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Atlantic Ocean

# ***A Draft Marine Research Plan for the European Atlantic Sea Basin*** Discussion Document

WP 6 - Task 6.1

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October 2011



**Disclaimer:**

SEAS-ERA Deliverable 6.1 was produced by the Marine Institute, Ireland (co-author: Geoffrey O'Sullivan) and the Marine Board-ESF Secretariat (co-author: Maud Evrard) for the FP7 SEAS-ERA consortium.

The information and views set out in this report are those of the SEAS-ERA Atlantic partnership and do not necessarily reflect the formal opinion of the Marine Board-ESF or its Member Organisations.

## A *draft* Marine Research Plan for the European Atlantic Sea Basin

### SEAS-ERA WP 6.1

OCTOBER 2011

#### Abstract

A key deliverable of Work Package 6.1 of the FP7 SEAS-ERA Project (May 2010 – April 2014) is to develop **a *draft Marine Research Plan*** as an input to the preparation of **a Strategic Marine Research Agenda for the European Atlantic Sea Basin**.

This **Discussion Document** is designed to engage European Atlantic stakeholders in a wide ranging debate on the content and priorities to be addressed by such a *draft* Research Plan and will be used by the SEAS-ERA Atlantic partners to inform a series of Consultative Stakeholder Workshops scheduled to take place in 2012 ([www.seas-era.eu/np4/events](http://www.seas-era.eu/np4/events)).

This Discussion Document was compiled by the Marine Institute (Partner 9) and the Marine Board-ESF (Partner 18) in collaboration with the SEAS-ERA Atlantic partners (Annex 1).

**EU FP7 Grant Agreement Number 249552**



# TABLE OF CONTENTS

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## **1. Introduction**

- 1.1. The SEAS-ERA Project 6
- 1.2. A Common Structure for the Sea Basin Research Plans 8

## **2. A Shared Vision for the European Atlantic Sea Basin**

- 2.1. An introduction to a Shared Vision 9

## **3. The European Atlantic Sea Basin**

- 3.1. Introduction 10
- 3.2. Geography of the European Atlantic Sea Basin 10
- 3.3. The Atlantic Sea Basin environment and environmental quality 12
- 3.4. Economic and social perspectives 12
- 3.5. Marine science and technology capabilities 13
- 3.6. Geographic boundaries 13

## **4. A draft Marine Research Plan for the European Atlantic Sea Basin**

- 4.1. Introduction 14
- 4.2. A Policy context 14
- 4.3. Benefits of a common approach 14

## **5. Marine Research Priorities for the European Atlantic Sea Basin**

- 5.1. Introduction 16
- 5.2. Basic Research & New Knowledge 17
- 5.3. Applied Research: Science supporting Society and Economy 20
- 5.4. Research support and cross-cutting issues 30

## **6. High-Level Road Map**

- 6.1. Next Steps – A High-Level Road Map 36

## **Annexes**

- 1. SEAS-ERA Atlantic Partnership 37
- 2. SEAS-ERA Work Programme Leadership Roles 38
- 3. European Atlantic Research Strategies and Funding Programmes 39
- 4. A European Union Strategy for the Atlantic (EUSA) 40
- 5. Marine Sciences and European Research Infrastructures Symposium 41
- 6. Glossary of Acronyms 42

# 1. Introduction

## 1.1. The SEAS-ERA Project

The **FP7 SEAS-ERA** Project (May 2010- April 2014) is a Network of Marine Research Funding Organisations (an ERA-NET) consisting of 21 partners and two third parties from 18 Member and Associated States (Annex 1), located along the European seaboard in the Atlantic, the Mediterranean and the Black Sea ([www.seas-era.eu](http://www.seas-era.eu)) (Figure 1.1).

*"The real act of discovery consists not in finding new lands, but in seeing with new eyes".*

Marcel Proust 1871-1922

The principle aims of the SEAS-ERA Network are to improve co-ordination between nationally funded competitive marine research programmes, to facilitate better co-operation in addressing shared opportunities and challenges, to ensure better use of existing resources and capacities, to bridge identified gaps, to avoid duplication, to jointly fund strategic projects of mutual interest, and, in so doing, contribute to the sustainable development of the marine resource and progress the establishment of the marine component of the European Research Area (ERA)<sup>1</sup>.

The SEAS-ERA project builds on the experience of the previous EU FP6 ERA-NETs: **MarinERA** (<http://marinera.seas-era.eu/>) which involved 16 partners from 13 countries and organised a joint €5 million call for proposals; **AMPERA** ([www.cid.csic.es/ampera/index.php](http://www.cid.csic.es/ampera/index.php)) which involved 10 partners from 8 countries and organised a joint €2.25 million call for proposals; and **MariFISH** ([www.marifish.net](http://www.marifish.net)) which involved 18 partners from 16 countries and organised a joint €4.1 million call for proposals and common programming within five topics.

For operational and management purposes, the SEAS-ERA project is divided into three regional "Sea Basins", i.e. the Atlantic, the Mediterranean and the Black Sea, with each region deciding its own priorities, and seven thematic work packages (WP): Strategic Analysis; Common Programmes; Joint Calls; Infrastructures; Capacity Building; Dissemination and Co-ordination and Management (Figure 1.2). Responsibilities for each of the component Work Packages are illustrated in Annex 2.

For the purposes of this Discussion Document the terms marine and maritime are treated as being synonymous.

<sup>1</sup>[http://ec.europa.eu/research/era/index\\_en.htm](http://ec.europa.eu/research/era/index_en.htm)

### Marine or maritime research?

Different European Coastal States have different terminologies to describe research related to the sea. In formulating the EU Integrated Maritime Policy (IMP-EU), the European Commission felt it necessary to include the terms marine and maritime whilst recognising that they overlap and in some countries are synonymous:

- **Marine research** addresses mainly earth sciences (physics, chemistry, geology, biology) aimed at a better understanding of earth ecosystem function;
- **Maritime research** focuses on technologies and innovative solutions for a better exploitation of the sea and ocean resources and includes, for example, marine technology and shipbuilding.



Figure 1.1: Geographical distribution of SEAS-ERA partners.

Work Packages 6, 7 and 8 include the preparation of individual *draft* marine research plans for each of the three sea basins: Atlantic Ocean, Mediterranean Sea, and Black Sea. These *draft* marine research plans identify opportunities and challenges specific to these regional seas and oceans for which there is broad consensus among the participating Member and Associate State Marine Research Funding Organisations (the SEAS-ERA partners).

The *draft* Research Plan for the European Atlantic Sea Basin (WP6.1), outlined in this Discussion Document, is informed by a shared vision for the European Atlantic Sea Basin (Section 2) and its unique geographical and environmental characteristics (Section 3). The document outlines the benefits of a common approach (Section 4) and sets out the research and technological development priorities and enabling actions to be addressed in the medium to long term (Section 5).

Following a broad stakeholder consultation process scheduled for 2012, the Atlantic partnership will develop in 2012-2013 a High-Level Road Map (Section 6) identifying those research and enabling actions that are within the competence of the partner organisations to bring forward, and which would inform a Strategic Research Agenda (SRA) for the European Atlantic Sea Basin.

Specific measures supporting the implementation of the *draft* Research Plan and the High-Level Road Map will be supported by other components of WP6: Identification of Common Programmes (WP6.2); Joint Calls (WP6.3), Infrastructures (WP6.4); and Capacity Building (WP6.5).

Regarding the research topics and enabling actions identified (Section 5) these are, in the main, within the remit of the participating Research Funding Organisations (RFOs). Where issues are obvious by their absence this is because these issues are not within the remit of a majority of participating organisations, though they are no less important and should be incorporated into any resulting Strategic Research Agenda. It is not suggested that the research and/or enabling actions identified here are “*the right ones*” – hence they are referred to as “*indicative*”. Through engagement with the wider stakeholder community, it is intended to refine these indicative priorities to approach a consensus on what are the most pressing issues and appropriate research, development and innovative responses.

It is further acknowledged that there are many other consortia (e.g. Marine Board, EFARO, EuroGOOS, JPI Oceans, etc.) and major EU-funded projects that have/are preparing sectoral research agendas relevant to the Atlantic Sea Basin. SEAS-ERA Atlantic partners intend to actively engage with these organisations and projects, and with relevant international organisations (e.g. ICES, IMO, OSPAR, etc), in the planned Stakeholder Consultative Workshops to be organised in 2012.

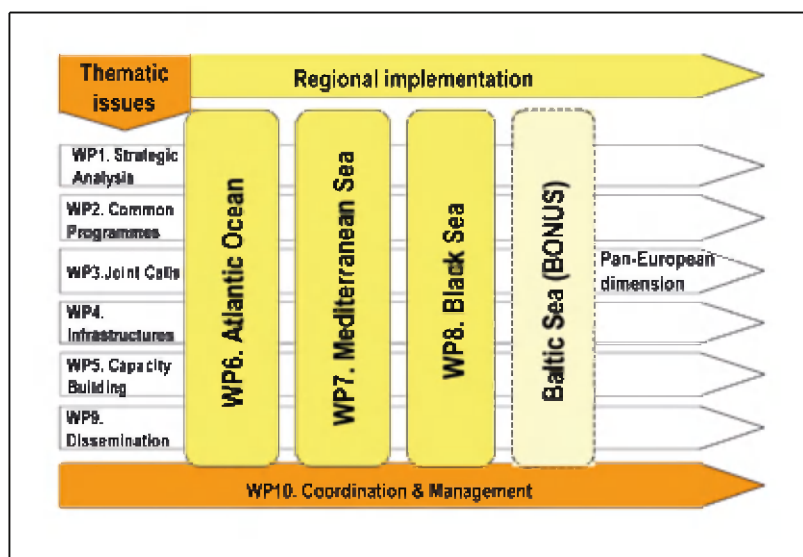


Figure 1.2: Structure of the SEAS-ERA project.



# 1. Introduction

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## 1.2. A Common Structure for the Sea Basin Research Plans.

The development of a common structure (Figure 1.3) for the three SEAS-ERA Sea Basin Research Plans was facilitated by Partner 18 (Marine Board-ESF) within SEAS-ERA WP1.2, in liaison with the regional Sea Basin Leaders: Partner 7 (GSRT/HCMR, Greece) for the Mediterranean; Partner 9 (Marine Institute, Ireland) for the Atlantic Sea Basin and Partner 15 (TÜBITAK, Turkey) for the Black Sea.

The common structure approach allows for regional specificities to be addressed, while, at the same time, providing consistency and allowing for comparison of the resulting outputs.

While a common structure is agreed in preparing the *draft* marine research plans, approaches to the development of these differ from one Sea Basin to the other. The Atlantic Strategy will build on previous work and on current initiatives including the European Union Strategy for the Atlantic (EUSA) and the proposed Strategy for the North Sea. The *draft* Atlantic Sea Basin Research Plan will be further developed through a consultative process involving Stakeholder Workshops and national consultations.

1. **Introduction** (1 page);
2. **A Shared Vision for the [ ] Sea Basin** (1page).
3. **The [.....] Sea Basin:** (2-3 pages).  
*Sea basin specificities, critical regional issues, challenges and opportunities – related to policy, management, environmental and scientific matters.*
4. **A Strategic Research Agenda for the [ ] Sea Basin** (1-2 pages).  
*a. Objectives and Benefits*
5. **Specific Research Priorities for the [ ] Sea Basin** (12-15 pages).
  - 5.1. **Basic Research & New Knowledge**  
*incl. climate change, new frontiers research (e.g. Deep-sea)*
  - 5.2. **Applied Research: Science supporting Society and Economy:**  
*Applied science themes incl. e.g. blue biotech, marine renewable energy, transport, etc.)*
  - 5.3. **Research Support & Cross-Cutting Issues.**
6. **High-level Roadmap** (2-3 pages).  
*Short, medium, long-term priorities timeline, milestones, review, etc.).*

**Figure 1.3:** A Common Reporting Structure.



## 2. A Shared Vision for the European Atlantic Sea Basin

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### 2.1. An introduction to a Shared Vision

The **Integrated Maritime Policy for the European Union** (IMP-EU, 2007)<sup>2</sup> recognises the very substantial maritime dimension of the European Union and Associated States comprising four seas (the Mediterranean, the Baltic, the North Sea and the Black sea) and two oceans (the Atlantic and the Arctic). It sets out a **Vision** and a **Strategy** (Blue Book and Action Plan) for the sustainable development of the European Seas and Oceans.

*A dynamic maritime economy, in harmony with the environment; supported by sound science and technology, which allows human beings to continue to reap the rich harvest from the oceans in a sustainable manner.*

The IMP-EU Vision Statement 2007

#### Proposed SEAS-ERA Atlantic Sea Basin Vision Statement

The European Atlantic Sea Basin Research Plan seeks to improve our understanding and protection of the European Atlantic, and its ecosystems, in order to catalyse a dynamic maritime economy, in harmony with the environment and which allows human beings to continue to reap the rich harvest from the oceans in a sustainable manner. This will be achieved through harnessing new and emerging science, technology and innovation to add value and competitiveness to traditional sectors and create new and dynamic maritime sectors in a spirit of regional partnership and international co-operation.

The IMP-EU (2007) aims to facilitate and support a positive and constructive interaction between policies and economic, social and environmental interests. It must also work in harmony with other key European Union policies, chief amongst these being the **Europe 2020 Strategy**<sup>3</sup>, which seeks smart, sustainable and inclusive economic growth, employment and innovation, the **European Innovation Union** (2010)<sup>4</sup>, **A Resource Efficient Europe** (2010)<sup>5</sup> and the **European Research Area** (ERA) Initiative.

A key deliverable of SEAS-ERA WP6.1. is to define an appropriate Vision for the European Atlantic Sea Basin. In keeping with the overall IMP-EU Vision Statement and recognising the roles and responsibilities of the SEAS-ERA Atlantic partners.

**A Vision Statement is proposed** which:

- is based on the Vision Statement of the Integrated Maritime Policy for the European Union;
- emphasises the key role of harnessing new and emerging science and technology to add value and competitiveness to traditional sectors and create new ones;
- recognises the key role of regional partnership and international co-operation.

<sup>2</sup><http://eur.lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0575:FIN:EN:PDF>.

<sup>3</sup>[http://ec.europa.eu/europe2020/index\\_en.htm](http://ec.europa.eu/europe2020/index_en.htm).

<sup>4</sup>[http://ec.europa.eu/research/innovation-union/index\\_en.cfm](http://ec.europa.eu/research/innovation-union/index_en.cfm)

<sup>5</sup>[http://ec.europa.eu/resource-efficient-europe/index\\_en.htm](http://ec.europa.eu/resource-efficient-europe/index_en.htm)

## 3. The European Atlantic Sea Basin

### 3.1. Introduction

The European Atlantic Sea Basin contains a range of diverse habitats from semi-enclosed seas (e.g. North Sea, Irish Sea), exposed bays (e.g. Bay of Biscay) to the open Atlantic Ocean. Its coastline is equally varied and includes indented rocky coastlines, sandy beaches and sheltered estuarine mudflats.

Gross Domestic Product (GDP)	The EU maritime regions account for around 40% of its GDP and the maritime economy for 3% to 5%.
Maritime transport	90% of external trade and 40% of internal trade; 3.5 billion tonnes/year and 350 million passengers/year.
Shipbuilding	0.8 million jobs; Turnover of €90 billion/year; World leader in the production of highly sophisticated vessels.
Energy	Alternate energies: tidal and wave power, offshore wind farms; €121 million turnover in 2005, with increasing growth.
Fisheries & Aquaculture	0.5 million jobs; 0.3% of EU GDP equating to about €20 billion/year; Aquaculture represents 19% of the Union's total fishery production.
Tourism and Coastal Zones	3 million jobs; €72 billion turnover in 2005.
New Resources and Blue Biotechnology	Emerging sector with predicted growth of 10% per year and a global market of €2.4 billion

**Figure 3.1:** Contribution of the marine/maritime economy to European GDP. Source "Maritime Facts and Figures".

The area is richly endowed with Centres of Excellence in science, technology and innovation, has a strong engineering base, a stable political and governance system and many knowledge based SMEs. Together this represents a unique opportunity to work together to add value to the existing resource base and develop new knowledge-based and globally traded products and services that will invigorate the local population and improve their quality of life.

The area is rich in natural resources and resource potential, supporting traditional sectors, such as maritime transport, tourism, fishing, aquaculture, seafood processing and sand and gravel extraction. New emerging sectors, supported by developments in science and technology, such as marine renewable energy, marine biotechnology and deep-sea mining are in evidence.

The European Atlantic Sea Basin and its coastal areas have their own unique characteristics which represent both challenges and opportunities for job creation and sustainable growth (Europe 2020 Strategy) and the attainment of good environmental status (Marine Strategy Framework Directive, MFSF, 2008)<sup>7</sup>.

### 3.2. Geography of the European Atlantic Sea-Basin

The Atlantic Ocean is the youngest and second-largest of the world's oceans with a total surface area of circa 106,400,000 km<sup>2</sup>. It stretches North-South from the Arctic to the Antarctic Ocean and East-West from the European and African continents to the Americas. It covers approximately 20% of the Earth's surface and about 26% of its water surface area.

The European Atlantic Sea Basin extends westwards from the European seaboard, over an extensive continental shelf, with associated canyons, seamounts, troughs, etc., to the abyssal plain. The Mid-Atlantic Ridge, extending from Iceland to approximately 58° South, forms a natural East-West boundary dividing the North Atlantic into two large troughs with depths from 3,700–5,500m. Several peaks rise above the water and form islands, e.g. Azores and Iceland (Figure 3.2.).

The continental shelf, slopes and underwater mountains support diverse biological communities, including cold-water coral reefs and gardens, as well as deep-sea sponge communities. The Mid-Atlantic Ridge is an active tectonic boundary, with hydrothermal vents occurring along its length where hot, massive polymetallic sulphide deposits support unique forms of life.

<sup>6</sup> [http://ec.europa.eu/maritimeaffairs/facts\\_figures\\_en.html](http://ec.europa.eu/maritimeaffairs/facts_figures_en.html)

<sup>7</sup> [http://ec.europa.eu/maritimeaffairs/facts\\_figures\\_en.html](http://ec.europa.eu/maritimeaffairs/facts_figures_en.html)

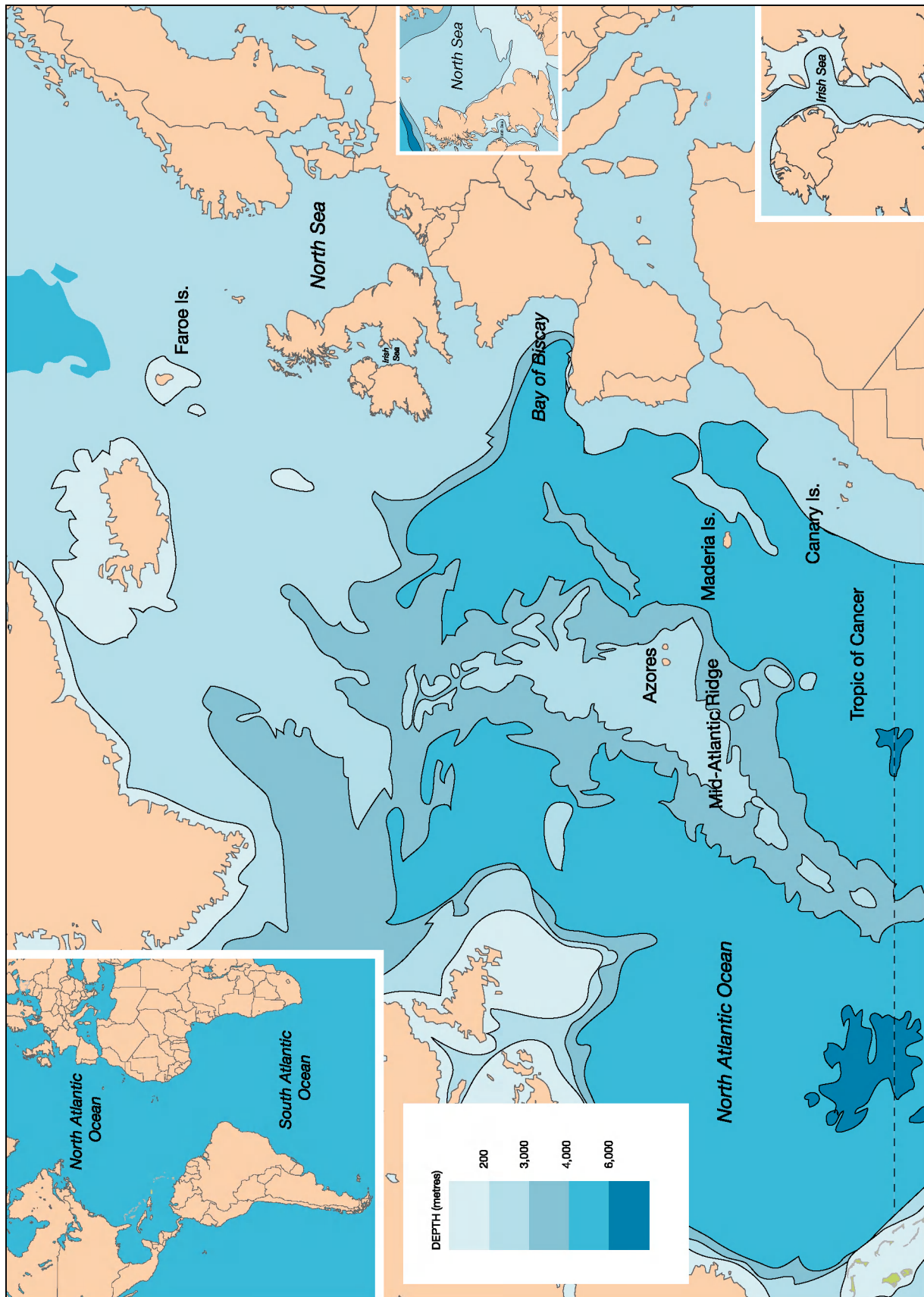


Figure 3.2: The European Atlantic Sea Basin.



### 3. The European Atlantic Sea Basin

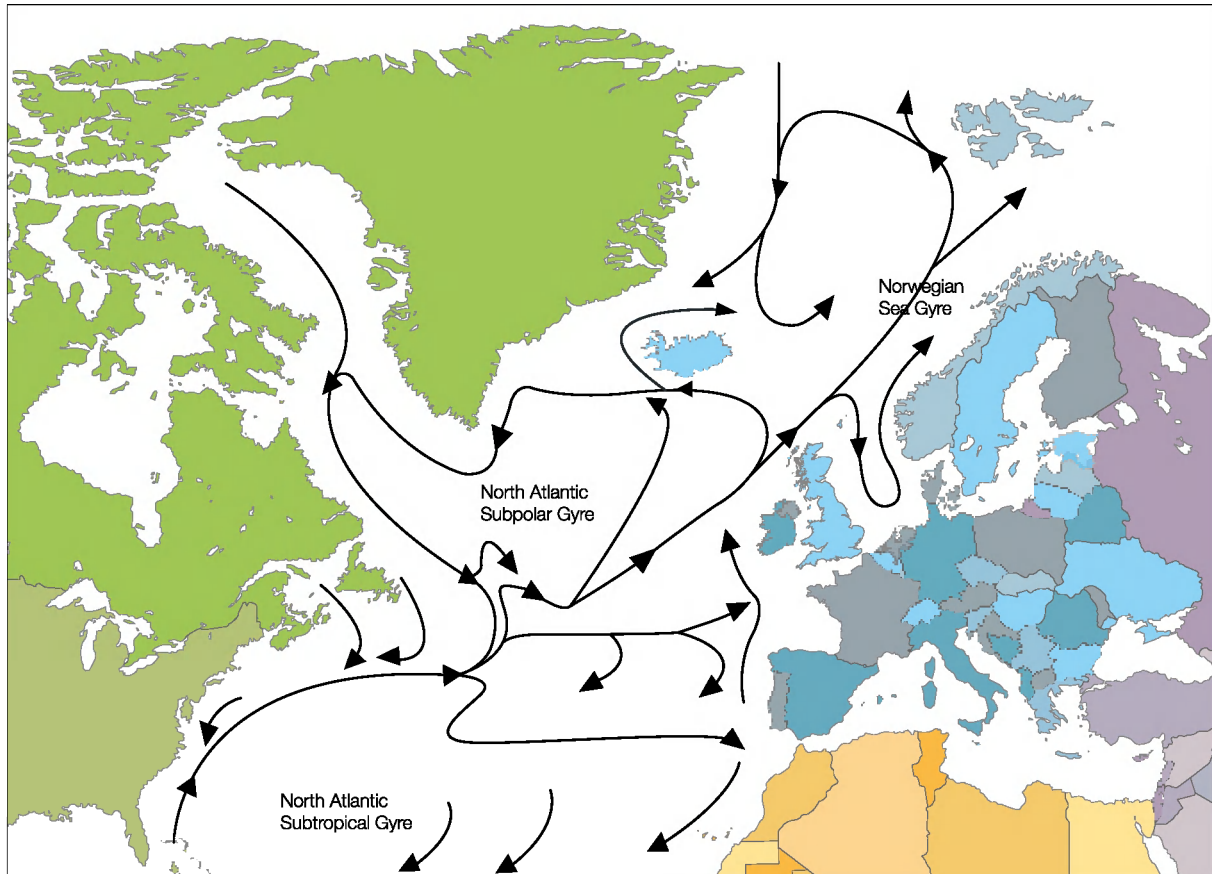


Figure 3.3: Atlantic Ocean Circulation. [courtesy of: FP7 Euro-BASIN and INTERREG-IV EasyCo circulation maps]

#### 3.3. The Atlantic Sea Basin environment and environmental quality

The 2010 OSPAR Quality Status Report (QSR)<sup>9</sup> provides an excellent and up-to-date description and assessment of the environmental quality and environmental issues pertinent to the European Atlantic. It includes a very comprehensive review of the current status regarding climate change, eutrophication, hazardous and radioactive substances, offshore oil and gas, fishing, human impacts and biodiversity and ecosystems. Water circulation in the Atlantic Ocean is complex as illustrated in Figure 3.3.

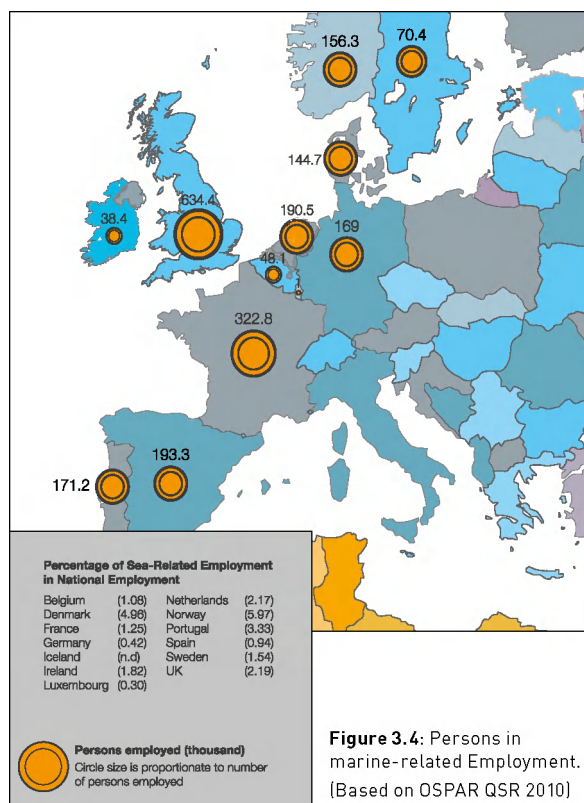
#### 3.4. Economic and social perspectives.

The Atlantic Ocean has significantly contributed to the development and economic, social and cultural history of the surrounding countries, including those on the European Atlantic seaboard. According to the 2010

QSR, marine-related industries and services contribute roughly 1.8% to the Gross Domestic Product (GDP) and 2.1% to employment opportunities. Much of the coastal area in the North-East Atlantic is densely populated, highly industrialized or used intensively for agriculture. Population density is much higher on the coasts than inland, with most of the population in some areas of Northern Europe being concentrated in coastal settlements. Population density is highest on the Iberian and North Sea coasts (with over 500 inhabitants per km<sup>2</sup>) and lowest on the open Atlantic seaboard (with fewer than 10 inhabitants per km<sup>2</sup> in some remote areas).

More than a third of the value of the maritime sector in the North-East Atlantic is generated by coastal tourism and shipping. Tourism and the fishing industry are the largest employers. Oil and gas resources are prevalent in the North Sea, while significant potential for offshore wind, wave and tidal energy has been identified on the open Atlantic seaboard.

<sup>9</sup> <http://qsr2010.ospar.org/en/index.html>



**Figure 3.4:** Persons in marine-related Employment. (Based on OSPAR QSR 2010)

### 3.5. Marine S&T Capabilities

The European Atlantic area is richly endowed with Centres of Excellence in marine science, technology and innovation. The EU FP6 MarinERA project database<sup>9</sup>, for example, lists over 340 Marine Research Institutes and University Research Groups.

### 3.6. Geographic boundaries

The objective in defining the extent and boundaries of the European Atlantic Sea Basin is provide a geographical and operational framework in which to set the *draft* Research Plan.

Much thought has been put into considering the approach to be taken with respect to specific geographical boundaries. In reality, of course, *the sea knows no boundaries* and any proposed boundary will be artificial. We should think, therefore, in terms of what objectives we want to achieve and what is the geographical area that needs to be considered in order to achieve those objectives (Figure 3.5).

Accordingly, **the European Atlantic Sea Basin**, as considered here, **is defined in terms of processes and usage rather than geography**. It includes the sea surface, the water column and seabed off the European Atlantic coastline (including the North Sea and the Irish Sea) extending westwards to include the OSPAR wider Atlantic region and the participating countries Exclusive Economic Zones (EEZ) and extended Continental Shelves. It also includes the maritime territories surrounding the Canary Islands, the Azores and Madeira.

Clearly, the European Atlantic Sea Basin cannot be seen from a European perspective alone – there is a need for co-operation in both governance and science with (i) the United States of America, Canada and Greenland, (ii) Central and South America and (iii) Western Africa.

Issue	Geographical Area
Governance and Implementation of EU Policies	Maritime territories of European Union Member States: Belgium, Denmark, France, Germany, Ireland, Netherlands, Portugal (Azores and Madeira), Spain (Canary islands) and the UK.
Economic Development and Environmental Issues	As above plus the Faroe Islands, Iceland and Norway.
International / global issues/ climate change	- USA, Canada, Greenland; - Central and South America; - Western Africa.

**Figure 3.5:** European Atlantic Sea Basin issues and relevant geographical areas.

#### Geographical boundaries

In defining the geographic scope or operational area of the European Atlantic Sea Basin Research Plan, the best approach is to consider the objectives aimed at and then consider the area (e.g. European Atlantic Arc, European Atlantic Seaboard, North Atlantic Sea Basin) necessary to achieve those.

<sup>9</sup> <http://marineinstitutes.eurocean.org/map.jsp>

## 4. A *draft* Marine Research Plan for the European Atlantic Sea Basin

### 4.1. Introduction.

The key deliverable of WP6.1 is a *draft* Marine Research Plan which will inform the preparation of a Strategic Research Agenda for the European Atlantic Sea Basin.

Such a *draft* Research Plan must add value to what is already being achieved at participating country and European level; it must have clearly defined benefits and facilitate policy development and implementation.

The SEAS-ERA project should be viewed as a progressive step forward:

- proposing a shared vision; identifying common challenges, opportunities and supportive research priorities;
- assessing identified topics that could be addressed through joint calls, common programming or enabling actions;
- informing the formulation of a Strategic Research Agenda for the European Atlantic Sea Basin.

The SEAS-ERA Project is thus a contribution to the European Strategy for Marine and Maritime Research [2008]<sup>10</sup>, and a further step towards establishing a marine component of the European Research Area (ERA) and an input to the work of the JPI Oceans ([www.jpi-oceans.eu](http://www.jpi-oceans.eu)).

#### Components of a Strategic Research Agenda for the European Atlantic Sea Basin:

1. Developing a shared vision for the European Atlantic Basin area;
2. Defining the geographical extent of the European Atlantic Basin;
3. Defining a Strategic Research Agenda (SRA) and SMART objectives (Specific, Measurable, Achievable, Relevant and Time-Bound); and
4. Preparing for implementation of the SRA by analysing the options, assessing expected impacts and defining the best mix of instruments to be used.

### 4.2. A Policy Context

A *draft* Research Plan for the European Atlantic Sea Basin cannot be developed in isolation from existing EU and Member State policies and strategies and must therefore be consistent with and supportive of:

- European Atlantic Member State Marine Development Strategies and Marine Research, Development and Innovation Strategies (Annex 3);
- The Integrated Maritime Policy for the European Union (2007), its environmental pillar the Marine Strategy Framework Directive (2008) and its research pillar, the European Strategy for Marine and Maritime Research (2008);
- The proposed European Union Strategy for the Atlantic 2011 (EUSA) and preliminary discussions on a North Sea Strategy (Annex 4);
- The Europe 2020 Strategy, the Innovation Union (2010), the European Research Area initiative and the Horizon 2020 - the common Strategic Framework Programme for Research and Innovation (2014-2020)<sup>11</sup>.

### 4.3. Benefits of a common approach

The proposed *draft* Research Plan must bring benefits over and above those which are already being achieved at participating country and European levels. Greater co-operation among countries (EU Member and Associated States) in the European Atlantic Area can provide very significant advantages in relation to a broad range of issues: including economic recovery; competitiveness; sustainable development; and environmental issues. It can provide significant opportunities and benefits including:

- Increasing awareness of common challenges and shared priorities;
- Fostering opportunities to work together where synergies for a common approach can be identified;
- Improving the implementation of EU policies (e.g. Common Fisheries Policy [CFP], MSFD, Energy Policy, etc.) and ensuring that the specificities of the Atlantic Area are taken into account;
- Stimulating economic development and a more efficient resource use;

<sup>10</sup> [http://ec.europa.eu/research/press/2008/pdf/com\\_2008\\_534\\_en.pdf](http://ec.europa.eu/research/press/2008/pdf/com_2008_534_en.pdf)

<sup>11</sup> [http://ec.europa.eu/research/csfri/index\\_en.cfm?pg=home](http://ec.europa.eu/research/csfri/index_en.cfm?pg=home)

- 
- Improving the competitiveness and sustainability of traditional sectors (e.g. maritime transport, sea-food, marine tourism);
  - Building and exploiting global markets for new knowledge-based and environmentally-driven services and products (e.g. Marine Renewable Energy, Marine Biotechnology linked to food and health, High tech smart products and services for environmental monitoring and management);
  - Establishing Maritime / Innovation Clusters, linking local educational institutes and industries, to promote a range of new maritime value-added products and services;
- Supporting an *ecosystem-based approach* in assisting the delivery of the Marine Strategic Framework Directive and with regard to Marine Spatial Planning (MSP) to assist in a more rational use of the Atlantic space;
  - Ensuring better exchange of and access to expertise and specialist infrastructures between Atlantic countries;
  - Liaising on issues related to the use of Exclusive Economic Zones (EEZ) and Continental Shelves;
  - Establishing co-operative initiatives to quantify and map the total economic value (TEV) of Atlantic Seaboard resources in terms of their market (economic) and non-market (quality of life) values;
  - Improving co-ordination and co-operation among the responsible agencies in the various jurisdictions in the area of maritime safety, security and surveillance, fisheries, tourism and energy, including information exchange, analysis and joint operations;
  - Co-ordinating and better focusing national and EU Funding Programmes (Structural; Regional; Common Strategic Framework, etc) to address priorities and seed fund economic opportunities of mutual benefit;
  - Capitalising on the Atlantic region's geographical location and unique attributes while recognizing its peripherality to the economic core of the European Union.

*"Our plans miscarry because they have no aim.  
When a man does not know what harbour he is  
making for, no wind is the right wind".*

Seneca, 5BC-65AD



## 5. Marine Research Priorities for the European Atlantic Sea Basin

### 5.1. Introduction

National marine policies, strategies and research priorities must be recognized and accommodated in preparing a *draft* Research Plan for the European Atlantic Sea-basin. These policies, strategies, research priorities, opportunities and challenges and cross-cutting issues, encapsulated in a Strategic Vision (Section 2), will define the scope and content of a supportive and enabling Research Plan.

#### High Level Objectives

- Economic Recovery, Competitiveness and Sustainable Socio-Economic Development;
- Environmental Protection & Climate Change;
- Good Governance supported by evidence-based regulation and legislation;
- Basic and Applied Knowledge;
- Issues to be addressed at the appropriate regional or pan-European scale;
- Regional and international co-operation.

With respect to this *draft* Marine Research Plan for the European Atlantic Sea Basin, it must also be emphasised that the research topics identified are those relevant to the SEAS-ERA Atlantic partners (Annex 1), these being the main competitive marine research funding bodies (RFOs) in the participating European Atlantic Sea Basin partner countries. These priorities are in turn defined by:

- The needs of parent Ministry / Government Departments to supply the knowledge-needs of national policies and EU Directives;
- The recommendations of National Expert Stakeholder Advisory Groups.

In order to ensure compatibility with the Research Agendas of other Sea Basins (i.e. Mediterranean and Black Sea Basins), three categories of research are recognised:

- Basic Research & New Knowledge ;
- Applied Research: Science supporting Society and Economy;
- Research Support & Cross-Cutting Issues;

Further, it is important to note that:

- all research is multi-disciplinary and cross-cutting, thus the above categorisation is to a degree artificial but nonetheless useful;

- the research topics, challenges and opportunities identified are those which benefit from and are best addressed by a regional and co-operative approach or are beyond the capacity of a single member state;
- research topics addressing or strengthening the internal competitiveness of individual Member States/participating countries, which may be significant components of national marine research programmes, are not included.

It must also be emphasized that the aims and objectives of the European Atlantic Sea Basin Vision will not be achieved by research alone. Political vision and commitment, funding, co-operation, appropriate regulation and governance and access to pan-European infrastructures are also critical ingredients necessary to deliver the Shared Vision (Section 2) and reap the benefits identified in Section 4.

**In setting out a list of indicative research issues and enabling actions we are providing a basis for stakeholder consultation.** This will be achieved through a number of mechanisms including Stakeholder Workshops and national consultations. Thus the issues and enabling actions identified in this Discussion Document (see following boxes) may not be those included in the resulting Strategic Research Agenda (Section 6).

#### Note to Reader

In the boxes listing Indicative Research Issues and Enabling Actions, stakeholders are invited to (a) agree/disagree with the topics identified (b) propose new issues/enabling actions and (c) identify issues/enabling actions where none have been included.

Indicative opportunities and challenges to be addressed in the Marine Research Plan for the European Atlantic Sea Basin, along with enabling actions or key research topics, include:

#### Basic Research & New Knowledge

1. Ecosystem functioning and processes;
2. Climate Change - mitigation & adaptation;
3. The Deep Ocean Frontier;
4. Conservation and Protection of Marine Biodiversity ;
5. Transformative and enabling technologies.

*"There is no applied science if there is no science to apply"*

Bernardo Houssay,  
Nobel Laureate in Medicine [1947]

## Applied Research: Science supporting Society and Economy

1. Marine Environmental Research;
2. Utilising the results/outputs of national marine environment and resource assessment programmes and nationally funded marine research programmes;
3. Marine Renewable Energy;
4. Shipping and Maritime Transport;
5. Maritime Safety, Security & Surveillance;
6. Marine Leisure & Tourism, including maritime culture & heritage;
7. Marine Bio-Resources: Fisheries, Aquaculture and Seafood Processing;
8. High-tech Marine knowledge-based Products & Services;
9. Marine Biotechnology;
10. Oil and Gas Resources;
11. Mineral Resources.

## Research Support & Cross Cutting Issues

1. Marine Socio-Economic Assessment;
2. Data Management and Dissemination;
3. Seabed Mapping;
4. Management tools;
5. Enabling Infrastructures;
6. Building Research and Innovation Capacity.

## 5.2. Basic Research & New Knowledge

**5.2.1. Ecosystem functioning and processes:** To better understand and manage the living marine resources of the Atlantic Sea Basin, it is vital to understand how these ecosystems function and what the factors and processes controlling them are. For example, more knowledge is needed about how the ocean climate influences the production of phyto- and zooplankton, the impact it has on the variation between predator and prey within the annual cycle and its role as a controlling factor in the migration, growth and recruitment of fish stocks.

**An ecosystem** is a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.

Art.2, United Nations Convention on Biological Diversity (1992)

### Ecosystem Functioning and Processes

#### Indicative Research Issues:

- Inherent complexity in marine ecosystems, requiring new modelling approaches;
- Air-sea and benthic-pelagic interactions;
- Energy flows and food webs, including harmful algal blooms (HABs);
- Non-linear tipping points and deoxygenated zones.

#### Indicative Enabling Actions:

- Review of ecosystem functioning and process research which is currently being funded

### 5.2.2. Climate Change: Mitigation and Adaptation:

The 4<sup>th</sup> Intergovernmental Panel on Climate Change Assessment Report (IPCC 2007)<sup>12</sup> warned that the continuing emissions of greenhouse gases at or above current rates will cause further global warming and lead to changes in the global climate system during the 21<sup>st</sup> century. These changes will be felt in marine ecosystems either directly, through changes in sea temperatures, or indirectly, through impacts on the seasonality, biogeography, distribution and abundance of species, including commercial species.

OSPAR, in its 2010 Quality Status Report on the North Atlantic, warns that the impacts of climate change are now becoming evident, especially in the northern regions (Arctic Waters and the Greater North Sea). Furthermore, this report highlights that while the nature and rate of these impacts were uncertain, rising sea temperature and increasing acidification represent major threats to marine ecosystems, sustainable marine resource development and biodiversity.

Another important source of information on climate change in the Atlantic Sea Basin is the ICES 2010 Report on Ocean Climate [August 2011]<sup>13</sup>.

A key challenge is to develop more effective interfaces between climate change knowledge, social and economic systems and policy making. In this context the development of modelling tools and data-sets to support cost-efficient mitigation and adaptation policies, including their cost, are crucial. Currently, many Atlantic coastal state marine research programmes have a focus on climate change assessments and impacts, including mitigation and adaptation strategies. Similarly, many have published national climate change assessments and strategies. Under the EU FP7 (Theme 6, Environment including Climate Change), a suite of

<sup>12</sup> [www.ipcc.ch/publications\\_and\\_data/publications\\_ipcc\\_fourth\\_assessment\\_report\\_synthesis\\_report.htm](http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm)

<sup>13</sup> <http://ices.dk/pubs/crr/crr309/ICES%20SCREEN%20PDFS/ICRR%20309-inner-singles.pdf>

## 5. Marine Research Priorities for the European Atlantic Sea Basin

collaborative climate change related projects are being funded, including large integrated projects, such as THOR: Thermohaline Overturning – A Risk? ([www.eu-thor.eu/](http://www.eu-thor.eu/)) and EuroBASIN: North Atlantic Ocean and associated shelf-seas protection and management options ([www.euro-basin.eu/](http://www.euro-basin.eu/)). Networking projects such as FP7 CLAMER: Climate Change and Marine Ecosystem Research Results ([www.clamer.eu/](http://www.clamer.eu/)) have assessed current European climate change research and public opinions on marine climate change impacts.

### An Annual European Atlantic Marine Climate Change Report Card:

One initiative that might be considered as part of the European Atlantic Sea Basin Research Plan is the establishment of a mechanism, based on the UK's Marine Climate Change Impacts Partnership (MCCIP), to produce an Annual Marine Climate Change Impacts Report Card (See: [www.mccip.org.uk/](http://www.mccip.org.uk/)).

Since the UK Royal Society (2005)<sup>14</sup> first warned of the related climate change problem of **ocean acidification**, significant international and European research has focused on this issue, including the European FP7 EPOCA: European Project on Ocean Acidification ([www.epoca-project.eu/](http://www.epoca-project.eu/)). While the current understanding of the possible consequences of ocean acidification is still rudimentary, both the scientific community and society at large are increasingly concerned about the possible risks for marine organisms and ecosystems associated with ocean acidification. In this context the EPOCA project has prepared *a guide to best practices for ocean acidification research and data reporting* and *a special introductory guide for policy advisors and decision makers on ocean acidification*.

### Climate Change

#### Indicative Research Issues:

- Development of regional and local forecasting and scenarios, including risk assessment, models;
- Development of autonomous and sensitive pCO<sub>2</sub> sensors for in-situ monitoring of ocean acidification.

#### Indicative Enabling Actions:

- Create/Improve the Atlantic Ocean Observing System to better track climate change;
- Development of an Annual European Atlantic Sea Basin Marine Climate Change Report Card.

**5.2.3. The Deep-Sea Frontier:** Europe's deep-sea frontier stretches over a distance of some 15,000 km along the Atlantic Ocean from the Arctic to the Straits of Gibraltar through the Mediterranean to the Black Sea. Beyond the continental slope much of the seabed is abyssal plain. Dissecting the abyssal plain is the Mid-Atlantic Ridge which runs from Iceland to the Azores and beyond. The continental slope, ridges and underwater mountains support diverse biological communities, including deep water coral reefs and gardens, deep-sea sponge communities, and fish aggregations.

In 2007, the European Commission promoted the Deep-Sea Frontier initiative<sup>15</sup>. This initiative brought together a large number of scientists across a wide spectrum of areas to discuss challenges and roadmaps for new European research and technology that will enable the improvement of our understanding of the deep seafloor. The Deep-Sea Frontier Initiative has identified key scientific challenges that need to be addressed to understand the role of the deep sea floor in the global Earth system. This knowledge is urgently needed for a variety of reasons that include:

- To understand how deep-sea ecosystems will respond to climate change;
- To understand the exchanges between the sub-sea floor, seafloor and water column (e.g., methane release, methane natural sequestration, carbon sequestration) and predict how they might modulate climate change or vary due to it;
- To assess the potential resources of the deep ocean and provide the background against which ecologically sustainable exploitation of the deep-seafloor and its living, mineral and energy resources can be adequately planned and monitored;
- To better understand geo-hazards and the threat that they pose to coastal locations, and to implement observatories and warning systems to mitigate their effects on coastal populations.

The OSPAR 2010 QSR concludes that although the environmental quality of deep-sea habitats is good, it is far from pristine and that the impacts of global change and pollution are not readily understood due to a lack of information. OSPAR has included a set of deep-sea habitats (e.g. carbonate mounds, seamounts, mid-ocean ridges with hydrothermal vents, deep-sea coral reefs and gardens), and species like orange roughy and several deep-sea sharks on its list of Priority Species and Habitats which are under threat and/or declining.

<sup>14</sup> <http://royalsociety.org/Ocean-acidification-due-to-increasing-atmospheric-carbon-dioxide/>

<sup>15</sup> <http://ec.europa.eu/research/environment/pdf/deepseefrontier.pdf>

Europe is a global leader in deep-sea research. Building on past achievements, and consolidating Europe's position will require further integration and investment in deep-sea research. Flagship collaborative EU projects such as HERMES, HERMIONE, EXOCET/D, DS3F and CORALFISH, etc., and deep-sea observatory projects such as ESONET, EMSO and EuroSITES, and the international initiative MAR-ECO [CoML], help to keep European scientists at the cutting edge of deep-sea research. The EU Deep-Sea Frontier (2007, 2009)<sup>16</sup> initiative is helping to define deep-sea research priorities.

### The Deep-Sea Frontier

#### Indicative Research Issues:

- Developing systems for deep-sea exploration;
- Sustainable deep-sea governance and management, (e.g. fishery, hydrocarbon exploration, polymetallic sulphides);
- Deep-sea geological processes that drive sea-floor ecosystems;
- The release of the potential of seabed archives for paleo-environmental reconstruction and improved prediction of future climate change;
- CO<sub>2</sub> sequestration in the deep-sea and its environmental impacts.

#### Indicative Enabling Actions:

- Establish formal networks with the USA and Canada to facilitate and co-ordinate deep-sea research.
- Establish a strategy for a long-term deep-sea observatory network (see also Section 5.4.5).

**5.2.4. Conservation and Protection of Marine Biodiversity:** Marine biodiversity (including genetic biodiversity) is an all-inclusive term to describe the total variation among living organisms in the marine environment – *life in the seas and oceans*. One of the major consequences of the unsustainable use of the Earth's resources is biodiversity loss, with a consequent loss or reduction in the environmental goods and services they provide.

*"It is estimated that every 20 minutes sees another species of plant or animal becoming extinct and during the same period 3,500 humans are born"*

R. Nash, FP7 ComEnvir Project

The European FP6 Network of Excellence on Marine Biodiversity and Ecosystem Functioning (MarBEF) prepared a detailed assessment of **European marine biodiversity** (MarBEF, 2009)<sup>17</sup> and identified the critical marine biodiversity issues to be addressed, including: the need for comprehensive baseline datasets; impacts additional to global warming; coastal management; phase shifts and alternate stable states; habitat diversity; ecosystem function, the role of species; the biodiversity of biodiversity and biodiversity at the microbial and genetic level.

The related issue of **invasive (alien) species** has been comprehensively addressed by the FP6 DAISIE (Delivering Alien Invasive Species Inventories for Europe, [www.europe-aliens.org/index.do](http://www.europe-aliens.org/index.do)) and ALARM (Assessing Large-Scale Environmental Risks with Tested Methods) projects.

Marine biodiversity baseline datasets and techniques to measure changes and trends are urgently needed to address the marine biodiversity challenge and to support the implementation of several environmental laws and policies such as the Habitats Directive<sup>18</sup>, the MSFD and the Convention on Biological Diversity (CBD, 1992)<sup>19</sup>. More recently (2011), the EU published its Biodiversity Strategy to 2020<sup>20</sup> which includes: full implementation of EU nature legislation to protect biodiversity; better protection for ecosystems, and more use of green infrastructure; better management of fish stocks; tighter controls on invasive alien species; a bigger EU contribution to averting global biodiversity loss.

### Marine Biodiversity

#### Indicative Research Issues:

- Research to operationalise the MSFD Indicator of Good Environmental Status (GES) on biological diversity, including consideration of appropriate scales for management (see also 5.3.1);
- Research to develop environmental genomics and other omics technologies, together with improved marine observation data, for improved understanding of functional biodiversity;
- Research to develop appropriate indices/indicators to measure and assess the impact of invasive species, including risk assessment techniques.

#### Indicative Enabling Actions:

- Establish a platform, including National Biodiversity Centres, to co-ordinate research related to the issues highlighted in the MarBEF and Millennium Ecosystem Assessment (2005).
- Development of an Annual European Atlantic Sea Basin Marine Invasive Species Report Card.

<sup>16</sup> [http://www.deep-sea-frontier.eu/front\\_content.php?idart=602](http://www.deep-sea-frontier.eu/front_content.php?idart=602)

<sup>17</sup> [www.marbef.org/](http://www.marbef.org/)

<sup>18</sup> [http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index\\_en.htm](http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm)

<sup>19</sup> <http://www.cbd.int/>

<sup>20</sup> [http://ec.europa.eu/environment/nature/biodiversity/comm2006/pdf/2020/1\\_EN\\_ACT\\_part1\\_v7%5B1%5D.pdf](http://ec.europa.eu/environment/nature/biodiversity/comm2006/pdf/2020/1_EN_ACT_part1_v7%5B1%5D.pdf)



## 5. Marine Research Priorities for the European Atlantic Sea Basin

**5.2.5. Transformative and enabling technologies:** New ideas, innovations, methodologies, and in general new ways of looking at or doing things, continually come on the market from the laboratory bench. Some are immediately taken up and transform industrial sectors sometimes beyond recognition. Others languish for a time and are then rediscovered.

There is no way of planning for such development, they happen, often as an offshoot of research and in particular from curiosity-driven or basic research, but their impacts can be immense.

Pan-European initiatives such as the European Institute of Innovation and Technology (EIT)<sup>21</sup> and national

**Transformative technologies** are defined as new knowledge, technologies and/or methodologies that do more than just change industrial processes. They change entire infrastructures, including governance and regulation. They may do this in uneven ways, leaving some sectors unchanged, while completely destroying and replacing others.

**Enabling technologies** are defined as knowledge technologies and/or methodologies that, alone or in combination with associated knowledge/technologies, provides the means to generate giant leaps in performance and capabilities of the user. For example, the coming together of telecommunication technologies, internet, and groupware has levelled the field so that even smaller firms are able to compete in areas where they otherwise could not.

initiatives such as the Irish SMARTOCEANS [2010]<sup>22</sup>, seek to exploit new knowledge emerging, in particular from the Information and Communications (ICT) and Life Sciences, to (a) create new opportunities to further develop traditional marine sectors such as for example in the fisheries, aquaculture, shipping, tourism, oil and gas sectors, etc and (b) to open up new opportunities such as the use of marine biological/chemical resources in drug development, bio-medical devices, food ingredients (the knowledge-based bio-economy) and industrial chemicals, development of renewable wave and tidal energy sources and the application of ICT and engineering technology to environmental monitoring and new service based and internationally traded sectors.

Balanced Research Programmes must always have a capacity to identify, support and bring forward such new ideas and this can be assisted by methodologies such as S&T Foresight Exercises, Technology Screening, Horizon Scanning, etc.

<sup>21</sup> <http://eit.europa.eu/>

<sup>22</sup> [www.marine.ie/home/SmartOcean.htm](http://www.marine.ie/home/SmartOcean.htm)

### Transformative and enabling technologies

#### Indicative Research Issues:

See note to reader (page 16).

#### Indicative Enabling Actions:

- Initiation of a jointly funded Foresight Study on emerging transformative and enabling technologies and support for Horizon Scanning initiatives.

### 5.3. Applied Research: Science supporting Society and Economy

In this Section, we deal with research related topics which address:

- **Societal issues:** e.g. marine environmental science and associated national marine environmental assessment and monitoring programmes, which are, in the main, driven by and of relevance to policy advice and good governance;
- **Economic issues:** e.g. applied science which supports and provides competitiveness and greater efficiencies to the productive sector (e.g. marine renewable energy, fisheries, etc).

These topics are also informed by basic research (Section 5.2).

**5.3.1. Marine Environmental Research:** The European seas and oceans are an important resource providing a wealth of valuable economic, environmental and cultural benefits. The quality of the marine environment is clearly crucial to the well-being of the European economy and to the goods and services it provides, particularly in the seafood and marine leisure and tourism sectors. It is not surprising that reference to “*in harmony with the environment*” is central to the IMP-EU, 2007 Vision Statement or that the Marine Strategy Framework Directive (MSFD) is regarded as the environmental cornerstone of the IMP-EU.

The overall aims of the MSFD are to achieve good environmental status in the marine environment by 2020, to promote conservation and protection preventing further damage and to manage human activities in the marine environment in accordance with the ecosystem approach.

Environmental policies, good governance and regulation are all dependent on knowledge of the

status and functioning of the marine ecosystem and the impacts of various pollutants. Improving this knowledge can only be filled by targeted marine research programmes and monitoring and assessment activities designed to provide a robust evidence base to inform, develop and implement appropriate policies and development plans. It also requires a mobilisation of regional and international co-operation, in research, monitoring and assessments and planning to achieve the vision we share for the sustainable use of our seas, the achievement of good environmental status, the protection and enhancement of marine products and services and the reduction of uncertainty.

Key environmental challenges include an improved knowledge-base to implement the MSFD and in particular in defining and monitoring *Good Environmental Status*, the effectiveness of management measures and the impacts of climate change (Section 5.2.2).

#### Marine Environmental Research

##### Indicative Research Issues:

- Development of a toolbox and guidelines for the application of the 11 indicators of Good Environmental Status (GES);
- Demonstrate the efficacy of the GES indicators in a variety of environmental conditions;
- Assess the feasibility of aggregation of MSFD Indicators;
- Identification and assessment of the risks associated with new and emerging anthropogenic pollutants.

##### Indicative Enabling Actions:

- Open access to all marine environmental research, monitoring and assessment data collected by European Atlantic Sea Basin countries (see also 5.3.2 and 5.4.2).

#### 5.3.2. Utilising the results/outputs of national marine environment and resource assessment programmes and nationally funded marine research programmes

Considerable effort, in both financial, personnel, infrastructural and time, is devoted to national marine environment and resource assessment programmes. While these are not research programmes *per se* they are informed by research and in turn inform the research agenda as new knowledge is discovered and new knowledge needs are identified.

Member and Associate State marine environmental monitoring programmes and fish stock assessments

are driven by a number of EU policies that require data:

**Common Fishery Policy (CFP):** Member States are required to collect data and share expertise on fish stock biomass and population structure and to agree on the Maximum Sustainable Yields (MSY) for each species. For these purposes, a number of parameters are required such as fishing effort, fish landings as well as socio-economical data. During fishery surveys, information on discards, by-catch, biodiversity, as well as direct information on fish and shellfish populations are obtained. These can be later used for applied research in their respective sectors, but also in a more comprehensive way for example for Integrated Coastal Zone Management (ICZM) and Maritime Spatial Planning (MSP)<sup>23</sup>.

In coastal waters (1 nautical mile), Member States must comply with the **Water Framework Directive (WFD, 2000)**<sup>24</sup>. Information on anthropogenic impacts, including chemical and microbiological contaminants, harmful algal blooms, eutrophication, etc., is required on a regular basis. Member States must strive to achieve good ecological status of their coastal waters by decreasing the levels of contaminants through policies and appropriate technologies/methodologies and developing new methods for pollution treatments and remediation.

The **Marine Strategy Framework Directive (2008)** is wider in its geographical reach than the WFD, integrates all the previous Directives in the marine and maritime areas and is applicable in the marine waters under the sovereignty or jurisdiction of Member States. Its data requirements include an assessment of good environmental status based on eleven descriptors or indicators including: 1. biological diversity; 2. non-indigenous species; 3. population dynamics of commercial fish / shell fish; 4. elements of marine food webs; 5. eutrophication; 6. sea floor integrity; 7. alteration of hydrographical conditions; 8. Contaminants; 9. contaminants in fish and seafood for human consumption; 10. marine litter and 11. the introduction of energy, including underwater noise. Research is needed to support the collection, use and interpretation of these indicators, including in space and in time.

National survey and assessment programmes, to support EU fisheries and environmental policies, generate a wealth of direct and indirect information about the marine environment. In a similar vein, SEAS-ERA partner organisations (Annex 1) fund a considerable amount of competitive marine research

<sup>23</sup> [http://ec.europa.eu/maritimeaffairs/spatial\\_planning\\_en.html](http://ec.europa.eu/maritimeaffairs/spatial_planning_en.html)

<sup>24</sup> [http://ec.europa.eu/environment/water/water-framework/index\\_en.html](http://ec.europa.eu/environment/water/water-framework/index_en.html)

## 5. Marine Research Priorities for the European Atlantic Sea Basin

focused on protection of the marine environment and resource assessment and utilization. EU initiatives such as **WISE-Marine**<sup>25</sup> and **EMODNET** (European Marine Observation and Data Network)<sup>26</sup> provide vehicles to centralise national survey and assessment data.

Other initiatives include:

- The **European Marine Ecosystem Observatory (EMECO)**<sup>27</sup> which is a consortium of European Marine Institutes that aims to integrate marine environmental monitoring, ecosystem modelling and coastal and ocean research;
- The **European Centre for Information on Marine Science and Technology (EUROCEAN)**<sup>28</sup> in association with EU funded projects such as FP7 SEAS-ERA, is starting to compile on-line InfoBases on EU funded and nationally funded competitive marine research projects.

### Utilising the results/outputs of national marine environment and resource assessment programmes and nationally funded marine research programmes

#### Indicative Research Issues:

See Section 5.3.1.

#### Indicative Enabling Action:

- Greater collaboration in the establishment of a single portal to facilitate access to nationally funded marine environment and assessment survey results and the outputs of national competitive marine/maritime research programmes.

**5.3.3. Marine Renewable Energy:** Energy from the marine environment whether contained in the world's wind, waves and marine tidal currents, or from marine biomass, provides an untapped source of renewable energy. The European Atlantic is one of the world's richest areas in terms of wind, wave and tidal energy generation. Indeed, this is one of the greatest assets and future opportunities for the European Atlantic Sea Basin.

The very significant potential value of the European / Atlantic seaboard marine renewable energy resource in terms of turnover, value-added and employment, has been described in a number of recent reports (EWEA, 2009<sup>29</sup>, EU-OEA, 2010<sup>30</sup>, Marine Board-ESF, 2010<sup>31</sup>) and is reflected in significant investments by industry along the European Atlantic coast.

While there are many technical, economic, environmental and social challenges related to these marine renewable energy technologies and there is increased competition for marine space (with existing sectors: transport, fisheries, aquaculture, leisure & tourism) and strong international competition, the potential benefits to the Atlantic Region of Europe are significant. It is currently estimated that by 2050 (Marine Board-ESF, 2010) a substantial proportion of Europe's electricity supply could be provided by renewable ocean energy generated off the Atlantic coast. This would have advantages for the region in terms of job creation and internationally traded products and services, and for Europe in terms of energy security, a reduction in a reliance on fossil fuels and carbon dioxide emissions.

However this potential will only be realised by coordinated action and governance putting the right regulations and supports in place to facilitate the sustainable development of this new emerging industry, mobilising the significant economic, technical and scientific capabilities of the region and ensuring inter-connectivity to move energy from where it is produced (Atlantic coast) to where it is needed (the urban and industrial centres of Europe).

**BioMass to Fuel:** There is currently a renewed interest in looking at the potential of algae (macroalgae – seaweeds and microalgae – phytoplankton) as a source of biofuel / bio-diesel. Much of this new interest is stimulated by increasing oil prices and a greater interest in energy security and supply, particularly from the aviation sector.

Biofuels from marine algae are un-economical to produce using the technology available today (US Department of Energy Biomass Program)<sup>32</sup>. It is argued that, based on conservative estimates, algal biofuels produced in large volumes with current technology would cost twice as much as those from terrestrial biomass (e.g. soybean oil). Lowering this cost will require coordinated R&D across a wide range of technical sectors over the next years. Although the technical challenges are significant, the broad public benefit of successfully commercialising marine algal biofuels, from both micro and macro algal species aquaculture, warrants placing a high priority on the needed research. In addition to its role as source of bio-products, algal aquaculture also has a potential role as an adsorbent of marine nutrients and CO<sub>2</sub>.

<sup>25</sup> <http://water.europa.eu/>

<sup>26</sup> [http://ec.europa.eu/maritimeaffairs/emodnet\\_en.html](http://ec.europa.eu/maritimeaffairs/emodnet_en.html)

<sup>27</sup> <http://www.emecogroup.org/>

<sup>28</sup> [www.eurocean.org](http://www.eurocean.org)

<sup>29</sup> [www.ewea.org/](http://www.ewea.org/)

<sup>30</sup> <http://eu-oea.com/>

<sup>31</sup> [www.esf.org/marineboard](http://www.esf.org/marineboard)

<sup>32</sup> <http://www1.eere.energy.gov/biomass/pdfs/algalbiofuels.pdf>



### Marine Renewable Energy

#### Indicative Research Issues:

- Measurement and mitigation of the environmental impacts of Marine Renewable Energy, including noise;
- Model testing, performance validation, hydrodynamic modelling;
- Control systems, power take-off (PTO) technologies, mooring design, wave forecasting, new and innovative Marine Renewable Energy devices.

#### Indicative Enabling Actions:

- An assessment/ review of current marine biofuels research in Europe;
- Contributing to the development of standards and testing protocols and strengthening the role of Test Centres in Europe.

**5.3.4. Shipping & Maritime Transport** The maritime transport and ports sector is one of the most valuable resources in terms of revenue and employment in the European Atlantic Area. The sector provides vital links for trade and commerce in the Atlantic Sea Basin, between European regions (e.g. the North Sea, Baltic and Mediterranean), North America and globally.

*Over 90% of EU's external trade and over 40% of its internal trade are transported by sea and 3.5 billion tonnes of cargo/annum and 400 million passengers pass through 1,200 European ports each year.*

Considerable opportunities exist for further development and improved competitiveness of the shipping and maritime transport sector within the Atlantic region, particularly in the area of green transport and the “*green ship*” (engine efficiency, reduction of emissions, on board/onshore waste treatment, etc).

The development and promotion of freight transport links throughout Europe, port and infrastructure development, and port hinterland traffic management are key issues. A strategic focus on developing and promoting maritime transport as a green and sustainable transport mode, with an emphasis on reducing emissions, protection from ship source pollution and development of green port infrastructure is important and would confer competitive advantage on the region and develop a range of value-added globally traded products and services. Short sea shipping and motorways of the sea, to take traffic off Europe's

congested road networks, particularly as it is estimated that the external cost of waterborne transport is 20% less than the cost of road transport, could significantly reduce the CO<sub>2</sub> loading of road transport.

European companies are world leaders in all fields of the maritime industry. Maritime RDI is recognised by the WATERBORNE Technology Platform<sup>33</sup> as one of the keys to European competitiveness covering the parallel development of supply chains, equipment and materials, manufacturing and support infrastructure. It deals with all vessel types from high volume and specialised cargo vessels, large cruise ships and ferries through special service supply ships, ice breakers, tugs and dredgers, research and coast guard vessels to super yachts, sail and power boats.

In May 2011, the WATERBORNE Technology Platform published a **Waterborne Strategic Research Agenda** and Vision 2020 Statement and an accompanying Implementation Plan. These documents contain a very comprehensive assessment of the current status of the sector, its development potential and identify the key for research, development and innovation necessary to support the sector.

### Maritime Transport

#### Indicative Research Issues:

- The green ship;
- Reduction of ship emissions;
- Environmentally friendly alternatives to anti-fouling hull coatings (e.g. nano-skins).

#### Indicative Enabling Actions:

- Promotion of research at the interface between marine and maritime sectors as is being elaborated by the EU FP7 EMAR2RES Project.

#### 5.3.5. Maritime Safety, Security and Surveillance:

At European and at Member State level there is recognition of the need to integrate the co-ordination and inter-operability of Europe's ability to guarantee safety and security of passage while at the same time exercising State sovereignty in European waters. In this regard, good progress has been made with co-operation in the area of maritime safety, security and surveillance in particular in relation to: emergency at sea responses (including search and rescue); pollution response (including catastrophic events); environmental protection, fisheries enforcement; improved vessel traffic management and information; and maritime security and surveillance at sea

<sup>23</sup> [www.waterborne-tp.org/](http://www.waterborne-tp.org/)

## 5. Marine Research Priorities for the European Atlantic Sea Basin

(including border control, counter-narcotics, human trafficking, smuggling and other forms of organized crime). Work is also underway to ensure a Common Information Sharing Environment (CISE)<sup>34</sup> to facilitate interoperability and the exchange of maritime ship-to-ship and ship-to-shore data. Given the broad expanse covered by the European Atlantic Sea Basin, there are significant opportunities to improve the efficiency and effectiveness of co-operation in these areas, both within the agencies within each jurisdiction and across jurisdictions through greater information exchange and shared analysis.

The WATERBORNE Technology Platform argue that given the high-technology nature of the European shipping sector and the high Europe-wide priority for safety and environmental quality, high global standards and effective international control are important. E-maritime approaches may provide a solution, providing a means to improve the flow of information from ship-to-ship and ship-to-shore and to provide the backbone for new products and services. Improved safety and monitoring services will be a high priority in the pursuit of zero accidents.

### Maritime Security, Safety and Surveillance

#### Indicative Research Issues:

- Promotion of research at the interface between marine and maritime sectors as is being elaborated by the WATERBORNE Technology Platform, including the development of ICT based maritime safety, security and surveillance systems;
- Mapping and reducing the risk of maritime accidents (collisions, fires, polluting incidences, etc);
- Developing integrated ocean services for navigation, ship routing and risk assessment.

#### Indicative Enabling Actions:

- Initiate a pilot Common Information Sharing Environment (CISE) project for Maritime Security, Safety and Surveillance in the European Atlantic Sea Basin.

**5.3.6. Marine Leisure and Tourism, including maritime culture and heritage:** Marine tourism, including angling, whale watching, leisure boating, yachting and surfing, scuba-diving and other holiday activities by the sea and more recently cruise liner holidays, is a very significant component of the global and European marine economy and is valued at over €72 billion (2004) or 43% of the global marine tourism market (Westwood 2005)<sup>35</sup>. Marine leisure and tourism has very different

aspects depending on the actual location in the Atlantic Area (e.g. from activity holidays in the north to sun holidays in the south). Marine leisure is increasingly a critical component of human health, leisure and well-being (the “*blue gym*”). Marine leisure and tourism is a rapidly growing sector, in spite of the economic recession, and is of great importance to coastal communities.

### Recreational Fishing (RF)

One of the emergent coastal/leisure activities is recreational fishing, defined as “*the use of fish resources for personal consumption and/or leisure*”. Around 10% of the European population fish for recreation, but the contribution of RF to exploitation of coastal fisheries resources is largely unknown and is an issue raised in the reformulation of the Common Fisheries Policy. The economic valuation of RF is complex because the goods and services (e.g. the angling experience) are only partly traded on formal markets and up-scaling of the induced economic impact requires combining expertise from fisheries biology, economics and social science.

Marine culture and heritage represent significant potential for coastal communities and new interactive ICT technologies are opening up new vistas in this area.

A more recent development has been the European cruise line industry. This industry generated €29 billion in total economic benefits for Europe in 2007. Significant potential exists to develop innovative cruise packages along the Atlantic coast.

### Marine Leisure and Tourism

#### Indicative Research Issues:

- Methodologies to assess the economic value and environmental impact of recreational fishing activities;
- Methodologies to assess and quantify the willingness of the public to pay for marine ecosystem conservation and protection, including maritime heritage.

#### Indicative Enabling Actions:

- An inventory of European Atlantic maritime culture and heritage.

<sup>34</sup> [http://ec.europa.eu/maritimeaffairs/pdf/integrating\\_maritime\\_surveillance\\_en.pdf](http://ec.europa.eu/maritimeaffairs/pdf/integrating_maritime_surveillance_en.pdf)

<sup>35</sup> [www.marine.ie/NR/rdonlyres/B66FBE34-3859-4FA8-9ABF-8C8558CDB15E/0/ForesightSeries1\\_global\\_market\\_analysis.pdf](http://www.marine.ie/NR/rdonlyres/B66FBE34-3859-4FA8-9ABF-8C8558CDB15E/0/ForesightSeries1_global_market_analysis.pdf)

**5.3.7. Marine Bio-Resources:** Marine Bio-Resources include primary productivity (fisheries, aquaculture), harvesting (fishing) and seafood processing, including the preparation of value-added products, seafood health and safety and traceability. It is a sector of very significant importance to the economic and social wellbeing of many Atlantic communities. Major challenges facing the marine bio-resources sector include supply of raw material, overfishing, impacts of climate change, food quality and security.

The success of the **primary productive sector** (fisheries; aquaculture and seaweed) depends primarily on a sustainable, profitable and self-reliant industry that will maximise the long term contribution to coastal communities in terms of the ecosystem, economy and social aims. This vision is contingent on a resource base maintained at sustainable levels in the context of a healthy and diverse marine environment and supports a scenario where seafood has re-established itself as a regular fixture in the diet of half a billion European consumers; where the sector can meet the demand for high quality locally produced seafood; where the resource base has been restored to maximum sustainable yield or some suitable multi-species and ecosystem based proxy thereof; where people in coastal communities once again see fishing as an attractive and stable means of making a living; where stakeholders fully participate in decisions and debate on policy implementation.

The identification and prioritisation of marine bio-resources research topics has been undertaken recently for fisheries by Symes & Hoefnagel (2010)<sup>36</sup>, for fisheries and aquaculture by Holmes & Lock (2010)<sup>37</sup> and by the FP6 FEUFAR Project (2007-2008) ([www.feufar.eu](http://www.feufar.eu)).

The resource base is the bedrock of the seafood sector and the European North Atlantic contains some of the most productive fishing grounds and biologically sensitive areas in European waters. There are major fishing grounds from Portugal to the north of Norway which yield very diverse and economically significant catches and which represent a major input to the European seafood market. Most of these species also have their main spawning and nursery areas in these waters. The Atlantic area also contains important coral areas and other biogenic as well as physical features that need to be protected. According to the recent 2010 Quality Status Report the exploitation of many North East Atlantic fish stocks continues to be beyond sustainable levels, while the status of a large number of stocks still cannot be fully assessed due to lack of data.

Currently identified fisheries research priorities include: the effect of long-term protection of fish in protected areas on stocks and ecosystems; the impact of bottom trawling on benthic communities; mapping of the seabed with respect to potential perturbation and damage; interlinking of data sampled for different purposes and projects and at different times and spatial scales; fishing gear selectivity, discards and the valorisation of underused components of the catch, understanding the interaction between fisheries and top predators especially seabirds and sea mammals, as well as elasmobranchs and reptiles is also a priority. A particular emphasis is placed on achieving MSY targets in the context of multi-species fisheries and an understanding of food web dynamics. The priority sea fisheries research topics identified are consistent with and supportive of the recommendations emerging from the CFP Review<sup>38</sup> process.

#### Sea Fisheries

##### Indicative Research issues:

- Linking productivity with ecosystem interactions to support the Ecosystem Approach to Fisheries Management (EAFM) and developing appropriate management approaches;
- Mitigation or elimination of discarding, as well as better use of by-catches;
- Achieving Maximum Sustainable Yield (MSY) for European fisheries.

##### Indicative Enabling Actions:

See note to reader (page 16)

**Aquaculture** is an important food sector in Europe producing healthy, nutritional products of high quality. It is strategically important for Europe especially in view of our heavy reliance on imports of seafood. The major species cultured in the European Atlantic include: Atlantic salmon, rainbow trout, sea bass, sea bream, common carp, blue mussels and oysters. In addition to these, there are several species in the early development of culture, the most important being cod. These species are at different levels of development in terms of traits selected for, use of reproductive and genomic technologies, and design of breeding programs. For a description of the state of farming development for each species see [www.aquabreeding.eu](http://www.aquabreeding.eu).

Aquaculture production must be carried out to the highest standards under an environmentally friendly regime. The protection of the environmental quality

<sup>36</sup> Symes, D. and E. Hoefnagel (2010). "Fisheries policy, research and the social sciences in Europe: Challenges for the 21st century." *Marine Policy* 34(2): 268-275.

<sup>37</sup> Holmes, J. and J. Lock (2010). "Generating the evidence for marine fisheries policy and management." *Marine Policy* 34(1): 29-35.

<sup>38</sup> [http://ec.europa.eu/fisheries/cfp/index\\_en.htm](http://ec.europa.eu/fisheries/cfp/index_en.htm)

## 5. Marine Research Priorities for the European Atlantic Sea Basin

in the Atlantic, in line with the Marine Strategy Framework Directive, offers unrivalled opportunity for the production of high quality seafood products. This can only be achieved by an appropriate development of technologies and practices within the industry in tandem with similarly appropriate frameworks for interacting with Natura 2000<sup>39</sup> goals and legislation and the requirements for MSP at a regional European level.

Recent identifications of aquaculture research priorities have been undertaken by the FP6 FEUFAR (Future of European Fisheries and Aquaculture Research Project (2007-2008) ([www.feufar.eu](http://www.feufar.eu)) and are being undertaken by the European Aquaculture Technology and Innovation Platform ([www.eatip.eu](http://www.eatip.eu)), the European Forum of Farm Animal Breeders – Technology Platform (EFFAB) ([www.effab.org/](http://www.effab.org/)) and the Sustainable Farm Animal Breeding and Reproduction – Technology Platform (FABRE) ([www.fabretp.info](http://www.fabretp.info)).

Priorities identified include: new species and species improvements by utilisation of bio- and genetic technology; improvements to fish health and welfare; food conversion efficiencies; disease treatments and resistance; escapees, decreasing the environmental impact of aquaculture, etc. These topics are consistent with those described in the Strategy for the Sustainable Development of European Aquaculture<sup>40</sup> in which the EU has committed itself to: “*pursue efforts in aquaculture R&D, and allocate a sufficient EU budget to aquaculture projects to further develop the knowledge-base for sustainable and competitive aquaculture practices*”.

### Aquaculture

#### Indicative Research Issues:

- Containment and Escapees: Development of guidelines and standards to ensure optimization of containment of aquaculture species. Development and implementation of guidelines to mitigate effects of escapees on the environment and on wild stocks;
- Disease control: Development of novel treatments, including vaccines for enhanced disease and pest control and development of best practice in integrated disease and pest management to ensure optimum use and efficacy of existing control measures;
- Species diversity: promoting diversity in the number of species farmed and opportunities for deepwater aquaculture;
- Interactions with EU Habitats Directive/Natura 2000.

#### Indicative Enabling Actions:

See note to reader (page 16)

**Seafood Processing:** four specific issues are identified, some of which overlap with the marine biotechnology sector (5.3.9):

**1. Product development** - Much of the seafood produced in Europe lacks differentiation, thus limiting the value-added from wild and farmed sources. Developing new products, to meet the needs of an environmentally aware, health conscious and/or convenience-oriented consumer is essential. Access to premium, high-value (global and local) niche markets is vital for securing the growth and competitiveness of Europe's seafood industry. High on the agenda is the need to provide knowledge which contributes to raising the competitiveness of the seafood sector. This requires research in: (1) consumer values, attitudes and behaviour; (2) production and management systems (including aquaculture and wild capture technologies); (3) new food processing technologies; (4) constantly improving quality, taste and texture; (5) ensuring food safety and developing new products from an expanded marine foods source, including processing waste streams.

The use of marine ingredients for functional food, pharmaceuticals, nutraceuticals and biomaterials requires increased bioprospecting and biodiscovery to identify and extract ingredients from fish, marine invertebrates, algae, marine plants and marine microorganisms. Building competitiveness in exploiting these novel sources requires research on bio-technology processes to collect, identify, classify and explore new and novel uses for marine derived compounds.

**2. Consumer health** - Health aspects are important both from a consumer preference perspective and a public health perspective. The production of safe food is an essential pre-requisite for all European seafood. From a public health perspective, a strategy for low-cost, healthy products to increase demand among poor consumers is called for. Research is also needed to describe the beneficial health effects of seafood or seafood components, with a particular focus on farmed fish and seaweeds. Also needed to maintain product quality and allay consumer concerns over product safety are low-cost, rapid monitoring and detection technologies for freshness, pathogens, and contaminants.

**3. Traceability** - Traceability is important for several purposes: (1) to assure consumers; (2) to document sustainable harvesting; (3) to document origin; (4) to document different aspects of quality; (5) to document all sources of input, e.g. days since catch,

<sup>39</sup> [http://ec.europa.eu/environment/nature/natura2000/index\\_en.htm](http://ec.europa.eu/environment/nature/natura2000/index_en.htm)

<sup>40</sup> <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0162:FIN:EN:PDF>



treatment, and additives. On the technical side, the further development of standards, procedures and systems is needed. Regarding applications, the focus on traceability is moving towards the business side, seeking new ways to ensure competitiveness of European producers and product diversification.

**4. Certification and branding (labelling)** - With a plethora of labels already used for food, knowledge is needed on what consumers need and want of information, on what to label and at which level to label. Research is needed to develop effective labelling systems and standards, including health, fish welfare, origin and treatment.

#### Seafood Processing

##### Indicative Research Issues:

- Food Safety: Developing fish processing methodologies in seafood products for (a) the elimination of parasites and to reduce the allergenic processes generated by parasitism, and (b) to reduce the pollution by metals and dioxins, etc) microbial load in shellfish;
- Processing: Developing processes for the reutilization of discards and by-catch biomass for the industry (animal feeders, cosmetic, etc);
- Food and health: Stimulate studies to determine the influence of seafood consumption on health.

##### Indicative Enabling Actions:

- Assessment of current status of fish processing waste recovery and utilisation.

**5.3.8. High-Tech Marine Knowledge-based Products and Services:** The Europe 2020 Strategy and the Innovation Union (2010) emphasise the importance of research and innovation in supporting smart, green, innovative, sustainable and inclusive growth and job creation.

Through the establishment of **Innovative “Maritime” Clusters**<sup>41</sup> and the *convergence of technologies*, Europe can draw on new and emerging technologies, particularly in the ICT and Life Science sectors, to facilitate and explore opportunities for a new knowledge-based, high-tech, marine products and services sector providing a range of value-added internationally traded high-tech products and services. These will be applied to:

- bring new opportunities to further develop traditional sectors (e.g. fishing, aquaculture, maritime transport, tourism, etc);

- open up exciting new opportunities such as the use of marine biological/chemical resources in drug development, bio medical devices, food ingredients (the knowledge-based bio-economy) and industrial chemicals, development of renewable wave and tidal energy sources and the application of ICT and engineering technology to environmental monitoring and new service based and internationally traded sectors.

There has been significant growth in the number of European and European-based multinational companies involved in this sector that mobilise national capabilities in ICT and Life Sciences to capitalise on opportunities for convergence associated with the marine sector. These include distributed sensing, wireless and cable communications and informatics for the development of next generation decision based management tools. These enabling technology platforms are currently deployed across a range of existing marine related sectors including shipping, security and logistics, environmental monitoring, offshore energy and emerging markets including marine renewable energy.

Across the European Atlantic area there are a number of key national marine test and demonstration infrastructures in place or under development for the *in situ* deployment of ICT solutions for ocean exploration/ marine environmental monitoring and the marine renewable energy test and demonstration sites. These test facilities form part of a potential network of marine infrastructure which can provide research, test and demonstration opportunities to European researchers and companies. Issues relating to infrastructures will be dealt with by Work Package 6.4.

#### Marine High-Tech Products & Services

##### Indicative Research Issues:

- Interoperability and integrated data management for multi-modal sensor networks;
- Web-enabled marine sensing platforms and mobile data applications;
- Nanotechnology and novel materials for anti-fouling coatings.

##### Indicative Enabling Actions:

- Establish and network Maritime Clusters/Technopoles.

<sup>41</sup> [http://ec.europa.eu/maritimeaffairs/clusters\\_en.html](http://ec.europa.eu/maritimeaffairs/clusters_en.html)

## 5. Marine Research Priorities for the European Atlantic Sea Basin

**5.3.9. Marine Biotechnology:** The European Atlantic is well placed geographically to maximise the potential of marine biotechnology. A long standing maritime heritage; an acknowledged competence in marine sciences; extensive marine territories comprising highly diverse marine habitats (including the deep ocean) represent opportunities to collaborate on the development and commercial exploitation of marine bio-resources.

Marine (blue) biotechnology involves the application of science and technology to exploit the unique biodiversity of living marine organisms for the production of knowledge, products, processes and services and offers a huge potential for innovative sustainable development. It has the potential to contribute to meeting many of the key societal challenges currently facing Europe and in supporting economic growth through:

- facilitating the ongoing sustainable supply of high quality healthy food from fisheries and aquaculture;
- providing a sustainable alternative source of energy, particularly through the use of microalgae;
- helping secure human health and wellbeing, through the discovery of novel bio-pharmaceuticals and nutraceuticals;
- securing good environmental status (GES), through the development of technologies to help protect and manage the marine environment; and
- developing new industrial products and processes, through the discovery of novel enzymes, biopolymers and materials for industrial applications.

Biotechnology is already contributing to nearly every industry sector, from healthcare to environmental bioremediation, from cosmetics to food and including novel advanced materials with industrial applications. The as yet largely untapped resources of the marine environment will ensure the discovery of new enzymes, biomaterials, biopolymers, and other related products such as bio-pharmaceuticals and nutraceuticals. This will help fill the gap for novelty demanded by industry in order to maintain a competitive position in global markets. Europe's diverse market-led industrial economy has targeted marine living resources as a huge and almost untapped source of genes, organisms and materials; some of which will present unique commercially viable solutions for industry.

Reflecting its economic potential, marine biotechnology continues to receive considerable attention from European institutional, agency and industry sectors. Most recently the Marine Board/ESF report *Marine Biotechnology: A New Vision and Strategy for Europe* (2010)<sup>42</sup> highlighted Europe's marine biotechnology opportunity which can be summarised as: *"To investigate marine biological resources for their sustainable exploitation in the production of food, biopharmaceuticals, biomaterials, bioenergy, bioremediation, nutraceuticals and improved industrial products and processes"*.

*With a projected global market valued at €3.6 billion (2012), Marine Biotechnology is expected to be one of the major enabling technologies of the 21st century, with a forecast annual average growth rate of the sector of 4% percent.*

Marine Board Position Paper 15  
"Marine Biotechnology: A New Vision and Strategy for Europe" (2010)

### Marine Biotechnology

#### Indicative Research Issues:

- Molecular biology investigation in life science - Genomic and meta-genomic analysis of systematically sampled marine organisms, including microorganisms (i.e. bacteria, viruses, archaea, pico and microplankton), algae and invertebrates;
- Cultivation of marine organisms and cell lines - Development of technologies to isolate and culture previously uncultivated microorganisms. Develop culture methods for vertebrate and invertebrate cell lines for the production of active compounds;
- Bio-mass production - Development and application of new effective systems, including bio-engineering, bio-reactors and cultivation systems, for the production, use and transformation of biomass from marine organisms. The production systems and the organisms are optimized to target specific applications (e.g. bio-refinery, aquaculture, etc.);
- Marine model organisms - Identify and prioritise new organisms of marine origin to increase life science knowledge and provide new opportunities for biotechnological exploitation.

#### Indicative Enabling Actions:

See note to reader (page 16)

<sup>42</sup> [www.esf.org/index.php?eID=tx\\_nawsecured1&u=0&file=fileadmin/be\\_user/research\\_areas/marine/pdf/Publications/MBPP15\\_MarineBiotechnology.pdf&t=1309958429&hash=41831aa99fdea665572baf999d2c83f4](http://www.esf.org/index.php?eID=tx_nawsecured1&u=0&file=fileadmin/be_user/research_areas/marine/pdf/Publications/MBPP15_MarineBiotechnology.pdf&t=1309958429&hash=41831aa99fdea665572baf999d2c83f4)

### 5.3.10. Oil & Gas Resources

The Atlantic continental shelf and margin may contain hydrocarbon resources critical to the security of supply of European energy in future decades. According to the OSPAR 2010 Report, offshore oil and gas activities in the North-East Atlantic have developed over the past 40 years, with the major offshore oil and gas developments in the North Sea and Norwegian Sea and mostly gas in the southern North Sea. Some production also takes place in the Celtic Sea (gas only), the Bay of Biscay and the Gulf of Cadiz (gas only). Gas reserves have also been identified off the west coast of Ireland (Corrib Field).

North Sea reserves are in decline. Enhanced recovery from existing fields and new discoveries of sizable volumes could mitigate this trend. The actual price of hydrocarbons favours more efforts in the development of cost effective technologies for both exploration and production. Innovative solutions are needed from academic and private R&D. The European industry is operating worldwide and represents a strong economic sector.

Exploration concerns small and marginal fields, deep-sea, and new provinces. The most promising province could be the Barents Sea, but all parts of the European Atlantic continental shelf and margin, including the Mediterranean and Black Seas, are of interest.

Better geological knowledge of the continental margins and associated sedimentary basins is required. Advances in the following fields could be crucial:

- Deep-sea margin structure (i.e. the Gold project in the Mediterranean sea - Deep Drilling in the Gulf of Lions), sediment deposition models based on source to sink approaches, assessment of geological hazards (seismic activity, slope stability, gas hydrate dissociation);
- New geophysical tools: sub-salt/sub basalt imaging; very high resolution 3D seismic; electromagnetism; seafloor monitoring system; systems with reduced impact on marine fauna (mammals, fishes);
- Basin and reservoir characterisation; integrating interpretation from various disciplines, through a real multidisciplinary approach.

Drilling technologies need to be improved: safer and environment friendly techniques, reduced cost of exploration wells (deep-sea, salt formation, basalt and tight carbonates).

Enhanced hydrocarbon recovery is very challenging. Innovations could greatly increase the amount of

reserves of existing and future fields (both onshore and offshore). Amongst the numerous items the following ones can be mentioned for reservoir management:

- CO<sub>2</sub> and polymer injection;
- Reservoir monitoring (4D seismic, down hole sensors);
- More accurate reservoir models.

During the last decades, floating production platforms, subsea umbilical riser and flowlines, and subsea production equipment have been successfully developed. New innovations are still required in order to conduct safer operations, especially in new frontiers: Arctic (systems resistant to ice loading, such as the Hibernia platform offshore eastern Canada), ultra deep water (harsh environment). Subsea processing and intervention need further improvements including electrical power supply from land. Also needed are cost effective solutions to tieback marginal fields to major fields.

Environmental pressures from the offshore oil and gas sector include impacts related to exploration, drilling, operation and decommissioning. Routine operations at production platforms lead to the release of oil, chemicals and naturally occurring radioactive materials to the sea, especially through discharges of produced water and partly from drill cuttings. Accidental oil spills can arise from different sources during operation. In 2007, around 60% of all operational installations reported air emissions and discharges to the sea as a result of oil and gas extraction. The recent Gulf of Mexico disaster has highlighted the need of updated standards and regulations for hydrocarbon exploration and production. Marine spatial planning based on sound environmental baseline data will be required to ensure that marine renewable energy and hydrocarbon resource developments are in harmony with fisheries and other marine activities.

The know-how and the innovations coming from the offshore oil and gas upstream sector can be applied to other sectors that are closely linked, such as:

- CO<sub>2</sub> sequestration and enhanced oil recovery and storage in depleted offshore fields;
- Gas hydrates: exploration tools, drilling, reservoir modelling, production technologies (development and economical evaluation: CO<sub>2</sub> injection, thermal activation, depressurisation) are subject to development and economic evaluation;
- Marine renewable energy: installation design, at sea operations, umbilicals (e.g. DC power cable).



## 5. Marine Research Priorities for the European Atlantic Sea Basin

### Oil & Gas Exploration

#### Indicative Research Issues:

- Resource assessment techniques, novel seismic imaging techniques, risk analysis particularly for small and marginal fields;
- Critical assessment of carbon capture and storage in the oceans and its potential environmental impacts;
- Exploitation techniques for marine gas hydrates.

#### Indicative Enabling Actions:

See note to reader (page 16)

**5.3.11. Mineral Resources** The deep-sea floor can be considered as one of the new and major challenges for expected deep-sea mining issues, specifically for metallic minerals. The driver is global demand and shortages from traditional terrestrial sources.

The sea bed represents today an alternative to onshore exploitation and possible new polymetallic and highly concentrated resources in several geological environments:

- seabed massive sulfides related to hydrothermal vents on mid-oceanic ridges;
- polymetallic nodules in deep abyssal plains;
- cobalt crusts on carbonate or basaltic submarine platforms.

In 2008, the European Commission launched the *Raw Materials Initiative- meeting our critical needs for growth and jobs in Europe*<sup>43</sup>. Several initiatives are being taken at European and national levels, including public and private initiatives to launch research programmes on mineral resources such as the European Technology Platform on Sustainable Mineral Resources<sup>44</sup> and the proposed ERA-MIN project under EU FP7.

Regarding the deep-sea, long-term scientific objectives and the development of a consolidated road map bringing together the European Commission, industry, national/ regional research programming agencies and implementing organisations as well as academia for the facilities and resources are needed. The underlying aim is to establish a permanent mechanism for planning and coordination of the European non-energy mineral raw materials research community, a task that will need sustained action over several more years. Sand and gravel extraction in the coastal zone is a

challenging issue in relation with the shortage of terrestrial materials. Inventories of sand and gravel resources in areas with other resource uses/conflicts have to be addressed in the context of ICZM / MSP to avoid spatial conflict and to be sure to maintain integrity of the biodiversity and to protect areas such as spawning grounds and critical nurseries areas.

### Mineral Exploration

#### Indicative Research Issues:

- Resource assessment techniques, novel seismic imaging techniques, risk analysis;
- Environmental impacts of deep-sea mining and mitigation techniques;
- Impacts of increased off-shore sand extraction to counteract sea level rise impacts.

#### Indicative Enabling Actions:

- Preliminary Assessment / Re-Analysis of existing mineral resources in the European Atlantic Sea Basin.

## 5.4. Research Support and Cross-Cutting Issues

In this section we consider research supporting actions and cross-cutting issues which put research into an economic, social, management (including governance) and spatial perspective.

**5.4.1. Marine Socio-Economic Assessment:** In its 2007 Report "Maritime Facts & Figures", the European Commission presented an impressive suite of marine socio-economic statistics for sea-related industries and services (Figure 3.1).

**Ecosystem goods and services** are the benefits arising from the ecological functions of healthy ecosystems. Such benefits accrue to all living organisms, including animals and plants, rather than to humans alone. There is a growing recognition of the importance to society that ecological goods and services provide for health, social, cultural, and economic needs.

However, these are gross figures and there are significant gaps in the economic and social evidence base that is required for marine policy and forward marine planning at the regional and local level. Exact

<sup>43</sup> [http://ec.europa.eu/enterprise/newsroom/cf/document.cfm?action=display&doc\\_id=894&userservice\\_id=1](http://ec.europa.eu/enterprise/newsroom/cf/document.cfm?action=display&doc_id=894&userservice_id=1)

<sup>44</sup> <http://etpsmr.org/>

comparisons between European marine economies have proved extremely difficult as the 'marine/ocean' sector does not formally exist in most national accounts. As part of the consultative process leading to the adoption of an Integrated Maritime Policy for the European Union, the European Commission initiated a number of studies to map the contribution of the marine/maritime economy to economic and social growth and development. Copies of these studies can be downloaded from the DG MARE Documentation Centre website<sup>45</sup>. The resultant studies, while assembling a comprehensive database and description of the contribution of the maritime economy to Member States economies, noted considerable difficulties in collecting comparable data and concluded that considerable work needed to be done before reliable, comparative and regular data on the contribution of marine/maritime sector to Member State and European GDP could be compiled.

In December 2010, a new study: *Blue Growth: Scenarios and Drivers for Sustainable Growth from the Oceans, Seas and Coast*<sup>46</sup>, was commissioned to identify scenarios and drivers of sustainable growth from the oceans, seas and coasts.

A few European Atlantic countries (e.g. France – Ifremer, UK-Crown Estate) regularly produce marine socio-economic statistics, while others (Ireland-Marine Institute) are beginning to do so. Clearly there is a need for making renewed efforts to develop appropriate methodologies, marine socio-economic indicators and routine data collection procedures that will support regular economic assessments of the contribution of the marine/maritime sector to National and European GDP.

#### Marine Socio-Economic

##### Indicative Research Issues:

- The development of appropriate, usable and comparable marine socio-economic indicators;
- The development of marine socio-economic modelling, scenario development and forecasting techniques;
- Measuring the non-market marine values of marine ecosystem goods and services.

##### Indicative Enabling Actions:

- Establish a network of European Atlantic Sea Basin Marine Socio-Economic Research Centres.

**5.4.2. Data Management and Dissemination:** According to the Commission's Communication "**Marine Knowledge 2020**" [November 2010]<sup>47</sup>, knowledge is the engine for sustainable growth in the interconnected global economy and a key element to achieve smart growth in line with the Europe 2020 Strategy. The magnitude of future changes in oceanic systems, their impact on human activity and the feedbacks on the ocean from changes in human behaviour cannot be forecast without understanding the way the system works now and how it worked in the past. Knowledge is necessary to achieve good environmental status of marine waters, in accordance with the Marine Strategy Framework Directive. Knowledge is a key component of the EU's plan to integrate marine and maritime research and a contribution to the Digital Agenda flagship initiative<sup>48</sup>.

*Without marine knowledge we cannot sustainably manage the changing seas and oceans, we cannot understand the impact of these changes on human activity and we cannot take advantage of new opportunities for growth and employment.*

Marine Knowledge 2020

In the context of the Marine Knowledge 2020 Strategy, three objectives to improve marine knowledge have, therefore, been identified:

1. Reducing operational costs and delays for those who use marine data and therefore:
  - helping private industry compete in the global economy and meet the challenge of sustainability;
  - improving the quality of public decision-making at all levels;
  - strengthening marine scientific research.
2. Increasing competition and innovation amongst users and re-users of marine data by providing wider access to quality-checked, rapidly available coherent marine data;
3. Reducing uncertainty in knowledge of the oceans and the seas and so providing a sounder basis for managing future changes

Environmental Data Directives, Regulations and Recommendations increase the need for marine data. The Marine Strategy Framework Directive obliges Member States to "*establish and implement coordinated monitoring programmes for the ongoing assessment of the environmental status of their marine waters.*"

<sup>45</sup> [http://ec.europa.eu/maritimeaffairs/info\\_mat\\_en.html](http://ec.europa.eu/maritimeaffairs/info_mat_en.html)

<sup>46</sup> [www.ecorys.com/news-items-press-releases/ecorys-advises-european-commission-on-sustainable-maritime-p-2.html](http://www.ecorys.com/news-items-press-releases/ecorys-advises-european-commission-on-sustainable-maritime-p-2.html)

<sup>47</sup> [http://ec.europa.eu/maritimeaffairs/marine\\_knowledge\\_en.html](http://ec.europa.eu/maritimeaffairs/marine_knowledge_en.html)

<sup>48</sup> [http://ec.europa.eu/information\\_society/digital-agenda/index\\_en.htm](http://ec.europa.eu/information_society/digital-agenda/index_en.htm)

## 5. Marine Research Priorities for the European Atlantic Sea Basin

The INSPIRE Directive [2007]<sup>49</sup> obliges Member States to adopt measures for the sharing of datasets and services between public authorities for the purposes of public tasks. The new Data Collection Framework [2008]<sup>50</sup> requires the collection, management and provision of high quality fisheries data for the purpose of scientific advice, mainly for appropriate fisheries management decisions.

*A conservative estimate of the benefits of creating an integrated network to replace the present fragmented marine observation system suggests a figure of €300 million per annum. Beyond this, a more rational use of marine data will not only improve the efficiency of existing users of marine data but will also open up new opportunities for innovation and growth.*

Marine Knowledge 2020

To address this growing demand for data there are currently a number of initiatives supporting data management and dissemination including the INSPIRE Directive, the Global Monitoring for Environment and Security Initiative (GMES)<sup>51</sup>, the Shared Environmental Information System (SEIS)<sup>52</sup> and the WISE-marine database.

Specifically related to marine data, the pilot EMODNET (European Marine Observation and Data Network) is reviewing existing marine data from different sources, measuring their quality, ensuring that they are complete with descriptors (metadata) and making them available through thematic portals. Projects such as SeaDataNet ([www.seadatanet.org](http://www.seadatanet.org)), a European network of Marine Data Centres, play a significant role at pan-European level for the standardisation of marine data and metadata (collected by oceanographic fleets and automatic observation systems), allowing interoperability and the building of a network of distributed data centres, and ensuring sustainability of this system.

<sup>49</sup> <http://inspire.jrc.ec.europa.eu/>

<sup>50</sup> <https://datacollection.jrc.ec.europa.eu>

<sup>51</sup> [www.gmes.info](http://www.gmes.info)

<sup>52</sup> <http://ec.europa.eu/environment/seis/>

<sup>53</sup> [http://www.un.org/Depts/los/convention\\_agreements/texts/unclos/unclos\\_e.pdf](http://www.un.org/Depts/los/convention_agreements/texts/unclos/unclos_e.pdf)

### Data Management and Dissemination

#### Indicative Research Issues:

- Development of applications for maritime safety, coastal environment protection and for the offshore sector;
- Development of user friendly and visualisation systems for operational management and governance, including smart phone applications.

#### Indicative Enabling Actions

- To co-operate in the establishment of an operational European Marine Data Architecture including sea-basin data assemblages and information services (Baltic, Atlantic, Mediterranean and Black Sea + sub-regions levels when relevant).

**5.4.3 Seabed Mapping:** It has often been argued that “a terrestrial developer would never embark on a major development project without a good map, why then should we expect marine developers to do so?”

The development of seabed mapping has seen very significant progress since the 1982 UN Law of the Sea Conference<sup>53</sup> which introduced the concept of Exclusive Economic Zones (Part V) and the Extended Continental Shelf (Part VI). The subsequent need by coastal states to establish the outer limits to their national jurisdictions/territories provided an impetus to national seabed and habitat mapping initiatives. This was greatly facilitated by new sonar swath bathymetry mapping and visualisation technologies.

Atlantic countries such as Norway ([www.mareano.no](http://www.mareano.no)), Ireland ([www.infomar.ie](http://www.infomar.ie)) and Portugal ([www.emepc.pt](http://www.emepc.pt)) have embarked on major seabed mapping exercises, while the EU INTERREG programme has supported a number of formative and co-operative seabed habitat mapping projects such as MESH in the North Atlantic and North Sea ([www.searchmesh.net/](http://www.searchmesh.net/)), BALANCE in the Baltic Sea ([www.balance-eu.org](http://www.balance-eu.org)) and MESH-Atlantic in the Celtic Sea/Bay of Biscay ([www.meshatlantic.eu](http://www.meshatlantic.eu)).

A 2008 presentation on seabed mapping, prepared by Ifremer (FR), NOCS (UK) and IFM-GEOMAR (D), pointed out that the offshore territories of Europe cover an area more than twice the size of the landmass, but that, for the most part, they have not been mapped by modern methods. These areas provide a basis for an increasing range of human uses including commercial fishing, aquaculture, harbour infrastructure works, navigation, pipeline and cable construction, wind and wave energy

production, offshore oil and gas development, and extraction of sand, gravel and metallic minerals. Accordingly, they argue that a framework for managing these marine resources is urgently needed to underpin the Integrated Maritime Policy for the European Union so that planning at European Union level can ensure that the European Seas remain healthy and productive for future generations. Such a planning framework requires geospatial information about sea floor sediments and topography, geology, engineering properties, energy regime and habitats that will need to be produced through seabed mapping in combination with sampling and/or observation techniques.

While swath bathymetry data has been collected over a number of years, by a wide variety of organisations, there is as yet no comprehensive database showing what has been mapped and what remains to be mapped in European waters, though the EMODNET project is starting to fill this gap.

A comprehensive, publicly-available, high-resolution map of European seabed morphology and habitats is essential to underpin the European integrated maritime policy. An ambitious programme is required to produce this map involving substantial long-term investment and partnerships between industry, the research community and governments. To start this process, the European Commission (DG MARE) has initiated a number of IMP-EU related actions including the establishment of an on-line **European Atlas of the Seas**<sup>54</sup>. This is closely linked to the EMODNET portals mentioned above and the UK led **EUSEaMap** project<sup>55</sup>, which has produced a broad-scale modelled habitat map of over 2 million km<sup>2</sup> of European seabed. Meanwhile, the EU FP7 Research Infrastructure Geo-Seas project ([www.geoseas.eu](http://www.geoseas.eu)) is compiling existing marine and ocean geological and geophysical data.

#### Seabed Mapping

##### Indicative Research Issues:

- Developments of standards for seabed data acquisition, archiving and public dissemination;
- Methodologies for the establishment of a cohesive pan-European approach to the identification and delivery of MSFD seabed monitoring requirements.

##### Indicative Enabling Actions:

- To co-operate in the establishment of a European Atlantic Seabed Mapping Programme.

**5.4.4. Management tools:** The *ecosystem approach to environmental management* tries to integrate ecosystem function and dynamics, socio-economic aspects, as well as governance and put these into a sustainable management framework. Marine ecosystems are affected by human activities on land, at the coast and in the sea. An integrated approach is crucial to develop a better understanding of the accumulative effects of these activities. Attention is given to integrating social-economic research and the impact of management options in marine environment policy decisions. The *ecosystem approach* has progressed significantly in recent decades and is now firmly embedded as a management principle in the Marine Strategy Framework Directive and in evolving Fisheries Policy (e.g. Reform of the Common Fisheries Policy).

Various management tools are used to assist the implementation of the *ecosystem approach*; these include Maritime Spatial Planning (MSP) and Marine Protected Areas (MPAs):

**Maritime Spatial Planning (MSP)** is an important cross-sectoral tool for implementing the IMP-EU and the MSFD.

MSP is defined as ‘*a process for public authorities for analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives*’. MSP includes spatial measures to sustainably manage the increasing and sometimes conflicting uses of the seas (i.e. maritime transport, renewable energy, fishing, oil and gas activities, leisure and tourism) and to ensure adequate protection of the marine environment.

**Marine Protected Areas (MPAs)** are areas for which protective, conservation, restorative or precautionary measures have been instituted for the purpose of protecting and conserving species, habitats, ecosystems or ecological processes of the marine environment. Recent evidence suggests that the establishment of (MPAs) have positive effects on biodiversity (FP6 projects: PROTECT<sup>56</sup> and EMPAFISH ([www.um.es/empafish/](http://www.um.es/empafish/))). MPAs also act as long-term study sites, which are crucial for enhancing the understanding of biodiversity and thereby providing the evidence base for future management and conservation. MPAs are being considered at the national, regional and global levels and it is becoming accepted that, correctly implemented, MPAs constitute a strong management tool and a key starting point to pave the way for ecosystem-based management of the marine environment.

<sup>54</sup> [http://ec.europa.eu/maritimeaffairs/atlas/index\\_en.htm](http://ec.europa.eu/maritimeaffairs/atlas/index_en.htm)

<sup>55</sup> <http://jncc.defra.gov.uk/page-5020>

<sup>56</sup> Website no longer available.



## 5. Marine Research Priorities for the European Atlantic Sea Basin

### Critical science priorities to underpin the Ecosystem Approach to Management of Biotic Ocean Resources

1. Develop tools for integrated policy evaluation to improve the ability of decision-making to take account of the important interactions between humans and marine ecosystems;
2. Improve the knowledge of how ecological support systems (food webs, physical-biological coupling, etc.) are linked to the provision of goods and services which benefit, and are utilized by, humans;
3. Assess the consequences of ecosystem changes for economies/societies, and investigate and develop mitigation and/or adaptation options;
4. Evaluate the advantages and limitations of alternative ecosystem conservation policies, including the use of economic incentives;
5. Ensure science support for strategic (regional) environmental assessments, including socio-economic factors; and
6. Take measures to improve data management and inter-operability of data sources and analytical methods.

Marine Board Position Paper 14 "Science dimensions of an Ecosystem Approach to Management of Biotic Ocean Resources - SEAMBOR" (2010)

In a global context, the Johannesburg Declaration [World Summit for Sustainable Development, 2002]<sup>57</sup> set a target for the establishment of representative networks of MPAs by 2012.

In its Quality Status Report 2010, OSPAR expressed concern on marine biodiversity in the North East Atlantic and recommended extending the network of Marine Protected Areas, especially in key offshore areas, to complete an ecologically coherent network. Further to the **OSPAR Bergen Statement** [2010]<sup>58</sup>, a network of unique and ecologically sensitive areas in the Atlantic has been protected bringing the network of OSPAR's marine protected areas to cover an area of 433,000 km<sup>2</sup>.

### Management Tools

#### Indicative Research Issues:

- Improved methodologies to better understand and monitor the application of the ecosystem approach;
- Improved methodologies to assess the application and effectiveness of Maritime Spatial Planning and Marine Protected Areas as tools for economic, social and environmental management.

#### Indicative Enabling Actions:

- Compilation of an inventory of good examples of the application of MSP and MPAs.

**5.4.5. Enabling Infrastructures:** The need to identify and support pan-European research infrastructures is a central tenant of the IMP-EU European Strategy for Marine and Maritime Research (2008). Such specialised research infrastructures are necessary to address identified marine challenges and opportunities. Current challenges facing infrastructure funders and operators include: long-term funding, networking existing infrastructures; standardising the datasets they collect and facilitating greater transnational access. More recently the issue of whether the distribution of existing infrastructures is *fit-for-purpose* and provides appropriate spatial distribution to address marine environmental and climate change impact assessments has been raised.

The need for a European Marine Research Infrastructure Strategy was supported by the European Marine Science Community Aberdeen (2007) and Ostend (2010) Declarations and is being addressed by a DG MARE Marine Research Infrastructures Working Group and by WP6.4 of the SEAS-ERA Project.

More recently the **Marine Sciences and European Research Infrastructures International Symposium, "The Future of the 21<sup>st</sup> Century Ocean"** (Annex 5) noted the need for:

- Co-ordinated implementation and encompassing European governance;
- A truly co-funding mechanism between EU and national funding;
- Training schemes for marine RI managers and researchers / engineers / technicians.

<sup>57</sup> [www.un.org/esa/sustdev/documents/WSSD\\_POI\\_PD/English/POI\\_PD.htm](http://www.un.org/esa/sustdev/documents/WSSD_POI_PD/English/POI_PD.htm)

<sup>58</sup> [www.ospar.org/html\\_documents/ospar/.../ospar\\_2010\\_bergen\\_statement.pdf](http://www.ospar.org/html_documents/ospar/.../ospar_2010_bergen_statement.pdf)

#### Examples of Specialised Marine Infrastructures:

- **Marine observation infrastructures:** including research vessels (EuroFLEETS), satellites, buoys, moorings (EuroSITES), deep-sea observatories (EMSO), drifting floats (Argo), towed recorders (Continuous plankton recorder), gliders, tide gauges, etc., which can operate at the surface, in the sea column or in the sea bed, are critical to understand the marine ecosystem and provide important test, trial and demonstration facilities for industry. Examples include the Spanish Canary Islands PLOCAN (<http://plocan.eu/en/index.php>) and the Irish SmartBay ([www.smartnbay.ie](http://www.smartnbay.ie)) facilities.
- **Marine biotechnology infrastructures:** the innovation potential of marine biotechnology across Europe is considered very high and can be boosted by putting appropriate infrastructures at the disposal of researchers and industries. Specialist facilities include the FP7 European Marine Biological Resource Centre ([www.embrc.eu/](http://www.embrc.eu/)) and European Consortium of Microbial Resource Centres ([www.international.inra.fr/partnerships/embarc](http://www.international.inra.fr/partnerships/embarc)) initiatives.
- **Aquaculture research infrastructures:** cover a wide range of applications depending on the particular field (e.g. breeding and genomics, health, production technologies, feed, food safety, productivity, species diversification, etc.). Recently, new FP7 aquaculture infrastructure co-ordination and access projects such as MESOAQUA (<http://mesoaqua.eu/>) and AQUAEXCEL ([www.aquaexcel.eu/](http://www.aquaexcel.eu/)) have been supported while interest in the establishment of test and demonstration facilities for offshore aquaculture are being explored.
- **Ocean energy test sites:** These are marine test sites connected to a grid, where ocean energy devices can be tested in real ocean conditions. Such facilities currently exist in Scotland, Ireland and Portugal and are being developed in Norway. The new FP7 MaRINET project ([www.fp7-marinet.eu](http://www.fp7-marinet.eu)) aims to coordinate research and development at all scales (small models through to prototype scales from Laboratory through to Open Sea tests) and to allow access for researchers and developers to facilities which are not available universally in Europe. The linking together of facilities at different scales together with the incorporation of test facilities for components such as power take-off systems, grid integration, moorings, environmental tests will ensure a focusing of activities in this area.

#### 5.4.6 Building Research and Innovation Capacity:

The IMP-EU (2007), the Europe 2020 Strategy and the Innovation Union (2010) emphasise the vital role of research, innovation and training to future economic recovery and sustainable development. The number of Centres of Excellence, including universities and Institutes of Technology in the European Atlantic area has already been referred to (Section 3.5). The skills and expertise of these Centres need to be better harnessed, and working closely with industry, enabled to address the challenges facing existing industries, such as shipping and maritime transport (e.g. the green ship), fisheries, aquaculture, and to provide a catalyst for creating new markets and industries linked to activities such as marine renewable energy; marine biotechnology and marine technology.

These Centres also have a critical role to play in supporting the science base of the MSFD and in evidence-based policy decisions and addressing regional aspects of climate change mitigation and adaptation strategies. A number of geographic information system (GIS) enabled databases of European Atlantic Centres of Excellence, Public Research Institutes, Universities, Institutes of Technology and knowledge-based marine SMEs are available on-line or are in preparation. These include:

- The FP6 MarinERA (2004-2009) Database on **European Marine/Maritime Centres of Excellence**, (<http://marineinstitutes.eurocean.org/>);
- The INTERREG-IV KIMERAA Project **European Network of Knowledge Transfer in the Regions of the Atlantic Area Database** ([www.kimeraa.eu](http://www.kimeraa.eu)).

Building new research capacities, supporting technology transfer and innovation and the uptake of research results by SMEs are key components of the SEA-ERA Atlantic Sea Basin Research Plan/Strategic Research Agenda. This topic will be further developed in SEAS-ERA WP6.5.

## 6. High-Level Road Map

### 6.1. Next steps – A High-Level Road Map

As stated in the introduction, a key deliverable of WP6.1 of the FP7 SEAS-ERA Project is to develop a *draft* Research Plan, as an input to the preparation of a Strategic Research Agenda for the European Atlantic Sea Basin.

This **Discussion Document** is designed to engage the European Atlantic Sea Basin stakeholder community in a wide ranging debate to identify key opportunities and challenges related to the sustainable development of the Atlantic marine resource base and to identify a suite of appropriate enabling actions and the research necessary to address these in a Strategic Research Agenda and Implementation Plan.

**6.1.1. Work Programme 2012:** In 2012, a series of Consultative Stakeholder Workshops and other dissemination activities are planned (see SEAS-ERA website events calendar [www.seas-era.eu](http://www.seas-era.eu)) to obtain feedback on this Discussion Document and to reach a consensus on the main enabling actions and research topics to be pursued. In parallel, the SEAS-ERA project intends to launch common programme and joint call initiatives based on an initial analysis of emerging research issues and enabling actions.

**6.1.2: Work Programme 2013:** Based on the feedback from these Workshops, and other forms of feedback including from other SEAS-ERA Work Packages, the SEAS-ERA Atlantic Partnership will prepare a high-level roadmap identifying common programmes and joint projects and enabling actions that its membership can support, along with indicative timelines, targets and milestones. Again it is important to emphasise here that, while it is the intention to present a comprehensive assessment of challenges and opportunities and the necessary research and enabling actions to address these, only some of these actions will be within the remit and competence of the SEAS-ERA Atlantic partners.

The Road Map will provide an input to inform:

- national marine research funding programmes and promote increased co-operation between participating Atlantic research funding partners;
- the EU Common Strategic Framework Research and Innovation Programme [2014-2020] (Horizon 2020);
- post-2013 Structural and Cohesion Policies and the proposed EU strategies for the Atlantic and the North Sea;
- the Joint Programming Initiative (JPI) “Healthy and productive Seas and Oceans”.

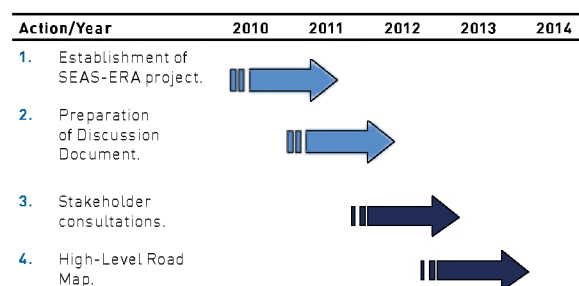


Figure 6.1: SEAS-ERA Road Map 2010-2014.



## Annex 1: SEAS-ERA Partnership

Partner	Organisation	Country	WP6 Atlantic	WP7 Med	WP8 Black Sea
1*	Ministry of Science and Innovation (MICINN) (Project Coordinator.)	Spain	●	●	
2*	Belgian Federal Public Planning Service Science Policy (BELSPO)	Belgium	●		
3*	Ministry of Education, Youth and Science (MEYS)	Bulgaria			●
4*	National Research Agency (ANR)	France	●	●	
5 <sup>1</sup>	Danish Food Industry Agency (DFIA),	Denmark	–		
6*	Jülich Research Centre GmbH (JÜLICH)	Germany	●		
7*	General Secretariat for Research and Technology (GSRT)	Greece		●	
8*	The Icelandic Centre for Research (RANNIS)	Iceland	●		
9*	Marine Institute (MI)	Ireland	●		
10*	Ministry for Education, Universities and Research (MIUR)	Italy		●	
11*	Research Council of Norway (RCN)	Norway	●		
12*	Malta Council for Science and Technology (MCST)	Malta		●	
13*	Portuguese Foundation for Science and Technology (FCT)	Portugal	●		
14*	Netherlands Organisation for Scientific Research (NWO)		●		
15*	Scientific and Technological Research Council of Turkey (TUBITAK)	Turkey		●	●
16*	Natural Environment Research Council (NERC)	UK	●		
17*	The Department for Environment, Food and Rural Affairs (DEFRA)	UK	●		
18	Marine Board-ESF (MB-ESF)	France	●	●	●
19*	The Executive Agency for Higher Education, Research, Development and Innovation Funding (UEFISCDI)	Romania			●
20*	Kyiv State Center for Scientific, Technical and Economic Information (KyivCSTEI)	Ukraine			●
21*	National Science Foundation of Georgia (SRNSF)	Georgia			●
22	Institut Français de Recherche pour l'Exploitation de la Mer (Ifremer)	France	●	●	
<b>Third Parties</b>					
*	Consiglio Nazionale delle Ricerche(CNR)	Italy		●	
	European Centre for Information on Marine Science & Technology (EUROCEAN)	Portugal	●	●	●

\* Denotes a Marine Research Funding Organisation (RFOS).

<sup>1</sup> Due to national restructuring, the Danish partner (Danish Food Industry Agency, DFIA), had to withdraw from the SEAS-ERA project.

## Annex 2: SEAS-ERA Work Programme Leadership Roles

WP	Title	Lead Partners <sup>1</sup>
1	Strategic Analysis	MB-ESF
2	Common Programmes	ANR
3	Joint Calls	BELSP0
4	Infrastructures	ANR
5	Capacity Building	MUIR
<b>6</b>	<b>Atlantic Ocean</b>	<b>RCN</b>
6.1	Strategic Analysis	<b>MI / MB-ESF</b>
6.2	Common Programmes	<b>RANNIS</b>
6.3	Joint Calls	<b>FCT</b>
6.4	Infrastructures	<b>Ifremer</b>
6.5	Capacity Building	<b>FCT</b>
<b>7</b>	<b>Mediterranean Sea</b>	<b>GSRT</b>
7.1	Strategic Analysis	GSRT
7.2	Common Programmes	ANR
7.3	Joint Calls	MICINN
7.4	Infrastructures	ANR
7.5	Capacity Building	MCST / MIUR
<b>8</b>	<b>Black Sea</b>	<b>TÜBITAK</b>
8.1	Strategic Analysis	TÜBITAK
8.2	Common Programmes	UEFISCDI
8.3	Joint Calls	MEYS
8.4	Infrastructures	MEYS
8.5	Capacity Building	KyivCSTEI
9	Dissemination	FCT / EurOcean
10	Co-ordination and Management	MICINN

**Notes:** For Organisation/Agency acronyms see Annex 1.

## Annex 3: European Atlantic Marine Research Strategies and/or Programmes (Source: SEAS-ERA WP1)

Country	National Marine Strategy and/or Marine Research Programme	Duration	Contact	Web-site
Belgium	Policy note of the Belgian Federal Minister of Science Policy	2010 -	BELSP0	<a href="http://www.dokamer.be/FLWB/PDF/52/2225/52K225020.pdf">www.dokamer.be/FLWB/PDF/52/2225/52K225020.pdf</a>
	Policy note of the Flemish Minister of Science Policy & Flanders in action (VIA)	2009-2014	Department of Economy, Science and Innovation of the Flemish Government (EWI)	<a href="http://www.evi.vlaanderen.be/sites/default/files/documents/Belaisnota%20Wetenschap%20&amp;%20Innovatie%202009-2014.pdf">www.evi.vlaanderen.be/sites/default/files/documents/Belaisnota%20Wetenschap%20&amp;%20Innovatie%202009-2014.pdf</a>
				<a href="http://www.vlaandereninactie.be">www.vlaandereninactie.be</a>
Denmark				
France	Exploring the sea to understand the earth: contribution to a national research strategy for marine sciences for 2020	2010-2020	Ifremer	<a href="http://w3z.ifremer.fr/strategie/plan_strategique">http://w3z.ifremer.fr/strategie/plan_strategique</a>
	Prospective Ocean Atmosphere	2006-2011	Ministry of Higher Education and Research	<a href="http://www.insu.cnrs.fr/f1198pdf,prospectiveocean-atmosphere-2006-2011.pdf">www.insu.cnrs.fr/f1198pdf,prospectiveocean-atmosphere-2006-2011.pdf</a>
	"Ideen. Innovation. Wachstum" Hightech Strategie für Deutschland Research for Sustainable Development (FONA)	2010-2015	BMBF	<a href="http://www.fona.de/pdf/publikationen/research_for_sustainable_development.pdf">www.fona.de/pdf/publikationen/research_for_sustainable_development.pdf</a>
Iceland	Science and Technology Policy	2010 -	Ministry of Education, Science and Culture	<a href="http://www.vti.is/english">www.vti.is/english</a>
Ireland	Sea Change: A Marine Knowledge, Research & Innovation Strategy for Ireland	2007-2013	Marine Institute	<a href="http://www.marine.ie/home/SeaChange.htm">www.marine.ie/home/SeaChange.htm</a>
Norway	HAVKYST Oceans and Coastal Areas	2006-2015	Research Council of Norway	<a href="http://www.forskningssradet.no/serveis/Satellite?c=Page&amp;cid=1226994/156364&amp;p=1226994/156364&amp;pagename=havkyst%2FHovedsidemal">www.forskningssradet.no/serveis/Satellite?c=Page&amp;cid=1226994/156364&amp;p=1226994/156364&amp;pagename=havkyst%2FHovedsidemal</a>
Portugal	The National Strategy for the Sea	2006-2016	Inter-ministerial Commission for Maritime Affairs	<a href="http://www.amam.com.pt/index.php?option=com_content&amp;task=view&amp;id=571&amp;Itemid=115">www.amam.com.pt/index.php?option=com_content&amp;task=view&amp;id=571&amp;Itemid=115</a>
Spain	Andalusian Plan for Research Development and Innovation (PAIDI)	2007-2013	Regional Minister of Innovation, Science and Enterprise	<a href="http://web.ceic.junta-andalucia.es/descarga/contenidos/cice/SGT-3305910/biblioteca/PAIDI_ingles/PAIDI_version_LIBRO-ingles2.pdf">http://web.ceic.junta-andalucia.es/descarga/contenidos/cice/SGT-3305910/biblioteca/PAIDI_ingles/PAIDI_version_LIBRO-ingles2.pdf</a>
	Science and Technology National Plan	2008-2011	Spanish Ministry of Science and Innovation (MCIINN)	<a href="http://www.mciinn.es">www.mciinn.es</a>
The Netherlands	Dutch National Program Sea and Coastal Research	2007-2012	Netherlands Organisation for Scientific Research (NWO)	<a href="http://www.nwo.nl/nwohome.nsf/pages/NWDA_795JFX_Eng">www.nwo.nl/nwohome.nsf/pages/NWDA_795JFX_Eng</a>
	NIOZ Science Plan	2008-2012	Royal Netherlands Institute for Sea Research (NIOZ)	<a href="http://www.nioz.nl/public/hioz_reports/scienceplan_08-12.pdf">www.nioz.nl/public/hioz_reports/scienceplan_08-12.pdf</a>
UK	Marine Science Strategy	2010-2015	UK Marine Science Coordination Committee (MSSCC)	<a href="http://www.defra.gov.uk/environment/marine/documents/science/mssc/msscstrategy.pdf">www.defra.gov.uk/environment/marine/documents/science/mssc/msscstrategy.pdf</a>

## Annex 4: A European Union Strategy for the Atlantic (EUSA)

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Since the publication of the Integrated Maritime Policy for the European Union (IMP-EU) in 2007, serious effort has been given to the development of strategies to implement the IMP in the different European Seas and Oceans recognising their individual physical, socio-economic and environmental characteristics. To-date, Sea Basin Maritime Strategies have been prepared for the Arctic (2008) and for the Mediterranean (2009). The Baltic Sea Region Strategy (2009), with a regional component, completes the list.

In 2010, the Commission undertook a number of actions to assess the added-value of a European Union Strategy for the Atlantic, including a Scoping Paper and a public on-line consultation (16th August to 15th October 2010). This resulted in a number of submissions by important stakeholders, including the Conference of Peripheral Maritime Regions (CPMR). Over the same period, EU Member States in the EU Atlantic Region (i.e. France, Ireland, Portugal, Spain and the UK) engaged in a dialogue which resulted in an official submission in December 2010 of a joint statement by France, Ireland, Portugal and Spain, supporting an EU Atlantic Strategy. In March 2011, the European Parliament adopted, by a large majority of votes, a Resolution calling on the Commission to adopt the Strategy. It is anticipated that the Commission will publish a Communication on the EUSA in November 2011.

The Portuguese Authorities are preparing a high-level Ministerial Meeting (Lisbon: 28-29 November 2011) to present the Atlantic Strategy. This will be followed by a Stakeholder Forum which will start discussing the strategy's implementation and Action Plan.

### Note

The geographical definition of the European Atlantic differs between the SEAS-ERA project (which includes the Atlantic waters surrounding Iceland and Norway and including the North Sea) and the DG MARE European Union Strategy for the Atlantic (EUSA) initiative which refers to the EU Atlantic Area (EEZ and adjacent international waters), excluding the North Sea.



## Annex 5. Statement from the Marine Sciences and European Research Infrastructures International Symposium: The Brest Declaration, July 2011.

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### **“The future of the 21st century ocean” European Marine Research Infrastructures Symposium, 28 June - 1 July 2011 The Brest Declaration**

Acknowledging the major contribution that seas and oceans can make to the EU 2020 objective of a smart and sustainable growth for Europe;

Recalling the great challenges for the future of the 21st century ocean as stated in the Ostend Declaration (2010);

Recognizing that the research infrastructures are at the heart of the Innovation Union;

Underlining the need for further development of the European marine research infrastructures in the following areas:

- Global, regional and coastal ocean observing systems including remote sensing (climate, operational oceanography, geohazards);
- Research fleets;
- Land and off-shore based experimental facilities (microcosms, mesocosms, testing facilities);
- Marine resource centres “from genes to ecosystems” back-to-back with biotechnology facilities.

Highlighting the contribution of marine research infrastructures to European innovation and growth:

- By fostering public procurement on specific marine & maritime technologies;
- As information and services providers enabling the development of marine industries;
- As knowledge and potential technology transfer producers;
- By attracting the best scientists and providing constantly updated, enabling technologies.

#### **“The future of the 21st century ocean” Symposium participants call for:**

##### **A coordinated implementation and encompassing European governance**

To allow an optimum cost-benefit strategy, the European marine science community calls for a coordinated and integrated implementation of marine research infrastructures at a European level. The symposium also encourages the establishment of an encompassing European governance for marine research infrastructures contributing to a higher global perspective.

##### **A truly co-funding mechanism between EU and national funding**

Member states funding is essential, but not sufficient for the sustainability of pan-European research infrastructures, which calls for a truly co-funding mechanism between EU (including structural funds) and national funding (and private where relevant). The EU should definitely contribute to the economic model of pan-European infrastructures, by supporting extra implementation / operational costs and transnational access including access from outside of Europe, so as to promote the international dimension of Research Infrastructures and the attractiveness of the Union in Marine Sciences. Moreover, EU funding is absolutely necessary for global or pan-European international ocean observing networks. The Research Joint Programming Initiative on “Healthy and Productive Seas and Oceans” provides a good platform for this co-development mechanism.

##### **Training schemes for marine RI managers and researchers / engineers / technicians**

The symposium welcomes the European Commission call for specific and multidisciplinary Research Infrastructures Management training and diploma. As for marine sciences, such training should include courses on the international legal and economic framework for marine & maritime policy. The long-term development, up-dating and maintenance of marine Research Infrastructures also calls for trained researchers, engineers and technicians, able to work in a specialized and multidisciplinary context, especially stimulated within the framework of the EU mobility schemes (e.g. Marie Curie Actions).

##### **Gender balanced marine Research Infrastructures**

The construction of the marine Research Infrastructures has been involving a relevant number of female researchers / engineers / technicians with a large variety of skills. This needs to be pursued and there is a need to open fast-tracked career path for females towards high level management positions.

## Annex 6: Glossary of Acronyms

Excluding SEAS-ERA partner acronyms (Annex 1) and those of EU funded projects which are included in the body text.

Acronym	Title	Website
CBD	Convention on Biological Diversity	<a href="http://www.cbd.int">www.cbd.int</a>
CFP	Common Fisheries Policy	<a href="http://ec.europa.eu/fisheries/cfp/index_en.htm">http://ec.europa.eu/fisheries/cfp/index_en.htm</a>
CISE	Common Information Sharing Environment	<a href="http://ec.europa.eu/maritimeaffairs/pdf/integrating_maritime_surveillance_en.pdf">http://ec.europa.eu/maritimeaffairs/pdf/integrating_maritime_surveillance_en.pdf</a>
CoML	Census of Marine Life	<a href="http://www.coml.org/">www.coml.org/</a>
CPMR	Conference of Peripheral Maritime Regions	<a href="http://www.cpmr.org">www.cpmr.org</a>
DCF	Data Collection Framework	<a href="https://datacollection.jrc.ec.europa.eu/">https://datacollection.jrc.ec.europa.eu/</a>
DG MARE	Directorate General for Maritime Affairs and Fisheries (EU)	<a href="http://ec.europa.eu/dgs/maritimeaffairs">http://ec.europa.eu/dgs/maritimeaffairs</a>
EAFM	Ecosystem Approach to Fisheries Management	
EATIP	European Aquaculture Technology and Innovation Programme	<a href="http://www.eatip.eu">www.eatip.eu</a>
EC	European Commission	<a href="http://ec.europa.eu/index_en.htm">http://ec.europa.eu/index_en.htm</a>
EEZ	Exclusive Economic Zones	
EFARO	European Fisheries and Aquaculture Research Organisation	<a href="http://www.efaro.eu/">www.efaro.eu/</a>
EFTP	European Fisheries Technology Platform	<a href="http://www.eftp.eu">www.eftp.eu</a>
EmbaRC	European Consortium of Microbial Resource Centres	<a href="http://www.international.inra.fr/partnerships/embarc">http://www.international.inra.fr/partnerships/embarc</a>
EMBRC	European Marine Biological Resource Centre	<a href="http://www.embrc.eu/">www.embrc.eu/</a>
EMECO	European Marine Ecosystem Observatory	<a href="http://www.emecogroup.org/">www.emecogroup.org/</a>
EMODNET	European Marine Observation and Data Network	<a href="http://ec.europa.eu/maritimeaffairs/emodnet_en.html">http://ec.europa.eu/maritimeaffairs/emodnet_en.html</a>
EPOCA	European Programme on Ocean Acidification	<a href="http://www.epoca-project.eu">www.epoca-project.eu</a>
ERA	European Research Area	<a href="http://ec.europa.eu/research/era/index_en.htm">http://ec.europa.eu/research/era/index_en.htm</a>
ESF	European Science Foundation	<a href="http://www.esf.org/">www.esf.org/</a>
EuroGOOS	European Global Ocean Observing System	<a href="http://www.eurogoos.org">www.eurogoos.org</a>
EuroMARINE	Integration of European marine research networks of excellence	<a href="http://www.euromarineconsortium.eu">www.euromarineconsortium.eu</a>
EU-OEA	European Ocean Energy Association	<a href="http://www.eu-oea.com/">www.eu-oea.com/</a>
EUSA	European Union Strategy for the Atlantic	
EWEA	European Wind Energy Association	<a href="http://www.ewea.org/">www.ewea.org/</a>
FP6	6 <sup>th</sup> EU Research Framework Programme	<a href="http://cordis.europa.eu/fp6/dc/index.cfm?fuseaction=UserSite.FP6HomePage">http://cordis.europa.eu/fp6/dc/index.cfm?fuseaction=UserSite.FP6HomePage</a>
FP7	7 <sup>th</sup> EU Research Framework Programme	<a href="http://ec.europa.eu/research/fp7/">http://ec.europa.eu/research/fp7/</a>

Acronym	Title	Website
GES	Good Environmental Status	
GDP	Gross Domestic Product	
GIS	Geographical Information Systems	
GMES	Global Monitoring for Environment and Security	<a href="http://www.gmes.info">www.gmes.info</a>
ICES	International Council for the Exploration of the Sea	<a href="http://www.ices.dk/indexfla.asp">http://www.ices.dk/indexfla.asp</a>
ICT	Information and Communications Technologies	
ICZM	Integrated Coastal Zone Management	
IFM-GEOMAR	The Leibniz Institute of Marine Sciences at the University of Kiel (Germany)	<a href="http://www.ifm-geomar.de">www.ifm-geomar.de</a>
IMO	International Marine Organisation	<a href="http://www.imo.org">www.imo.org</a>
IMP-EU	Integrated Maritime Policy for the European Union	<a href="http://ec.europa.eu/maritimeaffairs/subpage_en.html">http://ec.europa.eu/maritimeaffairs/subpage_en.html</a>
INSPIRE	Infrastructure for Spatial Information in Europe	<a href="http://inspire.jrc.ec.europa.eu">http://inspire.jrc.ec.europa.eu</a>
IPCC	Intergovernmental Panel on Climate Change	<a href="http://www.ipcc.ch/">/www.ipcc.ch/</a>
JPI	Joint Programming Initiative	
JPI Oceans	JPI "Healthy and Productive Seas and Oceans"	<a href="http://www.jpi-oceans.eu">www.jpi-oceans.eu</a>
MarBEF	Marine Biodiversity and Ecosystem Functioning	<a href="http://www.marbef.org">www.marbef.org</a>
Mar-ECO	Mid-Atlantic Ridge Ecosystems Project	<a href="http://www.mar-eco.no">www.mar-eco.no</a>
MB-ESF	Marine Board-European Science Foundation	<a href="http://www.esf.org/marineboard">http://www.esf.org/marineboard</a>
MCCIP	Marine Climate Change Impacts Partnership (UK)	<a href="http://www.mccip.org.uk">www.mccip.org.uk</a>
MESH	Marine European Seabed Habitats	<a href="http://www.searchmesh.net">www.searchmesh.net</a>
MPA	Marine Protected Area	
MSFD	Marine Strategy Framework Directive	<a href="http://ec.europa.eu/environment/water/marine/directive_en.htm">http://ec.europa.eu/environment/water/marine/directive_en.htm</a>
MSP	Maritime Spatial Planning	
MSY	Maximum Sustainable Yield	
NOCS	National Oceanography Centre (UK)	<a href="http://www.noc.soton.ac.uk/">www.noc.soton.ac.uk/</a>
OSPAR	Oslo and Paris Convention	<a href="http://www.ospar.org">www.ospar.org</a>

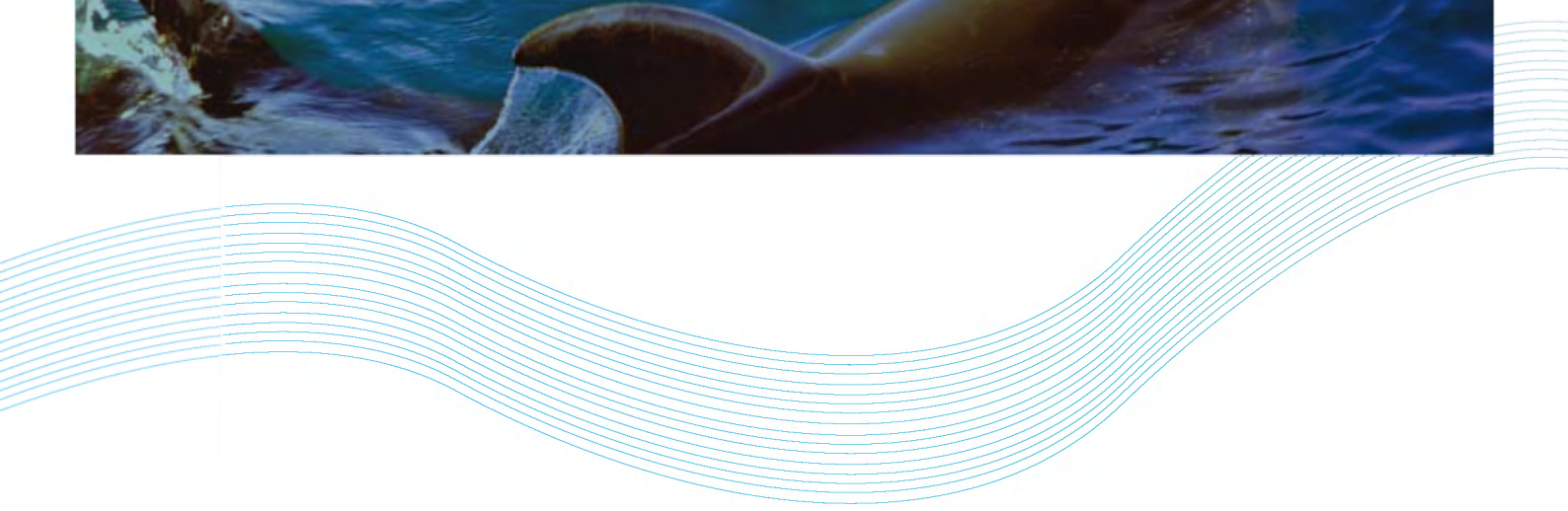
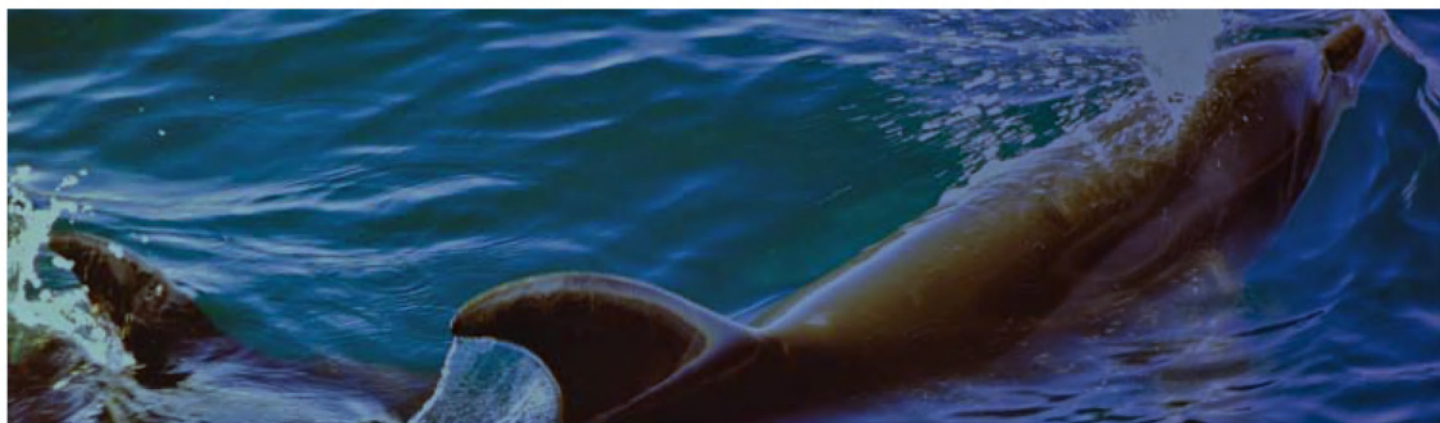
## Annex 6: Glossary of Acronyms

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Acronym	Title	Website
QSR	Quality Status Report	
R&D	Research & Development	
RDI	Research, Development & Innovation	
RFOs	Research Funding Organisation	
RTD	Research, Technology & Development	
S&T	Science and Technology	
SEIS	Shared Environmental Information System	<a href="http://ec.europa.eu/environment/seis/">http://ec.europa.eu/environment/seis/</a>
SMART	Specific, Measurable, Achievable, Relevant and Time-Bound	
SME	Small to Medium Enterprise	
SRA	Strategic Research Agenda	
TEV	Total Economic Value	
WISE	Water Information System for Europe	<a href="http://www.water.europa.eu/">http://www.water.europa.eu/</a>
WP	Work Programme / Work Package	







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