2.4 Fisheries Resources Research Programme

2.4.1 Introduction

Humans consume around 86 million tonnes of fish per year, almost 15.7 kg per person (versus 7 kg in 1950). Global demand for fish proteins, for human consumption and other uses, continues to rise. Recent predictions suggest that world fish consumption will increase to around 17.1 kg per person in 2020, although consumption rates in the EU are most likely to remain stable at 23.7 kg per person (23.6 kg in 1997). The proportion of total fish production obtained through aquaculture is predicted to increase markedly over the next two decades, reaching 41% by 2020, a growth of around 2% per annum. In contrast, capture fisheries are predicted to grow by less than 0.7% per year, as many stocks have become over-exploited. The EU accounts for about 5% of the global total in capture fisheries, making it the third largest producer after China and Peru. Within the EU, the largest producers are Denmark and Spain.

Global capture fisheries are now confronted with a growing structural imbalance between catch capacities and the biological potential of fisheries resources, resulting in over-exploitation of these resources and alteration of marine ecosystems. As fisheries management and nature conservation in the marine environment pursue common objectives—in particular the safeguarding of marine ecosystems and responsible use of living marine resources as part of sustainable development—they require better co-ordination and coherence.

The EU, under the Common Fisheries Policy (CFP), manages the main commercially exploited fish stocks in the waters around Ireland. The main instruments of the CFP are the annual Total Allowable Catches (TACs), supplemented by various technical measures; including closed areas/seasons, effort regulation and mesh size. Scientific advice underpins the CFP and international stock assessments are carried out in a number of international fora, including the International Council for the Exploration of the Seas (ICES), the International Council for the Conservation of Atlantic Tuna (ICCAT) and the EU Scientific, Technical and Economic Committee for Fisheries (STECF). Irish scientists play a key role in all these international fora, providing the advice that underpins the fisheries management and policy process.

In the 2001 European Commission 'Green Paper' on the future of the Common Fisheries Policy in Europe, stock development trends since the early 1970s were summarised as follows:

1 Almost all roundfish stocks have declined and the current harvest is, in most cases, not sustainable.
2 Several flatfish stocks are harvested at excessively high levels, but some are close to sustainable levels.
3 Pelagic species and species subject to fishing for industrial purposes are in better condition but harvest rates need to be maintained at current levels or reduced, to secure sustainability.
4 Several deep-sea species show signs of over-exploitation and some might have reached critical levels.

The EU fisheries resources need to be rebuilt to allow profitable and sustainable fisheries. Harvest rates and indirect effects of fishing on all species will have to be considered (i.e. an ecosystem approach) in order to ensure the rebuilding process. This rebuilding must be coupled with a rationalization of the overall size of the EU fishing fleet, driven by economic factors and the available fish resources. The many international instruments signed by governments are beginning to impact on the way in which fisheries resources are managed. Regional Advisory Councils (RACs) were established in 2005 and allow input from stakeholders to the EU management process.

Ireland's inshore fisheries sector is of major importance and does not come under the remit of the CFP. In 2005, the national Species Advisory Groups (SAGs) and Local Advisory Committees (LACs) were established. They will produce national and local Management Plans (MPs) for inshore resources and will develop the interactions between stakeholders, government and scientists. These MPs will be underpinned by credible scientific advice and will include the introduction of appropriate measures (e.g. effort and gear limitations) to maintain and, where necessary, rebuild stocks.

2.4.2 Sector Profile

The Irish fishing fleet consists of a little over 1,400 vessels and is divided into three segments; polyvalent, pelagic trawl and purse seine, and beam trawl. There are about 6,000 people working in the fishing fleet and associated activities.

Figure 2.9 Key Components of the Irish Sea Fisheries Sector

In 2004, landings of pelagic species achieved a first sale value of €56m, representing some 29% of the €193m value of national landings (Figure 2.10). Demersal landings were valued at €53m, or 27%, of national landings value. Shellfish, with a first sale value of €84m, accounted for the remaining 44%.

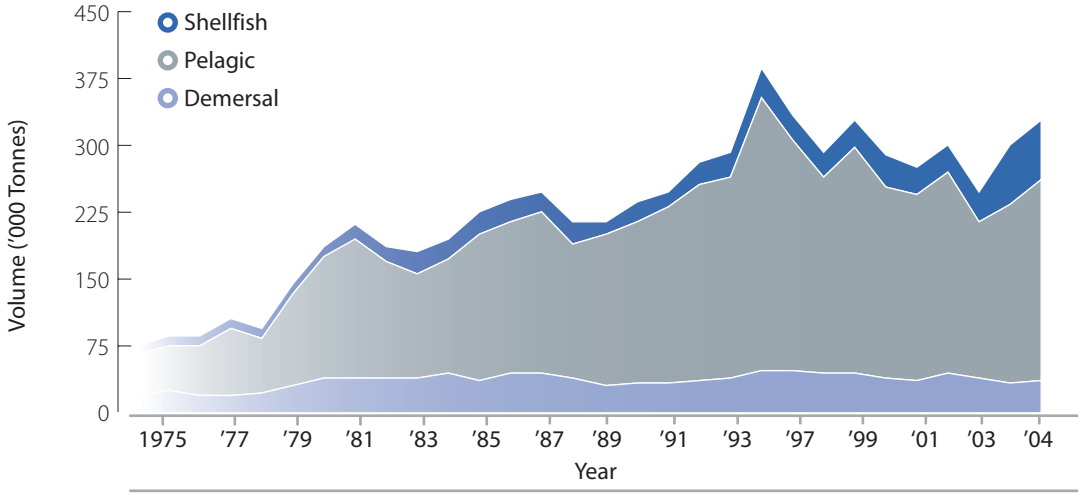

Figure 2.10a Irish Landings Volume (live weight) by Species Category, 1975–2004

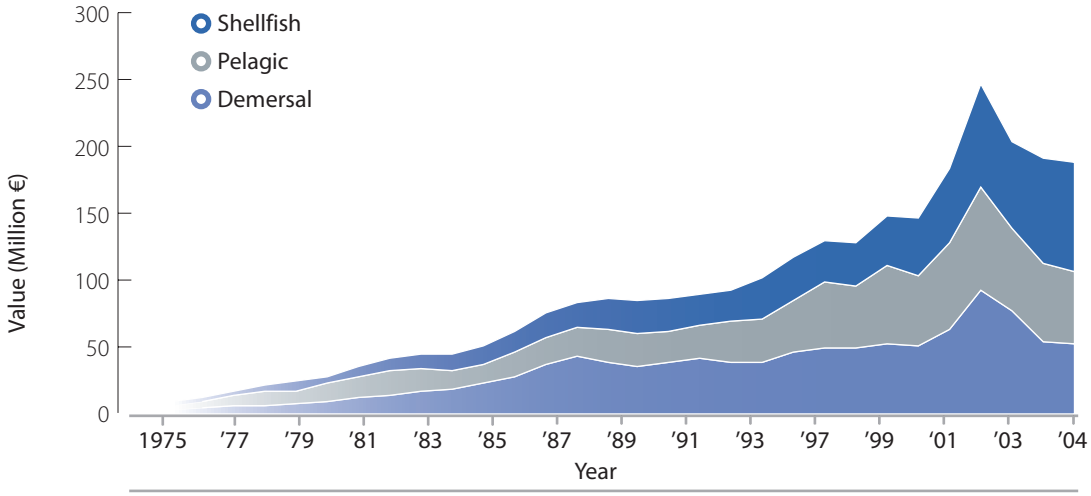

Figure 2.10b Irish First Sale Landings Value by Species Category, 1975–2004

In the waters around Ireland (ICES Sub Areas VI and VII), the total landings of marine fish and shellfish species taken by all nations in 2004 amounted to approximately 1.5 million tonnes with an estimated value of €1.4 billion. It is important to remember that research on the fisheries resource has implications for the entire international stocks and not just the 'Irish quotas'.

The following generic diagram (Figure 2.11) is indicative of the current general state of the marine fisheries resource in the waters around Ireland. The green area represents stocks at a high level with a greater probability of achieving profitable and sustainable fisheries. The amber area represents stocks at a lower level with increased probability of non-sustainable and less profitable fisheries. The red area represents increased risk of stock collapse with non-sustainable and non-profitable fisheries.

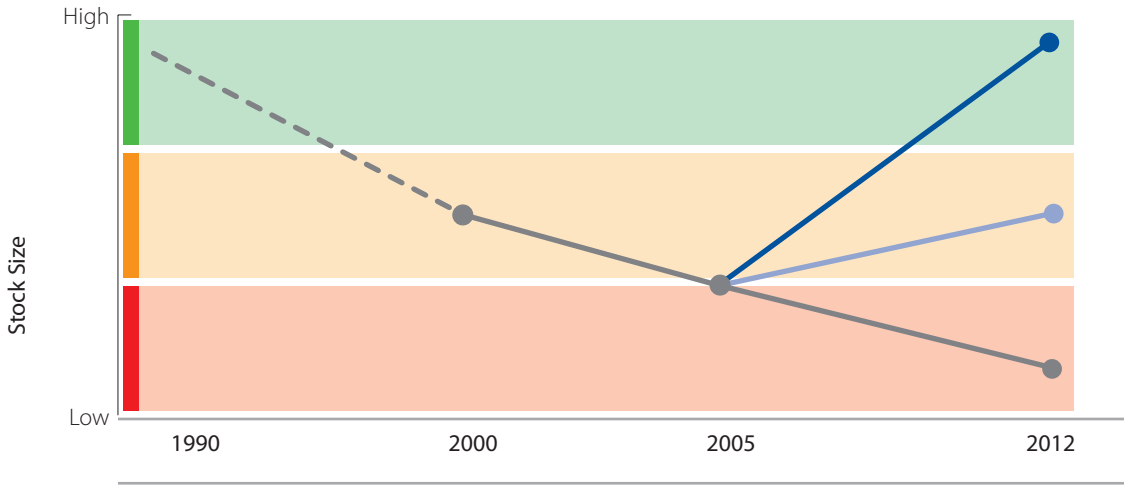

Figure 2.11 Past Trends and Future Scenarios for the General Marine Fisheries Resource

In general, stock size has declined over the period 1990 to 2000 and most fish stocks are either in the amber or red area. From 2000 to 2005, stock size has continued to decline due to high fishing mortality, poor recruitment patterns and climatic factors. Fisheries managers, scientists, industry and society face great challenges over the coming decade in relation to the rebuilding and utilisation of the fisheries resources. If we continue to fish as now, there is no doubt that stocks will continue to decline and move deeper into the red area. If we stop fishing altogether, the fishing industry will disappear and stocks may recover into the green area. However, there is no guarantee of recovery. These two options are a simplistic view but they do indicate the challenges. The answer is complex and lies between these two extremes. It hinges on the incremental adoption of the ecosystem approach to fisheries management over the next 10 years.

It is now accepted that all aspects of the ocean are inter-related and should be treated as an integrated system. In order to achieve a more rational management of resources and thus to improve the quality of the marine ecosystem, Ireland must adopt an integrated and co-ordinated approach to fisheries management and development planning. This will ensure that development is compatible with the need to protect and improve the marine ecosystem for the benefit of society. The ecosystem approach will be a feature of ocean management in the near future. The new fisheries science required will rely on the coming together of communities of marine scientists. These scientists may never have had meaningful dialogue with each other or may never have been exposed to the global, ocean governance

policy requirements that currently drive us towards a holistic ocean management and the ecosystem approach. (See Turrell, 2004)[9]

2.4.3 Key Opportunities and Challenges

Understanding of Resource

The waters around Ireland contain some of the most important spawning and nursery areas for the main commercially exploited fish stocks in the northeast Atlantic. They also contain some of the most important commercial fishing areas in the EU. As EU fisheries management moves towards integrated, holistic, science-based management, developing our knowledge of the life history, dynamics and ecology of fish stocks and the socio-economics and ecosystem role of fisheries resources becomes a key challenge. Ireland must invest in multi-disciplinary research with our international partners in order to meet this challenge.

Management Regimes (CFP)

The main instrument of the CFP is the annual Total Allowable Catch system. This short-term, year-to-year system of annual management decisions has been heavily criticised. The industry only knows what they can catch the following year; they cannot plan. Fisheries management must take a longer-term view. The annual policy decisions of the EU must be guided by longer-term strategies for each ecosystem and fish stock, rather than relying on year-to-year perceptions.

Recovery of Stocks

The EU (DG Fisheries and Maritime Affairs) will shortly release a policy paper that reaffirms the agreements reached in relation to fisheries management at the World Summit on Sustainable Development (WSSD) held in Johannesburg in 2002. The Johannesburg Declaration (2002) committed governments to restore fisheries to their maximum sustainable yields by 2015.

Fleet Size

Fleet overcapacity is a global problem in fisheries. We must achieve a balance between fleet capacity and the resource base in order to achieve the sustainable exploitation of fisheries.

Hub

In 2004, the total landings of marine fish and shellfish species taken by all nations in the waters around Ireland (ICES Sub Areas VI and VII) amounted to approximately 1.5 million tonnes, with an estimated value of €1.4 billion. Increased fuel costs will make steaming to fishing grounds a major factor in profitability. Ireland's strategic position in relation to the important EU fishing grounds represents a key opportunity to develop Ireland as a hub. This hub would encourage foreign vessels to land, trans-ship, exchange crews, purchase chandlery and supplies, undertake repairs and seek other services.

Improved Advice to Managers

The EU will move towards integrated ocean management and adopt the ecosystem approach to fisheries management. This new integrated management must be underpinned by sound and credible scientific advice. A key challenge will be to provide clear, reliable and impartial advice on the stocks of economic importance to Ireland.

[9] Turrell (2004). The Policy Basis of the 'Ecosystem Approach'. EuroGOOS Publication, No. 21.

International Scientific Profile

Ireland must continue to raise its fisheries science profile through participation in international research and chairing and participating at key scientific meetings on fisheries research. The Irish research vessels and Marine Institute laboratory infrastructure at Oranmore provide Irish fisheries scientists with a great opportunity to sustain this high and effective international scientific profile. However, a suite of multi-disciplinary marine science projects that allows Irish scientists to participate on the international stage must underpin this profile. Furthermore, there must be support for a new generation of marine scientists through appropriate funding mechanisms, training programmes and career structures.

Climate Change

Scientific data has confirmed the reality of global climate change. Ireland and Europe have become measurably warmer in the past two decades. This warming will have profound impacts on the marine ecosystem, through increases in sea temperature, sea level and storm intensity and changes in ocean currents. This will affect fish stock abundance, distribution and recruitment. Medium- and long-term development strategies over the next decade must take account of predicted climate impacts. Innovative policies and approaches to marine resource management, guided by sound marine science and advice, will be needed.

Data Integration

Ireland collects a large amount of data on the ocean ecosystem from a broad range of disciplines including fisheries, aquaculture, oceanography and environmental science. These data sets are housed as disparate databases in various institutes. Data integration will add value to these data sets and transform them into information and knowledge. This knowledge will be the cornerstone in developing the integrated advice that future ocean management demands.

Stakeholder Involvement

Stakeholder participation is now a feature of the fisheries management process. The establishment of the five Regional Advisory Councils (RACs) throughout the EU represents a key opportunity for scientists to interact with stakeholders. This will allow increased transparency of the scientific advice and the use of fishing industry information in the scientific advisory process.

International Obligations

Global societal concerns regarding use of the earth's natural resources have been translated into marine policy under the UN Convention on the Law of the Sea (UNCLOS), the UN Conference on Environment and Development (UNCED), and the UN Food and Agricultural Organisation (FAO). In the Stockholm Declaration (1972), governments (including Ireland) expressed the wish to work towards integrated, holistic, science-based management, employing decentralised, transparent decision-making involving local communities and users. These original founding concepts have been reaffirmed over the past three decades in numerous declarations and agreements made within UNCLOS, UNCED and FAO. A key challenge will be to provide scientific advice that informs this new ocean management policy.

2.4.4 2020 Scenario

2020 SCENARIO

By 2020, Ireland will have an economically viable fishing industry that contributes to the generation of prosperity in coastal communities, from a well managed and sustainably exploited resource base, informed by clear, reliable and impartial marine science and built on a foundation of strong stakeholder participation.

1 CFP Stocks – Global Sustainability Driven

The focus will be on the amount of global fisheries resource we can exploit without causing ecosystem harm. The fisheries resources will have been rebuilt to allow profitable and sustainable fisheries. The overall size of the EU fishing fleet will be rationalised, driven by economic factors and available resources. Fisheries in Europe will continue to be managed under the CFP; however, an effort-based control system is implemented with multi-annual quotas. Other migratory species (e.g. eels and salmon) that require new management thinking will be brought into the CFP framework. The many international instruments signed by governments will have an increased impact on fisheries management (e.g. the Johannesburg Declaration 2002 and the Convention on Biological Diversity). Regional Advisory Councils (RACs) will be well established and allow input from stakeholders to the EU management process. Greater integration will occur in the delivery of credible scientific advice coupled with effective control and enforcement through pan-European agencies. Where stocks are approaching precautionary limit points, fisheries will be closed until stocks recover. All fish caught will be landed (i.e. no discarding allowed). Any juvenile fish caught will count towards quota. Harvest rates and indirect effects on all species will be considered (i.e. an ecosystem approach) in order to ensure there are no stock collapses. There will be strong international restrictions/mitigation measures to protect seabirds and marine mammals. Closed areas will be established to protect sensitive habitats and others to protect stocks. Exploitation of deep-sea fish stocks will be tightly regulated. Real-time management measures and strong science/stakeholder interactions will be important components of the management process.

2 Ireland's Inshore Stocks – Nationally Driven

Ireland will continue to develop and strengthen the co-management framework for inshore non-TAC stocks introduced in 2005. The national Species Advisory Groups (SAGs) and Local Advisory Committees (LACs) will have produced national and local Management Plans (MPs) for the stocks and will continue to develop the interactions between stakeholders, government and scientists. The MPs will be underpinned by credible scientific advice and include the introduction of appropriate measures (e.g. effort and gear limitations) to maintain and, where necessary, rebuild stocks. Many fisheries will be accredited as being sustainable.

2.4.5 2013 Objectives

The following objectives have been identified as critical milestones to be achieved by 2013. Many of the key objectives can be met by adding value to, and maximising the use of, the data sets from the Data Collection Regulation (EU Council Regulation 1543/2000). It is essential that these data sets are accurate.

2013 OBJECTIVES

1 Increase transparency of scientific advice through increased stakeholder interaction and participation and use of fishing industry knowledge in the scientific advisory process.

2 Increase our understanding of the life history, ecology, socio-economics, dynamics and ecosystem role of fish stocks.

3 Improve scientific advice for stakeholders—to deliver clear, reliable and impartial advice on the fish stocks of economic importance to Ireland.

4 Contribute to the rebuilding of depleted fish stocks.

5 Build integrated data capacity and knowledge management.

2.4.6 RTDI Requirements & Key Outputs

The identified RTDI requirements and key outputs for delivering on the 2013 Objectives of the research programme are presented below.

Table 2.11 Research Requirements & Key Outputs for the Fisheries Sector to 2013

Objectives 2013	RTDI Requirements	Key Outputs
1 Increase transparency of scientific advice through increased stakeholder interaction and participation and use of fishing industry knowledge in the scientific advisory process.	> Develop strategies/procedures to assess and integrate fishing industry knowledge into scientific assessment and advisory process > Develop user-friendly interactive models that can be used to discuss the implications of different management strategies and current scientific advice with Regional Advisory Councils (RACs) and other stakeholders > Continue to improve the transparency of the scientific assessment and advisory process in relation to national and international assessment practices	> Protocols and methodologies for use in assessment and advisory process > Improved effectiveness of regional management within CFP > Improved effectiveness of national management of Inshore stocks (e.g. Species Advisory Groups) > Increased understanding and 'buy in ' by stakeholders to scientific advice > Improved inputs to the international assessment process (e.g. ICES)
2 Increase our understanding of the life history, ecology, socio-economics, dynamics and ecosystem role of fish stocks.	> Map the spatial and temporal distribution of spawning and nursery areas for fish stocks in the waters around Ireland and integrate with seabed survey data and oceanographic data > Expand knowledge of fishing impacts on target stocks and non-target species (through by-catch and discarding), and the impacts on food-web interactions, habitats and biodiversity > Study the biological basis of existing management areas through tagging and genetic research > Explore the relationship between fish stock recruitment (i.e. spawning success), migration, oceanography and climate change	> A better understanding of the fisheries resource base, feeding into and improving scientific advice and facilitating, e.g. 'real-time' management of the resource > Essential fish habitat maps for the waters around Ireland > Information and knowledge to inform new management measures > Scientific data available to support revisions to management areas > Improved understanding and prediction of fish stock size > Marine science has a greater impact on shaping EU and national fisheries policy

Continued

Table 2.11 Research Requirements & Key Outputs for the Fisheries Sector to 2013

Objectives 2013	RTDI Requirements	Key Outputs
3 Improve scientific advice for stakeholders—to deliver clear, reliable and impartial advice on the fish stocks of economic importance to Ireland.	> Conduct assessments and provide clear, reliable and impartial advice on stocks of economic importance to Ireland, both nationally (e.g. inshore stocks) and internationally (i.e. fish stocks managed under the CFP and migratory species) > Develop and trial practical assessment methods that use both commercial fleet data sets and survey data sets > Model impact of fishing gear changes, closed areas and seasons, and fleet activity (e.g. decommissioning) on stock assessment and advice. > Develop mixed fisheries, harvest control rules and long-term management scenarios, and model their impacts > Develop strategies and procedures to assess and integrate ecosystem knowledge into current management models used to provide scientific advice > Research and analyse the socio-economic factors that influence the day-to-day behaviour of vessel owners/skippers with regard to investment decisions, target species, choice of gear, fishing grounds, level of discarding etc. Ensure that the results feed into scientific assessment and management plans (See Policy Support Measure Section 4.3)	> Robust scientific advice on all stocks exploited by the Irish fleet > A toolbox of available and new stock assessment methods > Improved stock assessment methodology for offshore, migratory and inshore fisheries > Improved suite of short-term and long-term management options available to stakeholders > A suite of new fisheries management frameworks developed that incorporate ecosystem and socio-economic considerations > Research outputs that directly support the work of international organisations (e.g. ICES, NASCO) and national bodies (e.g. National Salmon Commission, inshore SAGs) > Conservation and restoration of habitats to meet international obligations in relation to the conservation of fish stocks and the maintenance of overall biodiversity targets
4 Contribute to the rebuilding of depleted fish stocks.	> Research and develop technology in the area of fishing gear and practices to improve gear selectivity and reduce the impact of gear on ecosystems > Research the potential impact of various management regimes (e.g. artificial habitats and Marine Protected Areas—MPAs) for fish stock recovery	> Science-based proposals to help protect sensitive habitats and rebuild fish stocks > Science-based proposals on recovery plans > Input into Coastal Zone Management (CZM) and measures for the 'Biologically Sensitive Area' off the south-west of Ireland > Effective measures to help rebuild depleted stocks (implemented with stakeholders)
5 Build integrated data capacity and knowledge management. *This objective is broad and has been identified as key to a number of sectors. See Knowledge & Information Management section.*	> Integrate and add value to the disparate marine data sets (fisheries, oceanography, environmental and others) that exist both nationally and internationally	> Integrated knowledge products that provide a broader range of advisory options for fisheries and ocean management

2.4.7 RTDI Capacity/Capabilities

Current Research Capacity

Third-level Sector

Historically, fisheries research within the third-level sector has been relatively low-key. This has changed in recent years with availability of funding under the Marine RTDI programme of the NDP for a range of fisheries related research. This mechanism now funds strategic projects, post-doctoral studies and PhDs in a number of third-level institutes. However, a small number of research teams are carrying out this work. There are five research teams in two universities and one Institute of Technology currently active in fisheries related research. Together, these groups comprise approximately 37 researchers (Table 2.12). In some cases, these researchers are not engaged in full-time fisheries research but also participate in teaching and in other marine research areas. Areas of research amongst these groups include genetic stock identification, fisheries/mammals interactions, modelling and simulation of fish stock dynamics, the impact of discard data on assessment and management, multi-disciplinary approach to stock identification, and management of fisheries resources.

In addition, a further 10–12 research groups and individual researchers (approximately 100 researchers in total) have the skills/technologies to become involved in fisheries research, based on the identified future RTDI requirements and objectives for 2013. These groups presently carry out research in the fields of marine biology, ecology and biodiversity; physical oceanography; and seabed mapping; with obvious contributions to make to the goal of adopting an ecosystem approach to fisheries management. Other research groups outside of the 'marine' community have skills in the areas of information technology and population modelling with potential for the transfer of skills/technology to fisheries related research.

Table 2.12 Overview of Current Fisheries Research in the Third-level Sector

Institutes	No. Research Groups	No. Researchers*	Research Focus
UCC UCD GMIT	2 Large 3 Medium	37	> Management of fisheries resources > Ecology of pelagic fish > Fish population genetics > Fisheries acoustics > Stock assessment > Modelling & simulation of fish stock dynamics > Discard data (impact on assessment & management) > Fisheries/mammals interactions > GIS & fisheries > Shellfish biology, fisheries assessment and management > Early life history cycles and recruitment dynamics > Genetic stock identification

Large: >10 researchers; Medium: 5–10 researchers; Small: <5 researchers

* In some cases, research groups may focus on more than one marine-related theme and the total number of researchers in these groups is greater than indicated here. The total number of researchers in the groups identified is approximately 55.

State Sector

The remit of the Marine Institute in relation to fisheries is to 'research, assess and advise' on the sustainable exploitation of the marine fisheries resource. The Institute's Fisheries Science Services (FSS) group carries out this work. FSS conduct an extensive data collection programme including the sampling of landings at ports, sampling for discards, analysis of fleet activity, research surveys on commercial and research vessels, and laboratory based work on age estimation, egg and larval identification, and histological work on fish reproduction. These data are used in the national and international stock assessments that form the basis of the scientific advice on the status of the stocks. This activity contributes significantly to Objectives 1 and 2 for 2013.

The active research programme of the FSS focuses on improving the knowledge base for the main commercial fisheries. Research currently underway includes linking fish spawning with oceanographic features, herring stock identification, cod tagging, and the development of tools for fisheries management. FSS also supports fisheries research programmes carried out in third-level institutes and there are currently several PhD students based with FSS. Altogether, the research activity of FSS amounts to approximately 7–10 FTEs.

The Institute's Aquaculture and Catchment Management Services group (ACMS) covers migratory fish species. The main functions of ACMS are to research, monitor, analyse and advise in the areas of finfish aquaculture, salmonid rearing, wild salmon & eel stock dynamics, and freshwater catchment studies. The team's migratory research currently focuses on long-term monitoring of wild eel and salmonid stocks, providing advice on current stock status and refining the methods used to provide this advice. Currently, the major challenges facing Atlantic salmon and eels lie in the marine environment and ACMS is a key player in NASCO's SALSEA initiative, designed to assess factors affecting marine survival of salmon (www.salmonatsea.com). ACMS is also playing a major role in the compilation of an EU-wide eel conservation programme.

Although primarily a development agency, BIM, through its Fisheries Development Division, funds research and has ongoing involvement in research projects that promote the sustainable development of the sea fisheries sector. Areas of work include the effects of temperature and salinity on shrimp recruitment, assessment of scallop fisheries using acoustic mapping methods, developing alternative gear modifications and fishing tactics to reduce non-target by-catch and improve selectivity, and the use of radar altimetry and other remotely sensed oceanographic parameters in fisheries management.

Industry

The fishing industry participates actively in ongoing research programmes. The Marine Institute and BIM regularly use commercial fishing vessels on research surveys and gear selection/assessment trials.

Identification of Research Skills/Competencies to Meet Future RTDI Requirements

A summary, based on the identified future RTDI requirements, of the competencies required to meet the 2013 Objectives is presented in Table 2.13. Also included in Table 2.13 is an assessment of whether there are current strengths (S), areas that require strengthening (R) or gap areas (G), in relation to the identified requirements, within the existing research community.

Table 2.13 Competencies Required to Meet Future Research & Innovation Requirements for the Fisheries Resources Sector

Objectives 2013	Competencies Required	Assessment
1 Increase transparency of scientific advice through increased stakeholder interaction and participation and use of fishing industry knowledge in the scientific advisory process.	> Sociological studies	R
	> Multimedia applications	S
	> Information and communications technology	S
2 Increase our understanding of the life history, ecology, socio-economics, dynamics and ecosystem role of fish stocks.	> Seabed habitat mapping	S
	> Data handling, integration and management	G
	> High-end computing	R
	> Fishing gear technology/design and impact assessment	R
	> Biodiversity and ecosystem functioning	S
	> Fish population genetics	S
	> Physical oceanography and modelling	R
	> Fisheries surveys	S
	> Stock/recruitment modelling	R
3 Improve Scientific Advice for Stakeholders —to deliver clear, reliable and impartial advice on the fish stocks of economic importance to Ireland.	> Population modelling and simulation	R
	> Scenario modelling	G
	> Data handling, integration, analysis and management	G
	> Ecological modelling	R
	> Socio-economics	R
4 Contribute to the rebuilding of depleted fish stocks.	> Fishing gear technology/design and impact assessment	R
	> Scenario modelling	G
5 Build integrated data capacity and knowledge management.	> Data handling, integration and management	G

* **S** – Current Strength; **R** – Requires Strengthening; **G** – Gap Area.

The Marine Institute has built up a strong fisheries team over recent years. This team carries out fisheries surveys in support of the goals of fisheries assessment and the provision of management advice. This is clearly a national strength. There is, however, scope for promoting and expanding such skills in the third-level sector. Biodiversity and ecosystem functioning, and habitat mapping are other areas where there are current strengths that need to be applied to the area of fisheries in order to reach the 2013 Objectives. Strengths clearly exist also within the third-level and private sector in areas such as ICT and multimedia applications. However, the challenge lies in identifying and harnessing the appropriate research groups and applying their skills to the specific RTDI requirements.

Understanding fish population ecology and dynamics, population modelling and simulation, ecological modelling capability, and inshore and offshore modelling are all skills that can contribute to the objective of understanding life history and dynamics and adopting an ecosystems approach to fisheries management. All of these are areas that require strengthening. In some cases, e.g. population modelling,

skills may exist outside of the 'marine' research community. Other areas that require strengthening relate to the design and testing of new 'environmentally-friendly' fishing gear and the compilation of socio-economic and sociological data.

Large volumes of data are collected annually in support of fisheries assessment and the provision of management advice. With the evolution towards the ecosystem approach to fisheries management, the integration of other data sets (e.g. environmental data) with fisheries data will be vital. Data handling, integration and management are a major gap and will be vital in achieving a number of the 2013 Objectives.

Current Strengths	Require Strengthening	Gaps
> Fisheries surveys	> Stock/recruitment modelling	> Data handling, integration, analysis and management
> Seabed habitat mapping	> Population modelling and simulation	> Scenario modelling
> Biodiversity and ecosystem functioning	> Ecological modelling	
> Fish population genetics	> Physical oceanography and modelling	
> Information and communications technology	> Fishing gear technology/design and impact assessment	
> Multimedia applications	> Socio-economics	
	> Sociological studies	
	> High-end computing	

Figure 2.12 Research Competencies Required to Meet 2013 Objectives for Fisheries Resources

2.4.8 Prerequisites for Achieving the 2013 Objectives

The following are some of the prerequisites for the successful delivery of the objectives for the fisheries resources research programme:

> Support a new generation of marine scientists by appropriate funding mechanisms;

> Provide training programmes and career structures for marine scientists;

> Make available appropriate laboratory infrastructure and research vessel ship-time;

> Increase international scientific and management co-operation;

> Develop and implement a suite of multi-disciplinary marine science projects;

> Further develop meaningful stakeholder participation;

> Increase public awareness;

> Implement the fisheries component of the new EU Marine Strategy;

> Improve scientific advice through the implementation of the EU Data Collection Regulation; and

> Develop integrated ocean management processes underpinned by a strong scientific base.