The MariFish Partners:

**Belgium:** Agriculture and Fisheries Department/Institute for Agricultural and Fisheries Research.

**Cyprus:** Research Promotion Foundation.

**Denmark:** The Danish Food Industry Agency.

**France:** French Research Institute for the Exploration of the Sea.

**Germany:** Johann Heinrich von Thünen Institute - Aquatic Resources.

**Greece:** General Secretariat for Research and Technology, Ministry of Development.

**Iceland:** The Icelandic Centre for Research.

**Ireland:** Marine Institute.

**Netherlands:** Ministry of Agriculture, Nature and Food Quality, Department of Fisheries.

**Norway:** The Research Council of Norway.

**Poland:** National Centre for Research and Development.

**Portugal:** Ministry of Agriculture, Rural Development and Fisheries.

**Sweden:** The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning.

**UK:** The Scottish Ministers acting through Fisheries Research Services and Marine Scotland.

Departments for Environment, Food and Rural Affairs (Co-ordinator).

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Introduction

The MariFish project, ‘Co-ordination of European Marine Fisheries Research Programmes’, was an ERA-NET project funded by the European Commission. Eighteen partners from fifteen European countries participated in the five-year project which started in 2006. Together, the ministries, research councils and research institutes making up the partnership invest approximately €190 million annually in fisheries science. This represents a very significant investment, and the MariFish partners are responsible for the acquisition and management of a substantial body of scientific knowledge on European marine fisheries.

Fishing is an important economic activity in many European Member and Associate States. Across Europe, fisheries have an estimated combined annual landed value in excess of €6 billion, and fish and shellfish products are an important source of food. Fisheries also provide a valuable source of employment, particularly where other opportunities for work may be limited, such as in small, isolated coastal communities; and when fish processing is taken into account the true social and economic value of fisheries far exceeds the actual landed value of the catch.

There are significant challenges facing fisheries management. The status and abundance of fish and shellfish stocks, on which the industry is based, are difficult to estimate as they are largely hidden from direct observation. Stocks are subject to wide natural fluctuations in recruitment rates due to factors beyond human control, such as food availability, predation and temperature. The impact of fishing on the marine environment is also difficult to observe and assess. Some habitats are more sensitive to impact than others and recovery rates vary widely. With so much uncertainty, developing management measures to achieve sustainable stocks and profitable industries is not a straightforward task, and there is an inherent risk of failure.

Faced with all these challenges, it is not surprising that fisheries managers have come to rely heavily on the science which helps provide essential evidence on which management plans are based. Science helps assess the state of stocks and provides an understanding of the pressure that fishing has on the marine environment. Computer models help managers assess alternative strategies for achieving sustainable fish stocks, and indicators, developed through research, measure progress towards the agreed management objectives.

Some of the challenges facing fisheries science are at the local or national level, but many are common across Europe. Big science challenges – such as how to assess the likely impact of climate change; how to develop an ecosystem approach for fisheries; how to assess the benefits of management measures, such as more selective gear and the value of closed areas – can best be tackled through collaboration.

There are, therefore, strong drivers for collaboration. Fisheries scientists have a long tradition of working together, for example through the International Council for the Exploration of the Sea (ICES), and through the support provided by the European Commission’s Framework Programmes.

However, before the formation of the MariFish partnership, there was a major weakness: a lack of co-ordination between the national funders of fisheries research. Figure 1 presents a simplified diagram of the pre-MariFish state, where funders operated largely independently, with only limited co-ordination and collaboration between the national funding bodies that have the responsibility for commissioning and managing national fisheries research budgets.

**Figure 1: Pre-MariFish, with limited co-ordination and collaboration between national funders of research**

MariFish has helped to tackle the lack of co-ordination and collaboration by bringing funders together into an effective partnership, as illustrated in Figure 2, to collaborate and help influence the research agenda.
At the outset of the project MariFish partners agreed to work on four key objectives to:

- Build an effective partnership between the funders of marine fisheries research and use the partnership to share experiences of identifying, commissioning and managing research;
- Exchange information on nationally funded research programmes and together identify areas of common interest, gaps and possible duplication;
- Adopt a practical, direct approach to increasing co-operation and co-ordination between partners by developing jointly-managed research programmes in five key areas; and
- Develop a jointly-funded programme to address strategic and innovative requirements for fisheries management.

This final report summarises the work undertaken during the life of the project, including how the partnership was developed, and how MariFish has put collaboration into practice. It only provides a high level summary of some of the project’s output, and further details are at: www.marifish.net
Building the partnership

This section outlines the work undertaken to develop the MariFish partnership, including sharing partners’ experiences in commissioning research. It also summarises the results of two studies: one on the drivers for fisheries management and the second on the importance of communication.

Partners’ experiences in commissioning research

MariFish partners were interested in how fisheries research is commissioned across Europe, to help identify ways in which they could develop their own commissioning arrangements, and to help develop good practice principles to be used when commissioning jointly-funded research within MariFish.

Based on the results of a questionnaire, it was clear that there was a wide variety of practices used by partners in managing research programmes, and that a best practice guide would not be appropriate. For commissioning both national and trans-national research, a set of general guidelines of good practice were developed. Barriers to trans-national collaboration that were identified included limited knowledge of research undertaken in other countries, little encouragement from others to increase trans-national research, and contractual barriers. To help overcome these barriers two solutions that were identified were to select topics that had trans-national interest to work on collaboratively, and to select strategic topics for joint funding of research.

Study 1: The drivers for fisheries management

At the outset, partners wanted to know the extent to which they shared common aims, and to assess the extent to which there was a natural cohesiveness between partners. A survey was conducted to understand the important drivers and priorities for fisheries management. Through a questionnaire, fishery managers were asked to rank their level of agreement with 48 statements which aimed to:

- Identify the principal high level policy drivers for fisheries management; and
- Seek information on the managers’ preferences for instruments such as quotas, closed areas, effort control and technical measures.

Figure 3 illustrates answers to four of the statements. For the majority of partners the fishing industry is not considered crucial to the national economy (statement 2), but is rated important at the local level (statement 3). Partners agreed strongly that the size of the European fleet was too large (statement 26), but partners were split in their response to the question on whether fishing is an important part of the country’s culture (statement 4). On other issues half the partners rated environmental concerns as the most important driver, while the remainder gave higher priority to socio-economic factors, especially stability. On technical measures, there was broad agreement that mesh sizes and closed areas were seen as useful measures, but the perceived value of No-Take-Zones was mixed.
Through this study partners developed a much improved understanding of the main drivers and priorities for fisheries management across Europe, and results confirmed that, although there were some differences, partners shared many similar drivers, strategies and management preferences.

**Figure 3: Partners’ response to four drivers for fisheries management**

![Graphs showing response to various statements](image)

**Study 2: The importance of communication**

The uptake of research into marine fisheries management depends on how effectively fisheries managers, researchers and scientific advisers communicate the needs for research, and the policy implications of that research. Because of the importance of communication and the role that MariFish partners have in commissioning research and relaying results, a study was undertaken to help identify strengths and weaknesses of current systems, and ways in which communication could be improved.

The study focussed on two key questions:

- How do fisheries managers communicate their need for evidence to the researchers and scientific advisers?
- How do researchers and scientific advisers communicate the research results and advice back to fisheries managers and the wider audiences?
The main part of the study comprised a series of paired interviews in six countries, first with researchers and scientific advisers, and then with the customers for research, the fisheries managers. The study provided a number of pointers towards good practice for establishing research needs and communicating research results (see Box 1), and also some important messages on communication.

To help strengthen communication and put some of the guidance into practice, MariFish organised a number of workshops bringing researchers and managers together. For example, MariFish hosted a workshop in Copenhagen on indicators for fisheries management (see Box 2) that brought together research teams actively undertaking indicator research funded by the MariFish project, and the managers who rely on indicators for fisheries management. The aim of the workshop was to create a common understanding between researchers and managers of what indicators are, what they can be used for, and what relevance they have in a policy environment. The workshop also helped build a sense of cohesiveness between the indicator projects, and avoid duplication.

Through all this work MariFish concluded that communication needs to be accorded a higher priority. There is an over-reliance on written communication, and experience from within the project has shown that there are considerable benefits from face-to-face communication between researchers and managers.
Box 1: Communication between scientists and managers

As expected, there are some significant variations between MariFish partners in their approaches to communicating evidence needs from managers to researchers, and the communication of research results and advice from researchers to managers. The study provided a number of consistent pointers towards good practice:

For establishing evidence needs the study highlighted the importance of:

- close interactions between the research organisation and the fisheries managers, building understanding and trust;
- having sufficient in-house scientific capacity to be an intelligent customer for research and advice; and
- having in place a long-term strategic plan for research with research institutes, the fishing industry and other stakeholders.

Effective communication of research results and advice requires:

- the channels used to communicate research and advice being chosen carefully according to the issues and the audience;
- the emphasis for fisheries managers and fishermen being on the research results and their implications, rather than how the research was carried out;
- face-to-face interactions providing an important opportunity to test and debate research results; and
- advisers playing a key role in bridging the research and policy communities, and being rewarded for their efforts.

Box 2: Copenhagen workshop on the use of indicators in fisheries management – putting good communication into practice

Use of indicators in fisheries management

Fisheries management aims to ensure that the exploitation of resources provides economic, environmental and social conditions that are sustainable. It is in this context that fisheries indicators are being developed and used. However, despite the immediate appeal of indicators, experience suggests that it is often not easy to create a common understanding of what indicators are, what they can be used for, and what relevance they have in a political environment.

Aims of the workshop

Through its open call MariFish is funding three research projects on indicators. The aims of the Copenhagen workshop were to:

- Link and develop the three projects in order to develop relationships between the project participants, and avoid duplication; and
- Support the policy relevance of the projects by bringing the researchers and fisheries managers together and provide the researchers with an early reality check of what the fisheries managers would like to achieve from the research.
Box 2: (continued)

Effective use of the research through better communication

Feedback from the managers to researchers identified a number of challenges that have to be tackled if the research on indicators is to be implemented through fisheries management. As one manager said “Although there is a general agreement about the relevance of indicators, there is still a lot more to be done if indicators are going to be taken up by fisheries managers. It is quite clear that indicators have to be relevant, reliable and understandable”.

Workshop conclusions

The workshop concluded that to improve the uptake of the research results into fisheries management, the following key messages needed to be addressed:

- Effective communication and knowledge management will need to become a central element of the projects to ensure the results are used.
- Research projects must show the relevance, effectiveness and efficiency of indicators to be of value to fisheries managers.
- Communication mechanisms need to be developed at every step of the research-policy value chain to help deliver this, as illustrated below.

This preparatory work helped MariFish address its first objective – that of building an effective partnership and a basis on which to take forward the agreed work programme. Partners became aware of the different practices adopted by partners for commissioning research and that there was no single best practice. There were barriers to collaboration that needed to be overcome, but partners shared many similar fisheries management drivers, strategies and management preferences, and as a consequence research needs were likely to be broadly similar. Communication was flagged as an important issue, and MariFish endeavoured to make this central to its working practice. This preparatory work helped lead the project on to the next stage – that of exchanging information on existing research.
Exchanging information and managing our knowledge more effectively

This section summarises MariFish’s work on assembling existing knowledge. It reports on three studies: the importance of knowledge and its management; the role of socio-economics in fisheries management; and the role of other disciplines outside mainstream fisheries science. It also looks at the challenges facing collaboration between partners.

With an annual investment by partners of approximately €190 million in fisheries science, a considerable body of knowledge has been acquired, particularly since several fisheries science institutes have been in existence for more than 100 years. The second key objective, therefore, set by the MariFish partners was to exchange information on nationally funded research programmes and identify areas of common interest, gaps and possible duplication. This objective needed to be addressed before progress could be made on programme collaboration and joint funding.

Assembling existing knowledge

An important product of the MariFish project has been the development of two databases to facilitate access to information on marine fisheries research undertaken by the 15 MariFish partner countries. One database holds information at the programme level, the other at the project level (see Box 3).

Box 3: MariFish databases: facilitating access to information on fisheries research funded by MariFish partners

The starting point was the development of the MariFish National Research Programmes Database to provide an overview of the existing national marine fisheries research programmes of the MariFish partners. The database (http://195.10.221.186/index.php?id=56) allows end-users to navigate through an interactive map to view information on funders, research programmes, research fields, sea areas and funding mechanisms.

A second database was developed at the project level – the MariFish Projects Database – which lists over 530 marine fisheries research projects co-funded or funded by the 15 MariFish partner countries. The knowledge held covers research undertaken between 1986 and 2011.
In addition to access via the MariFish website, the MariFish Projects Database can also be accessed through the EurOcean Marine Info-bases Common Search Tool at: http://marinedb.eurocean.org. Here, the MariFish Projects Database is hosted alongside other marine related information bases: AMPERA¹, EurOcean² and MarinERA³ databases. This common search tool performs a search on all four databases and represents a milestone for co-operation between existing marine ERA-NETs. It also facilitates access for those outside Europe to information on European marine research.

1 AMPERA database comprises Accidental Marine Pollution Research programs funded at the European level. (http://ampera.eurocean.org)
2 EurOcean database comprises Marine Science and Technology projects funded at the European level. (www.mapinfobase.eurocean.org)
3 MarinERA database comprises Marine Science and Technology projects funded at the National level and which are solely competitively funded. (http://nationalmarinedb.eurocean.org)

Study 3: The importance of knowledge and its management

Knowledge is fundamental to fisheries management. Managers rely on the output of research, an important component of knowledge, when developing plans for sustainable fisheries. Recognising both the importance of knowledge to their task of managing fisheries research effectively, and the considerable body of research that was available to the partnership, MariFish undertook a study early on in the project to look specifically at knowledge management. The study aimed to examine the broad topic of knowledge management and consider what practices should be adopted to access and use existing and future knowledge effectively. Partners sought answers to a number of questions including:

■ How can we best cope with the exponential increase in information?
■ Do we use existing knowledge to best effect?
■ Have we invested sufficient time and resources in this area?

The study found there were a number of key factors that need to be taken into account when seeking to adopt knowledge management best practice. For example, we need to guard against the instinct of always commissioning new research when a new question arises. Both researchers and policy customers for research need more routinely to build in knowledge-sharing and joint-learning activities, such as synthesis reviews of existing research, before investing in new research.
Another key finding was that research reports are typically assessed on the basis of scientific quality criteria, such as novelty. The relevance criteria, such as timeliness and synthesis of existing knowledge, are often neglected. This overemphasis on quality means that policy makers can find that research reports turn out not to be as relevant to their needs as hoped.

The study also came up with some generic findings, and nine golden rules of knowledge management (see Box 4).

### Box 4: Knowledge management for fisheries science and managers

MariFish undertook a study of knowledge management to help ensure the greatest possible value is gained from the investment in knowledge made by the MariFish network.

**Some generic findings – the 3Rs**

- **Resilience.** Organisations need to pay attention to the resilience of their knowledge. The biggest threat is often that particular members of staff leave, taking their knowledge with them.

- **Relationships.** These are key to effective knowledge management. We tend to give too much emphasis to gaining knowledge and expertise at the expense of building relationships. There tends to be a stronger focus on reports and publications than to outcomes that can be discussed and debated.

- **Research communication.** Problems include: research reports having incomprehensible titles with the result they go straight in the bin; reports are too long, instead of short summaries that policy makers universally request; and the emphasis given to written research reports rather than face-to-face communication.

**Nine golden rules of knowledge management**

1. Prioritise knowledge management.
2. Keep it simple.
3. Build resilience by balancing capture and connectivity.
5. Discover and map existing expertise; identify gaps.
6. Balance competition with co-operation.
7. Prioritise the sharing of knowledge as well as its discovery.
8. Use Information and communication technology but keep it simple; don’t put the IT boffins in charge.
9. Emphasise relevance as well as scientific ‘quality’.

This study also suggested seven practical actions that partners could take to encourage the adoption of better knowledge management practice. One of these was to consider in more detail the role of databases. The study referred to what can be termed ‘the database instinct’. Many people instinctively feel that knowledge needs to be captured, and that information technology – particularly in the form of databases – offers the means to do this. And yet databases often fail to fulfil their purpose. Problems include: failure to be maintained; lack of user friendliness; and the tension between comprehensiveness and simplicity. MariFish decided to look at the power and pitfalls of databases in more detail, (see Box 5).
Box 5: The power and pitfalls of databases

As described in Box 3, a projects database was constructed in 2006 to help share the knowledge held within the MariFish network. The aim was to develop a fully comprehensive listing of all current marine fisheries research funded by MariFish partners.

In developing the projects database, practical difficulties emerged which prevented it from achieving its full potential including lack of time, available text not in English, and incomplete project lists held by any central national unit. MariFish partners therefore decided to try a more direct approach aimed at capturing as much information about a single high priority research topic as possible in order to test the potential power of project databases. The topic selected for this new approach was discards since this is an area of research of interest to all MariFish partners. The aim was to develop a comprehensive listing of all discard and selectivity research undertaken across Europe since 2005.

A three step approach was adopted:
1. Collation of research projects
2. Uploading and editing of research projects onto the MariFish database
3. Analysis of the discard project data set including current emphasis, gaps and opportunities for collaboration.

The approach adopted for the discard projects database was more refined than that used in developing the original MariFish projects database. A more user-friendly project template was designed to gather information on research projects. Personal contacts were used where possible and the reason for requesting information was explained more fully.

As a result of these more tailored efforts details of 79 discards projects were gathered, providing a comprehensive snapshot of discard research across Europe. Analysis of the information gives a good overview of the current emphasis, gaps and areas for further collaboration in discard research.

This exercise provided a useful insight into the potential power of project databases in facilitating the exchange of research and uptake of knowledge. Project databases do have an important role but need to be set up with care and forethought:

Ten Golden Rules for developing and maintaining project databases.

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<tr>
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<th>Rule</th>
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<tbody>
<tr>
<td>1</td>
<td>Identify clear objective and target users at the outset.</td>
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<tr>
<td>2</td>
<td>Ensure correct funding from the outset as databases take time and money to develop.</td>
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<td>3</td>
<td>Create a user-friendly template for populating the database.</td>
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<td>4</td>
<td>Develop a direct working relationship with contributors.</td>
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<td>5</td>
<td>Provide incentives to contributors such as raising the profile of their research.</td>
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<tr>
<td>6</td>
<td>Be aware of time and technical constraints.</td>
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<tr>
<td>7</td>
<td>Use a central resource to edit and load data.</td>
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<tr>
<td>8</td>
<td>Add the people dimension – to analyse and share the knowledge.</td>
</tr>
<tr>
<td>9</td>
<td>Keep the database alive – update data.</td>
</tr>
<tr>
<td>10</td>
<td>Plan ahead for continued management of the database, including the provision of adequate funding to maintain the database.</td>
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</table>
Study 4: The role of socio-economics in fisheries management

Traditionally fisheries management has relied heavily on the biological sciences, and in previous years emphasis was given to understanding the biology of commercial fish and shellfish stocks. In recent years, understanding the wider impact of fishing has become a priority with the adoption of an ecosystem approach to fisheries management. More recently, socio-economic considerations are moving up the policy agenda. Responding to this new priority, MariFish partners wanted to develop a comprehensive overview of existing research in this area, and establish the key messages emerging from the existing knowledge. With a view to funding research jointly, MariFish also needed to identify priorities for future research.

A literature database was designed to contain full texts of documents on fisheries socio-economic research, and by the end of 2006 the database held 800 titles. This was added to by the European Association of Fisheries Economists (EAFE), and details of EU Framework Programme projects were also included. This database is a significant knowledge resource and can be accessed at http://www3.lei.wur.nl/marifish/. It is a living database allowing individual researchers to upload their work, and is available to the wider research community.

A review of the main publications highlighted the potential role of economics in policy advice and policy evaluation. It also identified the recent development of bio-economic models that have an important role to play in enhancing the interface between economics and the natural sciences. For social sciences, the review highlighted a number of important issues, including the relationships between government, society, culture and the environment. Key messages and priorities for future research were identified (see Box 6).

Box 6: Key messages on the role of socio-economics in fisheries management and research priorities

Key messages

- Fishing is primarily an economic activity, with a cultural/traditional component, taking place under the constraints of the natural environment.
- Economics and social sciences can provide relevant and independent contributions to the analysis of problems which arise and to the formulation of the required management policies.
- Policy should avoid introducing measures which go against market forces since this usually proves unsuccessful.
- Legitimacy and efficacy will be enhanced by community involvement in the decision-making process.

Priorities for further research

Socio-economic research priorities include:

- Property rights;
- Economic performance and incentives;
- Regional development and integrated coastal zone management; and
- Fishermen’s behaviour.

Quote from one of the contributors:

“In the view of many economists and social scientists, the ‘obsession’ with quantification of the size of stocks diverts attention from phenomena which really matter, namely the social and economic processes which are the driving forces of excessive use of natural resources.”
Study 5: The role of other disciplines outside mainstream fisheries science

As funders of research, MariFish partners wanted to gain a better understanding of new and emerging areas of science with the potential to improve fisheries management and the performance of the fish catching and processing industry. A MariFish study looked at five key policy drivers: adopting an ecosystem-based approach; waste reduction and new products; the need to assess stock status; maintaining a profitable fishing industry; and quality control of marine products. The study considered the scientific disciplines needed to help address these drivers. Each discipline was rated as either classic or emerging, and Figures 5 and 6 show the analysis for two of the five drivers.

Figure 5: Driver 1 – Adopting an ecosystem-based approach

To respond effectively to this driver, the analysis showed that as well as the mainstream disciplines of marine ecology, marine biology and oceanography, contributions are also needed from emerging sciences such as sedimentology and marine chemistry. In addition, conservation biology is needed to assess the effectiveness of, for example, marine protected areas; and structural engineering may be relevant to the development of artificial reefs.
Figure 6: Driver 2 – Waste reduction and new products.

Virtually all fishing activity produces a certain level of by-catch, much of which is discarded. Fish processing also contributes to the levels of waste. Increasingly there is a drive to tackle both these areas. So far food engineering has been the main discipline involved. Added value products are emerging as potentially new sources of income for the industry and biotechnology, nutrition, and pharmaceuticals are becoming disciplines of relevance to fisheries.

Study 5 helped highlight the need to draw on a wider array of disciplines than those currently contributing to fisheries management.

Establishing the challenges facing collaboration between partners

The MariFish partnership was formed to enhance research collaboration, with the ultimate aim of funding research through a joint call. But what obstacles are there to achieving this goal, and why was this not already happening? A wealth of background information was gathered on the extent to which partners were already broadly engaged at the regional, national and international level, but it was evident that collaboration between research funders was almost completely absent. To help understand why, two workshops were run, one focussed on more Northern countries, and one in the Mediterranean area.

Challenges to collaboration identified included: partners having different national interests; different legislative and funding structures; and a general reluctance to committing funds to multinational research programmes. Benefits that could arise from improved collaboration included addressing large scale problems that require multidisciplinary and holistic research approaches. Sharing facilities and expertise could also bring efficiencies and better utilisation of resources.

MariFish concluded that through partners’ combined efforts there was considerable potential for tackling priority research areas which require community-based solutions. This encouraged the partners to take on the next stage of the project, putting collaboration into practice. To achieve this MariFish set itself two challenges – to work collaboratively on existing research without the specific need to fund new research, and to fund research jointly to address an area of strategic importance.
Collaborating without additional funds

This section reports on the first challenge MariFish set itself – to work collaboratively on existing research without the specific need to fund new research. It outlines the approach used to select candidate topics for collaboration and describes progress made on each of five Collaborative Programmes.

The aim behind this challenge was to try to draw closer together important areas of research already funded by partners. As many of the research challenges are common across Europe, working collaboratively can bring benefits. Expressing a wish to collaborate is one thing, choosing which areas for active collaboration is another. The challenges and problems facing fisheries are multidimensional: area-based, topic-related, biological, mathematical, social, economic, man-made, natural impacts etc. – and agreeing topics for collaboration is complex.

MariFish approached the task in a systematic and rigorous way that ensured the priorities and interests of all partners were taken into account. A three step approach was adopted:

The three step approach to collaboration

**Step 1:** Detailed analysis of the MariFish National Research Programme Database on existing research to identify candidate areas for collaboration.

**Step 2:** Establishing the future demands for fisheries research through a dedicated symposium.

**Step 3:** Mapping strategic areas against current research and selecting candidate topics for collaboration.

Each of these steps is expanded on the following pages 17-19:
The MariFish programme database (see Box 3) provides an overview of the existing national research programmes of the MariFish partners. It includes information on 20 funders from 15 countries which support 23 research programmes in 17 sea areas. Analysing the data helped identify common interests, gaps and possible duplications, and MariFish developed the following list of 16 current research fields appropriate for collaboration:

- Anthropogenic impacts on fisheries and aquaculture
- Aquaculture
- Economics and socio-economics
- Effects of climate change on fisheries
- Fisheries (gear) technology
- Fisheries biology and ecology
- Fisheries management
- Fishing impacts on marine ecosystems
- Genetics and biotechnology
- Marine biogeochemistry
- Marine ecosystem studies
- Marine geosciences
- Modelling and data analysis
- Physical oceanography
- Seafood quality and processing
- Stock assessment and monitoring
Step 2: Establishing the future demands for fisheries research through a dedicated symposium

Following the analysis of current research (Step 1), Step 2 established future demands for research. A symposium in Roskilde, Denmark, helped identify strategic research needed to support the development of fisheries management within Europe over the next ten years. To help set the scene, presentations were given on strategic topics including: the integration of ecosystem considerations into future management; stakeholder involvement; scientific input to fisheries management; and experiences from Canadian and New Zealand fisheries.

There was agreement that fisheries management and research needs to focus more on strategic, outcome-based management rather than input and tactical studies. This means defining conservation goals and strategies to achieve them, leaving tactics to the fishing sector.

The symposium concluded with a list of 25 strategic research areas under the following five broad strategic themes:

- By-catch and discards, including gear technology, incentives for fishermen and real-time closures;
- Habitat maps, including mapping methods and impact assessments;
- Trade-offs, including climate aspects, contaminants and behavioural responses of fishermen;
- Governance and political economy, including spatial planning and achieving more integrated and multi-disciplinary research; and
- Ecosystem management, including footprints of fisheries and other activities, and how ecosystems and trophic levels could influence maximum sustainable yield policies.

In reaching its recommendations for future research a number of important points emerged from discussions. It was felt that fisheries science may not have kept up with some of the new challenges facing fisheries management including ecosystem management, strategies for multispecies management, and area-based approaches. This was partly because of a lack of data of sufficient resolution and there was broad agreement that data collection, data archiving and data sharing needs to be improved, taking advantage of new technology.
Step 3: Mapping strategic areas against current research and selecting candidate topics for collaboration

The final step to agreeing which topics should be developed into Collaborative Programmes was reached through a workshop held in Athens, involving all partners. In preparation for this each of the 25 research areas were mapped against the 16 current research fields. The strategic and current research fields were found to be broadly similar, but because the 25 research areas identified in Step 2 provided a more strategic challenge for collaboration, it was agreed that these should be used as the basis for selecting candidates for collaboration.

At the Athens workshop, the ranking of strategic research areas highlighted some differences between geographical areas in terms of their importance. For example, partners from northern regions gave high ranking to the themes ‘by-catch and discards’ and ‘ecosystem management’. Partners from southern regions chose ‘trade-offs’, ‘habitat mapping’ and ‘governance and political economy’ as well as ‘ecosystem management’.

The four broad topics and one sea area finally selected for collaboration, together with partners’ initial declared interest in being involved, are shown below:

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<th>Topic</th>
<th>Belgium</th>
<th>Cyprus</th>
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<th>Spain</th>
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<th>England</th>
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<td>Reduction of by-catch and discards from commercial fisheries</td>
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<td>Influence of climate on fish biology and population dynamics</td>
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<td>Managing fisheries within an ecosystem</td>
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Interest in joining collaborative programmes

X Level of interest
At the end of this three step process, MariFish partners had established the broad topics for collaboration. Following further discussions, these were then worked up into detailed plans. Partners involved in each Collaborative Programme signed a Memorandum of Understanding that set out what would be achieved and how partners would work together. Progress made on each of the programmes follows:

**Collaborative Programme 1: Management of fishing effort in the Channel**

**France (lead), Belgium and UK (Defra)**

A priority in developing plans for fisheries management is to gain a comprehensive picture of the spatial distribution of fishing effort – where fishing takes place, what fishing methods are being used in different areas, seasonality of fishing etc. Armed with details of fishing pressure, researchers and managers can examine how fishing has impacted on the seabed and develop management plans that will help protect the marine environment, for example by adopting marine protected areas, seasonal closures etc.

The Vessel Monitoring System (VMS), based on data collected through satellites, provides Member States with a comprehensive picture of fishing activity in territorial waters. Under the Commission’s Data Collection Framework (DCF), data sharing is required, but there are practical and administrative challenges associated with merging data from two or more Member States. MariFish agreed that the Channel was a suitable location to examine how to share VMS data in practice. Progress has been made on two fronts:

- On the administrative front, French and English authorities are now making final arrangements to share Channel VMS data as well as aggregated monthly logbook data.
- On the technical front, researchers from Cefas, an executive agency of Defra, and Ifremer are working closely together to develop a more comprehensive picture of the seasonal and spatial distribution of fishing effort in the Channel. This could not be achieved if the two organisations worked independently.

What has been achieved by MariFish under this Collaborative Programme provides an example for other regional sea areas, particularly in the context of the future Common Fisheries Policy (CFP) and the Marine Strategy Framework Directive, both of which give greater emphasis to collaboration at the regional level.

**Collaborative Programme 2: Reduction of by-catch and discards**

**UK (Defra) (lead), Belgium, Denmark, France, Germany, Greece, Iceland, Ireland, Norway, Poland, Portugal, Spain, Sweden and UK (Scotland).**

Reducing by-catch and discards is a major challenge facing fisheries managers across Europe. Research into possible solutions is a priority area for MariFish partners, and nearly all participated in this Collaborative Programme. A major focus of the work was to share knowledge and experience in existing selectivity devices, discussing how to improve knowledge transfer to the industry, and investigating new approaches.

MariFish workshops (in Lyon, Madrid and Norwich) brought together senior gear technologists from partner countries to help identify potential areas for collaboration, and facilitate networking between specialists. The process adopted was first to set out the broad areas of common interest. These included addressing knowledge gaps relating to fish behaviour,
developing cod-avoidance schemes, examining the scope for real-time closures, and investigating new technologies for recording discard data on board commercial fishing vessels.

The Lyon workshop helped identify ten collaborative actions that technologists wanted to work on including:

- **Data compatibility.** Improved collaboration is needed because there are significant differences in the methods used to collect data on discards. This makes the development of a Europe-wide discard atlas difficult to achieve.

- **Investigating the potential for using camera systems to record catch and discard rates.** Denmark, Spain, Sweden and the UK are all developing systems. It was agreed that by comparing the different approaches the best application of cameras, including their specification, location and monitoring target, could be identified.

- **Electro-fishing for shrimp.** Belgium is leading research on this technology. Denmark, Germany and the UK, were interested in learning more about its application, including attending sea trials.

- **Application of square mesh panels in trawl nets (T90).** Poland is leading this research including collaboration with industry. Belgium, France, Germany and Poland all agreed to share information on experiences using the T90 approach, including the planned construction of a ‘total T90’ trawl involving collaboration between Belgium and Germany.

A final workshop in Madrid summarised progress. It was agreed that experiences related to, for example, camera systems, electro-fishing, and T90 would continue to be shared. For some topics, such as the development of a video library of underwater footage, although needed, it was agreed that it was a low priority and no progress was made. To strengthen the links between gear technologists and fisheries managers, the Madrid workshop was also attended by representatives from two government departments (Spain and the UK) which supported the research efforts to tackle discards. A final action agreed was to develop a comprehensive listing of current and past research on gear selectivity, and this became a test case for examining the power and pitfalls of databases (see Box 5).

**Collaborative Programme 3: Essential fish habitats and trophic interactions in the Mediterranean**

**Greece (lead), Cyprus, France, Spain, with Croatia and Italy involved**

Collaboration within the Mediterranean Sea area faces significant challenges because it is not as well developed as, for example, in the North Sea. MariFish provided an ideal opportunity to build partnerships between scientists and also with countries which were not part of MariFish, including Croatia and Italy. Work focussed on two specific areas: essential fish habitats for small pelagics, and facilitating an ecosystem approach for demersal fisheries through the development of the MEDITS database.

**Essential fish habitats.** Through MariFish, progress is being made to identify areas in the Mediterranean Sea that could be considered as essential habitats for anchovy and sardine, and to predict their temporal (seasonal and inter-annual) variation in relation to environmental parameters. The identification of these areas was achieved by integrating existing and new knowledge, for example acoustic surveys, satellite environmental data, advanced statistical analysis, GIS techniques and the presence/absence of each species.

Using these techniques, partners were able to produce common results for the summer and winter surveys, for the years 2002-2007, for the Aegean Sea, the Sicily Channel and Spanish
Mediterranean waters. Results include models and maps of critical spawning, juvenile and adult habitats for anchovy and sardine species.

The MEDITS database. This database holds data gathered from collaborative international bottom trawl surveys from the Mediterranean, involving all European Mediterranean countries. The surveys are important for detecting the status and changes of demersal resources. Under MariFish, three aspects that need to be resolved were identified: the availability of the data; the availability of a standard exchange format; and the building of the common historical database. To address these, the partners agreed a statement of free access to the MEDITS data and are currently working on a website to make their MEDITS data for 1994-2000 freely available.

Collaborative Programme 4: Influence of climate on small pelagic fish

Spain (lead), France, Greece, Iceland, Portugal, and UK (Defra).

Gaining knowledge of the effects of climate variability on small pelagic fish is a major challenge for fisheries managers across Europe and a substantial amount of research is being undertaken at national and international levels. MariFish partners agreed to work collaboratively on climate and small pelagic fish under the programme heading ‘CLIMAFISH, the influence of climate on small pelagic fish biology, distribution and population dynamics’.

Under CLIMAFISH, partners exchanged information on existing research in order to avoid duplication and share knowledge. To develop collaboration, an interactive web page was set up as a communication tool for partners to use, and help create links between researchers. A number of research themes were suggested as candidates for more in-depth collaboration, including recruitment processes and drivers, stock structure and ecological and trophic interactions. It was agreed that the top candidate for collaboration was integrated ecosystem models because this was a gap in current research. Research models could potentially become an important tool for synthesising existing information and helping managers to take decisions.

To help take forward the integrated models theme, MariFish organised a workshop in Barcelona that also included the interests of Collaborative Programme 3 on essential fish habitats. The aims of the joint workshop were to discuss the state-of-the-art and the future of integrated ecosystem modelling as a tool to investigate marine ecosystems; and to further improve co-ordination and dissemination of research results within related research groups and EU-funded projects (see Box 7).
Box 7: MariFish supported workshop on integrated ecosystem models: why, how and what to expect from them

MariFish chose the topic of integrated ecosystem models for special attention because this was a research area that was identified by partners and researchers as a research/collaboration gap. Models aim to provide a representation of the ecosystem that incorporates environmental, biological and human interactions. A large diversity of drivers exist, from climate to human pressures, and these affect the ecosystem at a variety of spatial and temporal scales. If successful, models could become one of the main tools for managers when taking decisions related to ecosystem management.

To analyse the state-of-the-art of current ecosystem models, and their use in fisheries management, MariFish organised two linked workshops: one on integrated ecosystem modelling, the second on the ecosystem approach to fisheries management in the Mediterranean Sea.

The workshops identified some of the most prominent strengths of using integrated models to manage marine ecosystems including the synthesis of existing knowledge and data, the possibility of formulating and testing existing hypotheses, and the ability of complex scenario analysis and integrated assessment. Various potential problems were also identified, including: difficulties in coupling climate, physics and biology; the requirement that the different modules of the model need to have a common framework, scope and currency (i.e. biomass, energy, etc.); and the lack of knowledge on species acclimation and adaptation.

Overall, there were two consensus messages from the workshops;

- The need for improvement in communication and transfer of knowledge within the scientific community and between scientists, managers and interested parties.
- The need for scientists to be realistic about what these types of models can provide.

The participants agreed that some follow-up actions were required, including a discussion paper on the future of these models, and a proposed scientific forum to discuss the development of integrated ecosystem models. Participants concluded that a substantial effort should be dedicated to making methods as transparent and well documented as possible, and providing tools for assessing the quality of the models for the desired objectives.

Collaborative Programme 5: Use of indicators to support an ecosystem approach to fisheries management

Ireland (lead), all partners.

Given the importance of indicators to fisheries management, all partners expressed an interest in being involved in this Collaborative Programme. The use of indicators, to assess multiple pressures on the marine ecosystems as well as its state, plays an important role in implementing an ecosystem approach to fisheries management. Indicators are currently an important aspect of the EU Data Collection Framework (DCF) and the Marine Strategy Framework Directive, and will also play a significant role in developing science that supports the reform of the Common Fisheries Policy.
MariFish recognised that there is already a high level of collaboration on indicators. To avoid duplicating work elsewhere a rigorous approach was adopted to decide areas to work on collaboratively, as illustrated below.

**Figure 7: The process adopted to help select three indicator topics for collaboration.**

Through this process three topics were selected for collaboration:

**Inshore fisheries indicators: operating fisheries under the Habitats Directive – Natura 2000**

MariFish organised a workshop in Dublin to discuss the successes, failures and problems in managing the interaction between fisheries and Natura 2000 objectives effectively. The outcome of the workshop included the identification and ranking of current issues as well as three priorities for future international collaboration: data provision for managing risk at Natura 2000 sites; risk assessment methodology; and data requirements for the Marine Strategy Framework Directive and the Habitats Directive.

**DCF and deep-water indicators from research surveys**

A workshop in Aberdeen evaluated the adequacy of the proposed DCF indicators for the deep-water ecosystems. Key questions addressed included:

- Can the DCF indicators be applied to data from deep-water surveys to demonstrate impacts of fishing on the deep-water fish community?
- If the DCF indicators are applied to deep-water surveys, do their calculations need to be adjusted/optimised for deep-water species (taking into account different life strategies compared to shallow water species)?

The key outcome of the Aberdeen workshop was that indicators set by DCF are inappropriate for deep-water species because they are unable to translate, in a straightforward way, the relationship between the community’s state and fishing pressure. Indicators need to reflect changes in the most vulnerable part of the community. Different approaches, including using ratios of known species of high vulnerability and vulnerability scoring methods for different species, are being explored and applied on deep-water survey and observer fleet data sets.
Integrating VMS and logbook data

This third topic for collaboration was taken forward through other routes, including an ICES expert working group.

Lessons learned from the MariFish Collaborative Programmes

Collaboration undertaken within the MariFish programmes has extended outside the strict focus of developing joint research projects. It has included developing detailed databases on current research to help identify common priorities and avoid duplication. Agreement has been reached on the sharing of data on fishing vessel activity in the Channel and on ground fish surveys in parts of the Mediterranean. Gear technologists and modellers have been brought together to share experiences, in the context of fisheries management’s need for improved science. Future research needs and scope for collaboration have been identified through focussed workshops, for example on integrated ecosystem models and indicators for inshore and deep waters.

To help learn the lessons from achievements, MariFish undertook a SWOT² analysis, which recorded the views of all partners. Strengths identified included helping provide critical mass; identifying research gaps; and avoiding duplication. Weaknesses included insufficient time and resources allocated to involving scientists in collaboration; and protracted time needed to identify common priorities and build collaborative programmes. Opportunities included encouraging researchers to collaborate from the start; and offering an effective way of maintaining research output as budgets decline. Threats included the loss of momentum once the MariFish project comes to an end.

² Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis.
This section reports on the second challenge MariFish set itself – to fund research jointly to address an area of strategic importance. It describes the approach used to select the topic for funding, and the three projects supported through the common call.

All ERA-NETs have as their final goal to fund research jointly through a common call. MariFish decided to fund research that was strategic in nature. The rationale behind this decision was that a strategic rather than applied topic was more likely to attract support from the majority of partners, and that a contribution from several partners would result in sufficient funds to tackle a challenge which individually partners would have little chance of making progress on.

The question was which topic to choose. To help with this decision MariFish drew on the output from the Roskilde symposium which identified a number of key strategic challenges for fisheries management including ecosystem-based management, implementing sustainable fisheries through maximum sustainable yield, and stakeholder involvement.

Following further consultation it was concluded that the maximum sustainable yield principle, including its implementation, would be a suitable topic for the joint call. Member States have signed up to this principle through the World Summit on Sustainable Development (Johannesburg 2002), but what precisely does it entail and is it achievable? The proposal put to partners was that research was needed to investigate five issues: recruitment relationships; by-catch and discards; biological interactions between species; environmental impact of fisheries; and economic indices.

MariFish partners endorsed the general thrust of this proposal and agreed to invite researchers to submit proposals addressing the following topic:

*The development of the concept of operational fisheries management indicators that can assist fisheries managers in developing long-term fisheries management plans, and exploring ways these indicators could be formulated by applying the concept on selected fisheries.*

Eight partners committed a total of €4.0m to the ‘common pot’ (Denmark €1m, France €0.6, Greece €0.8m, Iceland €0.1m, Norway €0.5m, Spain €0.3m, the Netherlands €0.2m, the UK (Defra) €0.6m). An additional €1.7m was made available through co-financing by certain partners.

The call was launched in December 2008, and six proposals were received. Following an evaluation by a panel of international experts, three proposals were selected for funding:
Jointly Funded Project 1: By-catch and discards: management indicators, trends and location (BADMINTON):

This project, led by the Hellenic Centre for Marine Research (HCMR), involves research teams from Denmark (IFM and DTU-AQUA), France (Ifremer), Iceland (Matis), Spain (IEO), the Netherlands (IMARES) and the UK (Cefas). In Europe there is intensive data collection of by-catch and discard onboard commercial vessels, but until now there have been few attempts to describe the general patterns in these data, and understand the factors that determine what and how much is discarded. This project will develop indicators of by-catch and discards in European fisheries, especially the relationship between pressure indicators (fishing selectivity and intensity), and state indicators describing the amounts and attributes of discards. As illustrated below, output from the project will help fishery managers develop effective plans for tackling this high profile problem.

Jointly Funded Project 2: Developing fisheries management indicators and targets (DEFINEiT)

This project, led by the Danish Technical University (DTU-AQUA), involves research teams from Greece (HCMR), Iceland (MRI), INE also from Denmark, Norway (IMR), the Netherlands (IMARES) and the UK (Cefas, IC, USTAN).

Successfully achieving the economically optimal level of exploitation of a fisheries system is strongly influenced by a range of factors including the current status of the fish stocks; the influence of environmental variability (e.g. climate change); interactions with the wider ecosystem; the effects of fishing on the non-target elements of the natural fish community; and the economic nature of fishermen’s responses to management. Proposed management strategies should therefore be robust to the uncertainty introduced by all these factors.

The effectiveness of a management strategy is strongly dependent upon the identification and use of appropriate targets and indicators. Fisheries management should ensure that exploitation of resources provides economic, environmental and social conditions that are sustainable. It is in this context that fisheries indicators are being developed and used. In particular, it is also necessary to consider the impacts on non-target and susceptible fish species to ensure that the level of exploitation is sustainable.
The project aims to produce the tools needed to determine the economically optimal level of exploitation of European ecosystems under changing climatic conditions. Operational models of fish stock dynamics under change are being developed and combined with economic models to help predict the effort required to reach optimal yield. Using case studies in the Aegean Sea, the North Sea and the Norwegian Sea, the project will combine economic, social and biological indicators to produce resource indicators that can be used by managers in developing long-term management plans.

**Jointly Funded Project 3: Understanding recruitment processes using coupled models of the pelagic ecosystem (REPROdUCE)**

This project, led by the Spanish Institute of Oceanography (IEO), involves research teams from France (Ifremer), Greece (HCMR) and Spain (AZTI). Portugal (IPIMAR) is also involved in the project with resources donated ‘in kind’.

Understanding recruitment processes is crucial to improving our knowledge and management of fish stocks, and yet is one of the most challenging in fisheries science. We know that both internal stock dynamics (biomass, age structure, distribution, etc.) and external variables (interactions with other species, fishing pressure and the environment) affect next year’s recruitment. We also know some of the mechanisms that control recruitment, such as reproductive potential, predation, starvation, physical transport to unsuitable areas, etc. But so far we have failed to quantify the effect of these processes in nature and to obtain indicators of recruitment strength.

This project aims to develop life cycle models for two specific case studies: sardine and anchovy in the Bay of Biscay; and anchovy in the Aegean Sea. Developing indicators of recruitment will be particularly crucial to the management of these short-lived species. The models will be used to understand the main mechanisms and drivers of the recruitment process and help predict the abundance of new individuals entering the stock. Indices for recruitment strengths will be produced to assist short, medium and long-term management plans.

**The benefits arising from jointly funded research**

The support provided to these three projects illustrates the considerable benefits that can arise from funders working together to tackle a shared challenge, and how research could be undertaken at a regional level. Individually the MariFish partners could have made relatively little progress in developing the concept of operational fisheries management indicators. By committing funds jointly MariFish has been able to focus the efforts of 15 research institutes from nine countries on this important research topic.

It is recognised that the benefits far exceed the €5.7m invested by the partners. For example research teams involved in the three projects have been able to draw on experiences from earlier research, such as in developing models, and have also been able to combine national data to provide a more complete picture on discards and effort at a regional level.
6 Conclusions and the future

MariFish has demonstrated the positive benefits that can arise from European collaboration. The eighteen partners working together delivered all the major outputs agreed at the start of the project. Key benefits that have emerged from the project include the following:

- A much improved understanding of the importance of science communication and knowledge management. Partners have used this understanding in conducting MariFish business, and within their own organisations.
- A better understanding of the full range of approaches used by partners in commissioning and managing research, leading to the development of good practice guidelines.
- A fuller understanding of the complexity of international and European collaboration associated with fisheries science, and the role that MariFish can play.
- A comprehensive assembly of socio-economic research related to fisheries, and identification of priorities for future socio-economic research.
- An inventory of partners’ national research programmes on the MariFish website, with public access, and an analysis which established areas of research suitable for collaboration.
- Development of five Collaborative Programmes which have resulted in data sharing agreements; practical management of existing knowledge through information sharing; joint model development; and gaining experience in working together.
- Strengthened fisheries policy-science links through workshops on topics including identifying strategic requirements for fisheries research; research on indicators for fisheries managers; delivering more science with fewer resources; and drivers for fisheries management.
- Partners have, for the first time, committed funds to a common call, and have selected, and are jointly funding three research projects with a total value of €5.7m. Projects will be monitored jointly, helping to maintain the partnership into the future.

Collaboration developed through MariFish has set a firm foundation on which further collaboration can be built. It has stimulated valuable contacts between funders, managers and scientists which will help find solutions to the future challenges facing fisheries management. The Commission’s Green Paper ‘Reform of the Common Fisheries Policy’ asks how we can best ensure research programmes are well co-ordinated within the EU, and the Marine Strategy Framework Directive will require greater collaboration at the regional level. Collaboration between the funders of fisheries science will, therefore, need to increase to respond to these challenges, and partners believe that MariFish has demonstrated how collaboration can take place in practice, and the benefits that can be realised.

Certain initiatives started under MariFish will continue including the Collaborative Programmes and the jointly-funded projects. Experience gained through MariFish will feed into SEAS-ERA, and into the proposed Joint Programming Initiative (JPI) ‘Healthy and Productive Seas and Oceans’. Other options for continuing collaboration, such as bi-lateral agreements, may also emerge, again building on the achievements made under MariFish.
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All publications of the MariFish project are at: www.marifish.net/publications
Websites of the three MariFish joint call projects are at:
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