

# EU contract FISH/2004/011 on “Sport Fisheries” (or Marine Recreational Fisheries) in the EU

Prepared for

For The European Commission Directorate-General for Fisheries

Prepared by

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This report provides a first assessment of marine recreational fisheries at the EU level. In it we evaluate their importance in environmental, social and economic terms, compared with commercial fisheries, explore public perception of any related problems and issues, and attempt to indicate the most important issues on which fisheries management should concentrate (Call for Tenders FISH/2004/011 “Sport Fisheries”). The study has been carried out by accessing available data (published or through web-sites) and through personal contact with individuals and organisations involved with recreational fisheries in the relevant countries. No original data were derived and, where possible, information was validated from more than one source.

The report is divided into 6 chapters, structured in relation to the Terms of Reference of the Tender and broken down by the regions defined for Regional Advisory Committees, viz.: Baltic Sea, North Sea, North Western waters, South Western waters and Mediterranean Sea.

In order to “describe sport fisheries at EU level by type of fishing, its social importance (time of occupation, associations, level of organisation), and its level of management by Member States” (TOR 1), it proved necessary to define what is meant by sport fishing in the context of recreational fishing. A review of European Member States’ national legislation (provided in Annex 1) revealed considerable variation in ownership and access to coastal waters/fisheries, and in the legal distinction between sport fishing and other recreational uses of fisheries (for example, where commercial fishing gear is used chiefly for home consumption) and their commercial (catching for sale and profit) counterparts. It has, however, clarified the issue and enabled us to suggest common definitions for the various forms of recreational fishing.

Thus, **Recreational fishing** is fishing which is not deemed to be commercial fishing (i.e. it does not have sale or profit connotations), and is not undertaken for predominantly subsistence purposes. **Angling** is the activity of catching or attempting to catch fish on hooks, principally by rod and line, whilst **recreational anglers** do not sell the fish they catch. **Sports fishing** is generally perceived to be a sub-set of recreational angling, although the distinction varies between countries (and may be absent), is often associated with competitions, and may include underwater spear fishing. The review indicated that we should adopt ‘Marine Recreational Fishing’ for the overall title of the report and, as a consequence, the generic **MRF** is used wherever we refer to marine recreational fishing.

On this basis, an exhaustive search of relevant websites and literature sources has been used to describe the recreational fisheries in each Member State, the gears used, species fished for, and level of involvement (as far as is possible). This information is presented, together with an appreciation of the social importance of these fisheries, management infrastructure (if any), and an exploration of public perception of the interactions between recreational and commercial fisheries and any issues arising (TOR 4: “to explore and summarize the results of existing polls of opinion about both sectors”). The main areas of conflict are competition for resources in terms of sharing mortality/catch and space/gear interactions, for example between anglers and nets set close inshore or around wrecks, and the perception that the use of some gears leads to over fishing. In northwest Europe (UK, Ireland, France and Norway), the availability of large fish (possibly with a degree of exclusive access) is important to sport anglers, who increasingly practice catch and release as a conservation aid.

Much of this information is pertinent to TOR 3: *to describe and, where possible, assess the economic importance of sport fisheries and associated industries such as tourism, transport, tackle manufacturing and sale, etc.* We have collated and reviewed readily available published information and data on the economic impact of recreational fishing (it is sometimes difficult to distinguish between marine and freshwater activity) in the different Member States. Using readily accessible data for a variety of years ranging from 1997-2005, but lacking figures for Belgium, Cyprus, Estonia, Latvia, Lithuania, Malta, Portugal and Slovenia, we estimate that at least ten million people are active in the MRF sector in Europe. Any assessment of the economic importance of recreational fishing requires careful consideration of the geographic coverage and quality of available information for each country and the variety of methods used to prepare existing studies or reports, whether to arrive at an EU-wide valuation or to compare these values with commercial fishing activity. At present, it is not possible to produce a comprehensive, quantitative overview of the importance of MRF because the information is neither available for each country nor is it in a consistent format. This suggests that new studies are required to provide robust information upon which to make decisions, and we have included a description of the methodological approaches to this task in Annex 3.

In order *“to describe and, where possible, assess the environmental impact of sport fisheries and associated industries, including the relative importance of catch of target species, by-catch, lost gear, use of bait, etc, and how this compares with the environmental effects of commercial fisheries”* (TOR 2), we have reviewed what is known about the environmental effects of commercial fisheries on benthic fauna, habitat, diversity and community structure in a European context. This provides a perspective against which to view whether it is possible or necessary to predict or manage MRF-induced changes in marine ecosystems. These, and the most important issues on which fisheries management should concentrate to alleviate problems associated with MRF, are more fully explored in the final chapter, which presents information and discusses the implications for policy, legislation and/or management systems and addresses TOR 5: *“to describe the most important areas of conflict or mutual interest between the sport and commercial sectors and identify possible management action associated to these”*. Management options are considered at a pan-European level, describing the problem and possible solutions, without considering the differing legal and management structures existing in each Member State. For this reason alone, we conclude that though some solutions may be possible through European legislation, they are most likely to be achieved through subsidiarity in the short to medium term.

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## Outline and objectives of study.

Managers of marine fisheries in European Community waters have paid little attention to the impacts or requirements of recreational fisheries, though recreational fishing constitutes a considerable social and economic activity. Total expenditure on recreational fishing across Europe is believed to exceed €25 billion a year (Dillon, 2004). By comparison, the 1998 value of commercial landings in the 15 EU member states was estimated at €20 billion (Megapesca, no date given). In its report on the problems encountered by inshore fishermen (A6-0141/2006), the European Parliament's Committee on Fisheries noted that there is increasing tension between inshore fishermen, who fish for a livelihood, and recreational fisheries that are competing in the same physical space of the same coastal areas for the same fish and crustaceans, and suggested that this needs to be addressed. Given the absence of any formal framework for managing (or even identifying) marine recreational fishing, there is therefore a need to define, distinguish and evaluate this activity at the EU level, so that management strategies and measures can be implemented (as necessary) to establish a balance between and maximise benefits from commercial and recreational fishing activities.

Recreational fisheries may interact with commercial fishing in many ways. For example, they may contribute a substantial source of mortality for some species (sea bass: Dunn *et al.*, 1989, 1995; Pickett and Pawson, 1994) that is seldom accounted for in stock assessments (ICES, 2004). Recreational fisheries also interact with commercial fisheries through competition for fishing space, and when unlicensed "recreational" or "hobby" fishermen compete with commercial pot or net fisheries both for the resource and by supplying low priced fish to markets (though, by definition, fishers who sell their product on the market are not truly engaged in recreational fishing, but illegal, unregulated and unreported (IUU) commercial fishing). On the positive side, alternative employment opportunities for commercial fishing vessels are provided through chartering by sport angling parties. Further, at the political level, sport anglers and commercial fishermen can make conflicting claims over the conservation needs of fish stocks, since they tend to have differing requirements either in terms of fish availability or size structure.

Though perceptions of the interactions and "problems" between recreational and commercial fishing activity may be quite focused on either side, from a management viewpoint their definition and resolution is problematic, in particular due to a lack of definition of what constitutes a "recreational" or "sport" fishery. Consequently, it is not easy at present to demonstrate or quantify the scope and potential benefits of any changes to management of these types of fishing. It is, therefore, necessary to clarify these issues through practical definitions and quantification of the scale of these activities, in order to better manage marine resources and to help the Commission (through the CFP) and Member States decide whether specific actions should be undertaken in the future. These may include a change of management policy, or further research on issues that may be identified as crucial for a more sound fisheries management in relation to stock conservation and benefits from exploitation.

The main objective of this project (as specified in the Call for Tenders FISH/2004/011 "Sport Fisheries") is, therefore, to provide a first assessment of the character of marine recreational fisheries and their relative importance in social, economic and environmental terms in the European Community waters. This involves identifying those activities that may be regarded as either recreational or sport fisheries, comparing their scale and value (to the user, and the economy) with those of commercial fisheries, and identifying any significant interactions. Note that "recreational" fisheries may be diverse, viz: rod and line; spear fishing; small-scale netting and potting; etc.

A secondary objective is to explore public perception of the interactions between recreational and commercial fisheries, and any issues that attend “sport” fisheries. AS outlined above, the main areas of conflict are (a) competition for resources (both in terms of sharing mortality/catch and the different stock structures (chiefly size) that are most suited to “optimal” exploitation by “sport” and commercial fisheries, and (b) competition for space/gear interactions, for example between anglers and fixed nets, set close inshore or around wrecks. In northwest Europe (UK, Ireland, France and Norway), the availability of large fish (possibly with a degree of exclusive access) is important to sport anglers, and catch and release as a conservation and aesthetic aid an increasing practice (with sea bass, sharks and salmon, e.g.). Commercial fisheries, on the other hand, require high catch rates of marketable fish that enable them to continue to make a livelihood, and are much less likely to accept management actions that require restraint, without compensation. Generally, commercial and recreational fisheries are governed and restricted by different legislation. We are also aware that there is an historic legal framework of fishing “rights”, ranging from access to the UK shoreline under Magna Carta, through Pru d’homme in the Mediterranean, to quota allocation under the CFP (Symes and Phillipson, 2001).

Our work programme has been structured in relation to the Terms of Reference (TOR) of the Tender, carried out mainly by accessing available data (published or through web-sites) and through contacts in the relevant countries. In order to address TOR 1: *to describe sport fisheries at EU level by type of fishing, its social importance (time of occupation, associations, level of organisation), and its level of management by Member States*, we have attempted to define what is meant by recreational fishing and, as a subset, sport fishing (**Chapter 2**). This has allowed us to make a distinction between other recreational uses of fisheries (for example, where commercial fishing gear is used chiefly for home consumption) and their commercial (catching for sale and profit) counterparts.

The next step was to conduct a search of relevant websites and literature sources to describe the recreational fisheries in each member state, the gears used, species fished for, and level of involvement. This information is presented in **Chapter 3**, together with an appreciation of the social importance of these fisheries and the management infrastructure (if any). Much of this information is pertinent to TOR 3: *to describe and, where possible, assess the economic importance of sport fisheries and associated industries such as tourism, transport, tackle manufacturing and sale, etc.*, and there is therefore some duplication in **Chapter 4**, which collates and reviews existing studies on the economic impact of recreational fishing in the different Member States (no new data were collected or analysed). These studies tend to have been carried out at various times and with different base methodologies, and it is not reasonable to use the results to provide a comprehensive, quantitative evaluation of the economic importance of MRF at the EU level, particularly if these values were subsequently to be compared with commercial fishing activity. This suggests that new, standardised studies are required to provide robust information upon which to make decisions, and we have included a review and description of the methodological approaches to this task in Annex 3.

TOR 2: *to describe and, where possible, assess the environmental impact of sport fisheries and associated industries, including the relative importance of catch of target species, by-catch, lost gear, use of bait, etc, and how this compares with the environmental effects of commercial fisheries*, is addressed in **Chapter 5**. Since so little is known about the environmental impact of sport fisheries, we start with a

review and discussion of the impact on the environment of the various aspects of commercial fisheries as a whole, for which relevant information is readily available. In general, we might assume that similar, but less well quantified, impacts will be expected in recreational fisheries using the same catching gears, but there are some aspects of marine recreational angling or sport fishing that require special attention.

The main aim of TOR 4: to explore and summarize the results of existing polls of opinion about both sectors, and TOR 5: to describe the most important areas of conflict or mutual interest between the sport and commercial sectors and identify possible management action associated to these, is to identify the “problems” related to, and interactions between, recreational, sport and commercial fishing. We have explored public perception of the interactions between recreational and commercial fisheries and any issues that attend recreational and sport fisheries, based largely on published studies. However, given the extensive and time-consuming search for information and evidence for the previous sections of this report, we decided not to meet with EAA representatives or administrations of Member States to further determine the perceptions of the different groups. This was a deliberate choice of prioritisation, because it soon became apparent that many views are polarised and highly politicised, and we did not feel able to conduct a meaningful survey that would stand scrutiny without a clearer view of what the Commission is either looking for or will do with the results. That is, there is no scientific structure to such an enquiry, and we are well aware that expectations are raised by such questioning.

Similarly, our investigations have clearly demonstrated that using a dedicated website to pose a simple questionnaire in order to collect new information to supplement existing data involves a self-selecting sample, with those with an interest in promoting recreational fishing more likely to respond than those that are relatively indifferent. Any results from such a ‘consultation’ would need to be treated with caution. This has been illustrated by a public consultation process that took place in the UK throughout most of the project period, as part of a multi-stakeholder project to elicit public perceptions about the interactions between the two sectors (in relation to management of the sea bass fishery). From a strictly policy viewpoint, Cefas has taken a neutral stance on the issues involved, which has precluded our participation in any related activity.

**Chapter 6** presents information on the most important issues on which fisheries management should concentrate to alleviate problems associated with marine recreational fisheries, and discusses the ways in which policy, legislation and/or management systems might be changed in order to provide the greatest benefit (using examples where this is already happening). Management options are considered at a pan-European level, describing the problem and possible solutions, without considering the legal or management structures existing in each Member State. Some solutions may be possible through European legislation, but they are most likely to be achieved through subsidiarity.

The chapters in this report thus reflect the Terms of Reference of the contract, viz:

## 2. Definitions and legislative review

3. A description of marine sport fisheries at EU level by type of fishing, its social importance (time of occupation, associations, level of organisation), and its level of management by Member States. Including the relative importance of catch of target species, by-catch, lost gear, use of bait, etc, where possible,

4. A description and assessment, where possible, of the economic importance of sport fisheries and associated industries such as tourism, transport, tackle manufacturing and sale.
5. A description of the environmental impact of marine fisheries and an assessment of the relative impact recreation fisheries.
6. A discussion of the most important issues concerning recreational fisheries and conflicts between the sport and commercial sectors, and of possible management action.

*Each of these topics is addressed at the EU level, and for 5 regions defined for Regional Advisory Councils (RACs). RACs aim to create a permanent structure for exchange of information and views, and a link between the European Commission and representatives of the main fishery stakeholders at a regional level. The RAC regions and their constituent sea areas and bordering countries are given below, and shown in the figure:*

Baltic Sea (ICES Divisions IIIb,c,d: Norway, Germany, Denmark, Sweden, Finland, Poland, Lithuania, Latvia, Estonia)

North Sea (ICES Sub-area IV and Division IIIa: UK, Germany, The Netherlands, Belgium, Denmark, Sweden, Norway)

North Western waters (ICES Sub-areas V (EC only); VI and VII: UK, Rep. Ireland, France)

South Western Waters (ICES Sub-areas VIII, IX and X, CECAF 43.1.1, 43.1.2 and 34.2.0: France, Spain, Portugal, Azores, Madeira and Canary Isles)

Mediterranean Sea (east of 5° 26'W: Spain, France, Italy, Greece, Malta, Cyprus, Slovenia)



The table below gives the approximate length of coastline and the current total marine recreational fishers and anglers (both freshwater and marine) relative to total national populations in the EU member states, where known (sources: coastline and total population, Wikipedia and Google; fishing population numbers, this report)

Country	Coastline (kilometres)	Marine recreational	Angling	Total population millions
		fisher population thousands	population thousands	
Belgium	66		300	10
Cyprus	648	“several”		0.78
Denmark	7314	267	451	5.3
Estonia	3794		50 *	1.4
Finland	1107	292	1 390	5.2
France	5500	4 000	4 000	59.2
Germany	2389	818	3 300	82.2
Greece	13676	96		10.5
Ireland (Rep.)	1448	67	200	3.8
Italy	7600	1 500	900	57.7
Latvia	531		200	2.4
Lithuania	99			3.5
Malta	197			0.39
Netherlands	451	450	1 500	15.9
Norway	25148		1 450	4.5
Poland	491	50	600	38.6
Portugal	1793			10
Slovenia	47			2
Spain	4964	93		39.4
Sweden	3218	817	2 020	8.9
United Kingdom	12429	1 100 (E&W)	4 000	59.6
EU total		9 500 +		

\* may not include people aged <18 years

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## Chapter 2. Definitions

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### Introduction

There is considerable potential for confusion and interchangeable use of terminology relating to the subject of this study. The Terms of Reference call for an “*overview of the economic and social importance of **marine recreational fishing** in the European Community Waters*”. Whilst it is possible to distinguish between ‘marine recreational fishing’ and ‘**commercial fishing**’, the title of the study and TOR make reference to ‘**sports fisheries**’ throughout and appear to use this term interchangeably with that of ‘*marine recreational fishing*’.

This section of the report aims to clarify the meaning of terminology that is commonly used to define aspects of the recreational fishing sector and its constituent parts and activities, and provide a common set of language that is used throughout the report.

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### Methodology

A review of definitions used in relation to recreational fishing and its constituent, and associated, parts was undertaken from a variety of published sources (e.g. reports, web-sites and journal articles) in order to clarify their meanings and identify the common features. A synthesis of these terminologies and definitions is presented below with the aim of proposing a consistent working nomenclature for use throughout this report.

In addition, a review of primary national legislation of relevance to defining and regulating those activities that are construed to be fishing for recreational or subsistence purposes, as opposed to fishing for commercial purposes, was also undertaken. This was expanded to incorporate secondary national legislation where readily accessible, and appropriate, and is presented in **Annex 2**. A summary of this has been used to further extend the review of definitions relating to recreational fishing and to show how these legal definitions vary between Member States, and thus provide a basis for evaluating recreational fishing activities within the EU.

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### Definitions

There is a confusing array of definitions in the literature pertaining to recreational fishing and its constituent parts and related sectors (EAA, 2004a; FAO, 2000). Most confusing, to those not intimately involved with the field, is the interchangeable use of some of the following terms: fishing, commercial fishing, subsistence fishing, recreational fishing, marine recreational fishing, leisure fishing, sports fishing, angling and recreational angling. Fishers, anglers, managers, politicians, scientists, etc. need appropriate and common definitions to enable better and more fluent communication in relation to evaluation of fisheries and regulation of their respective activities.

We begin the discussion of definitions by first defining ‘**fishing**’ or ‘**fisheries**’. The Oxford English Dictionary describes fishing as “*The action, art, or practice of catching fish*”. However, this is a rather limited description focusing only on fish as opposed to including molluscs, crustaceans, etc. A more complete definition in terms of target species can be taken from the US National Marine Fisheries Service (NMFS) (<http://www.nwfsc.noaa.gov/>):

Fishing or fisheries is “the industry or occupation devoted to the catching, processing, or selling of fish, shellfish, or other aquatic animals”.

This definition also introduces the notion that fishing or fisheries may be related to the catching activities itself or to a combination of catching, processing or selling.

A common theme represented in many definitions of ‘recreational fishing’ relates to a description of the sector in terms of what it does not constitute. For example, the European Commission defines ‘recreational and game fisheries’ as “*all fishing activities not conducted for commercial fishing purposes*” (EC, 2001). Other definitions use linked concepts to define recreational fishing as an activity that “*does not include sale of catch*” (Roberts *et al*, no date), or as an activity “*not deemed commercial fishing*” (EAA, 2004b). However, the definition used in the NMFS ‘Marine Recreational Fishery Statistics Survey’ introduces a notion that part of a recreational fishery catch could be sold for financial gain, “*If part or all of the catch was sold, the monetary returns constituted an insignificant part of the person’s income*” (Witzig, 2004).

Additionally, not all non-commercial fishing can be easily described as ‘recreational’. In Europe, there are very few examples of subsistence (non-commercial, but not recreational) fisheries, but it could be argued that some regions or societies place an element of ‘cultural’ or ‘heritage’ importance or value on traditional fishing activities, which are perceived as being separate to more obvious recreational activities. For example, in many countries including France, it is traditional to hand-pick shellfish from the beaches, and the use of a small number of pots to catch crabs or lobsters is often allowed to be outside regulations governing commercial fisheries.

Some definitions of ‘recreational fishing’ go further and introduce a notion of the types of gears and methods with which recreational fishing can be undertaken (EAA, 2004b; Witzig, 2004), whilst others focus on the motivations for the activity, e.g. “*Harvesting fish for personal use, fun, and challenge*” (Roberts *et al*, no date) and “*Fishing primarily ..... for pleasure, amusement, relaxation, or home consumption*” (Witzig, 2004). A summary of the definitions used to characterise recreational fisheries is given in Table 2.1.

**Table 2.1: Definitions of ‘recreational fishing’**

Term	Definition	Source
Recreational and game fisheries	All fishing activities not conducted for commercial fishing purposes	European Commission (2001)
Recreational fishing	Fishing (i.e. an activity intended to catch fish or other aquatic organism) which is not deemed to be commercial fishing (i.e. catching and selling fish in order to support a livelihood, at least in part).  Angling, the use of nets, longlines, hand-held lines from small boats or from the shore, and capture of fish by free divers and sport divers with spear guns, are various forms of fishing included in the definition of recreational fishing, provided that no sale of fish is involved.	EAA (2004b)

Recreational fishing	Harvesting fish for personal use, fun, and challenge.	Roberts <i>et al</i> (no date)
	Recreational fishing does not include sale of catch.	
Marine <sup>s</sup> fishing	recreational Fishing primarily with hook and line for pleasure, amusement, relaxation, or home consumption. If part or all of the catch is sold, the monetary returns constitute an insignificant part of the person's income.	Witzig (2004)

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\$. The term includes the word 'marine' but the description does not specifically describe what constitutes 'marine'.

There are a number of definitions of 'recreational fishermen' and their 'fishing activities', e.g. recreational fisherman, sports fisherman, subsistence/household fisherman, angler and marine recreational angler (

Table 2.2.2). Definitions vary between countries, regions and water-body types and, as with the recreational fishing activity in general, definitions focus on some combination<sup>1</sup> of distinction in terms of time spent fishing, motivation for undertaking the activity, type of gear used or physical activity.

Toivonen *et al.* (2000) prepared a range of definitions for the different types of recreational fishermen and fishing activities found in Nordic countries. A 'recreational fishermen' was defined as someone "*who fishes during leisure time and does not sell the catch*" whilst 'subsistence/household', 'sports', and 'generalist' fishermen were defined in terms of the type of fishing gear used. '**Angling**' as an activity was defined as "*Fishing with a simple rod and line with a short operating distance*". The EAA definition of angling is more detailed, in that it includes reference to the hooking method, the concept of pole and hand-held line fishing in addition to rod (and reel), and that the term 'angling' can be used for commercial and non-commercial fishers alike, viz.:

"Line fishing using hooking method, or activity of catching fish or attempting to catch fish, principally by rod and line, pole or hand-held line for non-commercial purposes, but can be both commercial and non-commercial".

The EAA (2004b) expand on this definition by introducing a separate definition for 'recreational' anglers. Witzig (2004) provides a US definition of the same term carried out in marine waters.

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<sup>1</sup> Arlinghaus (no date) noted the use of this combination of explanatory factors when attempting to define 'angling' for the EAA

**Table 2.2 Definitions of types of ‘recreational fishermen’ and ‘fishing activities’**

Recreational fishermen	Fisherman who fishes during leisure time and does not sell the catch	Toivonen <i>et al</i> (2000)
Subsistence household fisherman	/ Recreational fisherman who mainly uses gill nets or other static gear	Toivonen <i>et al</i> (2000)
Sports fisherman	Recreational fisherman who mainly uses rod and line	Toivonen <i>et al</i> (2000)
Generalist fisherman <sup>1</sup>	Fisherman who uses all types of gear	Toivonen <i>et al</i> (2000)
Angling	Fishing with a simple rod and line with a short operating distance	Toivonen <i>et al</i> (2000)
Angling	Angling is fishing with a hook and either rod and line or hand-held line and can be for both commercial and non-commercial purposes.	EAA (2004b)
Recreational angling	Non-commercial activity using hook and line.  Catch may be returned or retained to be consumed within the immediate social circle but not sold or bartered for other goods.  Motivations for recreational angling are diverse and may include challenge, achievement, sport, recreation, relaxation, social activity involving water, etc.  Recreational angling is one form of recreational fishing.	EAA (2004b)
Marine recreational anglers	Those people who fished in marine waters primarily for recreational purposes. Their catch was primarily for home consumption, although occasionally a part or all of their catch may have been sold and entered commercial channels.	Witzig (2004)

Whilst the above definitions are reasonable clear cut, there is more confusion over the term ‘sports fishing’. EAA (2004b) notes that, in some countries, the terms ‘recreational angling’ and ‘sports fishing’ have different meanings whilst in others they are used interchangeably. In Nordic countries, Toivonen *et al* (2000) define ‘sports fishermen’ as “*Recreational fisherman who mainly uses rod and line / spinning rod*”. US-based definitions of ‘sports fishing’ also suggest that the term encompasses mainly rod and line or reel-based fishing method:

“Sport fishing is a form of recreational fishing where the primary reward is the challenge of finding and catching the fish rather than the culinary or financial value of the fish’s flesh..... Sport fishing methods vary according to the area being fished, the species being targeted, the personal strategies of the angler, and the resources available..... However, in virtually every case, the fishing is done with rod and reel rather than with nets or other aids”.  
[http://www.reference.com/browse/wiki/Sport\\_fishing](http://www.reference.com/browse/wiki/Sport_fishing)

Examples of ‘sports fishing’ in this context include beach fishing, big-game fishing, fly fishing, ice fishing, rock fishing, trolling and lure fishing. However, the term can also take on another meaning – aside from a physical definition of associated fishing gear and techniques. Some definitions imply that ‘sports fishing’ is a type of recreational fishing that is “*more sportive, competition-oriented and technically complex*” than the average type of recreational or leisure fishing (Anagnopoulos, 1996). Catch and release is an increasingly common activity within ‘recreational angling’ and ‘sports fisheries’; it is often a requirement of competitions that caught fish be released alive after weighing and this is often associated with tagging undertaken for research and conservation purposes. However, some lobby groups and recreational fishermen are increasingly becoming sensitised to the ethical arguments relating to catch and release practices (see section 6).

In relation to the European Commission funded project No. 96/018 ‘Sports fisheries in Eastern Mediterranean – Greece and Italy’ (Anagnopoulos – Coordinator), the EAA (2004b) has argued that the term ‘sports fishing’ has been used inappropriately as a term encompassing not only rod and line activities but also other non-rod and line forms of recreational fishing, e.g. netting or spear fishing.

Roberts *et al* (no date) and EAA (2004b) have also defined the wider set of economic activities and sector surrounding the recreational fishery and recreational angling sectors respectively (Table 2.3).

**Table 2.3: Definitions of the wider ‘recreational fishery’ sector**

Recreational fishery	<ul style="list-style-type: none"> <li>Refers to and includes the fishery resources, fishermen, and businesses providing needed goods and services. Roberts <i>et al</i> (no date)</li> </ul>
Recreational angling sector	<ul style="list-style-type: none"> <li>Includes anglers, tackle shops and tackle manufacturers, bait suppliers, charter-boating, recreational boat builders and chandlery suppliers, marine operators and specialised angling media, angling tourism and other related businesses and organisations as well as the whole management environment (e.g. public agencies) to varying degrees dependant on, or directed at, recreational angling. EAA (2004b)</li> </ul>

It is also pertinent here to define game fish – salmonids (salmon, trout, sea trout, grayling and char, see Appendix 1 for scientific names of species of interest to recreational fisheries in Europe) that are usually

not regarded as marine recreational fishery species, and coarse fish, which are freshwater fish other than aforementioned salmonids.

**Table 2. 5: Report definitions associated with recreational fishing**

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<b>Recreational fishing</b>	Recreational fishing is fishing which is: <ul style="list-style-type: none"> <li>• not deemed to be commercial fishing;</li> <li>• is not undertaken for predominantly subsistence purposes;</li> <li>• is not undertaken for primarily cultural or heritage purposes</li> </ul>
<b>Angling</b>	Angling is the activity of catching or attempting to catch fish on hooks, principally by rod and line, pole or hand-held line. Note that this also includes the use of hook-less lures where fish capture depends on entanglement (e.g. billfish, squid, eels)
<b>Recreational angling</b>	Recreational angling is the activity of catching or attempting to catch fish, principally by rod and line, pole or hand-held line for non-commercial purposes; recreational anglers do not sell the fish they catch.
<b>Sports fishing</b>	Sports fishing is generally perceived to be a sub-set of recreational angling, although the distinction varies between countries.
<b>Non-angling recreational fishing</b>	Other forms of non-commercial recreational fishing (i.e. not with hook and line) include: <ul style="list-style-type: none"> <li>• small boats equipped with nets or longlines;</li> <li>• use of fish or crustacean pots;</li> <li>• capture of fish by divers with spear guns;</li> <li>• hand-gathering of shellfish from the beach or shore</li> </ul>

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## Chapter 3. Description of Marine Recreational Fisheries

This section of the report uses the definitions of “recreational fishing” and, as an important subset, “sport fishing”, presented in section 2, us to make a distinction between commercial and recreational fisheries, describe the types of gear used in marine recreational fisheries, and identify the species that are targeted in this connection. We have attempted, where possible, to provide information on the popularity or quantities caught of species fished for by MRF, and the level of participation by country. Descriptions of European inshore fisheries, their organisation, participation and issues for the Baltic through to France and in the Mediterranean are presented in Symes and Phillipson (2001) and Symes (1999) respectively, and are not reproduced here. There is, inevitably, some duplication of information with other sections of the report, but we feel that this is necessary to help address the Terms of Reference.

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### Methodology

The major part of this investigation has been to gather as much information as possible on MRF that is available from the Internet using the search engines ‘Google’, ‘Google Scholar’ and ‘Scopus’, which proved to be the most reliable and are the most widely used by academics. The search was ordered by ‘country by RAC’ area, using a range of descriptors appropriate to each country within the EU, where the words used to describe MRF/sport fishing tend to follow their own national legislation (see section 2).

There are thousands of potentially useful websites, but many contain negligible information on MRF, so searches were restricted to the first ~50 pages, holding 10 links per page. Searches were conducted according to the following procedure: sport fishing in ‘country’; marine recreational fishing in ‘country’; sea angling in ‘country’; and angling in ‘country’; after which it was broadened to RAC regions (e.g. Mediterranean and angling; Mediterranean and recreational fishing, etc). Filtering sites with a broad range of information extending beyond the remit of this project has amounted to around 10% being used overall, ranging between ~1 - 6% for areas with few available sources (e.g. Greece, Spain) and ~25% where vast amounts of information exist and published sources are already available that account for MRF (e.g. Finland). The more useful links are provided in the bibliography at the end of this section.

The scientific literature databases, Science Direct and ASFA, have also been used throughout the project, and the peer- reviewed publications and reports used in this report are also listed in the bibliography. Some translations of reports (into English) have been carried out within Cefas, Cemare and the Marine Institute in Gydna, but some information remains to be translated. In general, data have been collected and collated only where sources are considered reliable, using newspapers, magazines, general websites and peer-reviewed papers as objectively as possible

The Internet has also been used to find links and contacts for various EU fisheries institutes and, where useful reports have been identified on country-specific MRF issues, requests for these publications have been made to the host institutions.

It should be emphasised that the results of this review are based solely on publicly available sources, and do not include anecdotal information. Thus, whilst we know well that sea anglers in some northern European countries target particular species, for example, this is not included in the report unless revealed by our search.

## Baltic RAC (Norway, Germany, Denmark, Sweden, Finland, Poland, Lithuania, Latvia, Estonia)

### Nordic Countries generally

Recreational fishing is an important leisure activity in all of the Scandinavian countries. It is estimated that almost 25% of recreational fisherman in Europe are Nordic, and their expenditure in connection with this hobby is considerable (Anon, 1997).

The benefit of recreational fishing is derived not only in the catch itself, but also in social, physical and mental health and educational functions. However, there is no market value for the pursuit, mainly because economic markets exist only for commodities that can be owned, and recreational fishing in the Nordic countries is, to a large extent, a public commodity with the emphasis on fishing rights. For the recreational fisherman, however, there may be an economic value for the activity, most obviously if there is a possibility that fishing opportunities will be lost.

Nordic Councils of Ministers provide a forum for researchers to discuss the diversity of topics involved in economic valuation of non-market goods in general and recreational fishing in particular. Methods that are currently used for valuation are also presented. Anon (1997) comprises papers that were given in the workshop "Socio-economics of recreational fishery" in Vaasa, Finland 1997. The publications are not within the public domain.

Toivonen *et al* (2000) provided information on recreational fishing activity in Norway, Denmark, Sweden and Finland. The report collates considerable socio economic data that are separated by country along with species caught and the gears used, though this appears to be restricted to freshwater and diadromous species (Table 3.1).

**Table 3.1: Main target species and methods used to take them in recreational fisheries in the Nordic countries.**

Site	Stream	Lake	Lake
Species	Salmon, sea trout	Pike, perch, pike-perch,	Brown trout, arctic char, grayling (Denmark, Finland)
Tackle	Rod and line,	Rod and line, gillnet (Finland)	Rod and line, gillnet (Denmark, Sweden)

The findings in terms of the mean and total number of recreational fishing days per fishermen in each of the countries surveyed are presented in Table 3.2.

**Table 3.2: Number of annual fishing days of recreational fishermen (ages 18-69) in Nordic countries. Ice fishing days are included in the recreational fishing days (Toivonen *et al.*, 2000).**

	Number of fishing days	Recreational fishing days	Recreational fishing days (1000s)	Recreational ice fishing days	Recreational ice fishing days (1000s)
		mean/person	total	mean/person	total
Denmark	546	12.1	5 440	0.1	44
Finland	1 263	18.8	26 200	3.7	5 120
Norway	1 161	12.9	18 700	0.9	1 350
Sweden	1 286	13.2	26 700	2.2	4 470
Total	4 524	14.4	77 400	2.1	11 000

Out of the 25 000 “Nordic” people interviewed, the most popular recreational fishing activity was recorded under the category ‘occasional angler’. In Sweden, however, the largest category is the rod and line sport fishermen. For those aged 18 to 69, Toivonen *et al.* estimate that over 77 million days annually are spent recreational sport fishing in the Nordic states by over 5 million recreational fishermen, and 1.63 million of those indulge in ice fishing. Finnish recreational fishermen ‘fish’ on average 19 days annually. Ice fishing is a popular sport in Finland and fishermen spend approximately 4 days ice fishing on average each year. In Denmark, on the other hand, very few take up ice fishing. In Denmark, Sweden and Norway, the preference is to fish at coastal locations (i.e. MRF).

The mean numbers of Nordic recreational fishing days by country are given in Table 3.3. The overall mean annual recreational fishing days is 14.4 per Nordic fisherman.

**Table 3.3: Mean number of days fished each year by category of fishermen in Nordic countries (Toivonen *et al.*, 2000).**

Country	Number of fishing days	Sports fishermen	Household fishermen	generalists	Occasional anglers
Denmark	546	21.0	28.4	27.4	8.4
Finland	1 263	27.3	33.7	41.0	8.1
Norway	1 161	21.1	16.9	20.2	7.0
Sweden	1 286	12.1	10.7	20.4	-
Total	4 524	15.5	23.9	25.3	7.6

## Norway

### Description

English publication listings in the Norwegian Institute of Fisheries and Aquaculture Research publications on [www.fiskeriforskning.no](http://www.fiskeriforskning.no) do not include any covering recreational/sport/angling fishing. Other institutes searched were Department of Fisheries (<http://www.odin.dep.no/>). The limited information from the Institute of Marine Research (<http://www.imr.no/>) and Norwegian Institute of Fisheries (<http://www.fiskforsk.norut.no/>) suggests that Norway focuses research on marine mammals and salmon.

Recreational fishing may only be conducted using handlines or rod-and-line, or in nets with a maximum total length of 210 metres, long lines with up to 300 hooks or in a maximum of 20 pots or traps. Recreational fishermen who are not Norwegian citizens are only permitted to fish using hand-held gear, i.e. hand lines or rods, and they are not allowed to sell their catch (FAO, 2005).

FAO figures (FAO, 2005) suggest that salmon is the main species targeted by recreational fisheries in Norway, together with sea trout and Arctic char. While most salmon are caught at sea, sea trout and Arctic char are predominantly caught in freshwater. In 2000 approximately 1,164 t of fish were caught, of which 525 t (423 t salmon) were caught in rivers and 639 t (627 t salmon) in the sea.

### Participation

Although Norway is not part of the EU, the operation, management and opportunities provided by its fisheries have a considerable influence on those within the Community. Sport fishing is popular in Norway, and half of the adult population participate in recreational fishing at least once a year. The available sources cover mostly socio-economic and regulatory approaches, with some information on species caught.

In Norway, there is a distinction between government property, state common land and private property, but, regardless of who owns the land, one may only fish with the permission of the landowner and/or having bought a fishing licence (see legislative review, Annex 2). In rivers and lakes, sport fishing is not included in the right of free access: fishing rights belong to the landowner. All anglers over the age of 16 who wish to fish for salmon, sea trout and Arctic char (anadromous salmonids) in fresh water must buy a national fishing licence, the annual fee being payable to the Norwegian Government. (<http://english.dirnat.no/wbch3.exe?p=2090&sec=Hoveddel&secnr=1#Fishing>).

Sport fishing is free in the sea, and is an important part of the right of free access (Right of Access from the Sea to the Sky, 1995). As a general rule, you do not need the landowner's permission to use a rod and line or fixed gear. However, the landowner has exclusive rights to fishing for anadromous salmonids (salmon, sea trout and sea char) with fixed gear on his own property and adjacent areas. Norway has a comprehensive set of rules governing commercial fishing in salt water, including the types of gear that may be used, marking of gear, and fishing seasons. However, there are relatively few restrictions on fishing with a rod and line.

Recreational fishing may only be conducted using handlines or rod-and-line, or in nets with a maximum total length of 210 metres, long lines with up to 300 hooks or in a maximum of 20 pots or traps. Recreational fishermen who are not Norwegian citizens are only permitted to fish using hand-held gear, i.e. hand lines or rods, and they are not allowed to sell their catch.

### **Perceptions and Opinion**

Ander Skofhoft, from the Norwegian University of Science and Technology, is currently investigating the management of recreational sport fisheries for salmon in rivers in relation to the commercial marine fishery and taking biological as well as economic factors into account. Various models are being analysed for regulation through a quota-based marine harvesting scheme, balancing the 'demand' for both marine and freshwater recreational fishing against the quality of a river, approximated by the average catch per fishing day and with a view to maximizing the total long term economic surplus.

## **Germany**

### **Description**

Pinter (1998) and Arlinghaus (personal contact 2006) have conducted most research in recreational fisheries in Germany, although it is still unclear how this activity is defined and much of the emphasis has been towards socio-economic studies in freshwater lakes and rivers.

### **Participation**

Approximately 3.3 million people engage in recreational fishing in Germany. In 2002, a survey was conducted of people aged 14 and above who had spent time angling at least once in Germany or abroad (EAA report, 2003) Recreational fishing in inland, brackish and marine waters is a popular activity and it is not uncommon for anglers to spend time abroad for the sport. The two most popular angling clubs are the German Sport Fishers (VSDF) and the German Anglers Association (GAA). The most important fish for marine and coastal recreational fisheries are cod, herring, mackerel and garfish. With a permit, it is possible to fish off the coast of Germany (for example, in Schleswig-Holstein's coastal waters) and go deep-sea angling. However, much of the angling in Germany is carried out inland ([www.wtsh.de/](http://www.wtsh.de/))

(Pitcher and Hollingworth, 2002) estimated that, if the average annual catch per person amounts to 25kg, the annual catch by around 960 thousand sea anglers would be between 16 and 31 thousand t. This compares with the annual commercial marine catch of 30 – 40 thousand t. Table 3.4 illustrates anglers' preference for fish to capture or consume. Anglers based inland generally fish in lakes and rivers and subsequently choose pike and pike-perch, whilst coastal and marine anglers tend to prefer cod, eel and trout.

**Table 3.4: the top ten species preferred for fishing and for consumption by German anglers (German Anglers Association 1999).**

Species preferred for fishing	%	Species preferred for consumption	%
Pike	21	Pike-perch	18
Carp	20	Brown trout	17
Pike-perch	17	Carp	15
Eel	9	Eel	10
Brown trout and Rainbow trout	9	Pike	8
Cod	6	Cod	6
Perch	6	Perch	5
Tench	2	Salmon	2
Roach	2	Herring	2
Wels catfish	2	Roach	2

### Perceptions and opinion

Approximately 700 anglers replied to the questionnaires provided by the GAA. The results were collated by Pitcher and Hollingworth (2002), who also combined findings from Steffens *et al* (1999) and Wedekind (2000) to show that the main motivation for recreational fishing in Berlin Bavaria and Saxony-Anhalt is to relax and enjoy the natural environment. Otherwise, fish were largely caught for consumption.

Furuno Deutschland, a large Japanese-based company specialising in providing electronics to the marine fishery sector, including recreational fisheries, has established itself in Germany to cater for Austria, Germany and Switzerland (<http://www.dbmarine.com/default.asp>), (<http://www.furuno.co.jp/english/marine/news/press33.html>). However, contact with the Federal Ministry of Food, Agriculture and Consumer Protection in Bonn has proved to be ineffective in providing information on the technological involvement of Germany, Austria and Switzerland in MRF and the gears and vessels used. There has been limited investment in scientific research or evaluation of biological, socio-economic and sustainability aspects and the impacts and the public perception of this activity, and there is no management strategy for MRF in Germany.

### Denmark

#### Description.

Control of fisheries in Denmark differentiates between commercial, part time, spare time (for household consumption) and sports fishing by rod and line and whether it is marine or freshwater. This distinction also applies access to fishing rights. Recreational fishermen can be distinguished either as those who fish in their spare time using a restricted number of passive gears (nets or fish traps) in marine waters, generally for home consumption or local bartering, or those using rod and line in marine or fresh water areas. Sea angling seems to be the preferred type of recreational fishing in the east of Denmark. Only

riparian owners are allowed to use nets and traps in their own lakes and streams (Roth, 2003). Much of the recreational data are unreliable due to under reporting.

Recreational fisheries are restricted to 6 gear types (rod and line, gill net, long lines, other standing gear, nets and traps) and management varies depending on location and type of gear. Bohn and Jenson (2003) state that, out of a sample of 396 recreational fishermen, 73% had fished in coastal waters (30% in lakes and 25% in streams), and 27% fished in 'put and take' waters that are restocked with farmed trout. It is forbidden to sell fish caught in the recreational fishery, though there are no limits on the catch itself. Apart from these regulations, national measures include the release of fish and research financed by fees charged for fishing permits (Anonymous, 2004)

### **Participation**

There is no statistical information concerning the recreational fishery in Denmark, though it appears to represent an important part of the national economy, and sport fishing is recognized as one of the best therapeutics against stress and seen is a solution to the problem of increased leisure time (<http://www.fao.org/fi/fcp/en/DNK/BODY.HTM>).

In the 1980s, a preliminary attempt to analyse recreational fisheries was initiated (Dahl, 1980,) and, with information obtained for the Proceedings of the Technical Consultation on Allocation of Fishery Resources (1980) was used to highlight particular concerns. However, there is little information of the status of Danish recreational fisheries.

Rasmussen (2001) reviewed the status of fisheries in Danish inland waters in 2000, whilst Roth (2003) used socio-economic data in 8 expenditure categories from 546 questionnaires to estimate the aggregate expenditure of recreational fishermen (both freshwater and marine) in Denmark to be DKK517 million in 1999. Roughly one in eight Danes engage in recreational fishing (non specific), of which 15% are women (Roth, 2003).

### **Perceptions and opinions**

Danish recreational fisheries may have more similarities to commercial fisheries than in many other European countries. Although consumption replaces income as the economic benefit, recreational fishing has become part of the life cycle of commercial fishing as well as an integral part of inshore fisheries, helping to maintain social networks. MRF contrasts with inshore fishing in that it tends to appeal to urban dwellers rather than rural inhabitants. It is growing in popularity and has exerted a strong influence on policy. Whilst freshwater anglers may be forced to pay higher prices for access to privately owned fishing opportunities, sea angling may not have to contend with the same issue. It does, however, face strong opposition from other user groups in accessible inshore waters, where overcrowding is considered to be lowering the quality of the recreational fishing experience.

### **Issues**

There are disputes between recreational and commercial fishermen over the right to fish for migratory fish (salmon, sea trout). Recreational fishermen emphasise their considerable contribution to restocking programmes through the licence fee system, they establish their own hatcheries, contribute to fish welfare projects, research and river improvement organised by the Danish Institute of Fisheries Research, and thus conserve stocks. Approximately one in four sea trout caught can be attributed to the restocking

programmes. The wild Baltic salmon is a declining resource, but correctly managed, it is suggested that it could be a source of jobs, recreation and foreign tourism (Area for action, 2004).

The Danish Institute of Fisheries Research summarises the economic and biological importance of sport fishing in the Denmark on their website and in a report on Socio-economic value of recreational fisheries in the Nordic states (Toivenen, 2000).

The Danish Saltwater Fisheries Act (1999) led to the Fisheries Development Plan for Limfjord, encapsulating the interests of various recreational (and commercial) fishermen in Nordjyllands, Viborg and Ringkoebing. Mussel production is an important part of employment in this area, and its increasing regulation has been well received by recreational fishermen.

## Finland

### Participation

Finland has a government-funded Game and Fisheries Research Institute that places as much emphasis upon recreational fisheries as on the commercial sector (<http://www.rktl.fi>). The website states that game fishing or hunting in general is incorporated into the sustainable management of wildlife and their habitats to better understand the processes of regulating their quarry. Results from research are published in scientific journals and magazines to promote wildlife management, and under <http://www.rktl.fi/?view=publications&cat=41&lang=english>, although the listings are in Finnish. The tables below summarise recreational fisheries statistics for 2002, when there were 418 000 recreational fishermen using marine waters and 1 651 000 using inland waters in Finland.

**Table 3.5: Quantity and value of Finnish recreational fishery catch in the sea and inland waters in 2002 (Nylander et al, 2004) The value of the catch is estimated on the basis of average price paid to commercial fishermen.**

Species	Catch (t)			Value of Catch (1000s Euro)
	From inland waters	From the sea	Total	
Perch	8961	2707	11667	12367
Pike	7890	1820	9710	11944
Roach	3566	838	4403	793
Vendace	2461	43	2503	3612
Bream	1948	464	2412	1231
Pikeperch	1476	489	1965	5698
Whitefish	1198	395	1592	5101
Rainbow trout	653	36	689	1469
Brown trout	540	116	656	1862

Grayling	173	7	180	578
Sea salmon	75	34	109	262
Land-locked salmon	92		92	220
Burbot	759	180	939	1916
Other	405	1180	1585	444
Total	30196	8307	38503	47497

**Table 3.6: Number of Finnish recreational fishermen using different gears in 2000 and 2002.**

<b>Gear</b>	<b>2000</b>	<b>2002</b>
Hook and line	1300	1350
Spinning rod	780	780
Jig	600	580
Gill net	500	450
Fish trap	450	450
Trolling gear	350	375
Fly rod	50	50
Other	50	45

## Sweden

### Description

There are many opportunities for recreational fishing in Sweden through the 'Right of Common Access' (FAO, 1980) that includes the right for everybody to trespass and temporarily stay on land or water(s) belonging to others. The Swedes' love of outdoor life has also stimulated interest in recreational fishing, and it is a requirement to have free access to woods, countryside and fishing waters (former Minister of Agriculture and Fisheries of Sweden, Mr Svante Lundkvist, EIFAC/T 26, app B.)

A governmental commission found that fishing is one of the most extensive outdoor leisure pursuits in Sweden. Because of good natural conditions and tradition, household fishing formed the basis for a development of fishing being practised more for sport and recreation (Johansson and Norling, "Sportfishing in Sweden"). Among some 100,000 lakes having a total area of about 40,000 km<sup>2</sup>, there are more than 2000 areas where the public is allowed to fish for a fee paid to the landowner (Anon, Google, 2006). Some areas in the 5 largest lakes are open to public use. Thus, the main part of the licensed fishing water is privately owned, but the government and the municipalities also grant public use of some areas. Fishing in coastal waters is, to a large extent, 'free' for Swedish citizens.

## Infrastructure

The Swedish Anglers' Association (SAA) has about 100,000 members, of which 60,000 are members of different sport fishing clubs. Each of Sweden's 24 counties has a regional body coordinating activities within and among the clubs. The SAA informs anglers, both its own members and the general public and tourists from abroad, about legislation and fishing waters through a yearly publication and in the form of booklets and leaflets. Very often the clubs have their own youth sections, and sport fishing lessons are quite common in schools, 2 hours a week in grades 7, 8 and 9 (ages 9 to 12), where the students can choose between different study courses.

## Perceptions and Opinions

MRF is thus one of the most important forms of recreation in Sweden, and there is considerable fishing that is pursued in leisure time but using professional gear for the purpose of catching fish. As a consequence, recreational fisheries and commercial fishermen compete for the same resource, and often in the same water. Wendt (FAO, 1980) argued that, whilst commercial fishermen's interests should be given priority, it is also important to promote recreational fishing. On the other hand, there is less reason to support MRF pursued for the purpose of catching fish for home consumption (Cit Minister of Agriculture and Fisheries of Sweden, Mr. Anders Dahlgren, in Parliamentary Bill 77/78:112.).

Recreational fishing is a large component of ecotourism in Sweden (<http://fiskeriverkat.se/pdf>). Whilst there are no peer reviewed publications, the Sea at Risk website, <http://www.seas-at-risk.org/>, is under construction and may prove useful in future.

Because the species and stocks caught are similar to those given for the Baltic region and are generally freshwater species, many boundary disputes have occurred (University of Gydnia, personal communication).

## Poland

Although there has been little or no research on MRF for other countries bordering the Baltic Sea, Krzysztof Radtke (personal communication, November 2005) from the University of Gydnia claims that the results of research in Poland on the views and perception, species and gears used are similar to those used for the former Russian countries. Thus, the following review for Poland is thought to be representative of Lithuania, Latvia and Estonia.

## Description

There is no legal definition of commercial or sport fishermen, the common understanding being that commercial fishermen are those who have a legal income from fishing, while a sport fishermen fishes mainly for pleasure. The rules and regulations of the Polish Anglers Association (PAA) define types and numbers of the gear that can be legally used, minimum size of retention for fishes, for some species at larger sizes than those defined by the Ministry of Agriculture for commercial fishing, and daily catch quotas for anglers. Licence fees vary with the kind of angling and water bodies (e.g. shore fishing is cheaper than from boat, spinning requires an extra fee, fishing in trout streams requires a special licence, etc.), but are inexpensive, roughly 5% of the total expenses of fishing.

Navigation on the Baltic Sea is limited for small vessels and, except for shore angling, fishing for sport is practically non-existent. In contrast, the inland fisheries resources are considered indispensable by sport

fishermen, and benefit from an “environmental” approach adopted by some new government agencies and societies. The press and TV touch on inland fishery and inland water pollution problems much more often than those related to marine environment. TV frequently provides programmes for anglers.

### **Participation and infrastructure**

Administration of sea fisheries, including coastal waters, is the responsibility of the Ministry of Foreign Trade, whilst operational management of inland fisheries is the responsibility of those bodies that have fishing rights. The PAA manages the fisheries on waters let to them, but otherwise there are no special organizations or agencies that could provide services to recreational fisheries. The private sector does not play any role in recreational fisheries.

Angler involvement can be illustrated by the growing number of members of the PAA—over 700 000 in 2005 - and roughly 30% of all people fishing with rod and line for pleasure and/or food. Members of the PAA constitute approximately 2% of the country's population, but it is believed that some 6% of the population fishes at least occasionally. The PAA is a powerful organization, and plays a significant role in formulating regulations regarding fisheries and water management. Like the SAA in Sweden, it is active in matters of water pollution and public relations with respect to the recreational value of sport fishing.

A paper by the Gdynia Marine Institute (presented at the Trondheim Recreational Fishing Conference in July 2005) stated that biological / environmental MRF research in the Baltics has been limited largely for political reasons: [www.mir.gdynia.pl/pliki/wed/r1.htm](http://www.mir.gdynia.pl/pliki/wed/r1.htm). However, there has been an increasing interest in MRF in Poland, and angling cruises take places all year round. To assess MRF (angling), the Gdynia Institute has used data on the number of anglers obtained since 1999 from the harbour captains, information from the Polish association of angling (PZW), and sampling data from the sea fisheries inspectorate (SFI) research projects that participate on angling cruises.

Of the 5 ports from which anglers tend to travel, data were collated only from Wladyslawowo, Darlowo and Leba. In 2004, the mean number of anglers were 11500 and 10800 in the ports of Wladyslawowo and Darlowo respectively, and the website shows an increase in the number of anglers using their facilities since 1999. In Leba, there has been an increase from 1999 to 2001, and then a steady decrease from 2001 to 2004 amounting to approximately 7,500. These changes could reflect poor data: some boats still have access to commercial fisheries and therefore are not registered as angling boats, and because insuring angling vessels as well as the passengers is expensive (and hence avoided?). Darlowo has fishing festivals and competitions and, with Leba, is becoming a popular tourist location.

The law currently states that no more than 7 cod per recreational angler are allowed in a 24-hour period ([www.mir.gdynia.pl/pliki/wed/rl.htm](http://www.mir.gdynia.pl/pliki/wed/rl.htm), 2005). Examines of length compositions suggest that anglers catch cod in the same length distribution found in commercial catches. Species such as herring, sand eel, garfish and scorpion fish are caught as a by catch. Data collected from 3 cruises on licensed sea angling vessels were used to estimate the mean weight of an angler's catch as approximately 3.51 kg for 2004 (2.89 kg in 2002 and 3.30 kg in 2003). Given the number of anglers, the estimated total catch of cod in recreational fisheries in 2004 was 174 t. Because 1.3% of the Polish TAC is for cod, and as this account for 0.25% of the eastern cod catches used in ICES assessments, the impact of marine recreational angling in Poland on cod stocks is considered to be negligible. However, there is still concern that, as with commercial fishing, marine angling contributes to the decline in cod numbers.

Most information on MRF is not within the public domain, and permission is required for any further use of the data (Gydansk has the copyright).

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## North Sea RAC (UK, Germany, The Netherlands, Belgium, Denmark, Sweden, Norway)

### Belgium

#### Description

Although sources on recreational fishing in Belgium refer mainly to freshwater, they also cover issues related to MRF. The capture of freshwater fishes in Belgium is essentially by hook and line with a dead or live natural bait or artificial bait, and it is considered to be a respected hobby that contributes a source of income, sometimes indirectly, for retail businesses and tourism. Fishermen may operate from the shore, from a boat, or by wading. In addition to angling, a number of other methods are authorized such as bow nets, eel pots and crayfish traps. FAO (Anon. Allocation of Fisheries Resources in Belgium.) estimated that there were 220 000 licensed fishermen out of a total population of almost 10 million work in 1980, and that recreational fishing was a growing pursuit. A socio-economic study currently in progress at the *Administration des eaux et forêts* has indicated that the average annual expenditure of a Belgian fisherman for fishing gear and equipment is >5 000 Euros per angler.

Although, there are a growing number of anglers in Belgium, it is difficult to differentiate between freshwater and marine activity in the limited reports of the research, which tends to be conducted holistically. The economic importance of river sport fishing is mostly through the businesses it supports such as manufacturers or wholesale distributors of fishing gear. There are approximately 800 such companies in Belgium. However, MRF provides a large proportion of the hotel clientele along the coast, and anglers visit many commercial camping grounds in Belgium. It is claimed that the increasing number of fishermen and the development of other activities related to the water (water skiing, sailing, etc) are more and more difficult to reconcile.

#### Participation and infrastructure

About 40 000 Belgian fishermen belong to some 600 local societies, which have common regulations to improve the protection and utilization of the fishery resources. These societies often form regional, provincial or inter-provincial federations that represent the fishermen in the provincial fisheries commissions. Most of the federations belong to the *Confédération belge des sociétés de pêcheurs à la ligne*.

The Belgian Fisheries Fund was created in 1954 (FAO, 1980) to ensure restocking of waters, strengthen surveillance, control pollution and improve fishing in general. The *Administration des eaux et forêts* controls the fund, and nine fisheries commissions at the provincial level and a national central committee were appointed to ensure collaboration between the fishermen's associations and the government ministries and agencies.

The fisheries commissions coordinate the efforts of the local or regional fishery societies to pursue common actions in the interests of fishing and aquaculture. They propose and implement projects to improve stream productivity, especially by fry production and restocking.

The Institute of Forestry and Game Management (IFG-IBW) carries out research on MRF in Belgium, but predominantly refers to game fishing, and much of the research is conducted within inland waterways around the Flanders region. The involved species (pike, burbot, dace and chub) have no commercial value (in Belgium), inferring that this activity is of recreational importance.

The results of a socio-economic study of fishing by the Fisheries Research Unit of the Institute of Zoology, University of Liège (“An explorative inquiry into sport fishing in Belgium.”), were based on a sample of 700 fishermen in the province of Liège during 1978/79 (where half of the fishermen belong to fishing associations and federations). According to the Gydnia Marine Institute, the principal results show that 9% of the 700 fishermen surveyed fished at sea.

There were 60,520 licensed anglers in the Flemish Region in 2004, down from around 120,000 in 1983 (Data Section Forest and Green, Belpaire, 2005). The number of licensed anglers in the Walloon Region was 65,687 in 2004 (Data Fisheries Service, General Directorate of Natural Resources, Ministry of the Walloon Region), and in the Brussels-Capital the number of licensed anglers was approximately 1,400 in 2004 (Data Brussels Institute for Management of the Environment).

Eel fishing is quite popular in Flanders, where 8.3% of the anglers are reported to fish exclusively for eels (De Vocht and De Bruyn, 2005). Eel fishing is not as popular in the Walloon Region (data from an inquiry from the Federation of Anglers in Walloon), where only 2% of the anglers are reported to fish exclusively for eels. Eel fishing techniques vary considerably between areas, the most common being with worms, live and dead bait on hooks. Fyke nets and square net fishing is also used and, on some waters, the traditional (hook less) bobber method is still popular. The catches and the number of eels retained have been considerably influenced by the obligation to catch and release them, a law introduced as a result of the high PCB levels measured in most Flemish eels.

There are no records of fishing effort, since these data are based on survey estimations or inquiries, and no official data on the catches of eels. A recent estimate of the total amount of fish (all species) taken from Flemish waters by recreational anglers was 431 t, 28% being eels (cited by De Vocht and De Pauw, 2005).

### **Perspectives and Opinion**

The Management Unit of the North Sea Mathematical Models have recently started to record recreational species and by-catch species (Haelters, 2004). A collaborative project with the EC-Life Nature programme (1999-2001) looked at the economic importance of tourism, as the restoration of Belgian beaches to their original ecological function, and the possibilities to establish a nature reserve including both the terrestrial and marine part of the environment. There appears to be a concern about the impact on seabirds of marine activities, including MRF.

## Netherlands

### Description

Marine recreational fisheries in the Netherlands include all non-commercial fishing in waters outside the so-called *Binnenwateren* (lit. 'inner waters', which include all freshwater in the Netherlands), and in Lake Grevelingen, which is saltwater but is dammed and tide-free. No fishing licence is required for MRF, except if carried out in L. Grevelingen. Though Smit *et al.* (2004) studied both fresh and saltwater recreational fisheries in the Netherlands, the latter are generally far less well documented than freshwater fisheries, and there are far fewer data available, possibly due to absence of fishing licence data. Hence, the report relies on interviews and literature studies. A large proportion of the fish caught by MRF are consumed, though a small quantity is sold.

In 2003 there was an estimated total of 1.5 million recreational fishers in the Netherlands, including 910 000 men (age 15 years or above), 460 000 children and 100 000 women, plus 100 000 tourists. One third of these were marine recreational fishers, 70% fishing in fresh and saltwater, and 30% exclusively in saltwater. Most recreational fishers live in the west of the Netherlands (North and South Holland, Zeeland and Utrecht provinces) where the population density is highest.

### Gears

MRF occurs in three geographically different regions of the Netherlands, aspects that determine to some extent the methods used. The *Kustvisserij* ('coastal fishery') in the Wadden Sea, a shallow estuary, is typically by rod-and-line from the dikes in the deeper parts between Den Helder and Harlingen (especially the Afsluitdijk), whereas it is from piers, breakwaters, seawalls or the beach itself along the North Sea coast of Holland and from dikes along sea-arms or from the beach in Zeeland. Rod-fishing from privately owned motor-boats (*Bootjesvisserij*) can vary from small open boats with light engines in quiet waters such as the Zeeland sea-arms or the Wadden Sea or within a few nm of the coast in the North Sea, to a smaller group that may fish >20 nm from the coast (e.g. to fish near shipwrecks), using boats mostly <6 m long (small enough to be transported by trailer) but nevertheless very sea-worthy, with 50–100 hp external engine, and equipped with navigation technology, GPS, depth meters/fish finders and sea survival equipment. About 22% of boat fishers have a mooring place in a port; the others use trailers.

The third category is *Opstapschepen* (lit. 'step-onboard vessels') where recreational fishers pay to fish offshore on charter vessels. For many people, this is a first introduction to MRF, since fishing equipment can be rented and a range of baits sold. Some of these vessels take 20–40 persons (at ~16 Euro each) to visit quiet waters such as the Wadden Sea and Oosterschelde, and have a large galley where, apart from sports fishing, being together and enjoying a drink can play an important part of the experience. The North Sea opstapschepen are usually larger (40–75 persons, ~20–30 Euro) and popular among those who seek larger catches and bigger fish further offshore. Most fish for mackerel in summer, whereas cod is targeted in winter, often near shipwrecks. In 2003, there were 25 North Sea opstapschepen, and about 15 smaller high speed charter vessels (6–12 persons, ~65 Euro) that can visit several wrecks in one day.

### Species

The most important species are flounder, sole, mackerel, garfish, eel, whiting, cod and sea bass. In recent years, catches of cod have decreased, whilst those of sea bass have increased, in line with the population dynamics of these species. The species composition in catches depends on method and

area. In the Wadden Sea, garfish are targeted, and flounder, whiting, sea bass, plaice and eel are also caught. In the North Sea, cod, mackerel, sole, garfish and sea bass are targeted, and flounder, dab, plaice and whiting are often caught. Off Zealand, sea bass and garfish are targeted, with flounder, plaice, sole, cod, dab, whiting, bib, mackerel and eel as a by-catch.

Of these species, dab, flounder, whiting, bib, mackerel and garfish have relatively low prices (<1.50 euro/kg) and are generally not sold by recreational fishers. Plaice and cod have intermediate prices (1.50–4.00 euro/kg), and whilst there is hardly any directed sport fishery for plaice, cod is sometimes caught in large quantities in a targeted recreational fishery especially near wrecks (see below).

Though eel and sole have higher prices (>4.00 euro/kg), eel is only caught in low numbers and for personal use. There is a targeted MRF for sole at night along the Zealand coast, but the catches are unpredictable and not sold.

However, from interviews with sport fishers, there appears to be a directed MRF for sea bass for marketing (there is no quota). This is motivated by the high price of sea bass (7.87 euro/kg in 2002) and increasing catches taken from small boats at a number of sites along the Dutch coast. Fish are regularly collected from small groups of anglers specialising in sea bass, and offered for sale to traders. The scale of this directed MRF is not known.

## Issues

A potential issue is that, with the current low population status of cod, estimated cod catches by MRF may amount to a substantial fraction of the Dutch North Sea cod quota, given that most cod caught are retained. Smit *et al.* (2003) provide provisional estimates (low/high) of total cod catches by MRF in 2003: opstapschepen ~99–198 t, small boats 62–135 t, land-based 25–75 t, i.e. in total 186–408 t; equivalent to 7.1%–15.6% of the Dutch cod quota (2619 t).

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## North Western Waters RAC (France, Rep. Ireland, UK,)

### Ireland

#### Description

Ireland is an important angling venue, having large areas of natural fishing in lakes, rivers and the sea, and over 250,000 people - locals and visitors, most notably, the UK, Netherlands and Belgium - are estimated to enjoy recreational angling in Ireland each year, where there are over 720 angling clubs (Sykes, 2001).

The main species of importance to MRF in Ireland are blue shark, sea bass, tope, skate and various rays, cod and, recently, bluefin tuna. Whilst salmon are not a target for MRF, there has been more scrutiny of commercial and recreational fisheries for salmon than all other species combined (see section 6). Even the European Commission has been involved in trying to reconcile the dispute between coastal commercial fishermen and recreational fishermen over allocation and conservation of the salmon resource.

A particularly important species for MRF in Ireland is the sea bass, which was traditionally taken by surf casting using a baited hook. Since the advent of regulatory measures in 1990 to protect sea bass by effectively closing down the commercial fishery (a minimum landing size of 40 cm - S.I. No. 128: Bass (Conservation of Stocks) Order, 1990, a bag limit of 2 fish per day per angler and a closed season from 14<sup>th</sup> May to the 14 June - Bass Fishing Conservation Bye-law No. 673 of 1991), there has been a rapid development of rods, reels and lines for lure and fly-fishing. This branch of sport fishing has benefited tourism and other service industries in areas such as Cork and Kerry in South-west Ireland.

In 2005, regulation (S.I. 353 of 2005 – Sea Fisheries (Tuna and Certain Other Species Fishing) Regulations 2005 – PRN A5/1102) prohibits fishing for tuna and certain other species by means of fishing gears such as gill nets, driftnets, bottom set gill nets, trammel nets and entangling nets, and thus offers Irish and international anglers the opportunity to fish for bluefin tuna on rod and line from various sea angling centres.

### **Participation and Infrastructure**

The Central Fisheries Board (CFB) is responsible for the conservation, management, and improvement of inland fisheries and sea angling. In recent years, there has been more focus on sea angling, but contacts in the CFB, and at Irish Sea Angling Accommodation and Charters, have not been particularly forthcoming. A recent CFB bulletin (Anon., summer 2005) focussed on gear and equipment to catch sea bass, and reported the increase in anglers over the years. This lack of information may be because the Irish angling sector is fragmented, and the changing dynamics of Irish society, government and the role of state bodies have resulted in new policies and procedures that have impacted on angling organisations. Being largely run by volunteers, these have found it difficult to deal with new initiatives and regulations.

With this in mind, the Irish Sports Council (ISC) hosted a meeting of angling bodies and other interested parties in May 2001 (Anon, 2005). The resultant group, the National Angling Forum, held further meetings in 2002 and, from the results of a questionnaire survey sent to representative bodies and hundreds of angling clubs, established Recreational Angling Ireland (RAI) in October 2002. Its aims are to develop an angling training programme; assist and secure new resources for development and support for national recreational fishing organisations; raise the profile of the recreational fishing sector; and provide technical advice on relevant issues. Though the RAI is focussed chiefly on game (salmon and trout - fly) fishing, the European Federation of Sea Anglers (EFSA) is a member.

Whilst the CFB provides a complete guide to angling in Ireland, the Regional Fisheries Boards (Eastern, Northern, North Western, Shannon, South western, Southern and Western) are the statutory regional bodies responsible for the conservation, protection, development, management, promotion and marketing of Ireland's inland fisheries and sea angling resources. Bord Iascaigh Mhara (the Irish Sea Fisheries Board) and the Department of Communications, Marine and Natural Resources are responsible for developing commercial fishing and aquaculture industries, and maritime transport, public safety, environmental protection and coastal zone respectively, but it is not apparent that they have any responsibility for MRF.

## Issues

### *Catch and Release*

The CFB Sea Angling Unit co-ordinates the Marine Sport Fish Tagging Programme, which encourages charter skippers and anglers to tag and release the fish they catch in order to provide data on the migrations of the fish and to conserve stocks. Conservation Awards were introduced by the CFB in 1992 as an incentive scheme for charter skippers to tag and release marine sport fish. Points are awarded for different marine species, with the rarer fish such as porbeagle shark and common skate receiving the highest points. Some 70 charter skippers took part in 2004, when over 1,000 fish were tagged. Since 1970, a total of 36,587 fish have been tagged and released, including 17,419 blue shark, tope, angel shark, common skate, thornback ray, undulate ray, and blonde ray (Anon-website, 2005). This programme is the second largest in the world after the U.S.A.

The CFB also issues publicity to stimulate angler interest, for example 'the first angler to catch the blue shark' (Anon-website, 2005) 'increased codling catches' (unknown-website, 2005), and provides factual information about the individual species and promotes the aims of the tagging programme.

### **Perceptions and Opinions.**

The RAI has initiated and sponsored a young anglers training programme to encourage 12- 18 years olds into angling (Anon., 2004). Instruction and demonstrations are given on safety, the environment, good waterside manners and on specific types of angling appropriate for each location, including the sea. The events resulted in many new young recruits for local angling clubs.

In January 2006, the RAI launched its 'Handbook of Angling Club Organisation'. Its purpose is to guide angling clubs towards better management, improved communications, proper regulation and transparent financial accounts. Topics include: membership, the committee, finance and funding, enjoyment and access, competitions, catch and release, and insurance, with a 'Code of Conduct'.

The Irish government has committed 30 million Euro in an Angling Investment Plan (1996) recognising that angling is uniquely placed to help the lesser-developed areas of the country derive social and economic benefits from angling. This programme extends previous work to develop recreational angling tourism to training, promotion and marketing, and includes protection, conservation and sustainable development of fisheries resources and habitats, for coarse, game and sea angling (though it is difficult to identify the actual support for the latter).

### **Competitive angling**

The Irish Specimen Fish Committee maintains and encourages anglers to submit records fish of a number of sea (and coarse and game) species. The identification of a fish must be fully documented, including close-up photographs and, for some species where there is a possibility of confusion, scales or the actual body must be forwarded as proof of identification. "Merit Badges" in the case of Specimen Fish and Silver Medals in the case of Record Fish and Certificates are awarded to encourage anglers to participate in this scheme.

Given the absence of a general monitoring programme, this information is a useful guide to the numbers of visiting anglers, their success rate, and the status of some species. For example, in the latter half of

2004, many sea angling days were lost to windy weather, and it was one of the worst years for blue shark since 1970 with less than 100 fish caught and no specimens claimed (Champ, 2004; ISFC reference, Annual Report 2004). In 2004, records were also created in two new categories, golden grey mullet and red mullet, whose appearance on the Irish coast is thought to be a sign of warmer water temperatures.

## United Kingdom

### Description

The diverse coastline of the British Isles ranges from the warmer climate of Cornwall and south Devon to the cold water of the North Sea and provides a wide variety of target species for MRF. The most recent study on sea angling in the UK was by Drew and Associates in 2003 for the Department for Environment, Food and Rural Affairs (Defra), which focussed on social and economic aspects of angling in England and Wales (Drew, 2004). The survey revealed that nearly 70% of anglers caught round white fish such as cod and sea bass, whilst 10% caught flat fish such as flounder and 20% caught mackerel. There were significant differences ( $p < 0.001$ ) between types of fishing, with shore anglers catching and retaining fewer fish than boat anglers (Table 3.7). It might be anticipated that boat anglers would retain a higher proportion because they have greater opportunities to target fish of a size and species they may wish to retain.

**Table 3.7: Number of fish caught and proportion retained at the usual fishing area (mean per trip) (Drew, 2004)**

	Shore	Charter boat	Own boat
Number caught	5.11	12.52	12.94
% retained	32	38	39

According to the National Association of Sea Angers (NFSA), the order of preference and frequency of capture of marine species in the UK is as follows:

	<b>Preferred species</b>	<b>Caught species</b>
1	sea bass	mackerel
2	cod	cod
3	mackerel	sea bass
4	flounder	dogfish
5	pollack	whiting
6	bream	flounder
7	mullet	pollack
8	whiting	pout
9	ray/skate	bream
10	conger eel	mullet
11	dogfish	ray/skate
12	plaice	conger eel
13	tope	silver eel
14	sole	wrasse
15	smooth hound	tope
16	wrasse	plaice
17	pout	smooth hound
18	dab	dab
19	shark	sole
20	ling	ling
21	turbot	coalfish
22	silver eel	huss
23	haddock	gurnard
24	huss	haddock
25	coalfish	turbot
26	gurnard	shark

## Participation

Drew (2004) estimated that there are around 1.1 million sea anglers in England and Wales (2% of the total population), who fish from beaches, harbours, piers, and from boats both close to shore and offshore over wrecks, and together spend £1 billion a year on their sport (<http://www.nfsa.org.uk/>). An Omnibus survey used a sample of 10,200 households in England and Wales to identify the sea angler population and their activities. An additional 383 member of (30) angling clubs and 514 sea anglers on angling trips in 12 regional locations were used to obtain information on types of angling activity, number of visits, expenditure and consumer surplus. Four case studies produced descriptive information on the characteristics of sea angling, its economic contribution, trends and factors limiting development of the sector. Finally, a business survey was carried out with 162 tackle shops, charter skippers and boat equipment suppliers.

Table 3.8 suggest that a substantial amount of time is spent on recreational sea angling activity (days fished) in England and Wales. There are significant differences in the number of days fished by different angler groups, with shore and boat anglers spending most time on the activity. However, few days were spent fishing more than 50 miles away from home, ranging from a mean of 3.56 days per year for anglers with their own boat to 13.90 days for anglers who fished both from boat or shore.

**Table 3.8. Days sea angling per year (Drew, 2004)**

### Mean days spent sea angling

Fishing venue	Face to face interviews	Club postal questionnaires	Days spent >50 miles from home
Shore	64.0	65.7	7.48
Charter boat	30.3	23.3	6.79
Own boat	78.0	45.2	3.56
Equally boat / shore	46.4	52.1	13.90

From the above, it is apparent that information on MRF in the UK only concerns angling, but there are many people who collect shellfish or use small boats to set a few pots, small nets or lines to catch fish for household consumption. These are not recognised by law (other than being unable to sell their catch) and there is no published information on their activity.

## Infrastructure

Unlike some other European countries, MRF has contributed little toward fisheries management policy in the UK, where it operates under an open access system in which the government has focussed on controlling effort and catches in commercial fisheries. Whilst the extent of commercial and recreational freshwater fishing can be gauged in England, Wales and Northern Ireland by the number of rod and commercial licences issued (there is no rod licence in Scotland), there is no licensing scheme for MRF. This makes it difficult to estimate the impacts of MRF on fishing mortality at a national level, though this information is becoming increasingly of interest to fisheries managers. For example, sea anglers' catches

of sea bass in England and Wales in 1987 were of the same magnitude (415 t) as commercial landings (630 t) (Dunn *et al.*, 1989).

### **National Federation of Sea Anglers (NFSA)**

The NSA, founded in 1904, is recognised as the official organisation for the sport of sea angling in the UK, and 516 sea angling clubs are members of the NFSA. It relies on its members to report cases of denied access, pollution, dumping of industrial waste and dredging of shingle, and part-sponsors a Safety at Sea Code and has developed conservation codes on bait gathering and sea angling that are approved by the government (Uttley, pers comm.). Junior members are encouraged through award schemes for skills and participation, and the NFSA operates a Specimen Fish Award Scheme by providing certificates and medals. It acts as the secretariat of British Records for Sea Fish for ratification by British Record (rod-caught) Fish Committee, organises National Festivals, and sponsors official teams to represent England at Home and World Championships for Boat, Shore, Ladies Shore, Junior, Big Game fishing and Casting (see Portugal).

The NFSA Conservation Group (UK) reports reductions in recent years in the size and number of the fish anglers target (notably cod, monkfish and rays, but not warm water immigrants such as sea bass), together with increased restrictions on access to beaches and estuaries, attempts on environmental grounds to stop bait digging and attempts to create no take zones for anglers. They strongly encourage Defra to implement schemes such as those mentioned in the Ireland section, and produced a set of actions in 2004 to have:

1. Representation commensurate with economic importance and participation level in the Recreational Sea Angling (RSA) sector, increased representation of shore, private and charter boat anglers and the tackle trade on Sea Fisheries Committees that manage the inshore fisheries up to 6 miles of UK coasts along with management over environmental issues.
2. A total ban on trawling and the use of gill nets within one mile of UK shore and around some wrecks to ease pressure on fish stocks and ensure access anglers.
3. Increased Minimum Landing Sizes (MLS). The RSA sector is much more influenced by the size of fish than the commercial sector, and the current trend to fish just over the MLS is thus detrimental to the RSA sector.
4. Establishment of areas where commercial fishing is excluded and RSA takes place under agreed guidelines.
5. Promote some species, such as sea bass, conger eels, dabs, flounders, small sharks, rays and grey mullet to be considered RSA only. These have a huge influence over RSA spend levels, but may have little value to the overall UK commercial sector.

A report from the Prime Minister's Strategy Unit produced a wide ranging set of recommendations to ensure the UK has a sustainable fishing industry and included, for the first time, suggestions for developing RSA (NFSA, no date). As a result, several NFSA Conservation Group members are representing RSA on workgroups set up by Defra to develop plans for the future.

The group has also been involved with a wide range of activities supporting RSA, including:

- involvement with the Invest In Fish SW project to develop a plan for best use of the use of the marine environment in south west England.
- submitting detailed responses to 8 Government consultation papers concerning the future of our fish stocks and inshore fisheries.
- briefing of fishery ministers and shadow ministers on RSA issues.
- representation on the European Anglers Alliance, the only RSA voice in Brussels.

### **Bass Anglers' Sportfishing Society (BASS).**

BASS was formed in 1973, and has members from all parts of the British Isles and further afield. BASS has been campaigning for the conservation and improvement of the recreational sea bass fishery, including the designation of sea bass nursery areas in river estuaries, harbours and power station outfalls where juvenile sea bass usually predominate and are most easily caught, and where they would receive additional protection from fishing. However, lobbying by sea anglers generally resulted in sea bass fishing being prohibited seasonally only from boats in the 34 nursery areas designated in 1990 (plus an additional 3 in 1999), since they insisted on their right to fish freely from the shore (MAFF, 1990).

### **Sea Anglers Conservation Network (SACN)**

The SACN promotes recognition of recreational sea angling as an important economic industry with an equal right to enjoy the sea as commercial fisheries. The web-page (<http://www.anglers-net.co.uk/sacn/>) provides news of current campaigns, details of existing organisations, on-line forums and advice on MRF, and differs from other MRF links in that it encourages anglers to compile accounts of the nuisances suffered (i.e. "If you've ever spent a fishless session, only to see a boat arrive to pull in the gill net 50 yards from the beach, if you've ever seen a boat unloading spawn-laden sea bass by the t, if you've pulled flatfish from the sea covered in sores, and if you've ever felt that 'someone has to do something', but powerless to do anything yourself, then here's the place to start"). Although aimed primarily at recreational anglers fishing UK waters, it recognises that these problems are shared with anglers in mainland Europe and that there is much to learn from the conservation achievements of anglers from places like Australia, New Zealand and the United States.

### **The Shark Trust**

<http://www.sharktrust.org/default.asp?home=1>

The Shark Trust is a registered charity established in 1997 in the UK, dedicated to promoting the study, sustainable management and conservation of elasmobranches. The Trust works with the public and a wide range of specialists groups including divers, boat owners, politicians, recreational and commercial fishermen through scientific research campaigns and education programmes to provide guidance, facilitate decisions, influence legislation and raise public awareness of sharks and rays at a national and international scale.

The Trust is working to secure the protection of several large species of skate and the angel shark under the current review of the Wildlife and Countryside Act, 1981 and The Wildlife (Northern Ireland) Order, 1985 and, with Defra, the World Wildlife Fund and the Wildlife Trusts to highlight the short and long term needs of the common skate and basking shark through Species Action Plans.

The Shark Trust aims to contribute to the better management and conservation of British skates and rays, through tagging of common skate; liaising with anglers through the 'South Coast Skates and Rays – Angling for Data' project to investigate population trends; liaising with Sea Fisheries Committees; producing field guides and raising public awareness of skates and rays around the British coast; whilst campaigning for maximum landing sizes and enforcement of appropriate management measures.

### Perceptions and opinions

According to Crabtree *et al.* (2004), the main factor for development of the angling sector in the UK is the quality of the fishing experience, associated with the size and the number of fish caught, though anglers also suggested that future development would be based upon the level of facilities available (e.g. car parks) and associated costs. In England and Wales, club-based MRF activities were reported to “generate increased community spirit” and members “strengthen the democratic ethos in society”. Other social impacts reported include: “angling enhances social capital”, “is a healthy pastime” and “provides anglers with a greater appreciation of the environment”.

Respondents also commented on changes in the numbers of fish caught over the last 15 years. Of the positive responses, 83% and 70% thought that there had been a decrease in fish numbers over the last 15 years and 5 years respectively. Fewer than 5% considered that numbers of fish caught had increased over the last 15 years. The perception appears to be that declines in fish catches are not confined to some historic period but are continuing.

### Issues

Recreational fishing from both the shore and boats within the coastal zone conflicts with many of the other uses of the marine environment, as does the associated activity of bait digging. A common recognised conflict is in relation to exploitation levels of fish stocks and gears used, but conflicts also arise between recreational fishers and bathers, conservationists, sailing and motor boating, wind surfers, jet and water skiers, commercial traffic, and over port/ landing facilities with other boat users.

### Bait digging

A number of links ([http://www.rspb.org.uk/international/albatross\\_appeal/solutions/index.asp](http://www.rspb.org.uk/international/albatross_appeal/solutions/index.asp)) ([http://www.nationaltrust.org.uk/main/w-vh/w-visits/w-visits-activities/w-visits-activities-other/w-activities-other-bait\\_digging.htm](http://www.nationaltrust.org.uk/main/w-vh/w-visits/w-visits-activities/w-visits-activities-other/w-activities-other-bait_digging.htm)) express concern over digging lugworms and gathering crabs for bait. They mention research by the Royal Society for the Protection of Birds on the consequences of bait digging, including:

- Damage from mechanical harvesting.
- Hand digging can cause population decline of target species (e.g. lugworms (*Arenicola*, spp), ragworms (*Nereis* spp) and crabs), which are usually temporary and/or localised but can be

serious if large quantities are taken, trenches are left open, no unexploited areas are left or original population is localised.

- Habitat damage, especially through boulder-turning, will have detrimental effects on populations of non-target species, especially the larger and slow-growing species (marine invertebrates and flora).
- Disturbance of birds and removal of their food resources.

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## South Western Waters (France, Spain, Portugal, Azores, Madeira and Canary Isles)

### Portugal and Azores

#### Description

There has been a rapid expansion of MRF in Portugal over the last 20 years, and though it is recognised to have important social and economic values (along with the multiplicity of pressures affecting fisheries), information is still inadequate to formulate management actions (Marta *et al*, 2001). A survey of freshwater recreational fishing the Guadiana River Basin carried out in 1998 provided information on anglers' preferences and arguments supporting recreational fisheries as a whole, and recommended improved mechanisms for future development and management of recreational fisheries (Marta P. Bochechas J. Collares-Pereira M.J.).

Almeida do Vale (2003) describes the types of gear and bait used by sports fishers in the Lisbon area, and notes that there is no regulation or licensing to enforce MRF legislation in Portugal (e.g. undersized fish are landed). Coastal fishing in Portugal mainly takes place from rocky cliffs or from sandy beaches and from sea walls and defences. Line fishermen (anglers?) can register with the Portuguese Federation for Sports Fishing (FPPD), which was created in 1947 and has 1247 members. The FPPD is responsible for national competitions and Portuguese participation in international tournaments in which Portugal is increasingly active (see below).

Almeida do Vale's (2003) bibliographic research revealed a limited availability of scientific documents, but reviewed information collected via a questionnaire survey in the field, online, and on a fishing-related website. A total of 94 questionnaires were completed covering socio-demographics of the fisherman, the type of gear used and the species captured. Lacking a fishing licence system, it was not possible to know the target population size or to determine whether the sample is representative. There were few replies from women fishers, and only 5% of the fishers registered with the FPPD are female. Most of the respondents fish from cliffs or sea walls, using lines. Fishing from a boat is not as popular, although half the respondents do or have fished from a boat, usually rented. Most of the fishers use natural bait, but few of them catch their own bait, preferring to buy it.

Lopes (2004) carried out interviews and roving creel surveys of artisanal and sports fisheries in the Tagus (Tejo) estuary. He infers the economic importance of sports fishing in Portugal, although data are not presented in the report.

Oliveira and Erzini (submitted) presents the results of a survey of sports fishing in the north of Portugal, using questionnaires on socio-economic characteristics of the target population to describe fishing activity including preferred fishing gear and most important species, and creel surveys. It discusses the management perspective, but this is not yet published (and undergoing revision).

## Participation

### *Angling tournaments.*

The Sports Fishing World Cup is held in Madeira, but we have found little published information about it despite an EU-commissioned study carried out by Madeira Regional Fisheries Directorate for 2 years on the catch composition of sports fishing (we are trying to obtain the report). There is, however, extensive information about the 2006 World Championships that will be held in Portugal in September 2006. Links to sources are given in Annex 2.

There are many companies operating sports fishing excursions in Madeira, in the Azores and in the rest of Portugal (for examples, see: <http://www.fishmadeira.com/>, <http://www.madeirabiggame.com/index.php>, <http://www.atlantic-sportfisheries.com/eng/>, <http://www.biggamefishing.info/index.htm>, <http://www.designars.com/pescamar/>), where .

numerous competitions and tournaments are organized, many of which are international. For example, the site <http://www.nauticapress.com/modules/news/article.php?storyid=217>, reports that in July 2006 a Portuguese team, JOCANANA, taking part in the World Cup Blue Marlin Championships, caught a blue marlin weighing 288 kg in the Algarve, south Portugal. However, participants in this competition can fish anywhere, as the winner this year caught his 386 kg fish in Cape Verde. The organiser's winner's archive (<http://www.blumarlinworldcup.com/winnersarchive.html>) shows that the winning fish were all caught in Madeira in 1995, 1996 and 1997, whilst 4 of the 12 available charter boats for this competition are Portuguese (<http://www.blumarlinworldcup.com/results.php>).

A major event presently being organised by the FPPD and the Portuguese Federation of High Sea Sports Fishing (FPPDAM) is the 2006 II World Fishing Games (<http://www.portugalfishing2006.com/>). These include World Championship marine events for Under 16, U21, Women and Senior Shore Angling; U21 and Senior Boat Angling, Big Game Trolling and Scuba Hunting. In mid August 2006, there were about 1500 registrations for this event, each paying between 500-1000€ to cover transport, accommodation and meals.

The FPPDAM is responsible for all the boat angling events, which will take place in the Azores and involve 22 big-game teams, 18 senior boat angling teams and 8 junior boat angling teams from 21 countries (including the USA; Egypt, Angola, South Africa and Mexico). Each team pays between 5700-6600€ for transport, hotel and meals, boat rental and other local costs. This competition is very important to the local economy (Eduardo Cunha, President of FPPDAM, pers comm.).

The FPPDAM promote sustainable fishing and set out guidelines for their members to compensate for the lack of national regulation. These include fishing for a maximum of 5 hours and using no more than 3 hooks. The European Federation of Sea Anglers (EFSA) has a delegation in Portugal (<http://www.efsaportugal.pt>) and has numerous events for 2006 listed on their calendar (Table 3.9).

**Table 3.9. International tournaments held in Portugal in 2006 (Gordoa, 2004)**

Competition	Location	Date (2006)	Number registered	Registration fee*
IV International competition of High Sea Sports Fishing	Albufeira (Algarve)	10 <sup>th</sup> June	82	100€ (without boat), 60€ (with own boat)
I International Tournament of High Sea Sports Fishing	Ílhavo (Central Portugal)	1 <sup>st</sup> / 2 <sup>nd</sup> July	100	90€ (without boat), 40€ (with own boat)
II Big Game Fishing	Albufeira (Algarve)	25 <sup>th</sup> / 27 <sup>th</sup> August		400€ / team
II Open EFSA Big Game Fishing	Vila Franca (Azores)	1 <sup>st</sup> / 4 <sup>th</sup> September		400€ / team
III International Tournament of Big Fish <a href="http://www.torneiopescalagos.com">www.torneiopescalagos.com</a>	Lagos (Algarve)	22 <sup>nd</sup> / 24 <sup>th</sup> September	Maximum 20 boats	380€ / team
2 <sup>o</sup> International Tournament of Marine Sports Fishing	Cascais (Lisbon region)	14 <sup>th</sup> October		

\* does not include accommodation or meals.

## Issues

Whilst a few Portuguese recreational fishermen use catch and release, most eat the fish they catch. Their main concerns are pollution, the lack of regulations and thus enforcement for sports fishing and, in particular, the lack of respect for minimum landing sizes. There is also conflict with professional fishermen, who think the sports fishermen do not respect regulations.

## Spain.

### Description

There is little available information on MRF in Spain, though we know that sea bass, for example, is an important target species along some parts of the Atlantic coastline (Pickett and Pawson, 1994). Targeted bluefin tuna catches taken on a variety of gears in Spain averaged about 2,500 for the last two years, but those most popular gears used in MRF are hand lines and long lines which took approximately 27% of the total catch of bluefin tuna in 2003 (Gordoa, 2004 SFITUM n°02/C 132/11/41 Final Report December/2004).

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## Mediterranean RAC (Spain, France, Italy, Greece, Malta, Cyprus, Slovakia, Slovenia)

### Mediterranean: General

#### Perceptions

In the Mediterranean, the term “sport fishing” has been used widely in place of recreational fishing, implying (erroneously) fish being landed by non-professionals. The definition of sport fishing, as an organised competitive rule-based activity to catch the largest number or heaviest fish of a certain species, may have little relevance to MRF in the Mediterranean. However, MRF is understood to be a fishing activity that is performed with no intention of selling the catch, the intention being recreation, sport or tourism fishing, which can be conducted by tourism professionals (*pesca turismo*) or by recreational professionals (charter vessels).

An FAO report (GFCM, Cacaud, 2005) considered the increasing importance of recreational fishing in several countries in the Mediterranean Sea, simply describing recreational fishing as ‘entailing all types of fishing activities including sport fishing activities undertaken by individual, with or without a boat, for leisure purposes, and does not involve the selling of fish or other aquatic organisms.’ The report also emphasises the access regimes governing MRF, and considers the Mediterranean holistically as opposed to just EU member states, which share the resources with African countries.

#### Participation

In an evaluation of the implications of recreational fishing upon coastal resources, Moralis-Nin *et al* (2005) estimated that approximately 38,000 people (5% of the fishing population) participate in MRF and account for 10% of the total fish catch. Given the large number involved in this activity, MRF may exceed commercial activity. Both commercial and recreational fisheries share the same demographic and ecological and economic implications (Coleman *et al*, 2004).

#### Issues

As tourism has grown in the Mediterranean, interest in MRF has increased, and there has been a growing concern about its impact on fish stocks and the commercial fishing sector. In response, EU member states have regulated recreational fisheries within their national jurisdiction of the 12 nm limit to comply with the Common Fisheries Policy (CFP). Thus, restrictions such as minimum legal length, prohibited species, protected areas and closed seasons are applicable both to commercial fisheries and the recreational sector and some legislation restricts the number of vessels and the type of gears that are used by recreational fishers. Typically, fisheries legislation establishes three types of access regimes for individual recreational fishers, recreational boats and divers.

#### Fishing gears and methods

Regulation of fishing gears in the Mediterranean coastal states is designed to prevent fishers using destructive gears and methods of fishing. A common approach is to compile a prohibited list of destructive methods: explosives, electrical devices and toxic substances. Some states, such as Slovenia, permit gears to be used that have special authorisation and specify gear use (e.g. length) and conditions of their use (area and depth).

In one of the first specific regulations (*decree 154 and 155/1986, 9<sup>th</sup> October, BOC 17 October*) related to fishing gears in the Mediterranean, the *cofradias* (non profit organisation that represents all of the fishing sector) stated that certain techniques were impacting the marine ecosystem negatively. As a result of this, lines fished around the Spanish archipelago fishing grounds have been restricted to 500 hooks per day.

Although research conducted on both biological and socio-economic aspects of MRF in the Mediterranean is limited (Gordoa, 2005 and Moralis-Nin *et al.*, 2005), management measures have been implemented. For example, the Balaeric legislation limits effort (though gear restrictions and bag limits) and there are closed seasons for certain species. Although there are no data available on catches (licence holder records are not official), some species are probably over exploited, and the grouper has increased in abundance in shallower waters following the implementation of closed areas.

Data from 813 on-site interviews showed that 60 cephalopod and 60 fish species belonging to 28 families were caught (boats: 54 species; shore fishing: 34; spear fishing: 29). Yield per trip was estimated to be between 1 and 3 kg for both boat and shore fishing. The percentage of anglers catching more than 10kg per trip was 7.7% from boat angling and 5% from shore fishing. The catch was taken predominantly in the summer corresponding to the highest level of effort. Detailed estimates from the survey responses and are given in Table 3.10 below.

**Table 310: Summary of fishing effort and yield by MRF method in the Mediterranean. Effort is expressed as total number of fishing outings per year, mean number of gears used concurrently by a single fisher, and mean number of hours fished per day. (EU Project 96/18, 1996)**

Method	Share (%)	Outings per year	Gears per fisher	Hours per trip	Catch per trip (kg)
Boat fishing	62.9	387,000	1.24	4.05	4.16
Shore-fishing	33.4	205,550	1.31	3.42	4.03
Spear fishing	3.7	22,320	1.49	4.18	4.48

During competitions, anglers spent 4.1 hours fishing from a boat and 4.2 hours fishing from the shore. Mean catches (number of fish per bag) were much higher for boat fishing (45.8) and for shore fishing (26%) than for spear fishing (4.39), whilst mean catch per trip (kg) was highest for boat fishing (2.45) and spear fishing (2.26), and lowest for shore fishing (1.5). Clearly, shore fishing accounts for many small fish, and spear fishing for relatively few, large specimens.

## Issues

### Conflicts

(<http://www.oceansatlas.org/servlet/CDSServlet?status=ND0yNjI1JmN0bl9pbmZvX3ZpZXdfc2l6ZT1jdG5faW5mb192aWV3X2Z1bGwmNj1lbiYzMz0qJmM3PWtvcw~~>)

In Greece and Italy, the most serious source of conflict between recreational and commercial fishermen is competition for space (mooring places and valuable fishing sites), followed closely by market competition.

In addition, conflicts also arise from the vagueness of the legislative provisions regarding allowed recreational fishing gears. Whilst professional fishermen object to the use of nets and long-lines by recreational fishermen, recreational fishermen say their use should be encouraged.

The conclusions of a collaborative research project between Greece, Italy, France and Spain to define the biological and socio-economic importance of sport fishing in the Mediterranean region, have been published via the websites [www.lamans.gr](http://www.lamans.gr) or [www.irpem.it](http://www.irpem.it). It appears that MRF is undoubtedly socio-economically important in the Mediterranean Sea, but despite attempts to establish the numbers involved, Moralis-Nin et al. (2005) stated that figures were underestimated and the magnitude of environmental and socio-economic impacts are not well known. Existing fishery management measures based around effort control do not consider MRF, despite this being responsible for a considerable effort expended and a commensurate catch. Clearly, planning and implementing of a comprehensive management strategy for fisheries must include considerations of the socio-economic repercussions for MRF, which need to be weighed against investments in resource protection.

## Cyprus

### Description

The fishing industry has only a relatively minor direct impact on the economy of Cyprus, though it is significant as a source of fish (to eat) for the tourist industry. In some communities, however, fishing is an important means of livelihood or as a secondary, seasonal occupation. Boat building is well established. Like the rest of the eastern Mediterranean, waters around Cyprus are rather impoverished and the fishing grounds are probably fully exploited (Stephanou, 1980).

Cyprus has no legal definition for sport fishing, which is considered a leisure activity in reservoirs and the sea and attracts the town dwellers and villagers equally, though the latter fish primarily fish to eat and to a lesser extent to simply catch and release. Stephanou (1980) focuses largely on freshwater recreational fishing, and notes that sport fishing also contributes considerably to the attraction of tourists in the area of the reservoirs.

No licence is required for sea angling in Cyprus, or for fishing with hand lines, trolling or spear fishing without the use of diving equipment. In contrast, the use of aqualungs when spear fishing, fishing with nets, longlines and traps, fishing at night with spear guns, and any kind of commercial fishing require a licence.

All Cyprus-flagged commercial fishing vessels require an annual fee-paid fishing licence. Regulations for the management of fish stocks and fishing activities include the specification of closed areas and seasons, minimum size of fish, gears and methods of fishing and nets and meshes, and can encompass recreational fishers as well as commercial fishers.

### Participation and Infrastructure

Sport fishing in the sea is quite popular and it was estimated that about 300 people practiced sport fishing from a boat and invested \$2 million in gear and boats in the 1980s. There are no data referring to fishing with rod and line from the shore, although this is the most popular mode of sport fishing among the lower paid class and several thousands of people are practicing it (EU Studies 96/018). Six angling clubs, run

mainly by foreigners, are in close contact with the Department of Fisheries, which facilitates the release of information to anglers, and their opinions are taken into consideration on issues affecting sport fisheries. It also provides navigation charts to the public and builds fishing harbours providing shelter and facilities to fishermen.

Boats used for recreational purposes are also sheltered in marinas that are under the control of the Cyprus Tourism Organization, with which the Department of Fisheries cooperates to encourage angling and organize angling tours for foreigners. Boats and/or guide services for those interested in sea angling, etc can be rented in all harbours, fishing stations and most of the tourist installations along the seashore. Most of the world-famous angling equipment firms are represented in Cyprus, where a variety of fishing tackle can be bought at reasonable prices. An angling magazine called "The Cyprus Angler" is published privately.

### France (Mediterranean coastline)

In France, it is the responsibility of local authorities to establish daily bag limits within their area of jurisdiction. Sykes (2001) noted particular issues in relation to commercial and recreational fisheries that include recreational fishing rules not being adhered to, competition for space, coastal development (including industrial spoil and farmland run off), and the conflict between portrayal of a worked fishing port and a picturesque harbour (for tourists).

## Greece

### Description

Greece legislation requires recreational fishermen fishing from a boat to have individual and boat-fishing licences, but provides no autonomy to regional authorities to regulate recreational fisheries. A report (EU Project 96/18) compiled by Anagnopoulos Planning Consultancy (APC Ltd) and Istituto di Ricerche sulla Pesca Marittima (IRPEM) estimated that there were 27 841 participants in MRF, based on the number of individual licences that were issued in 1994. This EU Project 96/18 used two datasets to estimate the average annual number of recreational fishermen, one of which was census data from the National Statistical Service of Greece (NSSG) and the other through contacting the Port Authorities at all registered ports in the country. The demographic profile suggests that MRF is predominantly male dominated, but the population of women around larger cities such as Athens suggests (3.11) that women were probably underrepresented in the survey. About half of the respondents were retired, 35% were workers and 15% were employees.

The 1996 census in Greece, initiated by the Ministry of Merchant Navy Marine, estimated the number of recreational fishermen at approximately 96,000 and the number of vessels that hold a fishing licence at 71 100, with an average engine power of 20.5 hp. The corresponding numbers of professional fishermen and boats were 15, 633 and 7, 361 respectively. Although not all recreational fishermen were surveyed, and the figures may therefore be underestimated, the authors (Anagapoulos Consulting) considered that the recreational sector might not actually be so much larger than the commercial sector.

**Table 3.11: Characteristics of the fisheries organisations that completed questionnaires on MRF in Greece (EU Project 96/18).**

Region	Name of organisation	Locality	Members	Vessels	Men	Women
Attiki	Athlitiki Enosi Voulas	Voula	150	100	40	10
	Erasitexnikos Nautikos Athlitikos & Alieftikos Syllogos Selinion	Selinia	150	80	140	10
	Nautikosathlitikos Omilos Ag. Mar. Kor. Kekrops	Peiraias	250	150	230	20
	Nautikosathlitikos Omilos Delfinario	Peiraias	50	50	50	
	Nautikosathlitikos Omilos Tzitzifion	Kalitheia	500	100	450	50
	Omilos Erasitexnon Alieon & Nautikon Athlimaton Peiraia	Peiraia	150	70	150	
	Prrooeutikos & Alieutikos Syllogos "Agios Eleutherios"	Salamina	30	30	30	
	Somateio Erasitechnon Alieon & Nautikon Athlimaton Tzitzifies Kalitheas	Kalitheia	180	100	180	
	Syllogos Erasitechnon Alieon "To Maroudi"	Salamina	60	60	45	15
Syllogos Erasitechnon Alieon "O Agios Nikolaos"	Salamina	107	107	102	5	
Pieria	Erasitexnikos Syllogos Alieon Pierias "To Delfini"	Katerini	277	100	257	20
Kavala	Syllogos Erasitechnon Alieon "Aithria"	Thassos	80	80	80	
	Syllogos Erasitechnon Alieoon "O Triton"	Kavala	210	210	209	1
	Syllogos Erasitechnon Alieon N. Irakleitsas "arethousa"	Nea Irakleitsa	150	150	150	
Cyclades	Syllogos Erasitechnon Alieon Parou-Antiparou	Paros	80	80	78	2
	Syllogos Erasitechnon Alieon Syrou	Syros	150	150	150	
Total			2574	1617	2441	133

The majority of the vessels used for MRF were 4 – 6 m in length and between 6 and 15 hp and they fish an average of 77 days per year with effort concentrated in the spring and summer, when the activity is concentrated around the Aegean Islands. Average daily catches are about 2kg/day and estimates of the annual catch ranged between 163 and 194 kg. The total annual production is about 19,000 t. Hand/long lines and set nets are the most widely used fishing gear. Species of major interest to the recreational fishery are jacks, red pandora, bogue, striped sea bream, large-eyed dentex, horse mackerel and Couches sea bream.

In Greece, all persons using a boat for MRF require individual and boat fishing licences, though those fishing from the shore do not need a licence. Anyone under 18 years of age also requires signed permission from his or her parents or guardians. Regular fishers are required to also obtain a fishing licence booklet. General prohibitions relating to sport fishing include fishing during the night, fishing with any source of light (unless spear-fishing), selling any fish caught and angling using more than 1 rod. There are also restrictions on the size and total weight of the fish that a sport fisher is permitted to retain.

A vessel licence is required for commercial fishing, and commercial activities not involving a vessel are only permitted for corals, shells and sponges, otherwise a vessel licence is required. Management measures include provisions pertaining to fishing gear, fishing practices and fishing seasons and areas, including closed seasons and areas for bottom trawl fisheries, purse seining, boat seining and dredging and specifications as to the size and type of gears that can be used.

### **Gear**

Men aged between 30 and 60 owning their own boats dominate MRF and, with rare exceptions, operate in the coastal zone. Their vessels are usually between 4 and 6 m in length, and few are longer than 6m pr over 15 hp. Hook and line is the most common method used, and the gear is usually reflects the tradition of the local fishing conditions. For example, the 'syrti' (trolling line) is common in Pieria and Kavala, though the survey conducted by APC Consulting (EU Project 96/018, 1997) stated that long lines and set nets are the preferred gear.

Annual fishing expenditure varies greatly among fishermen, areas, size and type of boat and the type of activity, and depends on the willingness to pay for the pursuit (see chapter 4).

### **Species**

The recreational catch consists of many species, most of which are the target of commercial fisheries (jacks, red Pandora, bogue, striped sea bream, large-eyed dentex, horse mackerel, Couch's and sea bream), though, some species such as conger eel, rainbow wrasse and grouper are of greater interest to the recreational fisheries sector. Targeted bluefin tuna catches taken on hand lines and long lines in the Ionian, Aegean and the Levantine Basin reached around 400 t in 2003 (Restrepo, 2005). Swordfish caught on drifting long lines amounted to 1,420t. In the last 20 years, 500-1,800 t of albacore were caught using long lines and troll-lines.

### **Conflicts, opinions and perceptions**

A survey of recreational fishermen to indicate conflicts between particular types of recreational and professional gear in Greece indicated that the three main causes of conflict were spatial competition, inadequacy of legislation and resource competition, though extent of the conflict varies regionally (EU

96/18). Most conflicts recorded were between recreational fishermen using lines, trolling line, nets and long lines and professional fishermen using nets and long lines. In the southern region of Attiki, conflict was almost exclusively over the use of trawls and beach seines, whilst concern about the use of traps prevailed in Kavala and Pieria, in both cases the recreational fishermen arguing that such gears destroy resources. However, the commercial fishermen pointed out that recreational fishermen utilise the same gears and thus share the same resources.

In Greece, conservation measures favour MRF, but commercial fishermen argue that it is necessary to enforce legislation preventing recreational fishermen from selling their catch, and subsequently have little faith in the authorities. The report seems to indicate that there is a perception that the recreational sector caters for an affluent society.

## Italy

### Description

In Italy, the recreational sector has evolved from what was previously subsistence fishing, and there is no obligation to hold fishing licences, so regulation of recreational fisheries is difficult and leads to conflicts between the commercial and recreational sectors. However, recreational fishers are expected to record catch data. A survey conducted in 1996 suggested that Italy has approximately 746 000 boats <7.5m supporting 2 fishermen per boat, giving a figure of ~ 1.5million recreational fishermen, of which 900 000 are anglers (EU Studies Project 96/018, 1997). About half of the recreational fishing vessels are between 4 and 6 m in length and 39% are between 6 and 11 m. The average time spent fishing is approximately 27 days per year, the average daily catch being 6 kg and the annual catch 167 kg. The annual production by MRF activity in Italy is thus estimated at 24,000 t.

MRF is of great social and economic importance in Italy. It is expensive, and is linked with tourism, thus benefiting the regional economy as well as generating an income for the local population. With respect of 1.5 million recreational fishermen, the expenses per capita (for yachts, engine and accessories) is €336 per annum.

According to the distribution of the mooring places, the survey suggested that the north east and north west regions support most MRF vessels (191,000 and 195 000 respectively). In 1997, the Commission apparently set up an agenda to tackle problems associated to MRF, but no further document on the progress of this initiative is publicly available.

Sport fishers are only allowed to use 'lenze' (fishing line) and none of the other designated commercial fishing gears. There is also a daily 5kg bag limit, with the harvesting of mussels for recreational purposes limited to 3kg each day.

Italian fishing vessels require a fee-paid licence to fish commercially, and each fishing vessel is only authorised to use a restricted number of the 12 categories of recognised and permitted fishing gears, as specified on the licence. Similarly, no person may engage in professional underwater fishing without prior authorization. The fishing vessels are further categorized by their characteristics and area of operation, viz: coastal; offshore; Mediterranean; and high seas.

## **Gear**

A typical recreational fisherman in Italy is married, employed and aged between 30 and 50. Nearly half of the people surveyed amounted to retired or of a 'good' professional background, supporting the general perception of the commercial sector. The most frequently used gear is rod and line, followed by tuna line and hand lines, though there is no specific national legislation on the type of gear used. Any form of authorisation is issued by the Port Authority.

## **Species**

The most popular species for MRF are bogue, striped sea bream, horse mackerel, sea bream, tuna and mackerel. In 1998, the average annual catch per vessel was estimated to 167 kg, which gives a total production of MRF of about 24,000 t at the national level, equal to 10% of the total fishing production. As with Greece and Spain, tuna, albacore and swordfish fisheries are of interest, and several Italian scientific institutes have conducted projects on tuna tagging and on the recreational fishery targeting large pelagic species. Swordfish is also a target species in the harpoon fishery and in the recreational fishery (Coll *et al.*, 2004; EU Project 96/018, 1997). A pilot study was carried out under the EU Data Collection Regulation in 2003 for overall evaluation of recreational bluefin tuna fishing. Collection of data concerning the catches per unit effort and/or effective effort of specific commercial fleets started in 2005. The Italian national programme contains data series for catches and effort for the following fleet: bluefin tuna traps, bluefin tuna purse-seiners, swordfish long line and demersal trawl fishery.

## **Conflicts**

The EU study 96/18 stated that 45% of the administrative agencies contacted reported conflict between illegal recreational fishermen and commercial fishermen. In southern Italy, recreational fishermen rely on artisanal methods, whilst the commercial sector use dredges and trawls that tend to conflict with their methods. Overall, the main sources of contention between the two sectors are illegal fishing, use of gears that are destructive and resource competition. Because information on such matters is in the form of a complaint, it is not retained by the authorities and thus cannot be analysed to any great extent.

## **Opinions and perceptions**

Over fishing has been an area of much debate within national and international bodies set up the management of fishing, and both sectors use it as an excuse to support their own arguments. Conservation is of growing concern in Italy, and commercial fishermen feel there is a need for recreational fishermen to be licensed. Both sectors agreed that a legislative reform is required to differentiate between the two sectors. This is discussed in Chapter 2 of this report.

## **Malta**

A commercial fisher is defined as 'a person who is engaged or who intends to engage in fishing for sale -- - and --- relies on his fishing activities for the whole or part of his income'. Sport and recreational fishing are not comparably defined. Commercial fishing within the territorial waters of Malta requires a vessel to be entered on the record of fishing vessels and authorised to fish by a licence. The record of fishing vessels has four categories: full-time and part-time professional fishing vessels, auxiliary vessels used in fishing operations, and a fourth category of 'non-commercial fishing vessels, i.e. recreational'.

There is also a requirement for all vessels being used for fishing (not limited to commercial fishing vessels) to be licensed, with vessels of 6m or over also registered. No fishing vessel of less than 6m in length is permitted to fish beyond 12nm from the coast and, as with commercial fishing vessels of 10m or over, recreational vessels of this length must also keep a logbook of fishing activities and catches where the catch of any one species is larger than 50kg. However, there is no distinction between the gears available to be used by commercial and recreational fishers in Malta.

## Spain

In Spain, no boat can be used for recreational purposes unless it is licensed, and special authorisation issued in respect of a recreational boat may impose an annual quota. There is a comprehensive system in which daily catch limits are set for protected species as listed in the legislation, and licence holders are required to report catch data for certain marine species broken down into area and period fished.

### (Balearic Islands)

Moralis-Nin et al. (2004) used information from telephone household surveys (1271), on-site interviews (774) and volunteer logbooks (1432) from 1998 to 2003 to show that MRF participants were predominantly male, with very few women accompanying them on trips around the Balearic Islands. Although anglers from 40 to 50 years made the largest contribution (30% of the total sample), 20% were older than 60 years. Morales-Nin (2005) reported that MRF in Majorca was most often employed from a boat (62 %), followed by fishing from the shore (33%), with spear fishing (4%) being the least common. Nearly all recreational anglers fished from the shore (93%) and the rest from boats, though most boat anglers are the boat owner, which gives them more options for choosing a fishing method. The maximum fishing activity was in the summer (35%) and least (17%) in winter. Most anglers fished on weekends (68%) and only (6%) fished only on weekdays.

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## Landlocked countries

### Austria

Though “Google” and Scopus searches found eleven pages with ‘Sport fish’, only one held relevant information. Under the subtext of MRF, only one document (from 25 pages on Google) held relevant information.

Austrian sport fisheries appear to be limited to freshwater lakes and ponds, and there were no demographics quantifying the number of tourist’s travelling to destinations that support MRF. However, over 3,173 sport fishermen from Austria, Germany and Switzerland have acquired Alaskan licences to fish, a third of all tourists to Alaska (Hermann *et al*, 2002).

A report on biodiversity by the Federal Ministry of Environment, Youth and Family (Austrian Implementation Strategy for the Convention of biological Diversity, 1998) mentions commercial and recreational aspects of fisheries and, whilst it is difficult to distinguish the two sectors, any references made to recreational fisheries are restricted to lake and freshwater fisheries. Angling is important in Austria, where the number of anglers is estimated at 200,000, most of whom are organized in fishing clubs or are members of regional associations.

## Former Czechoslovakia

### Description

As in Austria, the limited information on recreational fisheries focuses largely on freshwater species salmonids, cyprinids and percoides. Recreational fishing is highly regarded in Czechoslovak, where the fishers keep their catch though this does not get to the market. Sport fishers are members of the Fishers' Union, and must pass an examination on fishery knowledge and possess a fishing licence (issued by the District National Committee) and a fishing permit (issued by a respective organization of the union). Records are required to be kept that include the date of fishing and the catch.

The number of organised anglers exceeded 245 000 since the 1980s and the total angling fish crop is 3000 t annually. The sum of the annual fees (membership fee, fishing licence, the basic permit, administrative fee) is 65 million crowns (265 crowns per person annually), in addition to 122.5 million crowns spent annually on fishing clothes, gear, baits and literature. The value of boats and other facilities owned by anglers is 770 million crowns. The Government Office gives support to the development of transport, communication, and services for fishermen for tourism.

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# Chapter 4. An Evaluation of The Socio-Economic Importance of Marine Recreational Fisheries in Europe

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## Introduction

This section of the report provides a description of the economic importance of MRF and associated industries in each EU country, based upon secondary, readily available published information and data for each country. We draw attention to the geographic coverage and quality of available information for each country and the variety of methods used to prepare existing studies or reports.

**Annex 3** presents a review and discussion of the general methodological issues relating to the economic assessment of the importance of MRF and associated industries. It is based primarily on a desk-based review of published academic and other relevant literature, sourced from both within and outside the EU, particularly drawing from the rich vein of North American literature on the subject. MRF economic data and associated methodological literature are scarce in the EU. Therefore, where appropriate, we have included information relating to freshwater recreational fisheries, to indicate how methodological issues relating to MRF might be dealt with in the EU in the future. The intention is to develop an understanding of the most appropriate and meaningful way to describe the economic importance of MRF. Annex 3 also sets out the way in which the economic benefits of the recreational activity might be compared with those derived from other sectors, notably commercial fishing. The merits of estimating gross, as opposed to net, contribution to the economy are discussed, as well as the importance to policy makers of valuing the economic impact of marginal changes in recreational or commercial fisheries.

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## Overview of findings

### Data availability

The available economic information was found to vary markedly between European countries in terms of whether it relates purely to MRF, some combination of freshwater and marine fishing, or freshwater recreational fishing only. To date, more economic information has been published relating to the latter than to MRF. The contract specification requires that MRF be reported for each EU country by RAC area. However, for countries with coastlines in more than one RAC area (i.e. France, Spain, UK, Denmark) it was often not possible to identify the proportion of the results or information that related to specific areas. In these cases, the information for the country was reported as a whole. A summary of data availability gathered in the course of this study is presented in Table 4.4 below.

National-level data relating to MRF activity (specifically number of fishers) were generally not collated regularly by government departments or national bodies. Ireland, Greece and Azores were found to hold annual records at the national level relating to the number of marine recreational fishers. However, those in Ireland only related to overseas sea angling tourists visiting the country, whilst those in Greece related to the number of individual recreational fishers licensed to use vessels (and numbers of vessels licensed to fish recreationally) and in the Azores to numbers of licensed spear fishers. Despite there being a requirement to hold a licence for MRF and competition fishing in Italy, Gordoia *et al.* (2004a) reported that no respondents in their survey held these licences. In Greece, Anagnopoulos *et al.* (1998) reported that government officials thought the number of licensed recreational fishers and vessels underestimated the true extent of activity and, in the Azores, Diogo and Pereira (2002) found that around half of spear fishers interviewed did not hold a licence. National records relating to freshwater recreational fishing activities tended to be more available and accurate, though these are not reported on in this study that is focused upon marine activities.

Comprehensive national-level data based on unique primary survey activity were available for Denmark, Finland, Sweden, England and Wales, the Netherlands, the Spanish Mediterranean coast and Greece. Some data for the Baltic countries was available relating to purely marine activities, however much was reported for a combination of marine and freshwater recreational fishing activities – as was the case in Germany. Data for Greece related only to recreational activities from vessels. A pilot study of MRF in France at the national level is currently underway (Morizur, pers comm.). Other notable national-level data were available for sea bass fishing on the French Atlantic coast and tuna fishing in Italy and the French Mediterranean coast.

**Table 4.4 Extent of accessible economic/socio-economic information for MRF, by EU country with marine coastline.**

	National level information	Localised information	Other comments
<b>Baltic Sea</b>			
Germany	-	-	See North Sea section
Denmark	Yes, but mostly relates to freshwater and marine activities in combination.	Yes, on salmon and sea trout river fishing	
Sweden	Yes, but mostly relates to freshwater and marine activities in combination.	Yes, on charter boat angling, coastal activities including cod fishing and benefits of marine protected areas, salmon river fishing and methodological techniques.	
Finland	Yes, but mostly relates to freshwater and marine activities in combination.	n/a	
Poland	n/a	n/a	
Lithuania	n/a	n/a	
Latvia	n/a	n/a	
Estonia	n/a	n/a	
<b>North Sea</b>			
UK	-	-	See Western Waters section
Germany	Yes, but study covers freshwater and marine activity in combination	Not marine, much on freshwater	

	National level information	Localised information	Other comments
The Netherlands	Yes, results available at national level on marine activities.	n/a	
Belgium	n/a	n/a	
Sweden	-	-	See Baltic Sea section
<b>NW Waters</b>			
Ireland	Limited data at national level for marine fishery.	Yes, for southwest Ireland, wild salmon recreational and commercial fishing.	
UK	Yes, study on MRF for England and Wales.  Salmon and sea trout angling in freshwater covered in Scotland at national level. No data for Northern Ireland.	Yes, for localised areas (south west England, Wales) or species-specific fisheries (sea bass).	
France	See comment in South Western Waters section.	n/a	
<b>SW Waters</b>			
France	No, but national level pilot study on marine activities currently underway.	Yes, on Atlantic Coast sea bass fishing and salmon river fishing in Finistère region.	
Spain	Very limited data on Atlantic coast activities	n/a	See Mediterranean sections
Portugal	Not at national level	Yes, on shore angling in Northern Portugal, coastal fishing in Lisbon area and estuary activities in Tagus.	
Azores	Not at national level	Yes, on spear fishing, Bluefin tuna sports fishing.	
Madeira	n/a	n/a	
Canary Isles	n/a	n/a	
<b>Mediterranean</b>			
Spain	Yes, covers marine activities	Yes, on spear fishing in Balearic Islands,	
France	See comment in South Western	Yes, on tuna fishing and big	

	National level information	Localised information	Other comments
	Waters section	game tournaments	
Italy	Yes, from Final Report. Project No. EC/96/018: Sport fisheries in eastern Mediterranean (Greece and Italy).	Yes, on tuna fishing	
Greece	Yes, covers marine activities from vessels	n/a	
Malta	n/a	n/a	
Cyprus	n/a	n/a	
Slovakia	n/a	n/a	
Slovenia	n/a	n/a	

Notes: n/a = not available through easily accessible channels, e.g. academic journals, published literature accessible through internet, personal reference of people contacted in relevant regions.

Localised data were more readily available, and generally related to marine recreational activities in a particular area (e.g. shore angling in Northern Portugal or boat and shore angling in south west England), a particular species (e.g. wild salmon in Ireland, sea bass in France or tuna in Italy and the Azores). The methodological focus of many studies varied considerably as well as ranging, for example, from the quantification of non-use values associated with recreational fish stocks in Sweden, estimation of the marginal consumer surplus associated with recreational sea angling in England & Wales, the impact of recreational fishing expenditures on the national economy in Denmark, to the socio-economic importance of recreational fishing from a boat in Greece.

As a result of the patchy availability of national level data and the inconsistent methodological approaches used to analyse MRF in different EU countries, it has not been possible to produce comprehensive global estimates of magnitude or economic value of the sector at the EU or regional level. However, the following sections present similar types of information for countries or regions of countries where it is available to provide an indication of the scale, profile and importance of the activity.

### Magnitude and profile of participants in sector

The magnitude of the MRF sector in various European Union countries, for which data were readily accessible, is shown in

Table 4.5.



**Table 4.5 Demography of marine recreational sector (number of fishers, gender and age), by EU country.**

	No. marine recreational fishers	Type of activity	Gender (% male)	Average age (yrs)	Data source
<b>BALTIC SEA</b>					
Denmark	267,000	All marine	79*	40*	Toivonen <i>et al</i> (2000)
Sweden	817,000	All marine	71*	41*	Toivonen <i>et al</i> (2000)
Finland	292,000	All marine	65*	42*	Toivonen <i>et al</i> (2000)
<b>NORTH SEA</b>					
Germany	818,400 <i>877,800</i>	Marine & all-rounders  <i>Salmonid anglers</i>	94*	41*	Arlinghaus (2004)
The Netherlands	450,000 <sup>1</sup>	All marine	94	n/a	Smit, de Vos and de Wilde (2004)
<b>NW WATERS</b>					
Ireland	41,000  67,300  47,400	Overseas anglers  Domestic anglers  <i>Salmonid river anglers</i>	n/a	n/a	Institute of Technology (1997)  Indecon (2003)

	No. marine recreational fishers	Type of activity	Gender (% male)	Average age (yrs)	Data source
England & Wales	1,100,000 <sup>2</sup> <i>800,000</i> (241,000) (600,000) (361,000)	Marine angling <i>Salmonid anglers</i> (Local anglers in SW) (Visiting anglers in SW) (English sea bass anglers)	97	46 <sup>3</sup>	Crabtree <i>et al</i> (2004) Spurgeon <i>et al</i> (2001) Cappell & Lawrence (2005) Pickett <i>et al</i> (1995)
Scotland	n/a <sup>4</sup>	Salmonid river anglers			
France	>4,000,000 <sup>5</sup> (900,000)	All marine (Sea bass anglers)	(79)	(35-49)	Morizur <i>et al</i> (2005)
<b>SW WATERS</b>					
Portugal	n/a n/a	(Lisbon area) (Tagus estuary)	(99) (n/a)	(20-50) (51)	Do Vale (2003) Lopes (2004)
<b>MEDITER-RANEAN</b>					
Spain	(93,000)	(From boat)	(Majority)	(50)	Gordoa <i>et al</i> (2004a)
France	n/a	(Tuna fishing)	(Majority)	(55)	Gordoa <i>et al</i> (2004a)
Italy	(1,500,000)	(From boat)	(>99%)	(30-60) <sup>6</sup>	Anagnopoulos <i>et al</i> (1998)
	n/a	(Tuna fishing)	(Majority)	(50)	Gordoa <i>et al</i> (2004a)
Greece	(96,075)	(From boat)	(99) <sup>7</sup>	(50% retired) <sup>8</sup>	Anagnopoulos <i>et al</i> (1998)

Notes: \* Denotes average age of marine and freshwater fishers combined.

( ) Denotes values within a subset of the total MRF population.

1. Over the age of 15 years.
2. Around 1.1 million households in England and Wales contained 1 adult sea angler, so it was estimated that there were at least 1.1m adult sea anglers. It was further estimated that there may be a further 0.34 million children participating.
3. Own estimate based on Crabtree et al (2004).
4. Number of angler days for salmon and sea trout was estimated at 545,000.
5. The source of this estimate is unclear.
6. 60% of fishers were 30-60 years old, with the modal age range (32%) being 30-40 years.
7. Majority of Greek respondents were male, although 5% of membership of club's interviewed were female.
8. 50% of those interviewed were retired, but 75% of club members were 31-60 years old.

There appear to be at least 9.5 million marine recreational fishers active in marine, based on information for a variety of years ranging from 1997-2005 depending on the source data (see the following country-specific sections for details). However, this is likely to be a significant underestimate of true numbers as national figures were not readily available for Belgium, Cyprus, Estonia, Latvia, Lithuania, Malta, Poland, Portugal, Slovakia or Slovenia, whilst figures for a sub-segment of the national sector (those fishing from boats) were only available for Greece, Italy and Spain.

A further 1.7 million anglers were identified as targeting salmonids in freshwater in England & Wales, Ireland and Germany. Similar figures were not readily available for the Baltic Countries, France and Scotland – all of which are likely to have significant populations of salmonid anglers. A significant number of recreational sea bass fishers were identified as being active in the UK and French fisheries, whilst recreational tuna fishing was important in the Mediterranean.

The vast majority of marine recreational fishers were male (>94% in the Mediterranean, Portugal, Germany and England & Wales), though a lower proportion was found in the Baltic States (Denmark – 79%, Sweden – 71% and Finland – 65%) and for sea bass anglers in France (79%). Higher proportions of recreational fishing club and federation members tended to be female. The average age of fishers tended to be older in the Mediterranean and Portugal (around 50-55 years) but decreased the further north the location (46 in England & Wales and between 40-42 in the Germany and the Baltic countries).

An analysis of the proportion of the adult population (>14 years of age) active in MRF varied notably from 1.2% in Germany to 11.3% in Sweden (

Table 4.6). A greater proportion of the population appeared to be active in the Baltic countries and France compared to Ireland, England & Wales and the Netherlands.

**Table 4.6 Estimated proportion of total marine recreational fishers in adult population (>14 years) (does not include freshwater salmonid anglers).**

Country	Ger	Ire	E&W	Net	Den	Fin	Fra	Swe
Proportion of adult population (>14 years)	1.2%	2.4%	2.6% <sup>2</sup>	3.2%	6.1%	6.9%	8.0%	11.3%
Year of source data	2002	1997	2003	2003	1999	1999	2005	1999

Source: Own calculation

### Activity and effort

A wide range of activity and effort levels in MRF was found between countries. In Greece, recreational fishers using vessels spent an average of 77 days at sea per year mostly in the spring and summer months. This type of fishing was a social activity – nearly two-thirds of recreational vessels went out with two fishers onboard. The boats tended to be very small, typically 4-6m in length, of wooden construction and with small engine powers. Anagnopoulos *et al.* (1998) also reported on the very varied range of types of recreational fisher found in Greece:

- coastal dwellers and inland dwellers;
- holiday tourists and locals;
- club/association members and non-members;
- retired social anglers and working anglers;
- sports fishers for whom catching is paramount and those for whom making a catch is second place to just enjoying the activity and being at sea, and;
- leisure anglers and those seeking to enhance their earnings under the guise of recreational fishing.

This typology of marine recreational fishers is applicable in most countries, although the proportion of various types tends to vary between regions and fisheries. For example, in Ireland there were around three overseas visitors to every five local fishers in 1996/7 (Institute of Technology, 1997) and, in the South West of England, there were 2.5 non-locals (mainly from other parts of the UK) to every one local recreational fisher in 2005 (Cappell & Lawrence, 2005). Club or association members in all regions tended to be more likely to be engaged in sports fishing and taking part in competitions than non-members. In Italy, many recreational vessels were actually operating in a cash commercial fishery supplying local restaurants and small shops (Gordoa *et al.*, 2004a).

Tuna fishers using boats in France (Mediterranean Coast) and Italy reported fishing for 35 days per year on average (Gordoa *et al.*, 2004a). The French boats tended to be larger (9-12m in length) than those typically used by Italian tuna fishers and all Spanish fishers (7-9m). Competition fishing accounted for less than 3% of all Spanish activity, 6% of Italian and 10% of French tuna boat fishing activities. In the Languedoc-Rousillon region of the French Mediterranean alone, there were 25 big-game fishing tournaments in 2003 attracting a total of 416 participants (Gordoa *et al.*, 2004a). Whilst in the Balearic Islands, there were on average 6 spear fishing competitions each year between 1975-2000 with 80 participants each time catching mostly white bream (Coll *et al.*, 2004).

Spear fishing for octopus, wrasse, parrotfish, etc. was also popular in the Azores. Around three-quarters of spear fishing was found to be undertaken for recreation or subsistence purposes (Diogo & Pereira, 2002), though nearly half of total catches were destined for illegal sale. An active big-game charter boat fleet exists in the Azores, mainly targeting blue marlin.

Shore-based recreational angling was popular along the Portuguese coast. Recreational sea bass catches in one study area were found to be equivalent of around 7% of commercial catches (Oliveira and Erzini, forthcoming). Two-thirds of coastal fishers in the Lisbon area fished once a week or more often and most preferred fishing from cliffs or sea walls using a rod and line (Do Vale, 2003). Fishers in the Tagus estuary were either retired or had little income (Lopes, 2004).

In France, on the other hand, households including a recreational sea bass angler were more likely to have an employed person or a middle level professional at the head than the average household (Morizur *et al.*, 2005). Just under half of sea bass fishers lived in French Departments with no coastline, indicating that they travelled far to go sea bass fishing and only a small proportion (3.7%) were members of a club or association. Around half fished from shore, whilst the remainder fished from boats (43%) or used underwater methods (9%). One-third of the 900,000 recreational sea bass anglers were most active fishing for more than 7 days per year, with an average for the whole sector of around 9 days or less per year. Recreational sea bass fishing is also very popular in England and Wales – there were an estimated 340,000 participants in 2004 (Defra, web site).

Recreational sea anglers (all types) in England and Wales fished for an average of 11 days per year, though a quarter of the total fished for only one day in the previous year and half fished for four days or less (occasional fishers), whilst a decreasing number (the highly dedicated) reported fishing for an increasingly large number of days above the average (Crabtree *et al.*, 2004). This skewed distribution of activity levels – with a high number of fishers fishing fewer days per year compared to the average and a smaller number fishing for many more days per year – was commonplace in survey findings in all countries.

An active charter boat fleet exists in England and Wales comprised of around 450 boats in 2003, reflecting the popularity of sea angling. Charter boat fishing accounted for around a quarter of average annual days fished and private boat activity was also significant (another quarter) (Crabtree *et al.*, 2004). Private boat owners were more likely to be from a higher social class, which was to be expected given the cost of ownership and maintenance. Around 12% of MRF households contained members who belonged to clubs or associations. This proportion was high compared to membership amongst French, Portuguese or Mediterranean fishers. Also, 15% of English and Welsh recreational sea anglers fished outside of these countries, indicating the importance of the activity to this sub-set of participants.

Sea angling in Ireland was popular with locals and foreign visitors alike. Overseas anglers were predominantly (90%) from Britain and mainland Europe, with around 75% of deep-sea anglers (using larger boats in offshore waters including specialised angling for fish such as sailfish, tuna and shark) being from Britain and the Netherlands (Institute of Technology, 1997). Around 70 deep-sea angling charter boats were registered in 1997 and a further 30-40 coastal boats could also run similar trips. Boats generally carried up to 12 passengers.

Charter boat fishing was also popular in the Netherlands. One section of the fleet operated in the Wadden Sea and southern estuaries carrying 20-40 paying guests orientated towards tourism and onboard catering, whilst larger vessels carried 40-75 people on a trip who were mainly interested in making high volume catches (Smit, de Vos and de Wilde, 2004). There were also between 6,000 and 7,000 small privately owned boats active in recreational sea angling, of which a small number were fully equipped for wreck fishing for cod. Dutch marine recreational fishers were active for an average of 4.4 days per year, which was the lowest reported average activity level compared to all other countries for which data were available.

Recreational fishers in the Baltic countries of Denmark, Sweden and Finland were generally categorised as (Toivonen et al, 2000):

- sports fisher – mainly using rod and line
- household fisher – mainly using nets and other static gear
- generalists – using all types of gear
- occasional angler – who participate only sporadically

These definitions were derived for all activity regardless of whether it was in marine or freshwater. However, an analysis of results finds that Danish fishers spent around 10 days per year active in marine, Finnish 18 days and Swedish 33 days, placing Baltic activity levels lower than Mediterranean levels but higher (particularly for the Finnish and Swedish) than other reported levels in the South West, North West or North Sea regions of the EU waters. The majority of fishers in all countries were either 'occasional anglers' or 'sports fishers', although the highest proportion of 'occasional anglers' was reported for Denmark (76%), which may explain the lower level of annual activity.

### Economic importance

As discussed in the initial section on economic valuation methodologies, the non-market benefits of MRF activity can be captured by determining the consumer surplus associated with the activity. Alternatively, regional economic impact analyses can be undertaken to determine the effect on the economy and employment of MRF related net expenditures. An economic comparison of recreational and commercial activities requires the use of a consistent methodology.

### Non-market benefits of recreational fishing

Whilst a considerable amount of research is available relating to the non-market benefits of freshwater fishing, as discussed previously in this chapter when focusing on the range of available methods, there is a paucity of similar information for the MRF experience in Europe.

The only national-level study that estimated the non-market benefits of all marine recreational angling activity was undertaken in England and Wales by Crabtree *et al.* (2004). Dunn, Potten and Whitmarsh (1995) estimated non-market values associated with a sub-set of marine recreational activities - sea bass fishing - at the national level in England and Wales. However, Toivonen *et al.* (2000) estimated consumer surplus at the national level for a combination of fresh and marine recreational fishing activities in the Baltic countries, as did Arlinghaus (2004) in Germany. A handful of studies also estimated non-market benefits of MRF at the non-national, local level, including Paulrud's (2004) work on the coastal and guide/charter boat angling in marine waters of the Swedish Bohus region, and Cappell & Lawrence's

(2005) work on marine recreational angling in South West England. More work has been undertaken for freshwater salmon fisheries (e.g. Paulrud, 2004 (Sweden); Procher & Brulard, 2002 (France); Curtis, 2002 (Ireland); Spurgeon *et al*, 2001 (England & Wales); Appelblad, 2001 (Sweden)), but this activity is not the main focus of this study.

The non-market benefits of fish stocks (existence values), as perceived by both recreational fishers and the general public, were also explored by Toivonen *et al* (2000) in the Baltic countries for marine and freshwater stocks targeted by recreational fishers, and by Spurgeon *et al.* (2001) for freshwater stocks, including those targeted by salmonid fishers.

The consumer surplus associated with one day of fishing from the shore in England and Wales was found to range between £5.7-35.5 per angler day, depending on the estimation method used (Contingent Valuation (CVM) and Travel Cost Methods (TC); Crabtree *et al*, 2004). Consumer surplus associated with the charter boat activity was higher (£18.4-90.0 per day), and the upper range limit for a day spent on a privately owned boat was higher still (£14.3-108.7). The total annual value of consumer surplus associated with all recreational sea angling in England and Wales in 2003 was estimated to be between £117 and 759 million. In 1992, the consumer surplus associated with recreational sea bass fishing in England and Wales – a subset of total recreational sea angling activity - was estimated to be £21.6 million (CVM: Dunn, Potten and Whitmarsh, 1995). Toivonen *et al* (2000) estimated similar values for marine and freshwater recreational fishing activities combined, and estimated the total economic value in Denmark to be between DKK1900 and 2140 million depending on the method used to derive the estimates: FIM994-967 million in Finland and SEK2,425-2,500 million in Sweden. It is not possible to combine or compare these results meaningfully as they were derived using differing methodologies, using differing assumptions about baseline expenses (e.g. relating to the inclusion of fixed costs or not) and for different types of activity or focus (CVM).

Crabtree *et al* (2004) extended the analysis to estimate consumer surplus values associated with marginal changes in the diversity and quality of the angling experience in England and Wales using a choice-based analysis. All types of angler were found to be willing to pay more for a 1% increase in the size of fish caught (£0.22) and to catch species that are different to those they usually catch (£8.86). Only shore anglers were willing to pay more for each extra fish caught (£0.81).

Cappell & Lawrence (2005) also estimated a 'variable' WTP over and above expenditures on fixed costs (i.e. cost of buying a boat or a rod), which were deemed to have been already been paid for using a choice-based method. A non-linear relationship was found between anglers' WTP and the catch of their favourite species. They had a high WTP (£13.56) to increase catches from 0 to 1 fish per day, but a declining WTP to catch more fish thereafter (e.g. £2.03 to increase catches from 6 to 7 fish). Anglers were much less willing to pay more money beyond catches of 6 or 7 fish, indicating that this was some kind of threshold beyond which anglers derive little additional utility from catching more fish. The utility derived from catching increasing numbers of target fish also varied depending on the species. Anglers also displayed a low WTP to catch additional fish of other (non-favourite) species, however, the general size of fish caught was found to have a very big impact on WTP and were willing to pay £13.27 more for a 50% increase in the size of individual fish.

Oliveira & Erzini (forthcoming) did not estimate consumer surplus or WTP, though they found that a third of shore-based anglers in northern Portugal considered their fishing sessions to be unsatisfactory whilst a third felt they were 'good' or better (Oliveira & Erzini, forthcoming). Whilst catches were generally an important factor explaining the level of satisfaction with a fishing experience, the actual number of fish caught and their size was not. Oliveira & Erzini noted that this may be explained by the large proportion of undersized fish being caught. Sea bass angler satisfaction was found not to relate to whether or not sea bass were caught.

### **Regional economic impact analysis**

Many studies estimated expenditures associated with MRF activity. However, as discussed in the methodology section (Annex 3), gross expenditure is not a measure of economic benefit in itself. Estimates of net expenditures, which take into account substitution and displacement effects, can be used in conjunction with regional/national economic models of the economy to determine the economic impact of these expenditures (and changes in these expenditures) on the region's output or employment.

A range of estimated expenditures associated with the marine recreational fishing activity are shown in Table 4.7. Expenditures per fishing day tended to be determined by dividing an estimate of average total annual spend per person by the number of days fished. Expenditure categories for which data were collected varied somewhat between countries, but basic categories covered to some extent in each country included:

#### *Variable expenses*

- variable costs of fishing trip (e.g. fuel, other operating costs, rental costs, charter boat fees, bait, non-permanent fishing items, e.g. lines, etc.)
- transport costs to fishing site
- food, drink and accommodation associated with fishing trip
- competition fees

#### *Fixed expenses*

- boat/trailer purchase, maintenance, moorings, equipment, accessories, etc.
- permanent fishing equipment (e.g. rods, reels, etc.)
- club/association membership fees, licences, etc.
- journals, magazines, books, etc.
- insurance for boat, trailer, equipment

As discussed in the methodology section, the inclusion of spend on fixed (capital/permanent) items such as vessels and fishing rods can introduce an element of bias into economic estimates, as items such as vessels, for example, can be used for activities other than recreational marine fishing and the amount spent on a rod, for example, often depends on the wealth of the purchaser as much as anything else. Therefore, it more informative to focus upon variable expenditures, as opposed to those relating to fixed or capital items, particularly when attempting to determine the impact of a change in expenditure as a result of some factor affecting the marginal recreational fishing experience.

Toivonen *et al.* (2000) focused their survey work on non-permanent items of expenditure (i.e. variable expenses), although relevant expenditures shown in Table 4.7 relate to salt- and freshwater activities in

combination. Smit, de Vos and de Wilde (2004) estimated both fixed and variable expenses, but presented gross national figures which included both types of expenses. Marine angling-related expenses in England and Wales were presented as fixed and variable in combination (Crabtree *et al.*, 2004) whilst Gordoia *et al.* (2004a) presented data relating to the gross expenses (both fixed and variable in combination) associated with recreational fishing from vessels in the Mediterranean waters of Spain, France and Italy.

**Table 4.7 Average expenditure per fisher day (or year), by type of activity and country (various years)**

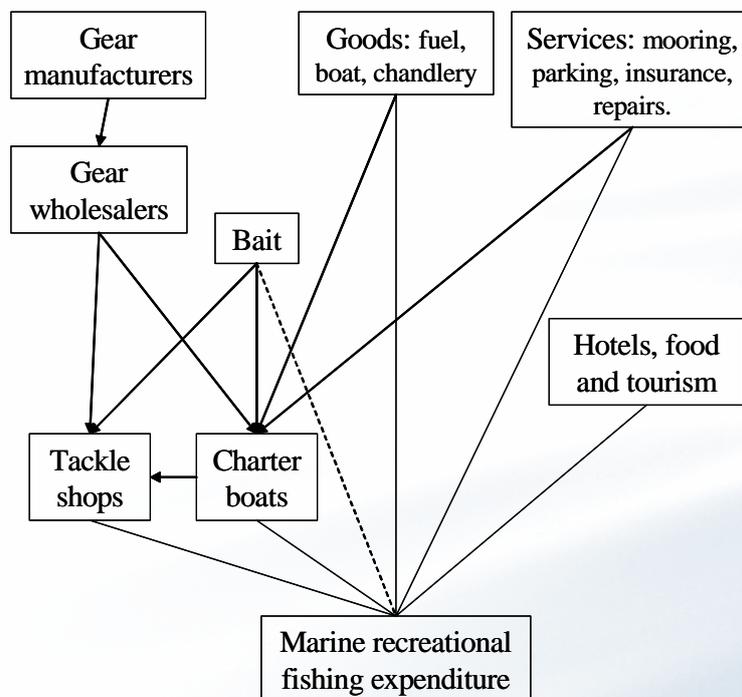
RAC Region	Avg. expenditure per fisher day or per year (year of money)	Fixed+ variable or variable expenses only	Type of recreational fishing activity	Data source
<b>BALTIC SEA</b>				
Denmark	DK95 (1999)	Variable	Salt- & freshwater	Toivonen <i>et al</i> (2000)
Sweden	SEK102 (1999)	Variable	Salt- & freshwater	As above
Finland	FIN47 (1999)	Variable	Salt- & freshwater	As above
<b>NORTH SEA</b>				
The Netherlands	EUR 68 (2003)	Fixed+Var	All marine	Smit, de Vos and de Wilde (2004)
	EUR 52 (2003)	Variable		
<b>NW WATERS</b>				
Ireland	IR 441 (1995)	?	Overseas sea anglers	Institute of Technology (1997)
	IR 134 (1995)	?	Domestic sea anglers	
England & Wales	£22/68/88 <sup>1</sup> (2003)	Fixed+Var	All marine angling	Crabtree <i>et al</i> (2004)
<b>MEDITERRANEAN</b>				
Spain	EUR 213/994 <sup>2</sup> (2003)	Fixed+Var	From boat	Gordoia <i>et al</i> (2004a)
France	EUR 100/288 <sup>2</sup> (2003)	Fixed+Var	Tuna boat fishing	As above
Italy	EUR 86/395 <sup>2</sup> (2003)	Fixed+Var	Tuna boat fishing	As above

Notes:

1. Average daily expenditure per sea angler for shore-based, charter boat and own-boat fishing respectively
2. Average daily fishing vessel expenditure per boat for vessels between 5-7m and 9-12m in length respectively

Cappell and Lawrence (2005) produced a simple schematic detailing the linkages between various recreational fisher expenditures and upstream sectors of the local economy, which benefit from these expenditures (Figure 1). These economic linkages are formed as a result of direct fisher expenditure on charter boat fees and sea angling tackle, etc. and indirect expenditure on food, drink, accommodation, transportation to the coast, etc. The purchase of these goods and services create employment and income in the region, which in turn creates a second and subsequent round of induced expenditure and so economic benefit.

As discussed in the methodology section, it is important to determine which proportion of the direct and indirect expenditure, created by both locals and visitors, is attributable to the region being analysed. For example, purchases of tackle made locally will contribute to the regional economy, but if a new vessel is purchased outside of the region there will be no local economic benefit from the sale of the boat by its manufacturers.



**Figure 1 Economic linkages with MRF expenditure (reproduced from p. 36, Cappell and Lawrence, 2005)**

Data on the sale of tackle or vessels used specifically for marine recreational fishing activities were not available at the European or national levels (personal communication, European Fishing Tackle Trade Association (EFTTA)). Only information available in individual country studies is therefore presented.

It should also be noted that there is a plethora of sport fishing competitions held annually within European waters. These events bring extra income to areas resulting from participant expenditures, competition fees, etc., albeit for short periods each year.

Very simple estimates of the first round economic impact of gross recreational sea angler expenditures in Ireland were made by the Institute of Technology (1997). Visiting and domestic sea anglers were

estimated to have spent around IR£15 million and IR£9 million in 1995 respectively, however, no information was provided as to what items this money was spent on. These combined gross expenditures were estimated to support around 850 FTE equivalent jobs and generate about IRE£6 million in tax revenue to the government. Whilst it could be assumed that visiting anglers would stop coming to Ireland if sea angling were to cease altogether, the substitution and displacement effect on domestic expenditure of a change in sea angling were not specifically analysed.

In the Netherlands, Smit, de Vos and de Wilde (2004) estimated that gross expenditure of €127 million was linked to an estimated direct and indirect employment in the MRF sector of around 800 Full Time Equivalent (FTE) jobs. Direct employment was found in the charter boat, fresh bait supply and small boat sectors (i.e. new builds, imports, maintenance and repairs, etc.), though it was more difficult to attribute employment in other sectors (such as the artificial bait and equipment provision sectors) wholly to sea angling, as they tend to serve other sectors as well. The authors also acknowledged that many goods are imported, so expenditures in these sectors flow out of the Netherlands and do not provide so much direct economic benefit (including employment) to the economy than if they were made in the Netherlands. Indirect employment estimates were calculated based on employment coefficients, which provide a method for linking expenditure to estimates of the amount of associated employment generated within a sector

The first-round economic impact of sea angler expenditure in England & Wales was estimated by Crabtree *et al* (2004) in terms of its effect on supplier's income and the number of jobs supported by this expenditure. Income and employment coefficients were estimated using data collected from a primary survey of businesses benefiting from angler expenditures. Around £71m of supplier's income and nearly 19,000 FTE jobs were generated by gross national sea angler expenditure of £538 million in 2003. Crabtree *et al* (2004) went on to determine the local economic impact of visiting anglers by focusing on the impact of expenditure made by those making fishing trips or spending money more than 50 miles from home. The local income effect on suppliers was estimated to be £31.2m and around 8330 FTE jobs were created.

Cappell and Lawrence (2005) carried out a similar economic impact analysis for sea angler expenditure in the South West region of England. They determined that the total spend derived from sea angling in the South West of £165 million (in 2004) was comprised of £110 million (58% of total) of resident's expenditure, whilst visitors accounted for a further £55 million of spend in the area. Spend by residents attributable to angling activities outside of the region was not taken into account. Cappell and Lawrence estimated that 3153 FTE jobs in the South West were linked to sea angling in the region and noted that, if sea angling were to cease to exist for some reason, some of these jobs could be maintained by redirecting effort towards different customers or markets.

Only one study relating to MRF actually used a formal Input-Output analysis approach to estimating the economic impact of recreational fishing expenditures. Roth and Jensen (2003) complemented the Toivonen *et al* (2000) economic analysis of Danish recreational fishing by developing a demand-driven model using the Danish Input-Output tables and utilising Danish fisher expenditure data for salt- and freshwater activities collected by Toivonen *et al* (2000). The economic impact of Danish residents fishing abroad was not included nor were those expenditures of foreign tourist anglers visiting Denmark. It was

found that variable expenditures on the recreational fishing activity resulted in the direct employment of 500 people and the combined direct and indirect employment of 758 people.

Finally, Radford *et al* (2004) estimated the regional and national economic impacts of freshwater salmonid angling in Scotland. Whilst salmonid freshwater fishing is not the main focus on this study, this analysis is noteworthy due to the robust methodology used. The economic impact of expenditure on income, output and employment was determined at the national level and for seven regions of Scotland and for four types of fishery. Regional economies were modelled using specially constructed trade matrices and coefficients derived from Scottish Input-Output tables. Impacts were disaggregated according to angler expenditure by locals to a region, visiting Scottish anglers and non-Scottish anglers.

### **Comparing marine recreational and commercial fisheries**

The economic impact of new national legislation on the commercial and recreational marine fisheries for sea bass in England and Wales was investigated by Dunn, Potten and Whitmarsh (1995) for the years 1987 and 1992/3. The economic impact on the recreational fishery was assessed by comparing numbers of fishers, catches, gross expenditures and consumer surplus (calculated using a CVM approach) associated with the activity for each year. The economic impact on the commercial fishery was determined by comparing fleet size, catch volume and first sale and wholesale values. No data on the costs of production was available. Whilst each of these measures has merit in their own right for a within-sector year on year comparison, they provide no basis for direct comparison between sectors as discussed previously in the methodological section.

Indecon (2003) provided an economic/socio-economic evaluation of commercial and recreational wild salmon fisheries in Ireland. The economic impact of commercial salmon fishing in coastal and estuary areas was quantified mainly on the basis of estimating gross commercial revenues, and adjusting the results to account for the proportion of inputs that came from imported goods. No data was available relating to operating costs or taxation payments. Whilst it was acknowledged that downstream activities such as processing and smoking would add value, no detailed data was available to link domestic catches with local processing. The impact of recreational salmon fishing was quantified by determining total recreational angling expenditures for domestic and overseas visiting anglers and adjusting the results to account for the proportion of expenditures on imported goods, and including an estimate of potential displacement effects were the activity to become unavailable for some reason. An economic multiplier was used to estimate the second-round effect of visiting angler expenditure and an employment coefficient was applied to first-round expenditures to estimate associated employment.

In summary, both studies were hindered by a lack of appropriate method or data with which to make a direct comparison between sectors. Further, each focused upon estimating the total economic impact of the activity. Estimation of the economic impact resulting from a marginal change in activity (i.e. an increase or decrease as opposed to the complete demise of a fishery) is usually more informative and relevant to policy makers and interested parties than an analysis of total economic impact.

### **Review of published economic studies by region**

This section provides a review of published information relating to studies and reports that consider economic and socio-economic aspects of MFR. It is not intended to form a comprehensive inventory of all

available data, but focuses upon the most relevant and easily accessible information. Information at the national level is given precedence over that which is more localised or site-specific.

The review attempts to present information relating specifically to MRF, however many studies/reports present results relating to a combination of both marine and freshwater activities. Where possible, results relating purely to marine activities have been drawn out. Details are provided on methodologies as well as results.

## Baltic Sea

A project to derive the economic value of recreational fisheries (both freshwater and marine) in the Nordic countries (Toivenen *et al*, 2000) covered Denmark, Finland, Iceland, Norway and Sweden. The study was undertaken with finance from the Nordic Council of Ministers and support from a number of other institutions within the Nordic States. Its aim was to estimate the annual Total Economic Value (TEV) of recreational fisheries, and the non-use value that the overall population (both fisher and non-fisher) attach to preserving the existence of current Nordic fish stocks and the possibility of passing on this existence to future generations.

The study was devised to estimate the total TEV of the recreational fisheries where 'recreational fisheries' was taken to mean more than just the recreational fishing experience *per se*. This Nordic definition of 'recreational fisheries' also attempted to encapsulate values associated with the use and non-use of the fish stocks as well as the fishing activity. This broad definition of TEV was captured in two different ways, as follows:

1. The first estimate involved a combination of the 'fisher's use value' (i.e. the value fisher attribute to being able to use the fish stocks for their fishing activity) and the 'non-fisher's non-use value' (i.e. the value that non-fisher place on non-use values associated with fish stocks, such as option, existence and bequest values). These use and non-use values were derived from asking respondents about their WTP for the preservation of natural fish stocks and present quality of recreational fishing.
2. The second estimate involved combining the 'non-fisher's non-use value' with the fisher's use and non-use values derived from asking respondents about their WTP for the preservation of natural fish stocks and present quality of recreational fishing.

The second method of deriving TEV was designed to capture the fact that fisher may place a non-use value on the existence of fish stocks as a pre-requisite (or in addition) to being able to actively use them, i.e. go fishing.

Toivenen *et al* (2000) adopted a Contingent Valuation Method approach to measuring TEV by estimating the WTP for recreational fisheries and the preservation of fish stocks. A survey was carried out which included questions concerning: attitudes towards the environment and outdoor recreation; which category of recreational fisher they belong to; recreational fishing activities and preferences; fishing expenditures; WTP for three scenarios of new recreational fisheries; WTP for a stock preservation scenario; and socio-economic variables. Parallel mail surveys were conducted simultaneously in all five Nordic countries and

the national population registers were used as sampling frames. In total, 25,000 Nordic citizens between the ages of 18 and 69 were sampled and the final response rate was 45.8%.

The individual results for the EU countries of Denmark, Finland and Sweden are reported in the relevant country/RAC sections below. The majority of results were reported in Toivonen *et al* (2000) by type of fisher as opposed to by water type (i.e. sea/coast, river or lake), with type of fisher being defined as:

- sports fisher – mainly using rod and line
- household fisher – mainly using nets and other standing gear
- generalists – using all types of gear
- occasional angler – who participate only sporadically

Where possible, results are reported for recreational fishing activities at the ‘coast and sea’ as opposed to all water types (i.e. marine and inland freshwaters combined).

Toivonen *et al* (2004) can be referred to for further details of tests undertaken to explain the factors affecting the actual fishing expenditures and WTP for non-market benefits of users or non-users of the resource. Explanatory variables tested for included demographic characteristics, types of fishing pattern and differences in the countries’ management regimes.

## Denmark

In order to derive the economic value of recreational fisheries (both freshwater and marine) in the Denmark, (Toivonen *et al*, 2000) sent a mail survey to 5181 people and received 2376 responses in total including 546 usable responses from fishers. The mean age of recreational fisher respondents was 40 years old and 79% were males. There was a fisher in every second household in Denmark. No significant difference was shown between fishers and the total population in terms of either education or household income.

It was estimated from survey results that the total population of recreational fishers in Denmark (all water types) was around 451,000 (12.5% of total population 18-69 years old) in 1999. Approximately 59% (267,000) of recreational fishers spent the majority of their fishing days at the sea.

The most common type of recreational fisher was categorised as ‘occasional angler’ (76%), followed by ‘sports fisher’ (13%), ‘generalist’ (7%) and then ‘household’ (4%). Fishing at the ‘sea or coast’ was the most common location for Danish recreational fishers amounting to 48% or around 2,611,200 annual fishing days (Table 4.8).

**Table 4.8. Number of fishing days by main water type, Denmark (1999) (Toivonen et al, 2000).**

	Sea or coast	River	Lake	Total
Proportion of fishing days (%)	48	27	25	100
Annual no. of fishing days	2,611,200	1,468,800	1,360,000	5,440,000

The breakdown of total annual expenditure on variable (i.e. non-permanent) fishing items is shown in Table 4.5 and amounted to DKK 517 million in 1999. Permanent/ fixed cost items such as boats and fishing tackle were excluded from the survey due to the difficulty in determining the proportion of these expenditures attributable as annual costs. The largest expenditures were on transportation to the fishing site, licence fees (mainly payable for freshwater fishing activities) and variable boating expenditures. Mean annual expenditure per fisher was estimated to be DKK 1,170 (there was a 95% probability that the true mean falls within  $\pm 26\%$  (plus or minus) of this figure).

**Table 4.9 Breakdown of total annual recreational fishing expenditure (all water types) on non-permanent items in Denmark by category, 1999 (Toivonen et al, 2000).**

Expenditure category	Proportion (%)	Total annual expenditure (DKK million)
Automobile transportation to fishing site	27	139.59
Boating (fuel, other operating costs, rental costs)	17	87.89
Other transportation to fishing site	13	67.21
Lodging/accommodation	8	41.36
Licences, annual membership fees	20	103.40
Journals, books, videos, etc.	4	20.68
Food and drink expenses additional to normal purchases	8	41.36
Other expenses (no tackle, clothes, etc.)	3	15.51
<b>Total</b>	<b>100</b>	<b>517.00</b>

The economic values associated with the current quality of the recreational fishing experience (all water types) and the existence of fish stocks are shown in Table 4.10. Danish recreational fishers held slightly lower mean net economic values for the same fishing experience (1, Table 4.10) when compared to the general public's mean non-use value in relation to the preservation of natural fish stocks and maintenance of the current quality of the fishing experience (2). However, when fisher were asked directly about the value they place on the preservation of natural fish stocks, in addition to maintaining the current quality of recreational fishing (all water types), they attributed nearly twice as much value as non-fisher (DKK 1280 per fisher as compared to DKK 668 per non-fisher). The total economic value of recreational fisheries (all water types) in Denmark was estimated to be between DKK 1900 million and DKK 2140 million, depending on the method used to derive the estimates.

**Table 4.10 Total economic value of recreational fisheries and stocks (all water types) in Denmark, 2000 (Toivonen et al., 2000).**

Measure of annual economic value	Mean WTP (DKK/person)	Total WTP (DKK million)
1. Recreational fisher's WTP for same fishing experience over and above current expenditures	616 ( $\pm 27\%$ ) <sup>1</sup>	248
2. Non-fisher's WTP to preserve current natural fish stocks <u>and</u> current quality of recreational fishing	668 ( $\pm 12\%$ ) <sup>2</sup>	1,650
<b>Total Economic Value – Measure A (1+2)</b>	-	<b>1,900</b>
3. Recreational fisher's WTP to preserve current natural fish stocks <u>and</u> current quality of recreational fishing	1280 ( $\pm 22\%$ ) <sup>2</sup>	494
<b>Total Economic Value – Measure B (2+3)</b>	-	<b>2,140</b>

Notes:

1 – 95% confidence limit

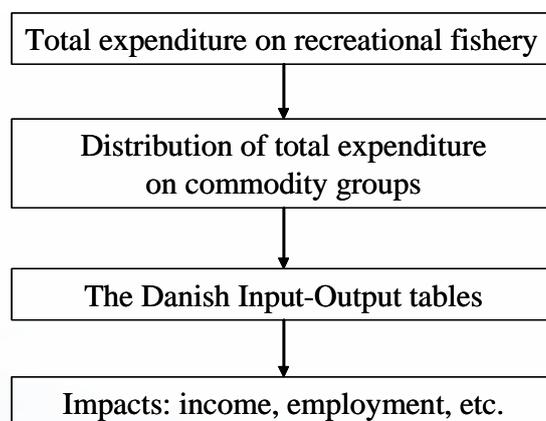
2 – result from open-ended question

The recreational fishers' WTP for three different types of fishing sites were also elicited using specially constructed scenarios. One of these scenarios related to the recreational fishers' WTP for “*an exclusive fishing right to a good quality stream with salmon and sea trout*” – the others related to lake fishing. In Denmark, the mean respondent was WTP an additional DKK 921 ( $\pm 17\%$ ) for this right over and above what they currently spend, indicating that they value the opportunity far more highly than they value their current fishing experience (DKK 616, see Table 4.10).

### **Economic impact analysis of Danish recreational fishing expenditure on national economy**

Roth and Jensen (2003) complemented the Toivonen *et al.*'s (2000) economic analysis of Danish recreational fishing by examining the economic impact of expenditures in the recreational fishery (all water types) on the formal Danish economy. Original expenditure data collected as part during Toivonen *et al.*'s (2000) study were used in the analysis. As a result, the expenditure data were limited to those relating to Danish residents. The economic impact of Danish residents fishing abroad was not included, nor was the expenditures of foreign tourist anglers visiting Denmark.

A demand-driven model was developed using the Danish Input-Output tables. Each expenditure category (see Table 4.9) from the Toivonen *et al.* (2000) survey was allocated to an appropriate commodity group posting in the Input-Output model nomenclature. This method (depicted in Figure 4.2) enabled the calculation of the economic impact of recreational fisheries expenditure (all water types) on Danish employment, imports, indirect taxes and income.



**Figure 4.2 Summary flowchart of method estimating impact of recreational fishing expenditure on Danish economy (Roth and Jensen, 2003)**

Roth and Jensen (2003) found that variable expenditures on the recreational fishing activity resulted in the direct employment of 500 people and the combined direct and indirect employment of 758 people (the distinction between full-time and part-time employment could not be made). This total accounted for some 0.03% of total Danish employment. The employment impact of expenditures within the sector would be greater if fixed cost expenditures (e.g. investments in boats and rods, etc) were also included. Every million DKK of expenditure on recreational fishing generated employment for 1.52 people. This was slightly more than the employment generated by private consumption in the Danish society as a whole (amounting to 1.36 people per million DKK spent in 1998).

Nearly 14% of the share of recreational fishers' consumption expenditure was spent on goods and services imported from abroad (Table 4.11) amounting to DKK 67.7 million. Around one quarter of this consumption contributed towards indirect taxes, primarily VAT. The contribution of variable expenditure in the sector to gross domestic income (i.e. rent to labour and capital in the form of wages and profits) amounted to DKK 303 million or 61% of total expenditure.

**Table 4.11 Impact of variable recreational fishing expenditure (all water types) on formal Danish economy, 1999 (Roth and Jensen, 2003)**

	Total (DKK million)	Distribution (%)
Import	67.7	13.6
Indirect taxes	126.7	25.5
Income	302.7	60.9
<b>Total</b>	<b>497.2</b>	<b>100.0</b>

Note: Figures are in 1998-prices.

## Finland

In order to derive the economic value of recreational fisheries (both freshwater and marine) in the Finland, (Toivonen *et al*, 2000) sent a mail survey to 4969 people and received 2550 responses in total including

1263 usable responses from fishers. The mean age of recreational fisher respondents was 42 years old and 65% were males. There were 1.15 fishers in every household in Finland. No significant difference was shown between fishers and the total population in terms of either education or household income.

It was estimated from survey results that the total population of recreational fishers in Finland (all water types) was around 1,390,000 (40% of total population 18-69 years old) in 1999. Approximately 21% (292,000 fishers) of recreational fishers spent the majority of their fishing days at the sea.

The most common type of recreational fisher was categorised as 'occasional angler' (56%), 'sports fisher' (20%), 'household' (13%) and then 'generalist' (11%). Fishing at the 'sea or coast' was the second most common location for Finnish recreational fishers (after lake fishing) accounting for around 20% or around 5,240,000 annual fishing days (Table 4.12).

**Table 4.11 Total economic value of recreational fisheries and stocks (all water types) in Finland, 2000 (Toivonen et al., 2000).**

Measure of annual economic value	Mean WTP (FIM/person)	Total WTP (FIM million)
1. Recreational fisher's WTP for same fishing experience over and above current expenditures	446 ( $\pm 11\%$ ) <sup>1</sup>	501
2. Non-fisher's WTP to preserve current natural fish stocks and current quality of recreational fishing	287 ( $\pm 14\%$ ) <sup>2</sup>	493
Total Economic Value – Measure A (1+2)	-	994
3. Recreational fisher's WTP to preserve current natural fish stocks and current quality of recreational fishing	388 ( $\pm 9\%$ ) <sup>2</sup>	474
Total Economic Value – Measure B (2+3)	-	967

Notes:

1 – 95% confidence limit

2 – result from open-ended question

**Table 4.12 Number of fishing days by main water type, Finland (1999) (Toivonen et al., 2000).**

	Sea or coast	River	Lake	Total
Proportion of fishing days (%)	20	15	65	100
Annual no. of fishing days	5,240,000	3,930,000	17,030,000	26,200,000

The breakdown of total annual expenditure on variable (i.e. non-permanent) fishing items is shown in Table 4.13 and amounted to FIM 1,220 million in 1999. Permanent/ fixed cost items such as boats and fishing tackle were excluded from the survey due to the difficulty in determining the proportion of these expenditures attributable as annual costs. The largest expenditures were on transportation to the fishing

site, variable boating expenditures (e.g. fuel, other operating costs, rental costs, etc.), licences, annual membership fees, etc. and food and drink. Mean annual expenditure per fisher was estimated to be FIM 930 (there was a 95% probability that the true mean falls within  $\pm 11\%$  (plus or minus) of this figure).

The economic values associated with the current quality of the recreational fishing experience (all water types) and the existence of fish stocks are shown in Table 4.14. Finnish recreational fishers held somewhat higher net economic values for the same fishing experience (1, Table 4.14), compared to the general public's mean non-use value in relation to the preservation of natural fish stocks and maintaining the current quality of the fishing experience (2). However, when fishers were asked directly about the value they place on the preservation of natural fish stocks in addition to maintaining the current quality of recreational fishing (all water types), they attributed 80% more value compared to non-fisher (FIM 388 per fisher as compared to FIM 287 per non-fisher). The total economic value of recreational fisheries (all water types) in Finland was estimated to be between FIM 994 million and FIM 967 million, depending on the method used to derive the estimates.

**Table 4.13 Breakdown of total annual recreational fishing expenditure (all water types) on non-permanent items in Finland by category, 1999 (Toivonen et al., 2000).**

Expenditure category	Proportion (%)	Total annual expenditure (FIM million)
Automobile transportation to fishing site	35	427.00
Boating (fuel, other operating costs, rental costs)	19	231.80
Other transportation to fishing site	3	36.60
Lodging/accommodation	8	97.60
Licences, annual membership fees	15	183.00
Journals, books, videos, etc.	3	36.60
Food and drink expenses additional to normal purchases	13	158.60
Other expenses (no tackle, clothes, etc.)	3	36.60
<b>Total</b>	<b>100</b>	<b>1,220.00</b>

The recreational fishers' WTP for three different types of fishing sites were also elicited using specially constructed scenarios. One of these scenarios related to the recreational fishers' WTP for "*an exclusive fishing right to a good quality stream with salmon and sea trout*" – the others related to lake fishing. In Finland, the mean respondent was WTP an additional FIM 415 ( $\pm 10\%$ ) for this right over and above what they currently spend indicating that they value the opportunity less highly than they value their current fishing experience (FIM 446, see Table 4.10).

## Sweden

In order to derive the economic value of recreational fisheries (both freshwater and marine) in the Sweden (Toivonen *et al.*, 2000) sent a mail survey to 7402 people and received 3456 responses in total including 1286 usable responses from fishers. The mean age of recreational fisher respondents was 41 years old and 71% were males. There was a fisher in every household in Sweden. No significant difference was shown between fishers and the total population in terms of either education or household income.

It was estimated from survey results that the total population of recreational fishers in Denmark (all water types) was around 2,020,000 (35% of total population 18-69 years old) in 1999. Approximately 41% (817,000 fishers) of recreational fishers spent the majority of their fishing days at sea.

The most common type of recreational fisher was categorised as 'sports fisher' (81%), 'generalist' (14%) and then 'household' (5%). Fishing at the 'sea or coast' was the second most common location for Swedish recreational fishers (after lake fishing), accounting for around 33% or around 8,811,000 annual fishing days (Table 4.12).

**Table 4.12 Number of fishing days by main water type, Sweden (1999) (Toivonen et al., 2000).**

	Sea or coast	River	Lake	Total
Proportion of fishing days (%)	33	21	46	100
Annual no. of fishing days	8,811,000	5,607,000	12,282,000	26,700,000

The breakdown of total annual expenditure on variable (i.e. non-permanent) fishing items is shown in Table 4.13 and amounted to SEK 2,730 million in 1999. Permanent/ fixed cost items such as boats and fishing tackle were excluded from the survey due to the difficulty in determining the proportion of these expenditures attributable as annual costs. The largest expenditures were on transportation to the fishing site, variable boating expenditures (e.g. fuel, other operating costs, rental costs, etc.) and accommodation and licence fees (mainly payable for freshwater fishing activities). Mean annual expenditure per fisher was estimated to be SEK 1,470 (there was a 95% probability that the true mean falls within  $\pm 13\%$  (plus or minus) of this figure).

The economic values associated with the current quality of the recreational fishing experience (all water types) and the existence of fish stocks are shown in Table 4.14. Swedish recreational fishers held somewhat higher net economic values for the same fishing experience (1, Table 4.14) compared to the general public's mean non-use value in relation to the preservation of natural fish stocks and maintaining the current quality of the fishing experience (2). However, when fishers were asked directly about the value they place on the preservation of natural fish stocks, in addition to maintaining the current quality of recreational fishing (all water types), they attributed 40% more value compared to non-fishers (SEK 623 per fisher as compared to SEK 447 per non-fisher). The total economic value of recreational fisheries (all water types) in Sweden was estimated to be between SEK 2,425 million and SEK 2500 million, depending on the method used to derive the estimates.

**Table 4.13 Breakdown of total annual recreational fishing expenditure (all water types) on non-permanent items in Sweden by category, 1999 (Toivonen et al., 2000).**

Expenditure category	Proportion (%)	Total annual expenditure (SEK million)
Automobile transportation to fishing site	39	1,064.70
Boating (fuel, other operating costs, rental costs)	17	464.10
Other transportation to fishing site	6	163.80
Lodging/accommodation	13	354.90
Licences, annual membership fees	13	354.90
Journals, books, videos, etc.	3	81.90
Food and drink expenses additional to normal purchases	5	136.50
Other expenses (no tackle, clothes, etc.)	4	109.20
<b>Total</b>	<b>100</b>	<b>2,730.00</b>

**Table 4.14 Total economic value of recreational fisheries and stocks (all water types) in Sweden, 2000 (Toivonen et al., 2000).**

Measure of annual economic value	Mean WTP (SEK/person)	Total WTP (SEK million)
1. Recreational fisher's WTP for same fishing experience over and above current expenditures	548 ( $\pm 21\%$ ) <sup>1</sup>	1,025
2. Non-fisher's WTP to preserve current natural fish stocks <u>and</u> current quality of recreational fishing	447 ( $\pm 10\%$ ) <sup>2</sup>	1,400
<b>Total Economic Value – Measure A (1+2)</b>	-	<b>2,425</b>
3. Recreational fisher's WTP to preserve current natural fish stocks <u>and</u> current quality of recreational fishing	623 ( $\pm 12\%$ ) <sup>2</sup>	1,100
<b>Total Economic Value – Measure B (2+3)</b>	-	<b>2,500</b>

Notes:

1 – 95% confidence limit

2 – result from open-ended question

The recreational fishers' WTP for three different types of fishing sites were also elicited using specially constructed scenarios. One of these scenarios related to the recreational fishers' WTP for "an exclusive fishing right to a good quality stream with salmon and sea trout" – the others related to lake fishing. In Sweden, the mean respondent was WTP an additional SEK 639 ( $\pm 8\%$ ) for this right over and above what

they currently spend, indicating that they value the opportunity somewhat more highly than they value their current fishing experience (SEK 548, see Table 4.10).

### **Overview of other types of economic valuation study in Sweden**

A number of other economic valuation studies of relevance to Swedish MRF are briefly reviewed by Paulrud (2004) in his Doctoral Thesis 'Economic Valuation of Sport-Fishing in Sweden'. Some of the most relevant to MRF are shown in

Table . This summary highlights the diverse range of studies available in some countries which: (a) explore specific aspects of economic valuation methodology, (b) can have varied and relatively inaccessible formats (e.g. unpublished Doctoral Thesis, studies only in the domestic language or grey-literature i.e. government reports) and/or (c) present results which are very site-specific and localised in nature.

### **Coastal and guide/charter boat angling in Swedish Bohus region marine waters**

Paulrud's (2004) thesis aimed to quantify the net economic benefit of sport fishing through a number of empirical valuations for various areas and recreational fishing types in Sweden. These areas included the southwest Bohus region encompassing both inland and marine recreational fishing opportunities, the Byske river, the exclusive Kaitum river, and northwest inland Jämtland region. A number of different categories of angling were used for the study of the Bohus region: ordinary angling (in lakes for species other than salmonids), put-and-take (stocked) angling (in lakes for salmonids), river angling, coast angling (from boat or shore); and guide/charter boat angling at sea. Contingent valuation method, multi-attribute CVM and zonal average travel cost method (ZTCM) analyses were undertaken. Both mail survey and on-site sampling were used.

Table 4.16 shows the results for the three areas of Byske, Kaitum and Bohus. Angling on the exclusive Kaitum river attracted the highest mean consumer surplus estimate (SEK 166 per day) in addition to mean costs of SEK 465 per day. Marine guide/charter boat angling incurred the highest expenditure (SEK 503 per day) whilst attracting the third highest mean consumer surplus (SEK 115 per day). Coastal angling (either from shore or private boat) was attributed with one of the lowest consumer surplus estimates (SEK 56 per day) – only slightly higher than that for ordinary lake angling in the Bohus region.

### **Anglers social welfare change through the creation of Marine Protected Areas in the Stockholm-Roslagen archipelago**

Olsson, Soutukorva and Söderqvist (2005) reported upon the welfare effect of changes in Swedish recreational fishing in the Baltic Sea. A mixed logit (travel cost) model was developed using data on travel costs and catch rates collected via postal survey in the Stockholm-Roslagen archipelago region in 2002 and 2003. The analysis was based on a total of 94 and 79 usable responses received for the spring and autumn seasons respectively. Catch rate data focused on three main target species which of recreational importance (perch, pike and sea trout).

**Table 4.15 Relevant extracts from Paulrud's (2004) summary of existing Swedish sports fishery surveys.**

Author and year	Title of study	Type, approach and source of data	Principal findings
Weissglas <i>et al.</i> (1996)	Lax i strida strömmar – sportfisket som regional utvecklingsresurs ( <i>English: Rapids wild with wild salmon – sport-fishing as a resource in regional development.</i> )	Overview, discussion and empirical survey. Uses existing data and mail surveys. Open-ended CVM (and biological and impact analysis).	Shows the potential of developing sport fishing in the Baltic Sea.
Finn and Snellman (1997)	Socioekonomisk undersökning – av fisket efter lax ( <i>English: Socio economic survey – of salmon fishing.</i> )	Overview, discussion and empirical survey. Uses existing data and on-site interviews. Explains and analyses the problem from a socio-economic viewpoint. Qualitative interviews.	Shows that benefits are less than costs for commercial salmon fishing. The report states that the potential to develop angling tourism in Sweden is large.
SOU (2001)	Effektiv användning av naturresurser ( <i>English: Efficient use of the natural resources.</i> )	Overview with case studies of existing data. Compares recreational and commercial angling.	Finds arguments in favour of recreational fishing.
Appelblad (2001)	The spawning salmon as a resource by recreational use: The case of the wild Baltic salmon and conditions for angling in north Swedish rivers.	CVM. Mail survey. Estimates WTP for quality changes. (Also includes an overview and impact analysis)	Presents net economic values and value for quality change.
Olsson (2004)	Two Essays on Valuation of Marine Resources: Applications to Sweden.	Open-ended and dichotomous CVM. Mail survey. Also includes a Choice Experiment on marine amenities.	Estimates WTP for improved cod stocks. No significant difference in WTP between anglers and non-anglers.

**Table 4.16 Mean estimates of consumer surplus and costs per fishing day by type of fishing and area, Sweden (1998 and 1999) (Paulrud, 2004).**

Area; method	No. in sample (year sampled)	Type of fishing	Mean consumer surplus per day (SEK)	Mean costs per day (excluding food) (SEK)
Byske; ZTCM	203 (1998)	River angling	108	361
Kaitum; ZTCM	106 (1999)	River angling	166	465
Bohus; ZTCM	1220 (1998)	Ordinary angling in lake	53	99
		Put-and-take (i.e. stocked) fishery	83	231
		River angling	127	494
		Coastal angling (shore or boat)	56	240
		Marine guide/charter boat	115	503

Using the random utility based approach, Olsson, Soutukorva and Söderqvist (2005) estimated the welfare effects (through WTP) of various scenarios regarding increased catch rates of the target species and qualitative and quantitative changes in the fishing site attributes. The scenarios represented policies intended to preserve catch rates by converting sites into marine protected areas (MPAs). The results showed a high demand for increased stocks - welfare benefits associated with a 50% increase in catch rates were estimated to be around SEK 11.4 million (2002/3) for the sport-angling population. A 30% increase in catch rates was found to compensate for the welfare loss of converting the five most popular fishing sites into MPAs. A 50% increase in catches rates would compensate anglers for lost catches if the five sites with the highest catch rates were converted to MPAs.

## North Sea

### Belgium

There is no economic data or information relating to MRF in Belgium.

### Germany

There is no economic data or information relating to MRF in Belgium, though Arlinghaus (2004) analysed the social and economic importance of freshwater recreational fisheries in Germany

### Netherlands

Economic significance of MRF in the Netherlands

Smit, de Vos and de Wilde (2004) studied the economic significance of recreational fishing in both inland fresh water bodies and at sea in the Netherlands. The work was carried out at the request of the Fisheries Directorate of the Dutch Ministry of Agriculture, Nature and Food Safety as part of a broader evaluation of the current fisheries management policy initiated in 2003. Prior to this study, no structured collection of

relevant data had been undertaken in the Netherlands, so the economic and socio-economic importance of the activity was unknown.

This was recognised to be a problem, particularly for sea angling, given that some recreational landings were of species controlled by the EU's Common Fisheries Policy Total Allowable Catch system. LEI<sup>2</sup> was, therefore, commissioned to undertake research to determine the economic magnitude of recreational fisheries (in inland waters and at sea) in terms of its economic value of production, number of people employed, daily catches and catch composition. In addition, the recreational and tourism potential of the fishery was indicated.

Data for recreational sea fisheries were obtained through interviews with 25 individuals selected on the basis of their knowledge and experience in the activity. The factors driving the recreational and tourism potential of recreational sea fisheries were identified and the expected development of these factors, and their influence on the development of recreational sea fisheries, was determined. This part of the research focused on trends in recreational fisheries, tourism and recreational activities in general and demographic developments. The economic significance of the MRF sector was based upon an assessment of total expenditure estimates for day and overnight recreation activities. The researchers acknowledged that the study findings were limited, given the small number of people interviewed and the lack of a sound cost and earnings database.

### **Sector overview**

MRF is an important leisure activity in the Netherlands. According to research by NVVS (Zeevissers 2003, NVVS), around 425,000 men older than 15 years of age had undertaken some form of MRF, 70% undertaking both inland fresh water fishing and sea fishing, whereas 30%, some 125,000, only engage in marine fishing. When women, children and tourists are included, the total number of marine recreational fishers is estimated to be half a million. On average, men over 15 years of age undertake 4.4 sea angling trips annually, amounting to some 1,870,000 sea fishing trips each year.

There are three main types of MRF:

- fishing from the land (e.g. off the beach, sea walls, piers, etc.)
- from small privately-owned recreational boats
- from larger recreational vessels designed for group activities (i.e. charter boats).

There are between 6,000 and 7,000 small privately owned boats active in recreational sea angling, of which a small number are fully equipped for wreck fishing for cod. The larger recreational charter vessels vary in size and sea worthiness. They range from 'small' charter vessels operating in the Wadden Sea and the southern estuaries, accommodating 20 to 40 paying guests. These boats can fully equip guests for the fishing trip and their focus is orientated towards tourism and onboard catering. At the other end of the scale are the 'larger' North Sea charter vessels, carrying in the range of some 40 to 75 people on a

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<sup>2</sup> The Agricultural Economics Research Institute LEI is one of the research institutes at the Wageningen University and Research Centre, The Netherlands. LEI carries out statutory tasks and tasks relating to service-provision for the Ministry of Agriculture, Nature and Food Quality.

trip. These anglers are mainly interested in the catches, especially the quantity, as opposed to the fishing experience from a tourism perspective.

The most important species for the marine recreational fisheries are flounder, sole, mackerel, garfish, eel, whiting, cod and sea bass - in the summer mackerel is the main target species for charter boats; cod in the winter. Of the eleven main species targeted by sea anglers, six have shown reduced catches over the past ten years, in particular cod, eel and flounder. Only catches of sea bass have increased over the last decade.

Based on the interviews it can be estimated that per year some 186-408 t of cod are being caught by the leisure fisher. This would, in comparison to the 2003 Dutch cod quota of 2,619 t, be between 7-16%, although recreational catches are not included in the national quota.

### **Trends in the recreational fleet**

The overall infrastructure demand from both fishing from land and from small boats is rather limited. The number of larger recreational charter vessels has decreased due to diminishing catches and an increase in rules and regulations concerning safety and equipment. Both cod and sea bass used to be sold by anglers. An estimated 25 well-equipped small boats were thus more or less involved in a professional fishery using anglers to catch the fish. However, due to increased monitoring of these practices, these sales have been drastically reduced.

### **Economic importance**

The recreational sea fishery in The Netherlands had an estimated total economic value of 127 million Euro in 2004, measured in terms of the amount of money spent within the sector (Table 4.17). Around 3% of this total was spent on bait, whilst a further 17% was spent on artificial lures. Expenditure on fishing equipment (both fixed/permanent and variable/disposable) was around 32% of the total. Combined expenditures on both large/charter and small vessels amounted to 15%, and the remaining 33% was spent on associated expenditures of travel, food, accommodation and magazines, etc. Around 60% of all expenditure went towards variable (non-permanent) costs items, 23% towards fixed costs and a further 17% on associated expenditures (**Error! Reference source not found.**). A reduction in fishing activities is expected to lead to a direct reduction in total expenditure.

Total direct and indirect employment in the MRF sector was estimated to be around 800 persons in 2004 (

Table 4.19). Direct employment was found in the charter boat, fresh bait supply and small boats sectors (i.e. new builds, imports, maintenance and repairs, etc.) and accounted for nearly half (381 persons, 47%) of the total employment estimate for the sector. It was more difficult to attribute employment in other sectors (such as the artificial bait and equipment provision sectors) devoted wholly to sea angling as they also tend to serve other sectors (e.g. freshwater recreational fishing and general marine leisure sectors). In addition, many of the goods are imported, so expenditures on these sectors flow out of the Netherlands and do not provide so much direct economic benefit (including employment) to the economy compared to if they were made in the Netherlands. They do, however, contribute indirectly to the economy through induced and multiplier effects. Indirect employment estimates were been calculated based on employment coefficients.

For some provinces (such as Zeeland), specific regions (such as the north of Noord-Holland province) and certain specific places such as Scheveningen and IJmuiden, MRF was considered to be of considerable importance to the economy, offering an important extension to the range of tourism-related activities.

**Table 4.17 Estimated Total Expenditure on MRF in the Netherlands by Detailed Category, 2004 (Euros).**

Expenditure Category	Total Amount (€1,000)
Bait	4,300
Artificial bait (hooks, lures, etc.)	21,250
Fishing equipment – fixed/permanent costs (rods, reels, etc.)	19,125
Fishing equipment – variable costs (lines, etc.)	21,250
Larger vessel/charter boat fees	9,313
Larger vessel/charter boat fuel costs	18,700
Smaller boat costs (incl. fuel)	10,250
Angler food and accommodation	21,063
Magazines, angling literature, etc.	2,125
<b>Total</b>	<b>127,376</b>

**Table 4.18 Estimated Total Expenditure on MRF in the Netherlands by Summary Category, 2004 (Euros).**

Expenditure Category	Total Amount (€)	Proportion of Total (%)
Variable costs (bait, fuel, travel expenditure)	76,937,750	60.5
Fixed costs (equipment, including cost of vessels)	29,375,000	23.1
Recreational expenditure (food and accommodation)	21,062,500	16.6
<b>Total</b>	<b>127,375,250</b>	<b>100.0</b>



**Table 4.19 Estimated of Direct Employment Dependent on MRF in the Netherlands, 2004 (man years).**

<b>Employment Category</b>	<b>Man Years</b>
Mechanised bait digging and commercial sale	25
Hand bait digging for private sale	50
Artificial bait production	93
Fishing equipment production – fixed/permanent costs (rods, reels, etc.)	84
Fishing equipment production – variable costs (lines, etc.)	93
Charter boat operations	226
Larger vessel/charter boat fuel costs	73
Small boats (maintenance)	55
Small boats (new builds and importing)	25
Associated recreational expenditure	69
Magazines, angling literature, etc.	10
<b>Total</b>	<b>803</b>

### **Development potential**

International literature demonstrates a clear relationship between an increase in the status of a stock and the recreational activity level in terms of motivation and frequency of trips. In the Netherlands, angling activity in the cod fishery has decreased in line with decreasing catches of this species. Thus, improved government and EU policies resulting in healthy fish stocks can be expected to result in an increased level of MRF activity. Within the sector itself, the development of more active types of fishery, increased specialization and further modernization of the sector could also increase its attractiveness.

In the Netherlands, the trend of an aging population and increasingly multi-national society is expected to have a limited impact on the sector. The general trend towards active, existing and exciting recreation opportunities is expected to allow recreational fisheries to develop further.

## **North Western Waters**

### **Ireland**

#### **Economic evaluation of Irish angling**

The objective of Whelan & Marsh (1988) was to assess the economic importance of the angling resource in order to facilitate its development potential in terms of generating income and employment within the Irish economy. The study was prepared for the Central Fisheries Board and covered game (salmon and sea trout), coarse and sea angling. Two surveys were carried out: one of anglers resident in Ireland and the other of visiting anglers.

Whelan and Marsh (1988) estimated total expenditure by all anglers (sea and inland) in 1987 to be IRE£57 million, which supported 1,900 full-time job equivalents through direct, indirect and induced effects in the economy and generated IR£15 million tax revenue. Around 5% (43,600) of the Irish angling population at the time were estimated to be sea anglers.

### **Survey of sea angling in the South West of Ireland**

The 'Survey of sea angling in the South West of Ireland – Ballycotton to Kerry Head' (Institute of Technology, 1997) was prepared to review the structure and extent of sea angling in the South West region, investigate factors that will influence development and make recommendations on how it can achieve maximum sustainable development in the future. Sea angling was categorised into three types: shore-based, inshore (using small open boats in shallow and sheltered waters) and deep-sea angling (larger boats in offshore waters including specialised angling for pelagic fish such as sailfish, tuna and shark).

Sea angling tourism grew notably from 24,000 overseas sea anglers in 1987 to 53,000 in 1994 and 41,000 in 1996. Overseas sea anglers were predominantly from Britain and the European Continent (90%) with around 75% of overseas deep-sea anglers being from Britain and the Netherlands. The Marine Institute estimated there to be 67,300 domestic sea anglers in 1997.

Sea angling visitors were estimated to have spent around IR£15 million in 1995 whilst domestic sea anglers spent around IR£9 million. These combined gross expenditures were estimated to support around 850 FTE equivalent jobs and generate about IRE£6 million in tax revenue to the government. However, it should be noted that these figures are not based on net expenditures and do not take into account potential substitution and displacement effects if sea angling were to change or cease to exist.

Most of shore-based and inshore sea angling is conducted by domestic anglers. However, the deep-sea angling sector is most attractive to visiting anglers and has seen substantial development over the years. In 1997, more than 70 deep-sea angling charter boats were listed as operating in Irish waters, in addition to a further 30-40 angling boats that were also capable of running deep-sea angling trips. In the South West coastal region, 48 charter boats operated for an average of 74 days per year in 1996. Up to 60% repeat business was reported for deep-sea anglers in the South West, indicating their specialist knowledge and the quality of the product on offer. The profitability of deep-sea angling charter boats in the South West was found to be relatively low and to vary markedly, depending on whether boats were old with low operating costs or relatively new with higher operating costs but higher turnovers.

### **An economic /socio-economic evaluation of wild salmon in Ireland**

Ireland's Central Fisheries Board commissioned a study (Indecon, 2003) to address the requirements for the long-term sustainable management of wild salmon stocks in Ireland. The main focus of this work was to ascertain the economic and socio-economic value of the commercial and recreational wild salmon fisheries in Ireland. Further, the study provided recommendations of options for the best management of both segments of the fishery, whilst giving due consideration to the importance of wild salmon to coastal and rural communities. Commercial salmon fisheries in Ireland are mainly conducted using drift nets in coastal/offshore waters and draft nets in estuaries and tidal stretches of river systems. Recreational fisheries are comprised of salmon angling in river systems.

The study methodology consisted of a review of salmon management in Ireland and existing research on the economic/socio-economic value of Atlantic salmon. The economic impact of commercial and recreational salmon fishing were quantified mainly on the basis of estimating gross commercial revenues and total angling expenditures respectively, and adjusting the results to account for the proportion of inputs and expenditures (respectively) on imported goods. Finally the views of commercial salmon fisher, tourism and angling interests were sought.

### Economic impact of commercial salmon fishing

The economic impact of commercial salmon fishing was quantified by determining gross revenues (before operating expenses or taxes) derived from sales of commercially caught salmon on a regional basis. These gross revenues were adjusted using an estimate of the proportion of direct or indirect expenditure on imported goods. Data on employment and additional income sources were also presented. The impact of downstream activities such as fish smoking and processing were not evaluated. Data were sourced from number of sources including: an Indecon survey of 135 commercial salmon fishers in Ireland, the Central Fisheries Board, Regional Fisheries Boards, Bord Iascaigh Mhara and the Central Statistics Office.

**Table 4.20 Economic impact of commercial salmon fishery, 2002 season.**

Method	Drift net	Draft net	Other	All methods
No. salmon caught <sup>1</sup>	179,177 <sup>2</sup>	23,032	4471-Snap net 142-Bag net 77-Loop net	206,899
Total license holders <sup>3</sup>	883	544	n/a	-
Total revenue value <sup>4</sup>	€4.048m	€0.656m	€0.103	€4.807m
Direct income/ economic value <sup>5</sup>	€3.643m	€0.590m	€0.093m	€4.326m

Notes: (1) Data based on National Carcass Tagging and Logbook Programme. (2) Excluding the Foyle region. (3) Central Fisheries Board. (4) Total revenue value = total salmon catch \* average weight per salmon \* average price. (5) Assumption that 10% of direct and indirect costs are imported inputs.

Drift netting accounted for 87% (179,177 salmon) of all commercial salmon catches in the 2002 season and draft netting for 11% (23,032 salmon), despite the fact that there were only 1.6 drift net licences issued for every 1 draft net license (Table 4.20). Compared to the 2002 catch of 206,899 fish, commercial salmon catches of 233,401 fish were taken in 2001 (highest catch 1996-2002) and 134,400 in 1999 (lowest catch of period). A high proportion of commercial catches were taken by a small proportion of licence holders and many licence holders appeared to be relatively inactive. Indecon (2003) concluded that whilst commercial fishing may provide a significant proportion of income for some fisher, this is not likely for all licence holders.

The average commercial boat was 6.7m in length and employed 2.6 crew, who were most likely to be relatives of the owner (43%), followed by joint owners (36%) and employees (21%). Average income derived from salmon fishing in the previous season was 42%, other fishing (12.7%), farm work (7.8%) or other sources, other employment or unemployment.

Indecon (2003) estimated that average commercial salmon sales in 2002 were €4,464 per fisherman, whilst the average (mean) income per week from salmon sales was €536, though the median was much lower at €195. The median sale price among survey respondents was equal to €3.3 per lb. The total value of revenues generated by commercial salmon fisher was estimated to be €4.8 million in 2002, of which just over €4 million was from the drift net sector (Table 4.20).

Adjusting for a notional level of imported inputs, Indecon estimated a total direct economic value or income from commercial salmon fishing of €4.33 million (Table 4.20). This calculation was based on the notional assumption that 10% of direct and indirect costs were imported inputs and, as no other data was available relating to operating costs or taxation payments, the estimates of direct economic value were only adjusted by this notional factor. Whilst it was acknowledged that downstream activities such as processing and smoking would add value, no detailed data was available to link domestic catches with local processing. Finally, it was noted that the economic impact of the commercial salmon fishery was concentrated in areas that generally lack an intensive industry base such as rural areas and small coastal towns.

### **Economic impact of salmon angling**

The economic impact of salmon angling was quantified by determining the activity patterns of domestic and overseas anglers and providing an estimation of overseas visiting angler expenditure. This estimate was also adjusted using an estimate of the proportion of direct or indirect expenditure on imported goods to provide a proxy for the first round contribution of the sector to the economy. A multiplier was applied to estimate the second-round effects of this expenditure. Data were compiled from a number of sources including: Bord Fáilte, Central Statistics Office, Indecon surveys of overseas (83 respondents) and domestic (218 respondents) anglers and an analysis of angling accommodation in Ireland.

Salmon catches by recreational anglers in 2001 were estimated to be 26,074 – around 11% of the commercial catch in that year. The highest catches in the 1996-2001 period were recorded for 1996 (41,507 salmon) whilst the lowest were those for 2001. Catches were largest in the North West and South West regions followed by those in the Southern region, which saw a substantial decline compared to previous years.

There were around 24,000 overseas salmon angler visits per year between 1998-2000, with nearly three-quarters of visitors arriving between May and August. Around 54% of these overseas anglers came from Britain, 33% from mainland Europe and 13% from North America. The majority of these anglers were on holiday (69%), whilst one-fifth (19%) were visiting friends/relatives. Nearly all overseas salmon anglers (90%) surveyed by Indecon stated that salmon fishing was the primary purpose of their trip. Salmon anglers were found to generally stay longer (6-8 days) than other tourist visitors, and a higher proportion were repeat visitors to the country and in the managerial/ professional class. Over one-quarter (27%) of overseas salmon angler nights spent away from home were spent in dedicated fishing lodges and a further fifth (21.4%) were spent in rented homes/chalets.

**Table 4.21 Economic impact of recreational salmon fishery, 2001 season.**

	Overseas anglers	Domestic anglers
No. of anglers	24,000 <sup>1</sup>	23,351 <sup>2</sup>
Avg. daily expenditure per salmon angler <sup>3</sup>	€203	€136
Median daily expenditure per salmon angler <sup>3</sup>	€140	€100
Expenditure per trip <sup>3</sup>	€407	-
Total annual expenditure	€10m <sup>4</sup>	€51m <sup>5</sup>
Total economic contribution (first round effects) to Irish economy per annum <sup>6</sup>	€5.85m	€4.59m
No. jobs supported per annum <sup>7</sup>	235	-
Total economic contribution (incl. second round effects) to Irish economy per annum <sup>8</sup>	€6.44m	-

Notes: (1) Bord Fáilte survey. (2) Based on an adjusted estimate of rod angling license holders. (3) Indecon survey of salmon anglers. (4) Bord Fáilte survey. Expenditure = average annual expenditure per visitor trip to Ireland (all purposes) 1998-2000 \* no. of salmon angling trips made by overseas visitors. (5) Expenditure = no. of domestic salmon anglers \* no. trips per year \* no. days per trip \* expenditure per trip (6) Adjusted based on assumption that 40% of direct and indirect costs (i.e. expenditure by overseas visitors and domestic anglers) were imported inputs; No data was available on actual proportion of costs that are imported inputs or opportunity cost of labour and other goods; Assumption that 85% of domestic angler expenditure would have been spent on other activities if salmon fishing had been unavailable; (7) Based on Dean & Henry (1995). (8) Multiplier value of 1.22 was used.

An estimate of the economic impact of overseas visiting salmon anglers was made by determining the total value of first round expenditure based on the number of trips made per year (24,000) multiplied by the average expenditure per visitor trip (for all purposes) (€406.6). This total was then adjusted based on the assumption that 40% of direct and indirect costs were imported inputs, to arrive at a total first-round contribution to the Irish economy of €5.85m per annum. No data was available on the actual proportion of expenditures made on imported inputs or the opportunity cost of labour and other goods used in supplying products and services purchased by overseas visitors. It was further estimated that this adjusted first-round expenditure supported 235 jobs per annum. Second-round expenditure effects were further estimated to produce a total economic contribution to the Irish economy from overseas visiting salmon anglers of €6.44m.

Indecon (2003) estimated that there were 23,351 domestic salmon anglers in Ireland in 2001, each making just over 6 fishing trips per year with an average length of 2.5 days. Around 80% of trips were made between May and September and a high proportion (75%) of days fished were in local waters. For trips involving nights spent away from home, 30% were spent in guesthouse/farmhouse accommodation and 11% in dedicated fishing lodges. Daily average expenditures were reported to be €136 (median €100). Expenditure items include accommodation, food/drink, tackle/bait, boat hire, guides, permits/licences, gifts/souvenirs, etc. Just over 16% of domestic anglers reported taking trips abroad involving salmon fishing in other countries in the past five years.

Total annual domestic angling expenditure was calculated to be €51 million per annum, though it was assumed that 85% of this expenditure would have been made on other activities if salmon angling had not been available and that 40% of spend related to imported goods. Hence, the total net benefit of domestic salmon angling to the Irish economy was estimated to be €4.59 million per annum. The combined net economic value of overseas tourism and domestic salmon angling, adjusting to reflect imported inputs and displacement impacts (but not reflecting the opportunity cost of labour and other resources), was estimated to be €11 million per annum.

The values presented in this study provide an estimate of gross and net economic contribution of salmon angling to the Irish economy. They convey information about expenditure on angling, but do not provide information on potential net or marginal contributions to the economy, which may result from changes in angling quality or experience.

### **Estimating the demand for salmon angling in Ireland**

Curtis (2002) estimated the demand and economic value for salmon angling in County Donegal, Ireland. The study was intended to provide useful information to fishery managers about the factors that drive salmon angling and from the welfare estimates they could also infer the value to anglers of their trips and attempt to extract the surplus enjoyed by anglers. The study results were also intended to inform the national debate about the management and exploitation of salmon fisheries – particularly related to the interaction between commercial and recreational sectors. A travel cost approach was applied<sup>3</sup> where demand at a given location is a relationship between the number of days taken by an individual in a given period, trip price (i.e. travel cost), and angler characteristics. The data were collected from an on-site in-person survey of anglers visiting Co. Donegal in 1992.

Angling quality and angler age and nationality were found to affect angling demand. The mean WTP of the average salmon angler was travel cost of IR£68 per day and consumer surplus of IR138 per day. The results suggest that there is scope for fishery managers to increase their revenues given the large consumer surplus, though the results also indicated that anglers with the largest surplus were those most sensitive to price (i.e. German anglers). The ability to increase fees will also be constrained by available substitutes. The WTP estimates highlight the economic importance of the recreational salmon fishery, but they do not indicate anything of the value of the commercial fishery. If more WTP could be captured, it could possibly be used to offset or compensate any socio-economic loss that would stem from a reduction in the commercial fishery to benefit the recreational fishery.

### **The economic effects of management options for a salmon fishery**

Members of the Central Fisheries Board, the Salmon Research Agency and the Economic and Social Research Institute carried out a study to estimate the biological and economic effects of management options for a typical medium-sized Irish salmon fishery (Gargan, Whelan & Whelan, 1997). A model was developed examining grilse (a salmon which has spent only one winter at sea) survival under a range of differing catch scenarios for the Eriff Fishery in County Mayo. The economic consequences of the various scenarios were compared after considering the income and employment generated by the three

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<sup>3</sup> A truncated negative binomial model was used allowing for endogenous stratification.

components, namely the recreational rod fishery, the commercial fishery and the 'surplus' fish (i.e. those that remained uncaught and went on to add to the spawning stock). The first scenario represented the status quo, whereby drift nets exploited 66% of returning grilse, that had an economic value estimated to be IRE£291,000 with an employment level of 12 FTE's. However, this 'economic value' was comprised of a combined estimate of the total amount of recreational angler expenditure on the activity and the first sale value from the commercial fishery. In a second scenario, the removal of the drift net fishery would cause catch rates to rise in both the estuary net catches and the rod and line catches, creating an increase in the total recreational expenditure and commercial first sale income to IRE£373,000 (supporting 16 jobs).

## United Kingdom

### Total Economic Value of recreational sea angling in England & Wales

Crabtree *et al.* (2004) provides the most comprehensive overview of recreational sea angling in England and Wales to date (*Economic impact of recreational sea angling in England & Wales*). Commissioned by the Department for Environment, Food & Rural Affairs (Defra), the work identified the important local centres for sea angling in England and Wales, the economic contribution of the sector both nationally and locally and the value of the sea angling experience to those who participate in the activity.

A Households Omnibus survey (10,200 households interviewed) was used by Crabtree *et al.* (2004) to estimate the total population of recreational sea anglers in England & Wales. A survey of 900 anglers (using face-to-face and postal methods) elicited information on their patterns of activity and expenditure and utility associated with the activity. A survey of business suppliers to sea anglers was also undertaken to estimate impacts on employment and income as a result of angler expenditure (130 businesses were surveyed). These businesses were surveyed in three English sea angling centres (Weymouth, Whitby and Hastings) and one in Wales (Anglesey)) which were also the focus of wider case studies.

It was found that 1.1million (or 5% of) households in England & Wales contained at least one member who had been sea angling in the previous year. There were at least 1.1m individual adult sea anglers and perhaps a further 0.34m if children under 12 and households containing more than 1 adult angler are included. The mean number of sea angling days per year was estimated to be 11.3 days, though 24% of anglers fished for only one day in the previous year, whilst some claimed to fish every other day of the year. Just over 3% of anglers were female and activity was spread across all social classes. Just over half of sea anglers (54%) were mainly active from the shoreline, whilst around a quarter (23%) mainly used private boats and another quarter (22%) mainly used charter boats. In terms of distance usually travelled to go sea angling, 37% of sea anglers typically travelled less than 25 miles, though 44% travelled more than 50 miles either out of choice or necessity (i.e. to reach a suitable part of the coast).

Over 300,000 sea anglers were members of clubs representing 12% of households containing at least one sea angling member. Around 41,100 anglers were estimated to be members of clubs belonging to the larger associations of the National Federation of Sea Anglers, Northern Federation of Sea Angling Societies and Welsh Federation of Sea anglers. Many clubs operate busy social programmes, competitions and angling activities and trips for their members, as well as maintaining buildings and other facilities.

The total economic value of sea angling in England & Wales was calculated by combining an estimate of angler expenditure and consumer surplus, where consumer surplus is the utility anglers derive from their activity over and above what they actually pay to undertake it. Both an expressed preference contingent valuation method and a revealed preference travel-cost method were used to determine estimates for consumer surplus. The total annual expenditure of recreational sea anglers in England & Wales was estimated to be £538m in 2003 (Table 4.22). The mean number of days angling per household per year according to main angling activity was greatest for shore anglers (13.62) and lowest for those using charter boats (4.96), whilst mean expenditure per angling day was greatest for boat owners and lowest for shore-based anglers. Boat owners accounted for around half of total annual expenditure, which is to be expected given the amount of money spent on purchasing, maintaining, operating and mooring boats in addition to that spent on tackle, transport, food, accommodation and charter trips. The total economic value of recreational sea angling in England & Wales, in terms of expenditure and consumer surplus combined, was estimated to be between £650m and £1,300m per year, depending on the method used to derive the consumer surplus estimates.

**Table 4.22 Total economic value of recreational sea angling in England & Wales, 2003 (from Crabtree et al, 2004).**

	Main angling activity			Total
	Shore	Charter boat	Own boat	
No. angling households (m)	0.61	0.24	0.26	1.10
Days angling/household/year, mean (days)	13.62	4.96	12.41	
Expenditure/angling day, mean (£/day)	21.6	67.7	87.9	
Expenditure/household/year (£)	295	336	1091	
Aggregate expenditure/year (£m)	178	82	278	538
Consumer surplus, range of estimates (£/day)*	5.7-35.5	18.4-90.0	14.3-108.7	
Aggregate consumer surplus/ year, range of estimates (£m)	46-295	20-107	51-357	117-759
<b>Total economic value (£m)</b>	<b>224-473</b>	<b>102-189</b>	<b>329-635</b>	<b>655-1297</b>
Supplier's income generated by angler expenditure**	19.1	9.0	43.3	71.4
Employment supported by angler expenditure** (FTE)***	5652	3092	10145	18,889

Note: \* The lower range bound values were derived using the Contingent Valuation Methodology; the upper bound using a Travel Cost Methodology.

\*\* First round impacts only.

\*\*\* Full Time Equivalent (FTE)

The first-round economic impact of sea angler expenditure was estimated by Crabtree *et al* (2004) by determining the impact of angler expenditure on supplier's income and the number of jobs supported by this expenditure (indirect and induced impacts were not calculated). Around £71m of supplier's income and nearly 19,000 FTE jobs were generated by sea angler's expenditure. There were 452 charter boats known to be operating around the E&W coastline, which will have accounted for a small proportion of this employment. The majority of employment was generated as a result of expenditure by boat owners (61%) and those fishing from shore (27%).

It is important to note that if sea angling were to cease for some reason, much of the angling expenditure would be diverted to other forms of leisure activity or other types of expenditure, therefore the first-round economic impact would not be lost to the England & Wales economy. Any loss, or negative impact on the economy, would be linked only to that expenditure which was diverted overseas.

The local economic impact of visiting anglers was determined by focusing on the impact of expenditure made by those making fishing trips or spending money more than 50 miles from home. The income effect on suppliers was estimated to be £31.2m and around 8330 FTE jobs were created. Expenditure by visiting (i.e. non-local) sea anglers amounted to just less than 1% of total tourism spending.

### **Recreational sea angler utility: motivations and preferences in England**

A choice experiment was used in the Crabtree *et al* (2004) to estimate consumer surplus values associated with marginal changes in the diversity and quality of the angling experience. All types of angler were willing to pay £0.22 more for a 1% increase in the size of fish caught, and £8.86 more to catch species which are different to those they usually catch. Only shore anglers were willing to pay more (£0.81) for each extra fish caught. Boat anglers were not willing to pay more for extra fish caught – in fact they had a negative utility associated with catching extra fish. The report's authors explained this unexpected result by suggesting that boat anglers may have become so skilled at finding fish that they derive little utility from catching more, but they do gain more utility from catching larger individual fish or more diverse species. However, shore-based anglers catch far fewer fish on average than boat-based anglers, and have fewer ways of influencing the number of fish caught (i.e. they only have access to fishing spots adjacent to the shore), and so derive increased utility from catching more fish. The result may also have been influenced by methodological choices.

### **Marginal impact analysis of changes in the angling experience in south west England**

A study carried out to determine "*The Motivation, Demographics and Views of South West Recreational Sea Anglers and their Socio-economic Impact on the Region*" (Cappell & Lawrence, 2005) also estimated the marginal impact on utility from changes in the angling experience using a choice experiment methodology. This study was part of the 'Invest in Fish South West' initiative, funded by private and public funds, which is a unique co-operative project aimed at agreeing the measures needed to best sustain fish stocks and fisheries within the region (Celtic Sea, English Channel and Western Approaches), whilst being considerate of the regional economy, local communities and the wider marine environment. Results were based upon 356 face-to-face interviews carried out in the South West of England. The following attributes were identified as being most important in influencing recreational sea angler s' choices: average catch per day of favourite species, average catch per day of other species, size of fish caught, existence of a catch/bag/rod limit, quality of surrounding environment and cost per day.

The study of recreational sea anglers in South West England (Cappell & Lawrence, 2005; Lawrence, 2005) estimated a 'variable' WTP over and above expenditures on fixed costs (i.e. cost of buying a boat or a rod), which were deemed to have been already been paid for. A non-linear relationship was found between anglers' WTP and their catch of their favourite species. They had a high WTP (£13.56) to increase catches from 0 to 1 fish per day, but a declining WTP to catch more fish thereafter (e.g. £2.03 to increase catches from 6 to 7 fish) (Table 4.23). Anglers were much less WTP more money beyond catches of 6 or 7 fish, indicating that this was some kind of threshold beyond which anglers derive little additional utility from catching more fish. The utility derived from catching increasing numbers of target fish also varied depending on the species. Catching more cod and mackerel was associated with less utility than catching more sea bass, for example. The authors conjecture that this result stems from the fact that cod is generally perceived to be 'food fish', whilst sea bass tends to be regarded as a 'sport fish' and mackerel tends to be caught by casual anglers, who in the South West are often holidaymakers.

South West anglers displayed a positive WTP (£1.02) to catch one additional fish of other (non-favourite) species. This result was much lower than the WTP associated with catching more of their favourite species. So whilst they gained utility from catching other species, they appeared to be very discerning about the type of fish they catch. However, the size of fish caught was found to have a very big impact on WTP. Anglers were WTP £13.27 more for a 50% increase in the size of individual fish. The existence of catch/rod/bag limits and the 'environmental quality' of the angling experience (which encapsulated factors such as water and air quality, aesthetics and facilities) were found to be only minor factors influencing angler's decisions.

The marginal effect on utility was measured by determining angler's WTP to increase catch and size of their favourite species by 50% from current levels. Results varied depending on the favourite species of those surveyed.

**Table 4.23 Marginal effect on angler's WTP of increasing catch and size of favourite species (from Cappell & Lawrence, 2005).**

Favourite species	50% increase in catch (£)	50% increase in size (£)
Sea bass	8.46	12.45
Cod	6.35	-4.74
Mackerel	-0.61	9.29
Others	5.60	12.45
<b>All species</b>	<b>6.38</b>	<b>10.24</b>

Cappell & Lawrence (2005) note that marginal effects on angler utility in changes from the current situation may be more useful than absolute values to decision makers. Although results vary for individual favourite species, it can be seen from the table above that a 50% increase in the size of fish caught has notably more utility value than a 50% increase in the number of fish caught, although there is still a substantial positive utility associated with catching more fish. This result holds true for sea bass and 'other' species. The report's authors suggest that the anomalous negative result for an increase in the

size of cod caught may be due to a relatively small sample size, whilst the small, but negative, result for an increase in numbers of mackerel caught may reflect the fact that mackerel catches tend to be high (11.2 per day on average) in relation to those of other species (i.e. 2.5 for sea bass, 2.9 for cod). Therefore, anglers may already be catching mackerel at levels beyond which they derive no tangible extra utility.

### **Study into Inland and Sea Fisheries in Wales**

This study was commissioned by the National Assembly for Wales (the devolved government administration) to benchmark the current state of inland and sea fisheries in Wales and to formulate a development strategy encompassing all sectors of the industry (Nautilus Consultants, 2000). The study and development strategy were designed to support the EU Objective 1 funding plans for Wales and to contribute to the co-ordinated socio-economic development of the coastal and rural Welsh economies. The work was undertaken by Nautilus Consultants in association with EKOS Economic Consultants.

Recreational fisheries were separated from commercial fisheries and aquaculture, and were further subdivided into game angling for salmon and trout predominantly in rivers, coarse angling for all other freshwater species and sea angling. Each sub-sector was reported upon in terms of its current status. An analysis of its strengths, weaknesses, opportunities, threats and development potential was undertaken and the fisheries/environment interaction was also examined. Sub-sectors of relevance are sea angling and game angling that includes river-based angling for sea trout and salmon, which are targeted commercially in marine. Hence, there is an interaction between the effects of commercial and recreational activities for these species.

### **Game angling**

A total 24,629 sea trout and 3403 salmon were caught by angling in Welsh rivers in 1999 and 49% and 35.5% respectively were returned alive to the water. The Environment Agency (the government agency responsible for the management of inland water bodies and associated fishing activities) sold salmon and sea trout licences required for freshwater fishing amounting to £276,440 in 1999. This income is spent by the Environment Agency maintaining and improving freshwater fisheries, with much being spent on habitat improvement.

Direct expenditure by game fisher on rod licences, fees/permits, rods/reels/nets, tackle and competitions in Wales was estimated at £3.425m in 1999, based on the number of salmon and sea trout licence purchases and an unadjusted estimate of direct expenditure transferred directly from another study which quantified expenditure of anglers fishing one particular river in Wales targeting resident trout (Spurgeon *et al*, 2001).

Estimates of indirect fishing-related expenditure and additional indirect non-fishing related expenditure by anglers and family members were also calculated, based on the estimated mean number of Welsh freshwater angling days (including both salmon/sea trout and brown trout/coarse fishing days) in the period 1994-98 and unadjusted expenditure transferred from the aforementioned study. An economic multiplier of 1.1 was also applied to the total of direct, indirect and indirect non-fishing related expenditure to account for the knock-on/second round impact of these expenditures within the economy bringing the estimated total value of game fishing (for salmon, sea trout, brown trout and coarse fish) to just under £9 million.

A very basic estimate of direct employment in salmon fisheries (21 jobs) was made of by extrapolating secondary data on a single estimate of direct employment per number of salmon caught in 1997.

### **Sea angling**

Statistical and economic information about sea angling in Wales is much less available compared to game angling. A major contributory factor being that rod licences are not required, as is the case for freshwater angling.

Shore-based sea angling occurs mainly in the summer months when visiting anglers add to local populations. During the autumn and winter, shore-based angling is mainly undertaken by locals. The Welsh Federation of Sea Anglers recorded that there were 294 registered charter angling vessels operating in Wales, generally between April and October. Typical charter costs were estimated to be in the order of £30 per person per day. There is also a healthy sub-set of anglers who fish from their own boats – but no specific figures were estimated or available.

In the absence of official statistics, estimates were made following interviews with local experts as to the amount of expenditure made by sea anglers per trip. Estimates of the number of days local residents and visitors spent undertaking shore-based, charter boat and own-boat angling were combined with estimates of average spend per day, to provide a suggested gross contribution to the Welsh coastal economy of over £28million.

Based on 294 charter vessels, and applying an expert estimate of there being 1.5 Full Time Equivalent (FTE) jobs aboard the average vessel, it was estimated that charter boat activity represented direct employment of around 441 FTE.

### **Development potential**

Sea angling was ranked as the most important sub-sector, along with inshore commercial fishing and coarse angling, in terms of the level of priority it should be given when allocating public-sector resources for development of the Welsh inland and sea fisheries sector as a whole. The recent trend in sea angling was deemed to be upwards, and the scale of public sector investment required to bring about a significant level of development in the sub-sector was considered to be relatively low, compared to that required to develop some other sub-sectors, e.g. offshore fishing, finfish aquaculture and processing. The risks associated with any public sector involvement were deemed to be low and the potential gains high.

### **Commercial and recreational sea bass fishing in England and Wales**

In 1995 a review was published by MAFF<sup>4</sup> assessing the impact of new national sea bass fishery legislation that had been introduced in 1990 (Pickett *et al*, 1995). This legislation aimed to maintain or increase yields from the sea bass fishery whilst safeguarding the sea bass spawning stock and involved an increase in Minimum Landing Size, technical restrictions relating to enmeshing (gill) nets and the prohibition of fishing for sea bass from boats in 34 nursery areas. One element of this review included an

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<sup>4</sup> Formerly the Ministry for Agriculture, Food & Fisheries, now known as the Department for Environment, Food and Rural Affairs (Defra).

assessment of the economic value of both the commercial and recreational sea bass fisheries in England & Wales in 1987 and again in 1992.

The economic value of the commercial fishery was assessed (Pickett *et al*, 1995 based on original work by Dunn, Potten and Whitmarsh, 1995) by applying first sale and wholesale prices to an estimate of commercial catch volumes that were derived by combining official sea bass catch statistics (mainly for vessels over 10m in length) with those from an annual sea bass logbook scheme providing catch and effort from a sample of the under 10m segment (combined with an effort census to allow results to be scaled up for this sub-sector). The economic value of the recreational fishery was estimated by calculating gross expenditures on sea bass angling with base activity and expenditure data derived through survey work (a total of 400 onsite interviews in 1987 and 1992 and a further 470 postal surveys in 1993), and the total population of recreational anglers derived from a wider census survey. The comparison of results between years was complicated because the market post-1990 was substantially affected by imports of farmed sea bass, which depressed prices significantly. A CVM approach was also undertaken to determine recreational anglers' WTP for their involvement in the sea bass fishery.

The comparison focused upon the years 1987 and 1992, but as 1993 was a particularly good year for commercial sea bass landings, it was also included. It was also noted that the economic analyses provided a snapshot view in 1987 and 1992 compared to the ongoing biological monitoring programme carried out by Cefas. The results shown in Table 4.24 highlight the short-term negative economic impact felt by the commercial sector between 1987 and 1992: commercial catches and real first-sale and wholesale prices declined notably, despite the increase in full-time commercial fleet size. However, catches volumes and real values in 1993 increased dramatically as the fishery recovered from the short-term impact and began to derive the benefits of the management measures introduced in 1990.

There was a 20% increase in the number of recreational sea bass anglers over the 1987-1992 period, though numbers of shore anglers actually decreased (boat anglers increased). The popularity of recreational sea bass angling also appeared to increase over the period in line with the improved status of the species as a preferred target species. The estimates of recreational catches were remarkably similar in 1987 and 1992, at 415 and 412 t respectively, and the 1992 survey reported that some recreational anglers sold sea bass (illegally) for profit – possibly a total of 20-25 t each year. Gross expenditure on sea bass angling increased over the period from £9.7m to £18.3m (£13.5m in 1987 prices). The gross Consumer Surplus, as measured by WTP to retain access to recreational sea bass fishing, was estimated to be £5.4m in 1987 and £21.6m in 1992 (£15.9m in 1987 prices). As total recreational sea bass catches did not change over the period, this increase in Consumer Surplus was thought to indicate that sea bass fishing had become more popular and highly regarded by recreational anglers. This may in part have been due to the abundant 1989 year class (which was still protected from commercial exploitation by the 36 cm MLS in 1992), as well as the support being afforded to the recreational fishery by the introduction of the 1990 management measures.

### **Freshwater salmon and sea trout angling in England and Wales**

Spurgeon *et al*. (2001) estimated the economic values associated with inland recreational fisheries in England and Wales. This work was commissioned by the Environment Agency. Market values were estimated for fishing rights, expenditures and indirect economic values associated with the recreational angling activity. Migratory salmonid market values per fish were estimated from an analysis of 42 fisheries

and scaled up using national salmon catch data. Expenditure and non-market values were derived from a telephone survey of 806 anglers.

**Table 4.24 Economic value of commercial and recreational sea bass fishery in England & Wales (Pickett et al, 1995).**

	1987	1992	1993
<b>Commercial fishery</b>			
Full-time sea bass-fishing fleet (no. vessels)	192	272 <sup>1</sup>	-
Average vessel length (metres)	7.4	7.1	-
Commercial catch (t)	630	515	1079
First sale value (£m) <sup>1</sup>	3.9	3.9 (2.9) <sup>2</sup>	7.9 (5.7)
Wholesale value (£m)	5.5	5.5 (4.0)	9.9 (7.2)
<b>Recreational fishery</b>			
Recreational fishing population (no. fishers)	301,000	361,000	-
Recreational catch (t)			
Boat anglers	219	-	217
Shore anglers	196	-	195
Total	415	-	412
Gross expenditures on sea bass angling (£m)			
Boat anglers	-	5.2	-
Shore anglers	-	13.1	-
Total	9.7	18.3 (13.5)	-
WTP (£m)	5.4	21.6 (15.9)	-

Notes:

1. A further 1099 commercial fishing boats were operating on an occasional or part-time basis and another 700 boats fishing on a charter/casual-angling basis.
2. Italicised figures in parenthesis indicate monetary values deflated to 1987 prices.

The total market-priced value of fishing rights for migratory salmonid (salmon and sea trout) was estimated to be £86.0m in England and £41.6m in Wales. These figures suggest that the private sale value of migratory salmonid fishing rights in inland waters is considerable. The key determinant of these values was the previous 5-year average annual salmon catch for that stretch of river. The proximity of parking to the fishing spot was also found to be important. The market value per salmonid caught was substantial: £7791 in England and £9,951 in Wales.

The average annual expenditures per game angler (for migratory salmonids plus other trout) was estimated to be £682. Nearly a quarter of this expenditure went on fishing permits, just over a quarter on

club and competition fees and one third on food, accommodation and travel. The total annual expenditure of game anglers in England and Wales was estimated to be in the order of £545m.

A CVM approach was used to determine the Consumer Surplus (CS) of game anglers in the form of their WTP to maintain their fishing experience as it was. On average, these anglers expressed a CS of £2.70 per trip and it was found that the WTP increased for better quality fisheries. It was noted that these values may have been underestimated due to possible strategic behaviour on the part of angler respondents, who already had to pay both national licence and private permit fees to fish in inland waters.

### **Regional and national economic impacts of freshwater salmonid angling in Scotland**

In 2004 a comprehensive study of the economic impact of game and coarse angling in Scotland's freshwater fisheries was undertaken. Radford *et al* (2004) analysed the impact of expenditure on income, output and employment (by modelling the economic effect of direct, indirect and induced expenditure) at the national level and for seven regions of Scotland and for four types of fishery. Regional economies were modelled using specially constructed trade matrices and coefficients derived from Scottish Input-Output tables. Impacts were disaggregated according to angler expenditure by locals to a region, visiting Scottish anglers, and non-Scottish anglers. A survey of fishery owners was undertaken in addition to a census of Scottish freshwater fisheries. Over 3000 observations were derived from anglers relating to their expenditure on particular region/fishery combinations.

It was estimated that there were over 545,000 angler days spent fishing for salmon and sea trout in Scotland's rivers (39% of all angler days) in a typical fishing season (for the period 2000-2002), and £73m of related expenditure in Scotland accounting for 65% of total freshwater angling-related expenditure. Of the £73m total, 66% was made by non-Scottish visitors, 23% by locals to the region, and the remaining 11% by Scottish visitors. It was assumed that if angling were to cease for a particular region/fishery combination in Scotland, Scottish anglers would continue to fish but Scottish visitors would take 50% of their spend outside of the country, whilst non-Scottish anglers would leave entirely. Under this scenario, if salmon and sea trout fishing were to cease, the effect on Scottish economic output would be a loss of £80.9m, whilst £39m of household income would be lost in addition to 2,200 full-time equivalent jobs. The marginal effect on Scottish economic output and household income of a change in angler expenditure was also estimated. On average, an increase/decrease of one salmon and sea trout angler day in Scotland would increase/decrease Scottish economic output by £134.83 and increase/decrease output by £80.20. Therefore, increasing or decreasing angler activity would have a real and quantifiable effect on the Scottish economy.

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## **South Western Waters**

### **France (Atlantic coast)**

There are currently no national level studies of MRF in France. However, Ifremer (Institut français de recherche pour l'exploitation de la mer) are participating in a pilot study of marine recreational fisheries in France which began in early 2006 (O. Thebaud, IFREMER, personal communication, 2006) and which is being conducted at the national level. This pilot study is being coordinated by a working group led by the Direction des Pêches Maritimes et de l'Aquaculture (the administration responsible for the management of fisheries and aquaculture in France) with the participation of representatives of both recreational and commercial fishers. Ifremer is providing the scientific input and the organisational framework for the study.

The national pilot survey is initially using a telephone-based methodology, and will be followed at a later stage by on-site surveys designed to cross reference the different sources of information collected. The interviews will be carried out by a poll institute and by Ifremer. The study began in January 2006 and the first results are expected early next year (2007).

The objective of the national level pilot survey is to provide information on the level of activity and catches of marine recreational fisher in addition to collecting data that will allow an assessment of the economic importance of this activity. The study will include all forms of recreational fisheries (e.g. angling, hand gathering, diving, etc.) - at least in the initial telephone-based survey data collection phase. The overall study objectives will be achieved by gathering the following types of data: number of trips per fishing mode, catches per species, expenditures, socio-economic information on recreational fisher. These data will be collected for different time scales (e.g. last trip, last three months and last year). The economic data sets will be analysed to provide a preliminary assessment of expenditures made by marine recreational fishers, and non-used values associated with the activity (i.e. consumer surplus) will probably be estimated using the travel cost method, however the final decision in this respect has not yet been made. Following the completion of the pilot survey in 2007 it is expected that a comprehensive national study will be undertaken.

### **Recreational fishing for sea bass, France**

Little is known about the overall extent of MRF for sea bass in France despite the number of studies on the subject. Morizur *et al* (2005) noted this paucity and attempted to address the knowledge gap by analysing the scale of recreational sea bass fishing at the national level in France.

Data were collected by telephone survey in 2004/05 covering recreational fishing activities in five periods of 2004 (spring, summer, autumn, early winter, end winter) following a pilot survey conducted in 2003. Persons over 15 years of age were asked questions on: extent of recreational fishing activity in general; number of fishing trips targeting sea bass in 2004 by area (Départments); fishing method (underwater, from boat or shore); fishing gear (net, spear gun, trawl or line/rod); number and weight of sea bass caught; sea bass fishing in 2003; membership of sea fishing club or association.

Around 2.2% of all respondents fished at least once for sea bass in 2003. Between 2.5% (late winter) and 9.1% (summer) of respondents fished recreationally in the sea in 2004, and between 0.6% (late winter) and 2.1% (summer) of respondents fished specifically for sea bass in 2004.

The majority of recreational sea bass fishers were male (79%) and aged between 35 and 49 years old. Compared to the employment profile of the head of household for all interviewees, sea bass fishing households were more likely to have an employed person or a middle level professional at the head. Sea bass fishers were more likely to live in the West (23% of total) and Mediterranean (19%) areas of France and less likely to live in the East (2%) or Central East areas (5%). Around 17% of sea bass fishers also lived in the Paris region. Around 54% lived in Départments with a coast. Only 3.7% of recreational sea bass fishers were members of a club or association.

The most visited French regions for recreational sea bass fishing in 2004 in terms of number of fishers and trips were Finistere (Brittany), Morbihan (Brittany), Manche (Normandy), Bouch du Rhone (Provence - Alpes Du Sud), Pas de Calais (Picardie - Nord - Pas De Calais), Vendee (Pays de la Loire) and Herault

(Languedoc – Roussillon). Fishing from the shore was most popular (48%), closely followed by from a boat (43%), whilst 9% fished using underwater methods. Around 82% of recreational sea bass fishers used a rod/line, 7% used a net, 9% a spear gun and only 2% a trawl. In the year 2003, 34% estimated that they caught between 5-10kg of sea bass, 22% caught 1-4kg, 13% caught more than 20kg and 12% caught 11-20kg. Around 51% undertook 9 or fewer trips per year whilst 41% made 10 or more trips.

Morizur *et al* (2005) estimated that there were more than 4 million recreational sea fishers in France, round 900,000 of which fished for sea bass with around 300,000 being most active (i.e. those making more than 7 trips per year). It was estimated that between 4000-5000 t of sea bass were caught recreationally in the Mediterranean and between 3000-4000 t in the Channel/Atlantic. Morizur *et al* (2005) concluded that questions remain as to the economic importance of this activity and the extent of interaction between different user groups, e.g. anglers and commercial fishers.

### **Economic analysis of salmon fishing in the Finistère Department, France**

Porcher and Brulard (2002) reported on an analysis of the economic importance of Atlantic salmon fishing in the Finistère region of France conducted in 1995. The study was supported by the National Council of Fishing and the Federation of Angling Associations in the Finistère Department. Its purpose was, firstly, to characterise the socio-economic profiles of anglers; secondly, to assess the commercial and non-commercial value of salmon fishing for the Department; and finally, to consider the consequences of the development of a commercial fishery in the estuary. A total of 176 salmon anglers were questioned on rivers in the Finistère Department in 1995, but no further details on study methodology were given.

In 1995 the total number of recreation salmon anglers in the Department was estimated to be 891, whose total expenditure was FF9,000,000, of which FF6,500,000 was spent within the Department. Around 30% of the total expenditure came from anglers who lived outside the Department. A total turnover of FF8,200,000 was reported to be generated by salmon fishing for the Department.

The average salmon recreational angler was 49 years old and was from a high socio-economic bracket. Amongst 85% of those who gave details of their income, 37% received more than FF20,000 a month, whereas only 20% had an income under FF8,000 a month. Of the 176 anglers interviewed, approximately half were residents of the Department and, of those who were non-residents, 20% lived in the three other Brittany Departments. Of the remaining anglers, 27% came from remote Departments such as the Maritime Alps, Savoy and Auvergne.

The average expenditure by an individual salmon angler each season was estimated for five categories: transport, accommodation, food, fishing equipment and fishing rights, to be FF10,669. However, it should be noted that local anglers spent around FF166 per day whilst non-locals spent nearly three times as much (FF486 per day).

Based on a hypothetical scenario, the development of a commercial salmon fishery in the estuary alongside the recreational fishery, anglers stated that they were willing to pay between FF369 and FF504 to pay to buy-back commercial salmon quota. Around 8% of anglers said they would carry on angling in the Department regardless of whether a commercial fishery was developed in the estuary, 31% stated that they would continue angling for a while and 58% thought they would stop angling altogether. Porcher and Brulard (2002) concluded that there would be a transfer of wealth between Departments, regions and

countries in response to such a scenario. Around 75% of salmon anglers who also travelled elsewhere to fish stated that they would be less likely to do so if fishing conditions improved in the Department.

## Portugal

### Recreational shore angling in northern Portugal

Oliveira & Erzini (forthcoming) assessed the impacts and implications of recreational shore angling in northern Portugal. They used a face-to-face questionnaire-based methodology with telephone survey follow ups to gather information relating to: fishing effort, species caught, sizes, catch rates and factors influencing catches and angler satisfaction. Completed questionnaires were obtained from 2081 anglers who were surveyed at beaches, rocks and jetties from March-September 2001 in the northern region from Aveiro to Moledo. Data were collected on distance travelled, fishing trip expenses (transport, gear, bait and food), fishing conditions, equipment, type of activity, bait, target species and gear loss, catch and quality of their fishing day.

Portuguese MRF is generally divided into recreational activities and sports activities where sport fishing takes place within a “*framework of organised competitions and/or with the objective of obtaining records*”. The authors report that little or no information is available on total numbers of marine anglers in Portugal, whilst there were 270,000 freshwater recreational fishing licences issued in 1998. No licences are currently issued for recreational marine fishing, but the commercial sector is increasingly calling for licensing to be introduced and catches regulated (i.e. daily bag limits) to allow for more effective monitoring.

A total of 3652 recreational sea anglers were encountered during the survey work. Grey mullet were the most important species type caught followed by sea bass and sea bream. Sea bass was the most targeted species although just under half of all sea bass catches sampled appeared to be below the Minimum Landing Size (MLS). Total annual recreational catch of sea bass and spotted sea bass in the study area was estimated to be equivalent to 6.9% (8833kg) of the official total annual commercial catch for the same area, corresponding to a first hand sale value of around €61,200. Recreational sea bream catches were estimated to be equivalent to 1.4% (2477kg) of commercial catches for the same area with a first hand sale value of €10,700. Survey data on recreational angler expenditures were not provided.

Recreational shore anglers reported that 35% of their fishing sessions were not satisfactory, 18% were average, 19% good, 12% very good and 4% excellent. Oliveira & Erzini (forthcoming) carried out a regression of these results against a range of explanatory factors and found that, whilst catches were an important factor explaining the level of satisfaction with a fishing experience, the actual number of fish caught and their size was not. The authors noted that this may be explained by the large proportion of undersized fish being caught. Bass angler satisfaction was found not to relate to whether or not sea bass were caught. The authors concluded that the impact of shore-based catches on commercial fisheries for the same species was probably minimal, though the same probably cannot be said for recreational fishing from boats and underwater spear-fishing.

### Coastal recreational fishing in the greater Lisbon area of Portugal

Do Vale (2003) questioned 94 marine recreational fishers resident in the greater Lisbon area of Portugal in 2003 about their fishing activities. Questionnaires were completed either face-to-face at fishing sites or

online either directly or through clubs and associations. As licences are not issued for MRF in Portugal, it was not possible to establish the total population of marine recreational fishers and therefore it is not known how representative the survey results are of the true population.

The vast majority of marine recreational fishers surveyed were male, though 5% of fishers registered with the Portuguese Federation for Sports Fishing (FPPD) were female. The majority of respondents were between 20-50 years old and the modal length of time as a fisher was 6-15 years. Around a third were members of a fishing club and nearly two-thirds of club members had taken part in competitions. Around 18% described themselves as occasional fishers, 62% as sport – hobby fishers, 8% as sport – competition fishers. Most fished regularly- two-thirds fished once a week or more often - and they would travel quite far within Portugal to fish.

Most respondents preferred to fish from cliffs or sea walls using rod and line. Fishing from a boat was less popular, though half had fished from a boat, which was usually rented as opposed to being owned by them. Around 18% of respondents collected their own natural bait although all used it; 33% also used artificial baits. The most common target species were sea bass, sea bream and gilthead bream whilst the most commonly caught species were sea bream, sea bass, gilthead bream, horse mackerel and mackerel in decreasing order. Whilst most respondents claimed to know the MLS, only a few practice catch and release whilst the vast majority eat the fish they catch.

The main concerns of marine recreational anglers were pollution, lack of respect for the MLS, lack of regulation within the sector and enforcement and activities of the commercial fishing sector.

### **Recreational fishing activities in the Tagus estuary**

The Tagus estuary is around 325km<sup>2</sup> and one fifth of Portugal's population lives around the estuary, mainly in the cities of Lisbon, Almada, Barreiro and Seixal. Lopes (2004) surveyed recreational fishing activity in the estuary by conducting 101 roving creel surveys and completing 493 interviews with recreational fishers. The average Tagus recreational fisher was 51 years old and had 22 years of fishing experience. Many recreational fishers were old and appeared to have no or little income.

Sea bream, sea bass, toadfish and meagre accounted for over 80% of catches sampled. Just over half of fish sampled were under the MLS and 80% of interviewees did not know what the MLS was. Around two-thirds of respondents claimed to release juveniles back into the water and a similar number were against the introduction of licences for MRF.

Recreational boat and night fishing are also conducted in the Tagus estuary, though these activities were not covered in the study. Lopes (2004) estimated that over 146,000 fish were caught recreationally from the shore in the Tagus estuary in the spring-summer season. Just over half (51%) of these catches were under the MLS and meagre and sea bass accounted for over 90% of this catch.

## **Azores**

### **Spear fishing in the Azores**

The impact of recreational spear fishing in the Azores was assessed by Diogo & Pereira (2002). A 2km stretch of rock coastline near Ponta Delgada was monitored between Aug 01 and May 02; this area

represented approximately 1% of the coast of S. Miguel Island. Spear fishing accounted for around 70% (106 individuals/ 222 spear fishing episodes) of all fishing activity (commercial and recreational) and was mostly carried out in the summer months and at the weekends and in holidays. Other forms of fishing activity recorded at the site were: intertidal activities, octopus snorkel fishing, rod and line from shore and fishing boats.

Spear fishing catches were mainly comprised of octopus, wrasse, parrotfish and combers and an estimated 1 tonne of species was caught in the study period. Environmental impacts were found to be low: spear fishing does not require bait, is highly selective and involves no gear loss. Around 73% of spear fishing was undertaken for recreation or subsistence purposes, however Diogo & Pereira (2002) found that 45% of total catches were destined for illegal sale. Over half of individuals interviewed (52%) did not hold a spear fishing licence despite the fact that in 2002, 1142 spear fishing licences were issued in the Azorean archipelago.

### **Sport and recreational fishing for bluefin tuna in the Azores**

Ramos & Pereira (2003) reported on a pilot study of catches of bluefin tuna in sport and recreational fisheries in the Azores conducted in response to EC Regulation 1639/2001. The study primarily focused upon compiling a historic record of Big Game Fishing (sports fishing charter boats) in the Azores by developing a paper-based survey questionnaire for skippers of vessels operating between 1985 and 2003. Club member catch records (for a nautical club at Ponta Delgada, S. Miguel Island) were also analysed for the period 1999-2002.

Big Game Fishing in the Azores traditionally targeted blue marlin and whilst catching bluefin tuna is regarded similarly challenging, Ramos & Pereira (2003) reported that it was not generally regarded as a target species in the Azores. Billfish and tuna tag and release policies have generally been practiced since the mid-1980s.

The number of Big Game Fishing boats in the Azores varied from 4 in 1985 to 13 in 1999 and 5 in 2003. The 1996 season was the best on record in the 90's: 32 giant bluefin tuna (weighing between 400-500 kg) and 354 blue marlin were caught. In preceding years, no bluefin tuna were caught. Catches in 1997, 1998 and 1999 were 31, 2 and 1 respectively; thereafter none were caught up to 2003 when 1 was recorded. During the period 1999-2003, combined sports fishing catches in S. Miguel consisted of mainly bigeye, bonito and skipjack tuna.

### **Big game fishing competitions in the Azores**

Many international sports fishing competitions and tournaments are organized in Madeira, in the Azores and in the rest of Portugal. A major event presently being organised by the FPPD and the Portuguese Federation of High Sea Sports Fishing (FPPDAM) is the 2006 II World Fishing Games (<http://www.portugalfishing2006.com/>). In mid August 2006, there were about 1500 registrations for this event, each paying between 500-1000€ to cover transport, accommodation and meals. The boat angling events will take place in the Azores and involve 22 big-game teams, 18 senior boat angling teams and 8 junior boat angling teams from 21 countries (including the USA; Egypt, Angola, South Africa and Mexico). Each team pays between 5700-6600€ for transport, hotel and meals, boat rental and other local costs. This competition is very important to the local economy (Eduardo Cunha, President of FPPDAM,

pers comm.). The European Federation of Sea Anglers (EFSA) has a delegation in Portugal (<http://www.efsaportugal.pt>) and has numerous events for 2006 listed on their calendar (Table 4.25).

**Table 4.25. International tournaments held in Portugal in 2006 (Gordoa, 2004)**

Competition	Location	Date (2006)	Number registered	Registration fee*
IV International competition of High Sea Sports Fishing	Albufeira (Algarve)	10 <sup>th</sup> June	82	100€ (without boat), 60€ (with own boat)
I International Tournament of High Sea Sports Fishing	Ílhavo (Central Portugal)	1 <sup>st</sup> /2 <sup>nd</sup> July	100	90€ (without boat), 40€ (with own boat)
II Big Game Fishing	Albufeira (Algarve)	25 <sup>th</sup> / 27 <sup>th</sup> August		400€ / team
II Open EFSA Big Game Fishing	Vila Franca (Azores)	1 <sup>st</sup> / 4 <sup>th</sup> September		400€ / team
III International Tournament of Big Fish	Lagos (Algarve)	22 <sup>nd</sup> / 24 <sup>th</sup> September	Maximum 20 boats	380€ / team
<a href="http://www.torneiopescalagos.com">www.torneiopescalagos.com</a>				
2 <sup>o</sup> International Tournament of Marine Sports Fishing	Cascais (Lisbon region)	14 <sup>th</sup> October		

### Spain (Atlantic coast)

Some information relating to MRF on the Spanish Atlantic Coast is reported on in the section on Spanish Mediterranean Coast.

## Mediterranean

### MRF in the Mediterranean (Spain, France and Italy), with particular focus on tuna fishing

Gordoa *et al* (2004a) presented results from an EC funded-project on sport fishing in the Mediterranean waters of Spain, France and Italy. The main project objectives were: (1) review the legislative framework for sport and recreational fishing activities in the each country; (2) assess the economic yield of these activities in each country and to consider its development potential in the tourist sector, and; (3) to develop a network of biological information provision from volunteer recreational fisher.

The legislative review of recreational fishing in Spain, France and Italy highlighted significant differences between legislative provisions as well as the level of control and enforcement (Gordoa *et al*, 2004b). A complete review of legislation was only possible for Spain and France – insufficient information was available for Italy. Spain was reported to have the most restrictive legal provision and was the only country to operate a licensing system for recreational fisher. None of the countries operated a licensing system for

the recreational fleet of boats. As a result, the total population of recreational fishers was only known for Spain. The authors note that this lack of global knowledge makes it more costly to carry out economic or biological impact studies of recreational fishing, where the total population of the sector has to be estimated as part of the study.

Whilst the legislative review noted that it was illegal to sell recreational catches in all countries, exceptions existed in France and Spain for catches made during fishing competitions. In France, competition catches of tuna could be sold through controlled commercial channels with profits distributed amongst charities and the club organiser of competition. In Spain, the profit was distributed entirely amongst charities. Gordoia *et al* (2004b) report that whilst illegal under national law, it was socially acceptable and commonplace to sell recreational catches for profit in Italy.

Gordoia *et al* (2004a) analysed recreational fishing activities in each country using primarily a survey-based methodology. Data was compiled on the total number of Mediterranean ports and moorings (for all types of vessels – not just recreational fishing) in each country at the regional (NUTS II) level by contacting relevant authorities and private organisations and sourcing further information from the worldwide web. This collected data set was reported to be complete for all countries. Follow-up data on ports and moorings was collected by survey questionnaire on mooring prices, port employment, fuel consumption, etc., however 65 were completed in Spain, 17 in France but none in Italy.

Information about recreational fisher, their activities and expenses was gathered using a paper-based survey questionnaire sent initially to recreational fishing clubs and associations, enclosed in the most popular recreational fishing magazine, and subsequently through direct survey at nautical fairs and events. Data were collected on characteristics of the recreational fisher and their vessel, type of fishing activity, annual catch and associated costs and expenses (e.g. moorings, licences, equipment, fuel, bait, gear, insurance, accommodation and tournament costs). The survey response rate was generally poor although a sufficient number of responses (350) were generated in Spain at nautical fairs (including some responses from Atlantic coast fisher). However, only 19 responses relating to tuna fishing were received in France and nearly 100 were received relating to tuna fishing in two pre-selected Italian regions: Liguria and Sicilia. As a result of the poor response rate, general results for recreational fishing were only reported for Spain.

Recreational fishing for tuna was analysed separately for each of the three countries. An indirect approach to estimating the total recreational catch of tuna was adopted for Spain whilst a direct sampling programme in every port and bay was adopted for Italy. A case study was prepared for France highlighting the importance of French recreational tuna fishing tournaments.

Detailed results for each individual country are reported in the following relevant country-specific sections. Gordoia *et al* (2004a) stated that the results should be viewed as approximate and treated with caution due to the varied, and sometimes poor, response rates received from the surveys and the bias towards more active recreational fisher respondents.

### **France (Mediterranean Coast)**

Gordoia *et al* (2004a) estimated that there were approximately 108 ports with over 74,000 moorings (for all types of vessels, but not including moorings outside of ports, e.g. in coves or near beaches) along the

French Mediterranean coastline amounting to just around 113 moorings per km of coastline. High season mooring prices for an 8-10m boat ranged from €350 in Languedoc-Rousillon (LR) region to €375 in Provence-Alpes-Côte d'Azur (PACA) region.

The age structure of recreational fisher in France holding Federation Licences revealed that the majority of adult fishers peaked at around 55 years of age. Over 70% of recreational fishing vessels owned by respondents targeting tuna in the LR region were 9-12m in length. This vessel size was larger than the dominant size range in either Spain or Italy (7-9m). Around 60% of French respondents reported holding Federation Licences for Sports fishing and, as to be expected given the bias of these respondents towards sports fishing, a high proportion (80%) reported taking part in competitions (Gordoa *et al*, 2004a).

The French tuna recreational fisher respondents indicated that they fished recreationally for around 35 days per year with 33% stating that they fished all year round as opposed to seasonally. The average annual number of competitions per active sport fisher was 3.5 per person, accounting for around 10% of their total recreational tuna fishing days. Around 80% of respondents owned their own boat but less than 10% used their friend's boat.

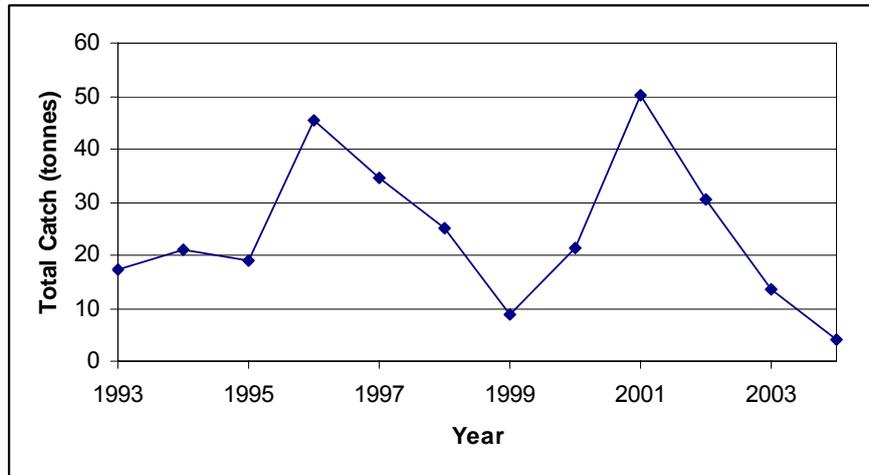
The most popular recreational fishing methods were big game chumming (39%; catching mainly bluefin tuna, longfin pompano and albacore), big game trolling (28%; catching mainly bluefin tuna, dophinfish and albacore), coastal surface trolling (9.4%; catching mainly Atlantic bonito, sea bass and dolphinfish), line fishing (7%; catching mainly chub mackerel and gilthead bream) and squid fishing (5%). French respondents appeared to be most selective (compared to Spanish or Italian respondents) targeting the most "noble" species. It was not possible to estimate total annual French Mediterranean recreational catches from the survey data due to the small number of respondents (Gordoa *et al*, 2004a).

The average annual cost of recreational fishing by vessel in France (Mediterranean Coast) was estimated for a range of vessel length categories. Average costs per vessel excluding the initial purchase price of the vessel or mooring are shown in Table 4.28. Expenses for a vessel over 7m in length were broken down as follows: maintenance (may include electronic equipment) (35% of total), fuel (22%), tackle and bait (16%), moorings (14%), insurance (9%), transport (4%) and licences (<1%).

**Table 4.26 Average annual recreational fishing vessel expenses, France (Mediterranean Coast) (Gordoa at al., 2004a).**

Vessel length category (m)	No. of vessels in sample	Average vessel expenses (€per annum)
<5	-	-
5-7	2	3,500
7-9	4	7,226
9-12	7	10,070
12-16	-	-
>16	-	-

French fishing tournaments in the Mediterranean



Source: Data supplied by the Fédération Française des Pêcheurs en Mer (FFPM).

**Figure 4.27 Total catch (t) from big game fishing tournaments in French Mediterranean waters (1993-2004) (Gordoa et al., 2004).**

Gordoa *et al* (2004a) reported on the scale of big game fishing tournaments taking place on the French Mediterranean coast. These fishing tournaments are held throughout July, August and September and mainly target blue fin tuna, thresher shark, blue shark and swordfish. The combined total catch from these big game tournaments in the Côte d'Azur and Languedoc-Rousillon coastal regions is shown in

Source: Data supplied by the Fédération Française des Pêcheurs en Mer (FFPM).

**Figure 4.27** for the period 1993-2004 and ranged from around 4 t in 2004 to 50 t in 2001. Annual fishing effort was not reported to have varied much during the decade, therefore catches were thought to vary mainly due to numbers of tuna present in the region or their abundance (Gordoa *et al*, 2004).

In 2003, 25 big game tournaments were held in the Languedoc-Rousillon region. A total of 416 participants spent 1981 days fishing in these tournaments paying total fees of over €32,200 (approximately €77 per participant). Total catches amounted to 7.8 t and of this 2.6 t was consumed. The remainder was sold raising around €20,200. In France, it is permissible to sell recreational catches from

competitions with monies raised being shared between the club organiser of the contest, the local professional fishing committee and the FFPM for their charitable institutions.

## Italy

Gordoa *et al* (2004a) estimated that there were approximately 409 ports with over 111,000 moorings (for all types of vessels, and including moorings outside of ports, e.g. in coves or near beaches) along the Italian coastline (including the Sicily and Sardinia) amounting to just over 22 moorings per km of coastline. High season mooring prices for an 8-10m boat ranged from €607 in Liguria (data from only 2 ports) to €872 in Sardinia (data from 7 ports). The authors note that mooring prices in Italy are often set on a case-by-case basis rather than using pre-defined transparent prices.

Around 40% of Sicilian recreational fisher respondents targeting tuna were around 50 years old whilst more than 20% were 26-35 years old – this proportion of younger fisher was high compared to other Spanish and French regions (Gordoa *et al*, 2004a). Nearly two-thirds of recreational fishing vessels owned by respondents in Sicily were 5-7m in length. No recreational fisher in Sicily or Liguria reported holding recreational licences – even those required for sports fishing competitions which 47% of Ligurian fisher reported taking part in.

Italian recreational tuna fisher indicated that they fished recreationally for around 35 days per year with 28% stating that they fished all year round as opposed to seasonally. Competitions accounted for around 6% of their total tuna recreational activity. The average annual number of competitions per active sport fisher was 3 per person. Practically all Sicilian respondents owned their own boat (and 82% of Ligurians) and just less than one-third used their friend's boat.

The most popular recreational fishing methods were big game trolling (68%; catching mainly bluefin tuna, frigate mackerel, dolphinfish and albacore), coastal surface trolling (14%; catching mainly bluefin tuna, mackerel and swordfish), line fishing (4.5%; catching mainly cuttlefish, pandora, porgy/pinfish/bream and mullet) and unspecified gears (12%; catching mainly hake, porgy/pinfish/bream, greater weever, albacore, bluefin tuna, swordfish and forkbeard). It was not possible to estimate total annual Italian or regional recreational catches from the survey data (Gordoa *et al*, 2004a).

The average annual cost of recreational fishing by vessel in Italy was estimated for a range of vessel length categories. Average costs per vessel excluding the initial purchase price of the vessel or mooring are shown in Table 4.28. The authors noted that there were possible discrepancies in the results for Italy where boats under 9.9 metres were not required to hold a fishing licence. As a result many of these vessels were considered to be recreational fishing vessels, but were actually operating in a cash commercial fishery supplying local restaurants and small shops. Expenses for a vessel over 7m in length were broken down as follows: fuel (42% of total), tackle and bait (20%), moorings (12%), maintenance (12%), transport (6%), insurance (5%), electronic equipment (3%) and licences (0%).

**Table 4.28 Average annual recreational fishing vessel expenses, Liguria & Sicily (Gordoa *at al*, 2004a).**

Vessel length category (m)	No. of vessels in sample	Average vessel expenses (€per annum)
<5	-	-

5-7	60	3,012
7-9	24	8,760
9-12	13	13,834
12-16	-	-
>16	-	-

Following the decision to establish an individual quota for bluefin tuna by the Ministry of Agriculture and Forestry Policy (art. 5 Ministerial Decree 27 July 2000) 1826 Italian sports fisher made a formal request for quota (Gordoa *et al*, 2004a). Around 75% (1379) of requests were accepted. The highest number of requests came from the following regions: Tuscany (16% of total), Veneto (11%), Marche (11%) and Lazio (10%). From their comprehensive survey of the entire Italian coastline, Gordoa *et al* (2004a) estimated that true size of the Italian recreational tuna fishing fleet was around 4,233 vessels and that tuna catches were approximately 1,942 t in the previous year (2003) and of this 79 t were under the minimum size limit. The total annual expenses of this fleet were estimated to be around €42 million.

### Spain (Mediterranean coast, including Balearic Islands)

Gordoa *et al* (2004a) estimated that there were approximately 221 ports with over 87,000 moorings (for all types of vessels, but not including moorings outside of ports, e.g. in coves or near beaches) along the Spanish Mediterranean coast (including the Balearic Islands) amounting to just over 40 moorings per km of coastline. High season mooring prices for an 8-10m boat ranged from €230 in Andalusia to €965 in Catalunya.

Spanish recreational fishers were found to be around 50 years old although the average age fisher in Andalusia tended to be higher. Nearly half of recreational fishing vessels owned by respondents in the Balearic Islands were 5-7m in length, whilst vessels in Andalusia and Catalunya were more likely to be 7-9m in length. Of the 57 Spanish Atlantic coast fisher questioned, 95% held fishing licences. A similar proportion (around 93%) of Mediterranean Spanish fisher reported the same. Approximately 2.6 individual recreational fishing licences were issued for each recreational fishing vessel indicating that it is a social activity (Gordoa *et al*, 2004a).

Spanish recreational fisher indicated that they fished recreationally for around 51 days per year (the true average was later estimated to be lower – around 35 days per year) with 45% stating that they fished all year round as opposed to seasonally. Whilst 34% of respondents reported taking part in competitions (sports fishing), this only accounted for around 2.7% of their total recreational activity. The average annual number of competitions per active sport fisher was 3.2 per person. Around three-quarters of respondents owned their own boat and around one-third used their friend's boat.

The most popular recreational fishing method was rod and line (35%; catching mainly comber, sea bream, pandora, white bream, etc.), followed by coastal surface trolling (22%; catching mainly dolphinfish, greater amberjack and Atlantic bonito) and big game trolling and chumming (?) (16% and 2% respectively; catching tunas, swordfish, thresher shark, dolphinfish, greater amberjack, marlins and swordfish). Squid fishing by hand or rod accounted for around 8% of activity. Gordoa *et al* (2004a) noted

that the proportion of rod and line fishing activity may actually have been higher as the sample was biased towards big game fishers. Nets, traps and long-lines are prohibited in Spanish recreational fisheries, hence there being no reports of using these methods recreationally.

Gordoa *et al* (2004a) estimated that the total number of MRF licences issued to individuals in the Spanish Mediterranean for fishing from a boat was around 93,000 giving an estimated recreational fleet size in the region of around 36,000 vessels. However, this estimate was adjusted to account for survey bias and revised to a fleet size of around 40,000. Total annual catches of the Spanish Mediterranean recreational fleet were estimated to be around 6,600 t per annum.

The average annual cost of recreational fishing by vessel in Spain was estimated for a range of vessel length categories. Average costs per vessel excluding the initial purchase price of the vessel or mooring are shown in Table 4.29. Expenses for a vessel over 7m in length were broken down as follows: fuel (31% of total), moorings (22%), maintenance (14%), tackle and bait (12%), electronic equipment (9%), insurance (6%), transport (5%) and licences (<1%). Total annual expenses incurred by the Spanish Mediterranean recreational fishing fleet were estimated at around €534 million. When an estimate of the annual depreciation cost of a vessel was included, the figure rose to around €800 million.

**Table 4.29 Average annual recreational fishing vessel expenses, Spain**

Vessel length category (m)	No. of vessels in sample	Average vessel expenses (€per annum)
<5	39	7,445
5-7	119	11,169
7-9	101	11,226
9-12	62	17,899
12-16	13	37,225
>16	5	34,777

Source: Gordoa *et al* (2004a)

Around 2580 Spanish vessels were reported to hold recreational fishing licences for Big Game fishing in the Mediterranean (Gordoa *et al*, 2004a). It was estimated that, based on adjusted survey results, the number of recreational fishing days spent targeting bluefin tuna was between 45,000-64,000 per year with total catch being between 455-649 t – however the authors noted that their estimates compiled using an indirect approach were probably high as a result of bias in the baseline catch rate and effort information gathered from the primary survey. Using a similar approach, total annual expenses for the Spanish recreational fleet targeting tuna were estimated to be nearly €42 million.

### **Spear fishing competitions in the Balearic Islands**

Spear fishing is practiced both recreationally and competitively in the Spanish Balearic Islands. Coll *et al* (2004) studied catch and effort records of official spear fishing competitions in the Balearics since 1975 to build up a picture of rocky littoral fish resources evolution over the period and to determine which resources were most affected by competition fishing.

Spear fishing licences are required but SCUBA gear and sale of catches are prohibited. Daily bag limits were established and Minimum Landing Sizes set for some species in response to the increasing pressure on commercial activities from the success of spear fishers. The introduction of marine protected areas prohibiting fishing has not been popular amongst spear fishers. Coll *et al* (2004) found that 2128 spear fishing licences had been issued (in 2004) to individuals but stated that this number probably represented only around two-thirds of the real number of spear fishers.

Competition records for selected participants in 71 local, regional or between-island competitions from 1994-2000 were analysed. It was found that catches of white bream accounted for 30-40% of total catches and peacock wrasse, brown wrasse and grey mullets each accounted for a further 10% or more.

During the period 1975-2001, Coll *et al* (2004) estimates that 7692 participants caught just over 27 t of fish in 95 spear fishing competitions in the Balearic Islands. The average number of fish and catch weight caught by participants, as well as the mean weight of fish, was found to decrease over time. Large specimen catches of grouper became increasingly rare over the period. Coll *et al* (2004) conclude that both recreational and competition spear fishing appear to have contributed to the over fishing of some target fish inhabiting rocky bottoms between 0-40m depth and thereby contributed to the diminished profitability of some traditional and highly selective commercial fishing activities in the area which targeted the same resources as spear fishers.

## Greece

Anagnopoulos *et al* (1998) reported upon the findings of a study carried out between 1996-1998 which aimed to benchmark MRF activities in the eastern Mediterranean; specifically the recreational sector using boats in Greece and Italy. The study aimed to describe the following in each country: legislative framework, magnitude of fishery, level of catch and effort, socio-economic profile, perception of key conflicts experienced by the sector and attitudes towards policy and legislation.

In Greece marine recreational fishers and vessels from which recreational activities are being undertaken have to be registered and licensed.<sup>5</sup> Anagnopoulos *et al* (1998) estimated the number of recreational fishers using boats and vessels from which recreational activities were being undertaken by inspecting the relevant registries of 150 port authorities for the period 1995-96. A survey-based questionnaire was developed to ascertain information relating to catch and effort, the socio-economic profile of fishers and perceived conflicts. An open-ended interview approach was also developed to further capture conflict perception and elicit attitudes towards policy and legislation. Interviews were carried out in the winter of 1997. The surveys were carried out between Jun-Aug 1998 in four regions: Attiki, Pieria, Kavala and Cyclades Islands. In total, 270 recreational fisher and 16 recreational fisheries organisations were surveyed. A further 60 professional fisher and 9 organisations were also surveyed but these results are not reported on in the following sections.

During the period 1995-96, licences required for recreational fishing activities from a boat were held by 96,075 Greek fisher and a further 71,144 vessels were licensed for the activity. Anagnopoulos *et al* (1998)

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<sup>5</sup> Licences are not required for recreational fishing from shore in Greece.

noted that these figures were, however, likely to underestimate the true scale of MRF using vessels: fisheries inspectors and Ministry of Agriculture staff indicated that many recreational fishers simply did not apply for the appropriate licences. According to the distribution of licences, recreational fishing by boat was most concentrated large urban areas, e.g. around Athens and Thessalonica but relatively high concentrations were also found in the Cyclades Islands and some of the islands in eastern Aegean Sea – areas where people are likely to fish recreationally during their holidays and also where few economic alternatives exist to professional fishing (which also requires licensing) and tourism.

The majority of boats were between 4-6m in length, of wooden construction, and with engine powers of between 6-10 HP. Anagnopoulos *et al* (1998) noted that the average size of recreational vessels may have been relatively small due to the fact that vessels over 5m in length were subject to tax and also that owners had to be able to demonstrate an income proportionate to the size of their vessel to ensure that they had the means to acquire and maintain it. Finally, many owners preferred not to keep their boat permanently moored in one location (or had difficulty finding a mooring if they wanted one); rather they kept the boat out of the water and launched it each time they went fishing.

The most commonly used fishing gear was reported to be lines, followed by logline / trolling and set nets. The average respondent fished for 77 days per year from a boat, mostly in the spring and summer months, with the majority fishing between 60-90 days per year. The most common caught by the recreational fleet in decreasing order of importance were: white sea bream, couch's sea bream, red Pandora, comber, bogue, large eyed dentex, horse mackerel, fish, striped sea bream, jacks and black sea bream. Annual catch rates per vessel were estimated to be between 163-194 kg. Total annual catches from the Greek recreational fishing fleet were estimated to be nearly 19,000 t however Anagnopoulos *et al* (1998) discussed reasons why this may be an underestimation. These reasons were that (1) the figure was based on the total number of licensed recreational fisher which was thought to be an underestimate by fisheries inspectors and Ministry of Agriculture staff, and (2) survey respondents may have been unwilling to reveal the true scale of their catching activity due not wishing to report that they exceeded the maximum daily recreational catch allowance of 5kg per day.

In Greece, the majority of marine recreational fishers using boats were male although 5% of the members of clubs interviewed were female. Around 30% of all respondents were members of some sort of club or organisation. Around half of individual survey respondents were retired however nearly three-quarters of interviewed club members were between 31-60 years old. Either the individual survey results were biased towards older, retired people or the age structure of club members and non-club members differed (Anagnopoulos *et al*, 1998). Recreational fishing from a boat was generally a social activity – 61% of respondents reported there usually being two people in a boat, 12% reported three and 27% reported only one.

Some anecdotal information collected during the interviews was provided relating to the cost of undertaking recreational fishing from boats. The cost of buying a small boat varied between 300,000-1,200,000 drachmas depending on the type of construction, size, etc. The main expenses thereafter were on maintenance – especially of wooden boats, which need repainting every two years. The main expenses for each fishing trip related to bait and gear purchases. Expenses for fisher living further from the coast, as opposed to close by, were obviously greater. It was not possible to quantify sales of boats, engines, gears, electronic equipment, etc. relating to the marine recreational sector. At least seven

periodicals distributed in Greece were reported to relate, at least in part, to MRF. Anagnopoulos *et al* (1998) also reported on the varied range of types of recreational fisher: coastal dwellers 'v' inland dwellers; holiday tourists 'v' locals, club/association members 'v' non-members; retired social anglers 'v' working anglers; sports fishers for whom catching is paramount 'v' those for whom making a catch is second place to just enjoying the activity and being at sea, and; leisure anglers 'v' those seeking to enhance their earnings under the guise of recreational fishing.

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## Chapter 5. The Environmental Effects of Fishing on Marine Ecosystems

This section deals with the effects of fishing on ecosystems in temperate marine environments, through the direct and indirect effects of fishing gears on benthic fauna and their habitat in comparison with natural disturbance, and of fishing itself on fish community structure (diversity and size) in relation to life history traits. We do not consider the down-stream impacts of these community changes on trophic interactions or the abundance of top predators such as birds and marine mammals, for which the reader is referred to Jennings and Kaiser (1998), Gislason and Sinclair (2000), Kaiser and de Groot (2000) and Sinclair and Valdimarsson (2003). The implications of these impacts for management of MRF are discussed, comparing the impact of commercial fisheries with those due to recreational fishing and angling in particular. Bibliographical references to this section are given in Annex 4, and the scientific names of fish caught by MRF are given in Appendix 1.

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### Introduction

Commercial fishing is the most widespread human exploitative activity in the marine environment and Pauly and Christensen (1995) estimated that over 20% of primary production is required to sustain fisheries in many intensively fished coastal ecosystems. Previously, Vitousek *et al.* (1986) concluded that fishing had few fundamental effects on the structure or function of marine ecosystems apart from those on fished species. These views were widely accepted by many fisheries scientists, who based their assessment and management actions upon the short-term dynamics of target fish populations (Frank and Leggett, 1994; Smith, 1994). However, empirical evidence for shifts in marine ecosystems imply that the actions of fishers may have important effects on ecosystem function (Sherman and Alexander, 1986). As a result, the emphasis of marine fisheries research began to shift from population to ecosystem-based concerns, as reflected in a number of reviews describing the effects of fishing on ecosystem structure and processes (Hutchings, 1990; Gislason, 1994; Matishov and Pavlova, 1994; Anon, 1995; Dayton *et al.*, 1995; Jennings and Lock, 1996; Jennings and Kaiser 1998; Kaiser and de Groot, 2000; Gislason and Sinclair 2000; Sinclair and Valdimarsson 2003).

The existing concerns of fisheries scientists in relation to human activities have largely focused upon fish populations, for example, the dramatic collapse of stocks such as the Atlantic cod (Myers *et al.*, 1996), that the high proportion of fish caught in many fisheries leaves little latitude for recruitment failure (Myers *et al.*, 1995; Cook *et al.*, 1997), or that unwanted by-catch often forms a relatively large proportion of the total catch (Alverson *et al.*, 1994; Hall, 1996). The possibility that fisheries have major effects at the ecosystem level and that the ecosystem should be considered as an assessment and management unit have been expressed by some marine ecologists (Sherman and Alexander, 1986; Sherman *et al.*, 1991, 1993). Fishing has a number of direct effects on marine ecosystems because it is responsible for increasing the mortality of target and by-catch species and disturbing marine habitats. The direct effects of fishing have many indirect implications for other species. Thus fishers may remove some of the prey that piscivorous fishes, birds and mammals would otherwise consume, or may remove predators that would otherwise control prey populations. Moreover, reductions in the density of some species may affect competitive interactions and result in the proliferation of non-target species.

The aim of this section is to describe the effects of fishing on ecosystem structure or function, and to determine whether there is a scientific basis for management of changes in marine ecosystems that might be brought about by recreational fishing. We have restricted this review to a European, northern temperate, perspective, though it is obvious that an understanding of fishing effects requires the integration of population and ecosystem-centred research ecological questions on many spatial and

temporal scales. We have also limited this review to the effects of fishing on benthic fauna, habitat and community structure. It is clear that a study of trophic interactions is the key to understanding cause and effect, but that is beyond our present remit. Having reviewed the evidence for the ecosystem effects of commercial fishing, we consider what impacts recreational marine fishing could have and whether there is a specific need for management action.

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## Benthic fauna and habitat

### Introduction

Fishing activities lead to changes in the structure of marine habitats and can determine the diversity, composition, biomass and productivity of the associated biota (Kaiser and de Groot 2000). Many fishing gears have direct effects on habitat structure that vary according to the gears used and the habitats fished, but they usually include the scraping, scouring and resuspension of the substratum. The magnitude of changes, which can be attributed to fishing often, depends upon the nature of the physical environment in which a given habitat is found. Thus the effects of fishing on communities of short-lived burrowing worms that temporarily inhabit mobile sediments in shallow shelf seas will be harder to detect than the effects on reefs. The indirect effects of fishing on non-target fishes and invertebrates may also lead to changes in community structure and habitat type. In section 2.2 we describe fishing methods that impact the marine ecosystem directly and their effects on habitat structure, benthic communities and non-target species. In section 2.3 we consider the relative roles of natural and fishing disturbance in the marine environment.

### Direct effects of fishing gears

Fishing techniques that affect benthic fauna and habitats can be grouped into two categories: active and passive. Active fishing methods usually involve towing trawls or dredges, whilst passive fishing techniques include the use of pots or traps, baited hooks on set lines, gill nets and drift nets. Actively or passively fished surface, mid-water and bottom fishing gears can have direct effects on non-target species that are taken as by-catch. In addition, the actions of fishers and their gears extensively modify seabed habitats and their associated benthic communities.

### Active fishing techniques

#### Trawls and dredges

The majority of mobile demersal fishing gears can be described as trawls or dredges, which are used to capture species that live or feed in benthic habitats. They have been designed and are operated to maximise their contact with the seabed, and have been fine-tuned to exploit the behaviour and habitat preferences of target species and to achieve the maximum catch-per-unit-effort. Presumably, fishers use the most effective techniques currently available, which have been modified to maintain yield as commercial stocks have diminished. The increasing power of fishing vessels has permitted the use of larger and heavier trawls and dredges, with a concomitant increase in environmental damage to non-target benthic communities.

Our review of recreational or non-professional marine fisheries in Europe (section 3) has demonstrated that trawls and dredges are considered to be used only for commercial purposes, and are generally operated from larger boats than are used for MRF. There are exceptions, of course, since not all countries distinguish between fishing gear that is to be used for MRF and that used by professional

fishers, but the cost of operating this type of gear is unlikely to be borne if the catch cannot be offered for sale. Nearly all European member states either prohibit the sale of catches taken by MRF, and/or specify the gear that non-professional fishers are allowed to use (Table 2.??). Thus, the environmental impacts of towed gears outlined below have a negligible contribution from recreational fishers, set in the context of the fishing power of the European commercial fleet, but there are implications for recreational fishers, which might suffer disproportionately from habitat degradation and loss of some less commercially important species.

### **Otter trawls**

In order to maintain the lateral opening at the mouth of the net otter boards are attached to the towing warps (Jones, 1992). Otter boards may penetrate soft mud to a depth of 15 cm (Krost *et al.*, 1990). The ground gear of otter trawls comprises a foot rope protected by twine or rubber bobbins, and tickler chains may be attached between the otter boards when used to catch flatfishes, (Harden Jones and Scholes, 1974; Sainsbury, 1987). The most extreme type of ground gear fitted to otter trawls is Rockhopper gear, in which large rubber discs (> 50 cm diameter) and metal bobbins, which each weigh > 10 kg, are fitted to the ground rope for use over rocky substrata. Otter trawls are used at depths of up to 1500 m, which is far in excess of any other towed fishing gears (Jones, 1992; Clark, 1996).

### **Beam trawls.**

Beam trawls comprise a rigid beam held off the seabed by two beam shoes, and the mouth of the net is fixed in an open position between the beam and a footrope attached to the beam shoes. As fish stocks have decreased, modifications such as increasing beam width and the addition of more tickler chains or the use of chain mats and flip-up ropes have been adopted. Consequently, beam trawls increased in weight from a mean of 3.5 t in the 1960s (Cole, 1971) up to 10 t in the early 1980s (Beek *et al.*, 1990), though they are still towed at speeds of up to 7 knots (Kaiser *et al.*, 1996b). Beam trawlers specifically target benthic species such as sole, plaice, and shrimp, *Crangon crangon* L. which are normally buried in, or rest on, surface sediments, from which they are disturbed by up to 25 tickler chains depending on the sediment characteristics of the fishing grounds (Polet *et al.*, 1994). The heaviest trawls are used over rough grounds and are fitted with a chain matrix ('stone mat' gear) which prevents large rocks entering the net and causing damage to the gear and catch.

### **Hydraulic dredges.**

Hydraulic dredges use jets of water or air to create a venturi effect, which lifts the sediment, non-target and target species onto a boat for further processing on fixed or mechanical riddles (Meyer *et al.* 1981). Some of the largest commercial hydraulic dredgers harvest lugworms, *Arenicola marina* L., and important angling bait, in the Dutch Wadden Sea, and leave furrows 1 m wide and 40 cm deep (Beukema, 1995). Similar devices are used to harvest cockles, *Cerastoderma edule* (L.) and Manila clams, *Tapes philippinarum*, at mid to high tide on sand flats in northern Europe (Hall and Harding, 1997; Spencer *et al.* 1997). Suction dredges are also used on a much smaller scale by divers to remove razor clams, *Ensis siliqua* (L.); although the area disturbed is relatively small, pits are often excavated to depths of 60 cm (Hall *et al.* 1990 a).

### **Mechanical dredges.**

Mechanical dredges physically dig target species such as scallops, *Pecten maximus* (L.), clams, *Mercenaria mercenaria* (L.) and razor clams out of the sediment, and are designed to dig further into the

substratum than beam trawls. Most dredge designs incorporate a heavy duty bag or net attached to a rigid metal frame, which usually bears tooth bars or cutting blades of various designs. For example, the tooth bar on the Newhaven dredge bears teeth approximately 11 cm long that are designed to disturb scallops that lie in shallow depressions in the seabed. Since scallop dredges tend to be used over rough ground, steel ring bellies are usually fitted to the net bag. Large scallop boats fish between 36 and 40 dredges simultaneously and the gear's total width and weight is comparable with some of the larger beam trawls (Kaiser *et al.*, 1996b). Deep burrowing species such as razor clams are caught in dredges fitted with teeth up to 30 cm long (Gaspar *et al.*, 1994). Dredges are rarely towed at speeds in excess of 2.5 knots (Caddy, 1973; Dare *et al.*, 1993), and consequently disturb smaller areas of seabed per unit time than beam trawls (Anon, 1995; Kaiser *et al.*, 1996b).

### Impacts.

It has been demonstrated that trawls and dredges have marked impacts on the substratum, either by physical disturbance due to direct contact with the fishing gear and/or the turbulent resuspension of surface sediments (Kaiser and de Groot 2000). The magnitude of the impact is determined by the speed of towing, physical dimensions and weight of the gear, type of substratum and strength of currents or tides in the area fished. The effects may persist for a few hours in shallow waters with strong tides or for decades in the deep sea.

Commercial fishing intensity is very high in many shelf seas, and Rijnsdorp *et al.* (1991b) reported that some intensively fished regions of the southern North Sea were swept by trawls several times each year. High resolution video images of sediment surfaces before and after otter trawling indicate that trawling reduces the overall surface roughness of the seabed, both by mechanical action of the trawl smoothing over ripples, detritus aggregations and surface traces of bioturbation, and by the suspension and subsequent redeposition of the surface sediment (Schwinghamer *et al.*, 1996). The physical disturbance of sediment can result in a loss of biological organisation and reduce species richness (Hall, 1994).

All mobile bottom gears scrape the surface of, or dig into, the seabed to varying degrees, so it is not surprising that non-target fishes and benthic invertebrate species comprise a large proportion of the catch in some fisheries (Andrew and Pepperell, 1992; Robin, 1992; de Groot and Lindeboom, 1994; Anon, 1996b; Raloff, 1996). Gear modifications such as the addition of extra tickler chains increase the catch of both target and non-target species (Cruetzberg *et al.*, 1987; Kaiser *et al.*, 1994) and, while net designs have been refined to reduce by-catch of non-target and undersized commercial species (e.g. Briggs, 1992), few attempts have been made to reduce by-catch or the physical effects of fishing gears on invertebrate benthic species. For the purposes of this review, infauna are defined as those animals living entirely within the sediment, whereas epifauna are defined as those animals living on, protruding from, anchored in, or attached to, the sediment.

### Effects of trawls and dredges on infauna

By-catches of non-target infauna species indicate the extent to which benthic communities are perturbed by a particular gear. For example, the occurrence the bivalve, *Arctica islandica* (L.), and the heart urchin, *Echinocardium cordatum* (Pennant), in a 12 m beam trawl catch suggested that the tickler chains had penetrated hard sandy substrata to a depth of at least 6 cm (Bergman and Hup, 1992). The position of small urchins within the sediment column, and not their size, makes them vulnerable: smaller size-classes of heart urchins were found closer to the sediment surface and were most vulnerable to physical damage.

In Bergman and Hup's (1992) study, it was estimated that 90% of the *A. islandica* in the catch had broken shells, and damaged *A. islandica* were found in larger numbers in a dredge towed directly behind an otter board than in the centre of the net by Rumohr and Krost (1991), and by divers while surveying areas of the seabed disturbed by beam trawls (Kaiser and Spencer, 1996a). A side effect is the prevalence of *A. islandica* in the stomach contents of Atlantic cod at times of intensive otter trawling in Kiel Bay (Arntz and Weber, 1970).

While it is relatively easy to detect the changes in abundance of large macroinfauna that result from fishing disturbance, smaller fauna (< 10 mm) show conflicting responses. For example, (Gilkinson *et al.*, 1997) suggest that the pressure wave in advance of otter trawl doors resuspends fauna below a certain body size or mass so that they are redistributed to the sides of the gear. Bergman and Hup (1992) found both decreases and increases in the abundance of smaller invertebrates after fishing an area of seabed with a beam trawl. Furthermore, studies in the southern North Sea have been hampered by the fact that this area has already been disturbed by fishing for at least 100 years.

Kaiser and Spencer (1996b) studied the effects of beam trawl disturbance at two distinct habitats: stable sediments composed of coarse sand, gravel and shell debris, which supported a rich epifaunal filter-feeding community of soft corals and hydroids, and mobile sediments characterised by ribbons of mega ripples with few sessile epifaunal species, and found that the effects of beam trawl disturbance were undetectable in the mobile sediments. This is not surprising given the levels of natural disturbance experienced in mega ripple habitats (Shepherd, 1983), and because animals living in the troughs of mega ripples were less likely to be disturbed by fishing since the gears rode over the crest of each sand wave. Similarly, Brylinsky *et al.* (1994) were unable to detect any adverse effects of otter trawling over intertidal mud flats that are regularly exposed to large-scale disturbances such as ice-scour. In contrast, Kaiser and Spencer (1996b) found that the number of species and individuals in the stable sediment community was reduced by two and three-fold respectively, and that the less common species were most severely depleted by beam trawling. Thrush *et al.* (1995), in a similar study on the effects of scallop dredging on a coarse sand community, found changes in the populations of individuals and compositional differences in the community that lasted for at least 3 mo after initial disturbance. Because infauna that live within a few cm of the sediment surface at depths < 30 m tend to be small opportunistic species that quickly recolonise areas after disturbance (Dauer, 1984; Levin, 1984), the effects of trawling on this component of the infaunal community are unlikely to last more than 6 to 12 mo. However, Posey *et al.* (1996) suggested that fauna burrowing to a depth of 7-15 cm, which is well within the depths disturbed by trawls and dredges (Krost *et al.*, 1990; Bergman and Hup, 1992), were not affected by severe episodic storms. If these fauna are less well adapted to periodic natural disturbances, they may be more severely affected by trawling activity.

In general, the effects of physical disturbance are likely to be short-lived in communities adapted to frequent natural perturbations in contrast to those communities found in habitats exposed to fewer disturbances. For example, Hall and Harding (1997) found that the effects of mechanical and suction cockle dredging on an intertidal benthic community in the Solway Firth, Scotland were immediately obvious, with a drastic reduction in the abundance of individuals, but after only 8 weeks the community in disturbed areas was similar to that in control undisturbed areas. This rapid recolonisation was attributed to the immigration of adults. Thus, the persistence of disturbance effects may be approximately correlated to the level of natural disturbance experienced in a particular habitat. For example, Kaiser and Spencer

(1996b) found that light shrimp trawls do not cause significant disturbance to communities in poorly sorted mobile sediments in shallow water that are adapted to frequent disturbance. Furthermore, while the changes associated with disturbance are relatively short-lived for the majority of small species, longer-lived organisms recolonise more slowly. For example, Beukema (1995) reported that the biomass of gaper clams, *Mya arenaria* L., took 2 years to recover after commercial lugworm dredging (for bait) in areas of the Wadden Sea, whereas small polychaetes and bivalves had recolonised the dredged areas within 12 months.

### Effects of trawls and dredges on epifauna

Clearly, sessile epibenthic species are most likely to be vulnerable to the passage of bottom gears, and observations of the changes in epifaunal communities in heavily fished areas have provided some of the first indications of the potential long-term effects of fishing on benthic communities. The disappearance of reefs of the calcareous tube building worm, *Sabellaria spinulosa* Leukart and their replacement by small polychaete communities, indicated that dredging activity had caused measurable changes in the Wadden Sea benthic community (Riesen and Riese, 1982). Collie *et al.* (1997) identified comparable substrata that experienced different intensities of scallop dredging on the Georges Bank, north-west Atlantic. Areas that were less frequently fished were characterised by abundant bryozoans, hydroids and worm tubes which increased the three-dimensional complexity of the habitat and had higher diversity indices attributable to the large number of organisms, such as polychaetes, shrimp, brittle stars, mussels and small fishes. Thus, the species association was broken down by fishing disturbance. Many of these species associated with the biogenic fauna were also important prey for commercially exploited fishes such as cod (Bowman and Michaels, 1984). In contrast, the more intensively dredged areas had lower species diversity, lower biomass of fauna, and were dominated by hard-shelled bivalves (e.g. *Astarte* spp.), echinoderms and scavenging decapods. In addition, there was a reduction in the habitat features produced by some of the target species, e.g. pits created by scallops and crabs (Auster *et al.*, 1996). However, recovery from disturbance may be rapid. Collie *et al.* (1997) found that the biogenic epifauna at a site, which had previously been dredged for scallops, and then closed to fishing, showed signs of recovery after 2 years, and Kaiser *et al.* (1997) found that epifaunal communities that had been trawled over experimentally in relatively shallow (35 m) water were indistinguishable from control unfished areas after 6 months.

Where fishing occurs in shallow clear waters, marine plant communities are likely to be affected. In particular, seagrass (*Posidonia*) meadows are vulnerable to physical disturbance as dredges and trawls reduce plant biomass and abundance by shearing off fronds, exposing rhizomes, digging shoots from the substratum and increasing local turbidity through sediment resuspension (Fonseca *et al.*, 1984; Guillén *et al.*, 1994). Seagrass meadows are highly productive, support complex trophic food webs, provide sediment and nutrient filtration, enhance sediment stabilization and act as breeding and nursery areas for species of commercial importance (Short and Wyllie-Echeverria, 1996).

Clearly, there are two main effects of mobile gears on epifaunal communities: *i*) modification of substrata (shell debris, boulders, mud veneers) and *ii*) removal of biogenic taxa and a consequent decline in the abundance of fauna associated with them. Not only does the latter reduce the supply of important prey species, but it also increases predation risk for juvenile commercial species thereby lowering subsequent recruitment to the adult stocks (Walters and Juanes, 1993).

## Static fishing gears

Static bottom gears are anchored to the seabed and left to fish passively. The most commonly used are gill, trammel or tangle nets, which are designed to capture target species by enmeshing or tangling them (Potter and Pawson, 1991). Traps and pots are commonly anchored to the seabed in fleets, each is baited to attract target species through one or more entrances into chambers in which the animals are trapped. Reefs are frequently damaged by the hauling of set nets, and the problem has been exacerbated by the use of mechanical net haulers or power blocks (Munro *et al.* 1987). The effects are regarded as minor in comparison with those attributable to active fishing techniques, as is the area of seabed likely to be affected by static gear. Nevertheless, the impact may be significant if fishing effort is concentrated in relatively small areas with communities of long-lived fauna. Eno *et al.* (1996) observed that pots that landed on, or were hauled through beds of the foliose bryozoan *Pentapora foliacea* (Ellis and Solander) caused physical damage to the brittle colonies. However, sea pens, *Pennatula phosphorea*, *Virgularia mirabilis* O.F. Muller and *Funiculina quadrangularis* Pallas bent in response to the pressure wave created by the descending pot and lay flat on the seabed. Moreover, when uprooted, the sea pens were able to re-establish themselves in the sediment. This study suggests that the direct contact of fishing gears with fauna may not be the primary cause of mortality and the frequency and intensity of physical contact is more likely to be important.

There has been considerable expansion in the use of enmeshing nets in marine fisheries over the last 40 years, in part due to the adoption of synthetic non-biodegradable materials such as monofilament nylon (Potter and Pawson, 1991). This has led to concern over the incidental entanglement of marine mammals and seabirds (see, for example, Northridge 1992), but static fishing gear, such as gill and tangle nets and pots or traps, might otherwise be considered to be environmentally friendly. They are highly selective for target species and cause relatively little disturbance to seabed communities when compared with towed bottom-fishing gears (Jennings & Kaiser, 1998). Unless otherwise prohibited through national legislation, static gears of all types are used by MRF, though generally in relatively small amounts compared to the corresponding commercial fisheries. Their impact will therefore be proportional to the amount of gear used, though it is likely to be more evident in near-shore areas where there may be greater concerns about habitat impacts than further offshore.

When bottom-set nets or pots are lost, either because of bad weather, snagging or when inadvertently towed away by mobile fishing gears, they may continue to fish. This phenomenon is known as 'ghost-fishing' (Breen, 1987; Carr *et al.*, 1990). In contrast to the numerous records of bird, reptile and cetacean entanglement in set gears (see Dayton *et al.*, 1995), little is known about the frequency of net loss or for how long lost gear is likely to fish. This lack of knowledge results from the reluctance of fishers to report such incidents and the difficulty in undertaking long-term studies in a realistic manner. Estimates of the proportion of nets lost from commercial fleets have been reported in a variety of studies reviewed by Dayton *et al.*, (1995). The phenomenon of ghost fishing was clearly perceived to have negative effects on commercial stocks by commercial fishers in the Greenland halibut fishery, who instigated their own voluntary clean-up programme (Bech, 1995).

Both lost nets and pots can persist and continue to fish in the marine environment for several years (Carr *et al.*, 1992), although their actual persistence will depend on the prevailing environmental conditions. Nets lost in areas exposed to large swells and storm activity are rapidly destroyed by physical forces (Puente, 2003). Those lost in shallow, clear waters are rapidly overgrown with epibiota, which makes

them highly visible, reducing their fishing capabilities (Erzini, 2003). However, in circumstances where nets or pots are snagged onto rocks, holding the net in place, or lost in deep water in a relatively stable environment, they may continue to fish indefinitely (Carr *et al.*, 1992; Reville *et al.*, 2003).

Pots tend to be constructed of robust materials and have a rigid structure, which means that lost pots are likely to maintain a higher capture efficiency for much longer than lost nets. Not surprisingly, ghost-fishing mortality rates of up to 55% of the mortality rates recorded in attended pots have been reported (High, 1976; Miller, 1977). A rebaiting cycle occurs in lost pots as described for lost nets above, which suggests that an intact pot could fish indefinitely. The 'ghost-fishing' potential of pots also varies for different fisheries and pot designs. For example, in the red king crab fishery off Norway, tagged crabs gradually left experimental pots "lost" for periods of between five days, to be replaced by new ones, and very few dead crabs were found in the pots (Godoy *et al.*, 2003).

There is a lack of information about the quantity of static gear lost, possibly resulting from the reluctance of fishermen to report such incidents and the difficulty in undertaking realistic long-term studies. As a consequence, there is little information on the potential of lost nets to cause mortality to both target and by-catch species. Nevertheless, losses from the respective fisheries due to ghost-fishing gear are undesirable from a conservation and an economic point of view, and fishermen in North America and Norway have undertaken grapnel retrieval programmes to reduce the number of nets capable of ghost fishing, most noticeably in the Greenland halibut fishery (Bech 1995; Humborstad *et al.*, 2003).

May (1976) and Carr *et al.* (1992) are examples of the few studies to have examined ghost fishing in bottom set nets off North America, but there had been no such work in European waters before an EU-funded study, FANTARED ("ghost net", in Spanish), was set up to simulate ghost fishing in bottom-set gill and trammel nets and in pots, using divers to describe and quantify changes in catches and the deterioration in the integrity of the fishing gear through time (Kaiser *et al.*, 1996a). The results of FANTARED agreed with those of Carr *et al.* (1992) in suggesting that catches of fish in nets lost in inshore waters decline rapidly over the first few days. As the fish die, they cause the nets to collapse and attract large number of scavenging crustaceans that also become trapped in the gear, replacing fish as the main component of the catch. Thereafter, there appears to be a continuous cycle of capture, decay and attraction for as long as the gear remains intact. It was hypothesised that the decline in catch rate was probably linked to the reduction in net size and degree of entanglement as the free end of the net became rolled up. The fishing capabilities of set nets are likely to be most rapidly reduced if they are lost in areas exposed to large swell and storm activity and are soon destroyed, and in nets lost in shallow, clear water that are rapidly overgrown with encrusting biota that makes them more visible (Erzini *et al.*, 1997). However, it was postulated by Carr *et al.* (1992) and by Kaiser *et al.* (1996) that static gear which becomes snagged onto rocks, holding it in place, or is lost in deep water in a relatively stable environment, may continue to fish for more than a year, whilst the longevity of monofilament nylon (for example) means that some lost nets could fish for several years (May 1976). As a consequence, the total catch of animals during the life of a lost net may be considerable, depending upon the composition of the local faunal community, habitat type and environmental conditions such as tidal currents and weather.

A research programme of *in situ* studies of ghost fishing in active commercial fisheries - FANTARED 2 - was designed to cover those European fisheries where net loss was thought to be a problem (Pawson, 2003). The trials were conducted under conditions experienced by commercial operators, but they

adopted the same experimental protocol, ideally shooting a series of short fleets of nets or pots on known fishing grounds (preferably where there is no trawling activity), and retrieving three replicates in sequence every few months to make an assessment of their condition and catching efficiency. The latter was estimated by comparison with catch rates of similar gears being operated by the commercial fleets at the same time and place, or by deploying and hauling identical nets with the "usual" commercial soak time, so that variations in fish abundance and availability were accommodated.

In most cases where nets were set on open ground in water < 100 m deep, their relative catching efficiency fell to below 20% within one to four weeks of being "lost", and their catching capacity reached zero within three months after deployment. The exceptions were cod gill nets set over a wreck off the North-east coast of England and in a sheltered area of the Baltic, where catches continued at a low level for at least two years. In each case the loss of catching capacity was related to deterioration of the nets' structure, brought about by the action of currents and storm surges. Studies on monkfish and Greenland halibut (*Reinhardtius hippoglossoides*) tangle nets in deeper water showed that the catching efficiency of the "lost" gears remained relatively high over the first 7 - 20 weeks, but declined to zero after 10 months in the monkfish tangle nets (the halibut nets were not monitored beyond 10 weeks). Catch levels in red king crab (*Paralithodes camtschaticus*) pots in deep water declined gradually over a period of 9 months, during which time there was a flux of crabs escaping from and entering the pots. Whilst the overall mortality of crabs was estimated to be <10% of those entering the pots, all fish caught in lost nets should be considered to contribute an unaccounted mortality of their respective populations.

Information on the structure and colonisation of nets and netting over the most damaging periods of "ghost" fishing - which will vary from a few weeks up to several years depending on the fishery (depth, trawling activity etc) and the environmental conditions - can be used to judge how long retrieved nets have been "lost". This will enable estimates to be made of their fishing capacity, though it may be possible to relate this directly to net condition (area intact, biofouling etc). Estimates of the number of nets lost in the Cantabrian Sea monkfish tangle net fishery, and in the hake gill net fishery off the Portuguese Algarve, indicate that losses due to ghost fishing were equivalent to 1.5% and 0.5% respectively of total catches of these target species in these fisheries.

Compared with the proportions of target species removed by active fishing gears, the number of organisms removed by ghost-fishing nets or pots is probably small. However, these fisheries tend to be highly localised leading to a concentration of lost gear within relatively small areas. Consequently, the proportion of local stocks removed can be significant (Kruse and Kimber, 1993). Furthermore, many of these species have a high individual value and hence represent a large economic loss to the local fishing industry. In order to reduce these losses for undersized specimens, escape panels are now fitted to many pots used in North America and biodegradable materials are used to ameliorate losses from 'ghost-fishing' (Guillory, 1993).

### **Indirect effects on habitat**

The direct effects of fishing change the structure of fish and benthic communities and may affect the growth of those organisms that are responsible for structuring habitats. The resuspension, transport and subsequent deposition of sediment may affect the settlement and feeding of the biota in other areas. Trawling, in particular, can be responsible for resuspending a large proportion of the sediment load in some marine environments. Those parts of the trawl net that come into contact with the sea bed will

cause bottom sediments to be resuspended, but the turbulence created by the trawl doors suspends most material and plays a key role in herding fishes towards the net (Main and Sangster, 1981). This is more significant in deeper areas where storm-related bottom stresses are generally weak (Churchill, 1989). The potential effects of sediment resuspension include clogging of feeding apparatus or reduction of light availability (Rhoads, 1974) and sediment deposition has been shown to inhibit the settlement and growth of oysters and scallops (Moore, 1977; Jones, 1992). However, given the range of sediment types in the marine environment and the natural spatial and temporal variations in sediment load (Moore, 1977), it is unlikely that the population level consequences of sediment resuspension and deposition can be determined from small scale studies of siltation effects.

The surface of marine sediments is an important site of benthic production. Emerson (1989) found a significant negative correlation between wind stress and total macro- and meiobenthic production in the southern North Sea. The intensive trawling of *Posidonia oceanica* meadows in the Mediterranean Sea may lead to reductions in littoral primary productivity (Guillén *et al.*, 1994), but it is unlikely that large scale changes in primary production could be reliably correlated with changes in fishing intensity using existing data.

### **Natural versus fishing disturbance**

To date, most studies have investigated the effects of fishing on benthic communities in shallow seas on the continental shelf at depths < 100 m. This is not surprising as the majority of demersal fishing activity occurs in this depth range, and quantitative ecological studies become logistically complex at greater depths. Benthic communities in these environments experience continual disturbance at various scales (Hall, 1994). Large-scale natural disturbances, such as seasonal storms and strong tidal currents, form a background against which other smaller disturbances occur, such as those induced by predator feeding activities (Von Blaricom, 1982; Oliver and Slattery, 1985; Hall *et al.*, 1994). Hall *et al.* (1994) concluded, however, that while it was possible to detect short-term effects of predator disturbance, large-scale effects could not be inferred. This implies that small-scale disturbance events, even when frequent, are masked by a background of large-scale disturbances or that the small-scale of disturbance permits rapid recolonisation such that large-scale effects never become apparent.

Clearly, the scale and frequency of disturbance events can increase until lasting ecological effects can be observed against a background of natural disturbance. The additive effects of an entire fishing fleet may reach such a threshold. Moreover, fishing effort in shelf seas is not homogeneously distributed. Fishers concentrate their effort in grounds that yield the best catches of commercial species and avoid areas with obstructions and rough ground that would damage their gear. In addition, fishing is severely restricted in some areas, such as shipping lanes and around oil rigs. Consequently, early estimates of area swept by bottom gears are unintentionally misleading as they imply physical disturbance spread homogeneously across large (> 100 km<sup>2</sup>) areas (Welleman, 1989). The Dutch beam-trawl fleet accounts for 50-70% of the total beam trawling effort in the North Sea. Records from 'black box' satellite tracking recorders fitted to a proportion of the Dutch fleet indicate that beam trawling effort is very patchily distributed in the North Sea; while it is estimated that some areas are visited > 400 times per year, others are never fished (Rijnsdorp *et al.*, 1996a). The distribution of bottom trawling disturbance can also be ascertained from the occurrence of physical damage in populations of animals that are able to withstand such injuries. Up to 55% of the starfish, *Astropecten irregularis* Pennant had lost arms in a heavily beam-trawled area of the Irish Sea, compared with only 7% in a less intensively fished area (Kaiser, 1996). Within intensively fished

grounds, the background levels of natural disturbance may have been exceeded leading to long-term changes in the local benthic community. However, community structure observed at the present time may be the product of decades of continuous fishing disturbance.

Detecting those long-term changes in benthic fauna, which can be attributed to fishing activities, has been problematic in all but the most obvious cases (Riesen and Riese, 1982; Sainsbury, 1987). Philippart (1997) examined a dataset of epibenthic by-catch species from the southern North Sea dating back to the 1930s and showed the decrease in the incidence of species continued after 1970 when beam trawling superseded otter trawling as the main Dutch fishery. Furthermore, Holtmann *et al.* (1996) reported a decrease in the abundance of the fragile burrowing heart urchin and the brittle star *Amphiura filiformis* O.F. Muller in areas of the southern North Sea between 1990 and 1995. These trends suggest that fishing activity may have been the main cause of these changes. However, the southern North Sea has been influenced by eutrophication events leading to increases in the abundance of polychaete species and echinoderms such as *A. filiformis* (Pearson *et al.*, 1985) and by oceanographic changes (Lindeboom *et al.*, 1995), so these changes cannot be attributed to fishing alone.

## Conclusions

Fishing activities lead to changes in the structure of marine habitats and influence the diversity, composition, biomass and productivity of the associated biota. The direct effects of fishing vary according to the gears used and the habitats fished, but they usually include the scraping, scouring and resuspension of substratum and occur against a background of natural disturbance. The relative impact of fishing on habitat and benthic community structure is determined by the magnitude of natural disturbance. The direct effects of a given fishing method on infaunal and epifaunal communities will tend to increase with depth and the “natural” stability of the substrate. In sheltered inshore areas where complex habitats develop in shallow water, the direct effects of fishing may be marked and have profound effects on the ability of the habitat to sustain fish production. It appears that MRF activities have a negligible impact in this respect, except in those situations where “commercial” gears (usually static nets or pots) are used to catch fish or crustaceans for household use, and which are chiefly limited to near-shore areas. There may, however, be considerable impacts on the quality of recreational fishing due to decreased production of target species.

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## Fish community structure

### Introduction

Fishing has direct effects on fish community structure, and changes in the growth, mortality, production and recruitment of target fish populations provided the basis for conventional fisheries assessment and management (Beverton and Holt, 1957; Beverton, 1963; Cushing, 1968; Nikolskii, 1969; Gulland, 1977; Hilborn and Walters, 1992). However, the capture of target or by-catch species also has indirect effects on fish populations and the direct and indirect effects of fishing act in combination to determine the resulting biomass, size structure and diversity of communities. In this section we describe the effects of fishing on the diversity and size-spectra of fish communities and the life history traits of fishes.

Whilst MRF may not have the same impact on general fish community structure as commercial fishing, even sport angling can generate significant losses to target fish populations. Dunn *et al.* (1989) estimated that, because of its good eating qualities and high market value, the annual catch of sea bass taken by recreational anglers in England and Wales in 1987 was 415 t, compared to a catch of 630 t estimated for

the commercial fishery. This was largely due to the numbers of people active in the respective fisheries, some 24 500 recreational sea-anglers and around 400 full-time 2,500 part-time commercial fishers who fished regularly for sea bass in the UK in 1986/87. The increased uptake of catch and release in recent years will, of course, have resulted in a lower mortality of species such as sea bass, sharks and billfish due to angling.

Since many fishing techniques are size-selective, changes in the size structure of populations should be expected following fishing. Decreases in the mean size of target fishes and reductions in the abundance of larger fishes are one of the most widely reported and quickly observed changes when fishing effort increases (Russ, 1991). Since the size structure of the biota in marine ecosystems follows relatively regular patterns, there may be general changes in these patterns as a result of fishing (Rice and Gislason, 1996). These may result from the direct effects of size-selective fishing and the indirect effects of fishing on predator-prey relationships. We consider these changes and their ecological significance in section 3.3.

Size selective fishing will affect species with different life history traits in different ways. Since species with late maturity and slow growth towards a large maximum size are typically affected more by size selective fishing than small fast growing species with early maturity, it might be expected that the species composition of fish communities will change in response to fishing and that smaller fast growing species will dominate the biomass. Moreover, within species, fishing is selective with respect to a number of life history traits such as growth, which are at least partially heritable, and exploited populations would be expected to evolve in response to harvesting.

To date, such evolution of life histories has often been overlooked because it is slow in comparison with the periods in which managers, operating under contemporary socio-economic constraints, have to act. However, given that ecosystem-based management may operate on longer time scales, the effects of fishing on life history traits need to be considered as part of any management strategy.

### Extinctions

Fishing has been responsible for the local loss of species such as common skate in the Irish Sea (Brander, 1981) and marked depletion in many other species that are vulnerable by virtue of their low intrinsic rates of increase and hence their low capacity to withstand additional fishing mortality (e.g. Dulvy et al 2000; Ellis et al 2005; Quero 1998). Local and regional extinctions due to fishing are well documented for a variety of species, but global extinctions are relatively infrequent although they have occurred (Dulvy et al 2003; Sadovy, Y. & Cheung, 2003).

### Intraspecific diversity

Losses of intraspecific diversity are expected to occur in response to fishing. Numerous fished stocks have collapsed, and many other stocks have been reduced to very low abundance before they recovered (Myers *et al.*, 1995). Since large old fishes may be more heterozygous and some stock structures may have a genetic component (Smith *et al.*, 1991; Carvahlo and Hauser, 1994), reduced intraspecific diversity would be expected following intensive exploitation. This has been of considerable concern in salmonid fisheries (Ryman *et al.*, 1995) but has rarely been investigated for strictly marine species. The results of Smith *et al.* (1991) suggest that losses of genetic diversity will take place well before the stock would be considered endangered by those concerned with fish population dynamics. There is a continued

need to identify those population units that have defined genetic characteristics for the purposes of recording losses of intraspecific diversity and deciding how to protect it.

### Size structure

Since fishing will lead to the selective removal of larger fishes and their removal may, in turn, affect their predators or prey, it is reasonable to expect that fishing is one process that may cause the size distribution of biota within an ecosystem to differ from that which is predicted by models. Comparison of numbers of all fish species combined by length class in space and time in North Sea groundfish surveys indicate that slope of the distributions varies considerably between areas but much less through time within an area. Pope *et al.* (1988) considered that the slope of the line provided a broad indicator of exploitation regime, with more heavily exploited areas having a steeper decline with size. Further study of North Sea data also suggested that the relationships between total biomass and body size were effectively linear over the selective size range considered (larger fishes sampled during groundfish surveys) and that the slopes and intercepts of these lines were linear functions of fishing intensity (Anon, 1996b; Greenstreet and Hall, 1996; Rice and Gislason, 1996). These effects were largely attributed to the selective removal of larger fishes by fishers.

### Life history traits

#### Changes in multispecies communities

Fishes exhibit a range of life history tactics, which are presumably shaped by natural selection, to fit particular ecological demands (Stearns, 1976; Stearns and Crandall, 1984), and it is therefore expected that fishing will affect fishes with different life history traits in different ways. Species with short life-spans and rapid population growth, which mature early and channel a large proportion of their resources into reproductive activities, are likely to respond rapidly to fishing, but, so long as fishing intensity and recruitment are in balance, they may be fished sustainably at younger ages and higher levels of mortality. Fisheries based on slower growing species, which mature later and at a larger size, are likely to be vulnerable to intensive exploitation despite having naturally more stable population sizes which, in the unexploited state, are buffered by numerous age classes against the recruitment failure of individual cohorts rate (Adams 1980; Beddington and Cooke 1983, Roff 1984; Kirkwood *et al.* 1994). A number of empirical studies have suggested that larger and late maturing species are more susceptible to exploitation (Brander 1981; Trippel 1995) and, since the maturation and growth parameters of fishes are closely interrelated (Alm 1959; Beverton, 1963, 1987, 1992b; Leggett and Carscadden 1978; Jennings and Beverton 1991; Charnov 1993), a suite of other life history traits may also correlate with responses to exploitation.

Most fisheries are relatively unselective and many species experience high levels of mortality as bycatch even if they are not the primary targets of the fishery (Alverson *et al.*, 1994). The susceptibility of late maturing and larger fishes to fishing suggests that small and early maturing species would increase in relative abundance in an intensively exploited multispecies fishery. However, while the life histories of smaller species may enable them to sustain higher instantaneous mortality rates than larger species, they may also suffer lower fishing mortality simply because they are less desirable and less accessible targets in a size-selective fishery. As a result, observed shifts in fish community structure result from the combined effects of differential fishing mortality and the variable susceptibility of species with different life histories.

There have been changes in the structure of fish communities in most fished marine ecosystems which have been studied for a decade or more (Pauly, 1979; Harris and Poiner, 1991). Greenstreet and Hall (1996) compared community structure in the North Sea groundfish assemblage in the periods 1929-1953 and 1980-1993. Despite marked increases in fishing effort during this period there was little change in community structure of the non-target species and the changes in the target species were a result of the direct effects of fishing and recruitment changes that have been widely documented elsewhere (Ursin, 1982). These results were corroborated by Rijnsdorp *et al.* (1996b) who compared data from 1906-1909 and 1990-1995. Even in the earlier period, however, the North Sea was already heavily fished (Cushing, 1988) and many of the major changes in community structure may already have occurred.

### **Intraspecific changes in life histories**

If some part of the phenotypic variation within species is due to genetic differences among individuals, then selective fishing will cause genetic change (Law, 2000). The selection differentials owing to fishing can be large (Law & Rowell, 1993), and several examples of trends in life history traits such as growth and age at maturity have been attributed to the genetic effects of fishing. This is increasingly seen as a management issue (Kenchington *et al.*, 2003), particularly when there were clear commitments to biodiversity conservation in the Convention on Biological Diversity. Conventional single-species fisheries management will almost always create selective pressure that favours traits such as early maturity and slow growth, since fishing mortality increases with size. This selection pressure could be changed if fishing mortality on the larger individuals were reduced relative to that on smaller individuals, since the faster growing individuals would have a lower risk of mortality and potentially contribute more to future generations.

### **Reproduction**

Size selective fishing can have a marked impact on the sex ratios of fish populations and artificially curtail reproductive lifespan. Shifts in the size and age distributions of fish populations can also have profound influences on their reproductive output. The relative fecundity (number of eggs per unit of body mass) of fishes increases as they grow and thus a population of a given biomass will have a greater potential fecundity when composed of larger rather than smaller individuals. In addition, when the reproductive lifespan of fishes is artificially curtailed by fishing, their potential reproductive output will not be realised. In unfished populations, changes in reproductive output will be governed by changes in other life history traits or physical and biological characteristics of the environment (Jennings and Beverton, 1991). However, when a reduction in reproductive output is a direct consequence of fishing mortality and, therefore, of no evolutionary benefit, the population will only maintain evolutionary fitness by rapid changes in reproductive strategy. These changes should involve a compensatory increase in reproductive output at a given size or age. In the North Sea plaice, younger fishes of a given length had a higher absolute fecundity (Horwood *et al.*, 1986). The responses of individuals can have a marked effect on the response of the population to exploitation. Rijnsdorp *et al.* (1991a) reported that the observed changes in growth, maturation and fecundity appeared to have compensated for about 25% of the losses in total egg production due to increased exploitation for North Sea plaice, cod and sole.

### **Conclusions**

Most of the marked effects of fishing on diversity and community structure occur at relatively low levels of fishing intensity. However, once systems enter a fished state, diversity and overall production may often remain relatively stable despite further changes in fishing intensity, whether by commercial fisheries or

MRF. Top-down (predator controlled) effects on prey fish diversity do not appear to be strong and the direct effects of fishing on fish community structure dominate those that result from the depletion of predators.

Within a fished community, those species that grow slowly, mature late and have low reproductive output tend to be more susceptible to the direct effects of fishing than faster-growing species with early maturity. This is particularly relevant to elasmobranchs, many of which are targets for MRF. Fishing has selective effects on the life history strategies and genetic structure of many exploited stocks, but such effects have not been widely investigated because they are small in relation to short-term plastic responses in the life history. In the longer term, it is likely that the genetic effects of fishing will become increasingly marked and new approaches to management will be required if fishing is not to act as the overriding evolutionary force for many fish populations.

### **Trophic interactions**

One of the most widely expressed concerns about the intensive and selective fishing activities of humans is that they will lead to imbalances in ecosystem function that have ramifications for non-target species. Thus fishers who capture small 'forage fishes' such as sardines or pilchards *Sardina* spp., anchovies *Engraulis* spp., sandeels *Ammodytes* spp., capelin *Mallotus villosus* (Müller) or Norway pout *Trisopterus esmarki* (Nilsson) will compete with other predators in the marine ecosystem. Industrial fisheries in the North Sea, for example, accounted for over half the total catch by the late 1980s (Anon, 1993).

Many forage fishes provide food for bird and marine mammal populations and in many cases the birds or mammals are species of considerable conservation concern (Bax, 1991). There is increasing pressure to manage marine ecosystems with a view to ensuring the well being of birds and marine mammals rather than maximising fish production for humans. Thus, the indirect effects of fishing on trophic interactions in marine ecosystems have become a major concern of the conservation movement (Anon, 1996a). Moreover, some fishery biologists have also expressed concern about the intensive fishing of forage fishes since these may provide food for more valuable fished species. Clearly, a good scientific basis for management decisions is essential, but it is unlikely that recreational fishing in temperate marine waters will add significantly to the pressures already apparent that are due to commercial fishing. Examples on the impacts of fishing on changes in marine community structure and the implications for predator-prey relationships can be found in Jennings and Kaiser (1998), Pope (1979), Sparre (1991), Pope and Macer (1996), Myers *et al.* (1996), Fogarty *et al.*, (1991), Sherman *et al.* (1981), Andersen and Ursin (1977), Mehl, (1986; 1987) and Magnússon and Pálsson (1991).

### **Species replacement**

There have been dramatic shifts in the composition of fish catches from many locations (reviews: Kawasaki *et al.*, 1991; Sherman *et al.*, 1993) and it is often suggested that the depletion of one species by fishing has allowed another species to proliferate as a result of reduced competition or predation. Because species replacements are assumed to involve large absolute changes in the biomass of species within the system that appear to be compensatory: i.e. one species proliferates as another declines, it is highly unlikely that this could be caused by recreational fishing alone. In fact, it is often difficult to dissociate these effects from those due to climatic changes (Russell *et al.*, 1971; Steele, 1974; Southward, 1980 and Southward *et al.*, 1988), and the environment, rather than intraspecific competition or predation, is usually shown to govern cycles in fish populations. Indeed, it is a combination of fishing

and environmental changes that has been responsible for many of the collapses observed, in populations that have fluctuated for hundreds of years when levels of fishing mortality were relatively low (e.g. herring (Jenkins, 1927; Hodgson, 1957) and pilchards (Culley, 1971; Southward, 1980) in European fisheries). In the English Channel, changes in climate largely explain the variation in pilchard and herring abundance (Russell *et al.*, 1971; Southward, 1980; Southward *et al.*, 1988).

### Scavengers and discards

Fishing activities result in the capture of non-target species and undersized individuals of target species. A proportion of this by-catch will be discarded dead or dying because it is illegal to land it or because there is little or no economic gain associated with sorting or retaining it. In addition, pelagic fishes such as mackerel may be 'slipped' and returned into the sea when their catch is too large to be landed or of poor market quality. The majority of these fishes are damaged during capture and confinement and die shortly afterward (Lockwood *et al.*, 1983). Moreover, in fisheries that are managed using quotas, small target fish (though above the minimum legal landing size) may be rejected in favour of larger, more valuable, specimens. Alverson *et al.* (1994) have estimated that 27 million t of by-catch are discarded every year. This is approximately 27% of the current global fish catch. Discards are preyed upon by a range of scavengers whose ecology was extensively reviewed by Britton and Morton (1994).

Camphuysen *et al.* (1993) estimated that 475 000 t of fish, offal and benthic invertebrates are discarded into the North Sea annually, and that seabirds consumed approximately 90% of offal, 80% of roundfish, 20% of flatfish and 10% of the invertebrate discards. This was estimated to be enough food to maintain c. 2.2 million seabirds; more than the total estimated population of scavenging seabirds in the North Sea. The effects of this additional supply of food have been reflected in population changes, with a tenfold increase in the number of breeding seabirds from 1900-1990 (Lloyd *et al.*, 1991; Furness, 1996).

The material discarded into the sea that is not consumed by seabirds sinks to the seabed and becomes available to mid-water and benthic predators and scavengers. Few studies have recorded the consumption of discarded material in midwater, probably reflecting sampling difficulties (Britton and Morton, 1994). Fishing activities also provide food for benthic scavengers when demersal trawls and dredges dragged across the seabed dig-up, displace, damage or kill a proportion of the epi- and infaunal animals in the path of the gear. In addition, some of the animals caught in nets may escape, but subsequently die. These latter sources of carrion have been termed 'non-catch' mortality (Bergman and Santbrink, 1994), though there have been few studies of the influence of carrion generated from fishing activities on the benthic communities of shelf seas (Ramsay *et al.*, 1997b).

The behaviour of scavenging fish species in response to trawling disturbance is frequently exploited by North Sea trawlers, and Caddy (1973) noted that the density of predatory fishes in recently dredged areas was 3-30 times higher than in the area outside the dredge tracks. Kaiser and Spencer (1994) observed 35 times as many fish shoals over a recently beam-trawled line compared with adjacent unfished areas. These studies implied that fish moved into areas of disturbance. Adult queen scallops, *Aequipecten opercularis* L. do not occur in the diet of whiting under normal circumstances. However, after trawling, the distinctive orange gonads of these bivalves were recorded in whiting stomach contents, indicating that the molluscs had been damaged by the trawl (Kaiser and Spencer, 1994). Similar responses to fishing disturbance were also recorded for dab that were attracted to animals damaged by the trawl within 20 min, and increased to three times their former abundance after 24 h (Kaiser and

Spencer, 1996a). It is clear that fish consume damaged or exposed animals in the trawl path, but there is no clear evidence, as yet, that they consume discards in the form of food falls from the surface (but see Olaso *et al.*, 1996).

Many of the mobile epibenthic invertebrate fauna are facultative scavengers (Britton and Morton, 1994), and have physiological features or behavioural adaptations that enable them to survive the capture and discarding processes. Not surprisingly, therefore, invertebrate scavengers are indicative of areas of trawl disturbance (Collie *et al.*, 1997). Berghahn (1990), Kaiser and Spencer (1996a) and Ramsay *et al.* (1997b) have all demonstrated that scavenging invertebrates consume both discards and damaged fauna left on the seabed in the path of the trawl, where they show an increase in density.

Whereas populations of seabirds have shown clear responses to the extra food resources made available by discarding (Furness, 1996), the consequences for fish and invertebrate scavenger populations are not clear. In the period from 1970 to 1995 there were increases in the biomass of several non-target species in the North Sea while the biomass of gadoids and species fished industrially decreased. Those species that have increased in abundance, such as the dab and long rough dab *Hippoglossoides platessoides* (Fabricius) (Heesen, 1996), are scavengers and may benefit from damaged benthic fauna due to beam trawl activity. However, there are alternative explanations for the proliferation of dabs and long rough dabs, which are small in size, grow rapidly and mature early, and eutrophication appears to have enhanced populations of polychaetes and brittle stars in coastal waters thereby increasing the food supply for juvenile flatfishes (Duineveld *et al.*, 1987; Heessen and Daan, 1996; Rijnsdorp and van Leeuwen, 1996).

So far, evidence for the expansion of populations of benthic invertebrate scavengers in response to carrion generated by fishing activities is weak, while increases in populations of scavenging seabirds are well documented. This could be because seabirds actively seek out and target fishing vessels as a source of food, whilst benthic invertebrates rely on the chance occurrence of food-falls of fisheries carrion, and they themselves are subject to increased mortality due to fishing. Scavengers, such as crustaceans and starfish, may be better adapted to withstand the effects of repeated trawling disturbance, which, coupled with the removal of predators and competitors, has maintained their populations at a fairly constant level (Ramsay, 1997).

Given the low level of the use of towed demersal gears in MRF, it appears that there is little scope for a detrimental impact of this type

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## Summary

This review of the effects of fishing on benthic fauna, habitat, diversity and community structure in a European context has been carried out to indicate whether it is possible or necessary to predict or manage MRF-induced changes in marine ecosystems. Such considerations are timely given that policy makers need a scientific basis for deciding whether they should respond to social, economic and political demands for instituting or preventing ecosystem-based management.

Fishing has significant direct and indirect effects on habitat, and on the diversity, structure and productivity of aquatic communities. These effects are most readily identified and last longest in those areas that experience infrequent natural disturbance, or when fishing is initiated in a previously unfished system. Though the effects of fishing may be more difficult to detect as levels of fishing activity increase, fishing has accelerated and magnified natural declines in the abundance of many forage fishes. It is not apparent whether this has led to reduced reproductive success and abundance in fish species that are the top predators, however, since they have rather plastic feeding strategies and fishers tend to target species in sequence as a fishery develops, with consequent changes in the composition of fished communities with time. In those cases when predator or prey species fill a key role, fishing can have dramatic indirect effects on community structure. There is good evidence that fishing has reduced, and locally extirpated, populations of predatory fishes (for example, common skate in the Irish Sea), but these reductions do not have a consistent effect on the abundance and diversity of their prey: environmental processes control prey populations in some systems whereas top-down processes are more important in others. Furthermore, the dramatic and apparently compensatory shifts in the biomass of different species in many fished ecosystems have often been driven by environmental change rather than the indirect effects of fishing.

The impacts of MRF in this context and the issues raised are more fully explored in Chapter 6.

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### Introduction.

In this section we describe the most important areas of conflict or mutual interest between the sport and commercial sectors and identify possible management action associated to these. The main objective of this component of the study is to identify the “problems” related to, and interactions between, recreational, sport and commercial fishing, and to explore public perception of the interactions between recreational and commercial fisheries and any issues that attend recreational and sport fisheries. These range from gear conflict and competition for the resource, through impacts of fishing on the marine environment, to ethical issues such as catch and release versus catch and keep. The information used is based on the review of publicly available sources and studies mentioned previously in this report.

In most cases, it is quite evident where fisheries management should concentrate to alleviate problems associated with the most important issues, and we provide a discussion of the ways in which policy, legislation and/or management systems might be changed in order to provide the greatest benefit (using examples where this is already happening). Although this is informed by a review of recreational fishing management systems from around the world, management options are considered at a pan-European level, describing the problem and possible solutions, without considering the legal or management structures existing in each Member State (though subsidiarity is clearly important in formulating effective management regimes).

#### Recreational and commercial fishing: contrasts and comparisons

In a paper that focuses on the contrasting characteristics of commercial and recreational fisheries in relation to conservation and sustainability of exploited fishes in both marine and freshwater environments, Arlinghaus et al. (2005) suggests that the same issues that have led to global fisheries concerns regarding commercial fishing can have equivalent, and in some cases, magnified effects in recreational fisheries. The issues of by-catch and catch-and-release, fisheries-induced selection, trophic changes, habitat degradation, gear technology, fishing effort, and production regimes are remarkably similar. This suggests that issues and threats are also similar in these philosophically different fisheries, and that management of recreational fishing should be on the same scale and urgency as commercial fisheries (Cooke and Cowx, 2005). Clearly, failure to recognise this will further polarise these sectors and retard efforts to better manage exploitation of aquatic resources.

Commercial and recreational fishing both contribute substantial economic benefits to local and national economies (e.g., Arlinghaus et al. 2002; Cowx 2002; Hilborn et al., 2003), though recreational fisheries are usually considered those where fishing is conducted by individuals for sport and leisure, with a possible secondary objective of catching fish for personal consumption (FAO, 1997; Pitcher and Ilingworth 2002). In most EU member States, it is prohibited to sell surplus catch to offset costs, whereas commercial fishing is conducted specifically to capture fish products for sale. In recent years, commercial fisheries have been repeatedly identified as the primary causal agents in the decline of fish stocks globally (Botsford et al., 1997; Smith, 2002; Christensen et al., 2003; Hilborn et al., 2003; Pauly et al., 2003). Although there are few documented reports of stock declines attributable to MRF, (Beal et al., 1998) reported that recreational harvest rates for striped bass (*Morone saxatilis*), bluefish (*Pomatomus saltatrix*), dolphinfish, redfish (*Sebastes marinus*), and tautog (*Tautoga onitis*) off of the eastern coast of the United States exceeded those of the commercial fisheries.

The main commercial fisheries in Europe are subject to intense exploitation, and catch-per-unit-effort in many fisheries have been declining for some time (e.g., Botsford et al., 1997). The FAO (2002) estimated that ~47% of fish stocks globally are exploited to their maximum sustainable threshold, whilst a further 18% are estimated to be over-exploited. For many, the perception is that recreational fishing is a benign activity, but participation can be considerable and appears to be increasing in Europe (Arlinghaus et al., 2002). Recreational fishing is now highly developed and pursued by large numbers of people, primarily for pleasure, but also for income generation and to supplement food supply. The fundamental characteristics of recreational fisheries are high effort and low catchability, whereas in commercial fisheries they are high catchability and low effort (Pereira and Hansen, 2003). This is relevant not only to understanding the characteristics of the fisheries, but also to potential management and conservation strategies.

In the commercial sector, the development of new fisheries is typically characterised by an initial fishing-down phase to a level where harvesting rates do not permit the maintenance of a viable fishery (Hilborn and Walters, 1992). Declines may not be noticed until well after the event, because fishers are mobile and can relocate to other areas to maintain their catch rates. Participants in recreational fisheries also respond to changes in catch rates by shifting location (Cowx et al., 2004), and may continue to operate in areas that are unprofitable or inaccessible for commercial fisheries. Thus, to some degree, recreational fisheries are self-regulating, but their outward performance may obscure potential declines (Pereira and Hansen, 2003).

In some regions it is difficult to determine whether exploitation from commercial or recreational fisheries is responsible for changes in fish population structure and abundance, and there is no hard evidence for this in European marine fisheries. There are many instances where commercial fisheries have been restricted due to such concerns, and recreational fisheries have continued to expand. For example, during the 1990s, declining stocks of red drum (*Sciaetia opifera*) were observed in the Gulf of Mexico, commercial fisheries were curtailed, but the recreational fishery expanded (Gulf of Mexico Fishery Management: Cowell, 1999). In California, protected areas had the highest density and best size structure (i.e., mix of all age classes) of rockfish (*Sebastes* spp), whereas in recreational fishing areas, densities were lowest and size structure was poor (Schroeder and Love, 2002). Impacts of recreational fishing activities (including spears and rod-and-reel angling) have also been reported in South Africa (Buxton and Clarke, 1991), Florida (Sluka and Sullivan, 1998), the Mediterranean (Jouvenel and Pollard, 2001), and Australia (Young et al., 1999). It appears important (as recommended by Arlinghaus and Cooke, 2005) to examine the contrasting characteristics of commercial and recreational marine fisheries in Europe, and whether some of the same issues that have led to concern about commercial fishing can have equivalent, and in some cases, magnified effects in recreational fisheries.

In the central Mediterranean, the expansion of urbanisation and build up of the tourist industry threatens the economic and social viability of coastal fishing (Sykes, 1999). Tourism offers young people better remuneration and has thus undermined the commercial fishing sector, ironically leading to more recreational activity involving commercial fishing gears. This increased in MRF has led to a growing concern about its impact on commercial fish stocks and the commercial fishing sector. In response, some member states have implemented restrictions applicable to commercial fisheries under the Common

Fisheries Policy (CFP) to the recreational sector (e.g. minimum legal length, prohibited species, protected areas and closed seasons), within their national 12 nm limits, together with legislation restricting the number of vessels and the type of gears that are used by MRF or that can be carried on board each recreational boat.

In Italy and Greece, serious disputes exist over rights of access and competition for space and markets between recreational and commercial fishermen, and the argument whether the legislative provision should allow recreational fishermen to freely use nets and long lines. Research suggests that both parties agree that there is a need for more effective legislation to control illegal fishing and keep fishing mortality at relatively low levels, although, in Greece, commercial fishermen believe a complete ban of nets and long lines is required and a more effective method of fishing is enforced. ([http://europa.eu.int/comm/fisheries/doc\\_et\\_publ/liste\\_publi/studies/biological/1309R03B\\_index.htm#recreational%20fishing](http://europa.eu.int/comm/fisheries/doc_et_publ/liste_publi/studies/biological/1309R03B_index.htm#recreational%20fishing))

There have long been disputes between recreational and commercial fishermen over the right of fishing access to diadromous fish (Atlantic salmon *Salmo salar*, sea trout, *Salmon trutta*). Sport fishermen emphasise their contribution to restocking programmes through licence fees, to fish welfare projects, research and river improvement and their contribution to tourism. The different fishing sectors often allege that others are responsible for observed changes in populations and communities. For example, the perception that commercial coastal fisheries for salmon are responsible for reduced angler catches has resulted in the buyout of many coastal net fisheries (Chase, 2003), but there is no empirical evidence to show this strategy has improved angler catches.

These examples suggest that we must reject the assumption that recreational fishing impacts are inevitably negligible or less than those of commercial fisheries (Schroeder and Love, 2002). Thus, accepting the notion that any fishery has the potential to produce negative consequences, and that both recreational and commercial fisheries can contribute to fishery declines, may help to encourage more holistic and inclusive management strategies.

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## Catch and release

The problems of injury and mortality caused by the release of by-catch discards have become an important issue in commercial fisheries (Greenstreet and Rodgers. 2000). Most fisheries managed using total allowable catch, quota systems and minimum mesh sizes, result in excessive catch and under-sized individuals being dumped, with few surviving the experience. Recreational fishing has a parallel to by-catch in that a proportion of fish caught are released because they are not the intended target, or are illegal sizes, or there is a strong conservation ethic promoting voluntary catch-and-release (Policansky, 2002). Whilst this may contribute to the view that recreational fishing is benign relative to commercial fishing, an unknown proportion of fish captured by anglers and released under that assumption that they will survive, does subsequently die (Cooke et. al., 2002a).

Catch and release (C&R) can mean different things to anglers, conservationists, managers, scientists and politicians (Berg and Rotsch 1998). The concept can be applied in various management scenarios and can also be an angling philosophy, and has significant implications for several important elements of recreational fishing and for tourism fishing businesses. C & R, both voluntary and mandatory, can be used to influence stock characteristics such as size, age and abundance that are essential to stock

maintenance, and different levels of C & R are acceptable to different groups of people. Fly fishers and conservation groups seem to be the strongest supporters.

Recently, managers have adopted the C & R concept as a specific management tool to conserve fish populations, in association with size and bag limits, seasonal and area closures and gear restrictions. It is also associated with tagging schemes (see Irish shark tagging below). However, the practice of C&R is also presented as an ethical issue, both from people who support and oppose it. Fedler and Ditton (1994) argue that recreational fishing meets psychological, environmental, social and non-utilitarian needs, but a recent development in the US, and more recently in Europe, is that 'it is inappropriate and unacceptable to impose cruelty upon a fish for no utilitarian purpose'. The idea that fishing is cruel has a long history and has been a subject of much contention. At the extreme, some animal right activists (PETA) are actively campaigning against fishing. In Germany, like the US, the Animal Protection Act makes it illegal to harm an animal for inappropriate / non-utilitarian use, which makes voluntary C & R illegal. The distinction between fishing for food or for recreation is clarified because people who fish for food tend to stop fishing when they have caught enough for consumption, whereas recreational fishers who practice C & R continue to fish despite how many they may have caught, and probably aren't aware of the adverse implications of their activity.

There are two main perspectives of C & R in Europe. Some see fishing solely as a means of catching fish and consider that there is no purpose for a fisher to catch a fish for pleasure, thus C & R is an unethical fishing practice that causes distress and physiological damage. The second perspective is that C & R is ethical and a conservative approach to sustaining recreational fisheries, and is preferable to catch and kill.

Historically, European C & R tradition was associated with coarse fishing, but spread after 1950 throughout European salmon and sea trout game fisheries (Pitcher and Hollingworth, 2002). C&R is limited in European marine waters and is largely voluntary, though the growth of in tourism and the MRF sector in areas where commercial fisheries are under strict regulation is now becoming a concern. Angling quotas and C & R are becoming prevailing issues among other resource users. There are regional differences of opinion in relation to fish resource utilization, angling practices, legislation and tradition. For example, the northern countries hold a strong harvest focus, similar to subsistence fishing in other countries and regions, even if it takes place in a leisure context. Participation in angling is lower in the southern countries, with consequent differences in its impact on resources.

Aas *et al.* (in Pitcher and Hollingworth, 2002) used key word searches such as 'fishing', 'catch-and-release', 'angling' and 'recreational' in literature from Finland, Norway, the UK, Germany, Belgium and the Czech Republic to investigate social, management and scientific perspectives in Europe. The results included themes such as fish welfare and mortality; support or opposition for C & R; ethical views about fish being exposed to unnecessary suffering; whether fish are used at a subsistence level or for sport; sustainability of the fishing activity; and conserving the resource.

In Finland, 'welfare' and 'mortality' were most prevalent, plus subsistence and recreation, whereas 'welfare' occurred most frequently followed by mortality in Norway, where there has been a shift of view from using fishing as an approach to harvest food to a purely recreational activity, with a concomitant adoption of C&R.

In Belgium, welfare and mortality were mentioned but with little importance, and subsistence was divided into strict subsistence or a by-product of recreational fishing. The Czech Republic similarly emphasised 'welfare' and 'mortality' as a subordinate theme to the 'recreation' theme, whilst management, conservation and resource themes were mentioned.

In Scotland and Northern Ireland, mortality and recreation were prominent (specifically C&R of salmon), followed by welfare of the fish and sustainability/ conservation of the fishing activity.

The European countries most aware of C&R appear to be England, Wales and the Republic of Ireland, where the predominant theme was conservation and sustainability, especially with reference to salmon. Though C&R of sharks and sea bass in sea angling has been a strong ethic there for many years, it was not mentioned by Aas *et al.* (2002).

In Germany, 'welfare' was important, as evidenced by requirements for skills in conducting fishing in least intrusive and damaging manner (supplemented by exams). Other countries such as Finland, Norway, Scotland, England and Wales require skills in C & R, but do not follow a stringent regulatory protocol.

Pitcher and Hollingworth (2002) identified geographical patterns in which the central eastern countries such as Germany and Czech Republic are emphatic about ethical fishing, the UK is focussed on conservation and management, whereas the Nordic states tend towards harvest/ subsistence (though not for sea bass, Colman, pers comm.). There was a distinction between anglers' perspective on C&R and authorities' views, which tend to be sceptical about C&R (Aas *et al.*, 1995).

Aas *et al.* (2002) concluded that, although hook and line is the most popular (though not the only gear) used for MRF across the EU, anglers from different countries still relate C&R to different motivations. In Norway and Finland, where MRF is mainly for harvesting, the 'sport' aspect prevails. In the Czech Republic, the UK and Belgium, where angling dominates MRF, the dominant view is that this method has limited the impact on fish populations. This contention over its utility and acceptance suggests that the European Union might find it difficult to find a global resolution with respect to C&R in MRF.

One example of C&R in MRF is the Marine Sport Fish Tagging programme co-ordinated by the Central Fisheries Board (CFB) in Ireland, which encourages charter skippers and anglers to tag and release the fish they catch. This programme provides the CFB with data on the migrations of the fish and is the second largest in the world after the U.S.A. A total of over 36,000 fish have been tagged and released including such species as blue shark, tope, monkfish, common skate, thornback ray, undulate ray, and blonde ray (Anon-website, 2005). The CFB also runs a Conservation Award scheme as an incentive for charter skippers to practice C&R.

The U.S. National Marine Fisheries Service (NMFS) has devised a set of environmental rules for angling. These include a requirement for anglers in billfish tournaments to use only non-offset circle hooks when deploying natural bait, or J-hooks on artificial lures. This is intended to reduce mortality rates of overfished Atlantic billfish. In addition, the NMFS has proposed, from January 2007, to recognise the ICCAT annual landing limit of 250 recreational-caught blue and white marlin, combined, beyond which fishing would be

by C&R only (ICCAT 2005; IGFA, 1990s). Any association affiliated to the NFSA or a member of the [International Game Fish Association](#) (IGFA) requires its members to follow these rules.

A study in Norway (Thorstad *et al.*, 2002) used information on the angling procedure, fish handling, and condition of fish at release and tagging to provide information on the effects of C&R on Atlantic salmon. Only 4% of the anchor-tagged salmon were affected by the C&R, indicating unnatural behavioural patterns, poor condition and increased stress levels. From this, Thorstad concluded that catch and release is an effective management tool. There are no data on the magnitude of the mortality of marine species in Europe due to catch-and-release, apart from non-quantitative inferences that can be made from tagging exercises. Pawson *et al.* (2007) estimate that survival rates of tagged sea bass caught and released from angling may be 4-5 times higher than those of equivalent fish selected from trawl catches. Millard *et al.* (2003) reported that over 90% of the >12.5 million fish landed in the striped bass fisheries on the eastern seaboard of North America are released, with a subsequent mortality of around 28%. To this might be added the sub-lethal physiological effects of catch-and-release and their influences on fitness, though there is a lack of relevant information (Cooke *et al.*, 2002a). Mortality rates associated with hooking of fish during angling are highly variable both within and among species and are influenced by factors such as gear type, water temperature, and handling (Muoneke and Childress, 1994; Cooke and Cowx, 2005). Nevertheless, even very low levels of catch-and-release mortality (< 5%) could have devastating effects on populations of long-lived species with low reproductive rates, such as giant sea bass (*Stereolepis gips*: see Schroeder and Love, 2002).

There is evidence of similarities between the effects of catch-and-release angling and by-catch discards, due to handling and air exposure (commercial, Alverson, 1998; Davis, 2002; recreational, Cooke and Suski, 2005) and external physical damage due to the gear (commercial: Lockwood *et al.*, 1983; Chopin and Arimoto, 1995; recreational: Rant *et al.*, 1997; Barthel *et al.*, 2003). Patterson *et al.* (2000) discussed the applicability of their results on capture and handling mortality in both commercial and recreational fisheries. The reasons for releasing fish may differ by fishery sector, but the factors that contribute to discard mortality do not.

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## Fisheries-induced selection

That commercial fishing may result in genetic changes in fish populations is now accepted (Hauser *et al.*, 2002). In addition to genetic changes, the phenotypic correlates associated with selection can also result in deleterious changes in population characteristics, such as life-history traits, behaviour, and mortality (Policansky, 1993; Heino and Godo, 2002). Evidence that such selection pressures may also occur in recreational fisheries has been accrued for freshwater species (e.g. brook trout (*Salvelinus fontinalis*), Nuhfer and Alexander, 1994; largemouth bass (*Micropterus salmoides*), Cooke, 2002). By simulating the harvest from a hypothetical fishery (not intended to be specific to the commercial or recreational sector), Conover and Munch (2002) concluded that, over four generations, removal of large individuals (a common activity in both recreational and commercial fisheries) selected for slow growth of the remaining individuals.

Evidence for recreational fisheries-induced selection in the wild is sparse, though one (unsubstantiated) example is the demise of multi-sea winter Atlantic salmon, which tend to migrate into rivers in spring and early summer and are targeted by commercial and game fisheries alike. The existence of long-term data sets on catches of salmon in many North Atlantic rim countries has enabled scientists to demonstrate that

this stock component has more-or-less collapsed in many fisheries, and has probably affected the genetic composition of stocks (Youngson et al., 2002). Perez et al (2005) collected biological samples and catch-per-effort data for Atlantic salmon from sport angling catches in the Asturias region of northern Spain which showed that more females (71.7%) than males and more multi sea winter (MSW) fish (67.7%) than grilse occurred in catches. This information was used to demonstrate that sport angling catches are based on females and that this may have strong implications for population conservation. In an effort to ameliorate the problem, several countries have opted to protect multi-sea-winter fish by imposing mandatory C&R or adjusting the fishing season (e.g. the British Isles, Youngson et al., 2003).

This example demonstrates that both commercial and recreational fisheries would benefit from the establishment of long-term monitoring programmes coupled with rigorous experimentation to understand the frequency and consequences of fishing-induced selection. In the interim, fisheries managers responsible for both recreational and commercial fisheries should be aware of the potential evolutionary consequences of fishing and develop management strategies such as closed seasons, aquatic protected areas, harvest regulations (e.g. slot limits) and the stocking of progeny from targeted specific components of the populations to minimise the effects (Ashley et al., 2003).

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### Underwater spear fishing.

Of more relevance to MRF, perhaps, is underwater spear fishing, which is generally dealt with separately by legislators and is subject to a specific set of rules. Even where there is no distinction between recreational fishing and sport fishing in a Member State's fisheries laws, legislators may prohibit the use of an underwater gun for recreational fishing, and subject it to licensing if used for sport fishing. In France, for example, recreational fishers who hold a licence from a registered sport federation are also required to hold an underwater licence issued by a local authority. Slovenian legislation also requires recreational fishers using an underwater gun to be licensed.

Underwater spear fishing is a popular MRF method in the Balearics (Coll *et al.*, 2003) for which a licence is required, though the use of SCUBA equipment and the sale of catches has been prohibited since 1963. At present there are over 2000 licences granted for spear fishing. Catch and effort records of spear fishing competitions since 1975 logged on the Balearic Federation for Subaquatic Activities (FBDAS) database indicate that spear fishing takes 36 species, among which the most abundant were white bream, peacock wrasse, brown wrasse and grey mullet. These data suggest that, since 1975, a number of exploited species have declined both in the number of fish caught as well as in individual weight. For example, the mean weight of grouper showed a slow but steady decline, indicating a serial depletion of the largest specimens through time. Taken as a whole, the results suggest over fishing of some target fish inhabiting rocky bottoms between 0 and 40m.

Coll et al. (2003) suggest that spear fishing is highly selective and has a substantial effect on these resources, possibly contributing to the lack of profitability of some traditional and highly selective commercial fishing gears. However, the Red Data Book of the fishes of the Balearic Islands draws attention to the dynamic nature of the littoral zone and the lack of data that support an adverse impact of spear fishing activity. It is difficult to isolate this single activity and to find the extent of damage it has inflicted to the littoral zone. Nevertheless, many other publications (Garcia-Rubies 1990, Harmelin, 1993, Harmelin, 1999, Jouvenal, 2001, Moranta, 1997, Renones, 1997, Renones, 1999, Zabala, 1997) state that spear fishing is an important factor that can affect the composition of fish communities.

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## Ecosystem impacts of recreational fishing

Examples of MRF-induced changes in trophic or community structure are rare. MRF primarily targets piscivorous fish (i.e. high trophic levels; Coleman et al., 2004), often for consumption, and recreational fishing activity on the Mediterranean Island of Majorca removed about 31% of production at the highest trophic level (Morales-Nin, 2004). Recreational anglers will, however, tend not to "fish down" food webs (Pauly et al., 1998) to the same extent as in commercial fisheries because many of the lower trophic feeders are not readily susceptible to capture by anglers. Recreational fishing in estuarine and near-shore habitats is most likely to have impacts on the structure and functioning of ecosystems, including disruption of nursery functions, trophic cascading, and potential for local extinctions (Blaber et al., 2000). Shepherd and Boates (1999) showed that commercial baitworm harvest for recreational angling reduced the foraging efficiency and ultimately migratory energy stores of semipalmated sandpipers (*Candris pusdia*) in eastern Canada.

A more obvious ecosystem impact is the interaction between cetaceans and MRF gear. Most nets used in recreational beach fisheries in Belgium are set from March to May to catch sole, and this has coincided with many dead porpoises (*Phocoena, phocoena*) being washed ashore along the Belgian coast. In 2001, as a measure to protect marine mammals, a Royal Decree was issued banning recreational beach fishing with gill nets below the low water line (Belgian official journal of 14 February 2002). Between 27 January and 31 May 2004, however, of 23 dead porpoises found on Belgian beaches, at least nine appeared to have drowned in fishing nets and at least five were considered to have drowned in nets used in recreational fisheries from the beach.

Staff at the Centre de Recherche sur les Mammifères Marins, the French national network that deals with stranded marine mammals, informed us that a relatively high number of porpoises were also caught in coastal fisheries in northern France in spring 2004. Given the level of by catch recorded, and the national and international obligations designed to better protect this vulnerable species, additional measures with regard to recreational fisheries seem necessary.

The impact of recreational angling on wildfowl was investigated by Bell and Austin (1985), who compared reservoir and marine angling activity in relation to the distribution of wildfowl. They claimed that wildfowl are disturbed when anglers remain on the shore for long periods of time, with short interspersed periods of movement, such as casting. They suggest that management of angling should be geared toward the distribution of wildfowl, depending on the size of the water mass and whether food is accessible.

On the contrary, fish-eating sea birds, especially cormorants (*Phalacrocorax carbo*) that, are legally protected, are seen as a serious problem in Germany and many other EU countries. These birds have multiplied considerably and expanded their distribution during the last two decades all over Europe, causing high losses in fish populations and reducing the quality of fishing in many inland waters (Carss, 2003). Though there has been some research to evaluate the impact of cormorants on fisheries, most has concerned freshwater sites. Further work is urgently needed to evaluate the true impacts and the public perception of this activity throughout Europe, and to develop a management strategy for MFR if required.

Overall, there is evidence that both commercial and recreational fishing can alter ecosystem function (see section 5 for more detailed review) and additional research and modelling to elucidate general patterns of fishery impacts on ecosystem function would benefit both sectors.

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## Habitat degradation arising from fishing

Recreational fishing is considered to cause less habitat degradation than commercial fishing. However, there are forms of habitat degradation and pollution that are unique to or more common in recreational fisheries which, if intense and spatially restricted, can result in degradation of localised habitats, particularly in near-shore environments (Bellan and Bellan-Santini, 2001).

Although superficially less harmful than commercial fishing gear, litter in the form of fishing line (Laist, 1997) or lead sinkers (Donaldson et al., 2003) and hooks (Cryer et al., 1987a) can lead to localised habitat degradation. Although rarely quantified, a variety of wildlife species including birds, marine mammals, and turtles can become entangled in fishing line and hooks resulting in injury or mortality (e.g., Neinoz et al. 2004).

The phenomenon is known as 'ghost-fishing' (Breen, 1987; Carr et al., 1990) arises due to fixed nets being lost or towed away, and though estimates of the proportion of nets lost from commercial fleets have been reported in a variety of studies reviewed by Dayton *et al.*, (1995), little is known about the frequency of net loss due to MRF. However, nets lost in shallow, clear waters are rapidly overgrown with epibiota which makes them highly visible, reducing their fishing capabilities (Erzini, 2003), and they are exposed to storm activity and rapidly destroyed by physical forces (Puente, 2003). Thus, it is likely that nets or pots lost from near-shore MRF activity are a major cause of fishing-related mortality.

Loss of lead fishing sinker from angling can have major negative consequences on local environments. Jacks et al (2001) estimated that in Swedish Atlantic salmon fisheries, up to 200 t of lead fishing sinkers are lost in river mouths. In littoral regions of the waters of South Wales, united Kingdom, between 24 and 190 sinkers/100m<sup>2</sup> were found (Cryer et al., 1987a). Other litter from bait containers, tackle packaging, etc. may not directly affect fish but is generally not compatible with natural environments. A challenge with all studies on lost or discarded fishing equipment is to determine whether it was generated by commercial or recreational fishing. Nevertheless, recreational angling was recently incorporated into a ban on commercial fishing in an experimental research reserve (Reed, 2002).

As with commercial fishing, motorised vessels used for recreational fishing can disturb benthic habitat or aquatic vegetation. Sargent et al. (1995) documented that over 6% of seagrass beds (some 70,000 ha) in Florida exhibited damage caused by propellers, noting that 95% of boats registered in Florida are recreational (not that all engage in recreational fishing) and it is those boats that typically operate in shallow, near-shore environments. In the Adriatic Sea, noise from the passage of outboard engines on purportedly recreational fishing vessels resulted in behavioural alterations in gobies (Gobiidae; Costantini and Spots, 2002). Smith and Murray (2005) reported that angler foot traffic combined with the collection of mussels (*Mytilus californianus*) for bait may reduce cover for mussels and create mussel-free gaps.

Collectively, recreational and commercial fishing both result in considerable habitat degradation. Efforts to educate fishers about the causes and consequences of habitat degradation, and developing techniques or gear that minimise such degradation, should be a common goal for both fishing sectors.

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## Lobbying

Anglers in Denmark have become a pressure group of considerable importance in recent years, for the protection and improvement of the quality of fishing waters (Toivenen, 2003; FAO, 1980). The traditional use of water by agriculture (irrigation, land reclamation, draining, canalisation, sewage discharge), industry, and trout pond culture (water diversion, effluent discharge) often conflicts with their need for a good quality, productive aquatic environment. Ministry secretariats may have conflicting views with respect to the use of water resources, and policy with respect to recreational fisheries, therefore, often appears to be ambivalent. Recreational fisheries often get more support from the Environmental Protection and Nature Conservation authorities than from the Fisheries authorities, which often fail to realize the rapidly increasing importance of recreational fishing.

The SAA in Sweden also acts as a pressure group to create a more socially acceptable view of sport fishing and to stop the still increasing pollution, especially acid rainfall, and the building of hydro-electric power stations. In order to get a shift “from fish to people”, the Association initiated socio-economic research on sport fishing in Sweden which, after 10 years, enabled them to put pressure on politicians to set-up a commission on the future of sport fishing in Sweden (Johansson and Norling, “Sport fishing in Sweden”).

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## Advances in gear technology

Technological advances in the commercial fishery have been applied increasingly in recreational fisheries (Bohnsack and Ault, 1996), providing them with tools such as global positioning systems (GPS) and depth finder technologies that enable recreational fishers to travel longer distances and then locate and capture fish (Leadbitter, 2000). Many boats are outfitted with the most recent technical advances, including reliable and more powerful motors that increase the distance that anglers can venture safely. The synthetic fibres used in commercial fishing have also begun to appear in recreational angling lines instead of monofilament nylon. These lines have increased strength and abrasion resistance, resulting in higher fish landing rates. In addition, the lures used by anglers incorporate a multitude of characteristics that increase realism, such as holographics, scents, and lights. Collectively, these gear advances provide anglers with more tools to permit the hooking and landing of more and bigger fish, and thus increasing their efficiency.

There has also been the realisation that advances in gear technology can provide conservation benefits by reducing selectivity, by-catch, and habitat degradation (MacLennan, 1990). For example, circle hooks have recently been applied to both recreational and commercial fisheries and this technological advance in hook design has reduced injury and mortality of C&R fish (see review by Cooke and Suski, 2004). Other efforts have been devoted to developing revival boxes (Farrell et al., 2001) or improving live-wells for C&R fish in recreational boats (Cooke et al., 2002b). The emphasis for technological development to focus on improvements in efficiency of both locating and capturing fish for both commercial and recreational fisheries could usefully be expanded to reduce the impact of fishing on discards and habitat.

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## Management strategies

Management of commercial and recreational fisheries follow similar strategies to reduce over exploitation of target species and maintain suitable stock structures. The imposition of a closed season, designed to allow uninterrupted reproduction and free passage to spawning grounds, has been extended to protect

stocks that are heavily exploited through restricted catch, often allied to closed areas. These can range from specific restrictions on fishing in areas where the fish are particularly vulnerable to exploitation (Pawson et al., 2005), to protected areas in which commercial fisheries are restricted or eliminated, though there are now greater efforts to regulate both fisheries sectors (i.e., commercial and recreational) in this way (e.g. Hellev. 2004: Meester et al., 2004). A number of ways have been suggested to achieve increased sustainability of sports fishing, including revision of legislation and implementation of adequate regulation (and enforcement); creating areas restricted to sports fishing; increasing the minimum landing size of certain species (a favourite); licensing, education for fishers as to how to fish “better” in order to conserve the environment; and implementing an MRF logbook scheme. All these have been adopted to some extent within European member states, though evaluation of their utility is usually lacking.

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## Allocation.

In the USA, the growing number of anglers has exacerbated conflicts between the commercial industry and depletion of fish stocks. Approximately 34 million anglers (16% of the population) made 75 million fishing trips in 2001 (Sutinen and Johnston, 2003). The Marine Recreational Fishing Statistics Survey (NMFS) report on integrated management (of recreational and commercial fishing) systems advised that a workable mechanism must exist for allocating catches among recreational, commercial and other user groups, and that managers must implement management measures that in practice provide a high degree of control over recreational fishing mortality. They recommended management based on a system of angling rights that are assigned to organisations or other groups as well as individuals in recreational fisheries. By decentralising recreational fishery management and aiming for cost recovery, accountability should be strengthened, resource stewardship improved, and enforcement and monitoring costs reduced, thus encouraging greater long-term economic benefits in recreational fisheries. This area clearly requires further research within the EU.

Restrictions on access in recreational fisheries vary between EU countries. Pereira and Hansen (2003) concluded that, to complex technical and socio-political challenges, effort control in recreational fisheries may be problematic. Where the catch is removed for consumption, limits are frequently placed on total catch in attempts to control over exploitation and conserve the spawning stock. Typically this is imposed through bag limits in recreational fisheries, allied to catch-and-release where all excess fish must be released back to the water. Such restrictions allow for the sharing of the catch when stocks are low or under intense pressure for exploitation.

For example, a decline in sea bass catches in Ireland prompted the introduction of a number of conservation measures in 1990. S.I. No. 128 – Bass (Conservation of Stocks) Order, 1990 - increased the size limit to 40 cm TL (36 in most of the rest of Europe) and forbade fishing from a boat for sea bass or the use of nets in their capture or to have the fish on board an Irish fishing vessel. A Bass (Restriction on Sale) Order (S.I. No. 191 of 1991) prohibits the sale or offer for sale of sea bass. The Bass Fishing Conservation Bye-law (No. 673 of 1991) imposed a bag limit of 2 fish per day per angler, and a closed season for angling for sea bass between 15 May and 15 June was established in 1992. Although the cumulative effect of these regulations has been to outlaw the commercial fishery for sea bass, fishing activity in Irish inshore waters has intensified and, given the high value of sea bass, there has always been an interest in re-opening the commercial fishery for sea bass.

This is one of the few examples of a European country recognizing the benefits that sport fishing bring to tourism and other service industries in coastal areas. It has encouraged catch and release, and there has been an almost revolutionary development of rods, reels and lines for lure and fly-fishing in salt water to enhance the quality of the sport-fishing experience.

This initiative has been welcomed by the Bass Anglers' Sportfishing Society (BASS), which has been campaigning for the conservation and improvement of the recreational sea bass fishery since 1973. One of their goals was to establish bass Nursery Areas in which juvenile bass would be protected from exploitation, but lobbying by other sea anglers resulted in sea bass fishing being prohibited seasonally only from boats in the 34 nursery areas designated in 1990, since they insisted on their right to fish freely from the shore (MAFF, 1990).

Gear specifications are used to reduce exploitation of populations by influencing the efficiency of fishing, and the size and species of fish caught. In recreational fisheries, gear restrictions are usually linked to the method used, e.g., angling might be restricted to fly fishing or spinning, and/or the baits used, and more recently the use of barbless hooks or circle hooks to foster C&R.

Restrictions on size of fish harvested are common in both commercial and recreational fisheries, and are traditionally designed to protect immature fish. Whilst most of the undersized fish caught in commercial fisheries do not survive and are lost to the fishery, a much higher proportion of fish returned in recreational (angling) fisheries survive to contribute to the fishery. Birkeland and Dayton (2005) identified that it is important to release larger fish, which are relevant to both fisheries sectors, but especially recreational fisheries. A recent government initiative in England has been to raise the legal minimum landing size of sea bass from 36 to 45 cm, in order to provide more, larger sea bass for anglers and thus enhance the socio-economic value of the recreational fishery (BASS, 2004). This proposal was subject to consultation, when the commercial sector pointed out that sea bass stocks around the UK were being fished sustainably (ICES 2004) and that such a high MLS would be extremely costly to many inshore fishers who currently relied on sea bass < 45 cm for their living. The outcome was a compromise (40 cm MLS) that is unlikely to provide the hoped for recreational benefits.

The failure of management of commercial fisheries to halt the degradation of resource stocks is partly due to the difficulty in enforcing regulations where resources are limited. Consequently, management of fisheries is moving towards ecosystem-based management and community participation approaches. Whether or not these achieve stock sustainability, such approaches are unlikely to be successful in recreational fisheries because of the individualistic behaviour of the proponents (Pereira and Hansen, 2003), although Cowx and Gerdeaux (2004) believe that success may come through incorporation of stakeholders in the decision-making. New approaches to recreational fisheries management are needed if the potential detrimental characteristics of the sector are not to be implicated in the demise of resource stocks. There may be opportunities to share knowledge from experiences in both fishing sectors.

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## Monitoring of recreational fisheries

Post et al. (2002) and McPhee et al. (2002) considered that the contribution of recreational fisheries to the collapse of many fish species stocks in Canada and Australia respectively, may have gone unnoticed because the remote and diffuse nature of many fisheries precludes rigorous monitoring programmes. This applies equally in Europe. Resource managers must recognise that recreational fisheries have many

characteristics that emulate what is well documented in commercial fisheries, including by-catch, fisheries-induced selection, trophic changes, habitat degradation, gear technology advances, fishing effort, and production regimes. There could be many fisheries at risk from recreational fishing simply because it is assumed that recreational fishing is unlike (i.e., less damaging than) commercial fishing. As we have demonstrated, it is essential to incorporate recreational fisheries into management plans and conservation strategies.

First, the number of recreational fishers potentially far exceeds that of commercial fishers in all European member states, and they can target productive coastal zones that can be important habitats for fish during particular phases of their life-history, e.g. spawning, juvenile, migration, that make them more vulnerable to fishing and thus influence sustainability. Thus, there is the potential for MRF to contribute to both local expiration and more widespread collapse of species that are also targeted by commercial fisheries. Clearly there is a need for more long-term, time-series data on recreational fishing effort, catch, harvest and population structure to evaluate the possible role and impacts of MRF.

We also need estimates of non-harvest-related mortality from C&R in recreational fisheries, and to include these factors in the analysis of fishing mortality, which varies substantially by species, environmental conditions, season and gear type.

Conflict between recreational and commercial fishing groups has been associated with differential allocation of fish and fishing opportunities, and both perceived and actual differences in effects of their activity on resource stocks. However, both can contribute to fishery declines, and this can be used as a starting point for addressing conservation issues. Indeed, Arlinghaus et al. (2002) suggested that the sustainability of resource use is driven largely by societal demands, and Arlinghaus (2005) argues that there is a pressing need to identify, understand and manage human conflict in recreational fisheries because such conflicts may retard progress towards generating sustainable recreational fisheries. Only recently have efforts been devoted to understanding the complex socio-economic factors that underlie the actions of fisher and the issues of exploitation related to human dimensions at the recreational-commercial interface (e.g., Policansky, 2002; Cowx, 2002; Arlinghaus et al., 2002). One well-recognised issue is the economic importance of recreational fisheries to local and regional economies that often outweighs that of the commercial fisheries.

One solution to this dilemma is to include both recreational and commercial fishermen in research aimed at elucidating the impact that fisheries have on resource populations. In the UK, BASS members participated in a tagging project in 2000 – 2002 prompted, in part, by a steady increase in the commercial exploitation of sea bass by pair trawling in the Western Channel in the 1980s and 1990s, and the concern of British anglers and inshore commercial fishermen that this fishery may be having an impact on their catches. This concern resulted in a letter writing campaign targeting both MPs and MEPs co-ordinated by BASS and the National Federation of Sea Anglers and the European Anglers' Alliance.

This study follows earlier work reviewed in Pawson et al. (1987) that established the current knowledge of the seasonal migration patterns of sea bass around UK and Ireland. The recent tagging project was managed and co-ordinated by Cefas, and BASS members were trained in tagging methods and formed angling teams to catch and tag sea bass at 15 sites around the UK, Channel Islands, Ireland and France, and with a number of commercial fishermen and charter-boat skippers who also participated in the

venture. This communication between anglers and scientists has allowed sea anglers to liaise with government bodies, and research information/data to be put in the public domain via the CEFAS website ([www.cefas.co.uk/Basstagging](http://www.cefas.co.uk/Basstagging)). A total of 2420 sea bass >36 cm were tagged inshore in England and Wales, Ireland and the Channel Isles between 2000 and 2005, and a further 2539 sea bass were tagged in the pair-trawl offshore fishery in the western Channel between March 2000 and March 2004. The results of this project have been used in a consultation exercise on proposals to increase the MLS of sea bass (see above), and submitted for publication (Pawson et al., 2007).

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## Conclusions

The above review clearly indicates that, although rarely considered to be an important factor, MRF activity has the potential to negatively affect fish, fisheries, and aquatic habitats. This is not to cast a negative light on recreational fisheries, but to suggest that efforts must be made to understand this impact in both commercial and recreational fisheries. Recreational fishing must above all be viewed in the context of conservation and sustainability, not just that of applying management of fisheries for the benefit of anglers. The similarities between recreational and commercial fishing sectors should also be emphasised to their constituents, who typically have polarised opinions, assuming that the other sector is to blame for habitat degradation or fishery declines.

As a starting point, further study on the role and magnitude of recreational fisheries is required, including long-term monitoring and, perhaps, the increased use of aquatic protected areas to elucidate the role of recreational fisheries in alterations to populations and communities. The FAO code of conduct for responsible fisheries (CCRF; FAO, 1996) is designed to offer guidance on how to manage large scale, mainly marine, commercial fisheries sustainably, but there is no such code of conduct for recreational fisheries. Although recreational fisheries are undoubtedly of high value, they are widespread throughout Europe and there is a general lack of cohesive policy or international regulation.

It is also important to increase our understanding of participation and harvest in recreational fisheries, and it is essential that recreational fisheries catches are monitored and included in mainline databases (e.g., FAO catch statistics) to give a true reflection of fishery yield (at least for the main target species). The development and utilisation of catch and effort sampling programmes for recreational fisheries may serve to provide information on the distribution, magnitude, importance and effects of MRF. It is expected that a greater understanding of recreational fishing issues and their relationship with those in commercial fisheries will serve to promote more effective management and conservation of all aquatic resources.

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## Annex 1. The legal definition and scope of sea fishing for recreation and sport in Europe – in contrast to commercial fishing (Chapter 2).

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### Introduction

This Annex addresses the legal distinction between recreational or sports fishers and commercial fishers. It draws where possible on readily available and translatable primary legal documents for the countries concerned, supplemented by information obtained from secondary sources. There is likely to be some ambiguity due to translation difficulties, or a lack of available definitions, but we have attempted to elucidate the meaning of the literal translation or the local term for purposes of better understanding. Thus, the legal wording has been changed in some cases, in an attempt to introduce more standardisation and improve comprehension. However, there are a number of issues within the UK section that we are aware are subject to misinterpretation, which suggests that there may be similar issues with those of other countries for which we have no real knowledge.

The European Union is a major player in the regulation of sea fisheries, using the Common Fisheries Policy and associated Council Regulations to determine the regulatory regimes governing sea fisheries within the waters of member states. However, this is primarily in respect of commercial fisheries, and the EU Council has not to-date introduced regulations pertaining specifically to MRF that generally takes place within the 12-mile limit. Nevertheless, European legislation in certain respects may influence recreational as well as commercial fishers through minimum landing sizes, prohibited species, closed seasons, closed areas and gear specifications. From the analysis undertaken, it is evident that the distinction between recreational and commercial fishers is currently the sole preserve of national and regional legislation, either primary or secondary.

Recreational fishing appears to be a growing activity within many of the countries studied, and concerns have been raised about its influence on commercial fish stocks. Correspondingly, there is a growing body of regulation at the national level governing MRF, albeit exerting far less control than is evident for fishing within inland waters. The extent and nature of any regulatory regime introduced is, however, a reflection of the traditional rights enjoyed by the public for sea fisheries in the different countries. By presenting this information, therefore, we also emphasise the importance of understanding the differences in national perspectives in relation to both measuring and managing MRF activity.

The distinction between recreational and commercial sea fishing differs between countries. Some countries provide explicit definitions, while others define the two activities implicitly by the licences they need to obtain (if any), the type and amount of gear they can use or carry onboard a vessel, and the size of the catch they can take. In most countries, the main distinction lies in recreational fishers being prohibited from selling any catch and generally not being obliged to report their catches, although there are exceptions to the latter, as in Italy.

There are three forms of access arrangements within the regulatory regimes covered, albeit not demonstrated for all countries, pertaining to individual fishers, recreational fishing boats and divers. Underwater fishing has specific attributes that means that it is often dealt with separately by legislators and is subject to specific sets of rules, not always detailed in legislation addressing other forms of recreational fishing. Consequently, it has been covered only briefly in this report.

The legal regimes for recreational fishing in the case-study countries are presented in alphabetical order, and the distinctions between recreational and commercial/professional fishery activities are summarised by country below.

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## Belgium

Belgium is a Federal state whose fisheries fall under the jurisdiction of the regional governments, although legislation, monitoring and enforcement are national. Marine fisheries fall under the jurisdiction of the Flemish government. The main legal provisions governing fisheries include the:

- Fishing Law (Wet betreffende de zeevisserij in de territoriale zee – Loi relative à la pêche maritime dans la mer territoriale) 1891, as amended
- Delegation Law (Wet waarbij de Konig wordt gemachtigd maatregelen voor te schrijven ter bescherming van de biologische hulpbronnen van de zee – Loi autorisant le Roi à prescrire des mesures en vue de la conservation des ressources biologiques de la mer) 1957, as amended
- Law of the Belgian Fisheries Zone (Wet houdende vaststelling van een Belgische visserijzone – Loi portant établissement d'une zone de pêche belge) 1978, as amended. (CEC, 2001)

Recreational fishing is covered predominantly by national regulations. While licences are required to fish in inland waters, a licence is not required to fish recreationally at sea. Anglers can cast a line free of charge from jetties, the beach and within harbour basins and, during the main (holiday – we assume) season, there are specified beach zones set aside for shore anglers<sup>6</sup>. Recreational fishing, however, does need to comply with minimum landing size regulations for a range of fish species. In addition, to protect marine mammals, since 2001, there has been a ban on recreational beach fishing using gill nets below the low water line<sup>7</sup>, although recreational fishers can use other types of net on the beach, notably fykes and so-called flat(fish?) nets<sup>8</sup> (see issues, section 6)

In contrast to a licence not being required for MRF, commercial fishers require a vessel licence from the Department of Sea Fisheries, under a restrictive licensing scheme that allows no increase in aggregate engine power or tonnage. Consequently, an application for a new licence requires it to replace an existing licence or combine existing licences. Further the granting of a licence requires an economic link with the Belgium coastal region to be proven, with only Belgian vessels being licensed to fish (which requires fishing vessels of over 25 grt to be at least 50% Belgian owned)<sup>9</sup>. The licences have catch quotas attached while, for certain species (for example, sole), there are also daily catch limits for commercial fishers and maximum time allowances on fishing grounds, in addition to minimum landing sizes. In terms of gears, while national legislation permits restrictions on the type of gears that can be used and sets minimum mesh sizes, to protect juvenile and spawning stocks, non-target species and habitats, the range of gears available to commercial fishers is far more comprehensive than for recreational fishers (FAO, 2005).

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<sup>6</sup> [www.visitbelgium.com/fishing.htm](http://www.visitbelgium.com/fishing.htm) 13/04/06

<sup>7</sup> Belgium Official Journal 14 February 2002.

<sup>8</sup> [www.mumm.ac.be/EN/news/page1.php](http://www.mumm.ac.be/EN/news/page1.php) 13/0/06

<sup>9</sup> Direct Investments in the Fishing Sector, [www.oecd.org](http://www.oecd.org). Note that fishers from the Netherlands also have rights in Belgian waters (Treaty of Benelux, art. 2.2).

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## Republic of Cyprus

In Cyprus, no licence is required for sea angling, fishing with hand lines, trolling or spear fishing without the use of diving equipment. In contrast, the use of aqualungs when spear fishing, fishing with nets, longlines and traps, fishing at night with spear guns, and any kind of commercial fishing require a licence from the Department of Fisheries and Marine Research. The licence holders are obliged to adhere to a range of restrictions, which regulate the equipment that can be used, days allowed to be fished and, in certain cases, an allowable catch per fishing outing. There is also a list of protected species that includes turtles, seals and dolphins. The licensing requirements and regulations governing fishing vessels flying the flag of Cyprus are contained within the Fisheries Law, Cap. 135 and Fisheries Regulations 1990-1994 as amended by Law No. 102(I)/2000 and Regulations P.I. 194/2000<sup>10</sup>. Further amendments were also made in 2004 pertaining to fishing outside territorial waters.

In terms of commercial fisheries, under the amended Fisheries Law, all Cyprus-flagged fishing vessels require an annual fishing licence for the payment of an annual fee, prescribed in Schedule IV of the amended Regulations expiring on the 31 December (ss.3, 4(2)), and fishing vessels with majority ownership in the hands of foreign interests are excluded from registering under the Cyprus flag<sup>11</sup> and from being used in fishing (s.3(2)). To obtain a licence, the vessel's management and operations must also be directed and controlled from the territory of the Republic of Cyprus (s.3(2)(c))<sup>12</sup>. The licence is issued by the Director of the Department of Fisheries and Marine Research<sup>13</sup> of the Ministry of Agriculture, Natural Resources and Environment and permits the vessel to conduct fishing activities in specific areas prescribed in the licence. The licence must be carried onboard at all times and the licence holder is obligated to unload at least 50% of their total annual catch in ports and/or fishing shelters of the Republic of Cyprus (s.7B of the amended Law).

The amended Law also provides for regulations for the management of fish stocks and fishing activities, notably for the specification of closed areas and seasons, minimum size of fish, gears and methods of fishing and nets and meshes, and other matters pertaining to the conservation of fish stocks. These rules can encompass recreational fishers as well as commercial fishers.

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## Denmark

In Denmark, the Fisheries Act 1999 (as amended) makes provision for the management of fisheries and provides for the possibilities of sport fishing (s.1). Chapter 4 of the Act specifies the different types of fisheries and fishing rights holders, section D (sections 26 and 27) pertains specifically to sports fishers, as do Chapters 9 and 12, which provide for the regulation of sport fishing and angler and sport fishing signals (buoyage?) respectively. Under the Act there is also provision for advisory councils for both commercial and sport fishing. Additional sections provide for commercial fishing licences (s.36), other

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<sup>10</sup> The Amendments are to facilitate harmonisation with European Union legislation, given Cyprus's intended accession to the EU.

<sup>11</sup> The provision also includes vessels over 20 years of age with foreign ownership of more than 25% (s.3(2)(b) Fisheries Law, Cap. 135 as amended)

<sup>12</sup> The cessation of compliance with these requirements of a licence result in its termination (s.3(3)). Also note that for vessels of 24m or over, Regulation 10A of the amended Regulations prescribes that licences will not be issued unless an approved device for the monitoring of fishing activities is also installed.

<sup>13</sup> The Minister may at his discretion limit the number of licences issued (Reg.6(1)(a) of the amended Regulations).

aspects of the regulation of commercial fishing (chapter 7) and fishing gear (chapter 6). The Minister of Food, Fisheries and Agriculture is responsible for regulating sport fishing.

Recreational fishing in natural waters in and around Denmark requires a fee-paid state licence, either annually, weekly or daily. Persons under 18 or over 65 years of age are exempt from requiring a licence. Fishing without a licence can potentially result in confiscation of equipment and a fine. The state licence permits the holder to use rod and reel, hook, line and sinker, and to fish otherwise free of charge in the territorial sea. In addition, beaches below high tide are public property, permitting access for both walking and fishing, although adjacent land may be private property and some beaches fall within protected or military areas and may be closed for all or part of the year. It is illegal for recreational fishers to fish within 75m of any nets, fish traps etc. and, since 1986, it has been prohibited to use nets within 100m of the shoreline. River mouths wider than 2m have a year-round protection zone with a radius of 500m centred on the river mouth, whilst smaller rivers have a seasonal protection zone running from September 16<sup>th</sup> to January 15<sup>th</sup> to protect migrating sea trout and salmon. The Minister may also extend these minimum stipulations where this is deemed appropriate for ecological reasons. Additional standard legal measures include the prohibition of trolling a line behind a boat closer than 100m from the shoreline, and a limit of two rods per fisher and a total of four rods from any boat<sup>14</sup>.

Recreational fishers are required to comply with minimum fish sizes and seasons specified under the Fisheries Act. Closed fishing seasons currently apply to the following species :salmon and sea trout, whitefish, plaice, flounder and viviparous blenny that show signs of spawning. All fish caught counter to these provisions must be returned to the water in as unharmed a condition as possible. In any event, all non-commercial fishers and any unregistered fishers (anglers and net and trap fishers) are prohibited from selling any of their catch<sup>15</sup>.

The Danish management of commercial fisheries builds on access regulations integrated with regulation of fleet capacity determined by tonnage and engine power. In order to fish commercially, a person must be an authorized full time/part time fisher and the vessel must be registered as a fishing vessel and granted a licence. The fisher must also be a Danish citizen or have undertaken a set period of residence in the country. Fishing vessels must similarly have two thirds of the crew satisfying citizenship or residence requirements as well as being active fishers.<sup>16</sup> The licence specifies the technical capacities of the vessel (e.g. tonnage and engine power) and can limit or not limit access. A licence is needed for the majority of fisheries, though for some, such as hake in the North Sea, Skagerrak and Kattegat, a licence is not needed. The management regime superimposed on this is determined by Ministerial Order following the agreement of catch quotas for Denmark. A number of management measures have been introduced over the years, including catch limits during different periods, vessel rations according to vessel size, periodic bans, tie-up schemes, demand for notification, bonus quotas in the pelagic fisheries given to vessels with a high percentage of catches used for human consumption, etc. The combination of measures utilized varies between species and water areas. The range of measures legally available include: vessel catch limits (monthly, daily or per trip), Individual Transferable Quotas (currently utilized for

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<sup>14</sup> [globalflyfisher.com/global/denmark/rules.htm](http://globalflyfisher.com/global/denmark/rules.htm) 24/04/06, [www.angling-eastjutland.dk](http://www.angling-eastjutland.dk) 13/04/06, [www.visitdenmark.com](http://www.visitdenmark.com) 13/04/06

<sup>15</sup> [www.angling-eastjutland.dk](http://www.angling-eastjutland.dk) 13/04/06

<sup>16</sup> Direct Investments in the Fishing Sector, [www.oecd.org](http://www.oecd.org). 20/06/2006

herring), monthly days at sea limits, time closures, minimum landing sizes, exclusion of specific gear types in specific areas, limits on engine power in certain areas.<sup>17</sup>

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## Estonia

Under the Fishing Act 1995, consolidated and reprinted 23 Jan 2003, distinctions are drawn between line fishing, the catching of crayfish, recreational fishing, restricted fishing and commercial fishing, based on the fishing gear used (s.6(2)). Anyone may exercise fishing rights if they have performed the acts necessary to create such rights (s.6(3)).

Under s.10 of the Act, Estonians have a life-long right to fish, free of charge and without having to apply for a right to fish, with one simple hand line on any body of water belonging to the state or a local government, subject to restrictions associated with fishing seasons, fishing areas and species of fish. These restrictions hold for both recreational fishing and commercial fishing and are detailed in the Fishing Rules provided for under s.17 of the Act.

Under s.11 of the Act, the right to fish for recreation requires an application for a fishing card from the county environmental services of the Ministry of the Environment (or local government or registered association of recreational fishers if the right to issue fishing cards has been delegated thereto) and the payment of a fee. The fishing card is valid for a period of up to one year and throughout Estonia, and it entitles the holder to use fishing tackle on a body of water belonging to the state or a local government, subject to the aforementioned restrictions. Fishing tackle is defined by s.11(3) as:

1. spinning reels, trolling lines, pulling devices, fly hooks, bottom lines, krunda (trans.?), unanchored trimmers, hand lines or more than one simple handline
2. harpoon guns and harpoons
3. hooks (gaffs? ).

In contrast, the right to fish commercially requires a fishing permit to be granted, either for a fishing vessel or a fisher (s.13(3)), and the payment of a fee determined on the basis of the characteristics of the fishing grounds, type of gear and fishing capacity (s.15(1)). In respect of fishing at sea, the granting body in both cases is the Ministry of the Environment (s.13<sup>1</sup>(3), 13<sup>2</sup>(5)). Commercial fishing gear is defined as longlines, gillnets and entangling nets, traps, seine nets and trawls (s.13(2)). A fisher is defined as a natural person who catches fish himself or herself with commercial fishing gear. A fisher's fishing permit grants the right to fish, other than for flounder, with commercial fishing gear at sea beyond the 20m isobath. A fisher's fishing permit for flounder grants the right to fish for flounder at sea, irrespective of depth (s.13<sup>2</sup>(1)). The number of persons accompanying a fisher is unlimited (s.13<sup>2</sup>(2)). A fishing permit of a fishing vessel grants the right to fish with commercial fishing gear at sea, within and beyond the EEZ. The vessel has to be registered in the commercial register and be in possession of appropriate certificates (s.13(1)). A commercial fishing permit is issued for a specified term (no longer than one

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<sup>17</sup> Country Note on National Fisheries Management Systems – Denmark, [www.oecd.org](http://www.oecd.org), 20/06/2006, FAO 2004c.

calendar year) with limits as to the permitted annual catch quota allocation for various species, number of fishing days, quantity/amount of fishing gear or number of fishing vessels (s.13<sup>4</sup>).

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## Finland

In Finland, the management of fisheries resources is dependent on the property rights regime. Waters close to the coast (to 500m from the 2m depth line) are generally privately owned, with many administered collectively by a fishing association at village level. Waters beyond this are generally public and belong to the state, which can also have possession of private fishing grounds. The different rights regimes underpin a complex array of provisions governing recreational and commercial fisheries.

Generally, the right to engage in fishing, to issue orders in relation to it and manage fish stocks lies with the owner of the waters, unless the right has been assigned to another party (e.g. a fishery association) or the Fishing Act 1982 (as amended) provides otherwise (ss.2(1),5). However, under this Act, citizens of a state belonging to the European Economic Area who reside permanently in Finland have a right to engage in fishing in public waters in Finland's fishing zone (s.6(1)), provided that this does not hinder or impede professional fishing in waters belonging to a fishing region<sup>18</sup> (s.6(2)). This is supplemented by the citizens of Finland, Iceland, Norway, Sweden and Denmark having a right to fish for domestic needs and recreation in the above mentioned areas irrespective of residence (s.6(1)); a right potentially extendable to other foreigners (s.6(3)). Under section 8(2), residents in a municipality also have the right to fish with a net for vendace, smelt, Baltic herring and sprat in the sea within the municipality, including non-public waters in the outer archipelago or facing open high seas. Persons residing in a village also have the right to fish with hooks (but not with a boulder (s.8(2)) in sea areas falling within village boundaries, whether public or not (s.8(2)), and to acquire a licence to fish for domestic needs or recreation in areas and under such conditions as directed by the owner of the waters, in exchange for a fee<sup>19</sup> (s.9).

Angling, ice fishing, lure fishing with one rod, reel and lure, and trolling with one weighted lure are also provided for in a variety of waters, except where fishing is explicitly prohibited (s.8(1)). Angling is defined as 'fishing done with a rod without a reel suitable for spinning and in which the rod or line is in the hand of the angler or within his/her arm's reach and no jigs, trolls, flies or other artificial implements are used as lures' (s.88(1)). Ice fishing is defined as 'fishing done with a vertically moved jig attached to a line, in which the line is held by hand, or a short rod not suitable for spinning' (s.88(1)).

Under the Fishing Decree 1116, 1982 section 34(1), a licence would appear to be required to exercise the above rights in state-owned waters or fisheries, or to fish in water areas owned by the state and situated within village boundaries in the sea (s.33(1), Decree 1116). In allocating licences by the State authority responsible for fisheries in the area, priority is given to professional fishers and persons fishing for domestic needs (ss.34(3), 35(1), Decree 1116), who also fall within the scope of this licensing system. Licences can be refused or restrictions attached in the interests of rational exploitation, the permanent productivity of the waters, fish culture and transplanting, and research (s. 34(4), Decree 1116). The licence is granted for a fixed period with stipulations, and is subject to a fee reflecting the water body,

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<sup>18</sup> A fishing region is a designated area of non-public waters, comprising one or more municipalities, where it is appropriate to apply uniform measures for the management of fishing (s.68).

<sup>19</sup> The licence is issued by the owner of the water area, unless the responsibility has been transferred to the fishing region (s. 10(2)).

management being carried out, and the spatial scope and type of fishing being conducted (s.35(2), 37(1) Decree 1116).

Apart from persons engaged in angling and ice fishing, and persons under 18 or over 65, anyone engaged in catching fish or crayfish are required to pay a fishery fee to the state (administered by the Ministry of Agriculture and Forestry and separate to any licence fee) of 15 Euros per calendar year or 5 Euros for a period of up to 7 days (s.88(1),(3) Fishing Act 1982). Fishing with one rod, reel and lure in private waters attracts an annual lure fishing fee of 27 Euros or a seven-day fishing fee of 6 Euros for each province fished<sup>20</sup>. Lure fishing in public waters or by persons under 18 or over 65 years is exempt (s.88(2)).

The above rights held by the residents of municipalities, villages and those who wish to angle, ice fish, lure fish and troll are subject to conditions. Firstly, they must not be conducted in a way that prevents or disturbs the owner's or leaseholder's<sup>21</sup> fishing activities in normal fishing grounds in non-public waters or places for fishing with large bow nets (s.8(4)). They must not excessively hinder the owner or leaseholder nor a person engaged in professional fishing from exercising their rights (s.10(1)). This condition also extends to the issue of licences for village residents above mentioned (s.10(1)). Angling, ice fishing and lure fishing may not be carried out closer than 50m to fixed or net fishing gear deployed and marked without special authorization (s.38), nor should they be carried out so close to another's inhabited shore, jetty, bathing beach, ice road or comparable area so as to cause undue difficulties or disturbance to the owner or occupier of the shore (s.39). Further, the Employment and Economic Development Centre can, under section 11 of the Act, as amended, restrict certain recreational fishing in the interests of commercial and other stocking, stock management and the protection of nesting birds. In state waters and private fishing grounds of the state, priority is given to the interests of professional fishers and local residents of provisions for their use (s.12(1)). Similarly, when fishing rights are leased, special consideration is also required to be given, as far as is feasible, to the interests of professional fishing (s.16(1)).

The distinction between recreational and commercial fishing is made in terms of the sale of catch and the gear that can be used. A professional fisher is defined as a 'person who is engaged in fishing and earns his living, or a substantial part of it (at least 30%), from fishing and from the processing of the catch he has caught' (s.6a(1)), the catch or a part thereof being sold for gain<sup>22</sup>. However, a fisher earning between 15% and 30% is similarly considered a professional fisher for the purposes of catch declaration, fishing regulations and fishing gears permitted (s.6a(3)). Under section 6(4), only professional fishers may use the following designated fishing gear:

1. a large bow net over 1.5 m high;
2. a seine or trawl
3. hook fishing gear which has more than 250 hooks per fishing unit
4. nets set at the surface or drifting nets with a total length of over 900 m per fishing unit (Fishing Decree 1116/1982, s.8a, as amended by Decree 232/1994).

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<sup>20</sup> With a deduction for costs, this fee is paid to the owner of the waters as compensation for the use of the water and to the fishing region (s.89a).

<sup>21</sup> Anyone in possession of fishing rights in specific waters can lease to another a right to a certain fishing ground, to a catch of a specified fish species or for the use of a specified fishing gear, against a remuneration (s.15).

<sup>22</sup> Under Fishing Decree No. 1116, 1982 (as amended), s.1,

Professional fishers can either lease fishing rights or acquire a licence to fish, just as can non-professional fishers, although there are supplementary legal provisions particular to professional fishers. Under sections 16 and 19 of the Fishing Act 1982, as amended, there are particular arrangements laid down for the owners lease of fishing rights for professional fishing (s.19), including the authorisation of fishing regions to request an owner to lease his fishing rights where they are not being appropriately<sup>23</sup> exploited (s.16(1)). The lease is to be for a fixed period between 5 and 20 years, though any misuse of rights or neglect of payment of rent can result in the lease being rescinded (s.20(1)). The rent is determined on the basis of the extent and productive capacity of the waters, the type and quantity of fishing gear, the locality and the yield as catch (s.39(1), Fishing Decree 1116 1982). As with non-professional fishers, the provisions for acquiring a licence fall within sections 34 to 37 of the Fishing Decree 1116, 1982, as described above. Other aspects of the regulation of commercial fishing activities constitute provisions for the Employment and Economic Development Centres to adopt administrative rules for the engagement in fishing in marine public waters and Finland's fishing zone (s.6(2)), and the creation of technical management measures by Government decree. The latter include the structure, period of use and method of use of fishing gears (s.31), minimum mesh sizes and their measurement (s.32), closed seasons and minimum sizes (s.34) and closed areas (s.43).

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## France

In terms of sport or recreational fishing, the key legislation is Decree No. 90-618 relating to the exercise of maritime fishing for leisure, as amended by Decree 99-1163 of 1999. Recreational fishing is authorised and defined under article 1 of Decree No. 90-618 as amended by article 5 of Decree 99-1163, as fishing for the exclusive consumption by the fisher and their family of any products caught, which cannot be sold or exposed for sale. It can be undertaken from a boat, from the shoreline and river bank, or by diving.

Registration is only required for underwater recreational fishing (Art. 4(II) of Decree No.90-618 of 1990), and only where an individual has not obtained a licence from a certified sport federation to undertake the activity. Under article 4(I), only people over 16 years may take part in underwater recreational fishing and, under article 4(III), then only if no breathing apparatus or powered fishing equipment is used, unless the former is authorised by the local authority ("Prefect"). Appropriate buoyage needs to be used (Art. 4(V)). Article 4(IV) specifies certain prohibited activities whilst underwater, including approaching less than 150m of marked fishing vessels, the taking of catch from the gears of other fishers, and the use of a light source for fishing.

Recreational fishers, as elsewhere, are bound by the same minimum landing sizes, prohibited species and fishing areas and closed seasons as commercial fishers (Art.2). Articles 2 and 5 also provide for the administrative authorities, in the interests of preventing resource degradation and ensuring health and safety, public health and the good order of fishing, to introduce a number of measures specific to recreational fishers. These include restrictions on the type and quantity of gear that can be used by an individual recreational fisher, the species caught, daily bag limits and exclusion zones around artificial structures (Art.5). These measures are taken locally by the relevant local administration (prefect) as specified under article 6. In respect of boats, there are also specific provisions under article 3 of the

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<sup>23</sup> Defined as 'when non-utilization of certain waters should substantially affect the management of the fish stock of the water system or its economic exploitation'(s.16(1)).

Decree, defining the gears and number that can be used, both generally and specific to certain waters. Fines are provided for the contravention of these rules and of those above mentioned in respect of underwater fishing.

All French vessels require a licence for commercial fishing (Art.3.I of Decree of 9 January 1852). It is the responsibility of professional fishers at the local level to establish the licensing system via fisheries committees, although the minister responsible for marine fisheries is empowered to determine the various categories of fishing licences according to the gear type used, the species targeted or the area being fished. Commercial fishing not requiring a vessel also requires authorisation. For the exploitation of fixed gears an authorisation under Decree No.83-228 of 1983 is required from the local Prefect under provisions for marine culture. For shore fishers, a permit/professional licence under Decree No. 2001-426 of 2001 is required. Each licence, permit or authorisation has conditions attached as to the conduct of fishing (in terms of area and species), their transfer (which is prohibited in France), and their revocation in the event of infringements of fisheries regulations. Supplementary to these are management measures imposed for the management of fishing effort and fishing capacity. For example, the authorities are entitled to determine the maximum number of authorisations to be issued for each fishing zone (Art.6, Decree No.90-95 of 1990) and to set quotas for any species or group of species (Art.16 of Decree No.90-95 of 1990). Subsidiary legislation has also been enacted to specify the fishing gears that can lawfully be used by professional fishers in the Mediterranean and the permitted manner of their use, along with requirements for the completion of log books (Art.18 Decree No. 90-95 of 1990) and stipulations governing the landing of catches (Art. 4 of Decree of 9 January 1852).

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## Germany

Deep sea and coastal sea fishing are subjects of legislation in Germany, with both the Federal Government and State Governments having legislative responsibilities<sup>24</sup>. In terms of recreational fishing, there are state ministries for Food, Agriculture and Forestry that enact the relevant laws and decrees, which vary from State to State, whilst subordinate offices at district and community level enact complementary regulations.

The principal distinguishing feature between recreational 'sport fishers' and 'commercial fishers' is that sport fishers are not allowed to sell their catch. Both commercial and sports fishers are required to comply with effort regulations, minimum sizes, closed seasons etc. which, in areas falling within the scope of an association of sports fishers, may be supplemented by additional provisions for sports fishers (whether members or not of the association).

There are three German States with sea fishing opportunities along the German North Sea and Baltic coasts: Mecklenburg-Vorpommern, Schleswig-Holstein and Niedersachsen. In Mecklenburg-Vorpommern the principle legislation is the Fischereischeingesezt für das Land Mecklenburg-Vorpommern 1992, in which anyone over the age of ten years old who undertakes fishing requires official permission in the form of a fishing ticket, which must be carried at all times whilst fishing (ss.1, 3). The fishing ticket is issued upon application by the fisher and the satisfactory completion of the associated fishing ticket

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<sup>24</sup> Basic Law of the Federal Republic of Germany (Grundgesetz, GG) 1949, as amended, article 74.

examination<sup>25</sup> (s.3). The ticket lasts for the applicant's life-time (s.2), and can be exchanged with fishing tickets of other States where the requirements of the two States' fishing ticket examinations are comparable. The Secretary of Agriculture is authorised to create regulations governing the distribution of tickets, the nature of the examinations, exceptions from requiring a ticket and the procedures for guest tickets (s.7). Correspondingly, a time-limited fishing ticket may be granted for tourists upon application, for a period of up to 28 consecutive days per year. If the fisher holds a fishing ticket issued by or recognised by a national body in Germany or abroad then, provided that the ticket is valid and the applicant does not principally domicile in Mecklenburg-Vorpommern, that fishing ticket will be recognised by the latter. In addition to possessing a fishing ticket, a recreational fisher is also required to pay a fishing duty (s.5), which is utilised by the fishing authority principally for the promotion of fishing and the protection and care of the waters.<sup>26</sup>

In Schleswig-Holstein the determining legislation is Fischereigesetz für das Land Schleswig-Holstein 1996, as amended. Under this legislation, while fishing is free in territorial waters with a handheld fishing rod or drop net up to 1m<sup>2</sup>, anyone over the age of 12 years wishing to fish in territorial waters or internal waters requires a valid fishing ticket (s.26), with the prerequisite successful completion of a fishing ticket examination (s.27). Again, valid fishing tickets from other States of the Federal Republic are recognised and provision is made for tourism, with in this case persons who do not have their main dwelling in Schleswig-Holstein (s.26) and not in possession of a fishing ticket from another State of the Federal Republic being able to apply for a holiday-makers ticket for up to 40 consecutive calendar days. As in Mecklenburg-Vorpommern, the tickets are made valid through the supplementary payment of a fishing duty (s.26), which goes towards the promotion of fishing, the waters and the fishery.<sup>27</sup> The legislation also provides for regulations for the protection of the fish, waters and fishery, including provisions for closed seasons (s.30). Under section 31 certain catching methods are similarly prohibited, including the use of artificial lights, explosives, poison or electric currents.

In Niedersachsen, the principle law is Niedersächsisches Fischereigesetz 1978 as amended, which provides for the free fishing in territorial waters for fish and crab<sup>28</sup> (s.16(1)), requiring no permit or payment, although a fishing ticket is required. The fishing ticket is unrestricted in duration and issued on request by the municipality offices for the area in which the applicant resides (ss.57-58). Here the applicant needs to be at least 14 years old (s.59) and have passed a fishing ticket examination either via a recognised national fishing federation (for example, the Landessportfischerverband Niedersachsen e.V. and Landesfischereiverband Weser-Ems e.V.) (s.59), or under the jurisdiction of another State of the Federal Republic. Alternatively, they must have passed the examination of a professional fisher.<sup>29</sup> Unlike the other two states, no stipulation is made as to a validity stamp for this State nor is provision made for tourists. Tourists are required to fish together with a licensed fisher, as distinct from alone. There are,

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<sup>25</sup> The Fishing Ticket Examination varies in its specification between States, from a 2 to 12 week course on fish, fishing, ecology, conservation and animal husbandry.

<sup>26</sup> "Fischereischein – Mecklenburg-Vorpommern", [www.portal-fischerei.de](http://www.portal-fischerei.de), 23/01/2006

<sup>27</sup> "Fischereischein – Schleswig-Holstein", [www.portal-fischerei.de](http://www.portal-fischerei.de), 23/01/2006

<sup>28</sup> Shellfish are, however, excluded from this provision, requiring a permit from the fishery office for territorial waters (s.17, Niedersächsisches Fischereigesetz 1978)

<sup>29</sup> "Fischereischein – Niedersachsen" and "Fischerprüfung – Niedersachsen" [www.portal-fischerei.de](http://www.portal-fischerei.de), 23/01/2006

however, Regulation making powers provided for (s.53), and provisions banning the use of certain gears, which apply to both commercial and recreational fishers, notably: explosives, poison, lights, torches or flares, spears and harpoons (s.44).

Legislative responsibility for commercial fishers lies with the EU and Federal and state governments, with fishing vessels subject to licensing through the Federal Ministry of Food, Agriculture and Forestry. Anyone who wishes to catch species of fish that are subject to EU effort limitation requires a licence; which encompasses virtually all commercially caught species. The principle Federal legislation governing commercial fisheries is the Sea Fisheries Act 1984 as amended and the Marine Fisheries Ordinance 1989 as amended. Under this legislation, the right to be granted a fishing licence requires the use of certain existing fishing vessels or the approval of the Ministry in respect of vessel purchases and new builds. There are two forms of licence – a general fishing licence and an individual fishing licence. The former can in principle be used for all types of fishery, running from the start of the year until it is revoked. It enables fishers to fish without restrictions on species targeted or being subject to quotas for stocks for which the national quota is unlikely to be exhausted in a short time period. Individual fishing licences are used where the national quota allocation is too small to permit unlimited fishing (as in the Baltic cod and saithe fisheries) and, as a consequence, have a catch limit attached, along with specifying the species that can be targeted and where. The allowable catch is distributed annually by the Federal Office for Agriculture and Food on the basis of the Sea Fisheries Act 1984 (s.3), as amended, the effectiveness and suitability of the fishing operation, their previous participation in the fishery, the economics of the fleet and the state of supplies to the market. In addition to such effort limitation measures, commercial fishers are also subject to the range of technical management measures, including mesh sizes, minimum landing sizes, protected areas and closed seasons, with national measures particularly targeting gear selectivity via selectivity grids and exit windows.

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## Greece

Within Greece, the Ministry of Agriculture's General Directorate for Fisheries is responsible for making fisheries policy and the Fisheries Divisions of Local Authorities and the Prefectures are responsible for implementing fisheries policy. The legal framework for regulating all fisheries issues is provided by the Fishing Code (Law Decree 420/1970), which has seen minor changes through Law Decrees 1740/87 and 2040/92. The regulation of amateur and sports fisheries falls under Presidential Order No.373 of 1985, for the regulation of sports fisheries, as amended by Ministerial Joint Decree No. 255844/1990 readjusting fees for appeals to the Council of Fisheries and for granting or renewing amateur fishing licensing of vessels and part repealed by Presidential Order No. 189/1978 regulating fishing activity in the gulfs of Thessaloniki and Thermaikos.

Within Greece, all persons sport-fishing by boat require individual and boat fishing licences issued by the local port authority, though those fishing from the shore do not need a licence. The licences are limited to Greek and EU citizens (Presidential Order No.373 of 1985). To obtain a licence, Greek citizens are required to submit photographs, a copy of their identity cards and tax roll number, while EU citizens require a passport rather than an identity card. Anyone under 18 years of age also requires signed permission from his or her parents or guardians. Regular fishers are required to also obtain a fishing licence booklet from the Greek Social Security Fund for Sailors. General provisions governing sport fishing include a prohibition of fishing during the night, fishing with any source of light (unless spear-fishing), selling any fish caught and angling using more than 1 rod. There are also restrictions on the size

and total weight of the fish that a sport fisher is permitted to retain. Such sport fishing specific provisions fall under Presidential Order No, 373/1985 as does the requirement that sport fishing be conducted generally in compliance with regulations governing professional fishing. Under Royal Decree 13-2-1954, a minimum size of 8cm is set for all species for both professional and sport fishers, with exceptions set for certain specified species for which other minimum sizes are prescribed.

A vessel licence is required for commercial fishing under article 1 of Royal Decree No. 666 of 1966, with foreign fishing vessels able to apply for a licence on a reciprocity basis<sup>30</sup>. Commercial activities involving no vessel are only permitted for corals<sup>31</sup>, shells<sup>32</sup> and sponges<sup>33</sup>, otherwise a vessel licence is required. There has been a freeze on the number of licences issued since the 1990s, with new licences only awarded for the replacement of vessels exiting the fleet, provided that they are of the same fishing capacity or to replace small-scale coastal fishing vessels less than 7m long or vessels with an engine capacity of less than 15 HP by an engine of maximum 15 HP. In terms of management measures for the rationalisation of resource exploitation, Greek legislation contains provisions pertaining to fishing gear, fishing practices and fishing seasons and areas, including closed seasons and areas for bottom trawl fisheries, purse seining, boat seining and dredging and specifications as to the size and type of gears that can be used. Council Regulation 1626/94 has been principal in laying down these provisions nationwide, supplemented by local provisions governing specific gulfs and lagoons. With the exception of blue-fin tuna, Greek legislation does not extend to catch quotas.

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## Ireland

The management of sea fisheries in Ireland operates through a centralised system under the Department of Marine and Natural Resources. Angling in Ireland is regulated by the state Central Fisheries Board, which has Ministerial advisory functions with respect to sea angling. Supplementary to this body are 7 fisheries boards located around the country to ensure that national and local fisheries laws are observed both inland and out to the 12-mile limit. Coastal waters are state owned. Under section 11 of the Fisheries Act 1980 as amended by the Fisheries (Amendment) Act 1999, section 8, the Regional Fisheries Boards are required to 'encourage, promote, market and develop angling for salmon, ...and sea-fish and, for the purposes of any or all kinds of angling, provide such facilities and amenities, if any, as it thinks fit.'

A state licence is required for rod and line salmon and sea trout fishing, with the licence dependent on duration, age of the angler, the area the angler wishes to fish, and a licence duty (ss.66-68 Fisheries (Consolidation) Act 1959). Under the licence only a single rod and line may be used (s.3 Fisheries (Consolidation) Act 1959). However, the licence does not necessarily convey an entitlement to fish. Under the regulations, there is specified a total allowable catch of a maximum 10 fish in the year with allowable catches per day varying with the time of year (Conservation of Salmon and Sea Trout Bye-Law No. 802, 2006), closed seasons, the requirement to record wild salmon catches (Wild Salmon and Sea trout Tagging Scheme Regulations 2006, made under the Fisheries (Amendment ) Act 1999) and the prohibition of sale of salmon caught by rod and line between January 1<sup>st</sup> and October 31<sup>st</sup> (Fisheries Act 1980, s.56). There are also several protected fish species relevant to sea angling, including salmon and

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<sup>30</sup> Article 32, Fisheries Code 1970, as amended by article 59 of Law 2538/1997.

<sup>31</sup> Law 1740/1987 and Ministerial Decree 324/1994.

<sup>32</sup> Fisheries Code, Ministerial Decree 227/2003.

<sup>33</sup> Articles 72-158 Fisheries Code.

sea trout as aforementioned, sea bass, molluscs and eels (Fisheries (Consolidation) Act 1959 as amended). These provisions apply to the named species wherever caught. Certain fisheries regions also have supplementary provisions – as with the Western Fisheries Region<sup>34</sup>.

For recreational sea fisheries, specific regulatory provisions relate only to sea bass and common, white or long-nosed skate, which it is prohibited to take or kill. Sea bass are covered by a minimum size limit of 40cm, a byelaw stipulating a bag limit of 2 bass per angler in any one 24hr period, a closed season from 15 May to 15 June (Bass Fishing Conservation Bye-Law – renewed annually) and an Order prohibiting sale thereof (Bass (restriction on Sale) Order – renewed annually). The penalties for the breach of the above laws include the confiscation of fishing tackle and heavy fines. Note that it is also illegal to have or to use live fish as bait (Bye-law No. 561). Such byelaws for the 'effectual government, management, protection and improvement of the fisheries of the State' are made under section 9 of the Fisheries (Consolidation) Act 1959.

Commercial sea fishing is regulated by the Fisheries Acts 1959 to 2006. Any vessel wishing to undertake commercial fishing requires a licence under section 4 of the Fisheries Amendment Act 2003<sup>35</sup> from the Registrar General of Fishing Boats<sup>36</sup>, with a new licence required where there is any change of vessel ownership or the tonnage or engine capacity is altered. Unlike for recreational fishing, the licence is required to fish for all species. Fishing vessels must also be registered under the Merchant Shipping (Registry, Lettering and Numbering of Fishing Boats) Regulations 2005. Eligibility for a licence requires a completed application forms giving full ownership details, and for vessels to be wholly owned within the EU. The licensing authority in determining whether to award the licence is also obliged to consider an independent report of the seaworthiness of the vessel, the sustainability of the proposed sea fishing and whether economic and social benefits will accrue to coastal communities. The licences can be made precluding the fishing for, landing and transshipment of specified species and made subject to such other conditions as deemed appropriate, limiting their scope. Holders of sea fishing boat licences are also subject to quota management regulations created under secondary legislation, plus a range of technical management measures, including minimum landing sizes, mesh sizes, seasonal and area closures (both EU and national closures) and by-catch limits, varying by species. Statutory Instruments restricting the quantity of specified fish held onboard vessels or landed are also made under section 4 of the Fisheries Amendment Act 2003.<sup>37</sup>

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## Italy

The rules pertaining to sport fishery in Italy have recently been reviewed. Legislative Decree no. 153/2004 Article 1 laid down a requirement for the Italian Government to amend Presidential Decree No. 1639 of 2 October 1968 and reform the rules on recreational and sport fishing not later than June 2005. Prior to this, no authorisation was required to engage in sport or recreational fishing within Italian waters, albeit subject to time, area and gear restrictions (Presidential Decree No. 1639/1968). Individuals involved in sporting competitions were required to be members of a national sport fishing federation and to report catch data.

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<sup>34</sup> [www.wrfb.ie/inforesources/regulations.php](http://www.wrfb.ie/inforesources/regulations.php) 24/04/06

<sup>35</sup> as inserted by section 97 of the Sea-Fisheries and Maritime Jurisdiction Act 2006.

<sup>36</sup> Under the Fisheries (Amendment) Act 2003 (s.3(2)(b)) the Minister for Communications, Marine and Natural Resources may give policy directions on sea-fishing boat licensing to the Registrar General.

<sup>37</sup> [www.fao.org/fi/fcp/en/IRL/body.htm](http://www.fao.org/fi/fcp/en/IRL/body.htm) 19/01/2006

Sport fishers are only allowed to use 'lenze' and none of the other commercial fishing gears detailed in Ministerial Decree of 26<sup>th</sup> July 1996. There is also a daily 5kg bag limit, with the harvesting of mussels for recreational purposes limited to 3kg each day (Ministerial Decree of 10<sup>th</sup> April 1997).

As a member of the EU, commercial Italian fishing vessels require a licence to fish under Legislative Decrees No. 153/2004 (Article 4) and No. 154/2004 (Article 12), which form the basis of recent reform of the Italian fishery system. The fishing vessel licence is granted by the Director General for Fisheries and Aquaculture, and specifies the vessel's technical features, the owner and the types of fishing gear that can be carried onboard and used from the vessel. Only 12 categories of fishing gears are recognised and permitted (Article 11, Ministerial Decree of 26 July 1995), and of these each fishing vessel is only authorised to use a closed and restricted number, as specified on the licence. Similarly, no person may engage in professional underwater fishing without prior authorization issued by the Italian Coast Guard Authority, determined on the basis of professional qualification standards. Italian fishing licences are of eight years duration, unless suspended or revoked under Article 6, Ministerial Decree of 26 July 1995 and under Presidential Decree 1639/68. A fee accompanies the licence, determined by the fishing system authorised. The fishing vessels are further categorized as to their area of operation, reflecting the characteristics of the vessel, its crew and safety features (MiPAF 2005):

- coastal fishing vessels
- offshore ('ravvicinata') fishing vessels
- Mediterranean fishing vessels
- High seas fishing vessels

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## Latvia

Under the Fishery Law 1995, as amended on 1 October 1997, 29 October 1999 and 17 February 2000, a distinction is made between amateur fishing and commercial fishing, with the former defined as '- angling – activities performed for recreation or sport in order to catch fish with angling equipment.'(s.1(7)) and the latter as '- activities for the purpose of catching fish, utilising commercial fishing gear'(s.1(8)). The distinction here is in terms of the fishing gear used, prohibiting the use of methods and fishing gear not provided for in the relevant regulations for each activity<sup>38</sup> (s.17(1)). A fisher is defined as a natural person directly engaged in fishing, that is, who operates fishing gear, or a legal person in whose name and at whose direction the fishing is performed.

Fish resources within the territorial waters of the Republic of Latvia are the property of the state and every inhabitant of the Republic of Latvia has the right to engage in amateur fishing in all marine waters of the Republic unless expressly stipulated as prohibited therein (s.10(1)), as in the case of waters used for fish farming (s.10(4)). However, if a catch limit or restriction on fishing gear is imposed for a specific body of water, or part thereof, especially in respect of valuable species, amateur fishing may require a special fishing permit (licence). The licence may be accompanied by a fee or subject to a tendering process, in

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<sup>38</sup> The fishing gear permitted for commercial fishing include: trawls (ground-trawl, pelagic trawl, 2-boat trawl), seine nets (flounder and beach seines), drift nets, floating anchored nets, fleets of nets, pound nets for Baltic herring, longlines and fish traps (fish-trap, eel fyke net, eelpout fyke net and group of eelpout fyke nets)(Annex 3, Cabinet Regulation 55 regarding commercial fishing in the territorial waters and economic zone waters of the Republic of Latvia and in the Gulf of Riga, 1998).

accordance with regulations applicable to the water body (ss.10(2), 25(1)). Amateur fishing in all waters must be undertaken in accordance with angling and other relevant regulations (s.10(3)), which the cabinet is obliged to produce under sections 13(1)(3) and s.15(2) of the Fishery Law. These regulations also extend the rights to fish to foreign anglers (s.10(5)). Along the shoreline, statutory provision is also made for access for fishing, in the form of 'towpaths'<sup>39</sup>(s.9(9)(3)) or compensatory provisions where 'towpaths' are not viable (s.9(13),(14)). Along these towpaths, at points specified by environmental protection authorities (s.9(8)) and approved by the landowner, fishers can set up fishing camps, engage in recreation, dry off fishing equipment and undertake other fishing activities (s.9(7)(3)).

People acquire the right to fish commercially via a fishing rights leasing agreement with the manager of the fish resources of such waters (derived from section 7 of the Fishery law 1995, as amended) and a fishing permit (licence) (s.11(1), Fishery Law 1995; section 5.2 Cabinet Regulation No. 55, 1998<sup>40</sup>). The fishing rights of the state may be transferred to a local government who manages those fish resources (s.7(1)). They in turn have the power to transfer (lease) fishing rights to other legal or natural persons in accordance with certain stipulated procedures (s. 7(2)), with priority given to co-operative associations of fishers, local or other companies whose basic activity is connected with fishing and fish processing, and residents who are engaged in independent fishing (s.7(6)). The conditions and processes attached to the leasing of fishing rights are determined by the Cabinet (s. 7(5)). Further, the form of the agreement for a lease of fishing rights is subject to Board of Fisheries approval (s.7(8)) and the lease itself is non-transferable (s.7(7)).

Priority for the issue of fishing permits is given as for the leases (s.11(2)). The permits are issued by the State Environment Inspection or the Marine Environment Administration in accordance with limits set by the Board of Fisheries for quantity of fishing gear, its type and amount of catch (s.11(3)). If the allowable catch and limits set are insufficient to cover demand for permits and leases, however, they may be allocated via public auction rather than allocated for a fee (ss.11(6),(7), 25(1)). Once allocated, the holder of a lease and/or permit for commercial fishing is bound to comply with provisions and other regulatory norms relevant to commercial fishing (s.11(8)). These provisions fall within the remit of secondary legislation, with the Cabinet obligated under the Fishery Law to issue fishing regulations for commercial fishing in territorial waters and the economic zone (s.13(1)(1)), providing for the determination of allowable catches, number and kinds of vessels, amount and type of fishing gear (s.15(1)). There are supplementary requirements for a fishery business to be in possession of a licence to conduct that business, and for an individual fisher to be registered with the Marine Environment Administration of the Ministry of Environmental Protection and Regional Development (s.5.1). Further, both natural and legal persons engaged in commercial fishing are required to have been assigned a specified catch limit or fishing gear number limit (s.5.2).

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## Lithuania

Under the Law on Wildlife (No.VIII-498) 1997, article 17, fishing is defined as the catching of fish and aquatic invertebrates by means of both commercial and recreational fishing equipment, supplemented by

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<sup>39</sup> A natural towpath width is specified as 20m, although the Board of Fisheries and the Ministry of Transport can determine a narrower or broader towpath (not exceeding 40m)(s.9(9),(10)).

<sup>40</sup> Regulations regarding commercial fishing in the territorial waters and economic zone waters of the Republic of Latvia and in the Gulf of Riga, Adopted 17 February 1998.

a requirement for the procedures stipulated by government for both to be observed. The Law of Fisheries (No. VIII-1756) 2000 provides for these latter procedures including the regulation of fishing, its sustainability, the protection of fish resources and fishing controls (art.1).

Within the Law of Fisheries 2000 “commercial fishing” is defined and distinguished from “non-commercial fishing” by being undertaken ‘by means of commercial fishing gear for commercial purposes’ and the latter by ‘non-commercial fishing gear in accordance with the requirements for non-commercial fishing’ (art.2). Commercial fishing in marine waters requires the issue of fishing permits conveying a statutory right to specified areas, using specified fishing methods and subject to conditions for the restocking and conservation of fish stocks (art.8, 12).

Under article 7, non-commercial fishing is split between ‘recreational fishing’ and ‘other (special) fishing’, e.g. fishing activities for the purposes of scientific research, monitoring, fish breeding, acclimatisation, and education (art.2(3)). Article 9(1) of the Law of Fisheries provides for recreational fishing to be permitted in all fisheries of Lithuania provided that fishing in these waters is not restricted. This permission is also extended to foreign nationals provided that it is undertaken in the manner specified by the laws, fishing regulations and other legal acts of the Republic of Lithuania (art.9(2)). Lithuania’s fisheries are both state-owned and private, with the Territorial Sea and the Exclusive Economic Zone (EEZ) in the Baltic Sea being state-owned (art.4). Article 9(4) provides for the Government or body authorised by it to determine the procedure for organising recreational fishing and for issuing fishing permits.

The regulatory measures provided for the management of fish stocks in Lithuania’s territorial waters and EEZ include: the prohibition or restriction of fishing within certain periods and in certain areas; the prohibition of fishing for certain species or the determination of allowable catches; the determination of authorised fishing gear, quantity thereof and fishing methods; and the setting of minimum sizes for individuals that may be caught (art.11). There is no distinction drawn within this primary legislation in the applicability of these regulatory measures between commercial or recreational fishers. Likewise, within the provisions for fishing permits for recreational fishing (art.9(4)), recreational fishers are encompassed within the definition of ‘users of fish resources’, those ‘natural and legal persons...having the right to exploit fish resources’(art. 2(17)), who are obligated to:

1. utilise in a rational way and conserve fish resources;
2. comply with the requirements of international agreements of the Republic of Lithuania, laws of the Republic of Lithuania on fishing and fish protection, fishing regulations and requirements of other legal acts, and the terms and conditions stipulated in...documents granting the right to exploit fish resources;’(art.15)

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## Malta

Under the Fisheries Conservation and Management Act 2001, a commercial fisher is defined as ‘a person who is engaged or who intends to engage in fishing for sale ----- and can satisfy the Director [responsible for fishing] that during such time as he engages in fishing for sale he relies on his fishing activities for the whole or part of his income’ (art.2). In respect of a company, society or association, the definition requires that the Director has to be satisfied of an ‘appreciable investment in the fishing industry’ or an intension of such (art.2). The core element here is that ‘commercial fishing’ is defined as the catching or taking of fish for sale (art.2). Sport and recreational fishing are not comparably defined. However, under article 38(e) of

the Act, the Minister responsible for fisheries has the power to make regulations for the regulation of amateur and recreational fishing. Also, while articles 7 and 8 of the Act stipulate that commercial fishing within the internal and territorial waters of Malta requires a vessel to be entered on the record of fishing vessels and authorised to fish by a licence or permit granted under the 2001 Act, under Part VI of the Act and the Fishing Vessels Regulations 2004, all fishing vessels (including recreational fishing vessels) have similar, annual, requirements.

Under the Fishing Vessels Regulations 2004<sup>41</sup>, the record of fishing vessels has four categories: full-time and part-time professional fishing vessels, auxiliary vessels used in fishing operations, and a fourth category of 'non-commercial fishing vessels i.e. recreational' (s.8(b)). The latter category also includes 'commercial' vessels with a value of landings of less than a stipulated minimum for the length of the vessel<sup>42</sup>(art. 9).

Under the Regulations, there is also a requirement for all vessels being used for fishing (not limited to commercial fishing vessels) to be licensed (art.3(a)), with vessels of 6m or over also registered under the Merchant Shipping Act (art.3(b)). The vessel can only be used for the purposes stipulated in the licence (art.3(c)) and with only those gears indicated in the licence (art.19). Unless the licence states otherwise, it is valid for one year and a period of 24 hours in respect of each fishing trip (art. 7). The fee for the licence varies depending on the vessel's classification in the register and the length of the vessel, with the recreational vessels paying the largest annual fee<sup>43</sup> (Schedule II, Fishing Vessels Regulations 2004). The Regulations also stipulate that no fishing vessel of less than 6m in length is permitted to fish beyond 12nm from the coast (art.10) and, as with commercial fishing vessels of 10m or over, recreational vessels of this length must also keep a logbook of fishing activities and catches where the catch of any one species is larger than 50kg (art.12). Large vessels of 17m or over have additional requirements placed on them irrespective of the category of vessel they fall within (art.13, 15, 16, 20).

The licences are issued at the discretion of the Director, for a specific fishing vessel (art. 12(1),(2) of the 2001 Act). The licence either authorises fishing generally or subject to limitations with respect to:

- the areas, periods, times or voyages authorised
- the form, quantity, size and presentation of the fish taken, and
- the method of fishing (art. 12(2)).

It can be varied, revoked or suspended in the interests of the regulation of sea fishing, the conservation or management of fisheries, or the economic benefit of Malta (art. 12(4)). In terms of gears, the 2001 Act specifies certain prohibited fishing methods, such as the use of poisonous or noxious substances or explosives (art. 28), and makes provision for the Minister for Fisheries to make regulations for the conservation, management and protection of fish resources through the control and use of types of

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<sup>41</sup> Registration involves an initial fee, irrespective of category, of Lm200 (Schedule II, Fishing Vessels Regulations 2004).

<sup>42</sup> For example, Lm500 for vessels of <5.99m length, Lm750 for vessels of 6-7.99m, Lm1000 for vessels of 8-11.99m (Schedule III, Fishing Vessels Regulations 2004).

<sup>43</sup> For example: Lm10 for recreational vessels less than 5.99m (compared to Lm5 for full-time commercial vessels) and Lm45 for recreational vessels between 12m and 14.99m (compared to Lm15 for full-time commercial vessels) (Schedule II, Fishing Vessels Regulations 2004).

fishing gear (art.38(2)(b)). However, there is no distinction between the gears available to be used by commercial and recreational fishers at the level of primary legislation in Malta.

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## Netherlands

In the Netherlands, the Fisheries Act 1963 as consolidated on the 11 February 2005 including amendments, provides the primary legislation governing marine and inland fisheries, both commercial and recreational. It provides both the general rules and principle exceptions.

Sport fishers are defined principally by gear, as individuals who fishes with one or two rods or a bobber – a hook less line to which is attached a number of worms. Gill nets and fyke nets, for example are not considered to be gear for a sports fisher. Generally, a rod licence ‘Sportvisakte’ is required (unless aged under 15 years, fish with one rod and a designated form of bait) and a permit from the owner or leaseholder of the fishing rights, which typically run with landownership. Use of certain gears, such as a bobber, requires a special permit in addition to the Sportvisakte. The use of certain ‘professional’ gear is also permitted, subject to a Comprehensive Fishing Licence (‘Grote Visakte’) and written permission from the owner of the fishing right. These provisions, however, apply to internal waters. MRF requires no licence or permit. Similarly, anyone using a single rod and a designated form of bait does not need a permit to fish in public waterways (defined as waters regularly used for commercial traffic), subject to stipulated exceptions including certain open harbours and estuaries.<sup>44</sup>

Sports fishers, as with commercial fishers, are subject to a range of management measures legislated for under cabinet orders created in accordance with powers under Article 2 of the Fisheries Act 1963: closed seasons, protected fish species and size restrictions. Any catches made contrary to these provisions by sports fishers require care to be taken in handling the fish with their immediate release in the same water undamaged. The use of live bait is also prohibited.

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## Poland

Under the Law of Fisheries 18 January 1996, sport – recreational fishing is included within the definition of sea fisheries, along with fishing and purchasing at sea of marine organisms and the exploitation and conservation of marine living resources (art. 2). As part of this definition, sport – recreational fishing in the Polish sea area is essentially the preserve of natural persons resident in Poland, organisations established under Polish law, and legal entities with their place of business in Poland (art. 4(1)). However, under article 4(4) of the Law the Minister of Transport and Maritime Economy may by Ordinance define terms under which foreign entities are permitted to take part in recreational fishing within the Polish exclusive economic zone.

To partake in sport fishing, a licence is required from the Director of an appropriate Maritime Office, for which a fee is charged. The Minister of Transport and Maritime Economy defines the licence, its form and fees through the passing of a national Ordinance. The permitted methods of undertaking sport/recreational fishing are similarly defined (art. 24(4) Law of Fisheries 1996). Anyone not observing the terms stipulated in the licence or sea fisheries regulations may have their licence withdrawn by the issuing body (art. 25); a stipulation endorsed by article 35 of Chapter 7 of the Law of March 21<sup>st</sup>, 1991 on Territorial Waters

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<sup>44</sup> www.ovb.nl, 14/05/2006.

which stipulates that tourism and aquatic sports may be practiced in Polish territorial waters, but within the terms of and in a manner consonant with the provisions of Polish Law.

Commercial fishing, unless the legal rules decide otherwise, also requires a fishing licence from the Director of relevant Maritime Office<sup>45</sup> (art. 17 and 18(1), Law on Fisheries 1996). The licence is issued for a fixed time period for each individual vessel (art. 18(2)) and is issued subject to a charge (art. 20). As with the licence for sport fishing, the form, periods of validity, application procedure and fees of commercial fishing licences are also subject to Ordinance enacted by the Minister of Transport and Maritime Economy (art.21).

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## Portugal

The main legislation with respect of recreational fishing in Portugal is Decree No. 246/2000, regulating sport fishing in oceanic waters, maritime internal waters and other internal waters, and falling under the jurisdiction of the maritime authority. Non-professional fishing is classified in two categories: recreational and sport fishing, the latter taking place within the framework of organised competitions and/or with the objective of obtaining records. Definitions of the different forms of recreational fishing are also given, along with articles extending the application of the legislation to the Autonomous Regions.

Articles 2 and 8 of the Decree prescribes leisure and sport fishing as fishing from the land or boat or underwater without commercial ends and utilising manual means, with any boat utilised being registered for recreation or marine-tourism activities. None of the catch from leisure and sport fishing is permitted to be displayed for sale or sold, although they may be consumed by the fisher, their family or donated to beneficial organisations, scientific or museum entities (Art.7). Fishing for leisure in turn is defined as that purely for recreation (Article 3), while sports fishing is that aimed at organised competitions (article 4). Under article 5, tourism fishing is defined in conjunction with Decree No. 564/80 of 6 December 1980, Decree No.200/88 of 31 May 1988 and Portaria No. 59/88 of 28 January 1988 as fishing for leisure within the context of marine-tourism activities and with the support of specialised staff supplied by tourist companies permitted to take part. Underwater fishing can only be undertaken in a recreational context by snorkelling and using fishing instruments that can be hand delivered or hurled without the use of chemical detonation or compressed gas propulsion (Art. 6). Scuba equipment for underwater spear fishing is strictly forbidden. Fishing activities other than recreational fishing for non-commercial ends using manual means are subject to licensing by the Director-General of Fisheries and Aquaculture (Art.12).

Attached to these definitions are certain conditions. Notably, only hand-lines or rods and underwater fishing instruments may be used in recreational fishing, with a maximum of 3 hooks per line and 3 lines or rods per fisher (Art.9). The use of other gear does not constitute leisure or sport fishing (Art.9(3)). In the interests of conservation and the rational management of the resources, there is also a range of management stipulations under article 10 with which recreational fishers must also comply. The relevant ministries (Defence, Economy, Agriculture Rural Development and Fisheries, Environment and Sport) can define regulations concerning specific species, gear and equipment characteristics, area closures, size or weight limits, catch limits per species, number of licences, fishing within protected areas and the process of licensing. Additional to such measures, there is also provision for measures to be taken for reasons of

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<sup>45</sup> The relevant office is designated by the Minister of Transport and Maritime Economy (art. 18, *ibid*)

public health and security, navigation and the public interest (Art.11). Non-compliance with these provisions by fishers can result in a fine (Art.14) and the possible seizure of equipment and/or catch, suspension of the licence to fish and any licence to use a boat (Art.15). This also extends to fishing without the required licence; the use of a boat without adequate certification, registration and navigation, security and communications equipment; the conduct of fishing tourism without the appropriate permit; underwater fishing between sunset and sunrise; the use of luminous sources for fishing other than in 'toneira' (to attract tuna); the conduct of fishing within a minimum distance from bathing beaches; the carriage and use of firearms, explosives, electric, poisonous and toxic substances for fishing; and the installation or use of equipment not permitted onboard recreational fishing boats (Art.14).

In terms of sport fishing, article 4 of the Decree prescribes the authorisation of organised competitions, including the prior authorisation required from the responsible authority for the area in which the competition is to be held, notably the maritime authority and the Instituto da Conservação da Natureza in the case of the event being planned in a protected area. Sport fishing as a tourist activity can only be carried out by licensed companies (Article 5). The authorizations are granted only when conditions of security and health are met and fines are imposed if appropriate approvals are not obtained (Art.14).

Commercial fishing is governed by a range of effort controls and technical management measures provided for under Decree No.3/87 of 17 July 1987 as amended by Decree No.7/2000 of 30 May 2000, which govern fishing both with and without boats by both Portuguese nationals and nationals of other EU member states within maritime waters out to the outer limit of the EEZ or nationally declared waters and 'internal maritime waters' (Art.1, 2). The use of most commercial fishing methods requires both prior authorisation and a licence, irrespective of whether a vessel is used (Art.74). The duration of the licence is typically annual although there is provision for a more restrictive term along with specificity of gears (Art.74). The issuing authorities are the Directorate General of Fisheries and Aquaculture and the respective agencies within the Autonomous Regions (Art.75). In terms of technical management measures, there are minimum sizes and weights for fish caught (Art.48), minimum mesh sizes (Art.50), maximum by-catch percentages and minimum percentages for target species catches, restrictions on fishing in certain areas and seasons and restrictions on the utilisation of certain gears. Articles 3 to 10 of Decree No. 3/87 as amended by Decree No.7/2000 define the gears that are generally permitted for use by commercial fishers in maritime waters, including: 'apanha' (fishing not using gears manufactured for the purpose, as in an individual's hands and feet), lines with one or more hooks, traps, towed gear and various forms of net. The use of these gears, however, is open to further regulation by the responsible government department (Art.3(3)). Gear-specific management provisions include a ban on trawling within 6 miles of the coast and a ban on the use of trammel and gill nets within a specified distance of the coast. The size, distances between, depth of deployment, mesh sizes and immersion times of nets are similarly specified for different gears. Fishing vessels in turn are regulated in terms of where they can fish given their location of registration, technical specification and their onboard accommodation (Art.63-69) and the requirement to keep logbooks (Art.80).

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## Slovenia

Within Slovenia, the Marine Fisheries Act 2002 is the principle piece of legislation distinguishing between recreational and commercial fishers, with specific sections addressing both. Sports and recreational marine fishing fall within the category of non-commercial fishing, along with scientific and research work, monitoring activities and the provision of public aquaria (art.27(1)). The key distinguishing feature

between sport and recreational fishing and commercial fishing is that the former is prohibited from offering any of its catch to the market (art.30) and employs 'fishing equipment', which is defined solely for their use, while a 'fishing vessel' and 'fishing tool' are defined as 'intended and equipped for commercial fishing' (art. 4).

Under the Act, sports and recreational marine fishing may be performed from the shore or from a vessel using permitted fishing equipment in the permitted manner and up to a permitted daily quantity of catch (art. 28(1)), which are stipulated by the Minister responsible for fisheries (art. 28(6)). Apart from sports and recreational fishing from the shore for which no permission is required (art. 28(7)), sports and recreational fishing requires a daily or weekly recreational fishing ticket or an annual non-commercial fishing permit for either sports fishing or underwater sports marine fishing (art. 27(2),(3)). The permit or ticket must be carried by the holder at all times whilst fishing and is valid for both the internal and territorial waters of the Republic (art. 27(5)).

A sports fisher at sea is required to be a member of a sports marine fishing society organised within a federation of sports marine fishing societies, the latter being responsible for issuing the recreational fishing tickets (art. 28(3),(4)). Similarly, a sports fisher using an underwater gun is required to be a member of a sports marine fishing society, and may not fish without an annual permit, nor between sunset and sunrise, in areas in which fishing is prohibited, nor in any manner other than prescribed (art. 28). Daily catch limits are also stipulated (art. 28(1)) and the use of underwater breathing devices prohibited (art.7(8)). Permits for marine sport and underwater fishing are issued by the Minister responsible for fisheries (art. 27(4)). Both the recreational fishing tickets and annual permits are subject to a fee determined by the Minister (art. 28(5), 29(7)), who also prescribes the fishing equipment, methods of sport and recreational fishing, the permitted daily quantity of catch and the form, content and manner of issuing the recreational fishing ticket (art. 28(6)).

Both sport/recreational and commercial fishers are bound by the provisions of the Act , which stipulates space- and time-related fishing restrictions (art.10) and provisions for the protection of juvenile fishes (art.9), and what gears and methods of fishing are prohibited, including surrounding nets or seine nets deployed so as to enable fishing from the shore, and dredges (art.7). The fishing gears permitted for each category of fishers are specified in the respective fishing permits or ticket (art.8). Specific provision is made in respect of certain fisheries management measures, as with fishing reserves, where commercial fishing is prohibited (subject to exception) while sport and recreational fishing from the shore is generally permitted (exceptions are provided for) (art.12).

The specific provisions for commercial fishing include the requirement to only use fishing vessels as defined by maritime regulations (art.13), to be in possession of a commercial fishing permit (art.14(1)), to register in the fishing vessels register held by the Ministry responsible for fisheries (art. 14) and for vessels of 10m total length or over, to submit daily reports on commercial fishing undertaken (art.15). Commercial fishing permits are issued by the Minister responsible for fisheries, subject to compliance with certain conditions, including citizenship or corporate basis in Slovenia, registration to engage in fishing activities, and being in possession of a professional qualification for commercial fishing (art.17, art. 23). Commercial fishing permits are non-transferable permits issued to a specific vessel for an indefinite

period<sup>46</sup>, containing such stipulations as prescribed by the Minister (art.18). Supplemental to the commercial fishing permits are special commercial fishing permits created by the Ministry and awarded to a particular vessel (art. 25(2),(3)) to fish in areas and cases where commercial fishing is otherwise prohibited (as in the case of fishing reserves (art.12(9), art.24(1))) for a specified period of time (art. 26(1)) to take advantage of enhanced stocks. Vessels under 10m in length and fishing exclusively in internal waters and territorial sea do not require a special commercial fishing permit (art. 24(3)).

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## Spain

The principal laws governing fisheries in Spain include Law No.10/1977 pertaining to territorial waters, Law No.15/1978 pertaining to the Spanish exclusive economic zone outside the Mediterranean, Ministerial Order of 26/2/1999 prescribing norms for the regulation of recreational marine fishing, Royal Decree No. 1315/1997 as modified by Royal Decree No. 431/2000 pertaining to the Spanish fishing zone, Law No.3 of 2001 and Law No.01-11 of 2001. Under Law No.3 of 2001 'Marine Fishing of the State' definition is provided of 'fishing' as the extraction of the resources, including crustaceans and molluscs, of outer waters using fishing equipment and gears (Art.2). Outer waters are marine waters under the jurisdiction or sovereignty of Spain, extending out to 12nm from the territorial sea baselines (Art.2). The distinction between commercial and recreational fishing is preserved in the licensing arrangements and in the rights conferred, as indicated below. There is explicit provision within Article 5 for policy making for fishing in the outer waters incorporating the regulation of 'non-professional fishing' and within Chapter V of the Law, which lays out the powers of the Minister of Agriculture, Fishing and Food to create specific measures for the regulation of recreational fishing. Article 36 of this Chapter specifies a number of measures that the Minister can use, which in detail are elaborated on via the Ministerial Order of 26/2/1999, norms for the regulation of recreational marine fishing, hereafter outlined.

All fishing activity within waters of Spanish jurisdiction or sovereignty is subject to authorisation. Sport or recreational fishing in Spain is governed by a very comprehensive system and requires an individual licence (Art. 3 of Ministerial Order, 26/2/1999) with special authorisation for certain species (Art. 36 of Law No. 3/2001). For sea fishing there is no national licensing system. A regional maritime recreational fishing licence '*licencia de pesca*' is required, obtained from the regional administrative office for the area intended to be fished (Art.3(1) of the Ministerial Order), either for fishing from the shore or from a boat near the coast. Angling in estuaries requires an annual angling licence obtained from an office of the 'Delegación Agencia Medio Ambiente'. All licences come with rules attached on the conduct of the activity. Recreational fishing boats also require a permit (Art.37 of Law No. 3/2001) to which the competence authority may add an annual total allowable catch.

In terms of obligations under the licences, as specified by the Ministerial Order, recreational fishers catching species other than those listed below are limited to a daily catch per licence of 5kg, and if a boat has more than 5 licences onboard, the daily catch for the vessel is limited to 25kg (Art.4). For Albacore, bigeye tuna and hake, a maximum catch of 5 fish per day per licence is stipulated, with a maximum of 20 fish permitted per boat per day. For the following fish species (as detailed in Annex III of the Ministerial Order) a maximum catch of one fish per day per licence is stipulated and a maximum of four per boat per

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<sup>46</sup> Validity ceases on the death of the holder, the cessation of fishing activity and the sale or leasing of the vessel (art.21(1)) or is temporarily or permanently revoked due to violations of fishing rules (art.21(2)).

day: bluefin tuna, swordfish, marlin, and sailfish (Art.4(3))<sup>47</sup>. Any catches of certain specified species, listed in Annex III of the Order, also require the licence holder to complete a landing declaration and send it to the General Secretariat of Marine Fishing (Art.8). As with commercial fishers, recreational fishers are also obligated to return to the sea immediately any fish smaller than any specified minimum landing size set for the species by Real Decree 560/1995 of 7 April (Art.9). There are also species<sup>48</sup> the capture and possession of which is prohibited (Art.10).

In terms of fishing gear, fishing from a boat or the shore can only use lines or equipment with a maximum of six hooks or two 'poteras' per licence, with artificial bait considered as hooks (Art.6 of the Ministerial Order). Fishing while submerged can only be undertaken during daylight hours (Art. 11(k)), with the use of manual harpoons or harpoons driven by mechanical means, with the diver marked by buoyage at the surface (Art.7). There are also a number of further general prohibitions which include: the sale of any catch; any interference with professional marine fishing in any form, with recreational fishing boats required to maintain a minimum 200m from professional fishing boats or their gear; the use of professional fishing gear; the use of non-manual fishing gear; the use of lights or other means to aggregate fish; the use or possession of poisonous, narcotic, explosive or polluting substances; fishing in ports, their access channels or within 100m of swimming areas (Art.11). Recreational fishing is also subject to the established norms as exist within any zones of special protection.

Spain operates a registration scheme of all commercial fishers at both a national and local level (Art.44 of Law No.3/2001). Any person wishing to engage in commercial fishing in Spanish waters is required to be registered, which in turn requires the applicant to having acquired a navigation/fishing certificate '*titulación náutico-pesquera*'. For commercial fishing vessels, the granting of a licence confers a general right for the vessel to fish within Spanish waters, though that vessel must be included in the record of fishing vessels (Art.23 of Law No.3, 2001). The extent of fishing rights is determined through the issue of a supplementary permit, which specifies the area(s) within which the vessel is authorised to fish. The issue of a licence requires the prior registration of the vessel and is subject to certain conditions the prohibition of the transfer of the licence and provision for the suspension or revocation of the licence upon conviction of infringement of fisheries regulations or terms of the licence. The non-use of the fishing licence for the period of its validity also leads to the deletion of the vessel from the fishing vessel record (Spain maintains both a vessel register '*Registro de buques pesqueros*' and vessel record '*Censo de buques de pesca marítima*': Art. 57 and Art. 22 respectively of Law No.3/2001). The Minister is authorised to also restrict the number of fishing vessels that can be licensed (Art.8 of Law No.3/2001). The collection of shellfish is also subject to a professional permit, obtained from the regional Autonomous Communities, while professional fishing activities on or from the shore are subject to a licensing system.

In terms of fisheries regulations, provision is made in law (Art.9 of Law No.3/2001) for the Minister to create allowable catches for a species or group of species, fishing zones, periods, methods or gears, vessels or types of vessels, which extend potentially to recreational fishing boats. The Minister also stipulates minimum landing sizes, which apply to most species and bind both commercial and recreational fishers.

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<sup>47</sup> Competitions requiring the exceed these maximums require the express authorisation of the General Secretariat of Marine Fishing (Art.5 of the Ministerial Order).

<sup>48</sup> As specified in Annex II of the Order

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## Sweden

The management of fisheries is mainly the responsibility of the National Board of Fisheries, 'Fiskeriverket', which operates within the EU and national<sup>49</sup> legal framework for fisheries and is responsible for the conservation and exploitation of fish resources. Among the Board's government directed aims is that of promoting increased angling opportunities for members of the general public. The main fisheries legislation includes: the Environmental Code 1998:808 on sustainable development with respect to the environment, including general rules for the sea and coast, and shore protection; the Fisheries Act, 'Fiskelag', 1993/787 on the rights to fisheries in Sweden including its sea territory and economic zone as amended; and Fiskeriverkets för Fattningssamling (regulations from the National Board of Fisheries) (FAO 2004b). Within the Swedish Fisheries Act sections 8-11 define fishing rights in Sweden, sections 19-25 prescribe regulation-making powers, and sections 30-32 pertain to professional fishing licences.

Coastal fisheries in Sweden are state-owned, except all water within 300m of the coast and islands, which is private property and requires the consent of the owner (FAO 2004). Ownership rights are particularly strong along parts of the east coast with individuals and communities having rights to fishing (S.E.A.C. 2006). There are also long-standing agreements with Norway and Denmark for common fishing within the Skagerrak and Kategatt up to the limit of 4nm from the Swedish territorial sea baseline (S.E.A.C. 2006).

Recreational fishing in Sweden takes two forms: subsistence fishing and sport-fishing. In terms of definitions, sport fishing involves fishing with a rod, hook and line for recreational purposes with the catch used within the household. Subsistence fishing involves equipment such as nets, fish-traps, creels, cages and long lines with the catch primarily used within the household. Neither activity constitutes part of the Swedish right of public access, although sport fishing is freely permitted along the coastline with the exception of salmon along the coast of Norrland<sup>50</sup>, and subsistence fishing is freely permitted along the west and south coast of Sweden. In other waters, recreational fishing would require a licence or form of authorisation. (FAO 2004) Within coastal private waters, many owners, with state support, have created fishing areas with uniform fishing rules for recreational fishing opportunities permitting access by the public<sup>45</sup>.

National technical measures such as mesh size and seasonal and area closures govern both commercial and recreational fishing. There are also local regulations. Legal provisions are also specific to each of the two sub-categories of recreational fishing. Those specific to sport fishing include a prohibition to fish closer than 100m to stationary professional fishing equipment. Non-compliance with the regulations potentially results in the forfeiture of catch and equipment. (FAO 2004) Subsistence fishing is subject to numerous regulations, but is generally permitted on public waters beyond 300m from the shore and waters surrounding islands of less than 100m in length. The regulations pertain to permitted fishing grounds and gears (e.g. net lengths and number of pots that may be set) and sale of catches (sales over 10kg must be reported to the National Board of Fisheries). (FAO 2004)

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<sup>49</sup> In coastal waters Sweden has sole responsibility for some specific fisheries, such as sea trout in the Baltic and lobster in the Kattegat-Skagerrak.

<sup>50</sup> [www.fiskeriverket.se/pdf/om\\_fiskeriverket/engelsk.pdf](http://www.fiskeriverket.se/pdf/om_fiskeriverket/engelsk.pdf) 29/04/06

Commercial sea fishing requires at least one fisher per vessel to hold a personal fishing licence and the vessel to be licensed by the National Board of Fisheries, taking into consideration the applicant's professional experience, the state of fish stocks and regional development and fishery regeneration issues. Unless prescribed by the Common Fisheries Policy or Board regulations, a fisher in possession of a licence is free to use any legally approved type of gear and in any quantity. The lack of a professional licence restricts the amount and type of gear that can be used. In addition to a licence, professional sea fishing is subject to national rules regulating the allocation of quotas in Sweden<sup>51</sup> and a range of technical conservation measures including gear regulations, minimum landing sizes, fishing seasons, maximum landings per vessel and week and limits on by-catches, some of which also apply to recreational fishing.<sup>52</sup>

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## United Kingdom

The legal framework governing commercial and recreational sea fishing is a composite of common and statute law. Under common law, as defined by cases brought before the courts, the public has a right to fish tidal waters and the sea up to mean high water of ordinary tides, except in certain areas where exclusive proprietary rights have been acquired (mainly in respect of shellfisheries) or where the public's common law rights have been restricted by Parliament<sup>53</sup>. Under common law, the public may lay lines, draw nets and adopt any other ordinary mode of fishing provided that fishing is exercised reasonably and in accordance with statute law. The right also extends to the right to take shellfish, except within the area of a several/private shellfishery. There is no right, apart from as defined by special custom or statute, for fishers to cross land above high water mark or to generally use the foreshore for fishing or to beach or store boats or nets. However, there is a public right for fishers to cross the foreshore at certain places appropriated by long usage or necessity to access the sea for fishing.<sup>54</sup> The right of public fishery and its associated rights incorporate both recreational and commercial fishing, between which the distinction in the UK is through statute law that require licences for 'fishing for profit', which incorporates the sale of any catch. The catch from recreational sea fishing cannot be sold.

The regulation of sea fisheries in the UK is subject to the EU, national and local provisions. There are four national fisheries departments: the Department for Environment, Food and Rural Affairs (DEFRA), the Scottish Executive Environment and Rural Affairs Department (SEERAD), the Department for Environment, Planning and Countryside of the Welsh Assembly Government<sup>55</sup> (WAG) and the Department of Agriculture and Rural Development for Northern Ireland (DARD). At the local level there are 12 Sea Fisheries Committees created under the Sea Fisheries Regulation Act 1966, which cover most of the coast of England and Wales (excepting certain estuaries – e.g. Dee and Severn – where the Environment Agency acts as an Sea Fisheries Committee) from high water mark to 6nm from the territorial sea baselines. They regulate sea fisheries in their districts through Secretary of State approved

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<sup>51</sup> The Government Bill - Amendments to the Fisheries Act 2002/03:41 – has been instrumental in increasingly the range of measures available in this respect.

<sup>52</sup> FAO 2004, [www.fiskeriverket.se/pdf/om\\_fiskeriverket/engelsk.pdf](http://www.fiskeriverket.se/pdf/om_fiskeriverket/engelsk.pdf) 29/04/06, FAO 2004b, S.E.A.C. 2006

<sup>53</sup> Sea Fisheries (Shellfish) Act 1967, s.1 as amended; Sea Fisheries Act 1969, s.15(1),(2); Sea Fisheries Regulation (Scotland) Act 1895, s.10.

<sup>54</sup> Halsbury's Laws of England – Fisheries. [www.lexisnexis.com/uk/legal](http://www.lexisnexis.com/uk/legal) 20/5/2006

<sup>55</sup> Licensing of the fishing industry is administered by DEFRA. The Welsh Assembly Government introduces secondary legislation, to enforce directives in Wales with respect to net sizes, vessel licences, days at sea etc.

byelaws for the regulation of fishing methods, gears, fishing seasons and minimum landing sizes<sup>56</sup> (Sea Fisheries Regulation Act 1966, s.5, Sea Fisheries (Byelaws) Regulations 1985: 1785).

No licence is required for recreational sea fishing in England and Wales or for the collection of bait for personal use in most cases. This extends to tidal watercourses as well as the sea. A migratory fish licence from the National River Authority is, however, required to catch salmon or sea trout in England and Wales. A licence may also be required from the relevant harbour authority to fish off some piers and jetties. Digging for bait in harbours, in the area of commercial shellfish beds and areas designated under section 9 of the Wildlife and Countryside Act 1981 as amended, may be subject to prohibitions. Recreational fishers are also obligated to comply with minimum landing sizes<sup>57</sup> and gear design specifications set for fisheries as a whole, with the retention of under-sized fish and shellfish prohibited (Sea Fish (Conservation) Act 1967 as amended by the Fisheries Act 1981), including fish or shellfish used for bait. These national provisions are supplemented by the aforementioned local Sea Fisheries byelaws, which contain many of relevance to MRF, as indicated in Table MM.<sup>58</sup> Most species, however, are not currently subject to specific management arrangements and recreational vessels for these species can fish unrestricted. However, certain species are protected, as with Allis Shad (*Alosa alosa*), which it is illegal to catch or land, and boat fishers are subject to bans on landings of TAC species (e.g. cod) where implemented (which affect commercial and recreational fishers alike), and are required to comply with bans or restrictions on fishing for bass in bass nursery areas<sup>59</sup>. In respect of the provisions for cod and bass here mentioned, shore fishing is exempt.

In Northern Ireland the legal provisions for sea fishing are very similar, in that a fisher does not require a licence for sea fishing as long as the catch is not presented for sale. Fishers, however, are required to comply with minimum size and other fisheries legislation<sup>60</sup>.

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<sup>56</sup> These byelaws can be more but not less stringent than national or European fisheries legislation.

<sup>57</sup> No person is permitted to land any undersized sea fish (Sea Fish (Conservation) Act 1967 as amended by the Fisheries Act 1981. The National Federation of Sea Anglers also has its own list of minimum sizes, below which the fish must be returned to the sea.

<sup>58</sup> Note that there are also similar byelaws in France and elsewhere, but it was not possible to access English translations of any other country's secondary legislation.

<sup>59</sup> The Bass (Specified Areas) (Prohibition of Fishing) (Variation) Order 1999.

<sup>60</sup> Environment Agency, 2006. Recreational Fishing and Angling. [www.netregs.gov.uk](http://www.netregs.gov.uk), 24/04/2006.

**Table 2.1: Extracts for English and Welsh Sea Fisheries Committee Byelaws with relevance to MRF**

Byelaw provisions	NE	N	S	NWNW	SW
Prohibiting the taking from the fishery of fish below the specified minimum size			*	*	*
Prohibition on the use of <i>Cancer pagarus</i> for bait	*	*			
Prohibition of the fishing for or taking of any 'V' notched or mutilated lobsters	*	*		*	*
A maximum of 'A' pots or 'B' m of net to fish for or take for personal consumption only, a daily maximum of 'C' lobster, 'D' crabs, 'E' whelk, 'F' Crawfish) and 'G' prawns. The catch must be landed the same day and not stored in a keep pot or similar device.	A=10 B=100 C=2 D=10 E=30	A=5 B=100 C=1 D=5 E=20	C=2	C=2 D=5 E=5kg F=1 G=1kg	
Within a specified area, unless in possession of a permit, a maximum of 'H' kg of cockles per day may be taken.	H=5				H=8
Prohibition of taking soft-shelled or berried edible crab or lobster		*			
The requirement to return shellfish where its removal from the fishery, possession or sale is prohibited		*		*	*
Requirement to mark submerged fishing gear at the surface, identifying also the owner or vessel		*		*	*
Prohibitions on fishing for periwinkles ( <i>littorina littorea</i> )			*		*
Prohibition of fishing for bivalve shellfish except by hand or certain stipulated fishing gear				*	*
Prohibition of fishing for or taking oysters from a public fishery between 1 <sup>st</sup> May and 31 <sup>st</sup> October and between sunset and sunrise			*		
Prohibition on fishing for, taking or removing cockles in a specified fishery on a Sunday and between sunset and sunrise					*
Prohibition of fishing for or taking scallop ( <i>Pecten maximus</i> or <i>Chlamys opercularis</i> ) from a specified area					*
Prohibition of fishing for or taking scallop between 1 <sup>st</sup> July and 31 <sup>st</sup> December				*	*
Prohibition of fishing in certain stipulated bass nursery areas					*

#### Notes

NE=North Eastern Sea Fisheries Committee, N=Northumberland Sea Fisheries Committee, S=Sussex Sea Fisheries Committee, North Western and North Wales Sea Fisheries Committee, SW=South Wales Sea Fisheries Committee

Similar provisions also hold for Scotland, with there being no requirement for a licence for MRF. However, under Common law, permission from the Crown or the party vested with Crown rights is required to fish there for salmon (and as an inferior right, sea trout), including in estuaries and the sea. In Scotland, salmon fishing rights have long been regarded as *regalia minora*, vested in the Crown for the patrimonial benefit of the Crown<sup>61</sup>, and are heritable titles with the rights granted to private individuals, companies and local authorities. Under the Salmon and Freshwater fisheries (Consolidation)(Scotland) Act 2003, 'any person who without legal right, or without written permission from a person having such right, fishes for or takes salmon in any water, including any part of the sea within 1.5km of mean low water springs, he shall be guilty of an offence...' (s.6). Conditions can be attached to any permission, but cannot exceed the rights held by the owner of the right.

Supplementary to the permission to fish, there is a ban on fishing for salmon on Sundays, and with nets or traps between 6pm on Friday and 6am on Monday, and during the annual close time (s.14), which generally runs from the end of August to mid-February. Only rod and line fishing is permitted during this period and only during certain periods specified (s.14). The lawful methods of fishing for salmon in marine waters of the salmon fishery districts, which extend seawards for 5km from mean low water springs, include rod and line (defined as a single rod and line with such bait or lure as is not prohibited), net or coble, or bag net, fly net or other stake net (s.1(2)). The use of fish roe, fire or light as bait or lure (s.4) is prohibited with respect to rod and line fishing, as is the use of explosives or noxious substances generally (s.5). Further, no person may sell any salmon taken within the limits of the Act during the annual close time (s.16). Note that salmon fishing around Orkney and Shetland is governed by the Norwegian system of Udal law, which preceded the feudal system and does not entail Crown ownership, the rights running with land ownership (Scott Robinson 1990).

In terms of commercial fishing, each of the four UK fisheries departments are responsible in their area for administering the UK Fishing Vessels Restrictive<sup>62</sup> Licensing Scheme, which requires all UK registered vessels<sup>63</sup> or British owned vessels fishing for sea fish for profit to be licensed (Sea Fish (Conservation) Act 1967, s.4 as substituted by the Fisheries Limits Act 1976, s.3), unless the vessel falls into one of the following categories:

- it is used wholly for conveying recreational anglers
- it will only fish within 12nm of the Isle of Man, Jersey or Guernsey to which separate licensing requirements apply
- it will fish only for salmon or migratory trout
- it is 10m or less in length and without an engine

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<sup>61</sup> Anderson v Anderson (1867) 6 M 117, 40 J 87, following Duke of Sutherland v Ross (1836) 14 S 960 (Scott Robinson 1990).

<sup>62</sup> No new licences are being issued. New entrants need to secure a licence entitlement from an existing holder and then apply to have the licence in your own name.

<sup>63</sup> Note that a fishing vessel over 10m in length must first be registered with the General Registry of Shipping and Seamen and be in possession of a Certificate of Registry prior to the award of a licence (Merchant Shipping (Registration, etc) Act 1993). Registration requires the owner to hold British citizenship or European citizenship with UK incorporation or UK place of business, and in any event the vessel's management, control and direction is to be from within the UK (Merchant Shipping Act 1995).

- it is 10m or less in length and fishes for common eels

The licence is granted to the owner of a named vessel and may authorise fishing generally or confer limited authority in terms of the: 1) areas which may be fished, 2) periods, times or particular voyages during which fishing is authorised, 3) descriptions and quantities of fish that may be taken, and 4) methods of sea fishing (Sea Fish (Conservation) Act 1967, s.4(5), as substituted by the Fishery Limits Act 1976, s.3). The licence can also be granted unconditionally or subject to such conditions as the relevant Minister considers necessary or expedient for the regulation of sea fishing, including where and in what manner the fish are to be landed, the use to which they may be put and restrictions on time spent at sea. Correspondingly, attached to each licence is a category that identifies the stocks that can be targeted and associated conditions, including vessel quotas distributed through producer organisations or directly by the Fisheries Departments for the 10m and under fleet and vessels not belonging to a producer organisation. The licences are open to variation throughout their validity (Sea Fishing (Licences and Notices) Regulations 1994), to facilitate the implementation of changes in quota management arrangements. They also have provision for transfer between vessels and vessel owners, provided certain provisions are met<sup>64</sup>. In addition to the three main categories of licence, special licences or endorsements are required for certain fisheries for which special access arrangements apply. For example, the commercial, targeted capture of certain specified shellfish requires a fishing vessel licence to be endorsed to allow unrestricted fishing using pots or nets for lobsters, crawfish, edible crabs, velvet crabs, spider crabs or green crabs. Without an endorsement a vessel is not permitted to retain onboard or land over 5 lobsters or crawfish and 25 crabs a day from pots or nets or over 5% by weight of total catch caught by towed gear<sup>65</sup>.

There are no general restrictions on the type of fishing gear that can be used for sea fishing<sup>66</sup>, unless prescribed under local sea fishery committee byelaws or orders regulating the construction, design, component materials and size of fishing gear, minimum landing sizes and closed areas and seasons in accordance with European legislation (Sea Fish (Conservation) Act 1967, ss.4, 5 as amended by the Fisheries Act 1981, s.22). As for all other member states, both European and national technical management measures apply. Despite the gears differing between commercial and recreational fisheries and therefore the applicability of certain of these technical management measures, recreational fishers are equally bound by their provisions as are commercial fishers.

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<sup>65</sup> Department of Agriculture and Rural Development 2006 Explanatory Leaflet – Restrictive Licensing Scheme for Shellfish: Guidelines. [www.dardni.gov.uk/fisheries/file/fish0027.doc](http://www.dardni.gov.uk/fisheries/file/fish0027.doc), 16/05/2006.

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## Annex 3. Review of methodology for economic evaluation of MRF (Chapter 4)

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### Introduction

This section presents the general methodological issues relating to the economic assessment of the importance of MRF and associated industries. It is based primarily on a desk-based review of published academic and other relevant literature, sourced from both within and outside the EU, particularly drawing from the rich vein of North American literature on the subject. MRF economic data and associated methodological literature are scarce in the EU. Therefore, where appropriate, we have included information relating to freshwater recreational fisheries, to indicate how methodological issues relating to MRF might be dealt with in the EU in the future.

The methodological review begins by developing a robust understanding of the most appropriate and meaningful way to describe the economic importance of MRF. It also sets out the way in which the economic benefits of the recreational activity might be compared with those derived from other sectors, notably commercial fishing. The merits of estimating gross, as opposed to net, contribution to the economy are discussed, as well as the importance to policy makers of valuing the economic impact of marginal changes in recreational or commercial fisheries.

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### Valuing marine recreational fisheries: theoretical overview

Both recreational and commercial fishing activities generate economic benefits. While this fact is incontrovertible, deriving comparative values for these benefits is far from straight forward. This may be because the activities themselves are not directly comparable. One activity – commercial fishing – provides a market-based measure of value through the provision of goods (i.e. fish) to the general community. The other – recreational fishing – provides no marketable goods (except in the case of charter boat fishing where the good is fishing trips), and hence provides only non-market benefits related to the ‘enjoyment’ and ‘recreational experience’ derived from a MRF trip. Expenditures made in relation to both recreational and commercial activities also provide direct, indirect and induced economic effects within the economy, which can be measured at both the regional and national levels. However the gross and marginal effects of a change in these expenditures are highly dependent on the extent to which they are substitutable or could be transferred to other sectors or regions of the economy.

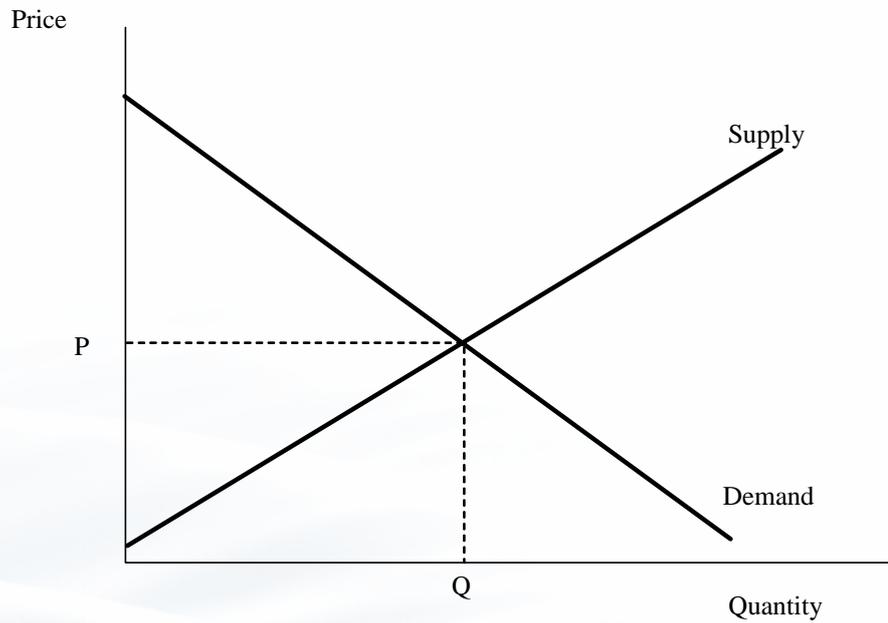
In the following sections, the basic economic theory underlying the valuation of both marine recreational and commercial fishing is presented, together with a brief review of non-market valuation techniques and an analysis of regional economic impacts. Finally, the appropriate economic method for comparing these activities is identified and discussed.

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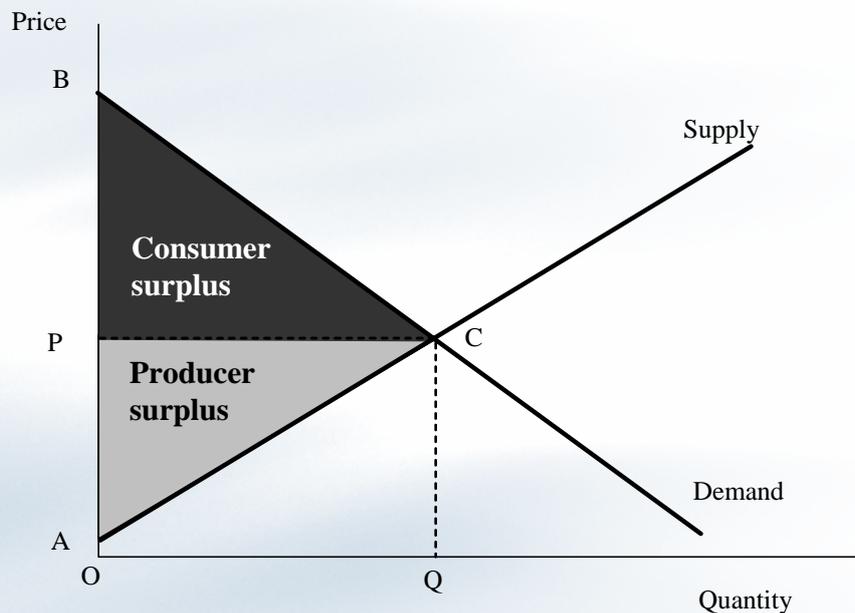
### Economic benefits – an introduction

The derivation of economic benefits are most easily demonstrated by first considering market goods rather than non-market goods. The price of a good is a function of both its supply and demand. In

**Figure A3.3**, the quantity of the good demanded is shown to decrease as price increases. At least some individuals are willing to pay a high price if few of the good are available, but if many are available the price must decline in order to clear the market.



**Figure A3.3** *Supply and demand for a market good*



**Figure A3.4** **Consumer and producer surplus**

The supply of the good relates to its cost of production. At a low price, only the most efficient producers are able to operate, resulting in a low total quantity supplied. As prices increase, less efficient producers enter the industry, resulting in increased supply. Hence, the supply of the good increases with increasing price.

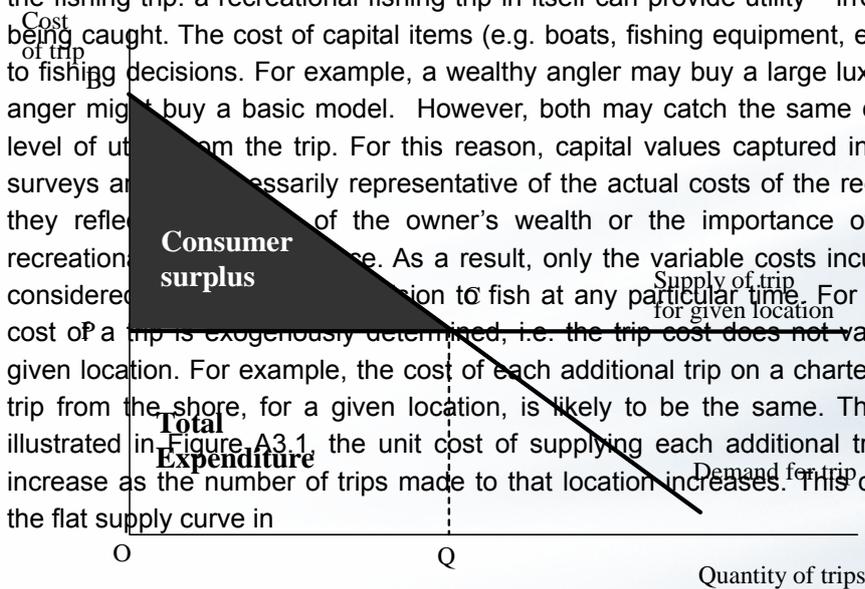
If markets are working efficiently, then the supply and demand for the good will equate at quantity  $Q$  and price  $P$  (Figure A3.4). If some consumers are actually willing to pay *more than* the market price ( $P$ ) for the good, if they purchase at the lower price  $P$  they are effectively receiving a non-market benefit. The total amount of benefit accruing to these consumers, i.e. the difference between what they would be willing to pay as compared to what they actually pay – the *consumer surplus* – is therefore given by the area  $PBC$ .

The total cost of producing the good (by all producers) is given by the area under the supply curve, namely  $OACQ$ . Hence, there exists a surplus accruing to the production industry, i.e. the difference between the total revenue generated from sales and the total cost of production, given by the area  $APC$ . This surplus - *the producer surplus* - represents the benefits accruing to the producers from being able to sell the good at market price  $P$ .

### Economic benefits of the MRF activity

The supply and demand for MRF activities exhibit similar characteristics to those illustrated above for a market good. Although the activity of recreational fishing results in the harvesting of fish (which for the most part cannot be sold legally<sup>67</sup>), there is considerable evidence to indicate that the quantity of fish harvested is less important than the fishing experience itself. Recreational demand is, therefore, usually expressed in terms of quantities of trips rather than catch of fish<sup>68</sup> and varies inversely with the cost of a fishing trip.

Determining the costs of recreational fishing trips is itself problematic due to the multi-attribute nature of the fishing trip: a recreational fishing trip in itself can provide utility<sup>69</sup> irrespective of whether any fish are being caught. The cost of capital items (e.g. boats, fishing equipment, etc.) is also not necessarily linked to fishing decisions. For example, a wealthy angler may buy a large luxury boat whereas a less wealthy angler might buy a basic model. However, both may catch the same quantity of fish or gain the same level of utility from the trip. For this reason, capital values captured in recreational fishing expenditure surveys are not necessarily representative of the actual costs of the recreational fishing activity. Rather, they reflect aspects of the owner's wealth or the importance of other attributes in the overall recreational experience. As a result, only the variable costs incurred within an individual trip are considered in the decision to fish at any particular time. For the individual fisher, the variable cost of a trip is exogenously determined, i.e. the trip cost does not vary with the number of trips for a given location. For example, the cost of each additional trip on a charter boat or the cost of each fishing trip from the shore, for a given location, is likely to be the same. Therefore, unlike the supply curve illustrated in Figure A3.1, the unit cost of supplying each additional trip for a given location does not increase as the number of trips made to that location increases. This constant relationship is shown by the flat supply curve in



<sup>67</sup> See the previous discussion about definitions of MRF activities.

<sup>68</sup> One exception to this is salmon fishing, where economic values – calculated in the most part for inland fisheries - tend to be expressed as value per fish (Radford *et al*, 2001). In the UK the market value of salmon fishing rights, for example, is generally valued based on a unit price per average number of fish caught in preceding years.

<sup>69</sup> Utility is a general term used by economists to capture all benefits (market and non-market) derived from a good or service.

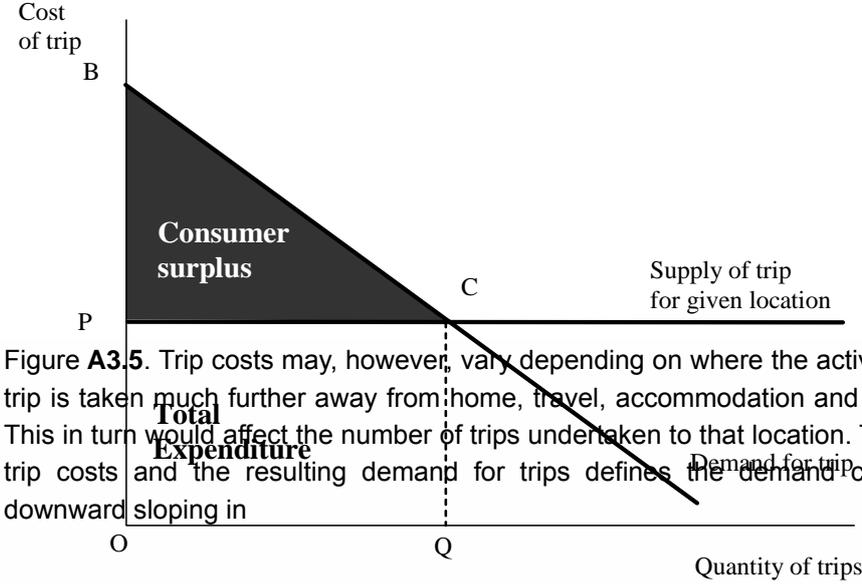


Figure A3.5. Trip costs may, however, vary depending on where the activity takes place. For example, if a trip is taken much further away from home, travel, accommodation and food costs are likely to increase. This in turn would affect the number of trips undertaken to that location. This relationship between varying trip costs and the resulting demand for trips defines the demand curve, which is shown as being downward sloping in

Figure A3.5.

Hence, the equivalent supply and demand for recreational fishing activity for an individual fishing at a given location can be seen in Figure A3.3. Supply is assumed to be unlimited and provided at a given price.<sup>70</sup> The demand for the activity decreases as the cost of undertaking the activity increases.

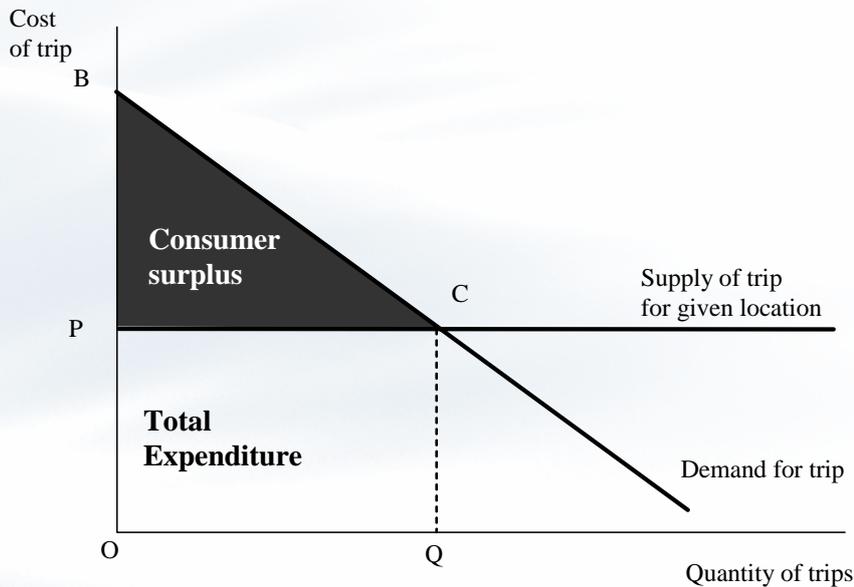


Figure A3.5 Demand for recreational fishing trips for a given location

As with the market good, some recreational fishers may be willing to pay more per trip than it actually costs them to fish. As a result, *consumer surplus* exists, and this represents the economic benefits (i.e. utility) generated by the recreational fishing activity. Several attempts have been made to measure this economic benefit in recreational fishing (e.g. McConnell, 1978, Englin *et al.*, 1997; Wheeler and Damania, 2001; Shrestha *et al.*, 2002; Cantrell *et al.*, 2004) using a number of non-market valuation methods that are described below.

In general, marginal measures of consumer surplus are more useful to decision makers than are gross estimates: it is far more likely that marine recreational fisheries will be affected by marginal changes in

<sup>70</sup> In practice, supply is not unlimited as a site could only support a limited number of fishers. Crowding would also decrease the enjoyment at the site, effectively increasing the social cost (although not affecting the financial cost). For the purposes of simplification, these limits are not considered binding.

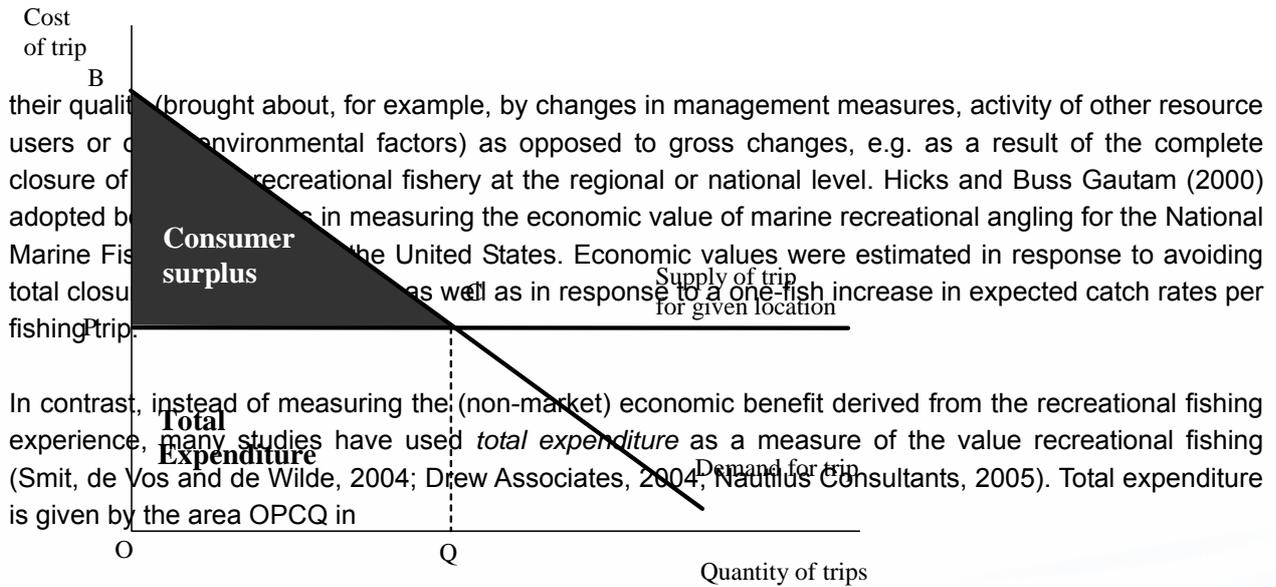


Figure A3.5. The implicit assumption behind this measure is that recreational fishing must be worth at least this amount, as fishers have been observed incurring these costs.

However, total expenditure on recreational fishing *per se* is not an economic benefit, as it involves the consumption of resources that (most probably) could have been used elsewhere in the economy and is, therefore, in economic terms, a cost to society resulting from the activity. For example, if MRF were to become unavailable for some reason in a region (or country), it is likely that many participants would switch to another form of activity (e.g. freshwater angling or another hobby or activity). In this case, previous expenditures on MRF would simply be transferred to the other activity and hence expenditures in the regional (or national) economy as a whole would remain unchanged. There may, however, be some dedicated local recreational fishers who would choose to carry on with the activity, but would be forced to go to another region (or country) to do so. In this situation, a proportion of their expenditure would be lost to the regional (or national) economy, and expenditure estimates would provide a measure of economic benefit that would be lost to the economy if the activity were to become unavailable – but only for that proportion of expenditure that is spent elsewhere. Foreign/non-local visiting anglers would, however, be forced to fish in an entirely different region (or country) and would not make any local expenditures. In this special case, their gross expenditure would be entirely lost to the region (or country), and their lost gross expenditure would provide a true measure of economic benefit from the recreational activity.

To deal with these effects of expenditure substitution and displacement in response to changes in the fishing experience or availability, it is, therefore, most appropriate to estimate the *gross and marginal substitution and displacement effects* on expenditure at the local, regional and national levels, rather than simply estimating total expenditure on the activity as a measure in itself.

Furthermore, expenditure is linked to the national and regional economic impacts of the activity, as expenditure contributes to employment and income generation in other sectors of the regional economy. Therefore, true measures of the gross and marginal economic impact of changes in expenditures on MRF are best estimated by tracking their direct, indirect and induced impacts on the regional or national economy taking full account of possible substitution or displacement effects resulting from changes in these expenditures.

## Non-market benefit valuation methods

The supply and demand functions for marketable goods can be derived from observable information (i.e. market prices for fish, cost of a charter boat fishing trip, costs of production etc). However, a market price does not exist for recreational fishing activity. Hence, other approaches are necessary to derive the recreational fishing demand curve. The three most common approaches employed are the travel cost, contingent valuation and choice-based experiment (also known as conjoint) methods.

The **travel cost method** is based on *revealed preferences*. That is, it is based on observable behaviour in response to changes in the cost of undertaking the recreational activity. The assumption underlying the travel cost method is that fishers who incur lower costs (including the cost of time spent travelling to a site) in undertaking the activity (e.g. by living closer to the coast) would undertake more trips. By comparing the actual number of trips taken to a site with the actual cost of participation to those recreational fishers, a demand curve can be derived. From this, total (and marginal) consumer surplus can be estimated.

Travel cost is an expenditure-based technique. A consequent difficulty with the approach in the MRF context is that the activity is often part of a broader “package” of activities. For example, whilst some fishers go on holiday with the sole intention of fishing, many fishers undertake recreational fishing as one part of their holiday experience. These anglers will, therefore, have high travel costs, potentially including flights, accommodation and other general holiday expenses, and disentangling which of these costs are specifically related to fishing can be problematic. Similarly, purchases of boats and other capital items (e.g. four-wheel drive vehicles to tow the boat) can also be considered expenditure on the activity. However, it is likely that these provide benefits other than those directly related to recreational fishing. For example, a day spent on a boat may produce benefits irrespective of whether the owner fished or not. The estimation of *marginal* travel costs (i.e. those directly related to the trip) can help reduce this bias.

The basic travel-cost method is not suited to considering changes in site quality, as it determines values for activity at a site in a given period in time, which limits its use in respect of policy-related analysis. However, when combined with **random utility modelling**, the effect of changing qualities or quantities of the recreational activity can be tested for a particular site by focusing on the choices that people make when deciding where to carry out their activity (Ozdemiroglu *et al*, 2006).

The **contingent valuation method** attempts to derive measures of consumer surplus directly through asking participants how much they would be willing to pay on top of their actual fishing trip-related expenditures to participate in the activity. This technique provides a direct estimate of the consumer surplus related to the activity (as it is over and above the actual cost of participation). This *stated preference* requires that questionnaire surveys take time to develop to ensure that the element being valued is clearly defined and an appropriate hypothetical market and payment method for that element is constructed. Results can be inherently subject to bias, as individuals are not actually asked to pay anything. Supporters of an activity may overstate their willingness to pay (WTP) if they believe that the response will somehow positively influence the activity. Their responses ultimately depend on how much they know about the element being valued and how much they are told in a neutral manner in the questionnaire. Respondents' WTP may also vary depending on their level of personal wealth. However, methodological developments over recent years have enabled some of these biases to be minimised. In particular, the double-bound approach reduces the potential for overestimating WTP. The respondent is

first asked if they are willing to pay a given amount for access to the resource. If they are (or are not), then they are asked if they are willing to pay a specified higher (or lower) amount. The initial amounts are varied randomly (i.e. some people are asked a high initial figure, others asked a low initial figure). Construct and validity tests should also be carried out to ensure that results conform to expected theory (Arlinghaus & Mehner, 2004).

A related stated-preference method to the contingent valuation approach is the **choice-based experiment** approach. Participants are presented with “packages” of attributes relating to the fishing trip experience with at least some components being capable of being independently valued. These attributes could be, for example: number of fish caught of particular species, variety of species being caught, size of fish, environmental factors, management restrictions, cost of trip, etc. The monetary value attached to each particular component of the package can be derived given the preferences elicited by those surveyed for different packages. Choice modelling is flexible in that it allows for the effect of potential (and marginal) changes in the fishing trip to be analysed. As with the previous methods, choice modelling requires detailed econometric analysis of results to elicit values. Additionally, there is a trade-off between the number of attributes that can be tested within a “package” and the number of survey responses required for analysis. The more combinations that respondents are asked to compare, the more difficult it becomes for respondents to process and compare the combinations effectively. Larger survey populations are required in this situation to ensure meaningful comparisons are made by each respondent (Ozdemiroglu *et al*, 2006).

While both the travel cost and contingent valuation method are susceptible to bias, they can also produce reliable estimates of recreational benefits if correctly undertaken. Travel cost estimates should be based on marginal, rather than average, costs in order to avoid problems associated with capital costs. Contingent valuation studies, in which values are directly asked – as opposed to through a carefully constructed hypothetical good and payment method - should be viewed with caution. Those carried out according to respected guidelines (for example, Arrow *et al*, 1993) produce valid results. Choice-based experiments allow for marginal changes in the characteristics of activity to be valued, thus providing the means to determine the impact of potential changes in the activity.

In order to derive an appropriate measure of consumer surplus using either the travel cost, contingent valuation or choice-based methods, a survey of participants is necessary. Contingent valuation and choice-based studies generally require considerably larger samples than travel cost studies - especially if the double-bound approach is used for contingent valuation (which is the preferred approach). Under choice-based analysis, the more attributes an activity has, the more comparisons are required to effectively analyse results, and this substantially increases the number of respondents required.

It is also important to note that extrapolating results from any method to derive estimates of total gross or marginal benefits requires additional estimates of the total number of participants for which census-based information – particularly for the recreational fishing sector - is often not available, and this has to be generated.

**Benefits transfer** involves transferring economic benefits derived for one particular study site to another without undertaking any new primary research. Economic values derived per unit of ‘good’ are either transferred from one site to another in an unadjusted or adjusted form, or a more complex method of

transfer can be undertaken by applying the coefficients describing the WTP and the factors influencing it (i.e. the WTP function) to the new site. The advantage of benefits transfer is that it provides a method of deriving an estimate of economic value for a new site without having to pay for the cost of site-specific primary research.

Benefits transfer is reliant on the quality, focus and analytical method of existing studies – none of which may be ideal - and assumes that new site is sufficiently similar to the previously studied site to allow for direct transference of results and therefore method. Whilst the technique may provide estimates of the order of magnitude for new sites, results have been found to differ by up to 75% if outliers are excluded and up to 450% if they are included (Brower, 1999; Bateman *et al*, 1999). The consensus based on ongoing research is that the approach is unreliable and should only be used as a form of initial screening to decide whether original valuation research should be undertaken (Bateman *et al*, 1999).

### Regional economic impact estimation methods

Another measure of economic benefit from the MRF activity can be estimated by determining the impact that related expenditures have on the local and national economy. Marine recreational fishers purchase goods and services from the local economy, which in turn create employment and income in the region. This increased income is further used in the economy to purchase goods and services, creating second and subsequent rounds of benefits. This “multiplier” effect can be estimated through the use of Input-Output analysis. Some recent examples of regional economic impact of recreational fishing include Steinback (1999) analysing marine charter boat fishing in the Maine, USA, Upneja *et al.*, (2001) on sport fishing and angler wildlife watching in Pennsylvania, USA and Radford, Riddington and Anderson (2004) on freshwater angling in Scotland.

When dealing with expenditure estimates, it is important to determine which proportion of expenditure items and services are wholly or partly attributable to the recreational fishing activity. For example, holidaymakers may attribute only a small part of their total holiday spend to any recreational fishing activities they pursue whilst in the area. Henry and Lyle (2003) adopted such an approach as part of ‘The Australian National Recreational Fishing Survey’ by asking respondents which proportion of their expenditure was wholly or partly attributable to the recreational activity.

As noted previously, economic impacts are based on the variable (/marginal) component of expenditure rather than benefits. A difficulty with regional economic impact assessments occurs if an implicit assumption is made that the expenditure would not be incurred if the activity was not undertaken. In the case of MRF, which by definition is a recreational activity, if the activity was not available then it is likely that much expenditure would still take place, but instead it would be spent on an alternative recreational activity. This is particularly the case in many coastal communities where MRF is undertaken by tourists visiting the area. These visitors have the highest expenditure (due to the higher travel and accommodation costs) compared to local fishers, although they would, in many cases, probably still visit the area if they were unable to participate in recreational fishing. However, it is also likely that a proportion of dedicated local anglers would choose to travel elsewhere outside the region to be able to continue to fish. In this case, a net negative effect on regional expenditure would result. It is therefore important to determine the displacement effect of expenditures in the event of a restriction or negative change in the fishing experience. Radford, Riddington and Anderson (2004) adopted such an approach whilst determining the economic impact of game and coarse angling in Scotland, by making implicit

assumptions about the likely displacement effects on local, non-local Scottish and non-Scottish visiting angler's expenditure in response to a closure of a particular region's fishing opportunities.

Similarly, provision of enhanced MRF opportunities may result in a substitution of recreational activities within the area rather than produce a net increase in recreational expenditure, i.e. more people might take up angling and so spend less on other hobbies. The net economic impact may be increased, decreased or the same, depending on which activities were replaced by the recreational fishing, and the extent of substitution compared with additional recreational activity.

Unless gross and marginal substitution and displacement effects are specifically modelled, variable expenditure-induced regional economic impact analyses can be of limited value, and potentially misleading, for use in the decision-making process determining the optimal management of marine recreational fisheries.

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## Comparing marine recreation and commercial fishing activity values

Economic values can be estimated for both marine recreational and commercial fisheries. However, the usefulness of comparing these measures is limited due to the difference in basic approach required to measure the values between the sectors, and the impact of management changes on these values.

### Economic values of commercial fishing

Commercial fishing differs from recreational fishing in that it produces a marketable good (i.e. fish), which itself has a demand, and an observable cost of production (i.e. the cost of fishing). Therefore, the economic benefits generated by the fishing industry could be expressed as a combination of the both the consumer and producer surpluses – as discussed in the introductory part of this section.

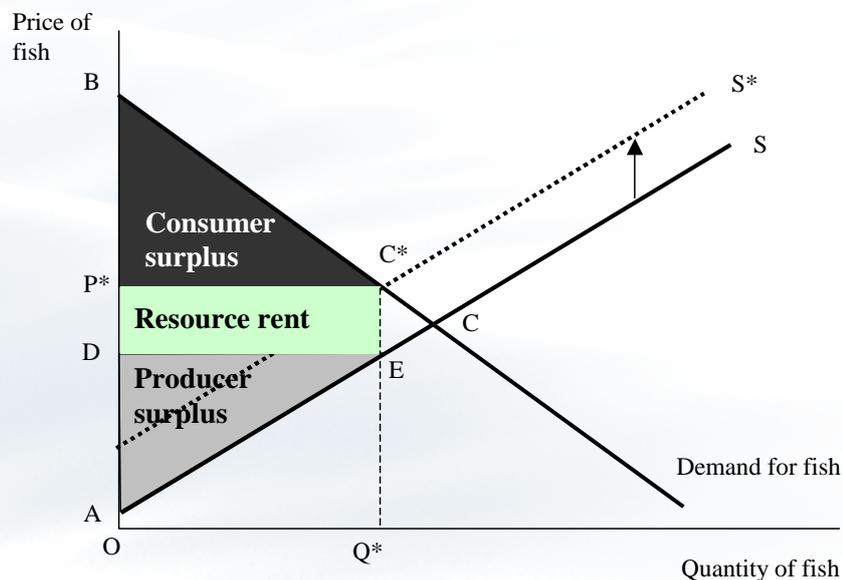
The process of deriving appropriate measures of consumer and producer surplus for commercial fisheries, however, is less straightforward. The supply curves shown in

**Figure A3.3** and Figure A3.4 do not take into account the cost of using the fish resource itself. This is because the fish resource tends to be unpriced, i.e. resource rents are generally not collected by government (on behalf of society) in return for allowing fisher to exploit the resource<sup>71</sup>. In such cases, fisheries tend to become overexploited as the true operating costs are undervalued and so excess capital

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<sup>71</sup> Iceland and Australia have introduced resource rent charges to parts of the commercial fishing sector. Some other countries charge access or use fees that have a similar effect, but are theoretically different in nature – they are lump sum payments as opposed to scaled charges designed specifically to capture the full amount of resource rent.

and effort is invested in the fishery, resulting in subsequently lower long-term yields of fish. Imposing a limit on production equivalent to a long-term sustainable yield (or imposing a tax on landings that shifts the supply curve from  $S$  to  $S^*$  making it more expensive to operate in the fishery) results in a reduction in both consumer and producer surplus, but the generation of resource rent (Figure A3.6.4).<sup>72</sup> If this rent is not extracted, it accrues to the industry. As prices are higher, it effectively results in a transfer of some benefits from consumers to producers. While there is an apparent loss of total surplus equivalent to  $CEC^*$ , this is an artefact of excluding the full costs of production. Although total surplus may have been greater in the short run, it would have resulted in a decline in stocks in the longer term, thereby increasing the costs of production, causing a decline in output and an increase in prices without the generation of any resource rent.



**Figure A3.6 Resource rent in commercial fisheries**

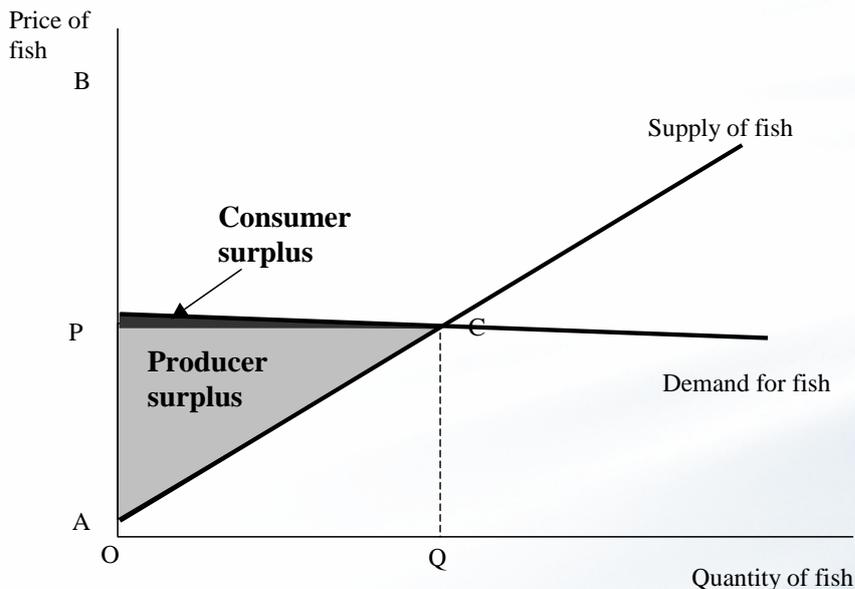
In any commercial fishery subject to management, the potential for generating some resource rent exists. In practice, however, relatively few attempts have been made to separate out resource rent from producer surplus ((total) economic rent). Economic surveys (i.e. cost and earnings surveys) have been undertaken to estimate average profitability in commercial fisheries, which can be used to derive estimates of total profits<sup>73</sup> for the fishery. In some cases, estimates of “resource rent” have been derived by subtracting a

<sup>72</sup> Similarly, resource rent can be generated by measures that increase the size of the stock, thereby lowering the cost of production. In this case, the supply curve shifts downwards. Constraining output at the lower level (rather than permitting output to increase as stock increases) results in the generation of economic rent.

<sup>73</sup> Economic profits differ from accounting profit. Accounting profit represents the difference between the revenues generated by the sale of goods and the price paid for inputs required to make these goods. Economic profit is the difference between the revenues generated and the total *opportunity cost* of the inputs. Opportunity cost is the cost of an input in terms of the next best alternative use for those inputs and so represents the benefit foregone from that next best alternative. Economists consider opportunity costs because they take the view that all of society’s resources (available inputs) are scarce and hence trade-offs have to be made in deciding how best to use these resources. Opportunity costs help in understanding the true cost of these trade-offs.

“normal” return to capital and labour from the estimated profits.<sup>74</sup> However, this also results in the producer surplus being included in the “resource rent” estimate (see Coglán and Pascoe, 1999). Nevertheless, the combined resource rent and producer surplus represents the economic benefits accruing to the producers, i.e. the commercial fishers.

A common assumption in many estimates of the value of commercial fishing is that consumer surplus associated with the consumption of fish is negligible if not zero, and can subsequently be ignored. Consumer surplus depends on the slope of the demand curve – the steeper the demand curve then the greater the level of consumer surplus. For most fish species the demand curve is relatively flat<sup>75</sup>, so prices do not vary substantially with changes in landings (Nielsen, 2005) (Figure A3.7).<sup>76</sup> This is largely due to the existence of a large number of generally highly substitutable species and a potentially global supply of substitutes. A stock decline in one species is more likely to result in an increased consumption of another, more abundant, species than a substantial increase in the price. In such a case, consumer surplus is negligible, with all benefits accruing to the industry.



**Figure A3.7 Benefits with “inflexible” demand for commercially caught fish**

<sup>74</sup> Financial estimates of “profits” include normal returns to capital and labour. However, these are economic costs and should therefore be excluded from the economic profit measures. Another value measure often employed in commercial fishing is “value added”, which is the sum of financial profits and incomes generated. As labour has an opportunity cost, (that is, the labour could be used elsewhere in the economy if not used in fishing) value added is not an economic value. Both revenue and value added are attractive measures of the value of a commercial fishery as they often are large numbers.

<sup>75</sup> Particularly whitefish species in markets without high levels of integration.

<sup>76</sup> This is referred to as demand being highly elastic, or highly price inflexible. In contrast, a steep demand curve is referred to as being highly inelastic, or price flexible.

The value of commercial fishing is also often expressed as its total revenue, given by  $P*Q$ , which can be represented by the area OPCQ in Figure A3.7. This provides an “optimistic” and overestimated value as it does not take into account the costs of production. A fishery could have a high revenue, but be producing few economic benefits if poorly managed (as the resource rent would be dissipated and costs of production may be high). Conversely, a well managed fishery with lower total revenue could potentially produce higher economic benefits. Therefore, gross revenue, while a readily derived estimate of value, provides little information about the economic value of the fishery.

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## Methods for comparing marine recreational and commercial fishing values

Comparing economic values associated with marine recreational and commercial fishery is complex. Two methods are proposed to enable comparison from a theoretical point of view. In practice, the choice of method may depend to a large extent on the availability of data required to make the comparisons or the ease with which it could be collated.

Economic comparisons between marine recreational and commercial fishing sectors usually focus on specific species that are targeted by both sectors, e.g. tuna and billfish (Galeano *et al*, 2004), Atlantic salmon (Indecon International Economic Consultants, 2003) and sea bass (Dunn, Potten and Whitmarsh, 1995). Comparisons at the gross fishery level encompassing activities targeting a whole range of species are less meaningful as some commercially caught fish species are not attractive to, or targeted by, recreational fishers (e.g. monkfish *Lophius* spp and hake *Merluccius merluccius*) and vice versa for species such as tope *Galeorhinus galeus* and garfish *Belone belone*, which are targeted recreationally but not commercially.

### Method 1 – comparing consumer and producer surpluses

The value of commercial fisheries is derived from the benefits generated in producing a market good – fish – whereas the value of marine recreational fisheries is derived from the benefits related to undertaking an activity or experience. Commercial fisheries are valued primarily in terms of the difference between the revenue generated from selling the produce and the economic cost of producing it. As discussed previously, this difference can be summarised as the *producer surplus* plus any *resource rent* generated. Additionally, any *consumer surplus attributable to the consumer of the fish* itself should also be included.

The commercial fishing activity can also produce non-market benefits that are not captured in the market-based estimates of producer and consumer surplus and resource rent. These include another form of *non-market consumer surplus experienced by the fishers themselves* relating to the value that they place on their way of life. Evidence that commercial fishers experience non-market benefits from participating in the industry is reflected in the fact that fishers stay in the industry even though many could earn higher incomes elsewhere (Smith, 1981).

By comparison, MRF is valued in terms of the difference between what the participant is willing to pay to undertake the activity and what it actually costs them, i.e. the *consumer surplus associated with the*

*recreational fishing experience*. The comparative nature of these value concepts is shown in Figure A3.8 below.

### **Robustness of measures to change**

The economic value of commercial fisheries reflects the effectiveness of management in producing economic rent (i.e. producer surplus and resource rent). A poorly managed fishery may have little or no economic rents being generated. In contrast, the same fishery, if well managed, may produce considerable economic benefits. Therefore, if management were to improve the biological health, and as a result the economic health, of the fishery over time, the economic value of the commercial fishery would similarly increase.

The economic value of recreational fisheries can also change in response to changes in catch rates and abundance. Attempts have been made to produce a recreational fishing value per kg of fish, either by dividing the total value from a “targeted” trip (i.e., where the fisher aimed to catch a particular species) by the weight of target fish caught (e.g. Wheeler and Damania, 2001), or through hedonic-style price estimation<sup>77</sup> with individual species as explanatory variables (e.g. Wheeler and Damania, 2001, Cantrell *et al.*, 2004, Johnson *et al.*, 2005). These values have been compared with the market price of the fish where available. For most species, the marginal value of *catching additional fish* recreationally declined as the number caught increased, although in most cases total benefits increased with an increase in recreational catch (e.g. see Cantrell *et al.*, 2004; Johnson *et al.*, 2005). This is similar to the reaction of market-priced fish, which also tends to decline as the quantity of fish landed increases.

Several studies have also found that the recreational value of some species is inversely proportional to its *abundance* (as opposed to catches as discussed above) (e.g. Wheeler and Damania, 2001, Johnson *et al.*, 2005). This reflects the sports-characteristics of the species, in that the value of catching the fish is a function of the difficulty in catching it – not its consumption value. In such a case, increasing the abundance of “recreational” species could reduce, rather than increase, recreational benefits for some species. Consequently, it is not appropriate to assume that improving stocks will increase recreational benefits in all cases.

### **Method 2 – comparing the economic impact of net expenditures**

A second method of comparing the economic importance of marine recreational and commercial fisheries focuses on examining the economic impact of net expenditures made by each sector. After the effects of substitution and displacement of attributable expenditures have been taken into account, the economic impact of net expenditures on the regional or national economies can be estimated using Input-Output methodologies which track the impact of expenditures between and through all sectors in the economy. Impact estimates in the form of contribution to economic income, output and employment can be derived and compared between sectors for specific fisheries.

A comparison of the impact of estimates of expenditure is perhaps more intuitive than a comparison of measures of consumer and producer surplus to the non-economist. However, this method is not without its own set of problems and constraining factors.

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<sup>77</sup> Hedonic price estimation is a technique that allows the known price or value of a good or commodity to be attributed to the various observable elements which make up that good.

For example, it is unlikely that data are readily available on expenditures relating to specific fisheries, so primary data collection is usually required. The problem of determining the proportion of expenditure that is wholly or partly attributable to the particular activity and/or target species being considered must be addressed. Where multiple species are targeted this could prove difficult, and implicit assumptions may be required to generate the appropriate breakdown or allocation. Information must also be collated about the likely expenditure substitution and displacement effects both within and outside the region resulting from the changes being measured. This generally involves asking respondents specific questions, or making assumptions about how their patterns of activity may change in response to certain events (i.e. the closure of a fishery or the decline of catch rates in a species) – though either method is likely to introduce bias into the results.

Expenditure estimates, particularly for recreational activities, often also include a measure of bias related to the income of the fisher. For example, a wealthy angler may spend far more on undertaking their activity (i.e. staying in more expensive accommodation) than a less wealthy angler. Expenditures for the commercial sector may also vary to some degree within fleet segments as a result of differing attitudes between skippers, but due to the commercial nature of the activity it is more likely that the range of variation is relatively small compared to that experienced in the recreational sector.

A consistent decision must also be taken about whether the economic impacts of variable expenditures (Method 2a in Figure A3.6) will be compared or whether a combination of variable and capital expenditures will be compared (Method 2b). Due to the problems of income bias noted above, it is preferred that only variable expenditures are compared. However, it is also possible to include capital expenditures (consistently between sectors) that reflect the amount spent on fixed inputs such as boats, trailers, fishing gears/tackle, other equipment, etc.

Comparing the impact of net expenditures will provide a reflection of the economic impact of each sector on the regional economy. However, the management objectives for the fishery may be more focused upon maintaining a commercial industry (and associated employment, tourist and community benefits), or it may be more focused upon developing a recreational sector to benefit the well-being and recreational opportunities for local residents. The limitations of focusing solely on either regional economy expenditure impacts (Method 2) or economic benefits at the societal level (Method 1) should be considered.

Whichever method or combination of methods are chosen, the overall objectives fisheries management are very important in determining how the results will be interpreted. Where management is more focused on conservation or social objectives (rather than economic objectives), it might be expected that the commercial fishery would compare unfavourably with a marine recreational fishery in terms of economic value.

Commercial and recreational fishing benefits are not mutually exclusive. Potentially, both commercial and recreational fishery benefits could be enhanced through more effective management that resulted in higher stock levels.

Finally, the issue of how management changes affect both sets of values (i.e. the marginal effects of management) is of key importance when managing fish stocks used for both recreational and commercial activity. Gross or total values are less useful to policy makers, as they represent the total economic loss if

an entire sector (either commercial or recreational) were to cease to exist. It is far more likely that management decisions will focus upon how best scarce fish resources can be shared between sectors, hence the need for economic information relating to marginal effects.

	Marine recreational fishing	Commercial fishing
Method 1	Consumer surplus	Consumer surplus (to fish consumers) Consumer surplus (to fishermen) Resource rent Economic profit
Method 2a	Economic impacts of variable expenditure	Economic impacts of variable expenditure
Method 2b	Economic impacts of fixed and variable expenditure	Economic impacts of fixed and variable expenditure

Figure A3.8 Methods for comparing economic values between sectors

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## Annex 6. References for Issues and Management of MRF (Chapter 6)

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