Skjemainformasjon

Skjema	SFU
Referanse	1006064
Innsendt	08.05.2013 17:09:12

Host

Information about host institution and center

Name of centre	BioCEED - Centre for Excellence in Biology Education
Host institution	University of Bergen, Department of Biology
PO Box address	Postbox 7803
Postal code / City/place	5020 BERGEN
Telephone	55582224
E-mail address	oddfrid.forland@bio.uib.no

Contact person

Contact person

Name	Vigdis Vandvik
Title	Professor
Telephone work / mobile	55583332
E-mail address	vigdis.vandvik@bio.uib.no

About the centre

About the centre

Is the centre already established at the time of application	No

Describe briefly the plans for establishing the centre (maximum 1500 characters)

BioCEED will be established 01.01.2014, and be in full operation from 01.03 2014. The personnel will then be in place, all work packages (WP) established, WP leaders appointed, the first annual budget detailed and approved, and Actions begun.
BioCEED expands on already-existing educational collaboration between the consortium partners. All partners will be involved as indicated in the project plan, timeline and budget. Longterm added value is secured by (i) the long-term agreements already in place between the partner institutions, (ii) the added value of the educational transformation and the new infrastructure which will provide an excellent platform for continued collaboration vs. via educational development and sector and societal communication, and (iii) the deep commitment of the partners, as documented by their in-kind contributions.
BioCEED builds upon established educational collaboration with research institutions, industry, and the public sector. These links will be strengthened during the project period, and new models for education-sector collaboration will be developed. These models will persist after the Centre period.
BioCEED will promote sector-wide reform in higher education biology by developing platforms for collaboration and dissemination (web forum, workshops, conferences). Centre resources are critical in building these platforms, and long-term continuation is secured through higher-education sector collaboration.

Describe briefly the aims and current as well as planned activities of the centre (maximum 1500 characters)

BioCEED is built on the vision that the expanding role of biology - and biologists - in today's society places new demands both on the content of the education we provide and on how we train tomorrow's biologists. BioCEED aims to meet this challenge by reforming biology education in response to changes in the biological sciences, in higher education, and in society's needs.

The consortium partners are the Department of Biology, UiB, Department of Arctic Biology, UNIS, Higher Education Research Unit, UiB, and Institute for Marine Research. Together, we offer a unique experience in biology education spanning from classical theory-based university degrees to more targeted education focusing on particular ecosystems and their management and vocational training in the integrated MSc programmes for teacher education and aquamedicine.

We will develop new approaches for integrating the learning of biological content knowledge and skills with practical training in academic, private and public institutions. This will support learning and strengthen the professional integrity of tomorrow's biologist. Our educational strategy will develop a strong learning culture among teachers and students, optimise learning environments, align education efforts, strengthen educational leadership, and spread best practice within higher education and society. A central BioCEED activity will be rigorous research into the effects of changing our educational practices, via two PhD projects.

Application Document

Application Document

Upload application document	profile_BioCEED application text.pdf

Timeline and budget

Timeline and budget

Upload planned timeline and the activities to be conducted	timeline_BioCEED Timeline.pdf
Upload plan for financial resource acquisition	financial_BioCEED Plan for financial resource acquisition.pdf
Upload budget	budget_BioCEED Budget.pdf

Attachments

Attachments

- budget_BioCEED Budget.pdf
- financial_BioCEED Plan for financial resource acquisition.pdf
- timeline_BioCEED Timeline.pdf
- profile_BioCEED application text.pdf
- Attachment_4_Collaborative_partners.pdf
- Attachment_1_Quality_in_education__additional_documentation.pdf
- Attachment_3_CVs_of_BioCEED_personnel.pdf
- Attachment_5_Letters_of_intent.pdf
- Attachment_2_Cases__excellence.pdf
- Attachment_6___literature_list.pdf

Comments

Comments to the application form (maximum 1500 characters)

Vi hadde problemer med opplastingen av dokument, særlig dersom man logget ut mellom opplastinger. For eksempel søknadsdokumentet forsvant hver gang man logget ut og inn igjen. Det samme gjaldt budsjett. Det er derfor mulig enkelte dokumenter er lastet opp flere ganger.
Det var heller ikke mulig å åpne å se på opplastede vedlegg under Attachments.
Dersom søknaden er mangelfull pga disse problemene, ta gjerne kontakt med Oddfrid Førland (oddfrid.forland@bio.uib.no, 48001853)for å få tilsendt manglende dokumenter.
Innhold i vår søknad:
Application document, Timeline, Financial resources, bugdet. Vedlegg: Attachment 1, 2, 3, 4, 5 og 6.

UNIVERSITY OF BERGEN

Nasjonalt organ for kvalitet i utdanningen (NOKUT)
Postboks 1708 Vika
0121 Oslo

Your ref	Our ref	Date
	2011/6578-BJUB	03.05.2013

Letter of commitment (SFU - BioCEED)

The University of Bergen hereby confirms its support for and its intention to host the proposed *Centre for Excellence in Biology Education (BioCEED)*.

The Centre for Excellence in Biology Education (BioCEED) consortium will consist of four partners; the Department of Biology, University of Bergen, the Department of Arctic Biology, University Centre at Svalbard, the Higher Education Research Unit, University of Bergen, and the Institute of Marine Research. It is hosted by and located at the Department of Biology, University of Bergen. The partners participate in the centre's steering committee on equal terms.

We hereby express our firm intent to host and to support the proposed Centre of Excellence in Higher Education; BioCEED. The University of Bergen regards the centre as an important part of our work with education, and we shall continue to provide support and contribute to the ongoing progress and development of the centre.

Yours sincerely,

Sigmund Grønmo
Rector

Kari Tove Elvbakken
University Director

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UNIVERSITETET I BERGEN
Det matematisk-naturvitenskapelige fakultet

Referanse

2013/5143-ELIHØ

Dato

08.05.2013

Letter of intent from the Faculty of Mathematics and Natural Sciences

The Faculty of Mathematics and Natural Sciences supports the application for status as a Centre of Excellence in Higher Education: BIO CEED - Centre for Excellence in Biology Education, coordinated by Professor Vigdis Vandvik and hosted by the Department of Biology, Faculty of Mathematics and Natural Sciences, University of Bergen.

The Centre for Excellence in Biology Education (BIO CEED) consortium will consist of four partners; the Department of Biology, University of Bergen, the Department of Arctic Biology, University Centre at Svalbard, the higher Education Research Unit, University of Bergen and the Institute of Marine Research. It is hosted by and located at the Department of biology, University of Bergen. The partners participate in the centre's steering committee on equal terms.

We hereby express our firm support to the proposed centre. The faculty regards the centre application as an important part of our continuing commitment to improve our education programs, and we shall continue to provide support and contribute to the ongoing progress and development of the centre.

If the application is successful, the faculty commits to supporting the centre with one 4-year ph.d-position.

Dag Rune Olsen
Dean

Harald Walderhaug
Vice Dean

Dette er et UiB-internt notat som godkjennes elektronisk i ePhorte

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Saksbehandler
Eli Neshavn Høie
55583227

UNIS
The University Centre in Svalbard

To whom it may concern

Your ref. Our ref. Date: 02/05/2013

Letter of intent

Cooperation: BIO CEED - Centre for Excellence in Biology Education, coordinated by Professor Vigdis Vandvik and hosted by the Department of Biology, Faculty of Mathematics and Natural Sciences, University of Bergen.

The Centre for Excellence in Biology Education (BIO CEED) consortium will consist of four partners; the Department of Biology, University of Bergen, the Department of Arctic Biology, University Centre at Svalbard, the higher Education Research Unit, University of Bergen and the Institute of Marine Research. It is hosted by and located at the Department of biology, University of Bergen. The partner participates in the centre's steering committee on equal terms.
We hereby express our firm intent to contribute to the centre as specified in the project description, timeline and budget. The University Centre at Svalbard regards the centre as an important part of our work with education, and we shall continue to provide support and contribute to the ongoing progress and development of the centre.

Yours sincerely
Ole Arve Misund
Managing director
UNIS

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E-mail: post@unis.no | Web: www.unis.no | Organisation number: 985 204 454

UNIVERSITY OF BERGEN
Faculty of Psychology

Bergen May 8th 2013

Letter of intent

Cooperation: BIO CEED - Centre for Excellence in Biology Education, coordinated by Professor Vigdis Vandvik and hosted by the Department of Biology, Faculty of Mathematics and Natural Sciences, University of Bergen.

The Centre for Excellence in Biology Education (BIO CEED) consortium will consist of four partners; the Department of Biology, University of Bergen, the Department of Arctic Biology, University Centre at Svalbard, the Higher Education Research Unit (HERU), Faculty of Psychology, University of Bergen and the Institute of Marine Research. It is hosted by and located at the Department of Biology, University of Bergen. The partners participate in the centre's steering committee on equal terms.

We hereby express our firm intent to contribute to the centre as specified in the project description, timeline and budget. The funding will include 20% of Professor Arild Raaheims position. The faculty will also allocate a 4 year PhD-position to this project provided that this position is funded by the University of Bergen.

The Faculty of Psychology regards the centre as an important part of our work with education, and we shall continue to provide support and contribute to the ongoing progress and development of the Centre.

Yours sincerely,

Jarle Eid
Dean

INSTITUTE OF MARINE RESEARCH
HAVFORSKNINGSINSTITUTTET

Dr. Karin Boxaspen
Research Director
Institute of Marine Research
Nordnesgt. 50,
Postb. 1870 Nordnes
5817 BERGEN
NORWAY

Tuesday, 07 May 2013

Professor Vigdis Vandvik
Department of Biology
University of Bergen

Letter of intent

Cooperation: BIO SEED - Centre for Excellence in Biology Education, coordinated by Professor Vigdis Vandvik and hosted by the Department of Biology, Faculty of Mathematics and Natural Sciences, University of Bergen.

The Centre for Excellence in Biology Education (BIO CEED) consortium will consist of four partners; the Department of Biology, University of Bergen, the Department of Arctic Biology, University Centre at Svalbard, the higher Education Research Unit, University of Bergen and the Institute of Marine Research. It is hosted by and located at the Department of biology, University of Bergen. The partner participates in the centre's steering committee on equal terms.

We hereby express our firm intent to contribute to the centre as specified in the project description, timeline and budget. The Institute of Marine Research (IMR) regards the centre as an important part of our work with education, and we shall continue to provide support and contribute to the ongoing progress and development of the Centre. In particular the IMR will lead Work package 7 focused on strengthening the links between education and society. This work includes arranging workshops to foster the interaction between the students and teachers and the collaborative partners, which employ biologists for diverse tasks in management, science and the business sectors. We hope that we will get the chance to strengthen our collaboration within the BIO CEED framework.

Yours sincerely,

Research Director

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BioCEED - Centre of Excellence in Biology Education

1. PROFILE AND VISION

The Centre of Excellence in Biology Education (BioCEED) merges the strengths of the Department of Biology, University of Bergen (BIO), the Department of Arctic Biology, University Centre at Svalbard (AB), the Higher Education Research Unit, University of Bergen (HERU) and the Institute of Marine Research (IMR). Together, we offer a unique experience in biology education with programmes spanning from classical theory-based university degrees to more targeted education focusing on particular ecosystems and their management (marine, coastal, arctic) and even highly specialized vocational training such as integrated MSc programmes in aquamedicine and teacher education.

Current developments within the biological sciences are profoundly impacting society, and our vision is that this 'biological revolution' should shape not only the content of biology programmes and courses, but also how biology is taught. BioCEED therefore expands on our existing collaboration to reshape biology education in response to changes in the biological sciences, in higher education, and in society's needs. The new centre will enable development and research-based assessment of learning practices that strengthen the knowledge base, skills sets, and vocational integrity of tomorrow's biologists. The centre will significantly promote sharing of 'best practice' within BioCEED, across the educational sector, and with society.

The BioCEED consortium is uniquely positioned to lead this development. It joins two biology departments with complementary strengths (BIO is large, excels across a range of research and education, is embedded in a large university, and has many societal links; AB is smaller, more specialized, and offers a close-knit academic environment) with an academic unit specialising in research on learning in higher education (HERU), and Norway's largest centre of marine science closely linked to industry and government (IMR).

Over the last decades, we've seen a dramatic expansion of the role of biologists, and biologically-based knowledge and theory, within both science and society. Biology has long had a strong theoretical foundation; since the 1859 publication of Darwin's 'On The Origin of Species' our domain has developed one of the best known, most fiercely debated, but also most widely influential scientific theories. Today, Darwinian evolutionary reasoning directly impacts fields such as medicine, psychology, agriculture, aquaculture, fisheries, and natural resource management and it is rapidly gaining a foothold in the social sciences and humanities. At the same time, the practical and analytical skills of biologists, from genetic engineering to biodiversity and ecosystem assessment, are increasingly sought-after, not only by biologically-based research and industries, but also by governments and NGOs facing increasing demands for evidence-based action on global climate and environmental change. The domain of biology in society is thus expanding, and this expansion is driven by the interplay between a wealth of theory-based biological content knowledge, a rapidly increasing skills 'toolbox', and the increasing demands of society for these insights and skills (Fig. 1).

BioCEED is built on the vision that the expanding role of biology - and biologists - in society not only places new demands on the content of the educations we provide, but also on how we train tomorrow's biologists. They must be competent in the theoretical and practical aspects of biology, but also build the professional confidence and integrity necessary to manoeuvre among conflicting pressures and demands in their professional lives. This requires education that exposes students, from day 1, to learning experiences that span the entire domain of biology (Fig. 1). BioCEED will give us a unique opportunity to develop and test new learning

practices and approaches targeted specifically at developing the knowledge base, skills sets, and integrity required by the different roles biologists occupy in society.

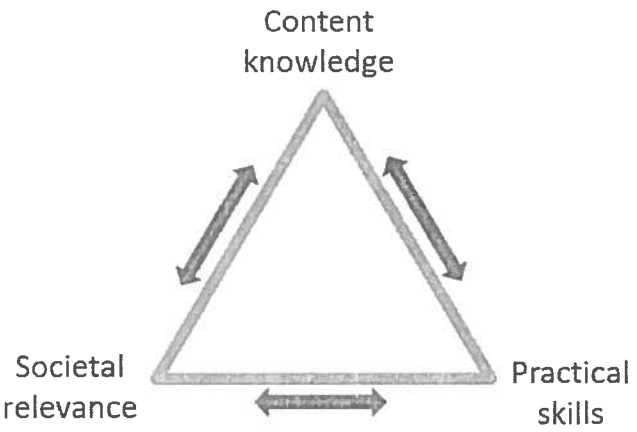

Figure 1. The 'domain of biology', can be defined by the interactions between the development of scientific content knowledge (theory, factual knowledge) and practices within biology itself, and society's applications of and needs for this knowledge and these skills.

Because of the complementary strengths within the BioCEED consortium, we are uniquely positioned to deliver this vision: We can explore learning methods and approaches across situations varying in theoretical and practical content, goals, and exposure to societal pressures and demands. Towards this end, BioCEED will appoint two PhDs to scientifically evaluate and document effects of our educational reform. In addition to the educational development *per se*, BioCEED will enable us to more effectively share pedagogic experiences, both within the consortium and across the educational sector, and facilitate dialogue with relevant industries and sectors.

BioCEED will lead a revolution in biology education by combining our vision as described above with two strong trends in higher education:

(i) We will actively encourage and support the often called-for shift from a teacher-centered to learner-centered education; and change focus from what instructors do to how students learn. These ideas date back more than 50 years[1-3], but the teacher-centered tradition still predominates in higher education. Active promotion of a learner focus, as exemplified by 'deliberate practice'[4,5], is needed. We will focus on three essentials[6-10]: a shift in responsibility for learning away from the instructor and towards students, active engagement of students with the learning material, and provision of formative assessment opportunities.

(ii)We will promote a cultural shift towards what Gibbs[11] describes as a 'professionalized and scholarly approach' to teaching and learning in our staff (see also [8]). This paradigm shift in teaching culture can be promoted by adopting strengths of the research culture: collaborative efforts towards common goals, focus on documentation and accountability, appreciation of peer-review and debate, internationalization, and recognition and reward for efforts and results[8,11]. BioCEED will work towards developing a culture of shared responsibility, educational creativity, exchange of ideas and experiences, reward for excellence, and alignment of learning environments, methods and evaluation with educational goals.

The education reform will be achieved through seven closely integrated strategies:

Strategy 1: A collegial learning culture among teachers

- Shift from 'teaching' to 'learning' perspective in teacher thinking and practice
- Develop a culture of shared responsibility for students, courses, and programmes
- Create physical, social, and virtual 'spaces' for sharing experience and ideas

Strategy 2: Optimal learning environments

- Align curricula, skills training, practice opportunities, and evaluation with learning goals
- Optimize the physical and digital learning environment to foster learning across the biological 'domain' (content knowledge, skills, and societal relevance; Fig. 1)
- Continuous optimisation of technical and administrative support to educational needs
- Engage staff and students in renewal of the broader learning environment

Strategy 3: Active and motivated students
- Set learning goals that engage students actively in pursuit of competence across the biological 'domain' (content knowledge, skills, and societal relevance; Fig. 1)
- Integrate development of problem-solving and learning-to-learn skills in the curriculum
- Increase hands-on experience with research, industries, management and education
- Provide students with formative feedback

Strategy 4: Aligned quality assurance, evaluation, goals and practice
- Develop quality assurance and evaluation as tools for monitoring progress, recognizing and rewarding excellence, and spreading 'best practice'
- Encourage and conduct learning 'experiments', and document and report outcomes

Strategy 5: Efficient leadership of education
- Appoint and empower 'leaders of education' as part of institutional leaderships
- Integrate education and research in institutional strategies and goals
- Identify and remove (infrastructure) obstacles to development and change
- Develop links to the higher education sector (within our institutions, in Norway, abroad)

Strategy 6: Spread of 'best practice'
- Enable learning and sharing of experience within BioCEED and beyond through virtual sites and tools, working groups/workshops, and an open biology education conference

Strategy 7: Interact with end-users and stakeholders in the private and public sector
- Increase and systematise communication with employers, end-users, and biology alumni to better understand society's needs and to communicate the contributions of biologists
- Develop mechanisms for student placement within the sector during BSc and MSc

BioCEED builds upon on-going strategic collaboration, formalised in institutional agreements, between the centre partners towards these goals. The on-going reform process is described in chapter 2, and BioCEED plans for further progress are described in chapter 3.

2. QUALITY IN ESTABLISHED EDUCATIONAL ACTIVITIES

Result factors

Student retention and degree completion rates are generally high for BIO's MSc programmes; and close to 100% at AB, and BIO's integrated MSc programme in Aquamedicine. The number of students graduating from our programmes is increasing, at all levels (Attachment 1), while credit production per student is at the national average. There is a strong relationship between various quality indicators and the learning methods and teacher-student interaction modes across different courses and programmes. BIO's 2011 BSc reform specifically aimed to increase student-active learning and assessment methods, focusing on field and lab training. Preliminary data indicates this has been successful. For AB, the unique destination, international setting, small classes and intimate campus contribute to good results. Our high educational quality and successful reforms have been recognized through a number of prizes[a] at institutional and national levels. In particular, BIO's introductory course for MSc students has won both the Owl prize and the prestigious National Award (Attachment 2).

Our alumni find relevant jobs within a year of graduation, and candidate surveys[b] find that an MSc from the natural sciences can be a ticket to relevant employment. Surveys find that graduates are satisfied with the content, relevance and quality of their education. Further, they

[a]The UiB Owl prize (2007, 2009) the NOKUT National Award for Quality in education (2002, 2007, 2009), see also staff prizes[j].
[b]Kompetanse 2020, Ideas2Evidence rapport 4/2011; Kandidatundersøkelsen 2011: NIFU, Rapport 39/2012

find that employers are satisfied with UiB candidates but think that we understate the competence of our candidates, probably because they value 'transferrable skills' like analytical, communication, and cooperative skills more than educators do.

Our students are active and involved. They are represented in decision-making bodies, and in all processes concerning education, and contribute to recruitment[c] and social activities. Student organisations are key in these functions. Senior students also work as teaching assistants, especially in the lab and field, which supports learning in both seniors and juniors.

Both UNIS and BIO have an international student mass, with 30-40% non-Norwegians among BIO's MSc students and 50-65% among all AB's students. BIO has long-standing educational partnerships with universities in the south (e.g., Makerere University, Uganda) that support development of higher education, and translational research (funded by SIU).

Process factors

At BIO and AB, biology students are exposed to an exceptionally broad range of learning and assessment methods (Attachment 2). In particular, we prioritize on-site field work, cruises, and expeditions as part of the education to enhance content knowledge and give hands-on experience with research methods and with arctic, marine and terrestrial biology. As an added value, this extraordinary learning environment supports development of social skills and long-term memory[12]. Course evaluations document that our students appreciate field experiences, and increased field- and lab-based learning was thus implemented in the 2011 BIO BSc revision. BIO is also unique among biology departments in offering vocational training of Aquamedicine biologists though an integrated MSc programme combining targeted highly-specialized biological courses, laboratory training, and internships in the industry.

Several courses specifically focus on developing independence of thought, and on introducing students to the culture and methods of research (Attachment 2). This is achieved through, for example, discussions, critical reading, writing, peer-review evaluation and feedback, and small research projects where students are supported through the research process (identify research questions, develop aims and objectives, identify study sites, learn new techniques, obtain equipment, collect data in the lab or field, analyse and evaluate these data, and write scientific reports). The learning outcome of such projects is an increased understanding of the scientific process; hence assessment methods evaluate several phases of the process. In most courses, different learning and assessment methods are used in combination, to foster and evaluate different skills and kinds of knowledge.

Linking research and education promotes learning outcomes, but can also ensure effective use of resources, and minimize environmental footprints in fragile field settings. Some courses and many student projects and field activities are therefore directly linked to on-going research projects (Attachment 2). The students benefit by learning relevant research methods and skills though 'apprenticeship' with staff in the field or lab.

To support high-quality, student-active professional education with a strong focus on field and lab learning (Strategies 1-5), a new organisational structure has recently been established at BIO. The core element is five Teacher groups, which are fora for coordination of courses and curricula, follow-up on assessments, (peer-review) evaluation, sharing of experiences and responsibilities, and fostering of a collegial teaching culture. The teacher group leaders, along with student and MSc Program representatives, constitute the Education Committee. This committee is led by the Head of Education, who is responsible for all education, in the broad

[c]Welcome Week, MSc information week, International Week, Career Day, and as ambassadors to secondary schools.

sense, at BIO, and is also Deputy Head of Department. This structure ensures close links between individual teachers, educational leadership, the Department Head and the educational leadership of the University. The Education Committee is supported by an external Advisory board for Education, consisting of three experienced professors from other universities. Their role is to provide an external perspective and an honest, critical and constructive assessment of the teaching and learning environments at BIO. Student democracy is ensured by student representatives in both the Education Committee and the Department Board.

The Quality assurance (QA) system, as described in the UiB Quality Assurance Handbook and the UNIS Annual report 2010,is generally well implemented in our educations[d].

Input factors

Research excellence is a major asset for high-quality education. In the 2011 RCN Evaluation of biology, medicine and health research in Norway, 13 out of 20 evaluated units at BIO, IMR and AB got the top scores "very good" or "excellent". We are involved in 3 Centers of Research Excellence[e], 3 Centers for Research-based Innovation[f], seven Research Schools[g], and a Centre for Development Cooperation[h]. Our staff includes internationally highly-profiled scientists such as the ISI Highly Cited and ERC Advanced Grant-awarded microbiologist Frede Thingstad, and the ISI Highly Cited palaeoecologist John Birks. We publish more than 400 papers in the international literature per year (BIO: 250; AB: 20, IMR: 150, HERU: 20), and in the last five years, we have had twenty papers published in *Science* and *Nature*.

Both BIO and UNIS offer unique opportunities for student-active learning, and for developing close interactions between content knowledge, practical skills training and relevance (Fig. 1) in our educations. We have excellent research and education infrastructure[i], including new educational and research labs with high-quality modern equipment, a number of field sites and stations, and geographical locations that offer excellent opportunities for field excursions.

We use this infrastructure to give hands-on experience with different biological phenomena, as well as with the research process. Fieldwork in remote areas with difficult weather conditions, limited emergency help and communication possibilities, require closer attention to safety, and AB has developed safety training and certification of all students (see Attachment 2). The aim of all these activities is to develop a scholarly, scientific attitude in our students, while preparing them for solving real problems in science, industry and society.

Our staff is recognized for and committed to development of educational excellence, as documented by prizes[j] and participation in projects related to educational development (PEK, see example). The BioCEED leadership is selected to represent broad experience with biology education and educational reform, project leadership, and research and educational challenges across the biological 'domain' (Fig. 1). BioCEED will be led by Vigdis Vandvik from BIO. She has extensive experience in teaching, supervision, educational reform, scientific leadership, dissemination and societal communication; particularly in relation to field-based activities and biostatistics. In 2010, she represented BIO in the programme committee for the

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[d]Follow hyperlinks ta access annual reports, student evaluations etc. for BIO and UNIS.
[e]Bjerknes Centre for Climate Research, Centre for Integrated Petroleum Research, Centre for Geobiology
[f]Sea Lice Research Centre, The Michelsen Centre for Measurement Science and Technology, Centre for Research-based Innovation in Sustainable fish capture and Pre-processing technology
[g]Bergen Summer Research School, National Graduate School in Educational Research, Nordic Marine Academy, Norwegian-Swedish Research School in Biosystematics, The Molecular and Computational Biology Research School, The Norwegian National Graduate School in Teacher Education, The Norwegian Research School in Climate Dynamics.
[h]The Centre for Development Cooperation in Fisheries
[i]See overviews of the field and lab research and educational infrastructure at BIO, AB and IMR
[j]The Faculty for Mathematics and Natural Sciences Best Lecturer prize (1998, 2001, 2006); The UiB Meltzer prize for excellent research dissemination (1998, 2005, 2008, 2011). See also the course and programme prizes[a])

international conference "Academic Writing from Bachelor to PhD", which brought several distinguished keynote lecturers and more than 150 participants from across the world to Bergen. The deputy leader, Pernille Bronken Eidessen (AB),, has extensive research and teaching experience from the Arctic, applying lab- and field-based approaches to problems spanning from ptarmigan management to microbial diversity. Ole Jørgen Lønne (AB) has more than 25 years experience of ship-based research and education, and brings with him insights from employment in private and public research and aquaculture companies. Geir Huse (IMR) contributes key competence in ecosystem-based management and extensive networks with industry and authorities. Arild Raaheim (HERU) has researched a variety of questions related to teaching and learning in higher education over 30 years, and contributes expertise in pedagogical theory and innovative teaching methods. Anders Goksøyr (BIO) contributes molecular and lab-based education experience. CV's are in Attachment 3.

3. POTENTIAL FOR INNOVATION AND DISSEMINATION

We firmly believe that on-going changes in the domain of biology (Fig. 1) and in higher education internationally[8,9,11] as well as in Norway[k] necessitate radical transformation of our educational processes. This is the motive behind BioCEED. Effective educational innovation requires *recognition* of the need for and goals of reform, *understanding* of the necessary steps towards new and improved educational practices; access to the appropriate intellectual, institutional, technical and financial *resources*; and availability of *channels* through which new ideas and practices can be spread. The BioCEED consortium draws its strength from the complementarity of the two biology departments (BIO, AB) coupled with HERU's research expertise in learning in higher education and IMR's close links to the public and private sector. The consortium provides a unique environment to compare, test, and develop educational approaches to integrate the full "domain of biology" (Fg. 1) in tomorrow's biology educations.

The project activities are organised in Work Packages (WP), where each WP addresses the corresponding strategy in Part 1 and the specific Actions (A) expand on the on-going work described in Part 2. Some represent potential for radical transformation (e.g., A8, A12, A13, A14, A17, A18, A21, A22, A29, A31, A33 and A34) others are more incremental but needed as part of a coordinated educational strategy. Relationships between WPs are seen in Fig.2.

Work package 0: Leadership and coordination (WP leader: BIO)

A1. Establish BioCEED organization and decision-making structures to effectively manage Centre activities and resources, fulfil tasks, and communicate internally and externally.
A2. Set up and maintain physical and virtual project infrastructure
A3. Appoint an international Advisory Board for BioCEED, with representatives from higher education in biology and pedagogy, relevant industries and sectors
A4. Daily management of the BioCEED, including monitoring of progress and reporting.

Work package 1: A collegial learning culture among teachers (WP leader: BIO)

A5. Annual 'teacher's retreat' where teaching, learning, and curricula are discussed. Each retreat will explore a specific theme in presentations, discussions, and group work.
A6. Appoint two adjunct Professors (educational scientists) to provide a conduit for exchange of new ideas, discuss and evaluate actions, and publish BioCEED findings.
A7. Develop 'Teacher groups' that share responsibility for education across related courses

[k] Meld. St. 18 (2012–2013) Report to the Storting (White Paper), where student involvement in research is listed as one of 12 key measures in Norway's research strategy; see also The Norwegian Qualifications Framework

A8. Promote teaching skills renewal at all career stages through pedagogic courses and educational 'sabbaticals' to exchange ideas and develop curricula

A9. Develop a web forum for presenting and discussing methods and experience.

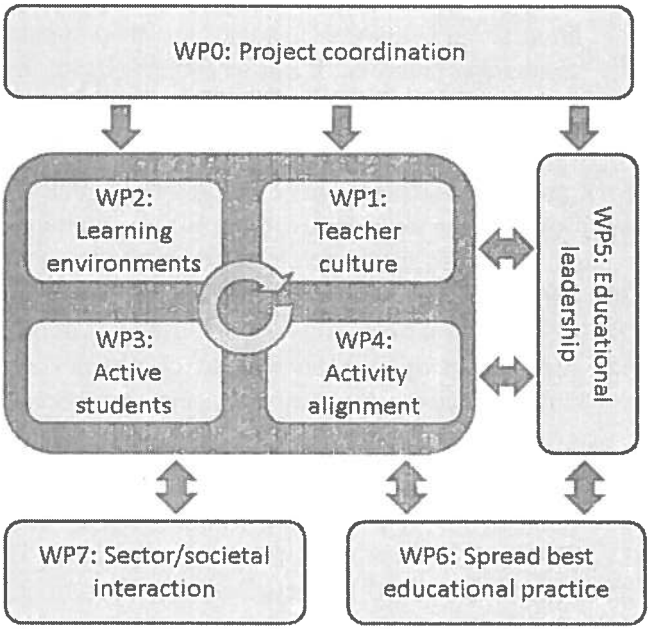


Figure 2. Relationships between work packages within BioCEED in terms of work and information flow. Circular arrow indicates strong inter-relationships between WP2-4. Note that coordination of the project (WP0) is kept distinct from the development of educational leadership at the partner institutions (WP5).

Work package 2: Learning environments (WP leader: BIO)

A10. Expand the learning environment through integrating field, lab, and internships

A11. Develop student spaces (room for active, interactive, and varied learning experiences).

A12. Set up an exploratory 'digital pack' where the potential of emerging new technologies in education is explored and assessed, focusing especially on lab and field education.

A13. Increase education support though appointing dedicated educational technical staff, and through targeted training and exchange visits for technical and administrative staff

Work package 3: Active students (WP leader: AB)

A14. Redesign programmes and courses and set learning goals that engage students actively in their pursuit of competence across the biological 'domain' (Fig. 1, see A14-A17)

A15. Integrate problem-solving and learning-to-learn skills across the curriculum

A16. Use students actively in planning and conducting learning activities; provide opportunities for extra involvement and activities, based on student interests

A17. Offer internships in the public and private sector and research laboratories from year 1

A18. Provide certification (acquired competence in specific topic, lab and field security, etc.)

Work package 4: Aligning quality assurance, evaluation, goals, practice (WP leader: HERU)

A19. Develop quality assurance and evaluation methods that enables monitoring of progress and spread of 'best practice' (see WP1)

A20. Focus on institutional learning in implementation of *The Qualifications Framework*

A21. Appoint and supervise two PhD students to do their research on BioCEED activities

A22. Experiment with and assess selected traditional and new learning methods, e.g., deliberate practice[5], flipped classroom[13], open labs, 'gaming attitude' in students[6], teaching-on-demand. Develop new learning methods that link theory and practice across the biological 'domain'(Fig. 1).

A23. Expand alternative learning methods, and reduce lecturing by 20% relative to 2011.

Work package 5: Strengthen and empower educational leadership (WP leader: AB)

A24. Appoint and empower 'education leaders' as part of institutional leaderships

A25. Integrate and align teaching and research in strategic planning at the institutions

A26. Identify and remove obstacles to development and change, and develop actions and strategies to remove or mitigate them (local, institutional and national level)
A27. Incorporate teaching and education efforts and success into staff reward systems
A28. Explicitly promote education in our internal communication (weekly newsletter, web,...)

Work package 6: Spread of 'best practice' (WP leader: HERU)

A29. Develop the web forum (A8) into a well-structured freely-accessible 'idea-bank' and discussion forum for biology educators.
A30. Publish project results in educational science journals and in educational practice fora.
A31. Develop 'test cases' that will be tried out in other biology educations in Norway
A32. Arrange an open, international conference in biology education every 3 years, with shifting focus to match project needs and development of knowledge

Work package 7: Strengthen links between education and society (WP leader: IMR)

A33. Annual meetings between BioCEED students and industry and sector representatives to echange ideas and communicate biologists' contributions and society's needs
A34. BioCEED workshops with end-user panels to discuss biology-society interactions
A35. Present BioCEED findings in sector-specific journals and meetings

4. ORGANISATIONAL PLAN

The BioCEED consortium consists of 4 partners, and is based on a strong understanding of common goals and joint responsibility. Management procedures are designed to promote effective decision-making, communication and collaboration among the decision-making and advisory bodies (see Fig. 3). The collaboration will be regulated in a consortium agreement.

The centre leader (UiB, Vigdis Vandvik) and her deputy (Pernille Bronken Eidessen) will be responsible for project leadership. They will report to the project consortium; chair project meetings; monitor progress; prepare periodic reports; communicate with NOKUT; manage the project financially and administratively; foster contact and communication in the consortium; ensure that all partners respond to the Strategies and Actions as committed in the consortium agreement and, after consultation with the involved partners and the steering committee, decide on any changes to plans when necessary to fulfil project goals and commitments. Supported by their departments, they will oversee the daily management and ensure efficient and transparent administration, financial management and communication.

The Steering committee includes the centre leader and deputy and the leaders of education at BIO (Øyvind Fiksen) and AB (Ole Jørgen Lønne) and the centre representatives at at HERU (Arild Råheim) and IMR (Geir Huse), and student representatives from BIO (TBA) and AB (TBA). It supports the leader in decisions of strategic and/or financial consequence.

The Work package leaders (TBA) who are responsible for work package-specific questions and decisions. They will report to the Centre leadership concerning the activities within the work package; ensure progress according to plans and schedule; produce reports on status of Strategies and Actions; maintain communication with WP participants; and publish progress updates on the web forum. The WP leaders will have the capacity to request Actions from the partners; organize short meetings as necessary, and travel to support the implementation of the WP as needed. WP2-WP4 will be supported by the dedicated technical staff.

The General assembly is constituted by all staff involved in the project and the boards of the student organisations at BIO and AB. This body will meet at project workshops and conferences, and advise the project leadership in important strategic decisions.

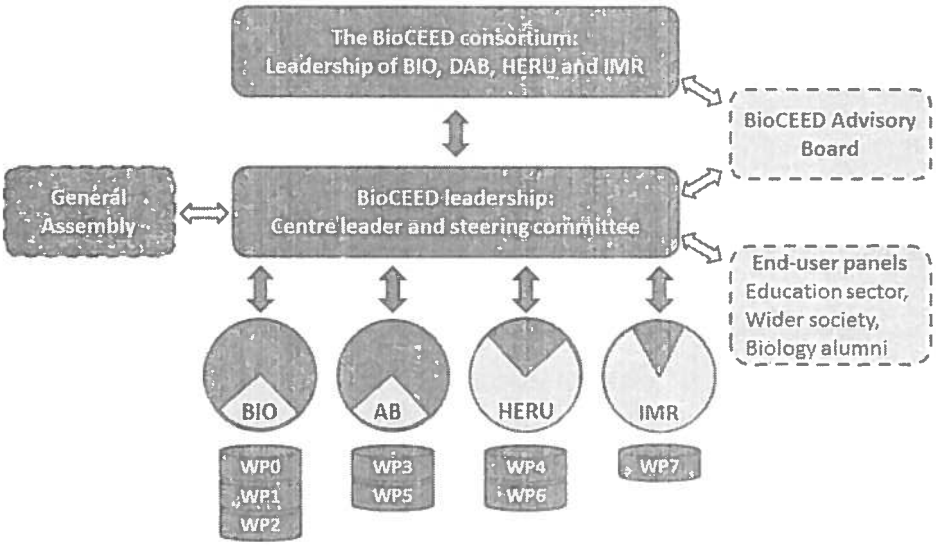


Figure 3. BioCEED project leadership, co-ordination, communication, and responsibilities. Rectangles represent governing (solid outline) and advisory (hatched outline) bodies, circles represent the educational activity at each of the partner institutions, stacked disks represent project work packages, and filled and open arrows represent decision-making/reporting and advisory communication, respectively. Dark shading represents core BioCEED activities, light shading represents associated activities at the partner institutions, and involvement of external bodies.

The BioCEED Advisory Board with ca. 10 members from research, industry, governmental and non-governmental organizations, the education sector, students and alumni will be established. They will oversee the development of the Centre and give feedback on strategies, actions, research, results, communication, and future development.

End-user panels will ensure a wider sector and societal involvement, including established collaborations (Attachment 4). These will be mobilized directly in contact with the students (e.g., courses, internships, annual meetings) and in an advisory role to ensure that research, industry, resource management and nature conservation authorities, and the education sector can guide and respond to BioCEED activities and findings.

Main communication avenues internally and with society and the education sector

Skype meetings: Held both one-to-one and between groups of project partners and students as needed to ensure timely and efficient communication, sharing of experience, and discussion of plans, and progress within and across WPs. Digital presentations can also be given over Skype to ensure clear communication over important aspects.

Project meetings: These will be held at least once a year to discuss plans, status, progress, and reporting. Specific attention will be given to evaluation of fulfilment of Strategies and Actions, any change of plans, and their consequences. Since interaction between work packages is high, both conceptually (all strategies and WPs are motivated by the same underlying conceptual framework and vision) and practically (Actions interact across WPs, see Fig. 2), all WP leaders will participate. Meetings within WPs will be held as needed.

Workshops: Project workshops will be held annually, open to staff, student organisations at the partner institutions, and external collaborators. This will be an arena for sharing experience with teaching, educational development, BioCEED research (A21), and Actions. Reports and findings from these workshops will be presented at the web site (see below).

Web forum: A project web forum will be established in the initial phase of the project (see A9). This will be an important tool for internal as well as external communication. It will include members-only pages where internal information, documents of common interest,

reports on WP findings, and the project database will be made available. As the project proceeds, the web forum will be developed into an open-access resource-base for biology teaching (see A29). The website will be hosted by BIO as part of WP0.

BioCEED conference: Every third year, BioCEED will host an international conference on issues in biology education. Each conference will focus on a specific theme, which will be explored through keynote presentations, practice, research, and student reports, demonstrations, workshops and discussions. The themes will reflect the project development.

5. COLLABORATIVE PARTNERS

The BioCEED consortium is based on existing research and education collaboration among the partner institutions. BioCEED will also mobilise our extensive collaborative networks (detailed in Attachment 4) in educational reform as follows:

The integration of student placements within industry, research, and the public sector into biological education 'from day 1' (A17) is a novel aspect of BioCEED. This is an expansion of the pioneering work in the aquamedicine programme and in the student-active research at AB and in BIO's MSc introductory course (see Attachment 2) where such partnerships have been successfully applied. The aquamedicine programme has focused on placements in industry (e.g., Marine Harvest AS, MSD Animal Health, Aqualab AS, Mattilsynet), AB has focussed on placements within research, and BIO 300 has initiated collaboration with the municipality of Bergen. BioCEED will expand these kinds of collaborations to a wider range of collaborative partners, including our research projects (e.g., our CoE's Geobio and NorMER, CoI Salmon Lice Centre, and ERC projects), research collaborators (in particular Uni Research), conservation and nature management authorities (County Governor, The Norwegian Biodiversity Information Centre, Statens vegvesen,) and a wider range of industry partners. In particular, the extensive marine sector in Bergen will provide a unique asset towards this end, as is our partnership within the FRAM Centre where we are collaborating with 21 industry, research, government, and management institutions.

Many of the above partners also contribute directly to our programmes though involvement in teaching, MSc- and PhD supervision, and expert lectures. For example, The Master's Programme in Nutrition is a collaboration between BIO and the National Institute of Nutrition and Seafood Research. BioCEED will expand such collaboration, focussing on the kinds of institutions mentioned above.

Cross-disciplinary collaboration, such as The Bachelor's Programme in Environment and Resources which involves two departments at the Faculty of Mathematics and Natural Sciences and two departments at the Faculty of Social Sciences, will also be expanded. In particular, a stronger of public management and legal aspects is needed in our education.

UiB is committed to increase the awareness of and recruitment to mathematics and natural sciences through existing and future cooperation with schools in the region. This includes a focus on training of teachers and strengthening their motivation and competence, and to soften the transition from school to university for students.

For disseminating BioCEED results within the sector, we will utilise UNIS agreements with NTNU, UiB, UiO, UiS, UiT and UiA. In particular we will seek to develop annual action plans, under the agreement, with a focus on development and dissemination of results from BioCEED. UNIS actively recruits adjuncts and guest lectures from the Norwegian universities, and these may be natural dissipation vectors.

All collaborators (see Attachement 4) will be activated in the sector communication (WP7).

REFERENCES

1 Barr, R. B. & Tagg, J. From teaching to learning: A new paradigm for undergraduate education. *Change* **27**, 12-25 (1995).

2 Alexander, P. & Murphy, P. in *How students learn* (eds N. M. Lambert & B. L. McCombs) 25–60 (American Psychological Association, 1998).

3 Lambert, N. M. & McCombs, B. L. in *How students learn* (eds N. M. Lambert & B. L. McCombs) 1-22 (American Psychological Association, 1998).

4 Mervis, J. Transformation Is Possible if a University Really Cares. *Science* **340**, 292-296, doi:10.1126/science.340.6130.292 (2013).

5 Deslauriers, L., Schelew, E. & Wieman, C. Improved Learning in a Large-Enrollment Physics Class. *Science* **332**, 862-864, doi:10.1126/science.1201783 (2011).

6 Wieman, C. E., Adams, W. K. & Perkins, K. K. PHYSICS PhET: Simulations That Enhance Learning. *Science* **322**, 682-683, doi:10.1126/science.1161948 (2008).

7 Smith, M. K. *et al.* Why Peer Discussion Improves Student Performance on In-Class Concept Questions. *Science* **323**, 122-124, doi:10.1126/science.1165919 (2009).

8 Deslauriers, L. & Wieman, C. E. Education Research: Set a High Bar Response. *Science* **333**, 1221-1221 (2011).

9 Blumberg, P. *Developing learner-centered teaching: A practical guide for faculty*. (Jossey-Bass, 2009).

10 Weimer, M. Learner-centered teaching: Five key changes to practice. (2002).

11 Gibbs, G. Developing students as learners – varied phenomena, varied contexts and a developmental trajectory for the whole endeavor. *Journal of Learning Development in Higher Education* **2009**, 1-12 (2009).

12 Nicholson, D. **T**. Embedding Research in a Field-based Module through Peer Review and Assessment for Learning. *Journal of Geography in Higher Education* **35**, 529-549, doi:10.1080/03098265.2011.552104 (2011).

13 Lage, M. J., Platt, G. J. & Treglia, M. Inverting the classroom: A gateway to creating an inclusive learning environment. *Journal of Economic Education* **31**, 30-43, doi:10.2307/1183338 (2000).

		2014				2015				2016				2017				2018			
Actions	*Indicators of progress*	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv
WP0: Leadership and coordination (BIO)																					
A1	Effective organisation and decision-making structures	*																			
A2	Set up and maintain physical and virtual infrastructure			*								*								*	
A3	Appoint an international Advisory Board																				
A4	Daily management, monitoring and reporting				*				*				*				*				*
WP1: Teacher culture(BIO)																					
A5	Annual teachers retreat				*				*				*				*				*
A6	Professor II positions		*											*	*						
A7	Teacher groups	*																			
A8	Teaching renewal through pedagogic courses and exchange																				
A9	Web forum				*																
WP2: Learning environments (BIO)																					
A10	Expand learning environment; field, lab, digital				*				*				*								
A11	Develop student spaces				*												*				
A12	Set up and experiment with digital tools for education								*												
A13	Dedicated educational technical and administrative staff																				
WP3: Active students (AB)																					
A14	Redesign courses to enhance student-active learing				*																
A15	Integrate learning-to-learn skills across curriculum								*												
A16	Use students actively in planning and education activities																				
A17	Offer internships in public and private sector												*								
A18	Provide certification for particular skills																*				
WP4: Activity allngment (HERU)																					
A19	Develop quality assurance and evaluation methods																				
A20	Use quality assurance in instiutional learning				*				*				*				*				*
A21	Two PhD studetns in educational science		*														*				
A22	Experiment with, and research, new learning methods																				
A23	Reduce lecturing by 20%								*												
WP5: Develop educational leadership (AB)																					
A24	Appoint and empower education leaders	*												*							
A25	Align teaching and research in institutional stragegies												*								
A26	Identify and remove obstackles to change								*										*		
A27	Incorporate teaching efforts in staff reward systems					*															
A28	Promote eduction in internal communication																				
WP6: Spread of best practice (HERU)																					
A29	Develop web forum to freely-acessible 'idea-bank'														*						
A30	Publish project results in the education science literature												*								
A31	Develop 'test cases' for use in other institutions																	*			
A32	Arrange international conference in biology education					*												*			
WP7: Sector / societal communication (IMR)																					
A33	Annual meeting between students and industry/sector		*				*				*				*				*		
A34	Arrange workshops with end-user panels		*				*				*				*				*		
A35	Present project results in sector-specific fora						*									*				*	

Grey scale indicate activity; dark grey: high activity

* indicate natural points for milestones and deliverables

BioCEED - Budget

BioCEED	year 1	year 2	year 3	year 4	year 5	SUM
	2014	2015	2016	2017	2018	
Personell total	7873	7949	8028	8109	5593	**37552**
Expenditures	300	150	250	150	150	**1000**
Development	740	735	755	795	705	**3730**
Dissemination	20	270	20	30	278	**618**
Total	8933	9104	9053	9084	6726	42900

Specification:

Personnel

Personnel includes one centre leader (professor, BIO) 40% position, one deputy leader (professor, UNIS) 20% position and 1.2 positions technical staff (BIO, UNIS). In addition, personnel includes two 20% adjunct professors (BioCEED).

In addition, all partners contribute to BioCEED with in-kind personnel:

- BIO: 10% of teaching time of all scientific staff, and administrative support
- UNIS: 20% of total course budget
- IMR: Adjunct professors, supervision and internships
- HERU: PhD-position, 20% professor (supervision, development, research)

The Faculty of Mathematics and Natural Sciences (MN) contributes to BioCEED with a PhD position.

Expenditures

Expenditures will cover the day to day cost of running the centre, and also infrastructure costs. Travel costs, meeting costs and other cost associated with WP0.

Development and innovation

Costs associated with WP1-5 as described in the Application document and time line. E.g. annual teachers retreats, developing student spaces, cost connected to internships and placements, developing and research on new learning methods, expansion of learning environment (lab, field, digital) and necessary equipment and IT support to renew and modernize teaching.

There are also in-kind contributions to this activity from BIO and UNIS.

Dissemination

Cost associated with WP6-7 as described in the Application document, mainly for workshops and international conferences in biology education.

BioCEED - Plan for financial resource acquisition

		year 1	year 2	year 3	year 4	year 5	SUM
		2014	2015	2016	2017	2018	
Personell	NOKUT	2173	2249	2328	2409	2493	**11652**
	In kind BIO	2000	2000	2000	2000	2000	**10000**
	In kind MN*	800	800	800	800		**3200**
	In kind AB	1000	1000	1000	1000		**4000**
	In kind IMR	900	900	900	900	900	**4500**
	In kind HERU	1000	1000	1000	1000	200	**4200**
Expenditures	NOKUT, WP0	300	150	250	150	150	**1000**
Development	NOKUT,WP1-5	340	335	355	395	305	**1730**
	In kind BIO	300	300	300	300	300	**1500**
	In kind AB	100	100	100	100	100	**500**
Dissemination	NOKUT,WP6-7	20	270	20	30	278	**618**
Total		8933	9104	9053	9084	6726	**42900**
NOKUT		2833	3004	2953	2984	3226	**15000**
In-kind		6100	6100	6100	6100	3500	**27900**

*Faculty of Mathematics and Natural Sciences, UiB

WP0-7 refers to Work packages described in Application document.

ATTACHMENT 1. QUALITY IN ESTABLISHED EDUCATIONAL ACTIVITIES

Table 1 Key statistics BIO programmes. Data from Samordna opptak, DBH and UiB Student Database. Programme names link to programme descriptions.

Programmes (BIO)	Average intake	Reg. students 2012	Graduates 2012	ECTS prod/student 2012	Applicants 2013	Change in applicant #
Bachelor programme in biology	91	193	46	41,9	117	43 %
Bachelor programme in Sustainable Aquaculture	15	27	3	43,5	22	47 %
Bachelor programme in Environment and Resourses	27	55	8	51,6	38	-0,30 %
Bachelor total	**133**	**275**	**57**	**45,7**	**177**	30,10 %
Integrated master programme in Aquamedicine	**12**	**40**	**12**	**49,9**	**35**	40 %
Master programme in biology	21	26	16	40,0	57	
Master programme in Marine Biology	10	26	9	39,1	20	
Master programme in Fisheries Biology and Managament	4	6	4	46,1	4	
Master programme in Aquaculture	5	13	10	76,9	5	
Master programme in Nutrition - marine	6	10	4	60,6	4	
Sum master	**41**	**81**	**43**	**52,5**	**90***	9,80 %

*Master applicant numbers only main intake autumn. International applicants and spring supplementary intake not included.

Figure 1 Graduated students, Bachelor and Master degrees, BIO, 2008-2012

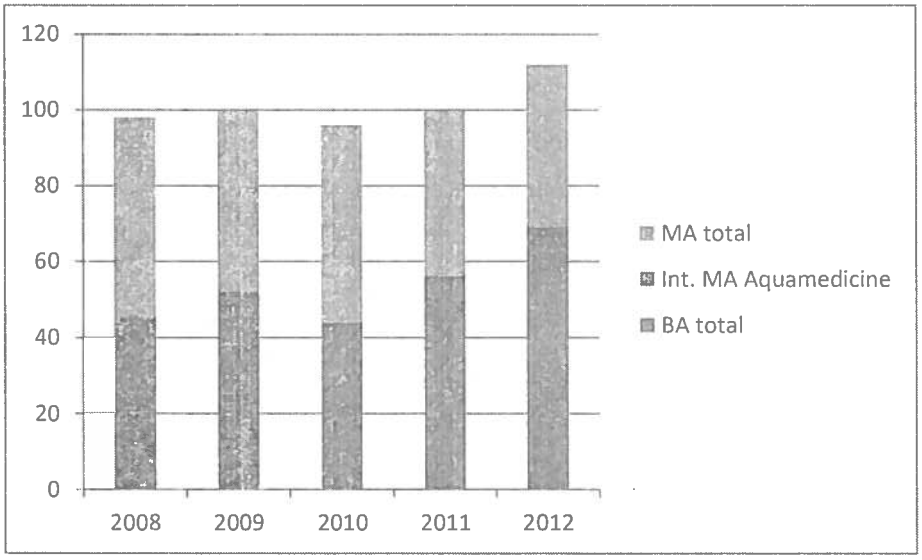
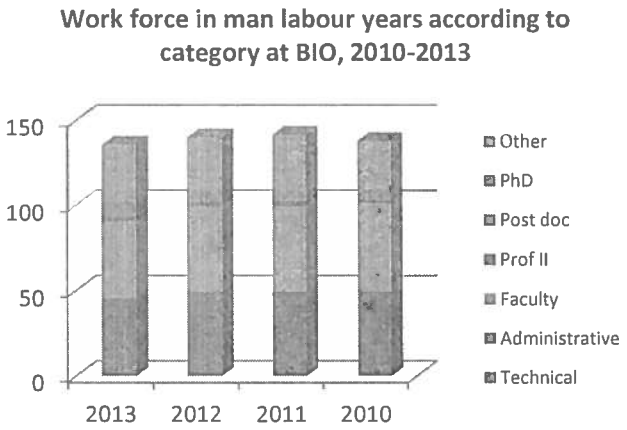


Table 2 Key statistics courses BIO and AB, 2012. Course descriptions are linked.

BIO Courses 2012	Number of courses	ECTS production	Av. # students per course
100-level courses	7	4730	103
200-level courses	35	4650	16
300-level courses	34	2803	11
total courses	**76**	12183	
total BIO (incl. MSc thesis, PhD ECTS etc.)		**16236**	
AB courses			
Bachelor courses	6	1405	16
Master courses	13	560	11
PhD courses	11	50	5

Figures 2 and 3. Work force UNIS and BIO



Short summary of feedback from students from student evalutions of field- and labactivities on basic biology courses (BIO101-102 Organismal Biology, 2012).

BIO101 Organismal Biology, systematics - 72 labhours
Students answer that the practical work in the lab enhances learning. They would like to see an increase in lab time, and even better correspondance to the lectures. Writing lab journals was challenging for many students, and better information and planning has been implemented in this years course (2013).

BIO102 Organismal Biology , ecology – 3 week field course
Students generally agrees on that the field course is socializing, fun and with a very high learning outcome. Seeing, touching and experiencing enhances learning significantly. They appreciate the interaction with professors and teaching assistants, and they find their teachers competent and engaging.

The students offer concrete suggestions for improvement in the organizing and planning of the field course, which will be included in the planning of next years course.

Learning outcomes:
Students were asked to comment on their learning outcome of spesific topics listed in the learning outcome description for the course. All students in the survey anwered that they had a good outcome of the course and an increased understanding of ecosystems and ecology. 91-96 % of the students feel that they have achieved the stated learning outcome of the course.

Full course reports: studiekvalitet.uib.no (in Norwegian)

Student contentment

The University of Bergen has recently conducted the student survey «UiB-student 2013[a]» where student contentment is measured. Although final results are not available yet, teh survey indicates that BIOs students are as content, or more content, than students at the University of Oslo and the Norwegian University of Science and Technology[b]. «UiB-student 2012» also indicates that BIO students are very content and would recommend UiB to others.

[a] Final results not available at present, but will be published by the UiB as soon as possible.
[b] Universells Learning Environment survey 2012

Figure 4 Teaching methods BIO-courses (100-200 level). Most UiB undergraduate courses include active learning activities: seminars, working in groups, lab exercises, or field trips.

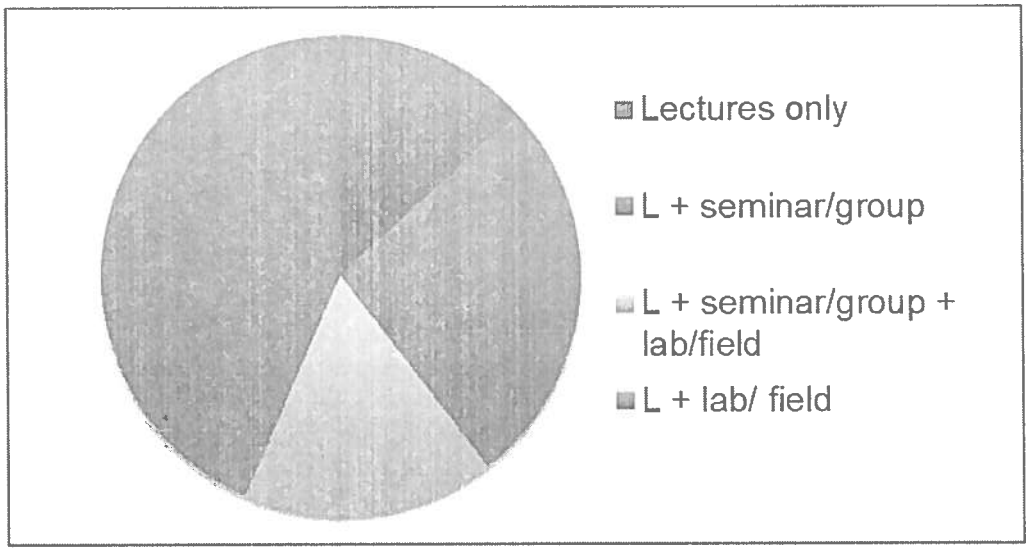
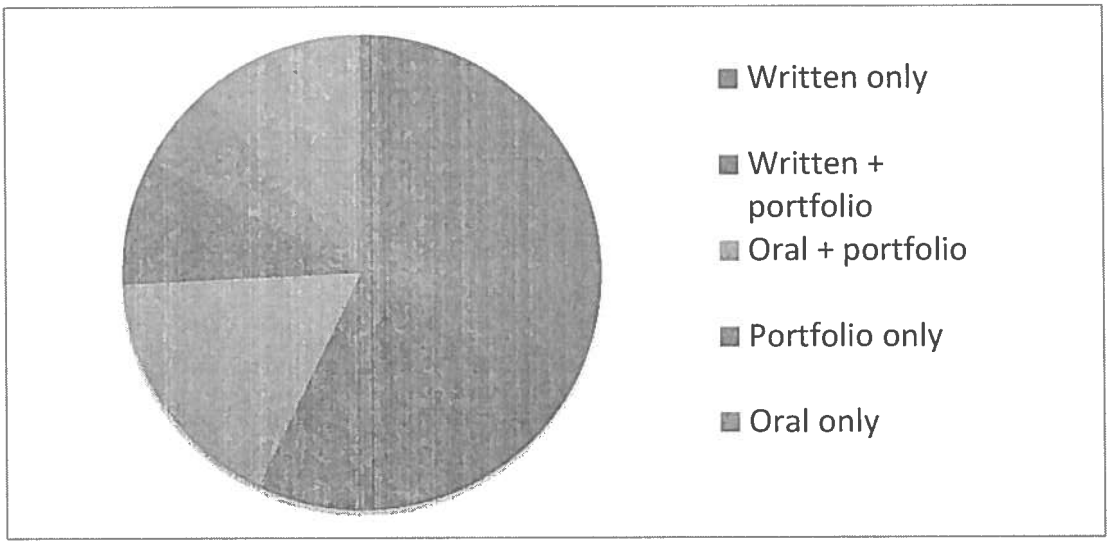


Figure 5 1 Assessment methods BIO-courses (100-200 level). UiB undergraduate courses are assessed in a variety of ways: written exams, oral exams, take-home exams, or portfolio evaluation



Attachment 2 – Examples of excellence in education from BIO and AB

Integrated master programme in Aquamedicine (BIO)

The programme builds on a basis of natural scientific courses, continues with highly specialized courses in aquamedicine, and includes two periods of placement (see examples of placement partners in attachment 4 Collaborative partners). To ensure well qualified candidates in a rapidly changing area the research based teaching is essential. The programme includes education through contact with a wide range of institutions and companies within aquaculture, fish welfare, management, education and research. This education is unique worldwide and is only offered at UiB and UiT, and there are few specific comparable education programs in the world.

Students who have achieved master in aquamedicine can obtain the title Aquamedicine biologist and have the same authorisation as veterinarians in the Norwegian legislation when it comes to for example treating diseases in aquaculture animals, including prescription rights for vaccines and drugs. Aquamedicine biologists are in demand in the Norwegian aquaculture industry, and candidates will have very good opportunities for relevant employment (100% of graduated students in 2012 are currently employed). They have often obtained a job before their final exam.

Internationally, there is now an increasing interest in establishing similar education programs and BIO is involved in support and collaboration to establish courses and programs within fish health.
Application numbers for this programme has increased steadily over the last years, and in 2013 there are 35 applicants for 10 places.

Safety training - UNIS

A course at the University Centre in Svalbard, UNIS, is in several aspects a unique experience. All UNIS courses are linked to Svalbard's geographical location in the high arctic, with strong emphasis on field studies. To do fieldwork and excursion in remote areas, with difficult weather conditions, limited emergency help and communication possibilities, require participants to pay closer attention to safety than usual.

In order to prepare our students for high arctic field work, all students participating in both bachelor and graduate level courses, are given safety training before joining field work. The safety training is a combination of lecturers and practical training, and covers all required aspects related to the planned field activities. AS-101 Arctic Survival and Safety Course (3ECTS) is a one week course based on both lectures and practical out-door exercises providing basic knowledge of potential risk scenarios, and achieve skills in planning and accomplishing field work under arctic conditions. E.g. polar bear encounters, a rubber boat/small boat, survival suits, snowmobile, glacier hiking, radio communications equipment and emergency beacons, use of map and compass, and first aid.

The safety training at UNIS is regarded as being of high quality (application for certification by DNV is under way), and our expertise have been utilized and acknowledged by several external partners (e.g. SAMCoT; Annual Report 2012).

BIO300 Biological Data Analysis and Research Design - BIO

This course links theoretical knowledge, practical skills and societal relevance through innovative teaching methods. BIO300 is a flagship course at BIO, an award-winning required graduate level experience with between 40-60 new Master-level students each autumn. It has a long-standing active partnership with Bergen Municipality, and relatively new partnerships with local artistic institutions. In 2009 BIO300 was awarded The National award for quality in education, as well as the Owl Price (for quality in eduction) at UiB.

BIO300 takes it role seriously when preparing new Master students for a place among practicing scientists in society. At the base is the science. There are three fundamental practical elements of the course: field work on projects in cooperation with Bergen Municipality; theory and practice of statisti-

cal analyses of the data collected; written and oral science communication of the project results. In addition, essential soft skills of teamwork are developed through group work in smaller groups made up of 40-60 students from over 15 countries. Integrating relevant field work with a practical fundament in statistical analysis, students must embrace the scientific "toolkit" of library skills, planning and carrying out sampling, data analysis, scientific report writing, critical reading, presentation techniques, and effective teamwork. Invited speakers bring the outside world into the classroom. A small team of PhD students acts as teaching assistants. The students' own work is presented in open lectures and the reports delivered to Bergen Municipality, as part of the academic-social dialogue.

There is an additional element of creativity in this course: use of artistic support to develop the oral presentations of the results. While about half the groups are guided on how to structure a basic scientific presentation and given free reign within that framework, the remainder are given artistic associations (e.g. dance companies, dramaturgs, computer graphics artist, composers). The response to this has been overwhelmingly positive from both sides of the podium and far beyond the classroom, and the new initiatives in science communication are attracting international attention.
http://upedblog.b.uib.no/maaneden/
http://www.uib.no/bio/en/education/bio-300

Key course elements at AB - Student research experience

The two courses, AB-202 Marine Arctic Biology and AB-201 Terrestrial Arctic Biology, share characteristics elements with several UNIS courses. Key components are safety training prior to the course (see safety training box), a section on theory and information on the arctic physical and biological setting relevant to the particular course. Group science projects that includes project design, collection of data in the field, lab work, statistical analysis, oral presentation of findings and a final delivery of a report, often as a scientific paper as the final key element.

A typical AB course consists 18 students where 9 comes from 3 or more different Norwegian universities or university- colleges. The other half are from various foreign universities. They are all 1-1.5 years away from having a bachelor degree. They are in the same courses throughout the semester, live and spend much of their free time together. In the course they will typically meet 5 (or more) scientists from UNIS, various universities and research institutions in Norway or abroad as teachers. The same order of people working on active research projects is often an integrated part of the field activities. The AB201 students are for instance every year assisting a Dutch research team with catching geese. During the catch all students hold goslings and guide it through the process of ringing, measuring, blood sampling and weighing. The students get the possibility to work alongside researchers and directly contribute to the conducted research, and the researchers get the job done more efficiently. In AB202 they will get to know scientists and their projects during and week long cruise on a research vessel. A 1:2 numerical relationship between students and teachers/ scientists are common during field activities. In recent years science projects on topics such as invasion of the snow crab, benthic community structure monitoring, diel vertical migration of zooplankton been integral parts of student projects. Several student projects have resulted in peer-reviewed publications (e. g. Brevik at al 2010, Eidesen, et al 2012).

This course structure is in line with the mission of UNIS, with field based courses, based on Svalbard's location in the High Arctic and that courses are supplementary and an integral part of the curriculums of the mainland universities.

In an education development setting, the role of class size, student heterogenous student groups, focus on practical scientific skills, close student - teacher/ scientist and student - student interactions key elements that can be explored, tested and compared to the typical setting for students at the larger BIO.

http://www.unis.no/10_STUDIES/1020_Courses/Arctic_Biology/arctic_biology_courses.htm

Attachment 4 . Collaborative partners

1. Partners involved directly in our educations:

The Univeristy Centre at Svalbard (UNIS) is a share-holding company, owned by the Norwegian Ministry of Education and Research. Educational collaboration is based on a signed agreement between UNIS and the Norwegian University of Science and Technology (NTNU), the University of Bergen (UiB), the University of Oslo (UiO) , the University of Stavanger (UiS), the University of Tromsø (UiT) and the University of Agder (UiA).

BIO collaborates over a number of courses and programmes with the following partners:

- The National Institute of Nutrition and Seafood Research (NIFES) offers the Master's programme in Nutrition in Aquatic Organisms in Aquaculture in collaboration with BIO, and specialized courses for this programme. NIFES also collaborates with BIO on PhD projects and supervision.
- The University Museum of Bergen (Natural History) is involved in 12 different biology courses at BIO (organismal biology, zoology, botany, and systematics), in addition to collaboration on master and PhD projects and supervision.
- The CoE Center for Geobiology (GEOBIO) offers the Master's programme in Biology, specialization Geobiology in collaboration with BIO, and specialised courses for this programme. GEOBIO also collaborates with BIO on PhD projects and supervision.
- The interdisciplinary Bachelor's programme in Environment and Resources (coordinated by BIO) is a collaboration between BIO and Department of Chemistry, Department of Economics and Department of Geography.
- The Integrated Teacher Programme with Master in Science or Mathematics at The Faculty of Mathematics and Natural Sciences (UIB) is offered in collaboration with all departments and the Faculty of Psychology. BIO teaches basic biology courses, courses in biology and science didactics, and supervise master students within this programme.
- The Department of Geophysics in collaboration with several other Nordic universities offer the Joint Nordic Master's Programme in Marine Ecosystems and Climate (MARECLIM). BIO is involved in teaching and master supervision within marine ecosystems.
- The Sea Lice Research Centre (Centres for Research-based Innovation) contributes to the education of Aquamedicine biologists (BIO).
- Uni Research contributes to education at BIO through lectures and master projects. Many collaborative research activities and personnel from Uni Research have their daily working spaces within research groups at BIO.
- BIO programmes include courses from the Department of Chemistry, the Department of Mathematics, the Department of Physics and Technology and the Department of

Molecular Biology. We also collaborate with the Department of Molecular Biology in master and PhD projects and supervision.

- Sars International Centre for Marine Molecular Biology – collaboration on PhD projects and supervision. Sars staff are also involved in teaching BIO courses.

2. Adjunct professors at BIO:

Institute of Marine Research (IMR): - Geir Dahle - Arill Engås - Egil Karlsbakk - Ole Bent Samuelsen - Egil Ona	National Institute of Nutrition and Seafood Research (NIFES): - Anne-Katrine Lund Haldorsen - Bjørn Tore Lunestad - Amund Måge - Rune Waagbø
Biodiversity Institute, University of Oxford: - Kathy Willis	University of Gothenburg: - Kristina Snuttan Sundell
University Centre at Svalbard (UNIS): - Tove Gabrielsen	Norwegian School of Veterinary Science: - Ian Mayer
Norwegian Institute for Water Research (NIVA): - Anders Hobæk - Albert Imsland	University of California Santa Cruz: - Marc Mangel
Universität Wien: - Christa Schleper (GEOBIO)	Haukeland University Hospital: - Ragnar Nordtvedt

3. Collaborative partners from industry (examples, and their roles vs. BIO):

- Marine Harvest AS - placement (aquamedicine/aquaculture), Industrial PhD
- Mainstream - placement (aquamedicine/aquaculture), Master projects
- MSD Animal Health - placement (aquamedicine/aquaculture), Master projects
- Lerøy Seafood Group A/S - placement (aquamedicine/aquaculture), Industrial PhD
- Cermac ASA – Industrial PhD,
- Marine Ecosystems Technologies AS - Industrial PhD
- Nofima (The food research institute) – Industrial PhD,
- Produs Aqua as – Industrial PhD
- Skretting Aquaculture Research Centre AS - Industrial PhD
- PHARMAC – placement (aquamedicine/aquaculture)
- Aqualab AS - placement (aquamedicine/aquaculture)
- Grieg Seafood AS- placement (aquamedicine/aquaculture)
- Cleanfish AS - placement (aquamedicine/aquaculture)
- Fiskehelse og miljø (FoMAS) - placement (aquamedicine/aquaculture)
- Eide Fjordbruk - placement (aquamedicine/aquaculture)

a. Research institutes and their roles vs. our educational programmes:

- Bioforsk – master projects
- Norwegian Veterinary Institute – professor II, master projects
- Skog og landskap - PhD projects
- Runde Environmental Centre
- Norwegian Institute for Nature Research (NINA) – master projects, PhD projects
- Norwegian Institute for Water Research (NIVA) – master projects
- FRAM Centre- UNIS and IMR are full a members of the FRAM centre. BioCEED will utilize the member institutions actively to develop internship agreements and get feedback on centre activities and education. FRAM Center members are: Akvaplan-NIVA, CICERO Centre for International Climate Environmental Research Oslo, National Coastal Administration, National Veterinary Institute, NGU - The Geological Survey of Norway, NILU - Norwegian Institute for Air Research, NINA - Norwegian Institute for Nature Research, NIKU - Norwegian Institute for Cultural Heritage Research, Nofima - The Norwegian Institute of Food, Fisheries and Aquaculture Research, NORUT - Northern Research Institute, Norwegian Polar Institute, Norwegian Forest and Landscape Institute, Norwegian Institute for Agricultural and Environmental Research, Norwegian Institute for Water Research, Norwegian Mapping Authority, Norwegian Radiation Protection Authority, Norwegian School of Veterinary Science, SINTEF Group, University of Tromsø

b. Nature Management and Conservation, Food Safety

- Mattilsynet (Norwegian Food Safety Authority) - placements (aquamedicine/aquaculture)
- County Governor of Hordaland and other counties. Field sites.
- Statens vegvesen – The Norwegian Road Authority Student placements
- Artsdatabanken – The Norwegian Biodiversity Information Centre

c. Dissemination- focussed institutions (selected)

- Heathland Centre (Museumssenteret i Hordaland) – outreach, master projects, communicate BioCEED findings and results
- The Arboretum and Botanical Garden, Milde – outreach, master projects, field courses

d. **International institutional collaboration (selected):**

- University of Makerere, Uganda - research collaboration, scientific competence building, student and staff exchange, and institutional development.
- Regional Master Program In Biodiversity And Environmental Management Tribhuvan University (TRIBH)/Universitetet i Bergen (UIB) - Norad's programme for master studies
- Cooperation in environmental microbiology between Armenia and Norway - Eurasia project with University of Bergen and Yerevan State University on research collaboration, scientific competence building, student and staff exchange and institutional development.
- Study abroad:44 ERASMUS agreements in biology throughout Europe. Bilateral agreements in e.g. Australia, South Africa, Canada, USA etc.

e. Collaboration with schools etc.:

- Nordahl Grieg Videregående Skole – collaboration with The Faculty of Mathematics and Natural Sciences: Mathematics, Natural Sciences and Technology
- Amalie Skram Videregående skole – an extensive collaboration with this new (opening 2014) high school is under development. The school is only 5 minute walk away from our campus. The planned collaboration is to build a joint platform in Store Lungegårdsvann where ocean sampling can be a continuous activity for both pupils at the school and students at the University. We also plan for Faculty members to visit the school and for pupils to visit University labs and lectures. This is an obvious benefit to both parties, in better education and in future recruitment to the Natural Sciences and UiB.
- The Centre for Science Education - link between schools at all levels and the University's departments of Mathematics and Natural Sciences. The main purpose is to give courses to teachers, both in-service training and supplementary training. We also run projects for schools, the main project is The Norwegian Environmental Education Network, miljolare.no.
- Forskerfabrikken – Science courses for children. Courses taught in BIOs teaching labs. BIO students involved in courses.
- The Faculty of Mathematics and Natural Sciences has 10 partner schools (different levels) in Norway. The collaboration focus on placement for teacher students and development of the vocational training through R&D activities and offer training to teachers within mathematics and science.

PROFESSOR VIGDIS VANDVIK — CURRICULUM VITAE

Professional Positions

2011 – VISITING PROFESSOR, IMHE, Chengdu, Chinese Academy of Sciences
2008 – PROFESSOR OF PLANT ECOLOGY, the University of Bergen (UIB)
2007 – 2008 ASSOCIATE PROFESSOR, Univ. Bergen
2002 – 2006 POST-DOCTORAL FELLOW, UIB/ University of Michigan
1997 – 2002 NFR DOCTORAL FELLOW, UIB/ University of Oslo
1996 – 2001 MATERNITY LEAVES for a total of 35 months

Education

2011 MENTORING PROGRAM IN LEADERSHIP DEVELOPMENT "Oppdagelsesreise", AFF AS, Oslo.
2002 DR. SCIENT. Department of Botany, UIB. Supervisors H.J.B. Birks & R. Elven.
1998 PEDAGOGY of the Natural Sciences, University of Oslo.
1995 CAND. SCIENT. Quantitative Ecology, Department of Botany, UIB.

Research administration and Leadership

2013 Scientific leader, BERGEN SUMMER RESEARCH SCHOOL (www.uib.no/rs/bsrs).
2012 – 2013 On program committee, KLIMAPRO, NORWEGIAN RESEARCH COUNCIL (www.forskningsradet.no)
2011 – The Danish Council for Independent Research, Panel Chair in biology (http://en.fi.dk/)
2010 – Board substitute THE NORWEGIAN BIODIVERSITY INFORMATION CENTRE (www.artsdatabanken.no)
2010 – Member of the NORWEGIAN PLANT NETWORK project Board (www.plantnorway.no)
2007 –2010 Leader of the ECOLOGICAL AND ENVIRONMENTAL CHANGE RESEARCH GROUP
2003, 2010– Member of the FACULTY OF MATHEMATICS AND NATURAL SCIENCES BOARD, UIB.
2007 – 2010 Deputy leader of the DEPARTMENT OF BIOLOGY, UIB.
2008 – 2010 Member of the UNIFOB A/S CORPORATE ASSEMBLY of (www.unifob.no)
2009 On the organizing committee for the NILE BASIN RESEARCH PROGRAMME (www.nile.uib.no).
2005 – 2008 Initiated and led The Norwegian Heathland Network LYNGHEINETTVERKET and arranged biannual national network workshops (http://lynet.zoo.uib.no).
2005 – 2007 Member of the UNIVERSITY BOARD, UIB
1997 – PI of eight major projects funded by the NORWEGIAN RESEARCH COUNCIL, and VISTA.

Teaching and Supervision

EDUCATIONAL DEVELOPMENT

2011-2013 On committee that development of the BioCEED project proposal, led the work from 2013
2010 Co-chaired the international conference "Academic Writing from Bachelor to PhD", which brought several distinguished keynotes and more than 150 participants to Bergen.
2008-2011 On the committee that planned the 2011 BSc reform at BIO, UIB.
2003– Member of various educational committees Department of Botany and BIO, UIB.
2002– Developed curricula, teaching and assessment in several different courses at BIO.

LECTURING AT BACHELOR AND MASTERS LEVEL

EXPERIMENTAL DESIGN AND BIOSTATISTICS BIO 300 (10 SP) (20-70 students)
- Contributed to the design of the course
- Lectured and led practicals in statistics (2002–2005)
- Lectured in scientific writing and speaking (2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011)

ORDINATION AND GRADIENT ANALYSIS BIO 303 (5 SP) (20 students)
- Led practicals in multivariate statistics (2003–2005)

ADVANCED BIOSTATISTICS BIO 302 (5 SP) (20 students)
- Participated in designing the course
- Lectured and led practicals in multivariate statistics (2002, 2003)

NORDIC NATURE BIO 262 (10 SP) Course in plant biogeography (20 students)

- Lectured and led the field excursion (2004, 2005, 2007, 2008, 2011, 2012, and onwards)

PLANT ECOLOGY BIO 240 (15 SP/10 SP) (5-10 students)
- Organised and led the laboratory course (1995, 2001, 2003)
- Lectured (2001, 2003) and developed new curriculum (2003)

BOTANY BIO 112 (15 SP) Second-year large introductory course to botany, (100 students)
- Lab assistant (1993)
- Organised and led the 1-week field course (1995, 1999)

ORGANISMAL BIOLOGY BIO 1O2 (10 SP) Second-year introductory course to ecology (80 students)
- Organised and led a 1-week field course (2012, and onwards)

TOPICS IN ECOLOGY AND EVOLUTION BIO 301 (10 SP) (20 students)
- Taught module on climate change effects (2010)

DOCTORAL -LEVEL COURSES

2012 CLIMATE CHANGE EFFECTS IN ARCTIC AND ALPINE ECOSYSTEMS. Research training course funded by the Nordic Council of Ministers. (25 students, 12 tutors). I organized and led the course.

2013 BERGEN SUMMER RESEARCH SCHOOL. Research training course funded by the University of Bergen (70 students, 4 paralell courses, 10 international keynote lecturers). Scientific leader.

SUPERVISION:

SUPERVISOR FOR 6 POSTDOCS – 1 completed, 4 as main supervisor
SUPERVISOR FOR 12 DOCTORAL STUDENTS – 5 completed, 6 as main supervisor
SUPERVISOR FOR 16 MASTER STUDENTS – 13 completed, 10 as main supervisor
SUPERVISOR FOR 2 BACHELOR STUDENT PROJECTS – 1 completed, 2 as main supervisor

ADJUDICATOR / SENSOR

CULTURAL LANDSCAPE MANAGEMENT. Nesna College, 30 sp course, evaluated on basis of term papers, 15 students (2004 – 2006)

ECOLOGY BIO 200 (10 SP) University of Bergen. Written exam, 95 students (2004, 2005)

MSC THESES EVALUATOR - University of Life Sciences (2007, 2012), Universty of Tromsø (2009).

PHD EVALUATION COMMITTEES – Hovstad, (2008), Auestad (2009), Edvartsen (2010), Lyngstad (2010), Dorji (2013), Auffret (2013), Brunbjerg (2013)

Major grants and Fellowships (selected from 16)

2012-2015	PI of UVB: NFR FRIBIO project 214359. NOK 8.610.000.
2011-2014	PI of EcoSET: THE NORWEGIAN ACADEMY OF SCIENCE AND LETTERS # 6158. NOK 2.568.000.
2010-2013	Co-PI on the NORDIC COUNCIL OF MINISTERS researcher network "Stay or go processes".
2009-2012	Co-PI of HIMALINES: NFR FRIMUF project 190153N10. NOK 9.712.000
2008-2012	PI of SEEDCLIM: NFR NORKLIMA project 184787/v10. NOK 9.565.730
2008-2012	PI of THE MATRIX: NFR FRIMUF project 184912. NOK 5.969.000
2007–2010	Cooperating partner on BEGIN: ESF EuroDIVERSITY CRP. My deliverables NOK 492.000
2007–2010	Partner on VILLSAU. NFR AREAL project 178209/I10. My deliverables NOK 2.643.500

Other Professional Activities

PROFESSORSHIP EVALUATION COMMITTEES – Stockholm University 2011, UNI Research 2012
GRANT APPLICATION EVALUATION – Five foreign national research councils and one EU panel.
ASSOCIATE EDITOR – Botany 2007-2010, Journal of Vegetation Science 2010 –, Applied Vegetation Science 2010 –
PRESENTATIONS AND INTERNATIONAL WORKSHOPS AND CONFERENCES – >40 (3 invited)
PUBLIC OUTREACH – >25 activities, including TV, Radio, newspapers and popular science journals
PEER REVIEWER – 28 international scientific journals including *American Naturalist, Ecology; Oikos.*

VISITING RESEARCHERS – 5, of 5 different nationalities
SEARCH COMMITTEES – 15 positions, from PhD to professorships. UIB and Lund University
ACTIVITIES RELATED TO NATURE CONSERVATION AND MANAGEMENT (MOST RECENT)

2013 Member of EXPERT PANEL for THE NORWEGIAN BIODIVERSITY INFORMATION CENTRE (www.artsdatabanken.no) revising the classification Nature types in Norway (NIN)

2010 – Substitute board member ARTSDATABANKEN / THE NORWEGIAN BIODIVERSITY INFORMATION CENTRE (www.artsdatabanken.no)

2009 – 2010 DIRECTORATE FOR NATURE MANAGEMENT (www.dirnat.no). Member on expert panel setting conservation targets for protected grasslands and heathlands.

Extended Research Stays Abroad

2003 – 2005 Univ. Michigan, Ann Arbor, MI, USA.
2003 Royal Botanical Gardens, UK.

Selected Scientific Papers

Total published: 50, first authorships: 11, senior authorships: 16, citations (Google Scholar) 695 (518 since 2008), H-index 15 (13 since 2008), i10 index: 20 (17 since 2008), papers with students as first authors: 16.

A1. Spindelböck J.P., Cook Z., Daws M.I., Heegaard E., Måren I.E. & **Vandvik V.** *In press.* Conditional cold avoidance drives variation in germination behaviour in *Calluna vulgaris*. Annals of Botany.xx: xx-xx.

A2. Lenoir J, Graae BJ, Aarrestad, PA, Alsos IG, Armbruster S, Austrheim G, Bergendorff C, Birks HJB, Bråthen KA, Brunet J, Bruun HH, Dahlberg C, Decocq G, Diekmann M, Dynesius M, Ejrnæs R, Grytnes J-A, Hylander K, Klanderud K, Luoto M, Milbau A, Moora M, Nygaard B, Odland A, Ravolainen V, Reinhardt S, Sandvik S, Schei F, Speed J, Tveraabak L, **Vandvik V,** Velle LG, Virtanen R, Zobel M, Svenning J-C. 2013. Strong local spatial buffering of climate-change impacts on species across Northern Europe. *Global Change Biology.* DOI: 10.1111/gcb.12129. *Highlighted by the editors in GCB.*

A3. Meineri E., Skarpaas O., Spindelböck J.S., Bargmann T., and **Vandvik V.** 2013. Direct and size-dependent climate effect on flowering performance in alpine and lowland herbaceous species. *Journal of Vegetation Science xx:xx-xx. DOI: 10.1111/jvs.12062*

A4. Paulsen T.R., Colville L., Daws M.I., Högstedt G., Kranner I., **Vandvik V.**, and Thompson K. 2013. Water impermeable seeds – what are they for? *New Phytologist* 198: 496–503. *Highlighted in New Phytoloigst, presented under 'Editors choice' in Science.*

A5. Payne R.J., Dise N.B., Stevens C.J., Gowing D.J., and BEGIN partners (Duprè C., Dorland E., Gaudnik C, Bleeker A, Diekmann M, Alard D, Bobbink R, Fowler D, Corcket E, Mountford JO, **Vandvik V.,** Aarrestad P.A., Muller P.) 2013. Impact of nitrogen deposition at the species level. *Proceedings of the National Academy of Sciences of the United States of America 110-3; 984-987.*

A6. Meineri E., Skarpaas O., & **Vandvik V.** 2012. Modeling alpine plant distributions at the landscape scale: Do biotic interactions matter? *Ecological Modeling* 231:1-10.

A7. Velle, L.G., Nilsen, L.S., & **Vandvik, V.** 2012. Fire intervals moderate post-fire successional trends in Northern *Calluna* heathlands. *Applied Vegetation Science* 15: 119-128. *Nominated for AVS Editors Award 2012.*

A8. Stevens C.J., Dupré C., Dorland E., Gaudnik C., Gowing DJ.G., Diekmann M., Alard D., Bobbink R., Corcket E., Mountford J.O., **Vandvik V.**, Aarrestad P.A., Muller, S., & Dise N.B. 2011. Grassland species composition and biogeochemistry in 153 sites along environmental gradients in Europe. *Ecology 92:1544. Ecological Archives E092-128.*

A9. Stevens C.J., Duprè C., Dorland E., Gaudnik C., Gowing D.J.G., Bleeker A., Diekmann M., Alard D., Bobbink R., Fowler D., Corcket E., Mountford J.O., **Vandvik V.**, Aarrestad P.A., Muller S. & Dise N.B. 2010. Nitrogen deposition threatens species richness of grasslands across Europe. *Environmental Pollution* 158: 2940-2945.

A10. Måren I.E., Janovský Z., Spindelböck J.P., Daws M.I., Kaland P.E. & **Vandvik V.** 2010. Prescribed burning of northern heathlands: *Calluna vulgaris* and germination cues. *Plant Ecology* 207: 245–256. DOI 10.1007/s11258-009-9669-1

A11. Måren I.E., **Vandvik V.** & Ekelund K. 2008. Restoration of bracken-invaded *Calluna vulgaris* heathlands: effects on vegetation dynamics and non-target species. *Biological Conservation* 141: 1034-1044.

A12. Telford R.J., **Vandvik V.** & Birks, H.J.B. 2006. Evidence for regional-scale microbial metacommunities. *Science* 312: 1025.

A13. **Vandvik V.** & Goldberg D.E. 2006. Sources of diversity in a grassland metacommunity: quantifying the contribution of dispersal to species richness. *American Naturalist* 168: 157-167.

A14. **Vandvik V.**, Heegaard E., Aarrestad P.A. & Måren I.E. 2005. Managing heterogeneity: the importance of grazing and environmental variation on post-fire succession in heathlands. *Journal of Applied Ecology* 42: 139-149

A15. **Vandvik V.** 2004. Gap dynamics in perennial subalpine grasslands: trends and processes change during secondary succession. *Journal of Ecology* 92: 86-96.

Public lectures and outreach (selected)

P1. **Vandvik, V.,** and Skarpaas, O. 2013. Slik velger fjellplantene. Klima 1-2013: 32-35.

P2. **Vandvik, V,** Erga, S.R, Savolainen, H, Storesund, J.E. and Strand, T. Do Head of Department's Christmas speeches reflect the true state of the working environment? – An empirically-based case study from BIO in 2012. Bio-info, 1:7-8, 2013

P3. Esaete, J., Eycott, A. E., Telford, R. J., Akite, P., Bulafu, C. & **Vandvik, V**. 2012. The Matrix: Influence of Disturbance and Fragmentation on Species Richness in Ugandan Forests. Presentation to the Norwegian Ambassador to Uganda, 11th September 2012.

P4. **Vandvik V.**, Klanderud K., Meineri E., Spindelböck J., Bargmann T., Berge A., Pötsch C., Skarpås O., Nordli Ø., Daws M.I., Munzbergova Z., Goldberg D.E., Rydgren K. & Ohlsson M. 2011. SEEDCLIM: Effekter av klimaendringer - fra fysiologi via populasjoner til økosystemer. TALK at *The Norwegian Research Council, Brukerforum med Miljøverndepartementet,* Oslo, May 6th.

P5. Gjerde I. & **Vandvik V.** 2010. Vårt ansvar for det biologiske mangfoldet. OP-ED or 'KRONIKK' in the nationally-distributed newspaper *Nationen,* December 28th.

P6. **Vandvik V.** 2010. Klimaeffekter – hvs vet vi? INVITED TALK at *Naturvernforbudnet i Hordaland annual meeting*, Bergen, Norway. March 20th.

P7. **Vandvik V.**, 2010. A changing climate – what will the ecological consequences be? ...and what are the lessons learned [by researchers and conservationists]? INVITED TALK at the *North-East Normal University*, Changchun, China, September 2nd.

P8. **Vandvik V**., Klanderud K., Meineri E., Spindelböck J., Bargmann T., Berge A., Skarpås O., Nordli Ø., Daws M.I., Munzbergova Z. and Goldberg D. 2010. SEEDCLIM: The role of seeds in a changing climate – linking germination ecophysiology to population and community ecology TALK at *The Institute of Mountain Hazards and Environment, Chinese Academy of Sciences,* Chengdu, China, September 10th.

P9. **Vandvik V**., Klanderud K., Meineri E., Spindelböck J., Bargmann T., Berge A., Pötsch C., Skarpås O., Nordli Ø., Daws M.I., Munzbergova Z., Goldberg D., Rydgren K. and Ohlsson M. 2010. SEEDCLIM: Effekter av klimaendringer - fra fysiologi via populasjoner til økosystemer. TALK at *The Norwegian Research Council, Brukerforum med Landbruks og Matdepartementet,* Oslo, May 19th.

P10. **Vandvik V**., Klanderud K., Meineri E., Spindelböck J., Bargmann T., Berge A., Skarpås O., Nordli Ø., Daws M.I., Munzbergova Z. and Goldberg D. 2009. SEEDCLIM: The role of seeds in a changing climate – linking germination ecophysiology to population and community ecology TALK at *Tribhuvan University,* Kathmandu, Nepal, September 29th.

P11. **Vandvik V.** 2008. Conservation biology as a science and as a practice – do the numbers add up? INVITED TALK at the *Norwegian Directorate for Nature Management*, Trondheim, November 2nd.

P12. **Vandvik, V.** 2008. Mot en kunnskapsbasert naturforvaltning. Oppdrag: et forskerperspektiv. INVITED TALK at the *Directorate for Nature Management Seminar*, Rosendal, Norway. May 5-7.

P13. **Vandvik V.** 2006. Fusk i forskningen. FEATURE in the NRK RADIO PROGRAMME *Ut i Naturen* February 19th.

P14. **Vandvik V.** 2006. Conservation biology as a science and as a practice – do the numbers add up? INVITED SEMINAR at *Hordaland County / Norsk Hydro*, Bergen, June 4th.

P15. **Vandvik V.** 2005. Ein revolusjon I naturforvaltninga? No lauvast det i li. Liv i stein. Økomat for aper? Nisjer? Sjimpansen og jeg. Det siste måltidet til en mammut. Me hadde ei lita syster.

Haustfargar. Evolusjuonsdebatt og spaghetti. Evolusjon eller skaping? Fusk i forskninga. Evolusjon eller ikkje evolusjon, er det spørsmålet? Pandoras eske i polisen? Alt for paradiset! Den store, vesle kloten vår. Det ligg i uttrykket. Flaks i forskninga. A MONTHLY COLUMN commenting on various topics in biology, ecology, and evolution published in the nationally-distributed Norwegian newspaper *Dag og Tid* (www.dagogtid.no).

P16. Kvamme, M. & **Vandvik V.** 2006. Hva skjer med de vestnorske landskapene? FEATURE in the NRK RADIO PROGRAMME *Ut i Naturen* January 29th.

P17. Måren, I.E., Ekelund, K. and **Vandvik V.** 2005. Einstape i det vestnorske kystlandskapet, problem eller bagatell? *Naturen* 129: 67-76.

P18. **Vandvik V.** 2005. Balansen i naturen? OP-ED OR 'KRONIKK' in *HUBRO – magasin fra Universitetet i Bergen* 12: 28-29.

P19. Verdal, T. & **Vandvik V**. 2005. Nye innsikter i naturforvaltningen? OP-ED or 'KRONIKK' in *Bergens Tidende* November 21th.

P20. **Vandvik V.** 1999. Harmony lost – ecology from Linné's time till today. TALK at the *Natural Science and Philosophy Lecture Series*, UIB.

P21. **Vandvik V.** 1999. Nature, Culture, and Cultural landscapes. TALK at *Biologisk Mangfold på lokalnivå, Norsk biologforening (BIO)*, August 22-25th.

P22. **Vandvik V.** 1999. The harmony of Nature – the growth of ecological thinking from Linné's time. TALK at *Biologisk Mangfold på lokalnivå, Norsk biologforening (BIO)*, August 22- 25th.

CURRICULUM VITAE, PERNILLE BRONKEN EIDESEN

Born 29.01.1974, married, two children. Address: Vei 232-49i, 9170 Longyearbyen;
Mobile phone: 41 93 05 09; e-mail: PernilleE@unis.no

Current position: Associate Professor in terrestrial biology, botany at the University Centre in Svalbard, UNIS, PB 156, 9171 Longyearbyen, Norway.
Phone: +47 79 02 33 43, Fax: +47 79 02 33 01; http://www.unis.no

Education

2007	PhD, National Centre for Biosystematics (NCB), Natural History Museum (NHM), University of Oslo
2001	Cand. scient. Biology– Botany, University of Oslo
1998	Cand. mag., University of Oslo
1997	One year study in arctic biology at the University Courses at Svalbard, UNIS

Other courses

2003-2005	Attended and completed the training in education for employees giving lectures at the university

Positions

2009-present	Associate Professor in terrestrial biology, UNIS
2008-2009	One-year stand-in position as Associate Professor at UNIS
2002-2007	Four -year PhD position with duty work at NCB, NHM, University of Oslo (maternal leaves in 2004 and 2006/2007).
2001-2002	Research assistant at the Biological institute, University of Oslo

Teaching:

2012-present	Course responsible for AB206 Introduction to Svalbard's terrestrial flora and fauna (5 ECTS; bachelor level)
2011	Course responsible for AB326 Arctic Plant Ecology (10 ECTS; Master/PhD level)
2009-present	Course responsible for AB201 Arctic Terrestrial Biology (15 ECTS; bachelor level)
2003-2006	Contributed with lectures in the master course BIO 361/BIO 343 (Alpine ecology), University of Oslo/ University of Bergen
2002	Part-time instructor in the master course BB 300 (botany)
2000-2001	Part-time instructor, laboratory and field courses in general biology BIO 110, University of Oslo.

Supervision

I am currently the main supervisor for two PhDs, and supervising/co-supervising seven master students, and I have been supervising/co-supervising six master students that now are graduated.

Honour prizes

1) The National Centre for Biosystematic's young scientist price for best paper published in 2007
2) The King's Gold Medal for my PhD work

Peer-reviewed publications

Pedersen ÅØ, Tombre I, Jepsen JU, Eidesen PB, Fuglei, E, Stien, A (in press) Spatial patterns of goose grubbing suggest elevated grubbing in dry habitats linked to early snow melt. Polar Research

Eidesen PB, Müller E., Lettner C, Alsos IG et al. (in press) Tetraploids do not form cushions: Association of ploidy level, growth form and ecology in the high arctic Saxifraga oppositifolia L. s. lat. (Saxifragaceae) in Svalbard. Polar Research

Alsos IG, Müller E, Eidesen PB, (2013) Germinating seeds or bulbils in 87 of 113 Arctic species indicate potential for ex-situ seed bank storage. Polar Biology (online).

Alsos IG, Ehrich D, Thuiller W, Eidesen PB, Tribsch A, Schönswetter P, Lagaye C, Taberlet P, Brochmann C (2012) Genetic consequences of climate change for northern plants. Proc R Soc B 2012 : rspb.2011.2363v1-rspb20112363.

Müller E, Eidesen PB, Ehrich D, Alsos IG (2012) Frequency of local, regional, and long-distance dispersal of diploid and tetraploid Saxifraga oppositifolia (Saxifragaceae) to Arctic glacier forelands Am. J. Bot. 99:459-471

Weijers, S., Greve Alsos, I., Bronken Eidesen, P., Broekman, R., Loonen, M.J.J.E. & Rozema, J. (2012) No divergence in Cassiope tetragona: persistence of growth response along a latitudinal temperature gradient and under multi-year experimental warming. Annals of Botany.

Buizer, B., Weijers, s., Van Bogedom, P.M., Greve Alsos, I., Bronken Eidesen, P., Van Rijckesvorsel, J., Van Breda, J., de Korte, M. & Rozema, J. (2012) Range shifts and global warming: ecological responses of Empetrum nigrum L. to experimental warming at the northern (high arctic) and southern (atlantic) geographical range margin. Environmental Research Letters, 7, 025501.

Vik, U, Carlsen, T, Eidesen, PB, Brysting, AK H Kauserud (2012) Microsatellite markers for Bistorta vivipara (Polygonaceae). American Journal of Botany - Primer Notes and Protocols

Eidesen PB, Gulden G & Høyland K 2011 Sopptur i busens fotspor. Agarica, 31, 35-40

Brevik A, Moreno-Garcia J, Wenelczyk, J, Blaalid R, Eidesen PB, Carlsen T 2010 Diversity of fungi associated with Bistorta vivipara (L.) Delarbre root systems along a local chronosequence on Svalbard. Agarica, 29, 15-26

Ehrich D, Eidesen PB, Alsos IG, Brochmann C. (2009). An AFLP clock for absolute dating of shallow-time evolutionary history – too good to be true? Molecular Ecology, 18, 697-708.

Westergaard KB, Alsos IA, Ehrich D, Eidesen PB, Hollingsworth PM, Brochmann C, Genetic diversity and distinctiveness in Scottish arctic and alpine plants (2008) Plant Ecology and Diversity, 1, 329-338

Alsos IG, Eidesen PB, Ehrich D, Skrede I, Westergaard K, Jacobsen GH, Landvik JY, Taberlet P, Brochmann C (2007) Frequent long-distance plant colonization in the changing Arctic. Science, 316, 1606-1609

Eidesen PB, Alsos IG, Suda J, Popp M, Stensrud Ø, Brochmann C (2007) Nuclear versus plastid data: complex Pleistocene history of a circumpolar key species. Molecular Ecology, 16, 3902–3925

Eidesen PB, Carlsen T, Molau U, Brochmann C (2007) Repeatedly out of Beringia: Cassiope tetragona embraces the Arctic. Journal of Biogeography, 34, 1559–1574

Skrede I, Eidesen PB, Piñeiro Portela R, Brochmann C (2006) Refugia, differentiation and postglacial migration in arctic-alpine Eurasia , exemplified by the mountain avens (Dryas octopetala L.). Molecular Ecology 15, 1827-1840.

Bonin, A, Bellemain, E, Eidesen PB, Pompanon, F, Brochmann, C, Taberlet, P (2004) How to track and assess genotyping errors in population genetics studies. Molecular Ecology, 13, 3261-3273.

Books

Carlsen T, Eidesen PB, Gulden G, Høyland K & Jenssen KM Sopp på Svalbard (in press), Imprintforlaget, Oslo

Theses

Eidesen PB 2007 Arctic-alpine plants on the move: Individual and comparative phylogeographies reveal responses to climate change. PhD thesis, University of Oslo.

Bronken P 2001. Circumpolar chloroplast and nuclear DNA variation in *Saxifraga cernua*. Cand. scient. MSc thesis, University of Oslo.

Brief CV: Arild Raaheim

Current Positions

Professor, Department of Education, Higher Education Unit, University of Bergen.
Adjunct professor, Norwegian School of Economics, Bergen, Norway.

Academic Degrees

- **Doctor of Philosophy** (1995) Dept. of Psychosocial Sciences, University of Bergen, Norway
- **Master of art** (Mag.art) (1981) Dept. of Cognitive psychology, University of Bergen, Norway
- **Bachelor of art** (Cand.mag.) (1979) Dept. of Cognitive psychology University of Bergen, Norway.

International work/co-operation

1990-93	Norwegian co-ordinator in an international student- and staff exchange programme under ERASMUS/SOCRATES.
1989-94	Member of scientific committee for EHPS's annual conference. Chairman at different symposia.
1995	President for EHPS 9th Annual Conference in Health Psychology, Bergen.
2003-2007	Member of Steering Group, NETTLE, Network of European Tertiary Level Educators, (EC-funded project).

Evaluation work

Served on several national and international committees to evaluate institutions of higher education, as well as individual teaching programmes, e.g.:

2001	Member of international committee evaluating the Bergen National Academy of Arts.
2002-2003	Member of national committee evaluating a new master program in Genetic Counseling at the University of Bergen..
2004-2007	Member of national committee commissioned by the Ministry of Education to evaluate the Quality reform of higher education in Norway.
2008-2009	International expert, FINHEEC, evaluation of Centres of Excellence in University Education.
2009	International expert, FINHEEC's auditing team, Åbo Academy.
2011	International expert, FINHEEC's auditing team, Arcada University College, Helsinki.
2013	International expert, ACE Denmark. Re-accreditation of master-program in management development, Copenhagen Business School.

Publications (selected):

Raaheim, A. (1984). Can students be taught to study? An evaluation of a study skill programme directed at first year students at the University of Bergen. *Scandinavian Journal of Educational Research, 1*, 9-15.
Raaheim, A. (1987). Learning to learn at university. *Scandinavian Journal of Educational Research, 31*, 191-197.
Raaheim, A. (2000). Learning, knowledge, and assessment at university. Using assignment essays as an alternative to traditional exams. I: Fahlen, V., Liuhanen, A.M., Peterson, L. & Stensaker, B. (Eds.). *Towards Best Practice. Quality Improvement Initiatives in Nordic Higher Education.* Copenhagen: Nordic Council of Ministers, Temanord, 2000:501.
Raaheim, A. (2000). En studie av inter-bedømmer reliabilitet ved eksamen på psykologi grunnfag. *Tidsskrift for Norsk Psykologforening, 37*, 203-213.
Lauvås, P., Havnes, A. & **Raaheim, A.** (2000). Why this inertia in the development of better assessment methods? *Quality in Higher Education*, Vol. 6, *No. 1*, 91-100.
Raaheim, A. (2009). Quality in Finnish University Education. *Das Hochschulwesen*, Vol. 57, *No.1*, pp.15-20.
Raaheim, A. (2009). Aber meine PowerPoint-Folien bekommen Sie nicht! *Das Hochshulwesen,* Vol. 57, *No. 3*.
Skøien, A.K., Vågstøl, U. & **Raaheim, A.** (2009). Learning physiotherapy in clinical practice: Student interaction in a professional context. *Physiotherapy Theory and Practice*, Vol. 25, *No. 4*, 1-11.
Raaheim, A. & Karjalainen, A. (2012). *Centres of excellence in university education – Finland 1999-2012. An evaluation.* PUBLICATIONS OF THE FINNISH HIGHER EDUCATION EVALUATION COUNCIL 13:2012.
Raaheim, A. (2013). Lehren und Lernen. *Das Hochshulwesen*, Vol. 60, *No.1-2* («in press»).

Raaheim, A. & Raaheim, K. (Red.). (2000). *Læring hos voksne*. Bergen: Sigma Forlag A/S.
Raaheim, A. & Raaheim, K. (Red.), (2002). *Eksamen – en akademisk hodepine. En håndbok for studenter og lærere*. Bergen: Sigma Forlag.
Raaheim, A. (2011). Læring og undervisning. Bergen: Fagbokforlaget.
Raaheim, A. (2013). *Råd og tips til deg som underviser*. Oslo: Gyldendal Akademiske Forlag.

CV Geir Huse

Date of birth: June 11, 1969. **Nationality**: Norwegian. **Social status:** Married, 3 children.

Present position: Head of research Programme at the Institute of Marine Research.

Academic degree: Dr. scient. (PhD equivalent) 1998.

Field of research: I have worked extensively in developing and utilizing individual based models, in particular utilizing novel adaptive techniques to incorporate behavioural and life history decisions into individual based models. Spatial fish ecology has been another key interest area where I have worked on several problems related to horizontal distribution and migration in fishes both in relation to stock demography, predator-prey interactions and oceanographic processes. Part of my work has also been centred on the ecology of the Barents Sea capelin. Recently much work has been devoted to develop zooplankton models and end to end ecosystem models.

Scientific leadership: Head of the Research Programme Ecosystem and Stock Dynamics at the Institute of Marine Research since 2007 (responsible for about 40 projects and an annual budget of 100 mill. NOK). Reviewer for 13 different journals and 8 different international funding bodies. Opponent for 3 PhD candidates. Invited international talks: 8. Co-author on 4 book chapters. Leadership of 3 NFR projects and co-leader of a WP an ongoing EU project. Contributed to 7 successful EU projects and many NFR projects. **Leadership training:** Fulfilled the course AFF Yngre ledere at the Norwegian School of Economics (see http://aff.no/Lederutviklingsprogrammer/AFFYL/default.aspx)

Teaching and supervision: Fulfilled supervision of 2 PhD student and 2 master students. Taught introductory course in Population genetics at University courses on Svalbard during 2001-2003.

International peer-review publications: 48

International research visits:

- 2001: Humboldt State University, Arcata, CA. 1 month with Dr. Steve Railsback.
- 1997: Leicester University, England. 3 months with Professor Paul JB Hart.

Recent publications (2010-2012):

Bailey KM, Ciannelli L, Hunsicker M, Rindorf A, Neuenfeldt S, Möllmann C, Guichard F, **Huse G** (2010) Comparative analysis of marine ecosystems: workshop on predator-prey interactions. Biol Lett 6:579-581

Hjøllo, S., **Huse, G.**, Skogen, M., Melle, W., 2012. Modeling secondary production in the Norwegian Sea with a fully coupled physical/ primary production/ Individual-Based Calanus finmarchicus model system. Mar. Biol. Res. 8, 508-526.

Huse G, Fiksen Ø (2010) Modelling encounter rates and distribution of mobile predators and prey. Prog Oceanogr 84:93-104

Huse G, Holst JC, Fernö A (2010) Establishment of new wintering areas in herring co-occurs with peaks in the 'first time/ repeat spawner' ratio. Mar Ecol Prog Ser 409:189-198

Huse G. 2012. Book review. Review of Ecosystem Ecology a New Synthesis by David G. Raffaelli and Christopher L.J. Frid. Marine Biology Research: 8, 568-569.

Huse, G., Holst, J.C., Utne, K., Nottestad, L., Melle, W., Slotte, A., Ottersen, G., Fenchel, T., Uiblein, F., 2012a. Effects of interactions between fish populations on ecosystem dynamics in the Norwegian Sea - results of the INFERNO project Preface. Mar. Biol. Res. 8, 415-419.

Huse, G., Utne, K.R., Ferno, A., 2012b. Vertical distribution of herring and blue whiting in the Norwegian Sea. Mar. Biol. Res. 8, 488-501.

Kempf A, Dingsør GE, **Huse G**, Floeter J, Temming A (2010) The importance of overlap - predicting North Sea cod recovery with a multi species fisheries assessment model. ICES J Mar Sci 67:00-00

Ottersen G, Kim S, **Huse G**, Polovina JJ, Stenseth NC (2010) Major pathways by which climate may force marine fish populations. Journal of Marine Systems 79:343-360

Petitgas P, Secor D, McQuinn I, Huse G, Lo N (2010) Stock collapses and their recovery: mechanisms that establish and maintain life-cycle closure in space and time. ICES J Mar Sci 67:00-00

Righton DA, Andersen KH, Neat[3] F, Thorsteinsson[4] V, Steingrund P, Svedang H, Michalsen K, Hinrichsen HH, Bendall V, Neuenfeldt S, Wright P, Jonsson P, **Huse G**, van der Kooij[1] J, Hussy K, Metcalfe J (2010) Thermal ecology of north-east Atlantic cod stocks: 20 degrees of separation. Mar Ecol Prog Ser 420:1-13.

Rose KA, Allen JI, Artioli Y, Blackford J, Carlotti F, Cropp R, Flynn K, Hill S, Hille R, Lambers R, **Huse G**, Mackinson S, Megrey BA, Moll A, Rivkin R, Salihoglu B, Schrum C, Shannon L, Shin Y, Smith L, Smith C, Soldoro C, John MS, Zhou M (2010) End-To-End Models for the Analysis of Marine Ecosystems: Challenges, Issues, and Next Steps. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystems Science 2:115-130

Søiland, H., **Huse, G.**, 2012. Using RAFOS floats to simulate overwinter transport of Calanus finmarchicus in the Norwegian Sea. Mar. Biol. Res. 8, 502-507.

Utne, K.R., Hjollo, S.S., **Huse, G.**, Skogen, M., 2012a. Estimating the consumption of Calanus finmarchicus by planktivorous fish in the Norwegian Sea using a fully coupled 3D model system. Mar. Biol. Res. 8, 527-547.

Utne, K.R., **Huse, G.**, 2012. Estimating the horizontal and temporal overlap of pelagic fish distribution in the Norwegian Sea using individual-based modelling. Mar. Biol. Res. 8, 548-567.

Utne, K.R., **Huse, G.**, Ottersen, G., Holst, J.C., Zabavnikov, V., Jacobsen, J.A., Oskarsson, G.J., Nottestad, L., 2012b. Horizontal distribution and overlap of planktivorous fish stocks in the Norwegian Sea during summers 1995-2006. Mar. Biol. Res. 8, 420-441.

Vikebo, F.B., Adlandsvik, B., Albretsen, J., Sundby, S., Stenevik, E.K., **Huse, G.**, Svendsen, E., Kristiansen, T., Eriksen, E., 2011. Real-Time Ichthyoplankton Drift in Northeast Arctic Cod and Norwegian Spring-Spawning Herring. Plos One 6.

Short CV for Dr. Scient. Ole Jørgen Lønne

University Centre on Svalbard, Arctic Biology. PO Box 156, 9171 Longyearbyen. Norway. Born 20 Apr. 1954

Education

Cand. mag. University of Oslo, 1978.
Cand. real. Marine Zoology, University of Oslo, 1984.
Dr scient, Marine Zoology, Norwegian College of Fishery Science, University of Tromsø, 1992.

Research interests

Ecosystem ecology. Polar marine ecosystems. Sympagic communities. Benthic communities.

Appoinments

2008 -: Associate professor, marine biology (marine invertebrates), The University Centre in Svalbard. Forskningssjef II, Institute of Marine Research. (-2010)
2003 - 2008: Research director, Institute of Marine Research, head of the Tromsø branch.
1997- 2003: Associate professor, marine biology (marine invertebrates), The University Centre in Svalbard.
1995 - 1997: Senior Scientist at Akvaplan-niva as, Tromsø. Head of research and of section for marine arctic ecology.
1990 - 1995: Research fellow at The Norwegian College of Fishery Science, University of Tromsø.
2001: Visiting Honorary Research Associate, Zoology Department, University of Cape Town, South Africa.
1988-1989: Visiting Honorary Research associate at Institute of Marine Sciences, University of California, Santa Cruz, California, USA. Visiting Honorary Research associate at The Polar Science Centre, Applied Physics Laboratory, University of Washington, Seattle, Washington, USA.
1986-1990: Research associate at Department of Marine Biology, Tromsø Museum, University of Tromsø.
1984 - 1986: Technical Assistant and Manager (from July 1985), North Star Seafood as. Nøtterøy.

Offices held

Member of scientific advisory board; Research council project; Circa (2012-).
Member of scientific advisory board; Research council project; Clepoatra II (2012-).
Member of the steering committee , SAK - Project; "Arven etter Nansen" (2012-).
Member of Advisory board at Centre for Ice, Climate and Ecoystems (ICE) at Norwegian Polar Institute (2009 -2012).
Chairman of the Research and Education committee, UNIS (2009 - 2012).
Chairman at Department of Biology, UNIS (1997-1999, 2008- 2012).
Member of the directors leader group, UNIS (1997-1999, 2008-2012).
Member of the UNIS board (2000-2003, 2012-).
Member of the Amundsensenter board (2003-2005).
Member of the Marbank advisory board (2004- 2007).
Member of the directors leader group, Institute of Marine Research (2003- 2008).
Member of "Regjeringens ekspertutvalg for nordområdene" (2005- 2007).
Chairman of the MAREANO program committee (2005-2007).
Member of the project "Barentshavet på Skjerm" reference group (2006-2007).
Member of the marine working group under the the joint Norwegian -Russian commission on environmental co-operation (2005 - 2008).
Member of the "Arctic Frontiers" advisory board (2007 - 2008).
Member of the "ARCTOS" scientific committee. (2006 - 2008, 2013-).

External examiner

PhD dissertations; 2012: UiT; Hildur Pétursdóttir; (Trophic relationships and the role of Calanus in the oceanic ecosystems south and north of Iceland). 1. opponent. 2004; UiT; Børge Holthe; (The benthic macrofauna in north Norwegian and Svalbard fjord sediments). 2. opponent. Master Theses; 2008: UiT; Ragnhildur Gudmundsdóttir (Pseudocalanus in Svalbard wateres: identification and distribution patterns of two sibling copepod species). External sensor . 2006: UiT; Eli Skoglund (Fatty acid composition of the blubber and dermis of the Atlantic walrus (Odobenus rosmarus rosmarus) on Svalbard, and its potential prey). External sensor. 2002: NTNU; Britt Wassbotn Kamfjord (Fotograferingsteknikk og programutvikling av bildebhandlingsverktøy til numeriske studier av vekst og slitasje hos mosdyrene Membranipora membranacea og Electra pilosa (Bryozoa)). External sensor.

Courses taught (UNIS)

AB-202 Marine Arctic Biology (15 ECTS). AB-204 Arctic Ecology and Population Biology (15 ECTS). AB-301 (AB321) Marine benthic Fauna of Svalbard (10 ECTS). AB-303 Light Climate and Primary productivity in the Arctic (10 ECTS). AB-330 Ecosystems in Ice Covered Waters (10 ECTS). AB-310 (AB320) Marine Zooplankton and Sympagic fauna (=Ice Fauna) of Svalbard Waters (10 ECTS).

Students

Graduated: Merle Bollen (Master of Science U Bremen & UNIS). Susanne Kortcsh (Cand. Scient. UiT & UNIS). Tormod G. Hansen (Cand. Scient, UiO & UNIS). Sten R. Richardsen (Cand. scient. UiTø & UiB & UNIS). Ingo Fetzer (Diplom, U. Bremen & AWI & UNIS). Frank Beuchel (Diplom, U. Berlin & UNIS). Beatrice Crona (Diplom, U Stockholm & UNIS). Sten R. Birkely (Dr. scient., UiTø & UNIS). Ulrike Bartke (Diplom, U. Friedrich-Schiller, Jena & UNIS). Carolin E. Arndt (Diplom, U. Hamburg & UNIS). Tore M. Hoem (Cand. Scient, UiTø & UNIS). Rupert Krapp (Diplom, U. Kiel & UNIS). Piotr Kuklinski (PhD, U. Gdansk & UNIS). Carolin E. Arndt (Dr. scient, NTNU & UNIS). Bernt R. Olsen (Cand. Scient, UiB &

UNIS). Trine Moland (Cand. Scient. UIB & UNIS). Ongoing: Eike Stubner (Dr. scient., UiTø & UNIS). Øyunn Sparre (Cand. Scient, UiTø & UNIS). Carl Ballantine (Cand. Scient, UiTø & UNIS).

Field work

Participated in (headed many) more than 40 scientific cruises in Arctic and Antarctic waters

Selected Publications

Kortsch, S., Primicerio, R., Beuchel, F., Renaud, P. E., Rodrigues, J., Lønne, O. J. & Gulliksen, B. 2012 Climate-driven regime shifts in Arctic marine benthos. P Natl Acad Sci Usa, 1–26.

Renaud, P. E., Berge, J., Varpe, Ø., Lønne, O. J., Nahrgang, J., Ottesen, C. & Hallanger, I. G. 2012 Is the poleward expansion by Atlantic cod and haddock threatening native polar cod, Boreogadus saida? Polar Biol 35, 401–412.

Beuchel, F., Primicerio, R., Lønne, O. J., Gulliksen, B. & Birkely, S.-R. 2010 Counting and measuring epibenthic organisms from digital photographs: A semiautomated approach. Limnol Oceanogr-Meth 8, 229–240.

Misund, O. A., Torrissen, O., Bjordal, A., Moksness, E., Lønne, O. J. & Toft, K. Ø. 2008 Reorganization of the Institute of Marine Research, Norway, to Improve the Quality and Responsiveness of Scientific Advice for Management and Conservation Under the Ecosystem Approach. AMERICAN FISHERIES SOCIETY SYMPOSIUM. 49, 1139–1147.

Kuklinski, P., Gulliksen, B., Lønne, O. J. & Weslawski, J. M. 2006 Substratum as a structuring influence on assemblages of Arctic bryozoans. Polar Biol 29, 652–661. (doi:10.1007/s00300-005-0102-5)

Kuklinski, P., Gulliksen, B., Lønne, O. J. & Weslawski, J. M. 2005 Composition of bryozoan assemblages related to depth in Svalbard fjords and sounds. Polar Biol 28, 619–630.

Camus, L., Birkely, S.-R., Jones, M. B., Børseth, J. F., Grosvik, B. E., Gulliksen, B., Lønne, O. J., Regoli, F. & Depledge, M. H. 2003 Biomarker responses and PAH uptake in Mya truncata following exposure to oil-contaminated sediment in an Arctic fjord (Svalbard). Science of the Total Environment 308, 221–234. (doi:10.1016/S0048-9697(02)00616-2)

Beuchel, F. & Lønne, O. J. 2002 Population dynamics of the sympagic amphipods Gammarus wilkitzkii and Apherusa glacialis in sea ice north of Svalbard. Polar Biol 25, 241–250.

Fetzer, I., Lønne, O. J. & Pearson, T. H. 2002 The distribution of juvenile benthic invertebrates in an arctic glacial fjord. Polar Biol 25, 303–315.

Hop, H. et al. 2002 The marine ecosystem of Kongsfjorden, Svalbard. Polar Res 21, 167–208.

Scott, C. L., Falk-Petersen, S., Gulliksen, B., Lønne, O. J. & Sargent, J. R. 2001 Lipid indicators of the diet of the sympagic amphipod Gammarus wilkitzkii in the Marginal Ice Zone and in open waters of Svalbard (Arctic). Polar Biol 24, 572–576.

Hop, H., Poltermann, M., Lønne, O. J., Falk-Petersen, S., Korsnes, R. & Budgell, W. P. 2000 Ice amphipod distribution relative to ice density and under-ice topography in the northern Barents Sea. Polar Biol 23, 357–367.

Falk-Petersen, S., Sargent, J. R., Lønne, O. J. & Timofeev, S. 1999 Functional biodiversity of lipids in Antarctic zooplankton: Calanoides acutus, Calanus propinquus, Thysanoessa macrura and Euphausia crystallorophias. Polar Biol 21, 37–47.

Scott, C. L., Falk-Petersen, S., Sargent, J. R., Hop, H., Lønne, O. J. & Poltermann, M. 1999 Lipids and trophic interactions of ice fauna and pelagic zooplankton in the marginal ice zone of the Barents Sea. Polar Biol 21, 65–70.

Bustnes, J. O. & Lønne, O. J. 1997 Habitat partitioning among sympatric wintering Common Eiders Somateria mollissima and King Eiders Somateria spectabilis. Ibis 139, 549–554.

Lønne, O. J. 1992 Distribution, abundance and trophic role of the sympagic macro-fauna in Svalbard waters. PhD thesis. The Norwegian College of Fishery Science, University of Tromsø. pp. 1–44. Tromsø: University of Tromsø.

Lønne, O. J. & Gabrielsen, G. W. 1992 Summer diet of seabirds feeding in sea-ice covered waters near Svalbard. 12, 685–692.

Gulliksen, B. & Lønne, O. J. 1991 Sea ice macrofauna in the Antarctic and the Arctic. J Marine Syst 2, 53–61.

Lønne, O. J. & Gulliksen, B. 1991 On the Distribution of Sympagic Macro-Fauna in the Seasonally Ice Covered Barents Sea. Polar Biol 11, 457–469.

Lønne, O. J. & Gulliksen, B. 1991 Source, Density and Composition of Sympagic Fauna in the Barents Sea. Polar Res 10, 289–294.

Lønne, O. J. & Gulliksen, B. 1991 Sympagic Macro-Fauna From Multiyear Sea-Ice Near Svalbard. Polar Biol 11, 471–477.

Gulliksen, B. & Lønne, O. J. 1989 Distribution, abundance, and ecological importance of marine sympagic fauna in the Arctic. Rapp PV Reun Cons Int Explor Mer 188, 133–138.

Lønne, O. J. & Gulliksen, B. 1989 Size, age and diet of polar cod, Boreogadus saida (Lepechin 1773), in ice covered waters. Polar Biol, 187–191.

Erikstad, K. E. et al. 1998 Sjøfugl. In Kystøkologi. Den ressursrike norskekysten (eds E. Rinde A. Bjørge A. Eggeride & G. Tufteland), pp. 134–165. Oslo: Universitetsforlaget.

Lønne, O. J. 1988 A diver-operated electric suction sampler for sympagic (= under-ice) invertebrates. Polar Res 6, 135–136. (doi:10.1111/j.1751-8369.1988.tb00589.x)

Lønne, O. J. & Gray, J. S. 1988 Influence of Tides on Microgrowth Bands in Cerastoderma-Edule From Norway. Mar Ecol-Prog Ser 42, 1–7.

Miscellaneous

2013: Polar Biology. Guest editor for a special volume on Polar Night Biology (2013)

2005-2006: "Solstrandprogrammet". Leadership development program organized by AFF at The Norwegian School of Economics and Business Administration (NHH) .

2004: Member of Minister of fisheries and coastal affairs, Svein Ludvigsens, visit to South Africa, Mozambique and Namibia. Sept. 10 – 19. 2004.

1999: Universitspedagogisk basiskompetanse.

CV and publication list – Anders Goksøyr

Name: Anders Goksoyr, born: 9. april 1957
Address: Nattlandsveien 115, N-5094 Bergen, Norway
Family: Married to Anne Øfsthus, 2 children (Siri, born 1988; Tale, born 1993)

Education: Cand. scient. 1984 (biochemistry), University of Bergen. Dr. scient. 1987 (biochemistry/toxicology), University of Bergen; FELASA certificate, 1998; EUROTOX reg. toxicologist, 2002.

Positions: 1992-1996: Associate Professor, Department of Fisheries and Marine Biology, UoB; 1996-2009: Professor and Group leader, Department of Molecular Biology, UoB.;1996-2007: Founder and R&D Director of Biosense Laboratories AS; 1998: Visiting scientist (sabbatical) at The Scripps Research Institute, La Jolla, California; 1999-2001: Managing Director, Biosense Laboratories AS; 2006-2009: Chair, Molecular and Computational Biology Research School, University of Bergen.

Current position (since Jan. 1, 2010): Head of Department and Professor, Dept. of Biology, UoB.

Research interests: toxicological research, food safety, applied biotechnology and biomarker development, especially on the cytochrome P450 system, nuclear receptor regulation and reproductive toxicology of aquatic species; recently focusing on toxicogenomics and environmental genomics, incl. proteomics. 128 peer-reviewed scientific publications and ca. 280 conference abstracts. H-index = 39, cited 4909 times (ISI, May 03, 2013); h-index = 48, cited 6640 times (Google Scholar, May 03, 2013). Popular science activities involve book writing (2 books, incl. one for kids), and numerous newspaper articles and interviews.

Teaching interests and experience: Course in university pedagogics, University of Bergen (1992). Lecturing and course responsibility in various smaller courses since 1993 (10-30 students), topics: Marine pollution, Aquatic Toxicology, Toxicology, Arctic Ecotoxicology (at UNIS). Lecturing at medium sized and larger courses (50-200 students) in Molecular Biology and Metabolism (2004-2010). Has experimented with various teaching methods, student assignments and assessments, incl duet lectures, group projects, journal clubs, student presentations, student "newsletters", seminar style teaching, lab courses, visits to industry/institutes, home exams etc. Nominated for Best Lecturer Award at the Natural Science Faculty, UiB, for the Toxicology course (2006).

Doctoral students supervised: total 18, 14 finished since 1996.
Cand. scient./Masters students supervised: total 35, 32 finished since 1992.

Other appointments: Chair of the National Board for Biological Sciences (UHR) since 2011. Chair of the Strategic Committee for Marine Science (UoB) since January 2013. Chair of the Strategic Advisory Board for the Institute of Marine Research, appointed by the Ministry of Fisheries and Coastal Affairs, since 2012. PhD Opponent in SF (2), ESP, DK, SE, NL, D, NO (4). National expert to ISO since 2008. Organizer, 7th International Symposium on Pollutant Responses in Marine Organisms, Bergen, Norway, April 1997. Member of International Advisory Board, International Symposium on Pollutant Responses in Marine Organisms (PRIMO 13-16), Alessandria, Italy, 19.-22. June 2005, Florianopolis, Brazil, 6.-9. May 2007, Bordeaux, France, 17.-20. May 2009, Long Beach, CA (USA), May 15-18, 2011, Faro, Portugal, May 5-8, 2013. Member of Scientific Committee, Dioxin 2006, Oslo, Norway, August 21-25, 2006. Member of Scientific Advisory Committee, 2nd Norwegian Environmental Toxicology Symposium, Trondheim, Norway, April 2-4, 2008. Chair, organizing committee and scientific advisory committee for 3rd Norwegian Environmental Toxicology Symposium, Bergen, Norway, April 14-16, 2010. Member of the International Scientific Committee, 27th Annual Conference of the European Society of Comparative Physiology and Biochemistry, Alessandria, Italy, 5.-9. September 2010, and 28th Annual Conference of the European Society of Comparative Physiology and Biochemistry, Bilbao, Spain, 2.-6. September 2012.

Experience as project manager for numerous NFR projects since 1988, as WP leader in EU projects (since FP5), as group leader at Department of Molecular Biology 1996-2009, and for Environmental Toxicology Research Group at Department of Biology since 2010.

Awards: L. Meltzers Høyskolefond's Award for Young Scientists, University of Bergen, 1989.
Special Dutch Award for Young Scientists 1990, The Dutch Community of Physiologists and Toxicologists.

Member of the Norwegian Academy of Technological Sciences (NTVA), the Norwegian Society of Pharmacology and Toxicology, the Norwegian Society of Biochemistry, the Norwegian Biologists Association (BIO), the Norwegian Non-fiction Writers and Translators Association (NFF), Society of Environmental Toxicology and Chemistry (SETAC).

Recent invited lectures:

The Norwegian Academy of Science and Letters (DNVA) seminar "Multiple stressors" (Oslo, 12. januar 2011): "Lavdose aktivering av kjernereseptorer: kan hormonforstyrrende effecter oppstå via ulike signalveier?"
Baltic-Mediterranean Workshop, (Marseille, April 4-5, 2011).

*Moteplass Marin: Marin bioteknologi (*Bergen 30. mai 2011)*:* "Marin bioteknologi: hvor kan universitetet bidra?"
3rd Rendezvous a Concarneau, Where academia meets industry (Concarneau, France, August 30-31, 2011): "Marine biotech as a future industry: where can the university contribute?"
Woods Hole Oceanographic Institution, USA, seminar (Woods Hole, October 4, 2011): "From toxicogenomics to mechanistic insights - or the other way around? Studies of CYPs and nuclear receptor SXR in fish and marine mammals".
KLIF's Miljogiftsymposium (Oslo, 18. januar 2012): "Når komplekse eksponeringer påvirker komplekse systemer: behov for komplekse metoder i effektovervåking".
CSA Marine Biotech Workshop (Olhana, Portugal, April 26-27, 2012): "Marine biotechnology for aquaculture, fish health, and ocean health" (Anders Goksøyr & Hans Kleivdal).
Norwegian Society for Pharmacology and Toxicology, the Poulsson Lecture Seminar (Oslo, September 6, 2012): "A systems biology approach to elucidate mechanisms involved in biological effects caused by environmental stressors".
Forum for Offshore Environmental Monitoring (Oslo, Norway, Oct. 30.-31. 2012): "Environmental genomics of Atlantic cod: A toxicogenomic approach for biomarker development".
Norman workshop at the VU University in Amsterdam on Occurrence, fate and effects of emerging pollutants in the environment – chemical analysis and toxicological assessment (Amsterdam, November 29-30, 2012): "Biological tools for effect assessment".
European Centre for Environment and Human Health, University of Exeter Medical School – Environment and Health Seminar Series (Exeter, September 5, 2013): "Ocean Health and Human Health".

Recent publication list AG:

Scientific articles w/referee (since 2010)

1. Marteil G, D'Inca R, Pascal A, Guitton N, Midtun T, Goksoyr A, Richard-Parpaillon L, Kubiak JZ. EP45 accumulates in growing Xenopus laevis oocytes and has oocyte-maturation-enhancing activity involved in oocyte quality. J Cell Sci. (2010) May 15;123(Pt 10):1805-13. Epub 2010 Apr 27.
2. Berntssen, M.H.G., Olsvik, P.A., Torstensen, B.E., Julshamn, K., Midtun, T., Goksoyr, A., Johansen, J., Sygholt, T., Joerum, N., Jakobsen, J.-V., Lundebye, A.-K., Lock, E.-J. Removing persistent organic pollutants while maintaining long chain omega-3 fatty acid in farmed Atlantic salmon by use of decontaminated fish oils during a full cycle production. Chemosphere, 81:242-252 (2010).
3. Berg, K., Puntervoll, P., Valdersnes, S. and Goksoyr, A. (2010). Responses in the brain proteome of Atlantic cod (Gadus morhua) exposed to methylmercury. Aquat. Toxicol., 100:51-65.
4. Meier, S., H.C. Morton, G. Nyhammer, B.E. Grosvik, V. Makhotin, A. Geffen, S. Boitsov, K.A. Kvestad, A. Bohne-Kjersem, A. Goksoyr, A. Folkvord, J. Klungsoyr and A. Svardal, (2010). Development of Atlantic cod (*Gadus morhua*) exposed to produced water during early life stages: Effects on embryos, larvae, and juvenile fish. Mar. Environ. Res., 70:383-394.
5. Olsvik, Pål A., Brattås, Marianne, Lie, Kai K., and Goksoyr, Anders. Transcriptional responses in juvenile Atlantic cod (Gadus morhua) after exposure to mercury-contaminated sediments obtained near the wreck of the German WW2 submarine U-864, and from Bergen Harbor, Western Norway. Chemosphere, 83:552-563 (2011).
6. Schwesig, David; Borchers, Ulrich; Chancerelle, Laure; Dulio, Valeria; Eriksson, Ulla; Farre, Marinella; Goksoyr, Anders; Lamoree, Marja; Leonards, Pim; Lepom, Peter; Leverett, Dean; O'Neill, Anne; Robinson, Rod; Silharova, Katarina; Slobodnik, Jaroslav; Tolgyessy, Peter; Tutundjian, Renaud; Wegener, Jan-Willem; Westwood, David. A harmonized European framework for method validation to support research on emerging pollutants. Trends Anal. Chem. 30:1233-1242 (2011).
7. Goksoyr, Anders (guest ed.). 3rd Norwegian Environmental Toxicology Symposium: Emerging Solutions for Emerging Challenges. Journal of Toxicology and Environmental Health-Part A, 74:405-406 (2011).
8. Karlsen, Odd Andre, Bjorneklett, Silje, Berg, Karin, Brattås, Marianne, Bohne-Kjersem, Anneli, Grosvik, Bjorn Einar, and Goksoyr, Anders. Integrative Environmental Genomics of Cod (Gadus morhua): The Proteomics Approach. Journal of Toxicology and Environmental Health-Part A, 74: 494-507 (2011).
9. Berg, K., Puntervoll, P., Klungsoyr, J. and Goksoyr, A. Brain proteome alterations of Atlantic cod (*Gadus morhua*) exposed to PCB 153. Aquatic Toxicology 105(3-4):206-217 (2011).
10. Odd André Karlsen, Pål Puntervoll, Anders Goksoyr. Mass spectrometric analyses of microsomal cytochrome P450 isozymes isolated from beta-naphthoflavone-treated Atlantic cod (*Gadus morhua*) liver reveal insights into the cod CYPome. Aquatic Toxicology 108:2-10 (2012).
11. Nøstbakken OJ, Goksoyr A, Martin SA, Cash P, Torstensen BE. Marine n-3 fatty acids alter the proteomic response to methylmercury in Atlantic salmon kidney (ASK) cells. Aquatic Toxicology 106-107:65-75 (2012).
12. Yadetie F, Butcher S, Førde HE, Campsteijn C, Bouquet JM, Karlsen OA, Denoeud F, Metpally R, Thompson EM, Manak JR, Goksoyr A, Chourrout D. Conservation and divergence of chemical defense system in the tunicate *Oikopleura dioica* revealed by genome wide response to two xenobiotics. BMC Genomics 13:55 (2012). doi: 10.1186/1471-2164-13-55.
13. Yadetie F, Karlsen OA, Berg K, Olsvik P, Lanzen A, Hogstrand C, Goksoyr A. Global transcriptome analysis of Atlantic cod (Gadus morhua) liver after in vivo methylmercury exposure suggests effects on energy metabolism pathways. Aquatic Toxicology, 126:314-325 (2013).

bioCEED – project plan

In this project plan we outline in more detail the practical aspects of the organization, work flow, and Activity integration within bioCEED, as well as the motivation behind the choice of organizational structures and processes. Figures and tables referred to are found in the original application, and specific Milestones and Deliverables for each planned Action are specified in the revised timeline.

Activities within a Centre of Excellence in Education face the challenge of integrating activities that form a major component of the everyday work of the institutions involved (i.e., running a number of biology programs at BIO and AB) while at the same time making room for and stimulating real change. bioCEED involves several institutions, and this confronts us with the additional challenge of leading and administering a Centre involving several partners, as well as fostering learning and sharing of experience across institutions within the project and beyond.

Our ultimate goal is to transform educational culture and learning methods in biology across the curriculum. This will require radical change. The bioCEED structure and organization reflects our conviction that this can only be achieved by working systematically with student and staff attitudes and behaviors, as well as with the wider learning environment, in collaboration with end-users in the public and private sector. Key aspects of and motivations for the planned structures and processes are given below.

1. Organization and delimitation of work packages

The bioCEED activities are organized in work packages (WPs); each of WP1-4 reflects a distinct aspect of the educational activity we want to transform (Figure 2), and WP5-7 reflect the interface between education *sensu stricto* and the internal and external structures in which education is embedded. Some important aspects of the rationale behind the delimitation and organization of WPs are:

- Development of teacher culture, learning environments, student attitudes, and curricula (WP1-4) are tightly interlinked, but we chose to designate separate WPs for each of these four aspects of education to ensure that we will identify, implement and monitor the success of specific Actions related to all aspects that are of particular importance for attaining our overall objectives.
- Development of educational leadership, spread of best practice, and strong sector and societal links are key to our vision for the future biology education, yet these aspects are often seen as 'external' to education itself. We designate separate work packages for each of these aspects (WP5-7) to ensure that we will efficiently identify, implement and monitor the success of specific Actions aimed at strengthening and utilizing these resources in developing our educational programs ('education *sensu lato*').
- To ensure focus on development of the institutional educational leadership and management structures, which we believe are critical to success, this aspect (WP5) is distinguished from coordination of the bioCEED Centre (WP0).
- The designation of WP Leaders with responsibility for each WP across institutions is deliberate, and will foster collaboration and sharing within the consortium. A number of specific Actions will be organized directly through bioCEED (e.g., A5, A12, A22, A29),

others can usefully be implemented locally at BIO and AB (e.g., A7, A24) but will still be planned, reported and monitored through the respective bioCEED WPs.

2. Spearheading radical change while achieving progress across the community

In bioCEED, we believe that excellence in education at the institutional or program level can only be achieved through interplay between activities that spearhead radical change in individual courses or parts of the programs and activities that foster improvement and sharing of experiences across the curriculum. The bioCEED Work Packages, Actions, organization (see Figure 3 in the original application), and planned internal communication avenues are specifically designed to achieve a productive balance:

- During the first 12 months of the bioCEED Centre period, a number of structures will be put in place to foster communication and sharing of educational experience amongst teachers (A5-7, Workshops), students (A11, A16, A17), leaders (A24, Project Meetings) and more widely within our institutions (A9, A27, A28, General Assembly). These will foster development in their own right, while also providing avenues for communicating lessons from the more radical action points (see below, and original application for a full list).
- 'Educational experiments' (A22a,b) with potential for fostering radical change are a key aspect of bioCEED, and they will be implemented in a project-based fashion within single courses, or parts of the curricula, throughout the Centre period. Each experiment will typically involve several other Actions (e.g., A8, A12-17, A23, A26), and last for a limited time (6 months – 2 years). The adjunct professors (A6) and the two PhD students in educational science (A21) and MSc students in our Integrated Teacher Program will be important resources in planning, testing, documenting learning outcomes, and sharing experiences within bioCEED and with the higher education sector (A29-32). Both bottom-up and top-down processes will be used in the design and selection of specific 'educational experiments', and institutional strategies, teacher commitment, and compliance with the bioCEED vision will be important selection criteria. Efforts will be recognized and rewarded (A8, A27-28). These 'educational experiments' will form the basis for two PhD theses (A21, A22b). At any time, 10% of our courses will be involved in educational experiments.
- Both progress across the community and radical change in selected parts of the curriculum will be supported by a number of Actions related to improved educational infrastructure (A9-13, A29), organization (A19,A26, A33-35), staff recognition (A19, A20, A27, A28, A30, A31a), and leadership (A24, A25). Such Actions are not *sufficient* for driving educational transformation but they are *critical* for supporting, promoting and sustaining improvements.

3. Activity alignment - both in the classical and in a broader sense

Through WP 4 we will focus on activity alignment of our programs in the classical sense. This WP will work towards developing educational plans, curricula, teaching and learning methods, quality assurance, and evaluation methods that are well aligned internally, and that all contribute to support student development towards our vision for tomorrow's biologists (see original application Chapter 1).

We envisage that the bioCEED vision should have implications not only for our educational programs *sensu stricto*, but also for the wider working environment. This is what we refer to as activity alignment in a 'broader sense' – as the bioCEED vision (promote integration across

the 'triangle', participatory learning, and educational scholarship) will also guide the various activities, structures and processes involving staff, leadership and stakeholders.

4. Strengthen links between education and society

Our vision of education that span the entire 'domain' of biology (Fig. 1) can only be realized if we succeed in involving end-users and our collaborative partners in industry, research and the public sector actively in our educational programs. Close collaboration and communication with the sector (WP7; A33-35) is critical towards this goal, not only for discussing the needs of employers vs. the qualifications of our candidates (incl. A18), and presenting students for the range of career opportunities in biology (through A33[1]), but also for involving the sector in our educational programs as lecturers (guest lectures, Adjunct Professors), by collaborating over development of research tasks and topics, through developing relevant case studies for active student participation and problem-solving, and as hosts for student placements (internships), from Bachelor to PhD (A17).

5. International collaboration within education and educational development

Collaboration with other institutions that offer biology education and with educational scientists both in Norway and internationally is critical for success, both in terms of our own educational development and our impact through spread of 'best practice'. bioCEED will foster such collaboration through appointment of the International Advisory Board (A3), recruitment of international Adjunct Professors with experience from biology education development at universities abroad (A6), participation in pedagogic courses and educational exchange in Norway and internationally (A8), development of a freely-available web-based 'idea-bank' for biology education in English and Norwegian (A29), publication of project results in international educational science peer-reviewed journals (A30), promotion of modules developed in bioCEED for use in other institutions Norway and internationally (A31a,b), and organizing an international conference in biology education, with high-profile international keynotes, every three years (A32).

6. Assessment of risks, and plans for mitigation

Major risks envisaged are (i) insufficient staff and student motivation for and involvement in progress towards the bioCEED goals, (ii) insufficient institutional support, (iii) organizational and practical obstacles to implementation, and (iv) improperly conducted 'educational experiments' resulting in a failure to identify and/or implement appropriate learning methods for different educational settings, and (v) poor dissemination of results. Through the bioCEED planning phase, we have identified the following measures to mitigate these potential risks: (i) set up structures and processes for involving and rewarding staff and students at different levels of commitment both during the planning and in the Centre (see e.g., 2 above and the communication avenues envisaged in chapter 4 in the application), (ii) ensured full support from our institutions, at all levels, before applying (including economic commitments, see the budget), (iii) developed critical structures and processes as described above and in the revised timeline and project description, (iv) secured efficient communication internally and externally and included research on participatory learning by scientists at HERU in bioCEED, including two PhD students in educational science who will conduct their thesis research on the learning outcomes of different educational practices within bioCEED, with particular focus on the 'educational experiments' (A21, A22a,b, A31a,b), and (v) a detailed multi-avenue communication plan and dissemination strategy.

[1] BIO's three student organizations are already hosting an Annual Biology Career Day, and the experience and contacts already established through this will provide a starting point for developing these Annual Meetings.

bioCEED – monitoring and measures of success

Monitoring of progress and follow-up within the consortium

The project meetings and annual reports will be the major arena for reporting within the consortium. Here all institutions and WP leaders will meet and report on and discuss progress and achievements as well as any significant deviations from the project description, plan, timeline, milestones and deliverables. Measures to support positive and mitigate negative deviations will be discussed here. For minor deviations, decisions on measures will be made within the Centre, by the Centre leader, supported by the bioCEED consortium. More substantial deviations will be reported to the project owner (NOKUT/KD, see below).

Between project meetings, WP leaders are responsible for reporting to the Centre leaders on significant deviations from the planned activities (as specified in the project description, project plan, and the revised timeline including milestones and deliverables). Many of the deliverables are quantitative in nature (e.g., internship rates increased by 15% of courses per year, 20% reduction in lecturing, one educational sabbatical at any time, 4 scientific papers documenting bioCEED results per year, involving 5% of the staff). For these deliverables, a 25% deviance from the set goal will lead to specific mitigation measures overseen by the project leadership. Many of the quantitative measures are also indirect indicators of a changed educational culture, i.e. staff interest in educational sabbaticals, involvement and engagement in changes at course and/or program level, participation at workshops, conferences etc. arranged by bioCEED and others.

Achievements and successes, but also needs for revisions and change of plans, will be communicated within the WPs in project meetings and workshops, within the project through project meetings and the web forum, and externally to the higher education sector, societal sectors, and end-users through the various structures set up in the project for communication with these specific audiences (see chapters 3., 4., and 5., in the Project Plan and the dissemination strategy for a detailed description).

The Quality Assurance (QA) Systems for education activities at UiB and UNIS[2] will supplement the centres own quality assurance and monitoring (A3, A4), and evaluations and student surveys will be used in measuring the effects of deliverables on student learning, engagement and satisfaction. bioCEED will also contribute actively in the institutions' on-going development of their QA systems to meet the needs for assessing learning outcomes. In addition to continuous monitoring by the QA system, the two PhD students' research will assess learning outcomes of bioCEED activities (see A21, A22, A31, and section 6 above).

Monitoring of progress for reporting to NOKUT and KD

Progress towards bioCEED goals and results relating to specific Actions will be reported to NOKUT through the standard reporting procedures set up for SFUs. We have carefully chosen the milestones and deliverables for each of the Actions to be useful and informative. In particular, a number of the deliverables are quantitative in nature (e.g., new aspects of student active learning implemented in 33% of courses per year, students involved in teaching in 50% of courses by the end of 2015). This will facilitate monitoring and help evaluate progress towards bioCEED goals, but may of course also be subject to revision if the bioCEED development suggests that the pre-set targets were unrealistic and/or undesirable.

[2] UiB Quality Assurance System and the UNIS Annual report 2010

bioCEED – dissemination strategy

Dissemination of bioCEED results and findings will take place both locally within our host institutions, regionally, within Norway, and internationally. The wide range of educational settings in our biology programs (theory, analysis, field, lab, expeditions, internships, project work) provide a rich source of experiences that will be of relevance across the university. We envisage that bioCEED will gain new knowledge on the development and implementation of participatory learning methods in different educational settings (the bioCEED triangle, Figure 1), on learning outcomes of the use of internships in biology education, on different approaches to transforming the university learning culture, and on biology education tools, that will be of interest for a variety of audiences, locally to internationally.

Although there is some overlap between the content of and channels for dissemination at these different scales, they are presented separately below to highlight which dissemination channels we envisage will be most successful and what audiences and end-users we consider especially relevant at each scale. bioCEED's large collaborative network, including institutions in higher education, research, industry, the public sector and NGO's (see attachment 4 in the original application) will be an important asset for dissemination vs. several audiences, and at all these scales. Our Alumni are found in industry, research and development, and education. By utilizing the alumni network, we will reach an interested and engaged audience with direct and broad impact on both industry and the public sector.

Local dissemination within the host institutions

Locally, we will focus on disseminating relevant findings and experiences from bioCEED to other departments and faculties within our institutions, and we will hence focus on findings of relevance outside the biological disciplines.

Dissemination to the current UiB and UNIS staff will be achieved through university-wide workshops and seminars focusing on implementation of different educational tools and methods: student-active learning in different settings; use of educational technology; the flipped classroom; internships in an university setting; meeting the MOOC challenge; making use of the research culture in university education. We will explore 'open house days', where all interested members of the UiB and UNIS staff are invited to visit some of our courses to experience different educational activities in a real-life setting. Within UiB, bioCEED results will form the basis for a module in student-active training that will be developed by HERU and given as part of UiB's initial entry training program for university teachers (A31b). This module will focus on findings of general relevance for university education, using bioCEED case studies as examples. Dissemination to the next-generation university teachers will be achieved through new training courses for PhDs and postdocs at UiB planned as a follow-up of the recent evaluation of HERU (Ideas2evidence).

We will also present our findings and ideas at departmental, faculty, and university-level workshops and seminars focusing on strategy, quality in education, and on university pedagogy and learning[3].

Regional dissemination

At the regional scale, within Western Norway, our dissemination strategy will focus on communicating our findings with (i) other higher education institutions, including university

[3] Local and National conferences on Quality in Education, UiB Education Committee (Utdanningsutvalget) etc.

colleges, (ii) schools, (iii) relevant regionally important institutions in industry[4], research, and the public sector, and (iv) the general public.

Dissemination to higher education institutions will follow many of the same lines as local-scale dissemination. Staff at relevant higher-education institutions can attend our training courses, spend shorter or longer periods as 'visiting educators' at bioCEED (A8), and use our new student-active learning modules (A31b). We will also offer seminars and courses to these institutions. In the school system the biology teachers at high school level will be the main target group, and we will cooperate with the Centre for Science Education (SCE) and the Teachers' Education program at UiB as well as with UiB's partner high schools.

Communication with and dissemination (WP7) to the regional private and public sector will be structured through the bioCEED annual student-sector meetings (A33), end-user panels (A34), and publications and presentations in various sector-specific fora (A35), but will also be facilitated through involving the sector directly in our programs as guest lecturers or adjunct professors, and as hosts for placement students, from Bachelor to PhD (A17). For an overview of relevant partners, see chapter 5 in the original application.

Dissemination to the general public will be through contributing to popular science journals, promoting coverage in outlets such as Forskning.no and ScienceNordic, and through collaborating with Bergens Tidende (the internationally award-winning regional newspaper that also shares material with several other newspapers in Norway, Scandinavia, and Europe). Bergens Tidende has recently launched a new priority on science journalism, to which bioCEED can contribute relevant material. We envisage 1-3 popular-science articles yearly, which would enhance the visibility of and debates concerning university education, and pique the interest of the general public regarding biology, university-society relations, our learning "experiments" and the improvement of higher education in a broader sense.

bioCEED will thus fill four important dissemination gaps at the regional scale: (i) We will disseminate the qualifications (including transferrable skills) of bioCEED candidates to the end-user institutions, (ii) the public and private sector will communicate career opportunities to the students, (iii) we will discuss future qualification needs (incl. A18), and opportunities for educational development, and (iv) we will communicate the importance of biology and the challenges of university education reform to the general public.

National dissemination

At the national scale, we will focus on communicating with (i) Norwegian higher education institutions offering biology programs, especially universities and university colleges[5], and (ii) with relevant Norwegian institutions in industry, research and the public sector.

The dissemination vs. other biology departments will enable sharing and testing of the biology-specific educational tools (A10, A12) and modules (A31a) developed in bioCEED, as well as staff exchange (A8). Staff from these institutions will be invited to participate in the bioCEED conference (A32; we target 50% Norwegian participation at the conference, including 25% from the bioCEED partner institutions) and to use, test, and contribute to the 'idea-bank' (A29). UNIS' collaborative agreements with NTNU, UiB, UiO, UiS, UiT, and UiA will

[4] The Bergen Chamber of Commerce and Industry, which organizes around 3000 members in the business sector in the Bergen Region, will be an important collaborator in the communication vs. this sector; The Christie conference where academia and society meets.

[5] Through fora like The National Conference on Quality in Education, , activities through Norgesuniversitetet, the annual Norwegian 'Science and Technology Conference, and the National Academic Council for Biology,

be used actively for dissemination at the national scale. We have been in contact with these institutions after we were invited to round 2 of the CoEE call, and they express enthusiasm and interest in participating in the bioCEED conference and other collaborative activities.

The national private and public sector communication and dissemination (WP7) will focus on the end-user panels (A34), and sector-specific fora (A35), although some national-scale institutions are also involved directly in our programs (see original application part 5).

Dissemination to the general public will be by contributing to popular science journals and through the press, such as by collaboration with Bergens Tidende.

At the national scale, bioCEED will thus primarily contribute to the development of biology education and educational science, but we will also contribute to national-scale communication between higher education in biology and the public and private sector, and we will participate to the public debate over biology and university education.

International dissemination

Communication and dissemination internationally, as well as within Norway, is critical for success, both in terms of our own educational development and our impact through spread of 'best practice'. Internationally, we will focus on collaboration with and dissemination to (i) other higher-education institutions that offer biology programs and (ii) the scientific community within educational science.

bioCEED will foster international collaboration and dissemination through appointment of an International Advisory Board with representatives from both educational science and biology education (A3), recruitment of international Adjunct Professors with experience from educational development within biology (A6), participation in pedagogic courses and both incoming and outgoing educational exchange (A8), development of an English-language interface for the freely-available web-based 'idea-bank' for biology education (A29), publication of bioCEED educational research results in international educational science journals (A30), participation in international conferences on education[6] promotion of tools and modules developed in bioCEED for use in biology education (A10, A12, A31a) and in general educational training (A31b) towards international universities. Our institutional networks[7] will be mobilized as channels of communication and dissemination.

Our flagship dissemination channel will be organizing an international conference in biology education, with high-profile international keynotes, every three years (A32). We have previous experience with organizing such conferences in Bergen (see Vandvik's CV), and we are confident that there is a strongly felt need and considerable interest for this conference. The themes of the conference will follow the bioCEED Centre development, and will ensure a dissemination channel for our results as well as contact with relevant international institutions and experts.

At the international scale, bioCEED will thus focus on contributing to the development of biology education and educational science.

[6] E.g. EFYE – European First Year Experience
[7] UNIS and UiB are members of a number of relevant international networks, including UArctic, WUN

		2014			2015				2016				2017				2018				MILESTONES	DELIVERABLES
Action	***Indicators of progress***	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv		
WP0: Leadership and coordination (BIO)																						
A1	Effective organisation and decision-making structures	M																			The bioCEED head office and structire in place	*Activity reported though A4*
A2	Set up and maintain physical and virtual infrastructure		M	D							M	D							M	D	Virtual infrastructure needs identified	Virtual infrastructure updated and operational
A3	Appoint an international Advisory Board		M	D			M	D			M	D			M				M	D	Appointment of, and meetings in, the advisory board	The Advisory board Annual Progress Reports
A4	Daily management, monitoring and reporting	M		D				D				D				D				D	Administrative routines in place	Annual reports to NOKUT
WP1: Teacher culture (BIO)																						
A5	Annual Teachers Retreat			M																	Annual Teacher's Retreats initiated	*Activity reported though A4*
A6	Adjuct Professors in educational development	M											D	M							Adjunct Professors appointed	Reports on Adjunct Professor contributions and activities
A7	Teacher Groups	M																			Teacher Groups established	*Activity reported though A4*
A8	Teaching renewal through pedagogic courses and exchange				M				M				M				M				New educational sabbaticals (incoming / outgoing) starting	At least one outgoing / incoming visiting lecturer at any given time
A9	Web forum	M		D																	Web forum designed	Web forum operational
WP2: Learning environments (BIO)																						
A10	Expand learning environment; field, lab, digital	M		D						M		D						M		D	New learning environment needs identified	New learning environment components in 25% of courses/yr
A11	Develop student spaces			M				D								D					Detailed plan for student spaces developed (2 stages)	Planned new physical and virtual structures in place
A12	Set up and experiment with digital tools for education				M			D									M			D	New digital tool needs identified	New digital tools operational and publicly available
A13	Dedicated educational technical and administrative staff	M										D									bioCEED technical and administrative staff employed	All courses have sufficient technical support
WP3: Active students (AB)																						
A14	Redesign courses to enhance student-active learing	M		D				D				D									Relevant student-active learning approaches identified	Aspects of student-active learning implemented, 33% increase/yr
A15	Integrate learning-to-learn skills across curriculum							M				D				D				D	Identify relevant skills across the curriculum	Learning-to-learn skills implemented at all levels, 25% increase/yr (BSc to PhD)
A16	Use students actively in planning and education activities	M						D													Plan for increasing student involvement in teaching	Student (incl PhD) assistants involved in conduction of 50% of courses
A17	Offer internships in public and private sector			D				D				M	D			D				D	Agreements with major collaborators for all programmes	internship rates increases by 15% /yr
A18	Provide certification for particular skills												M			D					identify potential certification schemes	Certification schemes in place
WP4: Activity alingment (HERU)																						
A19	Develop quality assurance and evaluation methods			M				D													Methods developed	Methods tested
A20	Use quality assurance in instiutional learning							D				D				D				D		NOKUT reporting
A21	Two PhD students in educational science	M														D					PhD students appointed	Dissertations on outcomes of bioCEED educational development
A22a	Introduce participatory learning methods		M					D				D				D					New learning methods relevant for bioCEED identified	New participatory learning methods introduced in 15% of courses/yr
A22b	Set up cases as part of participatory research on bioCEED		M							D											Participatory research initiated (HERU PhD students)	Results from research on participatory methods in biology published
A23	Reduce lecturing by 20%				M			D													Identify educational settings where lecturing can be reduced	Lecturing reduced by 20%
WP5: Develop educational leadership (AB)																						
A24	Appoint and empower education leaders	M											D								Leders appointed	Evaluation report on new leadership structure
A25	Align teaching and research in institutional strategies								M			D									Evaluation of aligment initiated	Report on alignment
A26	Identify and remove obstackles to change				M													D			Work starts	Major obstacles identified and, if possible, removed
A27	Incorporate teaching efforts in staff reward systems				M	D														D	Methods for reward developed	Schemes in place (D1) and evaluated (D2)
A28	Promote eduction in internal communication	M																			Channels for communication identified, used	
WP6: Spread of best practice (HERU)																						
A29	Develop web forum to freely-acessible 'idea-bank'									M				D							Start plan transfer of information from A9 to open forum	Launch open 'ideas bank' for biology education
A30	Publish project results in the education science literature				M							D				D				D	Work towards scientific publications starts	Publication in peer-reviewed literature (4 /yr, involving 5% of staff)
A31a	Develop student-active learning modules in biology										M						D				First learning module publicly available	Learning modules tested at other biology departments
A31b	Develop and run a module on student-active teaching												M				D				Module developed	Module taught as partof HERU's initial entry training program
A32	Arrange international conference in biology education	M			D								M				D				Program for bioCEED conferences advertised internationally	Conferences held (25% bioCEED, 50% international participants)
WP7: Sector / societal communication (IMR)																						
A33	Annual meeting between students and industry/sector	M																			Annual meetings between students and sector initiated	
A34	Arrange bioCEED workshops with end-user panels	M																			Annual workshops initiated	
A35	Present project results in sector-specific fora					M				D				D				D			Relevant fora identified (private and public sector)	Publications and /or presentation of bioCEED results (2/year)