

# SIXTH FRAMEWORK PROGRAMME

## PRIORITY 8

### SUSTAINABLE AQUACULTURE



# REPROFISH

Contract for:

**SPECIFIC SUPPORT ACTION**

<b>Annex I - "Description of Work"</b>
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Project acronym: **REPROFISH**

Project full title: Integrating basic and applied knowledge on finfish reproduction

Proposal/Contract no.: **044224**

Related to other Contract no.:

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## 1. Project summary

The present proposal is relevant to the priorities of the Specific Support Actions (SSA) and more specifically targets the work program of priority 8 in relation to sustainable aquaculture. Within this priority, this proposal falls in the scope of Sub-task 13.1.2 Exploitation of the results of the 5P<sup>thP</sup> and 6P<sup>thP</sup> frameworks: sustainable aquaculture excluding genomics. This proposal aims at maximising dissemination, accessibility, and applicability of the outcomes of FP5 and 6 projects dedicated to improve our knowledge and control on finfish reproduction.

### **Main objectives:**

- To organise two workshops to gather relevant expertise, expose results, exchange information, identify synergisms that emerge from the conclusions of the different programmes, and classify and distribute responsibilities
- Identify, analyse and synthesise main results in reviews/books targeting the scientific community, and the aquaculture industry
- To build up a website (to be hosted by INRA Rennes) containing simplified digested information on general and species-specific aspects of finfish reproduction and its control by external and internal factors. Target groups are – next to the scientific community and aquaculture industry – in particular the consumer and their associations.
- Based on these analyses, to submit to the European Commission an integrative document identifying knowledge caveats and problems requiring further or new research efforts regarding reproductive issues and their interconnection with other major life processes, such as growth and immunity.

### **Abstract**

During the 5P<sup>thP</sup> and 6P<sup>thP</sup> framework programs, a number of projects have been funded by the EU to improve our knowledge of fish reproduction in order to control the most pertinent steps of the reproductive cycle. These projects have produced a wealth of information that has been/is being disseminated mainly as scientific papers and communications to scientific or aquaculture meetings, resulting in a large amount of scattered information. This SSA aims at synthesizing this information, by gathering scientists and industry involved in these projects, in order to identify and extract the most important, common results. This will not only make them much more readily available to the scientific community, but will also facilitate access to this information for the industry, and – in a digested form – for the interested public (e.g. consumer and their organisations). Moreover, it is expected that integrating these data will release synergistic effects, as the robustness and significance of the combination will largely surpass the simple sum of the data generated by each of these projects. It will result in a unique state-of-the-art overview of both basic and applied aspects of finfish reproduction in a sustainable aquaculture perspective. This will be achieved through a series of specific objectives including analyses and synthesis of the results in joint publications, development of a web site, and a prospective on future actions.

## 2. Project objectives and state of the art

This proposal is relevant to the priorities of the Specific Support Actions (SSA) and more specifically targets the work programme of priority 8 in relation to sustainable aquaculture. Within this priority, this proposal falls in the scope of Sub-task 13.1.2: *Exploitation of the results of the 5<sup>th</sup> and 6<sup>th</sup> framework: sustainable aquaculture excluding genomics*.

Several projects have been funded under FP5 and FP6 with the general objective to improve the sustainability of European aquaculture, an issue of major relevance also for the future development of European aquaculture biotechnology. More specifically, some of these projects aimed at better understanding the mechanisms underlying finfish reproduction, at improving the current practices of finfish husbandry and/or at solving problems related to reproductive issues in certain species. Given the nature of the activities developed in this sector, such projects have addressed specific questions in different species and have generated a large amount of new data. In addition, the period covered by FP5 and FP6 projects was characterized by a spectacular evolution of research technologies, in particular the widespread use of molecular biology and the emergence and implementation of high throughput approaches, leading to an accelerated generation, as well as considerably larger amount of new information. However, dissemination of all these results followed traditional paths, mainly via scientific publications, communications to scientific or aquaculture meetings, and reports to the EU. Until now there has been little effort to integrate the results and give them a more robust significance, while one may predict that some of the main conclusions drawn in those different projects will gain a broader impact, if an effort is made to integrate them in a larger perspective. Hence our proposal aims at integrating the outcome of these different projects, addressing both basic and applied aspects of fish reproductive biology, and making the conclusions available also to industry and the public.

Despite significant progress in the overall understanding of the physiological mechanisms driving the development, sexual maturation and spawning of the main, economically-relevant fish species, there are still a number of black boxes that prevent effective control of important steps of the reproductive process (e.g. sex differentiation, puberty, or the timing of spawning). These processes contribute to determining the sustainability of aquaculture-based production systems. Indeed, the European fish-farming industry faces important loss due to imperfect understanding and control of two particularly relevant steps of the fish life cycle.

- One is the process of **sex differentiation**, a developmental process largely influenced by ill-defined, species-specifically acting epigenetic factors that moreover seems to be affected by commonly used, high density rearing conditions. For example, a very important problem of the European sea bass (*Dicentrarchus labrax*) aquaculture industry is a skewed sex ratio with the occurrence of 70-99% males. Male-biased stocks are undesirable, because males exhibit reduced somatic growth compared to females, resulting in 20-40% smaller body weight at harvest. Therefore, it is desirable to culture predominantly female stocks.

- Another constraint for the European aquaculture industry is the unpredictable rate of **early sexual maturation or puberty**, which often occurs before the fish have reached a marketable size. This is a large problem in established farmed species such as Atlantic salmon, rainbow trout and sea bass, but also in emerging species such as Atlantic cod, turbot and halibut. A range of environmental conditions and factors (e.g. photoperiod and nutrition) but also genetic factors, manifest their effects in poorly understood and often unpredictable manners, thereby influencing the timing of puberty.

A number of FP5 and FP6 projects have specifically addressed these reproduction-related problems in different species, mainly in sea bass, rainbow trout or Atlantic salmon. These projects have generated a large amount of data. The challenge is now (1) to analyse all these

results and extract the most relevant information, (2) to make it available to all actors (scientists, industry, and public) in this sector, and (3) to fuel considerations regarding issues to be addressed by future international programmes.

In addition, given the highly integrated nature of the reproductive function, the present SSA would benefit greatly from linking its output to those of other FP5 and FP6 projects related to **nutrition/growth, immune system and stress**. This because apparently complex and often ill-defined cross-talks exist between these major life processes and because high density rearing conditions and feeding regimes can affect differentiation of the reproductive axis, growth rate, age at first maturation, and welfare of the fish.

The overall objective of this proposal is therefore to synthesise the outcome of different projects funded under FP5 and FP6 in order to generate a complete, up-dated and integrated vision of the reproductive process in finfish allowing to advise on solutions to be employed to improve control of sex ratios and pubertal maturation under fish farm conditions, and to identify issues for future concern.

To reach this overall objective, a number of instruments will be used to ensure optimal communications between the teams involved in these different projects and to facilitate the accessibility to the results of the 5<sup>th</sup> and 6<sup>th</sup> frameworks to the scientific community, the industry and the general public in order to optimize the implementation of the available resources.

#### **Instruments to be used include**

- To organise two workshops to gather relevant expertise, expose results, exchange information, identify synergisms that emerge from the conclusions of the different programmes, and classify and distribute responsibilities
- Identify, analyse and amalgamate main results in reviews/books targeting the scientific community, and the aquaculture industry
- To build up a website (to be hosted by INRA Rennes) containing digested information on general and species-specific aspects of finfish reproduction and its control by external and internal factors. Target groups are, next to the scientific community and aquaculture industry, the consumers and their associations.
- Based on these analyses, to submit to the European Commission a synthesis document with identification of black boxes and problems requiring further or new research efforts regarding reproductive issues and their interconnection with other major life processes, such as growth and immunity.

#### **Measurable outputs**

- Two workshops, which will bring together representatives of the laboratories. The first one will involve scientists implicated in different relevant FP5 and FP6 projects in order to discuss the data, integrate them into a general outline, organise specialized workgroups, and distribute responsibilities. This first workshop could tentatively be organized on the occasion of the Fish Reproductive Physiology Meeting to be held in St Malo in June 2007. The second workshop will gather scientist together with representatives of the aquaculture industry. This second workshop is tentatively scheduled to be organized on the occasion of the European Aquaculture meeting in 2008.
- Production of a book or of review papers in a special issue of an established scientific journal, aiming at making publicly available an integrated vision of the reproductive physiology of finfish, identifying the main reproduction-related problems encountered in aquaculture and offering strategies to improve husbandry methods.
- Construction of a web site providing updated information on the functioning of the reproductive axis and the role of internal and external factors on sexual differentiation and first maturation.

- Generation of a summarizing document identifying the most relevant issues to be addressed by future programmes.

### 3. Participants list

<b>Partic. role</b>	<b>Partic. No</b>	<b>Participant name</b>	<b>Short name</b>	<b>Country</b>	<b>Date enter project</b>	<b>Date exit project</b>
CO	1	Université de Rennes 1	UR1	France	Month 1	Month 24
CR	2	Institute of Marine Research	IMR	Norway	Month 1	Month 24
CR	3	Spanish Council for Scientific Research	CSIC	Spain	Month 1	Month 24
CR	4	University of Utrecht	UU	Netherlands	Month 1	Month 24
CR	5	Institut National de la Recherche Agronomique	INRA	France	Month 1	Month 24

## 4- Relevance to the objectives of the specific programme

This proposal is highly relevant to activities in the SSP priority - Specific Support Action - and specifically addresses Sub-task 13.1.2: Sustainable aquaculture. In this proposal, no scientific or training activities are planned. Rather, the efforts will be devoted to transfer the knowledge obtained and to maximise the exploitation of results of the 5<sup>th</sup> and 6<sup>th</sup> frameworks. Indeed, this activity will combine the results of different, but complementary, research projects in the field of fisheries and aquaculture in an integrative way. The enhanced impact of the research activities is achieved by transposing the main conclusions from the species-specific to a more generalised level of fish reproductive biology, thereby also improving their significance for the aquaculture industry. These activities are of direct relevance to the objectives of the SSP priorities.

### 4.1- Integrating and strengthening the European research areas

This project will contribute strongly to structuring the European research potential in the field of aquaculture by bringing together scientists from different member states and expertise background (basic and applied biology as well as industry scientists) in order to generate a working group. This group will analyse and discuss the outcome of FP5 and FP6 projects dealing with several aspects of the reproductive biology of fish that are crucial for the sustainability of European aquaculture. It is expected that this effort will also provide a basis, on which the communication with related research areas and SSAs – such as those with an emphasis on e.g. genomic approaches in aquaculture – will be greatly facilitated, opening further options for an even wider level of integration. Therefore, it is expected that interactions among experts involved in this SSA will be instrumental for generating synergies between researchers or projects and for structuring research activities within Europe. This will most likely result in a **better use of the research potential and thus a strengthening of the impact and visibility of the European task force** in the field of fish farming, also – and perhaps in particular – with respect to future, joint research activities.

### 4.2- Scientific and technical objectives

Reproduction is a complex, integrated life function requiring a permanent dialog between the organism and its environment, but also integrative communication within the organism, to coordinate reproduction and other physiological functions (energy balance, growth, or immunity), involving communication between the cell types, tissues, and organs involved in these functions. Because of the inherently broad range of issues addressed in the different species and because of the ongoing development of increasingly sophisticated methodologies serving to investigate reproductive issues, there is now a strong need to bring together the resulting fragmented information and expertise. The main scientific objective therefore is to structure and integrate the yet fragmented information, thereby increasing its scientific significance, its impact as regards applicability, and its public perception. Since this proposal aims at bringing together the fragmented data obtained on different topics and different species from all previous FP5 and FP6 projects dealing with the reproductive biology of finfish, it will result in a high level of integration with a comprehensive view of the state-of-the-art of the field. This integrative effort, therefore, is very likely to facilitate a significant improvement of the state-of-the-art in this area, resulting in a **strong scientific added value** and a **positive impact on technical/applied issues**. Defining clearly and comprehensively the state-of-the-art moreover will be an excellent basis for achieving two other objectives, namely

(i) to define caveats in our knowledge that require attention in future research activities, and  
(ii) to identify areas of complementarities with other EU supported R&D or SSA activities, both improving the chances for effectiveness and synergism for future activities.

#### **4.3- Economic development and reinforcement of competitiveness**

Sustainable aquaculture in Europe depends on its capacity of producing high quality products at reasonable costs. This proposal focuses **on the two major problems** for the fish industry: the lack of understanding of the environmental factors leading to skewed sex ratio under farming conditions, and the lack of sufficient control on the timing of the first sexual maturation. These problems affect the production of the four most important species cultured in Europe: the rainbow trout, the Atlantic salmon, the sea bass and the sea bream. Unfortunately, there are clear indications that similar problems are found in emerging species such as Atlantic cod, halibut and turbot. Precocity is an undesirable trait because very often it is correlated with negative aspects such as reduced growth and feed conversion and low resistance to infectious diseases. This problem, which is much more pertinent in males than in females, is particularly serious for the sea bass, in which typically 70-95% of males are found in the farms. The cause(s) for this unbalanced sex ratio is unknown but is likely resulting from a combination of genetic (strain) and environmental factors (such as temperature and density among others). Also in species with stable sex ratios (e.g. Atlantic salmon or cod), precocious puberty is a problem preponderant in males and can reach a level of penetration among males as in sea bass.

Integrating the outcome of the projects that addressed these problems and increasing the dissemination of these results should improve the benefit of research already carried out, by improving its visibility and providing technical solutions. Another important aspect is to increase the attractiveness of the products to the consumer who is more and more asking for transparency and accountability. This can be achieved by clearly explaining that marketed products have been obtained using safe and animal as well as environmentally friendly methodologies.

#### **4.4- Societal objectives**

According to the FAO, fish is one of the most widely used low-cost protein source in many countries and aquaculture is the fastest developing food producing sector in the world, with an average annual increase of 9.4 percent during the period from 1993-2003. However, it is clear that the availability of fish harvested from capture fisheries will be inadequate to support the growing demand for fish protein. The world production was 54.8 million tons (with a value of 59 billions Euros in 2003). However, according to FAO projections, we will require 80 million tons of fish from aquaculture by the year 2050. Thus, there is an increasing demand for good and safe fish produced in aquaculture biotechnology facilities at competitive prices; this requirement is not restricted to Europe. To enhance the competitiveness and ensure the developmental options of this sector which supplies healthy food to the European citizens, there is the clear need to maximize the outcome of past and present, and to coordinate the identification of future, research and development activities.

Aquaculture also has an important impact to the local economy in many coastal areas – often in a SME setting. Therefore, a stable and sustainable aquaculture sector is an important aspect in the consolidation of the socio-economic structure of these often remote areas that offer only limited job alternatives for the local population, and can contribute to the creation of new opportunities in these areas.

## 5. Potential Impact

This proposal concerns the area "Modernisation and sustainability of fisheries, including aquaculture-based production systems".

Aquaculture is a sector of growing importance in Europe which, with 4.4% of the global production, is the second producing region, after Asia (91%). The top cultivated species by value in 2000 included the Atlantic salmon (41.6%), rainbow trout (16.6%), common carp (6.7%), gilthead sea bream (6.0%), blue mussel (5.9%), and European sea bass (4.9%).

The total farmed fish production in Europe in 2004 was reported to be above 1.3 billion tons, corresponding to more than 3.8 billion Euro in value (FEAP; [http://www.feap.info/Production/euproduction/euproduction\\_en.asp](http://www.feap.info/Production/euproduction/euproduction_en.asp)). However, after a rapid increase during the years 1970-1990, the annual growth rate of the Aquaculture sector in Europe over the last ten years (3.4%) is now significantly lower than the world figure (11%). Therefore it is necessary to keep providing impulses that support growth and secure cost effectiveness of this sector, strengthening its competitiveness and overall sustainability. Moreover, with the increasing net need for products from aquaculture biotechnology, sustainability issues become increasingly relevant. In some coastal regions, aquaculture has become a major employer for rural communities and is a major factor in the socio-economic structure of these communities. However, although there is clearly potential for further development (e.g. new species, sustainability issues), technological and biological problems may develop adverse impacts on the prospects. Particularly relevant in this context is the inadequate understanding and hence mastering of sex differentiation and/or precocious puberty, problem fields directly causing significant losses (see below) to the European fish farming industry.

The present proposal intends to bring together projects that have addressed such problems. A major constraint for the European aquaculture industry is the unpredictable rates of **early sexual maturation or puberty**, which often occurs before the fish have reached a marketable size. This is a large problem in established farmed species such as Atlantic salmon, rainbow trout, sea bass, and sea bream and emerging farmed species such as Atlantic cod, turbot and halibut. Problems relating to **early puberty** or as it is often described "**precocious maturation**" is a **major problem** for most if not all farmed fish species in the EU. Typically, Atlantic salmon exhibit up to 10% male maturation as parr and grilse levels may reach 70% of all fish in some stocks. Early maturation in male rainbow trout continues to be a significant constraint which is only tempered at present by the time-consuming and technically demanding procedures of all-female and triploid production. Male flatfish invariably mature before the fish have reached their ideal marketable size and most male cod mature in their first year of life. Finally, a very important problem of the European sea bass (*Dicentrarchus labrax*) aquaculture industry is the occurrence of 70-99% males. Male-dominant stocks are undesirable, because males exhibit reduced somatic growth compared to females, resulting in 20-40% smaller body weight at harvest.

Collectively, it has been estimated that these unwanted and unpredictable rates of first maturation or puberty generate losses to the aquaculture industries above **100 millions Euros p.a.** To this should be added the costs relating to **additional management and husbandry time** caused by the problems of early maturation and to the gaps in the production cycle and under-utilisation of facilities resulting from unpredictable rates of early maturation.

These problems have already been addressed by different EU projects concerned by this proposal, but extracting an overview of their outcome has never been attempted until now.

Yet, the complexity of the biological mechanisms underpinning the development and proper functioning of the reproductive axis makes it necessary to synthesise this outcome in a resolute integrated perspective. We believe that this proposal will be the first, in a long time, to have this ambition at the European, and probably at the world level. This joint effort not only will contribute to an added scientific value in comparison with the individual projects, but also will clearly lead to a better structuring and optimization of the European research potential, therefore increasing its impact and competitiveness.

To achieve these objectives is one of the tasks of the working group that will be constituted by gathering representatives of the projects listed below. This working group will organize workshops in order to identify synergies and complementarities between projects, define responsibilities for the writing of review articles and syntheses. The project intends to pay particular attention to the interactions between stress or nutrition and the reproductive axis. Moreover, this project focuses on transferring the essential information to the industry. One of the means used is by inviting representatives of the main European aquaculture associations to the workshops and making available reference documents in the form of integrated summaries to be published or made freely accessible on a dedicated web site.

## **6. Project management and exploitation/dissemination plans**

### **6.1 Project management**

The overall project coordination as well as the financial and administrative coordination will be the responsibility of the project coordinator Dr. Olivier Kah (University of Rennes 1). The coordinator will collate material for preparation of reports, arrange partner meetings and monitor and distribute funds. The coordinator will function as the contact person to the EC administration and thus function as the link between the EC and the project Partners. The coordinator will be supported in this work from the management committee (MC).

The management committee consists of the coordinator and the four partners, which are all responsible for well-defined specific tasks.

A clear project management structure will be implemented to ensure correct and appropriate decision making throughout the project. The Management Committee (MC) will consist of the five partners: Dr. Olivier Kah, Dr. Geir Lasse Taranger, Dr. Silvia Zanuy, Dr. Rüdiger Schulz, and Dr. Jean-Jacques Lareyre. These five persons will collectively act towards the Commission, implement the different activities, and participate in reports and other interactions at the administrative level. The five persons of the MC will be charged with the responsibility of reviewing progress, in their specific areas of responsibilities within the project, against the agreed deliverables and milestones. Dr. Kah and Schulz will be mainly responsible for the execution and finalising of WP 1 (First Workshop) and 2 (Book/Special Issue), Dr. Lareyre will be responsible for WP 3 (Website), Dr. Taranger will be in charge of WP4 and Dr Silvia Zanuy will be in charge of WP5.

The MC will also assist the coordinator in his financial responsibilities, in order to ensure the correct and effective use of funds provided. The MC will be in contact by e-mail or telephone when needed and will meet three times (months 3, 12 and 18) during the duration (24 months) of the project. The scheduled meetings do not preclude that other meetings might be organized whenever deemed necessary. This project management structure should therefore be able to take immediate corrective action in order to produce the milestones and deliverables within the stipulated time scale. The coordinator will head the Management Committee (MC) which represents the decision making committee of the project and will execute the decisions made by this group.

Although the responsibilities have already been determined, they will be, in case of acceptance of this proposal, further discussed, by phone and e-mail, immediately after the beginning of the project. The start up meeting (to be held within 2 months after start) will gather the MC prior to the first workshop in order to finalize the program, nominate chairmen and make sure that everything is under control.

### **6.2 Plan for using and disseminating knowledge**

Given that the project aims at integrating and disseminating the outcome of FP5 and FP6 projects, it is expected that all partners and participants to the workshops will share the relevant information in an open-minded collaborative perspective. The ethical rules governing our activities will be that normally accepted in science: honesty, mutual trust, open-mindedness, respect and responsibility should be and will be the shared moral values among partners and participants, before and during the workshops or during the process of publication. It is understood that the publication will follow the same general principles. It is expected, unless

requested by the EU, that copyright permission for publications will be in accordance with normal publication procedures for the contributing partners. It is also understood that, given the nature of this programme, contributors to the book/special journal issue do not expect to receive financial compensation for their contribution. On the contrary, participants are expected to take any necessary action to ensure maximal and low-cost diffusion of the outcomes of this project.

The main goal of REPROFISH is to increase the dissemination of data and results obtained in research projects to the public as well as to the European and the scientific community. There are no specific scientific or technical objectives in the project as no research activities will be conducted.

The interaction of experts involved in the invited projects and the analysis of project outcome and results should play an important role in generating synergies between researchers and projects. This will significantly contribute to strengthen the knowledge in Reproductive Biology of Fish. Integration of results from disparate projects will help strengthening what is currently sort of a puzzle that remains to be assembled. This should increase the visibility and impact of European research in this area.

#### ***Publication of book/journal issue***

The results obtained in the project will be published in one book/journal issue containing joint review publications from different combinations of FP5 and FP6 R&D projects on reproductive biology and other relevant topics. A well known editor (Academic Press) has already been approached and is willing to publish a special issue of around 200 pages gathering the reviews that will be produced by the project.

#### ***Open Workshops on Basic and Applied Aspects on Reproductive Physiology***

One of the final outcomes of the project will be to held 2 workshop gathering scientists for the first one and scientists plus representatives of the fish farming industry. During this workshop the management committee and persons within the working group will present the final deliverables of the project to the commission, the industry, the public as well as to the participating projects.

#### ***Internet site***

A web site will be designed with the aim of presenting basic knowledge on the reproduction of the main farmed fish, research projects working in the reproductive field and favourite contacts and exchanges between project partners. This web site will also include information to the general public on European Research in Fish Biology, its interest and the benefit for providing a safe and environmental friendly product to the European consumer. It will also propose simple information on fish reproduction for the general public or teachers.

#### ***Brochure – “REPROFISH ”***

At an early stage of the project (month 6 at the latest) a “Brochure” will be delivered by the consortium, through the coordinator (D18). This 1-2 page flyer including illustrations will be made by the coordinator with the help of the partners. This will contain general information about the work program, list of participants, project main goal, key issues expected achievements and exploitation strategy. The flyer will be written in a style directed towards the non-specialist and broadly distributed to e.g. EU, participants, industry, FEAP (Federation of European Aquaculture Producers), at scientific meetings, *etc.*

### **6.3 Raising public participation and awareness**

During the duration of the project, efforts will be made in order to make information available to the general public. This will be done mainly through the establishment of the web site which will offer information on the process of reproduction and on how research help developing new technologies for the farming of fish and diversification of fish products. Importantly, information

will be provided aiming at reassuring the public with respect to the safety of farmed products for health and environment.

The project will indirectly contribute to the *Community industrial policy* as the integration of complementary projects and public divulgation, particularly to the industry through running a session at an aquaculture meeting will contribute to strengthen the scientific basis of their production. Many of the R&D projects which will be integrated and promoted are developing methods which will provide means of better protecting consumers and improving product quality. Increased public confidence in production methods and the product will promote competitive and sustainable consumption of healthy fish products. In this way the present project will contribute to *Consumer Policy and Consumer Health Protection*.

The better integration and divulgation of research about R&D projects which have developed methods to improve the quality of farmed species and support the development of European aquaculture, directly responds to an important issue in the *Common Fisheries Policy*. Technical advances which help establish a sustainable and stable production activity in aquaculture will help, maintain/stimulate economic development in coastal areas where there are few opportunities for employment.

## 7 Workplan - for whole duration of the project

### 7.1 Introduction

The present projects aims at contributing to the implementation of the work programme in relation to the common fisheries policy regarding sustainable aquaculture. The overall goal of the project is to bring scientists together, to synthesise their data and to ensure maximal diffusion of the outcome to the scientific community, the industry, the general public and the EU through recommendation sheets, review papers and a web site.

To achieve its objectives, REPROFISH will use 6 work packages (WP).

WP1: Working group formation and working group meeting

WP2: Publication of a book/special journal issue

WP3: Development of a web site

WP4: Transfer activities

WP5: Prospective for future research activities

WP6: Management

WP - Working group formation and working group meeting

The first steps after signature of the contract will be to invite 2 representatives of each of the participating projects to a first workshop. Selected persons in charge of national projects will also be invited. The 5 partners and these invited scientists will collectively form the working group. Caution will be taken to minimize overlap between the different skills, competences and sensitivities of the representative of the different projects. The first workshop will gather the working group and will be divided into 4 sessions. The first 2 sessions (day 1) will be devoted to the presentation of the different invited projects and a rapid analysis of the main results, outcomes and pitfalls. Each of the projects will be assigned one or two specific sub-group(s): such as for instance puberty, sex differentiation, photoperiodic control, interactions with stress, nutrition, and immunity. Efforts will be made to ensure maximal mixing between the different projects. Sessions 3 and 4 (day 2) will gather the different sub-groups and will be devoted to a more thorough examination of the projects and should lead to a first overview of the different chapters/review papers to be written and issues to be considered for future activities.

WP2 - Publication of a book/special journal issue

The first workshop will allow to identify key issues deserving special integrative efforts and to nominate scientists (or groups of scientists) who will address these issues in review articles. These reviews will be written between 6 and 12 months after beginning of the project in order to start the reviewing/editing process as early as possible with the objective to achieve the editing process during months 14 and have the special issue produced by month 18-20. Although contacts have been taken with editors for the preparation of a book, it is likely that the review articles will be gathered in a special issue of a journal to reduce the costs and ensure maximal diffusion through bibliographic databases. The budget includes 4 months of salary for 2 persons who will help with the writing and editing work.

WP3 - Development of a web site

As soon as the project will start, information will be gathered to feed a website. Initially, the website will mainly present information from the public scientific literature, information from already established databases and internet sites and questionnaires to each project. This information will be discussed during the working group meeting (WP1), to finalise the information content on the internet site. The site will then present more detailed information on

fish reproduction and protocols to be established for a number of specific procedures. This information will target the aquaculture industry, the scientists and but also the general public.

#### WP4 - Transfer activities

WP2 and WP3 will collect, synthesise and present the results from all the projects identified so far, and from other if found relevant, in order to produce up-dated information targeting the fish farming industry. This WP also includes organization of a work shop with representatives of the farmers on reproductive control issues for various farmed species such as salmon, trout, sea bass, sea bream and cod targeting farmers in various regions, e.g. in connection with EAS meetings or national or regional fish farming association meetings.

#### WP5 - Prospective for future research activities

Finally, the activities of the previous WPs will be an outstanding opportunity to have an instant picture of the current status of the research in fish reproduction. This WP aims to analyse this situation and give recommendations to the European Commission on important or innovative/original research in the reproductive field that need to be reinforced or supported during the 7P<sup>th</sup> FP.

These different WPs are tightly interconnected (see Gantt and Pert charts) and will be implemented by the Management Committee.

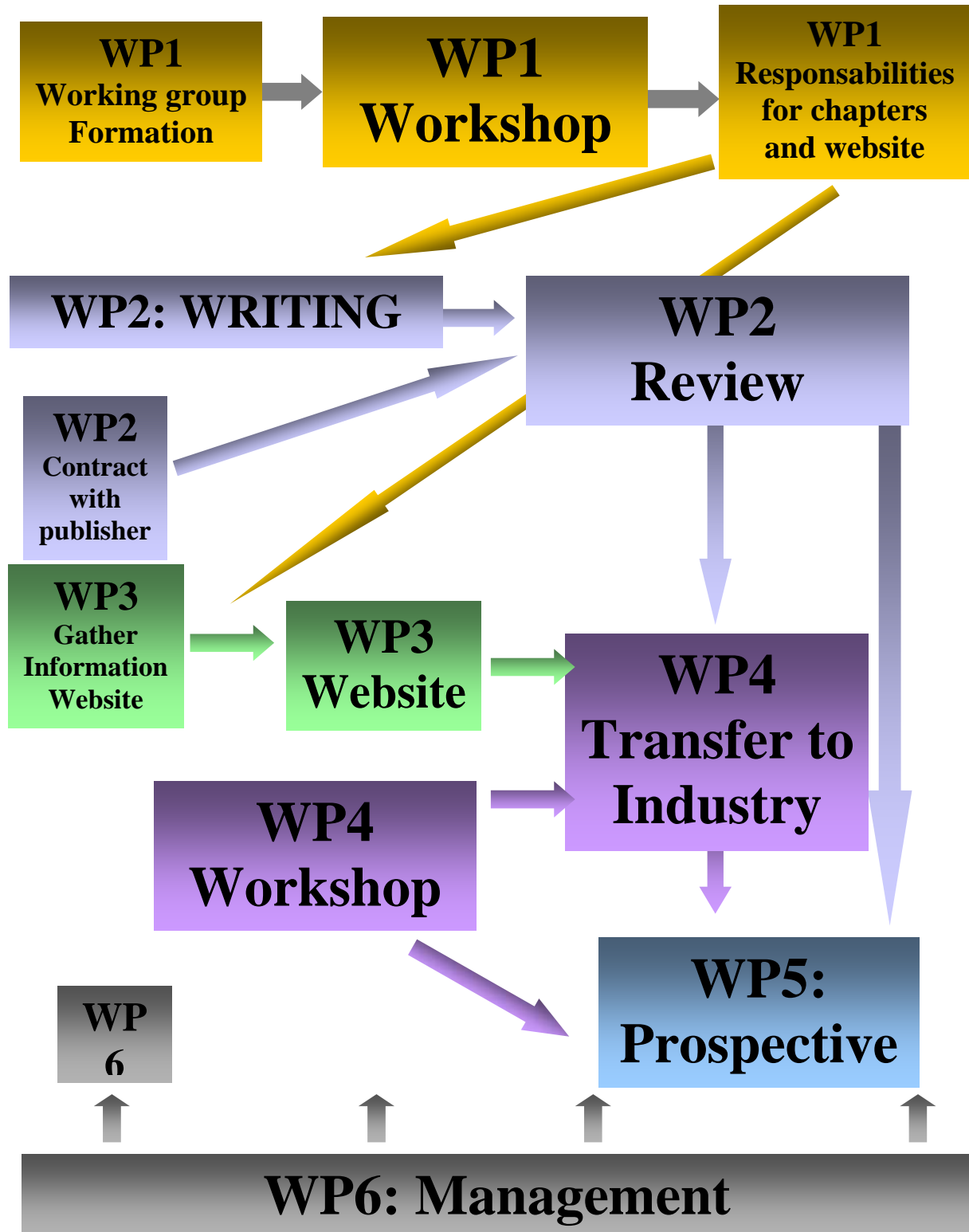
**7.2- Work planning and timetable**

**Time table (Gantt chart)**

	1	2	3	4	5	6	7	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
<b>WP 1</b>																								
Invitation of projects	X	X																						
Report on scientific and technical content of participating projects			X																					
Working group Meeting			X																					
<b>WP 2</b>																								
Establishing publishing contract	X	X	X																					
Writing			X	X	X	X	X	X	X	X	X	X	X	X										
Editing/Review process							X	X	X	X	X	X	X	X										
Publishing															X	X	X	X	X	X				
<b>WP 3</b>																								
Gathering information	X	X	X	X	X	X																		
Opening						X																		
Gathering information on fish reproduction	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Opening Section on fish reproduction											X													
Final opening with protocols																		X						
<b>WP 4</b>																								
Guide to research laboratories			X																					
Preparation of protocols for fish reproduction				X	X	X	X	X	X	X	X	X	X	X										
Workshop with fish farmers																		X						
Workshop with selected invited scientists and industry																		X						
<b>WP 5</b>																								
Identification of research issues				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Working group to produce recommendation																						X		
Send recommendation to EU																						X		
<b>WP 6</b>																								
MC meetings			X								X							X						
Project presentation Flyer					X																			
Final report																							X	

### 7.3 Graphical representation of workpackages

Pert diagram



**7.4 Workpackage list (full duration of the project)**

Work-package No <sup>1</sup>	Workpackage title	Lead contractor No <sup>2</sup>	Person-months <sup>3</sup>	Start month <sup>4</sup>	End month <sup>5</sup>	Deliverable No <sup>6</sup>
1	Working group and workshop	1	2	1	24	1-3
2	Publication state of the art book/Special Journal Issue	4	9.5	1	24	4-6
3	Development of a website	5	7	1	24	7-9
4	Transfer activities	3	3.5	3	24	10-13
5	Prospective	2	3	4	24	14-17
6	Management	1	2	1	24	18-20
	TOTAL		27			

<sup>1</sup> Work package number: WP 1 – WP n.

<sup>2</sup> Number of the contractor leading the work in this work package.

<sup>3</sup> The total number of person-months allocated to each work package.

<sup>4</sup> Relative start date for the work in the specific work packages, month 0 marking the start of the project, and all other start dates being relative to this start date.

<sup>5</sup> Relative end date, month 0 marking the start of the project, and all ends dates being relative to this start date.

<sup>6</sup> Deliverable number: Number for the deliverable(s)/result(s) mentioned in the workpackage: D1 - Dn.

## 7.5 Deliverables list (full duration of project)

<b>Deliverable No<sup>1</sup></b>	<b>Deliverable title</b>	<b>Delivery date<sup>2</sup></b>	<b>Nature<sup>3</sup></b>	<b>Dissemination level<sup>4</sup></b>
D1	List of national experts and members belonging to FP5 & FP6 projects invited to join the group meeting	2	O	RE
D2	Organisation of a 2 days workshop:	3	R	RE
D3	Report summarizing the scientific and technical content, and main achievements of each project	3	O	RE
D4	Publication strategy with distribution of the roles of the different working group members	6	O	RE
D5	Provisional contract for a book/special review edition with selected publishers	6	O	RE
D6	Title and outline of content of each chapter	6	O	RE
D7	Book/special review edition-publication	18	O	PU
D8	Web site with public access	6	O	PU
D9	Website with biological knowledge on fish reproduction	12	O	PU
D10	Website with information for the general public	18	O	PU
D11	Guide to the research laboratories with contacts persons for specific topics	8	O	PU
D12	Protocols for control of finfish reproduction	15	O	PU
D13	Workshop with fish farmers and EU officials	18	O	RE
D14	Arrange workshop with selected invited scientists and industry representatives	18	O	RE
D15	Identification of research themes on control of reproduction in farmed fish	18	O	RE
D16	Arrange working group to produce recommendation to the Commission	22	O	RE

<sup>1</sup> Deliverable numbers in order of delivery dates: D1 – Dn

<sup>2</sup> Month in which the deliverables will be available. Month 0 marking the start of the project, and all delivery dates being relative to this start date.

<sup>3</sup> Please indicate the nature of the deliverable using one of the following codes:

**R** = Report  
**P** = Prototype  
**D** = Demonstrator  
**O** = Other

<sup>4</sup> Please indicate the dissemination level using one of the following codes:

**PU** = Public  
**PP** = Restricted to other programme participants (including the Commission Services).  
**RE** = Restricted to a group specified by the consortium (including the Commission Services).  
**CO** = Confidential, only for members of the consortium (including the Commission Services).

D17	Send report containing recommendation to the European Commission	<b>24</b>	<b>O</b>	<b>RE</b>
D18	Project presentation on Flyer	<b>6</b>	<b>D</b>	<b>PU</b>
D19	Final plan for disseminating knowledge	<b>6</b>	<b>R</b>	<b>RE</b>
D20	Intermediate report	<b>12</b>	<b>R</b>	<b>RE</b>
D21	Final report	<b>24</b>	<b>R</b>	<b>RE</b>

## 7.6 Work package description (full duration of project)

<b>Work package number</b>	<b>WP1</b>		<b>Start date or starting event:</b>				Month 1	
<b>Work package title : Working group formation and workshop</b>								
<b>Participant id</b>	1	2	3	4	5			
<b>Person-months per participant:</b>	1	0.25	0.25	0.25	0.25			

### Objectives

1. To form the working group composed of representative from European projects identified in FP5 and FP6 and national experts (officials, scientific...) of sustainable Aquaculture
2. Identify complementarities and synergisms between projects. Write a short synthesis report summarizing the scientific and technical content of each project
3. Distribute responsibilities between members for the development of chapters and/or webpages content

### Description of work

#### **Task 1. Invitation of members of FP5 & FP6 projects and national experts to join the working group (WG).**

Coordinators of FP5 & FP6 projects dealing with fish reproduction, or biological functions affecting fish reproduction (excluding endocrine disruptors) will be invited to indicate one to two representatives who will represent the project at the working group meeting. In addition, EU member state national experts in sustainable aquaculture or agriculture will be identified and invited to participate in an open exchange of information. Project representatives and national experts will be requested to provide a scientific and technical report of their projects to the project coordinator. These summaries will be collated and circulated to all members of the WG in preparation for the working group meeting.

#### **Task 2. Working group meeting.**

The main objective of the working group meeting is to allow invited FP5 & FP6 project members to meet each other and establish a common culture. The meeting will be held within the first 6 month of the project. The project representatives will prepare a brief presentation, in which they will highlight the principal scientific and technical developments of their project and identify synergies and/or complementarities with other projects. Discussion groups will be established, which will group complementary projects. These discussion groups will identify and present a brief written synthesis of scientific and/or technological reviews arising from work they consider eligible for publication in the state of the art book/review edition. Responsibilities to WG members will be assigned for the development of the different chapters. During the meeting a number of other issues will be considered by the WG such as, effective mechanisms for divulgation of the R&D applications to the industry and the public, emerging research areas and future perspectives for the European research on reproduction in sustainable aquaculture. The WG member contributions to the webpage construction and content will be requested.

During the working group meetings inclusion in the WG of other EU projects will be considered.

### Deliverables

D1. : List of national experts and members belonging to FP5 & FP6 projects invited to join the

working group meeting. Write a report summarizing the scientific, technical content, and main achievements of each project

D2: Organisation of a 2 days workshop

D3: Report summarizing the scientific and technical content, and main achievements of each project

### **Milestones<sup>1</sup> and expected results**

Milestone 1.1 : Selection of manuscript titles and authors; identification of publisher and choice of the publication format (book, review, journal issue) (month 8)

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<sup>1</sup> Milestones are control points at which decisions are needed; for example concerning which of several technologies will be adopted as the basis for the next phase of the project.

<b>Work package number</b>	<b>WP2</b>	<b>Start date or starting event:</b>					<b>Month 1</b>	
<b>Work package title : Publication of a book/Special Journal Issue</b>								
<b>Participant id</b>	1	2	3	4	5			
<b>Person-months per participant:</b>	4	0.5	0.5	4	0.5			

### Objectives

1. The main objective is to disseminate state of the art knowledge on fish reproduction (including their applications in aquaculture) gained from the different FP5 and FP6 European projects to the scientific community and industries.
2. Identification of an appropriate publisher for the book/review edition and signing of provisional contract.
3. Preparation of a first draft of the book/review edition and editing to final format.

### Description of work

#### Task 1. *Publishing contract*

Scientific publishers have already been contacted (Elsevier...) and several more will be contacted (eg. Wiley, Oxford University Press) to establish if they are interested in the proposed book/journal issue and negotiate about the contractual agreement. On agreement of the conditions with the publisher the book plan elaborated in WP1 will be studied with the publisher and edited as appropriate. Details about style, format, and length of chapter will be agreed and an edited book plan sent to all WG members with information about deadlines.

#### Task 2. *Publication plan*

Two month after the working group meeting WG members who will prepare a manuscript for publication (discussed and selected in WP1) will provide a one page plan indicating the organization and contents of the book chapter they are preparing, and a signed agreement that they accept the publishers' conditions. Submitted manuscript plans will be studied by the editors, and modifications requested as necessary to avoid repetitions among the different manuscripts.

#### Task 3. *Editorial work*

Drs. Rüdiger Schulz and Olivier Kah will take responsibility for the group of authors to resolve any problems they have about the book/edition and also to keep them on schedule for the deadlines. Together with the other partners, they will prepare an Introduction in the context of the FP5 and FP6, collaboration of the commission in this process will be requested. First draft manuscripts will be reviewed, edited and returned to authors for alteration, manuscripts will then be compiled and the first draft sent to the publishers. The editors will then finalize the editing process in collaboration with the publishers. Manuscripts falling within the expertise of the different partners will be examined by them, although to facilitate organization the editors responsible for compliance with the work schedule will be partners 1 and 4.

### Deliverables

D4: Publication strategy

D5 : Provisional contract for the book with selected publishers

D6 : Title and outline of content of each book chapter

D7 : Book editing and publication

**Milestones<sup>1</sup> and expected result**

Milestone 2.1: Identification of publisher and conditions agreement (month 6)

Milestone 2.2: publication of the book dealing with fish reproductive physiology, reproductive associated biotechnologies and applications in aquaculture context (month 18)

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<sup>1</sup> Milestones are control points at which decisions are needed; for example concerning which of several technologies will be adopted as the basis for the next phase of the project.

<b>Work package number</b>	<b>WP3</b>		<b>Start date or starting event:</b>			Month 1	
<b>Work package title : Development of a website</b>							
<b>Participant id</b>	1	2	3	4	5		
<b>Person-months per participant:</b>	0.25	0.25	0.25	0.25	6		

### Objectives

1. Development of a website presenting 1) basic knowledge on the reproduction of the main farmed fish, and 2) research projects working in the reproductive field and 3) favourite contacts and exchanges between project partners.
2. Identification of the information that should be exchanged or shared between projects to increase the research potential (Infrastructure available, methodologies, training resources...)

### Description of work

#### **Task 1: *Gathering of information and test drive***

Documenting the requirements for the installation of the internet site will be carried out using a mixture of strategies including information from the public scientific literature, information from already established databases and internet sites and questionnaires to each project. This information will be discussed during the working group meeting (WP1), to finalise the information content on the internet site. The internet site will be implemented in a secure informatics environment at the INRA Institute, Rennes, France.

#### **Task 2: *Information on all projects and scientific area***

The internet site will be fully accessible to the scientific, public and industries communities. The official language will be English. It will include:

- Basic knowledge on fish reproductive physiology
- Research Applications in aquaculture
- Description of the reproductive cycle of the main farmed fish in Europe
- Links with EU Projects and laboratories working on fish reproduction classified according to a research area (i.e. sexual differentiation, gametogenesis, gamete quality, reproductive biotechnologies...)
- Summary of the research carried out in each research project and participating research groups
- Teams involved in the different projects. Names of participants, email address, key words, selected scientific contributions.
- Infrastructure available at each of the participating research groups
- Discussion forum and/FAQ (troubleshooting and techniques)
- Links with Web sites on aquaculture information (FAO....)
- Links with available Web tools for Genomics and Bioinformatics
- Links with biological databases (FISHBASE...) and resources (GADIE, NCCCWA....)
- Press releases for the media and public opinion.
- Links with institutional web pages
- Links with fisheries and industries
- Training offers
- Job openings

The web page will be searchable and updated on a monthly base. In order to accomplish this, each

contribution provided by all participants will include key words.

**Deliverables**

D8: Website opening with summary of the FP5 and FP6 projects and links

D9: Website with available information on reproductive biology of fish

D10: Website with information for the general public

**Milestones<sup>1</sup> and expected result**

M3.1 Web site opening with public access (month 9)

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<sup>1</sup> Milestones are control points at which decisions are needed; for example concerning which of several technologies will be adopted as the basis for the next phase of the project.

<b>Work package number</b>	<b>WP4</b>	<b>Start date or starting event:</b>					Month 3
<b>Work package title : Transfer activities</b>							
<b>Participant id</b>	1	2	3	4	5		
<b>Person-months per participant:</b>	0.5	1	1	0.5	0.5		

### Objectives

1. - The main objective is to transfer knowledge and protocols on controlled reproduction in farmed fish to the industry, based on the scientific results summarized in WP2.

### Description of work

1. Elaborate a specific guide and contact details of research laboratories, identifying specific competence areas of interest for the industry in terms of reproduction in farmed fish to be published on the web site.
2. Elaborate practical, validated and species-specific protocols of the different aspects of the control of reproduction in farmed fish, which will be published as "protocols for control of fish reproduction" on the web site. This would include techniques such as hormonal sex reversal for various species, triploidy protocols, photoperiod protocols, brood stock nutrition and management.
3. Provide a short guide with "frequently asked questions" (FAQ) regarding control of reproduction in farmed fish based on the "protocols for control of fish reproduction" on the web site.
4. To achieve direct interaction with fish farmers, we will arrange work-shops on reproductive control issues for various farmed species such as salmon, trout, sea bass, sea bream and cod targeting farmers in various regions, e.g. in connection with EAS meetings or national or regional fish farming association meetings.

### Deliverables

D11: Guide to the research laboratories describing the competence with contact persons for specific topics

D12: Protocols for control of fish reproduction and FAQ list on the web site

D13: Workshops to be held with fish farmers for salmon, trout, sea bass, sea bream and cod

### Milestones<sup>1</sup> and expected result

M4.1: Protocols for control of fish reproduction and FAQ list on the web site (month 24)

<sup>1</sup> Milestones are control points at which decisions are needed; for example concerning which of several technologies will be adopted as the basis for the next phase of the project.

<b>Work package number :</b>	<b>WP5</b>	<b>Start date or starting event:</b>					Month 9
<b>Work package title : Prospective for future research</b>							
<b>Participant id</b>	1	2	3	4	5		
<b>Person-months per participant:</b>	0.5	1	1	0.25	0.25		

### Objectives

This section aims to give recommendations to the European Commission on important or innovative/original research in the reproductive field that need to be reinforced or supported during the 7<sup>th</sup> FP.

### Description of work

Task 1. Organize a workshop with invited scientists and industry representative to present and discuss state-of-the-art as identified in Wp2, and to discuss bottlenecks, knowledge gaps and potential new solutions for the industry

Task 2. Based on task 1, identify important research themes in the sustainable aquaculture context

Task 3. Organize working group and write a short synthesis of the recommendations to the EU Commission about prospective research topics.

### Deliverables

D14: Arrange workshop with invited scientists and industry representatives (month 18)

D15 Identified research themes on control of reproduction in farmed fish (month 18)

D16: Arrange writing group to produce recommendations to the EU Commission (month 22)

D17: Produce report containing recommendations to the to the EU Commission (month 24)

### Milestones<sup>1</sup> and expected result

M5.1 Identified research themes on control of reproduction in farmed fish (month 18)

M5.2 Send report containing recommendations to the to the EU Commission (month 24)

<sup>1</sup> Milestones are control points at which decisions are needed; for example concerning which of several technologies will be adopted as the basis for the next phase of the project.

<b>Work package number :</b>	<b>WP6</b>	<b>Start date or starting event:</b>						
<b>Work package title: Management</b>								
<b>Participant id</b>	1	2	3	4	5			
<b>Person-months per participant:</b>	2							

**Objectives:** To ensure the overall coordination of the project, distribute responsibilities and budget, implement the work plan, identify potential problems and take action. To act as the link between REPROFISH and the European Commission.

**Description of work**

**Task 1. Coordination of the project**

The coordinator will collate material for preparation of reports, arrange partner meetings and monitor and distribute funds. The coordinator will function as the contact person to the EC administration and thus function as the link between the EC and the project Partners. The coordinator will be supported in this work from the management committee (MC).

The MC will also assist the coordinator in his financial responsibilities, in order to ensure the correct and effective use of funds. The MC will be in contact by e-mail or telephone when needed and will meet three times during the duration (6, 18, 24 months) of the project.

**Task 2. Management committee meetings**

Three meetings, the start up meeting, the progress meeting, and the final meeting will be organized and headed by the coordinator. During these meetings, the management committee will discuss the planning of the project, the interim progress towards the projects objectives as well as the conclusion and final dissemination of the project. Attainment of milestones and deliverables will be assessed and corrective action taken if necessary. The scheduled meetings do not preclude that other meetings might be organized.

**Task 3. Brochure – Project presentation**

A "brochure" of the project will be delivered by the consortium, through the co-ordinator. This 1-2 pages brochure will include general information about the work program, project main goals, key issues expected achievements and exploitation strategy, illustration and list of participants. The brochure will written in a style directed towards the non-specialist and broadly distributed to scientists and industries by email but also during international meetings: 8<sup>th</sup> International Symposium on Reproductive Physiology of the Fish that will be held in 2007 at St Malo, France; and "Aquaculture Europe" in 2008.

**Deliverables**

- D18: Brochure – Project presentation
- D19: Final plan for disseminating knowledge
- DP20: Intermediate report
- D21: Final report

**Milestones<sup>1</sup> and expected results**

Milestone 6.1: Continuous assessment of the progress of the project to be able to perform necessary adjustments in order to fulfil the deliverables

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<sup>1</sup> Milestones are control points at which decisions are needed; for example concerning which of several technologies will be adopted as the basis for the next phase of the project.

## 9. Other issues

The project does not aim to carry out research on humans and thus no gender issues pertain directly to the project objectives. The members of the present project aim to comply with the European policy of equal opportunities between women and men enshrined in the Treaty of Amsterdam and spelled out in the Commission's *Mainstreaming Communication* (CEC, 1996). Nevertheless, measures will be taken to ensure maximal representation of women in the different activities linked to the project. In particular, steps will be taken to favour the participation of women to the different workshops and to the dissemination activities. Whenever possible, female responsibilities will be actively encouraged to create positive female role models for scientists/technologists within aquaculture. The project participants in recognition of the importance of using human resources wisely and fostering equal opportunities will integrate gender equality into all project issues where relevant and ensure women are given equal treatment with men. The integration of participating projects will provide an opportunity to assess the way in which gender issues have been addressed and implemented by the various projects. The impact of measures taken will be specifically assessed and divulged to interested parties and through the website.

## APPENDIX A – Consortium Description

### A.1 Participants and consortium

**Partner 1, University of Rennes 1, Rennes, France:** Dr. Olivier Kah has participated in 4 EU projects in relation with fish reproduction under the FP5 and FP6 frameworks. He will be in charge of the overall coordination of the project, the relationships with the partners and the links with the European Commission. He will be, together with Professor Rüdiger Schulz, particularly implicated in the coordination of the production of book/review papers.

**Partner profile:** Dr. Olivier Kah is currently leading the team of Molecular Endocrinology of Reproduction (EMR) part of the CNRS Unit 6026 (headed by Professor Daniel Boujard) and hosted by the University of Rennes 1. The EMR team comprises about 25 members, including 13 staffs, and has skills in many of the most modern techniques in molecular and cell biology. The laboratory is very well equipped for a large variety of techniques and has a long term experience in steroid receptors and GnRH systems in teleost fishes. In particular, this group was the first to clone fish estrogen receptors, glucocorticoid receptors and melatonin receptors. The EMR team has also received 4 European TMR students and post-docs. The leader of the group has 30 years of experience in the central control of reproduction in fish and has contributed over 130 peer-reviewed papers and given around 30 invited lectures at international symposia. Dr. Kah is a member of the international committees for "Reproductive Physiology of Fish" and "Fish Endocrinology", and is member at large of the "Council of the International Federation of Comparative Endocrine Societies". Recent achievements concern the expression, regulation and functions of P450 aromatase in trout and zebrafish, cloning, expression and regulation of estrogen receptors in trout and zebrafish, cloning and characterisation of GnRH receptors in trout and sea bass (together with partners 3 and 4).

**Partner 2, Institute of Marine Research (IMR), Bergen, Norway:** Drs. Geir Lasse Taranger, Eva Andersson, Christian Mittelholzer and Birgitta Norberg have participated in 4 EU funded projects. Taranger is currently coordinator of the PUBERTIMING (FP5) and WEALTH (FP6) projects, and will be responsible scientist at IMR in the current project. Taranger will be main responsible for cooperation and communication with stakeholders from the salmon and cod farming industry in the current project. Taranger and Norberg are PI's of a range of ongoing Norwegian Research Council projects on sex differentiation, puberty control and brood stock management in salmon, cod and halibut of relevance to the current proposal.

**Partner profile:** Dr. Geir Lasse Taranger is currently Head of the Research Group Physiology of Growth and Reproduction in Fish at IMR. The group consists currently of 7 scientists, 3 post-docs, 2 PhD students, along with two adjunct professors at the University of Utrecht (Rüdiger Schulz) and University of Gotenburgh (Björn Thrandur Björnsson). The group has also close cooperation with University of Bergen. The research group focus on growth physiology and reproduction in farmed fish species such Atlantic salmon, Atlantic cod and Atlantic halibut. The group has activities at the two IMR Aquaculture Research Stations at Austevoll and Matre close to Bergen, as well as in the Molecular Biology Laboratory at IMR Bergen. IMR holds excellent facilities for controlled studies of reproduction in salmon, cod and halibut. The group has long experience (20 years) in experimental studies on reproductive physiology in farmed fish, with focus on environmental and endocrine control of reproduction and links to growth. Moreover, the group has strong links with industry, e.g. on the application of puberty control (e.g. by

photoperiod and diet control) and improved brood-stock management protocols in aquaculture. In more recent years, increased focus has been towards molecular reproductive endocrinology in salmon, cod and halibut, with focus on gonadotropins and gonadotropin receptors. Recent work focuses on expression studies using real-time quantitative PCR on P450 aromatase, gonadotropin subunits, FSHR and LHR in salmon, as well as molecular characterization and development of real-time quantitative PCR assays for P450 aromatase, gonadotropin subunits, as well as FSHR and LHR in cod. These activities are in close cooperation with partner 4. The group is also involved in a cod genome programme at IMR, including large-scale EST sequencing and cod cDNA micro array development, and the application of salmonid cDNA micro arrays, in part in cooperation with partners 4 and 5. Recently, the group has also started work to study sex differentiation and sex reversal in cod and halibut.

**Partner 3, Spanish Council for Scientific Research (CSIC), Spain:** Drs. Silvia Zanuy and Manuel Carrillo have been implicated in ten European projects and have coordinated three of them. They will particularly be in charge of the coordination of activities related to sexual differentiation, sea bass reproduction and transfer to the sea bass industry. They will also contribute book chapters or review papers on the endocrine and environmental control of reproduction in sea bass.

**Partner profile:** Dr. S. Zanuy is currently leading the Department of Fish Physiology and Biotechnology of the Institute of Aquaculture of Torre de la Sal (IATS), which itself belongs to the Spanish Council for Scientific Research (CSIC). She has 30 years experience in fish reproductive physiology and has published 54 papers in refereed journals in the last five years. Dr. M. Carrillo has 30 years experience in endocrine and environmental control of fish reproduction. He has over 140 peer-reviewed papers and given more than 15 invited lectures at international meetings. The above mentioned Department, lead by Dr. Zanuy, has a staff of 22 senior scientists, post-doctoral fellows, Ph.D. students and technicians mostly engaged in the study of fish reproduction. The group has received over 4 European TMR-post docs over the last 3 years. This group is one of the leading teams on the control of reproduction and culture of European sea bass being considered as the reference aquaculture team for the study of sea bass reproduction. In the last ten years efforts have focused in studies on: Environmental and hormonal control sea bass reproduction including mechanisms related to the onset of puberty and sex control and differentiation in this species. The group has ample experience in methods for measurement and visualization of a wide range of hormones and selected neuropeptides. It has, as well, technical expertise, laboratories and facilities to carry out diverse molecular (cloning, mRNA quantification, transfection, recombinant protein production, etc.) and cellular biology studies (use of use of cell lines and primary cell and tissue cultures). In particular, recent achievements of great importance are the purification, cloning and study of the expression and regulation of sea bass gonadotropins and its receptors (FSH and LH and FSHR and LHR), the cloning of estrogen receptors (ERs) and the development of immunoassays to monitor levels of sea bass gonadotropins, diverse forms of GnRH and various sex-steroid hormones.

**Partner 4, University of Utrecht, Utrecht, Netherlands:** Dr. Rüdiger W. Schulz has participated in 3 EU projects dealing with fish reproduction and has coordinated one of them. He will be, together with Dr. Olivier Kah, implicated in the coordination of the production of the book/special issue with review papers.

**Partner profile:** Dr. Rüdiger W. Schulz is currently Associate Professor in the Faculty of Science, Department Biology, Research Unit Endocrinology (headed by Professor D.G. de

Rooij) and is responsible for the subject area "Reproductive Biology of Fish", in which 7 staff are working (2 permanent positions). Moreover, he is adjunct Professor at the Institute for Marine Research in Bergen, Norway, and as such associated with the Research Group for "Growth and Reproduction of Fish", headed by Dr. Geir Lasse Taranger. Dr. Schulz has 23 years of experience in the research area "Reproductive Biology of Fish", has published 79 peer-reviewed papers, and has been invited to give 9 major (key-note or state-of-the-art) lectures at international symposia. Dr. Schulz is a member of the international advisory boards of the congress series "Reproductive Physiology of Fish" and "Fish Endocrinology", has served as peer-reviewer for 14 scientific journals, for 2 national and 4 international organizations providing research funding. Locally, Dr. Schulz is a member of the research advisory committee to the Head of the Department Biology, and the Program Leader of the Master track "Animal Biology". Within the Research Unit Endocrinology, Dr. Schulz collaborates closely with Assistant Professor Dr. Jan Bogerd, responsible for the subject area "Molecular Biology of Hormone Receptors", in which 6 staff are working (2 permanent positions). Dr. Bogerd has 16 years of experience in this research area, has published 68 peer-reviewed papers, and has been invited to give 4 major (key-note or state-of-the-art) lectures at international symposia. Dr. Bogerd has served as peer-reviewer for 11 scientific journals, for 1 national and 1 international organization providing research funding.

The Department Endocrinology has a long-standing experience in a broad range of molecular biological techniques (e.g. cDNA cloning, mRNA quantification, site-directed mutagenesis, transfection and recombinant protein production), cell and tissue culture approaches (production and use of cell lines as well as primary cell and tissue cultures), as well as different morphological (e.g. general histology, immunocytochemistry, in situ hybridization) and physiological (e.g. in vivo experimentation, hormone quantification, steroid hormone biochemistry, protein hormone purification) techniques. Recent achievements on the morphological and physiological level concern studies on Sertoli cell proliferation and its role in determining the quantitative outcome of spermatogenesis, the roles of the pituitary hormones LH and FSH in the regulation of testis functions, and the effects of gonadal sex steroid hormones or hypothalamic GnRH in regulating pubertal maturation in fish. On the molecular level, recent advances concern the cloning, molecular and pharmacological characterisation of GnRH, LHR and FSHR types in a number of fish species, and studies on the structure-function relationship of the human FSHR and LHR as regards the specificity of hormone binding and receptor activation.

**Partner 5, INRA, France:** Dr Jean-Jacques Lareyre has been involved in one European projects of the 6<sup>th</sup> framework. He will be responsible for the web site construction and administration in collaboration with all the other partners. He will also contribute to book chapters or review papers on the endocrine and paracrine control of fish gametogenesis.

**Partner profile:** Dr Jean-Jacques Lareyre belongs to the "Fish Reproduction" research group of the SCRIBE research unit which is part of the INRA institute. The research team involves 20 senior scientists, post-doctoral fellows, PhD students, and technicians working on sex differentiation, puberty and gametogenesis, egg quality and reproductive endocrine disruptors mainly in trout. The laboratory hosts unique fish husbandry facilities (882 m<sup>2</sup> including 142 m<sup>2</sup> tanks) with cool water circulating system. The research unit is also well equipped for molecular and cellular studies. The laboratory hosts several methodological plate-forms including a histological analysis core, a DNA sequence analysis core, and a transcriptome analysis plate-form either for radioactive or fluorescent complex probes. The research team is in the forefront of the national functional genomic project termed AGENAE that includes trout, pig, cattle and chicken.

Dr Lareyre has 15 years experience in molecular endocrinology including 7 years in fish. He has over 30 peer-reviewed papers and 3 book chapters. His work aims to identify and characterize molecular mechanisms involved in the control of farmed fish puberty. During the last five years, his work has mainly focussed on the functional characterization, cellular localization and regulation of trout and sea bass GnRH-R genes (together with partners 1 and 3) and on the trout gonadotropins receptors (FSHR and LHR). His work also aimed to the identification of paracrine factors involved in spermatogenesis onset using functional genomics approaches in collaboration with Dr. Florence Le Gac (SCRIBE, INRA) and Partners 2 and 4.

## **A.2 Sub-contracting**

Not relevant. There is no sub-contracting in the Reprofish project

## **A.3 Third Parties**

### **Special Clause 23**

"Université de Rennes 1 (UR1) is partner 1 in the REPROFISH project and represents CNRS (Centre National de la Recherche Scientifique). "Interactions Cellulaires et Moléculaires", JRU 6026, is a Joint Research Unit (Unité Mixte de Recherche) between Université de Rennes 1 and CNRS. A four year contract has been signed between UR1 and CNRS, called "contrat quadriennal", and defines the resources (human, financial, infrastructures) which are provided by the parties, at their discretion for use by the laboratory for its research activities in general. Human resources will be involved in the project."

## **A.4 Funding of third country participants**

Not relevant.