted within the Marine Institute laboratories, are now accredited by the Irish National Accreditation Board to ISO 17025. These include:

Okadaic acid, Dinophysistoxins (DTX-1 and DTX-2) by LC-MS
Domoic acid by HPLC via DAD
DSP Mouse bioassay
PSP by AOAC Mouse Bioassay
PSP by Jellett Biotek Rapid Test
Phytoplankton analysis in Galway and Bantry
Azaspiracids (AZA's 1, 2 and 3) via LCMS

Microbiological Quality of Shellfish Waters

Bacteriological Contamination
Shellfish production areas are normally classified twice yearly by the Department of Communications, Marine and Natural Resources based on the results for monitoring of shellfish for bacterial contamination. This is carried out in accordance with European Directive 91/492/EEC, which dictates the requirements, where necessary, for controls on harvesting or the use of processes needed to reduce the level of bacterial contamination to acceptable levels (Table 8). From 2006 classifications will be made under E.U. Regulations 853 and 854 of 2004. The production areas sampled in the monitoring programme are principally oyster and mussel cultivation areas, but some clam, sea urchin and razor shell areas are also included. A summary of designations made in October 2005 is shown in Figure 23. Some production areas are sub-divided and may have more than one classification. Additionally, production areas can have different classifications for different species, e.g. sea urchins from a production area can be harvested directly for consumption (Category A) but mussels need relaying/depuration prior to consumption (Category B).

Table 8. Criteria for Microbiological Classification of Shellfish Harvesting Areas (European Directive 91/492/EEC) and 2005 production areas classifications. Note: This does not include four areas with non-aquaculture species (razor clams and cockles).

Category	Microbiological Standard	Treatment Required	May 2005[1]	October 2005[2]
Total No. Production Areas			***57***	***57***
A*	<230 *E. coli* or 300 faecal coliforms per 100g flesh	May go direct for human consumption	17	17
B	<4,600 *E. coli* and 6,000 faecal coliforms per 100g flesh (90% compliance)	Must be depurated, heat treated or relayed to meet class A requirements	31	31
C	<60,000 faecal coliforms per 100g flesh	Relay for two months to meet class A or B requirements – may also be heat treated	0	0
D	>60,000 faecal coliforms per 100g flesh	Harvesting prohibited	0	0
A & B	As per relevant category	As per relevant category	8	8
B & C	As per relevant category	As per relevant category	1	1

1. - Live Bivalve Molluscs (Production Areas) Designation, 2005
2. - Live Bivalve Molluscs (Production Areas) (No 2) Designation, 2005
*Shellfish going directly for consumption must also be free from *Salmonella* spp.

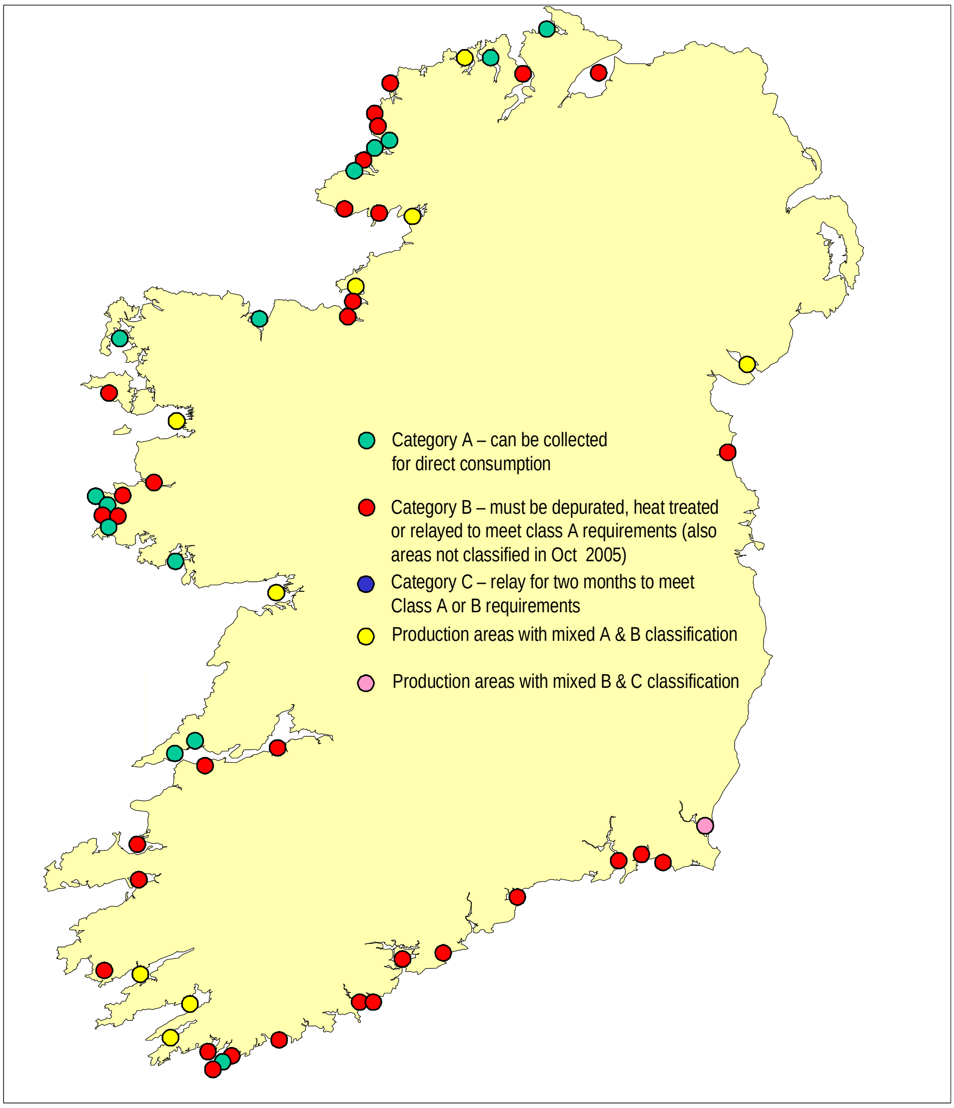


Figure 23: Microbiological Classification of Shellfish Production Areas October 2005 (DCMNR). In accordance with Council Directive 91/492/EEC. Source: Live Bivalve Molluscs (Production Areas) (No 2) Designation, 2005. Please note this figure is only intended as a guide to classifications in Oct 2005 and that classifications change (Appendix IV).

The classification of monitored sites can change. For example in May 2005 five sites were increased in classification from B to A's and four sites had their status reduced to B. There was also one site that was increased from a C to B. Later in October 2005 four sites dropped to B classification and three other sites were raised to A status.

Virological Contamination

Monitoring for bacteriological contamination of shellfish is well established and carried out on a regular basis. However, outbreaks of viral illness associated with shellfish consumption are also known to occur; e.g. gastroenteritis caused by Noroviruses (NVs) and infectious hepatitis caused by Hepatitis A virus (HAV). Monitoring for viral (and bacteriological) contamination of bivalve molluscs is the responsibility of the Marine Institute. A virus testing facility for shellfish in Ireland was introduced under the auspices of the National Reference Laboratory (Box 3).

Box 3. Irish National Reference Laboratory

The Marine Institute is the National Reference Laboratory (NRL) for monitoring microbiological and virological contamination of bivalve shellfish for Ireland. During 2005 the MI completed recruitment of staff for the NRL with three staff members dedicated to the work of the NRL with an additional team member working exclusively on a research project.

During 2005 the MI introduced standardised methods for enumeration of E. coli and detection of *Salmonella* spp. in shellfish. State of the art real-time PCR methods for detecting viruses in shellfish were also introduce.

The NRL is responsible for co-ordinating the activity of national laboratories carrying out testing for shellfish waters classification purposes (see main text). In 2005 the Marine Institute signed contracts with six testing laboratories to undertake E. coli testing for this purpose. The contracts set down strict quality assurance criteria and ensure reliability of the test results.

The NRL was also involved in a European wide research project investigating the potential for using risk based management procedures to control virus health risks associated with shellfish. The project will be completed by the end of 2006.

Finally, the NRL assists DCMNR in the organisation of the national monitoring programme for viral and bacteriological contamination of bivalve molluscs. This includes the provision of scientific advice, selection of appropriate sampling points, sample storage, and analysis and interpretation of monitoring data.

Contaminants in Shellfish and Shellfish Waters

Monitoring of a range of parameters in shellfish and shellfish growing waters is undertaken annually by the Marine Institute to ensure that the quality of edible species is maintained or enhanced.

Shellfish

The level of contaminants in shellfish (Box 4) can provide valuable information regarding the quality of the shellfish and the waters in which they are grown.

Box 4. Contaminants in Shellfish

Trace metals exist naturally in the environment and many, including, copper, iron and zinc are essential elements for living organisms. However, some trace metals such as mercury, lead and cadmium are not required for metabolic activity and can be toxic at quite low concentrations. These three elements occur naturally in the earth's crust, but they can also be introduced into the aquatic environment from activities such as mining, industry and transport. Once in the aquatic environment these metals can be bio-accumulated in shellfish tissues. Chromium contamination results mainly from human activities.

Polychlorinated biphenyls (PCBs) and organochlorine pesticides (OCPs) are man-made compounds that are ubiquitous air and water-borne contaminants. They are persistent pollutants with a tendency to bio-accumulate in shellfish tissues and bio-magnify through the food chain.

The determination of trace metal and chlorinated hydrocarbon concentrations in shellfish growing areas is carried out by the Marine Institute in part fulfilment of the monitoring requirements of various EU legislation, including:

- EU Directive 79/923/EEC on the quality required of shellfish growing waters (as implemented in Ireland by Statutory Instrument No. 200 of 1994);
- EU Directive 91/492/EEC laying down the health conditions for the production and placing on the market of live bivalve molluscs; and

EU Commission Regulation 466/2001/EC (as amended by Regulation 221/2002/EC and Regulation 78/2005/EC) sets maximum levels for mercury, cadmium and lead in bivalve molluscs of 0.5, 1.0 and 1.5 mg kg-1 wet weight, respectively. The UK is the only country at present to set down a guideline value of 50 mg kg-1 for zinc in food; however this excludes shellfish. There are no published guidelines for acceptable concentrations of chromium, silver and nickel in shellfish. Therefore, results are compared against other areas to assess for any obviously elevated results. Oysters accumulate silver to a higher concentration than mussels and this is evident from the results obtained. Oysters are also known to accumulate high levels of zinc, particularly in the digestive glands.

During 2005, samples of shellfish (blue mussel, *C. gigas* and native oysters) from 36 locations where shellfish are grown were analysed for metals. The results for 2005 are presented in summary format in Table 9 and compared with guidance and standard values for the various contaminants. The principal points are as follows:

- Water quality parameters measured during sampling of the shellfish growing areas in 2005 generally conformed to the guidelines of Council Directive 79/923/EC with respect to pH, temperature, salinity and dissolved oxygen. Dissolved oxygen levels were outside the guideline values on a handful of occasions. Also pH values were outside the mandatory range laid down in the Directive on a number of occasions. However, the Directive does not require 100% compliance for these parameters and breaches of the guidelines are not considered serious unless the conditions persist over an extended period.
- All shellfish samples tested for mercury and lead were well within the respective limits of 0.5 and 1.5 mg kg^{-1} wet weight, as set by the European Commission.
- All of the shellfish samples tested for cadmium were within the limit of 1.0 mg kg^{-1} wet weight, as set by the European Commission. Cadmium tends to accumulate to higher concentrations in native oysters compared with mussels. The highest concentrations of cadmium were in native oysters from Tralee Bay with one sample (native oysters sampled in Tralee Bay, Castlegregory - 0.95 mg kg^{-1}) close to the limit.
- No specific growing area stands out as having notably elevated levels of zinc, chromium, silver or nickel in comparison with other areas.

Table 9. Results of monitoring of shellfish-growing areas in 2005 and standard values for contaminants (Source – Marine Institute).

Contaminant	Species (No. Samples)	Range for 2005 (mg kg^{-1} wet wt)	No. Samples <LOQ	Standard Value (mg kg^{-1} wet wt)	Qualifier	Country
Cadmium	*O. edulis* (4)	0.49 – 0.95	0	1.0	Max. Limit	EC[1]
Cd	*C. gigas* (11)	0.12 – 0.52	0	1.0	Max. Limit	
	M. edulis (22)	0.04 – 0.20	0	1.0	Max. Limit	
Lead	*O. edulis* (4)	0.07 –0.11	0	1.5	Max. Limit	EC[1]
Pb	*C. gigas* (11)	<0.05 – 0.26	2	1.5	Max. Limit	
	M. edulis (22)	<0.05 – 0.85	3	1.5	Max. Limit	
Mercury	*O. edulis* (4)	<0.02 –0.04	2	0.5	Max. Limit	EC[1]
Hg	*C. gigas* (11)	<0.02 – 0.04	6	0.5	Max. Limit	
	M. edulis (22)	<0.02 – 0.04	6	0.5	Max. Limit	
Copper	*O. edulis* (4)	4.13 – 24.8	0	-	-	-
Cu	*C. gigas* (11)	4.14 – 24.5	0	60	Standard	Spain
	M. edulis (22)	0.96 – 1.97	0	20	Standard	Spain
Zinc	*O. edulis* (4)	279 - 445	0	-	-	
Zn	*C. gigas* (11)	93.5 - 266	0	-	-	
	M. edulis (22)	9.72 – 27.0	0	-	-	
Chromium	*O. edulis* (4)	0.16 – 0.29	0	-	-	
Cr	*C. gigas* (11)	0.08 – 0.53	0	-	-	
	M. edulis (22)	<0.05 – 0.66	1	-	-	
Silver	*O. edulis* (4)	1.48 – 3.36	0	-	-	
Ag	*C. gigas* (11)	0.12 – 2.11	0	-	-	
	M. edulis (22)	<0.013 – 0.22	10	-	-	
Nickel	*O. edulis* (4)	<0.13 – 0.19	1	-	-	
Ni	*C. gigas* (11)	<0.13 – 0.16	10	-	-	
	M. edulis (22)	<0.13 – 0.33	8	-	-	

Notes: 1. Commission Regulation 466/2001/EC (as amended by Regulation 221/2002/EC and Regulation 78/2005/EC).
For values reported as "< value", value = Limit of Quantitation (LOQ) for the relevant determinant.

The results for 2005 are consistent with those from previous years (e.g. Glynn *et al*., 2003a,b, 2004; McGovern *et al*., 2001) and are evidence of the continued clean, unpolluted nature of Irish shellfish and shellfish producing waters.

Shellfish Waters

In accordance with the monitoring requirements of Council Directive 79/923/EEC, seawater samples were collected from the 14 Irish shellfish waters, designated under SI 200 of 1994, twice during 2005 (summer and winter). In addition, three sites were sampled as part of a one-off survey commenced in 2004. Samples were collected by BIM officers, and analysed for trace metals (dissolved) and organohalogens (total) by the Environment Agency National Laboratory Service, UK. Analyses were co-ordinated by the Marine Institute.

No organochlorine results were detected above the minimum reporting value (LOQ). All results were <0.01 µg l^{-1}. The metal concentrations varied widely for some elements, e.g. zinc (Table 10).

Table 10. Contaminants in seawater - summary results for samples collected from shellfish growing waters during 2005.

	No. of Samples	Range (µg/l)	Median (µg/l)	No. <LOD
Mercury (Hg)	34	All < 0.008	<0.008	34
Silver (Ag)	34	All <1.000	<1.0	34
Cadmium (Cd)	34	<0.0400 - 0.175	0.069	22
Chromium (Cr)	34	0.215 - 0.54	0.370	0
Copper (Cu)	34	<0.050 - 14.1	0.768	1
Lead (Pb)	34	<0.024 - 57	1.5	1
Nickel (Ni)	34	0.489 - 12.9	2.05	0
Zinc (Zn)	34	7.08 - 305	23.1	0
Arsenic (As)	34	<1.000 - 2.14	1.15	16

Shellfish Health Status

Monitoring of shellfish for diseases in compliance with EU Directive 91/67/EEC and associated Commission Decisions (see Box 5) is undertaken by the Fish Health Unit of the Marine Institute. For example, as part of this work, at least 30 native (*O. edulis)* oysters are tested from each growing area in the country every spring and autumn. In addition to this routine screening, abnormal mortalities must be notified to DCMNR/MI and this prompts an immediate investigation into the cause.

All shellfish movements within the country are strictly controlled by DCMNR. Shellfish may only be moved under permit and there is a prohibition on movements of susceptible species from *Bonamia* positive areas to *Bonamia* negative areas. Council Directive 91/67/EEC regulates the movements of live molluscs into and out of the country.

The main actions relating to the shellfish disease monitoring programme during 2005 are as follows:

- All native (*O. edulis)* growing areas were tested twice during the year for the presence of the List II parasites, *Bonamia ostrea* and *Marteilia refringens*. A total of 2,099 oysters were tested in the course of this screening programme. In 2005, the entire coastline of Ireland was free of *M. refringens*. *Bonamia ostrea* was detected in Lough Foyle for the first time, bringing the number of areas infected with the parasite to seven. The infected areas are Achill, Ballinakill, Blacksod Bay, Clew Bay, Cork Harbour, Lough Foyle, and Inner Galway Bay.

- A further 435 native oysters were examined from Lough Foyle as part of an epidemiological study to determine the spread of the parasite within the Lough. As required under Article 5 of Council Directive 95/70/EC, an epidemiological report is being prepared by the Marine Institute, DCMNR, DARDNI and the Loughs' Agency, aimed at determining how the Lough became infected, and whether the infection has spread to other areas outside of the Lough. Sampling was stepped up in Lough Swilly, the nearest native oyster fishery to Lough Foyle.
- On the advice of the Marine Institute, documents were issued to cover the export of 22 separate consignments of shellfish in 2005.

Movements of mussel seed from the Irish Sea to Northern Ireland were dealt with separately by officials from DCMNR.

Box 5. Listed Diseases of Finfish and Shellfish

EU Directive 91/67/EEC (as transposed into Irish Law by S.I. 253 of 1996) concerns the animal health conditions governing the placing on the market of aquaculture animals and products. It represents the main fish health legislation under which the Irish aquaculture industry is regulated. The aim of the Directive is to prevent the spread of fish and shellfish diseases whilst promoting trade in aquaculture animals and products, and providing protection for countries (such as Ireland), which have a very high health status. EU Directive 91/67/EEC categorises the main fish diseases into three lists:

List I diseases are exotic to the EU and must be eradicated from any place in which they are found. ISA (Infectious Salmon Anaemia) is the only disease on this list. The ISA virus was isolated from two rainbow trout farms in Ireland in 2002. The virus was isolated in the absence of clinical disease and was picked up as part of a routine screening programme. Both cases were managed as per the Irish ISA Withdrawal Plan, which was approved by the EU Commission in 2001. ISAV has not been isolated, nor clinical signs of the disease observed, since 2002.

List II diseases are present in certain parts of the EU but not in others. These diseases can cause a severe economic impact on infected sites. The List II finfish diseases are VHS (Viral Haemorrhagic Septicaemia) and IHN (Infectious Haematopoetic Necrosis). IHN has never been detected in Ireland but a marine strain of VHS (Genotype 3) was detected in turbot, which were cultivated at Cape Clear off the southwest coast, in 1997. The farm was cleared and fallowed according to the procedures laid down in Council Directive 93/53/EEC.

The List II shellfish diseases are Bonamiosis and Marteliosis – both of which occur in the native (flat) oyster *Ostrea edulis*. Under Commission Decision 2002/300/EU, the entire coastline of Ireland obtained Approved Zone status with respect to Marteiliosis, and the entire coastline of Ireland with the exception of Clew Bay, Ballinakill, Galway Bay and Cork Harbour obtained Approved Zone status with respect to Bonamiosis. However, following the detection of *B. ostrea* in Achill and Blacksod Bays in late 2002 and Lough Foyle in 2004, these bays have now been added to the list of *Bonamia* poisitive areas in the country; by Commission Decisions 2002/378/EC (Achill); 2003/729/EC (Blacksod) and (L.Foyle).

List III diseases are widespread in certain parts of the EU, but certain countries have farms or zones, which are free of these diseases. The finfish diseases of interest on this list are IPN (Infectious Pancreatic Necrosis), Furunculosis, ERM (Enteric Redmouth Disease), BKD (Bacterial Kidney Disease) and *Gyrodactylus salaris*. BKD and *G. salaris* have never been detected in Ireland. Furunculosis and ERM have been detected in Ireland in the past but are now generally controlled by the use of licensed vaccines. IPN has been isolated sporadically in Ireland since the 1980s, both in rainbow trout and Atlantic salmon. However, 2005 saw a sharp increase in the number of isolations of IPNV. The virus (Sp serotype) was isolated from nine sites throughout the country. Clinical disease was observed in only one of these cases, with the remainder being sub-clinical in nature. Risk Reduction Measures were instigated on all sites, in order to control the spread of the virus.

Although all the diseases outlined above are listed in Annex A of Council Directive 91/67/EEC, the diseases mentioned in List III were not fully recognised by the EU Commission until 2004. Late in 2003, Ireland and a number of other countries made applications to the EU Commission, for recognition of its disease free status in relation to the diseases BKD and *G. salaris*. This application was successful and was granted under Commission Decision 2004/453/EC. Ireland can now insist on freedom from these (and the other diseases in List 1 and List II) both in imports from other Member States and from Third Countries. Additional Guarantees were not granted for furunculosis or ERM as these diseases are now routinely managed through vaccination and therefore, do not warrant the implementation of trade controls. Although the EU Commission granted Ireland an Additional Guarantee for IPN, at the request of industry, it was decided that for trade reasons, IPN would be controlled through a joint industry/government Code of Practice. Drafting of the Code of Practice began in 2004, and continued in 2005.

6. AQUACULTURE MONITORING – FINFISH

Sea Lice Monitoring

Sea lice (*Lepeophtheirus salmonis*) have a serious damaging effect on cultured salmon, resulting in major economic losses to the fish farming community.

The Marine Institute undertakes regular inspection of sea lice levels on marine finfish farms in accordance with protocols established under the National Sea Lice Monitoring Plan (Box 6). All marine fish farms undergo lice inspections 14 times per year. One lice inspection takes place each month at each site where fish are present, with two inspections taking place each month during spring (March to May). Only one inspection is carried out in the months of December/January. The results of the surveys are reported to stakeholders (DCMNR, BIM, Irish Salmon Growers Association, individual farms and Regional Fisheries Boards) on a monthly basis and are published annually by the Marine Institute (e.g. O'Donohoe *et al*., 2005, 2006).

Box 6. The National Sea Lice Management Plan

In 1991, in response to concerns about the possible impacts of sea lice from salmon farms on wild populations of sea trout, a sea lice monitoring programme was initiated by the Department of the Marine. In 1992/1993 the programme was expanded and culminated in the publishing in May 2000 of the '*Offshore Finfish Farms - Sea Lice Monitoring and Control Protocol*' (Department of the Marine and Natural Resources, 2000).

The purpose of the National Sea Lice Monitoring Plan is to:

- Provide an objective measurement of infestation levels on farms;
- Investigate the nature of the infestations;
- Provide management information to drive the implementation of the control and management strategy; and
- Facilitate further development and refinement of control and management strategies.

The management strategy for sea lice control has five principal components:

- Separation of generations;
- Annual fallowing of production sites;
- Early harvest of two sea-winter fish;
- Targeted treatment regimes, including synchronous treatments.
- Agreed husbandry practices (including fish health, quality and environmental issues).

Together, these components work to reduce the development of infestations and to ensure the most effective treatment of developing infestations. They minimise lice levels whilst controlling reliance on, and reducing use of, veterinary medicines.

When lice levels exceed pre-set treatment figures (the **treatment trigger level**), advice is given to treat the affected stock. These are designed to minimise any risk of transmission of sea lice from fish farms to wild sea trout stocks. The current treatment trigger level is 0.3 – 0.5 egg-bearing (ovigerous) female lice per fish during spring. Outside the critical spring period, the treatment trigger level is set at 2.0 egg-bearing female lice per fish. Where numbers of mobile lice are high, treatments are triggered even in the absence of egg-bearing females.

In 2005, 327 sea lice inspections of five different stocks were carried out at 22 sites in the three marine finfish growing areas around the coast – the west (Counties Mayo and Galway), the northwest (Co. Donegal) and the southwest (Counties Cork and Kerry). These were: (2004 rainbow trout – 18 inspections; 2005 rainbow trout – 17 inspections; 2003 Atlantic salmon – 12 inspections; 2004 Atlantic salmon – 148 inspections; and 2005 Atlantic salmon smolts – 132 inspections)

The principal results for the 2005 sea lice monitoring programme, from O'Donohoe *et al*. (2006), are:

- Overall, lice levels were below the treatment trigger levels outlined in the DCMNR protocols (see Box 6) on 70.03% of all inspections – 67.8% of Atlantic salmon inspections and 88.6% of rainbow trout inspections. For Atlantic salmon this can be further categorised as follows – lice levels were below the treatment trigger levels on 93.9%, 49.3% and 8.3% of inspections of smolt stocks, one-sea-winter salmon and two-sea-winter salmon respectively.
- On a regional basis, lice levels on one sea-winter salmon (representing 45.3% of all inspections) were below the treatment trigger level on 36.5% of inspections in the west region, 41.7% in the northwest region and 100% in the southwest region.
- During the critical spring period (March – May) lice levels were below the treatment trigger levels on 20.6% of inspections in the west, 46.7% of inspections in the northwest and 100% of inspections in the southwest.
- The monthly trend of lice levels in one-sea-winter salmon show that the southwest region achieved relatively good lice control throughout the year with a minor peak in September (Figure

24). Mean lice levels in the west region were relatively high for most of the year, starting in the spring period and continuing through to November. At the start of the year in the northwest region, lice levels were elevated and continued through the spring period before achieving control in June. Levels rose again in August and persisted into November.

- It can be seen from the annual trend (May mean) *L. salmonis* graphs (Figure 25) that there was an increase in both the May mean ovigerous levels and May mean mobile levels nationally. Both are at the highest levels recorded in at least 5 years.

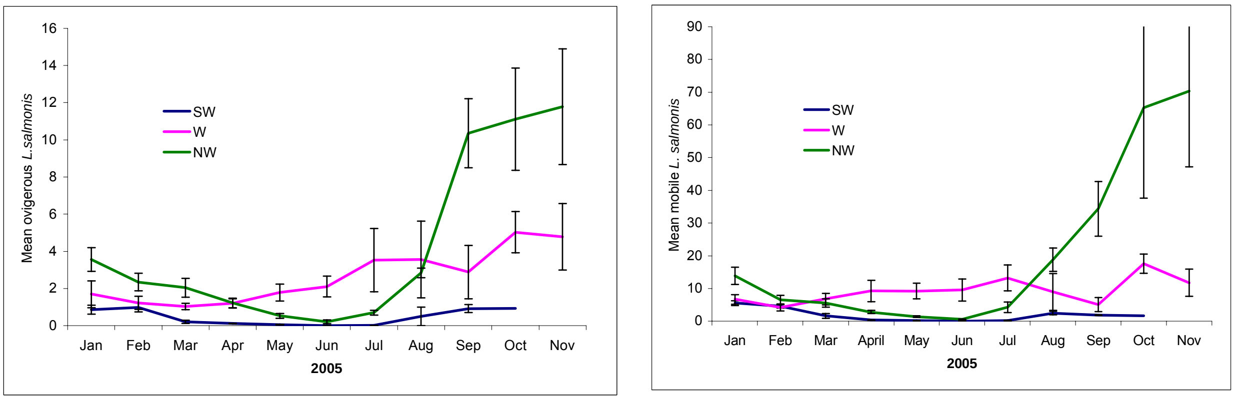


Figure 24: Mean (and standard error) Egg-bearing (left) Mobile (right) Sea lice (*L. salmonis*) per Month in each region during 2005 (O'Donohoe *et al*., 2006) (MI).

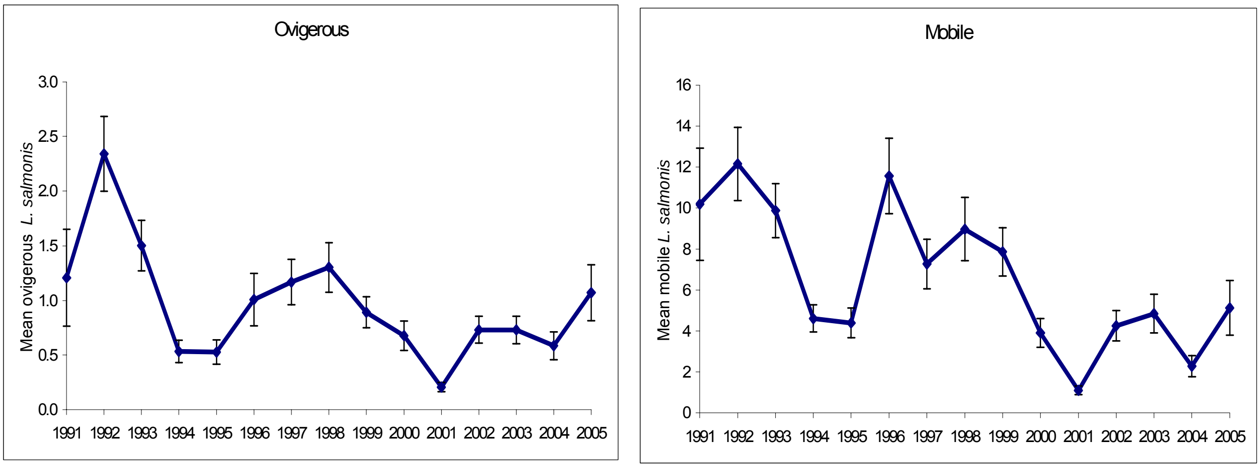


Figure 25: Mean (and standard error) Egg-bearing and Mobile Sea lice (*L. salmonis*) on One Sea-winter Salmon during May 2005 (O'Donohoe *et al*., 2006) (MI).

In 2005 lice levels below the treatment trigger levels occurred on 70.03% of inspections. The findings for the year 2005 are compared with the previous four years in Table 11. The decrease in the overall number of inspections, falling below the treatment trigger level is thought to be evidence of a combination of increases in infestation pressure and increased difficulty in carrying out effective treatments due to other issues, such as fish health. Pancreas disease (PD) causes appetite suppression and can make it difficult to administer in-feed treatments effectively. Bath treatments are more affected by bad weather or high temperatures and in where in-feed treatments are not an option. This can lead to reduced levels of lice control.

Table 11. Percentage of inspections where lice levels were below the treatment trigger levels outlined in the DCMNR protocols 2005 to 2001.

Year	% inspections below treatment trigger
2005	70.03
2004	79.5
2003	80.7
2002	87
2001	91

Increases in sea temperature accelerate the life cycle of the lice and lead to an increasing infestation pressure. For example, on average, mean monthly sea temperatures in 2005 were 0.29°C higher than 2003 and 1.36°C higher than the 30 year mean. Incomplete separation of generations can also lead to vertical transmission of lice within a site, also increasing infestation pressure.

Benthic Monitoring

The Marine Institute compiles annual reviews of benthic monitoring (see Box 7) at finfish aquaculture sites, based on survey reports submitted by licence-holders to the Department of Communications, Marine and Natural Resources (O'Beirn, 2004, 2005).

During 2005, the level of reporting compliance was 66%. While an improvement on levels reported in previous years (Table 12), it is only two thirds reporting compliance. This poor reporting record is in spite of notification, early in 2005, by the Coastal Zone Management Division of the DCMNR, to all relevant producers that surveys were required for some or all of their aquaculture sites. It is possible that some sites did not have fish during 2005. Unfortunately, if this was the case, this fact was not related to the Marine Institute prior to the compilation of the review. As a consequence, these sites would have been reported as non-compliant.

Of the reports submitted for sites surveyed in 2005, all of the sites (100%) had conditions that were within agreed environmental standards and thus deemed acceptable as per the protocols. However, taking non-reported sites, as non-compliant decreases the compliance rate to 66% (Table 12).

Audits were carried out at two sites by the Marine Institute to verify findings. The results from both sites of the Marine Institute report were consistent with the findings of the original surveys.

Box 7. Benthic Monitoring at Finfish Sites

Finfish farming results in inputs to the marine environment in the form of uneaten feed and faecal material. This oxygen-consuming organic 'rain' falls to the seafloor and can result in stress to the benthic environment, i.e. de-oxygenated sediments. This, in turn, can lead to changes in the benthic community structure, including a decrease in faunal diversity and increases in the abundance of so-called 'opportunistic' species associated with deteriorated conditions (e.g. the polychaete worms *Capitella capitata* and *Malacoceros fuliginosa*). The hydrodynamics of cage sites dictate the potential for organic build-up and associated impacts on benthic communities. Stratified, semi-enclosed water bodies with poor water exchange are most at risk from such inputs.

In 2001, the Department of the Marine and Natural Resources introduced benthic monitoring protocols for finfish sites (Department of Marine and Natural Resources, 2001). Adherence to the benthic monitoring protocols are now included as a condition in all new (and renewed) marine finfish aquaculture licences. The sea bed under and adjacent to finfish aquaculture sites is monitored annually with a view to minimising the impact and ensuring environmental quality is within acceptable limits.

All finfish farms that are subject to the monitoring protocols must carry out an annual survey at each site (production and smolt) included in the relevant licence. The level of detail required in the benthic survey is dependent on the biomass held at the site and the local hydrographic conditions.

The monitoring protocols allow for a certain degree of impact on the seabed beneath and adjacent to the fish cages, with the acceptable level of impact decreasing with distance from the cages. In the event of a breach of the allowable impact levels, the licencee must submit a Benthic Amelioration Plan to the Department of Communications, Marine and Natural Resources with the aim of achieving an acceptable benthic standard in the licensed area as soon as possible. The plan may include actions such as a feed waste control plan; a reduction in the documented volumes of fish feed into the licensed area in question; movement of all production cages; and a reduction in production tonnage. A subsequent survey of the impacted area determines if the amelioration plan has been successful.

Table 12. Summary of benthic monitoring results from 2001 – 2005 (MI).

Year	*Number of Sites (subject to protocols)*	*Reporting Compliance*	*Environmental Compliance*	
			*Overall**	*Surveyed Sites*
2001	27	65% (17/27)	59%	94%
2002	55	62% (34/55)	58%	94%
2003	54	54% (29/54)†	54%	100%
2004	50	50% (25/50)	56%	100%
2005	**48**	**66% (32/48)**	**66%**	**100%**

† Reporting compliance for 2003 was reported as 44% in the 2003 Aquaculture Status Report (Parsons *et al*., 2003). This difference arises because a number of benthic monitoring reports were submitted to DCMNR after the 2003 report was compiled.
* Overall - assumes that unreported sites are non-compliant

Residues Monitoring in Finfish

Through DCMNR, MI is charged with the responsibility for monitoring farmed finfish (Box 8).

The objectives of the residues programme are:

- To ensure that Irish farmed finfish are fit for human consumption and do not contain unauthorised substances or substances exceeding their Maximum Residue Limit (MRL)[1];
- To provide a body of data to assure that Irish farmed finfish is of a high quality -this is particularly important for supporting the export market; and
- To promote good practice in aquaculture.

[1] Authorised compounds have Maximum Residue Limits (MRL) prescribed by the EU. This is the maximum concentration allowable in the edible portion of the animal at the time of harvest. Generally, MRLs will not be exceeded if withdrawal periods are adhered to; *i.e*. the animal is not slaughtered for a set period of time after treatment. Unauthorised substances have no MRL and should not be detected. A "residue" is defined as "a residue of substances having a pharmacological action, of their metabolites and of other substances transmitted to animal products and likely to be harmful to human health". This includes banned and authorised substances such as steroids, therapeutic treatments and environmental contaminants.

Box 8. Residues Monitoring

European Union (EU) Directive 96/23 requires member states to monitor certain 'substances and residues thereof' (e.g. steroids, therapeutic treatments and environmental contaminants) in live animals and animal products. The Department of Agriculture and Food (DAF) is responsible for implementing the Directive in Ireland. The Food Safety Authority of Ireland (FSAI) co-ordinates the activities of the various departments and agencies involved in delivering this programme.

The National Residues Control Plan (NRCP) for aquaculture is submitted annually to DAF for inclusion in the overall national plan. It outlines the sampling frequency and analysis that will be undertaken. For aquaculture, a wide range of substances are tested for (Table 13). These are specified in the NRCP and are reviewed annually.

Any species of farmed finfish that is produced in greater quantity than 100 tonnes annually is subject to analysis under the residue programme. Based on this production level requirement, three farmed species (salmon, fresh-water trout and sea-reared trout) are currently monitored.

Samples of farmed finfish are collected at the time of harvest and at other stages of production by an officer authorised under the Animal Remedies Act, 1993. Samples are maintained under a strict chain of custody. Archive sub-samples are retained at the Marine Institute and are available for testing by reference laboratories in the event of a disputed result.

Directive 96/23 requires that following initial "screening" tests on samples, positive test results are confirmed using appropriate test methodology and according to EU guidelines. The Marine Institute reports all positives results to DCMNR, FSAI and DAF. Decisions in relation to the positive result(s) and follow-up action are made by the Case Management Group (CMG). The CMG is made up of representatives from DCMNR, FSAI and the Marine Institute. Follow-up action may involve further sampling, investigations and legal proceedings.

The results of the residues programme are submitted annually to DCMNR, DAF and FSAI. DAF compile the results for all farmed animals and products and submit the results to the EU. This report is also released into the public domain. The individual test results for specific aquaculture sites are also reported to the companies that supplied samples.

During 2005, target samples were collected on 37 sampling events (salmon were collected on 33 occasions, sea reared trout twice and freshwater trout twice) from fish farms and packing plants for residues testing in accordance with the NRCP. Generally, five fish were taken from each producer. In total, 164 target samples were collected from fish farms and packing plants in accordance with the NRCP for 2005 as follows:

- 105 target samples taken at harvest which comprised 88 farmed salmon, 7 fresh water trout and 10 sea reared trout;
- 59 target samples were also taken at other stages of production; 50 salmon smolts and 9 freshwater trout, from twelve farms for Group A and malachite green analysis.

In addition 17 suspect samples were also collected and tested for malachite green and leuco malachite green.

The main findings of the 2005 residues Target monitoring programme are:

- No positive results were obtained for banned (**Group A**) compounds as in 2005.
- Of the 105 samples screened for '*Antibiotic Residues*' (**Group B1**), no positive results were obtained as per 2004.
- **Group B2** contains treatments that are classed as '*Other Veterinary Drugs'* - generally authorised or unauthorised sea lice treatments. Two samples from two salmon farms, taken as part of target sampling in 2005 are reported as positive for the authorised sea-lice treatment Emamectin B1a i.e. concentrations above the MRL for Emamectin B1a of 100μg kg^{-1} (wet weight). No positive results were obtained for other group B2 compounds.
- "*Other Substances and Environmental Contaminants*" (**Group B3**) includes dyes (malachite green and its metabolite, leuco malachite green), metals, PCBs and chlorinated pesticides. All target and suspect samples tested for malachite green and its metabolite, leuco malachite green were found to be compliant. For the remaining substances in this group, all samples were compliant with the relevant EC Regulations for metals and guidance levels for PCBs and chlorinated pesticides as set by a number of OSPAR member states - and were consequently reported as negative.

A summary of the results for residues monitoring in 2005 is given in Table 13.

Table 13. Summary of 2005 Residue Monitoring Results for Target Samples (MI).

RESIDUE	GROUP	NUMBER EXAMINED	COMPLIANT	NON-COMPLIANT	Source of Maximum Level to assess compliance #
Group A - Unauthorised Substances					
Corticosteroids	A3	54	54	0	(v)
Methyltestosterone	A3	46	46	0	(v)
Betaestradiol	A3	45	45	0	(v)
Beta-agonists	A5	54	54	0	(v)
Chloramphenicol	A6	54	54	0	(v)
Nitrofurans	A6	49	49	0	(v)
Group B - Therapeutic treatments					
B1 - Antibacterial substances					
Antibacterial Screening:					
Tetracyclines	B1	105	105	0	(i)
Nitrofurans	B1	105	105	0	(i)
Quinolones	B1	105	105	0	(i)
Sulphonamides	B1	105	105	0	(i)
B2 - Other Veterinary Drugs					
Emamectin benzoate	B2a	104	102	2	(i)
Ivermectin	B2a	104	104	0	(ii)
Cypermethrin	B2c	104	104	0	(i)
Deltamethrin	B2c	94	94	0	(i)
Teflubenzuron	B2f	105	105	0	(i)
Diflubenzuron	B2f	105	105	0	(i)
B3 - Other Substances and Environmental Contaminants					
CCB Congener 28	B3a	21	21	0	(iii)
CB Congener 31	B3a	21	21	0	
CB Congener 101	B3a	21	21	0	(iii)
CB Congener 105	B3a	21	21	0	
CB Congener 118	B3a	21	21	0	(iii)
CB Congener 138	B3a	21	21	0	(iii)
CB Congener 153	B3a	21	21	0	(iii)
HCB	B3a	21	21	0	(iii)
α-HCH	B3a	21	21	0	
γ-HCH	B3a	21	21	0	(iii)
trans-Nonachlordane	B3a	21	21	0	
DDD-p,p'	B3a	21	21	0	
DDE-p,p'	B3a	21	21	0	
Lead	B3c	21	21	0	(iv)
Cadmium	B3c	21	21	0	(iv)
Mercury	B3c	21	21	0	(iv)
Aflatoxins	B3d	7	7	0	
Malachite Green	B3e	85	85	0	(ii)
Leuco Malachite Green	B3e	85	85	0	(ii)
% Lipids		21	21	0	

\# i) Maximum Residue Limit set according to Council Regulation (EEC) No 2377/90; ii) These compounds are not authorised for use in finfish, and should not be detected.; iii) Strictest standards applied by OSPAR contracting countries. (OSPAR: A compilation of standards and guidance values for contaminants in fish, crustaceans and molluscs for the assessment of possible hazards to human health, Update 1992, JMP 17/3/10-E); iv) Commission Regulation (EC) No 466/2001 as amended by Regulation (EC) 221/2002; (v) Substances banned by Council Regulation (EEC) No 2377/90 (Annex IV) and should not be detected.

Finfish Health Status

In 2005, the classification of diseases outlined in EU Directive 91/67/EEC (see Box 5 in Section 5, Shellfish Health) formed the basis for the trade of live fish within the EU. Ireland had obtained the highest classification possible within this scheme and can trade freely with any country within the European Community, and beyond. The Fish Health Unit (FHU) of the Marine Institute is actively engaged in

supporting the aquaculture industry and the inland fisheries sector in maintaining this superior fish health status. The FHU provides statutory services (in line with EU Directives) and diagnostic support.
To maintain Ireland's Approved Zone Status (the highest health status achievable under this regime) most of the statutory testing is carried out for Viral Haemorrhagic Septicaemia (VHS) and Infectious Haematopoetic Necrosis (IHN).

'Additional Guarantees' (see Box 5) had been given to Ireland in 2004 in relation to the List III diseases *Gyrodactylus salaris*, Bacterial Kidney Disease (BKD) and Spring Viraemia of Carp (SVC) allowing it to insist on certification showing freedom from these pathogens prior to importation.

The finfish disease work programme consists of three strands:

i. All marine and freshwater finfish sites in the country are inspected at least once per year. Farms holding broodstock are inspected twice per year. A farm visit consists of a full inspection of all ponds/cages and full post-mortem (including bacteriological, virological and histological analyses) of at least 30 fish.
ii. Under the terms of each Aquaculture Licence, any farm experiencing 'abnormal' mortality must report it to DCMNR/Marine Institute. All such mortalities are investigated by the Marine Institute, generally in conjunction with the farm veterinarian, and findings are reported back to DCMNR.
iii. In order to prevent the spread of disease through the movement of fish between sites (e.g. smolt transfers to sea), a movement permit is required. When an application is made to DCMNR for a movement permit, the health status of the fish is ascertained either by site inspection by the Marine Institute or via the submission of a recent veterinary report by the farmer's practitioner. Only clinically healthy fish may be moved.

The main points relating to the finfish health monitoring programme during 2005 were:

i. All marine and freshwater finfish sites were inspected and sampled as outlined in Council Directive 91/67/EEC. A total of 1,707 finfish were analysed for the presence of diseases listed in Annex A of the Directive. Ireland remained free of ISA (infectious Salmon Anaemia), VHS, IHN, BKD and *G. salaris*. The IPN (Infectious Pancreatic Necrosis) virus was isolated from parr/smolts on three freshwater sites, on five marine sites in post-smolts and on broodstock at a single site. Only one out of these nine sites experienced a clinical outbreak of disease. All others were detected as a result of routine screening and in all cases; the infection remained sub-clinical in nature.
ii. For diagnostic purposes 1,174 finfish were examined, generally as a result of mortality events at aquaculture facilities. *Vibrio anguillarum* was isolated from juvenile cod on foot of reported mortalities and the batch of fish with the infection was culled by the farm as a disease control measure. *Yersinia ruckerii*, the causative agent of ERM (Enteric Redmouth Disease), was isolated from a single rainbow trout farm, following a period of increased mortality. Motile *Aeromonads* and *Pseudomonds* were isolated from various species of freshwater fish, as a result of routine monitoring.
iii. The FHU carried out extensive testing and pre-movement clinical checks to facilitate the export of live fish and shellfish to other EU member states and to third countries such as Chile. In total, 36 Movement Documents were issued for finfish movements within the EU, and an estimated 3.2 million salmon ova, 1.4 million salmon parr/ smolts and 330,000 rainbow trout left the country for on-growing, mainly in the United Kingdom, but also in France and Denmark. An additional 8 Movement Documents were issued for the export of salmon ova to Chile. In total, 8.75 million ova were exported to Chile in 2005.

For the fifth consecutive year, Pancreas Disease was the major cause of mortality on Irish finfish farms; affecting the majority of farms along the western seaboard, with varying degrees of severity. It has been estimated that one in every eight fish that went to sea died from PD; with mortalities ranging from 1 to 32% in affected farms.

Tri-Nation initiative on Pancreas Disease
Following on from a seminar organised in October 2004 by the Marine Institute and IFA Aquaculture, the Marine Institute supported a delegation of eight researchers and industry representatives to take part in the seminar "*PD: similar pathologies and prevention*" in Bergen, February 2005. This seminar resulted in the formation of the **Tri-Nation PD Co-ordination Committee,** consisting of a steering group and three working groups, which are composed of researchers and industry representatives from Ireland, Scotland and Norway. The objective of the committee was to stimulate research into Pancreas Disease in each country with the aim of providing practical solutions to mitigating the effects of the disease. A number of projects received funding, and updates will be presented at seminars in Oslo, in February 2006, and in Galway in September 2006.

Current research on PD in Ireland

Throughout 2005, a number of research initiatives have received support from the Marine Institute and an overview of these projects was published in December (Ruane *et al.*, 2005).

- Site investigations and disease management of the PD virus – this two year project, funded under the NDP Marine RTDI Strategic Programme measure, involves the Marine Institute, Queens University Belfast and Vet-Aqua International. The study aims to increase our knowledge on the epidemiology of PD, diagnostic capabilities and management strategies. An important aspect of the study is the transfer of rapid diagnostic methodologies to the Marine Institute.
- Pathogenesis of the PD virus – a PhD study is currently underway at the Faculty of Veterinary Medicine, UCD and includes close collaboration with both Queens University Belfast and the Dublin Institute of Technology
- Biophysical properties of the PD virus – this study is currently being carried out by Queens University Belfast, in association with the ISGA and is funded under the Marine RTD Applied Industry measure.
- Smolt susceptibility trials – the development of salmon strains resistant to PD is an important factor in PD management. In 2005 two smolt trials involving Irish producers received assistance from the Marine Institute and these trials will continue into 2006.

7. AQUACULTURE RESEARCH AND DEVELOPMENT

Aquaculture Research 2005

Aquaculture research is undertaken by third-level institutes, industry and State sectors with funding from national and EU programmes. This section describes some of the research undertaken and projects that obtained funding in 2005.

There are seven third level institutes involved in aquaculture research involving a total of 60 researchers. An overview of the scope of research is shown in Appendix V. 1.

National Development Plan (NDP) Marine RTDI Measure
http://www.marine.ie/home/funding/ndpfunding/

The NDP Marine RTDI Measure is administered by the Marine Institute on behalf of DCMNR and Department of Enterprise and Trade and Employment. Aquaculture related funding is awarded under; applied industry awards, strategic research projects, post-doctoral fellowships and post-graduate scholarships. During 2005, a total of €1.117 million was allocated to new aquaculture research projects through this measure. There were also a number of projects funded in previous years which remained active in 2005 which are shown in Appendix V. 2.).

A description of three NDP strategic projects, an Applied Industry and a Post Doctoral project that were initiated in 2005 are provided below. Further information on Industry awards and all Marine RTDI funding since 2001 can be obtained from the Marine Institute.

Strategic
Site Investigations and Disease Management of the Pancreas Disease Virus in Irish Farmed Salmon
Duration: **2005-2007 (24 Months)**
Grant-Aid Approved : €404,634

Pancreas Disease is the single most significant infectious disease agent affecting salmon aquaculture in Ireland. PD causes high mortalities, it has a detrimental affect on growth rate of stocks and results in administrative restriction on fish movements. As a result of these factors PD is seriously curtailing the growth of the finfish aquaculture sector.

Although it has been prevalent in Ireland for much of the last two decades, very little is known about this viral disease. The problem has been particularly severe in Connemara, where 30-50% of fish have been lost on individual sites. This research programme proposes to carry out detailed epidemiological and longitudinal studies into outbreaks of PD. PD has also emerged as a significant problem in Norway and Sweden and a collaborative tri-nation approach has been adopted to solve the problem.

The primary objectives of this study are; a) to provide useful information on screening and early warning mechanisms (e.g. aetiology, life-cycle, environmental and farm risk factors) for the PD virus. b) To develop effective management strategies that will mitigate the effects of the disease ensuring the long-term viability of the industry.

The partners in this Investigation are: Marine Institute, Galway (Lead Partner), Queens University Belfast, Vet-Aqua International, Galway, Muir Gheal Teo., Galway and Eany Fish Products Ltd. Donegal.

Strategic
Novel Vaccines for the Control of Sea Lice on Salmonids
Duration: **2005-2007 (24 Months)**
Grant-Aid Approved : €186,775

Sea lice pose a serious problem for the fish farming industries of Ireland, Scotland and Norway, Canada and the USA. EU regulations with regard to the use of chemical products have put pressure on the animal health industry to move away from chemical control of sea lice in salmon farms. There are also concerns regarding the presence of chemical residue in food and in the marine environment.

Vaccination is a well-accepted means of increasing immunological resistance to disease. It is envisaged in this project that a vaccination of the appropriate sea lice antigen would enable a salmonid to generate an immune response sufficient to prevent infection with the parasite. Vaccines offer a preventative solution for sea lice infestation, leaving no residues in the salmon; and are simpler to bring through the regulatory process.

The objectives of this project are to identify and isolate novel sea lice vaccine candidates and the immunological parameters associated with immunity to infection in vaccinated fish. It will also develop new antibody and cellular assays to characterise the immunological basis of immunity in salmonids. (Partner) of this project are the Faculty of Veterinary Medicine, UCD.

Strategic
Finding Aquatic Viral Epitopes for Production of Peptide-Based Vaccines
***Duration*:** **2005–2007 (24 Months)**
***Grant-Aid Approved* : €186,714**

Disease outbreaks severely impact on the European aquaculture industry, threatening the livelihoods of farmers. During the last twenty years commercial inactivated vaccines administered by immersion or injection has been an important methodology for the prevention of infectious disease occurrence.

The development of recombinant vaccine to combat fish viral diseases is complicated by the limited knowledge of the host immune mechanisms and the viral antigens active in the induction of immunity. A concern in relation to recombinant DNA vaccines is the safety aspect relating to the use of DNA. Currently the issue of gene manipulated food supplies is controversial and peptide-based vaccines represent a safer approach, without the possibility of genetic transfer from foodstuff to consumer. This projects objective is to identify the potential vaccine epitopes for viral pathogens of significant importance to the Irish aquaculture industry.

The partners involved in this project are; National Diagnostics Centre, NUI Galway (Lead Partner)

Strategic
An Investigation into the Ability of Gigas Oysters, Scallops and Abalone to Act as Carriers of the Protozoan *Bonamia ostreae*
Duration: **2005-2007 (24 Months)**
Grant-Aid Approved **: €160,102**

Bonamiosis is a critical disease of native oyster (*Ostrea edulis*). The occurrence of Bonamia also creates problems for the movement of certain bivalves and molluscs as EU regulations prevent the relocation of live shellfish that potentially could be vectors of the parasite, e.g. scallops and abalone. An earlier EU-funded study undertaken in 1996 demonstrated that the Pacific oyster (*Crassostrea gigas*), mussels (*Mytilus edulis*) and clams (*Ruditapes decussatus* and *Venerupis (=Ruditapes) philippinarum*) could not be naturally or experimentally infected with Bonamiosis and did not appear to act either as vectors or intermediate hosts for the parasite.

The primary objective of this study is to increase the understanding of the life cycle of the parasite *Bonamia ostreae*. This project will use novel molecular-based techniques to screen Pacific oysters, abalone and scallops for the presence of *B. ostreae*. The resultant clarification of the possible role of these molluscs as carriers, or otherwise, for the *B. ostreae* parasite would allow the industry to respond according to the outcome.

The lead partner is: Department of Zoology, Ecology and Plant Science/Aquaculture Development Centre, UCC.

Applied industry
Development and Assessment of First Hatchery-Stage Composite Diets for Sea Urchins (Hatch Feeds)
Duration: **2005-2006 (18 Months)**
Grant-Aid Approved: **€59,430**
Industry Partner: **Dunmanus Seafoods, Ltd.**
Research Partner: **Aquaculture and Fisheries Development Centre-ERI, UCC**

This research builds on the successful project involved in developing intensive larval cultivation of sea urchins that was supported in 2003. The provision of live diatoms for newly settled spat and fresh macroalgae for juvenile culture is labour intensive and contributes significantly to the operating costs of a hatchery. Therefore a major obstacle in the hatchery process is the lack of availability of artificial diets.

The Aquaculture and Fisheries Development Centre recently developed a series of novel, moist-diet formulations (KX diets) for the on-growing stage of sea urchins under an INTERREG IIIB project. This study will produce three hatchery-stage artificial diets based on the original KX formulations. These hatchery diets will be assessed both individually and collectively in a commercial setting. The ultimate goal is to produce diets that can be stored for sea urchin hatchery production. The successful completion of this project will have an immediate impact on the running costs at Dunmanus and assist in developing a strong foothold in the €264 million world market for urchin roe.

Post Doc
Advanced Technologies for Aquaculture
Duration: **2005–2007 (24 Months)**
Grant-Aid Approved: **€119,928**
Fellow/Host Institute: **University of Limerick**

There are a wide range of increasingly sophisticated technologies (sensors, materials and ICT) evolving for use in the existing aquaculture industry and with potential applications in novel mariculture systems such as offshore farms. Potential applications include fish health and behaviour monitoring, feed delivery and consumption, security, estimation of biomass and cage construction. Ireland has two leading cage manufacturing companies and a range of technology research capabilities that can be harnessed to address the industry needs.

The objective of this fellowship is to review developments related to aquaculture at offshore and high-energy sites. It will identify niche technologies for further R&D, relevant Irish research groups and their capabilities; and shortlist potential projects for advancement.

EU 6th Framework Programme (FP6)
http://www.marine.ie/home/funding/International+Funding.htm

The 6th Framework programme is focused on competitive research and development involving partnerships of three or more Member/Associated States. Four projects of relevance to the aquaculture industry and involving Irish research groups were initiated in 2005 (ongoing projects are shown in Appendix V. 2.). These were:

Specific research activities

Project Title	**KEYZONES. The characterisation of the carrying capacity of key European coastal zones for commercial production of bivalve shellfish**
Project Leader	UK, Plymouth Marine Laboratory
Irish Partners	La Tene Maps, Clew Bay Marine Forum Ltd. Southeast Shellfish Co-op.
Project aims	• Historical Data Collection (collection and storage of historical data that describe environmental parameters and processes at each culture environment) • Field Work : Objectives are to measure: 1. Temporal and spatial variations in the environmental parameters that act as forcing functions driving our simulations of shellfish growth and ecosystem processes (e.g. food availability, light temperature) 2. Physiological responses required to parameterise the generic physiological model for each shellfish species, 3. Natural shellfish growth and ecosystem variables (e.g. chlorophyll) that will be used to calibrate and validate the models • Ecosystem scale modelling: Objectives are to describe and predict carrying capacity, using ecological modelling.

Project Title	**SPIINES 2. Sea urchin production in integrated systems, their nutrition and roe enhancement**
Project Leader	UK Loch Duart Ltd.
Irish Partner	**Irish SME (Dunmanus Seafoods Ltd.)**
Project aims	• Uniting the leading SMEs in sea urchin culture in Europe with experienced researchers • Focusing on the two most commonly fished, farmed and consumed sea urchin species in Europe • The investigation of the pigment (carotenoid) content of sea urchin roes (workpackages 1 and 2) will facilitate the DESIGN OF SEA URCHIN DIETS containing pigments from natural sources (e.g. microalgae). • In order to improve economic viability there is a need to reduce the time it takes for urchins to reach market size. The GROW-OUT TECHNOLOGY systems developed by this research are all integrated, linking sea urchin culture to that of other species with environmental and economic advantage (WP 3) • Developing PROTOCOLS FOR MICROBIAL FOOD SAFETY (WP 4) will further enhance the competitiveness and market compliance of the product

Policy orientated research

Project Title	**PANDA. Permanent network to strengthen expertise on infectious diseases of aquaculture species and scientific advice to EU policy**
Project Leader	UK, Centre for Environment, Fisheries and Aquaculture Science (CEFAS)
Irish Partner	**National University of Ireland Galway** Department of Microbiology
Project Aims	The establishment of a European network of experts in aquatic animal health. All known EU -and key non-EU-experts and laboratories will be encouraged to join and address the following topics, with a view to issuing recommendations to the Commission: • Risk analysis of exotic emerging and re-emerging disease hazards • Developing an epidemiology database and advising on methods for disease diagnosis, surveillance, and containment • Evaluating diagnostic methods (notably their standardisation and validation) • Environmentally safe disease control strategies • Training needs and opportunities

Project Title	**AQUAFIRST. Combined genetic and functional genomic approaches for stress and disease resistance marker assisted selection in fish and shellfish**
Project Leader	France, INRA
Irish Partner	**National University of Ireland, Galway** National Diagnostics Centre
Project Aims	The characterisation of stress and disease-responsive genes in sea bream, sea bass, trout and oysters as potential candidate gene markers for desirable traits. • Investigating the associations between 1. Variations in response to stress and resistance to pathogens 2. Selected candidate genes and microsatellite makers by segregation analysis in appropriate families (QTL analysis) • Mapping of these genes in linkage and gene maps

INTERREG III Programmes
http://www.marine.ie/home/funding/International+Funding.htm

The objective of the INTERREG Programme is to promote co-operation between the border regions of Europe in order to strengthen economic and social cohesion. INTERREG is not a research and development programme, though projects promoting economic, social and environmental cohesion can have an R&D element. In 2005, there was a total of seven marine sector participates involved in the INTERREG III Programme that were of relevance to the aquaculture sector. One of which was Forecasting Initiation of Blooms of Toxic Algae (FINAL) which was initiated in 2005 (ongoing projects may be seen in Appendix V. 2.).

Project Title	**Forecasting Initiation of Blooms of Toxic Algae (FINAL)**
Irish Partner	(NUIG) 34 months: Sep 2005 – Jun 2008
Project aims	Outputs: • Establishment of a network of European experts sharing and building knowledge on the management of Harmful Algal Blooms (HABs) • A statistical evaluation of records regarding location, timing and level of risk for recorded European HAB events • The establishment of pilot studies, based on this data, in each participant country, including a concerted analysis of local and general risk assessment models across the study sites • The prediction and quantification of HABs using an ecophysiological model of HAB growth. Synthesis of data from records evaluation, pilot studies and new ecophysiology HAB models to build a region-wide 'smart' strategy for HAB management and prediction.

Enterprise Ireland
http://www.enterprise-ireland.com

There were two projects in Irish Aquaculture area that were awarded funding in 2004 and received payments during 2005 under the Applied Research Enhancement Programme.

These were:

- Galway-Mayo Institute of Technology -Project Title: Development of Technologies for Live Shellfish Products. Project Funding: €748,250.
- Letterkenny Institute of Technology -Project Title: Centre for Applied Marine Biology. Project Funding: €735,500

Higher Education Authority (HEA)
The HEA have funded a number of projects in the area of Marine Science under PRTLI (the Programme for Research in Third Level Institutions). Full details of the PRTLI Cycle 3 which runs from 2002- 2006, and other HEA research programmes, can be found at www.hea.ie.

Commercial Development 2005

Grant Payments and Approvals
During 2005, BIM made grant payments of €6.69 million to 29 projects under the NDP, comprising €5.696 million in FIFG (Financial Instrument for Fisheries Guidance) grants and €0.994 million in exchequer grants (Appendix VI). As in 2004, the breakdown by species of these payments reflects the current investment climate in the industry, with significant expenditure in the shellfish sector. Of the total FIFG spend of €5.696 million, the extensive cultivation of mussels accounted for 78%. Both salmon and oysters accounted for approximately 6% of total FIFG support, while rope mussels accounted for 3.3%. Clams and sea water trout accounted for significantly smaller amounts; 0.4% and 0.5%, respectively. The balance (5.8%) went towards various environment (e.g. C.L.A.M.S.) and quality-related projects.

Údarás na Gaeltachta
Research and development and commercial grants, administered by Údarás na Gaeltachta and Taighde Mara Teo, are available to operators in the Gaeltacht areas of counties Donegal, Mayo, Galway, Kerry, Cork and Waterford. In 2005, 13 projects in Donegal (6), Mayo (1), Galway (5) and Cork (1) received financial support totalling €1.94 million (Appendix VI). Three salmon projects in Galway and Donegal received 60% of the total funds, indicating the importance of salmon farming. The remaining funds were distributed amongst marine finfish, native oyster, Gigas oyster and abalone projects.

NDP Approvals
A formal call for applications under the Aquaculture Development Measures of the National Development Plan was advertised in the trade press in October and November 2005. A deadline date of the 9th December 2005 was set for receipt of applications. A total of 53 applications were received by BIM.

BIM Approvals
Complementing the NDP Aquaculture Development Measure, BIM administers an Aquaculture Grant Scheme under which small-scale aquaculture projects are promoted in a pilot development phase prior to full-scale commercial development under the NDP. The Aquaculture Grant Scheme also pilots the introduction of new technology and the opening up of new site locations for aquaculture.

During 2005, 102 projects were approved for Exchequer grant assistance of €1.959 million on aggregate investment costs of €4.6 million.

A further 7 projects were approved for Exchequer grants of €286,500 on investment costs of €1.01 million under the Fish Handling Grant Scheme, which aims to improve quality and hygiene in the marketing of fish and shellfish.

Grant Payments

NDP Aquaculture Development Measure
During 2005, BIM made grant payments of €6,690,442 to 26 projects under the NDP, comprising €5,696,184 in FIFG grants and €994,258 in Exchequer grants.

BIM Grant Schemes
During 2005, BIM made grant payments of €1,299,707 to 82 projects under the Aquaculture and Fish Handling Grant Schemes.

Grant payments of €1,005,784 under BIM's Aquaculture Grant Scheme and €293,923 under the Fish Handling Grant Scheme are listed by project and county in the BIM 2005 Annual Report.

Seafood Processing Development Measure
During 2005, five applications submitted to BIM under the Seafood Processing Development Measure of the NDP 2000-2006 were approved for grant aid of €414,498 on eligible investment expenditure of €1.658 million in added value seafood processing facilities. During 2005 grant payments of €662,060 were made to seven companies approved in 2004 and 2005 under the Seafood Processing Development Measure.

A breakdown of grant payments by BIM under the NDP and Non-NDP Aquaculture Grant Schemes and under the Fish Handling and Seafood Processing Development Measure of the NDP is set out by county in the BIM 2005 Annual Report.

Bantry Equity Fund
The Bantry Equity Fund was established by the Government to promote the development of aquaculture in the Bantry region following the closure of the Whiddy Terminal. Investments from the fund are made in suitable companies by way of Cumulative Redeemable Preference Shares, which are registered in the name of the Minister for Finance. During 2005, BIM received €87,271 by way of share redemptions.

Technical Development Programme 2005

Rope Mussels
Review of the Rope Mussel Industry
In September 2005, BIM in conjunction with Enterprise Ireland commissioned a review of the Irish rope mussel sector which was to be completed in 2006. As part of this review every rope mussel producing bay in the country was visited and details of various methodologies and practices employed were recorded. The relative performance of different types of operations were assessed with a view to addressing some of the issues which have affected production over the last number of years such as stocking densities, growth rates, harvest yields and floatation per hectare.

Continuation of Smart Farm trials
Work continued on the Smart Farm trials in the Lough Swilly and Kenmare sites throughout 2005. A further harvest of seed was carried out in Lough Swilly in the autumn. Returns were disappointing on this occasion due to difficulties in actually removing the crop from the nets. This was in part due to the lack of tension in the system but also because the brushes for the purpose built harvester were not strong enough to remove the crop. Four of the eight lines in Kenmare were also harvested early in 2005. And a new settlement of seed came onto these in May. This settlement was thinned in August 2005 and will be harvested in 2006.

The four lines on the site deployed in October 2004 across the tide and prevailing currents and parallel to wave fronts did not perform well. They seemed to collect a considerable amount of debris and fouling and they did not hold their configuration well in heavy weather. It was concluded that the system did not allow for adequate mooring and any further expansion of the farm would revert to the traditional orientation of end on into the waves.

New Zealand farming systems
The Rope Mussel Workshop held in November 2004 generated significant interest in the New Zealand farming system and BIM assisted three mussel farmers in converting to the New Zealand technology which reduces labour costs and waste disposal.

Restocking bottom mussel beds with rope grown seed

The combination of prolonged closures in the southwest due to biotoxins and a poor settlement of seed off the east coast for bottom mussel producers led to the setting up of trials involving the transplanting of part or near full grown rope mussels onto bottom mussel sites. The critical issues to be looked at were survival and return and dissipation rates of toxins. However, apart from a period of time when mussels had been weakened by a heavy bloom of *Karenia mikimotoi*, survival rates were good and the crop usually had clumped well and established itself within 3 – 4 weeks of transplanting. This was the case during summer transplanting but seasonality factors may be found to have an affect. It is now considered among larger producers to be a viable option for both sectors during prolonged periods of closures. However, final assessment on the profitability will not be completed until the mussels are harvested in 2006.

Bottom Mussels

The impact of the arrival of the six new mussel dredgers on the bottom mussel season was overshadowed somewhat by the fact that almost all of the older dredgers were not permitted to fish, due to their inability to achieve certification under the Torremolinas protocol. It is estimated that 18,500 tonnes of seed was obtained, which is a significant reduction in comparison to 2003 and 2004. This was due to the annual variation in the natural settlement of the seed and to the fact that there were fewer vessels utilising the fishery. Trials of naturally enhancing seed collection within bays using artificial substrates showed signs of promise and this programme will be expanded in 2006. As mentioned above trials reseeding rope mussels onto the bottom were also undertaken in five bays.

Crassostrea gigas Seabed Culture

The commercial trials for the bottom culture of Gigas oysters commenced in Clarenbridge in 2002 with Emerald Oysters Ltd. continued to show promise during 2005 with an overall harvest of 200 tonnes being obtained. In order to enhance the fishery, satellite farms were commenced by individual members and a total of seven million *C. gigas* spat were purchased and cultured using bag and trestles. Once a suitable size of 20 g was attained, oysters were sold on to the parent company for relaying on the beds. Investigations into the behaviour of the oysters when re-laid showed that they generally congregated into clumps often with their hinges buried into the substrate. This made it difficult for the fishermen to dredge them using the standard flat oyster dredge. Trials were then conducted using a variety of dredge types and a modified scallop dredge proved to be very effective and gave the best overall results.

Abalone

During 2005 another relatively large scale recirculation system for abalone was installed on a farm in Kerry. This system was based on centralised biofilters and protein skimmers etc. An automatic dosing system was developed to maintain pH at the correct level which prevents the abalone shells thinning and becoming fragile. The recirculation system also incorporates a computerised monitoring and alarm system. Heat recovery systems were also installed after the hatchery to remove the heat from the waste water in order to reduce heating costs.

On Cape Clear, Co. Cork the buildings to house a twenty ton abalone grow out farm were erected. The farm will use South African manufactured re-circulation "clusters" from Global Ocean. A hatchery and increased capacity for ongrowing abalone is also planned for the site.

Salmon

While 2005 represented the lowest point in the production cycle for Irish farmed salmon for many years, the placement of juveniles to sea and their survival on transfer to the sea give good grounds for believing that a slight resurgence in output can be expected in 2006/7. Reflecting the increased optimism in the sector, nearly 6 million smolts were put to sea in 2005, which was an increase of 500,000 over the 2004 input.

E-aqua project

The E-Aqua project that was an eighteen-month project commencing in 2003 came to a close in October 2005. A spin off this project came in the form of designing websites for the industry, in conjunction with AquaTT. Several of these websites were completed in 2005, with the remainder scheduled for completion in 2006. All websites will have at least basic contact details as well as information on the company

Feed Workshop

A very successful two day feed workshop took place in May 2005, in Westport, Co. Mayo. This workshop was a joint activity between Skretting and BIM. There was a good turn out from industry with twenty-seven participants attending. The workshop was aimed at site managers, biologists, technical personnel and general operatives. The course gave a very good understanding of fish feeding, growth, feed manufacture and nutrition. The workshop was divided into five technical sessions 1) Commercial feed manufacture and production 2) Nutrition and health 3) Pigments in fish nutrition and quality 4) Growth performance and feed management 5) Biosecurity and sea lice.

Pancreas Disease

Pancreas Disease is an ongoing problem in the Irish salmon farming industry. Epidemiological surveys have shown that the average mortality on affected farms ranges from 14 to 18% in recent years. BIM have been involved in numerous PD projects in conjunction with the various farms around the country. One of these was a project where the farm examined the natural resistance of Atlantic salmon to salmon Pancreas Disease Virus (SPDV). It was to examine whether it is possible to improve the natural resistance of Atlantic salmon to SPDV, 6,000 genotyped, PIT tags from 150 full-sib families were exposed to a natural challenge over a six month period in the sea cage in the west of Ireland. Histopathological and serological examination was performed weekly and on a proportion of all moribund fish in order to determine the onset of infection and the likely cause of death. The results indicate that the susceptibility of salmon to SPDV could be reduced by selective breeding based on survival in a natural challenge to the virus. Longitudinal studies of two farmed salmon populations were also undertaken in 2005 to investigate the role of various risk factors in the impact of outbreaks of PD, as well as attempting to clarify and describe the clinical pathogenesis of the disease. In contrast to expectations there did not appear to be any correlation between the mortality level and the severity of the muscle pathology. In addition there did not appear to be any correlation between the percentage of samples positive to PD and the level of mortality. Both these findings indicate that other causes of mortality may have been involved, especially towards the Autumn months or, that sampling methods were not comprehensive enough. Other PD projects included, investigating as many aspects as possible in reducing stresses that could contribute to an increase in mortality. The main stress factors targeted were feeding, lice, environment (nets), biology (mort removal), and nutrition. Recommendations that came from this trial included that during severe PD outbreaks feeding is reduced to once per day. Another recommendation to come from this was that prior to the onset of PD, ensure that adequate sea lice treatments have been given and nets are cleaned with in cage mechanical cleaners but, be careful of the organic loading during bloom and jellyfish events.

Sea lice

Sea lice remain one of the main problems in Irish salmon farming, with estimated costs of treatment and losses of fish running to several million Euro. The use of chemical methods by the industry has brought adverse publicity and wrasse (cleaner fish) present an alternative, environmentally friendly means of biological control. There is a considerable interest in cleaner fish technology from fish farmers in Ireland. BIM was involved with Irish salmon farmers in investigating the possibility of using wrasse as cleaner fish in salmon net cages to control sea lice. This had the purpose to re-evaluate the knowledge on cleaner fish and to encourage the organic Irish salmon producers to develop this technology on a more broad scale. Mr. Johann Solgaard from the Norwegian company Villa Leppefisk was employed as a consultant to transfer current Norwegian know-how on cleaner fish to the interested Irish salmon farmers.

Idema net washers

The trial of an Idema diesel driven net cleaning system with dual 40cm discs was carried out in 2005. This new technology will allow three divers to clean the sides of salmon nets from the surface. This will reduce the amount of diving by two thirds and increase the surface area cleaned each day significantly, due to the restrictions of diving being eliminated.

Trout

A review, at the request of the Irish Trout Producers Group (ITPG), was completed to determine the current status in regards stock management, technical capability and quality performance of all eight trout farms involved in the ITPG. Recommendations will be separated into promising short-term options and actions with substantial but longer term potential. A confidential report was submitted to each farm and a generalised summary report was to be submitted to the ITPG in 2006.

Perch

Substantial progress was made in 2005 at all the licensed perch sites. PDS Irish Waters Perch Ltd. had a very successful larval production during May and June. Some 100,000 juveniles were weaned at the site and transported to ongrowing tanks at Emlagh Fisheries Ltd. in Roscommon. These fish represented the total production from the weaning unit. Juveniles taken from spawning in the ponds were also successfully harvested and weaned subsequently onto a dry crumb diet in the weaning unit. Emlagh Fisheries Ltd., the purpose built perch production unit, grew out its first consignment of juveniles and, while there were some unforeseen health challenges, the fish overall performed well.

The zooplankton composition of perch ponds was investigated by BIM during the summer period of 2005 in conjunction with PDS Irish Waters Perch Ltd. This involved a summary of the overall species assemblages that naturally occurred in the ponds before the introduction of perch fry. Further investigations were then made once fry were introduced to the ponds in order to ascertain the preferred species that were preyed upon. In summary, two species of *Cladocera* were the main food item for the fry, however, once stocks became depleted the fry then fed exclusively on immature copepods.

The farm, PDS Irish Waters Perch Ltd became involved in a European CRAFT funded project. Five European Universities and six SME'S make up the project grouping. The aim of this project is to further understanding of juvenile production of perch. The work programme includes broodstock mortality and welfare, broodstock manipulation for out of season spawning, genetic analysis, control of female and male gamete quality, dietary investigation and finally, economic analysis of production. Three further perch farms were granted planning permission and an effluent discharge licence in 2005.

Arctic Char
Commercial production of Arctic char has recommenced with Stofnfiskur Ire. Ltd. producing 5.5 t finished product to market, in addition to supplying 60,000 juveniles to Cool Springs Arctic Char Ltd. for ongrowing in their new state of the art recirculation unit. These fish will be ready for sale in 2006 and their combined tonnage will be in the region of 40 to 50 tonnes. Initial market testing indicates that there is a good potential for this product.

Cod
Juvenile cod that had been cultured from egg to 100 grams at the MRI Carna Laboratory hatchery were successfully transferred to sea in February 2005. The location of the cage site is a former salmon farm in Beirtragbui Bay, Connemara. Unfortunately the fish were adversely affected by an intense *Karneia mikimotai* bloom in June that caused losses of almost 50%. However, the remaining fish survived the maximum summer water temperatures of 17^{o}C and continued to feed and grow well. A second cohort of smaller juveniles (10 -15 grams) were transferred to a more sheltered site in the same bay in October and November. This is the first trial of marine fish cage culture in Ireland apart from salmonids.

Seaweed
The seaweed programme continued on in 2005 with the putting to sea of the first seeded *Alaria esculenta* collectors at sites in upper Roaringwater Bay and Castletownbere in County Cork. These collectors were seeded using specially developed techniques at the Daithi O' Murchu Marine Research Station in Bantry. This is the first time that commercial trials on grow-out of *Alaria* have happened on such a scale. The plants were left to grow at sea during the cold winter months and into the spring at these sites.
Cultivation of *Alaria* is a five month cycle. Mature plants with viable spores are usually observed in April. A peak in growth occurs in February and may last for 60 days. During this peak the plants can grow from 30-40 cm up to 200 cm. In upper Roaringwater Bay and Castletownbere mussel lines were used to grow out the seaweed so expenditure was kept to a minimum. Both sites recorded full coverage of lines with exceptionally good growth of the seaweed. An average wet weight of weed after four months at sea of 6 kg per linear meter was recorded from Roaringwater Bay as opposed to an average wet weight of weed of 4.9 kg per linear metre from Castletownbere. The average length of individual plants was greater in Roaringwater Bay with an average maximum length of a sample amounting to 1.17 m. The greatest recorded average length of plants in Castletownbere was in a sample that measured 0.95 m.

The full trial analysis including a detailed account of the manipulation of the reproductive cycle and the final grow out is contained in the BIM Aquaculture Explained Manual No 21*, 'Cultivation of Brown Seaweed – Alaria Esculenta'.*

8. QUALITY

The development of quality standards for the aquaculture sector continued in 2005 with the commencement of work on the Irish Quality Oyster (IQO) standard to add to the range of EN45011 schemes already in operation for salmon, trout and mussels. The standard is focused on the production and harvesting in order to optimise growing methods to ensure best quality oysters and full traceability of the system. This work will continue into 2006.

The Quality Seafood Programme progressed in 2005 through the buy-in of the major mussel processors into the scheme. This has allowed the QSP logo to be now used on a number of retail products destined for the UK, French and home markets. This involves close cooperation between the Aquaculture and Marketing divisions of BIM and the Quality Standards Development Committee.

In the area of finfish, organic salmon is increasingly becoming an important niche for Irish salmon farming, to further this, diversification of the base schemes which began with Label Rouge, continues with the commencement of development of an organic standard for salmon. The consolidation of the trout sector advanced, with plans to use the Irish Quality Trout scheme as a means of standardising quality of production as the group moves towards a more streamlined centralised sales system.

For further details on participation in the Irish Quality Schemes (salmon, trout, mussel and oyster) see: www.irishqualityfish.com

Box 9. Quality Seafood Programme

What is the Quality Seafood Programme?
BIM and IFQC have devised a number of quality assurance schemes for Irish aquaculture products; Irish Quality Salmon (IQS), Irish Quality Mussels (IQM) and Irish Quality Trout (IQT) (see main text for further details of the schemes). The Quality Seafood Programme is the umbrella-marketing programme for these base schemes.

How does a consumer or trader recognise the Quality Seafood products?
Aquaculture products approved under the Quality Seafood programme will carry a distinctive symbol, which assures the buyer that products carrying this symbol have either been caught, or raised on farms with excellent standards of safety, hygiene and quality throughout the supply chain.

This symbol has been adapted accordingly for European, UK and US markets. In order to comply fully with EU labelling regulations, companies licensed to use the symbol will add the country of origin at the base of the symbol.

What are the benefits of the Quality Seafood Programme?
Placement of the QS symbol on a seafood product is an assurance that the product has been caught/reared, harvested, packed and processed under a strict quality assurance scheme. It is also an assurance that there is traceability of the product to retail store. For those retail stores stocking QS products, ensuring that only the best quality, fully traceable seafood products are offered for sale in their outlet enhances their reputation.

In order to place the QS symbol on a seafood product, all seafood within that product and the process through which it has been produced must be certified under a quality assurance scheme, independently audited by an EN45011 accredited body.

9. ORGANIC FINFISH PRODUCTION

Organic Finfish

Organic Standards for salmon require farming conditions to be as close as possible to nature, having regard for food safety, animal welfare, and environmental sustainability. The product is certified organic (as relevant by product and market) by the following national certification agencies, accredited by the International Federation of Organic Agriculture Movements (IFOAM), and subject to independent audits by each separate agency in accordance with relevant EU legislation.

- Naturland
- IOFGA
- Quality France SA
- Bio Swiss

All salmon flesh is certified residue free. Fish are independently tested by the Marine Institute under the Residue Directive for the presence of universal pollutants Poly-chlorinated-biphenyls and heavy metals residues.

Market

Current global aquaculture production of organic seafood is estimated to be around 50,000 T out of a total aquaculture production of some 40 millions tonnes. North America and Europe represent around 96 % of global organic food revenues and the USA, Germany, UK and France are particularly important organic seafood markets. Organic salmon is the world leader in term of volume and the sector is suffering from undersupply. Current sales market value for organic salmon is put at $128.5 million.

Organic Fish Feed

Fish meal and oil are sourced from by-products of fish caught from sustainable fishery species intended for human consumption, caught off the Irish northwest Atlantic Ocean. Industrial caught species are not allowed. Phaffia yeast is used as a natural source of astaxanthin pigment. Total vegetable proportion of diet is approximately 30% to help reduce pressure on the wild fishery resources. However availability of these sources of fish meal and oil are limited, and there is current research exploring other sustainable sources of marine materials, and also replacing more of the marine sourced ingredients with organic sourced vegetable materials.

Organic Feed Guarantees

- Feeds are GMO free (to the <1% qualification). Feeds do not contain antibiotics except those licensed and under prescription
- Feeds do not contain hormones or growth promoters.
- Feeds do not contain land animal by-products.

Disease control

Medication is only used in exceptional animal welfare circumstances when organic alternative remedies such as the natural herbal feed additives cease to be effective. The number of treatments over the life cycle of the fish is limited by organic standards. Prior written approval must be sought from the organic certifying agencies and then only with double the standard veterinary prescribed withdrawal period.

Other methods, focused on the prevention of treatments are also used; Wrasse (feeder fish which are introduced into the nets containing the fish to naturally eliminate lice), and emitters (which use bio energetic control - the transmission of specially coded signals through electromagnetic fields) to eliminate juvenile sea lice.

Only licensed therapeutants and vaccines are used for any treatment of fish, which are approved by the "Irish Medicines Board". Uses of said therapeutants are listed in the Product Information Sheets of specific product where used.

Environmental Control and Fish Welfare

Environmental analysis on sites must be carried out annually to ensure that the surrounding environment and marine life are not being effected by any of the procedures involved in organic fish farming. These analyses show compliance with criteria set by the Department of Communications, Marine and Natural Resources. Stocking densities are limited to a maximum of 1% fish 99% seawater, with the average being only 0.5% fish 99.5% water. This effectively means that every two fish share 1,000 litres of pure seawater. Antifouling paint on cage nets is prohibited to avoid risks of toxic effects to fish or environment.

Regarding fish welfare harvesting methods are changing. Currently organic farms are using a combination of CO_2 and iced water to anaesthetize fish before killing. However in 2007, it is expected organic farms will have switched to other methods such as electrical or mechanical stunning. Research and trials are currently being carried out to determine the optimal methods for the relevant farms.

10. LOCAL AQUACULTURE MANAGEMENT SYSTEMS

CLAMS Activity 2005

Local Area Management Systems
The Co-ordinated Local Aquaculture Management Systems (CLAMS) process is a nationwide initiative to manage the development of aquaculture in bays and inshore waters at a local level. It allows for the integration of aquaculture into the coastal zone, whilst recognising the need to improve environmental compliance, product quality and consumer confidence.

Continued implementation of the CLAMS process formed the backbone of BIM regional development programmes in 2005. Around that framework, individual officers provided expertise and assistance in formulating and implementing navigation plans, environmental management projects such as trestle removal and pier cleaning and licence applications and ground division projects. Of particular note were a large scale redundant trestle removal programme, which was successfully carried out in Dungarvan Harbour, along with the installation of approved navigation plans and marks in Clew Bay and Dungarvan Harbour.

There are now 16 CLAMS groups established around the coast with 9 CLAMS plans already published. In 2005, three more plans were prepared for Carlingford Lough, south Shannon Estuary and Mulroy Bay.

Environmental Code of Practice for Aquaculture Companies and Traders (ECOPACT)
ECOPACT is an initiative developed by BIM to ensure the widespread introduction of environmental management systems in the Irish aquaculture Industry. In 2005, the ECOPACT initiative received renewed impetus, with 36 new growers being added to the list of participants. ECOPACT is proving itself to be a valuable tool for the whole of the aquaculture sector. It was successfully implemented in a wide variety of business types and sizes across all of the major species currently under cultivation both on a bay level, through the various CLAMS groups and also on an individual level. In order to enable operators to display their environmental management plan and schedule key activities on a monthly basis a wall-planner was produced and distributed to all participants in the programme. It is planned to accredit the process to the same standard as the quality assurance schemes in 2006, thus adding an "ECO" component to the overall suite of schemes.

Work continued in the area of sustainable management of both inorganic and organic waste arising from the aquaculture industry. In order to gauge the magnitude and nature of the waste, a survey of producers was carried out, the results of which allow for accurate information to be made available to the waste management sector when contact is being made in relation to either recycling or disposal options.
(See http://www.bim.ie)

Shellfish Designation
Work on supporting the DCMNR in implementing the Designation of Shellfish Growing Waters Directive continued to occupy the BIM regional officers. A large proportion of their time in the early months of the year was focused on completing the descriptions for the proposed new areas for designation and with ongoing sampling for the existing designated sites.

Single Bay Management in 2005

Single Bay Management (SBM) plans were in place for all finfish producing bays in the country. This initiative began in the early 1990's shortly after the introduction of the Sea Lice monitoring programme to advise on codes of best practices for sea lice treatments, harvesting procedures and good husbandry. SBM meetings are held annually in each region and are facilitated by Marine Institute (MI) staff.

At the end of the year 2004 and early in 2005 synchronous treatments of fish were carried out in a number of regions following SBM meetings with DCMNR officials and MI representatives. Later in the year a report was compiled for the DCMNR detailing the treatment types undertaken, dates administered and generations of fish treated. Subsequently in 2005, three year production projections (up to 2008) were created for each site to target strategic sea lice treatments and plans were made for site fallowing.

Coastal Zone Management (CZM) Aquareg Project 2005
The objective of this coastal zone management project is to review aquaculture and inshore fisheries management activities with the objective of producing guidelines for best practice by these industries.

In Ireland the study area is Clew Bay (Co. Mayo) and a pilot geodatabase is being developed comprising and integrating data such as; bathymetry; fixed station temperature data; environmental data; navigation channels; hydrography; marine boundaries; quays and piers; political boundaries; aquaculture site locations and inshore fisheries activities. This information will be used in setting the foundation for the development of a spatial plan for the bay. Expansion of this database is planned with the development of a new hydrographic model for the bay, which will integrate bathymetric data from recent seabed surveys.

This AquaReg CZM project is primarily a co-operative project between the Marine Institute in Ireland, CETMAR (Socio-economic institute for the Marine) in Galicia (Spain) and the Sor-Trondelag Fylkescommune in Trondelag (Norway). Many other interested groups were incorporated into the project through questionnaires and workshops and through linking with Mayo County Councils Coast Atlantic Project. Questionnaires were circulated in 2004/2005 to officials and license holders from the aquaculture, inshore fishing and recreational fisheries sectors. This focused on highlighting issues relating to: administration; licensing; monitoring programmes; access to results and data processing and; current management fora in place. An internal report on the results was compiled in 2005 and this will be circulated to participants at a later date.

11. IRISH FARMERS ASSOCIATION (IFA) AQUACULTURE ACTIVITIES 2005

IFA Aquaculture

IFA Aquaculture is the section within the Irish Farmers' Association that provides representation for the three Irish aquaculture groups: The Irish Salmon Growers Association (ISGA), The Irish Shellfish Association (ISA) and the Irish Trout Producers' Group (ITPG). During 2005, there were a number of important developments in each of the aquaculture sectors that were addressed by the Irish representative organisations:

Salmon

The market situation worsened from that experienced in 2004 as supply from non EU countries outstripped demand in the EU for the first half of 2005. The European Commission responded to Irish and UK Government demands for safeguards by applying measures against all non EU country imports in February 2005. Meanwhile, Irish and Scottish salmon farmers collaborated through the European Salmon Producers Group (EUSPG) to lodge an anti-dumping case in summer 2005 that succeeded in replacing the safeguards with a Minimum Import Price (MIP) on Norwegian salmon.

The Irish Salmon industry continued to work on finding ways to manage PD, which had caused losses for the previous two years and again proved to be a major challenge in 2005. This work was carried out in collaboration with the Marine Institute, Queens' University and Scottish and Norwegian institutions.

During 2005 a major effort was made to improve the understanding between stakeholders of wild and farmed salmon at a special conference organised by the International Salmon Farmers' Association and NASCO in Trondheim.

In Brussels, two important pieces of legislation were monitored throughout the year by ISGA through the Federation of European Aquaculture Producers (FEAP). These were the new Fish Health Directive and the Regulations to replace the Financial Instrument for Fisheries Guidance which later became the European Fisheries Fund.

The annual ISGA conference, Bradán 2005, was held in Galway City in November.

Trout

IFA Aquaculture welcomed the trout sector on board to join colleagues from the other aquaculture sectors. The group's work began with the hosting of a special freshwater workshop in Athlone in September 2005. Freshwater producers from the entire island of Ireland joined IFA Aquaculture members in Athlone, in September 2005.

Shellfish

Biotoxins remained a challenge and in particular the management of Azasparacid (AZP) which appeared to give anomalous results when using the mouse bioassay. A concerted effort by ISA saw extensive collaboration with producers in Galicia. This included a visit by ISA's MSSC members to view the Galician biotoxin system, leading to a modified management regime which came into place in autumn 2005. The differing emphasis placed on chemical and bioassay results, depending on the prevailing toxin succeeded in strengthening both consumer protection and longer-term producer confidence in the system.

Rope mussel producers, through the ISA, successfully lobbied for a joint BIM/Enterprise Ireland funded report on the sector. Consultants Price Waterhouse Coopers won the contract to produce the report that began with industry consultation in the last quarter of 2005.

During July and August of 2005 a massive bloom of *Karenia Mykimotoi* occurred off the west coast. The bloom was patchy but intense, intertidal farmers of oysters and clams reported heavy mortalities across a range of generations. The ISA prepared a case for compensation for those affected.

The ISA annual conference was held in Clarinbridge in March 2005.

Table 14. Some Aquaculture events and conferences in 2005

Conference/ Workshop	Location	Date
Irish Shellfish Association	Clarinbridge, Galway	3rd and 4th March
Living with Bonamia in a flat oyster fishery	Moville, Co. Donegal	24th and 25th September
IFA Freshwater Conference	Athlone	30th September
6th Irish Shellfish Safety Workshop	Galway	1st December
Bradán	Galway	2nd December

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European

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Council Regulation (EEC) No 2377/90 laying down a Community procedure for the establishment of maximum residue limits for veterinary medicinal products in foodstuffs of animal origin. O.J L 224, 18/08/1990, P. 1-8.

Council Directive 91/67/EEC of 28 January 1991 concerning the animal health conditions governing the placing on the market of aquaculture animals and products. O.J. L 046, 19/02/1991, P 1–18.

Council Directive 91/492/EEC of 15 July, 1991 laying down the health conditions for the production and placing on the market of live bivalve molluscs. O.J. L 268/1, 24/09/1991, P. 1-14.

Council Directive 93/53/EEC of 24 June 1993 introducing minimum community measures for the control of certain fish diseases. O.J. L 175, 19/07/1993, P. 23-33.

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S.I. No. 12 of 2001. Water Quality (Dangerous Substances) Regulations, 2001

Appendix I Irish Aquaculture 1990-2005

Table A I.1. Irish Aquaculture Production (Volume - tonnes) 1990 - 2005

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Shellfish																
Rope Mussel	3,380	4,700	5,091	4,773	3,707	5,500	7,000	6,694	7,790	6,467	4,045	7,580	7,699	9,313	8,755	8,755
Bottom Mussel	15,000	11,200	8,731	8,884	9,260	5,500	7,500	11,458	11,306	9,644	21,615	22,793	24,000	29,976	28,560	29,510
Gigas Oyster	361	1,278	1,750	2,014	1,862	2,539	4,000	3,135	5,369	6,555	5,031	4,909	5,444	4,830	5,103	5,811
Native Oyster	420	366	334	450	590	400	400	400	516	696	266	431	280	325	390	342
Clam	60	50	79	84	110	103	125	218	233	121	92	91	214	154	181	161
Scallop	-	-	-	-	-	-	-	24	25	33	61	49	67	80	103	87
Others	-	-	-	-	-	28	-	-	-	-	-	-	-	-	-	-
Total Shellfish	*19,221*	*17,594*	*15,985*	*16,205*	*15,529*	*14,070*	*19,025*	*21,929*	*25,239*	*23,516*	*31,110*	*35,853*	*37,704*	*44,678*	*43,092*	*44,666*
Finfish																
Salmon ova/smolt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Salmon	6,323	9,300	9,696	12,366	11,616	11,811	14,025	15,422	14,860	18,076	17,681	23,312	21,423	16,347	14,067	13,764
Sea reared Trout	324	560	432	677	613	470	690	1,020	1,046	1,077	1,360	977	888	370	282	717
Freshwater Trout	705	845	965	906	854	1,003	1,160	1,161	1,155	1,098	1,053	730	915	1,081	889	897
Others**	0	0	0	0	0	15	30	0	24	89	76	63	54	40	25	6
Total Finfish	*7,352*	*10,705*	*11,093*	*13,949*	*13,083*	*13,299*	*15,905*	*17,603*	*17,085*	*20,340*	*20,170*	*25,082*	*23,280*	*17,838*	*15,263*	*15,384*
Total Aquaculture	**26,573**	**28,299**	**27,078**	**30,154**	**28,612**	**27,369**	**34,930**	**39,532**	**42,324**	**43,856**	**51,280**	**60,935**	**60,984**	**62,516**	**58,355**	**60,050**

Table A I .2. Irish Aquaculture Production (Value - €'000) 1990 - 2005

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Shellfish																
Rope Mussel	1,717	2,343	2,974	2,727	2,118	3,143	4,000	4,252	5,094	4,298	2,358	4,205	5,489	7,568	6,871	6,579
Bottom Mussel	2,286	1,715	1,816	1,850	2,703	1,864	2,542	4,431	5,028	4,115	10,562	12,691	16,896	21,653	21,014	25,718
Gigas Oyster	646	1,379	3,000	3,197	2,837	2,095	4,571	4,020	7,025	9,231	6,813	7,993	11,912	9,920	12,204	12,089
Native Oyster	2,108	1,859	994	1,524	1,847	1,412	1,524	1,270	1,971	2,913	1,027	2,060	1,157	1,324	1,636	1,708
Clam	305	180	251	245	321	131	516	705	827	424	361	589	1,421	795	711	849
Scallop	-	-	-	-	-	-	-	216	93	127	338	339	333	380	437	425
Others	-	-	-	-	-	61	-		104	531	53	65	684	142	727	380
Total Shellfish	*7,061*	*7,476*	*9,035*	*9,543*	*9,827*	*8,706*	*13,153*	*14,894*	*20,142*	*21,639*	*21,512*	*27,942*	*37,892*	*41,782*	*43,600*	*47,748*
Finfish																
Salmon ova/smolt	-	-	-	-	-	-	-	-	-	2,616	4,401	2,905	4,848	2,000	2,337	2,500
Salmon	26,736	38,413	38,609	49,618	47,493	46,790	47,333	47,638	51,412	55,463	62,772	70,869	77,731	54,198	51,289	55,042
Sea reared Trout	1,131	1,671	2,150	1,371	1,947	2,598	1,927	2,720	2,980	3,525	4,831	2,837	2,108	1,200	860	1,568
Freshwater Trout	2,286	2,360	2,576	2,576	2,331	1,401	2,856	2,929	3,320	3,106	2,734	1,997	2,557	2,318	2,116	2,379
Others**	-	-	-	-	-	95	211	-	217	301	429	556	82	350	300	62
Total Finfish	*30,152*	*42,445*	*43,335*	*53,565*	*51,771*	*50,884*	*52,327*	*53,287*	*57,929*	*65,011*	*75,167*	*79,164*	*87,326*	*60,066*	*56,902*	*61,551*
Total Aquaculture	**37,213**	**49,921**	**52,370**	**63,109**	**61,598**	**59,590**	**65,480**	**68,181**	**78,071**	**86,650**	**96,679**	**107,107**	**125,218**	**101,848**	**100,502**	**109,299**

Appendix II Weight conversion rates for salmon

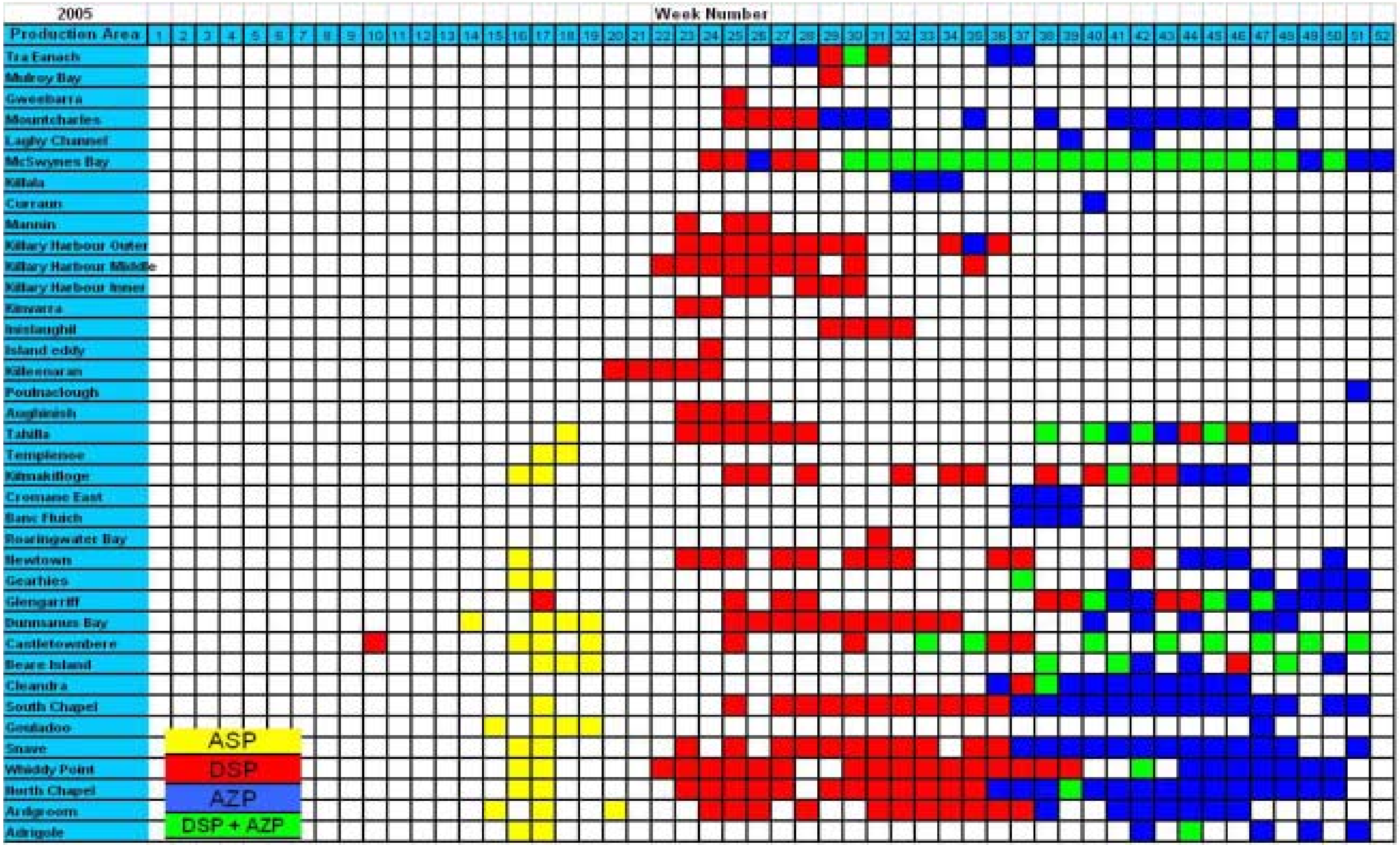
All salmon production is given as Round Weight Equivalent (RWE). This is the mass of a fish after it has been starved and bled, also known as the harvest weight.

In calculating the Salmon harvest it has sometimes been appropriate to work backwards using the following conversion rates:

Harvest weight (RWE)	- 100%
Gutted fish	- 90%
Head-off, gutted	- 83%
Fillet, skin on	- 68%
Fillet, skin off	- 60%

e.g. The RWE (Harvest weight) of 100 tonnes of head-off, gutted salmon equals –
100/0.83 = 120 tonnes.

Appendix III: Biotoxin Closures in 2005



Appendix IV Designated Bivalve Mollusc Production Areas in Ireland (October 2005)

I Production Area	II Boundaries	III Bed Name	IV Species	V Previous Classification	VI Current Classification
Lough Foyle	Magilligan Head to Inishown Head	All Beds	Oysters Mussels	B	B
Tra Breaga	Malin Head to Dunaff Head	All Beds	Oysters	A	A
Lough Swilly	Fanad Head to Dunaff Head	All Beds	Mussels Oysters	B	B
Mulroy Bay	Melmore Head to Ballyhoorisky Point	All Beds	Mussels Oysters	A	A
Sheephaven	Rinnfaghla Point to Horn Head	All Beds	Oysters Mussels	B B	A B
Gweedore	Carrick Point to Carrickacuskeame and Torglass Island to Dunmore Point	All Beds	Oysters	B	B
Dungloe	Wyon Point to Burtonport Pier	Dungloe	Oysters	B	B
Traweenagh	Dooey Point to Crohy Point	All Beds	Mussels Oysters	A	A
Gweebarra	Gweebarra Point to Cashelgolan Point	All Beds	Oysters	A	A
Loughras Beg	Loughras Point to Gull Island	All Beds	Oysters	A	A
McSwynes Bay	Carntullagh Head to Pound Point St. John's Point to Doorin Point	Bruckless	Mussels	A	A
Donegal Harbour	Area bounded to the West by a line from The Hassans to Murvagh Point. Doorin Point to Rossnowlagh Point.	All Beds All other Beds	Oysters Mussels Oysters Mussels	A B B B	B B B B
Drumcliff Bay	Raghly Point to Deadman's Point	All Beds	Oysters Clams Mussels Cockles	A B B B	A B B B
Sligo Harbour	Deadman's Point to Killaspug Point	All Beds	Oysters Clams	B	B
Ballysodare Bay	Killaspug Point to Derkmore Point	All Beds	Mussels	A	B
Killala Bay	Ross Point to Iniscrone Point	Sites 135,160,207	Oysters	A	A
Blacksod Bay	Blacksod Point to Kanfinalta Point	All Beds	Oysters	A	A

I Production Area	II Boundaries	III Bed Name	IV Species	V Previous Classification	VI Current Classification
Achill	Bolinglanna to the southernmost Point of Achill Beg, Kinrovar Point to Ridge Point	All Beds	Mussels Oysters	B	B
Clew Bay	Area bounded to the south by 53° 52.60' N and to the West by 9° 37'. W.[2]	Newport Bay	Mussels Oysters	B	B
	Area bounded to the west by 09° 35 .37' W	Westport Bay	Mussels Oysters	B	B
	Area within a one nautical mile (1,852 M) radius of Roskeen Point (53° 53.46'N, 09° 40.10' W)	Tieranaur Bay	Oysters	A	B
	Mulranny Pier to Old Head	Corrie Channel and Rosslaher Beds	Mussels Oysters	B	B
		All other Beds	Mussels Oysters	A	A
Killary Harbour	Rusheen Point to Rossroe Quay	All Beds	Mussels	B	B
Ballinakill	Renvyle Point to Cleggan Point	All Beds	Oysters	A	A
Streamstown Bay	Gubarusheen Point to Omey House ruins to Ardoe	All Beds	Oysters	A	A
Clifden Bay Inner	Errislanan Pier to Dooghbeg Quay (ruins)	All Beds	Mussels	B	B
Clifden Bay Outer	Errislanan Pt to western most Point of Turbot Island to westernmost Point of Ardmore Island and from Errislanan Point to Dooghbeg Quay (ruins)	All Beds	Clams	B	B
Mannin Bay	Errislanan Point to Knock Point	All Beds	Oysters	A	A
Kilkieran	Mulroa Point to Golam to Cloghmore Point	All Beds	Oysters	A	A
Galway Bay	Ardfry Point to Kilcolgan Point	Mweeloon Bay	Oysters Mussels	A B	A B
	Kilcolgan Point to Deer Island to Aughinis Point Excl Kinvarra Bay.	Corraduff Beds	Oysters Mussels	B	B
		Clarenbridge and Killeenaran Beds	Oysters Mussels Clams	B B A	A B A
	Knockapreaghaun Point to Goragh Island to Traught Point (8° 59.1' W and 53° 14.8' N.)	Kinvarra Bay	Oysters Mussels	B	B

[2] These boundaries have been altered since the previous classification

I Production Area	II Boundaries	III Bed Name	IV Species	V Previous Classification	VI Current Classification
	Aughinis Point to New Quay	Aughinis	Oysters	B	B
	Finnivarra Point to Muckinis Point	Poulnaclough Bay	Oysters Mussels	B	B
Carrigaholt	Kiloher Head to Leck Point and Corlis Point to Beal Point	All Beds	Oysters	A	A
Poulnasharry	Corlis Point to Baurnahard Point	All Beds	Oysters	A	A
Shannon Estuary	Aughinis Point to Courtbrown Point	All Beds	Oysters	B	B
Ballylongford	Beal Point to Knockfinglas Point	All Beds	Oysters	B	B
Tralee Bay	Kerry Head to Brandon Head	All Beds	Oysters	B	B
Castlemaine Harbour	Inch Point to Rossbeigh Point	All Beds	Oysters Mussels	B	B
Valentia River	Bray Head to Reencaheragh Point and Douglas Head to Fort Point	All Beds	Oysters	B	B
Kenmare River	Lamb's Head to od's Head	Ardgroom Cleandra Kilmakilloge Sneem/Tahilla All other Beds	Mussels Mussels Mussels Mussels Mussels Oysters	A A B B B B	A A B B B B
Bantry Bay	Ardnakinna Point to Fair Head and Lonehort Point to Bank Harbour Area bounded to the north by a line from Gortnakilla Pier to a point at 51° 37.5'N, 09° 42'W to Whiddy Point west to Relane Point. Sheep's Head to Back Ball Head	Castletownbere South Shore All other Beds	Mussels Mussels Sea Urchins Mussels Sea Urchins	A A B A	A A B -
Dunmanus Bay	Sheep's Head to Three Castle Head	All Beds	Mussels Sea Urchins	B A	B A
Roaringwater Bay	Cousnaganniv Point to Frolic Point	All beds	Mussels	B	B
Baltimore Harbour	Barrack Point to Beacon Point and Lettuce Point toSpanish Point to Grig's Point	All beds	Oysters	B	B
Sherkin North	Licensed sites	All licensed Beds	Oysters	B	A
Sherkin Kinish	Drawlaun Point to Long Point	All licensed Beds	Oysters	A	A

I Production Area	II Boundaries	III Bed Name	IV Species	V Previous Classification	VI Current Classification
Rosscarbery	Downeen Point to Creggane Point	All Beds	Oysters	B	B
Kinsale	Shronecan Point to Preghane Point	All Beds	Oysters	B	B
Oysterhaven	Ballymacus Point to Kinure Point	All Beds	Oysters	B	B
Cork Harbour	Between 8°16.4’ W and 8° 15.6’ W. Between 8°14.6’W and 8°13.2’W. Ahada Pier to Gold Point	North Channel West North Channel East Rostellan	Oysters Oysters Oysters	B B B	B B B
Ballymacoda Bay	Knockadoon Head to Knockaverry	All Beds	Oysters	B	B
Dungarvan Bay	Helvick Head to Ballynacourty Point	All Beds	Oysters	B	B
Waterford Harbour	Creadan Head to Hook Head	All Beds	Mussels Oysters	B	B
Bannow Bay	Ingard Point to Clammer’s Point	All Beds	Oysters	B	B
Ballyteigue Bay	Ballymadder Point to Crossfarnoge Point	All Beds	Oysters	B	B
Wexford Harbour	Rosslare Point to The Raven Point	ST 1,2,3,4 All other Beds	Mussels Mussels	C B	C B
Malahide	Between 53° 25.4’ N and 53° 29.4’ N	All Beds	Razor Clams	B	B
Skerries	Area bounded by a line from Hampton Cove to a point at 06° W, 53°36.3’ N to a point at 06° W, 53°34.5’N to Shenick Island	All Beds	Razor Clams	B	B
Gormanston / Laytown	Between 53° 38’ N and 53° 40’N and Between 53° 41’ N and 53° 42’ N	All beds	Razor Clams	A	A
River Boyne	From Bight Navigation Mark to South Point Navigation Mark and from Lyons Navigation Mark to Aleria Navigation Mark.	All Beds	Mussels	B	B

Appendix V Aquaculture Research

Appendix V. 1. Overview of current aquaculture-related research in the third-level sector (MI and Third Level Institutions).

Institute	No. Research Groups	No. Researchers	Research Focus/ Potential
University College Cork	1 Large 2 Medium	23	• Fin/shellfish aquaculture, aquaculture systems, new species • Mussel, abalone, sea urchin, and artic char • bonamia • Fish and shellfish health and immunology • Salmonid genetics, genetic interactions • Water quality assessment and modelling • Marine ecology, biodiversity and ecosystem functioning
National University of Ireland Galway	1 Large 1 Large	16	• Marine modelling • HABS • Aquaculture systems, New species • Seaweed culture, innovative fish feed • Bio-toxin identification/testing • Molecular biology of salmon • Functional genomic approaches to stock selection • New technologies, recirculation and marine finfish hatchery. • Commercialisation of applied projects • Water quality monitoring and assessment • Live food production systems • Broodstock programmes for fin and shellfish • Quarantine capacity
University College Dublin	1 Medium	1	• Toxicology, development of *in vitro* tests for bio-toxins
Galway/ Mayo Institute of Technology	1 Small	1	• Broodstock and re-circulation systems for finfish and shellfish • Storage, handling and transport protocols for shellfish • Population genetics • Sea lice biology, monitoring marine biodiversity • Novel marine and freshwater species aquaculture • Sustainable/Alternative Energy Systems for Aquaculture
Cork Institute of Technology	1 Large	9	• Bio-toxin analysis and isolation
Letterkenny Institute of Technology	1 Large	6	• Bivalve larval identification • Shellfish spat production • Shellfish toxins • Shellfish processing/MAP • Diagnostics for pathogen detection • Marine bioactives from processing waste
Dublin Institute of Technology	1 Medium	4	• Salmon smoltification • Shellfish histology and pathology • Salmon disease and stress diagnostics
TOTAL	*5 Large Groups* *4 Medium Groups* *1 Small Group*	*60*	

Appendix V. 2. Ongoing Research Projects in 2005

Marine RTDI Measure (NDP) funded aquaculture research ongoing during 2005.

Start-Up Year	Title	Funding Type	Support (€)
2001	Sea lice biology and interactions.*	Post-doc	157,400
2001	Investigations into the hatchery rearing of Cod (*Gadus morhua*) in Irish conditions.*	Post-doc	210,000
2001	Investigations into a reliable supply of scallop (*Pecten maximus*) for the inshore fishery and aquaculture industries.	Post-doc	209,280
2001	Health and disease in clams (*Ruditapes philippinarum*) in Ireland, with particular reference to brown ring disease.*	PhD	118,137
2001	Modelling of *Alexandrium* blooms in Cork Harbour.*	PhD	98,350
2002	ASTOX - Isolation and purification of azaspiracids from naturally contaminated materials, and evaluation of their toxicological effects.*	Strategic	419,854
2002	Resource and Risk Assessment of Mussel Seed in Irish Waters.*	Strategic	361,362
2002	BOHAB - Biological Oceanography of Harmful Algal Blooms off the west Coast of Ireland.*	Strategic	399,500
2003	Dunlop Offshore Cage Development Programme.*	Industry	42,868
2003	A Novel System for Intensive Larval Culture of the Sea Urchin *Paracentrotus lividus.**	Industry	38,958
2003	Development of an artificial roe enhancement diet based on waste products from the fishing industry.*	Industry	54,308
2004	Acclimatization potential of Arctic Char (*Salvelinus alpinus*) to a marine environment.	Industry	59,686
2004	Evaluation of selected biophysical properties of salmon pancreas disease virus (SPDV).	Industry	58,594

* Projects completed in 2006

EU 6th Framework Programme

Project Title	**SEAFOODplus**
Irish Partner(s)	UCC The National Food Centre UCD
Project Title	**HABIT - Harmful Algal Bloom Species in thin layers**
Project Leader	National University of Ireland, Galway (NUIG)
Irish Partner	Martin Ryan Institute, NUIG
Project Title	**BIOTOX - Cost effective tools for risk management and traceability systems for lipophilic marine biotoxins in seafood**
Irish Partner(s)	Marine Institute National University of Ireland, Galway Food Safety Authority Oyster Creek Seafoods
Project Title	**SEED - Life history transformations among Harmful Algal Bloom species and the environmental and physiological factors that regulate them**
Irish Partner	Martin Ryan Institute, NUIG
Project Title	**Collective Research on Aquaculture Biofouling (CRAB)**
Irish Partner	Department of Zoology, Ecology and Plant Science/Aquaculture Development Centre, UCC.

INTERREG IIIA (Ireland/Wales)

Project Title	**Shellfish Aquaculture in the Irish Sea - Detection and prevention of diseases in *Crassostrea gigas***
Irish Partner	Environmental Research Institute, UCC
Project Title	**SMART - Sustainable management of near shore water quality for aquaculture, recreation and tourism**
Irish Partner	Department of Biochemistry, UCD
Project Title	**Development of Mussel Hatchery Techniques in Ireland/Wales**
Irish Partner	Environmental Research Institute, UCC

INTERREG IIIB Atlantic Area

Project Title	**e-AQUA - Analysis penetration of ICT and promotion of e-commerce within the SMEs belonging to the aquaculture strategic sector of the Atlantic area**
Irish Partner(s)	BIM Aqua TT
Project Title	**NEMEDA - Network for the diminution of the effects of *Dinophysis* in Aquaculture**
Project Leader	National University of Ireland, Galway (NUIG)
Irish Partner(s)	Martin Ryan Institute, NUIG Marine Institute
Project Title	**AAAG - The Atlantic Area Aquaculture Group**
Irish Partner	Aquaculture and Fisheries Development Centre, UCC

INTERREG IIIC

Project Title	**AquaReg**
Irish Partner	Marine Institute

Appendix VI Aquaculture Grant Payments 2005

Table VI. 1. Aquaculture grant payments under the NDP in 2005, by species and region.

Project type	FIFG Grant Paid south & east	FIFG Grant Paid BMW	FIFG Grant Paid Total
Oysters	41,649	287,549	329,198
Rope Mussels	60,226	129,673	189,899
Bottom Mussels	2,783,006	1,656,677	4,439,683
Clams	-	20.089	20,089
Salmon	0	353,792	353,792
Sea Water Trout	0	30,367	30,367
Environment and Quality	137,826	195,330	333,156
Totals	***3,022,707***	***2,673,477***	***5,696,184***

Table VI. 2. Aquacultures grant payments (R&D and Commercial) to Gaeltacht-based projects by Údarás na Gaeltachta/Taighde Mara in 2005. Figures in brackets (*italics)* refer to FIFG drawdown.

	south & east Region		BMW Region		Total	
	Payments	No. Projects	Payments	No. Projects	Payments	No. Projects
Salmon	-	-	1,134,142 (+29,875)	3	1,134,142 (+29,875)	3
Marine Finfish	-	-	244,837	2	244,837	2
Native Oysters	-	-	25,592	1	25,592	1
Gigas Oysters	-	-	84,609 (+5,756)	6	84,609 (+5,756)	6
Abalone	421,872	1	-	-	421,872	1
Totals	***421,872***	***1***	***1,489,180 (+35,631)***	***12***	***1,911,052 (+35,631)***	***13***

Table VI. 3. Pilot project grant payments (non EU co-funded) in 2005, by species.

Project type	Payments Total
Oysters	107,667
Rope Mussels	280,310
Bottom Mussels	71,991
Clams	32,274
Salmon	281,363
Abalone	71,920
Seaweed	21,108
Arctic Char	30,455
Trout	11,504
Perch	65,074
Lobster	4,760
Urchins	6,714
Other s	20,644
Totals	***1,005,784***

Table VI. 4. Summary of non EU co-funded pilot project investment and grant approvals in 2005.

	Investment	Grant
Oysters	427,760	175,069
Rope mussels	1,577,967	650,864
Bottom mussels	200,103	88,071
Clams	99,630	39,852
Salmon	1,307,950	571,260
Abalone	99,430	44,743
Seaweed	68,287	30,730
Arctic char	160,996	72,448
Trout	131,205	59,042
Scallop	14,325	6,446
Perch	189,710	85,369
Lobster	102,177	45,980
Barramundi	21,940	9,873
Seahorse	33,350	15,008
Others	243,827	109,772
Totals	***4,678,657***	***2,004,477***

Appendix VII Role of State Agencies

State Agency Roles in the Aquaculture Industry

Department of Communications, Marine and Natural Resources
www.dcmnr.gov.ie/Marine/

Seafood Policy Division
The Seafood Policy Section of the Department is responsible for the strategic, economic and sustainable development of the aquaculture sector, as well as the broad regulation of it, within the framework of the Common Fisheries Policy and the Fisheries (Amendment) Act, 1997.

The Department's overall goal for aquaculture is to support the sustainable development of the sector in order to maximise its contribution to jobs and growth in coastal communities and to the national economy. The key objectives underpinning this goal include:

- Increasing employment, output value and exports;
- Creating a sustainable and environmentally appropriate framework and critical mass for sectoral expansion; and
- Securing increased competitiveness through enhanced quality, value added, technology acquisition and diversification.

The Seafood Policy section aims to identify and facilitate measures to securing these objectives. Key areas of involvement for the section include policy formulation, targeted investment support for aquaculture under the National Development Plan 2000 - 2006, the establishment of a national fish health policy framework and the pursuit of measures and action at EU and national level beneficial to the sector.

Coastal Zone Management Division
The Coastal Zone Division ensures that Ireland's coastal zone is used in a sustainable way to the best advantage of the Irish people from an economic, aquaculture, leisure, social and environmental perspective. As part of this wider remit the division is responsible for the licensing, monitoring and enforcement of aquaculture activities.

Údarás na Gaeltachta and Taighde Mara
www.udaras.ie www.taighde.ie

As a regional development agency, Údarás na Gaeltachta and its subsidiary Taighde Mara, bring an integrated approach to the development of aquaculture. The continuum of novel species, new techniques and business entities, from the research phase, through innovation and pilot scale trials to commercialisation is supported, as is the integration of the individual aquaculture enterprise into both the wider industry and the locale.

Both Taighde Mara and Údarás na Gaeltachta have offices and staff in each Gaeltacht region and between them can provide advice, technical support and financial support to new entrants and to expanding or diversifying aquaculturists. A broad range of support is available depending on the client's needs. Financial support may include investment by means of preference or redeemable shares as well as grant aid for capital, training and research and development. Technical support is equally broad and can include technology transfer, provision of technical staff while developing human resources within an enterprise as well as administration, IT, and business skill support. An overview of the industry's needs is maintained so that strategic planning and initiatives can be taken.

Bord Iascaigh Mhara (BIM)
www.bim.ie

BIM's mission is '*to promote the sustainable development of the Irish seafood industry at sea and ashore and support its diversification in the coastal regions so as to enhance the contribution of the sector to employment, income and welfare both regionally and nationally*'. BIM's role in aquaculture development is three tiered, with support being given by the Aquaculture Development Division, the Market Development Division and the Marine Services Division.

The *Aquaculture Development Division* is charged with promoting the sustainable development of the Irish aquaculture industry in terms of volume and value of output. It has three sections. The Technical Section provides a specialist technical support service to the aquaculture industry. The Project Development Section evaluates and prioritises investment proposals for grant assistance and assesses payment claims for draw-down of approved grants. The Environment and Quality Section promotes quality and environmental best practice in the aquaculture industry by providing specialist advice and guidelines and developing codes of practice and quality assurance schemes for the sectors.

The role of the *Market Development Division* is to promote Irish seafood at home and abroad and provide a range of market supports to assist clients capitalise on market opportunities. The Division provides a range of services to the sector. The Market Research and Intelligence Section provides market intelligence and targeted market research on products. BIM Overseas Officers located in Paris, Madrid and Dusseldorf provide support in business development including facilitating buyer and customer contact, providing market information and undertaking promotional activities. The Product Quality and Process Development Section provide a technical advisory service to clients through the Seafood Development Centre including the Laboratory facility. The Trade and Market Development Section operates two support programmes which help develop marketing expertise and skills in seafood companies and support market development efforts namely the Irish Seafood Business Programme and the Market Investment Programme. The Consumer Support Section focuses on encouraging consumer demand for Irish seafood. It manages a number of promotional initiatives at retail and food service level including consumer educational programmes to enhance the status of Irish seafood products.

The *Marine Services Division* is charged with developing the industry's human resources through the provision of training and educational programmes and to raise the quality of fish supplies through increased use of ice and improved fish handling practices. Training for the seafood industry is provided through a coastal service that includes the National Fisheries College, the Regional Fisheries Centre, and two mobile coastal training units. Courses for the aquaculture sector have been developed in consultation with industry and are accredited by statutory bodies. The Engineering Services Section manages BIM's ice plant network which provides a supply of ice to fish farms and fish processors to help ensure that fish and shellfish are maintained in top quality from time of harvest to market.

Cross-Border Aquaculture Initiative (CBAIT) EEIG

http://www.bim.ie/templates/text_content.asp?node_id=544

The Aquaculture Initiative is a European Economic Interest Grouping (EEIG) administered by Board Iascaigh Mhara (BIM), whose mission is *"To provide a range of support services for the sustainable development of the aquaculture sector, increasing volume, value and employment in the six counties of Northern Ireland and the six Border counties of the Republic of Ireland."*

The Initiative is involved in developing the considerable potential for expansion of the aquaculture industry within the remit area, through the full development of the natural resources available, contributing significantly to the economy of the area as a whole, and to rural areas in particular. The team advise the aquaculture industry on financial, technical and strategic issues, in order to provide effective support to new and existing aquaculture ventures.

The aquaculture Initiative provides advice and support to enable producers to meet increasingly rigorous environmental and quality standards. The Team also works to raise awareness concerning environmental responsibilities with respect to the sustainable use of natural resources.

Loughs Agency

www.loughs-agency.com

The Loughs Agency is an agency of the Foyle, Carlingford and Irish Lights Commission (FCILC), established under the 1998 Agreement between the Government of the United Kingdom and the Irish Government. The FCILC is legislated for by the North/South Co operation (Implementation Bodies) (Northern Ireland) Order 1999 and the British-Irish Agreement Acts 1999 and 2002. The FCILC's sponsoring Departments are the Department of Agriculture and Rural Development in the North and the Department of Communications, Marine and Natural Resources in the south.

The functions of the Loughs Agency are as follows:

- The promotion of development of Lough Foyle and Carlingford Lough for commercial and recreational purposes in respect of marine, fishery and **aquaculture** matters;
- The management, conservation, protection, improvement and development of the inland fisheries of the Foyle and Carlingford Areas;
- The development and licensing of aquaculture; and
- The development of marine tourism.

Marine Institute

www.marine.ie

The Marine Institute is Ireland's national marine R&D agency with the following general functions: *"to undertake, to co-ordinate, to promote and to assist in marine research and development and to provide such services related to marine research and development, that in the opinion of the Institute will promote economic development and create employment and protect the environment."* - Marine Institute Act, 1991.

The Marine Institute is an agency of the Department of Communications Marine and Natural Resources. It was established under statute in 1992. In 2005, the Institute had a staff of 180 people, located in Galway, Newport, Dublin and in ports around the country.

The Marine Institute carries out a number of specific roles in relation to Aquaculture:

1 – **Monitoring and Advice**. MI provides a range of key scientific services and advice to marine businesses and other State agencies that safeguard the quality of aquaculture products and the marine environment. These include statutory monitoring programs in fish health, sealice, benthos, residues in finfish, shellfish toxins and shellfish microbiology.

MI personnel provide statutory advice to the Department of Communications, Marine and Natural Resources in relation to the granting of aquaculture licences. MI personnel provide keys inputs to the Molluscan Shellfish Safety Committee and FSAI. It provides data and advice to the Management Cell which ensures a risk management approach to shellfish safety.

MI participates in the Aquaculture Forum and a number of working groups with industry.

2 – **Research.** The Institute carries out research and supports RTDI (research, technology, development and innovation) activity in the Aquaculture sector projects under the Marine Research Measure of the National Development Plan. These research projects in the areas of cod, mussels, scallops, sealice and shellfish toxins are designed to support employment, provide for sound management decisions to guide the on-going sustainable development of the resource and thereby to underpin future innovation, growth and wealth creation in aquaculture.

MI collaborates with BIM and Taighde Mara in many areas of aquaculture including the planning of research programmes, quality schemes and the work of the Co-ordinated Local Aquaculture Management Systems (CLAMS) processes in selected bays nationwide.

Appendix VIII Commonly used abbreviations

Amnesic Shellfish Poisoning	(ASP)
Aquaculture Licence Appeals Board	(ALAB)
Azaspiracid Poisoning	(AZP)
Bacterial Kidney Disease	(BKD)
Bord Iascaigh Mhara	(BIM)
Cadmium	(Cd)
Case Management Group	(CMG)
Chromium	(Cr)
Coastal Zone Management	(CZM)
Co-ordinated Local Aquaculture Management Systems	(CLAMS)
Copper	(Cu)
Department of Agriculture and Food	(DAF)
Department of Communications, Marine and Natural Resources	(DCMNR)
Diarrhetic Shellfish Poisoning	(DSP)
Enteric Redmouth Disease	(ERM)
Environmental Code of Practice for Aquaculture Companies and Traders	(ECOPACT)
EU 6th Framework Programme	(FP6)
European Commission	(EC)
European Economic Community	(EEC)
European Union	(EU)
Fish Health Unit	(FHU)
Food Safety Authority of Ireland	(FSAI)
Full Time Equivalent	(FTE)
Hepatitis A Virus	(HAV)
High Performance Liquid Chromatography	(HPLC)
Higher Education Authority	(HEA)
Infectious Haematopoetic Necrosis	(IHN)
Infectious Pancreatic Necrosis	(IPN - IPNV)
Infectious Salmon Anaemia	(ISA)
Irish Farmers Association	(IFA)
Irish Salmon Growers Association	(ISGA)
Irish Salmon Producers Group	(ISPG)
Irish Shellfish Association	(ISA)
Irish Trout Growers Association	(ITGA)
Lead	(Pb)
Limit Of Detection	(LOD)
Limit Of Quantification	(LOQ)
Liquid Chromatography Mass Spec.	(LCMS)
Marine Institute	(MI)
Maximum Residue Limit	(MRL)
Mercury	(Hg)
Minimum Import Price	(MIP)
National Development Plan	(NDP)
National Reference Laboratory	(NRL)
National Residues Control Plan	(NRCP)
Nickel	(Ni)
Noroviruses	(NVs)
Organochlorine pesticides	(OCPs)
Pancreas Disease	(PD)
Paralytic Shellfish Poisoning	(PSP)
Polychlorinated biphenyls	(PCBs)
Price Waterhouse Coopers	(PWC)
Regional Fisheries Boards	(RFB)
Round Weight Equivalents	(RWE)
Silver	(Ag)
Single Bay Management	(SBM)
Spring Viraemia of Carp	(SVC)
Taighde Mara Teo	(TMT)
Viral Haemorrhagic Septicaemia	(VHS)
Zinc	(Zn)

Common name	Scientific	Alternative
Clams	*Tapes philipinarium*	Cultured clams
Gigas oyster	*Crassostrea gigas*	Pacific oyster
Mussel	*Mytilus edulis*	Rope mussel, bottom mussel, mussel seed
Native oyster	*Ostrea edulis*	Flat oyster
Salmon	*Salmo salar*	Atlantic salmon
Scallops	*Pecten maximus*	