

# **QANU Research Review Biology**

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## FOREWORD

This report follows the Standard Evaluation Protocol 2009-2015 (SEP) for Research Assessment in the Netherlands that was developed by VSNU, KNAW and NWO. The purpose of this report is to present a reliable picture of the research activities submitted for this review and to give feedback on the research management and quality assurance.

The review Committee was supported by QANU (Quality Assurance Netherlands Universities). QANU aims to ensure compliance with the SEP in all aspects and to produce independent assessment reports with peer review committees of international experts in the academic fields involved.

QANU wishes to thank the chairperson and members of the review Committee for their participation in this assessment and for the dedication with which they carried out this task.

We also thank the staff of the units under review for their carefully prepared documentation and for their co-operation during the assessment.

Quality Assurance Netherlands Universities

Mr. Chris J. Peels  
Director

Dr. Jan G.F. Veldhuis  
Chairman of the Board



## **PREFACE**

This report describes the quality assessment of the research in Biology at the Vrije Universiteit Amsterdam (VU), University of Amsterdam (UvA), University of Groningen (RUG), Wageningen University (WUR), Utrecht University (UU) and Leiden University (UL). The assessment covers the period 2005-2010 and was conducted according to the Standard Evaluation Protocol 2009-2015 for Public Research Organisations (SEP).

The quality assessment was carried out by a review Committee consisting of one chair and seven members with expertise in the relevant disciplines.

The Committee is grateful to the Faculties for their time-consuming and successful efforts to prepare clear and informative self-assessments about their research programmes and activities. The Committee wishes to acknowledge the pleasant receptions and open discussions during the site visits, with the various boards and research coordinators, and with the PhD students.

As chair of the Committee, I greatly appreciate the commitment, the expertise and the excellent cooperation of my colleagues. The Committee would also like to thank all persons involved in the thorough preparation and support of the review, especially the skilful and smooth direction and assistance of Barbara van Balen, Roel Bennink and Floor Meijer.

Alexander J.B. Zehnder  
Chairman of the Review Committee





## 1. THE REVIEW COMMITTEE AND THE REVIEW PROCEDURES

### Scope of the assessment

The review Committee was asked to perform an assessment of the research in 12 Institutes in Biology at the Vrije Universiteit Amsterdam (VU), University of Amsterdam (UvA), University of Groningen (RUG), Wageningen University (WUR), Utrecht University (UU) and Leiden University (LEI). The review covers the research in the period of 2005-2010.

In accordance with the *Standard Evaluation Protocol 2009-2015 for Public Research Organisations* (SEP), the Committee's tasks were to assess the quality of the Institutes and the research programmes on the basis of the information provided by the Institutes and through interviews with the management and research leaders, and to advise how this quality might be improved.

### Composition of the Committee

The composition of the Committee was as follows:

- Prof. Alexander J.B. Zehnder, Director Alberta Water Research Institute Edmonton and emeritus ETH Zurich (chairman)
- Prof. Joan W. Bennett, Rutgers University
- Prof. Roger Butlin, University of Sheffield
- Prof. Hans A. Hofmann, University of Texas at Austin
- Prof. Barbara Hohn, Friedrich Miescher Institute, Basel
- Prof. David Tilman, University of Minnesota
- Prof. Fritz Trillmich, University of Bielefeld
- Prof. Claus Wasternack, Leibniz Institute of Plant Biochemistry, Halle.

Barbara van Balen, Roel Bennink and Floor Meijer of the Bureau of QANU (Quality Assurance Netherlands Universities) were supporting the Committee at different stages.

A short description of the expertise of the committee members is given in Appendix 1.

### Independence

All members of the Committee signed a statement of independence to safeguard that they would assess the quality of the Institutes and research programmes in an unbiased and independent manner. Any existing personal or professional relationships between Committee members and research groups under review were reported and discussed. The Committee concluded that there were no unacceptable relations or dependencies and that there was no specific risk in terms of bias or undue influence.

### *Data provided to the Committee*

The Committee received detailed documentation consisting of self-evaluation reports of the Institutes under review, including all the information required by the Standard Evaluation Protocol (SEP) and CD's with a list of all publications.

### *Procedures followed by the Committee*

The Committee proceeded according to the SEP. Prior to the first Committee meeting, all research programmes were assigned to two Committee members for review. A preliminary assessment was independently formulated on the basis of the key information supplied.

The day preceding the interviews, the Committee was briefed by QANU about the research assessment according to SEP. The same day the general research and teaching structure at Dutch universities and the individual 12 Institutes were presented to the Committee. In addition to the research groups, the Committee was asked to evaluate the individual Institutes, except Wageningen. The Committee came to a consensus about procedural matters and other formal aspects of the assessment. The final assessments are based on the documentation provided by the Institutes, the key publications and the interviews with the management and with the leaders of the programmes.

The site visits took place on 2-9 November 2011. Each day was opened with a brief introduction by the Dean, followed by interviews with each programme leader and a varying number of programme members. The day was closed with a poster discussion with a selection of PhD students of the local programmes. The PhD students were individually selected by each University. After the interviews, the Committee as a group discussed the scores and comments. The texts for the report were finalised through email exchanges. The final draft version was presented to the Institutes for factual corrections and comments. The comments were discussed by the Committee and the Faculties were informed of the Committee's reaction. The final report was presented to the Boards of the participating universities and was printed after their formal acceptance.

The Committee used the rating system and the meaning of scores as outlined in the Standard Evaluation Protocol (SEP). The definition of the scores is given in Appendix 2.

## 2. BIOLOGY AND BIOLOGICAL RESEARCH IN THE NETHERLANDS

### General remarks

Biology, the core of Life Sciences, has long been seen as a descriptive science helping humans to understand the ever changing world in which they live. Much effort has been undertaken to systemize and classify all organisms on this planet, to understand their physiology, and their adaptation to the environment. Though these activities remain an important pillar of biological research, in recent years groundbreaking insights have been generated using new concepts and advanced molecular analytical methods. This new understanding of the guiding principles from the atomic to the ecosystems level has made Life Sciences a rapidly developing field leading to dramatic changes of how we perceive the living world. Step by step, modern Biology can explain the regulation of molecular processes, how these processes proceed, the effects of molecular processes on organisms, and as a result the behaviour and adaptation of individual organisms and entire populations. The exploding quantity and precision of knowledge increasingly allow to make predictions in Life Sciences. All these new insights will considerably impact our every day life and will offer enormous opportunities, both socially and economically. Advances in Biology will make our lives healthier, more enjoyable and rewarding. This ever faster moving progress forms the basis for more equity and dignity for all humans on this planet.

### Netherlands national focus on biology

At the same time as the review preparation was in its final stage, the Royal Netherlands Academy of Arts and Sciences (KNAW) issued the report *Strategic Foresight on New Biology - The Core of Life Sciences*<sup>1</sup>. This report came to the following observations:

1. The Netherlands has a unique and robust position in the New Biology, thanks to its internationally prestigious researchers and its innovative, outward-looking enterprises. The New Biology drives the knowledge economy in six of the Netherlands' nine key economic sectors, i.e. Life Sciences & Health, Agro-food, Horticulture & Propagation Materials, Chemicals, Energy, and Water. Dutch biological research is among the best in the world, but the report also shows that that position is under threat. Knowledge institutions, enterprises and government – the 'golden triangle' – have cooperated closely on promoting research, innovation and knowledge valorisation in the past ten years.
2. Young people are very interested in New Biology university programmes; the number of students enrolled in such programmes has doubled in the past ten years and graduates have an excellent position in the labour market, but there has not been a concomitant increase in the number of tenured teaching positions – indeed, there has even been a decline. The training of tomorrow's top Dutch biologists is being eroded.

The report concluded that the Netherlands has enough focus and mass in five disciplines to remain competitive internationally. In addition, Dutch professors in these five key disciplines comprise a relatively large proportion of the group of internationally prestigious, most-cited biologists. These disciplines can therefore be considered the core of the life sciences in the Netherlands:

- Physiology and Neurobiology
- Cell Biology and Developmental Biology
- Ecology and Evolutionary Biology
- Microbiology
- Plant Biology.

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<sup>1</sup> *Strategische verkenning Nieuwe Biologie – Het kloppend hart van de Life Sciences*, Koninklijke Nederlandse Academie van Wetenschappen, Commissie Visie Biowetenschappen, September 2011.

## Views of the Committee

The Committee largely agrees for the Institutes evaluated for this report with the conclusions of the KNAW foresight on the quality of the Dutch biological research. The Committee specifically emphasizes that the Netherlands has an amazingly formidable cohort and an unusually large number of groups with excellent research teams in Ecology, Evolutionary and Behavioral Biology, Neurobiology, Plant Science and Molecular Biology. In general, Environmental and Industrial Microbiology are extremely strong when compared with the rest of the world. Imaging techniques have a marked input to different research groups in the various universities. Through supporting long-term studies in Neurobiology and Ecology on ecologically important sites, the Netherlands contributes considerably to knowledge advances in these fields. The integration of Behavioral Biology, Neurobiology and Molecular Biology at both Universities in Amsterdam and in Groningen was seen as unusually good. Moreover, Wageningen is making important steps toward integrating social scientists into Life Sciences teams.

The Committee was impressed by some really excellent examples of integration of theoretical, experimental laboratory, and field research, at several universities.

Advances in biological insights are increasingly dependent on the ability to handle vast amount of data. Mastering statistical methods becomes key for sound data interpretations. The bioinformatics groups in and outside the universities are specialists in these fields. In recent years, they have become increasingly essential partners for biological research. The dichotomy of data generation in one place and the handling of the data sets in another is reaching a physical and personal limit. Modern biologists need to be exposed to more statistics and computational sciences to successfully handle the routine computational needs in research and development. Bioinformaticists are in high demand in industry, and before biologists with this expertise leave universities, topical training in summer courses and the creation of a new cohort of liaison scientists bridging the two scientific fields is a necessity. The Committee has seen a number of innovative approaches in the different universities to overcome the obvious gap. However, the Committee feels that the Netherlands Biology and Life Sciences would greatly profit from a more coordinated effort to fill the emerging needs in computational biology.

To become a top performer is one thing, to stay at the top asks for even stronger intellectual, organizational and financial efforts. The excellent international position which Dutch Biology has achieved is under constant threat of erosion in an increasingly competitive global knowledge society. The Committee whole-heartedly supports the KNAW's conclusion that the excellent position of Biology in the Netherlands can only be defended, or better, further expanded, with a strong will of all those responsible in the "golden triangle" (academia, industry, politics). Highest quality Life Sciences with all its different facets, has the potential to become an important economic driver in an excellently educated society, however only if all stakeholders act in concert. In addition, in this global economy, it is important for Dutch universities to nurture and expand their existing international collaborations in agriculture, biotechnology, and conservation studies, as well as to develop new and diverse ties with emerging technologies in information technology, "omics" studies, and other cutting edge fields.

The involvement of PhD-students in the close integration of research and education is a formidable asset. In many scientifically successful countries this close involvement becomes weaker through concentrating much of the research in extra university Institutes. By doing so there will be an increasing lack of well educated and trained scientists. To keep the close link between research and education at all levels is a strong advantage and will keep the Netherlands highly competitive in Life Sciences with an increasing chance of economical benefit from Life Sciences applications. The Committee was charmed by the Sandwich PhD system as an excellent way to develop scientific

research in developing countries and as an efficient instrument for capacity building. This programme is a great contribution to the development of less privileged countries and helps to create a solid international network, which goes beyond transient collaborations in a single project and may eventually pay back through economic cooperation.

Many of the biological research topics and projects would profit from increased collaboration with social sciences. Biological research directly touches the well-being of humans and people react, not only intellectually, but more so emotionally, to new insights in Life Sciences. Biological research also deals directly with the global life support systems and is key to sustainability. Societies have had, and continue to have, difficulties developing good policies and regulatory systems which are enabled through new insights. Progress has often been hampered by the inability of the political system to react timely to new insights, e.g. targeted genetic ameliorations of plants in Europe. The reasons for this are manifold and all stakeholders, scientists, engineers, regulators, legislators, consumers, civil society, etc. have their share in complicating the acceptance and implementation. The pace of innovations and inventions, and the development of new insights is steadily accelerating. New models and alternative ways of a timely policy formulation and regulation implementations are urgently needed. Novel approaches allow society to make faster and informed choices and not be forced by *fait accompli*. The excellent biological research and the well recognized social sciences put the Netherlands in a good position for becoming the trendsetter of evidence-based, data-driven and future-oriented policy implementations.

### **Limitations of the Review**

The comprehensive overview over the biological research is hampered by the fact that the Committee has seen only part of the biological research in the Netherlands. The review covers the majority of the research in Biology at the Dutch universities, except for the University of Nijmegen. The decision to participate in a particular review is the responsibility of each individual university. Nevertheless, it is a pity that some really excellent research in Nijmegen has not been part of the present assessment.

A number of important institutes for biological research have not been visited and reviewed by this Committee. These are: the Netherlands Institute for Ecological Research (NIOO), the Royal Netherlands Institute for Sea Research (NIOZ), the Fungal Biodiversity Center (CBS), the Netherlands Institute for Neuroscience (NIN), Developmental Biology of the Hubrecht Institute, and the Netherlands Center for Biodiversity Naturalis (NCB Naturalis).

Biological research in the universities is not limited to the Biological Science Departments. Much of the biomedical research takes place in the various medical centers. Biophysical research (e.g. on photosynthesis) or biochemical research reside in Physics or Chemistry. The links and cross-fertilization between all these activities and Biology were not highlighted in the material presented to the Committee.

Visiting all these Institutes and institutions would have gone beyond the capacity of a single assessment Committee. However, a broader overview about the biodiversity and contemporary life science research in the Netherlands would have helped the Committee to obtain a more comprehensive picture of the biological research in the Netherlands, which might have enabled more balanced assessments in some cases.

### **Organisation of Faculties and Research Institutes**

In the organisation of the Netherlands universities, the present-day structure consists of Faculties and Research Institutes. The responsibility and budget authority of the different Faculties are in the hands of the Faculty Deans. Apart from small differences in leadership structures, the Institutes

are managed by Department Heads, or by Scientific and Managing Directors, and Directors for Education/Teaching. The Institutes are divided into Departments, Sections or Groups headed by one of the full professors. With this, the scientific leaders are the key players in a research organisation that is very transparent.

We were pleased to observe that the Faculties of all the universities have a growing number of women in their professorial ranks, and we look forward to seeing increasing gender parity at the higher administrative level in the future. It was somewhat disappointing to see that only one of the Institutes (Utrecht University) mentioned gender equity as a goal in their presentations on the first day of the review.

Overall, it is the observation of the Committee that all Institutes, Departments and Research Groups are being run very efficiently.

### 3A. INSTITUTE LEVEL - VU University Amsterdam

Three Institutes of the VU University Amsterdam are involved in this review:

- Center for Neurogenomics and Cognitive Research (CNCR)
- Department of Ecological Sciences (AEW), VU University Amsterdam
- Department of Molecular Cell Biology (MCB), VU University Amsterdam.

#### Center for Neurogenomics and Cognitive Research (CNCR)

##### 1. The Institute

As of 2008, the Center for Neurogenomics and Cognitive Research (CNCR) is the operational branding name of the Department for Neurosciences (formerly also known as Institute for Neurosciences) of the Faculty for Earth and Life Sciences (FALW) of the VU University Amsterdam. The CNCR executes integrated Neuroscience research programmes from genes to behaviour, each combining mouse and human studies and as such operates as one of the expertise centres of the Neuroscience Campus Amsterdam. Currently the chair of the CNCR, acts also as the director of the Neuroscience Campus Amsterdam ([www.neurosciencecampus-amsterdam.nl](http://www.neurosciencecampus-amsterdam.nl)). In addition, the CNCR is the coordinating Institute of several national and international consortia. The CNCR has three sections, but operates as an integral Department without boundaries between the different disciplines as far as collaboration is concerned. A total of twenty research teams collectively work on five research themes, including a) Behaviour and Cognition, b) Mechanisms of Brain Disorders, c) Neural Networks, d) Neuron-glia interactions and e) Synapse Biology.

##### *Assessment*

The Institute has been highly successful over the last several years in terms of both quality and academic reputation. It has continued to dynamically develop its research capacity through the recruitment of new, young and talented team leaders. Efforts to strengthen cooperation through involvement in the Neuroscience Campus Amsterdam have resulted in a concurrent increase in cooperation within the Institute. The need to strengthen computational neuroscience in the near future and to improve the integration of bioinformatics into the various research programmes is clearly recognized.

##### 2. Quality and academic reputation

The CNCR had major breakthrough collaborations and scientific output in recent years. The policy measures that were undertaken in 2007-2008 to formalize collaborations between team leaders from various sections within CNCR evidently worked. More papers and with higher impact were produced each year, often as the result of collaboration of team leaders within CNCR or by collaboration with others in the Neuroscience Campus Amsterdam. Five 'breakthrough trends' in CNCR were identified in recent years and published on more than 20 high impact research report ranging from *PNAS papers*, *Neuron papers*, *Nature Neuroscience papers*, *Science papers* and one paper in *Cell*.

- Mechanisms of presynaptic release conclusively resolved in recent years.
- Cellular imaging and recording in prefrontal cortex in relation to synaptic plasticity and mental retardation.
- Cellular and molecular mechanisms of synaptic plasticity and addictive behaviour in rodents.
- Biomarker, genetics and proteomics in relation to brain disease in humans.
- Advanced technology in neuronal network physiology on human neocortex, with label free photonics and in awake rodents.

### *Assessment*

All three programmes within the CNCR are vibrant enterprises working on important questions of modern neuroscience across multiple levels of biological organization. Most of the Group leaders are young, some more established, yet all are very energetic and productive. The quality of the work is excellent, as is demonstrated by the numerous publications in high-impact journals as well as the very good to excellent citation measures. Several groups have established international collaborations with top laboratories around the world, which is a testament to their own reputation. The Institute director does much of the coordination work himself. A large proportion of junior staff stays on. Many professors in the Department work on 'soft money', apparently due to problems with university funding. Finally, the institutional leadership does not shy away from tough decisions, as exemplified when they had to shut down an underperforming group.

### **3. Resources**

The total funding of the Institute increased from 4.6 M€ in 2005 to 9.5 M€ in 2010, mainly thanks to the increased 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> stream funding. Acquisition of projects and programmes through competitive grants, national and international is one of the major sources of income for CNCR. Currently the ratio of direct funding (category 1) to research grants and/or contract research (category 2 and 3) is 30 : 70 %. The HRM policy of the CNCR is focused on policy to recruit and promote (young team leaders). Publishing in high impact journals is rewarded and seen as instrumental in generating sufficient external funding for future research.

### *Assessment*

The CNCR has demonstrated an impressive ability to increase its outside funding and has thus become less and less dependent on institutional funds. The success in this area has allowed the Centre to grow in terms of staff and to acquire big-ticket equipment items for imaging and genome-scale analyses (e.g. the integrated cellular screening pipeline for gene-functional analysis). However, some sub-optimal financial arrangements with the university administration apparently have led to losses, which of course should be avoided in the future.

### **4. Productivity**

The CNCR had major breakthrough collaborations and scientific output in recent years. The policy measures to formalize collaborations between team leaders from various sections within CNCR evidently worked. More papers and with higher impact were produced each year, often as the result of collaboration of team leaders within CNCR or by collaboration with others in the Neuroscience Campus Amsterdam. With up to 82 primary research papers per year and currently 49 PhD students being employed, the productivity and outlook for the future are excellent.

### *Assessment*

The Committee concludes that this Institute has a clear policy to shift the emphasis from volume to quality of research articles by accumulating results until higher impact is possible. According to the Committee, this desirable change is needed more in some component programmes than others. On average, the quality is already high, as a number of high-profile publications have been put out and all indicators suggest that this trend will continue. The output volume is good for research articles and theses, but public understanding and translational activity is not currently reflected in the output.

### **5. Societal Relevance**

The research of the CNCR oriented towards producing insight in the etiology of brain disorders and thus creates output with has a high potential for society. Obvious translational implications



are in the areas of mental retardation and addictive behaviour. In addition to the role in (pre)clinical research, the societal orientation of the team leaders is also evident in the activities and/or interviews by local or national media., and in the fact that they provide their latest insights from addiction research to police officers. In addition, in 2007, a spinoff company was founded by CNCR chairs, called Sylics, which is a trade name of Synaptologics BV. The valorisation potential of the collaboration between CNCR and Sylics is solid. Currently more than 10 co-workers are employed by Sylics.

#### *Assessment*

Although the emphasis of the research performed in this Institute is on fundamental questions, the work is of great societal relevance in terms of neurological diseases and mental disorders. As of now, there has not been much focus on establishing ties with any specific 'disease communities' (i.e. Alzheimer's, Parkinson's, etc.), although this might be beneficial in the future. Several groups within the Institute have developed collaborations with industry and more clinically oriented groups, and a number of promising avenues for this kind of research can be identified in this regard. Patents are actively being pursued, especially in the context of regeneration. Outreach activities targeting public schools and the general public were not prominently highlighted.

### **6. Strategy for the future**

Research quality: Not producing more papers but in particular papers with high impact. This strategy has worked in recent years and is part of the HRM policy to create an asset for earning capacity. Earning capacity: Apply for new Marie Curie ITN grants based on previous success of Neuromics (2004-2008) and BrainTrain (2009-2012): one traditional multicenter grant and one new type of grant being the European Industrial Degree (in collaboration with a foreign industrial partner). Apply for NWO BIG grant in the field of Life Cell Imaging & Photonics Strategic Alliances: Solidify and integrate work of all CNCR team leaders in the context of the Neuroscience Campus Amsterdam. Strengthen and make production of collaboration within NeuroBasic profitable and enduring. Strengthen strategic position of CNCR (via NCA) in the national arena by providing expert consultancy and do community service in advisory bodies of the regional and national government. This can be done through the EDDBA, through SpinozaNet, through Translational Neuroscience Network Netherlands (TN3) and through use of the ENC-Network.

#### *Assessment*

The CNCR seems highly viable, with a young and dynamic leadership, and poised to take advantage of opportunities and tackle challenges. The confidence and energy were palpable. The leadership is committed to strengthening bioinformatics and computational neurobiology within the Institute, which will further improve visibility and standing. Overall, the Institute has adopted the strategy of concentrating on producing high-impact papers. Presumably, this will also involve training PhD students and post-docs to aim for high-impact journals. The future of the Institute is based on an active network within the university, in the region and internationally through e.g. project coordination. The Institute's lack of structural university funding is compensated by third party financing of researchers and faculty members. The Committee established that a clear risk management for the case of fading of the third party funding is missing. Finally, there was some concern about the operation of the animal facilities by the university, which appear to be inflexible and as a consequence have hampered research in several cases. Those in control are urged to bring the animal facilities up to international standards.

## 7. PhD Training

Since the initiation of PhD training in Amsterdam, the VU has played an active role when it comes to training research professional in the field of Neurosciences. The present organization has grown into a professional graduate school called the Graduate School Neurosciences Amsterdam - Rotterdam (ONWAR). ONWAR consists of five research Institutes of the VU University Amsterdam, the University of Amsterdam, the Royal Netherlands Academy of Arts and Sciences (KNAW) and the Erasmus medical center. The scientific directors of the research Institutes comprise the Directory Board of the Graduate School and one of them is appointed as Scientific Director. VU University Amsterdam has acted as the representative for the school ever since it was initiated. Currently all 49 PhD students employed at the CNCR, are actively enrolled in ONWAR. ONWAR not only offers courses and training but also an Annual Meeting involving active participation of PhD students as well as giving them feedback in terms of transferable skills. In addition, some PhD students are actively involved in participation in either a Marie Curie consortium like BrainTrain or an Erasmus Mundus funding consortium ENC-Network.

### *Assessment*

The Institute is clearly committed to training young researchers at the highest level. It is an active member in a very successful cross-institutional training programme, which exposes students to diverse approaches to neuroscience and facilitates their professional growth. Members of the Committee were impressed by the quality and enthusiasm of the students they met with. The graduate school ONWAR tracks the PhD careers, enabling the Institute to establish which students end up in which career trajectory.

## Department of Ecological Sciences (AEW), VU University Amsterdam

### 1. The institute

The Department of Ecological Sciences is part of the Faculty of Earth and Life Sciences, VU University Amsterdam. The mission of the institute is to answer fundamental ecological questions regarding the relationship between organisms and their environment at the full array of hierarchical levels: from molecular ecology to ecosystem research. This is accomplished by a combination of field studies, experimental studies in a common garden and greenhouses and in controlled climate rooms, laboratory analyses and by modelling studies. The results of this fundamental research are applied to areas where society needs sound and robust answers to environmental problems.

The objective of the institute is to achieve and maintain an internationally recognized position within ecological sciences. Indicators for this are: (1) publications in the top segment of the general scientific journals (*Nature*, *Science*, *PNAS*) and ecological journals (*Ecology Letters*, *Ecology*, *Molecular Ecology*, *Global Change Biology*, etc.); (2) frequent citations of the work of institute members; (3) a prominent position in relevant international networks; (4) acquisition of substantial external funds to achieve this position; (5) being attractive to guest researchers and young, talented new employees.

The institute is an active player in the Amsterdam Global Change Institute (AGCI) in which it cooperates with the Institute for Environmental Studies (IvM), the Institute for Earth Sciences, the Economics Faculty and the Social Sciences Faculty (Political Science).

### 2. Quality and academic reputation

According to the CWTS analysis the publications of the institute are well-cited and have an impact that is far above world average. Many papers are in the top 10% and top 5% of most cited ones, which means that the work of the institute is highly visible within the international academic community. The institute boasts a large number of international collaborations (as also shown by the participation in many international networks and a high number of visitors), which often result in high-impact papers.

Two of the highlights of the previous years were (1) the Dorrepaal et al. (2009) paper in *Nature* which shows with sophisticated isotopic techniques that slight climate warming (about 1°C) causes old sub-arctic peat layers to decompose substantially faster, resulting in a possible long-term positive feedback between climate warming and decomposition in northern peat lands; (2) the breakthrough in understanding how cooperation is stabilized in nature by the work of dr. E.T. Kiers. Kiers has shown that in the plant root-fungus symbiosis (arbuscular mycorrhiza) punishment and reward mechanisms stabilize fair trade between partners. Both partners are able to withhold nutrients or change partners in the case of insufficient cooperation. This work has been published in *Science* (2011), *Annual Review of Ecology and Systematics* (2008), *Ecology Letters* (2010) and *PNAS* (2010).

#### *Assessment*

The Committee notes that the institute has been successfully publishing high-impact papers and has thereby maintained its high international reputation. Long term research will be continued even though it is difficult to maintain from grant income only. Through the appointment of extraordinary professors (Kowalchuk, Witte, Van der Meer, Eijsackers, Brouwer), the institute aims at covering the whole field from molecules to ecosystems. Truly close cooperation between the groups working e.g. on molecules and those working on the ecosystem is not yet evident, but

there is a fair amount of communication. Finally, the Committee considers it a discouraging sign that the institute cannot fill the 20 places in its Masters' programme.

### **3. Resources**

20% of the research fte's is from direct funding, the other 80% is paid for by grant acquisition. The institute aims for continuous innovation, and tries to attract promising scientists. E.g. through innovation and investment in genomics technology and expertise, the institute has been able to secure an excellent position in the national and international ecological genomics networks and to draw significant funds from the national investment programmes started since 2004. The labs are well-equipped and are operated by skilled technicians. There are a number of long-term experiments running, which are considered important for increasing the robustness of results and cost-efficiency.

#### *Assessment*

The Institute has reached its limit to grow. With over 80 percent of outside funding, there is no capacity left to bridge a funding gap, to assure matching funds, or to just provide the university infrastructure. The necessary flexibility of an academic institution is at stake here.

### **4. Productivity**

According to the self-assessment report, the CWIS analysis shows that the institute is very productive and that productivity is still increasing. The successful acquisition strategy has resulted in a considerable leverage, leading to a remarkably high output/tenured staff ratio.

#### *Assessment*

The Committee concludes that productivity of research articles by the institute is high in relation to the research fte's. There is a strong output of professional publications reflecting a commitment to translational output. This success appears to reflect a stimulating and well-managed environment.

The Committee notes that this institute has an excellent hiring policy: young, energetic new tenure-track people have been hired, including one female scientist. The group is successfully active in attracting increased money through grants. The umbrella of various Dutch organisations contributes to a secure status.

### **5. Societal Relevance**

The institute applies the results of its fundamental research to areas where society needs sound and robust answers to environmental problems (e.g. environmental pollution, salinization, sustainable agriculture, genetically modified organisms, sea level rise and coastal protection, spatial planning). The work on the risk assessment of chemicals and the development of guidelines for assessing soil contamination and clean-up has resulted in a patent using a *Folsomia candida* soil analysis expression assay. The institute has generated guidelines for the Dutch government for spatial planning in response to climate change. Moreover, the work on the possibility for 'saline agriculture' on salinized agricultural soils is already being executed on a commercial scale at the island of Texel. Members of the institute have been successful in forging numerous collaborations with governmental and corporate entities.

#### *Assessment*

The Institute contributes to the development of national environmental regulations concerning the risks of chemicals in the environment. It is also associated with the EU REACH legislation activities. The Institute has also participated in specific private-public partnerships. The Committee had the impression that activities concerning the societal relevance depended strongly

on one group and one group member in particular, but the Institute assured us that this is not the case..

## **6. Strategy for the future**

The institute aims to maintain and expand its international top position in each of its four spearhead areas, i.e. climate change and ecosystem functioning; plant-soil interactions and community ecology; stress ecology and evolutionary adaptation; ecological genomics and ecotoxicology. This requires a sound mix of high-profile scientists and high-quality facilities. The institute aims for continuous innovation and has attracted honorary professors in areas where expertise was lacking (nature conservation, microbial ecology, ecohydrology) and promising young scientists to secure its future position. Since 2010 the institute is an active player in the Amsterdam Global Change Institute (AGCI). This provides a robust basis for further scientific work, but also enables facility sharing (such as the mass spectrometry facilities of Earth Science and chemical analytical facilities of the IvM). The AGCI initiative falls in a broader clustering of research, as foreseen in the VU strategic plan, in which three main clusters are defined, one of which is Science for Sustainability (S4S). The institutional program plays an important role in Ecology and Evolutionary Biology, one of the five core disciplines of New Biology in the Netherlands, as identified by a recent analysis of a committee of the Royal Dutch Academy of Sciences (KNAW).

### *Assessment*

The Committee concludes that this Institute manages to link Systems Ecology and Organisms Ecology in a very sound way. It also appreciates that there is a clear road map for the future among others by building strength through partnerships, locally, nationally and internationally.

## **7. PhD Training**

The training of PhD students involves their participation in the national network on environmental sciences, the Research School SENSE. Each PhD student draws up a personal training and development plan at the beginning of his or her appointment, and chooses a set of courses organized either by SENSE (the Research School for Socio-Economic and Natural Sciences of the Environment) or by another research school to improve their scientific and organisational skills.

The system of PhD progress evaluation is based on formal annual evaluations and informally also includes creating a challenging scientific atmosphere in which each PhD student is stimulated to expand his or her scientific creativity and contribute to the shared mission of the institute. The institute aims to achieve this by regular meetings and intensive personal supervision by the daily supervisor. In its experience, regular feed-back by the programme leader can also contribute to boosting motivation. Each PhD student presents his or her work once or twice a year during the weekly programme meetings and on one of the annual institute symposia and - of course - also at international conferences.

### *Assessment*

The Institute has a good cohort of PhD students. About 40 percent finish within 4 years, an additional about 30 percent within five years. One research program tends to have their students finishing within the 4 years, something which should also be achieved by the other program. Age becomes increasingly a competitive factor, giving an edge to younger researchers.



## Department of Molecular Cell Biology (MCB), VU University Amsterdam

### 1. The Institute

The Department of Molecular Cell Biology (MCB) is part of the Faculty of Earth and Life Sciences of VU University Amsterdam. It strives to unravel how life emerges from the dynamical organization and interaction of molecules. The Department also investigates the malfunctioning of underlying processes, i.e. the molecular basis of diseases.

The Department of Molecular Cell Biology comprises 16 principal investigators, whose research activities are coordinated within four research groups: Genetics (GEN), Molecular Cell Physiology (MCF), Molecular Microbiology (MM), and Structural Biology (SB).

Although the four different research groups do not have a specific and common research theme, together they provide different techniques and represent different areas of expertise, which can be used to combine efforts. Their research spans most of today's fields of modern Biology, from single molecule observations to system level approaches. Crucial advances in science usually have an interdisciplinary basis and occur in the interaction between different research fields. In addition, the overall mission of MCB is to develop and foster an internationally renowned research culture for cutting-edge basic biological sciences and for training of high-quality PhD and MSc students.

### 2. Quality and academic reputation

At the single molecule level, considerable success has been achieved in the field of fluorescence microscopy. This developmental work at the forefront of single molecule microscopy will be continued in cooperation with industrial partners and STW. At the molecular level, a still growing cluster within MCB aims to identify novel antimicrobial targets and to develop new antibiotics. This research offers outstanding opportunities for cooperation with the pharmaceutical industry (Johnson & Johnson and Galapagos), but also with partners at VUmc. In multicellular settings, it examines how (controlled) DNA methylation controls gene expression, drives diversity and contributes to disease (cancer). The Institute investigates the network of 14-3-3 signalling in cells. Under certain circumstances, this signal seems to be capable to initiate apoptosis in a broad range of human cancer cells.

At the highest level of complexity, systems biology approaches are employed. In international collaboration, interlaboratory standardization for rigorous quantification was achieved for yeast and lactic acid bacteria. Using newly-developed self-replicating models of unicellular growth, it shows that metabolic switching strategies can be the result of growth rate optimization and trade-offs between investment costs and subsequent benefits, following optimal return-of-investments principles.

The impact of the Institute's articles ranks at 1.5 times world average, meaning that the Institute's impact as a whole is significantly above (Western-) world average. According to the CWTS, the Institute can be considered a scientifically strong organization. 20% of its publications reside in the top 10%, which is roughly double the expected number.

#### *Assessment*

Though interdisciplinary innovation is hard to recognise in a discipline-based review of groups, the Committee appreciates what the Department of Molecular Cell Biology has achieved in this respect. The Westerhoff group established a nucleus of Systems Biology in this department and added excellent work on metabolic systems biology by the group of Prof. Teusink. The group of Lill established a strong collaboration with the department of Physics in the twin Faculty FEW,

in the LaserLab. Together with other groups, this group also started up a strong interdisciplinary collaboration with pharmacy and chemistry through the interdisciplinary institute AIMMS. The Luirink group set up an intensive collaboration with the Medical Faculty of the VU through Prof. Bitter.

The Committee notes that there are plans to develop the microscope facility further and strengthen and intensify the work on anti-microbial substances. This is intended to result in intensified cooperation with the pharmaceutical industry. It is not entirely clear to the Committee how much in-group cooperation there is and how this will change through AIMMS. The lack of new personnel to renew the efforts appears to the Committee as a serious threat to the effectiveness and productivity of the group.

### **3. Resources**

MCB enjoyed steady growth during the evaluation period. Starting from 975 k€ in 2005, the Department has collected external funding of 3,51 M€ in 2010. More importantly, whereas total funding increased some 40%, direct funding decreased from 44% to 23% during that period. Despite reduced direct funding, the Department was able to attract new personnel (Bitter, Teusink) and managed to place some strategic investments (MS).

#### *Assessment*

The various groups within this Institute are fighting hard for financial support. Most groups bring in the average close to 80 percent research support from the outside. Though the Committee applauds these efforts, an almost exclusive dependency on outside funds may affect the viability and scientific depth of some of the groups. Reaching one third (direct) to two thirds (external) is a healthier base.

### **4. Productivity**

The output of the institute has strongly increased during the evaluation period with a doubling in the period 2005-2010. According to the self-assessment report this is largely due to the high intrinsic motivation of the staff members and the successes in grant acquisition, which has led to a considerable leverage. Over the period 2005-2010, the institute produced 35 PhD theses, almost 6 per year. Most candidates finish their thesis within 5 years.

#### *Assessment*

The Committee notes that the quality and volume of output are somewhat heterogeneous across component Institutes, but overall both are very good. New facilities and appointments are likely to further improve productivity in the coming years. There is a strong concentration on research articles with no translational output or output aimed at the public recorded.

This Department resulted from the fusion of four previous Departments, in principle allowing for added coherence. It was not discussed whether the instrumentation situation has improved.

### **5. Societal Relevance**

During the last two years, the reorientation towards medically relevant research topics has increased the social relevance and potential impact of the Institute's research (the evaluation carried out in 2008 considered this a wise move). MCB interfaces the mono-disciplines of molecular biology, chemistry and physics, thereby providing insight into new mechanisms of trait evolution in the context of ecological interactions.



### *Assessment*

In recent years, the Institute has focused on internal re-organization, leaving little time for reflection on societal relevance. The individual sections within the Institute did a very good job in the past to disseminate scientific knowledge to the society at large. There is quite some effort needed in the future to increase the societal relevance of the Institute, if the Institute would like to become more than just the sum of its sections.

## **6. Strategy for the future**

The Institute has taken steps to secure and further improve its position in research with the participation in AIMMS and LaserLaB. As much as permitted by university and Faculty policy, it will continue to actively invest in these partnerships and also to support the on-going relations and cooperation's of both Institutes with the VU Medical Center.

The Department strives to use reserves for modernizing its equipment where needed, as well as allowing talented researchers to found a Group on a tenure-track basis. As mentioned earlier, not all the research lines of the Department fit into the university's spear heads. It is currently negotiating with the Swammerdam Institute for Life Sciences (UvA) about a realignment of research lines, including relocation of personnel. Obviously, the Department on its own cannot allocate the resources that are needed to facilitate such a process. It is dependent on the two Amsterdam universities that are actually proposing closer collaboration.

### *Assessment*

The Committee concludes that MCB has been able to run a successful research programme in the evaluation period. It seems – however - that the coherence is somewhat hampered by the dispersion of the different working groups over the entire campus. The Committee is of the opinion that some additional efforts are needed to further focus the research.

## **7. PhD Training**

All PhD students of the Department are members of one of more research schools (EPS, SENSE) or participate in larger research consortia. This implies individual training as well as research plans and supervision and control by an independent research Committee or scientific advisory board.

### *Assessment*

The PhD students are all members of one or more research schools. How the education is exactly structured for those students in research consortia is not so clear to the Committee. The success rate of the PhD students is high. However the duration of the thesis work of more than 6 or even 7 years for a large part of the PhD students is much too long. Immediate efforts are needed to reduce study length and a viable compromise between scientific depth and a start of a career outside academia must be found.



### 3B. PROGRAMME LEVEL - VU University Amsterdam (Programmes 1-9)

**Programme 1:** **Animal Ecology**  
Programme coordinator: Prof. dr. N.M. van Straalen  
Research staff 2010: 15.57 fte

Assessments:                      Quality:            4  
   Productivity:      4.5  
   Relevance:        5  
   Viability:         5

#### *Short description*

The mission of the programme Animal Ecology is to answer fundamental ecological questions regarding the evolutionary responses of organisms to environmental change, to partners in the community and to stress factors. The programme is basically fundamental, but simultaneously addresses issues of society-relevance such as nature conservation, soil pollution and sustainable use of ecosystem functions.

The specific research question of the programme is: which properties of the genome and its expression determine the cellular defence against stress and how does this defence translate to adaptation?

#### *Quality*

The group has maintained a high and increasing publication output in a competitive field and produces very strong publications – including papers in top journals - across a broad range of ecological disciplines with highlights in ecotoxicology in relation to soil collembola, evolutionary ecology of parasitoids and impacts of global change on community structure. Over the last two years, the quality of the output has further improved and is now in the range of quality score '5'. The average citation rate in the review period has been good but not excellent. This is likely to improve as a result of the appointment of excellent young scientists and policy decisions to focus on impact over number. Through acquiring competitive grants and forming a broad cooperative network the group is expected to be able to maintain its present high productivity and excellence. There are strong and improving external collaborations, for example internationally in ecogenomics and locally in evolutionary ecology, global change and community ecology within the Amsterdam Climate Change Institute.

A recent change of Group leader has been necessitated by new management roles of the former leader. The transition has been accomplished very smoothly so that the Committee expects the quality of the group and their output to continue at a high level.

#### *Productivity*

The Committee notes that numerically productivity has been very high in relation to research fte. The output of research articles, professional publications and theses has increased. The group recently concentrated on producing an increasing output of high relevance in high to top ranking journals. This move is welcome. Overall the papers produced are cited well. Some influential reviews have been generated but the focus should remain on high-quality primary papers. At the same time the group has been active in explaining the importance of its science to the general public.

### *Relevance*

The group focuses on important aspects of environmental processes such as soil contamination and its biological measurement and the loss of traits as an adaptation to parasitic life. The work on interactions among plants and mycorrhizal fungi is opening a new area of societal impact as it shows the agricultural significance of plant-fungal mutualisms. Ecotoxicological aspects also play an important role. These fields of ecology are increasing in importance for the maintenance of ecosystems and agriculture in the face of global change. The group is active in translating its research in both public policy and commercial directions. This includes the areas of soil contamination, in both national and European policy and in interaction with industry. Community ecology research is also relevant to policy in relation to global change. The group is very active in public outreach.

### *Viability*

Rejuvenation of the group with young staff is happening and the group has a good age structure. Partly as a result of outstanding recent appointments there is every promise of successful continuation. The departure of the director and his replacement has been managed successfully, promising that the high scientific standard and the visibility of the group will be maintained. The community ecology theme is strong but may have better links in the Systems Ecology group than in Animal Ecology, allowing this group to focus more. Introducing bioinformatics expertise into the group may help to exploit the opportunities presented by the ecogenomics thread. Administrative duties for senior staff are a drain on research opportunities.

The committee finds that the overall viability is excellent, with a sense of excitement in the group and a strong upward trajectory in research quality.

## VU

**Programme 2:**                      **Systems Ecology**  
Programme coordinator:        Prof. dr. R. Aerts  
Research staff 2010:            7.87 fte

Assessments                      Quality:            5  
    Productivity:     5  
    Relevance:       4  
    Viability:         5

### *Short description*

The mission of the research programme Systems Ecology is to elucidate how global change affects interactions between vegetation, soil, hydrosphere and atmosphere using a systems ecological approach.

The group aims at achieving this mission by:

- focussing on cold and cool biomes (including NW-Europe) using an experimental approach both in the field, experimental gardens and climate rooms
- performing long-term field experiments, using plant functional traits as the basis for response and effect parameters
- using state-of-the-art technology to analyse ecological responses and interactions, such as stable isotope spectrometry, HPLC, pyrolysis mass spectrometry and a wide array of microbial ecological techniques
- making projections of future ecosystem behaviour based on the results obtained today and from the past both by experimentation and modelling at various spatial and temporal scales.

### *Quality*

Although the Systems Ecology programme has a small staff, it has accumulated an extremely strong record of publication in major journals. Their papers on environmental topics, such as the effects of climate warming on carbon dioxide emissions from arctic soils, have been highly influential, giving an excellent citation impact score.

### *Productivity*

The programme has demonstrated excellent productivity in publications per staff member, in students trained, and in outreach to societal needs. Research is largely funded from the outside; the university contributes less than 20 percent.

### *Relevance*

The research and publications from this programme address many issues of national and global environmental importance. Moreover, their work on agricultural crops that are suited to mildly saline soils is of direct and immediate relevance to societal needs.

### *Viability*

During the period of this review, this programme made strategically significant changes in its publication focus, pursuit of funding, and philosophy that allowed this programme to produce research of excellent quality and productivity. Because of this, the programme is well situated for future success.

## VU

### Programme 3:

### Genetics

Programme coordinator:

dr. A.R. Stuitje (until 2010), Prof. dr. R. Koes (from 2010)

Research staff 2010:

3.0 fte

Assessments

Quality: 5

Productivity: 3

Relevance: 4

Viability: 3

#### *Short description*

The research of this programme is aimed at the question how regulated gene expression controls the development of a plant, and in particular the development of inflorescences and flowers. The objective is furthermore to understand how alterations in these gene regulatory networks during evolution have led to the enormous morphological diversity that is seen today among flowering plants. The research in the group can be distinguished in three lines:

- the first line focuses on the very earliest steps in the development of flowers, that is specification of the floral fate of meristems and the patterning within this meristem which determines the architecture of the flowers;
- the second line focuses on late steps in flower development, the differentiation of petal cells;
- the third line aims to understand how epigenetic mechanisms, and in particular DNA methylation, affect the expression of anthocyanin and developmental genes. An additional goal is to develop methods by which epigenetic properties can be artificially modified thereby changing gene activities and developmental processes.

#### *Quality:*

This group conducts excellent and groundbreaking research in the area of plant development and, more recently, in the evolution of developmental mechanisms. The group is actively involved in the international *Petunia* platform, which provides great resources to the community. The bibliometric measures also indicate excellence. Group leader Dr. Koes likes to see himself as challenging dogmas, which at least to some extent seems justified. The coherence of the group is not entirely obvious.

#### *Productivity:*

Productivity has been relatively low over the review period, but the group seems now poised to pick up publication activity given several recent discoveries and the fact that six PhD students are in the process of finishing up. Publications are expected to peak in the next period, also because a prestigious ALW-TOP grant was obtained at the end of 2011.

#### *Relevance:*

Overall, relevance of the research is very good, especially given the fundamental importance of flowering in horticulture. The group has obtained several patents, including one for flower pigmentation and another one for salt tolerance. They actively interact with companies to explore several lines of potential application, although it is not clear yet what will happen.

#### *Viability:*

The group has experienced a decrease in staff size and appears somewhat isolated within the university. There are plans in the works that would allow them to move to UvA, which might be an excellent solution, since a move would increase visibility, create a larger cluster that would be more competitive for large grants. Continued access to the excellent green house facilities at VU

should also be considered to be of crucial importance. Finally, this group suffers from a very high teaching load, which distracts from research and has impacted productivity. The group would benefit from teaching relief.

**Programme 4: Molecular Cell Physiology**

Programme coordinator: Prof. dr. H.V. Westerhoff

Research staff 2010: 17.9 fte

Assessments:	Quality:	4
	Productivity:	5
	Relevance:	5
	Viability:	4

*Short description*

Object of study is the emergence of 'life' in and between its smallest autonomous units, i.e. cells. The group focuses on energetics, carbon, nitrogen and redox metabolism, transport, and signalling. The group also studies how life of parasites and tumour cells can be understood and managed without disadvantaging their host, starting from the security of the mass balances of metabolic networks and considering their regulation by signal transduction and gene expression in the systems biology sense.

The group develops theory and models. It compares predictions of quantitative experimental data obtained in experiments. It uses selected, biological-function oriented approaches, develops analytical methods and implements others. The group tries to understand how functions of life flow, are controlled, regulated, adapted, traded-off and constrained by physico-chemical, economical and niche limitations.

The group aims at becoming one of the nuclei of the Infrastructure for Systems Biology Europe and it is one of the four coordinators of the IT Future for Medicine (ITFoM) EU flagship project. The group represents a stronghold of microbial and metabolic systems biology.

*Quality*

This group has a long track record of excellence in research, although this is not entirely reflected in their bibliometric ranking. They recently expanded into cellular systems biology, where they have already made a positive impact. The group is very interdisciplinary and maintains several collaborations with top labs. The training environment is therefore excellent as well. They suffer from outdated equipment, but are pursuing funding for new equipment.

*Productivity*

Overall, productivity is very high. Given the quality of their work, it was surprising that they have not published more frequently in higher impact journals. The research group has drastically expanded in the last five years, primarily based on a significant increase of outside funding. In 2010, the group got less than 20 percent for research from their university.

*Relevance*

The work of the group is of societal relevance in several aspects, as is also evidenced by their collaborations with several companies. For example, they have produced several tools for drug development. Also, their work on trypanosomiasis is very promising.

*Viability*

The leadership by Prof. Westerhoff has allowed this group to obtain international stature. However, his joint appointments at other institutions could overextend him. The current budget



freeze at the university level has prevented the group from investing 1 M€ they put aside and hampers hiring.

## VU

### **Programme 5: Molecular Microbiology**

Programme coordinators: Dr. J. Luirink, Prof. W. Bitter, dr. P. van Ulsen  
Research staff 2010: 6.2 fte

Assessments:                      Quality:            5  
   Productivity:    4.5  
   Relevance:       5  
   Viability:        4

#### *Short description*

The research group aims to combine expertise from different disciplines to elucidate the molecular mechanism of membrane protein biogenesis and protein secretion in bacteria. This aim is reflected in four research lines, with an emphasis on pathogenic bacteria protein production platforms and anti-infective agents (antibiotics and vaccines) with a focus on tuberculosis. The programme contains four research lines:

- the fundamentals of membrane protein biogenesis, involving targeting, insertion, folding, oligomeric assembly and quality control;
- protein transfer across the bacterial cell envelope via the type V secretion pathway. In an applied spin-off this protein is exploited to construct a platform for secretion and surface display of heterologous proteins and epitopes to streamline biotechnological production processes and live vaccine development;
- the molecular basis of protein secretion via the recently identified type VII pathway. In this line the intrinsic mechanism of the secretion system is studied: its components and substrates, the nature of the membrane translocation complex and the secretion signal;
- characterization of a novel signal transduction/regulation system that controls the production of virulence factors in *Pseudomonas aeruginosa*.

#### *Quality*

The research on secretion is extremely solid. The programme has established itself as doing high quality work on the bacterial membrane with a focus on the membrane of Mycobacterium, a bacterial genus that does not easily fit into the old Gram positive/negative dichotomy. The Type V secretion pathway can be used as a platform for vaccine development; the type VII pathway is of basic and theoretical interest in virulence.

#### *Productivity*

There is a steady production of solid papers in top journals in microbiology. There is effort to succeed also in high ranking journals.

#### *Relevance*

The health implications are multifaceted, spanning a basic understanding of bacterial pathogenesis to vaccine development. Work is under way for development of a tuberculosis vaccine; there is potential for work on influenza, pneumonia and other important infectious diseases. The programme has numerous national and international (Stockholm, Yokohama, Padua, Basel, Toulouse etc) ties. It is good at transforming basic research into clinical applications.

#### *Viability*

The group is stable and productive, and is well connected to other groups nationally and internationally. There is potential instability in the dependence on 'soft money' and PhD

students who are supported on outside money. Young scientists are well embedded in the group structure.

**Programme 6: Structural Biology**

Programme coordinator: Prof. dr. H. Lill

Research staff 2010: 7.1 fte

Assessments:	Quality:	4
	Productivity:	3
	Relevance:	4
	Viability:	3.5

*Short description*

The research of this group aims at the dynamics of intra- and intermolecular interactions of proteins. The group operates across the borders of (Molecular) Biology, Chemistry, and Physics. The consequences of structural alterations in the course of enzymatic activity, transmembrane transport and regulation is examined in vitro and in vivo. The main goal is to provide fundamental understanding of these processes.

The programme has three research lines:

- energy metabolism as a target for new antibacterial agents;
- the ubiquitous cellular regulator, the 14-3-3 protein because of its central role in a number of regulatory networks in health and disease;
- the bacterial Tat protein transport system.

*Quality*

The group has been active since 2001, although delays in renovations did not allow them to get started until 2003. While the work of this group is interesting, highly interdisciplinary, and valuable, it could be published and publicized better. The impact of the research is not clear, as bibliometric ranking is relatively low. Prof. Bollen has invested much time and effort in technology development, which positions him well for ongoing and future research addressing biological questions. The group has many local and international collaborations and coordinates a European research training network (RTN).. The group has had success in obtaining grant support, though apparently none of it is in the name of the programme leader.

*Productivity*

While publications are of high quality, the group's productivity is clearly too low and has even been decreasing in recent years (only 15 publications over the past three years), which is of concern given that the group has four tenured scientists.

*Relevance*

The research is potentially of high relevance with respect to drug research and innovative microscopic methods. But this potential has not been fully realized until now. The group maintains active collaborations with industry and actively pursues patents. The current hiring freeze has negatively impacted the group, however, they have successfully obtained funding to support PhD students and recruited through the interdisciplinary institutes (AIMMS).

*Viability:*

After eight years the group still does not seem to be completely up and running. Since a coherent vision and strong leadership seem absent, it is not entirely clear how this group will move forward, but the group feels that they are now at the point to harvest on earlier investments and

they have earned new grants from NWO and STW Representatives of the programme expressed their desire to maintain the current group size instead of pursuing growth.

**Programme 7:** **Functional genomics**  
 Programme coordinator: Prof. dr. M. Verhage  
 Research staff 2010: 22.62 fte

Assessments:                      Quality:        4  
    Productivity: 4  
    Relevance:    4  
    Viability:     5

#### *Short description*

The research group studies the presynaptic nerve terminal in health and disease and also contributes to the understanding of complex trait in rodents and humans. The studies of the nerve terminal aim to understand the gene networks that orchestrate the secretion of diverse chemical signals such as classical neurotransmitters from synaptic vesicles and large dense core vesicles.

For the secretion studies model organisms, mostly mutant mice are used, and in vitro preparations, such as primary neurons and secretory cells in culture. These models are studied using a variety of functional assays ranging from electron microscopy, molecular biology, protein chemistry and immunocytochemistry to life cell imaging, electrophysiology and behavioural phenotyping.

#### *Quality*

The programme is doing vibrant work on the synapse which has implications across neurobiology. The group is young and therefore is in the process of establishing a track record. They are doing high quality work that is trending towards a 5. The score is based on what has been analyzed to date.

#### *Productivity*

Because it is a young group, the future is likely to be stronger than the past. They are publishing in top ranked journals. The outside funding has increased during the review period from 40 to over 75 percent. Again, trending towards a 5.

#### *Relevance*

The work on the synapse has relevance to all neurological disease, but the emphasis on fundamental sciences (understanding the synapse) means that there has not been much focus on establishing ties with any single 'disease community' (i.e. Alzheimer's, Parkinson's, or etc.). The Committee understands that the group is interested in disease largely as a way to inform the study of the synapse, but it might make sense - depending on how the research unfolds - to focus on nurturing ties on one or more specific disease communities.

#### *Viability*

In the opinion of the Committee, this group seems highly viable. It has grown from 13 to 36 in a short period of time with a concomitant large increase in funding. Its members are full of energy, have good ideas and confidence. The Committee foresees that the future will bring increasing visibility, quality and funding.

**Programme 8: Integrative Neurophysiology**

Programme coordinator: Prof. dr. A. Brussaard (2005-2007), Prof. dr. H. Mansvelder (2008-2010)

Research staff 2010: 23.75 fte

Assessments:	Quality:	5
	Productivity:	5
	Relevance:	4
	Viability:	5

*Short description*

The Integrative Neurophysiology section studies mechanisms of plasticity and dynamics of neuronal networks underlying sensory information processing and cognition. The group wants to understand how events at the synaptic and cellular levels are involved in behaviour. A multidisciplinary approach is taken in which electrophysiological recordings and imaging from single neurons and networks of neurons are combined. A variety of approaches is used in the lab including in vitro and in vivo patch clamp techniques, two-photon imaging, human EEG and fMRI recordings, behavioural tests and in silico modelling and simulations.

*Quality:*

This is a very well-run group that does excellent and very relevant research in various rodent models. Several international collaborations with top labs are in place. In a display of leadership, the Van Ooyen group (computational neurobiology), which was not successful, was shut down. Group leader Prof. Mansvelder recently received a prestigious ERC starting grant.

*Productivity:*

This group has an excellent publication record. During the review period, it has been extremely productive, including numerous publications in high-impact journals. According to the Committee, its performance has been exemplary.

*Relevance:*

Collaborations with industry and more clinically oriented groups have yet to produce tangible outcomes, although there are several avenues that will likely lead to success if pursued aggressively. The collaborations with the VU medical centre and biophysics groups have the potential to produce tangible outcomes. Various research activities, such as on Fragile X mental retardation syndrome and white matter disease, and the focus on nicotinic modulation are already highly clinically oriented. Group members are involved in various outreach activities, such as open days for high schools, the Brain Awareness Week, Nemo neuroscience education for kids, etc.

*Viability:*

Overall, this group has strong and dynamic leadership and is thus well positioned for an excellent future. There is some concern within the Committee about the operation of the animal facilities, which appear to be inflexible and below international standard. In addition, some sub-optimal financial arrangements apparently have led to losses.

**Programme 9: Molecular and Cellular Neurobiology**

Programme coordinator: Prof. dr. A. Smit

Research staff 2010: 17.07 fte

Assessments:	Quality:	5
	Productivity:	5
	Relevance:	4
	Viability:	5

*Short description*

The Molecular and Cellular Neurobiology section aims at taking a Systems Biology approach to study brain function. The group tries to span and connect several levels of investigation, from molecules up to behaviour. In particular the molecular and cellular mechanisms that underlie the formation and plasticity of synapses in animal models of brain diseases are investigated with a focus on mechanisms of synapse formation during development, adult plasticity as well as de- and regeneration of central neurons.

The aim is to solve the architecture of protein assemblies that determine synaptic function and enable plasticity. Proteomics technologies are used to establish novel modulatory interactions in protein networks. High-content automated microscopy involving gene over-expression and knockdown approaches in cultured neurons is used for functional dissection of synaptic proteins. Neuron-glia interactions are studied to understand the hitherto underestimated role of glial cells in plasticity of the brain. Ligand-gated ion channels are studied to understand their structure-function relationships and their contribution to synaptic function.

*Quality:*

The research of this group is in the top tier internationally, as is also evidenced by their numerous high profile publications and impressive bibliometric data. The research projects are diverse, yet mostly focused on basic research on synaptic function, often in the context of affective behaviour and including structural Biology work. Over the review period the group has set up an integrated cellular screening pipeline for gene-functional analysis, which is both relevant and exciting by a new technology (optogenetics).

*Productivity:*

Overall, this group's productivity has been exemplary. It has an excellent publication record, with numerous papers in high impact journals. Permanent high level in contract research and increased research grants in 2010 indicates another strength of the group.

*Relevance:*

This programme is at the forefront of basic research in synaptic biology, as evidenced by strong bibliographic impact measures. Researchers of this group are involved in numerous collaborations at local and national levels; they also participate in international consortia. Their translational research efforts are very promising, but the long-term potential is not yet clear. Patents are actively being pursued, especially in the context of regeneration.

*Viability:*

This group, which has been under the same leadership since 2003, overall has an excellent outlook. The group leader is working on strengthening bioinformatics and computational neurobiology,



which will improve visibility and standing. Because so many researchers in the group are on soft money, there are some risks should funding deteriorate unexpectedly.



#### 4A. INSTITUTE LEVEL – University of Amsterdam

Two Institutes of the University of Amsterdam are involved in this review:

- Institute for Biodiversity and Ecosystem Dynamics (IBED)
- Swammerdam Institute for Life Sciences (SILS).

#### **Institute for Biodiversity and Ecosystem Dynamics (IBED)**

##### **1. The Institute**

The Institute for Biodiversity and Ecosystem Dynamics (IBED) is part of the Faculty of Science of the University of Amsterdam. It currently comprises nine research groups led by a full professor and clustered in three research themes: Biodiversity and Evolution, Geo-Ecology, and Community Dynamics. In addition, each research theme has several special chairs.

IBED's mission is to increase the understanding of the diversity and dynamics of ecosystems from the level of molecules and genes to entire ecosystems. The aim is to unravel how ecosystems function in all their complexity, and how they change due to natural processes and human activities. The focus in IBED lies on the study of two interlinked aspects: (i) how do organisms interact with one another and with their abiotic environment, and (ii) what are the dynamics that emerge from these interactions, both in space and in time.

IBED has a unique national and international research position. This is due to the combination of biotic and abiotic research, of experimental and theoretical studies, and the focus on understanding the dynamics of complex systems.

##### **2. Quality and academic reputation**

The CWTS analysis reveals that the impact of UvA publications (SILS and IBED) compares very well on the international level, as they are cited 50% more frequently than the average publication in the subfield. The CWTS trend analysis shows that the output and the average citation rate of papers by IBED has increased from 2001-2004 to 2006-2009, while the impact has been around the same stable level (MNCS around 1.6).

High impact characterizes all major research subfields covered by IBED. Of the 634 IBED research papers dating from the period 2001-2007, 181 publications were ranked among the top 20% most frequently cited papers in the field (43% more than the world average in the field), 82 in the top 10% (29% more), 46 in the top 5% (46% more). Top publications included three by young scientists (*ISME Journal* 2007; *Ecology Letters* 2007, 2009) highlighted as Editors' Choice in *Science* and in News & Views of *Nature*.

The academic reputation of IBED is also reflected by honorary titles awarded to its staff. These include an Academy Professorship from the KNAW (Prof. Maurice Sabelis), two memberships of the KNAW (Prof. Henry Hooghiemstra and Prof. Steph Menken) and an Honorary Doctorate of Umeå University, Sweden (Prof. André de Roos). IBED staff members hold over 40 editorships of peer-reviewed journals, including: *American Naturalist*, *Ecology*, *Ecological Monographs*, *Journal of Quaternary Science* and *PLoS One*, including a position as Editor-in-Chief (*Entomologia Experimentalis et Applicata*. Prof. Steph Menken).

##### *Assessment*

The Committee concluded that IBED maintained an excellent record of high quality research over the review period. The staff of IBED includes a significant number of genuinely world-leading scientists. Excellent strategies are in place to maintain this quality in future, including

closer collaboration with SILS, thereby combining strengths, a transparent and equitable funding model and clear embedding within University and National priority areas. Management at Faculty and Institute levels appeared to be very strong and forward-looking. The proposed new senior appointments in Aquatic Ecology and Macro Ecology are particularly important for the future.

### **3. Resources**

IBED acquired a grand total of 22.4 M€ in new projects in the period from January 1, 2005 to December 31, 2010. Ca. 70% of this money was derived from external funding. This included funding for the construction of research infrastructures for biodiversity research (combined 4.6 M€), several grants in the NWO Sea and Coastal Research programme (combined 1.2 M€) as well as funding for climate research (930 k€) and ecological risk assessment of GMO crops (992 k€). Personal grants included a TOP grant from NWO (Prof. Jef Huisman), 2 NWO-Vidi grants (dr. Eric Schranz and dr. Marc Davidson) and 2 NWO-Veni grants (dr. Katja Peijnenburg and dr. Jasper de Goeij). The relocation to the Science Park Amsterdam in 2010 coincided with a large scale renewal of research facilities.

#### *Assessment*

IBED was very successful in attracting both grant and contract funding over the review period. All programmes contributed to this success. There was a good diversity of funding sources. The research infrastructure now available in the new building is truly world-class and should enable the Institute to continue to attract funding. Good strategies are in place to promote the search grants and particularly for new funding sources. The future funding climate is clearly challenging and efforts must be made to pursue priority areas but this should not be at the expense of support for the core, fundamental scientific research on which the Institute's reputation is based.

### **4. Productivity**

The CWTS trend analysis shows that the output of papers by IBED has increased from 2001-2004 to 2006-2009. In the period 2005-2010 the Institute published 930 peer reviewed articles, 145 book chapters, 21 monographs and 71 PhD theses.

#### *Assessment*

The Committee concludes that the output of IBED is of high quality and productivity is very good across a range of output types, including research articles, theses and output for non-academic audiences. This reflects a commitment to both scientific quality and societal relevance, with attention paid to the impact of papers. We commend the specifically articulated strategy to value quality over quantity of output and the system to reward publications in top journals. However, mechanisms should be in place to target high quality output from the inception of new projects.

### **5. Societal Relevance**

IBED considers it one of its explicit tasks to perform research in cooperation with societal stakeholders, and disseminate its research outcomes to those stakeholders and the general public. Topics of societal relevance include endangered species, GM crops, biological control, biological filtration, bird strikes, algal blooms and CO<sub>2</sub> compensation. IBED scientists frequently feature in the national and international media as experts, and IBED research finds its way to popular scientific publications. In addition, in cooperation with external partners, research results are converted into practical applications. External partners include ARCADIS Nederland NV, Philips, Koppert Biosystems BV, the Dutch Air force, the National Authority for Data concerning Nature, KWR Water Research, the Swedish Fishery Board and the Ecuadorian Ministry of the Environment.

### *Assessment*

IBED was very successful during the review period in translating its research through a wide variety of routes. This includes commercial exploitation but the Committee also considers the roles of IBED staff in policy development and public outreach also to be extremely valuable. IBED is well placed to maintain this track record. Collaboration with companies will be increasingly important but also competitive and uncertain in the present economic climate.

## **6. Strategy for the future**

IBED's main strategy is directed at maintaining sufficient critical mass to be able to work on its multidisciplinary mission, invest in the priority research clusters and provide an optimal working environment for its scientists, all aimed at steadily increasing the quality of the output. This means that quality is valued above volume, and focus/coherence above latitude.

IBED aims to further stimulate the acquisition of personal grants (Veni/Vidi/Vici grants, ERC grants) as well as the hiring of female scientists, offering support for setting up their research line. Young researchers will be appointed on tenure track positions. IBED wants to maintain a steady level of external funding, aiming annually at 3.5-4.0 M€ in value. Approximately 15 new PhD projects start each year. For this three routes will be followed: (i) partnerships with other research institutions nationally (potentially through new special chairs) and internationally (through exchange programmes and national stipends for top talents), (ii) research coupled to infrastructures, since in the 8th EU framework programme substantial funding will be allotted to research related to infrastructures, and (iii) developing collaborations with companies, semi-private and governmental institutions that want to invest in R&D. The traditional system of a research group having one full professor as leader is abandoned. Instead, all scientists are responsible for their own career development that can eventually lead to a professorship, based on transparent evaluations.

### *Assessment*

The Committee notes well-formulated plans for the hiring of new senior and tenure-track scientists of high quality (and with good strategies in place to enhance appointment of women) that should secure a balanced age-structure for the future. These recruitment plans may place a strain on financing in the future since it is hard to foresee the level at which income can be maintained. Nevertheless, investment in excellent staff is the only way to maintain quality. The Institute appears to be stable for the immediate future and will most likely be able to maintain its high international visibility through its strategy of attracting new talent before retirement of the present leaders.

The outstanding new building stimulates interactions between the different research groups, with groups in SILS and, importantly, with others (especially Mathematics and Computer Science). The Institute has enthusiastic and committed faculty, an excellent collaborative culture and clear long-term planning. The planned move towards research clusters requires some cultural change to realise its full benefits but the Committee considered this a positive development, in keeping with the trend in Biology to work in larger, interdisciplinary teams.

## **7. PhD Training**

A mandatory training and supervision plan is made for all PhD students at the start of their appointment. The plan specifies the research activities, planned teaching activities, and the courses the PhD student will attend. Progress of the PhD student is evaluated at regular intervals, and the education and supervision plan is updated each year. Students have frequent formal and informal contact with their supervisor. PhD students (and postdocs) of IBED have their own institutional committee (CIPP) that maintains a dialogue with the IBED management. They also

participate in the PhD and postdoc council of the Faculty of Science, to discuss relevant matters with the Dean. Together with the CIPP and the Faculty of Science, IBED is currently developing a new supervision protocol for PhD students, to increase the number of PhD students that graduate within their contract period and to optimize training and supervision.

*Assessment*

The Committee very much enjoyed meeting IBED PhD students in the combined IBED/SILS session. They were uniformly very positive about their training experience and they spoke with enthusiasm and assurance about their research projects. The system in place for supervision appears to be excellent. Most PhD students finish after 5 to 7 years, rather than after 4 to 5 years. It should be a priority to reduce durations to an internationally more competitive length and increase success rates compared to the review period. However, we note the high success rate of graduated students in obtaining employment in a variety of contexts.

## **Swammerdam Institute for Life Sciences (SILS), University of Amsterdam**

### **1. The institute**

The Swammerdam Institute for Life Sciences (SILS) is a multidisciplinary research institute, established in 2000 as part of the Faculty of Science of the University of Amsterdam. The mission of SILS is to be a world-class multidisciplinary life science research institute where excellence in research, technology development and teaching is pursued and the resulting knowledge is translated into value-added economic and social benefit. The research vision of SILS is that a multidisciplinary systems biology approach is essential to understand the functioning of living cells at the molecular, cellular, tissue and organism level, during development and in different environments.

The institute brings together approximately 200 researchers, divided into thirteen research groups and two expertise centres that focus on 4 research themes: 1.) systems biology of the living cell, 2.) signalling in plants, 3.) neurosciences and 4.) life science technologies. The research objective of SILS is to understand the functioning of living organisms and their interaction with the environment from the most basic aspects up to its physiological function(s) with the aim to unravel how organisms interact with their environment. The knowledge obtained will make fundamental contributions to the improvement of quality of life, economic prosperity and societal well-being. Part of SILS research activities are directed to application-oriented research in close collaboration with industry.

### **2. Quality and academic reputation**

The CWTS analysis reveals that the impact of UvA publications (IBED and SILS) compares very well at the international level, as they are cited 50% more frequently than the average publication in the subfield.

SILS published 721 papers in the period 2001-2007; 290 of these belong to the top 20% which is 101% more than the world average in the field, 173 belong to the top 10% (138% more than average) and 88 to the top 5% (144% more than average). The MNCS (Mean Normalised Citation Score) which indicates the impact of SILS' articles, compared to the world citation average in the subfields in which SILS is active for the period 2001-2009 is 1.69 while for the period 2005-2009 it improved further to 1.75.

According to the impact of its publications, SILS ranked second of all the Dutch Biology institutes over the period 2001-2009. SILS has an extensive (inter)national embedding, as shown by collaborative partners within the Faculty of Science, UvA (IBED and HIMS), University of Amsterdam (AMC, Department of Psychology), Science Park Amsterdam (CWI, AMOLF, SARA), Amsterdam Region (VU University Amsterdam, NIN, NKI, Sanquin), The Netherlands (Graduate Schools Experimental Plant Science and Neurosciences Amsterdam/Rotterdam), Netherlands Genomics Initiative Centres (CBSG, NBIC, NCSB, NMC; TI Green Genetics; TI Pharma), EU and ESFRI Roadmap projects, HSFP and bilateral projects with companies.

The quality of staff is illustrated by numerous grants and awards, which include four VENI grants, five VIDI grants and one VICI grant, twelve individual prizes and awards to individual SILS scientists. Furthermore, staff members were awarded editorships of books and scientific journals, memberships of editorial boards of scientific journals and roles in (international) scientific organisations.

#### *Assessment*

SILS has produced excellent, high impact papers, has developed many industrial contacts and its research subjects are highly relevant for society. The strategy of SILS is to maintain the high standard of quality and broaden the base by increasing the interaction with other faculties. Strategies for attracting more PhD students are effective and this will boost the Institutes productivity in coming years. Upcoming vacancies will be advertised in time given that they can be replaced under the present and future expected financial cuts. If replacements in these positions are not possible this could potentially hurt the SILS seriously.

### **3. Resources**

The total annual budget of SILS is around € 19 million, of which over 60 percent comes from external funding. The annual scientific output consists of around 150 publications in peer-reviewed journals while approximately 12 PhD candidates obtain their doctoral degree.

In the period 01-01-2005 to 31-12-2010 SILS acquired funding of research councils, public private partnerships, EU and industry for the total amount of M€ 31. This included a grant of M€ 2.7 of the Netherlands Metabolomics Centre, a grant of the Netherlands Epilepsy Fund of 928 k€, a NWO Equipment grant of k€664, EU project subsidies of k€627, k€525 and k€561, a grant of k€598 of the Dutch Technology Foundation STW, a Top Institute Pharma grant of k€782 and a BiG Grid infrastructure grant of the Netherlands Bioinformatics Centre of k€612. The obtained external funding corresponds roughly to a multiplier of 3 in people: for each tenured scientist two additional fte are acquired from external sources. Additionally, personnel involved in a number of funded projects was hosted by SILS but was not on its pay-role, such as FOM employees. Furthermore a number of ERASMUS MUNDUS students were hosted by SILS.

#### *Assessment*

The Institute is very successful in acquiring outside resources, well balanced between research grants and contract research. The Committee feels that the balance found is optimal and efforts must be made to keep it there.

### **4. Productivity**

SILS published 1019 peer reviewed articles, two monographs, 89 book chapters, 90 PhD thesis, 27 patent applications and 26 publications aimed at the general public in the period 2005-2010.

#### *Assessment*

The Committee notes that SILS' productivity is outstanding and its papers have high impact. A significant output of patents reflects a commitment to valorisation and publications aimed at the general public are also produced regularly. The principal strategies for fostering productivity are the attraction and mentoring of excellent PhD students and staff and this is evidently successful.

This Institute generated two start-up companies (one on vaccines, one on production of fuel out of photosynthetic bacteria). Also the work on ageing and the gut micro flora is potentially applicable. The production of a vaccine against Dutch elm disease is another highlight.

### **5. Societal Relevance**

The Systems Biology of the Living Cell 1 programme has highly invested in safeguarding public health and developing environmentally friendly alternative energy sources. It has resulted in 15 patents, including a new technology to produce a wide range of chemicals and an accompanying spin-off company (Photanol BV). The Systems Biology of the Living Cell 2 programme has filed around 50 worldwide patents, such as the new advanced microscopy technology that is exclusively licensed to Nikon Europe BV. Intense collaborations exist with Nikon BV, Lambert



Instruments, Coherent and Scientific Volume imaging. Two spin-off companies, Chromagenics and Cellagenics, have been founded.

The Plant Signalling programme has filed 4 patents concerning insect repellence and resistance traits, resulting in novel crop lines. The programme has a long-standing collaboration with Arcadis and claims the leading role in a project with 3 plant companies. They initiated the focal area Green Life Science and strengthened the links with the plant breeding companies of the Seed Valley.

The Neurosciences programme actively strives to implement its findings in therapeutic applications in collaboration with industry and medical departments (Solvay Pharmaceuticals, Philips: Brain on a Chip & BrainMimick, Corcept Inc. USA). In addition, they have provided advice, hospitality and facilities for a young start-up company (Sensocom).

The Life Science Technologies programme has developed various software tools and distributed through the internet or downloaded, used and implemented in Open Source software. The programme entertains strong interactions with industry and has numerous academic collaborations with for instance DSM, Unilever, Solvay, Organon, BDS, RijkZwaan, IBM but also RIVM and TNO. A patent has been filed regarding the improvement of the microarray technology.

#### *Assessment*

A significant output of patents and a very good collaboration with the private sector and national laboratories reflect a thorough commitment to valorisation. Members of the Institute are regularly engaged in publications aimed at the general public. Overall, the members of the Institute take their “societal tasks” very seriously. Of particular mention are the collaborations with Solvay Pharmaceutical to develop new treatments for schizophrenia and with Philips Eindhoven for Parkinson’s disease.

## **6. Strategy for the future**

To be able to maintain sufficient critical mass, to invest in research priorities and to further improve the quality of the output, SILS aims at obtaining more research funding from research councils and private sector funding. Therefore the strategy of SILS is to take full advantage of the match of SILS research programme with the Dutch ‘Top Sector’ plans and to intensify the collaboration with industry by part-time professorships, bilateral research projects and hosting of start-up companies.

Acquisition of personal grants (VENI/VIDI/VICI grants, ERC grants) will be encouraged and the goal is to start at least 15 new externally funded PhD projects each year. To enhance its visibility to the scientific world, SILS will actively participate in national and international initiatives such as Eurobioimaging, Systems Biology and Elixir of the EU ESFRI Large Infrastructures Roadmap. SILS also wants to attract more native PhD students and postdocs by further improving its research quality and being more pro-active in the Dutch research world and by establishing a Master-PhD track for excellent students. To demonstrate the societal relevance of SILS research, the institute aims to intensify its presence in national radio, TV, newspapers and other publications. Other activities aimed at a broad audience will also be further stimulated.

#### *Assessment*

The Institute has an impressive size and does excellent work. Despite its quite heterogenic composition, the institute as a whole is highly adaptive and fits itself well into the future priorities (Top Sectors) of the Netherlands. There is room for improvement. The Committee is convinced

that the leaders of the Institute will show the necessary flexibility to profit from new opportunities.

### **7. PhD Training**

Together with their supervisor, PhD students draw up an extensive and mandatory training and supervision plan upon the start of their PhD project. They are stimulated to take a course in teaching and have the opportunity to teach by individual supervision of undergraduate students and participate in teaching in the practical courses. They are encouraged to participate in (inter)national conferences and to present and discuss their results. Approximately one year before the end of their contract they are stimulated to raise their own funding for a postdoc project abroad. The SILS PhD/PD Council serves as an interface between PhD students and postdocs and SILS management. The main goals of this council are to serve as a feedback mechanism for the SILS management, to improve the social coherence within SILS, and to communicate important management decisions to the community as well as the organisation of PhD/PD events and symposia.

#### *Assessment*

The Committee very much enjoyed meeting the PhD students in the combined IBED/SILS session. They were uniformly very positive about their training experience and they spoke with enthusiasm and assurance about their research projects. The system in place for supervision appears to be excellent. Most PhD students finish after 5 to 7 years, rather than after 4 to 5 years. It should be a priority to reduce durations to an internationally more competitive length and increase success rates compared to the review period. However, we note the high success rate of graduated students in obtaining employment in a variety of contexts.

#### 4B. PROGRAMME LEVEL – University of Amsterdam (Programmes 10-21)

##### **Programme 10: Aquatic Ecology and Ecotoxicology**

Programme coordinator: Prof. dr. W. Admiraal

Research staff 2010: 6.3 fte

Assessments:

Quality:	3
Productivity:	3
Relevance:	4
Viability:	3

##### *Short description*

The programme Aquatic Ecology and Ecotoxicology aims to understand the biocomplexity at the sediment-water interface arising from the interaction of biological, chemical and physical processes. The mission of the programme is to generate novel insights into the functioning of pristine, disturbed and artificial benthic communities. The research aims to:

- identify interactions in compact consortia of micro-algae, bacteria and burrowing invertebrates that carry out processes at the benthic boundary layer such as detritus degradation and particle trapping;
- quantify the response of species and communities to chemical stressors taking adaptation and feedback into account.

Collaboration with wetland ecologists, geochemists, molecular biologists and modellers is intensified in recent years. The programme operates on a disciplinary cross road of research and combines fieldwork, experimental manipulation in a special ‘Benthatron’, culture studies and modelling.

##### *Quality*

Some of the contributions are of good or even very good quality, but the whole output of the group lacks recognizable coherence. This may also reduce their overall impact in the field. The benthos work is of interest, but rather descriptive of activity in the benthos at the interface with water rather than providing a quantitative impression of the interaction of processes in the benthos and their importance for the water body above it. Recent steps to improve coherence and quality are acknowledged; these include six new PhD projects and a VENI postdoc, supported by competitive grants and partners in water management. The new professorship in Aquatic Ecology is a very important next step. The new experimental facilities that allow quantitative research on benthic ecosystem functioning in relation to diversity, are also promising.

##### *Productivity*

The Committee concludes that productivity has been steady, but the impact of the publications is not impressive. It appears that the re-organisation with less effort on eco-toxicology and more emphasis on benthic ecology has not paid off as the ecotoxicological work, though of rather routine nature, is still more cited than the benthos work.

##### *Relevance*

Aquatic ecology and eco-toxicology are obviously highly relevant to the use of aquatic resources by humans including water management and for the management of habitats for sustainability and conservation. The active cooperation of the Group with local and national water authorities proves the substantial societal impact of the Group. Given the low impact of its research this potential appears not to be fully realized.

### *Viability*

The Group works on an interesting topic but appears to be too small to cover the broad range of topics on their agenda. Given the imminent leaving of the leader of the Group it is not clear how it can survive independently unless it gets a very strong and creative new leader. It might seem possible to join forces, for example, with Earth Surface Sciences. That would add an aquatic aspect to the latter's agenda and hopefully enable the integration of the stable isotope analysis into the research of processes at the interface of the benthos and free water. The ecotoxicological knowledge of the group could productively be integrated into ESS's own research agenda.

## UvA

### **Programme 11: Aquatic Microbiology**

Programme coordinator: Prof. dr. J. Huisman

Research staff 2010: 6.4 fte

Assessments:	Quality:	5
	Productivity:	5
	Relevance:	5
	Viability:	5

#### *Short description*

The research group Aquatic Microbiology investigates the microbial communities of freshwater and marine ecosystems, with a specific focus on phototrophic micro-organisms ('phytoplankton'). These communities provide ideal testbeds for general ecological theory, play a key role in biogeochemical processes, and have large impacts on water quality.

Research of the group aims at an integrative approach, investigating the traits of the organisms, their physical and chemical environment, and the biodiversity and ecosystem functioning of aquatic microbial communities. Mathematical models, laboratory experiments and field studies are combined to address fundamental questions in:

- the molecular ecology of cyanobacteria;
- aquatic photosynthesis;
- competition for nutrients and light;
- hydrodynamics & plankton dynamics;
- biodiversity & biocomplexity.

The findings have relevance in algal biotechnology, water management, and nature conservation.

#### *Quality*

The group performs high-quality data driven research in ecological systems. They are globally highly recognized. In their study of pico-cyanobacteria in the Baltic, the group demonstrated that these systems show high predictability in the short term and low predictability in the long term, which is one of the signatures of chaotic dynamics. There is an outstanding link between theory, lab experiments and field studies, with coherence among research lines 'from genes to ecosystems', rarely seen elsewhere in this vigour. The combination of freshwater and marine microbiology is unique, in the Netherlands and at the international level.. The character of the research, the combination of ecosystems and the high impact publications are truly exceptional.

#### *Productivity*

The group has published a number of excellent publications in highest visible and impact journals. Their productivity has more than doubled during the review period and there is a steady flow of PhD students. Strong (inter)national network manifested in joint publications and shared PhD-supervision add to the already excellent productivity.

#### *Relevance*

The committee notes that this group has been able to patent appropriate results. In publicizing its work, it is assisted by the university's communications department. One example of such a publication is a book on toxic cyanobacteria, which is widely read by water managers around the world. Scientific discoveries of this group have been reported in national newspapers and

members of the group have been interviewed in national and international radio and television programs.

*Viability*

The group has a good number of highly motivated and enthusiastic younger tenure track faculty. The University has made important investments into infrastructure and has filled the chair in Microbial Systems Ecology, and excellent partner for Aquatic Microbiology. New hires and strengthening microbial ecology at NIOZ and NIOO adds to the excellent embedding into the Dutch Microbiological Ecosystem. There is no doubt to the Committee about the viability and even potential for growth of this group.

## UvA

### **Programme 12: Biodiversity & Evolution**

Programme coordinators: Prof. dr. S.B.J. Menken, Prof. dr. P.H. van Tienderen  
Research staff 2010: 7.2 fte

Assessments:	Quality:	4
	Productivity:	4
	Relevance:	4
	Viability:	4

#### *Short description*

The focus of the research programme Biodiversity and Evolution is understanding how biodiversity can be explained from underlying evolutionary and ecological processes: speciation and extinction, dispersal, reproductive isolation, genome duplication and hybridisation. Research on the history of taxa (phylogeny, biogeography, population genetics, phylogenomics) and on their actual functioning (ecology, reproductive biology, ecogenomics, sensory physiology) is combined to better understand organismal evolution. This concerns both how organisms adapt to their biotic environment, for instance the responses to changing temperature or water stress. The research of the group also includes empirical and theoretical studies on the influence of human-induced stress factors on biodiversity such as global change, alien species, habitat fragmentation, and escape of genetically modified organisms.

#### *Quality*

The Biodiversity and Evolution programme has done very good to excellent research on some major questions in evolution, with a focus around hybridisation and speciation, and has published this work in leading disciplinary journals as well as in some even-higher impact journals. Its work is generally of very high quality. The Committee also concludes that recent excellent appointments are likely to enhance performance in the future.

#### *Productivity*

The productivity of this programme is also very good, as indicated by the number of PhD students trained and the rate of publication in peer-reviewed journals.

#### *Relevance*

The Committee notes that this group is active in public outreach and in contributing to policy in relation to conservation and genetically manipulated plants. Its work on evolution is of central importance to biology and of high relevance to society. The causes of the earth's amazing biodiversity remain one of the most enduring and important mysteries of science.

#### *Viability*

This programme has very good viability because of the vitality of its research staff, its excellent new infrastructure, and its addition of excellent new team members. Plans for the future are clearly formulated.

## UvA

### **Programme 13: Computational Geo-Ecology**

Programme coordinator: Prof. dr. ir. W. Bouten

Research staff 2010: 7.2 fte

Assessments:	Quality:	5
	Productivity:	4
	Relevance:	5
	Viability:	5

#### *Short description*

The research programme Computational Geo-Ecology aims to contribute to increase the understanding of the diversity and dynamics of ecosystems by focusing on ecosystem functioning at different scales: from the behaviour of individuals to the response of species and populations to the (changing) abiotic environment. How does the abiotic environment influence the behaviour of species and their temporal and spatial distributions? How do organisms cope with environmental conditions that change in space and time? To what extent can we aggregate this behaviour to the observed distributions of species? The group combines experimental or data driven science with concept-driven (theoretical) modelling in order to close the gap between these two approaches. To cope with extremely large data sets and output of environmental models an eScience approach is used and Virtual Laboratories are developed for data visualization, exploration and analysis.

#### *Quality*

The explicit combination of experimental and data driven science and concept-driven modelling has proven to be extremely successful in this group. The technology-enhanced ecology (e.g. tracking systems, radar tracking) that is a hallmark of this group has allowed them to establish an excellent position in this relatively new community. The group also plays a leading role in several international research networks. The work is published in excellent journals and the group has already achieved high international visibility, as is also evidenced by their bibliometric rank.

#### *Productivity*

Over half of the group's budget comes from contracts. With the superb outcomes of the recent research, the group should aim for more of the highly competitive grants. The number of PhD students has been rising in the last two years and a steady state should be achieved in the coming couple of years. This should further augment the scientific output. It was well noted that there is a shortage of students with a combination of solid training in both biology and computational skills. The group is heavily involved in organizing an international summer school on animal movement to train the next generation of biologists.

#### *Relevance*

The group has acquired important expertise in technology/instrument development in house, which they can now utilize towards societal impact. The bird tracking system allows ESA and the military of many of the European countries to avoid migrating bird flocks, particularly at night. Several countries benefit from the possibilities to use the real time data to plan their air force activities. Also, the group's research programme is complementary to global climate change, although current work does not address these issues directly. A few years ago, the group organized a new bachelor degree in "Future Planet Studies", whose enrolment has grown from 40 to 100 students per year, which is an impressive achievement. The committee further concludes that the group's efforts to foster the careers of female scientists are to be commended.



### *Viability*

The group was formed in 2004 and developed a highly successful research and education programme. The overall prospects of both the research group and the field of investigation are excellent. The leaders have more than a decade to go before retirement, financial means are available and there is a growing public and institutional interest in the outcome of the group's work.

## UvA

### **Programme 14: Earth Surface Science**

Programme coordinator: Prof. dr. J.M. Verstraten (until 2007), Prof. dr. K. Kalbitz (from 2009)

Research staff 2010: 8.8 fte

Assessments:	Quality:	3.5
	Productivity:	4
	Relevance:	4
	Viability:	4

#### *Short description*

The mission of the Earth Surface Science group is to improve the understanding of the functioning of geo-ecological systems formed at the interface of soil, air and water. The group wants to know how natural variation and human exploitation of an ecosystem interact with its soils and water and how resilience of soil and water resources will be affected. The group focuses on the dynamics of organic matter in soils, sediments and waters.

Specific core research areas are:

- mechanisms and rates of carbon sequestration in soils under changing environmental conditions;
- land degradation, such as erosion and desertification and their effects on carbon sequestration and other ecosystem services;
- response of biochemical cycles to natural and human disturbances;
- the fate of organic pollutants and interactions with organisms exposed to them.

The combined expertise in biogeochemistry, geomorphology and environmental chemistry is needed to design innovative experiments that use modern analytical tools for research at scales from the molecular to the landscape level.

Given the recent appointment of the new leader of the group, the assessment comes probably at a somewhat too early moment.

#### *Quality*

The quality of the research output is substantial but high impact publications and national leadership are thus far largely missing, which is surprising given the importance of the field to global change. Publications cover a broad spectrum, but still lack a clear focus. This may be the result from a relatively long interregnum. The new leader has just moved in. The Committee is confident that the new leader will bring about this focus and considerably increase the impact. The Committee points out that more cooperation might be needed with neighbouring fields of biology, like microbiology (fungal biology).

#### *Productivity*

The scientific productivity of the group is high and generally of very good quality. It is still too early to judge the productivity of the group as influenced by its new leader. It would appear important to stabilize the increased number of PhD students and intensify their supervision to shorten the time to finishing PhDs.

### *Relevance*

The topics studied by this group are scientifically and environmentally of great importance and can potentially contribute vital information for management of the environment and of global challenges. Research in Spain and Ecuador as well as the findings about the role of Dissolved Organic Matter in soil remediation are of direct societal relevance. In Spain research by the group resulted in the publication of guidelines for the prevention of soil degradation and in Ecuador (in close cooperation with palaeoecology) in guidelines for sustainable reforestation near the upper forest line in the Andes. Furthermore, the special chairs funded by KWR Watercycle Research Institute and Deltares indicate clear societal relevance. Outreach activities like courses for high school teachers and lectures for children make the knowledge available to the public. The grant application for rock dust as a stabilisation method (absorption) of organic materials on sandy soils again shows that the group is making contact with stakeholders in its field.

### *Viability*

The group works at a node between several other IBED groups and through this interaction appears to be well embedded and excellently positioned to develop its impact, even though it has to face steep competition in its field. The new equipment and EU-grant networking possibilities will allow modern, state-of-the-art and internationally visible research if the new head of the group focuses the efforts of the group on the most productive research areas and increases the effort to publish in high impact journals.

**Programme 15: Paleo-Ecology & Landscape Ecology**

Programme coordinator: Prof. dr. H. Hooghiemstra

Research staff 2010: 4.6

Assessments:	Quality:	4
	Productivity:	4
	Relevance:	5
	Viability:	3

*Short description*

The objective of the Paleo-Ecology & Landscape Programme is to understand the composition and fragility of biomes, the present-day distribution patterns, and to assess and improve the conservation status of ecosystems and the services they provide. The research group mainly focuses on late Quaternary histories of temperate and tropical biomes and the Holocene is the interval where studies on paleo-ecology, landscape ecology, phytosociology, nutrient cycling and speciation mechanisms meet and reinforce each other. Records based on proxy information varying from pollen, macrofossils, and non-pollen palynomorphs are interpreted in terms of environmental and climatic change under influence of orbital and solar forcing and human impact.

The main objectives are to integrate information of different methods and proxies to arrive at robust reconstructions of past environments and climate, to search for correlations between land-sea-ice records of climate change, to make links between data and models, to relate present-day biomes and landscapes to their past dynamic histories and to anticipate on future environmental changes.

*Quality*

The combination of paleo-ecology and ecology is working out well in this group although further integration is possible. The two disciplines are mutually supportive and close cooperation allows them to tackle questions related to purely anthropogenic effects and effects triggered by climate change. In addition, the discipline of paleo-ecology recently underwent a paradigm shift from collecting data and local interpretation to coupling this information to global and geological change scenarios and profiting from the advances of modern molecular biological tools. This group has embraced the new opportunities and has drastically advanced the knowledge on a number of questions of global interest, in particular on the origin of the Amazonian biodiversity, the evolution of tropical mountain forests and high altitude grassland biomes. The findings on these topics have attracted worldwide attention. The shift of focus has taken place very recently and the fruits of these efforts have only started to be harvested. The Committee notes a high potential to even further increase the group's impact.

*Productivity*

The Committee concludes that the relative portion of highly competitive grants in the overall budget of this group is limited. However, the group is successful in attracting other special funds to support its research. Going for more competitive funds could increase the number of PhD students. The recent findings and high impact publications should facilitate such a step. Publications are of high quality and some are in the highest impact journals. The group is internationally highly visible, which is reflected by the invitation to key lectures in important international conferences and symposia.

### *Relevance*

The group has a high impact in restoration ecology, commonly part of the environmental policy on a governmental level. Their decisive help in reforestation policy of the government of Ecuador is just one such example. In addition the group publishes very frequently in professional journals, thus actively disseminating their scientific advances to practitioners.

### *Viability*

The retirement of two of the key scientist in 2012 and 2013 is of great concern to the Committee. The group is in full swing now and succession should be placed high on the university's agenda. The group has access to unique data sets collected in the past 30 years. With the right succession these sets will turn into a "gold mine" for the university. To let the succession slip at this point, may damage the potential of a high quality and very dynamic research field with great public relevance.

**Programme 16: Population Biology & Theoretical Ecology**  
Programme coordinators: Prof. dr. A.M. de Roos, Prof. dr. M.W. Sabelis  
Research staff 2010: 8.5 fte

Assessments:                      Quality:            5  
   Productivity:       5  
   Relevance:         5  
   Viability:           5

*Short description*

The Population Biology and Theoretical Ecology programme focuses on how genetic, physiological and spatial structure affects dynamics of populations and communities on both ecological and evolutionary time scales. This involves studying the feedback processes between natural selection, acting on physiology, life history, foraging, dispersal and social traits on the one hand and population dynamics on the other hand. Two lines of research stand out:

- the first deals with how individual, ontogenetic development and growth in body size affect the dynamics of multi-species communities, how it may lead to multiple stable states, both in population density and composition, and how community-level effects emerge as a result;
- the second deals with direct and indirect effects in multitrophic communities, in particular how constitutive and enemy-induced defences influence plant-herbivore-predator dynamics and how plants can influence these interactions to their own benefit in the face of cheaters occurring at all trophic levels.

In addition the group explores:

- how spatial pattern formation influences the evolution of pathogen virulence;
- how individual decisions to join or quit a group and to expel or accept a group member affects the emergence / evolution of cooperative behaviour.

Each of these four research lines involves a team of theoretical and experimental ecologists through collaboration with researchers outside the group.

*Quality*

The two programme leaders have outstanding international reputations and lead exceptionally strong research themes which are connected at the level of understanding the ecological and evolutionary dynamics of multi-trophic interactions. They have produced exciting and novel insights. A particular strength noted by the Committee is the testing of counter-intuitive theoretical insights in both experimental and natural systems. There is very good cooperation within the group, between the group and other IBED and SILS programmes, and there is an outstanding network of international collaborators. The best papers have been published in top journals. The Committee further observes that citation statistics are excellent.

*Productivity*

Output in relation to research fte is excellent, particularly for primary research articles in high-ranked journals for the field but also for theses. Two books were produced in the review period, a Princeton Monograph is expected in 2012 and a further book is planned. These major contributions are highly influential.

### *Relevance*

The work of the programme is highly relevant to a range of societal issues including fisheries policy and pest control. The opportunities that result have been actively and successfully exploited by the group and these aspects are very well integrated into the programme activities with strong connections to relevant translational organisations. For example, links with fisheries authorities have direct influence on stock management policies while also providing opportunities to test theoretical predictions. Work on predatory mites has resulted in marketing and widespread application of biological pest control agents.

### *Viability*

The Committee notes that the group has excellent research infrastructure, strong external funding and a good ratio of external to core funding, demonstrating an ability to attract support for their work. External support comes from a good range of sources, including contract research. A large new grant has recently been awarded. The age structure is good. Recently appointed staff are likely to achieve tenure and there is a plan to make a new appointment in 2012. The group is clearly thinking towards the future and, according to the Committee, there is every reason to expect that its current excellent standard will be maintained.

## UvA

### **Programme 17: Systems Biology of the Living Cell 1**

Programme coordinators: Prof. dr. S. Brul, Prof. dr. K.J.Hellingwerf, Prof. dr. M.J. Teixeira de Mattos

Research staff 2010: 15.1 fte

Assessments:	Quality:	4
	Productivity:	4
	Relevance:	5
	Viability:	4

#### *Short description*

The mission of the programme is to extend the fundamental insight in microbial life to its underlying molecular principles. The objective is not only to increase the understanding of microbes but also to deploy that understanding to generate a knowledge base to aid in prevention of disease and to provide the society with a sustainable supply of energy.

Sub programme Molecular Biology and Microbial Food Safety (MBMFS) aims at combining the research areas of biochemistry, molecular biology, imaging, genomics and physiology in selected model organisms to analyse in hypothesis-driven experiments the mechanisms of cellular homeostasis in the face of stresses that perturb the intracellular pH and drain energy sources.

Sub programme Molecular Microbial Physiology (MMP) aims at integrating the understanding of the molecular mechanism of the activation of enzymes and regulators as well as the properties of biochemical/ biophysical networks with the physiological strategies that bacteria use for survival and growth.

#### *Quality*

The systems biology programme at the University of Amsterdam is large and was divided into two parts for purposes of the evaluation. The research of “group 1” is fundamental in nature and mostly very good, although their impact could, in the opinion of the Committee, possibly be higher. Half of the group focuses on basic and applied aspects to food safety, whereas the other half concentrates on basic aspects of microbiology, such as the stress response in *B. subtilis*. Their involvement in local collaborations is commendable and there are international collaborations in the area of solar biofuel production and in the area of fungal vaccine development.

#### *Productivity*

The Committee notes that the productivity of this group is solid and good, but not outstanding, and could be improved substantially both in terms of number of publications and impact of the journals.

#### *Relevance*

Even though the group’s focus is on basic science, there is tremendous societal relevance as its work informs applied problems such as sustainable energy and food safety. The biofuel work (photofermentation) is of great interest in times of uncertain energy supplies. A spin-off company has been set up whose goal is to further develop production of solar bio-fuel production. The group is well connected with industry and has developed multiple collaborations in this area (e.g. artificial meat; development of novel preservatives with Unilever; use of intracellular pH for screening; use of stress response to improve fermentation processes). Finally, the committee observes that the group is doing well on gender equity.



### *Viability*

Given that several staff are near retirement, there is some concern that they will not be replaced. However, the group recently added a tenure-track McGillavry professorship (i.e. a position for female researchers). They are actively involved with several of the Top Sectors (Agrofood, Human Health, Energy), which should put them in a good position for future funding opportunities.

## UvA

### **Programme 18: Systems Biology of the living Cell 2**

Programme coordinator: Prof. dr. T.W.J. Gadella

Research staff 2010: 12.4 fte

Assessments:	Quality:	5
	Productivity:	5
	Relevance:	4.5
	Viability:	4.5

#### *Short description*

The Systems Biology of the Living Cell 2 programme consists of three subprogrammes:

- in the subprogramme Molecular Cytology & Centre for Advanced Microscopy (MCCAM) the two mechanisms to regulate the dynamic architecture of cells, self-organisation and signalling, are studied with emphasis on membrane-related architecture of living cells, using advanced microscopy tools including quantitative modelling approaches;
- the subprogramme Nuclear Organisation Group (NOG) focuses on the functioning of the eukaryotic genome in its natural environment, i.e. the cell nucleus;
- the Epigenetic Regulation of Gene Expression (ERGE) subprogramme explores chromatin-associated, gene-repressing protein complexes that are responsible for the inheritance of the expression status of genes to progeny cells.

The three groups combine a broad spectrum of advanced microscopy, biochemical, and (epi-) genetic tools with sophisticated mathematical modelling/ system biology approaches to unravel aspects of the proper functioning of the 'normal' cell. There are direct links with bio-medical and biotechnical research.

#### *Quality*

The Committee notes that this is a high quality group that is publishing in top journals. It has been able to generate a predictive and quantitative kinetic model. The new turquoise fluorescent compound has enormous practical potential, as it can be adapted in many dynamic systems. The nano-microscopy is cutting edge.

#### *Productivity*

The group is generating a large number of important papers. Of their published work over the review period (173 papers published), 34 were in top journals, giving an impact score that is 4 times above average. The Committee observes that this output speaks for itself.

#### *Relevance*

The group's work on imaging is of fundamental importance to most other biological disciplines because imaging has become so important. The group could work harder on generating interest from the public, but its networks with other groups are extremely strong, varied and appropriate.

#### *Viability*

It is clear to the Committee that the group has been highly successful in getting competitive grants. The group has a new chair of Synthetic Systems Biology and 7 PhD students have started in 2011. The viability is very strong.

## UvA

### Programme 19:

Programme coordinator:

Research staff 2010:

### Plant Signalling

Prof. dr. M.A. Haring, Prof. dr. B.J.C. Cornelissen

12.5 fte

Assessments:

Quality: 4.5

Productivity: 4.5

Relevance: 4

Viability: 5

#### *Short description*

The Plant Signalling programme consists of two sub programmes, Plant Physiology (PP) and Molecular Plant Pathology (MPP), which have extensive interrelated but also independent aspects. Most of the research is limited to two model plant species: *Arabidopsis* and Tomato. The mission of this programme is to understand the plant's response to biotic- and abiotic stresses at the molecular level. To identify key genes involved in these processes, metabolomic-, proteomic- and genomic approaches are used. To monitor detailed molecular events at the cellular level, biochemistry and state-of-the-art confocal microscopy is applied. Collaborative projects have been set up with IBED (UvA) and the MPI in Jena (Germany) to expand the research to a more ecological setting.

#### *Quality:*

The Committee observed that in two subprogrammes in PP (phosphatidic acid signalling, terpenoid volatiles) and MPP (resistance proteins, Fusarium pathogenesis, SUMO) high level research was performed with several first demonstrations (R proteins, horizontal gene transfer between pathogenic and non-pathogenic fungi, diversification of SUMO's) which are highly important in the field. The work is characterized by a permanent improvement of these research lines. The group has a strong position in the community working on plant-herbivore and plant-pathogen interactions. New lipid sensors were developed which are highly relevant and used in plant lipid research world wide.

#### *Productivity:*

Based in the CWTS analysis the productivity has increased since the last evaluation. The external funding including grants for PhD/technicians as well as Veni, Vidi and Vici grants is very good. Of the 10 NWO *Vernieuwingsimpuls* grants awarded to SILS in the review period, 6 went to scientists in this programme.

#### *Relevance:*

Most staff members acquired frequent invitations to act as speakers in major conferences, but also organisations of conferences were undertaken by some staff members. A strong link to biotechnological companies such as Keygene, collaboration in EU framework programmes, in TI-Green genetics, public activities as well as transfer of graduated PhD students to international renowned plant labs indicate the high standard of both subgroups.

#### *Viability:*

There is an ongoing increase in plant research in Amsterdam by the Green Life Sciences programme (SILS, IBED), by plant genetics, VUA, and companies (Syngenta seeds, ENZA seeds etc.). A long-lasting collaboration with the company Arcadis for the production of vaccines against the Dutch Elm disease also supplies funds. The young staff members are flexible and

innovative in the establishment of new strategies including new platforms and techniques. Two part-time chairs funded by industry will strengthen the group in respect to Applied Quantitative Genetics and Plant Virology in 2012.

## UvA

### Programme 20:

### Neurosciences

Programme coordinator: Prof. dr. C. Pennartz, Prof. dr. W. Wadman, Prof. dr. M. Joels (until 2009), Prof. dr. P. Lucassen (from 2009)

Research staff 2010: 22.1 fte

Assessments:	Quality:	4.5
	Productivity:	5
	Relevance:	4
	Viability:	5

#### *Short description*

The mission of the Neuroscience programme is to understand fundamental mechanisms that underlie information processing and synaptic and structural plasticity in the brain. The programme applies a wide range of state-of-the-art behavioural, biochemical, histological, molecular, imaging and in vivo and in vitro electrophysiological techniques to address its research questions.

The objectives of the subprogramme Cognitive and Systems Neuroscience are to understand the neural mechanisms and substrates underlying cognitive processes, predominantly in animals and recently also in humans.

The objectives of the subprogramme Cellular and Systems Neuroscience are to understand the regulation of neuronal excitability and plasticity at the membrane, cell and micro-circuit level.

The subprogramme Structural and Functional Plasticity of the Nervous System aims to understand structural and functional plasticity of the brain in relation to (early) life stress and diseased like depression, anxiety, dementia and epilepsy.

#### *Quality*

The highlights of the group clusters around the role of the hippocampus and prefrontal cortex during the different phases of sleep, the impacts and effects of early stressful life experience and chronic stress in the adult age, treatment of the negative effects of stress, and the link between the development of epilepsy and the immune system. The group is well linked with other universities in the Netherlands and abroad. They have a number of joint faculty appointments (e.g. University of Ghent). The Committee notes that the quality of the work is very good. The group publishes in top journals. Over 25 percent of its scientific articles have appeared in the top 10 percent of the journals. There were a number of highlights, published in high-impact journals. The three groups are interacting very well and profit from each others expertise in an excellent manner.

#### *Productivity*

Output in terms of PhD students and publications, and the impact of the publications is excellent. Though the group has solid internal funding and support, more than 50 percent of the finances are generated through highly competitive research grants and contracts.

#### *Relevance*

Research on brain and brain functions is in the centre of modern biological research. Results from this research are of high relevance to public health and trigger immediate public interest. The research group plays an important role in bridging the gap between scientific advances, its

application in the health and pharmaceutical sector and informing the public about the new insights. Participation in the national brain day, the brain awareness week and in patient days are examples of such outreach activities. There are a number of links with the pharma-industry, particularly concerning the fundamental aspects of the research. However, the Committee observes that there is still some room for improvement here.

#### *Viability*

The group has a good mix of younger and more experienced researchers and leaders. It is also linked to two flagship programmes soon to be decided on the EU level. At least one of them should be awarded. The group is successful in getting competitive external funding. The committee finds that the budget between direct funding, grants and contracts is well-balanced.

## UvA

### **Programme 21: Life Science Technologies**

Programme coordinator: Prof. dr. A.K. Smilde, dr. T.M. Breit, Prof. dr. C.G. de Koster  
Research staff 2010: 15.1 fte

Assessments:                      Quality:            4  
   Productivity:       4  
   Relevance:        4  
   Viability:         3.5

#### *Short description*

The mission of the programme is to develop technologies to further life science research. The programme has three subprogrammes: 1) Biosystems Data Analysis; 2) Microarray Department & Integrative bioinformatics Unit; 3) Mass Spectrometry of Biomacromolecules.

The objectives of the subprogramme Biosystems Data Analysis are to develop and validate models for organising, summarising and visualising complex biological data for systems biology. Application areas are medical biology, biotechnology, microbiology, biology and nutrition.

The Microarray Department & Integrative bioinformatics Unit aims to develop innovative transcriptome applications for microarray and next-gen sequencing technology; provide wet-lab support for the life science research groups in their transcriptomics research; implement and provide state-of-the-art microarray design, genome mapping, data normalisation, GSEA; provide an e-(bio) science environment including cloud/grid computing, design for experimentation and workflows.

The objective of the sub programme Mass Spectrometry of Biomacromolecules is to develop mass spectrometry methodologies to understand biology at the molecular level. The sub programme comprises three research themes that adhere in general to the study of cellular response to external signals:

- studying post-transcriptional regulation of gene expression;
- developing new analytical strategies for the experimental evaluation of models of the 3-D structure of protein complexes;
- acquiring insight in the adaptation of the cell surface proteome of fungi and bacteria.

#### *Quality*

All three subprogrammes are very good at development of new technologies in life science research, including microarray technology, bioinformatics methodologies, proteomics and metabolomics. BDA, MAD-IBU and MS staff members are excellently embedded in local, national and international research environment. The strong emphasis on development of analytical technologies leads necessarily to a dependency on biological questions by other groups. The Committee notes that the three groups are well linked but their clear scientific profile lacks visibility.

#### *Productivity*

BDA and MAD-IBU acquired excellent funding support (4.6 and 3.4 M€, resp.). All three groups have a remarkable number of publications embedded in the collaborative work. However, publications in high impact journals can be increased. According to the CWTS analysis the output of LST is very good. In case of number of citation the fact has to be taken into account

that technology-driven papers are regularly more cited. The access to PhD students could be increased.

*Relevance*

Several staff members received prizes and awards and are heavily engaged in conferences (organization, invitation to lectures), editorial boards, academic work. The technology platforms are very well embedded in the local research environment and in the EU of various life science disciplines.

*Viability*

The Committee observes that it is difficult to handle such a broad scale of technology-driven research lines. Structure and embedding in key biology research of all three subprogrammes should be critically reflected. The dependency on main research questions from the outside bears the danger of ending up as service unit. Creating its own biological research niche may be this group's way out of the dilemma.



## 5A. INSTITUTE LEVEL – University of Groningen (RUG)

Three Institutes of the University of Groningen are involved in this review:

- Centre for Behaviour and Neurosciences (CBN)
- Centre for Ecological and Evolutionary Studies (CEES)
- Groningen Biomolecular Sciences and Biotechnology Institute (GBB).

### Centre for Behaviour and Neurosciences (CBN)

#### 1. The Institute

The Centre for Behaviour and Neurosciences (CBN) is one of the twelve Institutes of the Faculty of Mathematics and Natural Sciences of the University of Groningen. The Institute comprises five research groups: Behavioural Biology, Behavioural Physiology, Chronobiology, Molecular Neurobiology and Neuroendocrinology.

It is the mission of CBN to understand the causes and consequences of individual variation in behaviour at all levels of organization and in the context of ecological niche: from the molecular construction of the biological clock in the cell to when people sleep; from the molecular machinery of energy metabolism to eating disorders; from molecular pharmacology to coping mechanisms for stress; from the molecular basis of Alzheimer's disease to clinical solutions; from molecular traces of memory to time/place learning; from epigenetic mechanisms to individual variation and evolutionary fitness. CBN aims to solve major questions concerning human and animal well-being, and to provide an attractive research and training programme for students and young scientists. CBN is an important scientific partner of the neurosciences within the University Medical Centre Groningen (UMCG) and is an active partner in the interfaculty research school for Behavioural and Cognitive Neuroscience.

CBN is the only institute in the Netherlands and one of the very few worldwide working on behavioural neuroscience in an evolutionary context, translating causal mechanisms to the level of the intact organism in its natural environment and making use of a broad variety of model systems. CBN research is embedded in the RUG Focus areas 'Energy' and 'Healthy Aging'.

#### *Assessment*

This Institute is unusual in that it covers a broad area of modern neuroscience yet always from an organismal and integrative vantage point. Overall, the research performed at this Institute is very strong and commands international respect. However, there is quite a bit of variation across the different groups in terms of reputation, productivity and impact, and viability. While several of the groups have been at the forefront of their respective sub-fields for decades (most notably Behavioural Biology and Chronobiology), other groups – most notably Neuroendocrinology – appear to be struggling somewhat due in part to the directions where the field as a whole is headed and in part to a lack of leadership.

#### 2. Quality and academic reputation

Programme leaders and staff at CBN attract funding from NWO, ESF, industry and national programmes (TI-Pharma). Personal grants and awards were granted to young scientists and staff, such as two Vici-grants (Morrow and Verhulst, 2005), a Vidi-grant (Meerlo, 2005), the International Prize for Biology (Daan, 2006), the Eminent Scientist Award of the Japanese Society for the Promotion of Science (Daan, 2008), membership of the Young KNAW (Verhulst).

CBN staff members serve on numerous boards of science and society, are frequently invited to participate in conferences and editorial boards and to write journal or book contributions. Invited contributions range from large international conferences and symposia to international PhD workshops.

#### *Assessment*

The Committee notes that the Institute has been very successful in publishing excellent research and in acquiring grants. It is strengthening its interaction with UMCG and will further extend national and international networks. Overall the research agenda is modern and clear and often at the forefront of science internationally. However, not all groups within the Institute display this level of excellence. The Neuroendocrinology group, in particular, despite solid yet unexciting output, has not been able to establish an international reputation, which is evidenced by its low citation rank and unusually high self-citation rate.

### **3. Resources**

Almost 50% of the research funds are obtained from external research grants e.g. NWO, ESF, TI-Pharma and industry. CBN has extensive in- and outdoor housing facilities for fish, birds, and mammals, for experiments under controlled and semi-natural conditions. CBN has a so-called human isolation facility for experiments on humans who are shielded from external time cues. There are just a few of such facilities worldwide and the facility of CBN is equipped with the most modern light regulation systems. CBN has state-of-the-art lab facilities for molecular up to behavioural studies which attract an increasing number of scientists from abroad. CBN will extend the collaborations with the UMCG and with industry.

#### *Assessment*

The Committee notes that the hiring of a Rosalind Franklin fellow and other fellowship awardees is to be commended. The majority of research grants are from direct funding – hopefully this will suffice for the future. Interaction between groups has helped to attract funds. The new facilities will certainly attract students and postdocs.

### **4. Productivity**

In the review period researchers of CBN have published 590 refereed articles, which is considerable in view of the small size of the Institute in terms of number of scientific staff members and in this period CBN staff supervised 54 PhD theses. The prospective bibliometric study of CWTS indicates that the impact of CBN research is significantly higher (MNCS of 1.48) than the world's average (1.00). Most publications appear in peer-refereed journals leading in the research area of CBN: *Neuroscience*, *Behaviour Genetics*, *Journal of Biological Rhythms* etc.

#### *Assessment*

The Committee concludes that productivity and quality of output are high. For several of the groups, CWTS statistics are exceptionally strong, partly due to influential reviews but also including excellent primary publications. Yet other groups, while very solid in their productivity, lack high-level publications. The number of theses produced is high in relation to tenured staff fte. The output is also stable. There is a clear effort in place to balance high quality research output with translational activity.

### **5. Societal Relevance**

The biology of behaviour and of the brain is fundamental to performance and to health and disease and the public interest is still rising. The forefront scientific position of CBN is crucial to maintain high quality educational programmes. CBN researchers play a leading role in local and (inter)national networks and policy making institutions. Examples are: Leadership in establishing

the Systems Biology Centre for Metabolism and Aging in Groningen, links with society stakeholders like Ministries (Education, Culture & Science, Justice), and a key role in interfaculty programmes with the UMCG.

CBN researchers are actively engaged with the lay press when high visibility papers are published. CBN contributes to the development of equipment for recording relevant behavioural and physiological parameters and to the development of drugs and other therapies to combat diseases like mental retardation and dementia. The CBN facilities attract interest from international companies for instance concerning shift work research (Philips, Shell) and therapeutic development (Abbott, Richter, Danone) and from societal organizations on Alzheimer's disease, Diabetes, Anorexia Nervosa, Obesity, Depression.

#### *Assessment*

The research work conducted in this Institute is largely driven by fundamental questions, yet the work is clearly relevant for a number of societal concerns, including ageing and animal welfare. The group is very active in developing policy and promoting public understanding of science in these areas. Potential applications of research, on maternal hormones in birds, for example, are being pursued actively and have attracted funds but have not yet reached the stage of practical application. The work of other groups is of obvious biomedical importance and there is a clear potential for developing collaborations with translationally oriented institutions.

### **6. Strategy for the future**

New tenure track staff has started their research very successfully by obtaining important grants. They strengthen the interactions between the CBN research groups.

CBN will promote collaborations with the UMCG, invest in national and international networks, and extend contacts with industry. These alliances are crucial for equipment, combining expertise, access to subjects for various studies, and future funding. CBN will organize regular meetings for the general public showing the results of the investigations and explaining why fundamental research is important to solve major societal problems, such as Alzheimer disease, obesity, health problems in shift work, aggression. The involvement of CBN in the research school Behaviour and Cognitive Neuroscience (BCN) remains crucial to the quality of the training programmes for master and PhD students and for the training of the next generation of scientists in the field.

#### *Assessment*

The Committee notes that CBN has functioned successfully for over 10 years. The new building supports close interaction between the members of the Institute, but also with the other three Biology Institutes. Viability and long-term strategy is secured through hiring the best people who are willing to interact within the Institute and the university and who support and actively work for the general goals of the Institute. Promising new tenure-track staff has come in. Some of the major chairs are close to retirement and this will need early consideration in order to fill the vacancies.

### **7. PhD Training**

During the first 4 years of the evaluation period, PhD training was organized in the local multi-disciplinary and interfaculty Research School of Behaviour and Cognitive Neuroscience, BCN. BCN has organized the preparation of 'training and support plans', in which the PhD students are informed about what to expect from their supervisor and what in turn is expected from them, including an outline of the timetable of the PhD project and the courses to be attended. Courses included transferable skills like project management and writing scientific English. BCN provided specific courses and meetings on neuroscience, annual retreats where PhD's meet and present

their progress, annual poster sessions and thematic scientific meetings, which are organized for the BCN community at large.

Since the beginning of 2009, PhD training is organized differently. Logistics, basic support activities and general courses are now provided within the faculty by the Graduate School of Science. Two major changes resulted from this transition: PhD students now receive an “Individual Training Budget” which can be used for courses or for conference visits; furthermore for each PhD project an external supervisor is appointed, who is involved in progress meetings and can serve as an external mentor. The Research School BCN still serves as the scientific community for the PhD students of CBN and still provides the neuroscientific courses.

Apart from this, the research Institute CBN stimulates PhD students to organize seminars with invited speakers, to give presentations at international conferences and to attend international PhD training courses.

#### *Assessment*

The CBN has shown a strong commitment to the training of both master and PhD students. The recent introduction of individual training budgets, which allow students to attend workshops and conferences, underscores the student-centred approach. The Committee was impressed by the enthusiasm of the students.

## Centre for Ecological and Evolutionary Studies (CEES)

### 1. The Institute

The Institute CEES is part of the Faculty of Mathematics and Natural Sciences of the University of Groningen. The mission of CEES is to understand how ecological interactions evoke evolutionary change and, likewise, how evolutionary change drives ecological interactions. Understanding the interplay among ecological and evolutionary processes requires a combination of research approaches at different levels of organization ranging from genes to organisms to ecosystems, and ultimately defines the current and future make-up of the biosphere. Findings at CEES have important ramifications to several other core fields of biology, including genetics, genomics, biochemistry, organismal physiology, behaviour, systems biology and theoretical biology. The integration of these disciplines is at the core of modern biology.

The ambition of CEES is to become the national top Institute in linking ecology and evolution, and a top 5% Institute in Europe, both with regard to research and teaching, by significantly advancing the scientific understanding and applications of the field. CEES is composed of 9 research groups, each headed by a full professor. Together, these groups work on integrative themes of research at the interface of ecological interactions and evolutionary biology. CEES focuses both on terrestrial and marine systems, and actively pursues application of research in the field of conservation biology. The Institute hosts about 125 researchers (of which 25 permanent scientific staff) and 25 permanent support staff.

#### *Assessment*

This is a big Institute that attempts to connect macroevolutionary and ecological processes to short term micro-evolutionary and ecological processes. Work proceeds by close and highly productive cooperation between experimental and theoretical groups. One strong focus of the Institute is the Wadden Sea and the processes influencing its stability or a possible regime shift. The Institute has been working stably for about a decade and CEES is indeed among the European leaders in its field and has been able to attract excellent leaders in most of the constituting programme groups. Through the fostering of intensive interactions among the groups the Institute generates additional value at the Institute level. Management is largely bottom up which is working well given the stature of the chair holders and general interest in interaction among research groups.

### 2. Quality and academic reputation

CEES has a strong (inter)national position in the field of ecology and evolution and further strengthened this position during the last 6 years. Nationally, it is the largest university-based Institute in its field, as was recently recognized in a 2011 national strategic plan for biology published by the Royal Netherlands Academy of Arts and Sciences (KNAW). Between 2005 and 2010 CEES scientists published 14 primary research papers in *Nature* and *Science* alone, in addition to many papers in top journals for their field, as *Trends in Ecology and Evolution*, *Ecology Letters*, *PNAS USA*, *American Naturalist*, etc. CEES is a productive Institute, and papers are well-cited: 36% more than the average research paper in the field (MNCS indicator of 1.36 in the bibliometric analysis). Recent research highlights include:

- evidence of how climate change affects migratory bird populations through seasonal mistiming of predators and prey (Both C., et al 2006. *Nature*, 441, 81-83);
- finding of a novel route to speciation by interplay of natural and sexual selection (Van Doorn et al 2009, *Science* 326, 1704-1707) and how animal personalities evolve (Wolf M et al 2007, *Nature* 447, 581-584);

- how haploid/diploid sex determination works in insects (Verhulst, EC et al *Science* 328, 620-623);
- unravelling the interplay of bottom-up and top-down forces in savannah food webs (Hopcraft JGC et al 2010. *Trends Ecol. Evol.*, 25, 119-128).

#### *Assessment*

CEES has indeed produced massive high-quality research output that has given it an outstanding international visibility. The age structure of the major players promises medium-term stability.

### **3. Resources**

From 2005-2010, the percentage of researchers in CEES who are externally funded has grown from 43% to 58%. This increase has mostly come from success in attracting contract research, particularly through the Dutch Wadden Fund (Waddenfonds) in collaboration with nature conservation organizations. Meanwhile CEES staff members continue to be successful in funding via grants (from the Netherlands Organisation for Scientific Research, NWO). The Institute has an active HRM policy where new staff members are hired and coached through the tenure-track system and stimulated to form independent research lines. The research facilities (labs, greenhouses, climate chambers, animal facilities) received a great boost in 2010 with the move to a new building.

#### *Assessment*

The new building provides large and excellent facilities to the members of CEES, a fact that is highly valued by all of its groups. This amazing new resource provides a firm basis from where to maintain the excellent ability of the group members to attract grants from NWO, EU etc. and other funding agencies as well as contract grants. Overall, about 75% of the money for the Institute now comes in through various funding agencies.

### **4. Productivity**

During the period 2005-2010, CEES researchers published 1058 research papers, 91 PhD theses, 31 books, 89 chapters in edited books, and 178 publications aimed at professionals in the public and private sector. This last group of output is important for direct communication and application of the results to the society.

#### *Assessment*

The productivity of CEES is truly outstanding and communication of the research findings to the society is successfully performed through many different channels (radio, TV, professional and newspaper reports). This outreach activity has recently also led to funding through major NGO's such as WWF and the Dutch Wadden Fund (Waddenfonds).

### **5. Societal Relevance**

To warrant a broad base for research and its successful implementation in practical conservation measures, CEES has intensive collaboration with key national and international nature management authorities such as Natuurmonumenten, Staatsbosbeheer and Provinciale Landschappen (which manage most nature reserves in the Netherlands), and with WWF and Birdlife International is maintained. Research has a high valorisation potential through the improvement of ecosystem services and the associated benefits for society. This often involves accepting short term costs to achieve long-term benefits. For example, the research directly led to the ban on cockle fisheries in the Dutch Wadden Sea (2005) and a large buyout of this ecologically harmful fisheries sector by the government, leading to strong improvements in ecosystem services.

### *Assessment*

Outreach activities have proven beneficial when it comes to influence important decisions concerning the environment. The Institute through its various groups is strongly involved in ongoing environmental discussions and can offer well-founded scientific advice based on large and often long-term data sets. The work has implications for nature management, ecosystem function in coastal areas, migratory birds and the like. The Wadden Sea provides a good focal point for topics like overfishing, clean drinking water, etc. and the group is doing a good job of capitalizing on this ecological treasure. The key economic sectors include Agrofood, Human Health, Chemistry, and Water Management.

## **6. Strategy for the future**

In order to maintain and extend a leading position in research and education in Ecology and Evolution three main choices are made: 1) increasingly putting efforts and resources on the core theme of the Institute enabling enforcement of necessary subfields in which CEES is not yet sufficiently strong (increased focus), 2) to make the role of CEES as an internationally leading Institute in the field of ecology and evolution more clear by promoting the bundling of all relevant efforts on this theme within CEES (increased visibility), and 3) targeting novel sources of research funding, for example through NGO's and businesses to become less dependent on traditional funding through NWO (funding diversification). These measures are intended to contribute to further strengthening the Institute's (inter)national position.

### *Assessment*

The Institute functions by now highly successfully over 10 years. The new building supports close interaction among the members of the Institute, but also with the other three biology Institutes. Viability and long-term stability is secured through hiring the best people who are willing to interact within the Institute and the university and support and actively work for the general goals of the Institute. The relatively flat hierarchy within the Institute makes decisions on the future development flexible and has the advantage of involving all groups when it comes to important strategy questions. Given the 10 year success of the Institute and its present excellent quality and high national and international status it appears likely to succeed in the future as well.

## **7. PhD Training**

PhD training is organized through the Research School for Ecology and Evolution (RSEE), which is embedded in the Groningen Graduate School of Science (GSS). In a Training and Support Plan developed for each PhD student, the supervision and progress monitoring are described and appropriate measures are taken immediately when unnecessary delays or deviations occur. The project supervisor meets with the student regularly, while an independent external advisor is also generally appointed for each project. A typical thesis contains 4-5 publishable papers, but theses with 6-10 publishable papers regularly occur as well. In addition to the thesis research PhD students complete a training programme (30 ECTS) that includes i) project related activities ( $\geq 6$  ECTS), ii) advanced theoretical courses ( $\geq 6$  ECTS), iii) transferable skills ( $\geq 6$  ECTS), and iv) electives ( $\leq 12$  ECTS). These PhD courses are organized by CEES staff members for RSEE, but PhD students can also participate in PhD courses of research schools of other universities, or of national research schools.

### *Assessment*

The PhD education system is well in place and securing excellent quality of the PhDs offering them very good chances to go on in science as well as in applied research. The necessary general soft skills are well trained in specially tailored courses. It may be valuable to further increase the ability of graduates to finish their PhDs within the planned 4 years.





## Groningen Biomolecular Sciences and Biotechnology Institute (GBB)

### 1. The Institute

The Groningen Biomolecular Sciences and Biotechnology Institute (GBB) is part of the Faculty of Mathematics and Natural Sciences (FMNS) of the University of Groningen. The Institute comprises 12 research groups that perform multidisciplinary research in the disciplines Biology (6 programmes) and Chemistry (6 programmes) in overarching themes such as:

- systems biology for integrative analysis of microorganisms, including single cell and population studies;
- physico-chemical characterisation of cell constituents, including ensemble measurements and single molecule studies;
- design of new functional entities (microorganisms, enzymes, semi-artificial systems);
- membrane biology, including design, synthesis and analysis by simulation and research on membrane translocation and signal transduction systems;
- structure-function relationships of enzymes and membrane proteins.

The mission of GBB is threefold: i) to excel in basic research on microorganisms and microbial processes (Prokaryotes and lower Eukaryotes) from molecule to cells, ii) to drive the research pipeline from basic research towards applications and innovation, and iii) to provide an attractive research and training environment for graduate students and postdocs by maintaining a modern infrastructure and by attracting highly competent staff members.

GBB's research focuses on the elucidation of the mechanisms by which molecular processes function within the living cell in relation to their environment. GBB aims to be a leading research and training Institute in the area of bio molecular sciences, integrating approaches from all relevant disciplines. Research is curiosity-driven, fundamental research involving multidisciplinary approaches and realizing a solid basis for application-oriented programmes that often are executed in collaboration with Life Sciences Industries and (inter)national research consortia. GBB aims to continue in this direction in the next years, whilst further strengthening in emerging areas like chemical biology, computational biology, synthetic biology, and cellular biophysics (e.g. super-resolution microscopy).

### 2. Quality and academic reputation

Between 2005 – 2010 GBB has published >1000 peer refereed papers of which the top 10% cover major achievements and appeared in journals such as *Science*, *Nature Genetics*, *Nature Biotechnology*, *Nature Cell Biology*, *Nature Structural and Molecular Biology*, *PNAS*, *EMBO J.* and others. In addition 12 patents were filed. Various senior tenured staff of GBB are involved in bodies of funding agencies or scientific councils (e.g. NWO, ESF, DFG, EU), are member of the Royal Netherlands Academy of Arts and Sciences (KNAW; i.e. Professors Poolman, Driessen, Dijkstra and Kuipers) as well as advisory committees or boards of research institutions and companies.

Programme leaders and staff at GBB have made successful applications for support from major national programmes (NGI, B(E)-Basic, IBOS, CCC, TIFN) and from the European Union. Awards were granted to young scientists and staff, such as the Wubbo Ockels Prize (Professor Dijkhuizen, 2006), the Simon Stevin Meester Prize (Professor Kuipers, 2011), the Dupont Young Professor Award (Professor Heinemann, 2011). In addition several major grants have been obtained over the last years from NWO (Veni, Vidi, and TOP) and ERC (3 Starting grants). Currently, 4 extraordinary professors are affiliated to GBB.

### *Assessment*

The Committee notes that this highly productive Institute has acquired prestigious grants to support its innovation activities and maintain its productivity. The goal is to strengthen GBB's profile in molecular systems biology and synthetic biology. The Committee also notes that the impact is high considering the interdisciplinary nature of the research. A strategy is in place to further increase impact by combining results into major papers and there is some evidence suggesting that this is having an effect.

### **3. Resources**

Approximately 56% of the research funds are obtained from external research grants (e.g. NWO, ESF), contract research (e.g. EU) and Public Private Partnerships (PPPs). GBB staff also attracted prestigious personal grants for fundamental research such as: NWO/CW-TOP for Professors Boekema (2005), Driessen (2006), Poolman (2007, 2010 together with Professor Kok) and Marrink (2009), Vidi grants for Professors Slotboom (2005) and Croce (2005) as well as Drs. Mulder (2006), Albers (2006), Koçer (2007), Veenhoff (2008) and Scheffers (2010), and ERC Starting grants for Dr. Koçer (2008), and Professors Slotboom (2011) and Croce (2011). In addition investments grants from NWO (Middelgroot and Groot) were attracted.

GBB provides a state-of-the-art research environment, including larger in-house facilities for high-throughput screening, carbohydrate bio processing, protein structure determination (incl. X-ray analysis), DNA micro arraying, advanced microscopy for cell and protein analysis, and membrane proteomics. The latter activity is part of the Netherlands Proteomics Centre.

### *Assessment*

The external research funding is oscillating around 60 percent and the staff has attracted some prestigious personal grants. This is excellent when it comes to cover the research running costs. Two-thirds of external funds is about hitting the ceiling in an Institute of this size. However, the Committee wishes to point out that a funding bottleneck could occur when it comes to maintaining research facilities' state-of-the-art. Steps have been undertaken to strengthen the position of GBB through strategic alliances within the Netherlands research environment and with industry in the field of genomics and biotechnology.

### **4. Productivity**

The annual total output of GBB has been stable between 2005 – 2010; the average output number is ~210/year, with the majority in peer refereed international journals (179/year) and PhD theses (21/year). The average output in refereed journal papers was close to 19 per fte research input of tenured staff.

### *Assessment*

The Committee notes that GBB has a high and stable output rate of research articles and theses. An average of 19 papers per research input fte and year is excellent. Attracting productive new staff is important here; recent appointments have been made, more are in the pipeline. The research is well embedded in national collaborations.

### **5. Societal Relevance**

GBB has many research collaborations with industry (e.g. via public-private networks and contract research) and the Institute aims to formalize strategic alliances by appointing part-time professors from industry. Patent applications (12 between 2005 – 2010) in general are produced in collaboration with these external partners. The application-oriented research at GBB primarily focuses on topics in a sustainable bio-based economy. In that respect, many researchers contribute to general scientific interest and public awareness (e.g. in view biotechnology and

synthetic biology) via for instance public discussions, events and media, whereas outreach activities are aimed at primary schools.

#### *Assessment*

Members of the Institute are active within national academic circles designed to support science policy development. Occasionally members do give interviews to national and regional newspapers, are part of national TV programmes which bring science closer to public, or are lecturing in to local public. The contours of a systematic outreach programme are not clearly discernible. There have been rather few professional publications or outputs for the general public. There is high potential in this institute to increase their societal impact even more; e.g. the cell biochemistry group has done work on basic protein chemistry that unexpectedly led to a link with Parkinson's disease. The microbial physiology group has done research on streptomyces that has implications for discovery of new biologically active secondary metabolites. These kind of results could be used as great show cases for the direct societal relevance of the research. The number of patents and the strategic alliances with industrial partners reflect a convincing commitment to valorisation.

### **6. Strategy for the future**

Research at GBB has focused strongly on molecular microbial sciences. Successful collaborations with organic chemists and physicists via the Stratingh Institute and National Top Research Centre Zernike Institute for Advanced Materials are expanding. GBB's multidisciplinary research contributes to solid collaborations with the Universities of Utrecht, Leiden, Delft and Wageningen in larger national research programmes in sustainable chemistry, genomics, bio-based economy and food & nutrition.

In recent years, the Institute strengthened its foundation with new chairs in strategic areas such as synthetic biology and chemical biology (Sector Plan Chemistry; in progress), while GBB further aims to integrate novel developments in biomolecular sciences for which talented young tenure-track staff have been (e.g. Drs. Veening (2009), Scheffers (2010), Johannes (2011)) or will be attracted.

#### *Assessment*

The Committee notes that GBB has functioned successfully for almost 20 years. The new building supports close interaction between the members of the Institute, but also with the other three biology Institutes. Viability and long-term strategy is secured through hiring the best people who are willing to interact within the Institute and the university and who support and actively work for the general goals of the Institute. Furthermore, the Committee concludes that the Institute fills an important niche in the Netherlands research landscape. No other Dutch university institute is active to a larger extent in the same area.

### **7. PhD Training**

GBB since 1993 acts as a research school that is accredited by the Royal Netherlands Academy of Arts and Sciences (KNAW), being fully embedded within the Graduate School of Science (FMNS) since 2010. In this respect, GBB implements a PhD training and supervision plan in which progress monitoring and competence development is documented. Courses are either organized by GBB (often together with external collaborators) and the Graduate School of Science.

In the first year of a PhD study a go/no go decision is made, whilst in the following years necessary actions are undertaken to increase the success rate of PhD projects. In case of extenuating circumstances, the supervisor and GBB take the responsibility to allow a short

extension. The current success rate is high (~94%) with the majority of PhD students (>65%) completing the thesis in 4.5 years; 128 PhD degrees were awarded in the period 2005 - 2010. GBB's performances have been acknowledged by the recent renewal of the accreditation in 2009.

*Assessment*

GBB is one of the oldest research schools in the Netherlands and had a structured educational programme for PhD students since inception. The success rate is high. The committee would like to draw the attention to the fact that many PhDs from GBB go to the private sector. To allow the students to be most competitive on the job market a speedy full completion of PhD thesis would provide the students with even more opportunities.

**RUG**

**Programme 22:**                      **Behavioural Biology**  
Programme coordinator:      Prof. dr. A.G.G. Groothuis  
Research staff 2010:              7.2 fte

Assessments:                      Quality:              5  
   Productivity:        5  
   Relevance:           4  
   Viability:            5

*Short description*

The research programme focuses on the epigenesis of behaviour from the perinatal phase up to old age. It not only contributes insights into developmental plasticity, ontogenetic adaptation, and the relative importance of genes and environment, but is also critical for a better understanding of individual differences in vulnerability to environmental disturbance, disease and ageing.

Research topics are:

- causes and consequences of variation in and effects of maternal hormones;
- the development of animal personalities or behavioural profiles as well as individual variation in lateralisation of brain and behaviour;
- the effects of early rearing condition and daily energy expenditure;
- individual variation in senescence;
- allocation of sex chromosomes and parental investments over their offspring;
- genetics and neurobiology of social recognition.

*Quality*

The current group leader took over from an outstanding predecessor (who has since retired) early in the review period. The Committee is pleased to find that he has succeeded in building on the excellent reputation of the group, which now plays a leading role in internationally important research foci, including animal personalities, trans-generational effects and stress effects on ageing. The research philosophy, aiming to combine all levels of understanding of behaviour, is excellent. A recent new appointment has significantly enhanced the group's ability to tackle mechanisms at the genetic level, as well as introducing *Drosophila* as an additional study system. There is already evidence of exciting interactions developing. Overall, the range of model systems is now very well suited to achieving the aim of studying behaviour at all levels. Key output is in very high quality journals and is exceptionally well cited.

*Productivity*

Output in relation to research fte has been very high over the study period. CWTS statistics are exceptionally strong, partly due to influential reviews but also including excellent primary publications. Recent appointments and an excellent strategy, including collaborations locally and internationally, mean that this high output is likely to be sustained.

*Relevance*

The research work conducted in the group is driven by fundamental questions but is relevant to a number of societal concerns, including ageing and animal welfare. The group is very active in developing policy and promoting public understanding of science in these areas. Potential

applications of research, on maternal hormones in birds, for example, are being pursued actively and have attracted funds but have not yet reached the stage of practical application.

*Viability*

The excellent recent tenure-track appointment significantly enhances the future prospects of the programme. The new tenure-track appointee will help to deal with the high teaching load. Similarly, the arrival of a Veni fellow will be stimulating and will enhance links with other programmes. Furthermore, the Committee notes that facilities in the new building are outstanding. Recent success in attracting funds will improve the proportion of external funding relative to the review period. The group's plans to study the epigenetic mechanisms underlying trans-generational effects represent an exciting new direction which is both timely and an excellent fit to existing strong themes.

## RUG

**Programme 23:**                      **Behavioural Physiology**  
Programme coordinator:            Prof. dr. J.M. Koolhaas  
Research staff 2010:                3.9 fte

Assessments:                      Quality:            4  
    Productivity:    5  
    Relevance:       3  
    Viability:        3

### *Short description*

The central aim of the programme is to unravel the mechanisms underlying the behavioural and physiological response to challenges and changes in the environment. The group covers three research lines:

- causal involvement of neurobiological mechanisms in the individual differentiation in coping style, aggressive behaviour and violence and their specificity, emphasizing the role of the serotonergic system and neuropeptides;
- the adaptive and maladaptive significance of the behavioural and physiological consequences of social stress, focusing on the neurobiological consequences of adult social stress and the developmental factors involved in adult coping style and stress vulnerability;
- functional significance of sleep and consequences of sleep loss, emphasising on sleep in view of brain function and memory processes, and sleep disruption with respect to stress vulnerability, and emotionality.

### *Quality*

The group leader has an outstanding reputation and is a leader in his field. The group as a whole has a high standing in the area of neurobiological mechanisms underlying behaviour, particularly in understanding individual variation in coping with stress. Their output in the review period has been of very high quality. A recent appointment has broadened the group's range to include the study of sleep, a topical area with clear links both within the group and elsewhere in the Faculty. The Committee notes that there is a tight and coherent research focus. However, external funding has been limited in the review period, which is surprising given the track record and research relevance of the group's work.

### *Productivity*

Productivity in relation to fte has risen during the review period and is now excellent, with very strong citation figures. These figures are enhanced by influential reviews but primary output should be the focus going forward.

### *Relevance*

The research is fundamental in nature but has very clear relevance to understanding and management of aggression, depression, stress and sleep in humans, and probably also in domestic animals. The panel was, therefore, surprised by the limited public engagement, societal impact and valorisation reported for the review period. This seems to arise partly from the group's focus on impact at the conceptual level.

### *Viability*

The viability of the group is threatened by the retirement of the group leader, by low external funding and by limited innovation in terms of research directions. On the other hand, the Committee appreciates that there are clear opportunities presented by the excellent neuroscience

skills in the group, outstanding facilities, the strong recent tenure-track appointment, opportunities for collaboration with strong programmes in the Faculty and the research and societal relevance of the general field. Linking the existing skills with genetic or epigenetic approaches is one very promising possible direction. The future viability of the group is dependent on strong and imaginative leadership which is likely to require a senior appointment.



## RUG

**Programme 24:** **Chronobiology**  
Programme coordinator: Prof. dr. D.G.M. Beersma  
Research staff 2010: 8.2. fte

Assessments:                      Quality:                      5  
   Productivity:                      4.5  
   Relevance:                      4  
   Viability:                      5

### *Short description*

The research programme aims to identify and unravel building blocks of the clock as genes and proteins, cells and organs, organisms and social groups. The research topics are:

- the analysis of functional aspects of clock output in memory and feeding;
- the interaction between energy balance and circadian organisation in mammals in order to understand the relationship between obesity and sleep timing in humans;
- the daily behaviour across the seasons.

### *Quality*

This group has long been influential in the chronobiology community, notably for its important theoretical contributions. The group is evidently producing highly novel and relevant new insights and is internationally of an excellent standing. They have successfully established new systems that prove that biological clocks exist and can be entrained in all kinds of eukaryotes. Their modelling has also shown how single cells of the SCN in an ensemble can synchronize and thereby can display emergent properties that are not evident in the constituting individual entities. Given the small size of the field, it is not surprising that the bibliometric statistics do not reflect the real impact of this group. For the future, the group is well positioned to identify input/output mechanisms of the clock, especially with regard to energy balance

### *Productivity*

The group has maintained high and excellent productivity over the period of change in leadership and has established new ways of demonstrating an internal clock in lower eukaryotes. The work on chronotypes as well is offering important prospects. The grants, among them a Vici grant to Prof. Meroo and major contributions to getting the Systems Biology Center for Energy and Metabolism in Ageing funded, as well as a large EU FP7 grant, show their high standing in the field of biological clocks as well as their ability to use this to attract funding for their research.

### *Relevance*

Biological rhythms are of fundamental importance to life and thus of high societal impact. The direct interaction with the police academy (grant) and Philips (consumer lifestyle grant) demonstrates how relevant the work of the group is to society. In addition, the work of several members in the group on shift work and chronotypes has immediate and important societal implications. Several group members have strong interactions with theoretical groups and are using these connections to foster communication between mathematicians, physics, engineering, and biology. Members of the group have given classes to physicians and made regular appearances on radio and TV, thereby transporting the important insights of the field to the general public. Further projects of valorisation that will directly impact society are underway (e.g. the 'On Time' programme).

### *Viability*

This group has a very strong outlook. Its members appear to have smoothly transitioned from its former high profile leader to new leadership. Output continues to be of high quality and the research is very attractive to students. Through the new tenure track member, the age structure has become even better balanced. As the group has a clear vision and is entering new fields employing state-of-the-art methods and cooperates widely within the RUG as well as internationally, its future productivity and internationally high status appears secured.

## RUG

**Programme 25:**                      **Molecular Neurobiology**  
Programme coordinator:            Prof. dr. P.G.M. Luiten  
Research staff 2010:                8.2. fte

Assessments:	Quality:	4
	Productivity:	4
	Relevance:	4
	Viability:	3.5

### *Short description*

The mission of the research programme Molecular Neurobiology is to understand the biological mechanisms of brain functions at the molecular and cellular level and how these molecular processes can explain how the brain regulates behaviour. The research themes of the programme are mechanisms of neurodegeneration and mechanisms of learning and memory in the mammalian brain. Within these themes both fundamental biological aspects are studied as well as biomedical approaches aimed at therapeutic strategies to protect brain tissue from damaging challenges. The focus of analysis is at the molecular, cellular and behavioural level.

### *Quality*

This is a very good research group, whose work is of biomedical importance, especially in the context of neurodegenerative disorders (e.g. Alzheimer's disease). Given the translational importance of much of the work, it is not clear why outside funding is relatively low, preferentially in contract research.

### *Productivity*

The Committee notes that this group has a solid record in mid-level journals. However, high-impact publications are lacking.

### *Relevance*

The research has a high potential for societal impact, which has so far only been partly realized. The group collaborates locally with behaviour and theoretical groups, also at the medical school. The project on whole body stimulation seems particularly promising. Drugs preventing cell death/neurodegeneration, which the group has been working on, appear to be moving into clinical trials. Finally, there is strong involvement with an EU NeuroPromise programme with a focus on multiple sclerosis. The group trains a considerable number of master students and is committed to fostering female scientists.

### *Viability*

Although funding has been on the low side over the review period, the group has recently been successful in obtaining substantial grants and is actively pursuing additional grant opportunities. There is some uncertainty about the future, as the group leader will retire in three years, and no clear vision has been developed yet for this transition period.

## RUG

### Programme 26: Neuroendocrinology

Programme coordinator: Prof. dr. A.J.W. Scheurink (until 2009), Prof. dr. G. van Dijk (from 2010)

Research staff 2010: 3.5 fte

Assessments:	Quality:	3
	Productivity:	3
	Relevance:	4
	Viability:	3.5

#### *Short description*

The mission of the programme Neuroendocrinology is to identify the neuronal, hormonal and (patho)physiological mechanisms that control food intake, body weight and energy expenditure. Research is focused on both the underlying neurobiological and physiological mechanisms with the ultimate objective to understand the factors that contribute to the etiology of eating disorders, and metabolic disorders like type 1 and type 2 Diabetes Mellitus. The emphasis in the research is on:

- metabolic, hormonal and gastrointestinal signals that inform the brain about the nutritional status of the body;
- functional brain circuits controlling ingestive behaviour and energy substrate homeostasis;
- individual differences (due to epigenetic factors) and their relation to deviations in energy balance and its co-morbidities;
- exercise and energy expenditure as factors that contribute to energy balance, or deviations herein.

#### *Quality*

The group has a steady output of publications in solid journals in its field, but apparently cannot attract sufficient attention to its work as it is. Despite the biomedical interest in the field, the work remains poorly cited and its bibliometric ranking is low. It appears to the Committee that the group does not have a good strategy to get into higher impact journals and they appear unaware that they would need such a strategy. The work has its central topic in the control of the energy balance with obesity as one of the main topics, although there are many different subprojects that might be diluting impact. The group does not appear to be very active in initiating collaborations, which is reflected in the lack of research grants over the last years.

#### *Productivity*

The productivity is steady but of low impact and does not compare to that of similar groups of similar size in the field. Their success at attracting research grants could be stronger, although they have a major stake in the Systems Biology Centre for Energy and Metabolism in Ageing (SBC-EMA) and recently obtained an NWO-funded grant to study ageing in mice. They apparently have good contacts with industry, but these are not utilized to full potential and generate mostly smaller contract grants. Their PhD students nevertheless appear to be able to obtain positions in the pharmaceutical industry and elsewhere due to their solid technical training.

#### *Relevance*

Given the translational potential of this research programme, the Committee is somewhat surprised by how little has been realized in this regard. The development of a forward-looking vision would be of great benefit to this group. Several mostly smaller grants were acquired from industry, but no clear strategy towards realizing the full potential is apparent.

### *Viability*

The group has a strategic position within CBN and its interactions with biomedical groups open up many possibilities for cooperation because of the evident methodological skills of this group, but a stronger focus would be needed to permit a leading role in such cooperation. Current attempts to attract a Veni personal grant are laudable. The Committee realizes that the group carries a heavy teaching load that may have affected the quality and productivity, and possibly the attractiveness of the group for ambitious junior researchers. This is an issue that is best addressed at the level of the faculty, also in view of the current attempts to attract a Veni personal grant. In the opinion of the Committee, new input from a strong leader is needed for the group to develop a focused and cutting-edge programme, which will allow them to become more visible nationally and internationally.

## RUG

**Programme 27:**                      **Animal Ecology**  
Programme coordinator:            Prof. dr. T. Piersma  
Research staff 2010:                15.6 fte

Assessments:                        Quality:            5  
   Productivity:      5  
   Relevance:        5  
   Viability:          5

### *Short description*

The mission of the research programme is to gain a fundamental understanding of the distribution and abundance of animals from an evolutionary perspective. The group studies life history evolution (including the historical constraints limiting the range of possible extant evolutionary stable solutions), and try to reach an understanding by empirically building on three 'trades' within ecology: physiological ecology, behavioural ecology and population ecology. The objectives of the research programme are:

- to do research on the functioning of animals in natural environments, with the aim to explain, at various spatial and temporal scales, their distribution and abundance;
- to provide the research findings necessary for evidence based advice in problems of nature conservation and wildlife management, including predictions of the ecological effects of global change.

The research is primarily done in natural settings and hinges upon detailed behavioural and physiological measurements, as well as fitness measurements to ascertain evolutionary consequences.

### *Quality*

The group is an international leader in its field and has an enormous output of high quality papers that are firmly based in theory and address scientifically important questions. The rather unique combination of behavioural ecology questions with experimental physiological and ecological work gives these papers their strong impact. Particularly valuable is the long term work of this group as it not only allows them to measure selection, but due to its long term perspective can avoid pitfalls and errors of more short term approaches. In addition such long term work can provide documentation of human impact and suggest measures to avoid further degradation of important ecosystems.

### *Productivity*

The Committee assesses the productivity of the group as truly outstanding and points out that it attracts major funding. Well established cooperation within the group provides extra opportunities for addressing research and conservation questions. Recently awarded TOP grants to Piersma and Komdeur demonstrate the exceptional quality of this group.

### *Relevance*

The research of the group is highly relevant for understanding processes at the individual, population and ecosystem level and thereby contributes significantly to scientific understanding, permits conservation advice and addresses important problems connected with global change. The group is doing an excellent job in communicating its findings to society and there is good evidence that this impacts policy and practice. Massive funding through major stakeholders

signals the societal recognition of the relevance of this work. The best example is the endowed chair added to the group that will be jointly sponsored by the WWF and Birdlife Netherlands.

*Viability*

The group is in good shape and has a balanced age structure. Given the size of the group it should not influence their success that the subgroup of Prof. Komdeur is being split off. The new group has great potential. Prof. Piersma's appointment on a newly created endowed chair in the group has facilitated the upcoming appointment of a new scientific staff member. Maintaining sufficient technical support, particularly for long-term studies, through well trained personnel and centrally through RUG will be important to maintain the excellence of the group.

## RUG

### Programme 28: Community & Conservation Ecology (COCON)

Programme coordinator: Prof. dr. H. Olf

Research staff 2010: 15.8 fte

Assessments:	Quality:	4
	Productivity:	5
	Relevance:	5
	Viability:	5

#### *Short description*

The mission of the research programme is to contribute both to fundamental insights in structure and functioning of communities and ecosystems on ecological and evolutionary time scales, and to provide insights that help in conserving the biodiversity of the planet and the sustainable management of ecosystems. The research of the group can be divided in the following areas:

- hybrid interaction networks are studied in intertidal ecosystems and salt marshes of the Dutch Wadden Sea and in the tropical savannas of Tanzania and South Africa;
- impact of herbivores on plant competition, facilitation and biodiversity. The research is aimed at unravelling the mechanisms of the effects herbivores have on the increase of plant diversity;
- trait-based community and ecosystem assembly rules;
- neutral biodiversity theory and evolutionary community ecology.

#### *Quality*

The group is internationally highly visible and has continuously published in high impact journals. This is a major achievement given the large changes in group composition. The group addresses important central issues in ecology by a good mixture of experiments and modelling and thereby contributes substantially to the development of ecological concepts. Important conceptual review papers contribute substantially to the impact of the group and there are also major modelling papers of high importance. Publications in the best general science journals are, however, largely missing in the review period. The Committee notes that these should be a target for the future.

#### *Productivity*

Despite major internal rearrangements, the group has maintained a steady income through large grants (Pionier grant to Prof. Olf, Wadden Sea research) and a regular output of influential papers. At the same time the group has made every effort to translate its scientific findings in accessible papers for professionals, thereby making their findings available to managers in the field of conservation. These efforts have made substantial contributions to important decisions in the field of practical conservation. This being a group not only of community ecology but also explicitly 'conservation', their productivity in the field of transfer of knowledge through professional papers should be given weight alongside their publication output of refereed articles.

#### *Relevance*

The impact of the group on planning and decision making in conservation is recognized and the new group leader is regularly advising on conservation issues in the Netherlands and in Africa. This is also reflected in a large number of professional publications that make the knowledge gained available to professionals in the field of conservation. Thereby the group has an important and economically highly valuable societal impact. The group has also been active in explaining its work through outreach activities.



### *Viability*

The group has benefited from attracting a number of excellent young people who have high profiles in their respective fields. The group was reduced by the retirement of a full professor and the leaving of an associate and an assistant professor in 2007 and 2008. In 2008, a young researcher with a Vidi grant joined and in 2010 it attracted another young scientist onto a tenure-track position. Despite these major changes in personnel, the group has maintained its vision and the leader is of high international stature and has shown a remarkable ability to maintain high productivity in his group despite the changes. As the group is addressing highly relevant topics in ecology in a novel way its continued success seems well assured to the Committee.

## RUG

**Programme 29:**                      **Evolutionary Genetics**  
Programme coordinator:            Prof. dr. L.W. Beukeboom  
Research staff 2010:                11.8 fte

Assessments:                      Quality:            4  
    Productivity:     4  
    Relevance:       4  
    Viability:        4

### *Short description*

The mission of the Evolutionary Genetics research programme is to gain a fundamental understanding of the evolutionary process. The objective is to gain more understanding of:

- the genetic basis and architecture of fitness related traits;
- the structure of genetic variation within and among populations and its evolutionary importance;
- the genetics and genomics of life histories and reproductive systems;
- how organisms and populations adapt to non-genetic (environmental stress) and genetic (genetic load, inbreeding depression) challenges;
- the evolutionary aspects of biodiversity, speciation and extinction.

The group combines experimental laboratory approaches with theoretical models and fieldwork, using several insect groups, including the model species *Drosophila melanogaster* and *haplodiploid* *Nasonia* and *Asobara* wasps.

The research is partitioned over five research topics:

- reproductive modes and sex determination;
- reproductive isolation and speciation;
- reproductive strategies and life history evolution;
- genome – environment interactions;
- insect biodiversity evolution.

### *Quality*

The Committee notes that this group tackles a broad range of evolutionary genetics issues. Its focus on the parasitoid wasps *Nasonia* and *Asobara* as model systems gives it the opportunity to make unique contributions to questions ranging from sex determination to host-parasite interactions and speciation. The recent addition of a tenure-track staff member focusing on *Drosophila* increases the strength of the group significantly. They have been major contributors to genome sequencing projects, resulting in high-level publications, including three Science papers, and they have made valuable contributions on other questions, often exploiting the new genomic resources. The sex determination work is probably the most distinctive element in the review period, but host-parasitoid interactions are likely to be a growing area in the future. Possibly due to the interdisciplinary nature of the work, CWTS statistics do not fully reflect the impact of the output during the review period. The group has attracted excellent young scientists with fellowship funding (Veni, Vidi and TOP) and has a strong funding profile overall.

### *Productivity*

Quality of output is strong and productivity is good in relation to research fte. Since the group has been growing steadily, output is likely to increase in the future due to lags in output, especially by PhD students.

### *Relevance*

This is a fundamental field where translational opportunities are limited. Nevertheless, the group has good plans to exploit its expertise with parasitoids in biological control and also to demonstrate the relevance of evolutionary thinking to conservation and global change issues. It has been working hard to establish contacts and to obtain European Union funding for work on beneficial insects. Furthermore, it is active in public outreach and fosters the careers of female scientists.

### *Viability*

The group has excellent infrastructure and is very active in pursuing funding opportunities, with high success rates. It has a growing reputation and growing output, helped by a very strong network of collaborations. An increase in focus might help to increase visibility (as reflected also in citation statistics) by establishing a leading role in one or two research directions. The group already has strong analytical skills but could benefit from further support in this area as high-throughput data sets continue to accumulate.

## RUG

### **Programme 30: Marine Benthic Ecology & Evolution**

Programme coordinator: Prof. dr. J.L. Olsen

Research staff 2010: 5.9 fte

Assessments:	Quality:	4
	Productivity:	4
	Relevance:	4
	Viability:	3

#### *Short description*

The mission of the research group is to understand the role of 'diversity in space and time'. The research area is spread over two broad themes: marine population genetics-genomics and experimental community ecology. The group utilizes field and laboratory experiments with an emphasis on integration of evolutionary and ecological questions relevant to climate change and human influences on subtidal-intertidal systems. The objective is to address questions that link ecological function with population-community structure and connectivity, as well as rapid adaptation and speciation in a context that bring evolutionary and ecological timeframes together.

Research areas in the programme are:

- marine population genetics;
- adaptive population divergence and resilience;
- marine community connectivity and regulation;
- marine invasive species.

#### *Quality*

The group has a strong reputation in marine population genetics and phylogenetics, particularly studying sea grass and fucoid seaweeds, and a growing reputation in marine community ecology. It has been developing ecogenomics approaches and is now in a position to exploit genome sequences for key study species. The group's output is well-cited and recognised as important in the research community, as evidenced by their roles in major international consortia. External funding has been very good.

#### *Productivity*

The Committee observes that output rate in relation to research fte was good over the review period as a whole, after allowance for changes in staff numbers. This may be constrained by the relatively low proportion of tenured fte.

#### *Relevance*

The work on keystone littoral species and on human impacts on marine communities clearly has policy and management relevance, particularly in the Wadden Sea and in the Baltic. The research feeds into relevant agencies, where it is influential, but there are limited opportunities for valorisation.

#### *Viability*

While a key issue has been resolved with the formation of a new chair group in marine biology, significant threats remain. Many of these were identified in the self-assessment, including resource and infrastructure provision, technical expertise and PhD funding issues.

## RUG

**Programme 31:**                      **Microbial Ecology**  
Programme coordinator:            Prof. dr. J.D. van Elsas  
Research staff 2010:                10.2

Assessments:                        Quality:            4  
   Productivity:      4  
   Relevance:        4  
   Viability:         4

### *Short description*

The Microbial Ecology group works at furthering understanding of key processes in complex ecosystems by unravelling adaptational and functional events at a simplified scale. The programme focuses on the adaptation of prokaryotic micro-organisms to a variety of environmental niches and the ways in which the genomes involved allow plasticity to enhance fitness. The research of this group is done in the following research areas:

- fungal-associated bacterial communities and their adaptation;
- plant-associated bacterial communities and adaptation;
- adaptation of specific bacteria to local conditions;
- microbial community ecology;
- metagenomic exploration of habitats;

### *Quality*

The research of the Microbial Ecology group has focused on the controls and effects of microbial interactions in complex natural environments, such as soils, and, most recently, on the effects of microbial diversity on system functioning. The Committee notes that the group has done highly original research and produced very good papers in solid disciplinary journals. It has contributed significantly to this discipline.

### *Productivity*

The overall productivity of this group is very good. Its publication rate in peer reviewed journals is high, and its training of PhD students is very good.

### *Relevance*

The research performed by this group is highly relevant to several important societal issues, in particular bio-prospecting for useful compounds produced by bacteria, seeking better metrics of the overall functioning of soil microbial communities, and, most recently and perhaps most importantly, experimentally determining the effects of changes in soil microbial diversity and composition on societally important aspects of soil functioning, such as the resistance of agricultural soils to invasion by human pathogens. Its work on soils microbial communities is of potentially great importance to agriculture.

### *Viability*

The Committee concludes that the viability of the Microbial Ecology group is very good. Its younger members are doing highly creative and novel research. Indeed, the quality of this newest research and its relevance to societal problems suggested to the Committee that the group should, as seems appropriate, be submitting such work to major journals such as *Nature*, *Science* or *PNAS*. The viability would be aided if, perhaps by partnering with one or two other groups, a researcher with skills in bioinformatics could be added.

## RUG

**Programme 32:** **Plant Ecophysiology**  
Programme coordinator: Prof. dr. J.Th.M. Elzenga  
Research staff 2010: 6.3 fte

Assessments:                      Quality:        3  
   Productivity: 3  
   Relevance:    3  
   Viability:     3

### *Short description*

The long-term goal of the Ecophysiology of Plants group is the elucidation of the interaction between plants and algae and the environment. The group uses advanced biophysical techniques to measure processes that are essential to plant functioning in a changing environment. This approach is applied in two areas of interest:

- determining the interaction between global change factors and plant/algal performance: DMS release by algae, the effect of CO<sub>2</sub> levels on Sphagnum growth and algal photosynthesis, and the effect of atmospheric sulphur compounds on plant performance;
- describing, understanding and, if possible, optimizing the acclimative characteristics of plants to suit the changing requirements of growing crop plants.

### *Quality*

For the period that is the focus of this review, the Committee concluded that the novelty, quality and impact of the research produced by the Plant Ecophysiology group was about average for this discipline. The research seemed technically strong, but seemed to address questions of limited breadth and limited scientific importance. The research would be improved by greater coherence and by a sharper focus on clearly articulated hypotheses.

### *Productivity*

The publication rate during the review period was low for the size of the group. The number of PhD students trained was on par with other programmes.

### *Relevance*

Many plant ecophysiology groups around the world address questions of great societal relevance. The work of this group on sulphur dynamics has potential societal relevance (such as because of the atmospheric impacts of dimethylsulphide produced by marine algae). The Committee urges that such potential relevance be more fully developed.

### *Viability*

This group has a narrow research focus, and did not articulate the scope or importance of its future mission clearly. The Committee observes that perhaps the group might need re-direction to increase its impact and to have good long-term viability.

## RUG

**Programme 33:**                      **Theoretical Biology**  
Programme coordinator:       Prof. dr. F.J. Weissing  
Research staff 2010:           8.9 fte

Assessments:                      Quality:           5  
  Productivity:    5  
  Relevance:       4  
  Viability:        5

### *Short description*

The Theoretical Biology group develops and analyses mathematical models with the aim of furthering the understanding of biological patterns and processes. The research of the group is focused on three interrelated areas:

- adaptive variation, centred on the causes and consequences of variation;
- cooperation and conflict. The group studies how the balance between conflict and cooperation shapes individual development, the social structure of populations and the dynamics of mutualistic interactions;
- self-organisation. The group studies whether, and to what extent, complex structures at a higher level of organisation can be explained as emergent properties from the rules governing the interactions at a lower level.

### *Quality*

This outstanding group of theoretical biologists tackles genuinely central conceptual problems across a remarkable range of biological fields and produces high-quality, high-impact papers, including frequent contributions to the very best, multi-disciplinary journals. Contributions during the review period on mechanisms of speciation, evolution of sex determination mechanisms and self-organisation, to name only a selection of examples, are highly influential. The group has extensive international collaborations and their local network significantly enhances activity in other RUG programmes. The leader is exceptional in his own research output and in the clear, thoughtful, strategic direction he provides.

### *Productivity*

The Committee notes that overall productivity has been excellent in relation to the research fte and is on an upward trajectory. This is likely to be enhanced in the near future as the leader relinquishes major administrative positions. Publication strategy is well articulated and actively implemented, focusing on high-profile output. The group's lively international scientific connections enable their graduates to find the most attractive positions in high profile groups worldwide.

### *Relevance*

Although the type of work undertaken by the group does not lend itself to commercialisation, there is clear evidence of societal relevance and of uptake of ideas in policy contexts. The group is a major provider of trained personnel with skills that are in demand and there is evidence that the training reaches a very high standard. Also the group is collaborating with other groups in the RUG and by developing mechanistic models helps to direct experimental research in the most fruitful directions. Its contribution to education by establishing an international Erasmus Mundus Masters programme also is considered an important contribution to valorisation.

### *Viability*

The Committee was informed that one permanent staff member is leaving the group to form part of a new unit within CEES. Most likely, this will not compromise viability, since the departure has been anticipated and the leaving staff member's skills will remain available to the group. There is a high ratio of PhD students to staff but this is sustainable because the group is consistently able to attract top-quality students from the masters programmes in the Faculty. The Committee has every reason to believe that this group will continue to produce important and influential output.



## RUG

**Programme 34:**                      **Ocean Ecosystems**  
Programme coordinator:            Prof. dr. ir. H.J.W. de Baar  
Research staff 2010:                5.3 fte

Assessments:                        Quality:            5  
   Productivity:      4  
   Relevance:        4  
   Viability:         4

### *Short description*

The mission of the Ocean Ecosystems group is to unravel bottom-up and top-down control of marine pelagic productivity and community structure. Emphasis is on marine elemental and energy flows in the context of global climate change. The research foci include:

- the limited role of iron in the Southern Ocean comprising 14% of the surface of the planet, also in relation to the invasion of anthropogenic CO<sub>2</sub> in oceans;
- climate change effects on marine productivity and diversity;
- marine behavioural mechanics, energetics and biomimetics. The research is both field and laboratory oriented.

The research group has three research lines:

- marine biosphere- atmosphere interactions;
- ecophysiology of marine microalgae;
- energetics and behavioural mechanics of marine animals.

### *Quality*

This group is part of the ESRIG Institute and no longer of CEES. The research topics are rather heterogenic but each subgroup's research is of very high quality and impact. Iron is one of the limiting nutrients in the oceans and largely controls growth of phytoplankton. This group has quadrupled the availability of iron data for the world's oceans in the last few years. The work on community structure and diversity of phytoplankton as a result of climate change in the arctic oceans is very comprehensive. Surprisingly new insights were generated in how flying seagulls increase the pressure on their wings by specifically adjusting the position of the wing ends.

### *Productivity*

Over forty percent of the outside financial means come from competitive research grants, the rest from contracts and other resources. On the average four PhD students populate the group. Additional young people would be helpful in stimulating additional areas of ocean research. The Committee notes that publication output and impact of the entire group is very good, although there are differences between the individual subgroups.

### *Relevance*

For this group, relevance to society is generally the inverse of the relevance to science. The seagull project stimulates thoughts about changes to rotor wings for windmills to increase power generation in wind parks for a given amount of winds. Such an adaptation might offer a 24% efficiency increase, which is a substantial amount. All three group leaders have contributed to television programmes and printed press discussion. The information gathered during research would actually lend itself for a more aggressive outreach activity.

### *Viability*

The group seems well anchored in the Dutch system to obtain the necessary funds in the future. The Committee learned that the head of the group will leave in three years. It considers this a real opportunity for the University to find a dynamic successor who can initiate new research lines in the framework of ESRIG, and attract young promising scientists and engineers to the exiting areas of Ocean Ecosystems.

## RUG

**Programme 35:**                      **Bioinformatics**  
Programme coordinator:            Prof. dr. R.C. Jansen  
Research staff 2010:                8.1 fte

Assessments:                        Quality:            5  
   Productivity:      4  
   Relevance:        4  
   Viability:         4

### *Short description*

The research programme of the Bioinformatics group concentrates on the development of novel analytical concepts, methods and models for the purpose of unravelling complex biological traits and processes.

The research focuses on four themes:

- Biotechnologies. Comprehensive profiling of biological samples for (epi)genomic make-up and disease;
- Biosoftware. Biological laboratories need computing science infrastructures to support their data production and interpretation on a large scale;
- Systems Biology. The approaches range from genome-scale constraint-based modelling to the detailed kinetic description of selected molecular modules, e.g. metabolic or signalling pathways;
- Systems Genetics. The design of efficient and effective experiments and development of novel methods for analyzing, integrating, visualizing and interpreting the high-dimensional and quantitative biomolecular and phenotypic data.

### *Quality*

The Committee notes that the Bioinformatics group has published excellent and highly influential papers in major journals, earning an international reputation for world-class excellence, particularly in the area of biotechnology, systems biology, systems genetics and software tailored to large storage and computing resources needed in the fast developing molecular biosciences.

### *Productivity*

The publication rate during the review period was medium but became much stronger in 2010. The Committee observes that the number of PhD students trained was good. Research funding from outside grants gradually increased to over half of the total.

### *Relevance*

The research of this group is highly relevant to the fast-growing field of genomics and, because of this, is also of central importance of the application of this field to medical and agricultural research.

### *Viability*

This group is well-focused, productive and has a strong and clear vision of its future. Its high viability will be significantly aided by the recently started a new tenure-track line.

## RUG

**Programme 36:**                      **Cell Biochemistry**  
Programme coordinator:            Prof. dr. P.J.M. van Haastert  
Research staff 2010:                4.2 fte

Assessments:                        Quality:            4  
   Productivity:      4  
   Relevance:        4  
   Viability:         3.5

### *Short description*

The Cell Biochemistry group studies how movement is directed by extracellular chemical cues. The aim of the programme is to unravel the molecular mechanisms that allow cells to use minimal spatial information for symmetry breaking. The group uses *Dictyostelium* for the research. As a spin-off of the studies on chemotaxis the group works on LRRK2, a human protein involved in Parkinson's disease. The research line on LRRK2 aims at resolving the molecular mechanism how this protein is regulated and to unravel how mutations can cause Parkinson's disease. *Dictyostelium* is used as host for LRRK2.

### *Quality*

The Committee considers the size of the group a weakness, which affects productivity and grant application. Despite its small number of research staff and PhD students, a high standard of research is reached by studying the *Dictyostelium* homolog of the human LRRK2 in chemotaxis as well as mechanism of LRRK2 in Parkinson disease (PD). The link between Dict. – GbpC and human LRRK2 is highly important for PD analysis.

### *Productivity*

The funding by research grants, the number of PhD students and publications is very good regarding the size of the group. The CWTS analysis indicates a high world citation index in this subfield. The group leader has a high academic reputation in the field.

### *Relevance*

The Committee notes that the analysis of LRRK2 inhibitors is extremely important to get drugs against PD. This high societal relevance puts the group into a position which requires support by direct funding to stabilize the staff. Some of this is provided by the Michael J. Fox foundation. The effort to screen for inhibitors of PD should be envisaged in collaboration with a company.

### *Viability*

The group is in a strong position on the basis of their work on the human LRRK2 in *Dictyostelium*. The present and future strategies are designed in terms of protein-protein interactions and the necessity for LRRK2 analysis in mammalian cells. The Committee notes that at the moment the group seems hindered by the heavy administrative burden of the group leader, who is Vice-Dean of the Faculty, but the Faculty supported the appointment of an experienced post-doc and agreed on a tenure-track position in the group. The group has an excellent collaborator (Prof. Wittinghofer, MPI, Germany).

## RUG

**Programme 37:** **Microbial Physiology**  
Programme coordinator: Prof. dr. L. Dijkhuizen  
Research staff 2010: 16.4 fte

Assessments:                      Quality:            4  
    Productivity:    4.5  
    Relevance:       5  
    Viability:        5

The research of the Microbial Physiology group is focused on the characterisation of key metabolic processes in the physiology of microbial cells: Elucidation of the global regulation of selected metabolic pathways by small signal molecules, the mechanisms and reaction specificities of enzymes involved, and the redesign of enzymes and pathways to explore the potential for technological and medical applications.

The group focuses on three research lines:

- streptomyces research: focus is on key processes in primary/ secondary metabolism;
- nocardioform actinomycete research: mechanisms and reaction specificities of key enzymes in cholesterol catabolic pathways are studied;
- carbohydrate enzyme research: starch and sucrose acting transglycosylase enzymes are studied to elucidate evolutionary relationships, reaction mechanisms, structural protein features determining substrate/product specificity, glycosidic linkage specificity.

### *Quality*

The group produces high quality research on cutting edge technologies for the production of antibiotic components by relevant manipulations of metabolic processes. A special highlight is the development of modular design for manipulation of pathways for antibiotics discovery – one of the essential components for overcoming multi-drug resistance. The impressive work, although at early stages, is complemented by analyses of streptomyces development, of cholesterol catabolism, and carbohydrate research. The Committee notes that this is very good and solid work.

### *Productivity*

This is a highly productive group, releasing a steady output of extremely good papers in very good journals, and reviews in top journals. The productivity for 2011 is impressive as is the number of patent applications.

### *Relevance*

The Committee observes that this group's work has implications for veterinary and human vaccine development, antibiotic discovery, and for nutrition (glucans for diabetics; plaque development in oral cavity). The tenured staff members give interviews on the subjects of their medically relevant research.

### *Viability*

The tenured staff members are great examples of a perfect compatibility of outputs. The group has contacts with the food industry and the drug industry; it has received many research grants and is in contact with the Gates Foundation. The collaboration with industrial partners is extensive and partnerships in many networks are in place. The group has a large number of PhD students and postdocs.



### *Relevance*

The group leader is well connected with industry and has robust collaborations both within and outside of the university. The Committee appreciates that the work is relevant for antibiotic production and ageing, and the group leader does outreach to the public community.

### *Viability*

The Committee notes that this is an excellent group, but a one person operation. Since 2005, when the senior staff member resigned prematurely, the junior staff head had to take over the responsibilities, student and administrative work as well as teaching, while simultaneously developing the research programme. The group leader has demonstrated a high degree of competence, but the group should be expanded. Although the replacement hire for the other permanent position in the group is apparently frozen, the Committee explicitly recommends that the Molecular Cell Biology unit recruits another permanent member for this group.

## RUG

**Programme 39:**                      **Molecular Genetics**  
Programme coordinator:          Prof. dr. O.P. Kuipers  
Research staff 2010:                18.4 fte

Assessments:                      Quality:            4  
    Productivity:     4  
    Relevance:       4.5  
    Viability:         5

### *Short description*

The Molecular Genetics group focuses on the molecular biology, physiology, genetics, cell biology and functional genomics of AT-rich Gram-positive bacteria of industrial and health interest. The objective of the research is to study *Bacillus subtilis* as a potential cell factory for enzyme and vaccine production as well as for basic insights in differentiation processes.

Research in the group consists of four major research themes coupled to application and societal relevance:

- antimicrobials. The molecular mechanisms underlying lantibiotic production are being unravelled to improve production;
- functional Genomics. How bacteria respond to their environment and combat various stresses.
- several ‘omics’ techniques are used (proteomics, transcriptomics) in combination with in-house bioinformatics to unravel the principles behind these responses;
- differentiation & Phenotypic heterogeneity. The main research theme is how noise contributes to the phenotype in model organisms;
- cell biology. New tools are employed to investigate virulence gene expression at the single-cell level.

### *Quality*

The Committee notes that this group is well embedded in numerous collaborations in academia and with industry. A very strong staff with long-term and short-term experience is combined by four complementary research fields in a well-designed strategy and is in the forefront of Molecular Genetics of bacteria. Publications in high impact journals appeared in seven different research lines such as antimicrobials, phenotypic heterogeneity, or biotechnological applications. New programmes such as cell biology of *S. pneumonia* have been established, and a strong link to industrial partners allows direct knowledge transfer and new projects (TIFN, Kluyver, STW). Additional grants from NWO, EU, EMBO, NWO-Veni, or ESF indicate the activities of the group and are equally distributed among the staff members.

### *Productivity*

All group members publish well, although the Committee observes that the normalised impact is not great (MNCS 1.11). Staff members were honoured by awards, grants or KNAW membership. The citation record preferentially for senior staff is very good in terms of quality and quantity of publications, or H-factor. The increase in funding by research grants is very good.

### *Relevance*

The lines of research are of high scientific relevance since they are novel and at the forefront of the corresponding area. Several of them allowed application by companies. Numerous patents were successfully applied; some of them have made money. Due to a strong strategy, one-on-



one-projects, and direct links to several companies, societal relevance is high. The Committee was informed of editorial and public activities as well as of activities in developing countries. Furthermore, the group has undertaken good outreach activities and training of numerous students.

#### *Viability*

The group is vital and stable with a good structure, a high grant application record, and should continue to do well. The Committee advises that concerns about access to next gene equipment should be addressed at institutional level. The SWOT analysis and the self assessment in terms of resources, infrastructure, innovation and income clearly indicate the excellent strength of the group. The envisaged direction of development in terms of technology and scientific line is very well designed.

## RUG

### **Programme 40: Molecular Microbiology**

Programme coordinator: Prof. dr. A.J.M. Driessen

Research staff 2010: 17.8 fte

Assessments:	Quality:	4.5
	Productivity:	4
	Relevance:	4.5
	Viability:	5

The Molecular Microbiology group focuses on the enzymology, energetics, structural biology and physiology of membrane-bound processes in micro-organisms, including organisms and processes that are of industrial and medical interest. The objectives of the research are to understand:

- how membrane proteins function in complex cellular processes such as solute transport, protein translocation etc.;
- how multidrug resistance transporters contribute to antibiotics resistance in bacteria;
- how bioinformatics can be employed to identify distant evolutionary relationships between transporters to predict and examine their folding in the membrane;
- how the unique cell surface of hyperthermoacidophilic archaea is assembled and how its organisation contributes to extremophilicity;
- how beta-lactams are excreted by filamentous fungi and how cells can be re-engineered by synthetic biology principles for the fermentative production of unnatural antibiotics.

#### *Quality*

The Committee notes that scientists of this group are absolute leaders in secretion. The basic and applied work on protein secretion is known worldwide. The analysis of protein folding with the help of chaperones using optical tweezers is also well-known. Moreover, work on protein translocation /protein secretion testifies to the continued solid research of the group.

#### *Productivity*

The longevity of very good publications is a measure of dependable productivity. The year following the evaluation period will witness a surge of fantastic output as a number of first class publications will appear. The programme leader has acquired three NWO TOP grants, in 1999, 2006 and 2011.

#### *Relevance*

The Committee observes that the work of this group has relevance to antibiotic production and many industrial processes. There are good contacts and collaborations with several companies and government panels and patents have been filed. The exploitation of research results is a strong component of this group. The leader takes the responsibility to deliver lectures to the public and local government, as well as to appear on TV and radio, and to serve on advisory boards. Moreover, he coordinates several larger projects, organises company interactions and leads international conferences.

#### *Viability*

The viability of this group is assessed as excellent, since the funding rests on many pillars. This is a strong group, with a good composition of scientists and with sufficient financial independence. There does not seem to be a problem with positions and the large number of PhD students

brings in money in the form of direct funding. A Honorary Professor in Synthetic Biology and Cell Engineering, joining the group two days per two weeks, helps to maintain the high standard of the group.



## 6A. INSTITUTE LEVEL – Wageningen University

Wageningen University is a one-faculty institute with a focus on the theme 'healthy food and living environment' and does not have a separate Biology research institute. A large number of the chair group programmes could be regarded as part of the domain of Biology, but the Executive Board of Wageningen UR has decided to include in this review only the chair groups that make a major contribution to the MSc programme Biology, one of the 17 teaching programmes at Wageningen University.

The mission of Wageningen UR is 'to explore the potential of nature to improve the quality of life'. Both research and education are focused around this mission. Although basic biological disciplines at Wageningen University (such as physiology, genetics, molecular biology, cell biology, ecology and microbiology) are similar to those at other universities, at WU these are combined with domain-focused biology related disciplines such as conservation biology, production ecology, adaptation physiology, and health related biology.

The five research themes in the domain of Biology are as follows:

- genetics and developmental biology of plants;
- adaptive capacity of animals;
- ecology of natural and agro ecosystems;
- plants, animals and their natural enemies;
- microbial interactions and biotransformations.

Wageningen UR employs 6,500 staff members and hosts around 10,000 students (BSc and MSc) and 1400 PhD candidates. The basic unit within Wageningen university is the chair group led by a full professor who is referred to as chair holder. Chair holders operate within one of the five Science Groups of Wageningen UR and interact with the management of their Science Group with regard to human resource management, financial management and facilities. They interact with the Graduate School with regard to the focus, direction and quality of their fundamental and (often multidisciplinary) strategic research and PhD programme.

The roles of the six Wageningen Graduate Schools are:

- to develop and coordinate education and training of PhD candidates;
- to stimulate and safeguard the quality of academic research;
- to contribute to a coherent university research programme within the mission of the Graduate School;
- to monitor the quality and progress of research programmes.

Wageningen University has a four-year PhD programme that consists of conducting research, participating in educational activities and supervising MSc students. Training elements are described in the individual training and supervision plan that is drawn up at the start of the appointment. The Wageningen Graduate Schools are responsible for PhD education. To ensure the quality of PhD research, the progress of students is monitored on a yearly basis and after 18 months a formal Go/No-Go decision is taken. The average time for PhD completion (corrected for drop-outs) of employed PhD students has decreased over the years from 5.2 years for the cohort 2001-2003 to 4.9 years for the cohort 2004-2006. The interests of PhD students are represented by the Wageningen PhD council (WPC).

In 2009, Wageningen University implemented a career policy (“tenure track”) for all newly appointed academic staff. The goals of this career policy are to ensure excellent quality and to be attractive to top talent by offering clear career perspectives.

*Wageningen University has not asked for an assessment at institute level in this review.*

## 6B. PROGRAMME LEVEL – Wageningen University (Programmes 41-59 )

**Programme 41:**                      **Entomology**  
Programme coordinator:      Prof. dr. M. Dicke  
Research staff 2010:            25.86 fte

Assessments:                      Quality:            5  
   Productivity:      5  
   Relevance:        5  
   Viability:         5

### *Short description*

The mission of the programme is to unravel the ecology of interactions between insects and other community members by combining ecological studies (population and community levels) with investigations of the underlying mechanisms (subcellular to individual levels). Integrated pest, vector and disease management strategies are being developed in both developed and developing countries. The research area of the group consists of the fundamental and applied aspects of the biology of insects with an emphasis on multitrophic interactions. There is a focus on integrating ecological, physiological and molecular approaches. In the tropical research programme, cooperation with social sciences ensures that societal stakeholders are included in the research process, and that research is centred around the needs and opportunities of farmers.

### *Quality*

The Committee notes that this unit makes outstanding contributions in all four of its priority areas. The research on plant-insect interaction and malaria vector groups is published in high-impact journals and has made significant advances in both understanding and application. The integrated pest management and entomophagy themes are unique and exceptionally valuable, even if this is not clearly captured by conventional indicators. Furthermore, group leadership is dynamic and highly effective.

### *Productivity*

This is a large group but it nevertheless produces an excellent average output per research fte. This includes refereed articles with strong average citation rates, many PhD theses and non-standard outputs that are important for dissemination of some aspects of the group's work.

### *Relevance*

All four major programmes have clear societal relevance and the research priorities are clearly tied to societal needs, without compromising scientific interest where this is also a major driver. Substantial funding support in the third stream is evidence for the value of this work. Participatory research in developing countries such as Benin, Mali and Ghana and public outreach activities are particularly impressive in this context. Of special interest is the 'City of Insects' festival held in Wageningen which also highlighted the groups' activities in launching the use of insects as low greenhouse gas emitting meat for human consumption.

### *Viability*

The size of the group clearly places a strain on the small current tenured staff group but two new appointments will improve long-term sustainability of current standards. The Committee notes that the rapid growth of the group may also result in infrastructure constraints. Nevertheless, there is every reason to expect continued exceptional performance.

## WU

### Programme 42:

### Genetics

Programme coordinator: Prof. dr. R.F. Hoekstra (until 2010), Prof. dr. B.J. Zwaan (from 2010)

Research staff 2010: 17.2 fte

Assessments:	Quality:	5
	Productivity:	4
	Relevance:	4
	Viability:	5

#### *Short description*

The interrelationship between genetics, heredity and evolution is the central focus of research of the Laboratory of Genetics. Central is the study of genetic variation that ranges from the processes that produce it (mutation, recombination), to the factors that have shaped its architecture in the past, and to the factors and processes that determine its fate. The research focus of the group is on three themes:

- generating variation;
- genetics and levels of selection;
- genetics of adaptations.

#### *Quality*

Using a broad range of organisms, from bacteria to yeast, fungi, animals and plants, the scientists follow genetic diversity and evolution. Examples presented included work on termites culturing fungi, a novel breeding idea making use of down-regulation of meiosis and the study of life history and ageing in a cohort of people in Ghana. The Committee notes that this research is highly important and of excellent quality. *Arabidopsis* populations serve as exquisite models to study adaptations. The work represents cutting-edge science, using the newest technology.

#### *Productivity*

In relation to the top level scientific quality the productivity, in terms of publications stemming from the Wageningen University, lags slightly behind. However, given the quality of presented data several high-profile publications are to be expected. A constant high number of PhD students (about 15 per year) was educated within the assessment period.

#### *Relevance*

The novel breeding idea has been patented and collaboration with a company has been initiated. Also the medically relevant ageing study and the work on specific fungi in eradicating malaria mosquitoes could eventually be applied. As societal relevance the dissemination of results in newspapers, radio and television can be listed. The Committee would like to stress that it may be possible to expand these activities.

#### *Viability*

After the merger of several research groups some years ago, the group now consists of about 40 people with several tenured and tenure track scientists and enjoys a stable situation and structure; the pipeline of research is filled, funds are coming in and the two 'superscientists' working one day per week as advisors and colleagues are contributing to the stable situation.



## WU

**Programme 43:** **Nematology**  
Programme coordinator: Prof. dr. J.Bakker, Prof. dr. W.H. van der Putten  
Research staff 2010: 16.9 fte

Assessments:                      Quality:            5  
   Productivity:       5  
   Relevance:        5  
   Viability:         5

### *Short description*

The overall objective of the Nematology programme is to understand and predict the functioning of nematodes in agricultural and natural ecosystems. The group studies the molecular interaction between nematodes and their host plants with special emphasis on the identification of nematode secretions and the processes triggered by those substances leading either to resistance or susceptibility. Another important research theme is studying the mechanisms underlying the plasticity of nematodes and their communities in relation to biotic and abiotic stress. Recent developments in ecogenomics, below-above ground interactions and the integration of molecular and classical nematode taxonomy play a key role in this research theme.

The research programme is divided in two areas;

- molecular and cell biology;
- biodiversity and ecology.

### *Quality:*

This group made a very strong impression on the Committee, as it has an excellent research programme in the important and increasingly prominent area of plant-parasitic nematodes. Their efforts to integrate traditional taxonomic expertise with modern diagnostic tools are laudable.

### *Productivity:*

The group has shown excellent productivity over the review periods, with a substantial number of papers published in high impact journals. Their record in obtaining outside funding is also excellent, including several personal grants.

### *Relevance:*

The relevance of this group cannot be overstated. As the largest nematology group in the Netherlands, their expertise and capabilities are unrivalled, which is of critical importance given the impact nematodes have on crop plants. The group has developed a bar-coding assay as an objective and efficient diagnostic tool. Also, they have obtained several patents, which form the basis of a new company. Although the group currently has few women in prominent positions, the leadership is working towards attracting female scientists. Finally, the group conducts excellent outreach activities in high schools (“Mobile DNA courses”), which are carried out by BSc students who receive “communication” credit for their involvement.

### *Viability:*

The outlook for this group is excellent, as they continue to implement a compelling vision for future research. The Committee was pleased to learn that the research programme is already consolidated till 2016.

## WU

### **Programme 44: Virology**

Programme coordinator: Prof. dr. R.W. Goldbach (until 2009), Prof. dr. J.M. Vlak (since 2009)

Research staff 2010: 13.9 fte

Assessments:	Quality:	4
	Productivity:	4
	Relevance:	4.5
	Viability:	4

#### *Short description*

The mission of this programme is to advance the insight in the interactions between plant and insect viruses and their hosts and to apply these insights for the benefit of human, animal, plant and environmental health. The objectives of the programme are to understand how plant and insect viruses replicate in their respective hosts and how they modify their hosts (and counteract host defense responses) to enhance the transmission of the virus.

The first subprogramme revolves around the question of how viruses evade the defense responses of the host using plant tospoviruses and insect arboviruses as models. The second subprogramme focuses on the issue of how insect viruses (baculoviruses) infect insects and how they alter the insect behaviour to maximise virus production and spread. The third subprogramme encompasses the question of how plant viruses move from cell to cell.

#### *Quality*

The Committee notes that this group does excellent basic work in plant virology, vector virology with exciting new developments on discovery of a clock gene. Its work on plant and insect viruses is highly complementary to the strong effort in plant pathogen interactions at WU.

#### *Productivity*

Despite the unexpected death of the chair in 2009, which led to a clear gap, the group today is good and active, much to the credit of the interim leader Prof. Vlak.. The Committee appreciates that plant viruses do not get as much coverage as animal viruses, which hurts the citation index. However, it concludes that the trend is in the right direction.

#### *Relevance*

The work of this group has great implications in agriculture as well as vaccine development. Even before valorisation was a goal of the Dutch evaluation system, this group started its practical work. It has a large number of patents and fosters collaborations with industry.

#### *Viability*

The Committee notes that this group has a good age distribution. The Committee regards the recent appointment of the new chair as important new information that has the potential to increase the viability of the group. This announcement was made after the site-visit.

## WU

**Programme 45:** **Phytopathology**  
Programme coordinator: Prof. dr. P.J.G.M. de Wit  
Research staff 2010: 28.9 fte

Assessments:                      Quality:            5  
   Productivity:       5  
   Relevance:        5  
   Viability:         5

### *Short description*

The programme Phytopathology studies ecological, physiological and molecular aspects of pathogenic bacteria, fungi and oomycetes, pathogen speciation and host specificity, and interaction with hosts and antagonists. The research focuses on microbes with different infection strategies (biotrophs, hemibiotrophs, necrotrophs, intracellular and extracellular pathogens) and different mechanisms of antagonism. The most important research themes are:

- the molecular basis of defence against pathogens in *Arabidopsis*, *N. benthamiana*, potato and tomato.
- the molecular basis of infection mechanisms of various pathogens.
- protection of plants against pathogens through resistance genes and biocontrol agents.
- molecular and evolutionary ecology of pathogens and antagonists.
- evolutionary mycopathology and bioinformatics.

### *Quality*

This is one of the world's best phytopathology groups for more than two decades. They use molecular genomic approaches to understand the mechanisms whereby important plant pathogens infect and kill plants. Unlike many plant pathology Departments, which in the USA tend to be highly fragmented, the members of this programme have focused on certain groups of pathogens (e.g. oomycetes, *Botrytis*, *Cladosporium*, etc) and certain host species (potatoes, tomatoes and *Arabidopsis*). They have played a major role in genomics projects for the respective pathogens and have made major contribution to the fundamental understanding of infection in plants.

### *Productivity*

Not only does the group publish a lot of papers, they publish a significant number in top journals. (Note: there were errors in the original citation index data given to us; the revised data show data are significantly better than they appeared in the analysis.)

### *Relevance*

The research on *Phytophthora* (potato blight and other major plant pathogens) is of huge economic interest. The group does well with collaborations and commercialization. Seven patents were filed between 2006-2010; one start-up company (MicroLife Solutions) has been formed. There is a collaboration with Syngenta. They are also developing some interesting education outreach programme, especially an e-module for teaching phytopathology.

### *Viability*

Funding is solid, as are arrangements with industry and granting agencies. It is a young group with a vibrant and robust student population. They are 'on a roll'.

## WU

### **Programme 46: Crop Systems Analysis**

Programme coordinator: Prof. dr. ir. P.C. Struik

Research staff 2010: 23.5 fte

Assessments:	Quality:	4
	Productivity:	4.5
	Relevance:	4.5
	Viability:	4

#### *Short description*

The objective of the programme Crop Systems Analysis is to analyse and understand processes that affect the productivity of crops and the performance of cropping systems. The programme aims to contribute to efficient use of limited resources and enhancing sustainable food production.

The emphasis of the subprogramme Crop Physiology is to study physiological processes within the plant and to synthesise understanding of the functioning of the crops by scaling up knowledge of these underlying processes through experimentation and modelling.

The subprogramme Crop and Weed Ecology has the ecology of crops and weeds at its centre, where ecology is defined as the scientific study of the relations of living organisms with each other and their surroundings. Studies are made of the effects of the abiotic environment on development and growth of crop plants and cropping systems. Plant-plant interactions are a focal point.

#### *Quality*

The Crop Systems Analysis group, which is a practical applied group dealing with real crops and real problems, has done research of high quality. Their work addresses issues of agricultural significance, and they have directed their efforts to many places around the world. In that sense, the group truly has global impacts. However, the citation impact is low, which is a concern. Because of the importance and relevance of their work, and the broad interest in this topic, we strongly encourage the Crop Systems Analysis group to target more of their efforts to communications in major, high-impact interdisciplinary journals such as Science, Nature and PNAS

#### *Productivity*

This programme has good productivity in its rate of academic publication and excellent productivity in training PhD scholars. It has good funding from outside sources.

#### *Relevance*

The work of this group is highly relevant to agricultural yields and sustainability. The group's social science component is good. We encourage the group to expand on its outreach to the direct applications of its research.

#### *Viability*

The programme has good viability for its work addressing sustainable agriculture and its global achievement. Its viability might be improved by a sharper focus on a few major themes. We note, for instance, the potential for intercropping to improve yields (and perhaps nutrient use efficiency) in developed nations, and wonder if this might be a novel but important focus.

The start of the newly appointed chair has the potential to further increase the viability of the programme.

## WU

**Programme 47:**                    **Molecular Biology**  
Programme coordinator:        Prof. dr. T. Bisseling  
Research staff 2010:            24.0 fte

Assessments:                    Quality:            5  
    Productivity:     5  
    Relevance:        4  
    Viability:         5

### *Short description*

The research area of the programme Molecular Biology is the post-embryonic development of plant organs and the evolutionary processes by which the underlying mechanisms are shaped. The goal of the programme is to unravel the molecular mechanisms underlying:

- the Rhizobium-legume symbiosis that involves the formation of a new organ;
- flower development.

The group focuses on the key aspects that control post-embryonic development: signal transduction, transcriptional networks, chromatin remodelling and identity of meristems. The obtained insight will be transferred to application.

### *Quality*

The research on nitrogen fixation is powerful and elegant. Over the last 15 years the group has contributed much of the basic work on nod factors, including the cloning of 4 out of the 8 nod factor signalling genes from *Medicago*. The new work on studying the 'symbiotic interface' has shown that the biological mechanism has been recruited from the widespread arbuscular mycorrhizal symbiosis. We learned less about the work on flower development but it is also strong. Both the root and the flower groups have strong international collaborations with many of the best laboratories in the field.

### *Productivity*

The number of publications is not as high as some groups but the quality is consistently high. There have been six papers in Science during the evaluation period as well as in many other top rated journals. It should be noted that because the work concerns plants, it somewhat hurts the WTS analysis, because plant papers are not cited as often as those in the biomedical sciences. Within the plant community, the programme is well known as a leading group in nitrogen fixation.

### *Relevance*

Scientifically the work is of the highest relevance. Several strong collaborations are in place, for example there is a new project in the Arabian peninsula on desiccation research. However, the group could do a somewhat better job of telling both the Committee and the outside world about their relevance, broader impacts, educational outreach and the like.

### *Viability*

Currently there is a good balance of staff members of different ages, good outside grant support, and the potential for collaboration with breeding companies. Ben Scheres, a prominent plant developmental biologist, will be joining the group shortly and bringing approximately 20 people with him. This new research line and accompanying staff, will strengthen the structure of an already strong programme.

## WU

### **Programme 48: Plant Cell Biology**

Programme coordinator: Prof. dr. A.M.C. Emons (until 2008), Prof. dr. M.E. Janson (since 2008)

Research staff 2010: 5.8 fte

Assessments:	Quality:	4
	Productivity:	3.5
	Relevance:	3
	Viability:	3.5

#### *Short description*

The mission of the group is to contribute to:

- the integration of physics in cell biology and
- the application and development of state-of-the-art light microscopy.

All sub programmes are related to the eukaryotic cytoskeleton; how are networks of cytoskeletal filaments self-organised and how do these networks function? The primary focus is on plant cells, but the group also tackles conserved mechanisms of general interest using yeast cells and reconstituted biochemical networks of multiple purified components.

The following subjects are studied:

- how molecular motors and other cytoskeletal regulators co-operate to link microtubules into functional networks;
- the acting cytoskeletal and its role in organising transport in the plant cell;
- the microtubule cytoskeleton in relation to the deposition of cellulose in the plant cell wall.

#### *Quality:*

The research of this small group is focused on physical and microscopic approaches on plant cytoskeleton and cell wall formation including the link to transport, patterns and polarity. New and very good research lines on microtubule networks during mitosis and cell wall pattern formation were established. Here genetic approaches should be addressed additionally to structural analyses. The orientation on light and microtubules in the research lines may require reformulation in the new context. There seems to be an imbalance in the number of teaching hours of the staff members.

#### *Productivity*

The output includes publications in high impact journals, but they partially originate from other groups. In view of the numerous technology-based collaborations, a higher number of publications can be expected. The proportion of external funding should be increased. The vision of the group to be a link between physics and molecular biology is not substantiated by the research lines, e.g. by developing methodological improvements.

#### *Relevance*

There is a significant impact by service and guest training via the light microscopic facilities. Additional societal relevance is indirectly given via NWO and more directly via links to companies (Unilever; breeders in Indonesia, etc.). Outreach activities on research in plant cell biology (microtubule orientation, cell wall formation) deserve to be further increased.

### *Viability*

The information provided in the documentation and in the interview did not give a very clear perspective on the viability. After the review, information was provided on a large grant for instrumentation, on a very competitive grant for the Human Frontiers Science Programme and on a recent co-authored paper in *Nature Cell Biology*. As this information was either not available during the review, or does not pertain to the period under review, the Committee could not take it into account.



## WU

### **Programme 49: Plant Physiology**

Programme coordinator: Prof. dr. L. van der Plas (until 2008), Prof. dr. H.J. Bouwmeester (since 2008)

Research staff 2010: 29.3 fte

Assessments:	Quality:	4
	Productivity:	4
	Relevance:	5
	Viability:	5

#### *Short description*

The programme Plant Physiology investigates how plants respond to and adapt to (changes in) the environment and how they in turn influence their environment. The group aims to understand how genetic information or changes in gene expression are involved in the response to the (changing) environment and how this results in a plant response: the formation of new proteins/enzymes, the production of metabolites/plant hormones and the resulting changes at the cellular and organ level as well as the effect of these changes on the environment.

The joint interest of the group are the use of genetics and metabolomics, the role of plant hormones in the plant's response to the environment and modelling/systems biology approaches to plant physiology, resulting in the following research lines:

- terpenoids, that are involved in plant-plant and plant-insect signalling;
- 'source-sink interactions', this line focuses primarily on flexibility in primary (carbohydrate) metabolism and nutrient use efficiency as related to growth and performance under optimal and sub-optimal conditions.
- the mechanism and regulation of dormancy and germination in relation to the (stressful) environment.
- cellular processing and transport of proteins and metabolites.

#### *Quality*

Since the last assessment PP research increased remarkably in terms of originality of the research lines (strigolactone, its function and biosynthesis including QLT mapping, effector protein LysM effector Ecp6, terpene transport, seed germination). Initially this group had a leading position in strigolactone research which in the meantime was kept via a collaborative work with an Australian group. This research line has returned and led to excellent work and publications in 2011. All research lines including germination/seed dormancy are well embedded in European research networks. This group is independent but interacts with others in using a metabolomics platform and genetic approaches. All staff members obtained significant results during the assessment period.

#### *Productivity*

The publication record is very good regarding the CWTS analysis. The PP publications are clearly above average of WU and world wide. The key publications in seed biology can be increased. The low number of PhD students is already bypassed by a remarkable increase (14) in 2009. Access to about 5 M€ are available by research grants and contract grants which is three-fold higher than in 2006.

*Relevance:*

Several facets of the PP work are of high societal relevance (plant insect interaction, strigolactone in arbuscular mycorrhizal interactions and nodulation, effector proteins, nutrient efficiency, biofuel crops) and will contribute to crop improvement. This is excellently organized by collaborative work with companies (parasitic weed project in Africa, antimalarial drug artimesinin, seed storage) and by activities in educating the public.

*Viability*

There is a significant increase in number of PhD students and non-tenured staff members. Great improvement has been observed in design of group strategy and organization linking top science to top structure of the group. The expanding activities of the group in terms of members, collaborative work, projects in developing countries, grants, or establishment of new technology platforms such as glycoproteomics indicate the excellent viability of the group and will lead to increasing number of publications and grants. Recently a complementary interaction of different research lines could be established in case of terpene transport/effector proteins.

## WU

### **Programme 50: Plant Production Systems**

Programme coordinator: Prof. dr. K.E. Giller

Research staff 2010: 27.3 fte

Assessments:	Quality:	5
	Productivity:	4
	Relevance:	5
	Viability:	5

#### *Short description*

The mission of the programme Plant Production Systems is to integrate biological knowledge to analyse and design sustainable production systems for crops, focused on efficient resource use and equitable management of natural resources. The group develops methods which enable integrated analysis and design of alternative futures at local (farm), regional, national, international and global scales.

The research approach combines empirical knowledge and production ecological theory with understanding of farming systems derived from survey and databases. The issues require analyses at multiple levels, and a key research issue is scaling from the field to farm, to region and the global level. An interdisciplinary approach is central, as the issues deal with complex human systems.

#### *Quality*

The research of the Plant Production Systems group is of excellent quality and international impact. Even while noting this quality, we must also strongly encourage the group to pursue publication in journals such as Science, Nature and PNAS. The issues the group address, and their unique findings, merit the widest possible communication and consideration.

#### *Productivity*

This programme has very good productivity via publications. Its productivity in training PhD scientists is excellent. The group finances close to 75 percent of its research with extramural funding, mainly contracts.

#### *Relevance*

The work of this group is highly relevant to the development of global agriculture, to the reduction (and hopefully, elimination) of the yield gap, and to the efficient use of agricultural inputs. As such, it is also of relevance to environmental sustainability, but this aspect of its relevance would be increased by explicit analyses (greenhouse gas emissions, nitrate loading, land clearing and loss of biodiversity, pesticide use, etc) and communication of the findings and their importance in high-impact journals.

#### *Viability*

The programme has excellent viability because of the skills, interests, enthusiasm and high vitality of its research staff.

## WU

### **Programme 51: Cell Biology and Immunology**

Programme coordinator: Prof. dr. ir. H.F.J. Savelkoul

Research staff 2010: 12.5 fte

Assessments:	Quality:	4.5
	Productivity:	3.5
	Relevance:	4
	Viability:	4

#### *Short description*

The programme Cell Biology and Immunology takes a comparative and conceptual approach to unravel molecular and functional aspects of immune regulation and its underlying cell biological principles that ensure a healthy adaptation to infection and other environmental challenges. These fundamental insights provide the rationale for the more strategic research on 'Immunomodulation', which offers possibilities to direct the activity of the immune system into a predefined state by interference with food or feed, thereby relieving immune-mediated diseases or enhancing immune capacity and disease resistance. Areas of interest include disease resistance in invertebrates; the innate and adaptive immunity in fish, chicken and cows; the development of allergic diseases in horses and human beings; and immunomodulation by environmental factors. The impact of several environmental parameters, such as food intake, infections, stress or electromagnetic fields, is taken into account.

#### *Quality*

The programme has achieved very good results on immunomodulation, featuring an integrative and comparative analysis of the immune function, with special focus on fish, but also mammals (including humans). Recently the zebrafish was added as a model to the research programme in order to improve the link between basic research questions and applied aspects. The group is well-known internationally for its work in Fish-Immunology and Fish Vaccination. It has some visibility in (food) allergy.

#### *Productivity*

Productivity is solid, with good potential to increase. Recent publications in high-impact journals (e.g. Lancet, PLoS Genetics, Cell), but somehow they seem to remain single events. The largest part of the funding is from contract research. The group seems not so successful obtaining competitive research grants. The number of PhD students is increasing.

#### *Relevance*

There are numerous international collaborations, and nationally with the Veterinary Faculty in Utrecht. Collaborations with allergologists include access to patient samples. Interactions with companies exist in the area of vaccine development. The group should profit from the increasing role aqua-culture is playing in providing protein for human consumption. It could use its knowledge for educating a broader public about the increasing impact of aqua-culture to our societies.

#### *Viability*

The recent restructuring is still ongoing. A new tenure-track position is expected to be filled soon. This new position should help the group to obtain a stronger profile and a clearer visibility in the University, the Netherlands and beyond its borders. The Netherlands is a fish consuming nation; thus all is there for a stronger profile of the group.

## WU

**Programme 52:** **Experimental Zoology**  
Programme coordinator: Prof. dr. ir. J.L. van Leeuwen  
Research staff 2010: 5.7 fte

Assessments:                      Quality:        5  
   Productivity: 4  
   Relevance:    5  
   Viability:     5

### *Short description*

The main research area of the Experimental Zoology programme is the biomechanics of the locomotory system in vertebrates in air, water and on land (in particular birds, zebrafish, horses and recently cows). Within this common theme four research lines are integrated:

- biofluid dynamics of swimming and flight, in which the effects of body motions on the fluid flow are considered.
- structure-fluid interactions of swimming in larval fish, in which effects of muscle activation on the combined motion of body and flow are studied.
- the effects of movement mechanics on the architectural organisation and remodelling of muscles and skeleton (including effects of training on the regulation of growth and development).
- applications of the previous lines to animal health and bioinspired designs of unmanned aerial and aquatic vehicles.

### *Quality*

The group is primarily focused in the small field of animal mechanics but has very high status internationally in this field, as reflected particularly in the number of papers published in high-impact general journals. The addition of a developmental research area has brought a common focus on juvenile zebrafish which has already allowed the group to exploit synergies between different specialists and offers many opportunities for the future without excluding other productive avenues.

### *Productivity*

Productivity of refereed articles has been high during the review period, despite considerable changes in the composition of the group. Average impact reflects a balance between high-impact papers in general journals and the bulk of output in more specialised publications. The output of PhD theses and other publication types is very good in relation to the size of the group.

### *Relevance*

There are several areas in which the group's research has strong potential for societal impact, particularly in biomimetic design and animal welfare. These opportunities are being exploited actively, with considerable success, and the group has attracted extensive media attention.

### *Viability*

Recent appointments have significantly strengthened the group. External funding is increasing and the potential for exploitation, particularly of biomimetic design, is likely to enhance this trend. Biomechanics is a difficult area in which to attract good PhD students but the group has attracted students of very high quality. Further integration of the biomechanics and developmental biology approaches presents exciting opportunities for the future.

WU

**Programme 53: Aquatic Ecology & Water Quality Management**

Programme coordinator: Prof. dr. M. Scheffer

Research staff 2010: 22.6 fte

Assessments:	Quality:	5
	Productivity:	5
	Relevance:	5
	Viability:	5

*Short description*

The research programme aims at generating novel insights that help to develop effective strategies for preserving and restoring aquatic ecosystems and water quality. This requires teamwork linking disciplines as ecology, ecotoxicology, environmental chemistry and mathematical modelling, and approaches on scales varying from microcosms to entire ecosystems.

Research themes are:

- critical transitions in complex systems;
- effects of climatic change;
- the role and fate of hazardous chemicals and particles (black carbon, manufactured nanoparticles, micropollutants);
- distribution and implications of cyanobacterial toxins.

*Quality*

This programme has produced an unusually high number of extremely novel and influential publications in the highest calibre journals. It is an internationally outstanding programme.

*Productivity*

The programme has an excellent record of productivity of peer-reviewed papers for a group of this size. The number of PhD students being trained by this programme has risen rapidly, which suggests that its productivity will be even higher in the future.

*Relevance*

The focus of the programme is of direct relevance to environmental problems faced by aquatic ecosystems. Moreover, the group has been excellent at seeking generality from their results and applying the resulting theory to other major environmental issues.

*Viability*

Because this programme is very well known and respected globally for its scientific advances, because of the partnerships it has formed, and because of its infrastructure, this programme has excellent viability.

WU

**Programme 54: Forest Ecology & Forest Management**

Programme coordinator: Prof. dr. ir. G.M.J. Mohren

Research staff 2010: 15.5 fte

Assessments:	Quality:	4.5
	Productivity:	4
	Relevance:	5
	Viability:	5

*Short description*

The Forest Ecology and Forest Management Group studies the ecology of forests. The research is concentrated around three themes:

- the ecology of forest regeneration in a changing world;
- understanding biodiversity and functional diversity in relation to resource gradients (notably water and light);
- sustainable supply of forest resources and environmental services, under changing environmental conditions.

The research approach starts from general ecophysiological, ecological and evolutionary concepts to interpret field observations, controlled experiments and modelling analyses, and involves a variety of academic disciplines.

*Quality*

The Forest Ecology and Forest Management programme has produced high quality publications in strong disciplinary journals, including some in very high impact journals. We applaud this work. Because much of the work done by this group is so relevant to major global issues, we encourage the group to strive for even more publications in very high impact journals.

*Productivity*

The group demonstrated very good scientific productivity through its research grant support and publications, and excellent productivity by its training of PhD students. It has produced a very substantial productivity of peer-reviewed papers for a group of this size. The number of PhD students being trained by this programme has risen rapidly, which suggests that its productivity will be even higher in the future.

*Relevance*

The programme focuses on forest ecology and management, both of which are of critical importance for simultaneously meeting societal need for forest products while maintaining the functioning of forest ecosystems, their sustainability, and the sustainability of the ecosystem services they provide. The relevance of the group reaches the highest level because of its excellence in training PhD and MSc researchers who return to their nations and use their skills to direct and manage tropical forests in a more sustainable manner.

*Viability*

This programme has excellent viability because of the talents, vitality and structure of the group and because of the facilities and infrastructure available to it. Its viability is also aided by the strong ties that the group has established with leading forest ecologists from around the world.

## WU

### **Programme 55: Nature Conservation and Plant Ecology**

Programme coordinator: Prof. dr. F. Berendse

Research staff 2010: 10.5 fte

Assessments:	Quality:	5
	Productivity:	5
	Relevance:	5
	Viability:	5

#### *Short description*

The mission of the Nature Conservation and Plant Ecology group is to understand biodiversity and ecosystem dynamics in a world that faces increasing anthropogenic pressures. The group links experimental work on plant-plant, plant-soil and plant-atmosphere interactions to simulation models and remote sensing. The objective of the group is to implement new insights into the development of effective strategies to maintain and restore biodiversity, the functioning of natural ecosystems and the services they provide.

Research is organised into two main themes:

- maintenance of biodiversity and the consequences of biodiversity loss;
- large scale vegetation-climate feedbacks.

Within these themes, empirical and theoretical research is performed at three levels of biological organisation: communities, ecosystems and landscape.

#### *Quality:*

Seven papers in Nature, Science and PNAS since 2005 is an amazing record for a group of this size. The group has published many highly influential publications. The programme is well known and highly respected internationally for its research on plant ecology and conservation biology.

#### *Productivity*

This programme has been producing about 40 papers per year in peer-reviewed, mainly top, journals. They have had a very good rate of production of PhD students. This rate should accelerate greatly with the increase in the number of PhD students being trained (almost doubled since 2005). The programme is also training many master students and undergraduates. Given the size of this group, this is excellent productivity.

#### *Relevance*

The work is highly relevant to major national and global environmental issues, especially those related to the factors controlling biodiversity and the effect of the loss of biodiversity on ecosystem functioning. The group has been very active in policy-relevant research and in producing professional publications, field guides and outreach material.

#### *Viability*

The programme seems to have adapted well to recent changes in the funding environment, and to be positioning itself well for the future by increasing its training of MSc students and building a strong cadre to fill the roles of its more senior members as they retire.



## WU

**Programme 56:**                      **Resource Ecology**  
Programme coordinator:        Prof. dr. H.H.T. Prins  
Research staff 2010:            17.1 fte

Assessments:                      Quality:            4.5  
    Productivity:     4  
    Relevance:       5  
    Viability:        4.5

### *Short description*

The mission of the Resource Ecology programme is to improve understanding of ecosystem functioning so as to promote human well-being, including health, through performing research with a focus on consumer-resource interactions and movement ecology in particular. The objectives of the group are to understand:

- the ecological and evolutionary forces that enable plants to (co-)exists under water stress while under high herbivory and fire pressures;
- how animals move through landscapes as driven by top-down and bottom-up processes;
- what ecological, genetic and disease consequences of these movements are.

The research is focused on consumer-resource interactions, and consequences of those in a spatial context, mainly in rangelands. The group is developing a new line of research: Disease Ecology.

### *Quality*

The research on Rangeland Ecology has produced a number of new and important insights in the relationship between soil quality, the response of the vegetation and the resulting quality of the vegetation as food for herbivores, the effect of herbivores and fire on trees and grass, and how range lands can be affected by other environmental factors. The work has a very good to high global visibility and is scientifically solid. Since the last review the group has developed a new research line, namely Disease Ecology. If a strong link with the rest of the group is maintained, this research line has a high potential to become a beacon in this research field.

### *Productivity*

Education of PhD students is very satisfactory. The group publishes in top journals and receives competitive grants. Research is financed for over 50 percent from the outside. With its emphasis on African Ecosystems with its large animals, the group has the potential to attract additional support from the outside. Its work on range land ecology and disease ecology receives worldwide attention. With its work on spread of diseases by animal vectors and the changing pattern of bird migration routes, which is of very broad (public) interest, the group should take an extra effort for publishing more papers in highest impact and interdisciplinary journals. This would add to quality and visibility.

### *Relevance*

The elephant movement and bio-economy optimality programme has a high impact on the management of natural reserves, but also of rangeland in general. It allows optimizing animal visibility while at the same time reducing the interference of park visitors with the normal life of wild animals. New findings are published in news papers in reserves for the local populations, like in the Kruger National Park. The work also helps to find acceptable compromises between the different potential uses of a given area, e.g. NGOs who like to protect an area, farmers who

would like to more intensively use an area of the land and other stakeholders inclined to develop tourism. The outcomes from Disease Ecology already start to attract attention from the general public and health organizations.

#### *Viability*

The group faces a debt of about 400 k€, which may force the researchers to look for outside money with a high overhead. Contracts with high overheads tend to ask for short term very applied research. A large number of such projects may hamper the group's ability to compete for highly competitive funds, with the high danger of quality erosion. Such an erosion is neither in the interest of the University nor of the research group in particular. Innovative solutions should be searched for by both, the management and the chair-group, incl. compromises by both sides.

## WU

### **Programme 57: Soil Biology and Biological Soil Quality**

Programme coordinator: Prof. dr. L. Brussaard

Research staff 2010: 14.7 fte

Assessment:	Quality	4
	Productivity	4
	Relevance	5
	Viability	5

#### *Short description*

The objective of the Soil Biology and Biological Soil Quality programme is to unravel the interactions among soil biota (soil organisms and plant roots) and between the soil biota and soil chemical and physical characteristics in terms of element transformations, bio-availability of nutrients, soil structure, and organic matter, nutrient and greenhouse gas balances of the soil.

The research area of the group can be described as ‘The Living Soil’; it has three research themes:

- fertile soils, with a focus on functioning and management of the soil biota in food production systems;
- soil biodiversity, with the focus on conservation and utilization of biodiversity (species, functional traits) in agricultural landscapes;
- soils in a changing climate, with a focus on the effects of the soil biota on soil quality and the greenhouse gas balance of the soil.

#### *Quality*

This unit conducts very interesting research on soil biodiversity and soil fertility with a focus on agricultural systems but significant collaborative work on natural soils. Soil diversity studies are closely linked to the impact on plant growth. A particularly topical line of research is on biochar and especially on the Terra Preta soils in South America as a model system. The work is of high quality with well above average impact but, so far, does not often reach the very top journals with wide visibility.

#### *Productivity*

The group’s output is strong in terms of the average citation rate of refereed articles although the number of articles produced is not high in relation to fte. Output of professional publications is high, which is important for the translational activity of the group. PhD thesis productivity is also high. More than 50 percent of the research money comes from outside the university.

#### *Relevance*

Food security and carbon cycling are issues of global importance in the near future and so it is clear that soil biology is a key research area. The group is active in feeding research through to policy and to management as well being involved in capacity building, especially in the developing world, and in direct valorisation.

#### *Viability*

The group is very well funded, from a diversity of sources. It has sufficient permanent staff and a good age structure. There is every reason to expect that the current level of activity can be maintained and that the both productivity and the proportion of outputs in high-impact, general science journals can be increased.

## WU

**Programme 58:**                      **Biochemistry**  
Programme coordinator:      Prof. dr. S.C. de Vries  
Research staff 2010:              14.5 fte

Assessments:                      Quality:              5  
   Productivity:        5  
   Relevance:         4  
   Viability:            5

### *Short description*

The mission of the Biochemistry programme is to understand how proteins fold, interact, work, and finally die inside the living cell. The objectives are to understand at the molecular level how relatively simple plant growth regulators activate specific signalling cascades that have spatiotemporal effects on development and growth. In parallel the group studies how enzymes can be viewed and used as dynamic and sustainable biocatalysts performing stereo- and regioselective transformations. The research is focused on how proteins function inside cells: Cellular Biochemistry with the use of fluorescence spectroscopy and mass spectrometry. A new line of research has been introduced: Signalling in Plant Development.

### *Quality*

This group is at the forefront of combining several traditional and new disciplines. They have an excellent record of relevant and high-impact research. And they are involved in numerous successful collaborations.

Both research areas are leading at the national and international level. The newly formed research line on signalling in plant development allows to keep the work in the forefront of research in plant embryogenesis and auxin/brassinosteroid signalling. There is a strong international position of staff members by an excellent publication record, permanently improved strategy and a good education of students.

### *Productivity*

There is an excellent track record, with research often published in high impact journals. External funding, quality and quantity of publication and number of PhD theses were kept at a high level or even increased. The CWTS data for the BIC clearly indicate high overall impact score compared to WU, Europe and world wide. More than 70 foreigners were trained during the assessment period indicating the BIC reputation.

### *Relevance*

Several prizes and awards for staff members indicate the high standard of BIC research. Most staff members are heavily involved in organization of international conferences, editorial board memberships, plenary lectures or academic membership/work. Related to basic science BIC research generates more indirectly the basis for crop improvement, but has a very good societal relevance in the WU environment by transfer of graduated PhD student into the industry or medicine.

The group has stakes in a spin-off company, that offers assaying and QC services. Through this and other efforts they have been able to attract substantial industry collaborations, while still pursuing others, especially in the agrochemical area. They have numerous collaborations at the local level, especially with a focus on bioinformatics. Public activities could perhaps be increased.

### *Viability*

BIC is part of the EPS research organized in a research school (YLAG). Short term and long term strategies in science and organization are already envisaged. Young researchers are clearly integrated. Facility development is taken into account. The group has an excellent outlook. While there is an emphasis to maintain the field of biochemistry, also because of its importance for student training, the group plans to become even more interdisciplinary. A planned recruitment in structural biology will add complementary strength.

## WU

**Programme 59:**                      **Microbiology**  
Programme coordinator:            Prof. dr. W.M. de Vos  
Research staff 2010:                34.1 fte

Assessments:                      Quality:            5  
    Productivity:     5  
    Relevance:       5  
    Viability:         5

### *Short description*

The mission of the Microbiology programme is to perform biomolecular research at the ecological, cellular and molecular level that aims at:

- discovery of fundamental details on selected microbial model systems;
- understanding of the molecular basis of key processes;
- application of the obtained knowledge to develop and optimize processes related to the areas of Food & Health, Bioproducts & Energy, and Environment.

The objectives are to unravel the molecular details of the interactions, biotransformations and control mechanisms of selected micro-organisms (both bacteria and archaea) and their macromolecules. The research of this group is focused on functional and structural analysis of microbial life at the full scale of complexity, ranging from microbial communities, populations, individual cells to biomolecules.

### *Quality*

The group works with quite a few Centres of Excellence and does cutting edge research in several important areas, particularly the development of microbial chip technology and topics related to anaerobic bacteria. There is a good integration of fundamental approaches to applied problems in molecular ecology and microbial physiology such as food and nutrition and biotransformation. The recent work on the CRISPR system, wherein small RNAs guide antiviral defence in prokaryotes is a recent 'hot topic' in microbiology. The group has a very good funding record. The science in the programme is exemplary.

### *Productivity*

Not only does the group publish regularly and consistently, many of the publications are in top ranked journals. In 2011 there have been two papers in both Nature and PNAS. The output and the bibliometric measures are excellent.

### *Relevance*

The group is active in outreach to the schools and the public (e.g. a book on microbes for high school students) and participates in the international synthetic biology programme. They hold patents and they collaborate with industry at the national and international level. Their Micro-dish (multi-compartment chip for growing microbes) is a nice example for this kind of work. The activities include emphasising the importance of 'omics' approaches to food and health (probiotics, intestinal metagenomics, enterotypes). The group participates in 3 Top Institutes: Food & Nutrition, Wetsus, Separation Technology).

### *Viability*

This is a strong group, with several tenure track professors in the pipeline; a robust and varied funding history; and extensive collaborations. The microbiology programme has a sustained

history of attracting outside support and high quality students. While it was not entirely clear how the different subgroups interact/integrate, the group is well positioned to continue in its tradition of excellence with strategic planning. In particular, they are developing new strengths in comparative genomics and are developing ties with systems biology programmes.





## 7A. INSTITUTE LEVEL - Utrecht University

### Department of Biology (DB)

#### 1. The Institute

The Department of Biology (DB) is one of the six Departments of the Faculty of Science of Utrecht University. Research within DB is focused on strategically chosen complex biological systems that are studied in a fundamental and applied context. It covers a broad spectrum of organizational levels (from molecules to ecosystems), is multidisciplinary and utilizes state-of-the-art technologies. DB research is thematically organized in two closely related research Institutes, which are interconnected via multiple collaborations:

The **Institute for Biocomplexity and Bioinformatics (IBB)** performs fundamental research on systems biology by studying the dynamic regulation and evolution of biological systems. Intensive collaborations are fostered between experimentalists working on appropriate model systems (e.g. mouse, *Caenorhabditis elegans*, *Arabidopsis thaliana*, Zebra fish, *Schizopyllum commune*) and computational biologists specialised in data analysis and modelling. IBB research combines developmental, molecular, and cellular biology, regulation of gene networks and state-of-the-art imaging with a strong theoretical and computational component. IBB research is embedded in the UU Research Focus Area of Life Sciences & Biocomplexity, and impacts the societal themes Health and Food.

The **Institute of Environmental Biology (IEB)** performs leading research in understanding the biological mechanisms involved in the interaction between plants and their biotic and abiotic environment, and aims to identify and assess the effects and consequences of environmental change on biodiversity and ecosystem functioning. To this end, plant studies are performed at molecular to ecological levels of integration and different spatial and temporal scales. Interactions between the groups are fostered by shared use of the model plant species *Arabidopsis thaliana* and by state-of-the-art services, facilities and equipment of IEB and IBB. IEB research is embedded in the UU Research Focus Area of Earth and Sustainability, and impacts the societal themes Climate Change, Biodiversity, and Sustainability in an ecological and agricultural context.

#### 2. Quality and academic reputation

All DB research groups have strong national and international links, and a drive for interdisciplinary collaborations. The reputation of DB programme leaders and staff is illustrated by the exceptional number of prestigious awards, such as the Spinoza (Scheres, 2006) and Simon Stevin Meester Award (Wösten, 2008), the highly competitive personal grants, such as ERC Advanced (Scheres, 2008; Pieterse, 2010), ERC Starting (3x), NWO Vici (Hoogenraad, 2010), Vidi (6x) and Veni (10x), and the KNAW Young Academy memberships (Sluijs and Hoogenraad) that were awarded since 2005.

The prospective bibliometric study of CWTS shows that the impact of the research of current DB staff is “at a very high level”, as their publications were on average almost 2-fold more frequently cited than the world field average. This reflects the high academic reputation of DB and is in line with its ambition to be a world-class research Institute in the field of biological sciences.

#### *Assessment*

##### Institute for Biocomplexity and Bioinformatics

After restructuring in 2005 and 2009 the Institute had to restructure again this year. Biomolecular imaging will become a central Utrecht Life Sciences facility and it is intended to move part of the

research program of Behavioural Biology to the Faculty of Social and Behavioural Sciences. The primate research group has been maintained but will be shared with the Dutch Primate Centre. Its present head has a special appointment as professor in the institute. Given the recent near catastrophic series of financially forced rearrangements, the imminent departure of the holder of the chair of Molecular Genetics (Ben Scheres), (a position which will have to be replaced in the near future), and the administrative burden carried by Prof. Wösten as the acting director, the Institute will have to struggle to maintain its previous output and standing. A rapid decision at the faculty level is required for a new chair holder in Molecular Genetics (for B. Scheres). One option could be to transfer this chair into the strong plant environment of the IEB.

Most of the IBB groups were evaluated as excellent. The maintenance of the primatology group in the IBB and its partial re-direction to more genetic questions seems somewhat precarious. Nevertheless, the now remaining groups present a focused programme that promises to maintain output and standing at a very high level given its present publication success and international reputation.

#### Institute of Environmental Biology

IEB has suffered through the same economically-driven crises as IBB. It is now moving Biomarine Sciences and Palaeo-Ecology into the geology Department. The remaining groups will present a more coherent plant science-oriented programme that will further permit much internal interaction. In addition, planned increased interaction with Physics and Geosciences will provide novel resources and research possibilities which should allow the programme to maintain its high productivity and international cooperations. Overall, the recent management decisions and reorganizations privilege research coherence over breadth in coverage. The three strong IEB groups Plant Ecophysiology, Molecular Plant Physiology and Plant Microbe Interactions could be complemented by a transfer of the Mol. Genetic chair of the IBB in the IEB. This would strengthen the IEB by a group putatively entitled “Developmental Plant Genetics”.

In summary, the quality of most IEB groups remains excellent. In addition, in both Institutes there is a well-organized support to increase the number of female scientists at the scientific level. Three female tenured positions (Dr. Hefting, Dr. Schluepmann, Dr. Soons) and three female tenured track procedures (Dr. Ten Tusscher, Dr. Van Wees, Dr. Sasidharan) are currently established. Moreover, Prof. Anna Akhmanova was recently appointed at the Cell Biology group.

### **3. Resources**

Due to a steep decrease in direct university funding between 2005 and 2010, DB research staff on this 1<sup>st</sup> flow of funds decreased from 48% to 26% of the total DB research budget. Nevertheless, the absolute number of research staff increased in this period (from 120,7 to 133,6 fte). This steep increase in the average earning capacity per staff member reflects the success of staff in obtaining prestigious personal grants (total >20 M€ between 2005-2010), and other research grants (e.g. NWO Open Competition, NWO-TOP, STW, EU) and support from industry. Moreover, consortia of DB groups were successful in securing substantial funding from the Netherlands Genomics Initiative and the Darwin Centre for Biogeosciences. Currently, ~75% of the funds are obtained from external research grants. The scientific “entrepreneurship” of the DB staff is to be applauded and reflects the strong merit, societal relevance, and quality of the research conducted at Utrecht.

In the review period, the most of the DB groups were physically located in the H.R. Kruyt-building, which further enhanced interactions between IBB and IEB research programmes. DB researchers have access to state-of-the-art services, facilities and equipment. Excellent research infrastructure is also available on campus in the Faculties of Science, Geosciences, Medicine and

Veterinary Medicine through collaborations within the Focus and Mass priority areas Life Sciences & Biocomplexity and Earth & Sustainability.

#### *Assessment*

The decrease in direct university funding between 2005 – 2010 (48% - 26%) was successfully balanced by increased funding via research grants and contract research including funding from the Netherlands Genomics Institute and the Darwin Centre for Biogeosciences. The DB groups are well-established in the H.R. Kruyt-Building and can take advantage from the strong infrastructure of the Faculty of Sciences and other faculties.

#### **4. Productivity**

In the review period 2005-2010, DB staff published 1663 refereed papers, 167 book chapters, 156 PhD theses, 46 professional publications and filed 47 patent applications. According to CWTS, DB researchers published on average in very high-impact journals, including 60 publications in *Science* and *Nature*. The high quality and quantity of publications, patents and PhDs is even more remarkable when viewed in light of the financial and organizational challenges faced by the group during the five year period.

#### *Assessment*

The Department of Biology overall is extremely productive and the average impact of its research articles is very high. Many theses are produced at high standard, based on a strong educational management. This is also evidenced by PhD students finding prominent national and international post-doc positions. The output of professional publications and patents shows strong commitment to translational activity. Outputs aimed at the public are not counted but the Department is clearly active in this area. Output policy is implemented through annual individual evaluations for all staff members which appears to be an effective management strategy.

Some interesting issues on teaching and coaching were presented: the coaching concerns both teaching and leadership.

#### **5. Societal Relevance**

An important function of DB is to train BSc/MSc and PhD students to become professionals that implement their talents in society. Knowledge and research within DB has high relevance for major societal processes and problems, like health, food security, sustainability of ecosystems services, climate change, biodiversity, and progress towards a biobased economy. DB research groups participate in programmes in which industry and small and medium enterprises (SME's) actively participate. Moreover, the Science Shop acts as an intermediate between DB and external parties (companies, NGO's, governmental organizations) that need advice. DB actively disseminates the importance of research in the context of human capital and valorisation. DB staff regularly informs the public via national and local radio, television and newspapers.

#### *Assessment*

Nature conservation is obviously a strong theme. Other research with high relevance for societal processes include climate change and biodiversity. There is an effort to support patents and start-up companies, and good educational and media outreach. Personnel have served on governmental advisory committees and are involved in education outreach. There are numerous international collaborations and the work on innovation and social learning is of enormous relevance. There are plans to combine the research efforts on climate, water and ecosystems into one Utrecht Sustainability Centre.

## 6. Strategy for the future

In October 2011, the Faculty of Science presented a more focussed, integrated research profile (Bèta 2015). The research programme of DB will be part of the Faculty's focus areas Molecular Life Sciences (IBB) and Science for Sustainability (IEB). The new profile should result in a financially sound Faculty, including departmental policy budgets. Within this profile, the IBB programmes Behavioural Biology and Biomolecular Imaging (BMI), and the IEB programmes Palaeoecology and Biomarine Sciences are no longer embedded. BMI will become part of a University Imaging centre, while the other groups likely will be re-positioned elsewhere in the University. Due to transfer of the group of Prof. Scheres to Wageningen University in 2012, the current Molecular Genetics programme will be discontinued.

The Bèta 2015 profile will enable new investments in recruiting an internationally leading expert for the vacant Chair Ecology & Biodiversity (full professor with central function in the Faculty's focus area Science for Sustainability). Following the move of the Molecular Genetics group, resources will be reinvested in DB. Recently, DB heavily invested in the new Cell Biology group (Hoogenraad/ Akhmanova), which harbours very high potential and quality, and will further the Faculty's focus area Molecular Life Sciences.

DB will continue to innovate its research programmes, in order to maintain output and quality at the highest level. This should ensure the attractive scholarly environment for high-potential staff members and students in the future. To foster internationally leading, multi-disciplinary research and maintain the critical mass needed to excel in science, new positions within DB will be strategically selected to maximize collaborations within DB, the Faculty, the University, and collaborative national and international research institutes. Tenure track systems have been introduced for assistant and associate professors as an instrument to secure the quality of the staff and to increase the number of female scientists at the scientific staff level.

### *Assessment*

The institutes went through a number of reorganizations in the last 6 years. There are clear plans for the future, but security is only given till 2015; beyond that date there is no clarity. Because the groups have become smaller, emphasis will be on interconnections and collaborations.

Utrecht University is noteworthy in that it has a gender policy which aims to involve females in leadership courses.

## 7. PhD Training

Before 2009, PhD training was organized in national Research Schools (e.g. Experimental Plant Sciences, Biomembranes, Cancer Genomics & Developmental Biology, Sedimentary Geology, and Production Ecology & Resource Conservation). Most of the DB research groups are still affiliated to one of these national Schools, which are a valuable network for training and education of PhD students and postdocs, and provides access to expertise and infrastructure of related research groups at other universities.

Since the launch of the Utrecht Graduate School of Life Sciences in 2009, all DB PhD candidates participate in one of its PhD programmes. During a PhD track, candidates conduct a 4-year research project resulting in a PhD thesis and articles in peer-reviewed scientific journals. Furthermore, PhD candidates receive training (at least 20 EC) in thematic research areas (at least 8 EC) and professional development (general courses; at least 4 EC). Upon admission, PhD candidates submit a Training and Supervision Agreement, which specifies rights and duties of the PhD candidate and his/her supervisors to safeguard the quality of the training and supervision of PhD candidates. PhD candidates are supervised by a professor ('promotor') and a daily

supervisor ('co-promotor'). In addition PhD candidates usually have an external expert supervisor that provides input during scheduled yearly meetings. When the requirements with respect to training and supervision are fulfilled, PhD candidates receive a formal training certificate from the Graduate School of Life Sciences.

#### *Assessment*

The Committee agrees that the variety of general courses, thematic courses, external courses and other activities offered, results in highly qualified and well-trained PhDs. Of the currently enrolled PhD students, 78% are within their 4-year contract. It is noted that a monitoring system is being implemented that is aimed at improving the progress and timely graduation of PhD students. A graduation bonus of 5 K€ is awarded to the research programme when the dissertation is submitted no later than one month after the end of the 4-year contract. The Committee regards these measures as commendable.



## 7B. PROGRAMME LEVEL – Utrecht University (Programmes 60-70 )

**Programme 60:**                      **Behavioural Biology**  
Programme coordinator:      Prof. dr. J.J. Bolhuis, Prof. dr. B.M. Spruijt  
Research staff 2010:              6.8 fte

Assessments:                      Quality:              5  
   Productivity:        5  
   Relevance:         5  
   Viability:            not scored

### *Short description*

The programme Behavioural Biology is focused on the behavioural and neural mechanisms of animal cognition. In particular the mechanisms of learning, memory and social cognition are investigated. In addition the group studies theoretical aspects of animal cognition and neurobiology in relation to evolution. The research areas are:

- birdsong learning and memory. The neural and cognitive mechanisms of birdsong learning and memory are studied, also in comparisons with speech and language acquisition in humans;
- innovation and social learning. The behavioural and neurocognitive mechanisms and evolutionary consequences of the invention of novel behaviour patterns and the acquisition of novel behaviour patterns from others are investigated;
- social cognition. this line aims at understanding the mechanisms and evolutionary history of social behaviours and social cognitive capacities in primates and humans.

Together the three research lines can provide an integrative understanding of brain and cognition at different levels of organisation.

### *Quality*

The group has maintained a very high excellent quality output in high profile journals. Its impact is clearly above average in its field and it is recognized as an international player in the three aspects of its work, bird song learning and memory, innovation and learning, and social cognition and learning in primates. They recently localized the neural substrate of auditory memory in birds and this again opens up new perspectives for future research.

### *Productivity*

The group has maintained a steady output of PhD theses and high profile journal papers. In addition the various members of the group have served as editors on journal boards and have edited various influential books that have summarized and stimulated discussion in their field. They have been able to support their activity through obtaining grants from the various science foundations and the primate group has obtained a Vidi grant.

### *Relevance*

The work of the group is conceptually highly relevant to understanding cognition in animals and humans. In addition, the line of work on language evolution and the philosophical questions addressed in the bird sub-group impacts the understanding of humans as a special animal. They are leading the debate on animal welfare and ethics connected to that aspect and have directly influenced legislation on the theme. There has been considerable and successful effort at outreach activities and the founding of the DeltaPhenomics firm is a clear sign that the work has resulted in societal valorisation.

### *Viability*

This group had extremely high viability until they were threatened with the present move. This change has certainly furthered the leave of Dr. Reader to McGill University, Canada. With the split-up between the two groups within Behavioural Biology and the intended movement of Prof. Bolhuis into the neighbouring faculty we see the ability of the Science faculty to educate Bachelor and Masters students in the field of zoology and behaviour considerably weakened. So it appears at present very important to support both groups as much as possible to maintain their viability.



UU

**Programme 61: Developmental Biology**  
Programme coordinator: Prof. dr. S.J.L. van den Heuvel  
Research staff 2010: 5.7 fte

Assessments:                      Quality:            5  
   Productivity:       4  
   Relevance:        4  
   Viability:         4.5

*Short description*

The programme Developmental Biology aims to obtain a deeper understanding of the coordinated regulation of cell division and differentiation in the context of animal development. In doing so it wants to improve the understanding of cancer, regeneration and developmental diseases, such as microcephaly. The research focuses on understanding the molecular mechanisms that underlie developmental processes, and is organised in four themes:

- molecular mechanisms of asymmetric cell division;
- regulation of cell proliferation versus differentiation;
- proteomics of polarity establishment;
- regulation of spermatogonial stem cell division, spermatogenesis, and reproduction in fish.

The group uses a multi-disciplinary approach, which combines gene-expression profiling, mass spectrometry analysis, yeast two-hybrid studies and experiments with cell/tissue culture.

*Quality:*

The group, which was established at the beginning of review period, is performing high quality work on current and relevant questions of developmental biology, specifically the regulation of cell division and development. Studies on asymmetric cell division in *C. elegans* have identified new components involved in this process, while experiments using the spermatogonial stem cells of zebra fish are yielding results on the regulation of division. This is original and very topical research.

*Productivity:*

Although there is at present a strong potential for contributing papers on the highest level, the productivity in the period of assessment was relatively low, also due to start-up phase. Nevertheless, the group has published a number of high profile papers during the review period. PhD students take more than 4 years due to lab start-up.

*Relevance:*

The group is beginning to seek valorisation of the developmental work. The strong focus on cell proliferation constitutes the potential to enter medical collaborations; collaborative work in this direction is therefore strongly encouraged. Also, the work on salmon reproductive development, which is performed in collaboration with a Norwegian group/company can be exploited further, since salmon work appears to have considerable potential economic impact on fish aquaculture. This latter research may also represent a beautiful example for informing the public about the potential of this work.

*Viability:*

This Department has undergone repeated reorganizations. The most recent reorganization (i.e., integrating endocrinology group) has been processed successfully, so a period of stability is now

expected. However, there is concern about uncertainty given the ongoing reorganizations, which might lead to increased teaching and administrative loads. Nevertheless, the ongoing output of excellent research should foster the viability of the group. The financial situation seems to be excellent, due in part to the recruitment of several major grants.

UU

**Programme 62: Molecular Microbiology**  
Programme coordinator: Prof. dr. H.A.B. Wösten, Prof. dr. J.P.M. Tommassen  
Research staff 2010: 16.6 fte

Assessments:                      Quality:            5  
   Productivity:       5  
   Relevance:         5  
   Viability:           5

#### *Short description*

The Molecular Microbiology programme focuses on molecular mechanisms enabling growth of micro-organisms in a dynamic environment, in particular on the role of cell surface and secreted proteins. The research is organised in two subprogrammes. The eukaryotic subprogramme studies:

- regulation and dynamics of protein secretion.
- regulation and function of cell wall proteins.

The prokaryotic subprogramme studies:

- mechanisms and dynamics of protein secretion.
- dynamics and biogenesis of the outer membrane of Gram-negative bacteria.

The objective of the Molecular Microbiology programme is to unravel how microbes adapt to changing environments by secretion of proteins and by modulating their outer surface. Both subprogrammes are multidisciplinary, driven by fundamental questions, and of interest for the industry and public health.

#### *Quality*

The members of the programme find commonality in looking at the way that microbes dynamically interact with their environments. The bacterial work focuses on how proteins are transported across the gram negative bacterial membrane. The fungal work is in two parts: 1) on mycelial heterogeneity and 2) on development in mushrooms. The bacterial work is excellent and both fungal projects are 'top of the top' in molecular mycology.

#### *Productivity*

The numbers and quality of publication are high. In addition, several licensed patents have been generated. Many students are being educated and mentored in an extremely high quality environment.

#### *Relevance*

The work spans both fundamental and applied (industrial, medical) fields. Individuals within the group have taken advantage of the bipartite opportunities to bring in both grants to fund fundamental research and contracts that interact with the commercial side. Moreover, these microbiologists work to inform the public that not all microbes cause disease and that there are positive sides of microbiology. They participate in outreach to schools.

#### *Viability*

The Molecular Microbiology programme is vibrant, balanced and well funded. We see no problem with the viability. This is a scientifically healthy programme.

UU

**Programme 63: Cell Biology & Biomolecular Imaging**

Programme coordinator: Prof. dr. A.J. Verkleij (Prof. dr. C.C. Hoogenraad, Prof. dr. A. Akhmanova; Dr. J.A. Post)

Research staff 2010: 22.3 fte

Assessments:                      Quality:            4  
   Productivity:       4  
   Relevance:         4  
   Viability:           5

*Short description*

The goal of the Cell Biology group is to gain insight into basic processes underlying mammalian cell physiology and in this way to provide mechanistic bases for devising therapies for cancer, metabolic and neurological diseases. The research is focused on cytoskeletal dynamics, membrane trafficking and signalling processes that contribute to cell cycle progression, cell proliferation and differentiation, neuronal development and brain function. Essential for the research is the application of highly advanced light microscopy. The goal of the Biomolecular Imaging section is to apply electron microscopy in various fields of (medical) cell biology and to develop new EM approaches (hardware, sample prep and software) related to 3D EM and correlative microscopy. The research relies on combining high-resolution live cell imaging and quantitative analysis of organelle dynamics using different cell culture systems. In addition to biophysical, biochemical and cell biological research mouse knockout technologies and coupe mouse genetic modification are employed to live tissue imaging. Furthermore advanced antibody technologies are used for therapies and in vivo imaging.

Research is organised around several interconnected themes:

- studies of the microtubule cytoskeleton and microtubule-based transport;
- studies of membrane-related processes;
- studies of neuronal function and synapse formation;
- use of Llma antibodies and their fragments against membrane receptors as tools for imaging studies and for development of therapeutic tools.

*Quality:*

Because the Cell Biology group is new, scoring is limited to the former group (Biomolecular Imaging and part of current Cell Biology): Here a strong focus on technology development, integrated light and electron microscope was done, which is now brought to market; template matching strong links to industry. Cell biology interested in basic cellular processes, but with an eye towards applications in cancer and related health research. Currently setting up super resolution microscopy. Funding in the past focused mostly on applied research (Unilever, etc.), now mostly on research grants.

*Productivity:*

Because the Cell Biology group is new, this assessment is limited to the original Verkleij group (so Biomolecular Imaging and part of current Cell Biology). They show a very solid productivity, overall solid impact, some high impact. The addition of new groups should add a lot of strength here. The publication activities can be increased in relation to the high number of group members.

*Relevance:*

The group is well embedded in local centres and collaborations. Outreach to public schools and charities are established. The group is involved in start-up companies. Cell biology group attributed strongly to the world-wide studied chemotherapeutic drug Taxol and a related group of compounds, the epothelones, and were able to show in collaboration that these microtubule-stabilizing compounds show promise for treatment of traumas of the nervous system.

*Viability:*

Overall there is great trajectory including a strong female PI. The programme resulted from an older department that was recently split into two groups. Electron microscopy will become a university facility and will mostly be used as a core facility. Cell biology has recently moved from Rotterdam, has several young PIs (two with Vici's; one Vidi; one Veni), not part of the review period.

UU

**Programme 64:**                    **Molecular Genetics**  
Programme coordinator:        Prof. dr. ir. B.J.G. Scheres  
Research staff 2010:            18.1 fte

Assessments:                    Quality:        5  
    Productivity: 5  
    Relevance:    4  
    Viability:     5

#### *Short description*

The programme is focused on the core networks underlying plant development and studies:

- gene and protein networks involved in stem cell specification;
- gene and protein networks involved in cell polarity and self-organisation of architectural patterns;
- phosphorylation cascades during organ initiation.

The objective of the Molecular Genetics research programme to work out in detail developmental mechanisms in a system that is simple enough to describe it a cellular resolution and complex enough to catch the essential of multicellular development in plants. The initial successes of this approach in roots have led to the expansion of research on related gene and protein networks in embryos and shoots. The group follows a ‘systems biology’ approach, where experiments are guided by mathematical and computational models.

#### *Quality*

The work of this group represents world class research on root development, which includes stem cell specification, the mechanism of cell polarity and architectural patterns in plant self-organisation. A combinatorial transcription factor code for stem cells has been discovered, which orchestrates sequential activation of genes. The research of this group is at the top of its field, as is also evidenced by very impressive bibliometric measures. The group is also engaged in several national and many international collaborations, plus close relations with the UU theoretical biology group.

#### *Productivity*

This group is amazingly successful, with papers regularly appearing in the highest impact journals. This output secures the recognition by the international scientific community.

#### *Relevance*

The group recently begun to interact with plant breeders and seed companies to explore ways in which the gene network insights could contribute to “agrofood” work. Specifically, the collaboration with the Rijk Zwaan seed company funds work on architecture of crop plants, with the aim of improving characteristics important for growth of cucumber and tomato. To increase visibility in the general public, educational and outreach activities could be strengthened.

#### *Viability*

The group has an excellent future. Since they no longer appear to be a good fit at UU, given the re-focussing of the lifesciences programme, the group (including the head, staff members and other co-workers), will move to Wageningen in 2012, which will provide an excellent environment.

UU

**Programme 65: Theoretical Biology and Bioinformatics**

Programme coordinator: Prof. dr. P. Hogeweg (until 2009), Prof. dr. R.J. de Boer (since 2009)

Research staff 2010: 13.3 fte

Assessments:	Quality:	5
	Productivity:	5
	Relevance:	4
	Viability:	5

*Short description*

The Theoretical Biology & Bioinformatics programme develops formal approaches of modelling and bioinformatics to better understand functioning and evolution of biological systems. The group combines large-scale computer simulations, mathematical modelling and bioinformatics with a strong biological background. The programme's goal is to understand the evolution and the functioning of complex biological systems through an approach of modelling and bioinformatics. The group aims to develop new theories, new concepts, and new approaches to learn how to handle and interpret the enormous complexity of biological systems, and the massive amount of data that are available.

*Quality*

The Theoretical Biology and Bioinformatics programme has a long tradition of excellent research in theoretical biology and bioinformatics. Members of the group have been highly productive, publishing important papers in high-impact journals. The group's excellence and international reputation comes, in part, from its intellectual breadth, with spans from dynamics models to mathematical analysis of complex systems.

*Productivity*

The number of peer-reviewed papers (many of high impact) per researcher is admirably high, and the number of PhD students in the programme is at an appropriately high level.

*Relevance*

Although much of the work done by this group would be classified as basic, fundamental research, the group also pursues broader societal impact through multiple collaborations with medical researchers, especially through its work on MHC and vaccines. Of note are also the evolutionary genomics analyses in the context of biomedical research, which allow hypotheses/prediction regarding drug action. There is substantial outreach to high schools and secondary school teachers as well as via media interviews.

*Viability*

This programme has a very talented and productive scientific staff that addresses challenging and important questions in modern biology. They recently completed a successful leadership transition. One staff position, which was lost during the transition, should be replaced.

UU

**Programme 66: Molecular Plant Physiology**

Programme coordinator: Prof. dr. J.C.M. Smeekens

Research staff 2010: 10.6 fte

Assessments:	Quality:	5
	Productivity:	4
	Relevance:	4.5
	Viability:	4.5

*Short description* The Molecular Plant Physiology research programme aims to understand at the molecular level the signalling networks that regulate metabolic and physiological processes in plants and the interconnections between such signalling networks. The focus is on sugar mediated signalling networks that regulate plant growth and development.

Three interconnected signalling systems are studied:

- the S1/C group of transcription factors;
- the Trehalose 6-phosphate (T6P) regulatory molecule;
- the SnRK1 (plant AMPK) energy sensing complex.

Research is carried out with the plant model system *Arabidopsis thaliana* that allows the use of the advanced technological and bioinformatics tools developed for this model plant.

Molecular and functional genomics, natural variation analysis, bioinformatics and computational analysis of regulatory networks are among the technologies used.

*Quality:*

Research in the MPP groups is focused on sugar-mediated signalling network and is known for its high international reputation in the last decade. The detection and identification of T6P (trehalose 6-phosphate) which has taken 3 years of work, remains an admirable tour de force. After the first identification of the SnRK1-S1/C bZIP transcription factors and T6P as part of a regulatory module for growth and survival of plants, the group could keep its leading position in research on sugar signalling by proteomic studies and protein/protein interaction analyses. Aspects on natural variation are another new highlight. Also the interesting finding of reduced heat-stress in times of sugar abundance is worth following up.

*Productivity:*

The productivity of this small group is very good in terms of publications and PhD education. CWTS data clearly indicate several parameters to be above 2-3 times above average worldwide. There is a very good success rate in grant application, PhD theses and academic reputation of the three staff members.

*Relevance:*

The scientific area of MPP on sugar signalling is highly relevant for improvement of crop plants and is well linked to industrial partners of networks like CBSG, TTI-GG, MERIT or VSEEDS EU programs. This is also indicated by the 15 patents applied or granted. The group has strong public-private partnerships in a top sector of Dutch funding system. Support is given to developing countries by collaborative work.



*Viability:*

Although small in number, the group is strongly resting upon the common platform of the sugar signalling, but is connected worldwide with collaborative efforts. The group is well structured by independent but collaborative work of the three staff members and the junior research group, concentrating their work on sugar sensing, trehalose-6-phosphate, seed germination and plant architecture. The work is focused to keep the high standard. The junior research group, although working in the highly competitive area of seed germination, is growing. The teaching activities of all staff members are remarkable (50% of their appointment time) and strong PhD education is done by each staff member.

UU

**Programme 67: Plant-Microbe Interactions**

Programme coordinator: Prof. dr. ir. C.J.M. Pieterse

Research staff 2010: 9.0 fte

Assessments:	Quality:	5
	Productivity:	4
	Relevance:	5
	Viability:	5

*Short description*

The Plant-Microbe Interactions programme is focused on gaining fundamental insight into biological and molecular mechanisms of the plant immune system, and is organised in three themes:

- molecular regulation of the plant immune signalling network during host-microbe interactions;
- molecular basis of disease susceptibility and pathogen virulence;
- microbial ecology of beneficial microbes in the plant host's microbiome.

The goals of the programme are to unravel in detail how the plant immune system orchestrates interactions with beneficial microbes, pathogens and insects, and how successful attackers hijack the immune system for their own benefit.

*Quality*

The group has existed in its present form only since 2007 but in that time the young and dynamic leader has produced an outstanding group. The aim of the work is 'to explore and exploit' the plant immune system. Beautiful work on the downy mildew-*Arabidopsis* system has been supplied as well as new discoveries on pathogen-induced suppression of host immunity. Using a newly developed chip the plant's microbiome, when it is attacked by pathogens or exposed to stress, is being analysed. They have an excellent collaborative network and internal management.

*Productivity*

Overall productivity in the review period has been good and is on an upward trajectory. Output so far lags slightly behind the quality of the research. However, several interesting lines of research are yielding results and a rapid increase in the number of publications is expected, with sustained quality. It may be advisable to gradually reduce the number of years needed to complete PhD work.

*Relevance*

The group's work on plant defence has clear societal relevance and they have close and effective working relationships with the green life science industry. There are good contacts with breeding companies. There is an effective pipeline for translation of discoveries of resistance mechanisms into commercial application and various patent applications are in progress. Several co-workers have moved to plant industry and thereby improved the academia-industry network. Staff-members interact with public and governmental organisations. The group has also been active in policy forums and in public outreach.

*Viability*

The group enjoys stable funding. Several grants have been secured, including an ERC Advanced grant. Given enthusiastic and effective leadership, outstanding current funding and earning

potential there is every reason to expect the current upward trajectory to continue. The group is likely to be highly successful over the coming years.

UU

**Programme 68:** **Plant Ecophysiology**  
Programme coordinator: Prof. dr. L.A.C.J. Voesenek  
Research staff 2010: 6.1 fte

Assessments:                      Quality:            5  
   Productivity:       4  
   Relevance:         4  
   Viability:           5

*Short description*

The mission of the Plant Ecophysiology group is to gain fundamental ecological, physiological and molecular knowledge and understanding of how plants interact and cope with environmental changes. The research focus is on the mechanisms leading to tolerance to environmental stresses such as flooding, plant-induced shade and multiple stresses. The goal is to delve into the mechanisms leading to flooding tolerance and shade avoidance in plants with a view to translating the findings to ecosystem understanding and crops. This is accomplished by using a comparative approach exploiting natural variation within species to identify genetic loci leading to variation in stress tolerance or traits associated with stress responses.

*Quality*

The Plant Ecophysiology programme has done work of excellent quality on flooding and shade tolerance. Much of their work is highly novel because of its close integration of observations and experiments in natural habitats with studies of the underlying molecular mechanisms, thus going from the gene to the field. There are not many groups in the world taking this approach – or doing it with such sophistication. The group has published highly influential papers in excellent journals.

*Productivity*

The productivity of the group is solid, based on publications per staff member and on the number of Ph. D. students being trained. The total publication rate is good, with many high impact papers but not an unusually high number of papers. The score of 4 reflects a comparison to other groups in The Netherlands who have an even greater productivity for a comparative size.

*Relevance*

The activities of the group have good relevance. Their work on ecophysiology is applicable to many agricultural issues, and is also of importance for understanding evolution and impacts of global climate change. In particular, flooding is a major problem worldwide and can have devastating impacts on agricultural productivity. Likewise, an understanding of shade tolerance can affect agricultural yields. The scientific value relevance is also high. The group is not as energetic about public outreach as they could be. What they do seems good but they are not out there pushing the relevance.

*Viability*

The programme in Plant Ecophysiology unites ecology and molecular biology, and is of central importance to the university's focus on Climate, Water and Ecosystems. Moreover, its young, talented and energetic members will contribute significantly to its long-term viability.

UU

**Programme 69:** **Ecology & Biodiversity**  
Programme coordinator: Prof. dr. J.T.A. Verhoeven  
Research staff 2010: 16.2 fte

Assessments:                      Quality:            4  
   Productivity:       5  
   Relevance:        4.5  
   Viability:           4

#### *Short description*

The Ecology & Biodiversity programme focuses on the development, maintenance and functioning of biodiversity, in relation to ecological processes and interaction with atmosphere, water and soil. The mission is to unravel, identify and quantify the ecological mechanisms by which plant diversity is regulated and by which it feeds back on ecosystems functioning. The results of the studies are applied to assess impacts of global change on biodiversity and ecosystem services. Strong emphasis lies on the interaction between soil- and vegetation processes. The group focuses on two objectives:

- to unravel the ecological mechanisms by which plant species diversity is regulated, and
- to quantify how the structure and functioning of ecosystems arise from the basic traits of – and competitive interactions between the constituent species.

#### *Quality*

This is a very strong programme focused on the relationship between biodiversity and ecosystem function, integrated across ecological scales and particularly in key threatened ecosystems (wetlands and tropical forests). There has been some excellent output in the review period, especially from the tropical biologists in the group. Very interesting work is also in progress in the Netherlands in relation to restoration of disturbed ecosystems.

#### *Productivity*

Output of research articles in relation to FTE has been excellent in the review period, as has the number of PhD theses completed. The work is very well cited. The strategy to pool results into high-impact papers is good but the proposal to contribute more reviews in order to enhance citation rates is less desirable. The group has been successful in obtaining major competitive grants in the review period.

#### *Relevance*

The work of the group has clear relevance to the crucial societal issues of climate change and management of biodiversity. The contact with stakeholders appears to have been taken furthest in tropical systems where the group's work is impacting on forest management. In other settings, the group is active in public outreach and in translational activities such as collaborative projects and workshops that involve stakeholder representatives.

#### *Viability*

The group has received excellent external funding, especially contract funding, in the review period and has produced very strong science. However, the delay in replacing the former group leader and the departure of at least two very successful group members seriously threatens the future of the group. A strong chair appointment is needed as soon as possible to secure the future of the group, which continues to have excellent members and great potential despite the recent changes.

UU

**Programme 70:**

**Palaeo-Ecology & Biomarine Sciences**

Programme coordinators:

Prof. dr. A.F. Lotter, Prof. dr. H. Brinkhuis (since 2010)

Research staff 2010:

8.3 fte

Assessments:

Quality: 5

Productivity: 5

Relevance: 5

Viability: 4

*Short description*

The Palaeo-Ecology and Biomarine Sciences investigates the response of individual species and terrestrial, aquatic and marine ecosystems and the Earth system as a whole to natural and/or anthropogenic-induced environmental changes at different geological and ecological temporal and spatial scales. The research programme is based on ecological, physiological, and geochemical analyses of living and fossil organisms recovered from continental and marine deposits to provide basic contributions to the understanding of the role of primary producers as monitors, recorders, drivers, and moderators of environmental and climate change on different temporal and spatial scales.

The research programme is characterised by an integration of modern observational and experimental data and/or models with palaeo-data to improve the understanding of past and present behaviour of biota, ecosystems, and system earth in relation to exogenous stressors (e.g. climate change, meteorite impacts, human impact) that can trigger dynamic biotic processes such as extinction, migration and evolution.

*Quality*

The group has now been split into two groups but is evaluated for the time period 2005-2010 as one. The research encompasses the time period from the Paleocene/Eocene Thermal Maximum to recent times. The methods used for analysis of the entire time period are similar and allow a high resolution. A particularly unusual and valuable aspect is the combination of experimental work on present day physiological plant response with reconstructions of the past. The unique combination of biological and geological approaches led to totally novel insights, which allowed the group to produce a number of excellent and highly visible publications with high impacts. The group's excellent quality is also apparent from the fact that it is very attractive to international visitors who often come supported by visiting grants.

*Productivity*

The output of publications per fte is very high. The group members were highly successful in acquiring extremely competitive grants from their own university, NWO, KNAW, ERC, EU FP6 and NSF. About 70 percent of the financing comes from outside the university.

*Relevance*

The group does an excellent job in disseminating their new research insights to the public and in 2007 the group received the Annual Dutch Academia Outreach Award. The group is well integrated into international drilling programmes of geologists and oil exploration companies. The group's research is one of the bases for defining the 'pristine' state of a catchment in historical perspective for the European Water Framework Directives.

### *Viability*

During the site visit it was official announced to transfer the Palaeo-Ecology group to the Geo-Sciences. Though this transfer was welcomed by the group, there are still many open questions concerning a smooth transfer. This was the reason for the Committee to be cautious on viability.





### Institute of Biology (IBL)

#### 1. The Institute

The Institute of Biology Leiden is part of the Faculty of Sciences at Leiden University. The IBL represents the core of modern biological research at Leiden and interacts closely with groups in the other life science oriented Institutes in the Faculty. It also collaborates with the Leiden based National Centre for Biodiversity (NCB-Naturalis) and with the Leiden University Medical Centre (LUMC). It participates in the Faculty's focal area 'Bioscience; the Science Base of Health'. In this setting it distinguishes itself by highly multidisciplinary fundamental and applied research using a selection of model organisms, and attention to evolutionary processes and the role of the environment in biological processes. It covers the relevant disciplines to maintain an excellent, broad BSc curriculum, and has an MSc and PhD education programme tightly linked to its research.

Research is concentrated in two programmes, covering different disciplines. The Evolutionary Bioscience programme addresses the processes that contribute to the evolutionary diversification of organisms and their traits, and their functioning in different environments. The Molecular Bioscience programme addresses the molecular processes that are fundamental for the functioning of cells within an organism and in interaction with other organisms (e.g. disease). Both programmes aim to apply their results, where possible, to questions of societal and economic importance.

#### 2. Quality and academic reputation

The bibliometric scores of IBL are well above world average with respect to the impact of the journals in which it publishes, as well as the number of citations that papers receive. The trends indicate that these figures are still on the rise.

Two prominent representatives of the programmes were awarded, respectively, an ERC advanced grant (Prof. Paul Brakefield-2010) and a special endowed position provided by the KNAW as 'Akademischhoogleraar' (Prof. Paul Hooykaas-2009). Nearly all researchers participate in international or national collaborations with other scientists, industry, (non)governmental organizations and others. Extraordinary professorships link the IBL to various other Institutes. It is also connected to various spin-off companies

The research highlights that attracted most attention (and all receiving major funding) concern: establishing the zebra fish as a model for drug screening; infectious diseases and cancer; the evo-devo studies on wing patterns in butterflies; the assessment of the impact of anthropogenic noise on acoustic communication in birds and fish; the gene technology research and studies of signalling molecules in plant development and defence; and studies of snake fang evolution.

#### *Assessment*

The Institute houses a number of first class scientists who are known world-wide; the ERC advanced grant and the special endowed position testify to the quality of the respective researchers. Research on plant transformation and gene targeting and on hormonal regulation of plant development are to be listed as examples of the plant side of the MBS, while the exciting zebrafish screening experiments lead into both medical aspects (cancer, infectious diseases, inflammation) and to questions of development. A dedicated robot system in which the animals swim in microfluidics and are automatically recorded has been developed. The fact that there is strong synergy between the MBS-specific and the EBS-specific zebrafish work is guarantee for

fruitful interaction of the two research units. Other work in EBS deals with effects of anthropogenic sounds on birds and fish, song learning, and plant defenses by secondary metabolites.

### **3. Resources**

During the assessment period the IBL had to accommodate a 30% cut in university funding. Its funding strategy is based on achieving a balance between direct funding and external funding, as well as combining fundamental and strategic research. This has resulted in an increasing proportion of (temporary) staff on external funding. Currently approximately 50% of the IBL income is by external funding, a figure that is on target.

Since 2009 the Institute, up to then scattered over several locations, is housed in the completely refurbished Sylvius Laboratory at the Leiden Bio Science park, close to its most important partners. This new unilocation provides excellent facilities for teaching and state-of-the-art experimental research, while the 'Cell Observatory' in the nearby Gorlaeus Laboratory offers excellent facilities for high end fluorescent spectroscopy and imaging.

#### *Assessment*

Scientists are in the lucky position to be able to work in a completely new building, which will help in getting the two units integrated. Facilities seem to be excellent. External funding and multiple interactions with industry give a total of 50 % of external funds.

A more balanced gender ratio may be desirable for the future.

### **4. Productivity**

The productivity (ISI publications) per tenured staff member (related to the staff present in 2010) is above the national average. The decline in the total number of papers for the Institute is related to the decline in staff over the past couple of years. The number of PhD theses per year shows a stable level of around 17-18. More than 50% of the staff is active in editorial boards, and many are active in outreach activities.

#### *Assessment*

The Committee observes that a recent decline in outputs reflects declining staff numbers and commitment to re-structuring activities. However, a good balance of output types has been maintained and the average impact of research articles has been maintained at a high level. There are incentives for aiming to publish in top journals and there is a strong commitment to building the reputation of the newly structured unit.

Housed in the new Sylvius laboratory and surrounded by other Institutes belonging to the Faculty of Science, researchers of the Institute work on molecular, organismal and evolutionary levels, with a limited variety of model organisms. New groups are being formed in microbiology & biotechnology (in collaboration with Delft University of Technology) and bioprospecting. Three new tenure track positions are created to foster cohesion and collaboration within the institute. This will result in an expanded institute working on animal sciences, on plant sciences and on microbial science and biotechnology.

### **5. Societal Relevance**

Both of the Institute's research programmes are involved in large scale projects (Smartmix, EU) with biomedical relevance (e.g. the zebra fish as a model for studying diseases and drug screening). Researchers in molecular plant sciences are active in the area of 'green biotechnology', receiving support from the TTI Green Genetics, while microbiologists participate in the Kluyver

Centre for applied research in industrial microbiology. These studies have over the years resulted in patents and in a series of spin-off companies in these areas connected to the IBL. Of societal importance are also risk assessment studies on GMO's and studies on the impact of anthropogenic noise on birds and fish (both supported by external funding).

#### *Assessment*

Researchers in the institute are very active in outreach and public education programmes, develop powerful screening pipelines, and build collaborations with various industrial partners. The cell observatory has a robust and diverse funding stream, and the zebra fish has enormous potential as a model for studying mechanisms of disease and for drug screening. Several patents originated from this work and from the biotechnological work on plants.

### **6. Strategy for the future**

The Faculty of Science, facing the rapidly changing scientific and funding landscape, recently decided to concentrate its priorities in two areas: 'Fundamentals of Science' and 'Bioscience: the Science Base of Health'. These developments also fostered a further adjustment of the IBL strategy and research focus, aligning both with the 'Bioscience' Faculty theme and the changing (inter)national research priorities. This strategy, formulated June 2011, aims to strengthen the IBL profile and coherence under the theme 'Healthy Lives in a Changing World'.

Building upon existing research in this direction, this strategy puts a stronger emphasis on research with relevance in a biomedical or broader health context, on biotechnology, and on research that may advance innovative applied projects in these areas. In this context, the IBL will establish two interdisciplinary research facilities: a Bioprospecting Laboratory and a Centre for Microbial Biotechnology. It will also promote its activities in Plant Biotechnology. These activities match the recently published *Strategic Foresight on New Biology* by the Royal Netherlands Academy of Sciences (KNAW) and 'Top Sector' policy – the top research areas for funding as identified by the government.

An important component of the strategic plan is the current investment in 6 tenure track positions for young postdocs. They will further strengthen cohesion and critical mass within the Institute, and also help to maintain a balanced age distribution among the staff and a broad BSc/MSc teaching programme.

#### *Assessment*

The IBL went through a number of cuts and reorganizations in the last 3 years; in its present form it is active only since 2010. The future now seems to be assured through a careful hiring plan of young faculty members.

The Committee notes that IBL has gone through a period of serious changes, losing substantial groups in 2008. The two programmes within the Institute, Evolutionary Bioscience and Molecular Bioscience, have taken the opportunity to join forces and present a clear strategy of integration of the two programmes under the heading of "Healthy lives in a changing world". This includes cooperation with the Naturalis, National Centre for Biodiversity, LUMC and the Universities of Delft and Rotterdam.

New tenure-track positions have been and will be filled to allow more coherent cooperation between the two groups as well as better, more productive scientific connections with the mentioned Institutes. These decisions reflect an intelligent strategy and wise management in the face of serious changes to the academic environment. Given the record of high productivity and long-standing record of high academic reputation these recent strategic decisions make it credible

that the Institute will continue to be highly productive and internationally visible, maintaining its publication record and its impact.

### **7. PhD Training**

The Graduate School of the Faculty of Science oversees admission, registration and performance of all PhD students and offers them a programme of mandatory courses training various research and presentation skills. All students admitted to the School have to hand in a training and supervision plan at the start of their project, outlining the intended training courses, the research targets for the first year, some indication for the later years and agreements about responsibilities and supervision by promoter and others. This plan has to be approved by the scientific director.

All PhD students are assessed after 9 months, resulting in a go/no-go decision. Their training programme is tailored to the specific background of the students and the requirements of the project. As part of their training, students usually follow courses in relevant areas elsewhere. Students are fully integrated in the various research groups, guaranteeing a 'master-apprentice' relationship between students and supervisors.

#### *Assessment*

The Committee found the PhD students highly competent, enthusiastic and realistic. The Committee noted that all consulted PhD students declared to wish to remain in science. This may be the consequence of a strict admission strategy, dedicated supervision and scientific support from the supervisor. A yearly internal symposium with both Institutes, with a common theme, will further advance the melting together.

## 8B. PROGRAMME LEVEL – Leiden University (Programmes 71-72)

<b>Programme 71:</b>	<b>Evolutionary Biosciences</b>
Programme coordinator:	Prof. dr. P.M. Brakefield (until 2009), Prof. dr. C.J. ten Cate (since 2009)
Research staff 2010:	40.5 fte
Assessments:	Quality: 4
	Productivity: 4
	Relevance: 4.5
	Viability: 4.5

### *Short description*

The aim of the Evolutionary Biosciences programme is to understand the processes that contribute to the evolution of the diversity of life, of organisms and of their traits, and to apply these results, where possible, to societal and economic needs. Research foci are ‘adaptation and speciation (addressing ecological speciation and trait evolution) and ‘development and plasticity’ (addressing developmental mechanisms, the translation of genotype into phenotype, and the functioning of phenotypes). Using a multidisciplinary approach, hypotheses about the dynamics of evolution are tested with field and laboratory experiments on plants, insects, fish and birds.

### *Quality:*

This is a very diverse group and thus difficult to evaluate. Several of the research programs are excellent and work on relevant problems in integrative and organismal biology. Several core members have developed an impressive drug screening and phenotyping pipeline for embryonic zebrafish, partly in collaboration with Molecular Biosciences (Prof. Spaik).

### *Productivity:*

Several of the groups in this programme have very good to excellent publication records. Given the recent joining of the groups, the establishment of a convincing joint research agenda and their change into a new building, the productivity of the group has remained at a high level.

### *Relevance:*

The outreach activities of the group are admirable. The use of zebrafish embryos for drug discovery has great potential and should be pursued aggressively. The group is also in a very good position to highlight examples that show how fundamental and applied approaches inform each other. The number of permanent female staff is low.

### *Viability:*

This group should continue to do well in the future as efforts at integrating the various programmes appear effective and making good progress. Current efforts to hire new tenure-track staff that help to strengthen interactions within the group, will also further improve the integration across groups.

## LEI

### Programme 72: Molecular Biosciences

Programme coordinator: Prof. dr. P.J.J. Hooykaas (until 2010), Prof. dr. H.P. Spaink (since 2010)

Research staff 2010: 59.9

Assessments:                      Quality:        4  
   Productivity: 4  
   Relevance:    4.5  
   Viability:     5

#### *Short description*

Since 2005 this research programme is characterised by a focus on three themes: Animal Cell Biology, Plant Molecular Biosciences and Molecular Microbiology & Biotechnology. Within the theme on animal cell biology a major change has been the establishment of a strong research line on cancer and infectious disease using zebra fish as the model. In 2010 *Streptomyces* was incorporated as a model organism in the Molecular Microbiology theme, thereby strengthening the collaboration with the Molecular Biotechnology group of the Leiden Institute of Chemistry. The aim of the research is to understand molecular processes that are fundamental for the functioning of cells within an organism, in interaction with other organisms (disease) and during other forms of stress, and to apply these results not only for the development of novel (gene) technology, but also, where possible, to societal and economic issues. The programme entails in all three themes topics as the molecular mechanism of signal transduction and the biosynthesis of signal molecules, horizontal gene transfer and gene targeting, and processes underlying cell polarity, differentiation and pattern formation.

#### *Quality*

The intellectual and practical merits are indisputable. The research is imaginative, innovative and potentially transformative. The zebra fish 'cell observatory' concept is being used in studies of bacterial-host relationships, cancer biology, immunology, and vertebrate development. Because each of these varied programmes is in its respective growth stage, the entire programme has not yet reached maturity. Fortunately, the zebra fish model is also used in evolutionary biosciences which leads to strong cross-talk between EBS and MBS. The potential is all there but has not yet been entirely developed. The trajectory is extremely positive and is trending towards a 5.

#### *Productivity*

Like the quality, the productivity is good to excellent, but not uniformly outstanding. There is variability in this heterogeneous group and not every part of the programme has had time to develop its maximum potential. Overall, both numbers of papers and impact of papers are high and trending toward even better.

#### *Relevance*

The potential for screening for drugs to treat infectious disease, cancer, and allergy is all there. There is good sensitivity to the media, educating the public and mentoring students within the programme. The cancer section is headed by a woman. Contacts with industry are strong and growing stronger. Several members serve on national committees.

#### *Viability*

The group receives the majority of its funding from outside. The members are young or mid-career, with a strong sense of future directions. With the establishment of new and strong

research lines, the positive trajectory of the Leiden Molecular Biosciences programme bodes well for an even brighter future.





## Appendix 1. Short profile of the committee members

**Prof. Alexander J.B. Zehnder** (Chair), Alberta Water Research Institute, Edmonton, Canada, is professor emeritus of ETH Zürich. He is also the former president of the ETH Board – the governing board of the ETH-system comprising two universities (ETH-Zürich and ETH-Lausanne), and four national laboratories (PSI, EMPA, WSL, EAWAG).

**Prof. Joan Bennett**, Rutgers State University, Department Plant Biology & Pathology, New Brunswick, USA.

Expertise: microbiology, biotechnology, mycology.

**Prof. Roger Butlin**, Department of Animal and Plant Sciences, University of Sheffield, UK.

Expertise: evolutionary genetics, speciation, ecology.

**Prof. Hans A. Hofmann**, Section of Integrative Biology (IB), University of Texas, Austin, USA.

Expertise: neurosciences, biochemistry, molecular biology, genetics.

**Prof. Barbara Hohn**, Friedrich Miescher Institute for Biomedical Research, Basel, Switzerland.

Expertise: molecular genetics, plant sciences, microbiology, epigenetics.

**Prof. David Tilman**, Department of Ecology, Evolution and Behavior, University of Minnesota, St. Paul, USA.

Expertise: ecology, plant sciences, biodiversity, conservation.

**Prof. Fritz Trillmich**, Department of Animal Behaviour, University of Bielefeld, Germany.

Expertise: behavioural biology, ecology, evolution, animal physiology.

**Prof. Claus Wasternack**, Leibniz Institute of Plant Biochemistry, Department Molecular Signal Processing, Halle, Germany.

Expertise: plant sciences, biochemistry, molecular biology, cell biology.

## Appendix 2: Explanation of the SEP criteria and scores

The four main criteria for assessment are: Quality, Productivity, Relevance, and Vitality & feasibility. The assessment at the institute level primarily focuses on strategy and organisation, whereas the assessment at the level of the research group or programme primarily focuses on performance and activities of researchers and the results of their work (output and outcome).

Quality	<p>The level or degree of excellence of the research, compared to accepted (international) standards in that field.</p> <p>The scope of the term ‘research’ is not limited to the research results. Research management, research policy, research facilities, PhD training and the societal relevance of research are considered integral parts of the quality of work in an institute and its programmes.</p>
Productivity	The relationship between input and output, judged in relation to the mission and resources of the institute.
Relevance	<p>Social, economic and cultural relevance. Aspects to be considered are:</p> <ul style="list-style-type: none"> <li>▪ <i>Social quality</i>: efforts of the institute or group to interact in a productive way with stakeholders in society</li> <li>▪ <i>Social impact</i>: how research affects specific stakeholders or procedures in society</li> <li>▪ <i>Valorisation</i>: activities aimed at making research results available and suitable for application in product, processes and services.</li> </ul> <p>Committee members can also remark on relevance for the academic community, but the assessment should be on societal relevance.</p>
Vitality & feasibility	The ability to react adequately to important changes in the environment. Also vision for the future.

The scores on a five-point scale are:

5 Excellent	<p>Research is world leading.</p> <p>Researchers are working at the forefront of their field internationally and their research has an important and substantial impact in the field.</p>
4 Very Good	<p>Research is considered nationally leading.</p> <p>Research is internationally competitive and makes a significant contribution to the field.</p>
3 Good	<p>Research is considered internationally visible.</p> <p>Work is competitive at the national level and makes a valuable contribution in the international field.</p>
2 Satisfactory	<p>Research is nationally visible.</p> <p>Work adds to our understanding and is solid, but not exciting.</p>
1 Unsatisfactory	<p>Work is neither solid nor exciting, flawed in the scientific and/or technical approach, repetitions of other work, etc.</p>