

Botany, Zoology and Ecology-related Disciplines

Panel 1

Evaluation
Division for Science

Molecular Biology
Panel 3

Botany, Zoology
and Ecology-related
Disciplines
Panel 1

Public Health and
Health-related
Research
Panel 5

Clinical Research
Panel 4B

Clinical Research
Panel 4A

Physiology-related
Disciplines
Panel 2

Psychology and
Psychiatry
Panel 6



Botany, Zoology and Ecology-related disciplines – Panel 1

**Evolutionary biology, ethology, marine biology,
limnology, plant physiology, systematics
and agricultural sciences**

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Preface from the Research Council of Norway

The Research Council of Norway (RCN) is given the task by the Ministry of Education and Research to perform subject-specific evaluations. According to the plan for these evaluations the RCN carried during 2010 and 2011 out a comprehensive evaluation of Norwegian research within biology, medicine and health in Norwegian universities, hospitals, relevant university colleges and relevant research institutes. Evaluations have previously been performed within these subjects/fields, in biology in 2000 and medicine and health in 2004.

Due to the large span in disciplines and the number of scientific groups involved in the evaluation, seven international panels of experts were established; each of them reviewed one of the following subfields:

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|----------|---|
| Panel 1 | Botany, Zoology and Ecology-related Disciplines |
| Panel 2 | Physiology-related Disciplines |
| Panel 3 | Molecular Biology |
| Panel 4a | Clinical Research – Selected Disciplines |
| Panel 4b | Clinical Research – Selected Disciplines |
| Panel 5 | Public Health and Health-related Research |
| Panel 6 | Psychology and Psychiatry |

The Research Council of Norway would like to thank the panel for the comprehensive work the panel has performed.

Oslo, October 2011

Hilde Jerkø (sign.)

Director

Division for Science

Mari K. Nes (sign.)

Director

Division for Society and Health

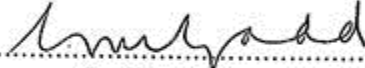
Statement from the Panel

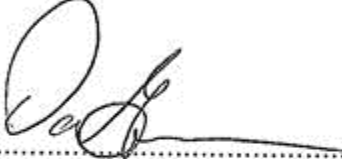
To the Research Council of Norway

The members of the research evaluation panel (hereafter referred to as 'the Panel') submit the following report, which is based on the self-evaluation documents submitted by each research unit, the bibliometric analysis provided by the RCN, and the Panel's meetings with group leaders that took place in Oslo on 28th March to 1st April 2011. The report represents the consensus opinions and recommendations of the Panel.

Prof Marie-Christine Van Labeke of Ghent University contributed to the initial evaluation of the submitted self-evaluation documents but did not attend the Panel hearings in Oslo and has not signed the report.


Paul Harvey
University of Oxford
England
Chair


Geoffrey Gadd
University of Dundee
Scotland


David Groman
Univ. of Prince Edward Island
Canada


Marlene Zuk
University of California Riverside
USA


Peter Burkill
Sir Alistair Hardy Foundation for Ocean
Science
England


Pedro Crous
Dutch Academy of Science
the Netherlands


Erica Fleishman
University of California
USA

Dr Oliver Pybus, University of Oxford, England, was secretary to the committee

Executive summary with general conclusions

The Panel met with representatives from twelve university departments, one University Centre (UNIS), and seven research institutes. The twelve departments that were assessed by the Panel were drawn from seven universities: UMB, NTNU, and the Universities of Adger, Bergen, Nordland, Oslo and Tromsø. The research institutes that took part in this evaluation were the Institute for Marine Research, the Norwegian Forest & Landscape Institute, Bioforsk, NINA, NIVA, the Norwegian Polar Institute, and SINTEF Fisheries & Aquaculture.

It appeared that many recommendations resulting from the evaluation undertaken in 2000 have been acted upon. We see this report as part of an ongoing process of evaluation and recommendations.

There are, however, a number of issues that appeared to be almost universal or were raised independently by a number of institutions. We discuss these trends below, in the section titled General recommendations, and in most cases do not revisit them in our reports and recommendations for individual units, departments, or institutes. Consideration of these common themes forms the substance of our general conclusions. The issues we highlight include (i) the status of, and attitude towards, gender equality in Norwegian biology, (ii) the inadequate provision of small grants or seedcorn funding, (iii) the consequences of offering four-year contracts, (iv) the cost of biological research in Norway and its impact on competitiveness, (v) the provision of technical support, and (vi) the importance of considering a diverse array of indicators of research success.

The Panel also considered the research quality of the various biological disciplines and research topics that were within its remit, with the aim of identifying strengths and noting areas that require attention. These conclusions are presented in the section below, titled General description of the field.

General description of the field

Several research groups have international strengths in the areas of ecology, biodiversity and conservation biology as well as in the synthesis of ecology and evolution. These combined strengths are important for coping with future challenges in environmental management including the prevention of habitat degradation, controlled harvesting, population conservation, and climate change.

Marine resources and aquaculture are of economic importance to Norway and a number of research groups are undertaking high quality research in fields relating to marine ecology, including plankton biology, arctic marine systems, and marine genomics and biodiversity.

For most other disciplines, the number of relevant research groups submitted to this Panel for evaluation were too small for general conclusions to be drawn. Bearing that caution in mind, we note that a pair of research units that study microbiology and microbial ecology were rated highly.

The Museums contain collections that constitute both national and international resources, including specimens and type specimens. It is not clear what role those resources will play in the future, or the extent to which they are being catalogued using DNA barcoding technology to constitute a national database or to fit into international databases. A national review to clarify the future roles of Museums in research should be undertaken.

General Recommendations

Gender equity

We noted that each institution or department was asked to describe briefly its policy for gender equity and the balance between men and women in academic positions. Almost all of them reported the sex ratio among the members of their units, with most indicating a highly male-biased ratio at relatively senior levels but a more balanced or female-biased ratio among PhD students and postdoctoral fellows. Most institutions presented the male-biased ratio at senior levels and the discrepancy between senior and junior ratios as problems to be solved. It appeared that the institutions' goal was an equal sex ratio at all levels. The institutions' most common suggestion was an effort to reach out and extend invitations to women to apply for vacant positions. A few institutions offered mentoring programmes for women to provide guidance in career development. Some institutions suggested, either in their self-evaluations or in their conversations with the panel, that the sex ratio would become more even given sufficient time as the higher proportions of women in junior positions moved through the system and the senior scientists retired.

We would like to share our reactions to this information and presentation with the Research Council. First, it is unclear what the goal of each unit should be with respect to gender balance; in some countries, the proportion of men and women expected to be employed in a unit are calculated on the basis of availability pools, that is, the proportion of each gender that were awarded PhDs during a given time period. This expectation is field- or discipline-dependent, such that fewer female applicants are expected in, for example, engineering than in the life sciences, simply because fewer PhDs currently are awarded to women in the former. Then, if the sex ratio of applicants for a given position deviates from the expectation, or if the proportion of applicants is consistent with the availability pool but the set of finalists is not, the unit knows where to focus its recruiting efforts. If data on availability pools are available in Norway, they could be made accessible to departments and other units during recruitment so the unit could develop evidence-based expectations of the sex ratio for their group and respond accordingly.

Second, the Panel thought that the units were not provided with tools to address any inequities that do exist. There is ample evidence that simply waiting for cohorts with a higher proportion of women to move through the system and thus passively correct the imbalance is ineffective. The proportion of women who pursue careers in science tends to decrease as seniority increases, so proportions of male and female PhD students may be roughly equal, but cohorts become more male-biased over time. The drivers of this pattern are complex. Policies allowing flexibility to raise children and take care of other family members are important, but so is the awareness of the potential for biases on selection committees and among other reviewers. These inadvertent biases may include, for example, a tendency for letters of recommendation to refer to future potential of male candidates versus past accomplishments of female candidates. We recommend that those involved in recruitment receive training in identifying and rectifying such biases, and in

how family-friendly policies can be implemented. Accommodation for spouses or partners is always an issue for hiring professionals, and although there is no simple solution, this will need to be confronted by the institutions.

It was not apparent to us that institutions or the Research Council responded to efforts of the units with regard to gender equity. If the gender composition of the recruitment pool does not differ whether a position advertisement notes that women are strongly encouraged to apply, are institutional or national protocols in place to address this issue? Again, institutions may lack tools to effect change, such as realistic goals, incentives, and means to accomplish the goals. If tools are not provided, then despite the best of intentions, it seems likely that the proportional representation of women in Norwegian science will be unchanged in another ten years time.

Small grants

Opportunities to receive funding from the Research Council are restricted, but in particular we noted the paucity of opportunities to apply for small grants, up to about US\$30,000. Such grants can be extremely useful for initiating a comprehensive project and for small projects. Furthermore, junior researchers that successfully compete for funds can build their confidence and motivation to apply for more substantial funding, both nationally and internationally. The administrative burden associated with a small-grants programme can be low. For example, a review committee can be appointed and short applications, say two pages long, can be evaluated by email. Several of us have experience in reviewing and receiving such grants and believe they provide a high return on investment from both the Research Council's and the recipients' perspectives.

Professor II

We felt the judicious appointment of Professor II positions was quite effective when particular research areas needed strengthening. Such visiting professors are committed to play a larger and more intensive role in a unit than, say, members of a scientific advisory board who make occasional very short visits to a unit.

Four-year positions

Many of the institutions and departments we met with indicated that the requirement to offer a permanent contract or terminate a postdoctoral contract after four years was a challenge to productivity and morale. Although we appreciate there is a trade-off between continuity and turnover, we suggest that this particular situation be reviewed. Alternatives that might be considered are offering a four-year contract with an optional two-year renewal or offering a five-year contract with an optional three-year renewal before a final decision is made to offer a permanent position or terminate the contract. The renewal process is likely to require an evaluation of progress by both the employer and employee. If a contract is renewed for two or three years, either targets for permanent employment can be set or the employee can have some job security while searching for a new position.

High cost of research in Norway

Several institutions and departments indicated that research costs are high, particularly in the institute sector. We were told these costs sometimes prevent application for and acceptance of grants provided by the European Union and other international funding agencies, some of which presumably are financially supported in part by Norway. As a result, research on some topics that might best be conducted in Norway is performed

elsewhere. If this situation continues, it may result in a deterioration of the research base in Norway.

Technicians

The self-evaluations and conversations with institutions and departments suggested that technical support is quite limited within many of those organisations. The drivers of this situation were not clear. We speculated that perhaps when directors or heads of department have freedom to allocate funds, they tend to support faculty, research staff, or administrators rather than technicians. Regardless of the cause, it seemed likely to us that research output per scientist would increase, considerably in some cases, if additional technical support were available. This situation may warrant a general assessment by the Research Council.

Diversification of measures of success

Many institutions differentiated between basic and applied research. Research traditionally has been classified along a gradient or axis from basic to applied, with different motivations driving each end of the gradient. In this schema, basic research produces new knowledge (i.e. it establishes fundamental principles) in a scientific or technological discipline. It is often theoretical and intended to increase understanding of certain phenomena or behaviour. This research may or may not be driven by a practical application to management or social priorities. According to the same schema, applied research is research that aims to address practical, often widespread challenges and develop or implement innovative technologies; it is reliant on established basic principles.

Research activities also may be mapped in two dimensions, according to the degree to which research is pursued to satisfy scientific curiosity versus a practical application, and the degree to which the research is intended to advance fundamental scientific knowledge. No matter the initial motivation, multiple phases ultimately are involved in the development and use of knowledge from initial concept to implementation. Louis Pasteur emphasized that there does not exist a category of science which one can name applied science. Instead, there is science and there are applications of science. Whether research is driven by curiosity or practical needs for information does not affect the quality of the work.

A number of institutions further implied that research motivated by practical needs is less amenable to high-quality publication than curiosity-driven research. We disagree with this suggestion. Instead, rigorous science generally is publishable in highly respected journals regardless of motivation. Nevertheless, we recognize that scopes of work and budgets for projects supported by contracts may not encompass preparation of manuscripts for submission to peer-reviewed journals. The quality of research does not depend on where – or if – the work is published. Reliable, objective information, analyses, and inferences have the potential to inform decision-making whether they be communicated in a journal, a report, or verbally. Accordingly, our evaluations of research quality encompass interaction with national and international bodies that render decisions or pass legislation (see following section).

Additionally, several institutions identified concerns over the current national publication rankings that are organized and run by the Norwegian Association of Higher Education Institutions, noting that for some disciplines journals that would be considered high

impact in a given discipline were ranked lower in the Norwegian system overall. It may be helpful to re-evaluate the current journal impact factors in Norway.

We encourage institutions and the Research Council to formalise recognition of outreach or collaboration with decision-makers as measures of success equal to publication in journals with high impact factors. Nevertheless, we encourage institutions to include publication within contract agreements whenever feasible. Because publication often confers greater credibility to a given research project, publication may be in the best interests of the sponsor. Numerous examples exist of successful publication despite the need or desire to withhold proprietary information from the public.

A Note from the Panel on Grades of Assessment

The Panel were asked to grade each research evaluation unit (level 2) according to the following five categories, which were supplied and defined by the Research Council of Norway.

Excellent

Research at the international front position: undertaking original research of international interest, publishing in internationally leading journals. High productivity.

Very good

Research with high degree of originality, but nonetheless falls short of the highest standards of excellence. A publication profile with a high degree of publications in internationally leading journals. High productivity and very relevant to international research within its sub-field.

Good

Research at good international level with publications in internationally and nationally recognised journals. Research of relevance both to national and international research development.

Fair

Research that only partly meets good international standard, international publication profile is modest. Mainly national publications. Limited contribution to research.

Weak

Research of insufficient quality and the publication profile is meagre: few international publications. No original research and little relevance to national problems.

Before undertaking this report, the Panel decided that a range of adjacent categories would be used, when appropriate, to represent the diversity of research activity generated within a single research unit. Evaluations of individual researchers are not given in this report.

Although the Panel adhered to the categories stipulated by the research council, it is mindful that no one set of criteria can wholly capture the quality and impact of the diverse range of activities undertaken by Norwegian biologists. Several Departments or Institutes have a clear service-orientated mandate, which means their output is difficult to measure

directly using numbers of peer-reviewed research papers, numbers of students, or by impact factor. Similarly, units located in museums have a unique mandate that includes education and public outreach. The Panel appreciated these issues and noted that the time allocated to research varied among groups and institutions. For the next evaluation, the Panel recommends that a clearer indication is given of the approximate percentage of time that each unit allocates to research versus service and/or outreach.

Norwegian University of Life Sciences (UMB)

Department of Animal & Aquacultural Sciences

Description of institution

This department is a relatively new combination of four previous departments, and now represents the only place in Norway for research into animal welfare and animal production. Both food production and companion animals are part of the unit's purview. A Head of Department oversees the unit, which now includes Ethology and Animal Environment – the only subunit that is part of the present evaluation. The various research groups cover virtually all animals that are used in production or as companion animals, including the welfare of fur-bearing animals, a topic not usually included in similar research efforts.

General evaluation & recommendations

As only one unit from this Department was submitted for evaluation, the Panel has no specific recommendations at the departmental level. See below for the appraisal of the Ethology and Animal Environment unit.

Follow up of previous evaluation

The previous evaluation had recommended the development of more coherent and sustained international collaborations in order to raise the research profile of the members of the unit. In addition, stronger ties with NTNU were recommended. The former has been achieved to some extent, but the latter has not. The evaluation also mentioned that the emphasis on “functional, behavioural ecology was not persuasively related to welfare issues”. This link is now clearer with, for example, the unit's work on companion and fur-bearing animals. At present, however, the Panel feels that effort might better be expended on ties with industry and governmental regulatory agencies rather than on attempting to increase basic research, with or without colleagues at other institutions within Norway.

Evaluation of individual research units

Ethology & Animal Environment

Grading of scientific quality

Fair to Good

Description of unit

The group consists of three full professors and one associate professor. The full professors are in their mid-fifties whereas the associate professor is in her early forties. In addition, there is a professor II (20% time) and two postdoctoral fellows and one research scientist.

Follow up of previous evaluation

The Department of Animal & Aquacultural Sciences has been substantially reorganised since the last evaluation. The reorganisation has improved the ability of members of this

unit to do focused research. The previous evaluation recommended an increase in international collaborations, and this has occurred to some extent, but it may be possible to explore more creative links, as discussed below.

General evaluation & recommendations

We were impressed with the breadth of the research conducted by this unit. The group is actively engaged in a number of important research areas, and members are publishing at a high rate. The unit is well placed to become a world leader in animal behavior and the application of science to animal welfare, which is of increasing interest to a number of governmental, private, and academic institutions.

Current publications are mainly in just a few journals, particularly Applied Animal Behaviour Research, which do not have high impact factors. The group has worked well to increase its productivity in refereed journals and to develop collaborations since the last assessment. However, publication impact could be improved. We encourage the group to consider the transferability of its inferences to other disciplines.

Although the self-assessment expressed some interest in trying to publish a greater quantity of basic research, and in submitting publication to a wider variety of journals, we felt it might be equally (or more) effective to increase the profile of ongoing work. For example, partnerships with corporations or other entities with interests in animal welfare could help support the activities of the university and also increase its ability to inform decisions. Such collaborative research might be appropriate for submission to higher impact journals.

It might be possible to obtain core or project-specific funding from food (e.g. large supermarket chains) and catering (e.g. international fast food outlets) industries for research on animal welfare. Research linked to national and international (European Union) legislation on animal welfare informs decisions to adjust stocking density and requirements for housing animals. Although the current senior scientists have started to develop this enterprise, continuity might be increased by appointing replacements before those individuals retire. Hosting visits from animal welfare scientists from other countries who have been successful in raising funds and producing high impact research might assist recruitment.

There may be potential to expand research on aquaculture. Many groups are interested in treatment of farmed fish, and the university has an opportunity to seek funding for study of welfare of such animals. There seem to be opportunities for cooperation between the various marine institutes and this university.

Societal impact

Research on animal welfare has extremely high societal impact. A first rate research group, supported by outreach and media coverage, has real potential to become self-sufficient.

Norwegian University of Life Sciences (UMB)

Department of Ecology & Natural Resource Management

Description of institution

The Department of Ecology & Natural Resource Management was established in 2003 when the Department of Biology & Nature Conservation and the Department of Forest Sciences merged during University reorganisation. The self-assessment indicates that the cultures and priorities of the former departments differed and caused friction within the new department.

Separate boards, both of which advise the department-level board, make most decisions about teaching and research. Research groups do not manage budgets or personnel. Research groups are intended to provide PhD students with scientific and social support but most PhD students primarily interact within their laboratory groups rather than their research groups. An effort is underway to reduce the teaching commitments of permanent academic staff. There are incentives for scientific publication, dissemination of popular science, and for securing external support for research.

Research priorities for 2009–2012 were set with input from all staff. The four priorities are renewable energy, climate change, nature conservation and land-use, and ecology, biodiversity, and conservation biology.

General evaluation & recommendations

The self-assessment suggested that staff would appreciate more opportunities for input into decisions concerning departmental priorities and activities. Currently the head of department makes most administrative decisions.

There is considerable overlap in the four research priorities. For example, the differences among nature conservation, land use, biodiversity, and conservation biology are unclear. The self-assessment commented that the priorities do not provide strong guidance for strategic research directions.

Are there opportunities to create partnerships with the private sector in order to recruit and fund PhD students in renewable energy? Perhaps industry would be willing to support part of the costs for existing employees to return to university for graduate degrees.

We strongly support the use of incentives for both dissemination of popular science and scientific publications.

Follow up of previous evaluation

The department responded to the 2000 evaluation by merging former departments into larger units and by externally announcing and recruiting department heads. The self-assessment suggests the merger was unwelcome and has been counterproductive.

Evaluation of individual research units

Ecology

Grading of scientific quality

Good

Description of unit

The ecology unit includes four research groups: biodiversity, systematics and evolution; wildlife management and ecology; plant-animal interactions; and environmental change biology. The latter three groups focus on both basic and applied ecological research across a wide range of organisms and themes, whereas the former focuses on genetics and taxonomy. As of December 2009 the unit included 18 permanent staff and seven postdoctoral fellows.

General evaluation & recommendations

The current research plan and output is excellent. However a strategic framework for research and for flexibility among groups to encourage collaboration was not apparent. Continued provision of technical support also is important to ensure research productivity is maintained.

If researchers are relieved of administrative duties, a more hierarchical structure is likely to result, and the department chair inevitably will make a greater proportion of decisions. Creating an advisory board of scientific peers, at least some of who are from outside the organisation, may help provide community and scientific support for such decisions.

Most current staff members are fairly senior and are male. There may be opportunities to recruit more diverse personnel in the future.

Societal impact

Topics of research are directly relevant to societal decisions.

Forest Resources

Grading of scientific quality

Good

Description of unit

Three research groups are included within Forest Resources: forest inventory and monitoring, wood science, and silviculture. Each group has two permanent academic staff.

Forest inventory and monitoring develops methods for comprehensive mapping of forest resources at multiple spatial scales and resolutions. The group has considerable expertise in combining ground data with LIDAR data and is the only academic forest-inventory group in Norway. The wood science group focuses on the effects of tree growth on wood properties, including wood formation and silviculture, and its relation to wood chemistry and morphology. The silviculture group focuses on models of tree growth, forest inventory, forest management planning, potential use of forest biomass for energy, and reduction of emissions from deforestation and degradation (REDD).

General evaluation & recommendations

The self-assessment noted that the forest inventory and monitoring group had difficulty in recruiting individuals with statistical expertise and females; two recent attempts to recruit female students have failed. The group or unit might conduct a more thoughtful analysis of recruitment methods, potential reasons for failure to achieve recruiting objectives, and alternative methods (see the Introduction to this report).

The forest inventory and monitoring group has found that the university is unable to maintain the group's computing infrastructure efficiently and therefore is conducting its own maintenance. Acquisition of data from national programs is perceived as a highly bureaucratic process.

The wood science research group is small, and the two current PhD students are not on site (they are based at the Norwegian Forest and Landscape Institute). It may be possible, perhaps with support of the industry, to attract a greater number of PhD students.

Societal impact

Societal impact is high. The forest inventory and monitoring group collaborates extensively with the private sector and the national forest industry. The silviculture group initiates or conducts much of its research in cooperation with forest managers.

Norwegian University of Life Sciences (UMB)

Department of Plant & Environmental Sciences

Description of institution

The department (*Institutt for plante-og miljøvitenskap*, IPM) was formed in 2005 after the merger of two departments of the former Agricultural University of Norway (NLH), Soil & Water Sciences and Plant Sciences, and plant physiologists and geneticists from two other departments. IPM is the largest department at UMB. Its 175 employees are organised into seven scientific sections, each led by a group leader. IPM has 14 administrative staff, including the head of administration, who serve all scientific sections. Staff members have competencies in many areas and are performing research and teaching in life sciences and their practical application, plant production, use of natural resources, climate change and renewable energy, food production, and food safety. The department has strong national and international collaborations.

General evaluation & recommendations

In general the department seems strong and dynamic, with a good organisational structure. Reducing the number of geographical locations where staff are based might result in stronger research groups and infrastructure. The department produces a high number of research papers each year, although relatively few of the papers are published in high-impact journals. The unit relies on external funding to pay the salaries of permanent staff. According to the self-assessment, four of the seven research sections are strong (Soil Science, Plant Genetics and Plant Biology, Plant Production, and Environmental Chemistry); the department might consider whether to retain all seven. A new appointment in limnology may strengthen that group. The decline in the number of undergraduate students may result in a decrease in government funding. If feasible, the department might secure funds to assist groups with short-term financial needs. The age balance of staff is poor in some areas. The department might investigate the potential for a stronger interaction with Oslo University in order to share the teaching load. We suggest investigating the possibility of establishing a National Plant Science Programme. The department might establish a strategic long-term research plan if one does not already exist.

Follow up of previous evaluation

The department has established strong national and international collaborations and the research output in ISI-rated journals has increased. Smaller groups have merged into larger and more productive units.

Evaluation of individual research units

Genetics, Plant Biology & Plant Production

Grading of scientific quality

Very Good to Excellent

Description of unit

Genetics & Plant Biology (GPB) covers plant genetics, plant breeding and plant physiology whilst Plant Production (PP) covers product quality, plant protection (from pests and diseases) and agricultural ecology. There is ample collaboration between the two sections. The sections comprise 11.9 full professors, 7.4 associate professors or permanent senior researchers (of which 0.4 are adjunct) and nine postdoctoral fellows or other researchers.

General evaluation & recommendations

It may be possible for some researchers, especially in PP, to increase their publication output. We recommend that time allocated to research does not decrease. Research topics chosen by existing groups in Genetics & Plant Biology are internationally significant (less so in Plant Production). The BIOKLIMA theme will be internationally important if funded. Increasing the physical proximity of the groups may increase their productivity; as the self-assessment proclaims “The plant biology group has staff and activities in eight places, with most offices far away from experimental facilities”. We understand that this problem is being tackled.

Societal impact

The potential to increase food production by producing strains that are resistant to *Fusarium* in wheat and oats and powdery mildew in wheat is of great relevance to society.

UMB Nitrogen Group

Grading of scientific quality

Very good to Excellent

Description of unit

The UMB Nitrogen unit was established in 2005 with the aim of establishing a robust group emphasizing molecular biology, process-oriented microbial ecology and soil science. An additional aim of establishing the unit was to break barriers in the study of microbial nitrogen transformations, primarily in terrestrial ecosystems. The group presently consists of 21 people (four professors, three postdoctoral fellows, 11 PhD students, three technicians) and five MSc students. Research topics include the genetics and physiology of prokaryotes (especially denitrifying, ammonia oxidizing and nitrogen-fixing prokaryotes) and ecology of microbial communities. Methods include process studies of nitrogen transformation kinetics (phenomics), field experiments, and watershed biogeochemistry and modelling.

General evaluation & recommendations

This small, robust group is led by experienced principal investigators who are carrying out excellent research on microbial nitrogen transformations. However, the average age

of unit members is relatively high. The group seeks to increase both its publication output and the proportion of publications in high impact journals. It is carrying out several projects on nitrogen transformations within and outside of Scandinavia (e.g. in China) and is pioneering the application of robotics in environmental sampling. Future appointments may alleviate the load placed on the senior principal investigators.

Societal impact

The research has societal impact. Microbial nitrogen transformations play key roles in ecosystems. The research may suggest mechanisms to mitigate undesirable anthropogenic effects on the global nitrogen cycle and improve biogeochemical models for natural and agricultural ecosystems.

Norwegian University of Science & Technology (NTNU)

Department of Biology

Description of institution

The Department of Biology at the Norwegian University of Science and Technology was established in 2002 in response to the research evaluation in 2000, which recommended the establishment of more-cohesive research units. The Department of Biology includes the former departments of botany and zoology and the department of marine biology at Trondheim Marine Biological Station (Museum of Natural History and Archaeology). After an interim reorganisation, the department was partitioned into three units: Ecology, Ethology & Evolution; Physiology, Environmental Toxicology & Biotechnology; and Marine Science. The Ecology, Ethology & Evolution section has three research groups: the Centre for Conservation Biology; Behaviour, Evolution & Life History; and Plant Ecology & Physiology. Our evaluation covered these three units, and Marine Science.

When the self-assessment was submitted the department's scientific personnel comprised 24 professors, nine associated professors, three adjunct professors, 17 research scientists, 13 postdoctoral fellows, 26 technicians, 54 PhD students, 150 MSc students, and more than 200 BSc students. The administrative section of the department has eight positions.

General evaluation & recommendations

Allocation of internal funding to research is based on number of publications averaged over the past three years and the number of students graduated. This is an objective metric that creates an incentive for publication, but might inadvertently lead to relatively piecemeal publication and to publication in journals with relatively low impact factors.

Exemptions from teaching are given to some of the professors with relatively active research programs, and staff who generate relatively few publications over long periods of time have increased teaching loads. On the one hand, this trade-off might allow those who particularly enjoy and excel at teaching to maximise their contact with students. On the other, it is possible that teaching will be devalued relative to research. Staff indicated that financial and teaching awards help to acknowledge excellence in teaching.

The department could recognise and reward service on science advisory panels and similar activities more formally. From 2012 onwards, physical proximity to the Norwegian Institute for Nature Research (NINA) may help increase opportunities for communication with end-users, whether by department staff or via collaboration with individuals at NINA.

The self-assessment notes that recruitment of group heads has been from among relatively well-known and established scientists. This could work very well provided the heads are able to allocate time for administrative tasks, including strategic leadership, in addition to maintaining their own research outputs.

Follow up of previous evaluation

The current structure of the department appears to have resulted from the previous evaluation. The establishment in 2007 of a new building for marine research, including aquaculture, similarly was a response to the previous evaluation. A replacement position in plant physiology and new positions in systems biology and plant molecular biology followed from questions raised in the 2000 evaluation about the future development of experimental plant biology.

Evaluation of individual research units

Centre of Conservation Biology

Grading of scientific quality

Excellent

Description of unit

The unit includes 14 scientists and secures approximately 30% of the department's external funding. According to the self-assessment, the unit focuses on predicting the effects of anthropogenic environmental changes, including harvest, on population viability and on trends in population size and community composition. The group also seeks to identify factors that affect the rate of evolutionary responses to environmental change. The group has considerable quantitative expertise.

General evaluation & recommendations

In the self-assessment, population biology was regarded as the research strength of the unit, which we accept. We note without prejudice that population biology is a relatively small subset of conservation biology as currently understood; the unit might consider increasing its breadth over time.

Societal impact

The societal impact of the group seems to be moderate, and likely could be increased if staff wish to do so. The group appears to rely on NINA to translate its work into less-technical language and to interact directly with end-users that might be able to apply the information. If students and junior staff do not already have the opportunity to collaborate with NINA on such activities, they might be encouraged more strongly and rewarded for doing so.

Behaviour, Evolution & Life History

Grading of scientific quality

Very Good

Description of unit

The unit contains five professors and three senior researchers or postdoctoral fellows. The group is strongly male-biased and all but one of the members are older than 50.

General evaluation & recommendations

The unit is small and highly specialised. The majority of its publications focus on brood parasitism, the evolution of ornamentation, and the reproductive ecology of a variety of organisms, particularly fish. Although the individual researchers are certainly productive, it was unclear to us why this group is separate from the Centre for Conservation Biology, which appears to be much larger, yet has scientists with research programs that overlap those in this unit. Some members of the panel felt the absence of a clear delineation of areas of focus might confuse potential new staff during the recruitment process. Recruitment is not trivial given the age structure of the unit. Furthermore, the existing structure may impede collaboration among units.

Societal impact

Understanding the behaviour and life history of organisms can increase the probability of successful management and conservation, and several members of the unit contribute more or less explicitly to management objectives. For example, some research addresses conservation of African mammals, the bushmeat trade, and salmonids.

Marine Science

Grading of scientific quality

Good to Very Good

Description of unit

The unit includes five professors, five researchers, 15 PhD students and more than 40 MSc students. It is based in two locations, at Trondheim Biological Station and at the NTNU centre of Fisheries and Agriculture. The group's activities are diverse and range from academic studies to technological applications of basic science. There is a strong emphasis on thematic 'areas' that are designed to strengthen interdisciplinary research. The unit has good research facilities that include a research ship and an aquaculture facility. The unit works closely with SINTEF as its main external research partner.

General evaluation & recommendations

The unit is well established and external interactions are extensive, both in Norway (with SINTEF, for example) and abroad (Vietnam, China, Spain, Belgium). The unit's age structure is weighted toward the senior level, with some staff retired but still active. Two professors are retiring in 2011. A succession plan would be very helpful. Postdoctoral appointments would maintain creativity and diversify the age structure.

Publications were mostly of international significance in journals such as *Aquaculture*. The number of publications seemed moderate. Quality of research is good and staff have national or international reputations.

Societal Impacts

Effects of changes in land use and climate in coastal zones have high societal relevance. The unit's interactions with SINTEF increase the practical value of its work. Patent activity is noteworthy.

Plant Ecology & Physiology

Grading of scientific quality

Good

Description of unit

Since the 2000 evaluation, the Plant Ecology & Physiology unit moved from the Department of Botany to the Department of Biology. Five of the eight academic members of staff with permanent positions in 2000 have since left the group, and one has a part-time advisory role (professor II). Two associate professors and two postdoctoral fellows have joined the group. As a result, there has been limited time for collaboration and cohesion to develop within the unit. The unit now contains one professor, three associate professors, two externally funded researchers, and one professor II.

General evaluation & recommendations

The unit has strengths in the ecology of bryophytes and lichens and in plant responses to climate change. The national and international network of those who participate in research on climate change and on the phylogeography of African bryophytes is strong. Similarly, some researchers are members of a network of European plant ecologists studying herbaceous species in forests.

The group has two technicians who appear to spend the majority of their time teaching and thus have limited capacity to contribute to research.

The self-assessment notes that “We are not really certain about how the institution’s policy for recruitment [of PhD students and postdoctoral fellows] is.” Communication between the unit and central administration with respect to recruitment could be improved.

Societal impact

As the self-assessment points out, outreach can be challenging because five of the seven research staff are not native Norwegians and so their communication skills within Norway are limited. Research that addresses the response of tree growth and distribution to climate change may have application to frozen and dried preservation of foods, drugs, cells, and tissues. The group participates in collaborative research on restoring a former military area and on Svalbard, and in the red-list process for bryophytes in Europe, Asia, and Réunion.

Norwegian University of Science and Technology (NTNU)

Museum of Natural History & Archaeology, Section of Natural History

Description of institution

The Section of Natural History is one of four sections of the Museum of Natural History and Archaeology (VM) within the Norwegian University of Science and Technology (NTNU). The museum and faculties are at organisational level 2, the sections are at level 3, and established research groups are being formalised at organisational level 4. The section has its own board with representatives from staff, students and two external organisations, and is chaired by the section head. NTNU reorganised the faculties in 2002. The Department of Natural History was renamed the Section of Natural History. In 2009 the museum was reorganised and a head of section was appointed. A new strategic plan was implemented in early 2011. This strategy encompasses biosystematics, focusing on the evolutionary development of species and the distribution of diversity through time and space, and science for evidence-based management, and conservation of biological diversity and cultural heritage.

General evaluation & recommendations

It seemed that output in peer-reviewed international journals could increase, as could the publication of work with strong social relevance in the popular press. Several members of the panel thought that collections should be central to all research activities. A high percentage of the staff is older than 63. The museum might investigate the potential to strengthen collaboration with other natural history museums in Norway. We suggest the database of holdings be linked to the DNA bank and to DNA barcodes, and made available online.

Follow up of previous evaluation

The previous evaluation was critical that the Section of Natural History and the Department of Biology had parallel research groups, or individual researchers who worked on similar topics and projects without collaboration. This aspect has since been addressed by a contract regulating collaboration on research, teaching and outreach between the Faculty of Natural Sciences and Technology and VM. The Department of Biology does not hire biosystematicists; biosystematics is taught by the museum. The previous recommendation to establish two research groups has been implemented.

Evaluation of individual research units

Systematics & Evolution

Grading of scientific quality

Good

Description of unit

The unit has nine scientific staff members, two of whom are female. Many of the members are over 60. The focus of the group is biosystematics of a few taxonomic groups, particularly mosses and some insects, and the molecular laboratory facilities have been recently upgraded.

General evaluation & recommendations

We were impressed with the unit's efforts to integrate research with the Department of Biology at NTNU. The productivity of the group is uneven, with relatively low publication rates and many publications in journals with relatively low impact and readership. We support efforts to increase the number of PhD students and postdoctoral fellows via teaching by the staff, but also recommend exploring other avenues for such recruitment, such as advertisement in online evolution fora. It is clear that the group is still responding to the changes implemented in 2009, and we encourage the unit to move toward more process-oriented research.

Societal impact

The museum is part of the national effort to understand and conserve biological diversity, an effort with clear societal relevance. Outreach to the public and other non-academic users of the museum's resources is an important component of museum activities.

Conservation Biology

Grading of scientific quality

Fair to Good

Description of unit

The Conservation Biology group aims to develop and integrate research, public outreach, and education and to generate strong interactions among professional researchers and students. The group is relatively small. When the self-assessment was submitted the group included six academic and research staff, three postdoctoral fellows, and one PhD student.

General evaluation & recommendations

The group's ability to collaborate effectively with the management community is a great strength. It might consider publishing manuscripts not only on natural science research but also on the process of working closely with stakeholders or end users. Many other researchers seek to improve the relevance of their research or their collaborations with diverse partners, and are eager for well-communicated guidance on what processes are effective as well as less effective. The pending retirement of a high proportion of staff may create opportunities to either reinforce or identify new strategic directions. Another strength is the emphasis on empirical research, which will allow the group to remain well grounded in natural history. It is possible that publication output is in part a function of

individuals' motivations for promotion rather than whether the research is primarily driven by curiosity or by the expressed needs of end-users.

Societal impact

The relevance of the group's work to society is high, especially its direct engagement with the management community and its dissemination of work in non-technical fora.

University of Agder

Department of Natural Sciences

Description of institution

The Department of Natural Sciences was established in 1994 when two colleges (Agder College and Kristiansand Teacher College) were merged to form Agder University (UiA). The Department is responsible for teaching basic sciences and for training of both science teachers and biomedical laboratory technicians. Research is conducted in the disciplines of functional ecology, biomedicine and didactics in natural sciences. Staff include three principal scientists, nine senior scientists, two research scientists, and one physician (60% time). The staff range in age from 35 to 65 years old, and include two non-Norwegians. Only two professional staff are female. The department does not currently have a PhD programme but shares four students affiliated with other institutions. Departmental staff have access to six general teaching laboratories and 11 research laboratories, a modest aquatic laboratory, a greenhouse and an observatory. These facilities are outfitted with a wide range of basic analytical equipment.

General evaluation & recommendations

See below.

Follow up of previous evaluation

Neither Agder University, Agder College, nor Kristiansand Teacher College were part of the evaluation in 2000.

Evaluation of individual research units

Functional Ecology

Grading of scientific quality

Good

Description of unit

The Functional Ecology group was formed in 2007. The group has two principal scientists and four senior scientists, one of whom is female. All are Norwegian, with a mean age of 52 years. The group engages in a wide range of research, including rodent, alpine plant, and aquatic ecology, fish immunology, and molecular aspects of tick-borne diseases. Research themes in the group are linked to general conservation biology or to the effects of invasive species. During the period of this assessment the group had three female PhD students and one short-term postdoctoral fellow, all affiliated with other Norwegian institutions with formal graduate programs.

General evaluation & recommendations

The group shows good collaboration with other universities and institutes leading to peer-reviewed publications. Its publications have a remarkably high impact given the lack of research infrastructure funding (as opposed to grant and contract research funding). Conversely, the group has little collaboration within the university. This may be due in part to the emphasis placed on teaching at UiA.

The group seems to lack a clear strategy or organised framework for its research; its members are independent with little apparent integration across their research efforts. Additionally, there does not appear to be administrative recognition of the trade-off between research and teaching obligations nor supporting technical staff for research.

We appreciate that the group and its associated undergraduate program was not previously a high priority for the university, but suggest it might be a good time to outline future goals and determine the resources needed to achieve them. For example, does the group intend to increase in size? If so, there will need to be a plan for increasing the number of PhD students and for providing a coherent research framework. If not, the criteria for evaluating group members might be clarified. Some individuals seem to focus on publishing in high-ranked journals and developing an active research programme, but others may not feel publications and research are high priorities. In part, this discrepancy may have been created by the system summarised in the self-assessment, with professors not being rewarded for publishing in ISI-classified journals with relatively high impact factors.

We encourage the group to develop a strategic plan in collaboration with the other units in the department. For example, it might be feasible for the department and this research group to develop one or two focused research centres (e.g. invasive species, effects of stress on fish immune responses) and to apply to national programs for financial support to build laboratory infrastructure. Alternatively, the group might highlight its focus on tick research and organic loading in the aquatic environment. The Panel also suggests the unit continues to develop collaborations with other universities and institutes, both in Norway and in other countries, possibly by developing a formal link or PhD program with an organisation with stronger infrastructure and equipment.

Societal impact

Some of the group's research activities have clear societal impact, such as the work on environmental chemistry. In general, this research is linked to the effects of human activity on the local environment and biological diversity. As such, the societal impact of the work may have greater relevance at regional than national or international levels.

University of Bergen

Department of Biology

Description of institution

In response to the previous evaluation, the department was restructured by a merger of the former departments (Zoology, Botany, Microbiology, Fisheries and Marine Biology) into one Department of Biology, and by the establishment of 16 research groups. Twelve of these groups were evaluated by this panel and were grouped under six unit headings. At the end of the evaluation period the scientific personnel included 51 tenured scientists (36 professors, 15 associate professors), 51 PhD students, 13 postdoctoral fellows, 18 adjunct professors and 23 researchers. The department is a partner in three Norwegian Centres of Excellence.

A head of department who serves for four years leads the unit and reports to the Dean. The head is assisted by the deputy head of department and by the head of administration. The research groups each have a leader who works with the group's members to determine areas of research focus and to help the department determine areas for growth and recruitment. A strategic plan was recently developed to guide the department for the period 2011 to 2015.

General evaluation & recommendations

The department is still in the process of determining the relative effectiveness of each research group. In general we were impressed by the energy and enthusiasm the department is bringing to its reorganisation. Some groups still lack a critical mass, and we recommend that decisions about future growth include a plan that explicitly estimates an optimal size for each research group.

Although the scientists in the department are able to fund their research, the department noted a lack of flexible funding sources for projects, and pointed out that salaries require almost all of the allocated amounts. We concur with this concern, and recommend that small grants or discretionary funds be made available so that the research groups can retain some ability to respond opportunistically to new and promising areas of research.

The areas of focus identified in the department's strategic plan mostly dovetail with those of the existing research groups, and we were impressed with the broad spectrum of biological questions being addressed.

Follow up of previous evaluation

The previous evaluation pinpointed two areas of concern, both of which appear to be in the process of being addressed. First, the previous evaluation noted the absence of a strategic plan. A plan is now in place, though it is too soon to assess its implementation. Second, it was suggested that the research groups be restructured to improve communication and ability to plan for the future. The reorganisation is well underway.

Evaluation of individual research units

Ecological & Environmental Change

Grading of scientific quality

Good

Description of unit

The group has seven permanent staff members, one postdoctoral fellow, two researchers, and 9 PhD students. It reports that since 2000 it has expanded its focus to include climate change and the response of species and ecosystems to interactions among natural and human drivers. The core strength of the group appears to be in quantitative ecology and paleoecology. It also has expertise in natural and social sciences related to coastal heathlands. The group has a large number of MSc and PhD students and provides strong mentoring for students and postdoctoral fellows. Popular dissemination of research is encouraged in addition to scientific publication.

General evaluation & recommendations

The group exhibits strong and distinctive expertise in paleoecology, as well as in vegetation ecology, and collectively offers expertise in diverse ecosystems worldwide.

The need for, or advantage of, discriminating between so-called ‘basic’ and ‘applied’ research on species and ecosystems is unclear. The self-assessment states, “Our research is motivated both by ‘basic’ questions of how biodiversity patterns emerge and are maintained, and by ‘applied’ questions of how global change drivers ... affect biodiversity and ecosystems.” One might argue that both these sets of questions have limited practical relevance unless the work is conducted in partnership with managers or decision-makers who help set research objectives and who can apply the results and inferences to planning and action. The work with collaborators in Uganda and Nepal appears to be a promising example of research with clear applications to potential end users.

Societal impact

Some of the work appears to be curiosity-driven and does not necessarily affect societal decisions (although it certainly contributes to knowledge). Other work, especially outside Norway, may be more relevant to societal needs or to priorities relating to the understanding and management of natural resources. The educational programs in which the group is engaged in Asia and Africa also may have a positive societal impact.

Behavioural & Evolutionary Ecology

Grading of scientific quality

Very Good

Description of unit

This unit is subdivided into an Aquatic Behavioural Ecology group and an Evolutionary Ecology group. There are 13 scientists in total (professors, associate professors, and researchers) and membership is still somewhat in flux because people are continuing to adjust to the reorganisation that followed the evaluation in 2000. Nearly one third of the

staff is female and most staff are over the age of 50. There are nine permanent scientific positions in the group.

General evaluation & recommendations

Like the other units in the department, this one has been reorganised in response to the previous evaluation, and it is clear that the groups are still determining which changes have been effective. The creation of two subgroups within Behavioural & Evolutionary Ecology appears to reflect historical patterns rather than a response to current needs. As was discussed during the panel meeting, this unit may need to rethink its group structure and alter it to suit current staff as well as to optimise recruitment. We recommend that the group members discuss a possible renaming of the unit and integration of the two groups into one. Additionally, we suggest the group develop clear succession and recruitment plans as members move towards retirement. Vigorous leadership, perhaps following an international search, may be necessary after the group decides how to integrate the aquatic biology and behavioural and evolutionary ecology.

Societal impact

The unit has been successful at merging fisheries and aquaculture research with investigations into more curiosity-driven research on life history evolution. These efforts affect society directly by providing answers to practical questions, as well as by illustrating the continuum between curiosity-driven and practical research.

Microbiology

Grading of scientific quality

Very Good to Excellent

Description of unit

The Microbiology Research Groups (MicBio) are within the Department of Biology. In the previous evaluation, microbiology was a separate department, with research groups evaluated by two different panels whose assessments ranged from fair to outstanding. The previous microbiology panel thought the sizes of most groups were below optimal size. The current microbiology unit has about the same number of permanent faculty (eight) as the Department of Microbiology in the previous evaluation. Microbiologists at the University of Bergen are involved in two centres of excellence (the Centre for Geobiology and the Centre for Integrated Petroleum Research), one ERC Advanced Research Grant, and several other substantial projects funded by national and international sources.

General evaluation & recommendations

The group has a small number of permanent faculty and there is a wide spectrum of research topics. These topics are split under the three headings of Marine Microbiology, Geomicrobiology, and General Microbiology. We thought the rationale for the three groups was weak because there were many overlaps or complementary research areas and the groups are co-located. However, MicBio appeared satisfied with this arrangement.

We were impressed by the quality of the output from this group, which is among the most substantial in the Department. Many articles have been published in top-quality international journals and cited extensively. There are some areas of low productivity within the group that could be addressed in future planning. We recommend considering

whether the large spectrum of microbiological topics can be accommodated or whether the strategic focus should be narrowed.

It may be challenging for the group to keep up with rapid developments in molecular biology and bioinformatics; further appointments might strengthen research activities. Overall MicBio is an impressive group with some excellent research.

Societal impact

Many research topics are of societal relevance given their relation to environmental status and trends, and to the understanding of global climate change, marine productivity, and pollution.

Fisheries Ecology & Aquaculture

Grading of scientific quality

Good to Very Good

Description of unit

The Fisheries Ecology & Aquaculture group contains four professors, three associate professors, four adjunct professors (20% time), one postdoctoral fellow, five PhD students and two researchers. The average age of the permanent members is over 50 years old. Although half of the scientific staff are female, only two of the seven permanent professional staff are female. The group has several non-Norwegian members, including one each from Canada, USA and Denmark. The unit has access to technical support from the department and to the Bergen marine infrastructure.

The research expertise of the group is marine and fisheries ecology and aquaculture and statistics. The unit's core work includes field and laboratory examination of fin-fish and shellfish growth, reproduction, and recruitment and environmental stressors in the marine ecosystem. The group also examines fisheries and aquaculture issues, such as fillet quality, strategies for evaluating the effects of salmon lice treatments, and production of larval and juvenile marine fish. In addition to undertaking research the group advises government agencies and stakeholders.

General evaluation & recommendations

The unit relies on the independence of researchers, a characteristic that can be viewed as both a strength and a weakness, depending on the willingness of researchers to collaborate. This group is internationally diverse, experienced in collaborating with stakeholders and other institutions, has a sound funding record from government and other external sources, has capacity to link laboratory findings to real-world scenarios, and has been very successful in undertaking cooperative research with the aquaculture industry.

It was unclear to us why aquaculture and fisheries ecology were grouped. It might be useful to develop a collaborative effort that would capitalise on expertise in ecology, aquaculture, and application of science to the needs of industry. If a succession plan does not exist, it might be worthwhile to initiate one given the high average age of the scientific staff. We did not find convincing the statement in the self assessment that the group is internationally distinct in its ability to conduct research on both fish ecology and aquaculture. Other institutions worldwide do both well.

Some members of the Panel recommended that the group focus more on either ecological or aquaculture research to maximise future funding and publication output. This group might better capitalise on new molecular methods that can be applied to aquaculture research and ecosystem modelling, perhaps by hiring new staff. There appear to be thematic links between research undertaken by this group and the Modelling & Evolutionary Fisheries group. Some members of the Panel thought the Department of Biology should consider whether to merge these units.

Societal impact

This group's work on the myriad effects of aquaculture on coastal ecosystems and food production is extremely important to Norwegian society and stakeholders. Production of larval marine fish is of direct benefit to the aquaculture industry and studies tracing origins of fish products are of moderate societal importance in a country with considerable economic reliance on fisheries.

Modelling & Evolutionary Fisheries

Grading of scientific quality

Good to Very Good

Description of unit

Two research groups were evaluated as a single unit in this assessment: the Modelling Group (MG) and the Evolutionary Fisheries Ecology (EvoFish) group.

The MG contains four permanent faculty members (three professors and one associate professor) plus three additional research scientists. Most staff are male and all but two are Norwegian. The group focuses on individual-based models to explore environmental effects on evolution (of pelagic fishes, for example) and on the dynamics of marine populations and communities.

The EvoFish group was formed in autumn 2007 with a grant from the Bergen Research Foundation. Between 2007 and 2010 the group had only one full-time research scientist (male, Finnish), one postdoctoral fellow (female, Finnish) and three PhD students (two international and one Norwegian). The group is essentially an offshoot of MG but focuses its research more narrowly on the effect of fishing on the evolution of economically-important fish stocks harvested in Norway.

General evaluation & recommendations

The MG has shown it can adapt, as exemplified by the creation of the EvoFish group. Modelling requires collaboration and both MG and EvoFish have national and international collaborations. The groups have a relatively high rate of publication in peer-reviewed journals and strong public relations with both the general scientific community and the public. They have been able to successfully model the evolutionary effects of fishing on fish populations.

The number of staff has fluctuated recently, but loss of some researchers may be compensated by newly appointed EvoFish staff. The self-assessment document does not explain proposed use of the new guppy lab. Additionally, there are few Norwegian PhD students and postdoctoral fellows.

Societal impact

Accurate predictive models can be applied to fisheries management and policy. In this sense, the MG group is important to national and international fisheries industries.

Marine Biodiversity

Grading of scientific quality

Good to Excellent

Description of unit

The Marine Biodiversity unit is of medium size, comprising eight members (four full time permanent staff, one researcher, one postdoctoral fellow, two adjunct professors (20% time). The group also has three active emeritus professors. The primary focus is on organisms and biogeography. The staff teach on a wide range of taxonomic groups, including macro-algae, animals and parasites. The group is involved in one centre of excellence - The Centre for Geobiology.

General evaluation & recommendations

Publications are strong and of international significance. Members of staff have CVs that are either internationally or nationally significant. Equipment and technical support are good and the unit has strong international connections.

Given the wealth of biological research being carried out in Bergen, stronger collaborative links within the city, for example with the University of Bergen Museum, should be developed. The Panel were impressed with development of the Centre of Excellence in Marine Taxonomy.

Societal impact

An emphasis on societal impact was not clearly apparent in the self-assessment, although biological diversity is a topic that engages the general public. It may be possible to strengthen public outreach via a link with the Centre of Excellence.

University of Bergen

Bergen Museum Natural History Collections

Description of institution

The Natural History Collections (*De naturhistoriske samlinger*, DNS) is a self-contained unit within Bergen Museum established in 2002, covering botany, geology and zoology. DNS consists of 10 biological collections with 14 scientific staff members, two postdoctoral fellows, and 14 technical staff. The research is connected to the scientific collections and reflects a range of organisms, taxonomic groups and research fields. DNS has three main research areas within biology: classic taxonomy and systematics, mainly on the basis on morphological characters; phylogenetics, systematics and evolution, which draws from molecular methods and morphology; and palaeobiology focusing on osteobiology and palaeobotany. DNS holds different types of collections and thus gives a range of scientific advice to governing authorities. There is a strong emphasis on the publication and dissemination of popular science.

General evaluation & recommendations

The budget lacks flexibility to facilitate strategic investment. It appears there could be more focus on publishing papers in ISI-ranked journals. Seven of the scientific staff are in their sixties. Plans for succession might provide an opportunity to consider gender balance, which is currently 71% male. The establishment of the Norwegian-Swedish research school in biosystematics is a highly positive development and we recommend retaining broad national and international collaborations. The Panel also suggests devising a reward system for staff working in collection management and dissemination.

Follow up of previous evaluation

In apparent response to calls for open access to data, DNS has become involved in projects and databases such as Artskart, GBIF and Barcoding of Life. The Panel agrees with the recommendation from the 2000 evaluation that biosystematics research should be expanded. Similarly, we agree with the previous recommendation to emphasise interdisciplinary research.

The Panel concurs with the strategy of the Bergen Museum to be highly visible, conduct focused research on natural and cultural history, engage in dissemination of research results, and manage the collections safely and productively.

We strongly recommend collaboration among university museums in Norway and the resulting development of a Norwegian-Swedish research school in biosystematics, with a focus on recruitment of PhD students.

Evaluation of individual research units

Biosystematic Research Group (BRG)

Grading of scientific quality

Very Good

Description of unit

The Biosystematics unit focuses on the taxonomy, systematics and biogeography of different groups of animals, fungi and plants. The group currently publishes annual accounts of the novel taxa described from Norway each year and also publishes faunas and floras of various parts of the world. Members pursue their own projects and the research group functions as an informal forum for updating other members of the group on ongoing projects and discussions of new projects. The unit has five scientific staff members and one postdoctoral fellow.

General evaluation & recommendations

Contingency planning strategies should note that most group members are close to retirement and should simultaneously seek to retain taxonomic expertise. The unit has strong national and international research collaborations. Where possible, we suggest linking taxonomic expertise with DNA techniques so that DNA barcodes and phylogenetic data can be added to descriptions and records of new taxa.

Societal impact

The unit provides a valuable service to society. By mapping the distributions of species and describing new taxa, members of the group provide basic data to national and international governmental bodies and other organisations that seek to conserve biological diversity worldwide. By compiling keys to animals and plants and by writing popular articles, members of the group provide tools for public education and recreation.

Phylogenetics, Systematics & Evolution (FSE)

Grading of scientific quality

Good

Description of unit

The unit was formed in 2008 and reflects the overlapping research interests of its members in phylogenetics, systematics and evolution. The unit consists of collections managers, hired by the museum as curators for scientific collections or public exhibitions, and technical staff affiliated with different sections of the collections. The basic rationale for FSE is partly to be a pool of resources and partly to be a forum within which advances in theory and methods in systematics, taxonomy and evolution can be addressed. The unit has six scientific members of staff.

General evaluation & recommendations

The research focus of the group was unclear. DNA barcoding activities currently fall within the remit of this unit, but we wondered if those activities could be combined with the Biodiversity unit, or the two units merged into one unit on Biodiversity and Evolution.

Research output is good, but the number of papers per researcher might increase if more technical staff were available to assist with collections.

Societal impact

The ability to identify taxa by means of DNA barcoding is applicable to the social determination of conservation priorities and strategies.

Palaeoenvironmental Research Group (PALAE)

Grading of scientific quality

Good

Description of unit

This unit focuses on the palaeoenvironment (fauna, vegetation, climate and environmental changes) and includes research within the disciplines of botany (palynology, plant macro-remains and ecology), quaternary zoology (osteology and invertebrates) and geology. The unit has three scientific staff members and one postdoctoral fellow, three PhD students and four technicians.

General evaluation & recommendations

Museum collections are central to all research activities, which is commended. The unit is of great national value because it is the only one that practices palaeosciences in botany and zoology. We suggest the group strengthen its international collaboration. We strongly recommend the group be retained if possible; recruiting a new senior scientist for the group would greatly strengthen its capacity.

Societal impact

Several projects have a link to tourism (e.g. the conservation of cultures, ancient animal and plant breeds) in collaboration with farmers and different governmental agencies.

University of Nordland

Faculty of Biosciences & Aquaculture

Description of institution

The Faculty of Biosciences and Aquaculture was created in 2008 from the former Department of Fisheries and Natural Sciences at Bodo College. There are five research units in this faculty: Aquatic Animal Health & Welfare, Reproductive Biology, Seafood Quality, Marine Ecology and Marine Genomics. The former three focus their research efforts on aquaculture and the latter two on marine ecology. The faculty established a Masters program in 2005 and a PhD program in 2009. The faculty is staffed by 10.2 principal research scientists, seven senior research scientists, two postdoctoral fellows and 7.5 technicians. The faculty also includes 16 general technicians not directly assigned to the research groups. At the time of this assessment there were 17 PhD students in the faculty. The research groups are divided between two laboratory complexes, with the aquaculture research units located at the Morkvedbukta Research Station and the marine ecology groups located on the main campus.

General evaluation & recommendations

With the reorganisation in 2008, the faculty took a major step in implementing many if not all of the recommendations identified in the previous evaluation. As a result of the reorganisation and the establishment in 2011 of the University of Nordland, we believe the faculty has the structure necessary to succeed. Scientific quality has increased progressively over the past five years. The relatively young professional staff appear to be enthusiastic.

However, some members of the panel felt group structure was fragmented, and thought it would be useful to consider merging groups into a consolidated unit with an emphasis on aquaculture. Although the new faculty has hired some good young researchers, we noted they may need help in securing funding for students and for additional technical support. We largely supported the faculty's strategic plan but pitfalls inevitably emerge when new departments are established. We hope the faculty will continue to nurture international collaborations.

Follow up of previous evaluation

The 2000 evaluation included Bodo College Faculty of Fisheries & Natural Science, which subsequently evolved into the Faculty of Biosciences & Aquaculture at the new University of Nordland. The previous evaluation had four recommendations:

- i) *Increase faculty publication rate.* This has been accomplished, especially after the reorganisation of the faculty into five research units, although the Reproduction Biology and Seafood Quality Groups have relatively weak publication records.
- ii) *Develop a strategic plan capitalizing on strengths and develop approaches for improving faculty weaknesses.* This was accomplished through the reorganisation.

iii) *Develop stronger links with researchers at other Norwegian universities.* This target was partially met with the faculty reorganisation.

iv) *Develop a more focused research direction for the faculty.* This goal was achieved by the reorganisation.

Evaluation of individual research units

Aquatic Animal Health

Grading of scientific quality

Very Good

Description of unit

The Aquatic Animal Health unit conducts research on fish-health management practices in the Atlantic salmon and cod aquaculture industries. In particular, the group examines the effects of stress on the fish immune system and other aspects of fish health, fish-pathogen-environment interactions, and diagnostics. The group is staffed by two principal scientists, two senior scientists, one postdoctoral fellow, two technicians and, at the time of this assessment, seven PhD students. The staff come from diverse countries and most are male. Funding has been solid in recent years, but the group is dependent on both industry contracts and competitive grants and is therefore affected by the economics of the aquaculture industry.

General evaluation & recommendations

This unit is a solid contributor to the faculty. The strategic recruitment of international expertise in aquatic animal health is a major reason for the initial success of the program. As result the unit has several international collaborative projects and many industry-driven projects, supported by an excellent wet-lab. There is a favourable ratio of PhD students to researchers, particularly given that the PhD program was only approved in 2009.

At present the unit has a low proportion of Norwegian PhD students, which could affect the unit's ability to secure funding from the Research Council and other national or local sources. It may be helpful to conduct outreach to ensure potential graduate students in Norway are aware of the Aquatic Animal Health Group. The range of research topics currently being pursued is broad given the number of staff and their expertise, and may lead to a reduction in research quality. The research in a high proportion of publications was completed elsewhere. We were surprised there are no staff who are clinical veterinary professionals, and thought although the group has access to veterinary consultation it might be useful to add this expertise.

We offer four suggestions: (i) reach out to Norwegian and other Scandinavian students as potential PhD candidates, (ii) hire an additional faculty member with a background in clinical veterinary medicine, (iii) narrow the primary research areas and concentrate on topics that complement the expertise of current staff, and (iv) consider merging or expanding some research groups, as described below.

Societal impact

The societal impact of the group's research is significant and relevant to the success of the regional aquaculture industry. The group studies nearly all aspects of fish health (for example, pathology, disease diagnostics, immune response, nutrition) and has assisted stakeholders in improving production efficiency and the general welfare of farmed fish.

Reproduction Biology Group

Grading of scientific quality

Fair

Description of unit

The unit has one professor, two associate professors, three PhD students and one technician. The three senior staff collaborate on research concerning farmed fish reproductive biology, biotechnology and larviculture, particularly Atlantic halibut, Atlantic cod and Ballan wrasse. More specifically, there is a focus on sperm physiology, chromosome set manipulations, induced sex reversal, germ-cell ablation, maternal and germline transcriptomics, and marine larviculture.

General evaluation & recommendations

This is a very small unit and productivity in terms of publications is modest, with one professor responsible for most of the publication. We recognise that the university as it now exists was recently formed, but nonetheless we are concerned that this unit is too small and narrowly-focused to be viable. Merging this unit with one of the others should be considered. As the institution continues to develop, we urge frequent reassessment of the division of scientists into research units, with the potential for larger groups that grow more easily than small groups.

Societal impact

Research has relevance to aquaculture and fisheries, including how food sources are obtained.

Marine Genomics Group

Grading of scientific quality

Good to Excellent

Description of unit

The unit contains 2.2 Professors, one Associate Professor, three PhD students and 1.5 technicians. Research focuses on two areas: (i) the genomics and transcriptomics of marine animals and (ii) the application of molecular markers to the study of marine ecology and evolution. The group's scientists employ the latest sequencing methods to address detailed questions. Articles range in quality from good to excellent.

General evaluation & recommendations

Scientific competence of the research staff has increased significantly, leading to the promotion of two associate professors to full professor and the hiring of two new associate professors. There is also a focus on the career development of female scientists within the faculty, including mentoring of research and relaxation of teaching responsibilities. With four professors the group is perhaps rather top heavy.

We recommend that (i) international projects explore the possibility of additional financial support, (ii) planning efforts recognise the unit's small size, which is a potential weakness if members leave, (iii) strong research links to industry are maintained, and (iv) efforts be made to increase the number of articles published per year.

Societal impact

The relevance of the unit's research is appreciated by industry and society and has significant impact.

Marine Ecology

Grading of scientific quality

Good to Excellent

Description of unit

The unit contains four Professors, two PhD students and 1.5 technicians. According to the self assessment, it aims to be "an internationally recognised centre of competence for scientific research within the fields of environmental effects of aquaculture and the dissemination of knowledge within the field of marine ecology to the local environment." This is quite broad whilst retaining aquaculture as a focus. The unit also conducts research on biophysical processes at multiple spatial scales, food web resilience, and climate change. The latter three topics seem somewhat inconsistent with the unit's aim.

General evaluation & recommendations

Most of the publications and CVs of the scientists are internationally significant. The research on biophysical processes is cutting-edge. Several excellent scientists were recently recruited and international collaborations are commendable. However, the unit is too small and top heavy to remain viable. We recommend considering whether on-going research is related to the stated aim of the unit.

Societal Impact

Some aspects of the research (e.g. climate change) are of direct social relevance whereas the relevance of others (e.g. biophysical interactions) is not immediately apparent.

Seafood Quality

Grading of scientific quality

Good to Very Good

Description of unit

The unit contains one professor, two associate professors, two PhD students and 1.5 technicians. It conducts research on various aspects of seafood quality, including fish quality and safety, muscle structure, development and growth. This was one of the few units in any institution with more female scientists than male.

General evaluation & recommendations

Much of the research output was either nationally or internationally significant. Strong links with Norwegian industry were evident, as were links with outside organisations (e.g. Gothenburg, Sweden and St Andrews, Scotland), although only one article seemed to have resulted from the latter collaboration. The unit seems quite small with only three staff. We encourage the unit to continue building on existing international links.

Societal Impact

Strong links with industry, including research funding, testify to this group's social impact.

University of Oslo

Department of Biology

Description of institution

The Department of Biology was formed from a number of research groups that existed before 2007, at which time the department was reorganised into three research programs and one interdisciplinary centre of excellence, the Centre for Ecological and Evolutionary Synthesis (CEES). Oslo University as a whole was also reorganised in 2005 into its current structure; each department has a head who serves for four years and, with the assistance of the head of administration, works with the department and university board to plan for the future. The research programs each have a chair and a vice chair who report to the head of department. The research programs are deliberately limited in scope and teaching undergraduates is not their primary mission.

The composition of personnel in the department has changed rapidly over the last several years. The number of PhD students increased from nine at the beginning of 2005 to 23 at the end of 2009. The total number of PhD students enrolled at the department in 2009, including both internally- and externally-funded fellowships, was 60. At that time there were 32 permanent scientific staff members. Women are well represented among PhD students and post-doctoral researchers but the department becomes more male-biased at senior levels.

General evaluation & recommendations

The department is making excellent progress towards its goals, and the Panel were impressed by the degree of substantive change in the department over the last several years. The rate and quality of publications increased following the reorganisation, and we noted that the productivity of many of the members of the department is extremely high.

A concern we had, which seems to be shared to some extent by the members of the department as expressed in the self-assessment and the panel meeting, was to prevent domination of the department by the CEES, which currently has the largest number of researchers by far in the department. The CEES secures much of the research funding, and has high visibility. The work of this centre is excellent, as detailed below, but for the overall health and viability of the department, it is essential to make strategic decisions about growth in the other research groups as well. In particular, the Marine Sciences group is rather small. We recommend developing an explicit succession plan for the group in terms of its leadership and continued funding.

We recommend appointing one or two people to help members of the department assess international opportunities for basic research, particularly EU funding, so that individual researchers can take advantage of as many calls for proposals as possible. The creation of small grants or discretionary funds for exploratory research is also a potential solution.

Follow up of previous evaluation

The department responded to the previous evaluation by undertaking the reorganisation described above, with an emphasis on research groups excelling in particular areas rather

than a more generic group of biologists. Although some of the changes are still in progress and hence difficult to assess, it appears that the majority of the restructuring has been beneficial. Other recommendations included increasing active collaborations within and between groups, which seems to be occurring due to the more focused nature of the research areas.

The previous evaluation had recommended that some of the members of the Oslo Museum transfer to the University. Although the department evinced willingness to accept researchers from the museum, this move has not taken place.

Evaluation of individual research units

Integrative Biology

Grading of scientific quality

Good to Very Good

Description of unit

The unit has 11 professors, associate professors, and postdoctoral fellows, with three women. It was formed in 2007 and has a research emphasis in environmental and ecological toxicology, with some members in the group working in various areas of ecology. As one of the units offering a Masters degree, the toxicology group is responsible for supervising research by a number of students each year. Some members of the unit have substantial teaching responsibilities at both the graduate and undergraduate levels. Outreach and dissemination of science to the public is also a significant component of the work of some of the members of the group.

General evaluation & recommendations

Several members of the group conduct internationally significant and highly visible research, most notably in environmental toxicology. Others have research programs that, from the outside at least, appear to overlap with those in CEES. The rationale for the constitution of the group and its relationship to CEES is not always apparent. Integrative biology is difficult to define, and the group members are active in a variety of fields. We recommend that the unit develop a more coherent definition of its mission and a strategic growth plan that emphasises the strengths of the group. As members retire, there is a risk that the group will be seen as a unit of individuals who share little beyond not fitting into one of the other units in the department. We appreciate that the restructuring of the department was relatively recent and that all aspects may not be optimal, but we encourage this and other units to continue to assess the success of the reorganisation.

We also recommend that the unit develop a mechanism for acknowledging and rewarding contributions other than publications in peer-reviewed journals, including teaching and outreach.

Societal impact

Research in toxicology has obvious importance for society, and the group's broader efforts to examine the effects of environmental factors on species, ecosystems, and human

affairs are also relevant. Environmental monitoring continues to provide a scientific basis for policy decisions.

Centre for Ecological and Evolutionary Synthesis (CEES)

Grading of scientific quality

Excellent

Description of unit

The centre consists of 18 core members, 46 researchers and postdoctoral fellows, 20 technical and administrative personnel, plus PhD and Masters students. Its director maintains a flat management structure. There is extremely high overall productivity and a fine training environment for younger scientists. The average age of scientific staff is low, about 42 years. The centre nominally has three themes: (i) the role of population structuring in adaptive evolution, (ii) the potential for adaptation, and (iii) the evolution of reproductive isolation. In fact the themes are well integrated. The centre is well equipped and capable of raising extramural support as required.

General evaluation & recommendations

The CEES needs continuity into the future and that is not guaranteed. We recommend that the centre be integrated into the university and longer-term funding made available. Much of the centre's research is motivated and driven by its highly successful director who is both an excellent scientist and a visionary scientific administrator. We recommend succession and contingency planning, perhaps by the appointment of two associate directors. We echo the recommendation of the 2000 report to move the behavioural ecology group from Oslo Museum to a university. The centre might be the ideal location.

Societal impact

The centre has considerable societal impact. We present four of many possible examples. The centre examines effects of climate change marine ecosystems and resource economics. It has initiated successful start-up companies and commercial enterprises, and become part of a Strategic Institute Programme on the effects of fishery harvest. The centre also sequenced the cod genome, which will allow its population structure to be analysed in the future.

Microbial Evolution Research Group (MERG)

Grading of scientific quality

Good to Very Good

Description of unit

MERG was initiated through a strategic program at the Faculty of Mathematics and Natural Sciences, University of Oslo. The rationale behind the creation of MERG was to establish a larger and more coherent research group capable of applying to be a Centre of Excellence in Norway in 2012. The Department of Biology is the host institution because most of the participants are affiliated with this department.

MERG includes eight professors, four associate professors, seven post-doctoral fellows, four engineers, and one administrator. The unit is interdisciplinary with staff affiliated

with five institutions: Department of Biology, Department of Molecular Life Sciences, Oslo Natural History Museum, The Veterinary Institute, and Norwegian Institute for Water Research. The latter two are outside Oslo University. At the Department of Biology, four research groups are represented in MERG.

General evaluation & recommendations

The extensive inter-disciplinarity of the unit creates a challenge but also potentially generates interactions that can lead to excellent research and education. It appears there are some good synergies, joint positions, and re-localisation steps that have helped MERG develop. Analysis of low output groups or groups below critical mass could be examined as part of strategic reorganisations. In addition, the obligations of some staff to other institutions might be assessed and clarified, so that the clear benefit to MERG can be realised. The nature of collaborative relationships could be assessed with a view to focusing on those that result in productive output. Relationships with the other units within the Department of Biology could be enhanced.

Efforts are being put into achieving Centre of Excellence status but receiving this status is not guaranteed. There was reference to limited success in obtaining research grants from the Research Council of Norway and the EU, but potential reasons for this were not discussed with us.

We could not discern any obvious needs for the group, although recruitment strategy could be examined in anticipation of future retirements and the potential for development or acquisition of new skills (e.g. molecular analyses, bioinformatics). We felt that there was potential for greater coherence, which may require some strong leadership to achieve. We also queried why evolution is in the unit's name, because its research extends beyond microbial evolution.

Societal impact

Much of the unit's research is of relevance to society, including work on toxic cyanobacteria and dinoflagellates, mycorrhizas, climate change, fragmentation of species' habitats, deep sea metagenomes of oil reservoirs, and abundance of parasites and harmful organisms. Two staff members are affiliated with the Veterinary Institute and the Norwegian Institute for Water Research. The unit's activities receive some exposure through the media and in popular scientific articles.

Marine Biology

Grading of scientific quality

Very Good

Description of unit

This research unit, which is the only one of its kind in eastern Norway, has undergone significant reorganization since the last evaluation. As a result, marine biology within the University has been strengthened and the responsibilities for conducting research and teaching in marine biology and ecology have been consolidated. Within the unit, there are four Professors, five other faculty and five Emeritus Professors. These staff are supported by just two technicians.

General evaluation & recommendations

The unit's research is strong and generates internationally significant publications. The staff's CVs are either internationally or nationally significant. The unit is well run and organised, strategically sound, and disseminates knowledge effectively. The group is using the algal cultures effectively, particularly for taxonomic research. The research on harmful algal blooms is commendable. Research facilities are good and the group's input into pelagic ecology and benthic ecology is notable. Collaborations at both national and international levels are strong. There are weaknesses in technical support and relatively few staff given the wide range of topics covered. A focus on genomic research might increase collaboration with other units within the department.

The unit has handled change well but may need to recruit technicians and retain staff. Stronger collaborations with other units may have this effect. We think it is essential to support the research infrastructure (ships and research labs) and to recruit high-calibre staff.

Societal impact

The unit's dissemination strategy is both theoretically and practically sound with a wide range of public outreach.

University of Oslo Natural History Museum

Department of Research & Collections

Description of institution

The Natural History Museum, University of Oslo derives from the previous Zoology, Geology & Botanical Museums and the Botanical Garden. Research is carried out in the Department of Research and Collections, which has a Director who reports to the Director of the Museum. We were charged with assessing research in three of the five research groups: (i) National Centre for BioSystematics, (ii) Interpretation & Modelling of Biodiversity, and (iii) Freshwater Ecology & Inland Fisheries Laboratory. The latter two groups were submitted for consideration as a single unit. The National Centre for BioSystematics contains 19 senior academic and postdoctoral staff, and the latter two groups contain a total of seven senior scientific staff and a Professor II.

General evaluation & recommendations

The Botanical and Zoological activities of the museum have been administratively combined. There is a Department of Research and Collections. The suggestion in the 2000 report that an increasing proportion of research should leverage the museum's collections did not appear to have been implemented.

The vision and coherence of the National Centre for Biosystematics and the Centre for Biodiversity Mapping and Modelling were unclear. Further, the logic of grouping the Centre for Biodiversity Mapping & Modelling and the Freshwater Ecology & Inland Fisheries Laboratory was not apparent. We therefore treated the two centres and the laboratory separately. Consequently in this general evaluation we describe areas of strength or potential strength, and how they might be developed inside and outside the Museum.

We noted the museum conducts research of very high quality on (i) Arctic and Afro-Alpine Plants, (ii) barcoding of permafrost DNA, (iii) sexual selection in birds, and (iv) population structure of Arctic marine mammals. The museum also conducts research of good quality on speciation in a particular taxonomic group of parasites.

Given that collections are a central resource for research in a natural history museum, and this museum's collection includes about six million objects, we suggest that the museum consider how to expedite recording of the collection into a central digital archive. It did not appear that the museum's substantial insect collections are being curated or that research is capitalising on that collection. The lack of maintenance seems like a potential liability, and the lack of research to be a potentially-unrealised opportunity.

DNA analysis is a strength of the museum's research. The museum currently is engaged in both barcoding for identification purposes and analysis of ancient DNA. A successful major-grant application would be necessary for the museum to become the hub of Norwegian barcoding (Nor-BOL). It may be worthwhile to develop a contingency plan for funding and for barcoding new acquisitions in the event that the grant application is

unsuccessful. The extent to which the initiative is actively integrated with EU and international barcoding efforts (European Consortium for the Barcode of Life, Network of European Leading Laboratories, and International Barcode of Life) was unclear. It would also be useful to clarify how the DNA barcoding pipeline in the museum would be established to handle new acquisitions.

The museum's strength in ancient DNA analysis has the potential to grow. However, Eske Willerslev's operation in Copenhagen seems to be of much greater magnitude than the one in Oslo. It is generally accepted as best practice to replicate all ancient DNA analyses at an independent laboratory and to establish formal agreements with appropriate institutions. Hiring a palynologist might increase the museum's capacity to analyze DNA in permafrost.

Some members of the Panel questioned whether research that was not based on collections was consistent with the organisation's mission. Systematics and taxonomy increasingly apply molecular biology, so it may be worthwhile to develop DNA facilities. To some extent, such facilities might support research that is not based directly on collections.

Aquarium research on parasites may need to move to a secure Level 3 biosafety facility. The Freshwater Ecology & Inland Fisheries Laboratory (which was established in 1969 to investigate the effects of hydroplants) generates some income through indirect costs, but the connection of its work to the organisation's mission was unclear.

We recommend that the museum consider the following.

- i) Establish a strategic plan for the Department of Research and Collections to strengthen institutional research coherence.
- ii) Consider restructuring current research groups and strengthening some, particularly entomology.
- iii) Consider transferring high quality research and personnel not closely associated with collections, such as sexual selection in birds (as noted in the 2000 report) and the Freshwater Ecology & Inland Fisheries Laboratory, to a university department.
- iv) Develop a strategy to integrate reconstruction of past ecosystems on the basis of ancient DNA with other new areas of museum expertise, for example, the collection and curation of a pollen bank.
- v) Develop a plan for ensuring compliance of a potential national barcoding centre with international standards. Metadata on barcodes should be linked with that of the museum's holdings via an online, open access data archive.
- vi) Develop a contingency plan for curation if the barcoding centre is not funded.

Follow up of previous evaluation

Botanical activities: The 2000 evaluation panel recommended that collections be used as much as possible for research. The current strategic plan does not address this recommendation, but a new six-year strategic plan is being prepared.

Zoological activities: Except for parasitology, the research groups are small. It might be worthwhile to explore whether efficiency would be increased if the groups combined their activities with the Department of Biology at the University of Oslo. Mammalogy in particular has few resources and might benefit from pooling activities. It was clear that the current research of the behavioural ecology group was not related to the collections and seemed more closely aligned with typical activities of a university department. The museum does not currently appear to have an effective plan for filling positions vacated by retiring professors. Consistent with the mission of the museum, there might be opportunities to enhance the quantity of taxonomic research conducted by the zoology groups.

Evaluation of individual research units

National Centre for Biosystematics

Grading of scientific quality

Good

Description of unit

Then unit contains nine full professors and three associate professors, with a high proportion of late-career researchers. The self-assessment states it aims “to become a nationally leading and internationally influential research and education centre in biosystematics in order to meet society’s need for knowledge in taxonomy and biodiversity.” In fact, we think its best research to date is in Arctic and Afro-Alpine plants, the barcoding of permafrost DNA, sexual selection, and Arctic marine mammals.

General evaluation & recommendations

The Panel recognised a high proportion of nationally- or internationally-significant research carried out by members of the centre. However, integration of the work into what might really be called a National Centre for Biosystematics was not apparent. Bringing a disparate group of research workers together and claiming that they constitute a National Centre is unconvincing. We noted that some research projects are relevant both to the museum’s mission and to development of a nascent National Centre for Biosystematics. In particular, the barcoding initiative may have potential. There is a real need to focus vision if the centre is to develop coherently.

Societal impact

If the centre developed to become a national resource for knowledge in taxonomy and biodiversity, it would have great societal impact. Currently, its lack of cohesion limits its social role.

Freshwater Ecology & Inland Fisheries (LFI)

Grading of scientific quality

Fair to Good

Description of unit

LFI was established in 1969 and undertakes research on how human activities, such as the generation of hydropower, affect species occurrence, with the goal of informing management of freshwater ecosystems and fisheries. The unit is staffed by three principal scientists and one senior scientist who is jointly employed by the University College of Telemark. All staff are male and close to retirement age, and all but one are Norwegian. External contracts fund salaries and operating costs, with the museum providing office space, consumables and technical support.

General evaluation & recommendations

Essentially this group is a contract research division of the museum and through contract research provides funding to the general operating budget. We recommend considering whether the group will be sustained and, if so, where it should be located. Some members of the panel felt the unit's relevance to museum activities was unclear. One option would be to affiliate the LFI with a university department.

Societal impact

See the impact statement below for the Modelling of Biodiversity (IMB) group.

Modelling of Biodiversity (IMB)

Grading of scientific quality

Good to Very Good

Description of unit

This unit was established in 2008 and undertakes research and statistical modelling with data obtained through the museum's Global Biodiversity Information Facility node. The goal of the group's research is to develop predictive models of changes in species occurrence due to factors such as climate change. During the assessment period, the unit contained one principal scientist and three research scientists (one of the latter left the unit and is based at the Norwegian Institute of Forest and Landscape). All staff are male Norwegians. The unit is funded primarily through external contracts, with the museum providing a portion of staff salaries, space, some consumables, and technical support.

General evaluation & recommendations

The self-assessment notes that separation of academic and technical staff is an organisational weakness that may limit output. It also has the potential to create a hierarchical culture with a negative effect on morale. The rationale for such a separation was not apparent to us.

Unpublished reports and policy documents may have limited credibility. Peer-reviewed publications may be regarded with greater confidence by decision-makers than non-reviewed outputs. It may be helpful to keep in mind that journals with high impact factors may have little impact in the real world. If the unit aims to inform practice, then publications in, say, regional or taxon-specific journals that typically are read by people taking action on the ground may have high actual impact. The reward structure within the unit and department could be adjusted to reflect this situation.

Evidence is equivocal as to whether open-access publications are more likely to be cited than publications that are not. Most major journals are made available to individuals in

low-income countries through consortia. It may be worthwhile to think strategically about potential users of the information who do not have access to the publications, and how access can be facilitated in other ways that do not violate copyright laws.

Biological diversity encompasses all levels of life and structure, composition, and function. All units within the department are interpreting biological diversity, hence the rationale for splitting biological diversity from other departments, and for the consideration of “biodiversity modelling” as a discipline, was not apparent. If there is a historical reason or a current rationale, making this explicit in future self-assessments would be helpful.

The unit could consider in a strategic manner whether and how its collective research efforts are transferable outside Norway.

Societal impact

Both the LFI (above) and the IMB provide recommendations and advice to national resource managers and conservation groups (corporate or government fisheries and freshwater managers and advocates) through both formal reports and public presentations. As such, the work of each unit is of moderate societal impact, as they both provide third-party evaluations that assist the implementation of national and regional policies. It could be argued that the LFI works on a contractual basis and as such provides more socially-relevant data and advice to clients than does the IMB.

University of Tromsø

Department of Arctic & Marine Biology

Description of institution

The Department of Arctic and Marine Biology was formed as a result of an external evaluation of research and teaching of biology across the University of Tromsø in 2007. The Department of Biology in the Faculty of Science and the Section of Arctic Biology in the Faculty of Medicine were merged with the Department of Aquatic Biology at the Norwegian College of Fisheries Science. Following this reorganisation, the new department established seven units and is located in several buildings. Restructuring may be incomplete and the Panel acknowledges that it is evaluating a department that is relatively young and still evolving.

General evaluation & recommendations

The department has some distinct areas of strength. There is an increasing awareness that the Arctic environment is highly responsive to climate change and pollution. The Arctic is also becoming increasingly relevant to European fisheries. The department is also one of the few research institutions with the skills and facilities to increase understanding of these issues. However, some members of the panel felt the department's vision, stated during discussions as being "a research base in the North with a global perspective", was too diffuse.

We suggest the department considers forming an international advisory committee to provide strategic advice. We recommend advisors conduct an in-person, multiple-day visit during which they meet with many individuals in the department.

Strong leadership is necessary to implement the advice offered by such an advisory process. Any strategic plan needs to be derived in an open, inclusive manner that gives all staff the opportunity to interact with the advisory committee. The head of department must then be able to implement strategic decisions with the backing of the university. We recommend that the necessary procedures are put in place before an advisory committee meets. There are some international links with other specialist Arctic institutions (notably in Canada and Russia). The department's strategy might include further development of an international network, perhaps linking with the greater volume of polar research carried out in the Antarctic.

Too many units operate in isolation and the full research potential of the department can only be realised by some key integration. For instance, bringing together Marine Plankton and Arctic Marine System Ecology would strengthen both areas of science. Similarly there is research common across both Freshwater Ecology and the two marine units. Whether this integration involves informal collaboration or the formal amalgamation of units is clearly a sensitive matter and one that the advisory committee should spend some time evaluating with the staff involved. The advisory committee might also consider mergers and links with NIVA, UNIS, and other regional institutes to form a larger centre of expertise. This would provide the critical mass and research breadth needed to compete for RCN funding

The department has some excellent resources (e.g. phytotron) but these are physically scattered, as are the staff. The Panel suggests that the university considers supporting physical unification that would allow strategic goals to be achieved faster.

We felt that expertise in mathematics, theoretical ecology and evolution would be of great advantage and would complement the field research.

Follow up of previous evaluation

The previous evaluation examined the departments of biology and botany. We did not evaluate the latter, comprising the Museum and Botanic Garden. In the previous evaluation, two groups were considered fair and one was considered good. The last evaluation recommended that a strategic plan be developed. Although this has happened, the current plan falls short of gaining the full potential of the current departmental capabilities, as described in greater detail above.

Evaluation of individual research units

Arctic Animal Physiology

Grading of scientific quality

Good to Very Good

Description of unit

The Arctic Animal Physiology group was formed in October 2010 as part of the reorganisation of the Department of Arctic and Marine Biology, and is staffed by six principal scientists, one postdoctoral fellow, four PhD students and six MSc students. The principal scientists have a mean age of 54 and five of the six are male; all but one are Norwegian. The group additionally has access to four technicians and a secretary through the department. The group undertakes research on vertebrate animal physiology (mammals, fin-fish and birds). Of particular importance is the group's research into the physiology of diving mammals.

General evaluation & recommendations

The group includes excellent senior scientific staff who have worked in the region for an extended period, adequate technical support, several funded international collaborations, a diverse funding structure, a good publication rate in higher-impact journals, excellent research infrastructure, and an outstanding location for conducting arctic research. Many of the senior scientists have excellent individual research records, but it is too early to determine if they will form a cohesive collaborative research group.

The group was formed recently and has not yet fully established a research focus. Furthermore, there are a number of weaknesses for the group to overcome in the near future: aging senior staff, gender inequity, small group size, low numbers of graduate students and postdoctoral fellows, low student recruitment, lack of new faculty positions, and inadequate molecular biology support. Lack of graduate students and postdoctoral fellows may limit the breadth and number of projects and publications. Additionally, the proportion of the group's funding from RCN has been low (10% of income). The group has several well-funded international collaborations but limited local and national

collaboration (with the NPI and UNIS, for example) with institutions that have matching mandates and complementary infrastructure.

We recommend the unit and department develop a recruitment strategy for replacement of those nearing retirement. The group might benefit from developing strategic alliances with regional institutes, and from increasing its focus on national and international student recruitment.

Societal impact

In the self-assessment the group did not identify any direct societal relevance. However, relevance is evident from the group's research. In particular, its work on harvested animals (marine mammals and reindeer) plays a key role in better understanding the physiological limitations of each population, and thus may inform quotas set by stakeholders and government regulatory bodies. Similarly, the group's work with salmonids provides information that is essential to the development of aquaculture in the region.

Arctic Marine System Ecology

Grading of scientific quality

Good to Excellent

Description of unit

This research unit considers how climate, physics, biology and pollution shape the systems ecology of the Arctic Ocean. Although this is a broad remit, in reality the unit focuses on biogeochemical processes, including the vertical export of particulate material in regional seas. Thirteen scientists work in the group. These include four full professors, two associate professors, two professor II, two senior researchers and five post-doctoral fellows. In addition the group has 13 PhD students, and leads a PhD school. Collectively they work on a very wide array of biological groups, including plankton, parasites, fish, mammals and benthic communities.

General evaluation & recommendations

There is some world-class research on particle export processes within this unit. This is particularly relevant to understanding of the role of high latitude seas in the global carbon cycle. Most of the staff have internationally significant CVs and publication rates are high. There needs to be greater collaboration between this unit and Marine Plankton. The unit has a high proportion of senior staff. Research facilities are good but technical support seemed to be inadequate.

Societal impact

There seems to be little focus on societal impact, yet socially relevant issues, such as climate and pollution, drive the research.

Fish Biology & Population Genetics

Grading of scientific quality

Good to Very Good

Description of unit

The Fish Biology & Population Genetics group contains five principal scientists and one senior scientist (all but one are male), one half-time postdoctoral fellow and six PhD students. Three of the professional staff are Norwegian; others are Italian, British and Danish. The group has access to two technicians (one is shared with other groups in the department), a population genetics lab, a fish physiology lab, a histology lab, shared analytical laboratories within the university, a research vessel, and an aquaculture research facility. The research activities of the group revolve around ecophysiology, biodiversity, population genetics, reproduction and early life history of marine and anadromous (salmonid) fin-fish along with research applicable to aquaculture in northern latitudes.

General evaluation & recommendations

This group contains excellent senior research staff, supported by a reasonable laboratory infrastructure. Members of the group have a good publication record in fisheries research journals and have several internationally-funded collaborations. The group formed recently so its track record is limited, but it has the potential to be very successful.

Because the group is new it is not yet working as a focused unit. Most senior scientists are male. The group has only two technicians and a considerable internal administration burden. It has not as yet identified a strategy for recruitment to replace aging staff. The group does not appear to have strong collaborations with similar research units in northern Norway (e.g. the NPI and UNIS).

The primary concern of the group is aging research infrastructure. Infrastructure may not be maintained by the university unless outside funding sources are identified. Additionally, the group believes it is unable to influence decisions at either the departmental or institutional level. Members of the group seemed convinced that the Norwegian system for evaluating publications (by which journals are classified into levels) does not fit the publication profile for fisheries disciplines. Because the group is funded according to this evaluation system, which gives fish biology journals low rankings, it believes its funding is less than it should be.

We suggest the group consider developing local collaborations in order to compete for RCN grants. Further, we suggest that the group, together with the department and other units at Tromsø, plan for the recruitment of younger staff and for a higher proportion of female staff.

Societal impact

Although the group's research is primarily conducted in northern Norway, it is transferable to southern Norway, Ireland, Iceland, and Greenland. Work on the tracking of northern European anadromous fish is of particular social and economic importance. The group's work is therefore applicable to anadromous salmonid fisheries throughout northern Europe and is of some benefit to local communities that rely on the rod and reel fishery or local harvest fisheries.

Freshwater Ecology

Grading of scientific quality

Fair to Good

Description of unit

The Freshwater Ecology group has been working as a team since the 1980s and is staffed by four principal scientists, one senior scientist, three adjunct researchers (10-20% positions), three postdoctoral fellows and six PhD students. The mean age of the professional staff is 50. All are male and all but two (from Canada and the UK) are Norwegian. The group has access to the equivalent of 2.6 technicians. The group has access to shared laboratories, vessels and field sampling gear as well as to a field station at Lake Takvatn. Its research is focused on ecology and evolution of anadromous and resident freshwater fish populations and effects of natural and human disturbances, such as invasive species and parasitism, on these populations. A goal of the group is to examine long-term trends in the ecology of subarctic freshwater ecosystems.

General evaluation & recommendations

The group has several strengths, including gender balance among PhD students and postdoctoral fellows; a task-driven internal organisation; an annual publication week; strong recent funding from national and international sources; access to infrastructure in Tromsø; an increasingly high publication rate; research focused on parasitism in trophic networks and invasive species (a distinct area of research that might be exploited for funding); and good national, international and local collaborations.

The senior researchers are male-dominated with a mean age of 50 years. It may be difficult to reduce this average age because many scientists are not close to retirement. The group is relatively small and its primary research field station at Lake Takvatn needs to be upgraded. There is no clear strategy for the field station in the self-assessment document, despite it being crucial to long-term data collection and other research.

As already noted in the departmental evaluation above, the Panel felt that links with the marine units would enhance research delivery of this unit. It was unclear why the group was separate from the Arctic Marine Systems Ecology unit.

Societal impact

The group's societal impact has been moderate. It has increased understanding of local ecological effects on capture fisheries of anadromous and resident fishes as well as cold water aquaculture in northern Europe.

Marine Plankton

Grading of scientific quality

Good to Very Good

Description of unit

The Marine Plankton unit carries out basic research on the lowest trophic levels of the marine food web. Their research focuses on phytoplankton and zooplankton ecology. The unit also conducts research in ocean physics, biochemistry and toxicology, as well as bio-prospecting. There are only seven members of staff covering this very broad remit. The work is carried out by four senior permanent staff scientists and two younger research Fellows. At present there are also seven PhD students who depend upon external funding. The unit is new and is clearly still finding its feet.

General evaluation & recommendations

The research carried out is good and most publications are internationally significant. Staff members have either internationally or nationally significant CVs. However, scientific productivity is low and the size of the group (given its remit) is small. The work of this unit complements that of the Arctic Marine Systems Ecology group and we suggest the two units work much more closely in the future. Facilities are good and international collaboration is strong.

Societal impact

The direct societal relevance of the unit's work was unclear.

Molecular Environments

Grading of scientific quality

Fair to Good

Description of unit

This group was established in 2010 after the plant molecular biology unit was strengthened in response to the previous evaluation. The Molecular Environments group is based on a shared interest in molecular signalling and communication. The staff comprise six academic positions (including one 20% emeritus appointment), four technicians (one temporary), four postdocs, seven PhD students and three Masters students. The researchers address a range of biological systems and aim to conduct work at multiple levels of biological organization, from molecules to ecosystems and the interactions among them. The principal investigators within the research group have quite specific expertise and interests and this determines what research activities are carried out. All group members share laboratory facilities. Two research areas – plant cell compartments and methanotrophic bacteria – contribute the most to the group's current profile and are currently well financed. These two areas are seen as cornerstones of future activities.

General evaluation & recommendations

Whilst there is some excellent research within the group, it is difficult to see a clear rationale behind its establishment, or coherence among the different systems, organisms, and topics being studied. Plant cell compartments and methanotrophic bacteria are extremely different and despite the success of research in each area, pursuing these topics alone does not represent a clear strategy for the group as a whole. We could not discern

what the other areas of focus might be. Proposed links with satellite activities were not clearly detailed.

The group's intentions were to develop research characterised as systems biology, yet they lack mathematical modellers or related expertise. Biotechnological exploitation of various experimental systems was speculative and appears to have been limited.

There seemed to be little cohesion between the different research areas within this group. Successful group members including the head appear to have significant administrative burdens. We could not discern a clear management or recruitment policy for this group. We thought a position in bioinformatics might be consistent with future development and interactions with other Departments.

We suggest that the future development of this group be considered within a more detailed review of research and strategy among the entire faculty.

Societal impact

The work has some societal impact. This may be enhanced by further interactions with other units in the department.

Northern Populations & Ecosystems

Grading of scientific quality

Good

Description of unit

As of November 2010, the Northern Populations & Ecosystems unit included seven full-time faculty, two part-time adjunct faculty (internationally respected scientists who help provide leadership in research and teaching within the unit), nine postdoctoral fellows, and eight PhD students. The unit has secured a relatively high level of external funding. Most of the unit's empirical research is conducted at remote locations in the Arctic or subarctic. The self-assessment indicated that a lack of technical equipment and facilities were constraining its research. Research topics are quite broad and the majority of work is conducted in terrestrial rather than freshwater or marine systems.

General evaluation & recommendations

The inclusion of social scientists within the unit's work is a strength. There is excellent collaboration with other organisations within Norway (especially the Norwegian Institute for Nature Research, with which the two part-time faculty are affiliated) and outside Norway. The unit itself reports that it is sacrificing depth for breadth. The group recognises that graduate students often are drawn into large team projects with established objectives and infrastructure. Accordingly, the group is making a concerted effort to provide students with opportunities to develop independent directions within the project as a whole. Because many staff are mid-career, there may be good opportunities to develop and pursue new strategic directions with sufficient time to realise results.

Societal impact

Probably moderate at present. The results and inferences of the unit's work might be applicable to societal needs and priorities, especially given the collaborations among natural and social scientists. Nevertheless, non-technical dissemination does not appear to be a high priority of the unit at present.

The University Centre in Svalbard (UNIS)

Department of Arctic Biology

Grading of scientific quality

Good

Description of institution

The University Centre in Svalbard (UNIS) was established in 2002 as a state-owned limited company. The Norwegian Ministry of Education and Research owns the shareholding company. The four Norwegian universities in Oslo, Bergen, Trondheim, and Tromsø are represented on the Board of Directors of UNIS along with representatives of UNIS's staff, students, and of the local community in Longyearbyen. UNIS replaced an independent private foundation, the University Courses on Svalbard, which was established in 1993. UNIS resides in the Svalbard Science Centre, which it shares with the Svalbard Museum, the Norwegian Polar Institute (NPI), Svalbard Science Forum, Governor's Heritage Magazine, and other organisations. UNIS aims to provide a range of programs of study and to engage in research that capitalises on its geographical location. Courses at the undergraduate, masters, and doctoral levels complement those offered at mainland universities. At the end of 2009 UNIS had 77 full time and 28 adjunct (or 20%-time) positions. The academic staff included eight professors, 11 associate professors, and 28 adjunct professors, of which 13 were affiliated with the Department of Arctic Biology.

General evaluation & recommendations

The evaluation conducted in 2000 noted three potential opportunities for strengthening the organisation: (i) increasing the productivity and focus of studies on terrestrial vegetation and marine invertebrates, (ii) interacting and coordinating more closely with the NPI, and (iii) decreasing the reliance of marine studies on access to a research vessel. It appears that collaboration with the NPI is now strong despite the inevitable tendency for the two organisations to compete as well as to collaborate. For example, the NPI assists UNIS in managing logistics for visiting researchers.

The appointment of a new scientific director is imminent. This may be an opportunity to increase the strength of scientific as well as business leadership at UNIS, ideally by recruiting a director with both types of expertise. Staff suggested that the creation of associate leadership positions, in both research and teaching, would increase the organisation's ability to focus on given scientific topics without sacrificing educational capacity. Offering staff a mechanism to participate in recruitment and hiring decisions also may help to ensure collegiality and support for new strategic goals.

UNIS indicated that the diversity of courses the organisation offers is perhaps too broad given the current level of staffing. The Panel also thought that the range of research topics seemed unrealistically broad given the personnel available. Restructuring could lead to an increased focus on quality rather than quantity, in both course topics and research output.

Positions at UNIS became permanent as opposed to fixed-term (primarily three years) in 2009. It may be useful to consider whether expectations and support for career development should change as a result. For example, increasing administrative support for permanent and visiting researchers may allow UNIS's staff to dedicate a greater proportion of their time to products and less to logistics.

The new position in terrestrial ecology may increase collaboration between terrestrial- and marine-oriented research groups, especially if such collaboration is identified as an expectation for professional advancement. Filling this position also may provide an opportunity to strengthen research and training related to climate change.

Societal impact

The research activities at UNIS are highly relevant to social priorities. For example, changes in Arctic climate are expected to be more rapid and more substantial than elsewhere, and probably will affect the climate of other regions. Changing levels of human activity in the Arctic that are linked to climate change, such as transportation and the development of energy sources, are also likely to affect the ecology of the region. UNIS increasingly collaborates with commercial companies, which have the power to manage resources in ways that affect societies both positively and negatively. Interactions between UNIS and the media, the local community and schools, and tourist organisations also have a direct effect on society.

Institute of Marine Research (IMR)

Description of institution

IMR is a national governmental research institute owned by the Norwegian Ministry of Fisheries and Coastal Affairs. It is the largest marine research institute in Norway with over 600 staff FTEs. Of these, around 370 FTEs are scientists (163 with PhD plus 22 other researchers) or R&D technicians (167 in total). IMR is based at Bergen (55% of staff effort) but also operates at five other sites as well as aboard five large research vessels. IMR carries out a substantial amount of research in marine biology. Our evaluation only addressed this area of research (conducted by 11 teams) and did not cover other types of marine science conducted by a further eight teams.

IMR's vision is to provide "knowledge and advice for rich and clean seas and coastal areas." Research groups share a common objective of "provid[ing] high competence and stimulating working conditions to develop a basis for management advice within aquaculture and marine resources and environment." IMR staff work across ten programmes and programme leaders are able to "buy" staff time from the research team leaders.

IMR is guided by a strategic plan that is developed and overseen by an independent international board.

General evaluation & recommendations

IMR has a challenging mission and balances its responsibilities for advice, monitoring, and publications well. The Managing Director's presentation and our interactions with senior team staff, including discussions of IMR's strengths and weaknesses, were frank and open. Collectively, the senior staff appeared to be skilled and competent leaders. It was clear that they had embraced training in leadership and management appropriate to the administration of a large organisation. The Panel thought the Institute's resources, including people, skills, and research facilities (including ships), were good.

The Panel thought it was sensible that the organisation places a higher priority on quality than quantity of products, and on the provision of advice than publication. Although we did not investigate career development, we suggest that it reflects IMR priorities. The point was made that approximately 20% of staff produce 80% of publications. This imbalance makes it important that open and transparent personnel evaluation procedures are agreed upon by all members of staff.

The following generic issues arose during the panel discussion:

- i) *Quantitative expertise.* Several units expressed concern about a dearth of quantitative expertise across IMR. We felt that mechanisms should be explored for training in quantitative methods for research staff.
- ii) *IT policies and procedures.* First, infrastructure for data archiving, which is integral to an organisation's IT strategy, may be inadequate. IMR needs to consider the trade-off between developing in-house capacity versus using external topical, national, or international data archives. Second, it was unclear to us whether IMR data and the

Norwegian Marine Data Centre have a strong relationship. Third, implementation of the IT strategy will need to incorporate mechanisms for storing data from diverse sources and with different formats.

iii) *Recognition of monitoring activities.* Monitoring is often a routine activity. Yet it is essential that monitoring is carried out professionally and that individuals who do it well are recognised. We suggest that IMR might introduce digital object identifiers (DOIs) to identify data sets, particularly those associated with monitoring. DOIs would allow credit to be attributed for collecting and archiving data and would enable data use by others to be tracked. IMR's data are invaluable and it should be possible for IMR to publicise its data in more creative ways and encourage their use by external stakeholders.

Follow up of previous evaluation

The previous evaluation of IMR included two programmes (*Mare Cognitum* and Marine Pollution). One was graded fair and the other was graded fair-to-good. The Panel thought some work by a wider set of units over the past ten years has been very good or excellent.

The recommendations of the previous evaluation were:

- i) Stronger connections between IMR and university staff. These relationships have been strengthened over the last decade, particularly in topics in which IMR is relatively weak (phytoplankton, primary production and ecosystem modeling).
- ii) Greater emphasis on publications. In our evaluation there was evidence of high publication output in most of the units assessed.

Evaluation of individual research units

Demersal Fish

Grading of scientific quality

Good

Description of unit

The Demersal Fish unit is tasked with monitoring, data collection and research on demersal fishes of importance to the Norwegian fishery and economy. The group collects biological data, examines stock recruitment, and provides modelling, stock distribution and fisheries management advice to the Ministry and stakeholders.

The unit is composed of 20 active personnel, two Masters students and two PhD students. The staff includes 14 research scientists (average age of 51 years) and six technicians (average age of 47 years). All but three of the research scientists are Norwegian, and the majority are male. Recent attempts to recruit female staff have not been successful.

General evaluation & recommendations

The unit generates important long-term baseline data on demersal fishes that are distributed to IMR, stakeholders, and international users. The unit has research expertise in both fisheries and aquaculture. The unit uses staff efficiently for grant applications and

has good public relations, publication rate in international journals, and international collaborations, especially through ICES.

The unit seems to have difficulty hiring new staff and needs a succession plan for the replacement of older staff. Additionally, in planning for future staff turnover, the group might benefit by recruiting postdoctoral scientists and training them to replace retiring staff. Upgrades to the fish ageing laboratory and image analysis systems are needed. At present, funding of projects is dependent to a large extent on Ministry mandates, which limits opportunities for self-driven research. It would be advantageous for the group to consider whether surveys could complement other research opportunities or funding options.

Societal impact

Given the importance of both fisheries and aquaculture to Norway, the work of the Demersal Fish unit, as well as others at the IMR, is of great societal relevance. Data generated by this group are important to both government ministries that set quotas and to stakeholders who harvest and consume fish. In this context, the work completed by the group is essential to Norway.

Bottom Habitats & Shellfish

Grading of scientific quality

Weak to Very Good

Description of unit

This is a large research group of about 44 scientists (five professors, six assistant professors, 11 postdoctoral fellows, four PhD students, three guest researchers, and 15 technicians) working on benthic and coastal ecology, with an emphasis on shellfish. Their remit is to carry out research and to advise stakeholders. The work is both inter-disciplinary and international. The latter aspect of the group's activity is aided by their ability to attract scientists from abroad.

General evaluation & recommendations

The quality of the research is diverse, from cutting-edge to modest. Many articles are published in low impact journals.

This is an important group carrying out research that is central to IMR's mission. The group has become inter-disciplinary, but likely will need additional statistical and modelling expertise to achieve their goal of an ecosystem research approach. This expertise may be obtained through stronger interaction with other research groups. For example, primary production might be included as one of the drivers of benthic communities.

To maintain a strong scientific reputation, the quality and quantity of publications should be increased. Further international collaboration may help bolster the publication record. The scientists with weak publication output might benefit from mentoring by colleagues with stronger publication records.

Societal impact

Societal impact at the national level is high and increasing.

Deep Sea Species

Grading of scientific quality

Very Good

Description of unit

This is a new research unit established in 2007 that brought together ten scientists from five other units. There have been some staff changes since 2007 and the group now contains six senior scientists, one PhD student and a postdoctoral fellow, as well as four technicians and three MSc students. The unit's remit is to undertake research on deep-water fish. This is a topic tackled by few other groups in the world. It is also an important group in the context of IMR's mission.

General evaluation & recommendations

The quality of the research is very good. Publications are generally in international journals. With some care and resources the unit could emerge as a world leader. Most researchers are located together in Tromsø. However, they do not seem to be realizing their full potential. It may be that they simply need time to adjust to the new organisational structure. It might be helpful for a small committee of specialists in deep-water fish to evaluate the group, with a remit of suggesting potential links with the few other groups conducting similar research outside Norway.

Societal impact

This group's research is relevant to the remit of IMR and research on deep water fish is undertaken by few other groups worldwide. Accordingly, this group has high societal impact.

Fish Capture

Grading of scientific quality

Fair to Good

Description of unit

The Fish Capture research unit utilises both historical and current information on fish behaviour and fishing gear to assist the fishing industry, fisheries managers, and other research units at the IMR, in the development of fishing gear that will result in more sustainable fisheries. The group is currently comprised of eight researchers (five principal scientists, one senior scientist, two research scientists), seven technicians, one adjunct professor from the University of Bergen, and one PhD student.

General evaluation & recommendations

This unit is indispensable to the successful operation of IMR's groups that research fin-fish captured at sea. The group has also demonstrated an ability to apply its expertise to aquaculture. Opportunities to publish could be increased by collaborations with national and international environmental organisations and research groups, especially those interested in fish welfare.

The unit does not have a public relations strategy for communicating the knowledge generated by its research. For example, work on the mitigation of negative environmental impacts from fish capture and on fish welfare could be promoted.

The unit shows some weaknesses. Funding sources are primarily linked to the Fishery & Aquaculture Industry Research Fund and direct links to IMR's thematic programmes are absent. There is a dependence on the "fish quota system" to cover costs of internal research, and research staff are relatively senior and male biased.

We recommend that the unit considers the following:

- i) Emphasise consumer-focused research, especially research on the mitigation of environmental effects of fishing gear and capture.
- ii) Continue research on Capture Based Aquaculture (CBA) of cod and other species that is directly related to improving fish welfare.
- iii) Link both the environmental mitigation and CBA research with international programmes on sustainable fisheries, e.g. programs of the Marine Stewardship Council.
- iv) Encourage staff with expertise in gear technology and engineering to participate in the publication process.
- v) Exploit the close ties nurtured with stakeholders, and leverage industry funding to support research, graduate students and postdoctoral fellows.

Societal impact

The current national and international focus on environmentally-sustainable harvest, and the growing concern of the general public for animal welfare, have resulted in fish capture and gear technology moving to the forefront of social concerns regarding food production. Consequently the unit's work in wild fisheries and CBA is important to both stakeholders and the general public, and can directly affect both public perception and fish welfare.

Fisheries Dynamics

Grading of scientific quality

Fair to Very Good

Description of unit

The main focus of this group is the management of data collections from commercial fisheries. The group includes ten scientists (nine with doctorates), and is headed by a senior scientist with a background in mathematical statistics and fisheries biology. There are also seven technicians.

General evaluation & recommendations

Much of the output of the group is of international significance; however, within the group output quality and quantity is variable. Accordingly, it may be helpful for the group to discuss and agree on the role of different individuals. Although some individuals have strong international collaborations, especially with the USA and Russia, the group as a whole does not. There may be room to augment such collaborations.

Societal impact

The management of data from commercial fisheries is an undertaking that clearly has strong social impact.

Observation Methodology

Grading of scientific quality

Fair to Very Good

Description of unit

The main focus of this group was not particularly clear although it seems to be reasonably successful. The group contains 14 male scientists with PhDs and three PhD students (one female).

General evaluation & recommendations

Much of the output of the group is of international significance but some members have low levels of output. Nevertheless, international collaborations are strong and there is considerable demand from industry for the group's core skills. The self-assessment document suggested that group leadership and cohesion could be stronger. For instance, keeping a spreadsheet of publications is not a publication strategy; a publication strategy should be developed. It was not clear to the Panel why the person who appeared to have the greatest amount of experience was not the unit leader.

Societal impact

As with several other groups in the IMR, the social relevance of this group is good and a direct consequence of the nature of the research being carried out.

Pelagic Fish

Grading of scientific quality

Fair to Good

Description of unit

The Pelagic Fish research group is tasked with surveillance, stock assessment and research of the Norwegian pelagic fishery. The unit is accountable to the Ministry, to stakeholders and to the general public and engages in national and international consultation.

The unit comprises 11 scientists (four principal scientists, two senior scientists, three research scientists, and two postdoctoral fellows, with an average age of 51) and 16 technicians (average age of 55). The high number of technical staff reflects the labour-intensive nature of data collection and the production of surveillance and assessment reports. Many of the unit's members are expected to retire within the next ten years. The group is 59% male, and all but one of the scientists are from Norway.

General evaluation & recommendations

The data this group collects are extremely valuable to other IMR units, fisheries stakeholders, government ministries and collaborators. In particular, the group has strengths in stock assessment (for example, population size and age structure) and tag-recapture data collection.

The group seems to have little or no means for assessing how the data it generates is used by collaborators, stakeholders and government ministries, either for publication or publicity. Additionally, the unit perceives a lack of time and opportunity to publish research results. It may be helpful to explore the possibility that when collaborators use

data generated by the group, a group member is included as an author on any resulting publication.

Some members of the panel suggested that the unit might develop a plan to reduce time at sea collecting baseline data and increase time developing publications. This might be achieved by increasing reliance on students and postdoctoral fellows for fieldwork. The group might also explore whether stakeholders could become collaborators on projects that they fund, increasing both revenue and the potential for joint publication. Furthermore, the group might benefit from recruiting PhD students and postdoctoral fellows from within or outside IMR to ensure that the group remains strong when senior scientists and staff retire.

Societal impact

Summary reports on pelagic fish stocks are routinely distributed to stakeholders, politicians and the general public, and are of high social relevance due to the dependence of Norway on the wild fishery. As a result, the work of this unit plays a critical role in making decisions. This is probably the unit's most prominent contribution to societal impact.

Plankton

Grading of scientific quality

Good to Excellent

Description of unit

The main focus of this unit is research on the role of plankton in marine ecosystems. The unit contains 13 scientists (11 with PhDs and two doctoral students) with expertise in chemistry, phytoplankton, zooplankton, and larval fish. In addition there are 12 technicians in the unit.

General evaluation & recommendations

Much of the output of the unit, especially that of the zooplankton group (ten of 13 scientists), is of international significance. However, the group does not appear to be well integrated. Phytoplankton, chemistry and ecosystem modelling could be better represented, perhaps through collaboration or new appointments. International collaborations are strong and the postdoctoral fellows are productive.

Societal Impact

The unit has less direct societal impact than many others at IMR. Nevertheless, much fisheries research ultimately requires a good understanding of plankton.

Population Genetics & Ecology

Grading of scientific quality

Good

Description of unit

The group consists of 14 senior scientists, eight of which are the equivalent of professors, as well as three postdoctoral fellows and three associated scientists. Few women are in the upper ranks, and the unit has invited women to apply for new positions. The unit

focuses on the structure and function of DNA in marine species and on the genetic drivers of ecological and evolutionary processes. Other research areas include the genetic classification of wild populations and farmed species and the evolutionary effects of fishing.

General evaluation & recommendations

Worldwide interest in fishery-driven evolution is increasing. The group has made significant contributions in this area, as well as to the study of predator-prey dynamics in marine ecosystems. Research on the control of salmon lice is essential at national and regional levels.

The Panel acknowledged the unit's contributions to genomic studies of fisheries but thought that the unit could take a stronger international lead in this area. There should be opportunities for increased publication in specialised fisheries journals and in journals with a higher impact factor. The Panel appreciated that the diverse expertise of the unit means that maintaining cohesion might be difficult; development of strategic plans for recruitment of new scientists into areas of existing strength may be helpful.

Given the quantitative nature of much of the unit's work, the Panel also recommend ensuring that statisticians and other quantitative scientists are readily available for consultation. This could be accomplished either by including statisticians in each unit or by recruiting such expertise to a centralised unit for the IMR.

Societal impact

The work has considerable societal impact. Understanding the long term, often inadvertent, effects of fisheries on the evolution of morphology and life history of cultured species guides the future direction of fisheries.

Marine Mammals

Grading of scientific quality

Very Good

Description of unit

The group consists of seven senior scientists, five technicians and three PhD students. Five of the senior scientists are over 50 years old. The unit's major scientific contribution appears to be the monitoring of whale and seal populations, particularly hunted species. The monitoring data are of national significance and contribute to international reports.

General evaluation & recommendations

Monitoring of hunted marine mammals and other populations is necessary to maintain sustainable harvest and the group has adequate statistical expertise. Much of the data typically appear in reports rather than in articles in high-impact scientific journals. It might be useful to recruit or develop collaboration with a behavioural ecologist to explore whether the data could yield inferences about migration and movement patterns and their causes. Given that most of the senior scientists are approaching retirement, one or two new appointments in the near future might provide continuity for the unit.

Societal impact

The work has considerable societal impact. The population status of hunted and otherwise exploited species must be monitored, and stability analyses performed.

Ecosystem Processes

Grading of scientific quality

Good

Description of Unit

The unit's expertise is diverse, including but not limited to assessment of fisheries, trophic interactions, taxonomy, behavior, physiology, responses to climate change, ethics, and survey methods. The unit informs major international organisations, including the Oslo and Paris Conventions for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Commission), the Arctic Council, and the Fisheries & Agriculture Organisation of the United Nations (FAO). The unit also emphasises the translation of research to the general public. As of June 2010, the unit included six individuals with experience equivalent to full professors, seven with experience equivalent to associate professors, three with experience equivalent to assistant professors, and one postdoctoral fellow,. The unit also included a Professor II, a PhD student, and six technicians. Approximately one-third of academic staff are not Norwegian and the gender ratio is approximately equal.

General evaluation & recommendations

We recommend that measures of success beyond publication in scientific journals are developed in order to acknowledge accomplishments in providing practical information. Such measures could be included in reports to the Research Council and other organisations. Moreover, we recommend recognising explicitly that high-quality taxon- and region-specific publications may have a greater effect than publications in international journals – impact factor is not necessarily positively correlated with on-the-ground impact. The unit might consider focusing more on processes than on traditional topic areas: breadth is not a weakness if depth is not sacrificed.

Societal impact

The unit engages well with decision-makers and emphasises the delivery of practical information.

Norwegian Forest & Landscape Institute

Description of institution

The Institute was established in 2006 by the merger of the former Norwegian Forest Research Institute with The Norwegian Institute for Land Inventory. The Institute is under the jurisdiction of the Ministry of Agriculture and Food and provides scientific knowledge to inform the sustainable management of land resources. The main office is in Ås, with regional offices in northern, middle and western Norway. Research activities are undertaken within departments, each of which is subdivided.

General evaluation & recommendations

It might be possible to produce a higher number of research publications per year. Some work conducted at the request of the Ministry may not lead directly to publications. Aspects of research that cannot be published in peer-reviewed journals might be disseminated effectively through public engagement. It may be useful to assess equipment requirements and develop contingency plans to update laboratory facilities if the BIOKLIMA proposal is not successful. There are relatively few young or female staff. Currently, research is classified into ten themes and we recommend the institute consider merging of some of the smaller groups.

Follow up of previous evaluation

The recommendations of the previous evaluation were:

- i) Increase the focus of small research groups to ensure greater competitiveness.
- ii) Pathology and entomology should move closer to forest genetics. The Institute acted upon this recommendation.
- iii) Increase cooperation with units at the Ås campus in order to establish a national centre for plant biology that includes a laboratory for the simulation of terrestrial ecosystems. This recommendation led to development of the National Network of Plant Scientists (PlantNorway) and an application for the advanced BIOKLIMA facility.

Evaluation of individual research units

Biodiversity

Grading of scientific quality

Good

Description of unit

Research is organised into projects with project leaders. Research priorities are decided at the institute level. The mission of the unit is to perform empirical and theoretical research that can inform conservation of biological diversity. Research activities can be divided into two main topics, conservation biology and forest history. The unit is composed of 11 people (10 scientific staff and one administrator).

General evaluation & recommendations

The forest biodiversity unit seems redundant with larger units at other institutes. Most research is national in scope, and we wondered if it would be possible to develop an international scope. The large number of small projects being conducted may result in some fragmentation of effort.

Societal impact

The unit's work is relevant to society but might have more substantial impact if the unit was merged with a larger group at another institute.

Forest Ecology

Grading of scientific quality

Very Good

Description of unit

The group consists of ten individuals: seven researchers and three technicians. Research areas include soil science, plant science, hydrology, forest pests and diseases, remote sensing, and the modelling of forest ecosystems and biogeochemical cycles. The unit also has a strong emphasis on statistical data analysis, time-series modeling, nonlinear system dynamics, and process-based modeling.

General evaluation & recommendations

This unit runs the chemical laboratory and we suggest future plans incorporate options to renew the apparatus in this lab. The relatively senior age profile of staff is a potential weakness.

Societal impact

Most of the research activities of the unit are socially relevant, for example, acid precipitation, forest decline, and climate change.

Forest Genetics

Grading of scientific quality

Very Good

Description of unit

The Forest Genetics unit, which contains 4.8 academic staff (including three individuals who also are affiliated with other units) is characterised by studies of i) climatic adaptation and epigenetics, ii) breeding and iii) phylogeography and genetic structure. Research extends from the field to the laboratory and includes progeny trials, studies of wood properties, and selection parameters in breeding. Molecular approaches to epigenetics include studies of DNA methylation and microRNAs for gene silencing and the identification of candidate genes for regulation of epigenetic memory. Research conducted in the group is mainly at the interface between genetics and either pathology or physiology.

General evaluation & recommendations

This is a small group but well focused. However, as molecular tools are increasingly being applied to research we suggest that the unit hire at least one technician to support

molecular analyses. The unit's publication rate might increase if fewer large projects rather than many small projects were conducted. The distribution of staff among three different locations also may limit productivity and collaboration.

Societal impact

The contribution to forest health through the use of breeding is a socially relevant output of this unit's research.

Forest Health

Grading of scientific quality

Very Good

Description of unit

The unit focuses on tree defences against insects and pathogens. Work also includes insect population dynamics, biological invasions, and root-soil interactions. Recently the unit has expanded into fungal genomics, including whole-genome sequencing and transcriptomics. The research is highly interdisciplinary, with integration of mycology, entomology, plant anatomy, and molecular biology. Projects on wood technology focus on the mode of action of various techniques of wood preservation and on minimisation of decay and mould fungi. The unit has eight full-time researchers (two female and six male, one male does not have a PhD) and two PhD students (one female).

General evaluation & recommendations

More students and postdoctoral scientists, especially females, might strengthen and diversify the group and increase research output. The current research programme is excellent and output in terms of publications and applications is high. The self-assessment discusses several state-of-the-art research efforts related to tree health, but the small size of the group means it currently lacks competence in all of these areas.

Societal impact

Forest health is important to society because forests provide recreation, renewable energy and clean, non-polluting building materials. Research projects provide mechanisms to breed for disease resistance, identify genes relevant to biofuel production, predict forests' response to climate change, and model the spread of invasive species.

Forest Resources

Grading of scientific quality

Weak to Very Good

Description of unit

The unit focuses on silviculture and development of national forest resource mapping programs. It aims to assist land managers in revising management plans and practices and monitoring changes in forest ecosystems. The research involves biometrics, statistics, mathematical modelling, ecophysiology and mensuration. The group presently consists of 14 researchers at research stations that cover all the regions of Norway.

General evaluation & recommendations

Although a large group in respect of the number of researchers, the unit's scientific output is low. The group's research strategy is general and its research focus is not very clear. It may be helpful to develop fewer large projects rather than many small projects. There are some links with universities, but the unit currently contains a single PhD student; we recommend increasing the number of students. Few external funds have been secured.

Societal impact

The unit supplies scientific advice and support to the forestry sector, and contributes significantly to innovation in forest planning, studies of carbon storage, and biomass assessments.

Wood Technology

Grading of scientific quality

Very Good

Description of unit

The unit comprises 14 people (one senior researcher, five researchers with PhDs, two PhD students and six technical staff). The unit focuses on the use of wood, solid wood products, wood protection and modification, wood for bio-energy, and wood for building. Interdisciplinary research occurs at the boundaries between wood technology and mycology, molecular biology, physics, and chemistry.

General evaluation & recommendations

The unit has a strong international profile (COST, EU) although that is not always obvious from the publication list. We recommend maintaining the currently strong contacts with industry. We also suggest efforts to increase the number of publications not come at the expense of the industry-driven research. In this field, interaction with industry is very important and increasing the number of patents is another way to show the unit's excellence. Strong links with industry might be used to partially fund required equipment.

Societal impact

This unit's research makes it possible to produce more environmentally-friendly products in an efficient manner, and to increase the durability of wood products.

Norwegian Institute for Agricultural & Environmental Research (Bioforsk)

Description of institution

Bioforsk's current organisational structure was established in 2006. The institute has seven research divisions: grassland and landscapes, arable crops, horticulture and urban greening, arctic agriculture and land use, organic food and farming, soil and environment, and plant health and plant protection. The organisation's four long-term themes are food quality and safety, climate changes, sustainable agriculture, and plants for non-food purposes. The sections of Entomology and Nematology and Plant Pathology are within the division of Plant Health and Plant Protection. The section of Fruits and Berries is within the division of Horticulture and Urban Greening. Scientific activities are project-based and approximately half of the institute's direct budget allocations are intended to inform policy.

General evaluation & recommendations

We were somewhat confused by Bioforsk's organisational structure. It may be worthwhile devising a way of more clearly communicating it. Research areas did not seem highly focused, and several panel members recommended that the institute strategically highlight potential areas for emphasis. The expansion of metrics of success to include direct application of research to practice would likely better reflect the organisation's role and strengths.

Provision of statistical training for staff and incentives for publication appear to be effective, and would be worthwhile to continue. Other organisations have attended the training programs, which adds value in terms of building capacity and collegiality across organisations.

It may be possible to generate publications that are grounded not only in ecological research, but also in processes for working effectively with end-users. Additionally, studies of interactions among researchers and end users may be appealing to social scientists. Bioforsk has unusual strength in providing practical information to end-users that is directly applicable to day-to-day environmental management.

Project management currently is reducing the ability of scientific staff to generate publications and other products, and may be reducing morale. The organisation has transitioned rapidly from managing small projects to managing substantial ones. Both administrative training for project leaders (who typically do not have training in, say, accounting practices) and increasing expert administrative support may be worth the investment. Members of Bioforsk staff feel their productivity is affected further by a lack of coordination among the Research Council and ministries about priorities for research and information transfer.

Follow up of previous evaluation

The principal recommendation of the 2000 evaluation was to develop a stronger strategic research focus. That evaluation noted that mobility of junior researchers might impede collaboration in the disease resistance group, which expressed the desire to work more

closely with forestry researchers. The self-assessment submitted for the current evaluation notes six actions that were taken in response to an evaluation in 2003: research facilities were renovated, investments were made in advanced research equipment, institutional memoranda of understanding were developed, adjunct research positions were created, research scholarships were provided to all internal PhD students to stimulate international collaboration, and financial mechanisms to facilitate sabbaticals for senior scientists were improved.

Evaluation of individual research units

Section of Entomology and Nematology

Grading of scientific quality

Fair to Good

Description of unit

The research unit contains nine permanent researchers and two postdoctoral fellows, and is one of five within the Plant Health and Plant Protection division. Since early 2010 the unit has been divided into two subunits: horticultural crops and agronomic crops.

General evaluation & recommendations

Research into the ecology and control of pests on crops, particularly fruits and vegetables, is strong. Several members of the panel found the impact of the unit's research difficult to assess because journals in this discipline tend to have low impact factors. Additionally, because research needs and sources of external funds often are regional, work may not have international transferability.

Climate change was listed as an area of interest for the unit, but no section-level research on this topic was apparent. We wondered whether it would be possible to link climate change to the population biology or control of pests. Many staff are at a fairly senior level. Recruitment of junior researchers may lead to increased productivity, including but not limited to publications. Additional technical support also may allow staff to spend more time on deliverables.

Societal impact

The section's work is of considerable societal relevance given its emphasis on horticultural and crop plants, particularly the detection and control of pathogens.

Section of Plant Pathology

Grading of scientific quality

Good to Very Good

Description of unit

The section focuses on viral, bacterial and fungal diseases of greenhouse crops, cereals, fruit, berries, ornamentals, potatoes, and vegetables. This section has the largest number of scientists among Nordic countries (eight female and seven male) conducting research with direct application to plant pathology. Core funding is from the Ministry, hence much research is directed toward meeting the needs of the Norwegian Food & Safety Authority (for example evaluation of fungicides, consultation related to quarantine). The section also competes for grants from the RCN and from the EU.

General evaluation & recommendations

Members of the panel commented favourably on the section's strengths in the epidemiology and population biology of Poaceae, outdoor crops (*Fusarium*, *Phytophthora*, *Pythium*), the collection of cultures of local crop diseases, and recent infrastructure and collaborations. There may be potential to explore to a greater extent the potential effects of climate change on the relevant biological phenomena and taxonomic groups.

The section currently has a large number of small projects that are not closely related to each other. International collaborations and greater participation in well-funded programs and EU networks might increase capacity for developing core research projects or programs. There seemed to be potential for increasing recruitment of staff from outside Norway. Increasing existing collaborations with university departments and developing shared projects or research may contribute to the same ends, as well as potentially increasing the volume of publications. Output might increase if capacity for administrative support within the organisation increased.

The culture collection is an organisational strength. Participation in a national repository of culture collections could increase links with research groups outside the institute and thus increase output. Research results are regularly published in high-quality phytopathological journals. As the self-evaluation states, however, it may be possible to increase the number of publications. Encouraging external funders to support preparation of manuscripts also may help increase the time available to staff for such activities.

Societal impact

Research conducted by this unit is highly relevant to society because it is related to the production of food, screening food for residues and organisms that might cause human illness, and monitoring colonisation of crops by non-native invasive organisms, especially those considered as pests.

Section of Fruit and Berries

Grading of scientific quality

Good to Very Good

Description of unit

The Section of Fruit and Berry has regular contact with the Plant Health and Protection Division. Among units conducting research on fruits and berries in Nordic countries, this unit is presently the largest. The 12 scientists in the Section typically have large international networks and collaborate with many international organisations. However the members of the unit work at diverse locations and the line management structure of the section is unclear.

General evaluation & recommendations

The publication output of the section is relatively high, perhaps in part as a result of collaboration with university departments and participation in research that supports cultivar breeding. The publication rate of junior researchers (those whose PhD was conferred within the last five years) in high-impact journals is also comparatively high. As seems common in the horticultural sciences, many research articles are published in proceedings volumes, which are often not widely disseminated and cited.

It would be ideal if the section had some core financial support, which likely would increase its intellectual freedom as well as providing staff with more time for conducting research, as opposed to writing proposals for grants and contracts.

Researchers are distributed among at least four locations. This may promote independence, but the logistic obstacles may hinder some collaboration. Members of staff have a high administrative load that may inhibit their ability to generate publications. A greater number of phytotrons (growth chambers) might enhance research activities. This section, and others within the institute, might consider a stronger and more focused strategy with respect to research topics in which it has distinctive expertise.

Societal impact

The section's work has high social relevance. The research it undertakes focuses on food production, quarantine, and the evaluation of fungicides and pesticides for plant disease and pest control.

Norwegian Institute for Nature Research (NINA)

Description of institution

The Norwegian Institute of Nature Research (NINA) conducts short-term and long-term research that is motivated either by curiosity or by the information needs of management agencies, industry, and international conventions. The Institute conducts public outreach and promotes conflict resolution. Areas of expertise are diverse and include both social and natural science in terrestrial, freshwater, and coastal marine systems.

The Institute's headquarters are in Trondheim. Branch offices are in Tromsø, Lillehammer, and Oslo. Research stations are located at Ims in Rogaland, Røst, and Hjelmsøya. The organisation runs a breeding farm for arctic fox at Oppdal on behalf of the Norwegian Directorate for Nature Management.

The Institute was established in 1988 as a non-profit private research foundation. The number of staff has increased consistently. Staff typically allocate 40-45% of their time to research, with approximately a quarter of total time dedicated to self-initiated research. Staff are not obliged to participate in teaching, but many contribute lectures at universities and colleges and supervise graduate students.

General evaluation & recommendations

The Institute is an outstanding organisation. There appears to be much enthusiasm and creativity among staff. It appears to be run effectively in terms of business, research, and outreach. Collaboration between natural and social scientists is a strength of the organisation. Staff members conduct excellent work that informs society and responds to societal needs for information.

The self-assessment notes, "long-term monitoring *per se* is not research." This is true, but perhaps monitoring programs can form the basis for adaptive management and thus could provide a foundation for research. Some differences in publication rate among departments may reflect not only the typical duration of a project but also the motivation or desire of staff to generate publications from their work.

Follow up of previous evaluation

The evaluation undertaken in 2000 differentiated between monitoring programs and research. This often is a false dichotomy. As noted in the self-assessment, however, there is no *a priori* reason that rigorous analyses cannot be based on data from monitoring. Moreover, as noted above, monitoring can form an integral part of management, and peer-reviewed publications potentially could be derived from such programs.

Evaluation of individual research units

Department of Arctic Ecology

Grading of scientific quality

Very Good

Description of unit

At the time the self-assessment was submitted, the 24-person academic staff included 18 permanent employees (15 with PhDs), one postdoctoral fellow, three 20%-time scientific advisors (professor II), and two PhD students. The department has a research director responsible for scientific and marketing strategy, staff management, generation of profit, and general administration. An administrative officer oversees department operations.

General evaluation & recommendations

The five principal research topics listed in the self-assessment (environmental effects of climate change, population dynamics, spatial ecology and spatio-temporal processes, impacts of anthropogenic activities and contaminants, adaptive management) cover virtually all topics in ecology, conservation science, and resource management. It is unclear how the department benefits from grouping research activities into these areas given the groups are so comprehensive and quite flexible. If there is a marketing benefit to highlighting expertise in these topic areas to potential clients, perhaps the next self-assessment might clarify this benefit.

It was unclear why a flat organisational structure would make it difficult to promote the department as a unit or to prioritise research directions (noted in the self-assessment). Perhaps at least a subset of the research staff could identify specific opportunities for promoting the department in the course of their existing activities and collaborations. An outside facilitator, or a colleague within NINA with skills in facilitation, might be able to lead a strategic-planning exercise that results in consensus on overall direction.

Societal impact

The department dedicates considerable effort to disseminating information to the public via diverse written materials and public presentations. There is a great deal of support for staff participation in outreach.

Terrestrial Ecology Department

Grading of scientific quality

Very Good to Excellent

Description of unit

This is the largest department in NINA, with a total staff of 65 in 2010. Of the 32 academic staff, eight are women. Clear efforts are underway to ensure gender equity, including a mentoring program for female scientists. Members of the unit collaborate with researchers at several universities in Norway and abroad. Individual projects are managed by those academic staff that lead the research, with senior administrators playing an indirect supervisory role.

General evaluation & recommendations

The unit is producing high-quality research, with particular strengths in carnivore and large mammal ecology as well as in the effects of environmental pollutants on wild animals. Monitoring of wild animals, including but not limited to seabirds and game species, forms a substantial component of the department's efforts. Junior scientists are encouraged to engage in outreach and public dissemination of their work, with a reward system for exceptional efforts in this regard; this structure is noteworthy and a strength of the unit. Nevertheless, the uneven ability of academic staff to balance a range of research goals continues to be a challenge, and we encourage the institute to explore additional means to support the diverse efforts of their researchers. Similarly, some members of staff are less likely to publish in peer-reviewed journals with high impact factors and citation rates, although they are doing valuable work. As noted in the Institute-level comments above, a sharp distinction between monitoring or user-targeted research and curiosity-driven research is frequently unnecessary. We recommend examining the opportunities for publication of work related to outreach and communication with the public; some of these outlets are well regarded in the field.

As with the other units in NINA, the Terrestrial Ecology Department finds it difficult to compete for EU funds because of the inherently high costs of performing research in Norway (as discussed in the Introduction to this report). This issue may be intractable, but we recommend continuing to task one or two scientists with working to obtain at least some EU support.

Societal impact

NINA's research efforts are directly concerned with maintaining biological diversity and understanding human-wildlife interactions, both issues with clear application to society. The members of the unit are active in outreach and dissemination of their findings.

Department of Landscape Ecology*Grading of scientific quality*

Good

Description of unit

At the end of 2009, Department of Landscape Ecology staff included 20 full-time scientists, one part-time scientist, and one technician. Fourteen scientists were classified as biologists and five as social scientists (sociologists or economists). The roles of the research director and administrative officer are the same as those in the Department of Arctic Ecology.

General evaluation & recommendations

Staff reported that many members of the group are not highly motivated to publish their results in peer-reviewed journals. Perhaps the group could consider an incentive structure for those who have been highly productive in terms of outreach but less productive in terms of publications. Publications need not be based on research only; perhaps some scientists could be encouraged to submit manuscripts that relate both successful experiences in communicating with decision-makers and experiences that were unsuccessful but provided learning opportunities.

Limited support for PhD students and postdoctoral fellows was regarded by the department as a weakness. Might a stronger strategy be developed to encourage clients to provide support for junior professionals? Such personnel might provide good return on investment. Their interactions with clients early in their career could improve their ability to deliver science that meets the needs of those clients throughout their careers.

Societal impact

The department successfully has encouraged staff to communicate with the public both orally and in writing.

Department of Aquatic Ecology

Grading of scientific quality

Very Good

Description of unit

The Department of Aquatic Ecology has 51 staff (ages 30 to 64) who are primarily located in Trondheim and Lillehammer. Six of the technicians are located at the freshwater fish station in Ims. The professional research staff includes 12 senior research scientists (all male), 15 other researchers, two postdoctoral fellows, eight PhD students, and 12 technicians. Female staff are restricted to junior researchers and postdoctoral fellows. The unit has access to a variety of field stations and to infrastructure at other research institutes and universities.

All of NINA's departments conduct at least some aquatic research. The Aquatic Ecology unit is considered world-class with regard to research on anadromous salmonids. The department examines the effects of climate, land use, hydropower and disease transmission on the ecology of Atlantic salmon, sea trout and Arctic charr populations. The department also studies interactions between wild populations, including those of Atlantic cod, and aquaculture. The unit has examined changes to the freshwater ecosystem in response to anthropogenic activities and it informs the development of national freshwater policies. The unit also consults on marine ecological issues and on human impacts to the coastal ecosystem.

General evaluation & recommendations

The department has many strengths. Research involving fish telemetry is excellent and research on interactions between aquaculture and wild fishes is internationally relevant. Applications of SNP chips are quite useful for understanding the response of stocks to interactions between aquaculture and fishing. Staff have successfully used the national infrastructure for research. Publication week and internal research competitions are innovative ways to address the lack of time available to draft manuscripts for submission to peer-reviewed journals.

Base funding for NINA is indicated to be 15% of budget, but the Institute's summary of funding is too general to accurately assess the Department of Aquatic Ecology's revenues. A 2008 figure is cited but it may be out-dated.

The unit's research has informed some policy decisions at the national level, such as targets for salmonid spawning and evaluation of the effects of power company operations on salmonids. However, no long-range national aquatic ecology target has been clearly

identified. Departments might unite to develop a more formal strategy to address nationally relevant topics. This could lead to longer-term base funding from government and stakeholders to ensure stability of staffing and research.

Societal impact

The topics addressed by the department are highly relevant to social priorities, in particular the interactions between aquaculture-reared and wild fish, the effects of hydropower on freshwater ecosystems and anadromous salmonids.

Norwegian Institute for Water Research (NIVA)

Grading of scientific quality

Very Good

Description of institution

The Norwegian Institute for Water Research (NIVA), established in 1958, is a national research institute organised as a private foundation that is headquartered in Oslo. Regional offices are located in Bergen, Grimstad, Hamar and Trondheim. NIVA also operates a large-scale research station in Drøbak in the Oslofjord. The members of the management board are appointed by the Environment Ministry, the Research Council of Norway (RCN) and NIVA's employees. NIVA receives a basic grant (constituting 11% of its annual budget) from the RCN, with the bulk of the budget coming from competitive contracts. The institute is one part of the larger NIVA group that is comprised of several consultancies worldwide employing approximately 300 individuals; for example, Akvaplan-niva AS in Tromsø, AquaBiota Water Research AB in Stockholm, Sweden, and NIVA Chile SA in Puerto Varas, Chile, plus the technological development firms NIVA-tech AS, BallastTech-NIVA AS, EIF-Air AS and DOSCON AS and their subsidiaries.

The institute employed 222 staff at the end of 2009, with 189 considered professional water research scientists or technicians. Approximately half of the research scientists hold PhD degrees and of these 47 were included in this evaluation: one principal scientist, 12 senior scientists, 28 research scientists, five research managers and one postdoctoral fellow. The professional staff are distributed amongst 12 scientific service and research units in the fields of freshwater biology, limnology, marine biology, chemistry, geology, hydrology, environmental technology, environmental toxicology, oceanography, geography, resource management and environmental economics. All of these units employ biological expertise to varying degrees, depending on the focus of monitoring and research topics in freshwater and marine environments. Approximately one third of NIVA's activity is related to the biological sciences. Research and monitoring data collected by the Institute are widely disseminated and play a key role in government and stakeholder policy-making.

General evaluation & recommendations

The institute's self assessment was cogent and clearly presented. NIVA is a large, well-run and well-capitalised institute with excellent infrastructure and research that is generally good-to-excellent, especially given the institute's monitoring mandate and reliance on contracts. It is noteworthy, however, that NIVA relies heavily on contract funding and depends on the 11% basic grant from the RCN to maintain internal development. The self-assessment identified a management structure that is consistent with the mission of the institute. Staff at NIVA are multi-disciplinary, diverse, skilled, and have sufficient critical mass to be flexible, which together constitute an ideal format for continued success.

We noted that NIVA has unusually high-quality taxonomic skills and an excellent algal reference collection (the largest in Europe). The institute should be commended for doubling its publication rate since the last review and has increased publication quality as well. Additionally, NIVA has developed international and university collaborations, recruited younger scientific researchers and improved gender balance. NIVA shows better gender equity and age distribution than many national organisations.

We did, however, identify some possible weaknesses that the institute may want to incorporate into any future strategic planning. The institute does not have a policy on division of staff working time between research and advisory roles (see Introduction to this report). Continued retention of taxonomic expertise is essential, whether by in-house training of young recruits or by collaboration with outside experts. We noted there seems to be limited funding for publications and wondered whether the operating grant from RCN could be used for this purpose. There does not seem to be a strategic plan for future recruitment.

Indirect costs on research contracts are high; this may become a limiting factor in future contract negotiations. There is a lack of project management experience for younger staff and the institute may need to develop in-house training on this issue. Major program criteria (e.g effects of climate change, genetic diversity and ecology, emerging contaminants) may limit research opportunities and we recommend the institute be open-minded on the type and scope of potential projects.

Finally, we were concerned that a research institution like NIVA that focuses on the application of science may be expected to compete against universities for funding. The profiles of individual NIVA staff include few internationally-significant CVs and as such NIVA may not be competitive for RCN funding. A possible solution could be to encourage and provide funds for extensive collaboration with universities. This would allow NIVA to raise its visibility in the research community and prove its relevance. In this scenario, the collaborating universities benefit by having access to some unusual resources and facilities. We recommend NIVA strive to increase the number of postdoctoral and PhD positions in partnership with any of these universities.

Clearly NIVA is a successful institution, as shown by its growth and generation of research publications. It may be possible to increase the publication rate still further, perhaps with a target of at least one paper per year per person. Another option would be to establish a publication objective for each project. Also, the institute might establish a policy to ensure that all third parties who use NIVA data credit the institute as a source or partner.

Follow up of previous evaluation

Although the previous evaluation did not delineate specific areas for improvement, there was a general consensus on three issues. First, indirect costs on contracts were, and still are, considered very high. NIVA might consider a full review of contract costs as a means to keep project budgeting competitive.

Second, the previous evaluation noted that the nature of the contract research provided by NIVA did not fit a model that supports postdoctoral scientists or PhD students. Some members of the Panel think this is still the case, and they suggested the institute examine options for increased collaboration with universities (as noted above).

Third, publication rate and quality was identified as a major issue in the previous evaluation. The number and quality of publications has increased substantially and we anticipate future increases.

Societal impact

NIVA's role as the primary water research and monitoring agency in Norway makes its work significant to the general public, policy makers, and stakeholders. Without the input of NIVA, management of freshwater and marine coastal ecosystems would be difficult at best.

Norwegian Polar Institute

Description of institution

The Norwegian Polar Institute (NPI) is Norway's central institution for mapping, environmental monitoring, and research of polar regions. The principal purpose of the NPI is to provide new scientific knowledge and use that knowledge to inform management of the Arctic and Antarctic.

The NPI was based in Oslo until January 1997, when it was relocated to Tromsø. Researchers with expertise in population biology, ecotoxicology and marine community ecology, terrestrial ecology, palaeobiology, and physical oceanography and sea ice were recruited to fill positions in Tromsø. In 2009, the Centre for Ice, Climate and Ecosystems (ICE) was established within the NPI. Environmental monitoring is a primary task of research scientists at NPI. Research is organised into four programmes: biodiversity, ecotoxicology, polar climate change, and geology.

The aim of the biological programmes at NPI is to conduct long term monitoring and research in order to detect and explain changes in polar marine and terrestrial populations, and to provide information to inform management decisions. Members of staff conduct research on human activities and their effects (including climate change), long-range transportation of pollutants, petroleum exploration and extraction, and the harvest of renewable resources.

The NPI is mandated to be the main advisor to the Norwegian government and management authorities regarding the polar regions and as a government institution it receives substantial base funding. At present, approximately 80% of research funding is from external sources.

Biodiversity and Ecotoxicology

Grading of scientific quality

Very Good to Excellent

Description of unit

Researchers within the Biodiversity and Ecotoxicology groups have high levels of competence; 18 of 19 have a doctoral degree. Three technicians and three current PhD students work within the biology groups; all of these staff members have MScs. Four of the senior researchers within the biology sections have Professor II positions, at either the University Courses of Svalbard or the University of Tromsø. Four of 14 permanent science staff are women. Seven of the 18 members of the Biodiversity and Ecotoxicology groups are from Finland, Germany, Sweden, The Netherlands, Canada, and Norway.

The research department has a strong emphasis on publishing in international peer-reviewed journals. Researchers are also strongly encouraged to publish popular science articles. Because NPI is a management-oriented institute, scientists from the Biodiversity and Ecotoxicology groups write and take part in status and assessment reports for ministries, directorates, and foundations.

General evaluation & recommendations

We were impressed by the activities and outputs of the Biodiversity and Ecotoxicology groups, and by the positive attitude and enthusiasm of the groups' representatives. They were confident and had sound plans for the problems they have identified. We felt that all research probably has greater regional transferability than was apparent from the self-assessment document.

The groups report they are understaffed and have difficulties in recruiting to Tromsø. There are no affiliated researchers that could cover gaps in mandated research. One strategy that might compensate for limited laboratory facilities and technical support would be to contract technical or analytical expertise as required. Similarly, there are few PhD and Masters' students (approximately four each). The representatives reported strong competition among researchers for students in Tromsø. The NPI is not a degree awarding body so students must be enrolled elsewhere. Many students are recruited from UNIS because they generally have appropriate training and experience for Arctic research. The groups might seek to increase the postgraduate pool by cooperative relationships.

The position of the NPI as primary advisor to the government creates some friction with other organisations, but the representatives of NPI indicated they perceive this to be a minor issue. In reality, the NPI is not the sole provider of advice.

The NPI is a member of many pan-Arctic organisations and the NPI is used by the government to liaise with groups from other countries who wish to establish research in the Arctic. Despite this, there is no funding from the EU. Links are being established with other institutions and the success of flagship, collaborative initiatives (e.g. ICE) will be crucial. Such collaborations can strengthen research and the organisation indicated its intent to expand collaborations, but without planned increases in staffing. We suggest that the organisation considers how such collaborations could be facilitated without detracting from core activities. Relationships with ICE, which brings in many visiting scientists, might facilitate intellectual renewal in the absence of any formal sabbatical system. Links with UNIS were not entirely clear and perhaps could be stronger, but we appreciate that these two organisations are competing in many ways.

Although the groups receive considerable external funding, a high proportion goes to external research partners. The Norwegian government expects that external support will fill a ~30% shortfall in funding.

The ecotoxicology group had an impressive list of projects. Biological diversity (biodiversity) includes all levels of life and its structure, composition, and function. Thus we thought *biodiversity* might be a poor name for such a unit and wondered whether changing the unit's name would improve the ability of external parties to associate the unit with its expertise. Among those areas are food webs and top-trophic ecology.

Future strategic plans might include (i) outsourcing some monitoring activities, (ii) linking aspects of biodiversity and ecotoxicology more strongly, and (iii) an analysis of future recruitment that takes into account the current age structure, expansion of the postgraduate or postdoctoral pool, balancing government assignments with other research, and strengthening collaborations.

The previous evaluation recommended investment in ecotoxicology and plant biology. The former appears to have been achieved but not the latter.

Societal impact

The research carried out by both groups has clear social impact. Relevant research topics include understanding the potential effects of toxic compounds, climate change, and animal management, in addition to the monitoring and assessment of pollutants.

SINTEF Fisheries & Aquaculture AS

Description of institution

SINTEF Fisheries & Aquaculture AS was formed in 1999 as a subsidiary research institution of the SINTEF Group, which is the largest non-governmental research company in Scandinavia. SINTEF Fisheries & Aquaculture AS is operated as a contract research institute examining issues of importance to the entire fisheries sector (governmental and industrial) in Europe and beyond. The organisation accepts contracts on a wide variety of topics, and for this reason has been organised into four research departments: Marine Resource Technology, Fishery Technology, Aquaculture Technology & Processing Technology. For international projects the organisation has also formed an International Projects & Consulting section. In 2009 the organisation had 112 staff (37% female) from 13 countries, of which 18 were biological researchers holding PhD degrees or equivalents. The average age of staff was 43 years. In Norway, the organisation operates from the SeaLab facility in Trondheim, where staff utilise a wide variety of sample-processing and seawater laboratories, including a complete aquaculture laboratory. Due to the substantial contract work it undertakes, SINTEF Fisheries & Aquaculture AS collaborates extensively with other research institutions and universities in Norway that have strong fisheries research units.

General evaluation & recommendations

See below.

Follow up of previous evaluation

SINTEF was not part of the evaluation in 2000.

Evaluation of individual research units

Interactive Biology & Aquaculture Technology

Grading of scientific quality

Good to Very Good

Description of unit

Two groups are included as a single unit in our evaluation, Marine Resources Technology (MRT) and Aquaculture Technology (AT). Research undertaken by MRT concerns the modelling and monitoring of the marine environment, especially algae, plankton, marine fish fry production, marine aquaculture and biotechnology. Similarly, research undertaken by AT is linked to aquaculture production systems and associated management issues. Taken together these groups comprise 53 employees, eight of whom are researchers holding PhD degrees (one principal scientist, one senior scientist, one research manager and five research scientists). The submitted self-assessment did not provide a breakdown of postdoctoral fellows or PhD students affiliated with these groups.

General evaluation & recommendations

This unit undertakes contract research on a wide range of aquaculture-related topics, showing a diversity of general expertise but no specialisation. The unit is able to obtain funding for aquaculture research from a large variety of public and private funding and contracting sources. It has shown steady growth in funding at a 13% annual rate of increase from 2005-2009. The unit exhibits excellent collaborative skills, linking projects to the needs of both public and private sectors, and its staff and affiliated students have broad expertise in aquaculture biology. This is due in part to good links with affiliate projects in Denmark and Vietnam, and memoranda of understanding with China and The Netherlands. Because the contracts are short-term and there is need for low-cost scientific labour, the unit is a good training ground for recent graduates and younger scientists. The publication output seems reasonable for a contract research organisation (0.76 publications per year per person) and most publications are in well-respected journals.

The unit's lack of specific research goals may not be easily changed due to the short-term contract focus. The unit relies heavily on government funding. According to figures presented a substantial amount of contract funding came from the Research Council of Norway (38%). This is perhaps problematic for a contract organisation, which might be expected to gain a larger proportion of financial support from the private sector. The self-assessment noted that the unit's equipment infrastructure is dated. This is not surprising because many contract research groups typically do not invest in infrastructure and equipment unless those investments result in consistent revenue streams.

The unit cannot realistically target a specific line of research because it must be flexible enough to complete work as dictated by the private sector. An inability to renew the equipment base means that the unit must borrow from university, institute and private sector partners. As a consequence, the unit could benefit from the development of longer-term commitments from private sector partners, i.e. strategic industrial partnerships. These may provide the flexibility to identify areas of research expertise, allowing for planned equipment and infrastructure renewal and for graduate and postdoctoral programs.

In summary, the Panel noted that SINTEF Fisheries & Aquaculture AS and its subunits perform necessary contract research for the marine science and aquaculture industries. This arrangement has worked successfully to date. The groups may depend too much on direct and indirect funding arrangements with the RCN. In short, SINTEF's MRT and AT groups are a scientific resource for Norway and are fulfilling their missions.

Societal impact

As a leader in focused contract work for the Norwegian marine fisheries and aquaculture sectors, the SINTEF Fisheries & Aquaculture AS plays an important societal role. The organisation has the flexibility to undertake targeted research and development projects that are not feasible for most university research groups and it provides a valuable training ground for scientists in the early stages of their careers.

Abbreviations Used

BOL	Barcoding of Life [initiative]
CBA	Capture Based Aquaculture
COST	European Cooperation in Science and Technology
DOI	Digital Object Identifiers
DNA	Deoxyribose Nucleic Acid
DNS	<i>De naturhistoriske samlinger</i>
EU	European Union
FAO	Food & Agriculture Organisation of the United Nations
FTE	Full Time Equivalent [position]
GBIF	Global Biodiversity Information Facility
GIS	Geographic Information System
ICES	International Council for the Exploration of the Sea
ICE	Centre for Ice, Climate & Ecosystems
IMR	Institute of Marine Research
ISI	Institute for Scientific Information
IT	Information Technology
LIDAR	Light Detection & Ranging
MSC	Marine Stewardship Council
NINA	Norwegian Institute for Nature Research
NIVA	Norwegian Institute for Water Research
NPI	Norwegian Polar Institute
OSPAR	Oslo & Paris Commission for Protecting the North-East Atlantic
R&D	Research and Development
RCN	Research Council of Norway
REDD	Reduction of Emissions from Deforestation & Degradation

SNP	Single Nucleotide Polymorphisms
UNIS	University Centre in Svalbard
USA	United States of America
UiA	Agder University

APPENDICES

Appendix A. Mandate

Mandate for the Evaluation of Research in Biology, Medicine and Health in Norway 2010-2011

The Research Council of Norway (RCN) is given the task by the Ministry of Education and Research to perform subject-specific evaluations. The Division for Science has decided to evaluate research activities in biology, medicine and health and psychology in Norwegian universities, university hospitals, relevant research institutes and relevant university colleges.

Evaluations have previously been performed within these subjects/fields, in biology in 2000 and medicine and health in 2003.

1. The objective of the evaluation

The main focus of the evaluation should be the scientific quality of Norwegian research within biology, medicine and health and psychology in Norwegian universities, university hospitals, relevant research institutes and relevant university colleges.

The evaluation will reinforce the role of the RCN as advisor to the Norwegian Government and relevant ministries. The evaluation will give knowledge, advice and recommendations on biological, medical and health related research and give the institutions as well as the RCN and relevant ministries a better basis for determining future priorities within and between fields of research.

Specifically, the evaluation will:

- provide a critical review of the strengths and weaknesses of the above fields, both nationally and at the level of individual research groups and academic departments. The scientific quality of the research will be reviewed in an international context.
- assess to what degree the previous evaluations have been used by the institutions in their strategic planning
- discuss to what degree the research units perform research in accordance with the strategy of their institution
- identify the research units which have achieved a high international level in their research, or have the potential to reach such a level
- identify areas of research that need to be strengthened in order to ensure that Norway in the future possesses necessary competence in areas of national importance. A key aspect is to enable the RCN to assess the situation regarding recruitment within the scientific fields
- discuss to what extent the research meets the demand for interdisciplinary research and future societal challenges

2. Organization and methods

International evaluation panels will be appointed for the following fields:

- Botany, zoology and ecology related disciplines
- Physiology related disciplines including corresponding translational research
- Molecular biology, including corresponding translational research
- Clinical research, including corresponding translational research (two panels)
- Public health and health-related research
- Psychology and Psychiatry

Self-assessments including information about the organization and resources, as well as future plans, will be provided by the research units. In addition the panels will be provided with bibliometric analysis. Representatives from the involved units will be invited to meet the panels for presentations and discussions.

Each of the evaluation panels will write a report with evaluations of the different research units as well as specific recommendations. These reports will be sent to the research units for factual control. In order to provide general recommendations at a national level for research within these fields, Joint Committees will be established comprising members from each of the different evaluation panels/research areas.

Specific criteria for inclusion and exclusion – see attachment.

3. Tasks of the evaluation panels

The panels are requested to

- Evaluate research activities with respect to scientific quality, national and international collaboration. Scientific quality should be the main focus
- Evaluate how the research is organized and managed.
- Submit a report with specific recommendations for the future development of research within biology/medicine/health/psychology in Norway, including means of improvement when required.

Aspects to be assessed in the panel reports:

3.1 National level

- Strengths and weaknesses
- Research cooperation nationally and internationally
- Recruitment and mobility
- General resource situation regarding funding and infrastructure

- Cooperation with other sectors of society (e.g. industry)

3.2 Institutional level

To be defined as the institution as such, or as a university department, or a research institute.

Depending on the size of the institution level 3.2. and level 3.3. may be merged. In case of two levels, level 3.2 focus on organisation and strategy, level 3.3. on research quality and production.

- Organisation, research leadership and strategy
 - Including follow up of recommendations given in previous evaluation/s
- Resource situation
 - Funding, staffing, infrastructure and the balance between resources and research activities
- Scientific quality
 - Including the description of a publication strategy
- Training, mobility and career path
 - Recruitment and policies for recruitment
 - Policy for mobility and career path
 - Policy for gender and age balance in academic positions
- Research collaboration
 - Collaboration and networking activities at national and international level including interdisciplinary and multidisciplinary research activities, as well as translational research (from basic to applied research or vice-versa)

3.3 Research units

- Organisation, research leadership and strategy
 - Including resource situation (staff and funding) and research infrastructure
- Research activities
 - Scientific quality and production
- Training, mobility and career path
 - Recruitment and policies for recruitment
 - Policy for mobility and career path

- Gender and age balance in academic positions
- Research collaboration
 - Collaboration and networking activities at national and international level including interdisciplinary and multidisciplinary research activities, as well as translational research (from basic to applied research or vice-versa)

4. Time schedule

Panel meetings will take place in Oslo March-June 2011

Deadline for submitting draft panel reports August 2011

Deadline for submitting final reports October 2011

Deadline for joint reports November 2011

5. Miscellaneous

Other important aspects of Norwegian biological, medical and health related research that ought to be given consideration.

Attachment - Delimitation and organisation

The panels are asked to base their evaluation on self-assessments from the research units, factual information, bibliometric analysis and hearing meetings.

Starting point for the present evaluation will be the research performed at the institutions in question. The university departments and several institutes in the institute sector are too large to be evaluated as one single research unit. In order to give an overview of the research the evaluation will be carried out as follows:

Departments at the universities and university colleges and institutes in the institute sector (named institution)

1. The institution – level 1 – describes its organisation and research strategy in a written document as well as factual information including funding, number of permanent and preliminary positions etc.
2. The level below the institutions (section, group, program etc.) is the unit that will be evaluated and which prepare the self-assessment for the research – level 2.

In some institutions the level 2 units might be placed in different panels. If so the institute structure and strategy will present their activities to all relevant panels. Large evaluations units within level 2 belonging to different panels may split in different evaluation units or will be evaluated in a panel covering the main content of their research.

The units to be evaluated at level 2 need to be units already established. However it is important that the evaluation units to be evaluated have a certain minimum size. If the research performed within two or more evaluation units belong together thematically, it

may be an advantage to prepare a joint self-assessment making it clear that the self-assessment describes the research in two or more groups. Level 2 units with minor scientific activities and production, are to be described on level 1, the general description of the institute.

Research at the university hospitals

The research performed in the university hospitals is often part in integrated research units between the university and the hospital. It will normally neither be practical, nor natural to separate the self-assessment from these units. It is preferable that these integrated units give a joint self-assessment and a joint oral presentation at the hearing meetings. The universities are asked to take the main responsibility for the self-assessment when the research unit is led by a researcher who has his/her main position at the university. The same is asked from the university hospital when the research unit is led by a researcher who has his/her main position at the hospital.

Appendix B. Criteria for grading

Excellent	Research at the international front position: undertaking original research of international interest, publishing in internationally leading journals. High productivity.
Very good	Research with high degree of originality, but nonetheless falls short of the highest standards of excellence. A publication profile with a high degree of publications in internationally leading journals. High productivity and very relevant to international research within its sub-field.
Good	Research at a good international level with publications in internationally and nationally recognized journals. Research of relevance both to national and international research development.
Fair	Research that only partly meets good international standard, international publication profile is modest. Mainly national publications. Limited contribution to research
Weak	Research of insufficient quality and the publication profile is meagre: few international publications. No original research and little relevance to national problems.

Appendix C. Letter to Institutions



Vår saksbehandler/tlf.

Berit Nygaard, +47 22037174

Vår ref.

201002437

Oslo,

21. juni 2010

Fagevaluering av biologi, medisin og helsefag, inklusive psykologi invitasjon til informasjonsmøte og invitasjon til å plassere forskningsenhetene i evalueringspaneler

Det vises til tidligere informasjon om fagevalueringen i brev av 25.2.2010, samt våre nettsider om evalueringen; www.forskningsradet.no/biomedhelseevaluering

Informasjonsmøte

Vi inviterer til informasjonsmøte på Gardermoen, Radisson Blu Airport Hotel

tirsdag 24. august kl 10.30 – 15.00

Informasjonsmøtet er primært for representanter for ledelsen ved involverte fakulteter og institutter i UoH-sektoren og instituttsektoren.

Hensikten med møtet er å informere om evalueringen med fokus på organiseringen, mandatet for evalueringspanelene, egenvurderingene og faktainformasjon, tidsplan med mer. Program for møtet og lenke til påmelding legges på www.forskningsradet.no/biomedhelseevaluering i løpet av uke 26. **Påmeldingsfrist er mandag 16. august**, og det er mulig å melde seg på allerede nå <https://web.questback.com/norgesforskningsrd/kyl3fa8ebo/>. På våre nettsider vil vi i uke 32 legge utkast til faktaark og mal for egenvurdering. Kommentarer til disse dokumentene kan gis på informasjonsmøtet.

Dialog og tilbakemelding

Vi inviterer med dette institusjon/institutt til å plassere sine evalueringsenheter i de ulike panelene, se definisjon i vedlegg 3, Avgrensning og organisering. For å være sikre på at vi har etablert hensiktsmessige paneler og at vi får en noenlunde jevn fordeling av evalueringsenheter i panelene, ber vi om en tilbakemelding fra alle institusjoner/institutter med forslag til plassering av evalueringsenhetene for den enkelte institusjon/institutt så snart som mulig og senest **fredag 27. august**. Tilbakemelding til evalbiohelse@forskningsradet.no. Ta gjerne kontakt underveis ved behov.

Vi ber også om å få oppgitt en kontaktperson ved hver institusjon/institutt. Det vil blant annet være behov for dialog i etterkant av fristen slik at sammenlignbare forskningsfelt ved de forskjellige institusjonene, så langt mulig, plasseres i samme panel.

Panelinndeling

Det planlegges en inndeling i syv paneler (se vedlegg 4). Panelinndelingen er basert på Norsk inndeling av vitenskapsdisipliner (vedtatt av Universitets- og høyskolerådet i 1994) for klassifisering av forskning. I arbeidet med å rekruttere eksperter til fagpanelene er følgende kriterier lagt til grunn:

- Det enkelte panel skal dekke disiplinene innenfor panelet
- Det tilstrebes å finne eksperter med bred kompetanse som kan dekke flere områder
- Det vurderes om det er mulig å få med ett medlem i hvert panel som deltok i forrige evaluering for å bidra til kontinuitet
- Det tilstrebes at hvert panel har minst 40 % av begge kjønn
- Det tilstrebes en viss spredning i alder blant medlemmene

Det er lagt strenge habilitetsregler til grunn ved utnevning av panelmedlemmene.

Mandat for evalueringen

Mandatet for evalueringen følger vedlagt, vedlegg 3.

Utvidet tidsramme

Det har tidligere vært gitt tentativ tidsramme for evalueringen. Tidsrammen har nå blitt noe utvidet. Dette medfører at høringsmøtene blir forskjøvet til perioden 20. mars -10. juni, kun ukene uten helligdager. Den utvidede tidsrammen gir noe mer tid til dialog med miljøene og arbeidet med egenvurderingen, samt bedre tid til ferdigstilling av rapportene. Evalueringen vil være avsluttet i løpet av 2011. Se tidsplanen i vedlegg 5.

Avgrensning og organisering

Hovedfokuset i evalueringen skal være vitenskapelig kvalitet i forskningen. Evalueringen er på gruppenivå, ikke enkeltforskernivå. Evalueringen vil bli gjennomført av fagfeller i paneler sammensatt av meritterte utenlandske forskere ("peer review") og alt materialet i evalueringen skal være på engelsk.

Evalueringen omfatter mange ulike institusjoner og antallet forskere er stort. Forskningsrådet har satt en grense for minstestørrelse for institusjon/institutt som inviteres til å delta i evalueringen. Det angitte antallet vitenskapelig ansatte gjelder innenfor hvert fagområde, dvs. innenfor biologi eller medisin og helsefag. Noen forskergrupper/forskere har deltatt i nylig gjennomførte fagevalueringer, disse skal ikke evalueres på nytt.

Kontaktpersoner i Forskningsrådet

Spørsmål i tilknytning til evalueringen kan rettes til:

- Prosjektleder Berit Nygaard, telefon 22037174, bn@forskningsradet.no
- Prosessleder Malena Bakkevold, telefon 95750533, post@malena.no

Hvert av panelene har en egen fagrådgiver, se vedlegg 4 med oversikten over panelene.

Parallelle evalueringer som berører flere av forskningsmiljøene

Formålet med fagevalueringer er å foreta en kritisk gjennomgang av forskningen med hensyn til kvalitet relatert til internasjonalt nivå, styrker og svakheter, rammebetingelser for forskningen og rekrutteringssituasjonen. I tillegg innhentes råd om hva som skal til for å styrke forskningen og hvilke prioriteringer som peker seg ut. De to første evalueringene nevnt nedenfor evaluerer spesielle satsinger i Forskningsrådets regi og overlapper bare delvis med fagevalueringen.

Evaluering av FUGE

Det er en pågående evaluering av FUGE (funksjonell genomforskning) for å se på merverdien av programmet, og bla å få innspill til det videre arbeidet med satsing på bioteknologi.

Midtveisevaluering av SFF-II

Formålet med evalueringen er å bedømme de vitenskapelige resultatene sentrene har oppnådd og å gi en vurdering av planene sentrene har utarbeidet for forskningen i siste 5-årsperiode.

Evalueringen finner sted i 2010 – 2011.

Midtveisevaluering av SFI

Evalueringen skal vurdere de forskningsresultater som er oppnådd og om virksomheten i senteret underbygger senterets mål. Evalueringen skal videre gi en vurdering av planene

for virksomheten i den mulige siste 3-årsperioden. Evalueringen gjennomføres høsten 2010.

Evaluering av idrettsvitenskap (sports sciences)

Parallelt med fagevalueringen vil det bli gjennomført en felles nordisk evaluering av idrettsvitenskap 2010-2011. Evalueringen blir administrativt ledet av Finlands Akademi. Forskningsrådet ønsker at relevante norske miljøer skal delta i denne evalueringen, og vi vil sende ut separat informasjon om dette. Finlands Akademi avholder et informasjonsseminar om evalueringen 17. august, kl 12.00 – 15.30 i Helsinki.

Evaluering av deler av instituttsektoren

Fiskeri- og kystdepartementet (FKD) og Landbruks- og matdepartementet (LMD) har initiert evalueringer av deler av sin instituttsektor – se vedlegg 1

Med vennlig hilsen

Norges forskningsråd

Hilde Jerkø (sign.)

Avdelingsdirektør

Divisjon for vitenskap

Mari Nes (sign.)

Avdelingsdirektør

Divisjon for vitenskap

Vedlegg 1

Institusjonene som omfattes av fagevalueringen

Alle Universitetene

instituttene ved de medisinske fakultetene omfattes av evalueringen. Når det gjelder biologi og psykologi (bortsett fra ved UiB og UiT) vil evalueringen omfatte institutter og naturvitenskapelige museer som er deler av naturvitenskapelige og samfunnsvitenskapelige fakulteter.

Helseforetakene

Alle helseforetakene med universitetsfunksjon omfattes av evalueringen. I tillegg kommer Diakonhjemmet. For integrerte forskergrupper mellom universitetsinstitutter og helseforetak se vedlegg 2 Avgrensning og organisering. Når det gjelder øvrige helseforetak ber vi om at de regionale helseforetakene vurderer om det er andre helseforetak som faller innenfor rammene for evalueringen. Vi vil gjerne ha en dialog om disse med de regionale helseforetakene.

Instituttsektoren

For instituttsektoren generelt kan det ved enkelte institutter være at nivå 1 og nivå 2 er sammenfallende – se vedlegg 2 Avgrensning og organisering.

Forskningsrådet er kjent med at Fiskeri- og kystdepartementet (FKD) parallelt med fagevalueringen vil evaluere Havforskningsinstituttet. Havforskningsinstituttet ønsker å være en del av fagevalueringen og FKD ønsker å benytte seg av det innsamlede materialet som delinnspill til sin evaluering og i tillegg benytte panelets delrapport om instituttet fra fagevalueringen.

Landbruks- og matdepartementet (LMD) har bedt Forskningsrådet om å evaluere bla Bioforsk, Norsk institutt for skog og landskap og Veterinærinstituttet i løpet av 2010. Rapporten for denne evalueringen skal være ferdig 1. desember 2010 for å kunne være en del av grunnlaget for en ny melding til Stortinget om landbruks- og matpolitikken. Disse tre instituttene inviteres også til å delta i fagevalueringen av biologi, medisin og helsefag. Som vi skrev i vårt brev i februar er skillet mellom grunnleggende og anvendt forskning nå mindre fremtredende og det er økt samarbeid på tvers av forskningsart både innenfor biologiske fag og medisin og helsefag. Det er derfor ønskelig å evaluere hele forskningsfeltet innenfor de ulike fagområdene og institusjonene samtidig. Forskningsrådet ser det som viktig at også instituttsektoren deltar i denne brede fagevalueringen. Vi regner med at det materialet som ferdigstilles til evaluering av vitenskapelig kvalitet i LMD's evaluering vil kunne være et viktig grunnlag for materialet til fagevalueringen.

Høgskolene

Som i instituttsektoren kan det være at ved enkelte høyskoler er nivå 1 og nivå 2 sammenfallende.

Vedlegg 2

Avgrensning og organisering

Panelene skal basere sin evaluering på egenvurdering fra forskningsmiljøene, faktainformasjon, bibliometrisk analyse og møter med forskningsmiljøene.

Evalueringen vil ta utgangspunkt i instituttene og den forskningen som foregår der. Universitetsinstituttene og flere institutter i instituttsektoren er imidlertid for store og sammensatte enheter til at instituttet kan være evalueringsenheten. For at evalueringen skal gi oversikt over forskningen i *faget* gjennomføres evalueringen etter følgende modell:

Institutter i UoH-sektoren og instituttsektoren

1. Instituttet beskriver organisering og strategi for forskningen ved instituttet og gir faktainformasjon (finansiering, antall ansatte og stipendiater med mer) (nivå 1)
2. Nivået under instituttet (instituttgruppe, avdeling m.m.) *er den enheten som evalueres* og disse lager egenvurdering for forskningen (nivå 2)

Nivå 2 har ulike benevnelser ved de forskjellige institusjonene (instituttgrupper, seksjon, avdeling, forskergruppe, tematiske program m.m.). Ved enkelte institutter vil det være slik at enheter på nivå 2 hører hjemme i forskjellige paneler. I de tilfellene vil instituttbeskrivelsen følge til alle panelene. Robuste/store undergrupper på nivået under nivå 2 som *kan* høre hjemme i forskjellige paneler, plasseres der hvor hovedtyngden av forskningen hører hjemme (mestprinsippet).

Enhetene som skal evalueres på nivå 2 skal være etablerte enheter, ikke konstruerte grupper for denne evalueringen. Det er viktig at enhetene ikke er for små. Dersom instituttene ser at forskningen i forskergrupper/evalueringsenheter tematisk hører sammen, kan det være en fordel at disse forskergruppene lager en samlet egenvurdering hvor det framgår at det er en fremstilling av forskningen i flere grupper. Evalueringsenheter/forskergrupper på nivå 2 som har liten vitenskapelig aktivitet og produksjon, beskrives i instituttets (nivå 1) generelle omtale i egenvurderingen.

Minstestørrelse på institusjon/institutt som inviteres til å delta i evalueringen er:

UoH-sektoren, inklusive helseforetak med universitetsklinikkfunksjon

- 1) Minst 5 vitenskapelig ansatte (professor I, førsteamanuensis I) innenfor hvert fagområde (biologi, medisin og helsefag) eller
- 2) Minst 5 fast ansatte forskere/klinikere med doktorgradskompetanse som har 40 % eller mer av sin stilling definert som forskning

Andre helseforetak

Minst 5 fast ansatte forskere/klinikere med doktorgradskompetanse som har 40 % eller mer av sin stilling definert som forskning

Instituttsektoren

Minst 5 fast ansatte forskere med doktorgradskompetanse som har 40 % eller mer av sin stilling definert som forskning innenfor hvert fagområde (biologi, medisin og helsefag).

Forskning ved universitetssykehusene

Ved universitetssykehusene er det i svært stor grad integrerte forskergrupper/enheter mellom universitetsinstituttene og helseforetaket. Det vil normalt verken være hensiktsmessig eller naturlig å skille egenvurderingen og presentasjonen av disse enhetene. Det er ønskelig at integrerte enheter mellom universitet og helseforetak gir en felles egenvurdering og en felles presentasjon.

Vi ber om at universitetet tar hovedansvar for egenvurdering og eventuell presentasjon når forskergruppen/enheten ledes av en som har hovedstilling ved universitetet, mens helseforetaket tar hovedansvar for egenvurdering og eventuell presentasjonen når enheten ledes av en som har hovedstilling eller hele stillingen ved helseforetaket.

Kriterier for eksklusjon

- Nylig evaluert i annen fagevaluering (eks sosiologi, økonomi, farmasi, kjemi, fysikk, geofag)
- Idrettsmedisinske fag – tas ikke med i denne evalueringen fordi en felles nordisk evaluering av idrettsvitenskap (sports sciences) vil bli gjennomført i 2010-2011.
- Sosialfaglig forskning (barnevern, sosialtjenester) inkluderes ikke i evalueringen.

Appendix D. Time Schedule for the hearing meetings

Time schedule for the Panel Hearings in Oslo, March-April 2011

Date	Time	Institution/department	Unit
Mon Mar 28 2011	0830-0900	<i>Panel Pre-meeting</i>	
	0900-0945	The University Centre in Svalbard (UNIS)	1. Department of Arctic Biology
	0945-1000	<i>Panel summary</i>	
	1000-1015-	<i>Break</i>	
	1015-1145	Institute of Marine Research (IMR)	1. Demersal fish 2. Benthic habitats and shellfish 3. Deep water species 4. Fish capture 5. Fisheries dynamics 6. Observation methodology 7. Pelagic fish 8. Plankton 9. Population genetics & ecology 10. Marine mammals 11. Ecosystem processes
	1145-1215	<i>Panel summary</i>	
	1215-1315	<i>Lunch</i>	
	1315-1425	University of Oslo, Natural History Museum, Department of Research and Collections	1. National Centre for Biosystematics (NCB) 2. Freshwater Ecology and Inland Fisheries Laboratory (LFI) and

			Interpretation and Modelling of Biodiversity (IMB)
	1425-1445	<i>Panel summary</i>	
	1445-1500	<i>Break</i>	
	1500-1545	Norwegian Polar Institute (NP)	1. Biodiversity and Ecotoxicology
	1545-1600	<i>Panel summary</i>	
	1600-1615	<i>Break</i>	
	1615-1700	Universitetet i Nordland, Faculty of Biosciences and Aquaculture	1. Aquatic Animal Health Group 2. Reproduction Biology Group 3. Seafood Quality Group 4. Marine Ecology Group 5. Marine Genomics Group
	1700-1715	<i>Panel summary</i>	

Date	Time	Institution/department	Unit
Tue Mar 29 2011	0830 - 0900	<i>Panel Pre-meeting</i>	
	0900-0945	The Norwegian University of Life Sciences, Department of Animal and Aquacultural Sciences	1. Ethology and animal environment
	0945-1000	<i>Panel summary</i>	
	1000-1015	<i>Break</i>	
	1015-1145	The Norwegian University of Science and Technology, Department of Biology	1. Centre of Conservation Biology 2. Behaviour, Evolution and Life History 3. Marine Science 4. Plant Ecology and Physiology
	1145-1215	<i>Panel summary</i>	
	1215-1315	<i>Lunch</i>	
	1315-1425	The Norwegian Forest and Landscape Institute	1. Biodiversity Unit 2. Forest Ecology Unit 3. Forest Genetics Unit 4. Forest Health Unit 5. Forest Resources Unit 6. Wood Technology Unit
	1425-1445	<i>Panel summary</i>	
	1445-1500	<i>Break</i>	
	1500-1545	SINTEF Fisheries and aquaculture AS	1. Interaction biology and aquaculture technology
	1545-1600	<i>Panel summary</i>	
	1600-1615	<i>Break</i>	
	1615-1700	University of Agder, Department of Natural	1. Functional Ecology Group

		Sciences	
	1700-1715	<i>Panel summary</i>	

Date	Time	Institution/department	Unit
Wed Mar 30 2011	0830 -0900	<i>Panel Pre-meeting</i>	
	0900-1010	The Norwegian University of Life Sciences, Department of Ecology and Natural Resource Management	1. Ecology 2. Forest Resources
	1010-1030	<i>Panel summary</i>	
	1030-1045	<i>Break</i>	
	1045-1130	University of Bergen (UiB), Bergen Museum – The Natural History Collections	1. Biosystematic research group 2. Phylogenetics, systematics and evolution 3. Palaeoenvironmental research group
	1130-1145	<i>Panel summary</i>	
	1145- 1245	<i>Lunch</i>	
	1245-1415	University of Bergen, Department of Biology	1. Ecological and Environmental Change Research Group 2. Behaviour and Evolutionary Ecology Research Groups 3. Fisheries Ecology and Aquaculture Research Group 4. Marine Biodiversity Research Group 5. Microbiology Research Groups (MicBio) 6. Modelling & Evolutionary Fisheries Research Groups
	1415-1445	<i>Panel summary</i>	
	1445-1500	<i>Break</i>	
	1500-1610	The Norwegian University of Life Sciences, Department of Plant and Environmental Sciences	1. Genetics and Plant Biology and Plant Production 2. UMB nitrogen group

	1610-1630	<i>Panel summary</i>	
	1630-1645	<i>Break</i>	
	1645-1730	The Norwegian University of Science and Technology (NTNU), Museum of Natural History & Archaeology - Section of Natural History	1. Systematics and Evolution Group 2. Conservation Biology Group
	1730-1745	<i>Panel summary</i>	

Date	Time	Institution/department	Unit
Thu Mar 31 2011	0830-1000	<i>Panel Pre-meeting</i>	
	1000-1130	Norwegian Institute for Nature Research (NINA)	1. Department of Arctic Ecology (Tromsø) 2. Terrestrial Ecology Department 3. Department of Landscape Ecology (Oslo) 4. Department of Aquatic Ecology including biologists at NINA Lillehammer
	1130-1200	<i>Panel summary</i>	
	1200-1300	<i>Lunch</i>	
	1300-1410	Norwegian Institute for Water Research (NIVA)	1. NIVA
	1410-1430	<i>Panel summary</i>	
	1430-1445	<i>Break</i>	
	1445-1615	University of Tromsø, Department of Arctic and Marine Biology	1. Arctic Animal Physiology 2. Arctic Marine System Ecology 3. Fish Biology and Population Genetics 4. Freshwater Ecology 5. Marine Plankton 6. Molecular Environments 7. Northern populations and Ecosystems
	1615-1645	<i>Panel Meeting</i>	

Date	Time	Institution/department	Unit
Fri Apr 1 2011	0830-0900	<i>Panel Pre-meeting</i>	
	0900-1030	University of Oslo, Department of Biology	1. Centre for Ecological and Evolutionary Synthesis (CEES) 2. Integrative Biology (IB) 3. Marine Biology (MB) 4. Microbial Evolution Research Group (MERG)
	1030-1100	<i>Panel summary</i>	
	1100-1200	<i>Panel meeting</i>	
	1200-1230	<i>Lunch</i>	
	1230-1340	Norwegian Institute for Agricultural and Environmental Research (Bioforsk)	1. Section Entomology and Nematology 2. Section Plant Pathology 3. Section Fruits and Berries
	1340-1400	<i>Panel summary</i>	
	1400-1500	<i>Panel concluding meeting</i>	

Appendix E. Overview of all panels

Panel 1	Botany, Zoology and Ecology-related Disciplines: Evolutionary biology, ethology, marine biology, limnology, plant physiology, systematics and agricultural sciences
Panel 2	Physiology-related Disciplines (human and zoophysiology), including corresponding translational research: Anatomy, physiology, neurobiology, toxicology, pharmacology, embryology, nutritional physiology, pathology, basic odontological research, veterinary medicine, fish health
Panel 3	Molecular Biology , including corresponding translational research. Microbiology, immunology, cell biology, biochemistry, molecular biology, genetics, genomics, biotechnology including breeding and bioinformatics
Panel 4a	Clinical Research , including corresponding translational research: All surgery, anaesthesiology, oncology, physical medicine and rehabilitation, gynaecology, paediatrics, dermatology and venereology, ophthalmology, otolaryngology and all clinical odontology
Panel 4b	Clinical Research , including corresponding translational research: All internal medicine (cardiology, nephrology/urology, gastroenterology, endocrinology, haematology, infectious diseases, respiratory tract diseases, geriatric medicine), neurology, rheumatology, radiology and medical imaging and other clinical medical disciplines
Panel 5	Public Health and Health-related Research: Public health, community dentistry and community nutrition. Epidemiology and medical statistics. Health services research, preventive medicine, nursing research, physiotherapy, occupational medicine, behavioural research and ethics, other health-related research
Panel 6	Psychology and Psychiatry: Clinical psychology, social-, community- and workplace psychology, organizational psychology, personality psychology, developmental psychology, cognitive psychology, biological psychology and forensic psychology. Psychiatry, including geriatric psychiatry, child and adolescent psychiatry, biological psychiatry, and forensic psychiatry. Behaviour research

Appendix F. Overview of panel members

Name	Institution
Paul Harvey (<i>chair</i>)	Dept. Zoology, University of Oxford, UK
Geoffrey Gadd	College of Life Sciences, University of Dundee, UK
David Groman	Atlantic Veterinary College, Univ. Prince Edward Island, Canada
Marlene Zuk	Dept. biology, Univ. California Riverside, USA
Peter Burkill	Sir Alistair Hardy Foundation for Ocean Science, Plymouth, UK
Pedro Crous	Fungal Biodiversity Centre, Dutch Academy of Science, Utrecht, the Netherlands
Erica Fleishman	Bren School of Environmental Science & Management, University of California, Santa Barbara, USA
Oliver Pybus (<i>Secretary of panel</i>)	Dept. Zoology, University of Oxford, UK

Appendix G. Biographies of Panel Member

- Name:** Professor Paul H Harvey CBE FRS
- Degrees:** B.A. Biology, University of York
M.A. University of Oxford
D.Phil Biology, University of York
D.Sc. Biology, University of Oxford
- Research:** 1. Evolution: comparative method; interpreting phylogenies and genealogies
2. Ecology: null models; community structure
3. Behaviour: adaptive functions of social behavior; warning colouration
- Present position:** Professor and Head of Department, Department of Zoology, University of Oxford, UK
-
- Name:** Professor Geoffrey Michael Gadd
- Degrees:** B.Sc. Microbiology
Ph.D. Microbiology
D.Sc.
- Research:** 1. Environmental microbiology: metal-mineral-microbe interactions; geomicrobiology; bioremediation of metals and radionuclides
2. Mycology: growth and morphogenesis; plant-fungal interactions; geomycology
- Present position:** Boyd Baxter Chair of Biology, College of Life Sciences, University of Dundee, Dundee, Scotland, UK
-
- Name:** Professor Erica Fleishman

- Degrees:** B.Sc Biological Sciences, Stanford University
M.Sc Biological Sciences, Stanford University
Ph.D. Ecology, Evolution & Conservation Biology, University of Nevada, Reno
- Research:** 1. Conservation biology
2. Application of science to management of public and private lands
3. Faunal responses to land-use and land-cover change in the Intermountain West (USA)
- Present position:** Researcher, Department of Environmental Science & Policy and John Muir Institute of the Environment, University of California, Davis
Editor in chief, *Conservation Biology*
- Name:** Professor Marlene Zuk
- Degrees:** B.A.
M.Sc.
Ph.D. University of Michigan, Ann Arbor
- Research:** 1. Evolutionary biology
2. Animal behaviour
- Present position:** Professor of Biology, Department of Biology, University of California Riverside, USA
- Name:** Professor Pedro W Crous
- Degrees:** B.Sc. Forestry, University of Stellenbosch, RSA
M.Sc. Agric. Plant Pathology, University of Stellenbosch, RSA
Ph.D. Plant Pathology, University of the Free State, RSA
D.Sc. University of Pretoria, RSA
- Research:** 1. Plant pathology
2. Fungal systematics

Present position: Director of the CBS Fungal Biodiversity Centre. Professor in Plant Pathology and Fungal Biology at the Universities of Stellenbosch and Pretoria (RSA), Wageningen (Netherlands) and Utrecht (Netherlands).

Name: Dr David B Groman

Degrees: B.A. Biology (Lafayette)
M.Sc. Pathobiology (Connecticut)
Ph.D. Aquaculture & Fish Health (Idaho)

Research: 1. Fish pathology
2. Aquaculture
3. Fish health management


Present position: Section Head, Aquatic Diagnostic Services, Atlantic Veterinary College, University of Prince Edward Island, Canada

Name: Professor Peter Burkill

Degrees: B.Sc. Biology
Ph.D. Oceanography

Research: 1. Plankton ecology
2. Marine foodwebs
3. Decadal scale changes in biological communities
4. Interactions between climate and ocean biology

Present position: Director, Sir Alister Hardy Foundation for Ocean Science, and Professor of Ocean Science, University of Plymouth, UK



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