

REPORT ON THE RESEARCH UNIT:  
Molecules of Communication and Adaptation  
of Microorganisms (MCAM)

UNDER THE SUPERVISION OF THE  
FOLLOWING INSTITUTIONS AND  
RESEARCH BODIES:

Muséum National d'Histoire Naturelle  
Centre National de la Recherche Scientifique -  
CNRS

**ÉVALUATION CAMPAIGN 2017-2018**  
GROUP D



In the name of Hcéres<sup>1</sup>:

Michel Cosnard, President

In the name of the expert committee<sup>2</sup>:

Craig Faulds, Chairman of the committee

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

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

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

This report is the sole result of the unit's evaluation by the expert committee, the composition of which is specified below. The assessments contained herein are the expression of an independent and collegial reviewing by the committee.

## UNIT PRESENTATION

<b>Unit name:</b>	Molecules of Communication and Adaptation of Microorganisms
<b>Unit acronym:</b>	MCAM
<b>Requested label:</b>	UMR
<b>Application type:</b>	Renewal
<b>Current number:</b>	7245
<b>Head of the unit (2017-2018):</b>	Mr Philippe GRELLIER
<b>Project leader (2019-2023):</b>	Mr Philippe GRELLIER
<b>Number of teams:</b>	4

## COMMITTEE MEMBERS

<b>Chair:</b>	Mr Craig FAULDS, Aix Marseille Université
<b>Experts:</b>	Ms Corinne BURE, Centre de Génomique Fonctionnelle de Bordeaux (supporting personnel)
	Ms Marie-France DELAUW-CESBRON, Université Grenoble Alpes
	Mr Paul DENNY, Durham University, United Kingdom
	Mr Marcel JASPARS, University of Aberdeen, United Kingdom
	Mr Pierre LABADIE, Université de Bordeaux (representative of CoNRS)
	Ms Amel LATIFI, Aix Marseille Université
	Ms Anna-Maria ROVERO-PAPINI, Université de Cergy-Pontoise (representative of CNU)
<b>HCERES scientific officer:</b>	Mr Steven BALL
<b>Representatives of supervising institutions and bodies:</b>	
	Ms Martine HOSSAERT, CNRS – INEE
	Mr Jean-Denis VIGNE, MNHN

## INTRODUCTION

### HISTORY AND GEOGRAPHICAL LOCATION OF THE UNIT

The Joint Research Unit N° 7245 of CNRS and the National Museum of Natural History (MNHN) Molecules of Communication and Adaptation of Microorganisms (MCAM) was established in 2009 in Paris after a period of restructuring and merging of laboratories, and was labelled a UMR of CNRS in 2011. The unit is spread across 5 buildings around the garden and the "Îlot Poliveau" of MNHN.

The unit is composed of a staff of 58 permanents, with 7 professors, 14 lecturers (MCF), 8 researchers, 29 technicians and administrators, and shared 5 analytical platforms and 3 mutualized technical services. The unit is responsible of 6 collections, not only culture but also ancient and patrimonial collections.

### MANAGEMENT TEAM

The MCAM Unit is headed by Mr Philippe GRELLIER, advised by the ex-Head of unit Ms Sylvie REBUFFAT.

### HCERES NOMENCLATURE

Principal: SVE1 Agronomie, Biologie Végétale, Ecologie, Environnement, Evolution

Secondary: SVE2 Biologie Cellulaire, Imagerie, Biologie Moléculaire, Biochimie, Génomique, Biologie Systémique, Développement, Biologie Structurale

SVE3 Microbiologie, Immunité

ST4 Chimie

### SCIENTIFIC DOMAIN

MCAM constitutes a unique pluridisciplinary scientific pole at MNHN devoted to the molecular mechanisms of communication and adaptation of microorganisms to their environment based on chemical, biochemical, biological, ecological and genomic approaches with the common objectives to study the role of microorganisms in the maintenance, the balance and the evolution of microbial systems. MCAM is organised into 4 research teams investigating: (1) the role, mechanism of action, and ecological roles of microbial proteins/peptides and metabolites; (2) the natural and chemical synthesis of fungal secondary metabolites and their role in the interaction of fungi with plants and algae; (3) the biodiversity of protists and nematodes and the mechanism of their adaption to the environment; and (4) the biodiversity of cyanobacteria and their toxins having an impact in their aquatic environment.

### UNIT WORKFORCE

Unit workforce	Number 30/06/2017	Number 01/01/2019
<b>Permanent staff</b>		
Full professors and similar positions	7	8
Assistant professors and similar positions	14	12
Full time research directors (Directeurs de recherche) and similar positions	2	2
Full time research associates (Chargés de recherche) and similar positions	6	5
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")	0	0

High school teachers	0	0
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	29	26
<b>TOTAL permanent staff</b>	<b>58</b>	<b>53</b>
<b>Non-permanent staff</b>		
Non-permanent professors and associate professors, including emeritus	4	
Non-permanent full time scientists, including emeritus, post-docs	11	
Non-permanent supporting personnel	1	
PhD Students	14	
<b>TOTAL non-permanent staff</b>	<b>30</b>	
<b>TOTAL unit</b>	<b>88</b>	

## GLOBAL ASSESSMENT OF THE UNIT

MNHN organisation enables MCAM to promote a unique national and international pluridisciplinary configuration in the communication between microorganisms and their adaption to different environments. The unit also hosts 6 enriched collections providing reference and environmental strains for fundamental and applied studies.

The unit has adopted such a pluridisciplinary approach within their research at the interface of biology and chemistry to address key questions involving the role of the different organisms in the global stability and evolution of ecosystems, and how these adaptations address important societal challenges related to the environment and health, and in providing innovation through bio-inspired novel molecules.

Members of MCAM have developed strong recognition and expertise in their areas, being highly involved in non-research activities as well as in a number of national and international publishing, evaluating and consultative activities. They have taken leading roles in the dissemination of their science to the public and to the academic community through high impact reviews and a very good publication record.

It is proposed to evolve the current research into four themes which will underpin the focus of each research team, adopting specific model organisms and an integrated comparative –omics approach in order to further increase the national and international visibility of the unit in the coming period. While this approach will lead to much more in-depth understanding of these organisms in their respective ecosystems, the challenge will be to further exploit the natural diversity of the collection. By undertaking a sharpening of focus and inter-team collaboration within the unit, this will lead to much more inspired discoveries in areas of high environmental and commercial importance, and place the unit at the forefront of their research and future socio-economic needs.

## DETAILED ASSESSMENT OF THE UNIT

### CRITERION 1: QUALITY OF SCIENTIFIC OUTPUTS AND ACTIVITIES

#### A – Scientific outputs and activities, academic reputation and appeal

Scientific outputs and activities, academic reputation and appeal From 01/01/2012 to 30/06/2017	Number
Articles: scientific articles	316
Articles: review articles	15
Scientific articles with a unit member as last author	143
Medical articles (if relevant)	0
Books: scientific book edition	3
Books: book chapters	33
Academic research grants: European (ERC, H2020, etc.) and international (NSF, JSPS, NIH, World Bank, FAO, etc.) grants	14
Academic research grants: national public grants (ANR, PHRC, FUI, INCA, etc.)	39
Academic research grants: local grants (collectivités territoriales)	73
Academic research grants: PIA (Labex, Equipex etc.) grants	4
Academic research grants: grants from foundations and charities (ARC, FMR, FRM, etc.)	5
Visiting scientists	58
Post-docs	
Electronic tools and products: softwares	0
Electronic tools and products: libraries and cohorts	3
Electronic tools and products: decision tools	1
Editorial activities: participation to journal editorial boards (books, collections)	6
Peer reviewing activities: participation to institutional committees and juries (CNRS, INSERM, etc.)	yes
Peer reviewing activities: reviewing of journal articles	yes
Peer reviewing activities: participation to lab site visit committees (HCERES etc.)	yes

Peer reviewing activities: grant evaluation (public or charities)	yes
Scientific recognition: prizes	2
Scientific recognition: distinctions	3
Scientific recognition: chair of learned and scientific societies	yes
Scientific recognition: invitations to meetings and symposia (out of France)	41

## Strengths

The MCAM Unit has made significant contributions between 2012-2017 in the chemistry and microbiological implications of molecules involved in signalling and adaption to environment and changes.

During 2012-2017, with a permanent workforce of 58 permanent staff, the MCAM Unit has produced 331 scientific articles and reviews from their 4 teams and 5 associated platforms, with 53 of them resulting from inter-team and platform collaborations, with an average of 55 papers per year. The mean IF of the journals in which the articles are published is between 3 and 4, and includes a number of high impact review articles from different teams. As far as global IF is concerned, the best journal consisted of Energy and Environmental Sciences (IF17) and several Natural Products Reports (IF11) coordinated by the unit. Several multidisciplinary journals were targeted including PNAS (1 as participant and 1 as leader of a collaboration). However, no science or Nature-type of multidisciplinary papers were reported. It must be noted that, especially in chemistry, the IF score does not necessarily correlate with the journal's reputation. Through common team papers, the quality of publication increases, and not including the one 3 team publication (IF 3.7, Q1), the average IF increases from 2.765 to 3.476 when 2 teams work together with/without the platforms, and the number of articles in the 1st Quartile increases from 43% to 62%. This value is not biased towards fundamental against applied research as it is based on the Quartile value for the given category in the Unit self-evaluation report.

Moreover, IF judgement is not the only criteria to judge scientific impact, and the inclusion of a number illustrating non-self citations from the unit publications illustrates more clearly the impact their science has on the academic community (119 average citations per year 2012-2017, using MCAM in address on WoS, and 168 citations per year using UMR 7245).

Members of the unit are involved in editorial activities, which, along with participation in working groups and evaluation panels, highlights their recognition in their respective research fields. Each of the teams has been involved in the organisation of international congresses/symposiums during 2012-2017, both at the scientific committee level and in the organising committees. Furthermore, members of the unit have participated in 13 research networks (GDR, COST, GIS and Labex), and two team members were responsible for a thematic chair of collaboration between France and Brazil in 2016. At the international level, more than 55% of MCAM publications are associated with a foreign team (European and French-speaking countries, Brazil, China, Vietnam, Malaysia, etc.). Most of these collaborations are supported by cooperative programs in which the unit is leader.

The MCAM is recognized in emerging infectious diseases, bacterial drug resistances, water sustainability, green chemistry. This recognition is realized by numerous national and international collaborations between the unit's researchers and teams with complementary expertise. The MCAM Unit has attracted 58 post-doctoral and invited researchers to come and work in the unit, although the distribution of these researchers across the teams is not uniform. They have attracted researchers to come and work in the unit from all parts of the world financed through different sources.

MCAM is responsible for 6 collections: Protist collection; zooparasitic Nematode collection, Porifera collection, living collections of unicellular eukaryotes, microalgae and cyanobacteria, and chemical and extract libraries. Collections are regularly enriched by deposits of type specimens or specimens sampled during naturalist expeditions that serve as taxonomic references. Living collections provide references and environmental strains that are used for fundamental (model organisms for biological questions) and applied researches (studies on human or veterinary pathogens for example)

## Weaknesses

There are no joint publications involving all four teams, and only one publication where 3 teams are involved (E2, E3 & E4), illustrating the disparity rather than integration of research themes within the Unit. The majority of common papers (52 out of 53) involve one team or two teams and/or the platforms and are published in journals over a large range of subjects (13 subject headings). The publication of high impact reviews, while

considered a strength, is not inter-team and gives a slight biased increased in the overall unit impact.

As indicated in their own SWOT analysis, the unit have a weak impact in the international arena with low involvement in European projects and COST Actions, and this will have an effect on their attractiveness as a research unit outside of France. Higher visibility of both the research activities of the unit and the expertise and availability of the platforms could contribute to improving this aspect.

### Assessment of scientific outputs, reputation and appeal

While occupying a unique area in research and having excellent and dedicated analytical support, the Unit has been able to deliver a sufficient number of very good to exceptional papers but not translate this towards outstanding original publications with high impact, which has an effect in obtaining international and industrial funding.

## B – Interactions with the non-academic world, impacts on economy, society, culture or health

<b>Interactions with the non-academic world, impacts on economy, society, culture or health</b> <b>From 01/01/2012 to 30/06/2017</b>	<b>Number</b>
Technical expert or standardization reports	324
Socio-economic interactions: industrial and R&D contracts	15
Socio-economic interactions: Cifre fellowships	1
Socio-economic interactions: creation of labs with private-public partnerships	0
Socio-economic interactions: networks and mixed technological units	3
Socio-economic interactions: start-ups	1
Socio-economic interactions: patents, licenced patents and inventions	20
Public outreach: radio broadcasts, TV shows, magazines	13
Public outreach: journal articles, interviews, book edition, videos, etc.	3
Public outreach other popularization outputs	yes
Public outreach: debates on science and society	26

### Strengths

Throughout the unit there seems to be a positive attitude towards filing disclosures of invention and proceeding from there to file patents. During the evaluation period 14 disclosures of invention and 6 patents were filed. For one of these patents, several notes of interest were received and for another, translational funding was awarded to validate the technology in a real world situation. They also have created 320 technical survey reports, in this evaluation period.

The development of software for genome analysis is an important and valuable output from the unit, as well as the formation of the chemical and extract libraries and their incorporation into the large French library



initiative. This resource will pump prime other projects as well as bring in some funds from its out-licencing. The unit also takes an active role in applying international policy to the unit's collection by providing advice on how the Nagoya protocol should be applied locally. Parts of the unit provide important input into the development of environmental policy. Public engagement is taken seriously by the unit, with many excellent examples in the print and broadcast media as well as presentations and participation in exhibitions, debates and science fairs. All of these will draw in different sectors of society and allow the unit to explain its relevance.

## Weaknesses

As with any academic research institution, prosecution, maintenance and valorisation of patents is difficult. A better strategy is needed within the unit to translate this intellectual property to a stage where it can be licensed to industry or form the basis of a spinout. It would be important to know how much contract research and patent royalties bring in currently. It is not clear how much direct interaction there is between the unit and industry, but the development of a strategy is essential to encourage this. Maintaining and increasing the size of collections will be challenging in the future. This may mean additional funds will be necessary, or that difficult decisions have to be made as to which part of the collections to maintain. An additional threat is implementation of the Nagoya protocol ' the unit should be proactive in counselling the developing national legislation for collections. In terms of public engagement, a consolidated approach, instead of the current ad-hoc approach, is lacking throughout the unit. Such a strategy should consider how to reach different sectors of society, which types of media/activities to use and how to spread the workload across the whole of the unit. Such an approach will lead to longer-term engagement with different actors in society. There is no clear unit strategy for encouraging and fostering industry interactions and this needs to be developed.

### Assessment of the interactions with the non-academic world

Industry interaction is good, with a reasonable number of disclosures and patents, as well as useful software products. Public outreach is considered to be good to very good with examples of high-level media appearances.

## C – Involvement in training through research

Involvement in training through research From 01/01/2012 to 30/06/2017	Number
Habilitated (HDR) scientists	21
PhD students	50
Defended PhDs	35
Mean PhD duration	36.9 months
Mean number of publications per student	3.1
Educational outputs: books	1
Educational outputs: e-learning, MOOCs, multimedia lessons, etc.	4

## Strengths

During the current contract, MCAM received 49 visiting foreigner researchers and academic, PhDs or post-docs, coming for trainings. During the interviews the PhDs were essentially satisfied both with the training they

received and their career prospects. The vast majority of PhD trainees of the last reporting published papers both at the first author level and as co-authors in very good mostly chemistry oriented journals MCAM members are strongly involved in the specialty "Mechanisms of the Alive and Environment (MVE) of the Master Environment, Natural Heritages, Societies (EPNS) of the MNHN. MVE allows the students to deepen theoretical knowledge and to acquire technical skills in the fields of microbiology, ecotoxicology and ecology, opening perspectives both for PhD positions and in the industry in the field of microbiology, toxicology, pollutants. It comprises one M1-program and two M2-programs (M2-MVE-Microbiology, Environment and Health and M2-MVE-Molecules and Therapeutic Targets) that are both in partnership with UPMC (40-50 students/year). MDCEM established strong international collaborations with Vietnam and Italy (3 students from the University of Science and Technology of Hanoi, an ERASMUS agreement with the University Federico 2 of Naples was signed up to 2021 allowing hosting Italian ERASMUS students for internships in the field of marine natural products, a PhD in co-tutorship was defended in May 2017). The participation in the COST European network MARISTEM on "Marine Invertebrate Stem Cells" (2017-2021) is particularly relevant. Moreover a collaborative project involving the Scottish Association for Marine Science (C. GACHON, Oban, Scotland) and Kongju University (GH KIM, Korea) was performed in CPNF with numerous PhD and master students from different nationalities. Research animation concerning Natural Product Chemistry and Chemical Ecology, including the initiation and management of the GDRI (i-NPChem) in 2016 was coordinated by CPNF. Numerous unit members participated in "Écologie chimique: le langage de la nature", a collective book under the direction of Ms Martine HOSSAERT McKey and A.G. BAGNÈRES-URBANY, in Chemical Ecology, ISTE Wiley. Moreover the participation to a COST action allowed the CCE group to be involved in the COST synthesis workbook "Handbook of cyanobacterial monitoring and cyanotoxin analysis" (first edition in January 2017). The unit also produced 3 MOOCs

## Weaknesses

Three new HDR were obtained during the evaluated period, limiting the number of hosted PhD students (two HDR are planned in 2018-2019). Some difficulties to recruit motivated PhDs are possibly linked to the national policy of the "Écoles Doctorales", especially because of the pluridisciplinary researches performed in the teams of the unit. On the other hand being the unit involved in several research working groups at the national (3 GdRs) and international level (GdRI, COST) more PhDs and Postdocs could be attracted, particularly in codirection. It is also possible that the heavy solicitation for collaborations in proteomics and metabolomics, mainly because of the analytical facilities, lead to a dispersion of MCAM's research themes and workforce..

### Assessment of the involvement in training through research

MCAM is excellent in training PhDs and Postdocs through research.

## CRITERION 2: UNIT ORGANISATION AND LIFE

Unit organisation and life From 01/01/2012 to 30/06/2017	Number
Women/men ratio in the unit	36/22
Women/men ratio among unit scientists	17/11
Women/men ratio among unit PhD students	31/19
Women/men ratio among team leaders, unit head and deputy heads.	6/1

## Strengths

Following the very highly rated last evaluation report, the unit underwent changes in team leadership, where the director and associate director of the unit relinquished their roles as team leaders, thus putting in place the current leadership team. Further management changes took place during the current contract with the retirement of Ms Sylvie REBUFFAT and Mr Philippe GRELLIER assuming his position as director of MCAM. Further reorganisation of MNHN in 2015 with the appointment of Mr Bruno DAVID as its president, has meant that the MCAM Unit is placed together with 4 other units in the new Department of the Adaption of the Living.

MCAM 4 research teams are strongly supported by 5 of the 13 MNHN technical platforms (NMR, MS, electron and fluorescence microscopy, cytometry and qPCR), animal facilities and shared technical services. The presence of the analytical platforms provides the research teams a fantastic opportunity to utilize state-of-the-art equipment with highly qualified technicians in the daily performance of their research activities. It is encouraging for those in the analytical platform to see their work acknowledged by adding their names as authors in certain publications giving credence to their essential role in the success of the unit's research.

University and research organisation staff is distributed across the 4 teams and 2/3rds of the ITAs are dedicated to the technical platforms. These Platforms are available for all research within MNHN and for outside collaborations. The CNRS model has been adopted for internal rules, and adapted to any particular site issue. These are continuously revised in consultation with the unit council. The unit supports a policy of gender equality and gender perspectives, with a high proportion of women to men in all categories in the table, which is becoming increasingly common in science. All heads of teams in both the present and future unit project are female.

Due to the unit being located in different buildings of the MNHN, an organisation structure that necessitates good communication and efficient day-to-day functioning was established, with different structures set up with the function to advice the unit direction. The director is assisted by 4 people in administrative and financial management, and member of the unit comprise separate health & safety, budget, computing/security, training, ethics, communication and international relations committees. Members of these committees represent the unit at relevant meetings with CNRS and MNHN, transferring information to the Director and Staff. The budget committee includes the director, the finance assistant and representatives of the 4 teams, and meets twice a year to discuss budget allocation, needs and reallocation when required. All committees ensure that many staff members assume responsibility in different areas of the unit and that information is well disseminated to all staff.

The unit holds a lab-council, statutory according to CNRS rules, which meets between 5-8 times per year and includes the director, 7 representatives across the different staffing categories, 2 members appointed specifically by the director and an ex-officio member. This council has a consultative role to determine broad scientific and technical guidelines for the unit, the acquisition and installation of common equipment and material, staff recruitment (researchers and ITAs). It is a positive aspect that decisions taken at this council meeting are validated by those attending before transmission to all staff. Additionally, the unit holds General Assemblies to discuss major issues and changes which affect the life of the unit. The unit produces an internal information bulletin to inform staff of changes and other events in the life of the Unit, and it is important that this and the seasonal gatherings are supported by the unit management to ensure a healthy atmosphere exists within the unit as a whole and in the different locations.

The director is aided by the presence of the previous director with an advisory role, and a meeting between these two and the team leaders is held on a regular basis. In the new project, this council will become the executive board of the unit. This is the only main alteration in the management structure proposed apart from the specific name and responsibility changes for the 4 teams.

The unit has seen a slight increase in personnel over the 2012-17 period, indicating a strong support of the unit by CNRS and MNHN, and showing that the unit is attractive, as 5 staff joined the unit through mutation/mobility, and 1 professor, 3 lecturers, 2 junior researchers and 3 ITAs were recruited in the unit. This growth should be considered a strong plus for the unit at a time where it is difficult to replace staff losses.

Innovative research ideas are encouraged through internal funding for trainees and this will lead to greater stimulation in the unit, although it is not clear what is meant by funding projects "at risk", and if this is specific for innovative ideas covering only one team or meant to have a multidisciplinary/multiteam approach. If it is meant to represent an allocation of resources to projects with a high level of risk ("blue-sky" research), then this is a great idea to allow the development of ideas and preliminary experimental data which would be incorporated into a full project proposal.

It is particularly worth pointing out the active scientific animation being carried out in the unit, especially the conference organisation which facilitates a dissemination of the work of the unit, and the invitation of external speakers (French and non-French) to present and discuss their research lines with staff of MCAM, and to generally widen the scientific and general knowledge of everyone. These aspects are not always taken as far in other Units, both in France and outside, and should be commended.

## Weaknesses

The dispersion of the unit across the 5 different locations is a logistical issue that requires duplication of equipment and services, and the physical partitioning of unit personnel. This can lead to a lack of cohesiveness and requires the direction and team leaders to pay special attention to communication and activities to ensure collectiveness.

Staff turnover obviously had an effect on the health and wellbeing of some of the administrative and financial support staff, which had to be addressed by the director of HR at MNHN. This issue appears not to be a solvable one at present unless new appointments replace those to be naturally lost by retirement and a system to help staff in need of advice is available. Stress management is also not facilitated by incompatible softwares and other issues resulting from the two main institutions of which the unit is dependant, i. e. MNHN and CNRS.

Increased competition in obtaining research funding to support good students and to attract new "blood" to the unit is an issue facing all research labs these days. A list of funded projects is provided in the self-evaluation document, but for every project funded there are many submitted that fail to be funded, whatever the reason. It is important to keep the motivation going and to encourage all staff members to contribute to project ideas, no matter how small. It is worth rethinking how adverts for new positions are written to attract more high-level applicants.

The promotion of cross-disciplinary and new themes between the researchers is obviously considered a difficult, and therefore weak, point by the unit. A unit must be always open to consider the application of cutting-edge technologies to their research plan, and this should be encouraged further within the new project plan by common technologies shared across the teams ensuring a better communication and brainstorming approach.

Reorganisation and fusion of existing University structures within Paris has obviously influenced the life of the unit in this period, including the appointment of a new president at MNHN and the loss of the Labex project. The unit must wait the outcome of the submitted EUR to know the future direction it has to take in terms of external collaborations within the region.

### Assessment of the unit's life and organization

The unit has an excellent, dynamic life through good communication and animation events despite location issues, good integration of staff in management/responsibility roles, but management needs to more proactive rather than reactive to the changing needs of the staff. Stress management is a continuing issue for staff.

## CRITERION 3: SCIENTIFIC STRATEGY AND PROJECTS

### Strengths

The MCAM Unit occupies a unique niche in the microbiology and synthesis of natural secondary metabolites. The recruitment of young researchers over the last few years has strengthened the unit although there will still be adaption to make through the natural loss of key researchers.

The proposed MCAM project plan for 2019-2022 comprises 4 overlapping consensus research themes. These themes are clearly in line with the competences available within the unit and have adaptability for all the model organisms of interest within the 4 research teams (bacteria, Archaea, marine holobionts, actinomycetes, endophytic fungi, algae, cyanobacteria, free-living and parasitic protists). The enactment of the proposed topics will be strongly supported through the collaborations with the technical platforms and support services. The themes integrate a bottom up approach, from molecule to ecosystem and should allow the research to become better integrated. The unit builds these themes on the competences in "comparative -omics" developed over the previous 5 years.

The scientific orientation and objectives for each team build upon selected model compounds and microorganisms identified from previous work, and strengthens the ability of the teams to create a more unique and powerful international impact. The project plan also builds upon the utilisation of the natural diversity found in the different culture collections in-house.

## Weaknesses

It is not clear, from the descriptions by the separate teams, if and how the 4 consensus topics will be integrated into their individual research plans and how this will lead to integration across all the teams, not just between BIM and CPNFB. While the vision is there, there is still a lack of detail on how this will be integrated.

There is still an imbalance across the 4 teams concerning permanent staffing. The high proportion of Museum/university researchers to CNRS/INSERM researchers may cause extra pressure in adapting these changes, both scientific focus and technical ability to addressing these new themes, given the high teaching and administrative demand placed on professors. The unit must take care to ensure that burnout does not start to develop.

Apart from Team 1 (BIM), no clear leaders have been identified for the proposed projects within the other 3 teams. An indication on how much time people will give to each project in the team should be given in order to assess if one project will have more time resource than another.

The teams have not assessed and identified where a strategic collaboration would be beneficial to cover aspects which were self-assessed to be still weak or yet to be established at MCAM, such as synthetic biology, metabolomics and bioinformatics. This also includes collaborations with other units within MNHN.

There is no proposed plan, either at the unit level or at the team level, to develop the proposed research towards industrial and/or governmental/NGO agencies to enhance the exploitation of the research.

Apart from doctoral research grants that will last up to 2019-20, there are no financial details to show how the unit will support the proposed cutting-edge and expensive technologies to be employed in the new scientific strategy. Only 3 research contracts going beyond 2018 are presented in the document, and in the case of some of the teams, there is no apparent external funding in place.

### Assessment of the scientific strategy and projects

The evaluation panel felt that the proposed new scientific strategy for 2019-2023 was good to very good requiring more coordinated working practices to ensure a clear and uniform vision to realize the ambitious and exciting projects proposed.

## RECOMMENDATIONS TO THE UNIT

### A – Recommendations on scientific production and activities (criterion 1)

The members of the unit are recommended to take more leading roles in proposals to funding bodies, including Horizon 2020, concurrent with their areas of expertise and proposed strategy. This will lead to a higher visibility of the unit at both the national and international level, and their ability to attract funding from a variety of academic, charitable and industrial sources and staff/students.

The unit is recommended to define a publishing strategy to target higher impact multidisciplinary journals which are accessible through their chemical ecology approaches.

Further collaboration between the 4 teams is encouraged to increase the impact of the unit.

The unit should exploit its position as part of the MNHN and its unique scientific focus on microbes from organism to gene to molecule to engage at the unit level rather than only at the team level more with both public and industrial players. The unit would benefit from a coherent and coordinated outreach strategy to build on the current successes. A strategy needs to be further developed to transfer the scientific discoveries from investigations towards IP protection and industrial contracts.

A rejuvenation of the staff, with now a majority of 35-45 year-old researchers and a renewal of the scientific competences in direct link with the unit project will overcome the weakness points of the unit in term of involvement in training through research for PhDs and Post-docs.

### B – Recommendations on the unit's organization and life (criterion 2)

The Unit should ensure a good balance of lecturers, researchers, post-doctoral appointments and doctoral students across all the teams; and while the unit has been effective in attracting new staff in the current period, it should pay attention to planned and unplanned changes to team and overall unit composition to ensure a continuation of high excellence and to deliver in the proposed new areas of research.

The proposed creation of a formal, rather than informal, executive board, comprising the director and team leaders, has to adopt collective responsibility for the delivery of a strategy to ensure clear communication with the actors across all areas of the unit. Particular attention should additionally be paid to a clear and strong strategy to replace planned and unexpected staff losses, in order to enhance the continuing development of the unit's organization and life, without placing unnecessary burden on existing employees.

### **C – Recommendations on scientific strategy and projects (criterion 3)**

While building on the scientific and technical development over the last 5 years, the unit needs to ensure general support of the 4 proposed themes across the teams, in order to enhance the productivity and international impact of their science. The unit should consider appointing PhD students to explore innovative cross-team pluridisciplinary approaches which would lead to higher impact research enhancing the unit's national and international profile in the field of microbial systems and natural product chemistry.

## TEAM-BY-TEAM ANALYSIS

**Team 1:** Biochemistry of Microbial Interactions (BIM) (former MDCEM team)  
**Team leader:** Ms Yanyan Li

### TEAM SCIENTIFIC DOMAIN

The MDCEM team research is focused on characterisation of the molecular interactions involved in microbial competition and adaptation of microorganisms to their environments, studying antimicrobial peptides, small molecules and prokaryotic surface-layer proteins.

### TEAM WORKFORCE

Team workforce	Number 30/06/2017	Number 01/01/2019
<b>Permanent staff</b>		
Full professors and similar positions	2	2
Assistant professors and similar positions	4	3
Full time research directors (Directeurs de recherche) and similar positions	1	1
Full time research associates (Chargés de recherche) and similar positions	1	1
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")	0	0
High school teachers	0	0
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	4	4
<b>TOTAL permanent staff</b>	<b>12</b>	<b>11</b>
<b>Non-permanent staff</b>		
Non-permanent professors and associate professors, including emeritus	0	
Non-permanent full time scientists, including emeritus, post-docs	2	
Non-permanent supporting personnel	0	
PhD Students	4	
<b>TOTAL non-permanent staff</b>	<b>6</b>	
<b>TOTAL team</b>	<b>18</b>	

## CRITERION 1: QUALITY OF SCIENTIFIC OUTPUTS AND ACTIVITIES

## A – Scientific outputs and activities, academic reputation and appeal

Scientific outputs and activities, academic reputation and appeal From 01/01/2012 to 30/06/2017	Number
Articles: scientific articles	72
Articles: review articles	4
Scientific articles with a unit member as last author	33
Medical articles (if relevant)	n/r
Books: scientific book edition	1
Books: book chapters	11
Academic research grants: European (ERC, H2020, etc.) and international (NSF, JSPS, NIH, World Bank, FAO, etc.) grants	2
Academic research grants: national public grants (ANR, PHRC, FUI, INCA, etc.)	16
Academic research grants: local grants (collectivités territoriales)	26
Academic research grants: PIA (Labex, Equipex etc.) grants	0
Academic research grants: grants from foundations and charities (ARC, FMR, FRM, etc.)	1
Visiting scientists	15
Post-docs	
Electronic tools and products: softwares	0
Electronic tools and products: libraries and cohorts	0
Electronic tools and products: decision tools	0
Editorial activities: participation to journal editorial boards (books, collections)	1
Peer reviewing activities: participation to institutional committees and juries (CNRS, INSERM etc.)	yes
Peer reviewing activities: reviewing of journal articles	yes
Peer reviewing activities: participation to lab site visit committees (HCERES etc.)	no
Peer reviewing activities: grant evaluation (public or charities)	yes
Scientific recognition: prizes	0



Scientific recognition: distinctions	2
Scientific recognition: chair of learned and scientific societies	yes
Scientific recognition: invitations to meetings and symposia (out of France)	11

## Strengths

In 2012-2016 the MDCEM team published 2.66 publications/year with an average impact factor of 4.370 (2012-2017, *JCR Thomson Reuter*) in multidisciplinary fields including microbiology, chemistry, i.e., analytical, medicinal, organic, physical chemistry, biochemistry and molecular biology, environmental sciences and bioremediation, ecological function resulting among others in 1 co-authored PNAS (in collaboration), 1 *Nat. Chem Biol.* Most of the published papers are in chemically oriented journals (*PNAS* 2014, *Nat. Chem. Biol.* 2014, *Sci. Rep.* 2016, *Metabolites* 2017). Particularly relevant is the identification *in silico* of a Biosynthetic Gene Cluster for a rare lasso peptide with two disulfide bonds in *Streptomyces svaceus* producing high level of the related peptide, expressing the BGC in an heterologous *Streptomyces* host (*ACS Chem. Biol.* 2015; a paper led by team). The MDCEM team is internationally recognised in the relevant field of antimicrobial peptides as demonstrated by the high impact of its scientific contributions. Moreover, the team is internationally recognized for the ribosomally synthesized and post-translationally-modified peptide family because they introduced the terminology RiPP (

MDCEM is leader in France for AMPs. In fact, it actively participates in the organization of the CNRS network GdR 3625 Multifunctions of AMPs (MuFOPAM, 2012-2017, renewal in progress), the French-initiated international symposiums on AMPs (2012-2018) and a thematic training school in 2016. MDCEM co-organized the first International conference on holobionts in 2017 and was actively involved in the GDR BioChiMar (co-responsible of axis) and MediatEC (co-responsible of axis and co-organizer of the first meeting in 2014). MDCEM established strong international collaborations with Vietnam and Italy. Cooperation with the Marine Biochemistry Institute (IMBC) of the Vietnamese Academy of Science and Technology (VAST) in Hanoi was initially supported by the Bio-Asia program "MarSpongAsia" (2010-2012) and pursued with the CNRS International Scientific Cooperation PICS program "PORIFALONG" (2014-2016) with the team of Mr VAN CUONG Pham. MDCEM contributed important monographs and book chapters (Wiley, Elsevier Science, Springer, etc.). The team presented a large number of oral and poster communications in international symposia (EPS, International Sponge Microbiology Symposium, USA, etc.) and some team's members were invited to present lectures all over the world. Existing expertise in peptido/proteomics and newly-acquired expertise in metabolomics put MDCEM in a strong position to contribute to interdisciplinary studies favoured in the context of the Labex "Diversités biologiques et culturelles" (BcDiv).

## Weaknesses

Even if MDCEM benefited from the recruitment of 1 MC (, microbiology of extreme environments), 1 Professor (environmental metabolomics) and an internal mobility of 1 MC (coral cell biology and development), there was no CNRS recruitment in the team in the past four years. That is possibly the reason of some difficulties to strengthen transversal projects in the unit. In fact considering the very good performances of the team in the last five years, an increased human capital from CNRS could be a driving force. The Team does not enough consider the strong effort requested for collaborations in proteomics and metabolomics that can sometimes decrease manpower in the relevant research themes of the team.

The team could be more involved in European networks with a preferential access to EU funding in the field.

### Assessment of scientific outputs, reputation and appeal

The scientific outputs and activities can be considered excellent overall. Despite some difficulties in attracting funds as at the end of the previous period, the academic reputation and appeal of the team remain very good.

## B – Interactions with the non-academic world, impacts on economy, society, culture or health

<b>Interactions with the non-academic world, impacts on economy, society, culture or health</b> <b>From 01/01/2012 to 30/06/2017</b>	<b>Number</b>
Technical expert or standardization reports	2
Socio-economic interactions: industrial and R&D contracts	3
Socio-economic interactions: Cifre fellowships	1
Socio-economic interactions: creation of labs with private-public partnerships	0
Socio-economic interactions: networks and mixed technological units	0
Socio-economic interactions: start-ups	0
Socio-economic interactions: patents, licenced patents and inventions	4
Public outreach: radio broadcasts, TV shows, magazines	1
Public outreach: journal articles, interviews, book edition, videos, etc.	3
Public outreach: other popularization outputs	yes
Public outreach: debates on science and society	1

### Strengths

This team is very active in protecting intellectual property. During the evaluation period, one disclosure of invention and 3 patents were filed, all of which are at an early stage having been filed in the last 2 years. Two of these patents have arisen from work using the chemical and extract library and promise the potential to treat neglected genetic illnesses. These patents are the subject of translational grants with the technology accelerator Satt-Lutech, so it will be interesting to learn of subsequent developments. Current work also shows promise, such as the potential of lasso-peptides as a next generation antibiotic, and a fungal extract is the topic of an early stage technology transfer grant. A lipophilic cyclic peptide with strong activity against *S. aureus* has also been patented. The most positive aspect of this group has been the careful development of the chemical and extract library which allows users access with legal certainty. In addition, the team is beginning to develop a strategy for valorising scientific discoveries via disclosure of invention, patents and translational awards. Public engagement highlights are the involvement in a documentary and a TV interview, as well as numerous articles in printed media.

The Curator of the national Collection of Porifera at MNHN, has the responsibility since 2005 for conservation and scientific valorization of more than 15,000 specimens of sponges and 8,000 microscopic preparations and related publications. 5-10 international loans and 6-8 weeks of consulting by foreign researchers per year are required. Loans of sponge specimens are available for exhibitions and Education.

### Weaknesses

Although this team is attempting to translate their intellectual property towards application, they need to be more proactive in approaching industry for the next steps of technology development. This will need stronger assistance from the technology transfer office and the technology accelerator. Reviewing the research and industry landscape will assist this team to only push those discoveries that will have potential for industrial take-up.

The threat is wasting time and money patenting discoveries that have no potential to be out-licensed or used. The cost model of the chemical and extract library needs to be considered so that it can be sustainable and allow the library to grow over time to become a valuable national resource. The threat is that insufficient funds are available and that the library will cease to function.

### Assessment of the interactions with the non-academic world

Interaction with private sector and industry is very good as evidenced by the protection and transfer of intellectual property. Outreach work is excellent with a large number of media appearances in broadcast and print media.

## C – Involvement in training through research

Involvement in training through research From 01/01/2012 to 30/06/2017	Number
Habilitated (HDR) scientists	5
PhD students	12
Defended PhDs	8
Mean PhD duration	36 months
Mean number of publications per student	1.8
Educational outputs: books	0
Educational outputs: e-learning, MOOCs, multimedia lessons, etc.	0

### Strengths

In 2012-2017, 8 PhD theses were defended, 2 in co-tutorship and 4 are ongoing. The team trained 15 Master 2 and 20 Master 1 students from various universities (Université Pierre et Marie Curie, MNHN, Université Paris-Sud, Université Claude Bernard Lyon 1, Université de Bretagne Sud etc.). The team hosted several foreign students, i.e., 8 ERASMUS students (Faculty of Pharmacy Federico 2 Naples, Italie), 2 from the Smith College, USA, 1 Fulbright fellowship and 3 PhD students (Faculty of Pharmacy Federico II Naples, Italy; Université Laval Canada; Université Abou Bekr Belkaid de Tlemcen, Algérie). The team trained also numerous students in BTS and licence. MDCEM is strongly involved in the Master « Evolution, Natural Heritages, Societies» from MNHN, speciality "Mechanisms of Living and Environment" (MVE) (in partnership with UPMC for M2) as well as in teaching of the École Doctorale ED277. The academics of the team occupy important educational responsibilities. The members of the team have also teaching activities in other universities, including UPMC, University Paris 7-Denis Diderot, the University Paris Est-Créteil- Val de Marne - UPEC, the University Paris-Sud (, AgroParisTech, Faculty of Pharmacy of Caen École Polytechnique Fédérale of Lausanne - EPFL the University Federico 2 Naples..

### Weaknesses

The MDCEM team is internationally recognised in the relevant field of antimicrobial peptides as demonstrated by the high impact of its scientific contributions. Despite this, the team had as a drawback a limited number of hosted Ph.D students. Some difficulties to recruit motivated PhDs are possibly linked to the national policy of the "Écoles Doctorales", especially because of the pluridisciplinary researches performed in the

MDCEM team. On the other hand, being a team involved in several research working groups at the national and international levels, more PhDs and Post-docs should be attracted, particularly in co-supervision. It is also possible that the heavy workload imposed by collaborations in proteomics and metabolomics, mainly because of the analytical facilities lead to a lack of focus of MDCEM's research themes and workforce. In particular the national Collection of Porifera at MNHN, represents an important workload.

### Assessment of the involvement in training through research

The team demonstrated a very good involvement in training through research even if it contributed to training more bachelors and master students than PhDs and Postdocs, although some of them at the international level.

## CRITERION 2: TEAM ORGANISATION AND LIFE

<b>Team organisation and life</b> <b>From 01/01/2012 to 30/06/2017</b>	<b>Number</b>
Women/men ratio in the team	10/2
Women/men ratio among team scientists	7/1
Women/men ratio among team PhD students	8/6

### Strengths

N/A

### Weaknesses

N/A

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

N/A

## CRITERION 3: SCIENTIFIC STRATEGY AND PROJECTS

### Strengths

The MDCEM team will be renamed "Biochemistry of Microbial Interactions" (BIM) based on the primary focus of its research project, which is the fundamental understanding of molecular interactions between microorganisms and their environment. In particular the team is characterized by a strong multidisciplinary, with excellent competences in analytical and structural chemistry, protein biochemistry, molecular biology, microbiology and cellular biology. The multidisciplinary competences will be instrumental to afford the three themes dealing with inter-microbial interactions (i.e. microbial competitions), microbial interactions with minerals such as in heavy-metal rich environments, and microorganism-host interactions in marine holobionts. Relevant breakthroughs could be obtained either targeting the function of selected (bio)molecules, e.g. lasso peptides or S-layer proteins in model microorganisms, or looking at the holobiont level in experimentally-accessible symbiosis models. Implementation of -omics approaches including metabolomics, proteomics/peptidomics and

transcriptomics, as well as cutting-edge methods of in situ imaging by photonic and electron microscopies and by mass spectrometry could really contribute to place the team in the international context not only at the fundamental level, but also with value-added microbial molecules and procedures. Therefore valorisation of the results from the fundamental research area of antimicrobial peptides and natural product chemistry, at both the national and international level, is the strongest part of the proposed scientific strategy. The team possesses most of the multi-disciplinary expertise necessary for the realization of the proposed projects. In fact the team has access to state-of-art instruments, notably mass spectrometry, NMR, fluorescence and electron microscopies and NanoSIMS. The laboratory is equipped with facilities of analytical chemistry, microbiology, molecular biology and cell biology.

### Weaknesses

Unfortunately, the team has decided to reduce the role of synthetic chemistry in their future plans. This decision reduces the possibility to reproduce the identified and characterized molecules to become lead compounds for industrial applications. Moreover considering that the most interesting molecules are characterised by multiple di-sulfide bonds, the available synthetic strategies to replace such difficult bonds could be really a challenge for synthetic chemists.

Transversal projects are not sufficiently encouraged, within the unit and with other units of MNHN, aiming to consolidate and amplify the research networks.

### Assessment of the scientific strategy and projects

The quality of the scientific strategy is ground-breaking and the proposed projects are cutting-edge. Therefore the team projects can be considered excellent.

## RECOMMENDATIONS TO THE TEAM

### A – Recommendations on scientific production and activities (criterion 1)

The panel members strongly suggest that the team be more strongly involved in EU networks with a preferential access to EU funding in their field.

Increased involvement in policy processes, especially developing the national policies on culture, chemical and extract libraries, should be encouraged as it will help with the expansion of these libraries nationally. A consolidated unit-wide strategy on public engagement would help enhance current efforts by this team.

### B – Recommendations on the team's organization and life (criterion 2)

No recommendations, except increasing the number of HDRs in the team.

### C – Recommendations on scientific strategy and projects (criterion 3)

With the decision to reduce the area of synthetic chemistry, the team should identify possible leading collaborators in this area. This could improve the valorisation of their fundamental research.

**Team 2:** Chemistry of Fungal and Bacterial Natural Products (CPNFB)  
**Team leader:** Ms Soizic PRADO

## TEAM SCIENTIFIC DOMAIN

The CPNFB Team will take a multidisciplinary and integrative approach focussing on the synthesis and characterization of fungal secondary metabolites, and how these chemicals mediate signalling and interactions between ecosystems involving bacteria, endophytic fungi and algae.

## TEAM WORKFORCE

Team workforce	Number 30/06/2017	Number 01/01/2019
<b>Permanent staff</b>		
Full professors and similar positions	1	1
Assistant professors and similar positions	1	1
Full time research directors (Directeurs de recherche) and similar positions	1	1
Full time research associates (Chargés de recherche) and similar positions	2	1
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")	0	0
High school teachers	0	0
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	2	2
<b>TOTAL permanent staff</b>	<b>7</b>	<b>6</b>
<b>Non-permanent staff</b>		
Non-permanent professors and associate professors, including emeritus	1	
Non-permanent full time scientists, including emeritus, post-docs	2	
Non-permanent supporting personnel	0	
PhD Students	6	
<b>TOTAL non-permanent staff</b>	<b>9</b>	
<b>TOTAL team</b>	<b>16</b>	

## CRITERION 1: QUALITY OF SCIENTIFIC OUTPUTS AND ACTIVITIES

## A – Scientific outputs and activities, academic reputation and appeal

Scientific outputs and activities, academic reputation and appeal From 01/01/2012 to 30/06/2017	Number
Articles: scientific articles	60
Articles: review articles	4
Scientific articles with a unit member as last author	40
Medical articles (if relevant)	n/r
Books: scientific book edition	0
Books: book chapters	6
Academic research grants: European (ERC, H2020, etc.) and international (NSF, JSPS, NIH, World Bank, FAO, etc.) grants	3
Academic research grants: national public grants (ANR, PHRC, FUI, INCA, etc.)	11
Academic research grants: local grants (collectivités territoriales)	18
Academic research grants: PIA (Labex, Equipex etc.) grants	1
Academic research grants: grants from foundations and charities (ARC, FMR, FRM, etc.)	1
Visiting scientists	5
Post-docs	
Electronic tools and products: softwares	0
Electronic tools and products: libraries and cohorts	0
Electronic tools and products: decision tools	0
Editorial activities: participation to journal editorial boards (books, collections)	5
Peer reviewing activities: participation to institutional committees and juries (CNRS, INSERM etc.)	yes
Peer reviewing activities: reviewing of journal articles	yes
Peer reviewing activities: participation to lab site visit committees (HCERES etc.)	yes
Peer reviewing activities: grant evaluation (public or charities)	yes
Scientific recognition: prizes	1

Scientific recognition: distinctions	1
Scientific recognition: chair of learned and scientific societies	yes
Scientific recognition: invitations to meetings and symposia (out of France)	11

## Strengths

Over the 2012-17 period, the team produced 60 scientific articles with an average impact of 2.84, of which 50% were ranked in the 1st Quartile of their field, 4 exceptional reviews in high impact publications (Natural Products Reports average 10.2 with one "cover" issue). Through this publication record, members of the team have co-authored 33% of these original scientific research publications with other teams and platforms within MCAM, and have been leading author for 77% of them. The average IF of the contributions not lead by the team was 3,18 with 50% ranked in the first quartile. The leading journal consisted of 7 Natural products Reports of which 3 were reviews and 4 original contributions all lead by the team

Since 2012, the team have coordinated 2 small European projects, 2 ANR projects, 1 EMBRC national project, 3 projects financed by Sorbonne University and 3 CNRS-projects, together with being a partner in a further 3 national or international projects. This has brought in approximately 0.55 M€, coupled with the 96 k€ obtained via ATM projects.

The academic reputation of the team is highly visible through the leadership and participation of all the permanent lecturers and researchers of the team in a number of evaluation and editorial committees, the organisation of international and national symposiums and congresses, and in the creation of 3 national networks (GDRs). The team has attracted both international and national post-doctoral scientists since 2015.

## Weaknesses

The yearly output of publications is not consistent over this evaluation period, with 2014 and 2015 being relatively poor years for the team (6 and 9 publications, respectively, and a low percentage of articles in the Q1 range for 2015). The 64 publications appeared in 41 different journals, with Natural Products Reports (5), Organic letters (4) and Natural Products Communications (4) being the more frequent journals used. A lack of targeted journal submissions has led to 50% of the articles from the team appearing in journal in the 2<sup>nd</sup> Quartile or less. There is a lack of publications with the named European and non-European collaborators, without a clear indication in the document why these people are specifically named.

### Assessment of scientific outputs, reputation and appeal

The scientific output of Team 2 is assessed as being very good with some excellent aspects such as the ability to coordinate international grants and networks.

## B – Interactions with the non-academic world, impacts on economy, society, culture or health

<b>Interactions with the non-academic world, impacts on economy, society, culture or health</b> <b>From 01/01/2012 to 30/06/2017</b>	<b>Number</b>
Technical expert or standardization reports	0
Socio-economic interactions: industrial and R&D contracts	0
Socio-economic interactions: Cifre fellowships	0



Socio-economic interactions: creation of labs with private-public partnerships	0
Socio-economic interactions: networks and mixed technological units	3
Socio-economic interactions: start-ups	0
Socio-economic interactions: patents, licenced patents and inventions	6
Public outreach: radio broadcasts, TV shows, magazines	0
Public outreach: journal articles, interviews, book edition, videos, etc.	0
Public outreach: other popularization outputs	yes
Public outreach: debates on science and society	1

### Strengths

The team has deposited 1 patent in 2016 and 5 declarations of invention from 2015-17.

Being part of the Museum of Natural History, the team have participated in various Public Awareness of Science activities, including holding workshops on the chemistry of microorganisms at Science Fairs at MNHN (2012), public conferences related to the botany of the MNHN (2011-2016), and a round-table on Molecular Herbs: between wonders and innovation (2013).

### Weaknesses

The team have no direct industrial funded projects nor have they participated as consultants with industry, while their research has certainly industrial relevance. Furthermore, the team have not published or contributed to articles in popular journals.

#### Assessment of the interactions with the non-academic world

Team 2 has a good to very good interaction with their industrial contacts and in their outreach to the public.

## C – Involvement in training through research

Involvement in training through research From 01/01/2012 to 30/06/2017	Number
Habilitated (HDR) scientists	4
PhD students	17
Defended PhDs	10
Mean PhD duration	37.2 months

Mean number of publications per student	2.3
Educational outputs: books	0
Educational outputs: e-learning, MOOCs, multimedia lessons, etc.	2

### Strengths

A total of 10 PhD students have defended their thesis during the last five years and 7 additional theses are ongoing. Most theses have been defended within 39 months. PhD students have a good publication track record (1– 6 per student, mean 2.3) and appear as first authors in most papers that they co-signed. The 10 successful doctoral students have on average published 2.3 articles during the course of their thesis, ranging from 1 to 6 articles, and one of the current list of students has already published 3 first author articles. In addition, PhD students delivered numerous presentations in international and national conferences. The former PhD students have found post-doctoral positions in industry and academia both in France and abroad.

Team members have created 2 MOOCs, one on marine biology and the other on NMR.

### Weaknesses

No particular weakness was identified.

### Assessment of the involvement in training through research

This team has displayed an excellent impact in the training of PhD and master students.

## CRITERION 2: TEAM ORGANISATION AND LIFE

<b>Team organisation and life From 01/01/2012 to 30/06/2017</b>	<b>Number</b>
Women/men ratio in the team	4/4
Women/men ratio among team scientists	2/4
Women/men ratio among team PhD students	10/7

### Strengths

N/A

### Weaknesses

N/A

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

N/A

## CRITERION 3: SCIENTIFIC STRATEGY AND PROJECTS

### Strengths

The abundance of information now available through fungal genome sequencing provides the CPNFB team with a rich natural reservoir to explore the synthesis of important fungal secondary products and to study the adaptation of fungi to challenges brought about by the environment and their fellow neighbours in the ecosystem. Through the proposed integrated –omics approach, and in selecting of a key endophilic fungus, *Acremonium zeae*, as their model organism, the CPNFB team have proposed very promising research objectives, i. e. to understand the role of pyrrocidines in maize infection, under current and future stress scenarios. Interactions with plant breeding groups will certainly strengthen this line of research, as will the proposed interaction with the BIM team, providing a better critical mass to address their objectives.

A new line of investigation into the role that these fungal compounds have in fungi interactions with bacterial and algal populations in the ecosystem will hopefully increase the visibility of the team and lead to new exciting advances in the field of natural product chemistry as well as microbiological sensing.

A positive interaction is proposed with the Concarneau, SAMS and Kongju University groups to help develop the new areas. The expansion of the team through interactions with European networks and in the collaborations through the GDR networks can only be encouraged as a means to take more leading positions in the field, and a COST Action will certainly be an advantage in this.

### Weaknesses

The small size of this team remains a concern for the successful deliverance of the proposed projects and a priority should be made to maintain and more favourably increase the number of staff (as proposed in the project plan, together with the recruitment of high quality post-doctoral researchers to aid in the training of the doctoral students).

It is not clear how the metabolite production responses will be compared between the in vitro (culture) and in vivo (in association with maize) experiments and how this will lead to the proposed exploitation in the pharma and other fields. Furthermore, the number of genomes planned to be screened is not clearly given. This of course will have an impact on resources available for these objectives.

### Assessment of the scientific strategy and projects

With the limited resources available, the Committee felt that the project of Team 2 was excellent, showing strong ambition and with some challenging risk involved.

## RECOMMENDATIONS TO THE TEAM

### A – Recommendations on scientific production and activities (criterion 1)

The panel members strongly suggest that the team be more proactive in coordinating bilateral research projects and EU networks in order to increase opportunities for further EU funding in their emerging field.

### B – Recommendations on the team's organization and life (criterion 2)

The committee has no particular recommendations, except increasing the number of HDRs in the team.

### **C – Recommendations on scientific strategy and projects (criterion 3)**

The team has an ambitious and groundbreaking research project for the next five years that will require a great effort in fundraising and the recruitment of additional dynamic working force.

**Team 3:** Parasites and free-living Protists (PPL)

Team leader: Ms Coralie MARTIN

## TEAM SCIENTIFIC DOMAIN

The team studies at both the cellular and molecular levels, the biodiversity and adaptation processes of parasites and free living protists to their environment.

## TEAM WORKFORCE

Team workforce	Number 30/06/2017	Number 01/01/2019
<b>Permanent staff</b>		
Full professors and similar positions	2	2
Assistant professors and similar positions	5	5
Full time research directors (Directeurs de recherche) and similar positions	0	0
Full time research associates (Chargés de recherche) and similar positions	2	2
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")	0	0
High school teachers	0	0
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	6	6
<b>TOTAL permanent staff</b>	<b>15</b>	<b>15</b>
<b>Non-permanent staff</b>		
Non-permanent professors and associate professors, including emeritus	2	
Non-permanent full time scientists, including emeritus, post-docs	3	
Non-permanent supporting personnel	0	
PhD Students	2	
<b>TOTAL non-permanent staff</b>	<b>7</b>	
<b>TOTAL team</b>	<b>20</b>	

## CRITERION 1: QUALITY OF SCIENTIFIC OUTPUTS AND ACTIVITIES

## A – Scientific outputs and activities, academic reputation and appeal

Scientific outputs and activities, academic reputation and appeal From 01/01/2012 to 30/06/2017	Number
Articles: scientific articles	115
Articles: review articles	7
Scientific articles with a unit member as last author	37
Medical articles (if relevant)	n/r
Books: scientific book edition	1
Books: book chapters	2
Academic research grants: European (ERC, H2020, etc.) and international (NSF, JSPS, NIH, World Bank, FAO, etc.) grants	7
Academic research grants: national public grants (ANR, PHRC, FUI, INCA, etc.)	2
Academic research grants: local grants (collectivités territoriales)	25
Academic research grants: PIA (Labex, Equipex etc.) grants	3
Academic research grants: grants from foundations and charities (ARC, FMR, FRM, etc.)	2
Visiting scientists	30
Post-docs	
Electronic tools and products: softwares	0
Electronic tools and products: libraries and cohorts	0
Electronic tools and products: decision tools	1
Editorial activities: participation to journal editorial boards (books, collections)	0
Peer reviewing activities: participation to institutional committees and juries (CNRS, INSERM etc.)	yes
Peer reviewing activities: reviewing of journal articles	yes
Peer reviewing activities: participation to lab site visit committees (HCERES etc.)	yes
Peer reviewing activities: grant evaluation (public or charities)	yes
Scientific recognition: prizes	1

Scientific recognition: distinctions	0
Scientific recognition: chair of learned and scientific societies	yes
Scientific recognition: invitations to meetings and symposia (out of France)	15

## Strengths

The research topics performed are quite diverse in both the models that are studied (*Plasmodium*, trypanosome, filariae, *Giardia* and *Gregarina*, free ciliates) and the approaches based on expertise in comparative genomic and phylogeny, molecular and cellular interactions, biochemistry and drug targets. In all these topics, the scientific production is quantitatively and qualitatively very good to excellent including an excellent international visibility evidenced by several invited international talks e.g. Gordon Conference.

Over this period, using deep next-generation sequencing of mitochondrial genomes and a novel algorithm for genome reconstruction, a significant breakthrough in the field of Haemosporidia diversity has been achieved with the discovery of an unexpected non-conserved organization of their mitochondrial genome. Another important achievement was the reassessment of the filarial phylogeny, which was allowed by the sampling and sequencing of an unusual large number of *Onchocercidae* specimens belonging to the collection of MNHN. Regarding Axis 2 on the functional analysis of host-parasite interactions, host factors contributing to parasite development blockade have been highlighted such as secreted human phospholipases A2 acting on the *in vitro* growth of *P. falciparum* and the chemokine CXCL12 which together with its CXCR4 receptor are effectors of innate resistance to filarial L3 Larvae dissemination at the skin level. Numerous projects on the development of new anti-parasitic have been successfully achieved in collaboration with chemists or as partners of a large world consortium searching for the malarial targets of the 400 components constituting the MMV-Malaria Box (Medecine for Malaria venture), in which the team's contribution was on the targets PfA-M1 and PfA-M17.

The team has produced a total of 121 publications including 6 reviews in international journals with an average impact factor of 3.1. Team members were first or last authors of 46 (38%). This reveals that the numerous collaborations positively impact the publications record. Outstanding contributions led by the team were *PNAS* IF=9.66, *J. Med. Chem* IF=5, *PloS Negl Trop Dis* IF 4.5, *Inf. Immunity* IF 5.59. One *Plos Pathogens* IF=6.6 was published as co-author of a multi-authored project driven by others.

The team was excellent to outstanding in obtaining numerous international and regional funding. Highly competitive grants, 1 EU FP7 and 2 ANRs, were also obtained. The most recent ANR will run until 2020.

## Weaknesses

The large range of model systems makes studies quite heavy to conduct and consequently, impedes the development of functional genomic approaches. It is a brake to go deeper in the mechanistic analysis of their findings. This could be compensated by good collaborations.

### Assessment of scientific outputs, reputation and appeal

Publication outputs were very good with some excellent examples, particularly the filarial work and phylogenetics; grant income was excellent to outstanding with a broad range of high-level sponsors; a number of invited talks, excellent – overall outputs, reputation and appeal are rated excellent.

## B – Interactions with the non-academic world, impacts on economy, society, culture or health

<b>Interactions with the non-academic world, impacts on economy, society, culture or health</b> <b>From 01/01/2012 to 30/06/2017</b>	<b>Number</b>
Technical expert or standardization reports	2
Socio-economic interactions: industrial and R&D contracts	7
Socio-economic interactions: Cifre fellowships	0
Socio-economic interactions: creation of labs with private-public partnerships	0
Socio-economic interactions: networks and mixed technological units	0
Socio-economic interactions: start-ups	0
Socio-economic interactions: patents, licenced patents and inventions	4
Public outreach: radio broadcasts, TV shows, magazines	0
Public outreach: journal articles, interviews, book edition, videos, etc.	0
Public outreach: other popularization outputs	yes
Public outreach: debates on science and society	0

### Strengths

As identified in their own SWOT analyses, the access to two major MNHC collections is a great strength of PPL. The aim to improve these resources, with non-academic partners, is admirable and of considerable importance to the wider community. The development of an algorithm to assist in the assembly of genomic data from these resources may also benefit those outside the academy. In terms of commercial engagement, PPL has filed for intellectual property on a number of inventions, particularly in the field of *Giardia* drug development, and has excellent industrial interactions. With respect to the general public, the production of a book and contribution to a science festival is noted.

The reorganisation and refocusing of PPL into a narrower range of research areas, coupled with the relatively small size of the group, could lead to further interaction with non-academic partners. Perhaps developing existing links with local and international partners and DNDi.

### Weaknesses

The age and condition of the MNHC collections may be problematic, for example it is particularly unclear if resource is available to improve the *Onchocercidae* collection. Furthermore, the open access status of these collections should be clarified if they are to benefit those outside the academy. The availability of the analytical tools reported is also unclear. Moving forward smaller, and still diverse research activity may hinder the development of deeper interactions with commercial and public partners and the general public. However, whilst much of the research could be termed 'blue sky', more interaction could be sought, for example, with the drug discovery industry.

The small size, and previously scattered focus, of PPL may have hindered the development of more numerous and deeper interactions. However, some exist, and the newly restructured group has the opportunity to deepen these and forge new relationships.



### Assessment of the interactions with the non-academic world

The level of interaction with industrial partners is excellent, as evidenced by funding and collaboration; and public dissemination is good e.g. contribution to La Plasmodione – overall Interactions with the non-academic world is rated very good.

## C – Involvement in training through research

<b>Involvement in training through research From 01/01/2012 to 30/06/2017</b>	<b>Number</b>
Habilitated (HDR) scientists	5
PhD students	9
Defended PhDs	7
Mean PhD duration	38.3 months
Mean number of publications per student	4.3
Educational outputs: books	0
Educational outputs: e-learning, MOOCs, multimedia lessons, etc.	1

### Strengths

The team have a very high output in the training of PhD students. The doctoral student numbers, whilst limited due to funding, are stable and all students complete in a timely manner with most very productive in terms of publications - this is commendable. 7 PhD students have defended their thesis during the period and 2 are ongoing. Except one who has 1 article in revision, they have all published at least 2 articles as first author, two of them having an impressive record (5 first authors out of 11 publications and 5 first authors out of 8 publications). Four PhDs have been in partnership with foreign universities (Heidelberg, Brasilia, Gabon, Tunis). There is also a high implication of the team in both teaching and teaching organisation (even for the full time researchers) and this impacts positively the recruitment of internships (M2, M1, L3 .....).

### Weaknesses

Given the high quality of the team in training, weakness is limited.

### Assessment of the involvement in training through research

Overall, the training through research is excellent.

## CRITERION 2: TEAM ORGANISATION AND LIFE

<b>Team organisation and life</b> <b>From 01/01/2012 to 30/06/2017</b>	<b>Number</b>
Women/men ratio in the team	15/5
Women/men ratio among team scientists	10/4
Women/men ratio among team PhD students	4/5

### Strengths

N/A

### Weaknesses

N/A

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

N/A

## CRITERION 3: SCIENTIFIC STRATEGY AND PROJECTS

### Strengths

The apparent recognition of the issue of 'over reach' and the development of a more focused scientific strategy in the currently proposed suite of projects is likely to improve the quality of outputs. The strategy and associated projects should help focus to exploit resources and skills available. The 2 "axes" chosen appear logical and based on current expertise within the team. The aim to exploit the availability of the MNHC collections is clearly beneficial and important. The external, including non-academic and international, resources to improve these collections is very positive. The collections will support several outlined projects, notably those in environmental sciences and taxonomy, as such these are well framed. The pathogenic parasite studies, drug target studies in Plasmodium and Giardia for example, are also well placed in the current global environment. The current international collaborations, for example the deep connections with Brazil, will aid the development of this axis.

### Weaknesses

The team remains small, and external income is relatively limited. This may hamper the execution of the stated strategy and further development. With respect to capacity, the extent of interactions with other MCAM teams remains unclear. There is significant potential to exploit synergies, and lack of consideration and of development of multidisciplinary work may lead to under exploitation of funding opportunities.

The small size of the team and current funding put progress at risk, and the opportunities to develop MCAM and external interactions need to be taken.

The strategy developed since the previous HCERES evaluation has become more focused, with the strengths in helminth research and phylogenetics clear; however it remains diverse with a need to link with other teams more deeply – for example bacterial endosymbionts and the cyanobacteria team:

### Assessment of the scientific strategy and projects

Overall the strategy and project are rated good.

## RECOMMENDATIONS TO THE TEAM

### A – Recommendations on scientific production and activities (criterion 1)

The committee recommends to develop collaborations, for instance in the fields of functional genomics or systems biology, which would increase the impact of the teams publications. Likewise, consideration and planning is required to improve industrial and commercial interactions in order to expand research opportunities, for example in the drug discovery sector.

### B – Recommendations on the team's organization and life (criterion 2)

N/A

### C – Recommendations on scientific strategy and projects (criterion 3)

The committee recommends to:

1. Ensure MNHC collections are maintained and, where possible, improved. Making access to these as wide as possible should be a priority.
2. Work on ensuring new, more focussed, strategy and associated projects improve outputs and income, for example a reduction of work published in Q3 and Q4 journals and an increase in Q1 publications.
3. Focus on increasing the number of researchers, for example develop a strategy to recruit more PhD students and, where possible, post-doctoral researchers. This should improve outputs etc.
4. Across both research 'axes' develop a clear strategy to engage further with both public and private organisations and companies, with a view to increase societal and commercial impact.
5. Articulate clear and achievable goals or milestones for the next assessment cycle.

It is recommended that Team 3 consider how it can incorporate the natural products expertise of the other teams into its proposed projects, and a closer interaction with the cyanobacteria team.

**Team 4:** Cyanobacteria, Cyanotoxins and Environment (CCE)

Team leader: Ms Cécile BERNARD

## TEAM SCIENTIFIC DOMAIN

The team CCE focus is the biodiversity and ecotoxicology of Cyanobacteria.

## TEAM WORKFORCE

Team workforce	Number 30/06/2017	Number 01/01/2019
<b>Permanent staff</b>		
Full professors and similar positions	2	3
Assistant professors and similar positions	3	3
Full time research directors (Directeurs de recherche) and similar positions	0	0
Full time research associates (Chargés de recherche) and similar positions	1	1
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")	0	0
High school teachers	0	0
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	3	4
<b>TOTAL permanent staff</b>	<b>9</b>	<b>11</b>
<b>Non-permanent staff</b>		
Non-permanent professors and associate professors, including emeritus	1	
Non-permanent full time scientists, including emeritus, post-docs	4	
Non-permanent supporting personnel	1	
PhD Students	1	
<b>TOTAL non-permanent staff</b>	<b>7</b>	
<b>TOTAL team</b>	<b>16</b>	

## CRITERION 1: QUALITY OF SCIENTIFIC OUTPUTS AND ACTIVITIES

## A – Scientific outputs and activities, academic reputation and appeal

Scientific outputs and activities, academic reputation and appeal From 01/01/2012 to 30/06/2017	Number
Articles: scientific articles	66
Articles: review articles	0
Scientific articles with a unit member as last author	33
Medical articles (if relevant)	n/r
Books: scientific book edition	1
Books: book chapters	14
Academic research grants: European (ERC, H2020, etc.) and international (NSF, JSPS, NIH, World Bank, FAO, etc.) grants	2
Academic research grants: national public grants (ANR, PHRC, FUI, INCA, etc.)	10
Academic research grants: local grants (collectivités territoriales)	4
Academic research grants: PIA (Labex, Equipex etc.) grants	0
Academic research grants: grants from foundations and charities (ARC, FMR, FRM, etc.)	1
Visiting scientists	8
Post-docs	
Electronic tools and products: softwares	0
Electronic tools and products: libraries and cohorts	3
Electronic tools and products: decision tools	0
Editorial activities: participation to journal editorial boards (books, collections)	1
Peer reviewing activities: participation to institutional committees and juries (CNRS, INSERM etc.)	yes
Peer reviewing activities: reviewing of journal articles	yes
Peer reviewing activities: participation to lab site visit committees (HCERES etc.)	no
Peer reviewing activities: grant evaluation (public or charities)	yes
Scientific recognition: prizes	0

Scientific recognition: distinctions	0
Scientific recognition: chair of learned and scientific societies	yes
Scientific recognition: invitations to meetings and symposia (out of France)	4

## Strengths

At the national level, the CCE team is leader in the field of ecophysiology and ecotoxicology of Cyanobacteria. The leadership of the team is visible through the strong participation of the permanent members in number of committees and institutions in the academic and industrial fields.

Over the 2012-17 period the team produced 66 scientific publications with an average impact of 3.44, of which 56% were ranked in the 1st Quartile of their field and 43% have CCE members as last authors. Among these 66 publications, 27% have been co-authored with other platforms and teams within MCAM. 58% of the output consisted in co-authored work where the CCE team was not driving the collaboration, as defined by the identity of the corresponding author. These publications appeared mostly of environmental sciences journals but included chemistry biochemistry and microbiology oriented journals. High impact publications were diverse and included publications such as Nature protocols (in collaboration) and Water Research (IF7, work driven by the team). Multidisciplinary journals included very good albeit low selectivity journals such as Plos One or Science Reports

The team is highly active in obtaining grants; since 2012, members of CCE have coordinated 1 European project, 1 ANR program, 1 CNRS project. They have also been partners in 4 ANR programs and in 4 projects funded by territorial agencies. Two members of the team (1 PR and 1 IE) are in charge respectively of the scientific animation of the UGC collection and of the curation of the Cyanobacteria and Algae collection of the MNHN.

## Weaknesses

The pluri-disciplinary nature of the team has as a consequence the involvement of its permanent members in several collaborations and various activities. The low number of ITARF staff may impact the focus of researchers on a main topic and may generate dispersion, and thus a decrease in competitiveness.

### Assessment of scientific outputs, reputation and appeal

CCE is an overall very good team with an excellent activity in obtaining academic and industrial grants, a very good publications level and a good participation to international conferences.

## B – Interactions with the non-academic world, impacts on economy, society, culture or health

<b>Interactions with the non-academic world, impacts on economy, society, culture or health</b> <b>From 01/01/2012 to 30/06/2017</b>	<b>Number</b>
Technical expert or standardization reports	3
Socio-economic interactions: industrial and R&D contracts	5
Socio-economic interactions: Cifre fellowships	0
Socio-economic interactions: creation of labs with private-public partnerships	0

Socio-economic interactions: networks and mixed technological units	0
Socio-economic interactions: start-ups	1
Socio-economic interactions: patents, licenced patents and inventions	6
Public outreach: radio broadcasts, TV shows, magazines	12
Public outreach: journal articles, interviews, book edition, videos, etc.	0
Public outreach: other popularization outputs	yes
Public outreach: debates on science and society	24

### Strengths

The expertise of the team allowed it to be involved in monitoring the risk management of Cyanobacteria through helping territorial managers to make decisions regarding these organisms.

During the period 2012-2017, the team submitted 1 patent and 6 declarations of invention. It also achieved 3 databases and 2 decision-making tools and wrote 3 technical survey reports. The team collaborated with industrial partners (SEDIF, NUTREA, Thermes de Baladuc les Bains, ALGAMA) and wrote 5 contracts. Several actions of dissemination towards the public were realized like articles aimed to lay public (4), theorized artistic creations (4), actions in Radio, TV and press (13). The team is very active in the social, economic and cultural environment. Cyanobacteria have an important societal impact and the CCE team is hugely contributing into the diffusion of knowledge on these organisms to the public.

### Weaknesses

No weaknesses were noted.

### Assessment of the interactions with the non-academic world

The team has an excellent interaction with the industrial and non-academic world. The public outreach of the team is also excellent.

## C – Involvement in training through research

Involvement in training through research From 01/01/2012 to 30/06/2017	Number
Habilitated (HDR) scientists	7
PhD students	9
Defended PhDs	8
Mean PhD duration	36 months

Mean number of publications per student	4
Educational outputs: books	1
Educational outputs: e-learning, MOOCs, multimedia lessons, etc.	1

### Strengths

The team displays good attractiveness towards PhD students and post-docs. All its members are actively involved in supervising students (PhD and Masters). Between 2012 and 2017, 8 PhD theses were defended, with an average number of published articles of 4.7. Of the 8 PhD students, 6 have already at least one publication as first author. The team has also been involved in the training of 11 Master 2 and 9 Master 1 students.

### Weaknesses

The involvement of PhD students in collaborative projects limits the number of publications where the PhD student is first author and a member of CEE last author.

### Assessment of the involvement in training through research

The training activity and the involvement of the team into teaching are excellent.

## CRITERION 2: TEAM ORGANISATION AND LIFE

<b>Team organisation and life From 01/01/2012 to 30/06/2017</b>	<b>Number</b>
Women/men ratio in the team	6/9
Women/men ratio among team scientists	3/6
Women/men ratio among team PhD students	9/0

### Strengths

N/A

### Weaknesses

N/A

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

N/A



## CRITERION 3: SCIENTIFIC STRATEGY AND PROJECTS

### Strengths

The project proposed by the CCE team is sound and relevant. The fact that it is strongly based on the data collected during the 5 previous years ensures its success and limits the risks. It is organized in 4 sub-projects: diversity of cyanobacteria - factors controlling biodiversity of photosynthetic organisms - ecotoxicology of cyanobacteria - decisional support regarding the risks related to cyanobacteria. The team has the required skills and the leadership necessary to the success of sub-Project 1 and 3. Sub-Project 2 consists in analyzing global data obtained during the 5 previous years, with significant advances.. At the national level, the CCE team is by far the leader in the interaction with the territorial agencies. Sub-project 4 should therefore be rewarded with success.

### Weaknesses

The proposed project is quite ambitious and may be a source of dispersion. The chemical diversity part (sub-Project 1) that will be supervised by the newly recruited professor requires extensive expertise in secondary metabolite chemistry. This part, probably the most exploratory of the project, will therefore rely on collaborations intra / extra MCAM.

Sub-project 2 consists in mathematical analysis and in modelling of data obtained previously. It will also rely on strong interactions with mathematicians/informaticians.

### Assessment of the scientific strategy and projects

The project will take advantage of the huge amount of data already obtained, the exploitation and the modelling of these data make the project a very good to excellent strategy.

## RECOMMENDATIONS TO THE TEAM

### A – Recommendations on scientific production and activities (criterion 1)

The team has the potential to acquire international visibility if it re-enforces its international participation to meetings and conferences.

### B – Recommendations on the team's organization and life (criterion 2)

No substantial recommendation is necessary.

### C – Recommendations on scientific strategy and projects (criterion 3)

The team should prioritize its research project to focus on the parts in which it will have the leadership. The data mining could benefit from extra collaboration with system-Biology groups.

## CONDUCT OF THE VISIT

### DATES

**Start:** 6 December 2017 at 8.30 AM

**End:** 7 December 2017 at 4.00 PM

### VISIT SITE

**Institution:** MNHN

**Address:** 57, rue Cuvier 75005 PARIS

### CONDUCT OR PROGRAM OF THE VISIT

#### **Wednesday December 6th**

#### Part 1 : Consolidated unit presentation: past achievements and perspectives. ("Salle des collections" Conference Room)

9h00-9h15:	Welcome of evaluation committee members and presentation of evaluation procedures by Mr Steven BALL (HCERES delegate).
9h15-10h15:	General presentation of the research unit: organization and scientific policy, achievements and perspectives Mr Philippe GRELLIER. Presentation, Discussion
10h15-11h00:	Biochemistry of Microbial Interactions Mr Yan Yan LI Presentation, Discussion
11h00-11h25	Coffee break
11h25-12h10:	Chemistry of Fungal and Bacterial Natural Products Ms Soizic PRADO Presentation, Discussion
12h15-12h45:	Meeting with MNHN and CNRS representatives
12h45-13h40:	lunch (panel members and HCERES delegate only; meal trays at the MCAM laboratory)
13h40-14h25:	Parasites and free-Living Protists Ms Coralie Martin Presentation, Discussion
14h25 h40-15h10:	Cyanobacteria, Cyanotoxins and Environment Cécile Bernard Presentation, Discussion
15h10-15h30:	Coffee break
15h30-17h00:	Closed meeting of the HCERES panel
17h00-18h30:	First report editing session
20:30:	Dinner at the restaurant "La Baleine" (panel members and HCERES delegate only)

**Thursday December 7th**

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Part 2: Meetings with MCAM representatives (Salle des collections; conference room )

In presence of panel members and HCERES delegate only

9h00 - 9h30: Meeting with researchers (academic research staff).

9h30 – 10h00: Meeting with technicians and engineers.

10h00- 10h30: Meeting with PhD students and post-doctoral fellows

10h30-10h45: Coffee break

Part 3 : Meetings with the Unit Head.

In presence only of panel members, HCERES delegate.

10h45 – 11h15: Meeting with the research unit direction

Part 4 : Final editing.

11h15-12h15: Second report editing session

12h15-13h15: Lunch (panel members and HCERES delegate only; meal trays at the MCAM laboratory)

13h15 -16h30: Final Editing Session

## **SUPERVISING BODIES' GENERAL COMMENTS**



## MUSEUM NATIONAL D'HISTOIRE NATURELLE

### **"Molécules de Communication et Adaptation des Microorganismes", MCAM UMR 7245 CNRS-MNHN**

#### **Observations de portée générale**

Le Muséum national d'Histoire naturelle tient avant tout à remercier le comité d'évaluation HCERES de l'unité Molécules de Communication et Adaptation des Microorganismes, MCAM pour l'important travail d'évaluation réalisé et la qualité du rapport très complet et détaillé qui a été produit. Cette évaluation externe par des experts internationaux sera très utile à la tutelle pour l'accompagnement de l'unité et de ses équipes constitutives pour le prochain contrat 2019-2023. En particulier le Muséum veillera à ce que soit renforcée l'interdisciplinarité et les interactions entre équipes au sein de l'unité.

Le Muséum s'associe aux avis très positifs portés par le comité sur l'unité MCAM. Cette unité constitue le pôle de microbiologie environnementale de l'établissement, focalisé sur la communication chimique et les mécanismes adaptatifs, domaines pour lesquels l'unité est reconnue internationalement. Par les compétences qu'elle rassemble en chimie analytique, protéomique et métabolomique ainsi qu'en microscopies et imagerie, cette unité apporte également une très large contribution au fonctionnement et à la visibilité de la Plateforme analytique du Muséum que l'établissement a souhaité renforcer et optimiser au cours des dernières années avec l'appui de ses partenaires, en particulier le CNRS-INEE. Ces forces et compétences spécifiques se traduisent par le très bon niveau de publications de l'unité et leurs retombées en termes de transfert vers la société et la valorisation des résultats de leur recherche, tant par des brevets qu'en direction du grand public. A ce propos, le Muséum souhaite préciser que la direction de la valorisation du Muséum, établissement co-actionnaire de la société de transfert de technologie Satt-Lutech, incite ses unités à procéder via la Satt aux transferts de leurs brevets en direction de l'industrie et les accompagne dans leurs démarches.

Responsable de six collections patrimoniales, l'implication de l'unité MCAM dans cette activité, très spécifique au Muséum, est indéniable comme le souligne le rapport. Cependant, le Muséum s'interroge sur la signification de la phrase *"little information is given on how the natural diversity of the different collections will be exploited"* qui figure dans la section "Global assessment of the unit". Cette phrase apparaît floue au regard des données fournies par le rapport d'auto-évaluation de l'unité et pourrait être mal interprétée et préjudiciable tant à l'unité qu'à l'établissement, internationalement reconnu pour ses collections d'histoire naturelle. Le Muséum apprécierait tout particulièrement que cet avis soit reformulé de façon à exprimer plus clairement le souhait du comité, éventuellement en termes de meilleure intégration de la richesse en diversité naturelle offerte par les collections aux recherches de l'unité.

Le Muséum approuve la vision très positive du comité sur le projet et la stratégie que le directeur d'unité et l'équipe de direction ont définis pour le mettre en œuvre durant le prochain contrat. Il apprécie les recommandations ou mises en garde formulées par le comité qui l'aideront à mieux accompagner l'unité dans la réalisation de ce projet.

## **General observations: point by point comments**

### **Global assessment of the Unit, page 5**

We consider that the sentence *"little information is given on how the natural diversity of the different collections will be exploited"* should be rephrased, as its meaning is confused. We showed in the report, through different examples, how this diversity is exploited in the Unit research (e.g. description of new species or redescription of species, use of the collection specimens for phylogenetic analyses). Furthermore, as being full collections of the Museum, they are opened to the scientific community and are currently consulted and specimens requested. The natural diversity they offer, not or rarely found in other institutions, being the interest of these collections. May be the committee meant that *"the challenge will be to further exploit the natural diversity of the collection"*. In that case, we agree, maintenance and enrichment of such collections is a question of funding and manpower that is challenging in the current context of the French research funding.

### **Detailed assessment of the Unit/ Scientific outputs and activities, academic reputation and appeal/weaknesses, page 8**

We do not agree with the sentence *"the unit have a weak impact in the international arena"*. This sentence is in contradiction with the international recognition of the Unit underlined by the committee in several parts of the report. The high number of international collaborations, supports or grants, and the number of publications with foreign teams demonstrate the international recognition of the Unit and teams. However, we honestly recognize, as mentioned in the auto-evaluation section of our report, that our involvement in European programs (e.g. H2020) is rather weak, although far from being trivial, and needs to be improved. It is possibly this aspect that the committee wanted to point.

### **Interactions with the non-academic world, impacts on economy, society, culture or health/weakness, page 9**

We do not agree with the sentence *"There is no clear Unit strategy for encouraging and fostering industry interaction"*. Such a strategy exists and is described in the autoevaluation report. Since its creation, the Unit strongly supports researchers to valorize their researches through interactions with socioeconomic actors and deposit patents. The strategy involves a stronger and constant interaction with the Technology Transfer Office of the Museum and the private technology transfer company Satt Lutech.

## **Comments concerning the team reports**

### **TEAM MDCEM**

#### **Scientific strategy and projects/weakness assessment, page 21**

MDCEM has never developed synthetic chemistry in its past or current research; therefore no decision has been made about reducing this activity, as regretted by the committee. However we do agree that we should and will seek appropriate collaborations in terms of synthesis of complex peptide molecules.

### **TEAM CPNF**

#### **Quality of scientific outputs and activities/weaknesses, page 24**

It is mentioned that *"there is a lack of publications with the named european and non-european collaborators without a clear indication in the document why these people are specifically named."* Indeed, many of the results obtained within these collaborations undergo a valorization protocol. Accordingly a PCT patent has been filed with SAMS, Scotland (Claire Gachon) and University of Kongju, Korea (Gwang Hoon) postponing the submission of the articles. A declaration of invention has also been arranged with the University of Malaya, Malaysia (Kok Gan) and the results are currently under a prematuration process with the SATT (a Technology transfer Company) before the

patent will be filed. All these collaborations are also supported by different grants (CNRS, Campus France). In addition, results of two collaborations have been recently published with the named collaborators:

- Gilles Alex Pakora (University of Félix Houphouët-Boigny). Reference : Gilles-Alex Pakora et al. 2017 Sep 30. doi: 10.1007/s11356-017-0283-9
- Katherine Duncan (Strathclyde Institute of Pharmacy and Biomedical Sciences). Reference : M. Vallet J Nat Prod. 2017 Nov 22;80(11):2863-2873

#### Scientific strategy and projects/weaknesses, page 27

The committee reports that *"it is not clear how the metabolite production responses will be compared in vitro (in culture) and in vivo (in association with maize) experiments and how this will lead to the proposed exploitation in the pharma and other fields."* As explained, the metabolome will be fully explored *in vitro* before inoculation of the fungi *in planta*. However, it is worth noticing, that the identity of the metabolites searched for are already known (pyrrocidine and related PKS-NRPS compounds). A targeted metabolomics approach *in planta* consecutively to the fungal wild type and KO pyrrocidine mutant inoculation will be thus performed and possibly completed by mass spectrometry imaging. Analysing the effects of the fungal presence on the host fitness in the context of a tripartite association with pathogens will allow to better understand the role of the endophytic metabolites and could lead to the discovery of agrochemicals.

#### TEAM BAMEE

##### General comment

We are very surprised at the use of the term "*small team*" for our team because it is the one with the largest staff of the unit (15 permanents). What is the meaning of such a designation?

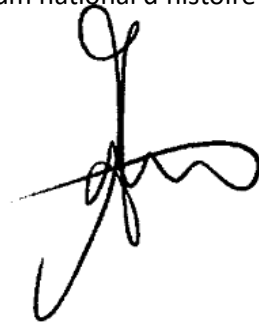
#### Scientific outputs and activities, academic reputation and appeal/weaknesses, page 30

Axis 1 is interested in the diversity of parasites, that's why a large number of taxa are studied; not all of them are model systems; indeed for axis 2 (functional analysis) studies are focused only on 2 models, one for malaria, one for filariasis.

#### Interactions with non-academic world, impacts on economy, society, culture or health/assessment, page 33.

We noted an inconsistency that needs to be corrected, between the paragraph p. 33 "Assessment of the interactions with the non-academic world" in which it is indicated "the level of interaction with industrial partners is excellent" and the paragraph p. 34 "weaknesses" of the "criterion 3" in which it is indicated "the level of industrial and other commercial interactions is currently low". These two comments should be reconciliated.

Le directeur général délégué à la recherche,  
l'expertise, la valorisation et l'enseignement du  
Muséum national d'histoire naturelle




Jean-Denis VIGNE

## Evaluation HCERES du laboratoire MCAM

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### Observations de portée générale



Le CNRS remercie l'HCERES pour la qualité de son rapport concernant l'UMR MCAM (Molécules de Communication et Adaptation des Microorganismes, dirigée par Philippe Grellier). Il s'associe à l'évaluation très positive de cette unité considérée comme une unité phare dans le domaine de la communication moléculaire et de l'adaptation des micro-organismes à leur environnement. Sa renommée internationale est confirmée par le très bon niveau de publications de l'Unité tant par la quantité que par la qualité. Depuis sa dernière évaluation, l'Unité a renforcé avec succès son effort d'animation scientifique et a su recruter de jeunes chercheurs. Il faut également noter une très bonne structuration des plates-formes en partenariat MNHN-CNRS qui a permis l'acquisition de nouveaux équipements performants. Cette Unité possède des collections de microorganismes, importantes pour la communauté scientifique française comme internationale.

Le CNRS apprécie aussi l'engagement de cette Unité dans le Protocole de Nagoya et dans les réflexions sur la mise en place de procédures dans les unités du CNRS et du MNHN. De plus les chercheurs et enseignants-chercheurs de MCAM sont fortement impliqués dans la diffusion des connaissances vers le grand public et vers l'industrie (dépôt de brevets). Au sujet des brevets, le CNRS-INEE souhaite informer l'HCERES que les activités concernant leur exploitation relèvent des Services de Partenariat et de Valorisation des organismes et établissements.

La stratégie de l'équipe de direction pour le nouveau contrat quinquennal devrait permettre de maintenir cet excellent niveau et de répondre aux nouveaux objectifs du développement durable (ODD). En accord avec la proposition de l'HCERES le CNRS-INEE veillera à renforcer les relations inter-équipes grâce aux programmes transversaux (avec des publications communes).



Stéphanie Thiébault  
Directrice de l'Institut écologie et environnement



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2 rue Albert Einstein  
75013 Paris, France  
T. 33 (0)1 55 55 60 10

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