

# HCERES

High Council for the Evaluation of Research  
and Higher Education

Research units

HCERES report on research unit:

Laboratoire de Physiologie et Génomique des Poissons

LPGP

Under the supervision of  
the following institutions  
and research bodies:

Institut National de la Recherche Agronomique - INRA

Evaluation Campaign 2015-2016 (Group B)

# HCERES

High Council for the Evaluation of Research  
and Higher Education

Research units

*In the name of HCERES,<sup>1</sup>*

Michel COSNARD, president

*In the name of the experts committee,<sup>2</sup>*

Luisa VALENTE, chairwoman of the committee

---

Under the decree No.2014-1365 dated 14 november 2014,

<sup>1</sup> The president of HCERES "countersigns the evaluation reports set up by the experts committees and signed by their chairman." (Article 8, paragraph 5)

<sup>2</sup> The evaluation reports "are signed by the chairman of the expert committee". (Article 11, paragraph 2)

## Evaluation report

This report is the sole result of evaluation by the expert committee, the composition of which is specified below.

The assessments contained herein are the expression of an independent and collegial reviewing by the committee.

Unit name: Laboratoire de Physiologie et Génomique des Poissons

Unit acronym: LPGP

Label requested: UPR INRA

Current number: 1037

Name of Director  
(2015-2016): Mr Patrick PRUNET

Name of Project Leader  
(2017-2021): Mr Julien BOBE

## Expert committee members

Chair: Ms Luisa VALENTE, University of Porto, Portugal

Experts:

Ms Marie-Pierre MOISAN, INRA Bordeaux

Mr Eric SAILLANT, The University of Southern Mississippi, USA

Mr Olivier SANDRA, INRA Jouy-en-Josas (representative of the CSS INRA)

Scientific delegate representing the HCERES:  
Mr Gabriele SORCI

Representative of supervising institutions and bodies:  
Mr Thierry BOUJARD, INRA PHASE

Head of Doctoral School:  
Mr Xavier LE GOFF, Doctoral School n° 92 "Vie - Agro - Santé"

## 1 • Introduction

### History and geographical location of the unit

The research unit LPGP (Laboratoire de Physiologie et de Génomique des Poissons) is an INRA research group located in the university campus of Beaulieu in the University of Rennes 1. This unit has a formal relationship with the university, integrating the research federal structure in Biology, Health and Technologic Innovation of Rennes (BIOSIT).

During the previous contract (2008-2011), this unit was restructured. The “Physiologie de l’adaptation et du stress” group integrated 2 new scientists whereas the group “Sexualité et reproduction des poissons” was divided into 3 new teams: “Physiologie testiculaire et puberté”, “Différenciation sexuelle et ovogenèse”, “Cryopréservation et régénération des poissons”. Several services are common facilities: secretariat, documentation/communication, histology, genomic, the TEFOR platform, dishwashing, informatics and experimental installations. The LPGP unit also relies on two other experimental units: INRA/PEIMA in Sizun (Finistère) and INRA-U3E in Rennes for the supply of certain model fish species.

### Management team

The unit director has been Mr Patrick PRUNET until January 2016. The current director is Mr Julien BOBE.

### HCERES nomenclature

Main: SVE Sciences du vivant et environnement

Secondary: SVE1\_LS4 Physiologie, physiopathologie, biologie systémique médicale

SVE2\_LS9: Biotechnologies, sciences environnementales, biologie synthétique, agronomie

SVE1\_LS2: Génétique, génomique, bioinformatique

### Scientific domains

The scientific objective of the LPGP unit clearly subscribes the main research lines identified in the INRA department PHASE directive scheme: the resources, the animal and the production systems. The unit addresses in particular the animal research line, by focusing on the improvement of the reproductive success, production of more robust and better adapted animals, farmed species diversification, prediction of product quality from different production systems.

## Unit workforce

| Unit workforce  | Number on 30/06/2015 | Number on 01/01/2017 |
|---|----------------------|----------------------|
| N1: Permanent professors and similar positions  |                      |                      |
| N2: Permanent researchers from Institutions and similar positions   | 17                   | 16                   |
| N3: Other permanent staff (technicians and administrative personnel)  | 29                   | 29                   |
| N4: Other professors (Emeritus Professor, on-contract Professor, etc.)                                      |                      |                      |
| N5: Other researchers from Institutions (Emeritus Research Director, Postdoctoral students, visitors, etc.) | 4                    |                      |
| N6: Other contractual staff (technicians and administrative personnel)                                      | 2                    |                      |
| N7: PhD students  | 6                    |                      |
| <b>TOTAL N1 to N7</b>   | <b>58</b>            |                      |
| Qualified research supervisors (HDR) or similar positions   | 10                   |                      |

| Unit record   | From 01/01/2010 to 30/06/2015 |
|---|-------------------------------|
| PhD theses defended   | 17                            |
| Postdoctoral scientists having spent at least 12 months in the unit           | 6                             |
| Number of Research Supervisor Qualifications (HDR) obtained during the period | 1                             |

## 2 • Overall assessment of the unit

## Introduction

In the last 4 years (2012-2015) the main research area of LPGP unit was fish physiology, with innovative developments to the problems raised by the fish farming industry. During the previous contract (2008-2011), this unit was restructured. The “Biologie de l’adaptation et du stress” group integrated 2 new scientists whereas the group “Sexualité et reproduction des poissons” was divided into 3 new teams: “Physiologie testiculaire et puberté”, “Différenciation sexuelle et ovogenèse”, “Cryopréservation et régénération des poissons”.

The unit focuses on improving the fish reproductive success, on the production of more robust and better-adapted fish, on farmed species diversification and on prediction of product quality in different production systems. This is achieved by combining both fundamental and applied research.

The LPGP unit will go through a new restructuration in the near future, as one of the groups “Biologie de l’adaptation et du stress” will be discontinued in the next research programme, but the topic will be maintained by the remaining groups, due to its transversal importance.

### Global assessment of the unit

The LPGP is a very strong research unit with an established international reputation in the field of fish physiology and genomics, and which is in good conditions to provide innovative answers to the problems raised by, and the needs of, the fish farming industry: improvement of the reproductive success, production of more robust and better adapted animals, farmed species diversification and prediction of product quality from different production systems.

The existence of a cryopreservation platform has a social-economic importance for the public and private sectors. The unit LPGP has already established strong collaborative actions with industrial partners that translated into relevant effects on the sector.

The previous evaluation report suggested the integration of an eco-toxicology approach in the research project, as well as the establishment of new relationships with other regional groups without losing the focus on the main research areas of LPGP. The unit has clearly made important efforts in the last few years to participate in collective structures at the regional and national level. The emergence of an important transversal axis related to miRNome, highlighted in the previous report, is included in the new research project of some groups and will provide new valuable information and open new opportunities in terms of cellular modulation by environmental factors.

The unit has improved its publication record: from 1.4 (2006-2010) to 1.7 papers per full time researcher per year (2010-2015). This effort should be continued in order to increase the unit visibility, both at the national and international levels.

### Strengths and opportunities in the context

There are internationally renowned researchers within the unit. The unit relies on cutting-edge methods and experimental facilities that should push further the understanding of the mechanisms determining and regulating fish physiological functions. This international scientific recognition is reflected by the number of publications in high profile journals, the participation to international meetings and collaborative projects.

All groups are very strong and successful in terms of applications for funding, both at the national and international levels.

The unit has established positive collaborations with industrial partners translating into relevant effects on the sector. Several tools and methods developed by this unit were already transferred to the aquaculture economic sector: a) a non-lethal method to predict yields was used by SYSAAF to integrate morphological characteristics into their breeding programmes; b) molecular tools to determine sex precociously are being used by the salmon industry for genetic selection; c) the establishment of a centralised cryobank for aquaculture (CryoAqua) with SYSAAF for sperm cryopreservation is already used by more than 9 public and private entities. Moreover, the progress in understanding the impact of the RAS system on fish performance, fish reproduction, quality and well-being stimulated several other projects in Brittany (Aquadis) and in the south-western part of France (les Landes, Aqualande); whereas the collaboration with NUMEA and PEIMA on trout feeds emphasises the importance of breeding programmes towards the improvement of fish capacity to use plant-based sources.

Applied research driven by the needs of the aquaculture sector also translated into major biotechnological achievements by the unit. A commercial company is considering transferring into the market a new freezing dilution product from CryoAqua. Also a new vaccine is being tested in collaboration with Pfizer.

### Weaknesses and threats in the context

The "Biologie de l'adaptation et du stress" team will not be part of the next project. The thematic focus of this group is quite transversal, and will be maintained by all remaining groups. However, this will be a great challenge for the unit due to the weak links between the different groups in the last years. This might also reduce the unit visibility in such an important research field as fish adaptation to changing environmental conditions. Some expertise and funding opportunities will be lost due to the departure of two key researchers on this topic.

The scientific project will also be weakened by the retirement of several key researchers.

Only 10% of the unit time-budget activity is devoted to interactions with economic partners.

There have been weak interactions among research teams within the unit. Not being able to bypass this threat might compromise the new project.

The connection between basic and applied research lines is not always very clear.

### Recommendations

A stronger internal collaboration between groups is desirable. The committee supports the development of a strategic axis on the concept of “robustness”, as proposed by the unit. The importance of environmental factors on fish biology and adaptation to changing conditions can be addressed collaboratively by all groups in the context of this axis.

A more active collaboration with socio-economic partners might increase funding opportunities as well as technologic transfer of results, with an increased economic impact at the regional and national levels. The unit should increase its effort to apply for collaborative grants in partnership with private companies (major stakeholders in aquaculture).

The unit should better integrate basic and applied research in order to further address societal demands.

As some senior scientists will leave the unit, younger researchers should be encouraged to get an HDR in order to maintain the unit capacity to supervise PhD students. An increased partnership with industry could also create new funding opportunities for students.

### 3 • Detailed assessments

#### Assessment of scientific quality and outputs

The LPGP is a strong research unit particularly focused on fish physiology and genomics that is in good conditions to provide innovative answers to the problems raised by, and to the needs of, the fish farming industry: improvement of the reproductive success, production of more robust and better adapted animals, farmed species diversification and prediction of product quality from different production systems. The existence of a cryopreservation platform has a social-economic importance for the public and private sectors.

In terms of scientific output, the main achievements of the unit over the past 5 years have been:

- 1) identification of the main sex determining gene in salmonids (Yano et al. 2012 Current Biology; highly cited in the Web of Science). These results already translated into new selection programmes by the salmonid industry in Norway and Canada;
- 2) sequencing of the rainbow trout genome (Berthelot et al. 2014 Nature Communications, 39 WOS citations);
- 3) discovery of strains of germinal cells that can enable species regeneration. New projects to protect endangered or rare fish species are envisaged;
- 4) description, for the first time in fish, of conjunctive tissue early differentiation and origin, which opens new questions concerning the migration of myoseptal cells to muscle conjunctive tissue.

The LPGP unit published 592 articles from January 2010 to July 2015, 163 being published in peer reviewed journals and 143 in WOS indexed journals. The publication record has increased: from 1.4 papers/year (2006-2010) to 1.7 papers/ full time researcher/year (2010-2015). 60% of the indexed publications were authored by members of the unit either as first or last author, and 35% of the publications included international collaborators. Manuscripts were published in 75 different indexed journals. From these, 6.1% had exceptional impact, whereas 42% had either exceptional or excellent impact (based on the INRA NORIA tool). The publications were cited by researchers from 82 countries. 8.39% of the manuscripts are included in the 10% mostly cited articles (all fields ESI/year) whereas 4.9% are included in the 1% most cited ones.

#### Short appreciation on this criterion

The LPGP is a strong research unit that focuses on innovative topics related to fish biology and genomics. The scientific production and outputs of the unit are good with some outstanding contributions.

#### Assessment of the unit academic reputation and appeal

The LPGP participated to 2 EU research projects as partners: LIFECYCLE and FISHBOOST. Five national ANR projects were coordinated by LPGP members. Most of these projects involved just one team. Several groups also participated to 5 other ANR projects. LPGP members were coordinators/participants in several EU COST actions: AQUAGAMETE, EPICONCEPT and FAIM. They also participated to national networks, being responsible of ATOL-INRA (Animal trait Ontology). LPGP members were partners of 3 AQUAEXEL EU infrastructure projects, involving 3 groups of the unit. The new rearing facilities are now a reference infrastructure mentioned by several other research centres in Brittany and in France.

This unit hosted 8 post-docs in the last period, among whom 6 were from abroad (USA, Denmark, India, Thailand, Canada, Turkey). An internationally renowned scientist was recruited as CR1 in 2013. The Brittany Region financed 10 fellowships for PhD students who were supervised by LPGP members. The region also financed a post-doc researcher who was involved in the organization of scientific meetings in the region.

The unit members contributed to several top quality international journals as editors: Cybium, General and Comparative Endocrinology, Fish Physiology and Biochemistry, PLoS One and Sexual Development.

Members of the LPGP were invited to 7 international (Conference of European Comparative Endocrinologists, International Congress on the Biology of Fish, International Congress of Comparative Endocrinology, International Symposium on Fish Endocrinology, Annual Meeting of the European Federation of Animal Science, International Plant and Animal Genome Conference, International Conference on Integrative Salmonid Biology) and 10 national (e.g., Congrès de l'Association Française d'Histotechnologie, Journées de la Recherche Filière Piscicole, Journées Sciences du



Muscle et Technologies des Viandes) meetings as invited speakers. One of these communications was given during a joint session of the “Académie d’Agriculture et Académie des Sciences”.

Ten researchers of the unit participated in the organisation of 4 international (e.g. International Symposium on Reproductive Biology of Fish) and 4 national meetings (Journées Sciences du Muscle et Technologies des Viandes).

All researchers of the unit are referees of several journals of high impact. In total they refereed articles for about 60 different journals related to fish biology (Fish Physiology and Biochemistry, Journal of Fish Biology, Aquaculture...), animal physiology (American Journal of Physiology, Endocrinology, Journal of Experimental Biology...), Reproduction and development (Biology of Reproduction, Sexual Development, Developmental Dynamics, BMC Developmental Biology ...), genomic and biotechnology (BMC Genomics, Transgenic Research, Marine Biotechnology, Cryobiology...) or larger scope journals (Plos One, INRA Production Animales, Medecine/Science...).

#### Short appreciation on this criterion

The academic reputation of the unit is excellent.

### Assessment of the unit interaction with the social, economic and cultural environment

The LPGP unit has established collaborations with industrial partners which translated into relevant effects on the economic sector: a) a non-lethal method to predict yield was used by SYSAAF to integrate morphological characteristics into their genetic improvement programmes; b) molecular tools to determine sex precociously are used by the salmon industry for genetic selection; c) a commercial company is considering transferring into the market a new freezing dilution product from CryoAqua that avoids animal proteins during cryopreservation, thus increasing the process safety. Also a new vaccination anti-GnRH is tested in collaboration with Pfizer, in order to inhibit sexual maturation.

The progress in understanding the impact of RAS system on fish performance, fish reproduction, quality and well-being stimulated several other projects in Brittany (Aquadis) and in Les Landes (Aqualande); whereas the collaboration with NUMEA and PEIMA on the use of vegetable sources for trout feeds evidenced the importance of a genetic selection programme to improve the capacity of fish to use vegetable sources.

A new and more appealing webpage was created (<https://www6.rennes.inra.fr/lpgp>).

The unit participated to several local and regional events like workshops, science fairs (Festival des sciences de Rennes, Matinales de la technopole de Rennes Atalante).

Several groups adopted different strategies to disseminate their results and establish collaborative links with industrial partners, and an industrial project (EcoSaumon) that also helped the unit to become involved in several EU consortia with various industrial partners.

The unit hosted 4 engineers from SYSAAF, which strengthened the links between institutions. The unit members have joint articles with non-academic researchers and are partners in some projects with industry. The social economic partners are major stakeholders at the local and national levels (e.g. SYSAAF) The unit established links with major stakeholders and participated in several working groups related to the aquaculture sector (e.g. GIS “Piscicultures Demain”). At the European level, the unit also participates to the annual meeting of the EATiP (European Aquaculture Technology and Innovation Platform). European partnerships helped the participation to new EU consortia like Aquaexel and BlueFood (under evaluation).

The unit stated implementing ISO 9001 rules and envisaging setting up processes to support the liability and traceability of scientific results. Members of the unit received special training to implement that system. Also, an auto evaluation is carried each year using a standardized procedure that helps following the major progresses of the unit.

#### Short appreciation on this criterion

The unit has a good interaction with the economic world.

### Assessment of the unit organisation and life

The unit is organized in 5 research groups: “Différenciation sexuelle et ovogenèse”, “Physiologie testiculaire et puberté”, “Biologie de l’adaptation et du stress”, “Croissance et qualité de la chair des poissons”, “Cryopréservation et régénération des poissons” and 8 common services, supporting all groups. The scientific objectives of each team are relevant to the aquaculture sector and to the European societal challenges.

The scientific animation is organised by the director and involves 4 main actions: a) unit weekly meeting for the presentation of new results, theses, projects, research topics and/or scientific methods to everyone in the unit; b) meeting of young researchers (trainees, PhD students, other students) to improve their critical thinking and favour their social integration; and c) transversal actions covering scientific topics complementary to those developed by each team and involving conferences and brainstorming open to external members.

The unit direction coordinates the answers to EU calls for proposals in order to foster a better integration within EU projects. The unit director together with the deputy director and 4 scientific animators constitute the CODIR that is involved in the unit decision-making process and in the general orientation of the unit. The CODIR is supported by 1) a scientific board including researchers and engineers; 2) a service board that meets every 2 months to discuss lab planning/running, equipment and budget utilization. Each technical platform has a scientific board of users (CSU) that meets at least once a year to present their activity report. A new website has also been generated with updated news.

Several unit members have already retired and some others will soon do. A new organisation, involving the disappearance of one group, will be implemented by the new direction board in the forth-coming project.

#### Short appreciation on this criterion

The previous unit organisation and overall life was very good. During the period the unit went through an external consulting to reorganise the internal management from 2015 onwards.

### Assessment of the unit involvement in training through research

The unit belongs to the Doctoral School 92 “Vie Agro Santé (VAS)” of the University of Rennes 1, Agrocampus Ouest. The vice-president of this school is a member of the unit.

The unit has hosted 24 PhD students, 18 of them having defended their thesis during the period under evaluation.

In addition to the PhD students, the unit has hosted more than 70 students at the BTS/DUT (13), licence 3 (4), master 1 (7) and master 2 (21) levels.

Unit members participated to 32 PhD committees, 8 of which abroad, and to 7 HDR committees.

The involvement of unit members in training programmes consisted in delivering 60-100 hours of teaching in several modules mainly at Rennes University. No member seems to be involved in the coordination of master training programmes. Members of the unit have been involved in the “Training School Aquagamete: molecular basis of fish gamete quality” with courses taught in Rennes (France), Stirling (Scotland), Faro (Portugal) et Cadiz (Spain). A member of the unit has been involved in the organization of the Summer School “Adaptive animal and livestock farming systems in a globally changing context”. Unit members have also been solicited to teach at Montevideo University (Uruguay) and Ancona University (Italy).

#### Short appreciation on this criterion

The training through research of the unit is very good.

### Assessment of the strategy and the five-year plan

The proposed project is in the line of the previous one, but all groups tried to consider the impact of several environmental factors on fish biology, as there will be no specific group dedicated to these issues. Applied research and straight collaboration with socio-economic partners is also proposed, but the duration of the project and the time estimated to produce reliable results might endanger the establishment of long-term relationships with industrial partners who generally wish a short-term answer to their major needs. This is often incompatible with good science.

The objectives are consistent with the expertise of each group and the facilities/infrastructures available to achieve them. The new project is clearly multidisciplinary, and aims at establishing new synergies between groups to strengthen the unit capacity to integrate international consortia and produce top science. The fish response to changing environmental conditions will be the focus of several groups, in order to understand and then select the best rearing conditions able to promote the desirable phenotypic traits.

The link between basic and applied science is promoted by the use of distinct approaches to a very same problem: starting from cell lines, moving to model species and demonstrating the final concept/pathway in farmed fish of economic importance. The project considers a strong participation of socio-economic partners, which will promote applied research and effective technological transfer of the main results/achievements.

The SWOT analysis is realistic and clearly identifies the main forces, weaknesses, opportunities and threatens that the Unit will face.

Short appreciation on this criterion

The overall project is very good. Although very ambitious, it is feasible within the proposed time-window.

## 4 • Team-by-team analysis

**Team 1:** Biologie de l'adaptation et du stress chez les poissons

**Name of team leader:** Mr Patrick PRUNET

### Team scientific domains

The team works in the field of fish physiology related to robustness and combines behavioural, biochemical and molecular approaches.

### Workforce

| Team workforce  | Number on<br>30/06/2015 | Number on<br>01/01/2017 |
|---|-------------------------|-------------------------|
| N1: Permanent professors and similar positions  |                         |                         |
| N2: Permanent researchers from Institutions and similar positions                           | 3                       |                         |
| N3: Other permanent staff (technicians and administrative personnel)                        | 2                       |                         |
| N4: Other professors (Emeritus Professor, on-contract Professor, etc.)                      |                         |                         |
| N5: Other researchers (Emeritus Research Director, Postdoctoral scientists, visitors, etc.) | 1                       |                         |
| N6: Other contractual staff (technicians and administrative personnel)                      |                         |                         |
| N7: PhD students  |                         |                         |
| TOTAL N1 to N7  | 6                       |                         |
| Qualified research supervisors (HDR) or similar positions                                   | 1                       |                         |

| Team record   | From<br>01/01/2010 to<br>30/06/2015 |
|---|-------------------------------------|
| PhD theses defended   | 3                                   |
| Postdoctoral scientists having spent at least 12 months in the unit           | 2                                   |
| Number of Research Supervisor Qualifications (HDR) obtained during the period |                                     |

## • Detailed assessments

The team being shut down, there is no assessment of the project.

### Assessment of scientific quality and outputs

The scientific questions tackled by the team (gill plasticity, robustness and fish well-being in farming conditions) are very original and important for the fish industry. This team is the only one in France working on these questions. The team has published 28 peer-reviewed articles in the period 2010-2015 for 3 full time scientists (1.9 publications per full time researcher per year), with a good balance between academic journals and journals targeted for fish industry, as well as 6 book chapters. Team members have been leaders (first or last authors) of 13 of these articles. Two articles have been published across teams. Good to very good articles were published from each of the declared objectives of the team. This includes papers published in American Journal of Physiology, BMC Genomics, BMC Genetics, General and Comparative Endocrinology, with team members being in the leading position for the latter article.

#### Short appreciation on this criterion

The team is recognised at the national and international level for its original work on fish robustness in fluctuating farming conditions. Overall, the team has very good scientific quality and outputs.

### Assessment of the team academic reputation and appeal

The team has led 2 work packages of the European projects Lifecycle and AquaExcel, and team members are involved in the steering committees of these projects. The team has also participated to two ANR funded programmes. A team member was co-responsible of the project Thermotac (metaprogramme ACCAF). A team member was in the steering committee and responsible of a zebrafish imagery platform in TEFOR project (Investissement d'avenir). A team member is co-leader of a Workpackage in the project WHELP (metaprogramme GISA). The team contributed to a FUI as well as to a project funded by Norway.

The team has organised two sessions in international congresses (Aquaculture Europe 2014, Conference of the European Comparative Endocrinologists).

Members of the team were invited to international and national congresses: International congress on the biology of fish (2010 and 2014), International symposium on fish endocrinology (2013), Congrès de l'association française d'histotechnologie (2013), Conference of the European Comparative Endocrinologists (2014) where they also organized a symposium.

A team member is in the editorial board of PLoS ONE and of General and Comparative Endocrinology.

The team has hosted two post-docs.

#### Short appreciation on this criterion

The team has secured a remarkable amount of grants, both international and national, and was invited to congresses and meetings, reflecting its recognised position. Thus, the team has an excellent academic reputation and appeal.

### Assessment of the team interaction with the social, economic and cultural environment

The team has developed a bioinformatics tool "Fish and Chip" devoted to the analysis of transcriptomic data of fish.

The team has also developed another tool (within the Image J software) to analyse fish activity. This has produced a paper (Sadoul et al., 2014. Aquaculture).

The team has contributed to the GIS "Pisciculture demain" (executive committee) and to the "Matinale de Rennes Atalante sur l'aquaculture".

They also published an article in "Science Ouest" (n° 331, may 2015).

Short appreciation on this criterion

An effort toward the socio-cultural world was done by the team. The interaction with the social, economic and cultural environment is good.

Assessment of the team involvement in training through research

The team organised a course on 'Contribution of genomic approaches to the development of a sustainable aquaculture for temperate and Mediterranean fish'.

Three PhD theses were defended over the period 2010-2015, and 13 master trainees supervised during the same period. Six papers have been published by the PhD students (4 as first authors) in General and Comparative Endocrinology, Aquaculture (2), Developmental Dynamics, Physiology and Behavior, Behaviour.

Team members teach in two master 2 of the Université de Rennes 1.

Short appreciation on this criterion

The team has made a real effort towards training students and involvement in teaching. The involvement in training is very good.

**Team 2:** Croissance et qualité de la chair des poissons

**Name of team leader:** Mr Jean-Charles GABILLARD

### Team scientific domains

The team focuses on the study of the biological mechanisms involved in muscle tissue growth, and the main genetic, nutritional and environmental factors involved in fillet yield and product texture.

### Workforce

| Team workforce  | Number on 30/06/2015 | Number on 01/01/2017 |
|---|----------------------|----------------------|
| N1: Permanent professors and similar positions  |                      |                      |
| N2: Permanent researchers from Institutions and similar positions                           | 5                    | 4                    |
| N3: Other permanent staff (technicians and administrative personnel)                        | 3                    | 3                    |
| N4: Other professors (Emeritus Professor, on-contract Professor, etc.)                      |                      |                      |
| N5: Other researchers (Emeritus Research Director, Postdoctoral scientists, visitors, etc.) |                      |                      |
| N6: Other contractual staff (technicians and administrative personnel)                      |                      |                      |
| N7: PhD students  | 1                    |                      |
| TOTAL N1 to N7  | 9                    |                      |
| Qualified research supervisors (HDR) or similar positions                                   | 3                    |                      |

| Team record   | From 01/01/2010 to 30/06/2015 |
|---|-------------------------------|
| PhD theses defended   | 1                             |
| Postdoctoral scientists having spent at least 12 months in the unit           |                               |
| Number of Research Supervisor Qualifications (HDR) obtained during the period | 1                             |

## • Detailed assessments

### Assessment of scientific quality and outputs

This group has focused on two main research topics with great impact and relevance for aquaculture: 1) understanding the biological mechanisms involved in muscle tissue growth; 2) identifying and determining the main genetic, nutritional and environmental factors involved in fillet yield and product texture.

This team provided new insights into the control of myogenesis in rainbow trout using transgenic fish. Several transcription regulators have been related to myogenesis for the first time in fish. The role of myostatin was evidenced in several publications in collaboration with other INRA groups (UMR NuMea, St Pée sur Nivelle). Also the differentiation and development of conjunctive tissue was described and related to muscle structure and functional characteristics.

Non-invasive image analyses were developed to predict and optimise the selection of the most adequate fish (in terms of yield and muscle adipose tissue growth), and applied for the genetic improvement of carcass quality. This achievement has practical importance for both fish farmers and meat processing industrial partners. This method was also applied for the analysis of sea bream life cycle and yield in relation to the production system. The group has also focused on the identification of genetic markers for textural properties, in particularly those involved in the extracellular matrix. A non-lethal method to predict yield was used by SYSAF to integrate morphologic characteristics into the genetic improvement programmes. Also IRM techniques applied to the identification of the adipose tissue were shown to be usable in a multi trait selection process. Dietary sources were shown to impact flesh quality and genetic selection toward a better capacity of using such sources was proposed. This group has shown an excellent capacity to translate results into the market by working closed with the aquaculture sector.

This group is heterogeneous in terms of research impact metrics having published 41 scientific articles in indexed journals (WOS) during this period (2010-2015), resulting in an average of 1.6 papers per full time researcher per year. Team members have been leaders (first or last authors) in 26 of them. Many of these articles were published in high impact journals [>3; e.g. Autophagy; Cellular and Molecular Life Sciences; PLoS One, BMC genomics (leader position), Cell and Tissue Research; Food Chemistry; Experimental Cell Research; Molecular and Cellular Endocrinology; American Journal of Physiology (leader position); British Journal of Nutrition), resulting in an important number of citations by the international community and demonstrating a high international recognition of the importance of the team results. But many articles were published in low impact journals (<1 e.g. INRA Productions Animales; Journal of Muscle Foods). Most publications just involve members of the group and rarely other members of the unit (only 3 articles are cross teams), and thus the committee strongly recommends an increased collaboration with other research centres, both in France and abroad.

#### Short appreciation on this criterion

Overall, the team has good scientific quality and outputs.

### Assessment of the team academic reputation and appeal

The group has participated to 3 EU research projects as partners: Lifecycle, Fish boost and Aquaexcel. Team members were leaders of two ANR programmes and have participated to a third one. Team members were also involved in two international networks (ATOL and COST FAIM). The team was involved in research programmes at the national level (FranceAgrimer, VegeAqua, ACI PHASE). The team hosted 2 post-docs, and one of the PhD students comes from Brazil. Members of the group were invited speakers to international meetings (Congress of Fish Biology, The Company of Biology workshops, COB workshop, ICCE 2013). The participation in international meetings was also very significant, with several oral communications (19) and posters (10).

Members of the team organised the “Journées des Sciences du Muscle et Technologie de la Viande” in 2012 and 2014.

Team members were involved in the evaluation of proposals from the “Association Française contre les Myopathies” (AFM), and of one proposal from the “United States-Israel Binational Science Foundation”.

#### Short appreciation on this criterion

The team was involved in a high number of EU projects and members were invited to participate in several international meetings. The academic reputation of the team is very good.

### Assessment of the team interaction with the social, economic and cultural environment

The team established collaborations with industrial partners of the aquaculture sector, the results of which were translated into relevant practical applications. A non-lethal method was developed to predict the yield and is already used by SYSAF to integrate morphologic characteristics into their genetic improvement programmes. Joint productions with non-academic partners were obtained, but there is no reference to any patent.



The team participated to different actions with economic partners: Journées Recherche Filière Piscicole, journée technique du SYSAAF, journées annuelles de la PEIMA. The team also participated to the Festival des Sciences and the “Salon International de l'Agriculture” (2014).

#### Short appreciation on this criterion

This group established very positive collaborations with industrial partners of the aquaculture sector the results of which were translated into relevant practical applications. The interactions with the social; economic and cultural environment are very good.

### Assessment of the team involvement in training through research

Three PhD students were supervised by members of the group (one PhD defended) but the record of resulting publications seems low (4 articles in General and Comparative Endocrinology, Plos One, Comparative Biochemistry and Physiology B, Biochemical and Biophysical Research Communications). A participation of the team in national and international training programmes, including teaching is not mentioned.

#### Short appreciation on this criterion

During this evaluation period the group attracted a small number of students (only 3) and did not seem very active in terms of participating to national and international training programmes that could help attracting a higher number of PhD students. The involvement in training through research is fair.

### Assessment of the strategy and the five-year plan

The proposed project is coherent and in line with the previous one, but moving a step forward. It seems to consider a better integration of the research topics within the group that can be consolidated by a common research theme. The subject shows interdisciplinarity focusing on the identification of the main biological mechanisms that determine muscle growth and flesh texture, using model species and cell cultures that will be further validated in farmed species in order to help tailoring fish growth and flesh quality properties. The group will address the issue of fish adaptation to environmental factors, by identifying the effect of temperature on muscle growth and on flesh quality (BlueFood project). A collaboration with professional partners, like SYSAAF, is foreseen.

The five-year plan is interesting and seems feasible. It will certainly provide new insights into the regulatory mechanisms of muscle differentiation in fish. The pathways controlling conjunctive and adipose tissues will also be deciphered. However, the identification of texture determinants should rely more strongly on the relation between molecular, genetic and phenotypic traits. This objective would gain from a tighter collaboration with other group members.

#### Short appreciation on this criterion

The proposed project is very good and coherent, shows interdisciplinarity and feasibility.

### Conclusion

#### ▪ Strengths and opportunities:

The team has a strong scientific background and international visibility.

The group established several collaborations with other INRA units, which can produce a multidisciplinary approach and also increase the applicability of results in the aquaculture sector. The group has well-established collaborations with professionals like SYSAAF that can promote technological transfer of results into the sector.

The group seems to have a good capacity of obtaining external project-based funding sources (>80K€ in 2013-2014), including from EU. The participation to EU projects increases their chance to start new collaborations with international partners.

The senior researchers were invited to participate in several international meetings.

- **Weaknesses and threats:**

The number of PhD students (3) and post-docs in the group is low in relation to the total number of scientists. The number of publications of these students also seems low.

- **Recommendations:**

A stronger collaboration with the university is suggested in order to attract more students, which would increase the publication record of the group. The cutting-edge fundamental research carried out by this group, in order to understand the basis of muscle differentiation and growth, should also be applied to identify the major determinants of flesh texture in order to promote a socioeconomic translation of such results into the market. The participation to international meetings involving industrial partners is also desirable and might promote the participation to new and more applied projects within the aquaculture sector and the publication of results in larger scope journals of high impact.

**Team 3:** Différenciation sexuelle et ovogenèse

**Leader** Mr Julien BOBE

### Team scientific domains

The team focuses on the study of the mechanisms underlying gonad differentiation and ovogenesis.

### Workforce

| Team workforce  | Number on 30/06/2015 | Number on 01/01/2017 |
|---|----------------------|----------------------|
| N1: Permanent professors and similar positions  |                      |                      |
| N2: Permanent researchers from Institutions and similar positions                           | 5                    |                      |
| N3: Other permanent staff (technicians and administrative personnel)                        | 4                    |                      |
| N4: Other professors (Emeritus Professor, on-contract Professor, etc.)                      |                      |                      |
| N5: Other researchers (Emeritus Research Director, Postdoctoral scientists, visitors, etc.) | 3                    |                      |
| N6: Other contractual staff (technicians and administrative personnel)                      | 1                    |                      |
| N7: PhD students  | 4                    |                      |
| <b>TOTAL N1 to N7</b>   | <b>17</b>            |                      |
| Qualified research supervisors (HDR) or similar positions                                   | 2                    |                      |

| Team record   | From 01/01/2010 to 30/06/2015 |
|---|-------------------------------|
| PhD theses defended   | 7                             |
| Postdoctoral scientists having spent at least 12 months in the unit           | 4                             |
| Number of Research Supervisor Qualifications (HDR) obtained during the period |                               |

### • Detailed assessment

The team being shut down, there is no assessment of the project.

### Assessment of scientific quality and outputs

The team is endowed with a recognized and solid expertise in the molecular and cellular mechanisms driving gonad differentiation and in the acquisition of competence for oocyte development in teleosts. In addition to high-throughput analytical approaches previously managed by the team during the former contract, a solid know-how in functional genomics (gene invalidation, alteration of gene expression using morpholinos and additive transgenesis) has been developed by the team in various models and farm fish species (trout, medaka, zebrafish) during the course of the current contract. The team had also a critical investment in developing and acquiring original technological methods (e. g. optical clearing for whole mount gonads, 3D imaging). Based on these tools, the team published major results on gene coding sequences by (i) identifying the master sex-determining gene in salmonids; (ii) reporting the contribution of maternal RNA *npm2B* and *rp2* in embryo development; (iii) deciphering the function of Shbga binding protein in steroid metabolism of fish gonads. Epigenetic mechanisms in relation to miRNAs were also investigated (characterisation of a repertoire of miRNAs and targets during oogenesis in fish), including an evolutionary analysis that led to a major paper unveiling a genomic reorganization specific for coding regions and distinct from non-coding regions (miRNA) that took place during the 100 million-year period following genome duplication in Salmonids.

The whole scientific production of the team is remarkable in term of quantity (62 publications, 7 book chapters and 18 invited oral presentations), and quality with papers published in high ranking specialized or generalist journals (Genetics, Biology of Reproduction, BMC Genomics, PLoS One, Reproduction) and in very high impact journals (Current Biology, Development, Nature Communications). It is also worth noting the participation in a recent article (appeared in 2016) in Nature Genetics. The team has played a leader role (first or last author) in 34 articles, including papers in Current Biology, Nature Communications, BMC Genomics. Eight articles were produced in collaboration with other teams of the unit, while eight involve collaborations with other labs in Europe and the USA. The whole team deserves congratulations for these successes that reflect (i) its very high rank in the international context; and (ii) quality and relevance of cognitive and scientific questions raised by the team scientists in this field of reproduction.

#### Short appreciation on this criterion

The scientific quality and output are excellent.

### Assessment of the team academic reputation and appeal

The team has been remarkably successful in obtaining national research contracts, as a coordinator or as a partner: 3 ANR projects as a leader (additionally to the 3 ANR that were completed during the evaluated period) and one as a partner; one European project (FISHEGG) as the coordinator, one European project as a leader of work package (LIFECYCLE), one European project as a partner (AQUAEXCEL); one project "Investissement d'avenir" (TEFOR) as a partner; one COST project as a workpackage leader; one French-Indian project (CEFIPRA) as the coordinator.

The team has hosted 6 post-docs. Team members have organised, or participated to the organisation of, 5 international meetings (7th International Symposium on Fish Endocrinology, Conference of European Comparative Endocrinologists, International Symposium on the Reproductive Biology of Fish,...). Team members were invited for plenary and keynote lectures in conferences (13) (Annual meeting of the aquaculture section of the Catalan Society of Biology, 9th International Symposium on Reproductive Physiology of Fish, Plant and Animal Genome meeting, First International Conference on Integrative Salmonid Biology, ReproSciences 2015), and pioneer data were also presented at the French Academy of Agriculture. As a member of the PHASE division Scientific Board, the team leader contributed to writing the strategic framework for this INRA division. Eventually, attractiveness and notoriety of the team were demonstrated through the integration of a new internationally recognized scientist who passed the "CR1 blanc" competition successfully.

Team members have been involved in evaluating proposals for funding agencies: NSF, USDA, National Commission for Scientific and Technological Development (Chile), Center for Tropical and Subtropical Aquaculture (Hawaii, USA), Czech Science Foundation, FranceAgrimer, German Research Foundation.

#### Short appreciation on this criterion

The team has an excellent academic reputation. The team deserves congratulations for reaching a high and internationally recognized position as an academic laboratory, as well as for having secured a remarkable number of grants.

### Assessment of the team interaction with the social, economic and cultural environment

The team has contributed to a book for the lay public (“La valse du sexe des poissons”, Éditions de la Martinière), to the new version of “La reproduction des animaux et l’homme”, to press releases as well as to publications dedicated to the diffusion of knowledge (Sciences Ouest). The team has also participated to the “Fête de la Science”.

#### Short appreciation on this criterion

The team interactions with the cultural environment are very good.

### Assessment of the team involvement in training through research

During the course of the contract, seven PhDs (three PhDs from the former contract, four PhDs starting and ending during the 2010 - 2015 period) were completed, four PhDs were initiated (including two European PhDs) and five international post-docs were hired. Regarding PhD positions, the training policy of the team was not based on master students as a reservoir of potential PhD candidates (one 1<sup>st</sup> year and two 2<sup>nd</sup> master students during the 2010-2015 period; only one switched to a PhD program in the team). PhD students have published 14 articles as first authors, mostly in journals such as Sexual Development, Molecular and Cellular Development, Biology of Reproduction. The team organized a South American/French training course. In addition the team participated to two international training schools, and gave lectures in two French “Master student” programs (Rennes and Tours). Finally, the team was an academic partner in a Marie Skłodowska-Curie Training Network.

The important contribution of the team in (i) organising and participating to training school (ii) supervising PhD students and post-docs must be acknowledged. Integration of new scientists should be used as a mean for strengthening the contribution of the team to supervising master student research activities.

#### Short appreciation on this criterion

The team involvement in training through research is very good.

### Conclusion

#### ▪ Strengths and opportunities:

- internationally recognized team with a solid network of academic partners;
- complementary and original approaches and methods, relying on existing expertise and skills;
- remarkable ability in obtaining national and international grants;
- team abilities enhanced with new scientific and technical expertise.

#### ▪ Weaknesses and threats:

- lack of explicit technological and scientific connections with other teams of the laboratory.

**Team 4:** Physiologie testiculaire et puberté

**Name of team leader:** Mr Jean-Jacques LAREYRE

#### Team scientific domains

The team “Physiologie testiculaire et puberté” investigates mechanisms of action and coordination of sex hormones (gonadotropins and sex steroids) involved in the initiation of spermatogenesis. During the reporting period, the team also initiated a research program focused on the early characterization of germ cells and the study of their fate during transition to puberty.

#### Workforce

| Team workforce  | Number on 30/06/2015 | Number on 01/01/2017 |
|---|----------------------|----------------------|
| N1: Permanent professors and similar positions  |                      |                      |
| N2: Permanent researchers from Institutions and similar positions                           | 2                    |                      |
| N3: Other permanent staff (technicians and administrative personnel)                        | 2                    |                      |
| N4: Other professors (Emeritus Professor, on-contract Professor, etc.)                      |                      |                      |
| N5: Other researchers (Emeritus Research Director, Postdoctoral scientists, visitors, etc.) |                      |                      |
| N6: Other contractual staff (technicians and administrative personnel)                      |                      |                      |
| N7: PhD students  | 1                    |                      |
| TOTAL N1 to N7  | 5                    |                      |
| Qualified research supervisors (HDR) or similar positions                                   | 2                    |                      |

| Team record   | From 01/01/2010 to 30/06/2015 |
|---|-------------------------------|
| PhD theses defended   | 5                             |
| Postdoctoral scientists having spent at least 12 months in the unit           |                               |
| Number of Research Supervisor Qualifications (HDR) obtained during the period |                               |

## • Detailed assessments

### Assessment of scientific quality and outputs

The PTP group focused on two main research axes (i) the effects of gonadotropins and sex steroids on maturation of the testicle and (ii) the characterization of germ stem cells and their fate during the acquisition of puberty.

The team is using a comprehensive approach incorporating plasma levels of target hormones, gonad morphology and physiology and gene expression patterns to investigate the role of gonadotropins and sex steroids on gonad development. During the reporting period, the team made significant progress on the mechanisms of action of gonadotropins, in particular through the analysis of gene regulation by FSH and LH, which revealed co-regulated genes and gonadotropin-specific genes. The discovery of two mechanisms of action of FSH (mediated by steroids versus steroid-independent) is also a significant contribution of the team and will likely open a new avenue of research. The group also made significant contributions on the mechanisms of action of androgens, notably on their effects on the transcriptome of target cells. During the reporting period, the team initiated a new research line on the characterization of germ stem cells and the study of their fate during gonad development and maturation. The team validated candidate markers of germ stem cells, previously identified in mammalian species, for use in trout. They also developed transgenic lines expressing reporter genes specific of cell types of interest (meiotic germ cells and Sertoli cells and germ cells forming pairs with asymmetric expression of the reporter gene). This ground methodological work led to two publications and a third manuscript in preparation. These tools will be a great asset to monitor germ and somatic cells, and in particular the potential role of the Apr cells in renewing the pool of GSC. The team is currently studying the transcriptome of Sertoli and germ cells, which there are able to identify at early development stages using their transgenic lines. Overall, the team PTP has developed valuable tools for the study of germ cells, their environment and the endocrine and paracrine regulations of their development and is producing high-impact research. The only weakness is that the connection of the research axes developed with the applied research questions highlighted in the background/context section would need to be more clearly made when presenting the research.

The team produced 19 peer-reviewed articles during the period 2010-2015 (average 1.9 per permanent researcher per year). Eleven of these articles were led by team members (as first or last authors). Most of the peer-reviewed articles are in top tier journals such as *Biology of Reproduction*, *General and Comparative Endocrinology* or *Plos One* (all of them with team members as leaders), which highlights the quality of the research. Three articles have been produced in collaboration with other unit teams. The team also produced 1 non-peer reviewed article, 18 presentations at international (13) or national (5) conferences publishing proceedings and 3 contributions to published books. The team thus generated a commendable amount of high quality research.

#### Short appreciation on this criterion

The quality of the scientific production is very good.

### Assessment of the team academic reputation and appeal

Scientists of the PTP team were involved in 3 European projects and 6 national or regional projects. They coordinated 3 tasks in 3 workpackages in the European projects (LIFECYCLE, AQUAEXCEL, Aquaexcel2020). They were also responsible for one task in a national project (NEMO), and coordinated an INRA project (GERMFISH). They also participated to three ANR funded programmes (including two "Investissements d'avenir": TEFOR and CRB Anim). They are involved in 5 national (GDR Reproduction, EpiPHASE, GermstemFish) or regional (BIOSIT, BioPoissons) networks and had coordinating roles in 3 of them. One foreign scientist visitor (from India) was hosted by the team during the reporting period.

Scientist members of the PTP group gave 18 presentations at international meetings including aquaculture conferences, the International Symposium on the Reproductive Physiology of Fish, the Conference of the Society for the Study of Reproduction, the International Symposium on Fish Endocrinology. Two of the presentations were invited. They gave 5 invited presentations at national workshops. One PTP scientist was member of the steering committee for an international workshop (European Testis Workshop).

Scientists of the PTP team provided reviews for top tier journals including *Biology of Reproduction*, *PloS One*, and *General and Comparative Endocrinology*. They were referees for 2 European PhD dissertations and 4 French dissertations. One team member was on the review panel for the selection of ANR projects.

One PTP scientist is a member of the scientific committee of the team INRA Department.

Short appreciation on this criterion

The team academic reputation and appeal are very good. The group is in a good position to build on its achievements to attract post-doctoral scientists and develop its networking activities in the coming period.

**Assessment of the team interaction with the social, economic and cultural environment**

The PTP team is involved with the industry (partnership with Pfizer) in a technology transfer project focused on developing and testing an anti-GnRH vaccine that aims to prevent gamete maturation.

Members of the teams were involved in multiple “Journées de la recherche Piscicole” workshops.

They also contributed to outreach events such as the INRA fêtes de la science, Rennes Métropole 2013 and conferences in middle schools and high schools.

Short appreciation on this criterion

The team involvement with its social economic and cultural environment is good. New opportunities for technology transfer and outreach may occur in the context of the new Maré team.

**Assessment of the team involvement in training through research**

The PTP group lists 5 master theses, 1 DUT report and 5 PhD dissertations defended during the period. Another PhD thesis is in progress (2014-2017). PhD students have published 8 papers as first authors (almost half of the total team production) in journals such as Biology of Reproduction, Gene.

Short appreciation on this criterion

The production of master and PhD dissertations by the PTP group is very good; some effort could be made on hosting and training also younger students whenever possible.

**Conclusion**

▪ **Strengths and opportunities:**

The team is leading in its field of research. The publication record is solid.

▪ **Weaknesses and threats:**

Most of the research is on the basic side and it may be difficult to maintain funding. The connection of the program with finalized objectives is not always made clear when presenting the research.



**Team 5:** Cryoconservation des génomes et régénération des poissons

**Name of team leader:** Ms Catherine LABBÉ

### Team scientific domains

The CRYO group focused on understanding and controlling the capability of cryo-preserved cells to produce viable and conform offspring.

### Workforce

| Team workforce  | Number on 30/06/2015 | Number on 01/01/2017 |
|---|----------------------|----------------------|
| N1: Permanent professors and similar positions  |                      |                      |
| N2: Permanent researchers from Institutions and similar positions                           | 2                    |                      |
| N3: Other permanent staff (technicians and administrative personnel)                        | 2                    |                      |
| N4: Other professors (Emeritus Professor, on-contract Professor, etc.)                      |                      |                      |
| N5: Other researchers (Emeritus Research Director, Postdoctoral scientists, visitors, etc.) |                      |                      |
| N6: Other contractual staff (technicians and administrative personnel)                      |                      |                      |
| N7: PhD students  |                      |                      |
| TOTAL N1 to N7  | 4                    |                      |
| Qualified research supervisors (HDR) or similar positions                                   | 2                    |                      |

| Team record   | From 01/01/2010 to 30/06/2015 |
|---|-------------------------------|
| PhD theses defended   | 1                             |
| Postdoctoral scientists having spent at least 12 months in the unit           |                               |
| Number of Research Supervisor Qualifications (HDR) obtained during the period |                               |

### • Detailed assessments

The team being shut down, there is no assessment of the project.

### Assessment of scientific quality and outputs

A first line of research of this team focuses on cryopreservation. The team has a long-standing internationally recognized expertise on this topic. During the period, the team further optimized sperm cryopreservation protocols for salmonids, allowing more flexibility for use after thawing, which will benefit the industry. Progress was also made toward increasing the yield of sperm collections for oligospermic species. Cryopreservation of ovules and embryos appears not feasible in fish (from this and other groups' experience) but was achieved by the CRYO group in a mollusc model with subsequent recovery of viable individuals.

Given the impossibility to preserve fish ova and embryos, the group focused on regeneration based on somatic fin tissue and using nuclear transfer approaches. During the period, gene indicators of the quality of the development were developed for use in characterization of re-programmation success. The group developed culture methods for donor cells (prior to transfer) and indicators of the level of de-programmation. The technologies that the group has developed so far place them in a leadership position internationally.

A third theme targeted by the team is the study of epigenetic marks induced by cryopreservation and their impact on development and conformity of embryos obtained using cryopreserved sperm. The team has begun addressing this question by looking at the effect of cryopreservation on sperm DNA methylation in various species. An applied mid-term objective is to try to reduce these impacts through protocol optimization (e.g. by modifying the cryopreservation medium).

The team has produced 26 peer-reviewed articles during the reporting period (2.6 per full time researcher per year), in journals including Proceedings of the Royal Society, Comparative Biochemistry and Physiology, General and Comparative Endocrinology, BMC Developmental Biology. Eleven articles have team members as leaders (first or last authors). Team members have a leading position in articles in Comparative Biochemistry and Physiology, Molecular Reproduction and Development, General and Comparative Endocrinology, BMC Developmental Biology. Seven articles have been produced in collaboration with other teams of the unit, while three involve international collaborations. The group also produced 4 non-peer reviewed articles, 39 presentations in conferences publishing proceedings (26 international, 13 national), and 6 books or book chapters.

#### Short appreciation on this criterion

The quality of the scientific production is very good and the scientific productivity is excellent.

### Assessment of the team academic reputation and appeal

Scientists of the CRYO team took leading and coordinating roles in several national and international projects. They were responsible for work packages in one European project (Aquaexcel) and one national project (CRB Anim) and were partners in another European project (LifeCycle) and four national projects (Projet Impact des pêches locales du Haut Maroni, Appel à projet ministère de l'agriculture, projet IBISA, projet OFIMER). Scientists of the group are actively involved in an European network (COST Aquagamete), where they led a working group, and in a national network (Agreenium). They engaged actively the international scientific community in the field of cryopreservation, epigenetics and regeneration. In this context they took a leading role in the development of a network of international collaborators, trained scientists and graduate students from other institutions in Brazil and several European countries. A team member is the deputy chair of the scientific committee of the "Parc Amazonien de Guyane".

The team has several international collaborations with groups in Hungary (Szent Istvan University), Czech Republic (University of South Bohemia in Ceske Budejovice), Spain (Universitat Politècnica de València, Universidad de León).

The group gave 26 presentations at a broad array of international conferences and workshops. They gave 2 invited conferences at international workshops (Biology of Fish Gametes), one invited conference at CRYO 2015 (Ostrava, Czech Republic) and one invited conference at Ancona University. A scientist of the team was the chairman of an international workshop on the biology of fish gametes. Scientists of the team acted as referees for one HDR and 8 PhD dissertations. They reviewed for 14 journals including top tier journals such as Biology of Reproduction and Plos One with on average 8 reviews per year. They also provided expertise in the evaluation of proposals for international (BARD) and national competitive programs.

The group appears to be a leader in the field of cryopreservation and in the emerging field of regeneration in fish. Efforts should be made to build on this international reputation to attract post-doctoral scientists, pending

funding availability. This could contribute to increase the proportion of high rank publications by enabling longer and more comprehensive projects.

Short appreciation on this criterion

The team academic reputation and appeal is very good. The team has shown an excellent strategic approach building on its existing reputation to expand its expertise and to position itself as a leader in the emerging field of genome regeneration.

**Assessment of the team interaction with the social, economic and cultural environment**

The research developed by the CRYO team finds numerous applications in aquaculture and conservation. The group has developed relationships with an industrial partner (société IMV) and is also transferring actively its applied findings to the industry via the SYSAAF structure.

CRYO is directly connected to the industry having developed a relationship with IMV technologies for the commercialization of new diluents developed by the team.

Finally, protocols for cryo-banking are transferred through the CRB ANim project.

Members of the CRYO team were involved in outreach activities including contributions to the 'Fete de la science' event and participation in programs with elementary and high school level students.

Short appreciation on this criterion

The CRYO team interaction with the social, cultural and economic environment is excellent. The team is directly involved with the industry through technology transfer and partnerships. These activities provide a strong base to build upon in the new merged Maré team.

**Assessment of the team involvement in training through research**

The CRYO group lists 6 master thesis, 6 DUT/BTS/licence reports and one PhD dissertation. Articles involving students (as first authors) have been published in Comparative Biochemistry and Physiology, Molecular Reproduction and Development, Gene.

A scientist of the CRYO group also developed two courses in the context of the Aquagamete COST action.

Short appreciation on this criterion

The team's involvement in training through research is good. Efforts should be focused towards training more PhD students.

**Conclusion**

▪ **Strengths and opportunities:**

The CRYO group is in a leadership position in its field of research. The productivity per scientist is excellent. The finalized objectives are clearly connected to the research axes and this seems to translate in success in generating extramural funds.

▪ **Weaknesses and threats:**

The team could build on its strength to bring in post-doctoral scientists and increase mentoring of PhD students if funding becomes available.

**Team 6:** Sexe, Ovogenèse et Comportements

**Name of team leader:** Mr Yann GUIGUEN

### Team scientific domains

This new team will focus on three main topics: 1) genome evolution and the study of breeding and fish behavior; 2) genetic network of gonadic differentiation and oogenesis; 3) environmental and transgenerational determinism of gonadic differentiation, oogenesis and behaviour.

### Workforce

| Team workforce  | Number on 30/06/2015 | Number on 01/01/2017 |
|---|----------------------|----------------------|
| N1: Permanent professors and similar positions  |                      |                      |
| N2: Permanent researchers from Institutions and similar positions                           |                      | 6                    |
| N3: Other permanent staff (technicians and administrative personnel)                        |                      | 5                    |
| N4: Other professors (Emeritus Professor, on-contract Professor, etc.)                      |                      |                      |
| N5: Other researchers (Emeritus Research Director, Postdoctoral scientists, visitors, etc.) |                      |                      |
| N6: Other contractual staff (technicians and administrative personnel)                      |                      |                      |
| N7: PhD students  |                      |                      |
| TOTAL N1 to N7  |                      |                      |
| Qualified research supervisors (HDR) or similar positions                                   |                      |                      |

## • Detailed assessments

### Assessment of the strategy and the five-year plan

The next 5-years project of the new team will build on the wealth of data generated during the evaluated period. A first set of generic analyses will be dedicated to deciphering molecular mechanisms and genes/genome evolution in female reproduction. A second part of the project will aim to characterizing genes involved in gonad differentiation and oogenesis, taking advantage of transgenic fish strains available for model species. These two aspects constitute the historical and clearly identified bases of the team activities. They will be enhanced with innovative technological approaches (e. g. analyses of whole mount cleared gonads; genome editing in model as well as farm species). In addition to molecular (high and low throughput) and cellular analyses, the project will integrate a new and original program with a multi-generational (rather than trans-generational) analysis for evaluating the impact of environmental variations (e.g. maternal feeding, climate factors, social environment) on gonad differentiation and oogenesis. Very interestingly, mechanistic approaches will gather epigenetic factors (e. g. miRNAs) as well as behaviour studies. The project presents a highly coherent structure that will (i) address several critical cognitive objectives and to a lesser extent an applied aspect that relates to domestication of new fish species, (ii) benefit from expertise and competences (3 scientists) recently integrated to the team (iii) be financially supported by existing

national and international grants, and (iv) take advantage of external academic partners of national, European and international origin (Japan, Singapore, USA) and one economic partner (SYSAAF).

The presented project is ambitious and comprehensive, with the development of new and original areas of scientific investigation areas. Altogether, the project has the potential to generate basic knowledge with a (very) high impact in the field. The governance of the team will need to pay attention to (i) keeping the level of excellence reached during the former contract in a new context with the promotion of the former leader to unit directorship (ii) increasing relationships with fish farming professionals, including diffusion and applied use of their results (iii) establishing connections and sharing expertise (e.g. transgenerational approach, epigenetics, clearing, genome editing) with the other teams of the unit in order to generate a solid and sustainable framework for the laboratory.

Short appreciation on this criterion

The scientific quality and expected output are potentially excellent.

## Conclusion

### ▪ Strengths and opportunities:

- international recognized team with a solid network of academic partners;
- complementary and original approaches and methods, relying on existing competences and skills;
- remarkable ability in obtaining national and international grants;
- team abilities enhanced with new scientific and technical expertise.

### ▪ Weaknesses and threats:

- very dense scientific project whereas one of the senior leaders will be less contributing;
- lack of explicit technological and scientific connections with other teams of the laboratory.

### ▪ Recommendations:

- keep the internal cohesion of the team project and its connections with other teams of the unit;
- maintain the transfer of fundamental knowledge and cognitive data to fish farming professionals;
- improve the international position of the team by coordinating European grants;
- encourage recently integrated scientists to obtain the HDR in order to maintain and diversify the training activities of the team.

**Team 6:** Maturation sexuelle, Cryoconservation, Régénération

**Name of team leader:** Ms Catherine LABBÉ

### Team scientific domains

This new team will focus on three main topics: 1) understanding stem cell programming; 2) studying nuclear reprogramming; 3) contributing to the development of biotechnologies applied to conservation and breeding.

### Workforce

| Team workforce  | Number on 30/06/2015 | Number on 01/01/2017 |
|---|----------------------|----------------------|
| N1: Permanent professors and similar positions  |                      |                      |
| N2: Permanent researchers from Institutions and similar positions                           |                      | 4                    |
| N3: Other permanent staff (technicians and administrative personnel)                        |                      | 4                    |
| N4: Other professors (Emeritus Professor, on-contract Professor, etc.)                      |                      |                      |
| N5: Other researchers (Emeritus Research Director, Postdoctoral scientists, visitors, etc.) |                      |                      |
| N6: Other contractual staff (technicians and administrative personnel)                      |                      |                      |
| N7: PhD students  |                      |                      |
| TOTAL N1 to N7  |                      |                      |
| Qualified research supervisors (HDR) or similar positions                                   |                      |                      |

## • Detailed assessments

### Assessment of the strategy and the five-year plan

The new team “Maturation sexuelle, Cryoconservation, Régénération (MaRé)” is one of the major structural changes of the reorganized unit. The merging of the PTP and CRYO teams seems logical considering the convergence of scientific interests and goals and the complementarity of expertise. The new group will aim at understanding the programming of germ cells during early differentiation of gonads and the reprogramming involved in the development of viable embryos during nuclear transfer. Applied objectives involve cryopreservation and regeneration for genome banking. The project integrates research axes of the previous PTP and CRYO group and benefits from the technologies acquired by the two groups and their leader position in their respective fields.

The first theme corresponds to one of the main activities of the former PTP group and will apply tools developed in the previous period including the GFP reporter transgenic lines to study endocrine and paracrine regulations of germ cell proliferation and differentiation. A mid-term objective is to develop a new research line studying the epigenetic control of GSC differentiation.

The second research axis is focused on nuclear reprogramming and development potential. This will be approached by comparing the development potential of embryos obtained by nuclear transfer from spermatozoa, GSC, embryonic cells and somatic cells. This research will also include the characterization of the epigenome of donor cells. The third theme includes applied research and technology transfer in line with previous activities of the CRYO group on the topics of cryopreservation and regeneration. This theme also includes evaluation of the risks associated with biotechnologies such as cryopreservation and manipulation of fertility using anti-GnRH vaccines.

The three research lines are still relatively distinct reflecting research axes of the two former teams. One potential objective during the coming period will be to bring together these different approaches to build a common comprehensive program that converges towards the objectives identified as reprogramming and genome regeneration.

The new team benefits from funding through two on-going contracts. The new team is more clearly connected to finalized applied objectives, which should bring opportunities for funding.

The new group will need to work on linking the different project components to converge towards the ultimate goals. This is identified by the group as one of the main area of efforts for the coming period through group meetings to develop common reflection and co-supervision of students.

#### Short appreciation on this criterion

The quality of the proposed research is very good and will contribute to maintain the leadership position of the unit in the field.

### Conclusion

#### ▪ Strengths and opportunities:

The new team Maré combines the former PTP and CRYO teams resulting in a larger size (4 permanent scientists). The team can build on the international networks developed by the two teams and on established relationships with the private sector. The applied focus of the new group puts them in a strong position to attract new funding and develop a productive program. The team combines two strong programs leading their field internationally and the integration of the two groups will likely strengthen this position.

#### ▪ Weaknesses and threats:

One of the main challenges will be to bring together the research axes of the two groups and to articulate a comprehensive and coherent strategy oriented towards reaching the desired goals.

Reprogramming seems to be a difficult question and the likelihood of short-term success seems uncertain.

The team will lose two senior scientists who will retire at the end of the coming period. The hiring plan prioritizes this team, but the group may still reach a critically low mass in 5 years depending on the success in obtaining new positions.

#### ▪ Recommendations:

Hiring new permanent scientists in support of the project is a priority in anticipation of the two coming retirements. Significant efforts should be devoted to coordinate and articulate the two programs, so that they converge comprehensively toward achieving the objectives of the new team. In particular, the connection of the research strategies in the three themes towards anticipated potential applications could be presented more clearly as it may help securing future funding.

The new group could also use its leader position to work on attracting more post-doctoral scientists.

## 5 • Conduct of the visit

### Visit dates

Start: 10<sup>th</sup> March 2016 at 1:30 pm

End: 11<sup>th</sup> March 2016 at 5:00 pm

Visit site: LPGP

Institution: INRA

Address: Campus de Beaulieu 35042 RENNES

### Specific premises visited:

The panel had the opportunity to visit the outstanding animal facilities of the unit.

### Conduct or programme of the visit:

The visit started at 1:30 pm of the 10<sup>th</sup> of March by a short presentation of the HCERES missions by the scientific delegate. Afterwards the head of the unit and the team leaders presented the achievements of the previous five years. Day 1 ended at 7:00 pm after the panel meeting with the faculty staff and the students/postdocs.

Day 2 of the visit (11<sup>th</sup> of March) started at 8:30 am with the presentation of the project of the unit and the teams by the unit head and the team leaders. Afterwards, the panel met with the technical staff, the representative of the doctoral school, the representative of INRA and the head of the unit. The panel met at closed doors at 14:00 after a short visit of the animal facilities. The final discussion ended up at 5:00 pm.



## 6 • Supervising bodies' general comments

**INRA Laboratoire de Physiologie et Génomique des Poissons - LPGP**

Campus de Beaulieu – Bâtiment 16A

35042 RENNES CEDEX

Tél. : + 33 1 (0)2 23 48 50 02

Fax : + 33 1 (0)2 23 48 50 20

[www.inra.fr](http://www.inra.fr)

[www4.rennes.inra.fr/lpgp](http://www4.rennes.inra.fr/lpgp)



à : **HCERES**

Rennes, le 7 mai 2016

**Ref : S2PUR170011917 - Laboratoire de Physiologie et Génomique des Poissons (LPGP) - 0755361V**

**Objet : Réponse de l'unité LPGP au rapport préliminaire d'évaluation HCERES**

Madame, Monsieur,

Nous avons bien pris connaissance du rapport préliminaire d'évaluation de notre laboratoire par l'HCERES suite à la visite du comité les 10 et 11 mars 2016.

L'ensemble des agents du laboratoire remercie le comité d'évaluation pour son analyse pertinente et ses remarques constructives dont nous tiendrons compte pour mener à bien notre projet d'unité.

Julien Bobe  
Directeur du laboratoire de Physiologie et Génomique des Poissons