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## GABI - Génétique animale et biologie intégrative

Rapport Hcéres

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agence d'évaluation de la recherche  
et de l'enseignement supérieur

Department for the evaluation of  
research units

AERES report on research unit:

Animal Genetics and Integrative Biology

GABI

Under the supervision of the following  
institutions and research bodies:

AgroParisTech – Institut des sciences et industries du  
vivant et de l'environnement

Institut National de la Recherche Agronomique - INRA





agence d'évaluation de la recherche  
et de l'enseignement supérieur

Department for the evaluation of  
research units

*On behalf of AERES, pursuant to the Decree  
of 3 november 2006<sup>1</sup>,*

- Mr. Didier HOUSSIN, president
- Mr. Pierre GLAUDES, head of the  
evaluation of research units department

*On behalf of the expert committee,*

- Mr Stephen BISHOP, chair of the  
committee

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<sup>1</sup> The AERES President "signs [...], the evaluation reports, [...] countersigned for each department by the director concerned" (Article 9, paragraph 3 of the Decree n ° 2006-1334 of 3 November 2006, as amended).



## Evaluation report

Unit name:	Animal Genetics and Integrative Biology
Unit acronym:	GABI
Label requested:	UMR
Present no.:	UMR 1313
Name of Director (2013-2014):	Ms Claire ROGEL-GAILLARD
Name of Project Leader (2015-2019):	Ms Claire ROGEL-GAILLARD

## Expert committee members

Chair:	Mr Stephen BISHOP, The Roslin Institute, University of Edinburgh, United Kingdom
Experts:	Mr Pierre BOUDRY, Ifremer, Brest (representative of CSS INRA GVA)
	Mr Bart DUCRO, Animal Breeding and Genetics Center, Wageningen, The Netherlands
	Mr Koenraad DUHEM, Département Qualité des Élevages et des Produits, Paris
	Ms Susana DUNNER, Facultad de Veterinaria, Madrid, Spain
	Mr Xavier GIDROL, CEA, Grenoble
	Mr Philippe GLASER, Institut Pasteur de Paris, Paris
	Mr Christophe HITTE, Institut de Génétique et Développement, Rennes

### Scientific delegate representing the AERES:

Mr Pierre COUBLE

### Representatives of the unit's supervising institutions and bodies:

Ms Muriel MAMBRINI, INRA

Mr Denis MILAN, INRA

Mr Daniel TOME, AgroParisTech

Ms Irina VASSILEVA (representative of Doctoral School n°435)



## 1 • Introduction

### History and geographical location of the unit

The Integrative Biology and Animal Genetics research unit of INRA (UMR 1313 GABI), hereafter referred to as GABI, was created on January 1<sup>st</sup> 2009, by merging six research units from the INRA Animal Genetics Division which were located on the Jouy-en-Josas research center. GABI was created as a joint research center under the supervision of both INRA and AgroParisTech, a higher education institution. The Jouy-en-Josas research center is located at Domaine de Vilvert (78352 Jouy-en-Josas), in the Yvelines department of the région Île-de-France. This site is approximately 20 km south-west of the center of Paris.

### Management team

The senior level of the management team currently comprises the scientific manager and director, Dr. Claire ROGEL-GAILLARD, and two deputy directors, Dr. Hélène HAYES and Prof. Etienne VERRIER. Collectively, this group is referred to as the senior management team, throughout this report.

### AERES nomenclature

Principal:

- SVE Sciences du vivant et environnement

Secondaires:

- SVE1\_LS2 Génétique, génomique, bioinformatique
- SVE2\_LS8 Evolution, écologie, biologie des populations
- SVE1\_LS1 Biologie moléculaire et structurale, biochimie

### Unit workforce

Unit workforce	Number as at 30/06/2013	Number as at 01/01/2015
<b>N1:</b> Permanent professors and similar positions	5	6
<b>N2:</b> Permanent researchers from Institutions and similar positions	62	72
<b>N3:</b> Other permanent staff (without research duties)	39	38
<b>N4:</b> Other professors (Emeritus Professor, on-contract Professor, etc.)		
<b>N5:</b> Other researchers from Institutions (Emeritus Research Director, Postdoctoral students, visitors, etc.)	5	5
<b>N6:</b> Other contractual staff (without research duties)	1	1
<b>TOTAL N1 to N6</b>	<b>112</b>	<b>122</b>



Unit workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	25	
Theses defended	33	
Postdoctoral students having spent at least 12 months in the unit*		
Number of Research Supervisor Qualifications (HDR) taken	6	
Qualified research supervisors (with an HDR) or similar positions	23	25

## 2 • Overall assessment of the unit

The objectives of the GABI unit are extremely well aligned with the mission of INRA. Further, it meets the requirements of INRA, producing high quality strategic and applied science, with strong links through to industry. The quality of science is uniformly very good and internationally recognized, with some aspects classified as outstanding. The unit is well led, with the senior management team having a strong and coherent vision of the forward-looking science requirements, and providing effective and democratic communication through the unit as a whole. This is evidenced by the recent restructuring of the research teams and laboratory resources, to enable the available resources to better match the scientific vision, however further beneficial restructuring is also possible. Increased collaboration between teams would also be greatly facilitated by relocating teams into fewer buildings on the site, and the desire of the senior management to do this is strongly endorsed. The publication strategy should be re-visited, to ensure an optimal balance between discipline-specific journals and higher impact journals, as this would increase the attractiveness and visibility of the unit beyond the field of livestock genetics. The unit is strongly encouraged to seek the means to increase the number of PhD students and post-doctoral scientists, in order to increase the scientific vitality as well as the rate of publications. The translation of research findings to industrial application is very good and outstanding in some cases. As target traits for genetic improvement become more complex, continued success will require communication with an ever wider range of researchers and other stakeholders or socio-economic actors.

### Strengths and opportunities related to the context

The GABI unit has a critical mass of highly trained and internationally recognized researchers in the field of animal genetics and genomics, spanning the range from fundamental through to applied research.

Several GABI teams are recognized as reference groups, i.e. internationally leading experts, in their field. This had led to prominent roles in international consortia, often leading large international projects.

The GABI unit has excellent infrastructure for both laboratory- and computer-led activities, however the currently spatially dispersed nature of these resources is a limitation.

The GABI unit has an excellent track record in producing resources and techniques of value in the field.

The GABI unit has an excellent track record in translating research findings into practice, and is effective in its direct collaboration with other agencies to achieve this.

The GABI unit appears to be well and cohesively managed, with the senior management team creating a democratic environment.

The GABI unit has shown flexibility and plasticity in terms of re-organisation of teams to better meet the mission of INRA and the vision of the senior management team. Opportunities may exist for further re-structuring, in line with the three new proposed research axes.

GABI is an attractive destination for PhD students who find the environment conducive to high-level research training.



The experts committee supports the vision of the Senior Management Team in applying an Integrative Biology approach to systems of practical importance to livestock genetics, breeding and efficient production.

An opportunity exists to exploit the extensive infrastructure resources and large quantities of data at GABI to ask more science-led questions.

An opportunity exists to increase the wider scientific impact of GABI by greater collaboration between groups.

An opportunity exists to further integrate data arising from the different platforms at GABI to increase GABI's impact in integrative biology.

An opportunity exists to further exploit high throughput genomics and phenotyping data to ask science-led questions and increase the visibility and attractiveness of GABI.

### Weaknesses and threats related to the context

A weakness is the currently dispersed locations of the different teams across the campus. This, together with a relatively high number of teams, contributes to reduce the effective size of each team.

Collaborations between some of the research teams appear sub-optimal. This is worsened by the various teams being dispersed across the campus.

The acknowledged scientific reputation of some groups within GABI is not fully matched by their publication metrics, and it would appear that both the current publication rate and publication strategy are sub-optimal. Publication rates, whilst improving, still lag behind the best in the field. Acknowledging the need to maintain a balanced portfolio of target journals, the publication strategy still appears to be too conservative, with opportunities to published some of the results in high impact journals possibly being missed.

In some cases, activities were dispersed across more topics than can be profitably studied given the available resources. This constitutes a risk to future success, and a strategy to maximise the focus on topics likely to give the greatest scientific and practical rewards is required.

Currently there are too few PhD students and post-doctoral scientists, with the unit missing both the scientific vitality and the publication possibilities offered by these two groups.

A threat, perceived by staff members, is the difficulty in remaining competitive with units elsewhere in France in terms of attracting and recruiting staff, due to the perceived financial and lifestyle benefits that other geographical locations may offer.

### Recommendations

The experts committee strongly endorses the desire of the Senior Management Team to relocate all teams to a common location.

The experts committee recommends considering the creation of an independent Scientific Advisory Board (SAB).

The experts committee recommends the external seminar programme be extended to include external speakers.

The experts committee recommends that the publication strategy be re-visited, with a view to increasing both the rate of publication in journals relevant to the field and the profile of the journals targeted for high impact research findings.

The experts committee recommends that GABI seeks to increase the number of PhD students and post-doctoral scientists.

The experts committee recommends that GABI seeks to increase the number of habilitated directors of researchers, this being one of the means by which the potential number of students in the unit can be increased.

The experts committee recommends that GABI reviews the balance between data-driven and question-driven research, however the balance between applied and fundamental research should be maintained.



The experts committee recommends that a strategy be developed to prioritise the choice of target mutations to be followed up by in-depth functional studies.

The experts committee recommends that GABI (and the proposed Scientific Advisory Board) consider whether its current team structure is optimal to match its three newproposed research axes (namely (I) understanding genetic variability, (II) dynamics of genes, genomes and populations, and (III) prediction of performance).





### 3 • Detailed assessments

#### Assessment of scientific quality and outputs

The GABI unit performs high quality research in the field of animal genomics, spanning the field from basic research, through innovation targeted at specific traits of economic importance, to practical implementation of results into breeding programmes. In doing so, it undertakes research and development activities that match the INRA mission well, this mission being “To combine scientific excellence and the social objectives of research”.

Probably every team can claim some level of innovation which has international recognition. Additionally, several teams at GABI are recognised as reference groups for expertise in their field of interest. However, whilst there is complementarity between groups, there is heterogeneity in terms of critical mass, achievements and outputs. In some cases this reflects the historical activity of the team or the size of the scientific subject area (discipline) being addressed, however variability in critical mass and team output must be addressed in future strategic planning.

International recognition for GABI researchers is evidenced by several observations, such as the 2013 EM Leroy award, participation in many international consortia (including the strategically important FABRE-TP), and leadership of several international initiatives (e.g. EADGENE, *Erasmus-Mundus* PhD Programme).

GABI can claim several methodological achievements or breakthroughs of relevance to animal genetics and genomics. A short (non-exhaustive) list of examples includes novel data analysis methodologies for both traditional data (e.g. continuing updates to Survival Kit software) and functional genomic data (e.g. novel approaches for analysing high-throughput transcriptome sequencing data which have been contributed to the R/Bioconductor Open Source Package), innovative genomic selection methods, novel measurement techniques applied to milk, novel phenotypes (e.g. plant-based diets for fish and new immunocompetence traits in pigs), and transgenic experimental animals. It is also apparent that several teams at GABI are early adopters of new technologies. An example is implementation of genomic prediction in dairy cattle, and now the approaches being implemented to solve multi-breed genomic prediction.

The approach to solving problems is robust, for example use of large-scale high-throughput genotyping and sequencing data for multiple purposes, e.g. genomic prediction as well as identification of deleterious mutations. Collaboration between groups (e.g. G2B with MoDiT and potentially with GFP-GM) allows the functional interrogation of these mutations. These across-team collaborations are to be encouraged, and the experts committee recommends that a strategy be developed to prioritise the choice of target mutations to be followed up by in-depth functional studies.

GABI has excellent infrastructure for laboratory and computer-led activities, however the spatially dispersed nature of the resources is a limitation, and it makes cost-effective management of such resources difficult. Further, a strength of GABI is the ability to create platforms, resources and large datasets; arguably, however, full scientific exploitation of these resources is not achieved in some cases. The experts committee recommends that GABI reviews the balance between data-driven and question-driven research.

In some cases, dispersion of activities across more topics than can be profitably studied was observed, and this is raised as a risk in the assessment of the forward-looking plans for several teams. A strategy to maximise the focus on topics likely to give the greatest scientific and practical rewards is required.

Publication rates have been recognized as an issue in the past, and GABI has worked hard at addressing this issue. However, there is still room for improvement, as publication rates still lag behind the best in the field. This is evidenced by the observation that publication metrics for several senior scientists (such as H-factors) arguably do not match their international reputations in their respective fields, even after accounting for differences between scientific disciplines. Most researchers are now targeting good international journals within their field. Nevertheless, the experts committee recommends that the publication strategy be re-visited, with a view to increasing both the rate of publication in journals relevant to the field and the profile of the journals targeted for high impact research findings. Whilst there are a small number of papers currently published in high impact journals, the experts committee observed several research topics with the potential to achieve publication in such journals. These actions would lead to a wider national and international visibility of GABI and it would make GABI a more attractive location for recruiting researchers and post-doctoral scientists. This is particularly the case for attracting high profile researchers outside the immediate field of livestock genomics.



It was observed that PhD students were an efficient means of achieving high publication rates, usually in journals ranked highly within the field. To achieve more students, it is necessary to have more Habilitated Directors of Research (HDR), and the goal of having more researchers at this level is endorsed by the experts committee.

It is disappointing that there are so few post-doctoral researchers in GABI. This represents a missed opportunity to employ highly-motivated young scientists (often from abroad) who, in a short time period, can make a large impact in terms of publications, enthusiasm, hard work, creative input and new ideas. The experts committee recommends that means are sought to further encourage post-doctoral scientists to visit GABI.

### Assessment of the team's academic reputation and appeal

The international reputation of GABI, within the unit's specific field of research, is generally excellent. The experts committee did not ascertain the reputation of GABI within the wider scientific context.

As evidence of the reputation of GABI researchers within their field of research, GABI is generally a prominent partner in relevant international research projects and consortia, including initiatives aimed at genome sequencing, genome annotation, analysis of function genomics data, genotyping and gut metagenome characterization. This activity and recognition is evidenced by the wide variety joint publications that were listed, and the large number of countries-of-origin of co-authors (49 countries). GABI has also been successful in obtaining external funding.

GABI scientists have also played leading roles in platforms and initiatives to coordinate or improve the visibility of research, such as EADGENE (the European Animal Disease Genomics Network of Excellence), the Genomics of Animal Health international symposia, etc. Although few prizes and awards were documented or brought to the attention of the experts committee, the 2013 EM Leroy award to a staff member is a notable achievement.

GABI scientists are documented as playing editorial roles for several journals (viz. Genetics Selection Evolution, Animal Biotechnology, Animal Genetics, Animal Science Papers and Reports, Aquatic Living Resources, BMC Genetics, Cytogenetics and Genome Research, Dairy Science and Technology, Frontiers in Livestock Genomics, Transgenic Research, World Poultry Science). Prominent amongst these is the major role in editing Genetics Selection Evolution, and overseeing the substantial rise in the journal's impact factor, to the point where it is now the journal of choice for livestock geneticists. This is an achievement to be commended.

Although some foreign students, postdoctoral researchers and senior scientists are present within GABI, overall there are disappointingly few within the unit. This small number arguably represents a lost opportunity, and it would be of benefit to GABI to increase this number.

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

A positive feature of GABI is the output of science of practical utility and the often-impressive efforts to see the research outputs translated into practice. It is important that with the desire to perform more basic research, including functional studies, this strength is not diluted.

A longstanding activity has been the estimation of pedigree-based breeding values for the livestock breeding industries, in particular for cattle, fish and horses. More recently, a notable feature is the speed and effectiveness with which cutting-edge genomic technologies have been translated into outputs of practical use to these industries, particularly the dairy cattle sector. These successes have been achieved with effective collaboration with other actors in the field, for example Idele and UNCEIA in the cattle breeding sector, SYSAF (Syndicat des Sélectionneurs Avicoles et Aquacoles Français) in the fish breeding sector and IFCE (Institut Français du Cheval et de l'Équitation) in the horse breeding sector. This translational work has been accompanied by appropriate certification (ISO-9001), to ensure robustness, traceability and repeatability of results.

Examples exist where innovative technologies have not as yet led to practical implementation, for example very promising and innovative techniques to measure milk protein composition by mass spectrometry. This may require timely assessment and benchmarking of the appropriate level of technology required for the problem.

Examples were presented where additional efforts will be required to ensure successful technology transfer and knowledge exchange. These include, firstly, cases where the industries are fragmented (e.g. beef cattle in G2B and fish breeding in GenAqua); here, multiple players need to be engaged with, and substantial and continued extension efforts will be required to ensure that the industry is able to utilise the results. Secondly, there are cases where novel phenotypes are to be measured, for example for new disease resistance or immunological traits; here a



wider range of stakeholders (including researchers in animal health, veterinarians and the animal health sector) will need to be included in the exploitation plans.

Examples were presented where a strategically forward looking assessment of industrial needs has indicated the requirement for new phenotypes. This includes plant-based diets in fish and immunocompetence traits in pigs. Exciting opportunities are also foreseen in focusing on the long-term effect of nutrition and environmental factors on the development of the mammary gland through the analysis of the miRnome.

Within PSGen examples were given of a longer-term strategic vision aimed towards the goal of “preservation of resources”, and also larger-scale relationships between genotype and environment, including activities focussed on developing countries.

### Assessment of the team's organisation and life

The Senior Management Team at GABI articulated a strong and coherent vision and plan for the future direction of the unit. Additionally, communication within the unit appears to be effective and democratic, with the voice of people at all levels of the organisation having the chance to be heard.

Considerable recent efforts have been made towards restructuring the unit, in light of both the scientific vision of the management team and the available staff and resources. Further, considerable effort has been made to pool laboratory resources, through the creation of @BRIDGe. Previously, the laboratory resources within GABI had risked becoming fragmented following the outsourcing of large-scale sequencing and genotyping activities. It is recommended that the Senior Management Team further considers the team organisation in light of the mission of the unit and the resources available, as there may be ways of further refining the structure. Further, it is also suggested that GABI seek to strengthen interactions with other units and platforms on the Jouy-en-Josas research center.

Communication between groups was identified as a potential issue, with some examples of between-group communication being suboptimal. This was attributable to several factors including:

- (I) the diversity of disciplines;
- (II) the previous organisational structure of the unit;
- (III) the spatial distribution of groups across the campus.

It was noted that the students, especially, tended to be very team focussed with rather little communication across groups. Consequently, the experts committee strongly endorses the desire of the Senior Management Team to relocate teams to a common location. This would have major benefits in terms of increasing the effective critical mass of scientists, it would greatly improve collaborations between groups, and it would greatly improve the scientific experience for young researchers and students.

The concept of one-day scientific retreats was considered by the experts committee. Such retreats may have benefits in the development of teams and scientific opportunities, and it is suggested that the Senior Management Team considers this option.

The existence of a comprehensive seminar programme was noted by the experts committee. It is recommended that this programme is extended to include (outstanding) external speakers.

Some perceived issues were expressed by staff in relation to the location of the Jouy-en-Josas research campus. Specifically, the threat is the difficulty in remaining competitive with units elsewhere in France in terms of attracting, recruiting and retaining staff, due to the perceived financial and lifestyle benefits that other geographical locations may offer.

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

Active and positive contributions of GABI researchers to student training were noted. Specifically, various researchers of the GABI unit participate in the Doctoral School ABIES, welcoming and training PhD students from different countries. Further, the Erasmus Mundus graduate school in Animal Breeding and Genetics is accredited by the European Union. This school is coordinated by a PSGen team member who is also a Professor within AgroParisTech. Additionally, in the PSGen team, several professors and associate professors at AgroParisTech are devoted to research training through the European Master in Animal Breeding and Genetics (EMABG) together with



other four university groups in Europe, and the team also coordinates the European doctoral program ESG-ABG together with Aarhus University (Denmark), Swedish University of Agricultural Sciences at Uppsala (Sweden) and Wageningen University (The Netherlands).

Training of students, especially PhD students, is a valuable activity within the unit. However, currently it is deemed by both the experts committee and the Senior Management Team at GABI to be under-utilised. Whilst it was observed by the experts committee that the quality of completed thesis was good, with a good rate of publications arising from such theses, there were fewer students than might be expected from a unit of this size. A greater number of students will assist with publication rates and enable exploration of areas of research which may not be pursued with existing staff. They will also bring energy and new ideas to the unit.

The capacity of GABI to recruit PhD students depends on the number of HDR scientists, and this number is currently unequal across teams. Therefore there is a need to increase the number of HDR scientists. The experts committee endorses the objectives of the senior management team and specifically recommends:

- (I) that GABI seeks to increase the number of HDR scientists to increase the potential for student supervision;
- (II) having achieved this, attempts to further increase number of students within the unit.

The good quality of the PhD theses produced attests to a generally high level of effective supervision. Further, PhD students, when interviewed, expressed satisfaction with their training experience within GABI. They find the environment conducive to high-level research training.

The Senior Management Team at GABI has observed a declining interest in research careers in animal science in France. This decline appears to be a global trend, and it may impact on the ability of GABI to recruit students. Solutions to this issue may include recruiting students from a wider range of scientific backgrounds; this will be assisted by actions recommended in this evaluation to increase the visibility and appeal of GABI to the wider scientific community.

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

The forward vision for GABI presented by the senior management team, along with the assessment of scientific challenges and priorities, is strong and accurate. The identification of the factors affecting the research environment (i.e. (1) worldwide global climate and environmental changes (encompassing food security, preservation of resources and ensuring animal health), (2) exploitation of up-to-date technologies and high throughput genomic data, and (3) efficient translation of science to practice), is helpful and provides a strong framework for the research.

The experts committee strongly endorses the objectives articulated by the senior management team, namely to:

- I) enhance synergies and complementarities between molecular and quantitative geneticists;
- II) increase skills and expertise in emerging fields such as bioinformatics and computational biology;
- III) adapt the research infrastructures to the rapid development of high-throughput genomic tools;
- IV) optimize the efficiency of the structure;
- V) increase the national and international visibility and attractiveness of the research unit.

Many of the recommendations made in this report relate directly to these objectives and are intended as a means of assisting the Senior Management Team in reaching these goals.

GABI has chosen to re-orientate its research axes from the previous genome-individual-population axes to a new set of multi-scale axes cutting across these classifications, i.e. to:

- I) understanding genetic variability and trait variants;
- II) dynamics of genes, genomes and populations, including biostatistics and systems biology;
- III) prediction of performance at the level of the gene, genome and phenotype.

However, the team structure and organisation has arguably not altered accordingly.



The experts committee recommends that GABI considers whether its current team structure is optimal to match these three new proposed research axes. Further, the Senior Management Team must recognise that because these axes are based on methodologies and technologies, it remains important to clearly define the scientific questions to be addressed. External collaborations will be key to achieving the best outcomes.

The experts committee recommends considering the creation of an independent Scientific Advisory Board. This would support the Senior Management Team in validating their scientific vision, and it would assist in external auditing of the quality of science and management.

GABI is also asked to consider the merits of periodic scientific retreats, focussed on particular topics, in which science-based issues can be fully discussed without the distraction of normal routines. This may assist with the development of transversal themes such as miRNA biology, impacts of the gut microbiome or genomic selection.

The desire to increase collaboration between the applied and basic science groupings is encouraged and fully endorsed. This will improve communication between groups, add critical mass in specific areas, and improve opportunities for publication in higher impact journals

As new phenotypes become more complex, it will be necessary to increase the range of stakeholders and disciplines involved in the research, particularly those researchers and professions who have different approaches and assumptions. In particular, in some teams within GABI it will be necessary to forge strong links with the animal health sector to ensure acceptance of the tools and approaches that GABI can provide.

There will need to be a careful focus on the projects most likely to give greatest payback in terms of scientific and/or practical outcomes. Therefore the number of projects must be balanced against the manpower available. The analyses undertaken for GABI as a whole (and for teams individually) classifying research along two axes: 'frontiers of science' vs. practical applicability of research, appeared to identify some research topics that scored poorly on both criteria. The value of such projects should be addressed.



## 4 • Team-by-team analysis

**Team 1:** BIGE (Biologie Intégrative et Génétique Equine)

Name of team leader: Mr Eric BARREY

### Workforce

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
<b>N1:</b> Permanent professors and similar positions		1
<b>N2:</b> Permanent EPST or EPIC researchers and similar positions	3	4
<b>N3:</b> Other permanent staff (without research duties)	3	3
<b>N4:</b> Other professors (PREM, ECC, etc.)		
<b>N5:</b> Other EPST or EPIC researchers (DREM, Postdoctoral students, visitors, etc.)		
<b>N6:</b> Other contractual staff (without research duties)		
<b>TOTAL N1 to N6</b>	<b>6</b>	<b>8</b>

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	3	
Theses defended	5	
Postdoctoral students having spent at least 12 months in the unit		
Number of Research Supervisor Qualifications (HDR) taken		
Qualified research supervisors (with an HDR) or similar positions	1	2

## • Detailed assessments

### Assessment of scientific quality and outputs

The BIGE team is devoted to the study of complex traits related to musculo-skeletal health and performance in sport horses (i.e. race horses and jumping horses). The focus on sport horses is justified because of the impact of the sport horse industry on the French economy. In their research the team is using the latest techniques in the field: 'omics approaches (SNP-array, transcriptome, miRNA, metabolomics) to detect new phenotypes. The group has a



strong expertise in quantitative genetics and is responsible for the genetic evaluations of different horse breeds in a classic manner adding genomic information.

This group has completely changed its team in very recent years and as a consequence, the last four years have not been especially fruitful in terms of publications. Over the reporting period, the publication rate (close to 2.1 papers/researcher/year) is close to the GABI average, however the team has an excellent proportion of 1st/last authorships (66 %), indicating leadership in the field. The former members of the team were mainly responsible for the international collaboration and were involved in publications in high standard journals for the field. A challenge is to lift the publication rate in the new research field, which currently is arguably behind target.

A good point is the long and good quality list of national projects currently running or recently completed. However, publication rate per project is low, and there is a project that has completed without any international publication. From the publications, it appeared that there has been international collaboration in the field of international breeding evaluation and developments of equine genomics (e.g. publication of the horse genome sequence). These publications were probably the fruit of networks of team members as no research project on these topics have been reported. Currently, there seems no international research projects being listed, although the team remains involved in the development of the high-density SNP-array.

### Assessment of the team's academic reputation and appeal

Worldwide there are only a few research groups working on equine genetics and the combination of genomics and quantitative genetics is even more unique in the world. The team has a very good reputation in this (small) field and has been frequently invited to international conferences and symposia, as well as to contribute to scientific books. Team members have co-authored on internationally high standard publications. Overall the level of publications is mainly attributable to the input of the "old" team.

The number of PhD-theses is relatively low; three in the last four years, resulting in only few publications.

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

The team has strong links with the breeding industry and is responsible for the breeding evaluations to the different studbooks. The strong links could facilitate a quick adoption of new knowledge into the practice, although adoption of advanced knowledge often requires additional extension in the field.

### Assessment of the team's organisation and life

The team has seen several changes in its composition during the evaluation period. This might affect the relational stability within the team. In addition, a small sized group comprising various fields of expertise results in even smaller critical mass for each area of expertise. Managing such a diverse group might be challenging. There were however no indications noticed of any problems in that direction.

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

Two PhD students are currently working in this team since 2012. The team is slightly involved in training in Master or doctorate schools. As a consequence the team is not especially visible to (international) students and young scientists.

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

Basically the team plans to continue on the same trait. The results until now suggest some QTL associated with these complex traits and as a continuation, a genomic selection scheme will be designed (jumping) or collaboration for a meta-analysis will be sought (osteochondrosis). These choices seem logical in light of the results obtained. A study in more detail on the genetic architecture of such complex traits is advised, because investigating the interplay between the QTLs found may retrieve fruitful knowledge and take the results that have been found to date to a higher level. Rather than continuing from the knowledge achieved, it seems that the team plans to follow a different strategy and will pay relative much attention to miRNA and mitochondrial DNA studies. Although interesting and certainly challenging, there is a concern that too many resources and too much effort is put into this area at the expense of further research on the results so far. In particular, ambitions might be too high in relation to the reduced group size.



## Conclusion

### ▪ Strengths and opportunities

The horse is a species with an economic importance in France which has justified the creation of BIGE. Worldwide there are only a few research groups involved in equine genetics. The team well covers the field of genomics through to implementation into practical breeding schemes; this is even more unique in the world. Further developments in integrative biology could feed their genomics work by developing better phenotypes. The team has a strong international reputation and it has a strong portfolio of research projects with which to attract international collaboration and which could be the basis of well-recognized publications. The opportunities for the next few years should be good.

### ▪ Weaknesses and threats

The team is quite small, especially as the number of scientists within the team has somewhat reduced during the last few years. However, the number of projects and the ambition within the projects seems not to be adjusted accordingly. This is a concern to the experts committee. The composition of the team in terms of expertise is quite diverse, with the consequence that the critical mass in each area of expertise is small as well.

### ▪ Recommendations

Because of its small (scientific) size the team should make clear choices in its research and prioritize topics. To compensate for its size, the team should actively seek collaboration both within GABI and INRA and internationally. The team should prioritize publishing and make a clear publication plan to optimize their scientific output and visibility.





**Team 2 :** G2B (Génétique et Génomique Bovine)

**Name of team leader:** Mr Didier BOICHARD

### Workforce

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
<b>N1:</b> Permanent professors and similar positions		
<b>N2:</b> Permanent EPST or EPIC researchers and similar positions	16	17
<b>N3:</b> Other permanent staff (without research duties)	11	11
<b>N4:</b> Other professors (PREM, ECC, etc.)		
<b>N5:</b> Other EPST or EPIC researchers (DREM, Postdoctoral students, visitors, etc.)	1	1
<b>N6:</b> Other contractual staff (without research duties)		
<b>TOTAL N1 to N6</b>	<b>28</b>	<b>29</b>

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	4	
Theses defended	7	
Postdoctoral students having spent at least 12 months in the unit		
Number of Research Supervisor Qualifications (HDR) taken	1	
Qualified research supervisors (with an HDR) or similar positions	5	5

- Detailed assessments

#### Assessment of scientific quality and outputs

G2B is a large and successful team. It covers the field of genetics and genomics applied to dairy and beef cattle, and is positioned in the area covering large-scale genomics through to application. The emphasis is on addressing questions of relevance to the two sectors, and taking the research through to application. There seems to be relatively little research positioned at the 'frontiers' or 'blue-sky' end of research, especially since the transfer of team members to MoDiT. However, the team does appear to be one of the very first groups that successfully implemented genomic selection in practice and were thus able to solve hurdles of implementation themselves, such as imputation between different density of SNP arrays. They have also had involvement in large-scale sequencing projects.



A strength of the team is in analytical skills and development of statistical/data analysis techniques. Here, the team has historically made noteworthy contribution to genetic data analysis methods and has also developed software that is applied by many other research groups. They have continued this success during the evaluation period, with several published innovations in SNP chip data analysis and genomic prediction methodologies. They have an international reputation in this field. The publication rate for G2B is close to the GABI average. During the reporting period they have achieved close to 2 papers/researcher/year, with 55 % being 1<sup>st</sup>/last author publications.

The strength of the research lies in application to dairy cattle genetics, rather than beef cattle. This is partly explicable by the fact that breeding structures and data acquisition are more advanced in dairy than beef cattle, and the fact that beef cattle breeding and genetics are more fragmented than in dairy cattle, not only in France but globally.

### Assessment of the team's academic reputation and appeal

The team enjoys a prominent role nationally and internationally, coordinating several ANR projects and involvement in several international projects and programmes, as tabulated. Their reputation was rewarded by the award of the 2013 AM Leroy Fellowship to a team member. The team attracts a good number of post-docs and students, however more students would assist in developing new areas. Publications are generally in the mid range of journals, although when considered in the context of appropriate animal science journals these are amongst the best journals. However, their scientific visibility and attractiveness would benefit from a publication policy that balances ambitious target journals as well good journals in the field of livestock genetics. The quality and originality of aspects of their research is well suited for publication in more ambitious journals. Within the field of livestock genomics, noteworthy is the recent success of the journal *Genetics, Selection, Evolution*, which is now a leading journal for scientists working in this field - two of the three chief editors come from this team.

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

The economic impact of the team is focused on the delivery of EBVs and genomic predictions to the dairy and beef cattle industries, assisted by close collaboration with Idele and UNCEIA. Therefore, without doubt the fruits of their research is taken up (or available for take up) by the industry, immediately. This is an outstanding achievement. Extension to a wider range of traits, meeting societal needs and expectations, such as resistance or robustness to various infectious diseases (e.g. paratuberculosis) is planned. Full success may require closer interaction with the animal health community, both researchers and professionals, to ensure success with these new traits.

### Assessment of the team's organisation and life

The team is effectively organized and managed, with three deputy heads and the policy of distributing research and service activities across many staff. Group members appear happy with the management of the team.

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

The team trains a relatively small number of PhD students, however these PhD theses appear to be of good quality as evidenced by the published refereed papers they produce. The team is encouraged to seek ways to increase the number of students trained, as training students is an efficient means of exploring new topics. Providing novel topics will be assisted by the large quantities of data arising from the high-throughput genomics. The team is active on a European Masters course.

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

The two main forward looking objectives appear logical and consistent with their expertise and resources. New traits and targets (e.g. methane production, health and disease resistance, behaviour and maternal traits) are more challenging than 'traditional' traits and entails that the G2B team opens more to other disciplines and collaborations. This will likely require cross-disciplinary studies collaborating with researchers who have different approaches and assumptions. Whilst challenging, this is essential to ensure acceptance of the tools and approaches that G2B can provide.



Identifying, and subsequently validating, 'large numbers' of causative mutations may be difficult. However, excellent collaboration opportunities exist within GABI to enable the full scientific potential to be realized for a small selection of causative mutations that have been found. Full scientific potential would include a functional validation of the causative mutations.

## Conclusion

### ▪ Strengths and opportunities

The major strength lies in the outstanding analytical skills contained within the team and the excellent links to industry. This combined with the opportunities given by high-throughput genomics put this team in a strong position for future success. The team have been early and effective adopters of genomic technologies and genomic prediction methods, and they are to be congratulated on this.

### ▪ Weaknesses and threats

The team faces two major challenges. The first lies in application of genetic and genomic strategies to situations that are more difficult than seen in mainstream dairy cattle breeding, i.e. cases where the breeds are small or fragmented, or for traits where data are difficult to collect or interpret. The second lies in fully exploiting the opportunities created through the identification of causative mutations, as this will increase the wider visibility and scientific attractiveness of the laboratory.

### ▪ Recommendations

It is recommended that the team continues with the same approach and strength of vision. Additional opportunities will be created if:

I) more PhD students can be trained;

II) strong dialogue is engaged with animal health scientists (for infectious disease) and animal physiologists (for methane and digestive efficiency studies);

III) strong internal collaborations are fostered to maximize scientific opportunities arising from analyses of the large-scale genomics data, including identification of causative mutations.



**Team 3 :** GenAqua (G n tique en Aquaculture)

**Name of team leader:** Ms Edwige QUILLET

### Workforce

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
<b>N1:</b> Permanent professors and similar positions		
<b>N2:</b> Permanent EPST or EPIC researchers and similar positions	6	7
<b>N3:</b> Other permanent staff (without research duties)	3	3
<b>N4:</b> Other professors (PREM, ECC, etc.)		
<b>N5:</b> Other EPST or EPIC researchers (DREM, Postdoctoral students, visitors, etc.)		
<b>N6:</b> Other contractual staff (without research duties)		
<b>TOTAL N1 to N6</b>	<b>9</b>	<b>10</b>

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	1	
Theses defended	5	
Postdoctoral students having spent at least 12 months in the unit		
Number of Research Supervisor Qualifications (HDR) taken	1	
Qualified research supervisors (with an HDR) or similar positions	3	3

- Detailed assessments

#### Assessment of scientific quality and outputs

The research of the team GenAqua comprises four pillars: genomic resources in rainbow trout, novel selection traits (adaptation to plant-based diet, disease resistance), optimization of fish selective breeding schemes and management of populations (in several species). All items are highly relevant to animal breeding and conservation. Most research topics are industry-driven, i.e. there seems to be little research directly positioned at the frontiers end of research. This does not affect the quality of the research, which fits well with the general objectives of the unit. One of the original aspects of the team's activities is that they developed research adapted to the specificities of the French fish breeding sector (i.e. many SMEs rather than a few large companies).



One of the strength of the team is that most aspects of fish breeding are covered by the team despite its limited size. There is a good balance between research dedicated to novel traits, covering both quantitative and molecular genetics, and improved design of breeding programs, notably using simulation-based approaches. The team is very efficient in obtaining funds at national or European level and in converting research into publications. They have a good list of publications (59 during the evaluated period) and these are very well distributed over the projects and the studied species. In relation to GABI, the team is slightly above average in terms of publications/researcher/year and in the proportion of 1<sup>st</sup>/last authorships. More than half of the publications are considered excellent (and beyond) in their field. Most of the publications are results of collaboration with other research groups (mainly Ifremer and SYSAAF) but few publications involve members of other teams within GABI.

### Assessment of the team's academic reputation and appeal

The team GenAqua is strongly involved in several national and European projects. It currently coordinates the European research infrastructures project "Aquaexcel". This reflects its excellent reputation in the field of fish breeding and genetics. Its participation in numerous national and international conferences and symposia is impressive. The team also contributed to the development of genomic resources and genome sequencing of the rainbow trout, collaborating with both US and French consortia. Concerning sea bass, collaboration with Ifremer and SYSAAF is effective and fruitful regarding quantitative genetics and breeding (but not to the same extent for genomic aspects which are led by other research groups in Europe).

Currently, only one PhD-candidate is present, which is low for a group of this size. Similarly only one post-doc was mentioned on the documentation.

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

The team has a strong and long-term collaboration with industry, mainly through SYSAAF, as illustrated by numerous jointly signed articles. It is participating in national and international networks and research projects, and is also involved in public extension. Being part of GABI and participant to Selgen-R2D2, its role in investigating the potential transfer of genomic selection methods to the fish breeding sector will be important, however this topic will be challenging.

### Assessment of the team's organisation and life

The team appears well managed and self-contained. It has relatively few interactions with other GABI teams as revealed by its publication record. This is mainly due to the specificity of the studied species, but also to its location within the INRA Center in Jouy-en-Josas. Its interaction with Ifremer in the form of a former Research Group (GDR), and the resulting permanent location for the last 8 years of one IR, clearly illustrates a fruitful and long term collaboration. A new researcher should join the team this year as a novel position is currently open, and this should be of great benefit to the group.

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

Currently the team has only one PhD-position, although 5 PhD-candidates have been supervised. A limitation might be the absence of a professor (or assistant professor) in the team. Given this situation, the track record on teaching activities is good as the whole team is involved in training and educating young scientists.

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

The strategic plan comprises mainly a continuation on current ongoing initiatives. There are clear new possibilities for collaboration in several research areas, although these might be limited by the present size of the team. Research on new traits which are related to more sustainable production methods is planned, and this is highly relevant to future fish production. Integrated physiology and genomics research is encouraged to provide added-value and broader interest.



## Conclusion

### ▪ Strengths and opportunities

GenAqua is a well-balanced group with a good track-record. It is rather diverse in its activities relative to its size, but this is not surprising taking into account the studied group of species. It is very efficient in generating output from the distinct research projects. The group has several collaborative partners and it is well involved in international networks on fish breeding.

### ▪ Weaknesses and threats

The team is relatively small, and as such there is a risk of dispersion and difficulties in integrating changes related to the availability of genome information in breeding. The group is quite demand-driven, directly collaborating with SME's. This should not be allowed to restrain its ability to develop ambitious and more academic research whenever possible and appropriate. Incoming recruitments will have to take into account the availability and quality of trout and sea bass genomes.

### ▪ Recommendations

The integration of the team within the GABI laboratory should be reinforced. There are clear opportunities to develop collaborations with other teams, notably as genomic resources for the targeted fish species are rapidly increasing. Considering the challenges that could be undertaken, future developments will probably require further increases in terms of manpower and collaborations. Beyond marker identification, finding causative mutations should be a goal that the team strives to achieve in as many instances as possible, as this would improve the impact of the publications.



**Team 4:** GFP-GM (Génomique Fonctionnelle et Physiologie de la Glannde Mammaire)

Name of team leader: Ms Fabienne LE PROVOST

### Workforce

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
<b>N1:</b> Permanent professors and similar positions		
<b>N2:</b> Permanent EPST or EPIC researchers and similar positions	2	7
<b>N3:</b> Other permanent staff (without research duties)	3	8
<b>N4:</b> Other professors (PREM, ECC, etc.)		
<b>N5:</b> Other EPST or EPIC researchers (DREM, Postdoctoral students, visitors, etc.)		
<b>N6:</b> Other contractual staff (without research duties)		
<b>TOTAL N1 to N6</b>	<b>5</b>	<b>15</b>

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	1	
Theses defended	3	
Postdoctoral students having spent at least 12 months in the unit		
Number of Research Supervisor Qualifications (HDR) taken	1	
Qualified research supervisors (with an HDR) or similar positions	2	2

- Detailed assessments

#### Assessment of scientific quality and outputs

The general objective of the GFP-GM team is to understand the development of the mammary gland in non-pathological conditions, as well as the long-term effect of Inflammation, nutrition, environmental factors, on this development. Members of the team are recognized experts in the field. They use physiology, developmental biology and genomics approaches to unravel the key genes at work in the normal development of the mammary gland, with a particular emphasis on microRNA.

The group arose from bringing together former members of DISC (a GABI's team that disappears as such) and GLP (another group from INRA UMR 1196). The former DISC members have a good scientific productivity and characterized, for instance, new miRNA involved in mammary gland development. However their production could



probably be qualitatively improved by further focusing on one or two major topics. They have also been quite successful in applying for both national and European grants.

In terms of publications, members of the DISC team who will join the GFP-GM team have published 16 articles since 2009. Approximately half of these publications were as first and/or last authors, and the team should seek to increase this proportion (in the same period, members of the GPL unit who will join the GFP-GM team have published 18 articles).

### Assessment of the team's academic reputation and appeal

The team has a sound academic reputation in its field and participates in different review committees for journal and grants. This is especially good given the young age profile of the team. The specificity of their analysis, i.e. of aspects of the mammary gland development not directly related with breast cancer, makes the GFP-GM team an attractive partner for collaboration. Indeed, they have set up partnerships with INSERM and Institut Curie teams to combine both aspects. However there were no post-doctoral researchers over the period under scrutiny, even though the team succeeds in obtaining funding and have recruited several students. The team secured funding for its current projects through four grants, including three ANR projects. In addition, it has submitted or participated in 5 additional ANR projects in 2014.

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

The main research aim of the team is the basic characterization of the mammary gland development. In the mid-term only, the analysis of the impact of environmental factors will be important to improve both human and animal health. For this reason, unlike most other teams of the unit, this group has only weak interactions with breeders and more generally with the economic environment. Nevertheless there is a potential for such collaborations and some possible links with the feed industry have been suggested. Globally, the research of the team fits well into INRA's research priorities and their cultural environment.

### Assessment of the team's organisation and life

Because the team is new, it is too soon to comment on this aspect.

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

The team is fairly well involved in research training, with 13 master degrees and 7 PhD over the period, which is a significant number considering the size of the team and the number of HDR. Students seem well trained in the team environment. A modest participation in teaching is also reported.

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

The project is sound and original. The new association of former DISC and GLP into one single team seems relevant and wise. The team secured funding for its current projects through four grants, including three ANR projects. In addition it has submitted or participated in 5 additional ANR projects in 2014. These projects involved collaborations with team from the unit and involved in medical research. However it remains regrettable that there is apparently no plan to interact with the LGS team despite a clear overlap between their research projects.

Studies of epigenetics, the nucleus organization or the impact of nutrition on the development of the mammary gland are very relevant. However, there is a risk of dispersion given the small size of the group. It raises the question as to whether or not the team will have the resources and expertise to address all these issues in sufficient depth to enable publication of the results in journals with a broader audience. For instance, is the "sudden" interest for lncRNA really relevant, when the main savoir-faire is on microRNA ?





## Conclusion

### ▪ Strengths and opportunities

The proposed project is excellent, with an original and relevant focus on the non-pathogenic development of mammary gland and the effect of nutrition or environmental factors. GABI's research environment and, in particular, collaboration with the G2B team will provide opportunities to identify new loci involved in lactation. This project should certainly offer opportunities to publish in journals with higher reputation and broader audiences.

### ▪ Weaknesses and threats

Large scale approaches are complex and time consuming, especially when considering experimental validation, so there is a risk of dispersion. The rationale for using two animal models (mouse and rabbit), although complementary with regard to the physiological systems studied, should be carefully evaluated both in term of scientific output and interaction with their socio-economic environment. The team also needs to secure stronger links with bioinformatics and biostatistics groups.

### ▪ Recommendations

We recommend focusing on the long-term effect of nutrition and environmental factors on the development of the mammary gland through the analysis of the miRnome. This positioning is very original and should provide opportunities both in terms of scientific output and interaction with the socio-economic environment. Similarly it is concluded that the scientific interests of the team are very complementary to those of the LGS team, and considerable advantages are foreseen if both team were to cooperate effectively. They could, for instance, look at the microRNA content in milk. Finally, it is also recommended to strengthen the collaboration with G2B to identify genes linked to lactation QTL, in cases where the size and position of the QTL are known with precision.



**Team 5:** GIS (Génétique, Immunité, Santé)

**Name of team leader:** Mr Bertrand BED'HOM

### Workforce

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
<b>N1:</b> Permanent professors and similar positions		
<b>N2:</b> Permanent EPST or EPIC researchers and similar positions	9	10
<b>N3:</b> Other permanent staff (without research duties)	10	8
<b>N4:</b> Other professors (PREM, ECC, etc.)		
<b>N5:</b> Other EPST or EPIC researchers (DREM, Postdoctoral students, visitors, etc.)	3	3
<b>N6:</b> Other contractual staff (without research duties)		
<b>TOTAL N1 to N6</b>	<b>22</b>	<b>21</b>

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	4	
Theses defended	2	
Postdoctoral students having spent at least 12 months in the unit		
Number of Research Supervisor Qualifications (HDR) taken		
Qualified research supervisors (with an HDR) or similar positions		

- **Detailed assessments**

#### Assessment of scientific quality and outputs

GIS is a large and successful team, investigating an important topic that is strategically very relevant, i.e. central to GABI's mission and very integrated to the social, economic and cultural environment of GABI.

The science presented to the experts committee was strategically important and of a high quality, however assessment of the evaluation team is that the publication output could be improved, both quantitatively and qualitatively. The team has 45 publications over the period. Out of these only 11 (25 %) had a first and/or the last authors from GIS. This is the smallest ratio within GABI. In relation to the size of the team, this output could be improved. Further, given the importance of the topic, the reputation and selectivity of journals chosen for publication could certainly be optimized in the future to enhance recognition in both the field and the wider academic community.



A balance always has to be achieved between activities promoting the profile of the team and activities promoting individual scientific output. A question is whether the high profile activity of the team in international consortia has occasionally been to the detriment of individual output. It is possible that the balance between research and leadership activities (locally, nationally, internationally) may not have been optimal.

### Assessment of the team's academic reputation and appeal

The team is very active in international activities and consortia, often leading such initiatives. Some members have coordinated European networks such as EADGENE, others have participated in different consortia. Senior researchers are often invited to international congresses. The team succeeds in attracting young foreign scientists through INRA packages and hosts three senior international scientists. Consequently, the academic reputation and international appeal of the team is excellent.

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

This is one of the strengths of the GIS team. The interaction with the social, economic and cultural environment, especially end-users of the research, is excellent. GIS scientists are involved in numerous projects and collaborations with breeders and the animal health industry. They play a key role in several so-called "metaprogrammes" launched by INRA, for example coordinating some different GISA programmes.

### Assessment of the team's organisation and life

The team has been, and continues to be, strongly led.

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

This aspect of the activities of GIS is weaker. The involvement of the team in teaching is limited, around 10 teaching hours/year for the whole team. In the same vein, only 2 PhD defended their thesis from 2009 to 2013. Within a group of near 30 people this is a very small number. A new policy appears to have emerged recently with 6 new PhD projects. This trend needs to be encouraged, and it will be facilitated by increasing the number of HDR in the team.

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

GIS team is large, but the proposed programme of research is even larger and more ambitious. Therefore, there is a risk of dispersion and fragmentation. The genetics and immunology programme constitutes the essence of GIS research, but it is necessary to carefully consider the relevance of other components of the proposed programme. The project on gut microflora and its impact on host phenotype is strategically very important; however it is a complex project that may require commitment of a large dedicated team. Does the team have sufficient resources to be deployed in this project? Are GIS scientists going to lead at least some aspects of the project or act as collaborators? Similarly the suggestion of the creation of a new team on the study of ncRNA regulation in viral pig diseases should be carefully evaluated. This may be a good research project in the first instance, but it is arguably too narrow for a team. To the contrary, the project on miRNA appears relevant and promising. In support of this, in addition to its scientific interest, several other groups in GABI also work on miRNA (BIGE, GFP-GM, GIS) and a significant amount of human resources and savoir-faire is now present at GABI in this field.



## Conclusion

### ▪ Strengths and opportunities

The team interacts extremely well with its socio-economic and cultural environment. The scientific projects fit INRA missions and have the potential to provide answers to several issues raised by the industry. GIS benefits from an international recognition that allows it to participate in many consortia at national and European levels. This increases the attractiveness and profile of the group.

### ▪ Weaknesses and threats

Although a large team, there is a risk of dispersion and missing their own scientific objectives and challenges, unless greater focus is placed on individual output. This is reflected by a low ratio of publications where GIS scientists appear as first and/or last authors.

### ▪ Recommendations

We recommend that the team continues to strive to successfully serve the GIS socio-economic environment, particularly the breeding and animal health industries. However we also recommend securing research activities that will enable the team to publish as first and/or last authors in higher impact journals that reach a wider audience. In that sense, microflora of the pig gut, although strategically sound, may potentially confine the team to a collaborator role and this is an outcome that should be avoided. We encourage the team to keep some leadership in a few well-chosen scientific projects, as this is important for the profile and attractiveness of the team. The future of the melanoma project in the laboratory also needs to be carefully evaluated in relation to the CEA commitment to that project.



**Team 6:** LGS (Lait, Génome, Santé)

**Name of team leader:** Mr Patrice MARTIN

### Workforce

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
<b>N1:</b> Permanent professors and similar positions	1	1
<b>N2:</b> Permanent EPST or EPIC researchers and similar positions	5	5
<b>N3:</b> Other permanent staff (without research duties)	1	
<b>N4:</b> Other professors (PREM, ECC, etc.)		
<b>N5:</b> Other EPST or EPIC researchers (DREM, Postdoctoral students, visitors, etc.)	1	1
<b>N6:</b> Other contractual staff (without research duties)		
<b>TOTAL N1 to N6</b>	<b>8</b>	<b>7</b>

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	1	
Theses defended	3	
Postdoctoral students having spent at least 12 months in the unit		
Number of Research Supervisor Qualifications (HDR) taken		
Qualified research supervisors (with an HDR) or similar positions	2	2

- Detailed assessments

#### Assessment of scientific quality and outputs

The general objective of the team is a genome-based analysis of milk production and of the nutritional quality of milk. To reach this goal, the team has a strong spirit for technology developments and they have been highly innovative during the last 5 years. The team has for instance set up an efficient capture platform for micro expression analyses and applied this technology to the mammary epithelial cells (MEC). With the support of an industrial partner this technology is now further developed in the framework of the @BRIDGe platform team of the unit. These technological developments aim both to address new scientific questions and to be transferred to industrial users for high throughput phenotyping of the physiology of mammary gland and of the milk composition. Another example is the novel protein profiling method to characterize and quantify the major milk proteins and their multiple isoforms by HPLC coupled to mass spectrometry.



The team itself has applied these new tools to address original questions on milk production in different models. However, the diversity of the addressed topics from expression analysis to proteomics and the focus on the technology preclude in depth analyses. In line with this, the team is mostly constituted of engineers and lack scientists as acknowledged in the report "However, it is in scientific terms that we are especially weak".

In terms of publications, the team has had only a fair recent productivity, with the lowest number of publications/research/year in GABI. It has published mostly in specialized journals. On the positive side, in many cases (60 %) the team is leader on these publications with the first and/or the last authorship. Globally these publications addressed diverse questions on the mammary gland physiology. A more in-depth analysis on a smaller number of topics would increase their impact and the international visibility of the work.

### Assessment of the team's academic reputation and appeal

The team has been very successful in obtaining funding during this period, with 10 academic contracts. This reflects its strong involvement in national projects in collaboration with other teams of the unit and with other teams from INRA and INSERM. It is also involved in international collaborations with groups from different European countries, and in the US with UC Davis. Its objective to address fundamental questions with applications for the dairy sector is reflected by industrial collaborations and funding.

The head of the team has a strong academic reputation; he is editor of two journals and member of international steering committees. He has been regularly invited to international meetings as a speaker and as a chairperson.

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

To translate technological developments into tools both for research and for applications to the industrial dairy sector is a priority of the team. Laser capture micro dissection has been successfully transferred to the @BRIDGE team with the support of five academic contracts. Members of the team are co-authors of 15 publications resulting of this platform activity. The procedures developed for transcriptome analysis of milk fat globules and of the milk protein composition by mass spectrometry are very innovative and could become very useful for genomic selection. However, the technologies involved are complex and this might hinder their applicability to routine analysis. The appropriate level of technology required for the problem must be benchmarked.

### Assessment of the team's organisation and life

The team has lost two scientists during the analysed period. There remain today only two scientists in the team: the PI and an associate professor (Maître de conférences). Together with the absence of postdocs, this might pose problems for the team to reach the proposed scientific objectives. The lack of interactions, for historical reasons, with the team GFP-GM with which they share a common interest in the mammary gland represents a second limitation for ambitious scientific achievements at the level of the unit.

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

During the period three theses were defended and a fourth one will be defended in spring 2014. All these students published as first authors one to three papers in international journals. These three doctors have now permanent positions. This witnesses the quality of the supervision.

Members of the team contribute occasionally to different teaching programs.

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

The team is planning to pursue several on-going projects and to further apply the developed technologies. Part of this research programme is already funded through ANR grants or with the private sector. These projects are in line with the general objective of the team, namely a functional genomic analysis of milk production and an assessment of the milk quality by innovative approaches. However, these projects might be overambitious and too dispersed given the small size of the team. In particular, most of these projects rely on the experience and the reputation of the team leader who is expected to retire within the next four years.



## Conclusion

### ▪ Strengths and opportunities

The major strength of this team is its capacity for innovation and the expertise of the team leader in the field of functional genomics of the mammary gland. The technological developments performed by the team represent opportunities for the research project and also for applications to the dairy industry, and particularly to the breeding industry.

### ▪ Weaknesses and threats

Given the small size of the team, the dispersion of the subjects and the absence of interaction with the GFP-GM team, the team risks not to be able to deepen the addressed questions sufficiently to publish in higher impact journals. Furthermore, there is a threat that some of these research projects will not be completed before the foreseen retirement of the team leader.

### ▪ Recommendations

It is advised (I) to focus the research programme on the most promising specific objectives and (II) to increase interactions within the GABI unit in particular with the G2B, GFP-GM and MoDiT teams to prepare the future of the remaining LGS team members.



**Team 7:** MoDIT (Modèles animaux et Différenciation Tissulaire)

Name of team leader: Mr Jean-Luc VILOTTE

### Workforce

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
<b>N1:</b> Permanent professors and similar positions		
<b>N2:</b> Permanent EPST or EPIC researchers and similar positions	4	3
<b>N3:</b> Other permanent staff (without research duties)	7	7
<b>N4:</b> Other professors (PREM, ECC, etc.)		
<b>N5:</b> Other EPST or EPIC researchers (DREM, Postdoctoral students, visitors, etc.)		
<b>N6:</b> Other contractual staff (without research duties)		
<b>TOTAL N1 to N6</b>	<b>11</b>	<b>10</b>

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students		
Theses defended	3	
Postdoctoral students having spent at least 12 months in the unit		
Number of Research Supervisor Qualifications (HDR) taken		
Qualified research supervisors (with an HDR) or similar positions	2	1

- Detailed assessments

#### Assessment of scientific quality and outputs

MoDIT is a new team, resulting from the merger of former members from two other teams (DISC and G2B). The main originality and strength of the MODIT team is its expertise on animal transgenesis, mostly mouse, that allows investigation of the function(s) of genes and gene variants. The proposed team project is original in the sense that although they work on the biology of the prion protein and related genes from the prion family, they are now initiating a project focusing on the investigation of loci linked to genetic disorders affecting early development.

As preliminary results, the team has identified three loci potentially responsible for recessive genetic disorders in the cow that affect early development with neurological consequences, progressive ataxia, SHGC and distal axonopathy. Further, preliminary data have suggested to this team that PrP (Prion Protein) has a role in early





embryonic development. They also proposed, as a concept, that transgenic animals could compensate for PrP absence through genetic adaptation or robustness.

Because the MoDiT team was created only a month before the visit of the experts committee, they don't have a history as a team. However, most members were already members of the GABI unit and were working in the field. The publication track of members of the MoDiT team indicates clearly that they are worldwide-recognized specialists in the mice transgenic field and have recognized expertise in the biology of the prion protein, as exemplified by articles of the team as first and/or last author published in *Febs. letter* (2009), *BMC genomics* (2010) and *PlosOne* (2012). The P.I. of the team collaborated in a study that reports that peripheral tissues are more permissive to prion propagation and replication than the central nervous system. This innovative work was published in a high profile journal (*Science*) in 2012.

In terms of publication rate (just under 2 papers/researcher/year for the former DISC team) the team is slightly below average for GABI, but the proportion of 1<sup>st</sup>/last authorships is equal to the GABI average.

### Assessment of the team's academic reputation and appeal

The PI has a very good reputation in the field. He was successful in obtaining national grant (ANR) in the past; he sits at the scientific committee of "Haut Conseil aux Biotechnologies"; and he is member of the editorial board of the journal *Transgenic Research*. Team members do not appear to be involved in many international infrastructures or scientific consortia. The team is aware of the need to build critical mass and plans to recruit PhD students and post-docs if successful with pending grant proposals.

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

A specificity of the team is their ability to produce transgenic mice and, more generally, to be specialists in mammalian transgenic technology and studies of gene function. Consequently they are positioned towards the 'blue-sky' end of GABI's research portfolio and have little direct interaction with the livestock industry. However, they have extensive collaboration established through their ability to use transgenic technology.

### Assessment of the team's organisation and life

Because the team is very new, it is too soon to comment on this aspect.

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

The PI supervises the transgenic experiments in the shared facility on the Jouy-en-Josas campus. The MoDiT team is involved in training courses on transgenesis through both lecturing and training. For example, (I) lectures to students of the Université Versailles-Saint-Quentin (Licence Pro Vocational Bachelor) and of the faculty of Pharmacology of Chatenay (Master II, 1 hour) and (II) training courses for students of the Université Versailles-Saint-Quentin ("Licence Pro", 8 hours/year).

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

The project is original and innovative. It is also risky on several aspects, although the risks have been well assessed. Alternatives are planned in case of delay in obtaining transgenic animals, with the use of cell lines for example. The project can be broadly divided into two inter-connecting parts. Firstly, the team will work on several members of the Prion protein family to study their biological roles. As a second axis, they will focus on loci/genes underlying recessive genetic disorders affecting early neurological development. This strategy is consistent.

The strategy is credible as it is well planned and starts from robust data. However, the team might not be sufficiently resourced or dimensioned to achieve all on-going projects. Studies on transcriptomics, bio-informatic analyses, and analysis of the development of tumours in mice will need additional people or collaborations.

If results of some preliminary steps are not obtained (invalidated genes, know-out mice, transgenic animals), the team has alternative plans that should not prevent them from advancing their projects. If things go smoothly, it seems reasonable to realize their project in a 5-year plan.



## Conclusion

### ▪ Strengths and opportunities

A strength of the team is its ability to produce transgenic mice and, more generally, its expertise on mammalian transgenic technology, allowing assessment of the function of genes. There are collaborative opportunities with other team from GABI or outside GABI to provide transgenic models for assessing function of candidate genes. The team plans to focus on loci/genes underlying recessive genetic disorders affecting early neurological development. The choice of the three loci potentially responsible for recessive genetic disorders relies on strong preliminary evidence. The analyses of the occurrence and development of tumors in transgenic mice is done in collaboration with geneticists specialized in homologous human diseases.

### ▪ Weaknesses and threats

In some cases, pertinent animal models remain to be established and to be accurately phenotypically characterized. Errors or inaccuracies in phenotyping may constitute limits to interpretations in the investigations. The team may soon face an excess of loci to analyze. It will require procedures to prioritize the genes to be further analyzed. Early embryogenesis is a multi-faceted, highly competitive field of research. Mutations might affect very different biological aspects and it might be difficult to be competitive. These projects rely on collaboration with external teams, which are required. However, the team should take care to conserve leadership in such studies. Lastly, the team will soon face the retirement of three group members, and succession planning for these people is critical.

### ▪ Recommendations

There is a need to accumulate strong evidence and, in collaboration with other GABI members, a need to establish a procedure to prioritise genes of developmental or disease-causing importance to investigate in depth. The team should establish priorities of which PrP-family members should be co-invalidated and plan which tissues need to be investigated to study early development. The achievements from studying prion protein biology, studied for its neurological role, should remain a priority as it enables the MoDiT team to establish and maintain their academic reputation in the field. This recognition will enhance their ability to obtain dedicated financial support. The impact of the project will mostly provide fundamental knowledge. However, the team should consider also how this knowledge could be useful for applications by breeders, particularly in the context of the mission of the GABI unit.



**Team 8:** PSGen (Populations, Statistique et Génome)

Name of team leader: Mr Denis LALOE

### Workforce

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
<b>N1:</b> Permanent professors and similar positions	4	4
<b>N2:</b> Permanent EPST or EPIC researchers and similar positions	6	6
<b>N3:</b> Other permanent staff (without research duties)	2	2
<b>N4:</b> Other professors (PREM, ECC, etc.)		
<b>N5:</b> Other EPST or EPIC researchers (DREM, Postdoctoral students, visitors, etc.)		
<b>N6:</b> Other contractual staff (without research duties)		
<b>TOTAL N1 to N6</b>	<b>12</b>	<b>12</b>

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	3	
Theses defended	5	
Postdoctoral students having spent at least 12 months in the unit		
Number of Research Supervisor Qualifications (HDR) taken	1	
Qualified research supervisors (with an HDR) or similar positions	5	5

- Detailed assessments

#### Assessment of scientific quality and outputs

The PSGen team is a rather heterogeneous group comprising population geneticists, population genomicists and statisticians. This heterogeneity enables them to address theoretical questions both in statistics and in genetic diversity, and contribute to a wide range of topics. The statistical axis is devoted to developing methodological analyses for new 'omics data, and also directed to the development of gene network methods with other GABI teams. The diversity axis is dedicated to the characterization of genetic diversity in different animal species, and also addressing topics such as estimation of demographic parameters or domestication processes with the aim of application in biodiversity policies. Part of the team also works in functional genetic diversity in poultry, exploring selection footprints (through the use of experimental poultry resources), identifying genes underlying major traits and developing genomic resources in poultry species (chicken, quail, guinea-fowl) as a tool for further projects dissecting complex traits (e.g., robustness, thermal stress).



The PSGen team is active in terms of publishing and has a high number of projects funded, showing good activity in the past five years. Part of the team has also an important role in providing statistics support to other GABI teams. Their publication rate (approximately 2.3 publications/ researcher/year) is the highest of the current GABI teams and the proportion of 1<sup>st</sup>/last author publications (66 %) is also high.

Several major achievements can be identified. Firstly, solving statistical problems linked to the continuously changing genomics data, with three R-based software contributions in BioConductor. Secondly, development of new methodologies based on pedigree and molecular data to estimate effective population size, with the aim of linking the management of populations with the characterization of the environment. Thirdly, participation in projects aimed at dissecting complex traits in chickens, such as robustness, heat stress or feed efficiency. This utilizes the experimental poultry resource, and aims to allow researchers to address functional questions.

### Assessment of the team's academic reputation and appeal

The team is involved and has been active in many different projects, mostly national projects but also in European projects. They also collaborate with developing countries in Africa and Asia, as seen in publications, although this work seems not to be specifically funded.

The group is known both for its statistical skills (they are experts in multivariate factorial analysis) and for its population genetics skills (collectively, the group is well known for its population diversity expertise). It has a strong activity in training schools included in European initiatives (GlobalDiv, Biobayes, PARC) and in different masters and doctoral schools.

The group has international appeal, including one researcher from another country and PhD students from Algeria, Burkina-Faso, Macedonia and Norway. One of the researchers is vice-president of the World Poultry Science Association and another participated in the scientific board of the Foundation for Research on Biodiversity.

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

The PSGen team has a good rate of production of expert and research reports. Also there is a strong interest of the team in the management of animal biodiversity through participation in forums with policy makers.

### Assessment of the team's organisation and life

The group is mixed in terms of disciplines and plays a transversal role: some of its partners are basic statisticians able to develop new methods but also able to give support to others in GABI. As a result, the contribution of PSGen to other teams of GABI is the highest in the unit. However, part of the team is located at AgroParisTech and thus interaction between population geneticist and statisticians must present some difficulties, although no indications of such are given. The members of the team make good and strong use of INRA platforms such as SIGENAE.

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

This component is strong. As part of the team comprises professors at AgroParisTech, and the number of HDR researchers is high (compared to other GABI teams), there is a good level of training activity in terms of the number of PhD theses and Master theses ongoing and/or completed in the last five years. The team undertakes an important task of training and dissemination through lectures for Doctoral, Master, Bachelor or Continuing education courses

The scientists from AgroParisTech are involved in the design and management of Master and continuing education courses. They contribute to the European master in Animal Breeding and Genetics (EMABG) and coordinate the European doctoral program ESG-ABG. Most researchers of the team also are lecturers in several courses in different French universities (on biostatistics, population genetics and animal breeding). They are also part of the training schools included in the dissemination programmes of different European projects (GlobalDiv, Biobayes, PARC).

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

Their strategy for the five-year plan includes pursuing the development of computational tools and collaborations to understand complex demographic models by clustering complex high-throughput 'omics data; analyzing high-throughput biological data produced in part by the platform CRB-GADIE (with the support of the new



@BRIDGE platform); identifying resources for adaptation to changing environments by studying traits such as thermal stress in the chicken; and, lastly, connecting genetic diversity with landscape parameters. There are no specific risks with this strategy. Given the resources and expertise available, the strategy is credible and good results are anticipated.

## Conclusion

### ▪ Strengths and opportunities

The team is strong in terms of publications, projects and research training, and has good skills in computation and use of genomic tools. The presence of diverse skills (statisticians and population geneticists/genomicists), if well managed, is a strength as it gives them good opportunities to perform research through “computational genetics”. The use of the experimental poultry, which includes various genetic lines, is a good opportunity to study footprints of selection.

### ▪ Weaknesses and threats

No potential threats, apart of possible lack of funding in the coming years (which can be seen in the high number of projects funded dealing with poultry versus those dealing with computing or with biodiversity). Another potential threat is that the research covers a diversity of topics; whilst this not a problem in itself, careful management is required to ensure that research at different levels creates synergies rather than fragmentation in the team.

### ▪ Recommendations

To ensure that the heterogeneity of the team is a strength rather than a negative point, the group should take special care to ensure that there are sufficient interactions between the different researchers of the team. This is especially important in the case of the computational experts and population geneticists, as they are spatially separated.



## 5 • Conduct of the visit

### Visit dates:

**Start:** Thursday February 13<sup>th</sup> 2014, at 09.45 am

**End:** Friday February 14<sup>th</sup> 2014, 05.15 pm

### Visit site :

**Institution:** INRA

**Address:** Domaine de Vilvert  
78352 Jouy-en-Josas

### Conduct or programme of visit:

#### Thursday February 13<sup>th</sup> 2014

09.45 am	Welcome to the experts committee
10.00 - 10.30 am	Preliminary meeting of the experts committee (closed hearing)
10.30 - 10.40 am	Presentation of AERES evaluation and of expert committee members (Mr Pierre COUBLE)
10.40 - 11.30 am	Presentation of the research unit by Ms Claire ROGEL-GAILLARD (including questions)
11.30 - 12.00 pm	Meeting with representative of Institutions
01.00 - 02.00 pm	Scientific presentation team Genaqua
02.00 - 03.00 pm	Scientific presentation team LGS
03.00 - 04.00 pm	Scientific presentation team GFP-GM
04.15 - 05.15 pm	Scientific presentation team PSGen
05.15 - 06.15 pm	Scientific presentation team BIGE

#### Friday February 14<sup>th</sup> 2014

08.15 - 08.30 am	Closed door experts committee meeting
08.30 - 09.00 am	Platform team @BRIDGE
09.00 - 10.00 am	Scientific presentation team MoDiT
10.15 - 11.15 am	Scientific presentation team GIS
11.15 - 12.15 pm	Scientific presentation team G2B
12.15 - 12.30 pm	Meeting with the representative of the doctoral school
01.30 - 02.30 pm	Sub-committee A: - Meeting with technical personnel (in French) - Meeting with Thesis students and post-docs (in English)
01.30 - 02.30 pm	Sub-committee B : - Meeting with administrative personnel (in French) - Meeting with researchers (in English)
01.30 - 03.00 pm	Meeting of the experts committee with the head of unit
03.00 pm	End of the visit
03.00 - 05.00 pm	Deliberation of the experts committee (closed hearing)
05.15 pm	Thanks and leave of the experts committee



### Specific points to be mentioned:

The experts committee enjoyed a productive, informative and interesting visit to GABI. The experts committee was generally impressed by the environment, the science and the standard and enthusiasm of presentations. Useful dialogue was enjoyed with staff (and students) at all levels of the organisation. The experts committee would like to thank not only the senior management team, but all personnel who made this possible.



## 6 • Supervising bodies general comments





*Réf. : rapport d'évaluation - S2PUR150007974 - Génétique Animale et Biologie Intégrative - 0753465J - de l'unité Génétique Animale et Biologie Intégrative*

## **UMR1313 Génétique animale et Biologie intégrative**

### **Response to the AERES Committee**

**April 10<sup>th</sup>, 2014**

All members of the GABI unit thank the Committee experts for the detailed analysis of results and research potential, and for their useful recommendations. Our response includes global comments about the whole unit as well as specific comments about each team.

#### **I - Comments about the whole unit**

##### **Scientific strategy**

GABI aims at exploiting and understanding genetic variability to increase knowledge in animal biology, and to improve production and sustainability of breeding systems in livestock. The unit carries out a continuum of activities from very fundamental to applied research, depending on teams and topics. As recommended, GABI will seek to maintain a good balance between fundamental and applied research, and will also pay close attention to continue promoting question-driven research in a context of high throughput data accumulation.

The Committee recommends vigilance in the cost-rewards ratio. We have a number of recent projects due to a renewal of scientific questions and methodological approaches in livestock during the last five years. We anticipate that strong priorities among existing projects could be further identified based on a critical evaluation of expected scientific and practical rewards. We are pleased that the Committee has identified the scheme providing an overview of GABI's research as a means to prioritize top projects since it was intended in part for this use.

The Committee suggests an external scientific advisory board. We have regular scientific discussions on our research priorities involving all team leaders and the scientific divisions we belong to. We do not think that our unit is large enough to motivate external experts to help us in challenging our priorities. There are ongoing discussions between all units involved in animal sciences aimed at creating a large-scale scientific dynamics on the Jouy-en-Josas research center. The resulting interdisciplinary scientific community (more than 450 permanent and non-permanent staff) could be a good scale to discuss scientific priorities and challenges in animal sciences with external partners.

The Committee insists on the need to host more postdoctoral and doctoral fellows. We fully endorse this strong recommendation and will seek to improve the attractiveness of our scientific topics.

## **Publications**

We agree that the unit has strong opportunities to publish results in journals with high impacts and broad audience and are quite confident that the recent successes in this direction will stand as inciting and driving forces for all teams. We will also keep on submitting articles to high level journals in our disciplines (genetics and genomics), and promote high standard publications in the journal Genetics Selection Evolution. Since the visit of the AERES Committee, we are in the process of initiating inter-team discussions on our overall publication strategy.

## **Partnerships**

The unit has had strong and long term partnerships with animal breeders that will be maintained. Due to our involvement in the genetic architecture of “new” traits related to health, the impact of digestive microbiota, and adaptation, partnerships are being enlarged to animal health academic and private partners, microbiologists, mathematicians, and the animal nutrition industry. The arrival of physiologists in the GABI unit will enhance our capacity to construct projects that combine genetics and physiology.

## **Organization, management and interactions between teams**

Our research has been presented as three axes, including modeling at the crossroad between axes. The Committee identified that the teams are not structured according to these axes. Indeed, the axes were not drawn to create team groups but to cover our scientific objectives in a multi-scale integration perspective. Our current objective is thus to increase team interactions by combining scientific questions and approaches and not to split teams between well-identified groups connected to scientific pillars. The process of preparing the AERES evaluation has paved the way toward an increase in inter-team discussions and our aim is to maintain this dynamics to construct innovative projects.

The research teams are heterogeneous in size for various reasons. We agree that opportunities still exist to refine the existing team organization, and we will be open to the onset of new teams when relevant and sound, with emerging leaders.

Even though we have reorganized the teams so that each team is located in only one building, GABI is still dispersed in five buildings across the campus. We appreciate the global recommendation that all teams should be relocated in a unique area on the campus to favor daily interactions between all GABI members and strengthen scientific links between teams. We hope that this strong recommendation will help us to promote our global project to gather all teams in a unique location.

## **II - Specific comments from each team**

### **Team 1 : BIGE (Biologie Intégrative et Génétique Equine)**

The BIGE team participates in important international projects that includes the development of a 3<sup>rd</sup> generation high density SNP chip that will be available to the scientific community, the meta-analysis of European osteochondrosis data, and the study of gene evolution using whole genome resequencing in collaboration with experts in equine phylogeny.

The team is currently being reorganized and the diversity of skills provides highly significant opportunities to study horse performances by integrative biology approaches. The combined expertise in equine exercise physiology and genetics represents one of the team’s strengths. In

addition, including the investigation of mitochondrial genetic variability and functionalities in our global objectives related to endurance and exercise is original at INRA, as well as at national and international levels.

### **Team 2: G2B (Génétique et Génomique Bovine)**

We thank the Committee for this evaluation. We agree that a good objective is to increase the notoriety of the journals selected for our publications. We already submit our results to the best journals in animal sciences and the challenge is to publish in more general scientific peer-reviewed journals. We also need to attract more postdoctoral fellows.

We fully agree that two major challenges are to apply genomic strategies to more difficult situations (small breeds, “new” traits) and to exploit the opportunities of the identification of causative mutations. This is the content of our project and we are confident that our strategies can be successful, through the combination of new phenotype collection in collaboration with animal health and physiology specialists, large scale genotyping, development of new strategies for genomic evaluation, and whole genome sequencing. We are aware of our limited capacity in functional validation and are fully open to collaborations with different GABI and external teams.

### **Team 3: GenAqua (Génétique en Aquaculture)**

We appreciate the positive analysis of our activity and strategic orientation, and the detailed recommendations provided in the report. We pay a lot of attention to the assessment that the GenAqua team is perceived as mostly industry driven, with little research directly positioned at the frontiers end of research. Links with the French fish breeding industry reflect the history of fish selection in France and thus the success of the methodological work developed by the team in this field. We want to secure this link, which is one of our strengths. At the same time, we are developing more academic programs than we did in the past (e.g. identification of causative mutations for resistance to diseases) and this orientation is being strengthened. For instance, the new position opened in the team has clearly been designed to implement an innovative approach in genetics of adaptation and homeostasis. We already have a long experience of collaboration with physiologists and specialists in biological functions, and as genomic tools become available, we will build on these existing collaborations to develop more integrative biology projects.

The report also recommends that integration of the team within the GABI unit be reinforced. With the advent of high throughput genomic data (i.e. first trout genome sequence, high density SNP array, RNAseq data), it will be possible to develop additional collaborations within GABI by sharing both methodological approaches and new scientific questions. Several projects or applications are already underway in collaboration with the GIS and PSGen teams (RNAseq analysis, detection of signatures of selection), but are too recent to have resulted in joint publications. The issue of the development and optimization of genomic selection in species other than cattle, including fish, is another important issue that can be shared within GABI.

### **Team 4: GFP-GM (Génomique Fonctionnelle et Physiologie de la Glande Mammaire)**

The GFP-GM team thanks the Committee members for their expertise. As mentioned by the Committee, the general objective of the team is to understand the development of the mammary gland. We would like to add that we also work on the function of the mammary gland. We will

carefully consider the weaknesses and threats mentioned by the Committee. We will pay particular attention to the relevance of the animal model (mouse or rabbit) chosen in our different projects. The existing interactions with the G2B team will be strengthened in a near future. Our new data on the mammary gland miRNome (Le Guillou et al., PlosOne, 2014) will provide a good opportunity to develop this collaboration.

#### **Team 5: GIS (Génétique, Immunité, Santé)**

The GIS team thanks the evaluation Committee members for their recommendations. We endorse the Committee's advice.

The Committee recommends evaluating the future of the melanoma project. This joint project between INRA and CEA is a unique large animal model of human skin melanoma, and we are confident of its great value for the study of the genetic determinism of melanoma susceptibility and the mechanisms of tumor progression and regression.

We agree with the Committee that the project on the gut microbiota is strategically very important. Animal geneticists have to play a major role in this emerging field to study the interplay between microbiota and host genetics in shaping phenotypes. We are aware that a strong team expertise in computational biology together with efficient partnerships will be required to successfully conduct such projects. We are confident that we have the capacity to build a leading position in this field, as shown by our network, ongoing projects and recent recruitments.

Based on inter-team discussions within GABI on opportunities to build a new group on regulatory genomics, the team structure may evolve during the next four years.

#### **Team 6: LGS (Lait, Génome, Santé)**

The team thanks the Committee members for their analysis which will be useful in the future. The team would like to add additional information and clarify a few points.

The team had the lowest number of publications/researcher/year in GABI for the evaluation period. However, the LGS team had the highest score for the notoriety of publications in GABI between January 2009 and June 2013 (73% excellent and exceptional), showing that the publication policy is aimed at prioritizing quality.

The Committee recommends more interactions with the GFP-GM team. Indeed interactions already exist for several projects such as the MilkChEST project coordinated by the LGS team leader, and a collaboration with Algerian colleagues on rabbit milk. In addition, the LGS team closely contributed to the PhénoFinlait project with G2B.

Finally, all ongoing research projects (MilkChEST, Caprimam, Ruminflame, EGS-ABG PhD) as well as the From'MIR project that will start in the autumn of 2014, will be accomplished at the end of 2017, before the team leader retires.

#### **Team 7: MoDiT (Modèles animaux et Différenciation Tissulaire)**

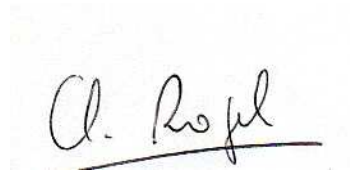
We thank the Committee experts for their support on our strategic orientation and helpful suggestions. We have no additional comments.

### **Team 8: PSGen (Populations, Statistique et Génome)**

Members of the PSGen team wish to thank the Committee experts for their appreciation and useful remarks, and more specifically, for the recognition of the publication activity of the team, the potential positive role of the combination of various skills (statistical and population genetics), and experimental work in poultry.

Concerning the points discussed in the “Weaknesses and threats”:

- We participate in recently submitted ANR and European projects that deal with statistics and biodiversity.
- We fully recognize and endorse the point about interactions and synergies within the team. We will take the opportunity of two recently funded ANR projects, DomesticChick and ChickStress, to strengthen these interactions.

A handwritten signature in black ink, reading "Cl. Rogel", with a horizontal line underneath.

Claire Rogel-Gaillard  
Head of the Laboratory  
With the agreement with the supervising institutions