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# Biology

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Title

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Series Quality Assessment of Research

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## Foreword

It is with great pleasure that I present this report on the quality assessment of the research in Biology. It is one of the first reports in the second round of quality assessments carried out in the programme started by the Dutch universities in 1993. In this programme international Committees of independent experts are assessing all university research. The second round started in 1998 on the basis of a renewed Protocol.

The Review Committee for the Assessment of Research in Biology examined the biology research at the faculties in Amsterdam (University of Amsterdam and Vrije Universiteit), Nijmegen, Leiden, Groningen, Wageningen and Utrecht. The report gives a description of the research activities in relation to the state-of-the-art in the fields of Biology. Moreover, the Committee gives a number of valuable recommendations and it is my expectation that their judgements and suggestions will be carefully taken into account by the researchers and by the faculties and universities.

As the Chairman of the Association of Universities in the Netherlands (VSNU) I would like to express my thanks to the Chairman and the Committee Members for their kind co-operation in this assessment and for their dedication with which they fulfilled this task. Furthermore, I thank those involved in this assessment within the universities.



Prof. Drs M.H. Meijerink  
Chairman of the Association of Universities in the Netherlands

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## Preface

Biology is a flourishing field of science, fascinating to investigate. In the past decades there have been unprecedented breakthroughs in molecular biology, genetics and cellular biology and major advances in ecology and evolutionary biology and it appears that the boom in biology is far from coming to an end. Just recently a new landmark in biology was reached with the publication in *Science*, 11 December 1998, of the complete sequence of the genome of the nematode *Caenorhabditis elegans*. This first complete sequence of an animal genome provides a gold mine of information on a diversity of problems ranging from gene control to evolution. Before long, the complete sequence of the human genome will be determined as well as that of the plant *Arabidopsis thaliana*. This information opens up new vistas for understanding how multicellular organisms develop and function, the working of the nervous system up to the evolution of genes and genomes, and the origin of species.

Biological research is a basic discipline for medical, agricultural and environmental science. It is becoming increasingly apparent that the results of biological research have a profound effect on man and society. Out of molecular biological research a whole industry has grown with clear effects in the fields of agriculture, medicine, biotechnology and human nutrition.

With their leading role in the education of biologists and the training of biological researchers, the universities will have a special responsibility in preparing students and researchers for the forthcoming era of biology in which new questions can be asked and new insights will be gained in the nature of living organisms.

The Review Committee for Biology Research was assigned the task of evaluating the research of the faculties of Biology. It was the second time that an assessment of the biological research took place as a part of the VSNU-programme for quality assessment of university research. The first report "Netherlands Biology in the Nineties" was published in 1993. The major conclusion of the earlier assessment was that the quality of biology research in the Netherlands was overall above average and could be qualified according to international standards as good with several programmes deserving the qualification excellent.

It is a pleasure to report that this overall qualification has not changed and that there are many good research groups. On the whole biological research in this country scores significantly above the world's average.

The different universities gave full assistance to the evaluation process in providing adequate documentation about the research programmes. The Committee appreciated the warm hospitality of the Faculties during the site visits, which created an open and constructive atmosphere and enabled the Committee to obtain valuable additional information.

Experts from the United Kingdom and Germany agreed to join the Committee in order to cover the various disciplines of the field. They have put in a great effort and I have appreciated it very much that they have been willing to spend so much precious time to the work of the Committee. In assessing the various programmes their broad experience in biological research was most profitable and I thank the Committee members in particular for the very pleasant co-operation. In addition the support given by the VSNU was excellent and helped to create an optimal working atmosphere.

Besides the assessment of the biological research programmes of the universities, the report gives some attention to the current organisation of the

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research in the Institutes within the faculties and the participation in Graduate Research Schools with their own scope and research programmes. This could be of interest for future assessments of the biological research. The Committee hopes that the findings put down in the report will be significant in the research policy of the universities and will contribute to the quality and relevance of biological research in the Netherlands.

Ab van Kammen  
Chairman of the Committee



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# 1 Introduction

## 1.1 The Dutch System for Quality Assessment of Research

The review of the research in Biology is part of a programme initiated by the Dutch Universities to assess all university research. The outlines of this review system are laid down in general terms in the Protocol 1998. This protocol indicates that the principal goals of the review are:

- C quality maintenance and improvement through feedback to the research group and the university management;
- C management on the basis of quality through the provision of quality assessments to the boards of faculties and universities.

The review is mainly based on the assessments of faculty and institute reports. These reports consist of a description of the research profile of the faculty or institute, a description of the organisational structure of the faculty (including research institute or research school), and a description of the research programmes. Every programme presents a short description of its approach, results, and future developments. A main part of the information consists of in- and output figures. The input figures give an indication of the research input in full time equivalents (fte) of scientific personnel for each year of the review period; the output data always include a selection of five key publications and an overview of publications. An important element of the programme description is the "mission statement".

Highly valued features of the assessments are the interviews, which the Review Committee conducts with the delegations of the faculty boards, the directors of the research institutes and the programme directors. The interviews with the delegation of the faculty boards are especially aiming at a discussion of the faculty's or institute's research profile and their research policy.

The focus of the assessments is the scientific quality of the research programmes. Other aspects of the assessments are scientific productivity, scientific and societal relevance, and scientific long-term viability. These aspects are assessed separately. A ranking, based on an integration of these four aspects, cannot be made.

This type of VSNU assessments is carried out per discipline, over a period of five years, by means of peer review. Committees of predominantly international experts are composed. The Royal Academy of Arts and Sciences (KNAW) advises on the constitution of these Committees. Every Committee finishes the assessment with a report. The assessment reports are public.

## 1.2 The Review Committee for Biology

By decree of 18 August 1998 the Chairman of the VSNU appointed the Chairman and the Members of the Review Committee for Biology. The start of the activities of the Committee was delayed because one member had to withdraw from the Committee because, on further consideration, he could not make time for the procedure which involved visits of several days to the Netherlands. By early October the Committee started in the following composition:

- Prof. Ab van Kammen, Chairman
- Prof. Charles Godfray, Imperial College at Silwood Park, Ascot, UK
- Prof. John Lee, University of Sheffield, UK
- Prof. Ulrich Lüttge, Technische Universität Darmstadt, Germany
- Prof. Robert McNeill Alexander, University of Leeds, UK
- Prof. Hidde Ploegh, Harvard Medical School, USA
- Prof. Bernhard Schink, Universität Konstanz, Germany

Drs. Roel Bennink was appointed secretary of the Review Committee.

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A short curriculum vitae of the members is included in Appendix II.

In the course of the procedure, Prof. Ploegh decided during the first site visit in January to withdraw from the Committee since his opinion that more individual information about the researchers was needed, was not shared by the rest of the Committee and the VSNU. The Committee regretted this decision, but respects Prof. Ploegh's motives.

### **1.3 Scope of the Assessment**

The Committee was asked to operate in accordance with the VSNU-Protocol 1998. For the assessment of Biology, this Protocol was elaborated in the 'Discipline Protocol for the Research Assessment of Biology 1998' (see Appendix III).

The universities participating in the assessment were:

- University of Amsterdam
- Catholic University of Nijmegen
- Leiden University
- Vrije Universiteit
- University of Groningen
- Wageningen Agricultural University
- Utrecht University.

The Discipline Protocol states which subdisciplines must be covered by the assessment:

- Cell Biology
- Microbiology
- Plant Biology
- Ecology
- Theoretical Biology/Evolution Biology
- Animal/Human Biology.

### **1.4 Data provided to the Committee**

The Review Committee received the following documentation from the participating faculties:

- A report 'Research Assessment 1993-1998', including a profile and key data of the Faculties, documentation for each of the 90 research programmes with input and output data and a list of publications issued in the assessment period.
- A set of five key publications for each research programme
- A bibliometric report, prepared by the Centre for Science and Technology Studies (CWTS) of Leiden University (see appendix).

### **1.5 Procedure followed by the Committee**

The Committee members received the complete set of documentation in October 1998. Each member was asked to complete a preliminary assessment form (see Appendix III) as first or second reviewer for a number of the 90 research programmes, in accordance with their specific expertise.

The preliminary assessments, the documentation and the procedure of the assessment were discussed in a Committee meeting in Woudschoten on 3 and 4 November 1998. At that time all committee members had completed a preliminary assessment of a number of research programmes assigned to them

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as first or second reviewer. One of the members of the Committee, Prof. Dr. H. Ploegh, was unfortunately unable to attend this first meeting and to participate in the deliberations of the Committee. In a letter to the Committee he insisted that the Committee should ask for additional information, particularly short biographical sketches of the programme directors and the senior staff members, as this would be essential for a good assessment of the research. The Committee has not followed this suggestion to make the assessments more person-oriented, but decided that the written documentation was generally adequate and together with the interviews with the programme directors during the site visits, would provide the information and experiences required for a sound assessment of the biological research. The Committee could not come to an understanding with Prof. Ploegh and that made him decide to withdraw during the first site visit and not further participate in the activities of the Committee. During the site visits and later in a formal VSNU-letter, the faculties were informed of this withdrawal and were asked if they could agree that the Committee would complete its task without a replacement for Prof. Ploegh. The faculties have not objected to this. The Committee continued its work following the prepared procedure with the full approval of the VSNU.

In a number of cases the Committee decided to consult external expertise, when it was felt that the particular topics were not adequately covered by the expertise of the Committee members themselves.

In the site visits in January and February the Committee had meetings with the Faculty Board, a group of PhD-students (AIO's and OIO's) and the programme directors of all programmes.

The first round of site visits took place on 11-13 January 1999. The Committee visited the University of Amsterdam, the Catholic University of Nijmegen, Leiden University and the Vrije Universiteit Amsterdam.

The second round of site visits took place on 1-3 February 1999. The Committee visited the University of Groningen, Wageningen Agricultural University and Utrecht University.

The Committee was impressed by the open manner in which these conversations were conducted and by the frankness with which all questions were answered.

In view of the very tight time schedule that had to be observed to allow 30 minute interviews with all programme directors, the Committee in most cases refrained from visiting laboratories and other facilities. On request of the Committee an exception was made for the new building of the Rijksherbarium in Leiden.

After each site visit the Committee discussed the conclusions per programme and agreed upon the final scores. After the site visits the Committee members revised the short texts about the programmes, in accordance with the findings.

In June 1999 a draft report was sent to the universities for factual corrections and comments on the reviews. The comments received were carefully considered and led the Committee to recalculate the productivity scores. In addition several adjustments were made in the text.

In all cases the conclusions presented in this report are supported by the entire Committee and are the sole responsibility of the Committee.

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## 1.6 Aspects and Assessment Scale

The criteria to be observed in the assessments are stated in the Protocol 1998 of the VSNU. The Review Committee is required to give judgements on four aspects: Quality, Productivity, Relevance and Viability. The Committee discussed the working method that would be used for the assessment and agreed that a five-point scale would be adequate for scoring these four aspects, and that an additional comment should be added for each research programme. These comments are an integral part of the assessment.

The Committee members understood that they had been invited to the present assessment of the biological research by virtue of their broad expert knowledge of various fields of biology. Therefore the Committee took it for granted that it should base the assessment of the different aspects first of all on its own judgement.

The Protocol 1998 allows the Review committee considerable freedom to interpret the criteria for the rating of the four aspects Quality, Productivity, Relevance and Viability. The Committee has taken into account the variety in the nature of the research programmes under scrutiny, which goes from fundamental scientific research in most cases to some degree of applied research in some cases. The criteria used for the judgement of each of the four different aspects, are described below.

### (A) Scientific Quality:

The scientific quality of a research group is based on:

- originality of approaches and ideas in tackling scientific problems
- coherence and cumulative character of the research
- contributions made to international scientific developments
- quality of the scientific publications and of the journals in which they appeared
- indicators of international recognition other than publications, such as positions in international scientific networks and advisory appointments based on scientific reputation.

The ratings on the five-points scale for quality are defined as follows:

- Excellent (5):** The research group belongs to the international elite within its field of research. It works at the frontiers of international progress in its field and contributes effectively to that progress by means of a substantial number of publications in highly rated scientific journals or, for mainly technology based programmes, contributes on a regular basis to the newest developments in important fields of technology by means of conference papers, designs and international advisory positions.
- Good (4):** The group meets the international standards in its field of research or technology and it makes worthwhile and recognised contributions to the international research community or to the newest technological developments.
- Satisfactory (3):** The group meets the international standards in its field of research or technology at a quite adequate and desirable level.

- 
- Unsatisfactory (2):** The group does not meet the international standards in its field, nor does it contribute significantly to its progress and development.
- Poor (1):** The group is far from meeting international standards of its field and has no influence upon its development.

## **(B) Scientific Productivity**

The productive functioning of a research group is evident by:

- the publications in international refereed journals and scientific books, which demonstrate the contributions of the group to scientific knowledge and understanding;
- the number of PhD theses
- presentations at international conferences and publications in the proceedings of these meetings
- other scientific output such as professional publications and patents.

The Committee has discussed whether the productivity scores should be based on a general impression of the production of each research group with reference to its size and resources, thus presenting the Committee's perception of productivity over the past five-year period. In such an approach account can be taken of fluctuations in group size, the output during these years and quality aspects such as the nature of the journals. However, such a score will be rather subjective and not easily verifiable. Since the quality aspects are, moreover, already included in the score for Quality and the impact of the journals is part of the bibliometric analysis, the Committee decided that a strictly numerical approach would be more appropriate.

The Committee decided to calculate the Productivity score on the basis of the number of articles in refereed scientific journals, increased by the number of PhD theses, per full time equivalent (fte) of academic staff paid by the university in the assessment period 1993-1997. For the calculations the numbers of refereed articles and PhD theses and the number of fte WP1 (other) were used as provided by each group.

Between the research groups there are substantial differences in the number of PhD students (AIO's and OIO's) and the number of temporary staff (postdocs) paid for by extramural funds. The presence of this additional academic staff can be attributed to the efforts of the staff on the payroll of the university, and that staff has a major responsibility for the productivity of the temporary staff. Therefore in the calculations of the productivity scores, the contribution of the PhD students and the temporary staff (not on the payroll of the university) is assigned to the academic staff on the payroll of the university (WP1, other).

The Committee then defined the following ratings for Productivity:

- High (5):** The number of articles in refereed journals plus the number of PhD theses per full time equivalent of staff is high (i.e. above 12 per year)
- Good (4):** The number of articles in refereed journals plus the number of PhD theses per full time equivalent of staff is good (i.e. between 8 and 12 per year)
- Satisfactory (3):** The number of articles in refereed journals plus the number of PhD theses per full time equivalent of staff is satisfactory (i.e. between 4 and 8 per year)

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- Low (2):** The number of articles in refereed journals plus the number of PhD theses per full time equivalent of staff is low (i.e. between 2 and 4 per year)
- Very low (1):** The number of articles in refereed journals plus the number of PhD theses per full time equivalent of staff is very low (i.e. less than 2 per year)

The Productivity score can only be appreciated in combination with the score for Quality.

It should be noted that there may be specific reasons for the outcome of the calculations that have nothing to do with the productivity of the group as such. One obvious reason can be fluctuation in the number of staff.

### **(C) Relevance**

The Review Committee has considered the following aspects as part of the overall assessment of relevance:

- the advancement of knowledge or expertise
- the significance of the contribution of a research group to the development of its field with special focus on originality of ideas and approaches;
- potential impact and applications in (a) food production, health care, biotechnology, and (b) in management of ecosystems, natural resources, environment;
- the contribution of the research group to relevant scientific and professional networks of (future) users (government, agencies, industry and others) based on its specific knowledge and expertise;
- the balance between fundamental and applied research;
- success in obtaining funding from the second and third money source.

The ratings for relevance are:

- Excellent (5):** Notable and influential contributions have been made to prominent fields. Such research groups play important roles in scientific and/or industrial communities.
- Good (4):** Some contributions have been made to prominent fields or else notable and influential contributions have been made to less prominent fields.
- Satisfactory (3):** The group has performed moderately well on not very prominent but still useful subfields
- Unsatisfactory (2):** The research does not appear to have great relevance to the actual or potential development or application of Biology
- Poor (1):** The research appears to have no relevance.

### **(D) Viability**

The following aspects are taken into account:

- whether it is worthwhile to continue the research topics, based on the group's ideas and plans for the future (scientific prospects);
- prospects of future funding of personnel and facilities;

- 
- continuity of leadership for the programme;
  - coherence of the programme.

The group's mission statement and plans are judged against the feasibility of developing or sustaining their research. Guarantees for continuity of leadership at a high academic level is seen as a major aspect of the viability of a programme.

The ratings used for viability are:

- Excellent (5):** The group is judged to have clear and coherent plans on the international frontiers in its field. It has reached and is likely to maintain, its leading role in international networks. Continuity of funding is assured. Highly qualified staff will continue to be available in the future.
- Good (4):** The group is seen as competent to do the proposed research. The scientific issues being researched seem to be fruitful. The research group's position in the field seems to be assured. There are few doubts about the future funding or the availability of the competent staff needed to maintain the programme of research.
- Satisfactory (3):** There are some reservations about one or more of the aspects mentioned above, but if the proper measures are taken in time, there is a good chance that the group will continue to contribute adequately to its scientific field.
- Unsatisfactory (2):** Based on the plans presented, the Committee has serious doubts about the continued viability of the research group, and considers that without additional measures for strengthening the group and/or continuity in leadership, it will not be able to function adequately.
- Poor (1):** Poor means that for one or more of a number of possible reasons, the research programme is judged to be non-viable, and should not be continued in its present form.

## 1.7 Bibliometric analysis

As part of the quality assessment the Centre for Science and Technology Studies (CWTS) at Leiden University has performed a bibliometric analysis of the publications produced by the research groups that submitted documentation for the current assessment. For this analysis a so-called 'back-to-the-future' approach was chosen, which focuses on the performance of the scientists who are still active in a particular group and have the task to shape the future of this group. Therefore the study only includes publications of senior scientist still active in the biological research programmes in 1998.

The first draft of the report was made available to the Committee at the beginning of the last series of site visits. The Committee members have read the report and how the bibliometric analysis was produced with great interest, but they had not used the results of the bibliometric analysis in their preliminary assessments of the separate programmes and during the first series of site visits. The Committee then confirmed its point of view to trust its own judgement of the different aspects and to add the report of the bibliometric analysis as additional information.

The report of the bibliometric analysis by the CWTS is added to the report of the Committee as an **appendix**. The report contains interesting information and confirms on the whole the main conclusions on the quality of biological research in the Netherlands.

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The overall outcome of the analysis is that the impact of publications of the different biological research groups is significantly above the average impact of the journals in which they are published, and of the world average in their subfields. The total number of publications produced has increased by about 28% since the previous bibliometric analysis, and the number of citations per publication increased from 5.0 to 5.8.

Trend analysis shows that the impact of Netherlands biology is not increasing but shows a slightly decreasing tendency and comes slightly closer to the world average. Most likely this reflects an improvement of the world average caused by better performance of countries in which biological research is developing well.

The analysis of the number of publications and their impact per subfield clearly shows that biochemical and molecular biological studies are an important subfield of biology and have become well integrated in biological research. The analysis of the number of publications and their impact in the subfield developmental biology shows a low number of publications, which is not in agreement with the number of groups involved in research in this field and the generally good quality of their work. The low number is probably due to the combination of journals used for the category of developmental biology. This combination of journals needs to be updated. At present it does not take into account papers published in some prominent journals that do not refer to developmental biology in the journal name.

The results of the analysis further indicate a low impact of research in cell biology, endocrinology and metabolism, and in immunology. As stated elsewhere in the Committee report, these areas of research are underrepresented in the documentation submitted for the current quality assessment, and therefore the outcome does not necessarily represent the actual impact of the Netherlands' research in these areas.

It is nice to see that the bibliometric analysis shows that the Netherlands' biological research substantially contributes to international scientific networking and that it receives a considerable part of its impact from publications that are internationally co-authored.

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## 2 Biology

### 2.1 Assessment of Biological Research in the Netherlands

#### > 2.1.1 *Quality and change*

Biological research in the Netherlands is strongly moving. On the one hand this movement is caused by the rapid developments in the research and the new knowledge and understanding which are acquired, on the other hand it is caused by the fact that the biological research at the universities is reorganised into institutes in which several disciplines are brought together. On top of that there are a considerable number of recent or forthcoming retirements of staff members and chairholders, which brings a new generation of researchers of biology to the forefront.

It is very gratifying to note that so far the biological research is very well able to accommodate these drastic changes.

The Committee has come to the conclusion that according to international standards biological research in the Netherlands can be qualified as good, and several groups are excellent and have a leading role in their field of research. The quality of the research programme in the diverse field of biology shows little variation and in the different aspects of the assessment there are only few scores which are less than satisfactory.

This conclusion on the quality of the biological research is confirmed in the bibliometric analysis of the publication output, which also indicates that the impact of Netherlands biology is significantly above the world subfield average. The output of the biology researchers increased by 28% and the number of citations by 47%.

#### > 2.1.2 *Coverage of this report*

The number of research programmes reviewed by the Committee comes to 96, which represents a substantial part of the biological research at the universities, but is far from complete. The Wageningen Agricultural University has not submitted the current programmes in animal research as it preferred to have their programmes reviewed as part of the quality assessment of Animal and Veterinary sciences. Therefore the biological research of the Wageningen Agricultural University is only partly represented in this report. As the Committee has not received any of the research programmes of the Veterinary Faculty of Utrecht University either, the report does certainly not give a complete and representative picture of research in animal biology. This is all the more so since the medical faculties of the universities also contain important basic biological research. Specifically, most of the cellbiological research and the development of molecular genetic tools for animal biology research is found there, not to mention the fundamental biological research on viruses, bacteria, protozoa, and on human biology. Nor does this report discuss the research of the four institutes of biological research of the Royal Netherlands Academy of Arts and Sciences (KNAW).

Furthermore, at least 45 research programmes which are either purely biological research or strongly related to biological research are not included in this assessment. These concern research programmes that have been reviewed in the framework of the VSNU-quality assessment of chemical research in 1996. A few of these programmes, notably some microbiology, have also been part of this assessment but the research of many groups involved in biochemical research, the elucidation of the structure of biomacromolecules, molecular biological research and biotechnology will not be found in this report on biological research in the Netherlands.

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The absence of a considerable part of biological research in this assessment does not imply any reservation regarding the conclusion of the Committee on the quality of biological research in the Netherlands. The research that has been assessed within other frameworks and is missing in this report, was generally found to be of good to very good quality. But the consequence is that this report cannot fully show the many connections of biology with chemical, physical and medical research and the cross-fertilisation between these disciplines. Neither does the report fully show the great importance of biological research for numerous applied fields such as medicine, veterinary medicine, animal production, plant production, public health, nutrition, biotechnology, environmental problems and nature conservation, to mention a few. This fact should not escape attention, because it could be a reason to reconsider the research assessments and particularly the aggregation level to be chosen in future quality assessments.

The report at hand is virtually complete in reviewing research in plant biology, in systematics, ecology, evolutionary biology and theoretical biology, and it contains a major part of the research in microbiology and substantial parts of research in animal biology, especially neurobiology.

### **> 2.1.3 New developments**

The Committee was very pleased to notice a growing integration of the knowledge acquired in different areas of biology. For example, the data on the sequence of genes, the organisation of genomes and differential gene expression are not only important for molecular geneticists, but also have a great effect on studies in evolutionary biology on the formation of species. That will further increase with the forthcoming flood of data on the sequences of whole genomes of eukaryotic organisms as different as nematodes, fruit flies, plants and humans, to mention only a few. The striking homology in mechanisms and gene systems among very divergent organisms presents totally new challenges for investigating the development and the nervous system, as well as for research towards understanding the formation of different species.

If biological research is currently of good to very good quality according to international standards, it will only maintain this position if it will join in with these developments and the Committee urges that necessary investments in additional staff and equipment will be done in time.

The Committee is especially concerned about the research on the nervous system. The Committee found that in the field of neurobiology there is hardly a beginning of the application of genetic technology and there is only little specific expertise in molecular genetics, gene mutation and the possibilities to knock out specific genes in model organisms. In these respects the research in neurobiology in the Netherlands is in danger of lagging behind and drastic changes are required for the research to keep up with international developments.

The Committee was pleased to note that molecular techniques are finding acceptance in the research in ecology. The Committee takes the view that molecular techniques have become indispensable tools in ecology and population biology and that the potential of these methods is not yet fully exploited. Further efforts will be required to maintain the quality of the research at the high level in view of the international competition.

### **> 2.1.4 Funding**

In view of the rapid developments and the strategic importance of the research for different applied fields, the funding of biological research at the universities is a matter of great concern. In the coming years there will be a considerable number of retirements of chairholders and senior staff. That will afford the

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necessary opportunities for renewing research programmes, and starting new directions in basic research. For making such new efforts successful in the long term, additional funding will be necessary to create a good starting position. Besides it should be borne in mind that Biology at the universities has gone through reductions in staff which appear not to be in proportion with those in other fields of study. This is particularly striking if the number of biology students is taken into account and the central position Biology is taking up in the faculties of natural sciences.

Furthermore, biological research requires increasing funds for consumables and equipment as a result of the development of the research techniques. Considerable investments in hardware are needed for studies of functional genomics, for computers, for data storage, for simulating model studies, for determination of the structure of biomolecules and for advanced spectroscopy and imaging techniques. Such investments will be essential for fundamental research on how genes develop and regulate the development of organisms, on the functioning of the nervous system, and for innovative research in animal and plant physiology, as well as for ecological and evolutionary studies. Extra funding by the Netherlands Foundation for Scientific Research (NWO) seems also required in order to be able to cope with the challenges of fundamental biological research and to keep up with the new developments.

In addition to the funding by the universities and grants from the Netherlands Foundation for Scientific Research (NWO) and the European Commission, many groups receive external support from industries, governmental institutions and private associations. This support is given for direct research in the short term interests of the funding bodies. On the whole the Committee finds that the different groups keep an acceptable balance between working for projects financed by industries and other external parties, and their efforts for basic research. The collaboration with industries, governmental and private bodies can be considered as proof of the good quality of the research. It shows the social significance of the biological research and provides solid reasons for stimulating further basic research in order to safeguard the social role of biological research.

### **> 2.1.5 Institutes**

The Committee noticed that the universities have established institutes in which different biological subdisciplines are amalgamated and have combined their research efforts. The organisation in institutes, each with its own scope and research programme, offers a good possibility for stimulating co-operation between different groups and for creating more coherence in the (by definition multidisciplinary) biological research. The institutes can have a major role in profiling new chairs and in the selection of new chairholders and senior staff members. In addition, the institutes can give support to preparing and submitting grant proposals and they can have a role in assigning PhD and post-doc positions. The institutes may also have a role in the regular control of the progress and the quality of the research. In that way the research institutes are obtaining a key role in the research policy of the faculties.

Although this organisation in research institutes may have obvious advantages, it should not result in a compartmentalisation of biology and the Faculties should care for regular contacts between the programme leaders of different institutes to discuss the desired initiatives for the progress of biological research as a whole.

### **> 2.1.6 Frequent reviews**

The Committee learned that many research groups in the current assessment had already submitted their research programmes for review several times in the past five years, even up to 5 times. This suggests that research assessment has become quite a fashion in the Netherlands. Whereas the research groups generally have an open eye for the potential value of research assessments, too

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frequent reviewing undermines the significance of the procedure and is not efficient. The contents and the quality of the research do not change so rapidly and it gives cause for feeling that much double work is done. It should be recognised that it has become part of the policy of the universities to regularly monitor the progress and to assess the quality of the research. The Committee strongly feels that national assessments of research should be done no more frequently than every five to six years.

#### **> 2.1.7 Graduate Research Schools**

The Committee further found that practically all biological research of the universities is part of the research programmes of Graduate Research Schools. It appeared during the visit to the different universities that all universities agreed that the Graduate Research Schools have a very positive effect on the education and training of PhD students and have undoubtedly encouraged co-operation between the groups of the School. The training of young researchers in the Graduate Research Schools is important for the future quality of the biological research and therefore deserves full attention. Besides, the Graduate Research Schools often bring together not only groups of the biological institutes of different universities, but, depending on the research theme of the School, also groups of the medical faculties and groups of chemistry and physics institutes, as well as research groups from the biological research institutes of the Royal Netherlands Academy of Arts and Sciences (KNAW). This setting of the research programme of the Graduate Research Schools is obviously a very good one for educating and training graduate students. Together, the research programmes of the Graduate Schools present a rather complete picture of biological research in the Netherlands in all its different aspects. It also makes the different Graduate Research Schools, each with their own theme, detailed in the research programme, suitable units for peer review by an international committee. Therefore, it deserves serious consideration to take the Graduate Research Schools and their research programmes for future assessment of the quality of biological research.

The Committee has learned that the definition of the administrative responsibilities and authority of the Graduate Research Schools on the one hand and those of the faculties and universities on the other, is not yet clear and needs to be worked out. If this is not forthcoming, it may have an adverse effect on the functioning of the Graduate Research Schools, and it is therefore important for the biological research that these issues are resolved shortly.

## **2.2 Biodiversity and systematics**

The most impressive aspect of the living world is its diversity. No two individuals in sexually reproducing populations are the same, nor are any two populations, species, or higher taxa. Wherever one looks in nature, one finds uniqueness. Systematics includes not only identification and classification of organisms but also the comparative study of all characteristics of species as well as an interpretation of the role of lower and higher taxa in the economy of nature and in evolutionary theory.

#### **> 2.2.1 Plant Systematics**

Plant systematics has had considerable problems over the last ten years in the Netherlands and in the last VSNU assessment received a generally unfavourable report. The situation found by this Committee was radically improved, largely through the formation of the National Herbarium, centred on the Rijksherbarium at Leiden. The Committee judged plant systematics to be in an excellent state at Leiden, to be in a good and improving state in Utrecht,

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while only at Wageningen there was uncertainty about its future, though reason for optimism with the planned creation of a chair in systematics. The Committee wishes to note that Professor Baas is providing exceptionally strong national leadership in this subject.

Systematics in general is an unusual science, and the Committee would like to stress that the normal bibliographic indicators of quality used to assess other disciplines are seldom applicable to work in this field. The best way to judge research quality in this area is through review panels.

Because of its colonial history, the Netherlands have particularly extensive holdings of tropical herbarium material, which is of immense global value in biodiversity studies. With the Leiden Herbarium focused on tropical Asia, the Wageningen Herbarium on tropical Africa and the herbarium of Utrecht University on tropical America, the Netherlands has a potential role in this field that is disproportionately large for the size of the country, and this is an area where it can make very important contributions to global change and biodiversity studies.

The way in which the science of plant systematics is carried out is changing rapidly. The Committee noted that the Rijksherbarium was in the vanguard of using Internet technology to make its collections more widely accessible. Nationally, more emphasis on plant phylogenetics using molecular techniques to supplement traditional methods would be helpful. The Committee was uncertain how systematic botany at Nijmegen, none of which was entered into this review exercise, related to the rest of the subject in the Netherlands.

### **> 2.2.2 Animal Systematics**

The Committee found it harder to obtain an overall view of animal systematics compared to plant systematics because a smaller proportion of the subject are based in universities. For example, the major group of systematists in the Naturalis Museum in Leiden were outside this review exercise.

The most important animal taxonomy occurs at the University of Amsterdam and in Wageningen.

The Committee considered that in neither university was animal systematics flourishing, lacking strong leadership, as well as investment and appreciation by the university authorities. The Committee believes that animal systematics in Dutch universities, and most probably in the country as a whole, needs to be reviewed by a specialist group with the possibility of setting up a national body equivalent to the National Herbarium in plant taxonomy.

As mentioned under Plant Systematics, this subject is difficult to judge by normal bibliometric means, and in the past there has been a tendency to run down systematics as old-fashioned science. The increased realisation of the importance of biodiversity, as well as the development of new methodologies in systematics has changed this, and in many countries there has been a renaissance in this subject. At least from the evidence submitted to this Committee, this is not happening in the Netherlands.

The Netherlands has a strong track in animal systematics and unique holdings of collections. For example, Wageningen holds the largest collection of nematodes in the world, but has severely run down nematode systematics (despite the increased realisation of the importance of nematodes in biodiversity and ecosystem function). With suitable investment, the

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Netherlands could be a disproportionately important centre for research in this area.

## 2.3 Animal Biology

### > 2.3.1 *Functional morphology and biomechanics*

Functional morphology as a part of anatomical science to discover the structural basis for the functioning of the various parts of an organism, is a field whose popularity has declined world-wide following rapid advances in the 1960's and 1970's. Excellent work continues to be done in a few places, notably in Leiden, and (outside the scope of the assessment of this Committee) in Wageningen. From functional morphology an area study is developing, referred to as ecological morphology, which focuses on adaptive relationships between structures and ways of life. This is also strong in Leiden.

Another development is biomechanics, which is the application of engineering principles to the understanding of the structure and movement of organisms. It is remarkably strong in the Netherlands, but this is not apparent from the data presented to the Committee. The important groups working on human mechanics at the Vrije Universiteit in Amsterdam and on equine biomechanics at Utrecht, and excellent work on theoretical biomechanics at Wageningen, are excluded from our scope by the subject classification adopted by VSNU. There are single biomechanists doing outstanding work in isolation within groups that are included in our scope, in Leiden and in Groningen, but the Netherlands has no substantial group of biomechanists in any university biology department.

### > 2.3.2 *Animal physiology*

Research in animal physiology is breaking up in neurobiology, developmental biology, biology of adaptation to stress (behavioural physiology) and endocrinology. The research is good, and receives international recognition, but without noticeable peaks. Unfortunately the animal physiology research in Wageningen and in the veterinary faculty in Utrecht has remained outside the scope of this Committee.

The research of the animal physiology groups in the Departments and Faculties of Biology is part of the research programmes of several Graduate Research Schools, in which also groups of the Medical Faculties (and the Veterinary Faculty) participate. This promotes the contribution of the biological research to medical physiology, and is in agreement with the aspiration of the universities to meet the current interest in medical biology and medical biological problems of a large part of the biology students. The better research is in Amsterdam (Vrije Universiteit as well as the University of Amsterdam) and in Groningen, where several groups collaborate on neurobiological topics and complement each others' expertise. The research uses obvious biochemical and molecular techniques often in combination with electrophysiological and optical methods and other biophysical techniques. But research in animal physiology, and especially neurobiology, stays notably behind the international developments in the sense that genetic and molecular genetic methods are not much applied so far. Yet the complete sequence of the nematode *Caenorhabditis elegans* genome has made apparent a strong evolutionary conservation a.o. in genes and gene families involved in development and in the nervous system, in addition to differences between this model organism and other invertebrates. Very soon the complete genome sequence of another important model organism, *Drosophila*, will be elucidated, not to mention the complete human genome sequence, which is expected within a couple of years. Furthermore the mouse

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has also developed into a model organism in which it is possible to knock out specific genes and to study the function of genes in transgenic animals. These data and the results obtained with these model organisms will undoubtedly have a great impact on the further research on the determination and analysis of functions in the nervous system and in the development of various animals.

The possibilities of so called functional genomics that come within reach will have a strong innovating effect on animal physiology as it adds a new dimension to physiological research.

### **> 2.3.3 Animal ecology, evolution and behaviour**

The Netherlands has a number of groups working in evolutionary biology, concerning animals as well as plants, and population genetics that are in the first rank internationally in this subject. Leiden, UvA, Groningen, Wageningen and Utrecht all have one or more exceptionally strong groups. Most groups have actively embraced modern molecular techniques, and in some cases lead the field in the application of the new methodology. The subject is strong and healthy in the Netherlands and deserves continuing substantial investment and support. To keep Dutch science in this area at the peak of international competitiveness, investment will be required to capitalise on the imminent genomic revolution that will markedly change the questions that can be addressed by evolutionary biologists.

Animal ecology consists of variety of subdisciplines of which the most important are population dynamics, community ecology, behavioural ecology, physiological ecology and applied subjects such as conservation biology. Rather few groups in this research assessment exercise described themselves as animal ecologists, and although there are some strong groups (particularly in Groningen), this subject in general is not a strength of the Netherlands. The exception to the last statement is in behavioural/evolutionary ecology where, as described above, a number of universities are producing research of the highest calibre. Some of the applied animal ecology in fields such as conservation biology and ecotoxicology would benefit from greater attention to its fundamental science base.

Behavioural ecology of animals is the study of how behavioural decisions affect evolutionary fitness. It rose to prominence in the 1970's and remains an active and productive branch of biology. Research of the highest quality on the behaviour of birds is in progress at Groningen. Research on socio-ecology of primates at Utrecht and on foraging strategies of animals at Wageningen also cover this field. Another branch of behavioural biology that is being pursued includes spatial behaviour in Utrecht. All in all, biology in the Netherlands continues to make substantial contributions to the study of animal behaviour.

### **> 2.3.4 Entomology**

Within the university system there is a large, strong group at Wageningen devoted to entomology, an important group at the University of Amsterdam, a substantial entomological component to the different evolutionary programmes at Leiden, and a more distributed scattering of entomologists among other groups. There is also much applied entomological expertise outside the university system.

The Netherlands' strengths in entomology derive from the importance of agriculture to the environment, and it continues to be a very important international player in applied entomology. A number of groups in the country have built on this work to develop significant research programmes in

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fundamental science, using insects as models. Dutch scientists are always comparatively over-represented at international entomological meetings, and this subject should be viewed as a national strength.

## 2.4 Plant Biology

### > 2.4.1 Molecular Plant Sciences

Molecular plant sciences aim at understanding the molecular basis of physiological processes in plants such as the functioning of plant organs, tissues and cells, the transduction of signals and plant development, and how these processes arise from the genetic programme of the plant and are affected by different biotic and abiotic factors. It thus involves the identification and the determination of the structure and properties of the relevant molecules for explaining their function in these processes. The research requires a multidisciplinary approach including plant genetics, functional morphology of plants, plant molecular biology, biochemistry and plant physiology.

On the whole the quality of the research in this field is good to excellent and several groups in the Netherlands produce original contributions and have a leading role internationally in their area of research. Major topics are plant development, organogenesis and the perception and transduction of signals, different aspects of which are studied in Utrecht, Wageningen, Leiden, Nijmegen and Amsterdam. In addition there is strong molecular and physiological research on the interaction of plant-pathogens (fungus, virus, bacteria) and plant-herbivores (insects, nematodes) and other plant microbe interactions, in Wageningen, Utrecht, University of Amsterdam and Leiden.

The Committee noticed that many groups have adopted, if possible, *Arabidopsis* as a model plant in their research in addition to other plant species like tomato, petunia, potato and vegetables. This is considered a strong point because it enables the research to benefit optimally from the data of the Arabidopsis Genome Project, which will very soon result in the complete sequence of a plant genome, and the huge collection of marked mutants of *Arabidopsis*.

The possibilities of functional genomics studies will notably affect the research of plant physiology and will give new vigour to that research.

The Committee found that the current molecular plant research should urgently invest in bioinformatics in order to fully exploit the abundance of data generated by several genome sequencing projects, and in DNA chip technology for further research on the function of genes and the interaction of genes in various physiological processes. Such investments are of great importance to maintain the prominent position of Dutch molecular plant research.

Groups in all seven universities visited by the Committee participate in the total research effort, each with a programme of their own. It appears that there are good contacts between the different groups, and this is expressed in frequent collaborations. The study group Experimental Plant Sciences of the Division Earth and Life Sciences of the Netherlands Research Organisation has a stimulating role in maintaining this network and contributes to making the research competitive and coherent.

Within each university the different plant biology groups also benefit from the varied expertise in fields such as chemistry, (bio)physics, or other adjacent disciplines.

The Committee noted with great interest the initiatives in Wageningen and Leiden to develop research on living plant cells using confocal correlation

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microscopy and other advanced fluorescent microscopy techniques for studying interactions in signal transduction and the effects produced. This appears to be an important new approach for understanding the functioning of cells.

It has struck the Committee that rather little attention goes to plant biochemistry and the study of the structure and function of plant proteins and other biomacromolecules. Also, the Committee did not meet a marked research effort aimed at the elucidation of the biosynthetic pathways of primary and secondary metabolites and the regulation of the pathways.

Molecular plant research greatly benefits from the use and application of genetics and molecular genetical methods, but many fundamental genetical problems still need to be elucidated. For that reason the Committee learned with great approval about the proposal at the Vrije Universiteit in Amsterdam to destine a forthcoming vacancy for a chair in epigenetics. Indeed, epigenetics is a field of genetics which is little explored and it is becoming very important for understanding gene expression under different conditions in plants as well as in animals.

#### **> 2.4.2 Plant Ecology and Ecophysiology**

Research in Plant Ecology is diverse. Several groups are working in phytogeography, vegetation dynamics and landscape. These studies also include tropical ecology. Most of this work, which is found in Wageningen, Nijmegen, Groningen, Utrecht and Amsterdam is satisfactory or good, but it largely appears to be particularly devoted to assessment of features. It appears that stringent analytical theory, and theory and observation based modelling should be much enforced to advance basic ecological understanding. The work can be strongly supported by good plant systematics and the herbarium units in Leiden, Utrecht and Wageningen, which constitute the new National Herbarium. This contributes to the good future viability of the research. There are interesting, original approaches and stimulating advances in knowledge in paleo-ecology and paleo-ecophysiology in Utrecht and in the University of Amsterdam.

The analysis of the interaction between plants and the environment in ecosystems under various conditions of climate and soil, is Ecophysiology. Prominent research on the ecophysiology of plants has been done for many years in the laboratory of Plant Physiology in Groningen. The present research director, Prof. P.J.C. Kuiper, will retire shortly, but hopefully his position will be filled with a successor of the same calibre, who could also add more molecular approaches in the ecophysiological research. The ecophysiology group in Utrecht lost its leading programme director, who accepted a position in Australia, but the faculty in Utrecht was able to fill the gap by establishing a refreshingly young group on molecular ecophysiology, an offspring from the strong Nijmegen ecology group with a reputation by its outstanding ecophysiological research on plants coping with frequent flooding.

Research of great impact on the (heavy) metal tolerance of plants with important ecophysiological implications has been done at the Vrije Universiteit in Amsterdam, but in its continuation it might benefit from a new drive.

Some areas are difficult to assess in relative terms because the most appropriate journals for these are not generally highly rated internationally. This is particularly true of ecotoxicology and to a lesser extent of soil ecology. Research in both these areas is very important and well represented, but if it is

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to achieve wider recognition, attempts must be made to publish more papers in journals of high international impact.

The overall achievements in plant ecology in the broadest sense are respectable. The research in the universities benefits from collaboration with the Netherlands Institute of Ecology (NIOO) of the Royal Academy of Arts and Sciences (KNAW).

Generally the research is focused on important ecological areas of investigation, many of which are highly relevant to local problems. There is thus a wide variety of work on wetland ecosystems. There is perhaps less emphasis than might be expected on major environmental issues such as global change and the release of genetically modified organisms.

The Committee was unable to assess fully the impact of the Graduate Research Schools on the ecological research programmes, but in general applauded this development which should help to cross fertilise the overall research effort.

## 2.5 Theoretical Biology

The Netherlands has a strong international reputation in theoretical biology, and historically has been a leader in this field. The best groups are in Leiden, Utrecht and Amsterdam, but there are also significant strengths in other universities within groups that are not exclusively theoretical. Not all groups are of international standing, and there has been a tendency for some to have become rather intellectually isolated. Some groups have also tended to become overly formal, with the risk of losing contact with empirical research. Overall there are good contacts and integration between the different theoretical groups in the country. Since the last review there is clear evidence of an increased integration of ecology, evolutionary biology and theoretical programmes, for example in Leiden and at the University of Amsterdam. There are also some experimental groups that could benefit greatly from input from theoreticians.

## 2.6 Microbiology

Microbiology in the Netherlands has a long-standing tradition of excellent quality that dates back to Antonie van Leeuwenhoek in the 18<sup>th</sup> century and later to M.W. Beijerinck and his successors in the so-called Delft School which has had a strong impact on the development of non-medical microbiology all over the world. Dutch microbiology is at the forefront of this field world-wide, in the same range of quality as in the United States, the UK, the Scandinavian countries or in Germany.

Excellent centres of microbiological research and teaching exist in Delft, Groningen, and Wageningen. At the Vrije Universiteit of Amsterdam and the Catholic University of Nijmegen, smaller microbiology units have been established. At the Universities of Leiden, Amsterdam and Utrecht, microbiology is represented only by one chair or less within a department that is basically devoted to other scientific fields.

The development of modern molecular biology techniques which use prokaryotic cells mainly as expression systems has supported the general understanding that microbiology is just a specialised area of molecular biology. As a consequence, microbiology departments are vanishing world-wide and turn into departments of molecular biology, cell biology, or biotechnology. Undoubtedly, these sciences have benefited strongly from this development.

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The disadvantage of this trend is an identity loss of microbiology as a science of its own. At the technical university in Delft, microbiology has become part of a biotechnology/enzyme department. The great and well-respected Laboratorium voor Microbiologie in Groningen has been split up between two different research units, that on ecology, ecophysiology and marine biology on the one hand and that on molecular biosciences and biotechnology on the other hand. Despite the merely strategic advantages associated with these changes, there is a strong concern for microbiology as a whole, especially with respect to teaching it as a self-sufficient science of an extremely important group of living organisms.

The identity of microbiology as a whole is still maintained in Groningen, as long as the feeling for the historic unity persists. In Wageningen, general microbiology is represented within a huge department encompassing a broad and colourful picture of microbiology as such. The Vrije Universiteit in Amsterdam has at present two chairs in microbiology which represent a minimum size necessary for the representation of microbiology as a self-sufficient unit. At Nijmegen, the planned expansion of microbiology to two chairs with different scientific orientations is a promising development which could maintain a self-sufficient representation of this field there as well. More critical is the situation at Utrecht where only one chair of microbiology exists which has to cover this field also in teaching for neighbouring programmes. In the long run this unit will only have a chance to survive if it finds a strong association with other strong research areas within the Faculty, for example plant sciences or cell biology, and if it succeeds in defining a strong position for itself by focussing on molds or other low eukaryotes. It has to be emphasised that also microbiology encompasses an enormous diversity of organisms which cannot be represented in research and teaching by just two or three model organisms.

Microbiology in the Netherlands maintains its quality world-wide in the first rank. In all areas of modern-day microbiology, especially in the fields of transport processes, biochemistry, metabolism, signalling, relationship to human, animal and plant hosts and targets, ecology and evolution, Dutch microbiology is in the first line. Dutch microbiologists are leading in their fields, maintain excellent connections world-wide to all other leading groups, and are very successful in acquiring their financial support from Dutch and external, especially from EU sources.

The generation change from the mainly physiology-oriented microbiologists of the 70ies and 80ies to the molecular-oriented microbiology of present days has been performed with impressive success. Nonetheless, as in other biological fields, the view for organismic diversity as one of the essential properties of life in general has to be kept in mind for the future.

For some smaller units of microbiology, it will be necessary to combine their efforts with other microbiology departments in the close neighbourhood to maintain their teaching programmes at sufficient breadth.



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### 3 Assessment per Faculty or Institute and per Programme

#### 3.1 Leiden University

##### > 3.1.1 General observations

In Leiden biological research is organised in three research institutes within the Faculty of Mathematics and Natural Sciences:

- the Institute of Evolutionary and Ecological Sciences (EEW)
- the Institute of Molecular Plant Sciences (IMP)
- the Rijksherbarium/Hortus Botanicus (RHHB)

Each institute has its own scope and a research programme is drawn up once every five years. The research programme of an institute integrates the subprogrammes of different sections. Sections represent different disciplines and have their own expertise. The clustering of different disciplines stimulates collaboration of disciplines and synergy in the performance of the research programme. Each institute has a scientific director who is appointed by the Faculty. The director is responsible for the smooth operation of the research programme and confers with the Dean of the Faculty on the state of affairs and the budget required. Regular meetings of the scientific directors must guarantee cross-linkages between the institutes where necessary or desired, and protect the interests of the discipline of biology as a whole. The scientific director of an institute directs a scientific management team consisting of the different programme directors and/or section leaders. The team comprises at least the different chairholders and keeps an eye on the quality of the research of the institute.

This organisation of the biological research has now taken definite shape with the renovation of the Van der Klauw laboratory, which has enabled the different sections of the EEW to be housed at a single location, and the formation of a National Herbarium which secures the future of the large and important collection of the Rijksherbarium. While the IMP continues to make major contributions to (molecular) plant research in the Netherlands, the EEW provides a strong profile of research on evolutionary processes characterised by important contributions to evolutionary ecology, functional biology, theoretical population biology and the developing field of evolutionary developmental biology.

The research of the EEW and the Rijksherbarium/Hortus Botanicus belong partly to the research programme of the Graduate Research School 'Functional Ecology' and partly to that of the Graduate Research School 'Biodiversity'.

The research of the IMP belongs to the Graduate Research School 'Biotechnological Sciences Delft Leiden' (BSDL). As the research of the IMP does not comply very well with the mission of the Graduate School BSDL, IMP intends to join the Graduate School 'Experimental Plant Sciences' in the near future.

Leiden University is confronted with serious financial problems which also affect biology. The coming year a further reduction of the budget by at least 10% is anticipated. This could be very harmful to the development of the biological research if it would result in a delay of the filling of vacant chairs or, even worse, a further reduction of the number of chairs and the number of staff. The IMP has a vacancy which they propose to use for appointing a full professor for physical biology. In that way IMP could strengthen its participation in the recently established Centre for Physics and Chemistry of Life Sciences which could greatly contribute to the research in the molecular

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processes in living cells. Besides, the IMP needs additional funds for updating its scientific equipment.

EEW will shortly fill the chair of animal ecology which will provide a very much needed strengthening of the current research. Equally important for a coherent development of the research programme on evolutionary constraints is the filling of the vacancy of a chair for integrative zoology, which will replace animal physiology.

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## Assessments per programme

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University	Leiden University	
Research Institute	Evolutionary and Ecological Sciences	
Programme	Evolutionary ecology	
Programme Director	prof. dr. P.M. Brakefield	
assessment	Quality	5
	Productivity	4
	Relevance	5
	Viability	4

This group contains some excellent scientists who are publishing in major international journals and who are collaborating with important laboratories overseas. The four sub-programmes are developing well, and the Committee noted that the vacant chair of Animal Ecology will be filled which should give further impetus to this sub-programme. There is evidence of the judicious use of molecular techniques and modelling approaches to advance the Programme. The Environmental Biology sub-programme is now publishing more in international journals, but its work on sustainable development is clearly of great importance nationally.

University	Leiden University	
Research Institute	Evolutionary and Ecological Sciences	
Programme	Evolutionary constraints	
Programme Director	prof. dr. G.A. Zweepers	
assessment	Quality	4
	Productivity	3
	Relevance	4
	Viability	4

This group has three distinct areas of research, in behavioural biology (concerned with bird song), in evolutionary morphology (principally on the trophic systems of birds) and in integrative zoology (concentrating on physiological responses of fish to hypoxia, and adaptive radiation of fishes). These areas are closely enough related to give good potential for interaction between them, but some work is needed to improve the cohesion of the group. We welcome current work on mathematical modelling of bird vocalisation as a step in this direction, and also the proposal for a chair in biomechanics. The general level of originality and interest of the research is high, and several members of the group have achieved international prominence.

University	Leiden University	
Research Institute	Evolutionary and Ecological Sciences	
Programme	Evolutionary dynamics	
Programme Director	prof. dr. J.A.J. Metz	
assessment	Quality	4
	Productivity	4
	Relevance	3
	Viability	3

This group contains very good individual scientists and has produced some excellent publications. However, the volume of research is not particularly high and some members of the group are currently under-producing. The programme is quite disparate, but the Committee was impressed by the efforts of the group leader to integrate the different research themes. While some of the research is highly relevant to experimental biologists, some of the theoretical work in the group is highly abstract and more links with experimental biologists are desirable.

University	Leiden University	
Research Institute	Molecular Plant Sciences	
Programme	Molecular cell biology	
Programme Director	prof. dr. H.P. Spaink	
assessment	Quality	5
	Productivity	3
	Relevance	4
	Viability	4

The research during the review period was mainly carried out under the direction of Prof. dr. R.A. Schilperoort. The research was focused on the characterisation of a transcription factor, CBF, binding to the *Agrobacterium T-cyt* gene promoter in plants, the role of homoeo domain transcription factors in rice embryogenesis and morphogenesis, and on genes involved in the biosynthesis of indole alkaloids in *Catharantus roseus*.

That research was of very good quality and satisfactorily productive. In 1997 Prof. Schilperoort withdrew from his chair of molecular biology in favour of a successor. Prof. dr. H.P. Spaink was then appointed to this chair, which was renamed molecular cell biology. The appointment has resulted in a redirection of the research programme. Prof. Spaink has an excellent record of research on the structure, function and biosynthesis of lipo-chitin oligo saccharides produced by *Rhizobium* bacteria, that are signal molecules in the induction of nitrogen-fixing modules on the roots of leguminous plants. A fascinating discovery is that chitin-oligo saccharides appear to have a role in vertebrate embryogenesis. In the coming years the programme of the group consists of research on the molecular basis of embryogenesis in rice, the role of chitin-oligo saccharides and their derivatives in plant and animal development and a comparison of signal transduction cascades and cytoplasmic organisation in *Arabidopsis*, *Lotus japonicus* and rice (*Oryza sativa*).

The latter part of the research will use confocal correlation spectroscopy and fluorescent lifetime imaging for analysing *in vivo* the cytoskeletal elements in signal transduction.

The new research programme is ambitious and challenging and the new techniques have the potential of introducing a new approach for studying molecular interactions in signal transduction in living plant cells.

University	Leiden University	
Research Institute	Molecular Plant Sciences	
Programme	Developmental Genetics	
Programme Director	Prof. dr. P.J.J. Hooykaas	
assessment	Quality	4
	Productivity	3
	Relevance	4
	Viability	4

This group has a high international standing owing to the research on the molecular mechanism of *Agrobacterium tumefaciens* T-DNA integration and the role of transferred Vir proteins in plant transformation. The studies of the role of phytohormones in plant growth and development are not yet of similar prominence. The research output in terms of numbers of scientific publications is not large, but the quality is generally of a high standard. The group is very well connected internationally, and has a well developed future programme in which it seeks to capitalize on new opportunities arising from plant genomics.

University	Leiden University	
Research Institute	Molecular Plant Sciences	
Programme	Virology	
Programme Director	Prof. dr. J.F. Bol	
assessment	Quality	5
	Productivity	3
	Relevance	4
	Viability	4

The group is one of the best groups in plant virology in Europe and has been very successful again through the past 5 years. Work concentrates on two subprograms, the alfalfa mosaic virus and the development of hypersensitive response by plants as a result of pathogen invasion. The alfalfa mosaic virus system is studied with respect to the virus RNA replication in the cell, the spreading of viruses into neighbouring cells through plasmodesmata and the development of resistance from the side of the plant. This connects to the second subprogram dealing with hypersensitive response and the development of necrotic lesions. In both areas, the group has been successful and publishes in first-class journals. Although the work on plasmodesmata is still in the state of development the overall score of this group is very good. Only the number of theses is a little under average.

University	Leiden University	
Research Institute	Molecular Plant Sciences	
Programme	Microbiology	
Programme Director	Prof. dr. E.J.J. Lugtenberg	
assessment	Quality	4
	Productivity	4
	Relevance	4
	Viability	4

The group is active in the field of cooperation between rhizobia and bradyrhizobia and their natural hosts. The system is exploited with respect to the communication between host and bacterium, and the long-standing experience is also used for the study of pathogenic relationships between plants, fungal pathogens and competing bacteria. The broad coverage of several different plant and microorganism species of major agricultural interest is considered as a specific advantage. The group has been successful, and has published papers in journals of high to excellent quality. The new field of root surface/ pathogen interactions is still developing but obviously in a good way. The group is very active in international cooperations and among the best groups in the world in the area of rhizobium research. Taking into account that this group has to cover the whole field of microbiology in teaching one should consider whether experience from other departments in the close neighbourhood should be sought to broaden the teaching program.

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University	Leiden University	
Research Institute	Molecular Plant Sciences	
Programme	Physiology	
Programme Director	Prof. dr. J.W. Kijne	
assessment	Quality	4
	Productivity	3
	Relevance	4
	Viability	4

Studying "good news" and "bad new" for plants sounds a bit mannered, however, it is evident that the quest for signalling molecules of bacteria and the corresponding plant gene-products is acute for understanding both symbioses and pathogenic effects, but on the whole the programme appears too broad and not cohesive. Doing research in diverse systems (root nodules, cell cultures) may be intellectually appealing but the research would gain if the director introduces more focus in the work of the group.

Since the group makes adequate use of advanced techniques and has shown to be capable of producing interesting results, it might be able to advance to real excellence.

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University	Leiden University	
Research Institute	Molecular Plant Sciences	
Programme	Cell Biology	
Programme Director	Dr. P. Schaap	
assessment	Quality	4
	Productivity	3
	Relevance	4
	Viability	1

The group deals with the developmental biology of the slime mold *Dictyostelium discoideum*, especially with signalling in programmed cell death and signal transduction by protein kinases. The work has been very successful through the past, and the group is among the leading ones in this field. Also the quality and frequency of publications is clearly over average for such a comparatively small group. Unfortunately, the group is rather isolated within the institute and does not find sufficient cooperation in the immediate neighbourhood. There is no direct connection to the plant sciences that are of central interest at this institute, and efforts to develop scientific bridges to the other groups in the institute at the level of molecular methods were only of limited success so far. The isolated situation may endanger the viability of this group on a longer perspective. If the group does not succeed in making a good connection with the further research of the Institute of Molecular Plant Sciences, it could probably be more successful if it would be embedded in a different environment.

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University	Leiden University	
Research Institute	Molecular Plant Sciences	
Programme	Yeast Genetics	
Programme Director	Prof. dr. P.J.J. Hooykaas	
assessment	Quality	4
	Productivity	3
	Relevance	4
	Viability	4

This group deals with yeast genetics with respect to basic science and applied aspects. Industrial needs of strain development are met in studies on the physiology and metabolic regulation in *Kluyveromyces lactis*. The studies on the fission process with respect to centromer structure and function in *S. cerevisiae* and *K. lactis* are of special interest. Also the work on the new 14-3-3-proteins in *S. cerevisiae* is developing well.

The overall productivity is only just sufficient, but papers are published in good to very good journals.

University	Leiden University	
Research Institute	Rijksherbarium / Hortus Botanicus	
Programme	Rijksherbarium / Hortus Botanicus	
Programme Director	Prof. dr. P. Baas	
assessment	Quality	5
	Productivity	5
	Relevance	5
	Viability	5

This group has suffered from the problems afflicting all plant systematics in the Netherland and has benefited from the recent restructuring. The Committee were very impressed by the strong and visionary leadership the group now enjoys, and believes that it has developed a logical research programme. The tropical flowering plant and cryptogram sections are strong, with impressive output and many international contacts. Leiden plays a world-leading role in SE Asian tropical botany. The decision to merge the comparative morphology section with the above is sound. The Netherlands and European Flora section has high national but not high international importance. The Hortus Botanicus has important support and educational functions through its unique living collections, but is not a scientific research programme in its own right, and should not be justified as such.

The Rijksherbarium is also a world pioneer in the use of modern technology for plant systematic research (for example all type material can be accessed via the Internet).

The number of theses is low in comparison with the number of PhD students and it should be a matter of concern that so many PhD students do not finish their thesis within the allotted time period.

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## 3.2 University of Nijmegen

### > 3.2.1 *General observations*

The subfaculty of Biology in Nijmegen has five departments, each of which is responsible for a research programme. Each department consists of two or three research units directed by a full professor. One of the full professors is research director of the programme of the department.

The research of the subfaculty has been regrouped around the central theme Biocommunication which means the study of the mutual interactions of living cells and organisms, and the interactions of cells and organisms with the biotic and abiotic environment. Within this area the research has been further restricted to that of adaptive processes that are essential for life and survival of organisms, including man. This has led to three main points of research, each organised in an Institute. The five research programmes of the five departments each belong to one of these Institutes:

- the Nijmegen Institute for Microbiology, Ecology and Botany (NIMEP)
- the Institute for Cellular Signalling (ICS)
- the Nijmegen Institute for Neurosciences (NIN, associated with the Nijmegen Research School for Cognition and Information (NICI) which also covers research of the Faculty of Medicine and the Faculty of Social Sciences.

All biological research is embedded in accredited national Graduate Research Schools.

The present situation is the outcome of a substantial reorganisation started in 1995. In that operation all activities that did not significantly contribute to stimulating the quality of the biological research were discontinued. The department of Molecular and Developmental Genetics and the research unit of Animal Ecology were removed. For internal quality management the departments and research institutes submit annual reports to the subfaculty board and the board of the Faculty of Science. In its final opinion about the research quality the subfaculty considers similar parameters to those used in the VSNU Quality Assessment of Research. The research on genomic responses to extracellular signals was intensified by the appointment of a full professor to the vacant chair of molecular biology, and the ecological research in aquatic and semi-aquatic systems was intensified by the appointment of a full professor for aquatic ecology. As a result of recent retirements, and in accordance with the profiling policy, preparations have been started for chairs of Physiological Microbiology and Genetics, and Microbial Ecology. In 2001 Biology will be housed in a new building, which will effectively stimulate spatial and functional integration of the biology departments. The new premises will be part of a completely new Faculty of Science building, which can further improve the relationships with other science departments.

University	University of Nijmegen	
Research Institute	Institute for Cellular Signalling	
Programme	Genomic Responses to Extracellular Signals	
Programme Director	Prof. dr E.J.J. van Zoelen	
assessment	Quality	4
	Productivity	2
	Relevance	4
	Viability	4

The programme contains the research of three research units organised around the chairs of Cell Biology Molecular Biology and Applied Biology. The research unit of Cell Biology studies the molecular mechanisms of the conversion of the signals emitted by peptide growth factors into a genomic response and the control of cell proliferation. Research is done on the function of the growth stimulating epidermal growth factor (EGF), the related transforming growth factor (TGF- $\alpha$ , produced by a large variety of tumour cells), the human platelet-derived growth factor and their receptors, and the signal transduction intermediates. The scientific output of this research is of high quality and accordingly the group has a very good international position. This especially applies to the studies on EGF/TGF- $\alpha$  chimeras, the binding of these chimeras to their receptors and the induction of activity.

The parallel studies by the unit of Applied Biology on human bone morphogenetic protein involved in bone morphogenesis, are less spectacular and productive and make no important contribution to the programme.

During the assessment period the research unit of Molecular Biology continued, after the death of Prof. dr. J.G.G. Schoenmakers in 1994, the studies on the regulation of gene expression in the vertebrate eye lens system. The research focused on the structure of promoter elements involved in the regulation of the expression of crystalline genes during differentiation. The solid results paved the way for a shift towards studying the mechanism of regulation of crystalline gene expression by different growth factors. This promising shift may result in a productive collaboration with the Cell Biology unit. This part of the research programme is now absorbed within the new programme of Prof. H.G. Stunnenberg who was appointed at the end of 1996. This programme includes research on retinoic acid induced differentiation, the mechanisms of transcriptional signalling by class II nuclear hormone receptors and the role of nuclear receptors in leukemogenesis.

The subprogramme on the production of a transmission blocking vaccine against malaria, which was supervised by Prof. dr. R.N.H. Konings till his death in 1997, will be incorporated into that of the Molecular Biology unit. The research on the malaria vaccine met with many difficulties and made only very slow progress. The recent identification of transmission blocking epitopes on one of the factors involved in sexual stage specific gene expression bears some promise of significant progress.

In its present composition the programme in its entirety is coherent and promising. It has the potential of combined effort and may result in important contributions to medical application in prevention of tumour formation and treatment of disease.

University	University of Nijmegen	
Research Institute	Nijmegen Institute for Neurosciences	
Programme	Differentiation and Plant Development	
Programme Director	Prof.dr. C. Mariani	
assessment	Quality	4
	Productivity	2
	Relevance	4
	Viability	4

In the assessment period the group has put itself into a good position due to the choice of pollen as the dominant system studied and by concentrating its efforts on this and no longer on the secondary metabolites. Genetic approaches and molecular biology are well advanced in the group. The use of pollen with its 2 - 3 haploid cells is unique in comparison to systems studied by most other groups in developmental plant biology. The research director appropriately emphasises that developmental biology in plants has its peculiarities and should not be necessarily linked to animal developmental biology. The pollen system allows the adequate studies. The *Petunia*-system was chosen deliberately because of the large germ plasma collection in the Netherlands, while moreover a transposon saturated line is available and can be used to isolate mutants. *Arabidopsis thaliana*, genomics and analogies shall be nevertheless considered. Strong plant groups are important in universities and this group contributes much to the reputation of KUN in this respect.

Although publications are placed in high impact journals, the publication record is small by volume and on the average line in the bibliometric analysis. The research director had to establish her new group at KUN during the last 5 years with very limited personnel and facilities. Good greenhouse facilities are very important for the research of this group and it is essential that these will be provided when Biology moves to a new building. However, although priority of quality remains a strong choice in publication policy, quantity is envisaged to be also increased in the future. The research director is only rarely co-author of papers which also is a special publication policy giving more junior staff members the chance to lead.

University	University of Nijmegen	
Research Institute	Nijmegen Institute for Neurosciences	
Programme	Adaptation Physiology of Animals	
Programme Director	Prof. dr. S.E. Wendelaar Bonga	
assessment	Quality	3
	Productivity	4
	Relevance	4
	Viability	4

The research programme on adaptation physiology of animals is carried by the joint efforts of three research units, each headed by a chairholder, specialised respectively in organismal animal physiology, cellular animal physiology and molecular animal physiology. The research is mainly done with the amphibian *Xenopus laevis* and the fish *Tilapia*. The biology of these lower invertebrates is well known and they lend themselves well for studying fundamental mechanisms of adaptation. The three groups collaborate and share their expertise in studying the two animal objects they have chosen, enabling integrative approaches at different levels. The group is well funded and has a large number of collaborations with groups in the Netherlands and different European countries.

The research is directed to understanding the neuroendocrine regulation of adaptation to different stressors. Organismal aspects include the action of stressors on brain, pituitary gland and peripheral organs. This research is mainly done with fish and is of strategic significance for the management of environmental problems and for aquaculture.

For the cellular and molecular aspects of adaptation research the emphasis is on *Xenopus laevis* in which the functioning of neurons and endocrine cells is studied with special attention to the mechanisms underlying neuronal signal transduction involved in the skin colour adaptation response of *Xenopus* to light. The molecular research has as main theme the molecular mechanisms of the secretory in neuronal and endocrine cells and the development of the neuroendocrine system in the *Xenopus* embryo. Besides the group working on the molecular aspects of adaptation is developing an interest in the molecular pathology of ageing and neuronal diversities, and expects its research to be directed more and more to the biomedical science fields.

Though the communication within the group as a whole seems to be good, the work at the different levels is not fully integrated. The group has prominent leaders and produces a good proportion of papers in high-ranking journals but as yet recent research has generated few remarkable discoveries. As the group leaders are involved in many different activities, diffusion of mind may prevent the group from reaching real excellence.

University	University of Nijmegen	
Research Institute	Nijmegen Institute for Microbiology, Ecology and Botany	
Programme	Methanogenesis	
Programme Director	Prof. dr. ir. G.D. Vogels	
assessment	Quality	4
	Productivity	3
	Relevance	4
	Viability	-

The group has a good reputation in the field of physiology, biochemistry and ecology of methanogenesis, as well as in the area of microbial associations with digestive systems of higher animals. The latter is also concerned with evolutionary aspects, especially coevolution of microbes and hosts. Further activities deal with prebiotic and early biotic evolution. The studies are of major concern not only for basic science but also with respect to application in animal sciences and waste management. The productivity is good, with most of the papers in journals of high quality.

Since both group leaders will retire within two years the future of the group is rather open. The evaluation committee appreciates the plans to concentrate for the future on microbiology, including biochemical/molecular and ecological aspects. Nonetheless, the field should not be confined too closely around those experiences and techniques presently available in the department. Depending on the available candidates, other fields of scientific interest might be just as welcome as those defined in the present plans.

University	University of Nijmegen	
Research Institute	Nijmegen Institute for Microbiology, Ecology and Botany	
Programme	Ecological Research in Aquatic and Semi-aquatic Systems	
Programme Director	Prof. dr. C.W.P.M. Blom	
assessment	Quality	4
	Productivity	4
	Relevance	4
	Viability	4

This group has been strengthened since the last evaluation by the appointment of Prof. dr. J.M. van Groenendael to a chair in aquatic ecology and a new sub-programme on Biogeology and Survival under Stress has also emerged. The research is published in good quality international journals and is of wide interest. The work on adaptation of semi-aquatic plants to flooding is an excellent example of an ecophysiological investigation from the molecular to the whole plant and field situation. The long term research on atmospheric deposition, particularly nitrogen deposition, is also well known internationally. The recent moving of two skilled researchers to positions at Utrecht University is further evidence of the quality of the research of the group, but at the same time gives the possibility to start new research activities. The overall viability of the programme appears to be good and the researchers are taking advantage of the most modern techniques to advance their work.

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### 3.3 University of Amsterdam

#### > 3.3.1 General observations

During the assessment period the research of the Faculty of Biology at the University of Amsterdam consisted of 6 programmes, which will be reviewed and assessed in the following section. Each programme has several subprogrammes headed by a chairholder. The different programmes are each part of an Institute within the Faculty and/or an accredited national Graduate Research School.

- The Institute of Neurobiology (IN), including the full chairs of zoology, animal physiology and cellular and molecular neurobiology, carries out research on neuronal plasticity of the nervous system at the molecular, cellular and network levels.
- The Institute of Molecular Cell Biology (IMCB), including the full chairs of molecular biology, molecular cytology, plant physiology and phytopathology, has a programme of research on molecular and cell biology of plants and micro-organisms.
- The Institute of Systematics and Ecology (ISO) including the chairs of Animal Systematics and Bio-geography, Evolutionary Biology, Experimental Plant Systematics, Population Biology and Geo-ecology carries out the programme called Analysis of Patterns and Processes of Biodiversity in the past and the present, and the programme on Dynamics of Quaternary Geoecosystems.
- The research programme on Aquatic Ecotoxicology and experimental biology of inland waters is part of the interfaculty institute ARISE (Amsterdam Research Institute for Substances in Ecosystems)

The research programme on Ecology of Fresh Water Plankton is separate, but part of the Graduate Research School SENSE.

The Faculty is in the process of restructuring, which involves the merger of the beta-faculties (Biology, Chemistry, Physics, Astronomy, Informatics, Mathematics and Physical Geography) into one Faculty of Science. Out of the existing institutes a limited number of new institutes will be formed with research priorities in areas in the natural sciences. In that way it should become possible that especially biology benefits more than before from the disciplines and expertise in the area of physics, chemistry and informatics. Indeed, these disciplines are becoming increasingly important for biological research.

After the reorganisation biological research will be concentrated in two institutes:

- The Swammerdam Institute of Life Sciences. This institute merges the IMCB, the IN and the E.C. Slater Institute of Biochemistry (now an institute of the Faculty of Chemistry).
- The Institute of Biodiversity and Ecosystem Dynamics (IBED). This Institute will contain the ISO, the Department of Physical Geography and ARISE, which is affiliated with the Faculty of Chemistry.

These new Institutes will be established October 1, 1999. At the same time the construction of new buildings and facilities is started in the Watergraafsmeer and in the coming five years the Faculty of Science, including Biology, will become part of the Scientific and Technological Centre Watergraafsmeer.

All these activities are evidence of a great deal of effort to improve and modernise the conditions for innovative research in the natural sciences, including biology.

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Of direct importance for the biological research is the decision to fill a vacant position as soon as possible for the chair in Experimental Plant Systematics, which will strengthen the coherence of the present research on systematics and ecology, now in the ISO.

New impulses to the biological research may be expected from the new 'Pioneers' recently assigned to the research team of the Institute of Neurobiology, and to the Institute of Systematics and Ecology.

In the near future the chairs for Plant Physiology and Molecular Cytology will become vacant due to retirement of the present chairholders and will be filled again, offering further possibilities to explore new research opportunities.

University	University of Amsterdam	
Research Institute	Institute of Biodiversity and Ecosystem Dynamics	
Programme	Zoological Systematics	
Programme Director	Prof. dr. F.R. Schram	
assessment	Quality	3
	Productivity	5
	Relevance	2
	Viability	2

This group is concerned with the systematics of a diverse array of animal groups including - amongst others- sponges, flatworms, decapods, cicadas, craneflies, lepidopterans and birds. The Committee had considerable difficulty in reviewing this group, partly because much of its output arose from non-core members, and because assessment of the research output is complicated by issues of taxonomic collection management.

Taxonomic work is often viewed as unfashionable, yet is extremely important in biodiversity studies. The University of Amsterdam should play a critical role in animal systematics in the Netherlands and more widely, yet considering the size of the group and the importance of its collections, the Committee considered the quality of the work not very high, especially that from core members. The Committee was concerned about the commitment of the group to basic descriptive alpha taxonomy, and was very worried about the future of taxonomic research in Amsterdam. There is a need for strong leadership in this area.

University	University of Amsterdam	
Research Institute	Institute of Biodiversity and Ecosystem Dynamics	
Programme	Evolutionary Botany	
Programme Director	Dr. J.C.M. den Nijs	
assessment	Quality	4
	Productivity	3
	Relevance	4
	Viability	3

This group has focused on an understanding of phylogenetic relationships and evolutionary mechanisms in polyploid species complexes, and aims to further develop these studies using molecular techniques. The departure of Professor Bachmann and the vacant chair raise questions as to the direction and activity of the group. However, the approach and output during the review period have been generally good. Publications, although relatively few in number, have been largely in good quality international journals, and there is every prospect that the group will flourish in the future. However, the direction of the research will depend largely on the person appointed to the chair. The group might make important contributions to studies of biodiversity and to the potential ecological importance of the use of transgenic crops.

University	University of Amsterdam	
Research Institute	Institute of Biodiversity and Ecosystem Dynamics	
Programme	Multitrophic interactions	
Programme Director	Prof. dr. M.W. Sabelis	
assessment	Quality	5
	Productivity	5
	Relevance	4
	Viability	4

This group is metamorphosing from an experimental group with particular expertise in mites, to a group that is predominantly composed of theoretical biologists. It is very well thought of internationally and makes itself felt by a high production of papers of very good quality. It is well led and with the appointment of two gifted young researchers it has the capability of producing excellent work, especially if it maintains its current links between theoretical and experimental studies.

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University	University of Amsterdam	
Research Institute	Institute of Biodiversity and Ecosystem Dynamics	
Programme	Dynamics of Quaternary Geo-ecosystems	
Programme Director	Prof. dr. H. Hooghiemstra	
assessment	Quality	4
	Productivity	5
	Relevance	4
	Viability	3

This group studies the quaternary ecology of Europe and the tropical Americas and the vegetation ecology of the tropical Americas. It has excellent international contacts, and it plays an active part in a number of programmes including TROPENBOS. Members of the Group have received international recognition for their work including Prof. dr. A.M. Cleef's share of the 1996 Körber prize. Overall the publication record is good, but the vegetation ecology sub-programme in particular could benefit from targeting journals of higher international impact. There are excellent prospects for the development of this group's research, but the decline in personnel is seen as limiting both internal and external collaboration.

University	University of Amsterdam	
Research Institute	Institute of Life Sciences	
Programme	Plant Physiology	
Programme Director	Prof. dr. H. van den Ende	
assessment	Quality	4
	Productivity	?*
	Relevance	3
	Viability	3

The main interest of this group is in developmental biology, which is studied in yeast and in the green alga *Chlamydomonas*.

The yeasts are used to study the dynamics of the cell wall, especially the regulation of the synthesis and assembly of the cell wall and the specific morphogenic responses to signals generated during the cell cycle or generated by changes in environmental conditions. The research is of good quality and results in better understanding of the control mechanisms of the molecular architecture of the cell wall.

In *Chlamydomonas* the research is focused on the sexual development and cell cycle control and the signals involved in these processes. Of special interest in *Chlamydomonas* are the studies on the role of second messengers derived from phospholipids in the plasma membrane, as these studies may result in models for phospholipid signalling in higher plants.

The group is well known for its long standing work on *Chlamydomonas* and it is presently involved in preparing a *Chlamydomonas* Genome project, which would improve the role of *Chlamydomonas* as model organisms. On the other hand the group plans to move on to higher plants and this seems a good decision for the future.

\* (The productivity score could not be calculated because no separate data were provided for these UvA-subprogrammes).

University	University of Amsterdam	
Research Institute	Institute of Life Sciences	
Programme	Molecular Cytology	
Programme Director	Prof. dr. N. Nanninga	
assessment	Quality	4
	Productivity	?*
	Relevance	4
	Viability	4

The group is active in studying the process of cell division and cell shape maintenance in *Escherichia coli*, especially the biochemical changes of the peptidoglycan layer and the process of DNA partitioning. A further subgroup deals with the development of new techniques for spatial analysis of cell components in the growing bacterial cell, using confocal microscopy in combination with specific fluorescent markers. Both subprograms have developed very successfully, and the results have been published in journals of good to very good quality. Especially the second subgroup has been extremely successful, and the new techniques developed are gaining interest on a broad scientific market. The group has also an outstanding record in external cooperation, both national and abroad.

\* (The productivity score could not be calculated because no separate data were provided for these UvA-subprogrammes).

University	University of Amsterdam	
Research Institute	Institute of Life Sciences	
Programme	Molecular biology	
Programme Director	Prof. dr. L.A. Grivell	
assessment	Quality	5
	Productivity	?*
	Relevance	4
	Viability	4

The group produces excellent research on the assembly of a functional mitochondrion, and the co-ordinated expression of genes in mitochondrial and nuclear DNA and the import of proteins into mitochondria. Of special interest is the discovery of a quality control system during the assembly of functional respiratory complexes and furthermore the identification of novel components of the translocation machinery of the inner mitochondrial membrane.

The group has been involved in the *Saccharomyces cerevisiae* genome project which has resulted in the complete genome sequence of this yeast. It has also improved studies using reversed genetics for unravelling the functioning of components in the mitochondrion.

Spin-off in terms of biotechnological application is good. The graduate research schools with their mixture of research and education are considered as a good and welcome instrument to foster contacts, ideas and enthusiasm among PhD students.

The post-doc situation is considered as a great bottle-neck, because it has little perspective for tenure track positions.

\* (The productivity score could not be calculated because no separate data were provided for these UvA-subprogrammes).

University	University of Amsterdam	
Research Institute	Institute of Life Sciences	
Programme	Plant Pathology	
Programme Director	Prof. dr. B.J.C. Cornelissen	
assessment	Quality	4
	Productivity	?*
	Relevance	4
	Viability	4

The group is studying plant-pathogen interactions with modern genetic, cytological and molecular biological approaches. The programme director sees a highlight in their work on molecular biology of *Fusarium* and tomato-*Fusarium* interactions. Several signalling compounds and key gene products are analysed. A real focus apparently still needs to be defined.

The publication record still is not as large as it might be. The Committee asks the question if in such a pathology-oriented programme there might be (hidden?) productivity other than publications. The group has invested in establishing the system under study and now harvest in terms of productivity (in terms of productivity in publications and otherwise) must come up in 1999 and onwards.

Another point needing attention is the small staff size. Is there the critical mass for such an interesting programme? Can the outside funding of this subprogramme be increased (NWO; industry)? These critical points taken care of, the group may have the potential to advance to excellence in the future.

\* (The productivity score could not be calculated because no separate data were provided for these UvA-subprogrammes).

University	University of Amsterdam	
Research Institute Programme	Institute of Life Sciences Neuronal plasticity of the nervous system at the molecular, cellular and network levels	
Programme Director	Prof. dr. F.H. Lopes da Silva	
assessment	Quality	4
	Productivity	3
	Relevance	4
	Viability	4

The theme of neuronal plasticity at the molecular, cellular and network levels is pursued in six subprogrammes, leading to improved understanding of effects potentially relevant to epilepsy, depression and the effects of stress on gut function. The group is motivated principally by fundamental scientific problems, but medical funding has drawn them to particular areas. The group now has a second Pionier, but has not received as much support as it had hoped, in its pursuit of excellence, from the University administration. There is a reasonable output of interesting papers in journals of high quality. The group has several very good scientists and seems to have extensive expertise for biochemical, biophysical, electrophysiological and histological studies on the functioning of the nervous system and the pathophysiology of disease states. The group has started to incorporate the use of knock-out mice and transgenic animals in the research on the function of specific molecules in neurons. If the findings of such experiments can be combined with electrophysiological studies, the group will keep a prominent position on the international scene and further advance to excellence.

University                      University of Amsterdam

Research Institute  
Programme                      Aquatic Ecology  
Programme Director         Dr. P. Coesel

assessment                    Quality                      3  
   Productivity                3  
   Relevance                   3  
   Viability                    1

Research has been aimed at understanding the mechanisms underlying species composition and behaviour of freshwater plankton. This research has now been terminated. The results have been published in appropriate journals. The work of this group was terminated in 1998.

University	University of Amsterdam	
Research Institute Programme	Institute of Biodiversity and Ecosystem Dynamics Aquatic ecotoxicology and environmental biology of inland waters	
Programme Director	Prof. dr. W. Admiraal, prof. dr. I.R. Mur	
assessment	Quality	3
	Productivity	3
	Relevance	4
	Viability	4

The Aquatic Ecotoxicology group studies the effects of organic micropollutants and heavy metals on benthic communities whereas the Environmental Biology of Inland Waters sub-group focuses on the effects of eutrophication. The latter include fundamental ecophysiological studies of cyanobacteria, and this sub-group has published a number of papers in major international journals. The group as a whole is well represented in EU programmes and has a number of international contacts. The emergence of a new integrated science faculty will stimulate further potential collaboration, and has already resulted in a special aquatic sciences plan with input from the 'old' faculties of chemistry and biology. The work is generally well funded reflecting the high societal relevance of many parts of the programme.

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## 3.4 Vrije Universiteit Amsterdam

### > 3.4.1 General observations

In the past five years several steps have been taken with the aim to enhance the research profile of the VU and the faculty board has taken the initiative to renew the research programmes in the majority of the research groups. The biological research in the Faculty of Biology is now done by 13 rather small research groups, each of which is led, in principle, by a full professor.

The Faculty has formed three research institutes which were given mandate concerning finance and personnel.

- The Institute of Molecular Cell Biology (IMBW) contains the departments of genetics, developmental genetics, molecular microbiology, molecular cellphysiology, and structural biology. The institute is part of an Interfaculty Institute of Molecular Biological Sciences which includes biochemical and biophysical departments.
- The Institute of Neurobiology (ION) with the departments of molecular and cellular biology, membrane physiology and developmental biology of the nervous system. The institute is part of the Interfaculty Research Institute of Neuroscience which includes medical departments.
- The Institute of Ecological Sciences, including the departments of animal ecology, ecology and ecotoxicology of plants, system-ecology and theoretical biology. The institute is part of an interfaculty institute (the research institute Amsterdam Centre for Environmental Sciences) formed by various beta and gamma research groups.

In addition, the Faculty contains the research group Biology and Society.

All institutes and research groups are part of accredited Graduate Research Schools. IMBW belongs to the research school BioCentre Amsterdam, which has as its main theme the Macromolecular Dynamics of the Living Cell.

The Institute of Neurobiology (ION) belongs to the research School Neurosciences Amsterdam (ONWA), which focuses its research on (dys)functions of neuronal networks.

The Institute of Ecological Sciences is part of the Graduate Research School for the Socio-Economic and Natural Sciences of the Environment (SENSE), which focuses its research on the analysis of substance flows through the environment and society.

The research group Biology and Society participates in the Graduate Research School Science, Technology and Modern Culture (WTMC).

As much as possible, the research activities of the faculty research institutes are geared to the research programmes of the Research Schools.

In the assessment period the development of new research was stimulated by new appointments to the chairs in Microbial Physiology, Molecular Microbiology, System Ecology and Developmental Neurobiology. Very soon the appointment to a chair in Structural Biology is to be expected. Three more professors will retire in the coming five years, which offers further opportunities for new initiatives. The faculty is in the advantageous position that it can compete for considerable grants from the Vrije Universiteit Research Fund, aimed at newly appointed professors in exciting new research areas. In the near future the chair of Genetics will become vacant and the proposed new field for this chair will be 'Epigenetics' or 'Neurogenetics'. These are indeed exciting areas of genetics, and of great interest for biological research as well as for medical research. The filling of other coming vacancies in chairs will be critical for further increasing the coherence in the different programmes. This applies especially to the plant research that may greatly benefit from a chair in modern molecular and cell biological plant physiology.

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The Faculty has introduced a system to maintain and increase the quality of research. Regular assessments of professors and staff are carried out by both the institutes and the faculty board. Temporary increase of salary for excellent performance is possible, and a special feature of this system is that an attractive financial reward is given to a group which has published a paper in a high impact journal. The Committee fully agrees on a system for encouraging and rewarding good quality research but feels that there are grave dangers if such a policy would make high impact factors, rather than scientific quality, the principal aim. The Faculty considers extending the bonus system to a system that more broadly monitors the good quality of research.

As a result of the different initiatives biological research at the Vrije Universiteit is moving strongly. The potential for new exciting research has been strengthened and creates high expectations.

University	Vrije Universiteit	
Research Institute	Institute Neurosciences	
Programme	Molecular and cellular basis of neurocommunication	
Programme Director	Prof. dr. W.P.M. Geraerts	
assessment	Quality	4
	Productivity	3
	Relevance	4
	Viability	4

This group pursues three related themes of research on neurocommunication largely through studies of moluscan brain preparations. These relate to synapse formation, neuronal plasticity and complexity of neuronal signalling. The programme is coherent and the long standing interest of the group in the molecular basis of (peptidergic) neurocommunication has resulted in excellent expertise. Moreover, the group has good international collaborations. Recently, the group has introduced synapse formation and neuroplasticity as important topics of its neurocommunications research. The research is productive and the quality of the work is reflected by the number of publications in journals of the highest standing.

The group is transferring its interests from the invertebrate to the vertebrate brain and will exploit more fully the potential of gene technology in mouse as a model organism. A reinforcement of the molecular approach promises to increase the basic understanding of synapse formation, neuroplasticity and neuronal signalling. The renewal of the research programme in the last years has been succesful and also the programme for development looks very promising with the growing success in acquiring extramural funds and the investments in advanced experimental methods and techniques the group has good opportunity to further advance to excellence.

University	Vrije Universiteit	
Research Institute	Institute Neurosciences	
Programme	Membrane Physiological Basis of Neurotransmission	
Programme Director	Prof. dr. T.A. de Vlieger	
assessment	Quality	4
	Productivity	4
	Relevance	4
	Viability	3

This small group has worked on calcium channels, on GABAergic synaptic transmission and actions of neuropeptides, and the research is of good quality. A major decision has been to shift from the snail *Lymnaea* as experimental animal to using the rat, and the supra-optic nucleus of the hypothalamus was chosen for studying a peptidergic, neuroendocrine system.

The group aspires to do physiology that relates to important medical problems.

The chair is now vacant, and a replacement is to be sought in the field of chemical transmission in mammalian systems. The prospects of the group depend critically on a candidate of high quality being found, in this rather closely defined field.

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University	Vrije Universiteit	
Research Institute	Institute Neurosciences	
Programme	Developmental Neurobiology	
Programme Director	Prof. dr. M.L. Gahr	
assessment	Quality	3
	Productivity	3
	Relevance	4
	Viability	4

This group has been working on the functioning of neural networks, especially in molluscs; and on changes in neural networks during the lifetime of the snail *Lymnaea* attributable to the effects of parasites. Cooperation with group VU1 led to the two groups having one of their key papers in common. The group is in course of re-structuring, following the death of Professor Boer and the recruitment of Professor Gahr, who intends to re-focus the group on sex-hormone dependent neural development studied by experiments on bird song. New appointments of two postdoctoral researchers and one UD will assist the transition, but we are concerned that it may not be easy to redirect the efforts of longstanding staff members.

University	Vrije Universiteit	
Research Institute	Institute of Molecular Biological Sciences	
Programme	Molecular Basis of the Regulation of Cell Function	
Programme Director	Prof. dr. H.V. Westerhoff	
assessment	Quality	4
	Productivity	5
	Relevance	4
	Viability	5

This group has been established only four years ago. Based on the experience established by Prof. Stouthamer and his coworkers, the group concentrates today on regulatory aspects of metabolism of *Escherichia coli*, *Paracoccus denitrificans*, and *Sacharomyces cerevisiae*. Physiological aspects are combined with modern molecular studies on regulation in a very successful manner which is promising also for the future, including new aspects of NO metabolism in nitrogen compound transformations by *Paracoccus* and *Nitrobacter*. The new group leader, prof. Westerhoff, has introduced his expertise in mathematical analysis and modelling as an important component of the research. This is now applied to regulatory networks, metabolic modelling and metabolic control analysis of cellular energetics a.o. It puts the group in a very good position for a leading role in the further development of the quantitative analysis of the molecular mechanisms of cellular complexity. Of special interest appears the possible application of the present experience also in the field of development of tumor cells. The group leader is very active in scientific organisations; the publication record is very good with respect to quantity and quality.

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University	Vrije Universiteit	
Research Institute	Institute of Molecular Biological Sciences	
Programme	Protein Secretion Pathways in Bacteria	
Programme Director	Prof. dr. B. Oudega	
assessment	Quality	4
	Productivity	4
	Relevance	5
	Viability	5

This group has been established only three years ago. The research concentrates on the excretion of proteins across the inner and outer membrane of Gram-negative bacteria, using *E. coli* as a model system. The group has been extremely successful and is one of the leaders in the field, cooperating with excellent groups in the Netherlands and abroad. Also the developing perspective of protein targeting appears promising for the future. The productivity has been good with papers published in excellent journals.

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University	Vrije Universiteit	
Research Institute	Institute of Ecological Sciences	
Programme	Ecology and Ecotoxicology of Soil Invertebrates	
Programme Director	Prof. dr. N.M. van Straalen	
assessment	Quality	4
	Productivity	4
	Relevance	4
	Viability	4

This group studies the responses of soil invertebrates to their environment and their effects on nutrient cycling and decomposition. It has extended the range of techniques and approaches used during the last five years, but is largely centred on applied ecotoxicology. The programme is well developed, with some innovative approaches, and has resulted in a number of papers in highly-rated international journals. More emphasis on publication in these journals would improve the group's profile. The use of overheads from applied projects to support the fundamental science base is to be applauded.

University	Vrije Universiteit	
Research Institute	Institute of Ecological Sciences	
Programme	Adaptation Mechanisms of Plants to Stress	
Programme Director	Prof. dr. W.H.O. Ernst	
assessment	Quality	3
	Productivity	4
	Relevance	4
	Viability	3

The Committee recognises that the contributions of the group in the field of metal tolerance ("heavy metals"), *viz.* uptake and membrane transport (plasma membrane, tonoplast), partitioning, ecophysiological implications, are important, so that internationally the group has good reputation and is well known for its perception of the field. There are also a few good publications in high impact journals on stress physiology (UV-B, CO<sub>2</sub>).

The latter has good future viability as the plant/atmosphere interactions and global-change problems will be a separate research programme headed by Prof. Dr. R. Aerts newly appointed to VU, which is an important strengthening of this subfield of the plant sciences at VU. The question regarding viability of the rest of the programme remains open since the present programme director is due to retire in 2002. Filling this position again will be very critical for VU. Strengthening of green-plant based groups is necessary, in view of the observation that - not the least due to the successful and hence dominating biomedicine programme in VU's biology faculty - plant physiology tends to get out of the trend and needs more support in the university.

Moreover, other groups (Prof. Aerts, Plant Development I and II, Plant Bioenergetics and Signal Transduction) especially need plant physiology. A good opportunity is given if a new professor in plant physiology is searched for, who covers the modern trends in this field, *viz.* molecular and/or cell biological plant physiology, and who with such a background can but does not need to be working in ecology (molecular ecophysiology of plants).

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University	Vrije Universiteit
Research Institute Programme Programme Director	Research Strategies for Technological Innovations Dr. J.F.G. Bunders
assessment	Quality - Productivity - Relevance - Viability -

The research programme of this group is focused on the analysis of decision making processes in biological innovations, including research, development, and dissemination, in order to develop strategies for generating appropriate innovations for specific end user groups. The group investigates the interaction between natural and social sciences and the role of interactive research methodologies in this interface.

Major parts of the programme are the interactive bottom-up approach in biotechnology research and development, and technology assessment and nature development.

The activities of the group are not biological research as such and the assessment of the programme with respect to content is not within the competence of the present review committee. This research programme should be assessed in the context of the Graduate Research School of which it is part.

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University	Vrije Universiteit	
Research Institute	Institute of Molecular Biological Sciences	
Programme	Plant Development I	
Programme Director	Prof. dr. J.N.M. Mol	
assessment	Quality	5
	Productivity	3
	Relevance	4
	Viability	4

Spatio-temporal pattern formation is the current theme in developmental biology. The group has access to a very good collection of *Petunia* and uses this to study plant development with genetic approaches of excellent quality. Development is exemplified by the anthocyanin biosynthetic pathway, and the work is focused on co-ordination of gene expression, gene silencing, transcription and regulation of genes of the pathway at the molecular level. The output of publications is not high in terms of quantity but very high in terms of quality and impact.

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University	Vrije Universiteit	
Research Institute	Institute of Molecular Biological Sciences	
Programme	Plant Development II	
Programme Director	Prof. dr. H.J.J. Nijkamp	
assessment	Quality	4
	Productivity	3
	Relevance	4
	Viability	3

The group studies genetics of seed development and disease resistance at a high level of mutational and molecular biological approaches. The impact and relevance of the project is particularly high in the field of biotechnology. Some important members of the group have left and it is not totally clear to the Committee which implications this may have for long-term viability. The bibliometric profile is significantly above average for the last 10 years and significantly below average for the last 5 years. Further development also depends on the prospects of green-plant based science at VU.

University	Vrije Universiteit	
Research Institute	Institute of Molecular Biological Sciences	
Programme	Plant Bioenergetics and Signal Transduction	
Programme Director	Prof. dr. R. Kraayenhof	
assessment	Quality	4
	Productivity	3
	Relevance	3
	Viability	4

The international competition in the field of molecular functions of energy transducing membranes (photosynthetic membranes, mitochondria) which is covered by the present group, is extraordinarily high, with Nobel prizes handed out to some of its protagonists. Nevertheless, the group has certainly used the challenge for producing good to excellent work, particularly also with respect to structural biology aspects. The Committee notes with pleasure that well known peers with good international prominence are among the younger team members (UD, UHD). Indeed, the research on cyanobacterial  $F_1/F_0$ -ATPase and on fusicoccin/14-3-3 proteins is very fine work, and the studies on the respiratory pathway with alternative routes (branched respiratory networks) are important contributions.

Can long-term viability be sustained at this level in view of the very strong international competition? How shall this be achieved? Regarding international competition it is noted that the group has found a good niche looking at three-dimensional structures of plant membrane proteins and their fast dynamics. With this the group, however, much depends and relies on the appropriate filling of the new chair of structural biology at VU for further viability.

University	Vrije Universiteit	
Research Institute	Institute of Ecological Sciences	
Programme	Mass and Energy Fluxes in Biota	
Programme Director	Prof. dr. S.A.L.M. Kooijman	
assessment	Quality	3
	Productivity	4
	Relevance	3
	Viability	3

The Committee found this a difficult programme to assess. The group specialises in modelling the energy budgets of individuals using an approach they have developed themselves called dynamic energy budget (DEB) theory. Among the theoretical biology community, the group's work is widely known, though it is poorly cited and has had relatively little impact on how other workers model individual organisms. However, the group believes that the superiority of their approach is such that it is only a matter of time before it is generally accepted.

While this may be true, the Committee felt that stronger leadership was required in arguing the case for the group's work. A more pluralistic approach to the range of modelling techniques employed might be helpful, relating DEB theory to more widely accepted approaches to population ecology; as well as more collaborations with workers in related fields; and a greater volume of publications in international journals. The Committee was concerned that the very narrow theoretical focus of the group might jeopardise its long term viability.

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## 3.5 University of Groningen

### > 3.5.1 *General observations*

At the University of Groningen, Biology is a department of the Faculty of Mathematics and Natural Sciences. Biological research consists of the research programmes centered on the structural chairs of biology which belong to this department. Since the beginning of the current evaluation period three research institutes were established in which the different groups with their research programmes are clustered, thus defining three areas on which the department wants to concentrate its research:

- Biomolecular Sciences and Biotechnology
- Brain and Behaviour
- Ecology, Ecophysiology and Marine Biology.

Two of the research institutes extend beyond the borders of biology as a research discipline and provide close collaboration with neighbouring fields of study, whereas one research institute covers collaborative research with groups of other universities.

The institutes are accredited Graduate Research Schools or part of a Graduate Research School.

- The Groningen Biomolecular Sciences and Biotechnology Institute (GBB). This Graduate Research School incorporates six biological subprogrammes and the research of eleven groups from the department of Chemistry. This collaboration provides a strong programme of structural biology.
- The Institute Behavioural and Cognitive Neurosciences (BCN). This Graduate Research School is a strongly multi-disciplinary institute in which groups from the Medical Faculty, the Faculty of Psychology and Social Sciences, the Faculty of Arts and the Faculty of Philosophy participate. Biology is represented in this Institute by three subprogrammes.
- The Centre for Ecological and Evolutionary Studies (CEES) unites six subprogrammes of biological research and participates in the Graduate Research School Functional Ecology, together with groups from Leiden, Utrecht and Nijmegen.

In the three areas of research covered by the Institutes the quality of biological research on the whole is very good and each Institute has some strong groups that make excellent contributions which are internationally held in high regard, especially in microbiology, animal behaviour, and animal and plant ecology.

During the assessment period there were new appointments to the chairs of genetics, microbial ecology and molecular plant biology, which promise initiatives for new research. However, the Committee noted that the reshaping of the research programme of the chair of developmental genetics met some difficulties; the Committee wonders whether this chair, which is now part of GBB, should not join the Institute BCN. The research in neurobiology lacks the molecular genetic approach, which, in view of the development of functional genomics, will be essential for the further development of the research in this field. The expertise and knowledge of the chair of genetics could provide a reinforcement of the neurobiological research.

In the coming five years the department of Biology will be confronted with a large number of retirements, which involve chairs that have greatly contributed to the strong characteristics of Groningen biological research, e.g. in molecular microbiology, animal ecology. Although the importance of an excellent replacement of the present chairholders is self-evident, the Committee wants to underline the importance of a strong plant physiology characterised by research on whole plant functions using molecular-biological methodology, and with good connections with the chair of molecular plant biology.

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University	University of Groningen	
Research Institute	Behavioural and Cognitive Neurosciences	
Programme	Neurobiology	
Programme Director	Prof. dr. B. Bohus	
assessment	Quality	3
	Productivity	3
	Relevance	4
	Viability	3

Subgroups are working on sensory information processing (especially in insects); on the role of the limbic forebrain in learning and memory; on neural regulation of energy balance; and on neuroendocrinology of mood. Much of this work has strong medical relevance. The work on insects will be discontinued after a retirement in 2000. The prominence of leading members of the group is indicated by numerous invitations to give keynote talks. Nevertheless, recent progress has included few notable developments.

A proposal to establish a chair in molecular neurosciences is pending. Indeed the research will gain considerably by using molecular biological techniques and genetic technology. That will also make sure that the research keeps up with international developments.

University	University of Groningen	
Research Institute	Behavioural and Cognitive Neurosciences	
Programme	Animal Behavior	
Programme Director	Prof. dr. S. Daan	
assessment	Quality	5
	Productivity	4
	Relevance	4
	Viability	4

This excellent and productive group with a distinguished leader has one subgroup concerned with life cycle fitness especially in birds (concerned with development of behaviour, with energy allocation and with investment in the sexes); and another concerned with circadian rhythms. The work on birds is of exceptional quality and interest, and there are strong and highly beneficial links with the Animal Ecology group (RUG6), which is also notable for its work on birds.

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University	University of Groningen	
Research Institute	Behavioural and Cognitive Neurosciences	
Programme	Behavioral physiology	
Programme Director	Prof. dr. J.M. Koolhaas	
assessment	Quality	4
	Productivity	4
	Relevance	4
	Viability	4

This group is concerned with the behavioural physiology of dealing with problems, and with responses to the stress of social defeat. Its scope overlaps with that of group RUG1, with whom they cooperate, making use of the complementary skills of the two groups. There is also good interaction with groups RUG2 (Animal Behaviour) and RUG6 (Animal Ecology) on coping styles and their consequences for the animal's fitness. The group also includes in its research programme the development of multimedia teaching materials for animal physiology, but we regard this activity more as development than as research.

University	University of Groningen	
Research Institute	Centre for Ecological and Evolutionary Studies	
Programme	Plant Ecology	
Programme Director	Prof. dr. J. van Andel	
assessment	Quality	3
	Productivity	4
	Relevance	5
	Viability	4

The work of this group is largely descriptive of vegetation dynamics in various natural, semi-natural and agriculture-affected systems mainly in the Netherlands (with some interests developed for Eastern Europe - Poland - for reference). Theoretical analyses are included in the approaches, while heuristic experimental interference still could be intensified. With respect to the advancement of basic ecological understanding, theory and new hypotheses this descriptive work remains standard, dwelling on established grounds. However, the Committee realises the high societal relevance of the programme which provides predictive models and operational grounds for restoration ecology. This gives the programme a touch of a kind of service programme which is also reflected in the substantial amounts of research funds obtained from political sources (ministries and the like). Thus, the long term funding of this ecological work looks secure. It is noted that it is quite adequate and important that in places universities are in the position of making such contributions on a sound scientific basis, and therefore the programme should be sustained. A special pride of the group are the prizes and awards obtained for doctoral theses. A bottle-neck appears to be the small size of the group in view of strong competition in the field.

University	University of Groningen	
Research Institute	Centre for Ecological and Evolutionary Studies	
Programme	Population Genetics	
Programme Director	Prof. dr. W. van Delden	
assessment	Quality	4
	Productivity	3
	Relevance	3
	Viability	3

This programme studies the evolutionary and ecological consequences of genetic variation under three main themes: the relation between genetic variation and fitness; conservation genetics; and theoretical aspects of selection processes. This research is highly relevant to major questions in both pure and applied fields especially in conservation. The group generally has a good track record of publications in high quality international journals, but this could be stronger. The group plays an important role in the Centre of Ecological and Evolutionary Studies and contributes a strong theoretical basis for the work of different groups. The proposals for research in population genetics and for evolutionary studies are very exciting as the availability of the complete genome sequence of several organisms, and the possibility of functional genomics studies offer new opportunities for both experimental and theoretical research.

In view of the impending retirement of the programme director, the viability of the research programme is critically dependent on the new appointment to the population genetics chair.

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University	University of Groningen	
Research Institute	Centre for Ecological and Evolutionary Studies	
Programme	Animal Ecology	
Programme Director	Prof. dr. R.H. Drent	
assessment	Quality	5
	Productivity	5
	Relevance	4
	Viability	4

This group studies the relations between animal populations and their food supplies, and involves both theoretical and long-term field studies combined with practical approaches including the use of animal energetics techniques. The group has an excellent international reputation, and nearly one third of the papers are co-authored by colleagues from abroad. It has a good record of publication in major international journals and also of disseminating its research to the general public through television. The research benefits from collaboration with the Netherlands Institute for Sea Research (NIOZ) and the Netherlands Institute for Ecological Research (NIE).

Output of PhD theses is perhaps rather modest. The appointment of Dr. J. Komdeur will allow more emphasis on molecular techniques in studies of mate choice and sex allocation. He is an important addition to the group.

University	University of Groningen	
Research Institute	Centre for Ecological and Evolutionary Studies	
Programme	Microbial Ecology	
Programme Director	Prof. dr. L.J. Forney	
assessment	Quality	4
	Productivity	4
	Relevance	4
	Viability	4

The microbial ecology group has been separated from the other microbiology groups of the former "Microbiology Laboratory" for organizational reasons, but this is not necessarily a problem since all microbiology groups still cooperate in a "cluster" due to their close spatial relation and joint teaching programmes. Prof. Forney has taken over responsibility only recently. The documented research continues in the well-established areas of microbial activities at oxic/anoxic interfaces, ecology of phototrophic bacteria in spatially structured environments, relationship of bacteria to brown algae, and recently also the occurrence of *Archaea* in marine waters. In all areas, the group has been very successful. Some of the recent advances are based on long-standing experiences in the lab, others are new additions (metabolism of chlorinated compounds, *Archaea* in marine environments) that have developed sufficiently today to establish their own reputation. The ideas to transfer and examine developing concepts in general ecology into microbial ecology are worth following. It should be emphasized at this point that microbial ecology at the molecular level requires far higher financial support than similar activities with plants and animals.

University	University of Groningen	
Research Institute	Centre for Ecological and Evolutionary Studies	
Programme	Plant Physiology	
Programme Director	Prof. dr. ir. P.J.C. Kuiper	
assessment	Quality	4
	Productivity	4
	Relevance	4
	Viability	4

The high prominence of the programme director as an internationally leading plant physiologist for several decades, with pioneering contributions to mineral nutrition, transport and stress physiology is acknowledged by the Committee. The work of the group has led to considerable new insights in ecophysiology of plants responding to stressors, such as various air pollutants, mineral nutrients including air borne supply, temperature etc. This comprises efforts in global change studies which also recur to palaeobotanical studies of developments in the past. Long lasting efforts in plant electrophysiology are also noted by the Committee with great respect, since these include pioneering contributions to the understanding of trans-organ polarity and electrical profiles in water plants and have recently led to advancement of expertise in patch-clamping and the study of ion channels. The long-term viability on the one hand, is good because strong members of existing staff are staying and pursuing their projects while the research director is retiring in 1999. Thus, electrophysiological work is extended to transgenic plants to deepen functional analysis of transport proteins (channels). On the other hand, this retirement causes a strong gap. It is underlined by the Committee that a strong plant physiology is important, comprising modern electrophysiology and possibly a more molecular-biological touch in methodology in the future. Thus, RUG is encouraged to support and sustain it at this good level, and the intention to look for a suitable person who can span the bridge from whole plant functions to their molecular bases is encouraged.

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University	University of Groningen	
Research Institute	Centre for Ecological and Evolutionary Studies	
Programme	Marine Biology	
Programme Director	Prof. dr. W.J. Wolff	
assessment	Quality	4
	Productivity	4
	Relevance	4
	Viability	3

Research is in progress on seaweeds (genetic variation, ecophysiology and biogeography); on phytoplankton cycling; on the hydrodynamics of animal swimming and feeding; and on the interaction of corals and algae on reefs. The laboratories are 25 km from the sea, obliging the group to depend on an artificial seawater system which is said to work well. The work on swimming and feeding is innovative and of excellent quality, but bears little relationship to the other spheres of activity. There is scope for interaction between the animal and plant subgroups in the research on coral reefs, and we applaud the strategy of promoting interaction while encouraging individual talent, but we see little prospect of the establishment of a coherent theme for the whole group.

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University	University of Groningen	
Research Institute	Groningen Biomolecular Sciences and Biotechnology Institute	
Programme	Microbial Physiology	
Programme Director	Prof. dr. L. Dijkhuizen	
assessment	Quality	4
	Productivity	4
	Relevance	4
	Viability	4

Research in the microbial physiology group concentrates on the metabolism of Actinomycetes, the engineering of cyclodextrin glycosyltransferase, the metabolism of dimethylsulfonio propionate by sulfate-reducing and other bacteria, and the regulation of CO<sub>2</sub> fixation in autotrophic bacteria.

A very promising new field appears to be the discovery of a plasmid-encoded mutator system in Actinomycetes.

In all fields, the group has been very successful and maintains a very good reputation.

The publication frequency is sufficient, but not all papers have been published in first rank journals. External financial support is provided to a large extent through TNO.

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University	University of Groningen	
Research Institute	Groningen Biomolecular Sciences and Biotechnology Institute	
Programme	Eukaryotic Microbiology	
Programme Director	Prof. dr. W. Harder, dr. M. Veenhuis	
assessment	Quality	5
	Productivity	5
	Relevance	5
	Viability	5

This group is unique in many respects. It has so far no budgetary support through the university and lives exclusively on external resources. Nonetheless, it is extremely successful and productive, with an impressive number of publications in excellent journals. The group is internationally highly respected as one of the leading groups in eukaryotic cellular biology. Especially the work on the microbodies in *Hansenula polymorpha* combines in an impressive manner physiology, biochemistry and molecular biological techniques into a future-oriented research program. Microbodies have been described for many eukaryotic cells, but just the *Hansenula* microbodies are regulated by a rather strict pattern. Therefore, this system lends itself as an excellent model for the detailed study of biogenesis and turnover of such microbodies at the molecular level. The Committee appreciates the planned support for this group through the allocation of personnell from university sources. This group could fulfill an important function in teaching eukaryotic genetics in the faculty in the future.

University	University of Groningen	
Research Institute	Groningen Biomolecular Sciences and Biotechnology Institute	
Programme	Molecular Biology of Plants	
Programme Director	Prof. dr. J.G.H. Wessels	
assessment	Quality	5
	Productivity	4
	Relevance	4
	Viability	3

In the past the programme had little to do with plants (see programme title), but it was outstanding excellent work on fungi with the discovery of a new class of proteins, *hydrophobins*, from studies of polarised growth of fungal hyphae and their pronounced secretion activities. The work included approaches of molecular biology and protein biochemistry and had a wide scope covering various functions of surface dynamics in growing hyphae, and in the past 5 years also reaching to societal implications of high relevance, *viz.* pathology/medicine and industry (manipulation of surfaces). The research director responsible for this work has retired. The interest in hydrophobins is shifted within RUG to microbiology. This brings about a change of the direction of research headed by the new director. The Committee breaks up its assessment of long term viability. First, the tomato-virus programme looks convincing. The study of plant pathogen interactions and the identification of virus-resistant genes have important practical implications. There are good interactions with industry and funding is promising. Second, the design of fundamental research does not appear to have reached the appropriate degree of maturity. The idea of using *Arabidopsis* mutants and aberrations for learning more about the role of *apoptosis* in normal development and senescence of leaves is, of course, sound, but so far seems to lack orientation in detail particularly in view of the important literature already existing on biochemistry of leaf senescence. Thus, the Committee asks what are the perspectives, which the new director may define for a long-term future.

A strong plant physiology with molecular background in methodological approaches is considered important (see RUG 8) and some co-ordination may also be advisable there in the future. A bottle-neck which the Committee also recognises is good green-house assistance which is essential for the tomato-virus programme.

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University	University of Groningen	
Research Institute	Groningen Biomolecular Sciences and Biotechnology Institute	
Programme	Molecular Microbiology	
Programme Director	Prof. dr. W.N. Konings	
assessment	Quality	5
	Productivity	5
	Relevance	5
	Viability	5

The group is internationally recognized as one of the leading groups in the field of transport processes across bacterial membranes. Work has concentrated earlier exclusively on the transport of low-molecular solutes, especially by secondary transporters. Through the recent years, the field has expanded also into the area of protein excretion, and the number of research objects studied has expanded as well, including now also extremophiles, especially thermophiles and halophiles, as well as microorganisms of medical interest. The successful establishment of these new activities has been acknowledged by the university administration through the allocation of a personal professorship within the group (Prof. Driessen). The group performs an independent research program with firm roots in basic science but with many ramifications into applied aspects of microbiology. The productivity is good, with a high number of publications in excellent journals. Only the number of doctoral theses, compared to the overall size of the group, is disappointing .

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University	University of Groningen	
Research Institute	Groningen Biomolecular Sciences and Biotechnology Institute	
Programme	Developmental Genetics	
Programme Director	Prof. dr. W. Kruijer	
assessment	Quality	3
	Productivity	2
	Relevance	3
	Viability	3

This group formerly studied plant developmental genetics but now studies signalling mechanisms which regulate cell growth, differentiation and pattern formation during early vertebrate development. It is a highly competitive area of research in which many large groups around the world are involved. The question which faces this group is thus how can it compete effectively. Its output in terms of refereed international journals is acceptable overall, but it seems to attract few PhD students. If it is to compete internationally it will require much further investment.

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University	University of Groningen	
Research Institute	Groningen Biomolecular Sciences and Biotechnology Institute	
Programme	Molecular Genetics	
Programme Director	Prof. dr. G. Venema	
assessment	Quality	5
	Productivity	5
	Relevance	4
	Viability	4

This group has a long-standing experience in the genetics and molecular biology of *Bacillus subtilis* and *Lactococcus lactis*. Research in recent years has concentrated on protein secretion and protein engineering with *Bacillus subtilis*, as well as lipopeptide synthesis with the same organism. The group has also contributed to the genome project on *Bacillus*. Work on *Lactococcus lactis* has focused on the production of essential amino acids, on non-lantibiotic bacteriocins, the molecular biology of bacteriophages, cell autolysis and the development of vaccines. The quality of research in these various fields is impressive as documented by top-quality scientific publications. The relevance of this research is considered high. After retirement of Prof. Venema, this successful research program has good chances to continue with Dr. Kuijpers as new director who has experience in most of the presently ongoing research programmes.

University	University of Groningen	
Research Institute		
Programme	Teacher training group biology	
Programme Director	Drs. R.J. Delhaas	
assessment	Quality	--
	Productivity	--
	Relevance	--
	Viability	--

The teacher training group Biology is involved in the development and implementation of new education in biology in the upper forms of secondary education.

This programme does not contain biological research and therefore the activities were not assessed by the Committee and no judgement is given on the quality and productivity. The activities of this group should be evaluated in the context of the assessment of the biology teaching programmes in order to be able to assess the importance of the contributions of this group concerning the connections between secondary education and biology teaching at the universities.

University	University of Groningen	
Research Institute	Science and society	
Programme	Dr. H.J. van der Windt	
Programme Director		
assessment	Quality	--
	Productivity	--
	Relevance	--
	Viability	-

The research of this group consists of two projects: (1) Ecology and Nature Conservation, focusing on historical, social and conceptual aspects of Dutch nature conservation and its ecological foundations, and (2) Ecological and ecotoxicological standard setting, in which the development and application of ecological and ecotoxicological standards in environmental policy are studied.

The research as such is not biological research and the Committee has decided not to evaluate the activities of this group. It was noticed that the majority of the publications are written in Dutch and the Committee has no opinion on the depth or the impact of the publications.

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## 3.6 Wageningen Agricultural University

### > 3.6.1 General observations

Wageningen Agricultural University aims at generating and disseminating the scientific knowledge needed to fulfil sustainably the demands for sufficient healthy food and a good environment for humans, animals and plants. Research at the University is characterised by the integration of fundamental and application-oriented sciences. An essential part of the research effort is biological research as an indispensable element of the development of the agricultural and environmental sciences.

During the current assessment period WAU has established research institutes which combine different research disciplines in order to stimulate collaboration and improve the quality of the research. Five of the institutes have been accredited as Graduate Research Schools. These Graduate Schools have research themes that stress the distinct features of the research of Wageningen Agricultural University and could become the centres of learning and research at the University. For biological research the following Graduate Research Schools are relevant:

- Experimental Plant Sciences
- Production Ecology
- Animal Sciences
- Environmental Chemistry and Toxicology.

Biological research at Wageningen Agricultural University is organised in 24 different programmes. Only 15 of these research programmes were presented for the current assessment, because three programmes (Molecular Biology, Biochemistry, Biomolecular Physics) were recently reviewed in the framework of the VSNU-Quality Assessment of the chemical research in 1996, and four programmes (Human and Animal Physiology, Experimental Zoology, Zoological Cell Biology, Fish Culture and Fisheries) preferred to be assessed as part of the forthcoming assessment of Animal Sciences together with Veterinary Sciences. Toxicology opted out of the current assessment as well. The Committee regrets that it was only presented with a part of the biological research for evaluation, and particularly that the animal sciences (except for entomology and nematology) were absent. This means that the current assessment can only give a rather incomplete picture of biological research at Wageningen Agricultural University.

The 15 research programmes presented to the Committee for evaluation are mainly organised either in the Graduate Research School Experimental Plant Sciences or in the Graduate Research School Production Ecology. That places the plant sciences, crop sciences, ecology and nature conservation on the forefront in the present assessment.

On the whole the quality of the research is good to excellent. Several groups have a very good record of publications with a high impact in the field in which the group is active. Some groups, notably in systematics and plant cell biology, need stronger leadership to improve their quality, while the group in plant physiology should receive encouragement and support for that purpose. For the rest Wageningen Agricultural University has the potential of an important centre for plant research and ecology.

The Committee visited Wageningen when the University was in the midst of discussions about a reorganisation involving a large reduction in permanent staff as a necessary consequence of a severe reduction of the budget by the Ministry of Agriculture, Nature Management and Fisheries. At the same time

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the University is involved in a process of integration with the Research Organisation for Agricultural Research (DLO) to form a Wageningen University and Research Centre.

The Committee was concerned that the focus on management principles appeared not to provide the long-term perspective required for high-quality research. Several programme directors commented that especially the more excellent and scientifically promising were suffering under the reorganisation because scientific quality appeared not to be taken into account in the reorganisation and because appreciation and reward of scientific quality seemed to be lacking in the proposals.

The Committee was surprised that the Research Institutes which are Graduate Research Schools and have the potential to become centres of research and long-term planning of the needs of basic research, had only played a minor role in the new research policy of the University. The role of the Research Institute is limited to designing and evaluating research programmes and giving advice to the Board of the University, but the Institutes have no budgets or executive power, since the executive competence belongs to the department, an organisational structure that is not congruent with the Institutes. The Committee was concerned that the current organisational and management structures were ill-suited to promoting the high quality research on which the university's reputation was built and its future depends.

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University	Wageningen Agricultural University	
Research Institute	Experimental Plant Sciences	
Programme	Entomology	
Programme Director	Prof. dr. J.C. van Lenteren	
assessment	Quality	5
	Productivity	3
	Relevance	4
	Viability	4

This is one of the largest groups the Committee reviewed, and contained some scientists of the highest international standing in their subject. Wageningen entomology is renowned for the successful application of basic science to applied problems.

Pioneering studies are done on multitrophic interactions (herbivore-plant-, carnivore-plant-, and carnivore-herbivore interactions) and the chemical information, the signal transduction pathways involved in these interactions and the behavioural response in the natural environment.

The programmes are coherent, and the group well directed. It is clear that they are embracing modern molecular techniques.

The group has not been uniformly productive throughout the assessment period, and efforts should continue to improve the productivity of the more poorly performing members.

University	Wageningen Agricultural University	
Research Institute	Production Ecology	
Programme	Ecological Phytopathology	
Programme Director	Prof. dr. M.J. Jeger	
assessment	Quality	3
	Productivity	4
	Relevance	4
	Viability	1

This group predominantly studies soil-borne plant diseases and employs a rigorous combination of field and laboratory experimentation supported by mathematical modelling. There have been major changes in staffing, and the opportunity has been taken to focus the group's activities, a process which could be completed if the vacant microbial ecology post were unfrozen. The group, and in particular Prof. dr. M.J. Jeger, have good international contacts. Its publications have become more focused on international journals, but this process could be extended. The group does not yet have an international reputation for fundamental research although it is trying to incorporate approaches from outside plant pathology. Its applied plant disease ecology is strong and is a substantial contribution to the University's research programme on Production Ecology. The projected loss of the chair raises serious doubts about the programme's viability.

University	Wageningen Agricultural University	
Research Institute	Experimental Plant Sciences	
Programme	Molecular Phytopathology	
Programme Director	Prof. dr. ir. P.J.G.M. de Wit	
assessment	Quality	5
	Productivity	3
	Relevance	4
	Viability	4

The group studies plant pathogenic fungi. The high international prominence of the research director is recognised by the Committee. The group contributes important work in genetic and molecular biological analysis of specific plant pathogen interactions, *viz.* pathogenicity genes, avirulence genes, plant resistance genes, ABC-transporters. In this way the work of the group is divided in 4 subgroups. The research director supports strong individual responsibility of the subgroup leaders. *Cladosporium* is used as a model system, where genomics are done by industrial companies.

A subgroup performs very interesting research on *Phytophthora infestans*, and has acquired excellent expertise in this area.

The high expertise of the group gives strong future viability.

Excellence of the work produced is also underlined by the bibliometric profile showing high quality of publications in good journals. Nevertheless, the output related to the group size could be larger as shown by the numerical productivity analysis.

University	Wageningen Agricultural University	
Research Institute	Experimental Plant Sciences	
Programme	Nematology	
Programme Director	Dr. ir. J. Bakker	
assessment	Quality	4
	Productivity	3
	Relevance	4
	Viability	3

This group is concerned with various aspects of plant-parasitic nematodes, including feeding cell induction, virulence, artificial host-plant resistance, soil quality assessment and life cycle analysis. They plan to concentrate their efforts largely on the function of nematode secretions, an area in which their approach is particularly original, but are also taking advantage of data from the *Caenorhabditis elegans* genome project to look for genes concerned with life history traits. They possess an outstanding taxonomic collection of nematodes; current staff members appear to be making little use of it, but it continues to be the basis for many publications by a long-retired member of staff. The group's productivity has been disappointing over the past few years during which their chair has been vacant. It has now been filled, but because the appointment was an internal one the University should consider bringing in new blood at a more junior level.

University	Wageningen Agricultural University	
Research Institute	Experimental Plant Sciences, Production Ecology	
Programme	Virology	
Programme Director	Prof. dr. R.W. Goldbach	
assessment	Quality	5
	Productivity	4
	Relevance	4
	Viability	4

The group deals with two fields in plant-related virology, plant viruses and insect viruses with respect to biological pest control.

The group is highly respected for its studies on tomato spotted with virus, which have led to a much better understanding of the molecular biology and properties of tospoviruses and which have proven that these tospoviruses are members of the mammalian virus family Bunyaviridae.

The insect virus studies concentrate on the mechanism of baculovirus DNA replication and gene expression for the development of vectors to be used as expression vectors and in biocontrol of pest insects.

The group also plays a major role in the study of the mechanisms of virus spread in plants and also in the research of RNA mediated resistance in transgenic plants.

The various activities are held together efficiently to maintain internal coherence. The group is one of the leading ones in plant virology in the world, especially in the area of virus spreading within plant tissue. Research has been very successful in both main research areas, as documented by a high number of publications in international journals of high standing.

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University	Wageningen Agricultural University	
Research Institute	Experimental Plant Sciences	
Programme	Plant Breeding (sub 1)	
Programme Director	Prof. dr. ir. P. Stam	
assessment	Quality	4
	Productivity	3
	Relevance	4
	Viability	4

This group studies genetic crop improvement with special emphasis on durable disease resistance and yield. It employs DNA markers in the identification and genetic mapping of polygenes and in the development of methods of marker-assisted plant breeding. Although the group appears to be doing good research on plant breeding, incorporating the most modern technologies such as the AFLP marker technology, construction of high density marker linkage maps, and identification of quantitative trait loci (QTLs), the productivity is not very high. The output in terms of papers in the international scientific literature is not large, and there is a strong apparent preference for publication in *Euphytica*. The group could improve its international profile by building on existing research links, and by targeting more of its output on other major journals.

University	Wageningen Agricultural University	
Research Institute	Experimental Plant Sciences	
Programme	Plant Breeding (sub 2)	
Programme Director	prof. dr. ir. E. Jacobsen	
assessment	Quality	4
	Productivity	4
	Relevance	4
	Viability	4

This group studies genetic variation and reproduction in three crop species (potato, cassava and *Alstroemeria*), utilizing natural variation and genetic modification. Research on potato predominates. A collection of plants harbouring disabled transposon in different linkage groups has been produced and is used in cloning resistance genes and in the research on the modification of the carbohydrate content and composition in potato. The research is further extended to tuberisation and sprouting of potato.

The group envisage taking full advantage of new advances in functional genomics including the use of DNA chips to study developmental processes such as tuberisation. The group is thus forward looking, but is concerned that re-organisation will lead to a decline in permanent staff. The group produces high quality publications and the overall output is good. In addition the group attempts to develop commercial aspects of the work. Further encouragement by the University may be required if the latter is to be successful. This can only be sustained if staffing levels can be maintained.

University	Wageningen Agricultural University	
Research Institute	Experimental Plant Sciences	
Programme	Plant physiology	
Programme Director	Prof. dr. L.H.W. van der Plas	
assessment	Quality	3
	Productivity	3
	Relevance	3
	Viability	3

In the period under review the group has undergone a major reorganisation, caused by the cutback in support by the university, which involved the merger of three rather independent groups and a considerable reduction of the permanent staff. The heritage was a programme with a very wide scope of interests (primarily production, stress and ecophysiology, photosynthetic energy transduction, seed physiology, desiccation tolerance, signal transduction in regulation and differentiation, photomorphogenesis, metabolism). This is too wide and lacks focus. In some of these fields international competition is tremendous, e.g. in photosynthetic energy transduction, where it appears suicidal to compete. Reshuffling of the programme is going on, but has not reached a definite state yet. It is advised to focus the research on the present strong points, i.e. seed physiology, photomorphogenesis, and potato tuber induction and formation, in which the group has found good supporting collaborations with other groups in Wageningen (Genetics, Plant Breeding). Strong leadership must be provided. Pressure needs to be exerted by the group for increased productivity. A question which arises is why the introduction of molecular approaches as methods and tools is not accelerated in the group. Becoming familiar with such techniques is important as functional/genomics studies can soon add a new dimension to physiology.

The University should note that overgrowth is not only controlled by pruning but also by focused support, and more cuts do not appear to be bearable. Clearly a good and strong plant physiology is important in an agricultural university and when WU has chosen to keep plant physiology, the group should receive advice and encouragement.

University	Wageningen Agricultural University	
Research Institute	Experimental Plant Sciences	
Programme	Experimental plant morphology and cell biology	
Programme Director	Prof. dr. J.L. van Went	
assessment	Quality	3
	Productivity	4
	Relevance	3
	Viability	3

The scope of the work of this group with respect to both objects and objectives in cell biology is rather broad, with cell growth and development, gametophyte development and fusion of gametes, and a new group on meristem development to be established. In general this steady and continuous work is considered to reflect solid and quite desirable standard. However, the recent work on cytoskeleton which comprises modern approaches of cytological, biochemical and molecular cell biology techniques needs to be singled out as it is distinctly above standard and good. It makes unique and original contributions to the advancement of knowledge in the role of the cytoskeleton and signalling sequences and networks regulating its dynamics and functions, so that, based on the expectation that it will receive continuous encouragement and shall be carried on at the current pace, the overall long-term viability of the programme is considered to be good. This makes it necessary that the university avoids bottle-necks in maintenance of facilities, *viz.* electron microscopes, CLSM etc., and that strong structural research is supported in the group not only as a service function.

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University	Wageningen Agricultural University	
Research Institute	Production Ecology	
Programme	Plant taxonomy	
Programme Director	Dr. ir. R.H.M.J. Lemmens	
assessment	Quality	3
	Productivity	2
	Relevance	4
	Viability	2

This group has suffered from the general problems with plant systematics in the Netherlands, but seems not to have benefited from recent reorganisation. Programme development is unclear and future plans very uncertain. The group has traditional expertise in tropical African botany and considering the international importance of this subject, its lack of encouragement in Wageningen is disappointing, especially as Wageningen is joining the recently established National Herbarium, together with the universities of Leiden and Utrecht.

Research output is below expected, especially from the tenured staff.

University	Wageningen Agricultural University	
Research Institute		
Programme	Animal taxonomy	
Programme Director	Vacancy	
assessment	Quality	2
	Productivity	2
	Relevance	2
	Viability	1

This small group works on the biosystematics and phylogeny of planthoppers, and on the accuracy of methods for reconstructing phylogenies. Within the review period it worked also on the taxonomy of sandflies and the threadworms that they transmit, but this work has come to an end following a retirement. The quality of the group's work is only moderate. There seems to have been no cooperation with the group on Nematology (WU4), whose collection of nematodes offers an opportunity for taxonomic research. The group has been greatly reduced, leaving the remaining members with a very heavy load of teaching and little time for research. The University has not provided the resources that would be needed to attract new funds, and it is planned to merge the remnant with Plant Taxonomy (WU9).

University	Wageningen Agricultural University	
Research Institute	Experimental Plant Sciences	
Programme	Genetics (sub 1)	
Programme Director	Prof. dr. C. Heyting	
assessment	Quality	4
	Productivity	3
	Relevance	4
	Viability	2

The research of this group is focused on meiotic chromosome behaviour and recombination during meiosis. In the research mammals, plants as well as fungi are used, as no single organism is suitable for investigating meiotic chromosome behaviour at all levels. Remarkable results were obtained in the animal and plant studies, but the work on fungi has not come to its own. Techniques for making animal meiotic chromosome preparations were improved, allowing quantitative analysis of meiotic chromosome behaviour using different molecular probes (antibodies, RNA- and DNA-probes) and comparison of normal meiotic chromosome behaviour with abnormalities in mutants with meiotic defects.

In plants chromosome pairing and chiasma formation in tomato and potato hybrids and in meiotic mutants of tomato were analysed. The group made major contributions in introducing improvement of the fluorescent in situ hybridisation technique for studying plant chromosome structures, and is developing a widely recognised expertise in this area.

Different staff members have not equally contributed to the productivity and the publication profile leaves some room for improvement.

This fundamental research has produced procedures and tools that are now used for diagnosis and analysis of fertility problems and in plant breeding research. It is surprising that a university with a strong profile of plant and animal breeding is not disposed towards this fundamental research and has proposed to end this chair of Molecular and Cell Genetics.

University	Wageningen Agricultural University	
Research Institute	Experimental Plant Sciences	
Programme	Genetics (sub 2)	
Programme Director	Prof. dr. M. Koornneef	
assessment	Quality	5
	Productivity	5
	Relevance	5
	Viability	5

The quality of research from this programme has the highest international standing and recognition in the field of plant genetics. The research director is held in the highest respect, attested by his recent election to the National Academy of Sciences USA and several other awards. With a number of students and post-docs, and involving collaborations in Wageningen (EPS, CPRO) and internationally, Botanical Genetics has been outstandingly productive, with multiple publications in the two best known plant molecular Journals. Importance, excitement, relevance and development of the Botanical Genetics programme are evident. It is of critical relevance to plant breeding and biotechnology. For instance, each of the five key publications addresses gene loci that are all of major economic importance and immediate agricultural relevance. The results of the QTL analysis of seed dormancy (also = grain sprouting) alone is worth many \$ 10s of millions each year - providing specific knowledge of critical agronomic genes. The analysis of abscisic acid genes and receptors covers one of the five major classes of plant growth regulators, perhaps the most important for stress and ripening. This work is directly applicable and is vital for plant breeders, as well as the research community. One can not imagine that the programme has other than the strongest viability, given the dynamic and relevant management it has had up to now.

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University	Wageningen Agricultural University	
Research Institute	Production Ecology	
Programme	Genetics (sub 3)	
Programme Director	Prof. dr. R.F. Hoekstra	
assessment	Quality	5
	Productivity	3
	Relevance	4
	Viability	4

This group studies the causes and consequences of fungal genetic transmission systems. It seeks to extend its research on population genetics and epidemiology of fungal viruses and plasmids with a view to achieving better estimates of the rates of transmission and fitness effects. The programme director, Prof. dr. R.F. Hoekstra, has an international reputation for his work on evolutionary biology which is published in excellent journals. The rest of the group is not as productive, and the overall output is rather modest despite its high quality.

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University                      Wageningen Agricultural University

Research Institute

Programme                      Microbiology

Programme Director      Prof. dr. W.M. de Vos

assessment	Quality	5
	Productivity	3
	Relevance	4
	Viability	4

This Laboratory is one of the biggest and most diversified laboratories of general microbiology in the world. Research activities cover aspects of microbial physiology, ecology, and genetics, with many different microorganisms of general and applied agricultural interest, including lactic acid bacteria, strict anaerobes involved in methanogenic degradation of organic matter, methanogenic *Archaea*, and extremophiles such as *Pyrococcus furiosus*. Others deal with environmental aspects regarding treatment of waste water in cooperation with the local engineering department, drinking water control etc. Further research concentrates on the microbiology of the digestive system of higher animals. Of special interest is the newly discovered involvement of peptides in intercellular signalling. The experience is broad also with respect to the methods employed, from basic microbiology through enzymology, molecular aspects of gene expression and signalling, and molecular techniques for identification of non-cultured microorganisms in situ. This broad program is maintained by a strong and competent staff of researchers at the lecturer level, and the internal cooperation is obviously very good, as are the external contacts worldwide. Not all articles have appeared in journals of top quality, but the overall impact of the work and the published papers is high. Considering the high importance of microbiology - in all its different aspects- within an agricultural university, it should be considered to support this group with a second chair of microbiology.

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University	Wageningen Agricultural University	
Research Institute	Production Ecology	
Programme	Soil ecology	
Programme Director	Prof. dr. L. Brussaard	
assessment	Quality	3
	Productivity	4
	Relevance	3
	Viability	3

This programme investigates interactions between soil organisms in forest, heathland and grassland soils, and includes studies of mycorrhizas, saprotrophic fungi, nematodes, oligochaetes and carabid beetles. It addresses issues of importance in conservation, and some results have informed management practice.

Several members of the programme are well known in their fields, but their research would have a greater prominence if more attention was given to publication of papers in high quality international journals.

University	Wageningen Agricultural University	
Research Institute	Production Ecology	
Programme	Nature conservation and Plant ecology	
Programme Director	Prof. dr. F. Berendse	
assessment	Quality	4
	Productivity	5
	Relevance	4
	Viability	3

This is a rather young group at WU where the research director - whose high international reputation is noted - started in 1994 with some staff members and with others even joining later. Conditions were hard at the beginning because the old group had published and produced very little. It was astonishing to the Committee that two out of five key publications submitted for the assessment were a review paper and the index of a book edited, respectively. Although some essential ideas of the group are laid down in these publications one might have expected that there were more original publications worth presenting. The work of the group to study the correlations between environmental stress factors (stressors), such as carbon, nutrients, herbivory, and biodiversity with respect to long-term dynamics of plant populations appears highly relevant. On the other hand this has been inseminated also by other groups internationally and one must ask more explicitly where the originality of the present group lies for long-term viability and what is the major thrust in the future. As this is described to be a stronger focus on the role of plant species in ecosystem processes and the relative role of dominant *versus* subdominant and rare species in plant communities and for conservation originality is visible. Thus, the topic is important and its study does provide important knowledge for nature conservation, so that the group deserves encouragement to develop its own specific profile more sharply in the future. The group had to suffer cuts where 3 out of 8 positions were lost due to the standard-group-size policy of the university, but consolidation after the initial difficulties of getting established and the cuts is now important.

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University	Wageningen Agricultural University	
Research Institute Programme	Production Ecology Nature conservation in the tropics and ecology of vertebrates	
Programme Director	Prof. dr. H.H.T. Prins	
assessment	Quality	3
	Productivity	4
	Relevance	3
	Viability	3

This programme investigates the conservation of biological diversity and nature management in the tropics, with particular attention to species richness of African grazer assemblages. Although this area of research would appear to be attractive to PhD students, the number of dissertations produced in the review period is small. The overall output of refereed journal articles is good. The programme director, Prof. dr. H.H.T. Prins, has considerable prominence, but there is the need to increase the international impact of other members of the group.

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## 3.7 Utrecht University

### > 3.7.1 *General observations*

During the period of the current assessment the Faculty of Biology started a process of reorganisation in which the quality of the research and the interaction between research topics within the Faculty are important aims. This process has certainly not come to an end and is driven on by a considerable number of chairs becoming vacant in the near future.

At present the dean of the Faculty, assisted by the Advisory Committee for Research, is designing a comprehensive plan for the Faculty, covering all chairs and research programmes, in which an important role is given to the Graduate Research Schools. Recently the chairs of biology with their research programmes have been amalgamated into one Research Institute of Biology. The newly formed research institute will have its own research budget and will be responsible for the research policy. It could also keep an eye on the development of the discipline of biology in its entirety.

In Utrecht, the Graduate Research Schools, in which almost all the biological research is concentrated, are considered the long term focal points of the research efforts. The Faculty is commissioner of two Graduate Research Schools and participates in five more. The areas of research covered by these Schools indicate on which themes the Faculty and the research of Biology want to focus their research policy.

The Graduate Schools concerned are:

- Developmental Biology
- Biomembrane Research
- Experimental Plant Sciences
- Functional Ecology
- Physiology and Pathophysiology of the Nervous System
- Environmental Chemistry and Toxicology
- Biodiversity.

In addition the Faculty makes a contribution to the graduate research schools for Sedimentary Geology, the Helmholtz School for Autonomous Systems Research and CERES. The Faculty of Biology is commissioner of the first two Schools listed above, and participates in the other Schools together with other faculties and universities.

The graduate research schools will participate in the Research Institute of Biology. They will be represented in the board of the Institute and benefit from a considerable part of its budget. In addition the Research Institute of Biology will participate in two institutes founded in other faculties.

The Committee learned about these plans for reorganisation with great interest, and has the opinion that they are well timed. Although many groups have done research of good quality and some groups, notably the groups of molecular genetics and theoretical biology, have made excellent contributions, the overall quality of the research, the productivity and the impact can be improved.

The Committee heard with approval the first decisions made about the reorganisation. A new group of Developmental Biology has been formed by fusing the earlier research groups (chairs) of Experimental Embryology and Molecular Biology. The recent appointment of a full professor to this group promises the initiation of a new research direction which can make Utrecht Biology stronger in developmental biology.

A further strengthening of this field may be established with the filling of the forthcoming vacancy of the chair of Endocrinology. In addition, the recent appointment of a professor of Molecular plant physiology, and, very recently, the refilling of the vacant chair of Ecophysiology which holds the promise of

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introduction of modern concepts of molecular ecophysiology, offer an important strengthening of plant biology and plant research.

The Committee was surprised to learn that the group which presents itself with a programme on Plant Ecology and Evolutionary Biology has chosen to disguise themselves as ecologists and evolutionists, while the research is on plant systematics. The Utrecht Herbarium specialises in tropical American botany and has become part of the new National Herbarium. A group on (plant) systematics will be in a good position to make a significant contribution to the description and understanding of tropical biodiversity, and renaming of the chair seems appropriate.

University	Utrecht University	
Research Institute	Research Institute of Biology	
Programme	Biochemical Physiology	
Programme Director	Prof. dr. D.J. van der Horst	
assessment	Quality	4
	Productivity	3
	Relevance	4
	Viability	2

This group is concerned with the adipokinetic hormones that control the mobilisation of the foodstuffs that fuel locust flight. It works on these neuropeptides at levels ranging from gene expression to signalling mechanisms, and on physiological responses to them. This well-integrated programme is building an excellent understanding of the system. The group see their research not only als a means of understanding an important and distinctive aspect of insect physiology, but also as giving wider insight into similar processes in other organisms. Further work along the present lines is planned, but funding difficulties are leading the group to look for an additional field in mammalian integrative physiology, taking into account the impact of medical biology on the faculty. The current expectation is that the group will extend its expertise in the study of the mobilisation of substrates to the study of obesity in mammals. The plans appear well-considered but the Committee is concerned that there seems to be no clear vision of the way ahead for this ageing group.

University	Utrecht University	
Research Institute	Research Institute of Biology	
Programme	Biological Toxicology	
Programme Director	Prof. dr. W. Seinen	
assessment	Quality	4
	Productivity	5
	Relevance	4
	Viability	4

The programme Biological Toxicology is carried out within the framework of the Research Institute of Toxicology (RITOX) which is an interfaculty institute of the faculties Biology, Medicine and Veterinary Sciences. The research is focused on three main areas:

- Environmental toxicology and chemistry
- Bio-kinetics and toxicodynamics
- Mechanisms of neuro- and immunotoxicology.

The scope of the research is the development of methods and technology, and new predictive models for risk assessment. In this way the group covers the areas of toxicology that are of great scientific interest and relevance, and the group cleverly takes advantage of the research needs in society. The group has a very good reputation both nationally and internationally, and receives support from a variety of national and supranational governmental organisations and industrial organisations.

The group combines its research activities with the post-graduate training of a large number of PhD-students. The need for such young qualified researchers is evident from the great variety of positions and functions filled after graduation.

The granting of KNAW-fellowships to two co-workers for new research in the field of neuro- and immunotoxicology and for environmental chemistry is further evidence for the innovative character and the high level of the research of the group.

University	Utrecht University	
Research Institute	Research Institute of Biology	
Programme	Comparative Endocrinology	
Programme Director	Prof. dr. H.J.Th. Goos	
assessment	Quality	3
	Productivity	3
	Relevance	3
	Viability	2

This group works on endocrinological problems concerning fish, especially on the control of puberty and on gonadal steroids and receptors. The group has authority in this field of research that has relevance for aquaculture, and also for environmental oestrogen pollution. In these latter areas the group is also actively involved in research.

The present scope of the research is too wide, which is at the expense of the leading role the group wishes in receptor structure-function relationships and testis differentiation.

The group wisely proposes to concentrate in the coming years on the molecular genetic basis for testis differentiation and on the input of the pituitary. Such research will fit in well with the programme on developmental biology on which the faculty wants to concentrate. Fish will continue to be the experimental animals but the group aspires to do work of more general endocrinological significance, that can raise the interest of medical biologists. These plans are well considered but with 2,5 retirements in the next few years, including the present programme director, the future of the group is uncertain.

University	Utrecht University	
Research Institute	Research Institute of Biology	
Programme	Ecophysiology	
Programme Director	Prof. dr. J.T. Lambers	
assessment	Quality	3
	Productivity	3
	Relevance	3
	Viability	5

The continuous coherent work of the group on allocation and partitioning of resources of plants in response to environmental constraints (e.g. mineral nutrition) has won it a good international reputation. The work on the role of respiration in ecophysiological compartment of plants - particularly the implications of the alternative pathway of respiration - was quite original and pioneering. The group leader is highly respected internationally, but that does not apply to several other staff members whose productivity is very low and whose contribution to the research is not visible. Unfortunately the project leader has recently left to accept an appointment abroad, but it can be concluded that overall the activities of the group in the past have provided very good foundations for viable continuation of plant ecophysiology in Utrecht.

A new chairholder has been appointed and will start work in 1999 and proposes to introduce modern concepts of molecular ecophysiology, where problems observed and defined in ecosystems in the field - river floodplains in this case - are pursued on different levels of scaling, *viz.* whole plant physiology and growth, cell physiology with environment sensing and signal transduction cascades and molecular biology as a tool to describe involvement of key genes and their products.

The new programme director is in the unique position to have adequate equipment and to fill a number of new positions, by using both university resources and a Pioneer grant, so that he can shape his own strong group right from the start. It was noted by the Committee that all peers working in related areas at UU unanimously welcomed this new development and were keen on new co-operations (Landscape Ecology; Vegetation Ecology; and others). The only bottle-neck named is housing of the different groups at some distance to each other and that uniting the groups would be desirable.

Thus the future viability is judged as excellent, provided the new programme director lives up to these expectations which now is his major challenge for the coming years.

University	Utrecht University	
Research Institute	Research Institute of Biology	
Programme	Ethology and Socio-ecology	
Programme Director	Prof. dr. J.A.R.A.M. van Hooff	
assessment	Quality	3
	Productivity	4
	Relevance	3
	Viability	-

This group's interests are divided between primates (the subject of the majority of their recently published papers) and social insects. The research is to a large extent the elaboration of earlier findings on conflict and stress regulation in primates and the adaptive significance of primate social characteristics, which is resulting in new and deeper understanding of the formation of social groups. This research has resulted in interesting collaborations among others with the Department of Child Psychiatry of the university. The research is similarly important for the management and protection of endangered species in tropical countries.

In addition, a subprogramme is devoted to research on the mechanisms of colony organisation in bumble bees and to comparative research on stingless bees.

The group has a heavy teaching load and perhaps that is the reason why the productivity is rather low and the impact of the results is less than might be expected from a group that previously aroused more attention.

The senior members will retire in the next five years, including the programme director, and the Committee is unable to assess the future development of the group.

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University	Utrecht University	
Research Institute	Research Institute of Biology	
Programme	Evolutionary Population Biology	
Programme Director	Dr. G. de Jong	
assessment	Quality	4
	Productivity	4
	Relevance	3
	Viability	1

The group's work was of good quality and productive. However, the Committee was confused by the composition of this group which consists of two talented workers, an evolutionary biologist and a plant taxonomist. There seemed no reason for the makeup of this group, and moreover very good reasons to transfer the personnel to the programmes in plant taxonomy and theoretical biology. The Committee believed that both the scientists and recipient groups would benefit from this transfer.

University	Utrecht University	
Research Institute	Research Institute of Biology	
Programme	Experimental Embryology	
Programme Director	Prof. dr. J.A.M. van den Biggelaar	
assessment	Quality	4
	Productivity	3
	Relevance	4
	Viability	4

This small group has worked on cell specification and pattern formation in early stages of development of molluscs, annelids and clawed toads. The research on molluscs is published in leading scientific journals, but no publications from the work on toads are listed. Productivity was low in the period covered by the report.

The group will merge with Molecular Biology (UU9) into a group on Developmental Biology. A new professor, dr. R. Zeller, has been appointed, who is expected to rejuvenate the group, re-directing its main efforts to pattern regulation in the development of the limbs of vertebrates. However, work on pattern formation in molluscs is continuing, building on the group's existing strength in this area.

University	Utrecht University	
Research Institute	Research Institute of Biology	
Programme	Landscape Ecology	
Programme Director	Dr. J.T.A. Verhoeven	
assessment	Quality	3
	Productivity	4
	Relevance	3
	Viability	3

The research of the group is aimed at understanding the role of wetland ecosystems in landscape bio-geochemical flows. The group carries out fundamental as well as more applied research on wetland ecosystems and their functioning, which is of direct importance to the management and restoration of nature reserves.

As a result of the approaches taken and the well-focused research questions, the group has a high productivity and a good record of publications with high impact. A greatly contributing member of the group has taken a position as professor at the Vrije Universiteit in Amsterdam. Although this is a loss, it also provides a healthy flow in this active group, as his position was taken over by a competent researcher coming from another university.

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University	Utrecht University	
Research Institute	Research Institute of Biology	
Programme	Molecular Biology	
Programme Director	Prof. dr. H.O. Voorma	
assessment	Quality	3
	Productivity	4
	Relevance	3
	Viability	--

The group has a good international reputation from its research on translation initiation factors and the regulation of translation initiation in eukaryotes. The work is solid but does not play a leading role in the field. The research on the molecular basis of the stress response in eukaryotes is not very focused and has not yielded remarkable results.

The Faculty has decided to amalgamate this group with the research group for Experimental Embryology (UU7) and a new research group Developmental Biology will be formed under the directorship of a new professor, who has recently been appointed.

University	Utrecht University	
Research Institute	Research Institute of Biology	
Programme	Molecular Cell Biology	
Programme Director	Prof. dr. A.J. Verkleij	
assessment	Quality	4
	Productivity	3
	Relevance	4
	Viability	4

The research programme of this group is divided into four subprogrammes with rather diverse topics. The group houses the Electron Microscope Facility and one subprogramme is devoted to developing and improving methodology for research of the ultrastructure of cells on the molecular level. The facility is also used by groups from other faculties of the university and from other institutes in Utrecht that gratefully utilise the advanced facilities and the expertise built up by the group. It also results in different collaborations on various subjects with researchers from other universities.

In two other subprogrammes electron microscopy together with other advanced microscopic procedures is used for studying signal transduction and cell cycle regulation and for research on ischaemia and reactive oxygen species. The signal transduction research has, among others, resulted in the identification of a new protein EPS15 involved in receptor mediated endocytosis. The recently started study on the relationship between signal transduction cascades and progression through the cell cycle looks very promising.

The ischaemia research and the role of radical oxygen species in membrane damage leading to cell death is of great interest and has important medical applications.

The fourth subprogramme on heterologous protein secretion uses the expertise of the groups for systematic study of the effects of secreting proteins on the flow of heterologous proteins through the secretion cycle in yeast and the final yield. These studies are relevant for biological application.

University	Utrecht University	
Research Institute	Research Institute of Biology	
Programme	Molecular Genetics	
Programme Director	Prof. dr. P.J. Weisbeek	
assessment	Quality	5
	Productivity	4
	Relevance	5
	Viability	4

The group has an excellent international reputation in plant molecular genetics and a high bibliometric quality score. Thus, their work on root meristems, carbohydrate signalling and chloroplast protein import has received very high international recognition.

The outstanding research on root development by dr. B. Scheres was awarded a prestigious PIONEER subsidy by the Dutch Research Organisation (NWO).

The leader of the subprogramme on sugar signalling and protein import, was recently appointed professor of Molecular Plant Physiology and has become fully independent (see UU18).

The recent appointment of a KNAW-research fellow who will work on plant pathogen interactions, ensures new research initiative and further strengthens the viability of the programme.

University	Utrecht University	
Research Institute	Research Institute of Biology	
Programme	Molecular Microbiology	
Programme Director	Prof. dr. W.P.M. Hoekstra	
assessment	Quality	4
	Productivity	4
	Relevance	4
	Viability	3

This group has a long-standing experience in research on protein transport across bacterial membranes and protein insertion into membranes, with *Escherichia coli*, *Pseudomonas aeruginosa* and *Yersinia enterocolitica* as study objects. There is intensive cooperation with the biomembranes group at the same university and various external groups. The research program is oriented to basic research with numerous applied aspects. Work through the last five years has been quite successful with respect to the topological analysis of various outer-membrane proteins and functional analysis by molecular methods. Also work on *Pseudomonas* outer membrane proteins and protein secretion has been very successful, and with *Yersinia* first indications of secretion of folded proteins have been obtained. The group is within the forefront of international research on protein excretion in the world. The publication record is impressive with a high number of first-class publications in very good journals. The long-term perspectives are secured by a strong staff of permanent scientists who carry most of the research already at present and are likely to maintain it at high quality beyond the retirement of the present group head.

University	Utrecht University	
Research Institute	Research Institute of Biology	
Programme	Neuroethology	
Programme Director	Prof. dr. W.A. van de Grind	
assessment	Quality	4
	Productivity	5
	Relevance	3
	Viability	3

This group has been much reduced in size during the review period. It is concerned with spatial behaviour, in part with humans, cats and pigeons using vision, and in part with catfish using their electric sense. The work has also led as a byproduct to improvements in microscopical technique. The group intends to focus more on cognitive neuroscience of spatial behaviour. It publishes interesting research, some of it in leading journals. Though small, the group includes two KNAW Fellows and believes that it is large enough to realise its ambitions over the next few years, in collaboration with the Biophysics group at Nijmegen.

University	Utrecht University	
Research Institute	Research Institute of Biology	
Programme	Paleobotany and Palynology	
Programme Director	Prof. dr. H. Visscher	
assessment	Quality	5
	Productivity	5
	Relevance	4
	Viability	4

The thorough study of various types of fossils performed by this group is to be considered highly important for various reasons:

- They relate their observations and analyses to environmental parameters of the past, and thus, arrive at a kind of palaeo-ecophysiology of plants (CO<sub>2</sub>/stomata); this is intellectually fascinating;
- they consider human impact on past environments which casts important light on early human interference and leads to a deeper understanding of land use and man/environment interactions.

The scope ranges over the ice ages and the historical past (little ice age). Young peat deposits are collected and covered globally. The dating (with pollen analysis) is precise and arrives at a near annual resolution, and thus important corrections of conclusions from ice-core studies can be made. The research programme is soundly integrated in the activities of the Graduate Research School for Sedimentary Geology. The group also managed to convince plant physiologists to obtain data sets (time series) under controlled environment conditions to provide experimental tests of conclusions from fossil analyses (co-operation with RU Groningen).

In general it is of high relevance to study the past by the type of approaches used by this group, because while all prognoses of global change suffer from the typical uncertainties of model-predictions a deeper understanding of what has actually happened in the past should help considerably to improve approaches of dealing with the uncertain future. The co-operation started with groups working on extant ecophysiology and modelling should be further encouraged. The small group is in the position of making important contributions at a very reasonable cost of resources and has very good viability in the future.

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University	Utrecht University	
Research Institute	Research Institute of Biology	
Programme	Phytopathology	
Programme Director	Prof.dr. ir. L.C. van Loon	
assessment	Quality	4
	Productivity	3
	Relevance	4
	Viability	4

The programme started after the appointment of Prof. Van Loon in 1992 and focuses on the interaction between pathogenic micro-organisms and their host plants and the relations between pathogenic and non-pathogenic micro-organisms in soil. The molecular-genetic approach is dominant in the research. The group has been particularly successful with their finding that selected strains of non-pathogenetic rhizosphere-colonising *Pseudomonas* bacteria can induce systemic resistance in various host plants against fungal and bacterial pathogens. The induced systemic resistance is phenotypically similar to classic acquired resistance, but is controlled by a novel signal transduction pathway. With that finding a firm basis for further research has been laid down.

University	Utrecht University	
Research Institute	Research Institute of Biology	
Programme	Plant Ecology and Evolutionary Biology	
Programme Director	Prof. dr. P.J.M. Maas	
assessment	Quality	4
	Productivity	5
	Relevance	4
	Viability	4

The title of the project is a misnomer, the group is not working in ecology and evolutionary botany. Why not in full self-appreciation and conceit call it systematics? The Committee realises that systematics based on well bestowed herbaria with good and continuously improved collections is highly important. The Committee acknowledges that with a new and more unifying organisational structure of the 3 major herbaria with their geographical specialisation (Leiden, SE-Asia; Wageningen, Africa; Utrecht, S-America) considerable progress has been made, and the group itself also considers this as an important improvement of their situation.

Good floras of difficult areas with high biodiversity, e.g. the Guianas, become increasingly invaluable for other scientists working there, e.g. indeed ecologists and ecophysiologicals, for applications of societal relevance (natural products), for management and maintenance etc. In this vein the Committee underlines that publication activity of such a herbarium group can not be judged by the same criteria as that of other groups with descriptive and experimental projects. The bibliometric score of the group is low, but indeed good floras are used by very many people but cited by very few.

In addition to the development of the herbarium structure in the Netherlands the group notes the support of systematics by the faculty of UU and the recognition of a different interpretation of citation indices in systematics as positive developments. On the other hand a strong bottle-neck is the size of the group which is below a sound level. One or two more people are required. A molecular systematist plus Ph.D.-student is foreseen. With the tasks given there is relevance and with the hope that the developments indicated can be realised the viability is good.

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University	Utrecht University	
Research Institute	Research Institute of Biology	
Programme	Theoretical Biology and Bioinformatics	
Programme Director	Prof. dr. P. Hogeweg	
assessment	Quality	5
	Productivity	5
	Relevance	4
	Viability	5

The strongest theoretical biology group in the country. The quality of many publications was very high. Very good links with experimental groups and many overseas contacts. Most senior members of the group have strong international reputations. The group has a good record in the production of high quality students.

University	Utrecht University	
Research Institute	Research Institute of Biology	
Programme	Transportphysiology	
Programme Director	Prof. dr. C. Kollöffel	
assessment	Quality	4
	Productivity	3
	Relevance	3
	Viability	3

The group was working on short distance transport (membranes) and long distance transport (xylem, phloem) of plants. Programme members have considerably advanced knowledge and expertise, particularly in the field of phloem loading and unloading, by developing the unique "empty seed-coat system" and by considering structure, distribution and function of plasmodesmata with the most modern cytological techniques. With this work of very good quality and high originality phloem research was opened again after having - internationally - become somewhat stagnant, and the group itself became leading internationally. Membrane transport kinetic studies are considered less original; but it is notable that the group also touches molecular biology-techniques in their study of aquaporines. The group appears to dissolve now due to retirement of the programme director and the call of a programme member on an esteemed chair in Germany. This may partially explain the lower publication productivity in recent years to which the departing programme member had previously made considerable contributions.

Recently the programme director has retired and in his place Prof. J.C.M. Smeeckens, who is appointed professor of Molecular Plant Physiology, will become programme director. The appointment will result in a redirection of the research programme. With his interests in sugar-sensing and signalling the new director seems to be well positioned to link the transport physiology studies to molecular biology. The future viability of the research of this group will depend on the initiatives of the new director.

University	Utrecht University	
Research Institute	Research Institute of Biology	
Programme	Vegetation Ecology	
Programme Director	Prof. dr. M.J.A. Werger	
assessment	Quality	3
	Productivity	5
	Relevance	4
	Viability	3

The programme examines plant strategies and vegetation structure both in temperate and tropical vegetation. Several members of the programme are well known in their fields, most notably the programme director, Prof. dr. M.J.A. Werger, and international contacts are well developed. These contacts, and the joint publications which result from them, enhance the programme. They also attract a wide range of overseas postgraduate students, which adds to the diversity of approaches and subjects under study. While this diversity is a strength, a greater focus on the major lines of enquiry might give the programme more impact, as would publishing a greater proportion of the programme's work in the most important international journals.



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# Appendix 1

## Curricula Vitae of the Members of the Review Committee for Biology Research

**Prof. dr. Ab van Kammen** (1932), chairman of the Committee. Emeritus professor of Molecular Biology, Wageningen Agricultural University (1972-1997). Doctor h.c University of Padua, Italy (1999). Member of the European Molecular Biology Organisation (EMBO). Fellow of the Royal Netherlands Academy of Arts and Sciences (1991) and member of the Board of the Division for Natural Sciences of the Academy (1996-1999). Numerous publications on plant molecular biology, particularly on plant viruses, Rhizobium-legume symbiosis, plant genome structure and somatic embryogenesis in plants.

**Prof. dr. Robert McNeill Alexander** (1934), Professor of Zoology (1969-1999), School of Biology, University of Leeds, Honorary member of the American Society of Zoologists (1986), Fellow of the Royal Society (1987), Muybridge Medal of the International Society for Biomechanics (1991), Member of the Academia Europaea (1996), Editor of the Proceedings of the Royal Society B (1998-present), President of the International Society for Vertebrate Morphology (1997-present). Numerous scientific publications on the mechanics of human and animal movement.

**Prof. dr. Bernhard H.L. Schink** (1950), professor of Microbial Ecology and head of the Department of Limnology, University of Konstanz (1991 - present), professor of Microbiology at the Department of Microbiology, University of Marburg (1995 - 1986), professor of Microbiology and Biotechnology, University of Tübingen (1986 - 1991). Numerous refereed scientific publications.

**Prof. dr. H. Charles J. Godfray** (1959). Professor of Evolutionary Biology and assistant director of the Centre for Population Biology, Imperial College at Silwood Park. BA Oxford University (1979); PhD (1983) & Post-doctoral research (1983-5) Imperial College; Demonstrator in Ecology, Oxford (1985-1987); Imperial College, Dept. Biology since 1987. Research includes experimental and theoretical studies of insect population dynamics, behavioural and evolutionary ecology, especially problems involving parasitoids (author of *Parasitoids*, Princeton 1994). Also theoretical studies of insect-pathogen interactions and life history theory, particularly the evolutionary theory of parent-offspring conflict.

**Prof. dr. John A. Lee** (1942). Professor of Environmental Biology and chairman of the Department of Animal and Plant Sciences, University of Sheffield (since 1994/95). Professor of Environmental Biology, University of Manchester (1988-94). President of the International Society for Ecology (INTECOL) since 1998 (vice-president from 1990-1995). President of the British Ecological Society (1996-1997). Editor *Journal of Ecology* (1982-1990). Editorial Boards: *Journal of Bryology*, *Journal of Ecology*, *Plant Ecology*, *Environmental Reviews*. Research on physiological plant ecology and pollution biology.

**Prof. dr. U. Lüttge** (1936). Professor of Botany, Technical University of Darmstadt, Germany. Member of the Academia Europaea (1992), member of the Deutsche Akademie der Naturforscher Leopoldina (1996). Research on molecular ecophysiology of plants in the tropics; membranes and membrane proteins; ecophysiology of plants in the tropics; biological clock and endogenous rhythmicity with non-linear dynamics of the metabolic cycle of crassulacean acid metabolism. Over 400 publications and 8 books.



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# Appendix 2

## Discipline Protocol Biology

April 1998

### 1. Introduction

**This research assessment covers the discipline of biology. Within this discipline research is devoted to living natural objects. Biological research deals with structure, function and organisation of organisms, the way organisms develop and evolved, and studies the relations between organisms and the interactions of organisms with their biotic and non-biotic environment. As such biology has a lot of interconnections with various disciplines in science.**

The main aims of the assessment are, in concordance with the Protocol 1998, the improvement of the quality of the individual research programmes and the provision of information for the accountability of the research carried out. Furthermore, the assessment will be placed in the context of the activities of the faculty or the institute in which it is embedded and it also will give an appraisal of the general features of the scientific area covered in this assessment.

### 2. Delineation

Biology can be delineated in three main themes, according to a recent report "Biology: het leven centraal", written by the "Verkeningscommissie Biologie", November 1997:

- Studies of integrative functioning of genes in their natural environment
- Studies of basic factors in the regulation of biological systems
- Studies of tolerance of biological systems.

**There are various subdisciplines within the field of biology, where research is done at the level of the molecule, the cell, the organism and the population. Sometimes research is done exclusively at one of these levels but more and more research themes are done at integrative levels.**

Expertise in the committee is required in order to cover the various sub-disciplines:

- cell biology
- microbiology
- plant biology
- animal/human biology
- ecology
- theoretical biology/evolution biology

### 3. Units of assessment; mission statement

The local research programme is the level on which the assessment takes place. The programme should be concisely described, should be coherent and should ideally be the result of work of a group of people that work together on a daily basis. A programme can be the work of a department within a faculty or institute or a coherent part thereof. A programme can also be defined on the basis of the group's mission in context of the research policy of the faculty or research institute or school. More specific arrangements for programme definitions will be made on the basis of a preliminary list of programmes (see the VSNU letter to the University Boards of 20 January 1998).

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A guideline for the formulation of a mission statement can be found in the following description:

**a: descriptive elements**

- the scope of the research: a factual description of the area covered;
- the nature of the work in terms of fundamental, strategic or applied research;

**b: goals and objectives**

- the objectives and ambition of the group, the institute or the faculty: the aims, the focus on specific targets; a statement of what is envisaged as the achievements after completion of projects or sub-programmes; the type of products envisaged (scientific or professional articles, patents, (industrial) designs, advisory reports, etc.);
- the audience (or clients) of the research: the academic community, professional audiences, society, (under)graduate students, etc.”.

Ideally, a mission statement should be less than 300 words.

#### 4. Specific aims and elements of this assessment

This assessment considers also to what extent biology acts as a nurturing discipline towards other (sub)disciplines such as biotechnology, medical biology, biochemistry, biophysics, geology and psychology. Since most of the biological research is organised in Research Schools/Graduate Schools, an element of the assessment should be to evaluate the added value of such Schools.

#### 5. Information for the Committee

The assessment will be performed on the basis of a self-evaluation report provided by the research programme directors and the faculty/research institute or school. Furthermore, the Committee will have meetings with the responsible boards for research management and policy within the university and with programme directors, and if desired by the Committee, other participants in the research programmes (e.g. PhD students (AIOs)).

A site visit to research groups is required. To make this feasible the committee may select from each faculty or department one or more Research Schools or research groups directed by that faculty or department.

The assessment will cover the research carried out in the period 1993-1997.

The elements of the self-evaluation report are mentioned in appendix 3 of VSNU Protocol 1998. The basic elements are the following.

**Per programme:**

- a. A list of participants names, a table (see VSNU format) of research input in terms of personnel (fte) and money.
- b. A short programme description (see VSNU format), its place in the structure of the university, the faculty or the research institute(s) or school(s).
- c. The research mission of the programme, future in the light of the recent evaluations and the development of the new structure for the university
- d. For each programme: five key publications (selected by the research group), in triplicate.
- e. A list of the scientific output over the five-year period of assessment, listing the PhD-theses, scientific publications (split up in international peer-reviewed, national peer-reviewed and others), professional publications and refereed congress proceedings.

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- f. A list of other proofs of scientific productivity (organisation of congresses, editorships, patents, etc.)

**For the faculty, research institute or school:**

- a. The research profile of the managerial structure; focal points; present professorial chairs and the future developments for this; major investment plans, the future developments.
- b. A short description of the research plans (the mission of the faculty , institute or school; its research policy).
- c. Any further material needed for the committee to answer specific questions with regard to the faculty management and research policy.

**Further relevant information for this assessment:**

- a. Bibliometric analysis of research output is necessary to evaluate the impact of the output.
- b. Material needed to allow the committee to answer specific questions, e.g. in relation to a re-accreditation of a research school, and in relation to the Foresight Report on Biology.

## 6. Responsibilities

**Discipline Committee Natural and Technical Sciences (or the Subcommittee Biology):**

- preparation of the discipline protocol
- proposals for Committee chairperson and members

**University/faculty/research institute/school:**

- preparation of the information on the managerial unit.

**KNAW:**

- agree upon Committee chairperson and members

**VSNU:**

- approval of discipline protocol
- appointment of Committee chairperson and members
- act as the principal for the bibliometrical analyses.
- determination of the terms of reference for the Committee
- appointment of the Committee secretariat
- publication of the final report

## 7. Finances

According to VSNU rules the standard costs of the assessment will be charged to the universities. An estimate of the costs can be made as soon as the preliminary list of programmes as well as the composition of the Committee is known.



# Appendix 3

## PRELIMINARY ASSESSMENT FORM REVIEW COMMITTEE BIOLOGICAL RESEARCH 1998

Please return to the secretary before 30 October 1998.

Programme serial number: ..... Reviewer: .....

.....  
Programme title: .....

### 1. Preliminary assessments of the programme

Please give your ratings on a 5-point scale, in which:

1 = "poor"; 2 = "below standard"; 3 = "standard"; 4 = "good"; 5 = "excellent".

Note: Start from the assumption that all university research should normally conform to a certain standard. Consider if each aspect of this programme is above/on/below that standard. The committee report will have to specify where and why deviation of the standard is perceived. **Your preliminary assessment is only for use in the committee meetings and will not be published in the committee report.** Only overall scores per category will be published in the report.

A. QUALITY	1	2	3	4	5
<b>How do you evaluate the quality of the programme with respect to the:</b>					
1. originality of the approach and ideas					
2. coherence and cumulative character of the research					
3. prominence of the director and the other members of the programme					
4. distribution of published output over the team members					
5. quality of the scientific publications					
Overall assessment of quality:					
B. PRODUCTIVITY	1	2	3	4	5
<b>How do you evaluate the scientific productivity in view of the input of human and material resources with respect to the:</b>					
1. number of PhD theses					
2. number of scientific publications					
Overall assessment of productivity:					

<b>C. RELEVANCE</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>How do you evaluate the relevance of the research with respect to:</b>					
1. the advancement of knowledge or expertise					
2. impact and application a. in food production, health care, biotechnology b. in management of ecosystems, natural resources, environment					
3. position in relevant networks (national and international)					
4. the balance between fundamental and applied research					
Overall assessment of relevance:					

<b>D. LONG TERM-VIABILITY</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>Considering the available personnel and facilities, how do you evaluate the long-term viability of the programme (taking into account the long term needs of industry and society and of other users of scientific and technological knowledge):</b>					
1. in view of what has been achieved so far					
2. in view of the plans and ideas for the future					
Overall assessment of long-term viability:					

**2. Points of attention, remarks**

**3. Questions (to the programme director, faculty board or research committee)**

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## Appendix 4 Abbreviations

AIO	Assistent in opleiding
CvB	College van Bestuur
fte	Full time equivalent
HL	Hoogleraar
KUN	Katholieke Universiteit Nijmegen
MUB	Wet Modernisering Universitair Bestuur
NWO	Nederlandse Organisatie voor Wetenschappelijk Onderzoek
OIO	Onderzoeker in opleiding (NWO)
RUG	Rijksuniversiteit Groningen
RUL	Rijksuniversiteit Leiden
UD	Universitair docent
UHD	Universitair hoofddocent
UU	Universiteit Utrecht
UvA	Universiteit van Amsterdam
vwo	Voorbereidend wetenschappelijk onderwijs
VSNU	Vereniging van Samenwerkende Nederlandse Universiteiten
VU	Vrije Universiteit Amsterdam
wo	Wetenschappelijk onderwijs
WP	Wetenschappelijk personeel
WP 1	WP gefinancierd door de universiteit (eerste geldstroom)
WP 2	WP gefinancierd door NWO of KNAW (tweede geldstroom)
WP 3	WP gefinancierd door derden (derde geldstroom)



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## Appendix 5 Bibliometric Profiles

CWTS CODE	VSNU CODE	VSNU PAGE	DIRECTOR
KUN1	KUN 1	35	Van Zoelen
KUN2	KUN 2	36	Mariani
KUN3	KUN 3	37	Wendelaar Bonga
KUN4	KUN 4	38	Vogels
KUN5	KUN 5	39	Blom
LUW1	WU 1	87	Van Lenteren
LUW2	WU 2	88	Jeger
LUW3	WU 3	89	De Wit
LUW4	WU 4	90	Bakker
LUW5	WU 5	91	Goldbach
LUW6	WU 6 SUB 1&2	92, 93	Stam
LUW7	WU 7	94	Van der Plas
LUW8	WU 8	95	Van Went
LUW9	WU 9	96	Lemmens
LUW10	WU 10	97	-
LUW11	WU 11 SUB 1,2&3	98, 99, 100	Heyting
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