4. FISHERIES AND AQUACULTURE

Common dragonet *Callionymus lyra*

Key messages:

- Irish Sea cod is suffering reduced reproductive capacity and is being harvested unsustainably, while sole is at risk of becoming harvested unsustainably.
- A sharp reduction in whiting abundance has led to significantly reduced catches.
- Haddock spawning biomass in the Irish Sea has recently increased as has the biomass of herring.
- The Irish Sea plaice stock is being harvested sustainably.
- The angel shark is severely depleted. The population of spurdog is depleted, while lesser spotted dogfish and nursehound are stable or increasing.
- The common skate is now severely depleted in waters around Northern Ireland, however, thornback ray and blonde ray are stable or increasing in numbers and the cuckoo ray is widespread and abundant.
- There have been significant declines in the natural survival of wild salmon at sea in recent years.
- An ecological quality measure used to classify estuarine fish communities under the Water Framework Directive scores the Foyle/Faughan as 'high', the Bann and Newry as 'good', while the remaining three systems (Roe, Lagan, and Connswater) are 'moderate'.
- The Dublin Bay prawn stock in the western Irish Sea has sustained harvests averaging over 7,000 tonnes since the 1970s while maintaining a stable size composition and sex ratio, suggesting that the stock is being harvested sustainably.
- The main shellfish species under aquaculture in Northern Ireland's sea loughs are blue mussels, Pacific oysters and to a lesser extent king scallops.

What is the status of our commercially exploited fish stocks?

A wide variety of commercially important fish species are exploited in the waters around Northern Ireland. In 2008, landings into NI fishing ports (www.marinemanagement.org.uk/fisheries/statistics/annual2008.htm) were topped by 7,876 tonnes of Dublin Bay prawn *Nephrops norvegicus*, with a first sale value of £14.2 million, followed by 527 tonnes of cod *Gadus morhua* and 500 tonnes of haddock *Merlanogrammus aeglfinus* with values of £1.2 million and £0.5 million, respectively.

Herring *Clupea harengus*

Overall landings of demersal (near bottom living) fish totalled 1,894 tonnes, with a first sale value of £3.18 million. In terms of pelagic (mid water living) species, there is a relatively small fishery for herring *Clupea harengus* in the Irish Sea, with landings into Northern Irish ports in 2008 of 5,722 tonnes, valued at £1.34 million. Inshore fisheries include lobster *Homarus gammarus,* king scallops *Pecten maximus*, cockles *Cerastoderma edule* and oysters *Ostrea edulis* and a variety of crabs and shrimps, with a total of 3,010 tonnes recorded in 2008, having a combined value of £3.2 million.

The Northern Ireland fishing fleet comprises around 147 registered vessels over 10 metres in length, the majority fishing mainly for Dublin Bay prawn in a mixed species demersal fishery. A small fleet of semi-pelagic trawlers target whitefish. Two vessels seasonally target the stock of Irish Sea herring, mainly in waters adjacent to the Isle of Man, while a small boat (skiff) fishery targets herring on the Mourne shore. Most inshore fishing is done using smaller vessels under 10 metres, with 204 registered in 2008.

Fishing for the main commercially exploited species is regulated through the European Common Fisheries Policy, via annual total allowable catches and a system of quotas for each species and sea area. Local administrations determine management measures for fisheries within their jurisdiction (i.e. within the 12 nautical mile limit).

Fish are among the most comprehensively monitored components of our marine ecosystems. Monitoring programmes include scientific examination of landings at fishing ports, monitoring of catches onboard fishing vessels and research vessel based fishery-independent surveys being conducted. A scientific stock assessment provides information on 3 key aspects of stock status:

- removal of various age classes of fish from the stock (the fishing mortality)
- abundance of the part of the population at reproductive age (the spawning stock biomass)
- number of young fish potentially entering the fishery (the recruitment)

These data are combined to produce an overall picture of the status of particular stocks in designated fishery management areas/sub-areas. Since most fisheries are conducted by a range of fleets from different countries, the data are pooled on an international basis before being assessed and quality assured by

the International Council for the Exploration of the Sea (ICES). Each stock is assessed with respect to a lower limit for spawning stock biomass, below which the stock will probably not be able to produce enough young to sustain future generations. There is also an upper limit for fishing mortality, above which the stock is regarded as over-exploited.

Under the Marine Framework Strategy Directive (2008/56/EC) indicators will be required for assessing good environmental status of commercially exploited fish species. The indicators likely to be used refer to level of pressure of the fishing activity, reproductive capacity of the stock and population age and size distribution. Specifically, good environmental status will require that fishing mortality values are equal to or lower than the level capable of producing maximum sustainable yield over the long term. In practice, maximum sustainable yield can only be established from appropriate analytical assessments.

These assessments are based on analyses of catch, discards, age and length and other information including spawning stock biomass. Where this information is not available expert judgement will need to be applied to develop a range of secondary indicators, such as the ratio of catch to biomass. There has been little consideration of appropriate good environmental status criteria for shellfish. The status of the main commercially exploited fish stocks in the Irish Sea is reviewed below and summarised in Table 4.1.

Species	Biomass	Exploitation	Trend	Irish Sea TAC 2010	2010 ICES assessment of state of stock
cod			▲	674t	Harvested unsustainably since the late 1980's. The stock has had reduced reproductive capacity since the mid-1990s. After 7 years of some of the lowest recruitments in the time series, the 2009 year class is estimated to be more abundant and is estimated by surveys to be the largest since 2001
haddock			▲	1,424t	Stock trends indicate an increase in spawning biomass over the time-series but a decrease since 2008. Total mortality appears relatively stable
plaice			▲	1,627t	The spawning biomass trends show an increase in stock size since the mid-1990's to a stable level. Total mortality shows a declining trend since the early 1990's
sole			▼	402t	Spawning biomass has continuously declined since 2001 to low levels and recruitment reached its lowest level in 2008. A large reduction of fishing mortality in recent years reflects a reduction in fishing effort
whiting			▼	157t	The present stock size is extremely low. Landings have seen a declining trend since the early 1980s, reaching lowest levels in the 2000s. Survey results indicate a decline in relative spawning biomass
herring			▲	4,800t	Spawning biomass is close to its highest abundance in the 17 year time-series. The current fishing pattern shows no signs of being detrimental to the stock

Biomass
- reproductive capacity impaired
- at risk of suffering reduced reproductive capacity
- at full reproductive capacity

Explotiation
- overfished
- at risk of becoming unsustainably fished
- sustainably fished

Trend
- ▲ state improving
- ▶ stable
- ▼ state deteriorating

Table 4.1 Overview of the status of the main commercially exploited fish stocks in the Irish Sea


Trawler, Irish Sea

Cod

Irish Sea cod is suffering reduced reproductive capacity and the stock is being harvested unsustainably. Recruitment has been below average for the past 17 years.
Total mortality rate of this stock remains very high, despite the introduction of a range of mitigation measures. These measures include the establishment of a closed spawning area since 2000, effort control since 2003, various vessel decommissioning schemes and a 15-25% total allowable catch reduction per year since 2006.

Since 2004, ICES has advised zero catches of cod in the Irish Sea. The age structure of the stock shows a relative absence of older age classes. The EU had adopted a long term plan for this stock (Council Regulation (EC) 1342/2008), with the objective of recovering cod stocks to maximum sustainable yield by maintaining a specified target fishing mortality. Although management is focused on reducing fishing mortality, ICES notes evidence that the reductions in cod biomass in the Irish Sea since the 1990s may be partly due to a combination of low spawning stock biomass and poor environmental conditions. These factors coincide with a shift towards above average sea temperatures. However, after 7 years of some of the lowest recruitments of the time series, the 2009 year class is more abundant and is estimated to be the largest since 2001.

Haddock

Survey trends indicate increasing spawning stock biomass of the haddock stock in the Irish Sea in recent years; hence the total allowable catch was increased by 15% in 2009. Below average recruitment in 2008 and 2009 is projected to lead to a decrease in spawning stock biomass and this was reflected in the survey based biomass estimate in 2009. Rapid changes in recruitment are a feature of haddock stocks. ICES advice for 2010 was for no increase in fishing effort.

Plaice

Plaice *Pleuronectes platessa* fishing takes place mainly in the eastern Irish Sea and is carried out using otter trawls and beam

trawls. ICES classifies the stock as having full reproductive capacity and being harvested sustainably. Furthermore, ICES advised that the total allowable catch for 2010 be slightly increased on the 2009 level.

Sole

Fishing for sole *Solea solea* takes place mainly in the eastern Irish Sea. ICES classifies the stock as having reduced reproductive capacity and at risk of being harvested unsustainably. Spawning stock biomass reached its lowest level in 2008, while the last 5 years of recruitment have been the lowest in the time series. Fishing mortality has decreased recently, however ICES advised that no fishing for sole should take place in the Irish Sea in 2010 to allow time for recovery.

Whiting

Whiting *Merlangius merlangus* formed a significant component of mixed demersal fishing in the Irish Sea during the 1980s and early 1990s, when over 2,000 tonnes were caught annually. However, a sharp reduction in stock abundance has reduced this to less than 500 tonnes in recent years, as total allowable catches have reduced progressively. The causes of the decline in Irish Sea whiting are largely unknown but have resulted in large numbers of very small fish, which mature at a much smaller size than previously recorded. AFBI has carried out a number of fishing gear studies [1] in recent years aimed at developing gear that reduces catches of juvenile whiting, in order to minimise discarding at sea. Since 2006 ICES has advised lowest possible catch, while a total allowable catch of 157 tonnes was set for 2010.

Herring

Irish Sea herring are mainly exploited as aggregations or shoals around the Isle of Man and adjacent areas during the autumn. Spawning stock biomass has increased greatly in recent years, from low levels during the 1980s and 1990s to over 50,000 tonnes in the last 3 years. ICES regards the stock as stable at the present level and has concluded that recent total allowable catches (4,800 tonnes) are not detrimental to the stock. Scientific effort has increased on herring in recent years, including joint science-industry acoustic surveys, with the objective of developing a long-term management plan for the stock.

While most of the scientific effort centres on the main commercially exploited fish species, a wide variety of fish are taken as by-catch in mixed fisheries. Many of these species form important components of our marine ecosystem. At the moment full scientific stock assessments are not currently possible for most of these by-catch species (in some cases only sparse or aggregated landings data are available). It will, however, be increasingly important to research their biology and stock status so that conservation objectives can be defined and achieved.

For example, Northern Irish waters contain a diverse range of elasmobranchs (sharks, skates and rays); 17 species have been recorded in our coastal waters, including 11 species of shark and 6 species of rays. These represent an important component of local marine biodiversity. Many of these species are considered 'endangered' in the North East Atlantic and are on the World Conservation Union (IUCN) Red List. They are also listed as priority species under the UK biodiversity action plan.

A recent study examined the status of elasmobranch fish species within Northern Ireland waters[2]. A comprehensive range of data, including scientific research surveys, recreational captures and anecdotal information from a diverse group of angling and fishing experts. The study concluded that:

- Angel shark *Squatina squatina* is severely depleted and deserves special protection from the impacts of fishing.
- The local status of basking shark *Cetorhinus maximus* is known largely through sightings close to the shore on the Northern Irish coast, as these fish migrate to or from feeding and courtship grounds. There are no directed fisheries, and accidental by-catch of this species in fisheries is very uncommon.
- The overall North East Atlantic population of spurdog *Squalus acanthias* is depleted. Although angling catches appear to be increasing in Northern Irish waters,

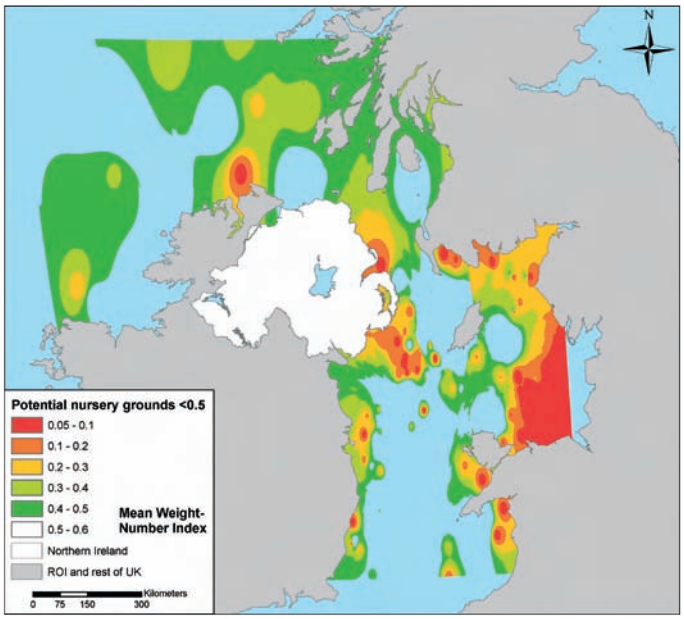

Figure 4.1 Potential nursery areas for spotted ray, *Raja montagui* as estimated from research survey data (average weight (Kg) / average abundance (no/hr). The lower the index value the higher proportion of smaller individuals in sample catch.

this probably reflects recent changes in recreational fishing patterns and intensity.

- Tope *Galeorhinus galeus* regularly occur in small numbers in scientific trawl surveys. They are targeted by anglers and caught as accidental by-catch in Irish Sea fisheries. A seasonal occurrence of tope with an autumn influx to the Irish Sea and the presence of large females and pups in local areas, including Strangford Lough, indicate important nursery areas.
- Lesser spotted dogfish *Scyliorhinus canicula* appear to be stable or increasing.
- Nursehound *Scyliorhinus stellaris* appear to be stable or increasing.
- White skate *Rostroraja alba* are now rarely observed in Northern Ireland waters and the species is regarded as severely depleted throughout most of the Celtic Sea eco-region.
- Common skate *Raja* or *Dipturus batis* are now severely depleted in Northern Ireland waters.
- The thornback ray *Raja clavata* and blonde ray *Raja brachyura* are stable or increasing in numbers
- The cuckoo ray *Leucoraja naevus* is widespread and abundant.

The main pressures on elasmobranchs in Northern Ireland waters include targeted fishing and accidental by-catch. Data for thornback ray, spotted ray and cuckoo ray, obtained from scientific research surveys and from recreational fishers, highlighted the importance of several areas of the Northern Irish coast as nursery grounds for these species. Nursery hotspots included Belfast Lough, Carlingford Lough and off Dundrum Bay (Figure 4.1). Despite stable or increasing abundance of these rays, their susceptibility to local depletions should be recognised.

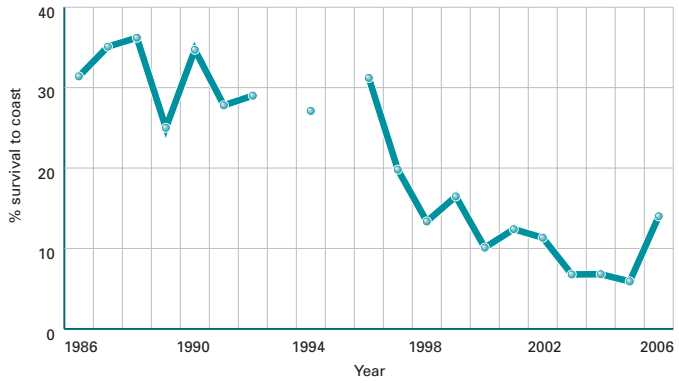

Figure 4.2 Estimates of survival rates of wild River Bush salmon, from migration as smolts to return to the Irish coat as maturing adults, after one year at sea.

What about Atlantic salmon?

North-east Ireland has many important salmon *Salmo salar* rivers. Adult salmon return to freshwater to spawn after 1 or 2 years at sea. Traditionally they have been commercially exploited in coastal netting fisheries, employing a variety of methods including tidal draft nets, fixed bag nets and drift nets. Long term data obtained from AFBI monitoring programmes on the River Bush in County Antrim have demonstrated significant declines in the survival of salmon at sea, after taking account of exploitation in salmon nets around Irish coasts (Figure 4.2).

Salmon survival at sea is believed to be influenced by a range of factors, including prey availability, predator abundance and distribution. Changes in the marine environments are also thought to influence conditions experienced by salmon during their migration to and from oceanic feeding areas off The Faeroes and Greenland. There is some evidence emerging from recent studies on the River Bush that changes in the timing of migration of young salmon from the rivers into the sea, caused by changes in the climate, may in turn lead to poor

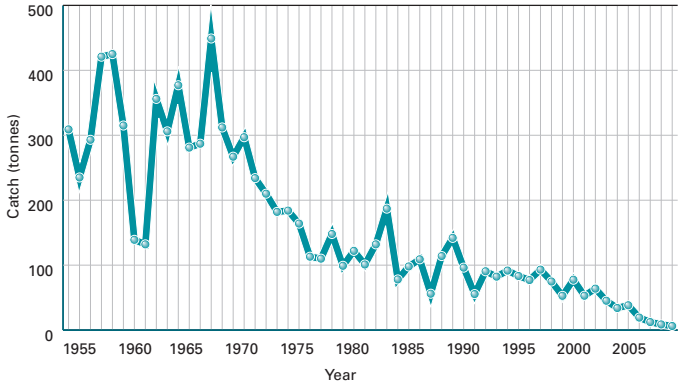

Figure 4.3 Recorded catches of Atlantic salmon in Northern Irish coastal and estuarine commercial fisheries

survival in the marine environment[3]. In addition, work from the Foyle has highlighted the potential negative impact that climate change may have on returning adult salmon numbers[4]. There has been a significant reduction in the number of licences issued for salmon fishing on Northern Irish coastal and estuarine waters. This combined with the reduced number of returning salmon have resulted in a decrease in commercial salmon catch from around 300-400 tonnes in the 1960s and 1970s, to 6.3 tonnes in 2009 (Figure 4.3). Recent reductions in netting were achieved through voluntary buy-out of licenses in the County Antrim area, the cessation of fishing for salmon seaward of Lough Foyle and a reduction in the numbers of remaining licenses within Lough Foyle. Salmon fishing gears have negligible impact on the seabed, though sea trout *Salmo trutta* are caught as a by-catch.

The status of sea trout stocks in Northern Ireland is largely unknown, though a compilation of disparate catch dataindicated an average annual declared commercial catch of around 1,400 fish during the 1980s, declining to 150-300 fish during the 1990s[5]. Declared catches of sea trout are believed to under-represent the true catch.

What is the status of the Eel?

Management plans for the eel *Anguilla anguilla* populations in Northern Ireland have been drawn up as required by EU council regulation 1100/2007 to establish measures for the recovery of the stock of European eel. Three management plans cover the Lough Neagh Basin, the eastern coastal drainages and the North Western International River Basin District. Since ratification of the plans by the EU in March 2010, only the Lough Neagh Basin remains open to commercial eel fishing. The remaining eel fisheries have ceased under regulations introduced in the DCAL, Foyle and Carlingford areas.

The remaining fishery in Lough Neagh now produces 300 to 400 tonnes of European eel annually. This has declined steadily from a peak of over 1,000 tonnes in 1979. Local recruitment of glass eel (the name given to a juvenile eel) in Lough Neagh via the River Bann has declined from an average of 4.3 tonnes between 1960 and 1982, to 0.5 tonnes from 2001 to 2008. Local stocks of glass eel have been augmented with glass eel from fisheries elsewhere on an *ad hoc* basis since 1984 and annually since 1999.

Waterbody	TFCI	EQR	WFD Classification
Foyle/Faughan	42	0.80	High
Roe	28	0.45	Moderate
Bann	35	0.63	Good
Lagan	32	0.55	Moderate
Connswater	27	0.43	Moderate
Newry	39	0.73	Good

Table 4.2. Water Framework Directive classification results from the transitional waters in Northern Ireland using the Transitional Fish Classification Index on (TFCI) 2008 fish survey.
The Ecological Quality Ratio (EQR) score is also included.

Do we know the status of fish in transitional waters?

Transitional waters refer to the waters in the gradient between fresh and sea water including sea loughs. These transitional waters form important nursery areas for many fish species, while at the same time facing many pressures and impacts, including water quality, fishing, aquaculture, habitat degradation and recreational use.

The Water Framework Directive (2000/60 EC) established a new legal framework for the protection, improvement and sustainable use of surface waters, transitional waters, coastal waters and groundwaters throughout Europe. Initial classifications have been carried out for the fish assemblages in Northern Ireland's transitional waters. Northern Ireland's

Figure 4.4 a) above: Dublin Bay prawn, *Nephrops norvegicus* and b) below: image from video survey equipment showing *Nephrops* burrows (Irish Sea)

transitional waters are assessed by NIEA using the Transitional Fish Classification Index, a multi-metric index that measures several fish community attributes and combines these into a single measure of estuarine condition[6]. Transitional Fish Classification Index scores are converted into an Ecological Quality Ratio, which ranges from 0 (bad) to 1 (high). The results of applying the Transitional Fish Classification Index to fish surveys conducted in transitional waters during 2008 are presented in Table 4.2, above.

Of the 6 transitional waterbodies assessed, the Foyle/Faughan was classified as 'high', Bann and Newry were classified as 'good', and the Roe, Lagan, and Connswater were classified as 'moderate'. No waterbodies were classified as 'poor' or 'bad'.

What is the status of commercially exploited shellfish?

Prawns

The Dublin Bay prawn is the mainstay of the Irish Sea commercial fishery, with 6,500-10,500 tonnes being taken in recent years by all countries from the mixed demersal trawl fishery in the western Irish Sea. Dublin Bay prawns are limited to a muddy habitat; hence the species distribution around the British Isles and elsewhere is determined by habitat distribution.

The EU manages the stocks on the basis of total allowable catches across wide areas; for example, the Irish Sea Dublin Bay prawn is included in an overall ICES Sub-Area Area VII total allowable catch. The ICES Sub-Area VII total allowable catch includes Dublin Bay prawn stocks from the Irish Sea, Celtic Sea, Porcupine Bank and the Aran grounds off western Ireland. Since crustaceans cannot be aged in the same way as finfish, the age-based methods used in traditional stock assessment cannot be employed for the Dublin Bay prawn. In recent years, sophisticated underwater video survey techniques have been developed, to provide estimates of the abundance of Dublin Bay prawns in the Irish Sea and the other main areas (Figure 4.4 a & b).

Counts of the burrows occupied by prawns are used to estimate numbers of Dublin Bay prawn available to the fishery. Advice on future catches is framed in terms of a target harvest ratio (i.e. the ratio of the proposed catch compared to the estimated abundance). The ICES advice for 2010 resulted in a reduction to the overall area VII total allowable catch by 9% because of particular concern about the status of the Porcupine Bank stock. The Dublin Bay prawn stock in the western Irish Sea has maintained a stable size composition and sex ratio during the past four decades, suggesting that the stock is harvested sustainably.

Scallops

Scallop stocks around the Northern Ireland coast are monitored on an annual basis by AFBI. Catch-at-age data collected during surveys indicate good recruitment of young individuals and stable catch rates, suggesting

that the stocks are withstanding current levels of exploitation, with around 600 tonnes landed in 2008.

Mussels

There are wild mussel *Mytilus edulis* fisheries in Lough Foyle, Carlingford Lough and Donaghadee Sound (Figure 4.5). The mussels in these fisheries settle naturally; the mussel beds can be ephemeral in nature, while highly variable recruitment makes sustainability of this type of fishery difficult to achieve. Reported landings in 2008 were around 1,000 tonnes.

Native oyster

Native oyster stocks have historically been over-exploited in Lough Foyle due to a lack of regulation, which in part accounts for their boom and bust production (Figure 4.6) this in turn affects productivity [7]. The situation has been rationalised with the introduction of the Foyle and Carlingford Acts (2007) through the implementation of a formal licensing regime. Management is currently being developed to help sustain production in this fishery. The majority of the oysters captured in this fishery are landed to the Irish ports of Moville and Greencastle with a small amount landed in Northern Irish ports. The Loughs Agency conducts an annual survey of the population to examine population trends. Restoration of native oysters in Strangford Lough has achieved some success.

Bonamia ostreae, a parasitic disease of oysters, has been present in Lough Foyle since 2005 and has been reported in Strangford Lough, however there has been no evidence to date of any significant negative impacts.

What is the status of shellfish aquaculture?

The shellfish aquaculture industry relies on good water quality and good growing conditions for survival and profitability.

Blue mussels

Bottom culture of blue mussels is carried out in Lough Foyle, Carlingford Lough and Belfast Lough (21 sites), with 2 rope suspended mussel culture sites in Strangford Lough. There is 1 bottom culture mussel site in Larne Lough. Bottom culture of mussels has yielded an average of 8,199 tonnes per year over the past 5 years, while rope/trestle culture yielded 43 tonnes per annum. Juvenile blue mussels are collected under quota from wild mussel seed beds around the coast and re-laid on licensed sites within the sea loughs. Scientific surveys of the seed mussel resource determine the amount of seed allowed to be fished each year.

Pacific oysters

Trestle culture of Pacific oysters *Crassostrea gigas* has yielded an average of around 277 tonnes per year over the last 5 years and is widespread in Carlingford and Strangford Loughs and to a lesser extent in Lough Foyle and Larne Lough (Figure 4.7). Pacific oysters (Figure 4.8) are bought in as juveniles from hatcheries in France and the UK. Culture of native oysters has yielded an average of 86 tonnes per year over the last 5 years.

Figure 4.5 Wild mussels, *Mytilus edulis*, in dredge

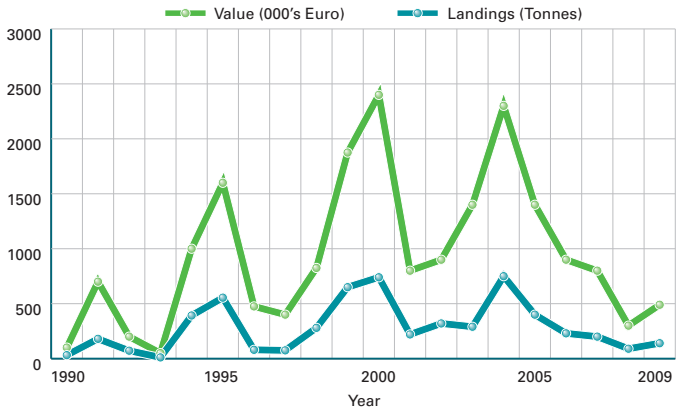

Figure 4.6 Trend in historical landings of native oysters from Lough Foyle. Note that landings pre 2008 are collated from a variety of sources and are likely to be less reliable than the log book returns from licensed fishers since 2008

Manila clam *Ruditapes philippinarum* production is licensed in Carlingford and Larne Loughs and yields around 54 tonnes per year. Bottom culture of the king scallop occurs at 2 sites in Strangford Lough but has produced only around 0.5 tonnes per year during the past 5 years.
Carrying capacity modelling for shellfish aquaculture production has been developed by AFBI for all 5 Northern Irish sea loughs, within the SMILE (Sustainable Mariculture in Northern Irish Lough Ecosystems- http://www.ecowin.org/smile/) project[8].

This technique can be used to predict areas within sea loughs where total production can be enhanced by changing stocking density.

Individual case studies can be run to show the impact on a number of ecosystem indicators, including nutrients, phytoplankton biomass and suspended solids. The Loughs Agency is investigating the potential practical applications of these techniques to develop environmentally sustainable aquaculture industries in the 2 cross-border sea loughs. Modelling of climate change scenarios, carried out under the SMILE project, indicated that increases in average annual water temperature of 1° and 4°C would likely lead to reductions in mean weight and length of individuals. This is more pronounced in mussels than oysters for physiological reasons. As a consequence there would be an overall decrease in productivity.

Figure 4.7 Trestle culture of Pacific oysters

Figure 4.8 Pacific oysters

Legislation

Legislation	
Marine Strategy Framework Directive Descriptor 3 Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock	
Other relevant EC Directives & Regulations (full references and corresponding regulations - Appendix II	
EU Council Regulation 1100/2007	Management plans for European eel populations
EC Council Regulation 1342/2008)	Cod recovery plan
Water Framework Directive	The protection, improvement and sustainable use of surface waters, transitional waters, coastal waters and groundwaters throughout Europe
International Agreements	
The IUCN (World Conservation Union) Red List	Assessment of global conservation status of plant and animal species
Local legislation	
The Fisheries Act (NI) 1966	Conservation and protection of fisheries.
Foyle and Carlingford Fisheries Act (2007)	Conservation and protection of fisheries in Foyle and Carlingford for commercial and recreational purposes

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