Evaluation of the strategic priority area marine research and education at the University of Bergen

Preface

Marine research and education has been a strategic priority area at the University of Bergen (UiB) since 1988. The current report presents the results from an evaluation of the strategic priority area with an emphasis on the period 2004-2013. The evaluation was commissioned by UiB, and carried out by a panel of international experts in the period June to December 2014. The Nordic Institute for Studies in Innovation, Research and Education (NIFU) has provided the scientific secretariat to the evaluation, with researcher Siri Aanstad serving as scientific secretary.

In their work, the Evaluation Panel has built on written documentation from UiB, as well as interviews with administrative and scientific staff during a site visit at the University in early October 2014. The Panel is grateful to UiB for their input and hospitality, and would especially like to thank the 19 departments/centres that handed in self-assessment reports and contributed with valuable information and stimulating discussions during the site visit. The work has been interesting, and the Panel hopes the evaluation report will help UiB further develop marine research and education as a strategic priority area.

8 December 2014

Thomas Kiørboe
Chair of the Evaluation Panel

Miquel Canals Artigas
Member of the Evaluation Panel

Åke Hagström
Member of the Evaluation Panel

Poul Holm
Member of the Evaluation Panel

Tim Minshull
Member of the Evaluation Panel

Johan Nilsson
Member of the Evaluation Panel

James Scourse
Member of the Evaluation Panel

Contents

Summary **9**

Sammendrag **12**

1 Introduction **17**
1.1 The marine research landscape in Bergen 17
1.2 The strategic priority of marine research at UiB 20
1.2.1 Background 20
1.2.2 Organisation and funding 21
1.2.3 Target groups and strategic goals 22
1.3 About the evaluation 23
1.3.1 Background and objectives 23
1.3.2 The Evaluation Panel 24
1.3.3 The Terms of Reference 24
1.3.4 The issue of delimitation: definition of marine research and selection of research units 25
1.3.5 Data sources 26
1.3.6 Data limitations 27

2 Marine research and education at the University of Bergen: an overview **28**
2.1 Thematic areas and resources 28
2.1.1 Main thematic areas and research units 28
2.1.2 Personnel 29
2.1.3 Research funding 30
2.1.4 Administrative resources and support functions 33
2.1.5 Summary 34
2.2 Education at Master's and doctoral level 34
2.2.1 Master's programmes 34
2.2.2 Doctoral education 35
2.2.3 Summary 36
2.3 Co-operation 36
2.4 Main findings in national evaluations 38

3 Bibliometric study of marine sciences at the University of Bergen 2004-2013 ..... **40**
3.1 Results 40
3.2 International co-operation 42

4 Assessment of the units **44**
4.1 The Department of Biology and the Sea Lice Research Centre 44
4.2 The Geophysical Institute 50
4.3 The Centre for Geobiology 53
4.4 The Department of Earth Science 56
4.5 The Department of Chemistry 59
4.6 The Department of Mathematics 61
4.7 The Department of Physics and Technology 62
4.8 The Department of Clinical Medicine (K1) 64
4.9 Department of Clinical Sciences (K2) 66
4.10 Departments at the Faculty of Law and the Faculty of Social Sciences 67
4.11 The Faculty of Humanities: the Department of Archaeology, History, Cultural Studies and Religion and the Centre for the Study of the Sciences and the Humanities 69
4.12 The Department of Psychosocial Science 70

5 Strengths, weaknesses, threats and recommendations **73**
5.1 Strengths 73
5.2 Weaknesses, threats, and recommendations 74
5.2.1 The research landscape 74
5.2.2 Uni Research 74
5.2.3 Research vessels 75
5.2.4 Centres of Excellence 75
5.2.5 Small scientific environments 76
5.2.6 Bergen Marine Research Cluster 77

5.2.7 Education and fate of candidates 77
5.2.8 Dissemination activities, both public, to stakeholders and to science communities 78
5.2.9 The marine strategy and the Strategic Committee for Marine Research 79

References 81

Appendix 1 Self-assessment report template 82

Appendix 2 Site visit interview plan 91

Appendix 3 Expenditure for marine R&D 92

Appendix 4 Central funding for marine and climate research at UiB, 2004-2013, in million kroner 96

Appendix 5 Tables 97

Appendix 6 Bibliometric study of marine sciences at the University of Bergen 2004-2013 105

List of tables 118

List of figures 119

Summary

Marine research and education has been a strategic priority area at the University of Bergen (UiB) since the late 1980s. The strategic priority area builds on long traditions for marine research at the University and in Bergen more generally. Together with several other institutions involved in marine research in the region, UiB has contributed to making Bergen an international hub for marine science. UiB has supported the strategic priority area with dedicated strategic funding, and a Strategic Committee for Marine Research was established in 2004 to promote marine activities at the University.

In the summer of 2014, UiB appointed an international panel of experts charged with the task of evaluating the strategic priority area marine research and education, with a focus on the last ten years (2004-2013). The main objective of the evaluation was to have a systematic review and assessment of the strategic priority area, and the Evaluation Panel was asked to evaluate the quality and relevance of the marine research and educational programmes at the University, as well as to assess the added value of the strategic funding.

The evaluation has been based on written documentation from UiB, including self-assessment reports from 19 departments/centres covering all six faculties at the University; a site visit by the Panel to UiB in the period 7-10 October 2014; a bibliometric analysis of marine sciences at UiB; and R&D statistics.

The evaluation report provides a mapping of resources, Master's and doctoral level education, external co-operation, and scientific publications within the strategic priority area, and presents the findings and assessments of the Evaluation Panel. The mapping shows that there has been a significant increase in both the total number of academic personnel involved in marine studies and total funding for marine research at the University in the period of evaluation. Scientific publications within the field have increased by 50 per cent between 2004 and 2013. Master's and doctoral level education is offered within a broad spectrum of marine subjects, mainly at the Faculty of Mathematics and Natural Sciences, but it has not been possible to draw firm conclusions about developments in the number of students and graduates due to a lack of data. Co-operation with local academic institutions is a key feature of marine research and education at UiB, with the Bergen Marine Research Cluster as a central arena for collaboration. UiB is also involved in extensive international collaboration within marine research and education.

The findings and assessments of the Evaluation Panel are summarised in eight points:

1. The Panel was impressed by the overall quality of research and education within marine disciplines at the University of Bergen, particularly within the natural sciences disciplines. UiB is recognised internationally for excellence across a diverse range of marine science and research, and for excellence in selected areas of teaching of marine disciplines. Some of the

Bergen marine research groups are amongst the most highly respected in the world. These are mostly situated within the largest of the departments and centres with a strong marine profile, including the Geophysical Institute, the Department of Earth Science, the interdisciplinary Centre for Geobiology, the Department of Biology and the overarching Bjerknes Centre for Climate Research. Research on the present, past and future role of the oceans in climate and climate change is exceptionally strong.

2. The Panel found it difficult to identify the concrete implications of being a strategic priority area at UiB. A similar confusion was evident among scientists and leaders at many units. The Panel heard about development of strategy at three levels: within the Faculty of Mathematics and Natural Sciences, across the University of Bergen, and within the Bergen Marine Research Cluster. However, it remained unclear to the Panel how the strategy has been implemented during the review period. The Strategic Committee for Marine Research had apparently had little impact. An additional concern is a lack of transparency around the level and mechanism of allocation of funding to the marine priority area. Funding flows often seem opaque to many of the researchers interviewed and the Panel was given several widely different estimates of the level of funding to the strategic priority area.

3. The Panel was overwhelmed by the complexity of the Bergen marine research landscape, both within the University, and between the University and the several independent research institutes in the Bergen area, each with their own research agenda. There appears to be a rather complex network of co-operative structures and initiatives, some of which lack critical mass. While such initiatives may be conducive to innovative research and education, it also appears that the complexity and number of collaborative structures is overwhelming and may imply significant bureaucracy and administration. The Panel was concerned that the co-ordination between the many structures and institutions may require more energy and resources than the outcome warrants. There is a trade-off here that must be carefully balanced.

4. A particular concern of the Panel was the research company, Uni Research, partly owned by UiB. On the one hand, the establishment of this company has allowed a more flexible strategy for hiring staff and has facilitated the growth of powerful research clusters. On the other hand, the Uni Research structure has developed powerful autonomy – effectively a research university within the University – that is allowing parallel development of research infrastructure and groupings. Such parallel development and duplication is not an effective way to operate and may constitute a waste of resources and expertise. Furthermore, the scientific staff has effectively been “blind” to the evaluation since the “independent” Uni Research is not formally a part of UiB. The status of Uni Research has therefore been technically problematic for the delivery of the evaluation, but much more importantly, is or may become a problem for UiB itself.

5. The Panel noted that much of the marine research at UiB is organised in centres of various kinds, ranging from virtual centres with limited funding, to Centres of Excellence and innovation centres with high levels of external funding. All these are temporary initiatives and help secure that the research environment remains dynamic and cross-disciplinary. However, at the termination of centres, there is also a risk of losing expertise and of dismantling productive research environments. This situation makes it vital for UiB to develop clear guidelines for how to embed successful temporary activities and employ excellent researchers within the university structure.

6. Some of the marine research environments at UiB are very small, and close to or below the critical mass, even when embedded in larger departments. This applies to environments within mathematics, chemistry, medicine, law and humanities/social sciences. In order to maximise

the potential of small research environments and enable them to be visible and successful partners in the marine research landscape, contact with other marine research environments should be strengthened. These should be bottom-up initiatives, but with support from the central level, including some seeding funds. However, it should be fully realised that a minimum critical mass of researchers within the involved units is required for these actions to be fruitful.

7. The need for personnel trained in marine disciplines from all UiB departments and faculties is presumably very high in Norway in general and in the Bergen area in particular. And although UiB seems to deliver excellent candidates, there seemed to be no record of the career trajectories of candidates at the Master's level, and most PhD students appear to pursue a postdoctoral career in academia rather than in industry and the public sector. Isolated initiatives to bring society and industry in contact with students were reported – notably by the Department of Biology - but more systematic programmes where students are exposed to outside work environments are particularly important for students graduating at the Master's level.

8. Dissemination activities, at both domestic at international level, are numerous, constant and performed according to the best standards using a variety of channels, in particular by the larger and more powerful units involved in marine research. The main target groups are academia and the public at large, and to a lesser extent industry. However, some weaknesses including low dissemination levels and imbalances with respect to target groups have been detected, in particular within units where marine research activities are a relatively minor part of their activities.

Sammendrag

Marin forskning og utdanning har vært et strategisk satsingsområde ved Universitetet i Bergen (UiB) siden slutten av 1980-tallet. Satsingsområdet bygger på lange tradisjoner for marin forskning ved universitetet og i Bergen mer generelt, og sammen med flere andre institusjoner involvert i marin forskning i regionen, har UiB bidratt til å gjøre Bergen til et internasjonalt senter for marin vitenskap. UiB har støttet satsingsområdet med øremerket strategisk finansiering, og et strategisk utvalg for marine fag ble opprettet i 2004 for å fremme marin virksomhet ved universitetet.

Sommeren 2014 oppnevnte UiB et internasjonalt panel av eksperter som ble gitt i oppdrag å evaluere det strategiske satsingsområdet marin forskning og utdanning, med fokus på de siste ti årene (2004-2013). Hovedformålet med evalueringen var å få en systematisk gjennomgang og vurdering av satsingsområdet, og evalueringspanelet ble bedt om å evaluere kvalitet og relevans på marin forskning og marine utdanningsprogrammer ved universitetet, samt å vurdere merverdien av den strategiske finansieringen.

Evalueringen har bygget på skriftlig dokumentasjon fra UiB, inkludert egenevalueringsrapporter fra 19 institutter/sentre fordelt på alle de seks fakultetene; et institusjonsbesøk panelet gjennomførte ved UiB i perioden 7.-10. oktober 2014; en bibliometrisk analyse av marine fag ved UiB; og FoU-statistikk.

Evalueringsrapporten kartlegger ressurser, utdanning på Master- og doktorgradsnivå, eksternt samarbeid og vitenskapelig publisering innenfor det strategiske satsingsområde, og presenterer hovedfunnene og anbefalingene til evalueringspanelet. Kartleggingen viser at det har vært en betydelig økning i både samlet antall vitenskapelig personale involvert i marine studier og total finansiering av marin forskning ved universitetet i evalueringsperioden. Vitenskapelig publisering på området har økt med 50 prosent mellom 2004 og 2013. Master- og doktorgradsutdanning tilbys innenfor en rekke marine fag, først og fremst ved Det matematisk-naturvitenskapelige fakultet. Det har ikke vært mulig å trekke klare konklusjoner om utviklingen i studenter og kandidater på grunn av mangel på data. Samarbeid med lokale akademiske institusjoner er et sentralt kjennetegn ved marin forskning og utdanning ved UiB, og Bergen Marine Forskningsklynge er en viktig samarbeidsarena. UiB er også involvert i omfattende internasjonale samarbeid innenfor marin forskning og utdanning.

Hovedfunnene og vurderingene til evalueringspanelet er oppsummert i åtte punkter:

1. Panelet var imponert over den generelle kvaliteten på marin forskning og utdanning ved Universitetet i Bergen, spesielt innenfor de naturvitenskapelige disiplinene. UiB er internasjonalt anerkjent for fremragende forskning innenfor flere ulike marine fagfelt, og for fremragende utdanning innenfor visse marine disipliner. Noen av de marine forskningsgruppene i Bergen er blant de mest anerkjente i verden. De tilhører i hovedsak de største instituttene og sentrene med en sterk marin profil, inkludert Geofysisk institutt, Institutt

for geovitenskap, det tverrfaglige Senter for geobiologi, Institutt for biologi og det tverrgående Bjerknessenteret for klimaforskning. Forskningen på havets betydning for klima og klimaendring i nåtid, fortid og fremtid er eksepsjonelt sterk.

2. Panelet slet med å få et klart bilde av hva implikasjonene av å være et strategisk forskningsområde ved UiB er. Det var tydelig at det var uklart også for forskere og ledere ved mange av enhetene. Panelet ble fortalt om strategiutvikling på tre nivåer: ved Det matematisk-naturvitenskapelige fakultet, på tvers av Universitetet i Bergen og innenfor Bergen Marine Forskningsklynge, men det gikk ikke klart frem hvordan strategien har blitt implementert i evalueringsperioden. Det strategiske utvalget for marine fag har tilsynelatende hatt liten betydning. Det er også uklarhet knyttet til nivået på og mekanismene for fordeling av strategiske midler til det marine satsingsområdet. Mange av forskerne panelet intervjuet oppfattet den strategiske finansieringen som ugjennomsiktig, og panelet ble gitt flere svært ulike anslag på nivået på finansiering av det strategiske satsingsområdet.

3. Panelet ble overveldet av kompleksiteten i det marine forskningslandskapet i Bergen. Det gjelder både internt på UiB, og forholdet mellom universitetet og de mange uavhengige forskningsinstituttene i Bergensområdet, som alle har sin egen forskningsagenda. Det ser ut til å være et forholdsvis kompleks nettverk av samarbeidsstrukturer og -initiativer, som på noen områder mangler kritisk masse. Mens slike initiativer kan fremme innovativ forskning og utdanning, fremstår kompleksiteten og antallet samarbeidsstrukturer som overveldende og kan innebære betydelig byråkrati og administrasjon. Panelet var bekymret for at koordineringen av det høye antallet samarbeidsstrukturer og institusjoner kan kreve mer energi og ressurser enn hva resultatene rettferdiggjør. Det er en balansegang her som krever nøye overveielse.

4. Panelet var særlig opptatt av forskningsselskapet Uni Research, som er delvis eid av UiB. Opprettelsen av dette selskapet har på den ene side muliggjort en mer fleksibel strategi for ansettelser av vitenskapelig personale og lagt til rette for utvikling av sterke forskningsklynger. På den annen side, har Uni Research utviklet en sterk autonomi – og i praksis blitt et forskningsuniversitet innenfor universitetet – som åpner forparallell utvikling av forskningsinfrastruktur og grupperinger. Slik parallell utvikling og duplisering er ikke en effektiv måte å organisere virksomheten på, og medfører sløsing av ressurser og ekspertise. Videre har det vitenskapelige personalet ved Uni Research i praksis blitt utelatt fra evalueringen siden Uni Research er «uavhengig» og ikke formelt en del av UiB. Statusen til Uni Research har således vært teknisk utfordrende for gjennomføringen av denne evalueringen, men langt viktigere er det at den er eller kan bli et problem for UiB.

5. Panelet noterte seg at den marine forskningen ved UiB i stor grad er organisert i ulike former for sentre, som omfatter alt fra virtuelle sentre med begrenset finansiering til Sentre for fremragende forskning og innovasjonssentre med høy grad av ekstern finansiering. Dette er midlertidige initiativer som bidrar til dynamiske og tverr-disiplinære forskningsmiljøer. Når sentrene avsluttes, er det imidlertid en risiko for å miste ekspertise og ødelegge produktive forskningsmiljøer. Det gjør det avgjørende for UiB å utvikle klare retningslinjer for hvordan suksessfulle aktiviteter og fremragende forskere skal integreres i den etablerte universitetsstrukturen.

6. Noen av de marine forskningsmiljøene ved UiB er veldig små, og i nærheten av eller under grensen for kritisk masse selv når de er forankret i større institutter. Det gjelder miljøer innenfor matematikk, kjemi, medisin, jus og humaniora/samfunnsvitenskap. For å utnytte potensialet til de små forskningsmiljøene og gjøre dem i stand til å være synlige og suksessfulle partnere i det marine forskningslandskapet, bør kontakten med andre marine forskningsmiljøer styrkes. Dette bør være «bottom-up»-initiativer, men med støtte fra det sentrale nivået, inkludert såkornmidler. Det er imidlertid viktig å være klar over at det er

nødvendig med et minimum av kritisk masse av forskere innenfor de enkelte enhetene for at slike initiativ skal lykkes.

7. Behovet for arbeidskraft med utdannelse innenfor marine disipliner fra alle instituttene og fakultetene ved UiB kan antas å være svært høyt i Norge generelt og i Bergensområdet spesielt, og UiB produserer fremragende kandidater. Det ser imidlertid ikke ut til å være noen systematisk registrering av karriereveiene til Mastergradskandidatene, og de fleste PhD-studentene velger tilsynelatende en postdoktor-karriere innenfor akademia heller enn en karriere i næringslivet eller offentlig sektor. Det ble rapportert om enkeltinitiativ for å etablere kontakt mellom samfunns- og næringsliv og studenter, særlig fra Institutt for biologi, men mer systematiske programmer der studenter blir kjent med eksterne arbeidsmiljø er spesielt viktig for studenter som tar en Mastergrad.

8. Formidlingsaktiviteten, både nasjonalt og internasjonalt, er høy, vedvarende og holder beste standard, spesielt blant de største og sterkeste enhetene involvert i marin forskning. Formidlingen skjer gjennom flere ulike kanaler, og de viktigste målgruppene er akademia og den store offentligheten, og i noe mindre grad næringslivet. Det har imidlertid blitt avdekket enkelte svakheter, herunder lav formidlingsgrad og ubalansert målretting av formidlingsaktiviteten, i særdeleshet hos enheter hvor marin forsking utgjør en relativt liten del av virksomheten.

1 Introduction

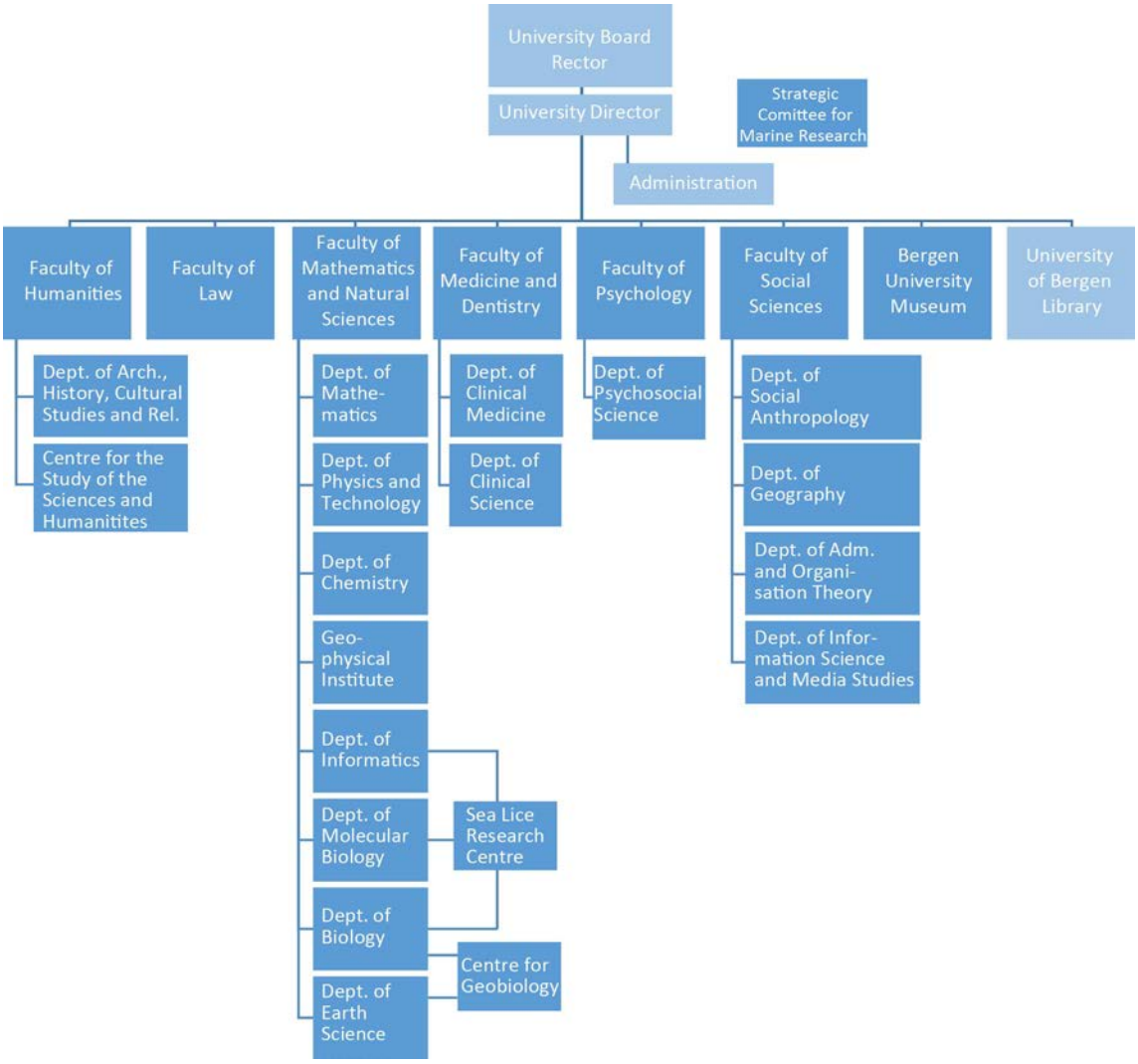
Marine sciences has been a strategic priority area at the University of Bergen (UiB) since the late 1980s. The current report is prepared by an international panel of experts commissioned by UiB to evaluate the strategic priority of marine research and education, with a main focus on the last ten years (2004-2013).

1.1 The marine research landscape in Bergen

Bergen has become an international hub for marine research due to its geographical location on the west coast of Norway and its long tradition in exploring and exploiting the ocean. The University of Bergen (UiB) is one of several institutions engaged in marine research and education in the region, and the institutional landscape is characterised by numerous and complex relationships.

At the University of Bergen, marine studies take place at all six faculties as well as the Bergen University Museum (Figure 1.1). The Faculty of Mathematics and Natural Sciences is the main actor. All departments at the Faculty are involved in marine research to some extent, and the departments of Biology and Earth Science as well as the Geophysical Institute all have a strong marine profile. The Faculty hosts to two centres engaged in marine research: the Centre for Geobiology (CBG) and the Sea Lice Research Centre (SLRC). CBG is a collaboration between the departments of Biology and Earth Science, and a Centre of Excellence (CoE) with funding from the Norwegian Research Council (RCN) for the period 2007-2017. SLRC is a Centre for Research-based Innovation (CRI) with RCN funding for the period 2011-2019. The Centre involves three UiB departments, two external research partners – the Institute of Marine Research (IMR) and the Norwegian University of Life Sciences, and several industrial partners.

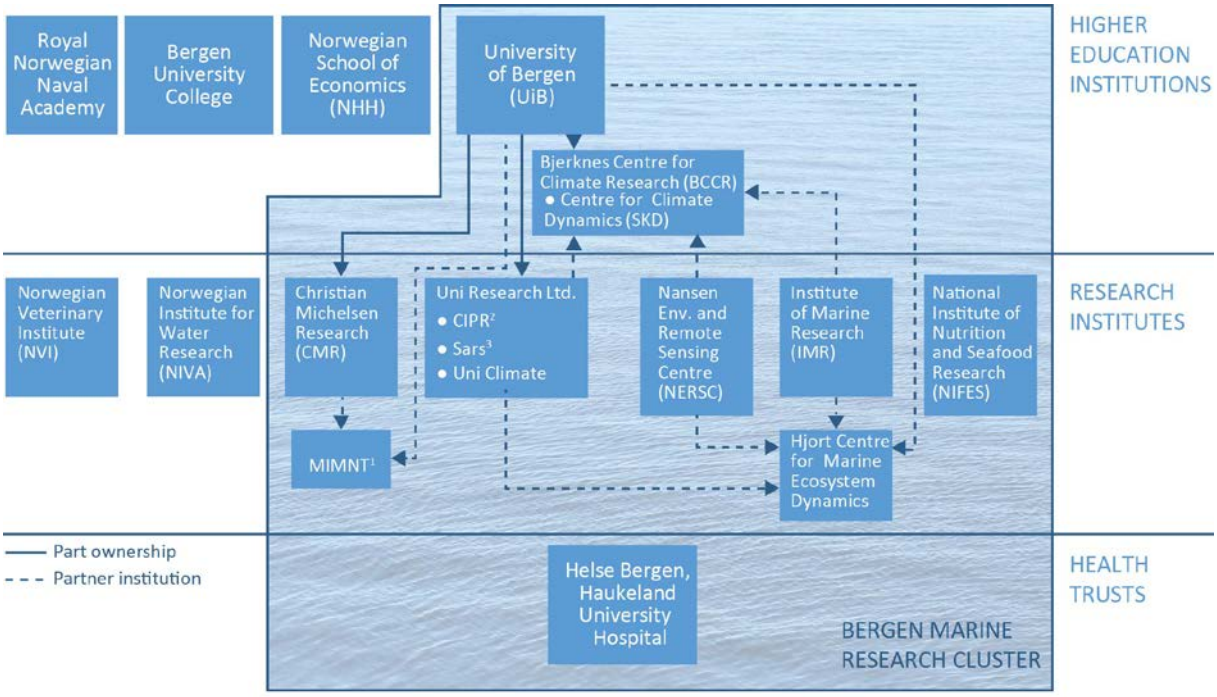
Figure 1.1 The organisation of marine research and education at the University of Bergen



Source: NIFU

External collaboration is a key feature of marine research at UiB, and the University has close links with a number of local research institutions (Figure 1.2).

Figure 1.2 The Bergen marine research landscape



[1] Michelsen Centre for Industrial Measurement, Science and Technology
[2] Centre for Integrated Petroleum Research
[3] Sars International Centre for Marine Molecular Biology

Source: NIFU

The Nansen Environmental and Remote Sensing Centre (NERSC) is a research foundation affiliated to UiB conducting environmental and climate research. The Centre was established in 1986, with the Scientific Foundation at the University of Bergen (Unifob) as one of the founders.[1]

Uni Research Ltd., formerly Unifob Ltd., is a research company owned jointly by UiB (85%) and Unifob (15%). It was established in 2003 with the main purpose of administering externally funded research at UiB, but has over time developed a more independent role as a research performing company. Uni Research has three departments involved in marine research in close collaboration with researchers at UiB, the Centre for Integrated Petroleum Research (CIPR), the Sars International Centre for Marine Molecular Biology, and Uni Climate. CIPR was a Centre of Excellence hosted by UiB in the period 2002-2012, with researchers from several departments at the Faculty of Mathematics and Natural Sciences as well as Unifob/Uni Research. The Sars Centre was established in 1997 with funding from UiB, RCN, and the Ministry of Education and Research, and receives annual earmarked funding from the University. The Centre is co-located with the UiB departments of Biology and Molecular Biology at Marineholmen Science Park.

The Bjerknes Centre for Climate Research (BCCR) was established in 2002 as a Centre of Excellence hosted by UiB and with Uni Research, the Nansen Centre (NERSC) and the Institute of Marine Research (IMR) as partner institutions. When the CoE funding ended in 2012, the Bjerknes Centre merged with the Centre of Climate Dynamics, which had been established in 2010 with funding from the Ministry of Education and Research to draw on and continue the accomplishments of the CoE. The Bjerknes Centre continues to involve a large number of researchers at UiB, and the University contributes annual funding and is represented on the Board of Directors by its Pro-Rector.

[1] Unifob was established in 1986 as an independent foundation with the mission to promote research, education and other activities of key interest to the University of Bergen.

Christian Michelsen Research (CMR) is a technical-industrial research institute owned 50 per cent by UiB and 35 per cent by Uni Research. CMR hosts the Michelsen Centre for Industrial Measurement Science and Technology (MIMT), a Centre for Research-based Innovation specialising in marine technology with UiB as a key research partner.

The Institute of Marine Research (IMR) is a publicly-owned research institute headquartered in Bergen. The institute is the largest marine science community in Norway, and co-operates closely with UiB, e.g. in operating vessels. In 2014, IMR and UiB established the Hjort Centre for Marine Ecosystem Dynamics with the Nansen Centre and Uni Research as additional partner institutions. UiB contributes funding to the Hjort Centre, which aims to produce internationally leading research on ocean ecosystems.

Furthermore, UiB collaborates in marine research with the National Institute of Nutrition and Seafood Research (NIFES) and Nofima, both research institutes with activities in Bergen, as well as with the Bergen divisions of the Norwegian Institute for Water Research (NIVA) and the Norwegian Veterinary Institute (NVI). Collaborative links within marine sciences also exist between UiB and Haukeland University Hospital and with the two other major higher education institutions in Bergen, NHH - Norwegian School of Economics, and Bergen University College.

In 2008, the Bergen Marine Research Cluster was established as a formal collaboration between UiB and seven other local institutions for marine research and education. The collaboration is legally binding, and organised with a project manager from UiB and a Board headed by the Rector of the University. The objective of the cluster is to strengthen regional co-operation and develop Bergen into a European capital for marine research and education. Co-location has been a long-term goal, and it has recently been decided that IMR and other member institutions will co-locate with the UiB departments of Biology and Molecular Biology and the Sars Centre at Marineholmen.

1.2 The strategic priority of marine research at UiB

1.2.1 Background

Bergen has a long and proud history of multidisciplinary marine research linked to such prominent names as G.O. Sars, Bjørn Helland-Hansen, Vilhelm Bjerknes and Johan Hjort. These and other scientists contributed to the development of oceanography, biology, geology and meteorology as key areas of research in Bergen as a site, and at the predecessor of UiB, Bergen Museum, founded in 1825. The University continued the research traditions of Bergen Museum from the time of establishment in 1946, and the Faculty of Mathematics and Natural Sciences has had a strong marine profile from the outset.

In 1988, UiB defined marine research and education as one of two strategic priority areas, the other being global and development-related research and education. The priority areas reflected the traditions and competitive advantages of the University, and emerged as particularly relevant given the background of the publication of the report of the Brundtland Commission in 1987 with its emphasis on sustainable development.

The strategic priority of marine studies is well aligned with national research policies, where marine research has been a long-standing priority area. A national strategy for marine R&D, HAV21, was presented in 2012, and marine research is supported by several programmes in the Research Council of Norway (RCN). The recent Government Long term Plan for Research and Higher education 2015-24 has included Oceans as one of six national priority areas. Moreover, marine research is supported through the Norwegian Government's strategic priority of the High North, where climate, petroleum and renewable marine resources are key target areas.

1.2.2 Organisation and funding

Organisation

The priority of marine research and education at UiB has its basis in the strategic plans of the University, both at central and faculty level. In the 1990s and early 2000s, there was strong commitment to the strategic priority area in the Central leadership and considerations of branding UiB as “the Blue University”. Subsequently, the priority of marine research has been based more on bottom-up initiatives and driven mainly by the faculties and departments.

A Strategic Committee for Marine Research (*Strategiutvalget for marine fag*, SMF) was established by the Faculty of Mathematics and Natural Sciences in 2004. The Committee was made up of representatives of the Faculty leadership as well as the heads of the three largest marine departments, and engaged in coordinating, profiling and promoting the marine activities at the Faculty as well as at UiB more generally.[2]

The ambition to broaden the disciplinary scope of the strategic priority of marine research led UiB to establish a new strategic committee in 2007. With the exception of the faculties of Humanities and Psychology, all faculties were represented along with the two Centres of Excellence - the Bjerknes Centre and the Centre for Geobiology. The Committee was to report to the central University leadership, and given the Terms of Reference to:

- develop a coherent research strategy for marine activities, including doctoral education;
- develop various strategic input on marine research and education; and
- strengthen and develop action plans for collaboration between UiB and regional, national and international partner institutions.[3]

In 2012, after a period of little activity in the Committee, it was reappointed without any changes in representation or the Terms of Reference.[4] Subsequently, the Bergen Marine Research Cluster has been included in the Committee and represented by the cluster manager.

The Strategic Committee has functioned as an advisory body without any financial resources at its disposal.

Strategic funding

Overall central funding for marine research at UiB is described in section 2.1.3 of the report. A significant share of funding has been allocated to buildings, infrastructure and research centres. In addition, dedicated central funding has been provided for the strategic priority of marine research. Table 1.1 shows the annual figures for the strategic funding in the period of evaluation (2004-2013).

[2] *Forskningsstrategi for Det matematisk naturvitenskapelige fakultet 2006-2010*; «Mandat for Strategiutvalg for marine fag (SMF) ved Det matematisk-naturvitenskapelige fakultet»
[3] «Strategiutvalg for Marine Fag (SMF) ved Universitetet i Bergen»
[4] «Gjenoppnevning av strategisk utvalg for marine fag», 2012

Table 1.1 Funding for the strategic priority of marine research at UiB, 2004-2013, in million Norwegian kroner

Year	Funding for UiB strategy
2004	4.421
2005	3.520
2006	3.520
2007	1.520
2008	1.520
2009	3.120
2010	1.120
2011	1.120
2012	1.120
2013	1.120
SUM	**13.040**
Annual average	**1.630**

Source: UiB

The strategic funds have been used for research vessel operations, project support, funding of positions, co-operation with NIFES, and from 2009, support to the Bergen Marine Research Cluster. The University Board has recently decided that UiB will allocate funding for the co-location of the cluster at Marineholmen.

There has also been strategic funding of marine research at faculty and department level, but the Evaluation Panel lacks information about the size and direction of this funding.

1.2.3 Target groups and strategic goals

The definition of marine research and education at UiB reflects that the strategic priority of marine research initially targeted the natural sciences:

> *Marine research and marine subjects cover studies of the ocean areas in a broad sense and involve physical, geological, chemical and biological aspects and processes and their interactions in and between land, the water column and atmosphere, as well as applications in connection with surveying and exploiting resources and studies of the climate and environmental conditions.*[5]

Marine biology was the first main focus area, followed by climate research. At the beginning of the period covered by this evaluation (2004-2014), there was an interest in developing cross-disciplinary research within the fields of nutrition, pharmacy and aquaculture, and there has subsequently been an explicit aim to broaden the disciplinary scope of the strategic priority area and promote cross-disciplinary and cross-faculty co-operation.[6] This is the background to UiB's decision to establish a new Strategic Committee for Marine Research in 2007 with representation from several faculties.

It has been part of the Terms of Reference of the Strategic Committee to develop an overall strategy for marine research at UiB, and a proposed strategy for the period 2015-2020 has recently been submitted to the central University leadership. According to the proposal, UiB should focus on:

- further developing the strong marine scientific communities at the University and including more faculties, subjects and perspectives in the strategic priority area;
- strengthening the collaboration with the partner institutions in Bergen Marine Research Cluster, i.a. through the establishment of new research centres, with the aim to develop a marine campus; and

[5] The web pages of UiB, URL: http://www.uib.no/forskning/75367/marin-forskning
[6] «Styrenotat marin forskning 2008»

- establishing a dedicated leadership for the strategic priority of marine research and education reporting to the Rector.[7]

During the period covered by the evaluation, however, there has been no overall strategic plan for marine research and education at UiB. Instead, goals and measures for the development of the strategic priority area have been set out in various strategy documents at both central and faculty level. Generally, there has been a focus on profiling the marine research activities at UiB and in the Bergen region more generally; strengthening marine research within biology; securing marine infrastructure; and promoting cross-disciplinary and cross-faculty collaboration as well as collaboration with local partner institutions.[8] Strengthening marine sciences through collaboration with local partner institutions in the Bergen Marine Research Cluster was highlighted as a key strategic objective by the central University leadership during the site visit meeting with the Evaluation Panel.

In the current strategy of the Faculty of Mathematics and Natural Sciences, covering the period 2011-2015, the Faculty signals that it wants to define climate research as a separate priority area in the next strategy period.[9] The Faculty has moreover presented a proposal for its own marine strategy. According to this proposal, which was developed by an internal working group appointed by the Dean in 2013, it should be the goal of the Faculty to contribute to Bergen becoming the most important city for marine research and education in Europe. Main lines of action to achieve this should be to recruit students internationally; establish new researcher positions and joint centres with other local research institutions; strengthen collaboration within the Bergen Marine Research Cluster; improve the infrastructure for marine research; and strengthen the capacity for marine research management.[10]

1.3 About the evaluation

1.3.1 Background and objectives

The current evaluation has been commissioned by the central UiB leadership. The strategic priority of marine research and education has been supported by the central strategies of the University for 25 years, and the current strategy states that a scientific evaluation of the strategic priority will be carried out during the strategy period (2011-2015).[11]

According to the guidelines from UiB, the main objective of the evaluation is "to have a systematic review and assessment of the focus area *Marine research* at the University of Bergen, such that this is delimited in understanding with the University. The evaluation is intended to provide a portrayal of the quality of the research and the educational programmes within this area. The evaluation must contribute toward learning and development for the academic communities, and provide insight into strengths, weaknesses and challenges for the research and educational programmes. The evaluation will be an important basis for decisions on how the focus area is to be pursued in the work on developing a new strategy for the University."

UiB has started the process of developing a new strategy, which will be implemented from 2016.

[7] «Forslag til strategi for marin forskning og utdanning 2015-2020»
[8] «Universitetet i Bergen – et forskningsuniversitet. Utkast til forskningsstrategi 2005-2010»; *Forskningsstrategi for Det matematisk naturvitenskapelige fakultet 2006-2010*; *Nye Tider – Nye Utfordringer – Nye Løsninger. Strategi 2011-2015*, Det Matematisk-Naturvitenskapelige Fakultet, Universitetet i Bergen
[9] *Nye Tider – Nye Utfordringer – Nye Løsninger. Strategi 2011-2015*, Det Matematisk-Naturvitenskapelige Fakultet, Universitetet i Bergen
[10] «Forslag til Marin strategi for Det matematisk-naturvitenskapelige fakultet»
[11] *Strategi 2011-2015. Universitetet i Bergen*

1.3.2 The Evaluation Panel

The evaluation has been carried out by a panel of seven international experts appointed by UiB (Table 1.2).

Table 1.2 The Members of the Evaluation Panel

Name	Institution	Subject area
Thomas Kiørboe (Chairman)	National Institute for Aquatic Resources, Technical University of Denmark, Denmark	Marine biology
Miquel Canals Artigas	Department of Stratigraphy, Paleontology and Marine Geosciences, Faculty of Geology, University of Barcelona, Spain	Marine geosciences
Åke Hagström	Faculty of Health and Life Sciences, Linnæus University, Sweden	Marine biology
Poul Holm	Faculty of Arts, Humanities and Social Sciences, Trinity College Dublin, Ireland	History
Tim Minshull	National Oceanography Centre Southampton, University of Southampton, England	Marine geophysics
Johan Nilsson	Department of Meteorology, Faculty of Science, Stockholm University, Sweden	Physical oceanography
James Scourse	School of Ocean Sciences, College of Natural Sciences, Bangor University, Wales	Marine geology

The Nordic Institute for Studies in Innovation, Research and Education (NIFU) has provided the scientific secretariat to the evaluation, with researcher Siri Aanstad serving as scientific secretary.

1.3.3 The Terms of Reference

The Evaluation Panel was given the following Terms of Reference (ToR):

On the basis of the communities' academic production, the communities' self-assessments, written documentation of the communities' activities and visits to the institution, the academic panel is asked to:

1. *On the basis of international standards to assess the quality and relevance of the scientific production within marine research based on the combined production of publications and theses, with emphasis on the last 10 years.*
2. *Evaluate the quality and relevance, including the development of expertise and level of execution, of the area's combined educational programmes at the master and doctorate level with emphasis on the last 10 years.*
3. *With the additional resources that accompany being a main focus area in mind, give a combined assessment of the strategic added value/utility this has provided.*
4. *Evaluate the associated academic communities' cooperation with relevant academic communities in UiB's periphery, including organization, participation in projects, ability to generate resources and networking.*
5. *Evaluate the associated academic communities' international activities, project cooperation, participation in conferences, presentations, marketing and networking.*
6. *Evaluate the associated academic communities' dissemination and promotion of their research results domestically and internationally.*
7. *Consider to which extent cross-disciplinarity and organization in cross-disciplinary centres has contributed to strengthening and developing activities in the focus area.*
8. *Assess utility value/function of the strategic committee for this focus area.*
9. *Assess the associated academic communities combined administrative resources and support functions.*

The meeting with the UiB leadership at the beginning of the site visit elaborated further on the Terms of Reference for the evaluation. Originally, the Panel was only to evaluate the quality of the marine research and educational programmes, and the added value of the Marine Priority Area initiative. However, the UiB leadership made it clear that in addition they wanted recommendations from the

Panel with respect to the strategic priorities, and on how best to promote the marine science profile of the University, and that they required this advice to formulate a new strategic plan. One overarching question that they emphasised was whether marine science is best developed through instruments that work bottom-up or top-down.

The Panel was not given the explicit task or necessary resources to make a thorough scientific evaluation of the individual units involved in marine studies at UiB. Yet, the overall evaluation has been based on more general assessments of the individual units, and the assessments have been included in the report with the purpose of providing UiB with the fullest possible picture of the strategic priority area.

The evaluation has focused on the development of the strategic priority area over the last ten years (2004-2013).

1.3.4 The issue of delimitation: definition of marine research and selection of research units

To delimit the units and activities to be included in the current evaluation, the Central leadership consulted all six faculties at UiB. They were asked to define what thematic research areas and associated organisational units/centres/research groups/research milieus should be included in the evaluation based on the following description of the strategic priority area:

> *Marine research and marine subjects cover studies of the ocean areas in a broad sense and involve physical, geological, chemical and biological aspects and processes and their interactions in and between land, the water column and atmosphere, as well as applications in connection with surveying and exploiting resources and studies of the climate and environmental conditions.*

A high number of research areas and units were reported back from the faculties and/or their respective departments/centres. The reporting was characterised by great variation, not least with regard to the nature and size of research units which ranged from departments/centres and research groups to projects and individual researchers. All in all the reporting covered units at 19 departments/centres and all six faculties.

These 19 departments/centres were asked to provide self-assessments of their marine research and education activities. A total of 18 units submitted self-assessment reports and these have been included in the evaluation (Table 1.3). In this way, the delimitation of the evaluation rests on the departments' and research units' decisions to participate, and their interpretation of what is included in the field of marine studies.

Table 1.3 Departments/centres included in the evaluation

Department/centre	Faculty
Department of Archaeology, history, cultural studies and religion	Humanities
Centre for the study of the sciences and the humanities	Humanities
-	Law
Centre for Geobiology	Mathematics and Natural Sciences
Department of Biology	Mathematics and Natural Sciences
Department of Chemistry	Mathematics and Natural Sciences
Department of Earth Science	Mathematics and Natural Sciences
Department of Mathematics	Mathematics and Natural Sciences
Department of Physics and Technology	Mathematics and Natural Sciences
Geophysical Institute	Mathematics and Natural Sciences
Sea Lice Research Centre (SLRC)	Mathematics and Natural Sciences
Department of Clinical Medicine (K1)	Medicine and Dentistry
Department of Clinical Science (K2)	Medicine and Dentistry
Department of Psychosocial Science	Psychology
Department of Administration and Organisation Theory	Social Sciences
Department of Geography	Social Sciences
Department of Information Science and Media Studies	Social Sciences
Department of Social Anthropology	Social Sciences

1.3.5 Data sources

The evaluation has been based on several different data sources, of which the main part is data provided by UiB centrally and self-assessment reports from the research units:

- documents and data on the strategic priority area, provided by UiB;
- self-assessment reports from the relevant research units;
- a bibliometric analysis from NIFU;
- R&D statistics from NIFU; and
- site visit and interviews at UiB.

UiB was asked to provide the Panel with relevant documentation of the strategic priority of marine research and education at the University, as well as information about education, research and co-operation within the field. The Panel received a significant amount of qualitative and quantitative data. Qualitative data included documents from meetings of the University Board; strategy documents; information on educational programmes and research schools; lists of local academic partner institutions and bilateral collaborative agreements; and material from the national evaluation of biology carried out on behalf of the Research Council of Norway in 2011. The quantitative data consisted of university budgetary figures; external funding figures; and student and graduate numbers.

Self-assessment reports from the units have been a key source of information. Based on a self-assessment report template, the units have provided both quantitative and qualitative data reflecting the Terms of Reference for the evaluation. The self-assessment report template is included in Appendix 1.

The Evaluation Panel was on a three-day site visit at the University of Bergen in October 2014. During the site visit, the Panel interviewed representatives of both the Central and Faculty leadership, as well as the departments/centres that are included in the evaluation (see Appendix 2 for the interview plan). The Panel also interviewed the project manager of the Bergen Marine Research Cluster.

1.3.6 Data limitations

The quality of the following evaluation can be no better than the quality of the material that the Panel received, and is further constrained by the expertise of the Panel Members relative to the fields evaluated. Originally, the evaluation focused on marine science within the natural science disciplines, but during the preparation phase leading up to the evaluation, the list of units to be evaluated was expanded to include also departments from the other five faculties at the University (Medicine and Dentistry, Law, Social Sciences, Humanities, and Psychology). This led to the addition to the Panel of one member with expertise in marine environmental history, but the Panel lacks specific expertise in several of the disciplinary fields covered by the evaluation. Unfortunately, the expansion of the number of units to be interviewed made it impossible to visit the actual research environments and to meet students, postdocs, and other young researchers.

The material received from the University, both from the central unit and the self-assessment reports submitted by the individual departments/centres, was of a somewhat uneven quality. UiB lacks a general overview of the scope and development of the activities within its marine priority area. Moreover, many of the self-assessment reports were incomplete and unenthusiastic, presumably the result of the multiple rounds of evaluation that some of the units have been through. The incomplete reporting may also reflect that the main objective of the evaluation has been to evaluate the strategic priority area as a whole, and not the individual units. This was explicitly stated in the self-assessment template.

The interviews helped fill many gaps and most often also transmitted the enthusiasm that was lacking in the reports. Finally, major activities closely associated to the University and in practice often partly integrated with university activities, were not part of the evaluation. This includes the Bjerknes Centre and Uni Research, including the Sars Centre, among others. Thus, the Panel often lacked crucial explicit information and relevant context for the evaluation.

The broad, bottom-up delimitation of marine research and education has also posed challenges in terms of supplementing the data from UiB with other data sources, such as national R&D statistics and bibliometric databases.

2 Marine research and education at the University of Bergen: an overview

2.1 Thematic areas and resources

2.1.1 Main thematic areas and research units

The majority of marine research activities at the University of Bergen is concentrated in four units (in decreasing order of magnitude) – the Department of Biology (including the Sea Lice Research Centre), the Geophysical Institute, the Centre for Geobiology and the Department of Earth Science. These constitute five reporting units in this evaluation. Furthermore, marine research is conducted as subsidiary activity in several other units, constituting 12 reporting units – the Department of Chemistry, the Department of Mathematics, the Department of Physics and Technology, the Department of Clinical Medicine, departments at the Faculty of Law and the Faculty of Social Sciences, and departments at the Faculty of Humanities. In addition, the Department of Psychosocial Science is engaged in maritime research, possibly bordering marine research questions.

At the Department of Biology, research is organised in four thematic areas – (1) Fisheries ecology and marine ecosystems management (2) Marine and environmental health, (3) Aquaculture and fish health, and (4) Marine biodiversity. In addition the *Sea Lice Research Centre*, a Centre for Research-based Innovation with its research agenda focused on sea lice biology, is hosted within the Department of Biology.

The Geophysical Institute (GFI) is divided into four research groups – (1) The Meteorology group, (2) The Oceanography group, (3) The Biogeochemistry group, and (4) The Climate Dynamics group. The Bjerknes Centre for Climate Research (BCCR) is important for GFI, as three of the academic staff of GFI are involved in the leadership of BCCR, and all climate-related research of GFI is branded through BCCR.

The Centre for Geobiology (CGB) is a Norwegian Centre of Excellence. Originally CGB consisted of two thematic areas – (1) Geodynamics of the Deep Seafloor and (2) Water-Rock-Microbe Interactions & the Deep Biosphere. In addition two more areas are now included – (3) Roots of Life & Life in Extreme Environments and (4) Vent and Seep Biota.

The research groupings of the Department of Earth Science are not clearly determined, but were for the purpose of this evaluation presented as (1) Marine geophysics, (2) Marine energy, and (3) Marine geology. However, the groups were also presented during the interview more thematically, e.g. as research groups for Glaciated continental margins, Submarine geohazards and Palaeoclimate/palaeoceanography.

The Department of Chemistry conducts research in three thematic areas relevant for marine research – (1) Marine environment, (2) Marine ingredients and health, and (3) Natural product synthesis, conducted by two research groups.

The Department of Mathematics conducts relevant marine research in two research groups – (1) the Statistics group (working on e.g. statistical ecology, statistical analysis of acoustic and trawl data and animal population dynamics) and (2) the Applied and computational mathematics (ACM) group (working on e.g. fluid mechanics).

The Department of Physics and Technology conducts various kinds of marine research within two research groups – (1) the Marine optics group and (2) the Marine acoustics group.

The Department of Clinical Medicine conducts marine research groups within two research groups – (1) Concentrating on the effects of marine-food intake on health and prevention and treatment of diseases, and (2) Concentrating on the identification and isolation of bioactive compounds from marine raw materials and examining effects of consumption of these compounds on health and prevention and treatment of diseases.

At the Faculty of Social Sciences, marine related research is conducted in a total of four departments, including themes such as coasts and climate, coastal zone management, management of fish farming and studies of fishing communities. At the Faculty of Law marine related research includes national property rights studies.

At the Faculty of Humanities marine research is conducted in two units – (1) the Department of Archaeology, History, Cultural Studies and Religion (AHKR) focusing on historical analysis of Norwegian fisheries and coastal culture, and (2) the Centre for the Study of the Sciences and the Humanities (CSSH) dealing with ethics of sea food, ethical aquaculture, and social network analysis trade.

At the Department of Psychosocial Science four research groups are engaged in research with direct or indirect relevance to the maritime sector, with a potential for collaborative activities with marine research groups.

2.1.2 Personnel

Table 2.1 below shows the development in academic personnel within marine studies at UiB over the past ten year-period based on the units' own reporting. Of the 18 departments/centres submitting self-assessment reports to the Evaluation Panel, 13 have provided figures for the total number of staff involved in research and/or teaching in the field, and ten figures for the number of staff involved in the field more than 50 per cent of their time. Hence, data are far from complete, but may still give an indication of the general development in UiB staff involved in marine research.

The overall figures show substantial increase in the number of staff members involved in marine studies. In 2004, the units report that they had 120 staff members involved in marine studies more than 50 per cent of their time, whereas in 2013 this figure had increased to 206 staff members.[12] Also including staff members involved in marine studies smaller parts of their time, UiB had 315 staff members in marine studies in 2013. Part of this difference – 315 with some of their time in marine studies and 206 staff members with more than half of their time in marine studies – is due to three more units being able to report the former rather than the latter.

[12] Due to organisational changes, such as the separation of Unifob/Uni Research from UiB in 2007, these figures are not directly comparable with national statistics on total academic staff at UiB in this period.

Table 2.1 Academic personnel in marine studies (research and/or teaching), 2004-2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Info*
Total number of staff involved	169.75	163.75	171.75	214.75	242.75	253.75	265.75	272.75	293.25	314.75	13
Number of staff involved in the field more than 50% of their time	120	114	118	140.8	155.8	167.1	168.5	172.4	188	205.6	10
Full time equivalents (FTEs) in the field:											
Professors (*professor/førsteamanuensis/andre førstestillinger*)	78.75	78.55	84.75	93.7	94.15	94.08	94.55	99.95	95.3	100.85	15
Other permanent academic staff	0.5	1.2	1.5	0.2	1	0.6	3.2	2.95	2.85	4.25	3
Postdoc fellows	22	26	23	25	31	34	34.2	43.1	59.4	59.3	9
PhD fellows	54.3	61.8	61.9	74.1	95.6	107.9	96.6	86.35	95.45	111.05	16
Researchers	16.1	12	11.8	18.9	19.75	18.55	23.7	21.1	14.7	17.5	1

Source: Self-assessment reports

*Number of units which provided information. “Researchers” was not a separate category in the self-assessment form, and additional information on researchers separately was provided by the Department of Biology only.

Furthermore, Table 2.1 indicates that the majority of the staff are professors and PhD fellows, and that there has been a large increase in particular in the number of PhD fellows. As measured in full time equivalents, there were 54 PhD fellows (FTEs) in the field in 2004, increased to 111 in 2013. In the same period the number of professors increased from 79 to 101 FTEs. There was also a notable increase in postdoc fellows, from 22 in 2004 to 59 in 2013.

A large proportion of these staff members were at the Department of Biology, which in 2013 accounted for 123 of those involved in marine studies and 120 of those involved more than half of their time in marine studies. Other units with more than 30 staff members involved in the field in 2013 were the Centre for Geobiology (45 staff members), the Department of Earth Sciences and the Sea Lice Research Centre (both with 36 staff members, see tables in Appendix).

2.1.3 Research funding

UiB and the Norwegian university funding system

Direct government funding plays a major role in the Norwegian higher education sector, and accounted for 76 per cent of total funding at UiB in 2013.[13]

UiB receives annual direct funding from the Ministry of Education and Research, consisting of two parts: a basic grant, which accounts for approximately 70 per cent of their direct funding from the Ministry, and a grant based on achieved results. The result-based grant is determined by a set of indicators related to education (student completion and mobility) and research (scientific publications, external funding and PhD graduates). Funding based on the research-related indicators accounts for a relatively small part of the direct funding (9% for 2014), whereas student completion is a more important determinant of funding levels at the universities (21% of UiB’s direct funding for 2014).

Most of the universities, including UiB, have introduced local variants of the government funding model. This means that the internal allocation of funding at the institutions is partly based on the results of the individual faculties and their departments.

[13] *Facts & Figures 2013. University of Bergen*

Funding for marine research at UiB

Three different sources for calculating funding for marine research at UiB

In this report, three different sources are used to estimate the amount of funding for marine research at UiB, giving somewhat different results:

A. National mapping of expenditure for marine and climate research and development (R&D) 2001 to 2011
These figures are provided by NIFU and are based on data for regular national mappings of R&D expenditure in Norway (see Appendix 3). Current expenditure is included in the figures for marine and climate research, but not scientific infrastructures/equipment/buildings. The R&D expenditure is calculated according to international standards, implying e.g. that expenditure for staff research time (but not teaching time) is included. The data includes R&D at 15 units at UiB as well as Uni Research, and hence only partly corresponds to the units included in our evaluation (the 15 units are listed in Appendix 3). The total current R&D expenditure for marine and climate at these units was 325 MNOK in 2011.

B. Allocation of UiB core funding (2004 to 2013)
These figures are provided by the UiB central administration, and include the part of the UiB budget/core funding specifically allocated to centres, strategic priorities, equipment and buildings within marine and climate research (in total 728 MNOK for the ten year period 2004 to 2013, see Appendix 4). These figures do not include the part of the basic funding used for 'regular' marine research at the ordinary departments. Hence, the figures are generally lower than the basic funding for marine and climate estimated based on the national mapping (e.g. 90 MNOK in 2011, compared to 135 MNOK basic funding in 2011 as estimated under source A).

C. Marine research expenditure reported in the self-assessments (2004 to 2013)
The funding data reported in the self-assessments include estimates of expenditure for marine research from 15 of the 19 evaluated units. In total, these units reported 520 MNOK for marine research in 2011 which is substantially higher than the figures from the national mapping (325 MNOK, source A). Likely reasons for the discrepancies are the different sets of units included, as well as different basis for the estimates. For instance, the self-assessments may include expenditure on infrastructures and staff teaching time, whereas the figures from the national mapping only include current R&D expenditure.

National mapping of expenditure for marine and climate research and development

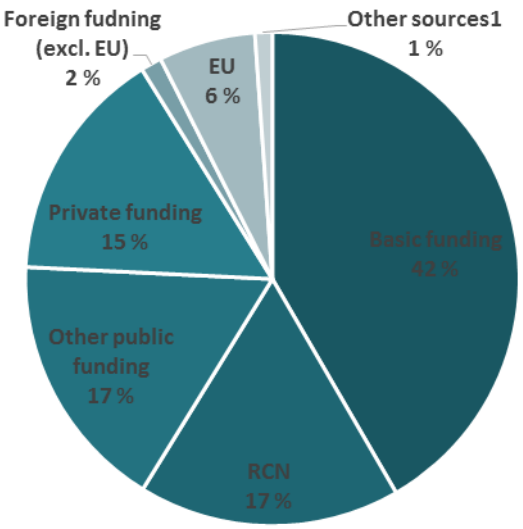
An overview of funding for marine research at the University of Bergen in the period 2001-2011 based on a regular national mapping of expenditure for marine research and development (R&D), is included in Appendix 3 in the report. The mapping is carried out by NIFU on behalf of the Research Council of Norway. Uni Research (previously Unifob), which is owned 85 per cent by UiB, changed its sector affiliation from the university sector to the research institute sector in 2009. However, in the overview, Uni Research is included as part of UiB throughout the investigated period.

The overview shows that total expenditure for marine R&D at UiB tripled between 2001 and 2011, from 109 million to 325 million Norwegian kroner (MNOK).[14] In 2011, about 60 per cent of the research effort was attributed to the university departments and about 40 per cent to Uni Research. National marine R&D efforts across the higher education, research institute and company sector amounted to 3189 MNOK that year, which means that UiB accounted for approximately 10 per cent of the total.

[14] Due to organisational changes, such as the separation of Unifob/Uni Research from UiB in 2007, these figures are not directly comparable with national statistics on total R&D expenditure at UiB in this period.

Figure 2.1 below shows marine R&D efforts at UiB in 2011 according to funding source.

Figure 2.1 Effort for marine R&D in the university system of Bergen 2011 by funding sources. Per cent.



Kilde: NIFUs kartlegging av marin FoU 2011

Public funding accounted for around 2/3 of the total, with basic government funding as the largest source (approx. 40%). The shares of funding from the Research Council of Norway and other public sources were equal at 17 per cent. Private sources also accounted for 17 per cent, whereas 8 per cent was foreign funding with the EU as the largest source.

An internal mapping of marine research at UiB in 2007 showed that the field is responsible for a large part of the University's total external funding. In 2007, 54 per cent of all Research Council funding at UiB was for marine research. Similarly, the field attracted 49 per cent of all funding the University received from the EU 6th Framework Programme.[15]

Allocation of UiB core funding

UiB has provided the Evaluation Panel with figures for its allocation of (central) funding for marine and climate research for the period 2004-2013 (Appendix 4). According to these figures, the total UiB funding in the period amounted to 626.3 MNOK, with an average annual funding increasing over the period, from 53.8 MNOK in 2004-2008 to 91.9 MNOK in 2009-2013. The increase in large part reflects investment in a new biology building and infrastructure at Marineholmen.

In addition to buildings, infrastructure and scientific equipment, a significant share of total central funding has been allocated to the Sars Centre and the three Centres of Excellence the Bjerknes Centre (2002-2012), the Centre for Integrated Petroleum Research (2002-2012) and the Centre for Geobiology (2007-2017). Funding for the four centres amounted to 54.2 MNOK in 2012, compared with total central funding for marine and climate funding of 69.4 MNOK in the same year. The Sars Centre, which is organised as a department at Uni Research, has been the largest recipient, with annual funding from UiB of between approximately 20 and 31 MNOK over the last ten year period. The current Central leadership at UiB has decided to re-integrate the Centre into the university structure as a direct follow-up of the strategic priority of marine research.

UiB funding of the Bjerknes Centre has continued after the Centre of Excellence-funding from the Research Council ended in 2012. In 2013, the Centre received 38.5 MNOK over the budget of UiB, of which 26.3 MNOK was a grant from the Ministry of Education and Research. Central funding for the

[15] «Styrenotat marin forskning 2008»

Centre for Integrated Petroleum Research has also been continued as earmarked allocations within the budget of the Faculty of Mathematics and Natural Sciences.

Marine research expenditure reported in the self-assessments

In the self-assessments, the units were asked to report on annual funding of research activities in the period 2004-2013. The table below is based on the reported figures. Not all units provided complete funding figures, and the tables must be interpreted accordingly.

Table 2.2 Total expenditure for marine research by source, 2004-2013 (in million Norwegian kroner)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Info*
Institutional core funding (total)	125.2	132.0	145.0	163.9	170.3	186.1	198.4	198.1	203.3	251.2	11
- funding from UiB's strategic priority	2.8	3.8	6.0	7.7	9.9	7.9	6.4	8.1	10.5	13.7	13
Grants from the RCN	81.3	89.5	43.9	67.6	81.2	98.5	107.0	104.7	110.2	180.3	14
Other Norwegian public funding	21.4	28.5	18.4	22.2	27.5	27.4	24.5	35.7	45.1	40.5	14
Private domestic sources	15.6	20.7	4.8	6.4	11.8	17.5	24.0	39.2	50.4	57.8	13
Funding from abroad	33.1	32.1	21.4	21.4	7.3	16.7	61.9	75.5	70.8	62.8	12
Sums entered in self-assessm.	210.6	234.2	217.4	266.0	298.5	341.5	383.5	403.5	431.0	554.5	12
Sum this table	279.4	306.5	239.5	289.2	308.1	354.1	422.1	461.3	490.3	606.3	15

Comments: *Number of units which provided information. This includes units which had obtained no funding from specific source, e.g. of the 13 which provided information on their funding from UiB's strategic priority of marine research, only three had obtained it (see table below). (When sum of total funding was entered in the self-assessment form, NIFU interpreted blank as zero, and when totals were missing, blank was interpreted as missing.)
Note: Units were asked to enter amounts in 100,000 NOK. Amounts apparently entered otherwise were corrected by NIFU (three units entering MNOK and four units entering 1000 NOK).
Source: Self-assessment reports

The largest funding sources reported are the institutional core funding (251 MNOK in 2013) and grants from the Research Council of Norway (RCN, 180 MNOK in 2013). Moreover, private domestic sources and foreign sources each accounted for about 60 MNOK of the funding of the marine research. In comparison, funding from UiB's strategic priority is reported as 14 MNOK in 2013, increased from 3 MNOK in 2004. Notably, there has been an increase in all sources reported, both in the core funding and in external funding, such as RCN grants and private sources. The total funding reported, increased from 279 MNOK in 2004 to 606 MNOK in 2013 (includes figures from 15 units; only including the 12 units who reported their total funding, the sum was 603 MNOK in 2013; see table above).

The overview of research funding gives a slightly different picture of the size of marine activities at various units at UiB than is apparent from the UiB staff overview. The Department of Biology and the Centre for Geobiology are still the largest units, but measured in funding there are more units which are larger than the number three measured in staff (the Sea Lice Research Centre): the Department of Earth Science, the Geophysical Institute, and the Department of Physics and Technology (see table A3 in Appendix 5). These differences indicate differences between the units in the level of cost intensive research (R&D expenditure per researcher).

2.1.4 Administrative resources and support functions

Administrative resources and support functions for marine research and education are mainly provided at the level of the individual faculties and departments. To the extent that the units of evaluation have provided information about administrative support functions in their self-assessments, it is included in the description and assessment of the units in Chapter 4.

At the central level, the Division of Research Management functions as the secretariat for the Strategic Committee for Marine Research, and the project leader for the Bergen Marine Research Cluster also belongs to this division.

2.1.5 Summary

This section has shown that marine research takes place across many faculties and departments at the University of Bergen, with a concentration of marine research activities in four units at the Faculty of Mathematics and Natural Sciences: the Department of Biology (including the Sea Lice Research Centre), the Geophysical Institute, the Centre for Geobiology and the Department of Earth Science. There has been a significant increase in both the total number of staff involved in marine studies and total funding for marine research at the University in the period of evaluation. Figures that include Unifob/Uni Research as part of UiB, show that total expenditure for marine R&D tripled between 2001 and 2011. This was a stronger increase than for UiB as a whole, and the University accounted for approximately 10 per cent of total Norwegian marine R&D expenditure in 2011. We have also seen that marine research is responsible for a large part of the total external funding at UiB, attracting 54 per cent of all Research Council funding at the University in 2007 and 49 per cent of all funding UiB received from the EU 6th Framework Programme.

2.2 Education at Master's and doctoral level

2.2.1 Master's programmes

Master's level education in marine subjects at UiB takes place mainly in the Faculty of Mathematics and Natural Sciences. Table 2.3 below shows the relevant Master's degree programmes offered by the Faculty in the period 2004-2013.[16]

Table 2.3 Master's degree programmes offering education in marine subjects, 2004-2013

Programme	Department
Aquaculture biology (MAMN-BIOHAV)	Department of Biology
Aquamedicine (MAMN-FISK) [1)]	Department of Biology
Biology (MAMN-BIO)	Department of Biology
Fisheries Biology and Management (MAMN-FIFO)	Department of Biology
Marine biology (MAMN-BIOMAR)	Department of Biology
Nutrition – marine (MAMN-NU)	Department of Biology
Advanced Spectroscopy in Chemistry (JMAMN-ASC)[2)]	Department of Chemistry
Chemistry (MAMN-KJEM)	Department of Chemistry
Earth Science (MAMN-GEOV)	Department of Earth Science
Geoscience of Basins and Lithosphere (JMAMN-BAS)	Department of Earth Science
Informatics (MAMN-INF)	Department of Informatics
Applied and Computational Mathematics (MAMN-MAB)	Department of Mathematics
Marine Ecosystems and Climate (JMAMN-MCLI) [3)]	Geophysical Institute
Molecular Biology (MAMN-MOL)	Department of Molecular Biology
Petroleum Technology (MAMN-PETR)	Department of Physics and Technology
Process Technology (MAMN-PRO)	Department of Physics and Technology
Meteorology and Oceanography (MAMN-GEOF)	Geophysical Institute
Energy (MAMN-ENERG)	Geophysical Institute

Comment: [1)] This is a five-year Integrated Master's Programme.
[2)] This is an Erasmus Mundus Joint Master's Programme.
[3)] This is a Joint Nordic Master's Programme.
Source: UiB

Whereas some programmes, such as Aquaculture biology and Marine biology, have a clear marine profile, others have a broader disciplinary or thematic scope. It is for this reason difficult to establish the exact number of Master's students within marine studies, but UiB estimates that around 2/3 of the Master's students at the Faculty of Mathematics and Natural Sciences write their theses on topics that can be classified as marine. The number of active students at the Faculty is approximately 600. There are on average between 230 and 270 students graduating every year, and based on the estimation

[16] The table is based on information provided by UiB.

that around 2/3 of the students specialise in marine subjects, the annual number of “marine” graduates is approximately 165.

UiB has not been able to provide exact figures showing the development in the number of Master’s students and graduates within marine subjects during the period of evaluation. Tables with available programme level figures for the period after 2006 are included in Appendix 5. The share of students within marine studies varies between the programmes, and the figures only give a general indication of how student and graduate numbers within the strategic priority area have developed. What the figures show is that there has been a modest and fairly steady increase in the overall number of students within Master’s programmes covering marine subjects, from 348 in 2007 to 421 in 2013. Earth Science is the Master’s programme in which student numbers have increased the most in the period, from 77 to 120. As for graduates, the total number has fluctuated between approx. 100 and 130 over the period 2011-2013.

It should be noted that some of the programmes in table 2.3 have been discontinued or merged with other programmes. From the autumn of 2014, the Department of Biology offers one Master’s programme in biology with seven areas of specialisation (microbiology; marine biology; fisheries biology and management; aquaculture biology; biodiversity, evolution and ecology; developmental biology and physiology; and environmental toxicology). The Integrated Master’s Programme in Aquamedicine is still in place.

2.2.2 Doctoral education

There are no specifically marine PhD programmes at UiB, and the University lacks a comprehensive overview of the number of doctoral students and candidates within marine sciences in the period under evaluation. A table showing figures based on a mapping carried out in 2007 is included in Appendix 5. According to these figures, there was an annual average of 43 “marine” doctoral candidates in the period 2005-2007. The candidates were almost exclusively from the Faculty of Mathematics and Natural Sciences. In connection with the preparations of a marine strategy for the Faculty, a new survey was carried out for the year 2012. That year, the Faculty awarded 16 doctoral degrees within marine research, and another 10 degrees that were “marine related”.[17]

UiB has organised several research schools within marine sciences over the past ten years: the Bergen International Research School in Marine Biology; the Research School in Molecular and Computational Biology; and the Bjerknes Research School in Climate Studies.[18] Only the Research School in Molecular and Computational Biology (MCB), organised by the Department of Molecular Biology, is currently active.

Moreover, the University has played a central role in the Nordic research school in marine sciences, the Nordic Marine Academy (NMA). NMA was established in 2005 with the Department of Biology at UiB as the organising institution. The research school received funding for a five year period (2005-2010) from Nordforsk and the Nordic Working Group on Fisheries Research (NAF), both bodies under the Nordic Council of Ministers. The main objective of NMA was to promote Nordic co-operation and mobility within marine research and research training, and more than 60 universities and research institutes in the Nordic countries were members. NMA offered advanced courses and mobility grants for PhD students and young researchers, and organised several scientific workshops and seminars.[19]

The Marine European Network for Training of Researchers, MENTOR, has been another international initiative in which UiB has participated, together with other marine research centres in Europe.[20]

UiB is currently involved in doctoral education through CRISP - a Centre for Research-based Innovation in Sustainable Fishing and Pre-processing Technology with RCN funding in the period 2011-2019. CRISP performs research aimed at enabling innovation in technologies and solutions for sustainable

[17] «Forslag til Marin strategi for Det matematisk-naturvitenskapelige fakultet»
[18] «Styrenotat marin forskning 2008»
[19] The webpages of the research school, URL: http://armauer.uib.no/nma/default.asp?k=10
[20] «Styrenotat marin forskning 2008»

harvesting and optimal pre-processing of live marine resources. The Centre is organised as a separate unit within the Institute of Marine Research but involves the University of Bergen as a research partner, with responsibility for education in fisheries biology in general, and specifically for this project, in general fish biology, experimental biology, fish behaviour, fisheries acoustics and fish capture.

2.2.3 Summary

UiB offers Master's and doctoral level education within a broad spectrum of marine subjects, mainly at the Faculty of Mathematics and Natural Sciences. The Faculty has many Master's prorgammes covering marine subjects, and has organised several research schools within marine sciences over the past ten years. We lack exact figures for the number of Master's and PhD students and candidates within marine studies in the period of evaluation, however. What this section has established, is that there has been a modest increase in the overall number of students within Master's programmes covering marine subjects from 2007 to 2013. It is not possible to say anything about developments in the number of PhD students, but we have seen that the Faculty of Mathematics and Natural Sciences awarded 26 doctoral degrees within marine or marine-related research in 2012.

2.3 Co-operation

As pointed out in the introduction, the University of Bergen is one of several institutions engaged in marine research and education in the Bergen area, and there is extensive co-operation in the field. UiB is closely associated with several local academic communities, e.g. through partial ownership, affiliation to joint centres, formal collaborative agreements, and project-based co-operation. Table 2.4 gives an overview of central linkages between the University and its main local academic partner institutions in the period 2004-2013.[21]

[21] The table is based on a list of main local academic partner institutions provided by UiB.

Table 2.4 Linkages between UiB and local academic partner institutions, 2004-2013

Name/type of local partner institution	Linkages with UiB
Uni Research Ltd., research company	• 85% UiB ownership • institutional collaborative agreement • partner institutions in - Hjort Centre for Marine Ecosystem Dynamics, hosted by Institute of Marine Research (IMR) - Bjerknes Centre for Climate Research (BCCR), a Centre of Excellence hosted by UiB (2002-2012), continued as a centre affiliated to UiB - Centre for Integrated Petroleum Research (CIPR), a Centre of Excellence hosted by UiB (2002-2012), continued as a centre/department at Uni Research - Bergen Marine Research Cluster • project-based co-operation
Christian Michelsen Research (CMR), technical-industrial research institute	• 50% UiB ownership (and 35% ownership by Uni Research Ltd.) • institutional collaborative agreement • partner institutions in - Michelsen Centre for Industrial Measurement Science and Technology (MIMT), a Centre for Research-based Innovation hosted by CMR (2007-2015) - Bergen Marine Research Cluster • project-based co-operation
Institute of Marine Research (IMR), government-owned research institute	• institutional collaborative agreement • partner institutions in - national cruise committee/instrument pool, administered by IMR - Hjort Centre for Marine Ecosystem Dynamics, hosted by IMR - Bjerknes Centre for Climate Research (BCCR) - Sea Lice Research Centre (SLRC), a Centre for Research-based Innovation hosted by UiB (2011-2019) - Centre for Research-based Innovation in Sustainable Fishing and Pre-processing Technology (CRISP), a Centre for Research-based Innovation hosted by IMR (2011-2019) - Bergen Marine Research Cluster • project-based co-operation
National Institute of Nutrition and Seafood Research (NIFES), government-owned research institute	• institutional collaborative agreement • partner institutions in - MitoHealth Centre for Bioactive Food Components and Prevention of Lifestyle Diseases, a Nordic Centre of Excellence with funding from NordForsk hosted by UiB (2007-2012) - Bergen Marine Research Cluster • project-based co-operation
Nansen Environmental and Remote Sensing Centre (NERSC), research institute	• established as an independent research foundation affiliated with and co-founded by UiB • institutional collaborative agreement • partner institutions in: - Hjort Centre for Marine Ecosystem Dynamics, hosted by IMR - Bjerknes Centre for Climate Research (BCCR) - Bergen Marine Research Cluster • project-based co-operation
Norwegian Institute of Food, Fisheries and Aquaculture Research, NOFIMA (Bergen departments), research institute	• institutional collaborative agreement • partner institutions in: - Bergen Marine Research Cluster • project-based co-operation
The Norwegian Institute for Water Research (NIVA) (Region West), government-owned research institute	• project-based co-operation
The Norwegian Veterinary Institute Bergen, government-owned research institute	• project-based co-operation
Bergen University College, higher education institution	• partner institutions in - Michelsen Centre for Industrial Measurement Science and Technology (MIMT) • project-based co-operation
NHH – Norwegian School of Economics, higher education institution	• project-based co-operation
The Royal Norwegian Naval Academy, higher education institution	• institutional collaborative agreement • project-based co-operation
Helse Bergen/ Haukeland University Hospital, health trust/university hospital	• institutional collaborative agreement • partner institutions in: - Bergen Marine Research Cluster • project-based co-operation

Moreover, there are linkages between UiB and several of the local research institutions in the form of secondary positions and doctoral education collaboration.

The co-operation in the Bergen Marine Research Cluster is a key element in UiB's strategic priority of marine sciences. The cluster was established in 2008 (cf. Section 1.1), and aims to strengthen regional co-operation within marine R&D and education in order to address regional, national and global challenges related to climate, environment and resources, technology and health. Central aims are to strengthen both basic and applied marine research, increase student and researcher recruitment, and contribute to innovations targeting the needs of industry and the public sector. The cluster is engaged in building cross-disciplinary centres within selected fields with the potential to become Centres of Excellence, and works to establish local collaboration in the areas of scientific cruises, infrastructure and research equipment as well as international collaborative agreements.

UiB also has extensive international collaboration within marine research and education, both with leading academic communities in North America, Europe and Asia and with institutions in developing countries. A table showing relevant bilateral agreements between UiB and foreign institutions is included in Appendix 5. The international profile of marine research at the University is reflected in the field's high share of total EU funding at UiB (cf. section 2.1.3), as well as in the level of international co-publications (cf. section 3.2).

Summing up, we see that marine research and education at UiB takes place in close co-operation with external actors. This section has shown that the University has many, diverse linkages to several local academic institutions within marine sciences, and that Bergen Marine Research Cluster is considered an important arena for local collaboration. International collaboration is also a central feature: UiB has bilateral agreements covering marine research and education with a high number of foreign institutions, and engages actively in international projects and co-publication within marine sciences.

2.4 Main findings in national evaluations

The Research Council of Norway carries out regular national evaluations of disciplinary or central thematic research areas, all performed by international review panels, and units at UiB involved in marine research have been part of three recent evaluations: of biology, medicine and health research (2011); earth sciences (2011); and climate research (2012).

In the biology evaluation, the research groups at the Department of Biology at UiB overall received good assessments. Scientific quality was graded as very good and/or very good to excellent for several of the units within marine sciences, including the research groups for Evolutionary Ecology, Marine Microbiology, Marine Biodiversity, Marine Developmental Biology, Fish Immunology and Fish Disease.[22]

The evaluation of research in earth sciences included research groups from the Department of Earth Science and the Geophysical Institute at UiB, as well as the Centres of Excellence: the Bjerknes Centre and the Centre for Integrated Petroleum Research. Several of the research groups with a marine focus were given high grades, particularly at the Bjerknes Centre and the Department of Earth Science.[23]

As many as eleven units at UiB provided input to the evaluation of Norwegian climate research, mainly departments at the Faculty of Mathematics and Natural Sciences, but also departments at the faculties

[22] The evaluation reports of panels 1 (Botany, Zoology and Ecology-related Disciplines) and 2 (Physiology-related Disciplines), Evaluation of Biology, Medicine and Health Research in Norway, the Research Council of Norway, 2011
[23] *Research in Earth Sciences in Norway. An Evaluation*, the Research Council of Norway, 2011

of Humanities and Social Sciences, and the Faculty of Law. Only the Bjerknes Centre, the Geophysical Institute and departments of Biology and Earth Science were invited to submit self-assessments and participated at the evaluation hearings, however. The evaluation report does not provide assessments of the individual units, but points out that the UiB departments of Earth Science and Biology and the Bjerknes Centre are prominent institutions in terms of publishing within key areas of research, and that UiB has been the most successful Norwegian research organisation when it comes to receiving funding from the Environment programme under EU 7th Framework Programme.[24]

To conclude, several marine research communities at UiB have received good reviews in the recent national evaluations of research in biology and earth science, and climate research. The evaluations, that have been carried out by international review panels on behalf of the Research Council of Norway, testify to high scientific quality in units involved in marine research at the departments of Biology and Earth Sciences, as well as the Geophysical Institute and the Bjerknes Centre.

[24] *Norwegian Climate Research. An Evaluation*, the Research Council of Norway, 2011

3 Bibliometric study of marine sciences at the University of Bergen 2004-2013

The main purpose of the bibliometric analysis has been to provide a macro view of the development of marine sciences at UiB during the period 2004-2013. Main issues analysed include: publication output; discipline profile; institutional contribution; citation rates; and international collaboration. In this chapter, we provide a summary of the full analysis that can be found in Appendix 6.

The study is based on two main data sources, the publicly-accessible database CRIStin and the Web of Science by Thomson Reuters.

It should be noted that the bibliometric analysis is carried out as a separate study, independent of the other parts of the evaluation. This means that there might be some differences in the way marine sciences have been delimited. In the bibliometric study, we have included publications based on the following criteria: research on phenomena located in or concerning marine areas; research carried out in marine areas or based on materials or observations from marine areas; and research aiming at direct application in marine areas.

Examples of types of research defined as marine research include:

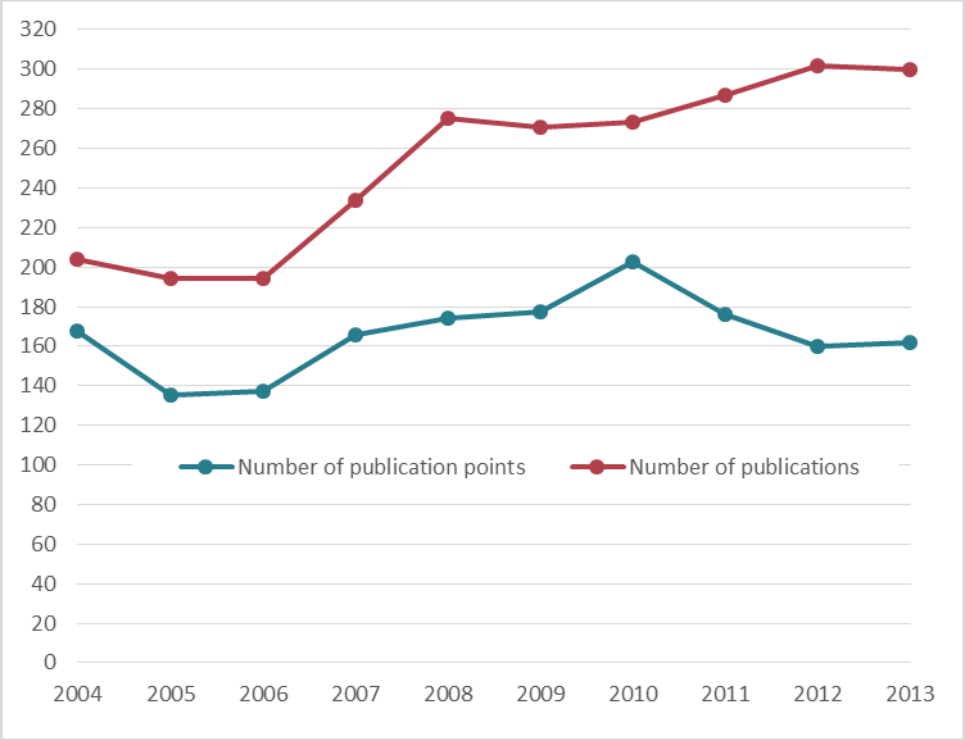
- Studies involving fieldwork or data collection in marine areas;
- Studies based on data by means of remote sensing and monitoring (by satellite or aircraft) of areas, ecosystems or species in the marine domain;
- Modelling of parameters (e.g. climate, sea ice) in the marine areas (although not requiring field work);
- Studies of equipment and technologies intended for applications in marine areas.
- Studies of foreign policy and security policy related to the marine regions and resource aspects
- Studies based on marine materials regardless of purpose (e.g. molecular biological studies based on zebrafish, chemical studies of marine substances, studies of human health and nutrition involving marine materials (e.g. fish oil), petroleum research.

3.1 Results

The results show that UiB scientists have published in total more than 2,500 marine research publications during the 10 year period 2004-2013. The number has increased from around 200 publications annually during the first years to approximately 300 publications (50% increase) (Figure 3.1). In terms of publication points the increase is less strong due to an increasing number of authors

per publication (lowest in 2005 with 135 points and highest in 2010 with 202 points) and there has been a decline during recent years.

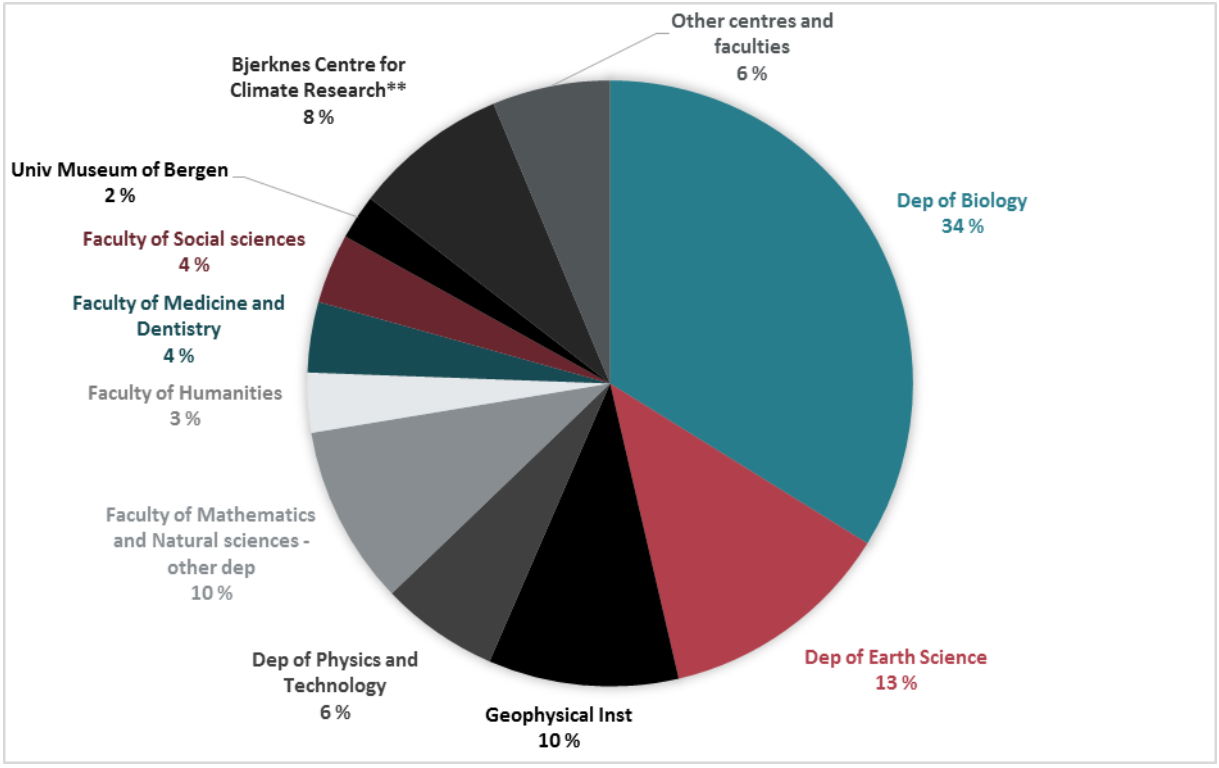
Figure 3.1 Number of publications and publication points, marine sciences, UiB, 2004-2013.



Marine sciences account for almost 10 per cent of UiB's total publication output (based on publication points). In other words, the analysis documents that UiB has a strong marine profile. During the period 2004-2013 the annual proportion has, nevertheless, declined slightly (to 7.9% in 2013). This means that the growth in publication numbers in other areas has been stronger than in marine sciences.

The large majority of the marine science at the University of Bergen is carried at the Faculty of Mathematics and Natural Sciences. The analysis shows that the Faculty produced 85 per cent of UiB's publication output in marine sciences during the period 2009-13. Figure 3.2 shows the proportions for the largest contributing departments. The Department of Biology is the largest and contributed one third of the total publication output. The Department of Earth Science, the Geophysical Institute and the Bjerknes Centre for Climate Research had proportions of 13, 10 and 8 per cent, respectively. As shown in the figure, there are contributions to marine science from most of the other faculties at UiB.

Figure 3.2 Contribution to marine research by departments and faculties. Proportion of publications 2009-13.*

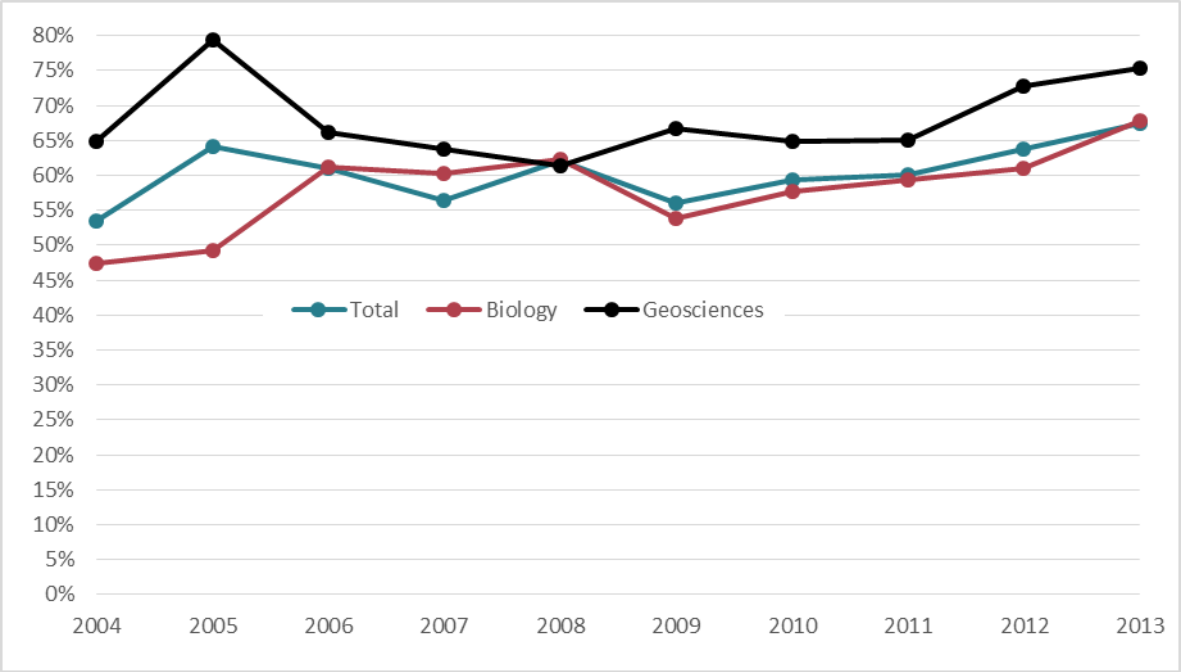


* Based on publication points. Only the largest departments in terms of publication output are shown separately in the figure.
** Only publication shares from the UiB part of the Bjerknes Centre included.

3.2 International co-operation

The collaboration profile of UiB's marine research has been studied based on data on international co-authorship (i.e. publications with author addresses both from UiB and other institutions). Of all the marine publications (2004-2013), 60 per cent had co-authors from other countries. Thus, the extent of international collaboration is wide, apparently involving the majority of the marine research. The proportion of international collaboration has varied from 54 to 67 per cent during the ten-year period, with an increasing trend (Figure 3.3).

Figure 3.3 Proportion of articles with international collaboration,* marine sciences, 2004-2013. Total, biology and geosciences.



* Only articles indexed in Web of Science are included in the calculations.

Table 3.1 shows the frequencies of co-authorship for the nations that comprise UiB's main collaboration partners from 2009 to 2013 in marine biology and geosciences. In both fields, the USA is the most important collaboration nation. Almost one quarter (24 per cent or 107 articles) of the UiB articles in geosciences had co-authors from the USA.

Table 3.1 Collaboration by country 2009–2013. Number and proportion of the article production with co-authors from the respective countries.* Marine Science, selected fields (biology and geosciences*)

BIOLOGY			GEOSCIENCES		
Country	No. articles	Proportion	Country	No. articles	Proportion
USA	86	13%	USA	107	24%
UK	66	10%	UK	100	22%
Germany	59	9%	Germany	97	22%
Iceland	49	7%	France	60	13%
Sweden	48	7%	Canada	27	6%
Denmark	44	7%	Sweden	25	6%
France	43	6%	Denmark	24	5%
Spain	42	6%	Netherlands	22	5%
Netherlands	31	5%	Switzerland	18	4%
Canada	30	5%	Spain	18	4%
Austria	30	5%	China	16	4%
Italy	21	3%	Australia	15	3%
Japan	20	3%	Japan	13	3%
Australia	20	3%	Russia	13	3%

* Only articles indexed in Web of Science are included in the calculations.
** Only countries with more than 19 and 12 collaborative articles, respectively, are shown in the table.

4 Assessment of the units

4.1 The Department of Biology and the Sea Lice Research Centre

The Department of Biology (BIO) has produced a self-assessment report of high quality and with sufficient detail to allow the Panel to actually evaluate their activities. The high quality of the report mirrors the generally high quality of the research performed and educational programmes offered by the Department. The report offered by the Sea Lice Research Centre (SLRC) is more superficial, but relevant information was provided at the interview to fill in the gaps.

Thematic areas, disciplines and research units

The Department of Biology represents the largest unit within the strategic priority area marine research, accounting for somewhere between 1/2 -2/3 of the marine related research at UiB. Also, most of the research at BIO is marine related. Of the 100-130 total academic staff at BIO involved in marine activities during the 2004-2013 period, by far the majority (>95%) spend most (more than half) of their working time on marine research. The Sea Lice Research Centre, hosted but only partly funded and staffed by UiB, has an academic staff of 18, mainly postdocs and PhD students and only 2-3 tenured staff and 1-2 other permanent researchers

The Department has evolved from a more traditional species- and organism-oriented focus to rather emphasise systems-oriented disciplines (ecology, developmental biology, evolution). This transition has also encouraged the involvement of auxiliary disciplines (e.g. mathematics, physics, chemistry) to a larger extent. This transition in emphasis and focus has happened during the past 20+ years, most explicitly when several institutes (including Zoology, Botany, Microbiology and Marine biology) were integrated in 2004 into the present day BIO. This development has been in parallel with similar developments in many other marine research institutions worldwide, but the BIO groups have often been pioneering, at least within a European context, in this development. The development is likely to have been further encouraged by the definition of marine research as a focus area at UiB.

The basis for evaluation is 11 research groups organised in four thematic areas within the Department: (1) Fisheries ecology and marine ecosystems dynamics; (2) Marine and environmental health; (3) Aquaculture and fish health; and (4) Marine biodiversity. Neither the self-evaluation report nor other material received from UiB allows an evaluation of the distribution of personnel and other resources to the different groups. The Sea Lice Research Centre, a Centre for Research-based Innovation established in 2011 and still developing, is associated with the Department, and here evaluated together with BIO. The Department is also one of two host departments for the Centre for Geobiology, which is evaluated separately.

The research activities are diverse within the Department and can only be briefly summarised here. The Fisheries ecology and marine ecosystems dynamics groups are internationally known for their novel and theoretically based approaches to applied as well as topical problems in marine science. Thus, the groups have revitalised fish and fisheries research by using evolutionary and ecological theory to interpret fish biology and population biology and to assess effects of fisheries. The groups are also internationally recognised for their work on the role of microbes for nutrient dynamics in the ocean and its development of simple powerful models that have helped understand fundamental problems in marine ecology. The groups also have a long history of examining behaviour of marine organisms, mainly fish, which has been important for the understanding of predator prey interactions and migration behaviour, among other things, and has applications with marine aquaculture. The groups have been very successful in attracting external funding, from EU and other sources, and they have a very prestigious ERC Advanced Investigator grant, among many others.

The Marine and environmental health groups conduct research within a range of areas. One main activity is fish physiology and developmental biology, with focus on aquaculture relevant species, such as salmon, trout, halibut, and cod, as well as “classical” laboratory models in developmental biology (tunicates). Related to physiology are fundamental and applied studies of the effects of mercury, oil-products, and other pollutants on the fish in particular, both at cellular, organ, and whole organism levels. Finally, environmental change is examined, mainly through the study of changes in certain planktonic groups (foraminifera) in the geological record. The groups have a rather strong record of external funding; mainly from the Research Council.

The Aquaculture and fish health groups have a more directly applied focus to their work. It is again rather diverse and includes, amongst others, studies of fish population biology, fish nutrition and development, shellfish production, larval fish ecology and climate studies, and thus seems to overlap broadly with some of the other groups. More group-specific activities are substantial bodies of work on fish and shellfish diseases and immunology. The groups receive funding from a diverse range of sources.

The Marine biodiversity group conducts fundamental and important research on the phylogeny and evolution of various marine animals, ranging from crustaceans to cetaceans. The group also has substantial research on population biology and ecology of macroalgae. The group apparently receives somewhat limited external funding.

Finally, the Sea Lice Research Centre, a consortium of researchers from UiB, the Institute of Marine Research, and the Norwegian University of Life Sciences, together with five industry partners, has a research agenda focused on sea lice in aquaculture and examines aspects of sea lice biology mainly related to its parasitic behaviour and ways to fight sea lice in aquaculture.

The general level of external funding is consistently high for BIO, about 30-50 per cent of the total budget of the Department, which is impressive. The most significant funding source is the Norwegian Research Council, which is probably also the most competitive national funding source. This high level of competitive external funding is a testimony of the high quality of the research conducted in the Department. The Sea Lice Research Centre receives only a small fraction (~15%) of its funding from UiB, about 1/3 from private sources (mainly industry), and the rest from the Research Council and other governmental funding agencies.

Scientific production

Biology accounts quantitatively for about 50 per cent of the marine science publications at UiB, and the Department of Biology produces about one third of all marine science publications at UiB, so BIO carries a substantial weight in marine science at UiB. The overall average impact of the publications in biology, as judged from citation analysis, is very good and about 15 per cent above the average for the field as such. This average pattern masks quite some variation in publication standard between groups within the Department, ranging from good to outstanding. The bibliometric analysis is not broken down to department and group level, so it is difficult to accurately assess the publication rate, but based on

staff numbers in BIO, total number of marine science publications and BIO's average share hereof (34%), it is possible to calculate an estimate of 0.7-0.8 papers per academic staff per year. Although this must be considered a conservative estimate because non-marine papers are excluded from the analysis, it seems towards the lower end of what one could expect from a university institute. Despite an increasing trend in publication volume, which mainly follows the increase in staff numbers during the study period, the scientific production, measured as "publication points" per researcher, shows a declining temporal trend. It is difficult to draw strong conclusions from this because the extraction of department-specific information from the bibliometric analysis is very crude, but it raises a flag that the Department should be aware of.

As regards the quality and relevance of the publications, they vary from good to excellent for the Department as a whole, and vary also somewhat between groups, as one would expect. However, overall, the quality and relevance of the scientific production is very high. Most thematic areas have published some papers in general, high rank journals (e.g. Science, Nature, PNAS), which demonstrates both the capacity and high ambition levels of the groups.

The publication profile of the Fisheries ecology and marine ecosystems dynamics groups reflects their interest in theoretical approaches to both fundamental and applied problems in marine science. The quality of their publications is very high, as is their relevance as judged against their mission as stated in the naming of the thematic cluster. The Microbiology group stands out with a particularly high-profile publication record.

The Marine and environmental health and the Aquaculture and fish health groups all appear to have satisfactory scientific production, which is relevant to their missions. Their publication record is respectable, with most papers published in good standard journals. There are few papers in high impact journals. The Marine biodiversity group publishes papers on phylogeny of topical interests and in outstanding journals. The group also produces papers on a variety of topics in more specific standard journals of good quality.

The Sea Lice Research Centre reports only a few publications, mainly in specialised journals. However, the Centre is still new, and the interview demonstrated important and interesting research of both academic and applied interest that is yet to be published. In addition, no less than four patent applications had recently been submitted.

The Department has produced 190 PhD candidates during the period, but the material provided yields no opportunity to assess the quality and relevance of the theses produced.

Master's and doctoral level education

The Department offers both Master's and PhD programmes. The Master's programmes have varied somewhat during the ten-year period, and there appears to have been 6-7 overlapping programmes running simultaneously (Fisheries biology, Marine biology, Aquaculture, Biology, Marine nutrition, Aquamedicine, Water and coastal management). Given the number of students recruited into the programmes, 40-45 each year, this appears to have been a large number of programmes. Also, the number of specific courses offered by the Department is very high, about 70. This implies a high workload, and the recent restructuring of the programme portfolio into one Master's programme in biology with seven areas of specialisation seems reasonable.

The topics taught and the kind of candidates produced appear highly relevant to the marine sea food and other marine-related industries that play such an important role in Norway. Also, the candidates should be well suited for jobs in public administration. Although there is no indication of the fate of the candidates, one can assume that the Norwegian job market must be very favourable to these candidates. A recent initiative, supported by a grant from the Norwegian Research Council, explicitly emphasises the suitability of the candidates for jobs in the private sector, e.g. by offering students placement in the industry during their studies. There is no basis in the self-assessment reports that allows a closer evaluation of the quality of the Master's programmes. However, in 2014 the

Department was awarded a Centre of Excellence in Education – bioCEED – which aims at improving the quality of the education in (marine) biology. This demonstrates both that the Department emphasises teaching and that its educational programme is held in high regard.

BIO graduates about 20 PhD candidates per year, i.e., approximately one PhD candidate per tenured staff every other year. About 80 per cent of the candidates are within marine science. The Department operates or takes part in specific research schools, such as the Bergen Summer Research School and the Molecular and Computational Biology Research School, that both offer lecture series and courses. While the Department has no systematic records of the fate of their PhD candidates, 17 examples of post-PhD-careers have been given. The majority of the candidates are in research (10), and most of the rest are in the industry, with only one in administration and one working with fisheries management. However, most of the researchers listed are in their early career (postdocs), and many of these may ultimately work in positions outside of academia. Again, one can assume that there is a good demand for this expertise in both industry and public administration. PhD candidates from BIO generally have a very good reputation, although this general (and poorly substantiated) assessment is likely to cover a significant difference between candidates.

The Sea Lice Research Centre contributes teaching to BIO's Master's programmes and advises PhD students. So far, no PhD students have graduated from their programme.

Co-operation with academic communities in UiB's periphery

The Bergen area abounds with marine research institutions and academic organisations within the marine area, including biology, and naturally there are strong links and co-operation between these various institutions.

BIO reports that their co-operation with other research communities in their surroundings is vital to their continued development and access to funding sources, expertise, and facilities, and they appear to be very active in creating networks and "centres" that evolve around both specific and rather general themes. Key to BIO appears in particular to be the Institute of Marine Research in Bergen, a governmental research institute with a research agenda that is more applied but that otherwise overlaps broadly with that of BIO; and Uni Research, which is an independent research institution that is entirely funded by soft money and consultancy contracts and that has grown out of and is mostly owned by the University. These networks and collaborative activities are not only limited to strictly academic institutions in the Bergen area, but reach out to national and European institutions and, in some cases, also to industry. The recently created "innovation centres", including the Sea Lice Research Centre, that involves both academia and industry, are good examples. In general, the involvement of BIO with other academic communities is very impressive.

International activities

Natural sciences are almost by default international, and BIO is very well connected internationally. This is manifest through the participation in many international projects, e.g. as funded through the EU FP programmes (as evidenced by funding sources), creation and participation in Nordic and European networks, as well as through co-authorships with non-Norwegian authors on scientific publications (more than 50% of the publications in biology are co-authored with foreign scientists, and this proportion has increased slightly during the study period). Staff members participate in various international working groups (e.g. ICES), panels, research schools, and participate in and organise international workshops and symposia. Thus, while some groups may be more nationally oriented in the scope of their research and activities, overall BIO staff have a strong international presence.

The Sea Lice Research Centre participates in international research projects, mainly with countries with significant salmon farming, but their scope is otherwise mainly domestic and directed towards the Norwegian aquaculture industry

Dissemination activities

The international dissemination of research is mainly through scientific publications (see above), presentations at international meetings, and participation in international working groups (see above). The participation in international symposia with presentations appears to be good to strong, both for BIO and the Sea Lice Research Centre. The main target groups for international dissemination are other scientists, but the Sea Lice Research Centre in addition has many dissemination activities directed towards the international industry. The groups also list a few international popular outreach activities.

The national dissemination is of two kinds, i.e. outreach to the public, and bringing new research to the industry and to public administration. Of course, some of the international dissemination may also be via international symposia organised in Norway. The self-evaluation reports list numerous contributions of all three kinds. The media for these contributions include the traditional ones (lectures, presentations, articles in newspapers and popular science journals), but some of the groups also use the social media, such as Facebook and Twitter, and they are writing blogs. Twitter in particular appears to become increasingly popular to rapidly disseminate new science to the science communities, while Facebook probably mainly reaches out to the general public. It is hard to evaluate the significance of these activities, but it is probably a worthwhile activity.

Cross-disciplinarity

Several groups at BIO are internationally recognised for their cross-disciplinary work, and mainly for blending biology and mathematics through the development of a whole suite of novel mathematical models of biological systems, ranging from vision in fish to the organisation and functioning of pelagic ecosystems. BIO has been pioneering this development in marine biology in Northern Europe. But cross-disciplinarity at BIO extends much further and includes several other “auxiliary” disciplines, such as computational biology and bioinformatics, physics, chemistry, and even medicine, and the more aquaculture-related activities have also explored the interface between biology and technology in the more applied projects. The Sea Lice Research Centre involves several biological disciplines (e.g. pharmacology, parasitology, immunology) in their hunt for ways to fight sea lice in salmon culturing. The increased focus on cross-disciplinarity has been paralleled by a change in focus, from traditional organism- and biome-oriented classical marine biology to a broader scope and a focus on more topical (e.g. evolution, ecology) or applied disciplines (e.g. aquaculture, sea lice combat). The merging of a number of separate discipline-focused departments (e.g. Zoology, Botany) into the integrative Department of Biology about 10 years ago has also encouraged cross-disciplinarity between these various disciplines.

Significance of additional strategic funding and the Strategic Committee for Marine Research

The Department has received some additional funding through the strategic programme, between 2.6 to 5.5 MNOK per year, corresponding to 4-8 per cent of the basic core funding that the Department receives, or 2-3 per cent of the Department’s total funding. The Sea Lice Research Centre has so far not received funding from the programme. The funds have been used to recruit a few students and staff but apparently mainly to maintain and improve infrastructure (buildings, boats, and research facilities). The Department acknowledges the importance of this contribution, which has helped develop a state-of-the art infrastructure. The Panel adds that these kinds of expenses are difficult to extract from external funding sources that typically supports flashier, specific activities. Essentially, the strategic programme funding functions as an increase in the basic funding, and it is unclear to what extent these funds have been directed to specific marine research, in contrast to the Department as a whole.

The Department is less impressed by the impact and significance of the Strategic Committee. While respecting the mandate of the Committee, it appears that the Committee’s activities have had no

significant impact on the actual direction and execution of the research and teaching conducted in the Department. Also, the Committee apparently has had no control over the flow of money.

Administrative resources and support functions

The Department expresses its satisfaction with the professional and service oriented support they receive from their administrative staff, both within the Department and from UiB's central administration. This is a rare statement! While the administrative tasks are similar to those in most other organisations, the requirement for technical support staff are more specific (maintenance and development of scientific instruments and infrastructure), but here again apparently conducted to the satisfaction of the Department.

The Sea Lice Research Centre mentioned administrative difficulties, because staff members are employed at different departments, and that no practical solution has yet been found to the administrative difficulties that this generates.

The Department notes that additional administrative source could be directed towards increasing its visibility with national funding bodies.

Strengths, weaknesses and opportunities

In its ten-year-long history (since the merger of smaller departments into BIO) the Department has experienced quite successful development, with the further development of already strong research groups, strengthening of former less strong groups, and the establishment of and participation in various centres of excellence , innovation centres, and a Centre of Excellence in Education. It appears that the purpose of the merger, i.e. to strengthen research and education in biology in general and marine biology in particular, has been successfully accomplished.

One of the keys to success (strengths) has been the very large scientific environment within marine research that exists in the Bergen area, both at UiB and at multiple other research institutions. The Department has been efficient in utilising this, both intellectually and in terms of infrastructure and facilities. The synergy between the multiple Bergen research institutions covering very different marine disciplines and with rather different scopes has been facilitated by the development of a strong sense for cross-disciplinarity at BIO. The contacts with industry is also strong, particularly for the more industry-oriented research groups and the Sea Lice Research Centre. The educational programmes, at all academic levels, appear to both recruit and function very well, and the candidates are in high demand in academia, public administration, and industry.

While the many different but partly overlapping research institutions in the Bergen area offer many possibilities for synergies, the somewhat kaleidoscopic marine research landscape may also lead to confusion, overlap, unproductive competition, and inefficiency. Because the various institutes are run by very different organisations (e.g. different ministries, industry, independent), each with their own agenda, co-ordination is difficult.

While successful overall, BIO also faces some challenges. With the modernisation of biology, taxonomy and natural history has become less fashionable, and these disciplines have difficulty in attracting external funding. Taxonomy papers generally have low citation rates (but may have long half-lives), and with the increased focus on impact, these disciplines are disadvantaged. While BIO still has taxonomic expertise, taxonomic research is only conducted for a few taxa, and BIO appears to be losing taxonomic expertise.

BIO cited challenges related to recruiting permanent staff in researcher positions as the main threat to their activities. Norwegian rules prevent long-term non-tenured positions, and the possibility of hiring staff in open-ended positions is very risky because it appears to be almost impossible to lay off people if funding sources dry out. Hiring through Uni Research has been a practical solution to this problem until now, but apparently this solution has become less attractive.

4.2 The Geophysical Institute

Thematic areas, disciplines and research units

The Geophysical Institute (GFI) is a small institute comprising about 20 academic staff of whom 18 are identified in the self-assessment report as working on marine research (and 14-17 in 2009-2012). The Institute has doubled in size over the last decade. There are currently 20 postdocs and 39 PhD students in GFI; these are very healthy numbers, indicative of a vibrant research environment. More than half of GFI's funding is external research funding, which is further evidence of research success. The proportion of external funding has grown steadily over the review period from about a quarter at the beginning of the period. The majority of this comes from the Research Council of Norway, with substantial sums listed under "abroad" (presumably mainly EU projects) and from other Norwegian public sources.

The Bjerknes Centre for Climate Research (BCCR) provides an important context for GFI. Three of GFI's academic staff are involved in the leadership of BCCR and spend 50 per cent of their time in this role. All of the Institute's climate-related research is branded through BCCR and more than half of the academic staff are involved in BCCR. The BCCR context is discussed further below.

Four different research groups are listed:

The Meteorology group has only one member of staff significantly active in marine research. The research is mainly of applied nature and focuses on offshore wind energy and air-sea interaction. This work involves offshore field programmes as well as data analysis and modelling. The group also makes offshore radiation measurements.

The Oceanography group has research interests in ocean circulation, ocean mixing, anthropogenic environmental impacts, marine ecosystems, and ocean-climate interactions. The group is involved in data acquisition at sea, laboratory experiments, and numerical modelling. The marine ecosystems area appears to be small and somewhat out of place in a geophysical institute.

The Biogeochemistry group has a predominantly marine focus in the area of marine carbon cycling, but there is also some terrestrial activity. Specific topics include ocean tracers and carbon system measurement, ocean carbon fluxes and their role in the global carbon budget, ocean acidification, earth system modelling and the modelling of biogeochemical tracers. The group is involved in a large number of EU projects and has significant seagoing field activity.

The Climate Dynamics group works on ice-ocean-atmosphere interactions at a global scale, on the hydrological cycle, and on how both of these are changing as the climate changes. It also works on atmospheric and oceanic heat transport, on sea-level change and on climate predictability. The research activity appears to be predominantly but not exclusively marine, and ranges from data analysis to the development and use of numerical models, but does not include data collection at sea.

There appear to be good relations between groups. Collaborations across group boundaries are driven largely by external funding opportunities.

Scientific production

GFI produced 10 per cent of the marine publications during 2009-2013, which is a strong contribution given the number of permanent staff in this area. A further 8 per cent are attributed to the UiB part of the Bjerknes Centre for Climate Research; presumably many of these come from GFI. GFI works globally and the overall quality of publications is very high, including many in the highest-quality disciplinary journals and some in Science and Nature. The Institute's presentation emphasised the breadth of activity and the global scope of that activity.

The publications listed for the Meteorology group are all from one professor whose research is focused on the atmospheric boundary layer, including offshore. These publications are in strongly

applied research, where the quality is often best judged by take-up in industry. In Oceanography the list of publications appears to be of mixed quality, with some world-leading contributions but also some in lower-quality journals. In Biogeochemistry the publication output is generally strong, with some papers in the top disciplinary journals and two listed in Science and Nature. Many of the publications have long author lists, so the extent of the Bergen contribution is difficult to judge. The publication output of the Climate Dynamics group is very strong indeed, addressing key research areas of broad international interest and appearing in the very top disciplinary and multi-disciplinary journals. On the basis of marine publication output, this appears to be the strongest of the four groups.

No information is provided about the content of PhD theses and PhD student authors are not identified in the publication list, so it is difficult to assess the quality of work produced.

Master's and doctoral level education

GFI has 40 current MSc students in three Master's programmes. These are two-year, 120 ECTS programmes with half of the credit for taught courses and half for the Master's thesis. The MSc Meteorology and Oceanography has four strands: Physical Oceanography, Chemical Oceanography, Meteorology and Climate Dynamics. These four strands are closely aligned with the focus of the four research groups, and therefore build centrally on GFI's expertise. There is appropriate overlap between the four strands. Students have the opportunity to go to sea on an ocean-going research vessel; this is an extremely valuable experience for them. The Joint Nordic Master's Programme in Ecosystems and Climate, delivered jointly by UiB and partners in three other countries, has closed to new applicants. The programme had few students and was administratively demanding. A new programme on Energy is now offered, with a focus on renewables; this programme is very topical and appears to build on expertise in the Meteorology research group. This programme has considerable overlap with the MSc Meteorology and Oceanography, with just two taught modules focusing specifically on Energy, so that it looks somewhat unbalanced. Perhaps this approach is necessary given the small number of GFI staff working specifically in energy. About 30 per cent of these students progress onto PhDs in GFI; the majority of students go into industry. The GFI leadership expressed an interest in developing a broader MSc programme that links into biology.

GFI hosts and leads the Norwegian Research School in Climate Dynamics, which involves ten national partners and seven international collaborators, so PhD students in the Climate Dynamics group have a particularly strong training environment. The web site mentions that 50 per cent of students are from abroad; this is a very healthy proportion and a sign that the PhD programme is held in high regard internationally. No quantitative data are given about destinations of PhD graduates, but most PhD students continue in research, while a few progress into the energy or offshore industries. Given the strength and international visibility of GFI's research, one expects its PhD graduates to be well-equipped to progress into research careers.

Co-operation with academic communities in UiB's periphery

BCCR is clearly a major element of GFI's external collaboration. BCCR is a research powerhouse of internationally leading quality, playing an important role in high-profile international activities such as the IPCC. The self-assessment report highlights BCCR's development of the Bergen Climate Model, a pioneering coupled global general circulation model, and the Norwegian Earth System Model. Both of these are internationally leading developments. The GFI leadership was very positive about BCCR; they emphasised that it has stimulated a lot of work across disciplinary boundaries and across organisational boundaries, and it was seen to work well in spite of its complexity. The new funding arrangement has fewer constraints than the original BCCR funding, and is used to support permanent staff involved in the Centre and to fund projects through an internal competitive process. There is a range of views within GFI on the benefits of this internal competition. The GFI leadership was also very positive about their relationship with the other organisations involved in BCCR, and felt they had ready access to ship-time through the Institute of Marine Research.

International activities

GFI is clearly well-connected internationally, as evidenced by international co-authorship on many publications, a large volume of EU funded research, and IPCC contributions. GFI has attracted some strong international academic staff, which is a good indicator of its international reputation. In particular the Biogeochemistry group participates in a large number of EU projects, but participation in such projects is growing in all areas. This growth indicates that GFI is sufficiently well-known internationally to be a partner of choice. The fact that BCCR is not a legal entity is sometimes a challenge in EU projects, because there is room for only one Norwegian partner, but the existence of this high-profile Centre means that Bergen scientists are invited to participate in almost all EU climate science projects. In the Geoscience area, which will be dominated by GFI and the Department of Earth Sciences, around 70 per cent of publications during the review period have international co-authorship. This is a very high proportion. There is also appropriate participation in international committees and working groups, and the report mentions that such participation is increasing.

Dissemination activities

International dissemination of research takes place through publications, presentations at international conferences, and presentations at EU consortium meetings. There is a high level of activity in all three areas, including more than 100 conference contributions/scientific presentations per year (mostly international but including national). The report mentions that the number of international meetings and workshops organised by GFI members has been increasing, though no quantitative data are given.

Clearly significant effort is put into communication of research to the general public, with around 70 media contributions per year during the review period. This is an impressive number. Policy-makers are also an important target audience for GFI's research, and IPCC participation and input to national government reports provide evidence of success in reaching this audience. No mention was made in the self-assessment report or the meeting of dissemination to industry, which may be important for GFI given the growth of the offshore industry and Norway's important role in that industry.

Cross-disciplinarity

The research of GFI is inherently interdisciplinary given the variety of scientific disciplines needed to study the ocean-atmosphere system. The self-assessment report describes interdisciplinary activity primarily in the context of BCCR, which has broader scope than GFI but covers many of the same disciplines. Collaboration with the Department of Earth Sciences and the Department of Biology takes place through BCCR. There are research collaborations with statisticians in the Department of Mathematics, and GFI would like to grow such collaborations, but they are limited by the limited number of Mathematics staff with appropriate skills and interests. There is more minor collaboration with the Department of Physics and Technology, primarily in instrumentation. There is a desire to develop more cross-disciplinary education.

Significance of additional strategic funding and the Strategic Committee for Marine Research

GFI reports that it has received substantial sums from the strategic programme, increasing steadily from 1 MNOK in 2005 (3.5 per cent of overall funding) to 7.5 MNOK in 2013 (8 per cent of overall funding). GFI is represented on the Strategic Committee by its Head and appears to be satisfied with the Committee's operation.

Administrative resources and support functions

GFI has a research coordinator, who assists with grant applications, two positions focused primarily on finance, 1.5 positions supporting education, and a Head of Administration. There are also three externally-funded administrative posts: one supporting the National Research School of Climate Dynamics and two supporting EU projects coordinated by GFI. Overall this appears to be an adequate level of support, though the self-assessment report mentions limitations in the support for HR matters.

Strengths, weaknesses opportunities and threats

Strengths: GFI clearly has overall a very strong research programme, with internationally recognised staff, a good and increasing number of high-profile publications and a very strong competitive funding record, though perhaps overly dependent on EU funding. Involvement in BCCR is clearly a great strength and advantage, and BCCR funding has stimulated a lot of bottom-up cross-disciplinary research initiatives. There are large numbers of postdocs and a good number of MSc and PhD students, and good relationships within the Department were highlighted.

Weaknesses: The self-assessment report includes a long list of perceived weaknesses; all appear to be relatively minor issues in an overall very strong department. The relatively small proportion of scientists on permanent contracts is listed as a weakness; perhaps this is the mark of a successful research centre. GFI feels that it should be stronger in mathematical statistics and theoretical development.

Opportunities: The future co-location with BCCR is clearly an opportunity for further strengthening of GFI. The Institute would like to see climate research developed as a theme within UiB, so that better linkages with social scientists can be made. The new funding stream for BCCR gives greater flexibility.

Threats: Research funding will always be a challenge, and some further diversification of funding sources would be desirable to limit vulnerability to changes in any particular funder. A demographic issue is mentioned regarding academic staff, with a predominantly male and late-career staff; it appears that the imbalance has been partially rectified though recent recruitment and the leadership team that we met was mixed in gender and relatively young. Expertise involved in coordinating EU projects is difficult to replace, so as senior staff retire, recruitment at a range of levels may be required to maintain GFI's international profile. GFI's observationally-based research is strongly dependent on access to ship time and uncertainties around the future of the research fleet represent a significant threat. It is unclear whether or how the Håkon Mosby will be replaced and mechanisms for UiB access to the new icebreaker that will be owned by the University of Tromsø are unclear.

4.3 The Centre for Geobiology

Thematic areas, disciplines and research units

The Centre for Geobiology (CGB) was formed in 2007 from a platform of two main topics "Geodynamics of the Deep Seafloor" and "Water-Rock-Microbe Interactions & the Deep Biosphere". The establishment of CGB added two marine research topics "Roots of Life & Life in Extreme Environments" and "Vent and Seep Biota". Together these topics make up a highly significant research ambition where major issues in science and technology are addressed. The relative inaccessibility of the deep sea and the basic questions of ancient life strategies make this research field exciting both from the standpoint of basic science and public interest.

Geodynamics of the Deep Seafloor

This theme involves deep-sea exploration and searching for new extreme environments. It provides a foundation for the Centre's geobiological research by providing knowledge about the geological and geochemical context of the Centre's focus sites. In addition, researchers working in this theme have several independent research objectives relating to hydrothermal systems, seabed fluid flow and the geodynamics of spreading ridges

Water-Rock-Microbe Interactions & the Deep Biosphere

The processes forming the deep-sea landscape have long been believed to be strictly physical and chemical. Yet, researchers are now coming to understand water-rock interactions as being strongly influenced by microbial metabolic processes. This has also been demonstrated in the deep-sea sediments of the Knipovich Ridge rift valley north of Loki's Castle vent field where this CGB group is working.

Life in Extreme Environments & Roots of Life

Given that life is thought to have arisen around 3.8 billion years ago beginning with relatively simple single-celled microorganisms, this research theme connects their research environment, the hydrothermal vent ecosystem, to the Early Earth system. The redox gradients developing when reduced fluids mix with seawater create the basis for chemosynthetic food-webs and hot spots for biological activity in and around the vents.

Vent and Seep Biota

This theme focuses on the little studied macro-fauna of deep-sea systems. In the extreme environments around hydrothermal vents researchers are discovering specialised communities of unusual organisms, most of which have not been found anywhere else on earth.

The Centre of Excellence was established as a unit working together in a close matrix with the above themes subdivided into a number of projects each headed by a team leader. The majority of the researchers (including postdocs) and the PhDs have been stationed at the same location.

Scientific production

The information presented to the evaluation committee was not organized in a coherent manner, thus we have drawn information from different sources and have tried to form an opinion about the volume and scientific quality of the work. Based on the information given in the annual report for 2013 the average publication rate is ≈1.3 scientific publication/year and person full time (32.4 man years, PhD and Postdoc fellows included). It can be noted that the number of scientific presentations are roughly twice the number of published papers.

During the interview it became obvious that communication of several major findings have been through high-ranking journals. Apart from these the presented selection of published papers, represents scientific correspondence mostly in well accepted journals, and as a whole the output must be considered very good.

There is no information on citation impact of the individual scientific contributions and although the bibliographic analysis places the geoscience average significantly higher than that of the average for biology and UiB as a whole, there is no way of knowing if this is valid also for the Centre for Geobiology as a separate unit. Also when comparing geosciences and biology in relation to the respective countries where co-operation has occurred patterns are similar, but it is not possible to make a separate statement for the Centre for Geobiology. However, in general the most important co-operation seems to occur in the EU dimension and then together with scientists from the USA and the rest of the world at about the same levels (table generated from bibliometric analysis).

Table showing the distribution of co-operation partners in the global landscape.

Region	Biology #	Biology %	Geosciences #	Geosciences %
EU	384	62	346	62
USA	86	14	107	19
Others	149	24	102	18
Tot	619	100	555	100

Master's and doctoral level education

A gradual change in the programmes for higher education has taken place from the start of the Centre for Geobiology. There has been an ambition to promote programmes that convey the new knowledge that this research field is generating and that can be suited to the students' needs. The specialisations geochemistry and geobiology are now (since 2010) under the Master's programme run by the Department for Earth Science. During the interview it became clear that the personnel resources responsible for the development of the curriculum have been, and are, very limited. Even so the Master's programmes have been very well received.

With the current scientific success of the Centre one could argue that it should have been the responsibility of the Faculty to provide more support to develop the teaching. However, the Evaluation Panel also recognises the difficult balance in the education output, between the ambition to promote exciting new knowledge and the need to maintain basic competence in order to handle the regular curriculum in the traditional subjects.

The rather large number of companies in the Bergen area producing supplies and services to the maritime sector should allow PhDs to find work in the corporate sector. This is however not the case and it appears that more effort to bring the companies into the governing structures of this kind of Centre could help transfer trust to the companies about the potential of future employees with an academic background.

Co-operation with academic communities in UiB's periphery

The Centre for Geobiology has shown extensive co-operation with the academic communities in UiB's periphery. This collaboration involves developing joint proposals, running collaborative national and international projects, developing national marine infrastructure, and organising joint cruises. It is also a fact that CGB collaborates closely with marine technology companies in the Bergen region in developing and testing marine instrumentation.

International activities

The international activities are prominent in most of the activities related to the Centre. This is typically demonstrated through the participation in activities such as the Ocean Drilling Programme (ODP), but also in the large number of international co-authors that have contributed to the scientific work. All this requires well functioning networks and administrative skills in supporting logistics and management.

Dissemination activities

It is obvious from the presentation in the self-assessment as well as from the annual reports that the Centre has taken public dissemination seriously. Even if the subjects that can be drawn from the activities are novel and intriguing, it is necessary to produce the popular/user–oriented talks that are listed in the self-assessment, which takes a significant effort. Although success in fundraising of course mainly lies in the scientific quality, it is also obvious that money from the private sector (e.g. oil) and the Research Council is sensitive to the public image of the sponsored activities.

Cross-disciplinarity

The close co-operation between geologists and microbiologists needed to explore the unique deep-sea environment is a very good example of cross-disciplinary work. The position of the Centre and its success in securing funds has clearly been reached through far-sighted ambitions and CGB has the pre-requisite to grow. In the near future the ability to work across disciplines should be extended to involve scientists forwarding bioinformatics and molecular evolution. This kind of co-operation will be essential in the data mining that follows high throughput sequencing and various –omics. In a few papers presented, and the subject of one PhD student thesis, signs of this research direction can be seen but there are likely to be more.

Significance of additional strategic funding and the Strategic Committee for Marine Research

The answers to questions regarding the Strategic Committee for marine research have been vague. It is only possible to conclude that the marine priority area has worked in favour of the Centre but not in any direct forms.

Administrative resources and support functions

In the self-assessment the administrative structure of the Centre is described as challenging. During the interview this challenge was clarified. While most researchers and PhDs work together in the same

building their salaries and support have been handled through a decentralised structure involving the different departments where the different people have been employed.

From the interview it was also very clear that the support of infrastructure in the form of ship time and equipment for work in the deep sea has been very good. The representatives for the Centre reported during the interview that the relative abundance of infrastructure has been a major factor in the success of the Centre.

Strengths, weaknesses and opportunities

It was noted during the interview that compared with working in a regular department the constant pressure for results and recognition in the Centre provides a strong motivation for Centre members to perform at the top of their ability. The scientific focus of the Centre has also made development of special skills and techniques possible. The finite nature of the funding structure is however a harsh situation since no defined career opportunities are available. In order to ensure the future of the science beyond the end of the funded period and to maintain established collaborations the Centre for Geobiology has adopted a pragmatic approach in which it has attempted to ensure that suitably well-qualified candidates from the Centre are appointed to permanent positions within the departments of Biology and Earth Sciences where appropriate.

4.4 The Department of Earth Science

The self-assessment report generated by the Department of Earth Sciences has been quite helpful as a source of information for the evaluation, but some aspects/acronyms used are unclear and it would have been useful to have access to a fuller narrative on the profile and character of the research groups. Such a narrative is not available on the departmental website.

Thematic areas, disciplines and research units

The Department of Earth Science contributes very significantly to the total marine research effort in UiB with 15-25 per cent of the total number of UiB staff involved in marine research over the 2004-2013 period. Until the inception of the Centre for Geobiology (CGB) in 2007 it was the third largest marine unit in UiB after the Department of Biology and the Geophysical Institute, but CGB now accounts for slightly more staff than Earth Sciences.

The self-evaluation reports that the Department's marine research effort is spread across three major research topics/groups: Marine geophysics, Marine energy and Marine geology. In terms of personnel the Marine geology group is the largest and, along with co-located staff in the Bjerknes Centre for Climate Research (BCCR), has an internationally world-leading reputation in climate science including palaeoceanography, and the Department as a whole benefits from close co-operation and collaboration with the very significant Norwegian offshore sector. This provides both research potential in both directions, but also facilitates training and employment prospects for graduating students. The location of Bergen has also facilitated access to research sites of critical importance not only for hydrocarbon exploration, but for ice-ocean interactions and for understanding the global thermohaline circulation.

It was clear from the interview with the Department staff, however, that the research grouping structure presented in the self-evaluation was more-or-less evolved for the purposes of the evaluation itself and that there is not a strong grouping structure within the Department. The groups presented in the self-evaluation are different from those presented on the website, for instance, and then another, third, grouping was presented in the actual interview. The groups presented in the latter were more thematic and included Glaciated continental margins, Submarine geohazards and Palaeoclimate/palaeoceanography.

A recommendation is that the Department should think very carefully about the way in which it seeks to structure itself for dissemination purposes. Whilst the flexible approach that seems to operate at present might have some advantages, there needs to be some clear thematic grouping that facilitates

external appreciation of the research strengths within the Department. This grouping should be explicit on the departmental website.

Scientific production

The publication output of the Department of Earth Science is very impressive indeed. In terms of peer-reviewed scientific outputs assessed in the bibliometric survey, geosciences (presumably including CGB and the Geophysical Institute) is second only to biology, contributing 34 per cent and 47 per cent of all marine outputs respectively in the census period (2004-2013). Over the period 2009-2013 the Department generated 13 per cent of all UiB marine publications and BCCR 8 per cent (compared with the Geophysical Institute 10 per cent and the Department of Biology 34 per cent). However, the most impressive element in the bibliographic analysis is that geosciences (as a whole) publications are consistently cited significantly above the world average, significantly better than the mean or the biology performance. This testifies to the internationally world-leading groups in climate science in both the Department and BCCR. Most of the publications are in peer-reviewed journals, but the contribution of the Department to the 2007 Intergovernmental Panel on Climate Change (the Scientific Basis) through the leadership of Jansen is a particularly noteworthy contribution at the highest level of international policy advice.

Master's and doctoral level education

The Master's Level Programme in Earth Science contains a number of specialisations that were revised in 2007 to overcome low recruitment, including the termination of the Environmental Geoscience specialisation. The best recruiting specialisation is in Marine Geology and Geophysics, with between 5 and 10 students per year. This level of recruitment reflects the very high reputation of the Department in both marine geology and geophysics; this is particularly relevant at Master's level because many of the students will view these courses as primarily vocational training for the offshore industry. The links between the Department and the offshore sector (hydrocarbons, marine renewables) are extremely strong.

PhD training within the Department forms a part of the Norwegian Research School in Climate Dynamics (ResClim) and this training also benefits from the Advanced Climate Dynamics (ACDC) courses co-ordinated by ResClim. These are outstanding collaborations and provide a stimulating context for PhD training. However, the number of graduating PhD students generated by the Department is relatively low, though increasing. This will be partly addressed through funding success for the EU GLANAM Marine Curie Initial Training Network hosted by the Department.

However, the career trajectories for graduating PhD students appear not to have been tracked closely, though many appear to continue within the research field. Some of these have become significant figures within their respective fields. It is possible that such monitoring is being undertaken but that the data were unavailable to the Evaluation Panel.

Co-operation with academic communities in UiB's periphery

The Department of Earth Science has close co-operation with Uni Research, BCCR, the Nansen Environmental and Remote Sensing Centre (NERSC), the Institute of Marine Research (IMR) and Christian Michelsen Research (CMR). Within Uni Research the Department has close affiliation with the Centre for Integrated Petroleum Research (CIPR). The relationship with BCCR is particularly important and has resulted in very significant research effort and output in climate science, and also with NERSC in the field of polar research. The Department has a close co-operation with IMR in developing marine research platforms and equipment. Co-operation with CMR has been "modest" but the Department envisages potential in the fields of acoustics and marine technology.

The UiB research landscape is extremely complex and for external evaluators this is particularly challenging (see 4.1 above), with some of the Department of Earth Science staff returned within Marine geology (e.g. Jansen) being also members of BCCR; for these staff the funding has not been attributed to the Department but rather to the Centre although their outputs (publications) are included

within the Department of Earth Science self-evaluation. The relationships between Uni Research, BCCR, other peripheral institutions and the Department are opaque and inhibit objective evaluation.

These complex relationships were explored during the interview. Whilst BCCR has been a transformative element within the Bergen marine and climate research landscape, the lack of legal identity for the Centre has resulted in research staff being employed through Uni Research (formerly Unifob), an independent company partly owned by the University. Whilst this has the advantage that the employment law governing contracts are more flexible within the private sector than within the University, and has facilitated the growth of powerful research clusters supported by long-term employment of key staff, the Uni Research structure has in recent years developed powerful autonomy – effectively a university within the University – that is allowing parallel development of research infrastructure and groupings. This could be seen as a parasitic development that is a threat at UiB level. This problem is exemplified by developments within the palaeoclimate/palaeoceanography research field included within the Department of Earth Science. There are now separate laboratories (e.g. for generating Mg:Ca trace element data) with identical equipment, supported by independent technical and scientific staff, operating within Uni Research and within the Department of Earth Science. Such parallel development and duplication may not be an effective way to operate and may represent a waste of resources and expertise. Furthermore, the scientific staff involved (e.g. Dokken, Andersson-Dahl, Riesebrobakken) have effectively been "blind" to the evaluation since the "independent" Uni Research is not formally a part of UiB. This is an artificial distinction. These scientists are clearly a major part of the Bergen marine research landscape – and are returned as part of the BCCR reporting – so it seems disingenuous not to include them within this evaluation of marine science at the University of Bergen. The status of Uni Research has therefore been technically problematic for the delivery of the evaluation, but more importantly, may be a problem for UiB itself.

A critical issue that emerged during the interviews was access to research vessels. Whilst some researchers combine seagoing research with teaching cruises in the immediate region (e.g. glaciated margins of Europe), other researchers who have a requirement to undertake research in other oceans e.g. Southern Ocean, find it very difficult to use the G. O. Sars. They find the application procedure opaque, and the planning period is not sufficiently long to accommodate long-distance cruise activity. Opportunities for collaborative work on cruises and the advertising of likely cruise routes to facilitate opportunistic activity should be highlighted to university staff. Apparently the original arrangement was that the University had access to ~3 months seatime on the G. O. Sars, but that because of over-allocation to the University in recent years this has now been cut to one month. Once the allocation for teaching commitments has been taken out of this there is too little time for research activity, especially to remote locations. This has materially affected the delivery of recently-won research grants where cruises have simply not been scheduled within the time-frame of the project.

International activities

Climate scientists working within the Department of Earth Science and affiliated scientists working within BCCR have an extremely high profile internationally; these are individuals grouped within the Marine geology theme. The self-evaluation report speaks for itself; it documents extensive involvement of individuals in, and in some cases leadership of, multiple international programmes and projects e.g. IODP, IPCC, PAGES, IMAGES and ECRA, and very active participation at the highest level in international conferences (e.g. AGU, EGU, ICP). This provides the evidential basis for the impression that Bergen is one of the foremost international centres of marine palaeoclimate research, standing alongside only a handful of other institutes operating at the same level globally.

Dissemination activities

The Marine geology group has an excellent record of dissemination at a domestic level. Some of these activities are notable for their sense of innovation and energy, notably Kleiven's involvement in the Klimatlok national lecture tour and more general engagement with the Norwegian media in the field of climate change, submarine slope instability and offshore carbon sequestration. At the international level, apart from conference participation, the leadership of Jansen of the 2007 IPCC report and

further lead authorship in the 2013 report has provided the Department with visibility and a dissemination vehicle at the very highest of international levels. Jansen currently provides advice on climate science to the Prime Minister, and Kleiven at ministerial level. This aspect of the Department's profile is exemplary.

Cross-disciplinarity

The self-assessment report does not detail the extent of cross-disciplinarity between the Department and other organisations, nor provides any specific examples of such collaboration, beyond mentioning that cross-disciplinarity has been facilitated by BCCR, CIPR and the Centre for Geobiology.

Significance of additional strategic funding and the Strategic Committee for Marine Research

No information was provided in the self-evaluation report on the amount of strategic funding received by the Department.

As regards the Strategic Committee for Marine Research, the self-assessment report highlights the need for the Committee to play a stronger and more strategic role in marine research platforms and large field equipment, notably research vessels. The Committee could play an important role in co-ordinating operational aspects, maintenance and renewal.

It may be that the Strategic Committee could be the body to improve access to research vessels via the IMR, but in the interview this recommendation for a strengthening of the Committee was not emphasised.

Administrative resources and support functions

The administrative support available to the Department is perceived to have improved over recent years, but deficiencies remain in technical support for laboratories and for fieldwork.

Strengths, weaknesses and opportunities

No detailed SWOT analysis was included in the self-evaluation report. The only point made is that the Department feels that a dedicated funded full-time leader should be appointed to head the Strategic Committee for Marine Research in order to co-ordinate all UiB marine research and to lobby politically for financial and other support (opportunity).

There are clear strengths in research quality, in external grant funding, publication outputs and in dissemination at both national and international levels. In the interview the difficulty in accessing sufficient ship time was identified as a major weakness.

4.5 The Department of Chemistry

Thematic areas, disciplines and research units

The Department is not very big, and marine research is a secondary activity within it, with 2-3 part-time staff involved for a total of 25 staff members. It hosts 8 research groups, none of which includes the term "marine" in its name. The Department reports three main marine topics: (1) Marine environment, (2) Marine ingredients and health, and (3) Natural product synthesis, with the later started in 2012 as a bottom-up initiative. The section on "Major research projects (2004-2013)" includes both true projects and topics the Department works on. The Department has state-of-the-art analytical facilities. Marine research is mostly performed within the Chemometrics group and the Analytical chemistry group. Most of it consists of chemical analyses and the interpretation of results, and is made in collaboration. There is the view that the Department is a provider of services to other departments.

The total number of staff involved ranged from 1 (2007) to 11 (2013), with a maximum of 4 (2013) involved more than 50 per cent of their time. FTEs per year have ranged from 0.5 (2008) to 5.05 (2013), mostly by PhD fellows. Therefore, marine studies in the Department are critically dependent on

PhDs. Funding for marine research is almost exclusively institutional core funding for the period under evaluation (124 x 10^5 NOK, 97% of the total), other sources being practically irrelevant. The annual mean is 12.77 x 10^5 NOK, with the highest and increasing budgets in the sub period 2010-2013. Overall, funding for marine research is a rather minor part of the total budget of the Department. There are a recently started and a new project due to start in 2014 that will likely increase funding for marine research in the Department.

Scientific production

Lists of most significant publications are provided for two of the three thematic areas of marine research (Marine environment, and Marine ingredients and health). No information is provided for the third thematic area (Natural product synthesis), as its creation is very recent. All publications listed correspond to journals included in the JCR. A large majority of papers correspond to journals with good to very good impact factor with a majority of them having a department member as first author, which is something to be highlighted.

Master's and doctoral level education

The Department has not been formally involved in educational programmes in marine studies at Master's and doctoral level in the period 2004-2013, but has had educational co-operation with marine institutes in Bergen.

Co-operation with academic communities in UiB's periphery

The Department has cooperated with several marine institutes in UiB's periphery in relation to the training of PhD and Master's students. There is also co-operation with the Norwegian Polar Institute, as related to project designing and sample collection. The Department is very much interested in extending its co-operation with marine institutes in UiB's periphery.

International activities

Some international project co-operation is mentioned as "continuous co-operation". A few "contacts" and additional co-operation are also mentioned in the self-assessment report.

Dissemination activities

The main target group for dissemination activities has been the international academic community. In consequence, the reported domestic and international dissemination activities consist exclusively of contributions to conferences and workshops. No popular/user-oriented talks, or articles, nor media contributions are reported. As for international dissemination activities, there is one member of the Department that is particularly active.

Cross-disciplinarity

Cross-disciplinarity is viewed essentially as a matter of opportunity, and not as the result of strategic planning. It refers to "aquaculture, nutritional and environmental studies". Most of the main points under this heading are not addressed in the self-assessment report.

Significance of additional strategic funding and the Strategic Committee for Marine Research

The Department has not benefited from or contributed to the marine research strategic priority at UiB during the period under evaluation. Its activities in marine research are unrelated to such priority and to the corresponding Strategic Committee, and have been general totally independent of them. However, the research group involved in the topic on Natural product synthesis has received two PhD scholarships from the marine priority programme, which are due to start from 2014 onwards. The Department would like the Strategic Committee for Marine Research to play a steering role within UiB as a whole, promoting interactions and initiatives.

Administrative resources and support functions

As stated in the self-assessment report “there has not been any administrative support apart from the department’s own”.

Strengths, weaknesses and opportunities

According to the Department’s view, the main strengths are “closeness to the North Sea, good equipment and seagoing vessels, many devoted researchers within a variety of fields”. No weaknesses or challenges are explicitly mentioned, though it is stated “the view to establish new marine activities which include fields that have not been included before has been too weak” (sic).

4.6 The Department of Mathematics

Thematic areas, disciplines and research units

The self-assessment report is a merging of responses and inputs from different department members. Marine related research in the Department looks as a secondary activity, with 3-4 part-time staff involved. The Department reports nine major marine research topics, which are addressed by two groups: (1) the Statistics group, and (2) the Applied and computational mathematics (ACM) group. Research projects involving national and EU funding are reported for some of the topics. The Statistics group works on statistical ecology, statistical analysis of acoustic and trawl data and animal population dynamics with a management goal in view. The ACM group mostly works on fluid mechanics at various spatial scales, with a modeling component.

The total number of staff involved in marine related research ranged from 3 (2004-2006) to 4, with a maximum of 2 (2013) involved more than 50 per cent of their time. Overall FTEs per year have not been provided, but PhD fellows have provided 1 FTE most of the years. Of the former 3 members of the Statistics group performing some marine related research, one retired and another is no longer active in the field. Therefore, marine related research in the Department seem to be critically dependent on PhDs. Funding for marine research is very limited and came almost exclusively from the Research Council of Norway (67×10^5 NOK, 96% of the total), being other sources practically irrelevant. The annual mean is 7×10^5 NOK. No funding at all is reported for the years 2010-2012.

Scientific production

Lists of most significant publications are provided for marine related research. Most of the publications listed correspond to journals included in the JCR, though there are also other types of publications, including project deliverables. The presence of papers published in highly ranked journals changes from one marine research topic to the other. Most papers reported for the topic on “Statistical interpretation of acoustic and trawl data for fish populations” have been published in good to very good, Q1, impact factor journals. Too many papers in the “Statistical ecology” topic have been published in medium to low impact journals. The production reported for the topic “Carbon capture and storage; the marine component” is a mix of papers in JCR journals, project deliverables and other publications, with no publication mentioned within the 2004-2008 period. Finally, papers reported within the “Ocean modelling” topic mostly fit in medium impact journals, with no publication mentioned within the 2004-2005 and the 2012-2013 periods. During their presentation to the Evaluation Panel, the Department representatives claimed that they do not look at journal impact factors when sending a paper for publication but they should.

Master’s and doctoral level education

The self-assessment report refers to two Master’s programmes, one started in 2012. It also includes a list of students within the Master in applied and computational mathematics, and a list of PhD candidates. One PhD degree on the 3D acoustics of fish schools is also reported.

Cooperaton with academic communities in UiB's periphery

Co-operation exists with the Institute of Marine Research and other centres. It seems to be cross-fertilising and mutually beneficial.

International ativities

The Department (ACM group) has been involved in some international cooperative projects, particularly on carbon capture and storage. However, at present it has no formalised international projects with a marine component.

Disemination activities

The main target group for dissemination activities has been the scientific community and, wherever possible, the public and industrial sectors. In consequence, the reported domestic and international dissemination activities consist exclusively of scientific publications and contributions to conferences and workshops. No popular/user oriented talks, or articles, nor media contributions are reported.

Cross-disciplinarity

Cross-disciplinarity looks high as the Department has expertise on tools that a broad range of natural scientists need. Therefore, the opportunities to interact are high and should be further explored, which strongly contrasts with the low number of FTEs devoted to marine topics.

Significance of additional strategic funding and the Strategic Committee for Marine Research

The Department has had no contact at all with the UiB's Strategic Committee for Marine Research.

Administrative resources and support functions

As stated in the self-assessment report "we get support from our administration which is very good", and "for running of larger projects we need a more robust economy/project administrative group".

Strengths, weaknesses and opportunities

The Department would require the development of communication strategies in order to develop synergies that could lead to the reinforcement of marine related research interactions within UiB, and also with industry, engineering companies and the public sector. However, the lack of manpower working on marine related issues undermines the Department's possibilities.

4.7 The Department of Physics and Technology

Thematic areas, disciplines and research units

The Department has a new director who took the position in May this year. Marine research in the Department has been undertaken by an increasing number of staff members, from 7 in 2004 to about the double from 2006 onwards, with 6 (2004) to 11 (2007-2009) of them involved more than 50 per cent of their time. However, it still involves a relatively small proportion of the department staff. Professors' FTEs per year have ranged from 3 to 4. PhD fellows have, in addition, provided 4 to 9 FTE per year during the period 2004-2009. No FTEs by PhD fellows are reported from 2010 onwards; we learned at the meeting that this was a mistake. Postdoc fellows have provided punctual inputs (1 FTE/year in 2006-2008).

The Department lists a rather large number of major research topics with a marine component, which are mainly undertaken by two groups: (1) the Marine optics group (part of the Optics and atomic physics group), and (2) the Marine acoustics group. Both groups are supported by research projects, with a good proportion of them including PhDs. All projects are nationally funded but one (SOBER).

Funding for marine research is almost exclusively from grants by the Research Council of Norway (135.5 x 105 NOK, 48%of the total) and from institutional core funding (120 x 105 NOK, 42.8%), with

minor contributions from other public funding and private sources. Total funding during the evaluated period has been 280.9 x 105 NOK, which results in an annual mean of 28.09 x 105 NOK. Funding in 2013 (67.5 x 105 NOK) has more than doubled the second best year. The percentage of funding for marine activities is less than 20 per cent of the total funding of the Department.

Scientific production

Lists of the most significant publications are provided both for the Marine optics and the Marine acoustics groups, the later subdivided by main thematic areas. Scientific outputs mainly correspond to papers in journals included in the JCR, contributions to conferences and PhD theses. The Marine optics group has published in upper rank journals (Q1), but also in a number of journals with lower ranks. The Marine acoustics group is a very practically oriented group with close collaboration with industry and users in general. Most of its scientific production corresponds to documents other than papers published in referred journals. The later have been published in mid to low impact journals, with few exceptions. Given the quality and interest of its research and its potential, this group (Marine acoustics) should make an effort to publish more and in highly ranked journals. Co-authors from the Department are not marked, which prevents a finer appreciation of their role.

Master's and doctoral level education

The Department has been involved in educational programmes in marine studies at Master's and doctoral level in the period 2004-2013. For optics the number of students has been fairly stable (though no numbers are provided), while for acoustics it has shifted from 4 to 10 and 4 to 8 for Master and doctorate, respectively. All students have been employed, either in academia, industry or the public sector other than academia.

Co-operation with academic communities in UiB's periphery

The Marine acoustics group has a broad range of co-operation in UiB's periphery, on different topics and also for accessing research infrastructures, which is highly beneficial both for the research itself and for PhD training and educational programmes. While no explicit information on co-operation in UiB's periphery is provided for the Marine optics group in the relevant section of its self-assessment, such co-operation seems to exist based on the number of projects listed, mostly with marine biology and fisheries groups.

International activities

The Department has participated in numerous international conferences and meetings, in particular the Marine Optics Group. Given its capabilities, the Marine acoustics group should reinforce its visibility in international conferences and meetings**.** This group has been involved in one EU funded project and a co-operation with the University of Dundee, and participates in the technical and scientific committee for the International North Sea Flow Measurement Workshop (NSFMW), a relevant industry conference in the field. No information on international projects or networks is provided for the Marine optics group.

Dissemination activities

Academic dissemination has been given priority over popular dissemination, as stated in the self-assessment report. Target groups (at least for the Marine acoustics group) also include administrations, manufacturers and operators of subsea equipment, and oil and gas operators. There is a long list of academic dissemination activities in conferences and meetings, both domestically and internationally. However, the description of target groups and dissemination channels in section 6 of the self-assessment report seems to refer only to the Marine acoustics group, while the lists of domestic and international dissemination activities refers essentially to the Optics group. This may reflect the reality but also some inconsistency in the preparation of the self-assessment report.

Cross-disciplinarity

The Marine optics group has had close collaboration with biology, which has been mutually beneficial. The Marine acoustics group participates in two national centres, the Michelsen Centre and NCE Subsea, which has yielded tangible benefits (facilities, financing, theses) including facilitating regular contacts with industry.

Significance of additional strategic funding and the Strategic Committee for Marine Research

The self-assessment report states that the Department has had sparse contact with UiB's Strategic Committee for Marine Research. For the Marine optics group no extra resources have been provided through the marine strategic priority. The Marine acoustics group has received 4 UiB-financed PhD scholarships related with fisheries (2) and other marine research (2). This has eased collaboration with research institutes and private companies and lead to the submission of three patents.

Administrative resources and support functions

This section is empty in the self-assessment report.

Strengths, weaknesses and opportunities

There has been a strong and long-term activity in marine research in the Department, which could be strengthened further by a stronger connection to UiB's Strategic Committee for Marine Research. The Department would like to see an explicit mechanism for meeting other marine researchers and the availability of funding to stimulate marine research across UiB.

4.8 The Department of Clinical Medicine (K1)

Thematic areas, disciplines and research units

The marine science group consist of two professors, one scientist and currently 4 PhD students. In a broad sense, the research is anchored around the effects of marine-food intake on health and prevention and treatment of diseases. The research can be grouped in four thematic areas: Epidemiology; Mechanistic animal studies; Laboratory analyses; and Clinical studies.

The group published its first studies in 2002 focusing on the effects of seal oil in patients with inflammatory bowel disease. Several subsequent studies have been conducted to investigate the effects of seal oil and other marine ingredients in patients with colitis, food hypersensitivity, inflammatory bowel syndrome and inflammatory bowel disease. More recently, researchers in the group have in similarly designed studies included patients with obesity and sarcopenia, as well as healthy overweight children and adults, and athletes. The Panel was impressed by the energy, enthusiasm and commitment demonstrated in the presentation of this research group.

Scientific production

There has been a steady output of scientific articles from the group. However, the output appears to have increased over the last few years. Currently, four PhD students are working on theses within the field of marine research. Recently, the health effects of fish intake have been for the first time demonstrated directly in a human cohort.

Master's and doctoral level education

The Department hosts two Master's programmes one in human nutrition and one in clinical nutrition. In the human nutrition programme, 13 students have graduated in marine research with a further two currently in post. Currently, four PhD students are working on theses within the field of marine research.

Most of the PhD students who have graduated in marine sciences are medical doctors and have continued their careers in hospitals as clinicians or researchers.

Co-operation with academic communities in UiB's periphery

The researchers at K1 have close collaboration with several hospitals in the region, in particular with the Haukeland University Hospital. There is also collaboration between the Section of Gastroenterology and the National Institute of Nutrition and Seafood Research (NIFES) with focus on the effects of seal oil on colitis, food hypersensitivity, IBS and IBD. In 2013, K1 received a large grant for a four year project from the Norwegian Seafood Research Fund (FHF) together with several institutions in Bergen including NIFES, Haraldsplass Deacon Hospital, and the Norwegian Seafood Centre.

International activities

The researchers at the Department are currently expanding their collaboration with foreign research institutions. They have initiated collaborations with the Royal Adelaide University, Australia and a couple of institutions in Germany. The collaboration with these institutions provided access to important data that is crucial for future research activities. This has already resulted in the submission of research articles written jointly with international partners.

Dissemination activities

The research group's results have been reported in international scientific journals. The researchers in the Department also put a serious effort in informing the general public about their research projects and findings. Since 2010, they have been featured in more than 40 articles in national newspapers, radio and television. This is a very impressive number given the small size of the group.

Cross-disciplinarity

The researchers are engaged in several cross-disciplinary activities. These include collaborations with clinical departments and laboratories in Haukeland University Hospital, the Department of Chemistry, Bevital AS, and the Kavli Research Centre for Ageing and Dementia in Bergen. The collaborative efforts have given the group access to advanced equipment for analyses and data.

Significance of additional strategic funding and the Strategic Committee for Marine Research

Two professors from K1 have been members of the Strategic Committee for Marine Research, both of them appointed by the Faculty of Medicine and Dentistry. Their experience with the Committee is generally good.

During the period 2005-2009, when initiating programmes for Bachelor and Master's studies in nutrition, the board of nutrition received 4 MNOK from UiB as strategic support to scientific collaboration between the marine institutions in Bergen. In addition from 2010, the Bergen Research Foundation (Trond Mohn) has donated 10 MNOK for a young scientist recruitment programme in clinical nutrition. The majority of this grant has so far been used for seafood and human health/marine research.

Administrative resources and support functions

The Department wishes to see a future strengthening of the administrative support dedicated to marine research.

Strengths, weaknesses and opportunities

A strength is the funding from the Bergen Medical Research Foundation, received for establishing a centre for clinical nutrition research. The proximity to Haukeland University Hospital, both geographically and scientifically is another strength.

The small number of permanent positions dedicated to marine research represents a weakness and a threat to the long-term stability of the research group.

The fact that the research group still is in the build-up phase represents a challenge.

4.9 Department of Clinical Sciences (K2)

Thematic areas, disciplines and research units

The marine science research group at K2 consists of two professors and couple of postdocs and PhD students. The research focuses on identification and isolation of bioactive compounds from marine raw materials and examining effects of consumption of these compounds on health and prevention and treatment of diseases. Their research includes laboratory analyses, clinical investigations and mechanistic animal studies.

The group has a solid base in biomedical research and well-established national and European research networks.

Scientific production

The group has listed fifteen scientific publications published between 2009 and 2014, suggesting a typical annual output of four to five papers. Given the relative small size of the group, this scientific output appears to be fair.

Master's and doctoral level education

There is no dedicated Master's or PhD programme in the Department. During the period 2004-2013, eight Master's students and nine PhD students have graduated in marine research.

Co-operation with academic communities in UiB's periphery

The researchers at K2 have close collaboration with several hospitals and industry partners in the region.

International activities

The researchers at the Department have been engaged in six international research projects between 2004-2013, including EU projects and a Nordic Centre for Excellence (MitoHealth Centre for Bioactive Food Components and Prevention of Lifestyle Diseases). These international collaborative efforts have been made possible through well-established European research networks, including partners in Sweden, Denmark, the UK, the Netherlands, France, Italy, and Spain.

Dissemination activities

The main target groups have been research communities, such as universities and other research institutions. The research group's results have been reported in international scientific journals.

Additionally, the group's research has been communicated through targeted conferences, seminars, and to a wider audience through newspaper articles. The visibility of the research group has been increased through the establishment of the Nordic Centre of Excellence MitoHealth. Joint workshops have also been arranged in collaboration with Nordic partners and other international research programmes during the Mitohealth project.

Cross-disciplinarity

The researchers are engaged in several cross-disciplinary activities. These include collaborations with Haukeland University Hospital and several industry partners.

Significance of additional strategic funding and the Strategic Committee for Marine Research

No information provided in the self-assessment report.

Administrative resources and support functions

No information provided in the self-assessment report.

Strengths, weaknesses and opportunities

The strong base in biomedical research has been a key for the development of the marine science in the Department.

A weakness is the difficulty in creating permanent positions for younger scientists in the field of marine research; this applies both for K2 and K1. Collaborations with Haukeland University Hospital are important for the research group. However, currently there is only one person in the field of nutrition at the hospital who holds a PhD degree, which hampers efficient scientific collaboration between K2 and the hospital.

4.10 Departments at the Faculty of Law and the Faculty of Social Sciences

Thematic areas, disciplines and research units

The departments of social sciences and law have about a dozen permanent staff members working in the marine field. Research is carried out in the Faculty of Law, and the Department of Social Anthropology, the Department of Geography, the Department of Administration and Organization Theory, and the Department of Information Science and Media Studies. The Department of Sociology did not provide a self-assessment report. Two other departments, the Department of Economics and the Department of Comparative Politics, do not have marine research activities.

Obviously with such low numbers, the research is affected tremendously by the decision of one staff member to move or to retire. The Department of Geography, in particular, has been hampered by the resignation of two professors.

The self-evaluations are generally very short and do not provide much in terms of self-reflection on the status and future of marine research within the departments.

Scientific production

Publications reflect the highly divergent publication cultures of the disciplines. The departments of Social Anthropology and Geography have a strong focus on international peer-reviewed journals, while the Faculty of Law on the other hand publishes almost exclusively in Norwegian although it is stated that hopefully more will be published in English when staff members qualify for senior professorships. In the departments of Administration and Organization Theory and Information Science and Media Studies there is a mix of English and Norwegian language reports. In general, productivity seems good to high. Publications all seem highly relevant to the marine field but there is a lack of high-profile international publications. In general, the projects and publications do not indicate high-risk and potentially high-impact research.

Among highly relevant marine research projects it may be mentioned that:

- the Department of Administration and Organization Theory houses the Norwegian part of a five-country EU/Marie Curie programme on Coastal Climate Risk handling, and recently (2012) arranged an inter-institutional and inter-disciplinary conference on innovation systems/networks in the Norwegian/North Atlantic fishing and fish farming industries. The background was earlier international research projects on marine resource policy analysis;
- at the Department of Information Science and Media Studies, projects include two nationally funded projects on information management of fish farming and optimisation of inspection of fishing vessels, and on pollution of salmon farming;

- at the Department of Geography, we may note externally funded projects on innovation and dynamics in fishing communities in Norway, a project on the Spanish salt fish market, and EU funded projects on fisheries in Chile and Africa;
- at the Department of Social Anthropology, research has concentrated on marine studies in the Black Sea and the Pacific, most externally funded by Norwegian and EU funds. Projects concern different knowledge cultures, seafood consumption, poverty, marine introduced species, and fisheries managed by coastal law;
- at the Faculty of Law, the focus is on national property rights studies. The group of 4 permanent researchers and 3 PhD students is in relative terms quite large compared to the size of the individual groups included in this subreport and for the field.

Master's and doctoral level education

The small size of the research fields is reflected in small numbers of PhD students and postdocs. There seems to be little emphasis on training the next generation of doctoral candidates except in the field of social anthropology but again the numbers are low. The Department of Geography on the other hand has a very high number of Master's candidates (19) but only one doctoral candidate. As much vitality in research fields stems from graduate studies the low numbers are a cause for concern.

Co-operation with academic communities in UiB's periphery

Collaboration with academic institutions within the Bergen Marine Research Cluster is "modest", non-existing or not commented on in the self-assessments. This is clearly lamentable and interviews confirmed that there is little collaboration with the wider Bergen Cluster. In the interview situation it was difficult to determine if the lack of co-operation was due to the groups being self-sufficient or whether the issues under investigation were such that no co-operation was needed.

It was remarked by interviewees that some collaboration takes place at the individual level but clearly not to any considerable extent. We noted a project on green innovation in salmon farming which has been developed between the Department of Geography and the Department of Biology.

International activities

Marine researchers at the departments of Social Anthropology and Geography have a high focus on international activities which are supported by several EU funded projects. The Department of Administration and Organization Theory also attracts EU funding but to a lesser extent. It is remarkable that the studies at the Faculty of Law are largely national in focus and do not seem to attract external funding. The Faculty has, however, developed a partnership with one American university.

Dissemination activities

Most research fields have a good presence at international conferences and obtain EU funding in addition to national funding. The Faculty of Law is an exception with a strong national focus but they have recently hosted an international conference on ocean governance with speakers from several partner institutions in the Bergen Marine Research Cluster. None of the research environments is notable for dissemination activity outside of academia. It can be noted, however, that the EU-funded ECOPAS project, coordinated from the Department of Social Anthropology, has a dissemination programme within the broad field of climate change and sea level rise with reference to the tropical Pacific ocean, which includes drama production; a comprehensive study of EU-Pacific relationships delivered to the European Parliament and informing the EU's future development co-operation strategy for the Pacific; and media-oriented collaboration with the University of Bergen's Bjerknes Centre for Climate Research to highlight the human dimension of climate change and sea level rise.

Cross-disciplinarity

The self-evaluations give little information about actual examples of cross-disciplinarity. The Department of Geography claims to be "inherently cross-disciplinary" and the Department of Social

Anthropology claims “strong” practice in the field. Other departments refer to occasional instances of cross-disciplinarity, dependent on personal links. There is no indication in the reports on how cross-disciplinarity is strengthening the field. There was too little time during interviews to follow up on this.

Significance of additional strategic funding and the Strategic Committee for Marine Research

With the sole exception of the Department of Social Anthropology which has recently received strategic funding from the Rectorate for a PhD fellowship, the social sciences have not received strategic funding and contact with the Strategic Committee has been modest to absent. The fact that the faculties of Social Sciences and Law are now represented in the Committee was little known by interviewees.

Administrative resources and support functions

The comments on administrative support are too terse for any meaningful summary.

Strengths, weaknesses and opportunities

The self-evaluations are remarkably similar in their suggestions for the future: there should be more institutional support for cross-disciplinary initiatives, and the strategy so far has been too focused on the natural sciences.

At the interview session there was a discussion of the potential utility of a providing a pool of PhD fellowships for strategic goals. It was indicated that cross-disciplinary initiatives and inter-disciplinarity take time and effort and it would be valuable to develop meeting places for presentations and to develop joint projects. A weakness was possibly a lack of societal input in the decisions on which projects to pursue.

4.11 The Faculty of Humanities: the Department of Archaeology, History, Cultural Studies and Religion and the Centre for the Study of the Sciences and the Humanities

Thematic areas, disciplines and research units

Marine studies at the Department of Archaeology, History, Cultural Studies and Religion (AHKR) focus mainly on historical analysis of Norwegian fisheries and coastal culture, mainly conducted by one current and one former permanent staff member. In addition the self-evaluation lists a number of projects on the history of meteorology, on ancient merchant networks, on missions and merchants in China, and on archaeological studies in South Africa focussing on the development of the human mind and climate change. These projects have a maritime component but do not deal directly with the marine environment.

The Centre for the Study of the Sciences and the Humanities (CSSH) has a core of two to three researchers and three postdocs who deal with the ethics of seafoods, ethical aquaculture, and social network analysis trade. The self-evaluation by the Centre is highly deficient as it is repeatedly stated that no information is available as all researchers are away for research in Asia at the time of the reporting. The interview was therefore highly useful but unfortunately hampered by time constraints.

Scientific production

With the cull of AHKR publications indicated above the group has produced or contributed to three major monographs/edited works in Norwegian in the last couple of years. These collective works represent a massive research effort, some but not all of it conducted at UiB.

CSSH did not provide a list of publications.

Master's and doctoral level education

No evidence is provided by either self-evaluation report. In the interviews it became evident that AHKR has had a large number of MA candidates in the marine field, and two PhD candidates. CSSH provide PhD courses across all university faculties.

Co-operation with academic communities in UiB's periphery

No collaboration has taken place according to the self-evaluations. However, when clarified in the interviews that collaboration might include collaboration with other partners than the strictly marine. AHKR gave a long list of collaborations with museums, archives and public services and sees great potential in coastal heritage partnerships. Similarly CSSH identified a list of community engagement, particularly in Northern Norway.

International activities

Researchers from both units have taken part in a good number of international conferences and workshops.

Dissemination activities

The books published as a result of the AHKR research projects are flagship national and regional history projects and are very likely to be high-profile outputs. They are recently published and the impact is impossible to assess in this review.

Cross-disciplinarity

AKHR reports "informal" contacts, while the ethics group claims that "All research at SVT [CSSH] is always cross- and inter-disciplinary!" In the interviews it became clear that there are indeed a number of active cross-disciplinary links, and especially highly promising links for history with climate studies and for CSSH for biology and social sciences.

Significance of additional strategic funding and the Strategic Committee for Marine Research

AHKR recently received match-funding for a PhD fellowship but reports no contact with the Strategic Committee. The ethics group reports on contacts: "none whatsoever". In the interviews both groups were clear that they do not favour a strong branding of UiB as a Blue University. AHKR stressed that the marine should be broadened to maritime.

Administrative resources and support functions

CSSH reports that administrative support is insufficient while AHKR simply reports that these functions take place.

Strengths, weaknesses and opportunities

AHKR sees good potential for the development of inter-disciplinary contacts in marine research. CSSH did not comment in the written self-evaluation but confirmed in the interview that the group is highly active in pursuing these opportunities across the University.

4.12 The Department of Psychosocial Science

Thematic areas, disciplines and research units

At the Department of Psychosocial Science, about 30-40 per cent of the research staff has been involved in research with direct or indirect relevance to the maritime sector. Typically 10-15 faculty researchers, 2-3 postdocs, and 3-8 PhD students are engaged in maritime research per year. The research comprises the following four groups: the Operational psychology research group; the Treatment research group; the Society and workplace diversity research group; and the research group for Leadership, conflict and psychosocial working environment.

The Department has good connections with Norwegian industry and is eager to engage in collaborative activities within UiB.

Scientific production

The Department has a good output of research articles in the field of maritime science. The Department also appears to be well known nationally and internationally recognised.

Master's and doctoral level education

There is no dedicated marine/maritime educational programme in the Department. However, maritime topics are included in the research programmes at BA and MA levels in General psychology and Work and organisational psychology. Some maritime educational elements are also integrated in Forensic psychology and Developmental/clinical psychology in the Professional psychology programme.

Similarly, there is no explicit maritime PhD programme at the Faculty, but in total 10 PhD candidates have completed or are in progress with dissertations related to maritime topics.

Co-operation with academic communities in UiB's periphery

The Operational psychology research group (OPRG) has collaborated with the Royal Naval Academy in several projects. This collaborative effort includes supervising four PhD candidates funded by the Navy. Lately, the OPRG has developed collaboration with Haugesund University College and a number of industry partners from the maritime oil and gas industry. The industry partners have made long-term commitments by funding PhD students and participating in joint research efforts. In the period 2004-2013, the OPRG has cooperated with more than 10 major companies from the maritime sector. The research group also collaborates with the National Institute of Nutrition and Seafood Research (NIFES) and the Department of Chemistry on several randomised control trials (RCT) concerning seafood and key nutrients found in fish (omega 3 and vitamin D) and mental health. The Treatment research group has extensive collaboration with the Norwegian Competence Centre for Sleep Disorders and the Centre for Maritime Research, both at the Haukeland University Hospital.

International activities

International collaborative projects include topics in nutrition/seafood consumption and mental health (a collaboration with partners from the USA) and group dynamics and crew performance in isolated and confined operational contexts (funded by PRODEX, European Space Agency).

In the self-assessment report, the Department states that there has been limited time and means to develop international networks and engage in marketing activities.

Dissemination activities

The dissemination of the research results have been chiefly through research articles. The group has also been involved in international projects. Some topics related to leadership, human factors and safety have been communicated in the education course "Operativ Psykology" at UiB.

Cross-disciplinarity

No information provided.

Significance of additional strategic funding and the Strategic Committee for Marine Research

The Faculty of Psychology has not received strategic money for marine/maritime research centrally from the UiB. However, the Faculty of Psychology has made its own strategic investments, directed at maritime research, in the form of permanent research staff and PhD positions. The Department deems that the activities in maritime research have benefited from this: it estimates that over the period 2004-2013, an accumulated internal spending of 6.7 MNOK has yielded a 350 per cent return on investment

through funding from the Norwegian Research Council of 24.5 MNOK and 3.8 MNOK from industry and international partners.

In the self-assessment report, the Department states that it believes that additional support from UiB strategic funds could have served as a catalyst to build more stable and enduring international partnerships and in competing for EU funds and large-scale projects. The Department also deems that it has a strong academic base in research with connections to a number of industry partners, which could be further developed into a research environment/cluster in maritime research.

The self-assessment report states that it would be an asset to include the Faculty of Psychology in the Strategic Steering Group for marine research at UiB. The Faculty of Psychology also deems that all relevant faculties at UiB should be invited to the table when future strategic initiatives in marine/maritime research are on the agenda.

Administrative resources and support functions

There is a need for administrative/technical support for the broad methodological approaches used in maritime research in the Department. This includes data management and building of databases.

Strengths, weaknesses and opportunities

The research base at the Faculty of Psychology could be further developed and supported in order to build a strong research cluster in maritime research at UiB and partner institutions. There may be potential for collaborations with K1 on research related to sleep disorders.

5 Strengths, weaknesses, threats and recommendations

5.1 Strengths

The University of Bergen is widely recognised internationally for excellence across a diverse range of marine science and research, and for excellence in selected areas of teaching of marine disciplines. Some of the Bergen marine research groups are amongst the most highly respected and regarded in the world. These are mostly situated within the largest of the departments and centres with strong marine interests, including the Geophysical Institute, the Department of Earth Science, the interdisciplinary Centre for Geobiology, the Department of Biology and the overarching Bjerknes Centre for Climate Research. Research on the present, past and future role of the oceans in climate and climate change is exceptionally strong, and this strength has been recognised by the appointment of senior staff as leaders in the Intergovernmental Panel on Climate Change (2007, 2013).

The strength of the Bergen marine research landscape builds on a long scientific tradition fostered by Bergen's location centrally on the west coast of Norway. Some of the most important figures responsible for establishing the foundations for modern meteorology and oceanography worked within the Bergen scientific community (Bjerknes, Nansen, Sars, Hjort). Clearly easy access to the coast and ocean, and the significance of the associated fisheries, has been vital, but several developments since the establishment of the University have coincidentally reinforced the relevance of marine science and the marine sector in Bergen: these include the discovery and exploitation of hydrocarbons in the North Sea and latterly the Barents Sea, the advent of commercial aquaculture, and the realisation that the hydrodynamics of the adjacent North Atlantic are crucial to global ocean circulation and climate. Consequently research on fundamental physical oceanography, marine biogeochemical cycles, dynamics of ocean circulation, ocean-atmosphere interactions, marine microbiology, fisheries, aquaculture, petroleum geoscience and marine geohazards has flourished in the Bergen context. The University strongly benefits from co-location alongside major commercial fisheries companies, government agencies and major players in the offshore sector concerned with hydrocarbon exploration, exploitation and engineering; this relationship is symbiotic since, in turn, these industries benefit from the supply of trained marine professionals from the University.

The University has invested heavily in marine science over many years and, in doing so, implemented top-down strategic instruments to exploit existing bottom-up strength. This investment has resulted in excellent heavy infrastructure, notably contributing towards the development of a research vessel fleet with ocean-going capability. Access to these research vessels and other heavy infrastructure has been central to the success of many of the most important marine research groups within the University. There is no doubt that without this access the marine profile of the University would not be as strong

as it now is. Equally important, the University has recognised and supported star research groups through heavy long-term investment in overarching research centres; the Bjerknes Centre for Climate Research is outstanding in this context. The scientific importance and policy relevance of the Bjerknes Centre has been recognised through funding directly from the Norwegian Government since 2010. A really distinctive feature of marine research in Bergen is its relevance either to policy at national or international level, or to industry, or to both, and a very strong public presence through powerful dissemination activities. Bergen is a powerhouse of marine research on the international stage and this research influences and has impact on international and national policies and is a driver of economic growth.

5.2 Weaknesses, threats, and recommendations

5.2.1 The research landscape

While a review of the research landscape itself was not part of the written Terms of Reference, the UiB leadership at the initial meeting invited advice from the Panel. In general, sharing between institutions of major infrastructure facilities, such as research vessels and advanced laboratories appears to have been efficiently organised through consortia with often clear rules for using and contributing to the facilities (see below, however). The Panel is concerned, however, that the coordination between the many structures and institutions may require more energy and resources than the outcome warrants. There is definitely a tradeoff here that must be carefully balanced.

Marine research at UiB and its academic partners constitutes a very successful academic ecosystem, which generally thrives in a healthy combination of research and teaching. Pillars of strength emerge from the bottom up, many of high international standing and some of world-leading quality. Partly as a result of this healthy open environment, the marine research landscape is very complex, both within the University itself (departments, centres, university-owned research companies (e.g. Uni Research)), and between the University and the several independent research institutes in the Bergen area (governmental and private) each with their own research agenda. Some of the independent research institutions are organised in the Bergen Marine Research Cluster, and there appears to be a rather complex network of cooperative structures and initiatives, some of which lack critical mass. While such initiatives may be conducive to innovative research and education, it also appears that the complexity and number of collaborative structures is overwhelming and may imply quite some bureaucracy and administration. Funding flows, especially for strategic initiatives, are sometimes opaque or at least seem so to many of the researchers interviewed.

Researchers are often engaged with several initiatives, each of which requires their full commitment. Several of the structures at the UiB itself, e.g. the Centres of Excellence, have been established as a means of attracting external funding and are not necessarily the result of a strategic priority of the University but rather driven bottom-up by strong research groups.

Recommendations

- That UiB aims to simplify the research landscape by merging entities under the control of the University.
- That UiB develops strategic partnerships with institutions in the region and the country to minimise unnecessary duplication and maximise strengths for a marine strategy.

Below we comment on specific elements included within the Bergen marine landscape.

5.2.2 Uni Research

The Evaluation Panel considers this the most important element of the entire report.

Many research staff in marine science are employed through Uni Research (formerly Unifob), an independent company owned 85 per cent by the University. Whilst this has the advantage that the employment law governing contracts is more flexible within the private sector than within the University, and has facilitated the growth of powerful research clusters supported by long-term employment of key staff, the Uni Research structure has in recent years developed powerful autonomy – effectively a research university within the University – that is allowing parallel development of research infrastructure and groupings (e.g. in marine geology/ palaeoceanography). Such parallel development and duplication is not an effective way to operate and is wasteful of resources and expertise. Furthermore, the scientific staff involved have effectively been "blind" to the evaluation since the "independent" Uni Research is not formally a part of UiB. This is an artificial distinction. These scientists are clearly a major part of the Bergen marine research landscape, so it seems disingenuous not to include them within this evaluation of marine science at the University of Bergen. The status of Uni Research has therefore been technically problematic for the delivery of the evaluation, but much more importantly, is a problem for UiB itself.

Recommendation

- Very careful consideration should be given to the status and role of Uni Research within UiB and whether these two organisations remain symbiotic. This is an issue that requires attention at institutional level. If the current trends continue there is a danger that a "research university within a University" is allowed to develop. This review should include detailed consideration of the legal status and independence of Uni Research, the reasons why Uni Research was established in the first place and whether other instruments might now be put in place to overcome these obstacles within the university structure itself.

5.2.3 Research vessels

Whilst some researchers combine seagoing research with teaching cruises in the immediate region, other researchers who have a requirement to undertake research in other oceans e.g. Southern Ocean, or long cruises, find it very difficult to use the G. O. Sars. They find the application procedure opaque, and the planning period is not sufficiently long to accommodate long-distance cruise activity. Opportunities for collaborative work on cruises and the advertising of likely cruise routes to facilitate opportunistic activity should be highlighted to university staff. Apparently the original arrangement was that the University had access to ~3 months sea time on the G. O. Sars, but that because of over-allocation to the University in recent years this has now been cut to one month. Once the allocation for teaching commitments has been taken out of this there is too little time for research activity, especially to remote locations.

Recommendation

- UiB should review its relationship with the Institute of Marine Research (IMR) to improve the process of applying for sea time, making it transparent, with better communication with scientists requesting sea time. Much potential for opportunistic involvement in research cruises is currently being missed, so IMR should publicise draft cruise tracks years to months ahead so staff can avail themselves of potential research opportunities. UiB should consider increasing the sea time allocation dedicated to university research on G. O. Sars, and should review whether using this vessel for teaching is really an appropriate use of this resource.

5.2.4 Centres of Excellence

We note that much of the research is organised in centres of various kinds, ranging from virtual centres with limited funding, to Centres of Excellence and innovation centres with high levels of external funding. All these are temporary initiatives and help ensure that the research environment remains dynamic. However, with the termination of centres, there is also the risk of losing expertise and of destroying productive research environments that still have huge potential.

Centres of Excellence, such as the Centre for Geobiology, with high profile publications and compelling outreach activities, will end at the stipulated date. This situation makes it vital for the UiB to develop clear guidelines for the embedding of successful activities and the employment of excellent postdoctoral fellows within the university structure.

Recommendation 1

- In the absence of direct governmental support (e.g. the Bjerknes Centre for Climate Research), that UiB considers two strategies for embedding temporary but especially successful activities:

    1. In a limited effort a small number of faculty positions (with supporting resources), could be advertised at relevant departments. This would allow the growth of individual research groups that might pick up and further the work of the successful centres, both in terms of human resources and ideas. In view of the research strategic priorities of UiB it seems contradictory that permanent positions are essentially allocated as a function of teaching needs and not to respond to research needs and prospects.
    2. Alternatively a more substantial funding effort could be launched where a single scientist or a small group would be given the responsibility to select and form a new research environment similar to the Max Planck initiatives in Germany. This would be a way to retain competent scientists in the former centre while at the same time allow relevant changes in direction and research focus to be made by finding new staff.

Research in climate science at UiB, which includes most of marine research in the Geophysical Institute and in the Department of Earth Sciences, is branded through the Bjerknes Centre for Climate Research (BCCR). BCCR provides an internationally prominent brand and represents a major component of UiB's marine research activity. BCCR's prominence results in invitations to UiB scientists to participate in EU funded international projects, participate in, for instance, influential international committees. BCCR's funding as a Centre of Excellence expired in 2012, but funding has been renewed as a direct grant from the Government to UiB, administered through the Geophysical Institute.

Recommendation 2

- Given its international prominence, the existence of BCCR should be secured into the future.

5.2.5 Small scientific environments

Some of the marine research environments are very small, and close to or below the critical mass, even when embedded in disciplinary departments. This applies to mathematics, chemistry, medicine, law and the humanities/social sciences departments.

In order to maximise the potential of small research environments and enable them to be visible and successful partners of the research landscape, better contact to other marine and maritime research environments should be strengthened (e.g. through exploratory workshops). These should be bottom-up initiatives, but should be supported from the top, including some seeding funds. However, it should be fully realised that a minimum critical mass of researchers within the involved units is required for these actions to be fruitful.

Marine research in the humanities and social science suffers from lack of critical mass, as about 15 permanent researchers and a like number of doctoral students and postdocs are dispersed across five social science departments, one humanities department and one centre. There is, however, potential to develop a strong focus for social science and humanities (SSH) marine research to complement the resources of the natural sciences. We feel that there is scope for social innovation in the set-up of academic research between departments. In particular, it would be useful to highlight already existing SSH marine research. We recognise that multi- and inter-disciplinarity take time and effort.

In clinical medicine there are two departments, K1 and K2, both of which are actively researching the impact of seafood on various aspects of human health and nutrition. This duplication of effort and artificial separation of scientists and clinicians working on very similar projects is wasteful of resources and hinders collaborative synergies.

Some of the marine science activities at the Geophysical Institute are limited by an identified lack of expertise in statistics, theoretical development and analytical model testing. A potential way to address this issue could be to use strategic money to increase the number of staff in the Department of Mathematics with expertise relevant to marine science. More generally, crucial subject-specific expertise that is lacking in the larger departments in marine science could be used to guide centrally-supported strategic recruitments in relevant departments where marine science is not the main activity.

Recommendations

- To set up formal “meeting places” or “cross-departmental marine initiatives” which would enable academics of smaller research environments to meet across disciplinary boundaries on a regular basis. The meetings should identify a couple of “champions” to organise the initiative and be a point of contact.

- A focus of the initiatives should be an effort to identify shared problems, calling on multidisciplinary approaches, ideally including partners from larger research entities and academic partners from the wider Bergen Marine Research cluster.

- Seed funding should be allocated to develop two or three grant proposals led by smaller research environments. Fund matching such as PhD grants should be allocated to successful competitive awards of a certain size.

- Small research environments should be encouraged to engage with and highlight their research at national events such as Havforskermøtet.

- Consideration should be given to merging the K1 and K2 groups working on seafood, nutrition and health.

- Consideration should be given to new faculty appointments within Mathematics to support advanced numerical statistical and modeling applications within the mainstream marine science departments.

5.2.6 Bergen Marine Research Cluster

The mission of the Bergen Marine Research Cluster seems unclear to the Panel as it was not explicitly described in the written material, and only discussed with the co-ordinator of the cluster. Its main role appears to be a platform for communication between eight important marine research institutions in the Bergen research area and to suggest strategies for new research centres; these will further complicate the Bergen marine research landscape. It also emerged from the interviews that the selection criteria for intiatives under the Bergen Marine Research Cluster are not very clear.

Recommendation

- That the selection of centre initiatives under the Bergen Marine Research Cluster be governed by clear priorities and review criteria.

5.2.7 Education and fate of candidates

Universities deliver knowledge to society in the form of written records but also, and perhaps most importantly, as well trained professionals that can satisfy the need of industry and public administration. The need for personnel trained in marine and maritime disciplines from all UiB

departments and faculties is presumably very high in Norway in general and in the Bergen area in particular. However one observation we made is that - where reported – most PhD students pursue a postdoctoral career in academia rather than in industry and the public sector. Isolated initiatives to bring society and industry in contact with the students were reported. Notably the Department of Biology had put in place a programme where students were exposed to outside work environments. This in particular, has proved important for students graduating at the Master's level. We also noted the view that civil engineers might have an advantage over candidates with a completed PhD education.

When asked about where the students had gone the answers were vague but more importantly there seemed to be no central information that the representatives for the different organisational levels were aware of or could draw information from.

Recommendations

- Doctoral students and postdocs should be exposed to private and public sector interests during their education. Initiatives to build strong partnerships outside academia would help generate new career paths as well as cross-overs between applied and academic research.

- UiB should consider developing a graduate school of marine studies which would expose all students to elements of human, social, natural and technical approaches as well as provide students with entrepreneurial and innovation skills.

- The alumni network could perhaps be used to provide this information but at present this network is closed for public access.

- If not already being done, the career trajectories of Master's and PhD graduates should be more closely monitored. It may be appropriate that such monitoring is organised at university level. Such information will be useful for recruitment and for developing relationships with industry and private companies.

5.2.8 Dissemination activities, both public, to stakeholders and to science communities

Dissemination activities, at both domestic at international level, are numerous, constant and performed according to the best standards using a variety of channels, in particular by the larger and more powerful units involved in marine research, with the main target groups being academia and the public at large and to a lesser extent industry. However, some weaknesses, including low dissemination levels and imbalances with respect to target groups, have been detected in particular within units where marine research activities are a relatively minor part of their activities.

Recommendations

- To steer groups that do good research but need to develop their publication culture, in particular as related to publishing in top journals in the field and contributing to international conferences (viz. Marine acoustics in the Department of Physics and Technology, the Faculty of Law).

- To promote a more balanced dissemination effort, in terms of target groups, channels and forums, both domestic and international, as some research groups seem to neglect key target groups, such as the general public and sometimes industry (viz. the departments of Chemistry, Mathematics, and Physics and Technology, and the Faculties of Social sciences and Law).

5.2.9 The marine strategy and the Strategic Committee for Marine Research

Strategy development
The Panel heard about development of strategy at three levels: within the Faculty of Mathematics and Natural Sciences, across the University of Bergen, and within the Bergen Marine Research Cluster. It is not clear that there are mechanisms in place to align these three levels of strategy development. For example, there appeared to be little awareness within the departmental leadership teams interviewed of the initiatives being developed by the Bergen Marine Research Cluster. There is therefore a potential danger that the strategies develop independently of each other and in conflicting directions. Given the apparently limited implementation of marine strategy within UiB (see below), it may be timely to refresh the strategy through a series of meetings and workshops across the University. A refreshed strategy will need to be clear about its scope (see below).

Implementation of strategy
Within UiB, although there has been an explicit strategy with formulated goals, and a strategic committee appointed to oversee its implementation, it remains unclear to the Panel how the strategy has been implemented over the review period. The marine priority area was originally developed as an initiative within the Faculty of Mathematics and Natural Sciences. However, even within this Faculty, several departments had little awareness of or contact with the Strategic Committee. Departments from the faculties of Humanities and Social Sciences were later included and represented in the Strategic Committee. Again, their inclusion appears to have had limited impact, and the non-natural sciences departments, some of which have significant marine research activity, have to their knowledge received no resources from the priority area. These departments were initially not even included in the evaluation, and they appear to have asked to be included to the surprise of the UiB leadership. Overall, smaller players in the marine field appear to have been simply left aside. So, despite an ambition of developing UiB as a “blue” university, the UiB leadership does not appear to have been very proactive in implementing strategy through a transparent process, and the blue profile has emerged to a large extent as a bottom-up process.

Funding the Marine Priority Area
An additional concern is a lack of transparency around the level and mechanism of allocation of funding of the marine priority area. The Panel was given several widely different estimates of the level of funding. The estimate given at the initial meeting with the leadership was 5-10 M€ per year, with increasing sums in recent years. Most of these monies appear to have been channeled through ordinary departmental channels and to go mainly into infrastructure; as such, academic staff within departments are generally unaware that funds have been received from the priority area. The Panel was told that a large share of the funds has recently been used to replace expired external funds for the Sars Centre for Marine Molecular Biology, which was not included in this evaluation. The Strategic Committee appears to have had no control over strategic funding, and so the implications of efforts of the Committee appear to have been rather insignificant in the past. Several departments expressed a wish to have a more powerful committee, with control over money that could more efficiently implement strategic decisions in a transparent way. Certainly the Committee would be much better

able to stimulate interdisciplinary marine research if it was allocated some funding to do so. Such funding might, for example, be available on a competitive basis to support PhD studentships, research fellowships or pilot research projects spanning more than one department or faculty, or to support meetings intended to develop interdisciplinary proposals for external funding.

Scope of the Marine Priority Area

At the meeting between the Panel and the deans from all involved faculties, those representing the humanities and social science departments expressed a strong wish to be an active part of any major top-down initiative in marine research. Some of these departments have significant marine research activity and should certainly be included. Others (for example, within the Faculty of Psychology) have little or no research that would be properly described as marine, but significant maritime research activity. This maritime activity has little connection to the marine research activity in the natural sciences. The Panel did not see evidence that sufficient maritime research was present within UiB to highlight it as an area of strength within UiB and therefore justify an expansion of the marine priority area into the maritime domain. A key component missing within the University, which might link existing marine and maritime activity, is marine and maritime engineering. If activity in this area was brought into the UiB through a merger, as has been suggested as a future possibility, an expansion into the maritime domain might be justified. Such expansion might alternatively be justified through partnership with other organisations in the Bergen area, but such a partnership would need to go beyond the current membership of the Bergen Marine Research Cluster.

Recommendations

- That the University ensures that marine strategies developed at different levels within UiB, and developed in collaboration with its partners, are appropriately aligned.
- Strategy should be developed to ensure balance between top-down and bottom-up initiatives, bearing in mind that some of the most powerful existing groups have largely developed bottom-up.
- That the scope of any future UiB marine strategy explicitly includes disciplines outside the Faculty of Mathematics and Natural Sciences.
- That the possibility of expansion of the marine strategy into the maritime domain is considered in the wider context of organisations across the Bergen area.
- That instruments are installed in a transparent way to implement the strategy decided. Such instruments should include promotion of interaction with departments for which marine research is a relatively minor part of their activities.
- That the Strategic Committee is made responsible for allocation of some funds to stimulate marine research; in this way even modest funding might be deployed very effectively to implement the strategy.

References

UiB sources

Facts & Figures 2013. University of Bergen, the web pages of UiB, URL: http://www.uib.no/sites/w3.uib.no/files/attachments/uibfactsfigures_213.pdf

Forskningsstrategi for Det matematisk naturvitenskapelige fakultet 2006-2010, the web pages of UiB, URL: http://www.uib.no/mnfa/strategi/MatNatForskningsstrategi_final.pdf

«Forslag til Marin strategi for Det matematisk-naturvitenskapelige fakultet», UiB

«Forslag til strategi for marin forskning og utdanning 2015-2020», UiB

«Gjenoppnevning av strategisk utvalg for marine fag», UiB

«Mandat for Strategiutvalg for marine fag (SMF) ved Det matematisk-naturvitenskapelige fakultet», the web pages of UiB, URL: http://www.uib.no/mnfa/strategi_omstilling/organisasjon/mandat_SMF.pdf

Nye Tider – Nye Utfordringer – Nye Løsninger. Strategi 2011-2015, Det Matematisk-Naturvitenskapelige Fakultet, Universitetet i Bergen, the web pages of UiB, URL: http://www.uib.no/filearchive/strategi_mn2011-15_web.pdf

Strategi 2011-2015. Universitetet i Bergen, the web pages of UiB, URL: http://www.uib.no/sites/w3.uib.no/files/w2/st/strategi_2011-15_web_1.pdf

«Strategiutvalg for Marine Fag (SMF) ved Universitetet i Bergen», the web pages of UiB, URL: http://www.uib.no/ledelse/smf/SMF_Mandat.pdf

«Styrenotat marin forskning 2008», UiB

«Universitetet i Bergen – et forskningsuniversitet. Utkast til forskningsstrategi 2005-2010», UiB

External sources

Botany, Zoology and Ecology-related Disciplines, Panel 1, Evaluation of Biology, Medicine and Health Research in Norway the Research Council of Norway, 2011

Norwegian Climate Research. An Evaluation, the Research Council of Norway, 2011

Physiology-related Disciplines, Panel 2 Evaluation of Biology, Medicine and Health Research in Norway the Research Council of Norway, 2011

Research in Earth Sciences in Norway. An Evaluation, the Research Council of Norway, 2011

Appendix 1 Self-assessment report template

Evaluation of Marine Research at the University of Bergen (UiB)

Self-Assessment Report 2004-2013

Department/centre at UiB to be included in the evaluation:

Introduction and general instructions

The present evaluation is initiated by the University of Bergen (UiB) in order to have a systematic review and assessment of the strategic priority area marine research at UiB. Whereas marine research has been a strategic priority at the University since the 1980s, the focus of the evaluation is on the last ten-year period (2004-2013).

The evaluation is conducted by an international evaluation panel, appointed by UiB, with secretarial help from NIFU. The panel is mandated to evaluate the quality and relevance of the scientific production and educational programmes (at master and doctoral level) within marine research at UiB, as well as the dissemination activities, co-operation with institutions in UiB's periphery (*randsoneinstitusjoner*) and international activities of the associated academic communities.

In order to do so, we need a wide set of information about the activities of the units conducting marine research at UiB. Against this background, we ask the departments/centres involved in marine research to fill in this self-assessment report template. The self-assessment template follows the Terms of Reference (ToR) for the evaluation. Each item in the template quotes the ToR-questions to be addressed, and asks for relevant information about the unit/its activities in the ten-year period to be evaluated, as well as the unit's experiences and assessments.

Your department/centre should return only one self-assessment report. However, if you have several major research topics/research groups within marine research, we ask you to provide information specified by research topic/research group where this is relevant.

To avoid double counting, please coordinate your reporting with other departments/centres involved in marine research at UiB. As a general rule, you should report the activities of researchers holding a main position at your unit.

The self-assessments will, together with other data sources, form the basis for a review and assessment of the strategic priority area marine research at UiB as a whole. There will not be separate evaluations of the research units.

Please send the completed self-assessment to NIFU by 8 September 2014 (siri.aanstad@nifu.no). The self-assessments will not be published or distributed to other parts of UiB.

1. Background information: thematic areas and resources

Please use the boxes in each section to specify your activities and views.

a) Thematic areas of marine research: In the table below, list your major research topics/research groups and projects (2004-2013).

Major research topics/Research groups (2004-2013)	**Major research projects (2004-2013)**

b) The department/centre's academic personnel in marine studies (research and/or teaching)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total number of staff involved										
Number of staff involved in the field more than 50% of their time										
Full time equivalents (FTEs) in the field:										
Professors (*professor/førsteamanuensis/andre førstestillinger*)										
Other permanent academic staff										
Postdoc fellows										
PhD fellows										

If relevant, please specify the size of your major research topics/research groups within marine research relative to the size of the department/centre and describe the main developments in academic personnel (growth/reduction) for these topics/groups in the period 2004-2013.

c) Funding of research activities: Fill in the department/centre's total expenditure for marine research by funding source (in 100 000 NOK).

Source	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Institutional core funding (total)										
- funding received from UiB's strategic priority of marine research										
Grants from the Research Council of Norway										
Other Norwegian public funding (ministries, directorates/agencies, etc)										
Private domestic sources (industry or NGOs)										
Funding from abroad										
Sum										

If relevant, please describe the main developments in research funding (growth/reduction) per major research topic/research group in the period 2004-2013.

2. Scientific production

ToR: “On the basis of international standards to assess the quality and relevance of the scientific production within marine research based on the combined production of publications and theses, with emphasis on the last 10 years.”

The panel will assess UiB’s overall scientific production within the field based on bibliometrics/publication lists extracted from Cristin and Web of Science. As additional information and background to interpret the bibliometric data we would like input on what you consider the department/centre’s most significant publications within the field. Five to ten publications per major research topic/research group should be listed.

Please provide full references to each publication.

The most significant publications per major research topic/research group, 2004-2013:

3. Education at master and doctoral level

ToR: “Evaluate the quality and relevance, including the development of expertise and level of execution, of the area's combined educational programmes at the master and doctorate level with emphasis on the last 10 years.”
Please list the names of the educational programmes in marine studies (at master and doctoral level) your department/centre has been involved in in the period 2004-2013.

Educational programmes in marine studies, 2004-2013:

Master programmes:	**Ph.D. programmes/research schools:**

Describe and comment on how these educational programmes have developed in the period 2004-2013 (scope of programmes, recruitment of students, completion and other relevant issues).

Please indicate the proportions of Ph.D.-candidates from these programmes employed by higher education institutions/research institutes and industry respectively, and provide examples of typical career trajectories of the candidates.

4. The significance of UiB's strategic priority of marine research

ToR: "With the additional resources that accompany being a main focus area in mind, give a combined assessment of the strategic added value/utility this has provided."

Please describe the types of added resources your department/centre has received through UiB's strategic priority of marine research in the period 2004-2013 (e.g. PhD positions, infrastructures). Refer to amounts reported in section 1 c) where relevant, and comment on the added value of these resources for your research and education activities; that is, what results you would not have achieved without the additional resources.

5. Co-operation with academic communities in UiB's periphery (*randsonen*)

ToR: “Evaluate the associated academic communities' co-operation with relevant academic communities in UiB's periphery, including organization, participation in projects, ability to generate resources and networking.”

If relevant, please report separately for your major research topics/research groups in this section.

Describe how your co-operation with relevant academic communities in UiB’s periphery (*randsoneinstitusjoner*) has developed in the period 2004-2013, and comment on how such co-operation has affected your ability to generate resources and build networks.

6. Dissemination activities and international co-operation

ToR: “Evaluate the associated academic communities' dissemination and promotion of their research results domestically and internationally.”

ToR: “Evaluate the associated academic communities' international activities, including project co-operation, participation in conferences, presentations, marketing and networking.”

If relevant, please report separately for your major research topics/research groups in this section.

Describe the major target groups of your research and the major channels for disseminating and promoting your research results domestically and internationally. Please comment on the relative importance of academic/popular and of domestic/international dissemination.

Describe and comment on how the dissemination and promotion of your marine research has developed (e.g. increase/decrease in activity level, new dissemination and promotion channels) in the period 2004-2013.

Please provide a list your most significant *domestic* dissemination activities (apart from scientific publications) in the period 2004-2013 (extracted from Cristin where possible). Categories to be included:

- contribution at conferences
- popular/user-oriented talks
- popular articles
- media contributions (newspapers, TV, radio, film, blogs, etc.)

Please provide a list your most significant *international* dissemination activities (apart from scientific publications) in the period 2004-2013 (extracted from Cristin where possible). Categories to be included:

- contribution at conferences
- popular/user-oriented talks
- popular articles
- media contributions (newspapers, TV, radio, film, blogs, etc.)

List your international projects in the period 2004-2013, and comment on the development in international project co-operation in the period.

Provide examples of other central international activities, e.g. marketing and networking, and comment on the development in these activities in the period.

7. Cross-disciplinarity

ToR: “Consider to which extent cross-disciplinarity and organization in cross-disciplinary centres has contributed to strengthening and developing activities in the focus area.”

If relevant, please report separately for your major research topics/research groups in this section.

Please comment on the degree of cross-disciplinarity of your research activities and education programmes, and the extent to which cross-disciplinarity and organisation in cross-disciplinary centres have contributed to strengthening the research and education activities within marine studies at UiB in the period 2004-2013.

8. UiB’s strategic committee for marine research

ToR: “Assess utility value/function of the strategic committee for this focus area.”

Please comment on your department/centre’s experiences with UiB’s strategic committee for marine research, its value/function for developing the field, and if relevant how the organisation of the focus area may be improved.

9. Administrative resources and support

ToR: “Assess the associated academic communities combined administrative resources and support functions.”

Please describe the types of administrative resources and support available to your department/centre, and give your opinion on the adequacy/sufficiency of the resources and support, and if relevant what ought to be improved.

10. Strengths, weaknesses and challenges

If relevant, please report separately for your major research topics/research groups in this section.

Please describe what you see as the main strengths, weaknesses and challenges for research and education within marine research at UiB, and how the field should be developed further.

Appendix 2 Site visit interview plan

	Wednesday October 8th		Thursday October 9th		Thursday October 9th	
Time	9.00-11.30: • interview with UiB central leadership • interview with UiB faculty leadership 15.00-16.30: • interview A1 and B1		9.00-12.30: • interview C1 and D1 • interview C2 and D2		14.30-16.00: • interview E1 and F1	
Track	A	B	C	D	E	F
Panel members	Thomas Kiørboe, Åke Hagström, James Scourse, Poul Holm	Miquel Canals Artigas, Johan Nilsson, Tim Minshull	Thomas Kiørboe, Åke Hagström, Poul Holm	Johan Nilsson, Tim Minshull, James Scourse, Miquel Canals Artigas	Poul Holm, Miquel Canals Artigas, Thomas Kiørboe	Åke Hagström, Tim Minshull, James Scourse, Johan Nilsson
Interviews	<u>Faculty of Mathematics and Natural Sciences:</u> • Centre for Geobiology	<u>Faculty of Mathematics and Natural Sciences:</u> • Department of Chemistry • Department of Mathematics • Department of Physics and Technology	<u>Faculty of Mathematics and Natural Sciences:</u> • Department of Biology • Sea Lice Research Centre (SLRC) <u>Faculty of Humanities</u>: • Department of Archaeology, History, Cultural Studies and Religion • Centre for the Study of the Sciences and the Humanities	<u>Faculty of Mathematics and Natural Sciences:</u> • Geophysical Institute <u>Faculty of Mathematics and Natural Sciences:</u> • Department of Earth Science	<u>Faculty of Law and Faculty of Social Sciences:</u> • Faculty of Law • Department of Social Anthropology • Department of Geography • Department of Administration and Organisation Theory • Department of Information Science and Media Studies	<u>Faculty of Medicine and Dentistry and Faculty of Psychology</u>: • Faculty of Psychology • Department of Clinical Medicine (K1) • Department of Clinical Science (K2)

Appendix 3 Expenditure for marine R&D

Introduction

NIFU has for several years carried out national mappings of expenditure for marine research and development (R&D) on behalf of the Research Council of Norway (RCN). The biannual mappings include relevant research communities within the higher education sector (universities and university colleges) and research institute sector, as well as companies within marine industries. While the last survey is for 2011[25], the survey for 2013 is ongoing and the results are expected during the first quarter of 2015.

The results of the surveys are based on self-reporting. This will introduce bias in the data, relating both to delimitation towards research within other subject fields and to activities not classified as R&D.

Below we present the development in expenditure for marine R&D at the University of Bergen (UiB) for the period 2001-2011, based on the NIFU surveys. Uni Research Ltd (previously Unifob) changed sector affiliation during the period, as several departments of Uni Research from 2009 have been included in the research institute sector, while previously being counted as part of the higher education sector. In this presentation, Unifob and Uni Research are included as part of UiB/the UiB system throughout the period.

UiB at a glance

The national expenditure for marine R&D has experienced a strong increase since the turn of the century, more than doubling between 2001 and 2011. In 2011, NOK 3.2 billion (appr. €400 million) was spent on marine R&D nationally, with approximately 10 per cent (NOK 325 million) undertaken at UiB, tripling the effort at the University during the investigated period.

Effort for marine R&D in Norway 2001-2011 by executing sector. Million NOK, current expenditure.

Executing sector	2001	2003	2005	2007	2009	2011
Company sector	289	236	234	330	666	738
Higher Education sector	279	331	382	423	504	594
Research Institute sector	809	1080	1153	1456	1677	1856
Total	1377	1647	1769	2209	2848	3189
of this University of Bergen	*109*	*146*	*155*	*205*	*243*	*325*
	8%	*9%*	*9%*	*9%*	*9%*	*10%*

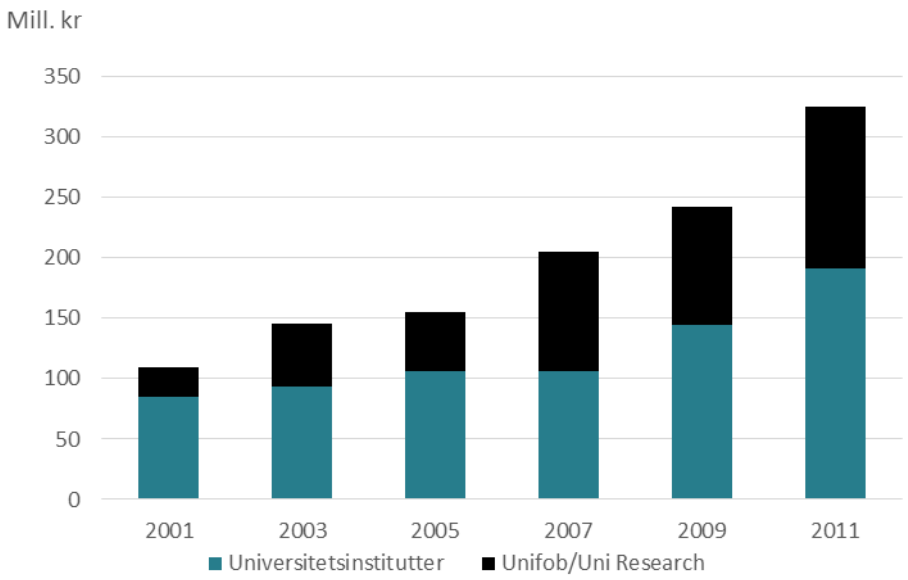
Source: NIFU survey of marine R&D

Marine research communities at UiB

About 60 per cent of marine R&D efforts at UiB was attributed to university departments in 2011, while about 40 per cent was attributed to departments at Uni Research. At the start of the investigation period, the share held by the university departments was around three quarters. The share of the Uni Research departments was in relative terms largest in 2007, when the departments accounted for almost half of total marine R&D efforts in the UiB system.

[25] Sarpebakken, Bo, Aksnes, Dag W., and Røsdal, Trude, *Marin FoU og havbruksforskning 2011: Ressurser og resultater*, NIFU-report 12-2013

Effort for marine R&D in the UiB system 2001-2011 by university departments and departments at Uni Research/Unifob. Million NOK, current expenditure.



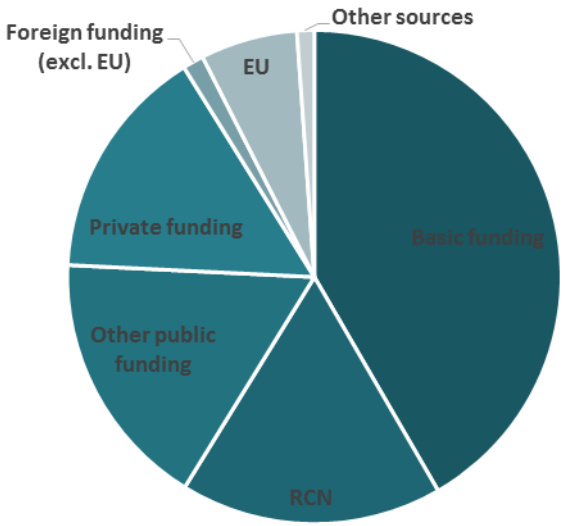
Source: NIFU survey of marine R&D

In the most recent survey (2011), a total of 15 departments/units in the UiB system reported on marine R&D activities. The group of departments/units has remained fairly stable during the investigated period. The departments/units are:

The Natural History Collections
Geophysical Institute
Department of Administration and Organisation Theory
Department of Biology
Department of Physics and Technology
Department of Earth Science
Department of Medicine
Department of Social Anthropology
Department of Chemistry
Department of Mathematics
Department of Molecular Biology
Faculty of Law
Uni Bjerknes Centre
Uni Computing
Uni Envrionment
Uni Sars Centre

Funding sources

Effort for marine R&D in the UiB system in 2011 by funding sources. Per cent.



Source: NIFU survey of marine R&D

NOK 246 million, corresponding to three quarters of the funding for marine R&D in 2011, was public funding. About 40 per cent was basic university funding, while the shares of funding from RCN and other public sources were equal at 17 per cent. Private funding amounted to NOK 50 million (corresponding to about 17%) and foreign sources NOK 25 million (8%) with EU funding being the dominant foreign source.

Effort for marine R&D in the UiB system 2001-2011 by funding sources. Million NOK, current expenditure.

Funding source	2001	2003	2005	2007	2009	2011
Basic funding	40	55	72	97	96	135
Research council of Norway	50	76	68	72	51	56
Other public funding	3	1	0	6	21	55
Private funding	8	1	5	18	60	50
Foreign sources (excl. EU)	1	1	0	0	0	4
EU	8	13	8	10	12	21
Other sources[1]	1	0	2	3	3	4
Total	109	146	155	205	243	325
of this Unifob/Uni Research	*24*	*53*	*49*	*99*	*98*	*134*

[1] Other sources is primarily foundations.

Source: NIFU survey of marine R&D

Funding from the different sources has fluctuated; however, there has been a nominal increase from all sources since 2001. Public funding has increased less than other sources, owing mainly to the weak development in funding from the Research Council.

Subject fields

Marine R&D within the UiB system is concentrated in two broad subject fields. *Oceanography, climate research, ecology, environmental toxicology, environmental contaminants and eutrophication* was the largest area in 2011 with 40 per cent of total funding, followed by *basic marine biology* with about a third of total funding. These two subject fields thus accounted for three quarters of the R&D activities of the UiB system. The rest is distributed across other subject fields, the largest being *marine biodiversity* and *aquaculture*, each receiving 7 per cent of the resources in 2011.

The two largest subject fields experienced a considerable increase in the period 2001-2011, especially *basic marine biology* which showed a significant growth in the 2011 survey. *Marine biotechnology* and *mathematical and numerical models for marine research* on the other hand, show decreased levels of activity over the last ten years. However, it has not been established whether the decrease is real, or due to changed perceptions of the subjective classifications done by the researchers.

Effort for marine R&D in the university system of Bergen 2001-2011 by subject fields. Million NOK, current expenditure.

Subject fields of marine R&D	2001	2003	2005	2007	2009	2011
Basic marine biology	14	17	17	50	59	106
Marine biodiversity	6	6	12	22	21	22
Oceanography, climate research, ecology, environmental toxicology, environmental contaminants, eutrophication	28	40	64	75	100	133
Technology for monitoring and estimating stocks of marine resources	0	3	1	1	3	10
Mathematical and numerical models for marine research	13	20	18	31	17	7
Bioeconomy, bio-economic models	0	12	0	2	2	0
Aquaculture, including the combination of harvesting and aquaculture	17	6	16	13	21	21
Marine and maritime technology related to harvesting, aquaculture and integrated transport solutions	2	2	1	0	0	2
Marine biotechnology	28	39	23	3	12	14
Food processing and other processing industries based on marine resources (processing, process engineering, hygiene, logistics, quality management, nutrition)	1	1	2	3	3	4
Market, organisation, framework conditions, society and politics, coastal zone management	1	1	1	5	5	6
Total	109	146	155	205	243	325
of this Unifob/Uni Research	*24*	*53*	*49*	*99*	*98*	*134*

Source: NIFU survey of marine R&D

Appendix 4 Central funding for marine and climate research at UiB, 2004-2013, in million kroner

	Strategic priority of math. and natural sciences	SARS Centre	Bjerknes Centre	Centre for Climate Dynamics	CIPR	Centre for Geobiology	Buildings (Marine-holmen)	I- lab/bio (Marine-holmen)	UiB strategy	Faculty budget. Fac. of Math. and Natural Sciences	Equipment. Fac. of Math. and Natural Sciences	SUM
2004		19.74	8.10		16.23				4.42	2.00	2.00	52.49
2005		23.76	10.41		7.65				3.52			45.34
2006		23.56	8.20		5.33				3.52	3.55		44.15
2007	3.80	24.01	8.29		5.46				1.52	2.00	7.00	52.07
2008		24.79	8.54		5.61	4.00		19.00	1.52	1.40	10.00	74.85
2009		25.85	8.04		5.83	4.00	59.00		3.12		13.00	118.85
2010		26.60	8.45		6.02	4.00	34.60		1.12		12.00	92.79
2011		26.40	8.40		6.30	4.00		33.70	1.12		10.50	90.42
2012		30.33	11.17		7.73	5.00		2.00	1.12		12.00	69.35
2013		31.19		38.50		5.17			1.12	3.12	9.00	88.10
SUM	3.80	256.22	79.60	38.50	66.16	26.17	93.60	54.70	22.10	12.07	75.50	728.41
Annual average	0.38	25.62	7.96	3.85	6.62	2.62	9.36	5.47	2.21	1.21	7.55	72.84

Comments: [1)] 26.3 MNOK from the Ministry of Education and Research and 12.2 MNOK internal UiB funding as continuation of funding for the Bjerknes Centre.
[2)] Faculty budget funding earmarked marine activity.
[3)] Total funding for equipment.

Source: *UiB*

Appendix 5 Tables

Table A1 Total number of staff involved in the field, by department and year, 2004-2013

Department/Unit	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Centre for Geobiology (CoE)				19	26	32	39	38	44	45
Earth Science	24	22	23	28	36	38	39	35	30	36
Mathematics	3	3	3	4	4	4	4	4	4	4
Chemistry	3	2	2	1	1	2	5	7	9	11
Physics and Technology	7	9	11	12	12	12	12	12	16	21
Biology	101	104	105	119	130	131	131	124	117	123
Sea Lice Research Centre. SLRC								13	33	36
Psychosocial science	10	12	15	19	21	21	21	22	21	20
Social anthropology	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.75	2.25
Geography	4.5	4.5	4.5	3.5	3.5	3.5	3.5	3.5	3.5	2.5
Administration and Organisation Theory			1	1	1	1	1	1	2	1
Information science and media studies				1	1	1	1	1		1
Archaeology. history. cultural studies and religion	6	6	6	6	6	7	8	11	12	12
Sum info from 13 units	**169.75**	**163.75**	**171.75**	**214.75**	**242.75**	**253.75**	**265.75**	**272.75**	**293.25**	**314.75**

Source: Self-assessment reports

Table A2 Number of staff involved in the field more than 50% of their time, by department and year, 2004-2013

Department/Unit	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Centre for Geobiology (CoE)				8.8	12.8	21.1	21.5	20.4	27	30.6
Mathematics	1			1	1	1	1	1	1	2
Chemistry	1	1	1			1	2	3	3	4
Physics and Technology	6	8	10	11	11	11	9	9	8	9
Biology	98	101	102	115	125	127	128	120	113	120
Sea Lice Research Centre. SLRC								8	25	26
Clinical medicine K1			1	1	1		1	1	1	3
Social anthropology	1	1	1	1	1	1	1	1	1	2
Geography	2	2	2	2	2	2	2	2	2	1
Archaeology. history. cultural studies and religion	1	1	1	1	1	2	2	6	7	8
Sum info from 10 units	**120**	**114**	**118**	**140.8**	**155.8**	**167.1**	**168.5**	**172.4**	**188**	**205.6**

Source: Self-assessment reports

Table A3 Total expenditure for marine research, by department and year, 2004-2013 (in million Norwegian kroner)

Department/Unit	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Centre for Geobiology (CoE)	1.6	1.6	3.9	14.9	40.1	41.0	44.5	51.9	56.6	106.3
Earth Science	47.0	56.9	62.3	74.3	82.4	74.0	76.6	82.0	77.2	90.2
Mathematics	0.0	0.7	1.5	2.1	1.9	0.4	0.0	0.0	0.0	0.4
Chemistry	1.0	0.8	0.8	0.4	0.4	0.3	1.5	2.1	2.4	3.2
Geophysical Institute	26.0	28.1	28.1	35.2	39.4	66.8	72.9	76.4	79.2	89.0
Physics and Technology	28.3	34.3	13.3	17.5	7.5	22.5	38.5	28.0	33.5	67.5
Biology	105.6	106.4	105.7	114.6	117.8	117.6	136.8	126.8	120.0	130.6
Sea Lice Research Centre. SLRC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	25.1	29.2
Clinical medicine K1	0.0	0.0	0.0	4.4	5.9	12.2	16.1	19.3	20.0	20.0
Psychosocial science	0.1	0.4	0.9	1.7	2.0	5.5	6.3	6.5	6.2	5.4
Administration and Organisation Theory	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.4
Archaeology. history. cultural studies and religion	1.0	1.0	1.0	1.0	1.0	1.2	2.8	7.5	10.3	12.0
Sum (info from 12 units)	210.6	234.2	217.4	266.0	298.5	341.5	383.5	403.5	431.0	554.5

Source: Self-assessment reports

Note: Units were asked to enter amounts in 100 000 NOK. Amounts apparently entered otherwise were corrected by NIFU.

Table A4 Funding received from UiB's strategic priority of marine research, by department and year, 2004-2011, (in million Norwegian kroner)

Department/Unit	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Centre for Geobiology (CoE)										
Earth Science			1.9	1.5	2.1	1.5	0.6	1.7	1.7	2.2
Mathematics										
Chemistry										
Geophysical Institute		1.0	1.3	1.9	2.3	3.3	3.2	4.4	5.7	7.5
Physics and Technology										
Biology	2.8	2.8	2.8	4.3	5.5	3.1	2.6	2.0	3.1	4.0
Sea Lice Research Centre. SLRC										
Clinical medicine K1										
Psychosocial science										
Social anthropology										
Administration and Organisation Theory										
Archaeology. history. cultural studies and religion										
Sum (info from 13 units*)	2.8	3.8	6.0	7.7	9.9	7.9	6.4	8.1	10.5	13.7

Source: Self-assessment reports

Note: Units were asked to enter amounts in 100 000 NOK. Amounts apparently entered otherwise were corrected by NIFU.

*Blank interpreted at no funding.

Table B1 Students per Master's programme covering marine subjects, 2007-2013

Programme	2007	2008	2009	2010	2011	2012	2013
Master's Programme in Water Studies	10	3	-	-	-	-	-
Master's Programme in Biology (MAMN-BIO)	45	50	51	33	30	42	46
Master's Programme in Nutrition – marine (MAMN-NU)	15	8	9	10	10	8	5
Master's Programme in Fisheries Biology and Management (MAMN-FIFO)	15	6	15	10	9	9	10
Master's Programme in Aquaculture biology (MAMN-BIOHAV)	10	17	15	13	17	8	11
Master's Programme in Marine biology (MAMN-BIOMAR)	34	26	21	17	22	28	31
Integrated Master's Programme in Aquamedicine (MAMN-FISK)	33	37	44	38	48	47	51
Master's Programme in Molecular Biology (MAMN-MOL)	38	49	51	44	29	28	27
Master's programme in Advanced Spectroscopy in Chemistry (JMAMN-ASC) (Erasmus mundus)	-	-	7	6	-	2	2
Master's Programme in Chemistry (MAMN-KJEM)*	6	4	1	?	?	?	?
Master's Programme in Informatics (MAMN-INF)*	0	1	1	?	?	?	?
Master's programme in Geoscience of Basins and Lithosphere (JMAMN-BAS)	-	-	-	3	6	2	2
Master's Programme in Earth Science (MAMN-GEOV)	77	76	80	86	101	110	120
Joint Nordic Master's Programme in Marine Ecosystems and Climate (JMAMN-MCLI)	-	-	3	6	9	6	6
Master's Programme in Energy (MAMN-ENERG)	-	-	-	-	-	5	14
Master's Programme in Meteorology and Oceanography (MAMN-GEOF)	37	40	28	30	35	37	27
Master's Programme in Petroleum Technology (MAMN-PETR)	26	30	36	45	41	39	39
Master's Programme in Process Technology (MAMN-PRO)	2	11	30	42	39	26	30
Master's Programme in Applied and Computational Mathematics (MAMN-MAB)*	?	?	?	?	?	?	?
Total	348	358	392	383	396	397	421

Comments: Terminated programmes are included in total numbers for related current Master's programmes in years before 2013.
* Number of students was not provided. Numbers early in the period includes only terminated Master's programmes.

Source: *UiB*

Table B2 Graduates per Master's programme covering marine subjects, 2011-2013

Programme	Year		
	2011	2012	2013
Joint Nordic Master's Programme in Marine Ecosystems and Climate (JMAMN-MCLI)	2	4	4
Master's Programme in Meteorology and Oceanography (MAMN-GEOF)	20	14	17
Master's Programme in Biology (MAMN-BIO)	18	7	11
Master's Programme in Nutrition – marine (MAMN-NU)	1	4	3
Master's Programme in Fisheries Biology and Management (MAMN-FIFO)	7	4	2
Master's Programme in Aquaculture biology (MAMN-BIOHAV)	7	6	7
Master's Programme in Marine biology (MAMN-BIOMAR)	7	7	14
Integrated Master Programme in Aquamedicine (MAMN-FISK)	12	7	6
Master's Programme in Earth Science (MAMN-GEOV)	44	38	52
Master's Programme in Molecular Biology (MAMN-MOL)	20	12	16
Master's Programme in Applied and Computational Mathematics (MAMN-MAB)	?	?	?
Master's Programme in Chemistry (MAMN-KJEM)	?	?	?
Master's Programme in Informatics (MAMN-INF)	?	?	?

Comments: Terminated programmes are included in total numbers for related current Master's programmes in years before 2013.
* Number of students was not provided.

Source: *UiB*

Table B3 Doctoral candidates within marine studies, 2005-2007

Faculty/department	Year		
	2005	2006	2007
Faculty of Mathematics and Natural Sciences	**30**	**49**	**47**
Department of Biology (BIO)	13	23	17
Geophysical Institute (GFI)	5	5	7
Department of Earth Science (IFG)	0	10	6
Department of Physics and Technology (IFT)	2	2	5
Department of Chemistry (KI)	1	3	3
Department of Molecular Biology (MBI)	3	1	6
Department of Mathematics (MI)	6	4	3
Department of Informatics (II)	0	1	0
Faculty of Medicine and Dentistry	**1**		
Faculty of Social Sciences		**2**	
Total	**31**	**51**	**47**

Source: UiB

Table C Bilateral agreements within marine research and education

Region	Country	University/ Insitution	Year signed	Type of Co-operation	Agreement level	Disciplines
Africa	Namibia	Benguela Current Commission	2010	Research	Institutional	Marine Biology, Fisheries, Oceanography
Africa	South Africa	University of Cape Town	2002	Research, Student and Staff Exchange	Institutional	All
Africa	South Africa	University of KwaZulu-Natal	2004	Research, Student and Staff Exchange	Institutional	All
Africa	Sudan	University of Science and Technology	2008	Research and Graduate Education	Institutional	All
Africa	Sudan	University of Juba	2008	Research, Student and Staff Exchange	Institutional	All
Africa	Tanzania	Tanzania Fisheries Research Institute	2008	Research, Student and Staff Exchange	Department	Biology
Africa	Uganda	Makerere University, Kampala	1999	General	Institutional	All
Asia	China	Nansen-Zhu International Research Centre	2008	Climate Research	Institutional	Natural Sciences
Asia	India	Cohin University of Science and Technology; Nansen Environmental Research Centre, India	2010	Climate Research	Institutional	Natural Sciences
Asia	Japan	Hokkaido University	2013	Research, Publication, Exchange of faculty and research fellows, Student exchange	Institutional	Earth Science, Geophysics, Biology, Polar, Marine and Climate + Japanese language and culture
Asia	Japan	University of Tokyo	2013	General, Research, Exchange of faculty, graduate and student exchange	Institutional	All
Asia	Japan	Osaka University, School of Engineering Science	2007	Research	Faculty of Mathematics and Natural Sciences	Natural Sciences
Asia	Malaysia	Universiti Teknologi Petronas - Institute of Technology Petronas Sdn.Bhd.	2010	Research and Graduate Exchange	Institutional	Natural Sciences
Asia	Malaysia	University College of Science and Technology Malaysia	2002	Student exchange	Faculty of Mathematics and Natural Sciences	Natural Sciences

Region	Country	University/ Insitution	Year signed	Type of Co-operation	Agreement level	Disciplines
Asia	Sri Lanka	University of Ruhuna - Dep of Zoology	2011	Research and Graduate Education	Department	Marine Biology, Fisheries, Zoology
Asia	Vietnam	Nha Trang University	2011	Research, Graduate Education, Student and Academic Staff Exchange	Faculty of Mathematics and Natural Sciences	Marine Biology, Fisheries, Aquaculture
Asia	Vietnam	Research Institute for Aquaculture - RIA 3	2011	Research, Graduate Education, Student and Academic Staff Exchange	Faculty of Mathematics and Natural Sciences	Marine Biology, Fisheries, Aquaculture
Asia	Vietnam	Can Tho University	2004	Research	Faculty of Mathematics and Natural Sciences	Biology
Europe	Germany	Alfred Wegener Institute for Polar and Marine Research	2006	Research	Faculty of Mathematics and Natural Sciences	Earth Science, Geophysics, Biology, Polar, Marine and Climate
Europe	Germany, France, UK and Norway	MENTOR - Marine European Network for Training of Researchers	2002	Research and Training of researchers	Institutional	Oceanograpy and Marine Sciences
Europe	Germany	The European Molecular Biology Laboratory	2003	Student exchange -PhD	Department/Centre	SARS International Centre for Marine Molecular Biology
Europe	Norway	United Nations University/ Global Virtual University/ GRID-Arendal	2007	Education	Institutional	Geoscience
Europe	Turkey	Dokuz Eylül University, Department of Geophysical Engineering	2007	Research	Faculty of Mathematics and Natural Sciences	Earth Sciences
Europe	UK	University of Southampton	2007	Research, Academic staff and Student Exchange	Institutional	Geophysics, Earth Science
Latin America	Bolivia	Universidad Mayor de San Andrés	2008	Student Exchange	Institutional	Biology
Latin America	Brasil	Universidade Federal Fluminense	2008	Research and Exchange of faculty, students and staff	Institutional	Earth Sciences and Climate Research
Latin America	Chile	Universidad Austral de Chile	2003	Research, Staff and Student Exchange	Faculty of Mathematics and Natural Sciences	Marine Sciences
North America	Canada	University of Alberta	2012	General	Institutional	All
North America	Canada	University of Alberta	2007	Research, Staff and Student exchange	Institutional	Natural Sciences, Petroleum studies
North America	Canada	Dalhousie University	2004	Student exchange	Institutional	Marine Sciences

Region	Country	University/ Insitution	Year signed	Type of Co-operation	Agreement level	Disciplines
North America	USA	University of Hawaii at Manoa	2003	Research, Staff and Student exchange	Institutional	Marine Biology, Geophysics, Earth Science
North America	USA	University of Hawaii at Hilo	2010	Student exchange	Institutional	Marine Biology
North America	USA	The University of Washington, Seattle	1998	Research, Staff and Student Exchange, Visitng Researcher Programme	Institutional	All (but climate and marine resarch in particular)
North America	USA	University of California Berkeley	2012	Research, Staff and Student exchange	Institutional	Earth Science
North America	USA	Stanford University,	2001	Research	Faculty of Mathematics and Natural Sciences	Petroleum and Earth Science
Oceania	Australia	University of Western Australia	2005	Research and Student exchange	Institutional	Marine Biology

Source: UiB

Appendix 6 Bibliometric study of marine sciences at the University of Bergen 2004-2013

Marine sciences at the University of Bergen 2004-2013

A bibliometric study

Dag W. Aksnes

NIFU

Working paper, September 2014

Introduction

This working paper presents a bibliometric analysis of marine sciences at the University of Bergen (UiB) and is a background report for the ongoing evaluation.

Publication and citation data have increasingly been applied as performance indicators in the context of science policy and research evaluation. The basis for the use of bibliometric indicators is that new knowledge – the principal objective of basic and applied research – is disseminated to the research community through publications. Publications can thereby be used as indirect measures of knowledge production. Data on how much the publications have been referred to or cited in the subsequent scientific literature can in turn be regarded as an indirect measure of the scientific impact of the research.

Within the scope of the evaluation, a comprehensive bibliometric analysis has, however, not been carried out. The main purpose of the analysis has been to provide a macro view on the development of marine sciences at UiB during the period 2004-2013. Main issues analysed include: publication output, discipline profile, institutional contribution, citation rates, and international collaboration.

Data & Methods

The study is based on two main data sources. One is the publicly-accessible database CRIStin which is a joint system for registration of scientific publications applied by Norwegian higher education institutions. The institutions' budget allocations are partially based on their scientific and scholarly publishing, as documented in CRIStin. The database includes all types of scientific publications (not only journal articles, but also monographs and book chapters), in all fields of research. Bibliographic data are collected through a common documentation system, resulting in complete, verifiable and structured data for use in bibliometric analysis. Publication activity is reported by the institutions as standard bibliographic references, which are analysable by publication channel and type of publication. A dynamic authority record, covering 25,000 controlled scientific and scholarly publication channels ensures that references from non-scientific publications are not entered into the system. Publication data from professional bibliographic data sources (e.g. the Web of Science) are imported to the system, to facilitate the registration of publications by the employees.

The other data source is Web of Science by Thomson Reuters (formerly known as Institute for Scientific Information (ISI)), the producer of the most important database for bibliometric purposes. Different database products are applied in the study (containing e.g. data on citation counts, co-authors etc.)

Data from Web of Science have been used for analysing citation rates and international collaboration. Most of the marine research publications are indexed in this database, but not all. These analyses are, therefore, based on a somewhat smaller dataset then the other part of the study.

In the study we have used number of publications and number of publication points as indicators. The latter indicator is a weighted expression of the publication volume where number of co-authors, publication type and level are used as parameters in the calculations.

As citation indicator, we have applied the relative citation index which is an indicator showing whether the publications have been cited above or below the world average (=100). Here the citation count of each paper is matched to the mean citation rate per publication of the particular fields.

The definition of marine sciences is open to different interpretations, and it is likely that the interpretation used in this report will differ from the one applied by some of the units. This may be seen as both a strength and a limitation. The strength is that the field is delineated in a coherent and uniform manner across faculties and departments. The limitation is that the analysis may not fully cover the research which the research units' themselves consider as marine.

The definition used by the University Management in the initial evaluation process is formulated in the following way (in Norwegian): «Satsingsområdet marin forskning omfatter studier av havområdene i vid forstand og innebærer fysiske, geologiske, kjemiske og biologiske aspekter og prosesser og deres interaksjoner i, og mellom, den faste jord, vannsøylen og atmosfæren, samt anvendelser i samband med kartlegging og utnyttelse av ressurser og studier av klima og miljøforhold.» However, during the evaluation process, units outside the Faculty of Mathematics and Natural Science were also included, suggesting that the above definition would be too narrow.

In this bibliometric study, we have therefore included publications based on the following criteria: research on phenomena located in or concerning marine areas; research carried out in marine areas or based on materials or observations from marine areas; and research aiming at direct application in marine areas.

Examples of types of research defined as marine research include:

- Studies involving fieldwork or data collection in marine areas;
- Studies based on data by means of remote sensing and monitoring (by satellite or aircraft) of areas, ecosystems or species in the marine areas;
- Modelling of parameters (e.g. climate, sea ice) in the marine areas (although not requiring field work);
- Studies of equipment and technologies intended for applications in marine areas;
- Studies of foreign policy and security policy related to the marine regions and resource aspects;
- Studies based on marine materials regardless of purpose (e.g. molecular biological studies based on Zebrafish, chemical studies of marine substances, studies of human health and nutrition involving marine materials (e.g. fish oil), petroleum research.

In order to identify publications that should be assigned to marine science, two principles have been used. First, all publications from the journals that entirely or mainly cover marine research have been included (e.g. the journals *Aquaculture* and *Marine Geophysical Researches*). Second, we have used the title of the publications as information. In this process, we have scanned the entire publication output of UiB and publications with a title suggesting a marine content have been included. Clearly, there are cases where this has been difficult or impossible. Either because of very esoteric titles where field experts would be required to assess the question, or because some publications may have a marine content not indicated by the title. The latter issues represent a source of error in the study and possibly, the marine publication volume is somewhat underestimated. However, as the intention has been to provide a macro view of the research output, and not detailed analyses of the contributions of individual departments, we regard the source of error as acceptable.

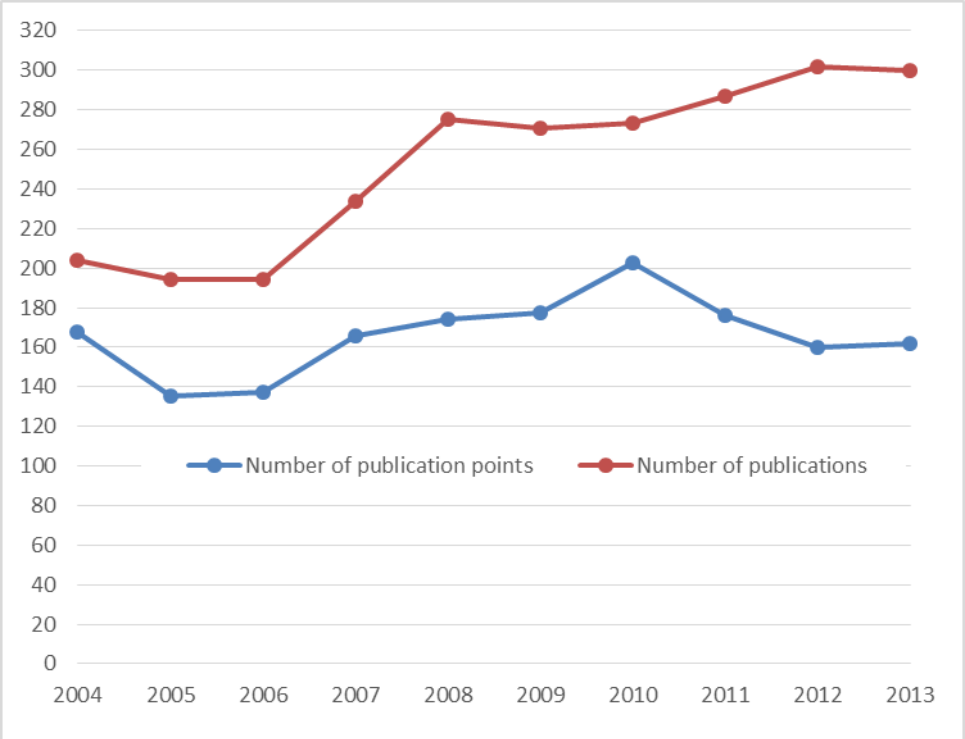
All publications were classified according to scientific areas, using the following broad categories: geosciences (covering marine geophysics and geology, oceanography etc.); biology (basically covering all non-human life sciences from molecular biology to fishery biology and aquaculture); medicine & health; technology (including petroleum engineering and geology); chemistry; and other.

It should be emphasised that the report is independent of the other parts of the evaluation. The units carrying out marine sciences at the University have neither been involved in the process nor verified the data.

Results

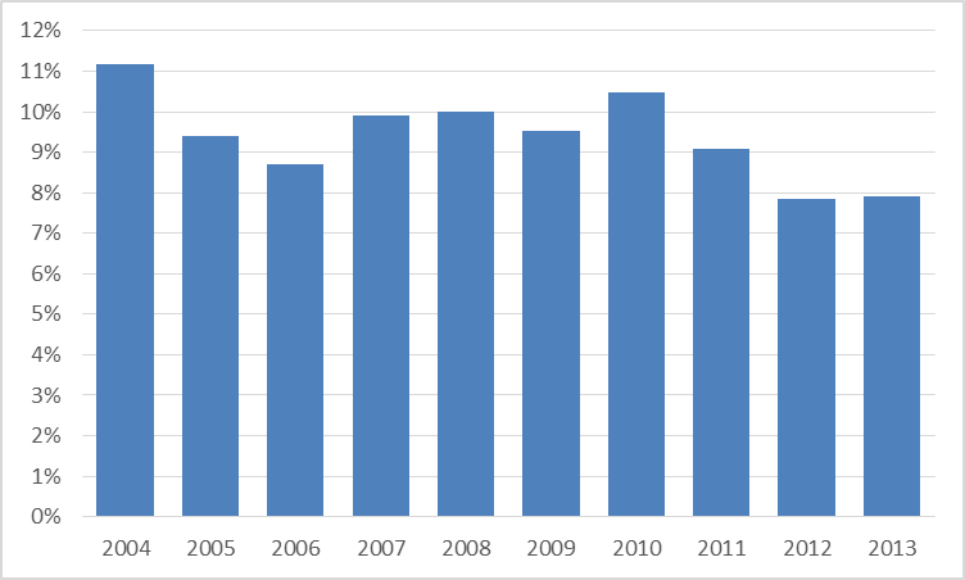
The results show that in total more than 2500 marine research publications have been published by UiB scientists during the 10 year period 2004-2013. The number has increased from around 200 publications annually during the first years to approximately 300 publications (50% increase), cf. Figure 1. In terms of publication points the increase is less strong due to an increasing number of authors per publication (lowest in 2005 with 135 points and highest in 2010 with 202 points) and there has been a decline during the recent years.

Figure 1. Number of publications and publication points, marine sciences, UiB, 2004-2013



Marine sciences account for almost 10 per cent of UiB's total publication output (based on publication points). In other words, the analysis documents that UiB has a strong marine profile. During the period 2004-2013 the annual proportion has, nevertheless, declined slightly (to 7.9% in 2013, Figure 2). This means that the growth in publication numbers in other areas has been stronger than in marine sciences. As will be shown below, the large majority of the publications are from the Faculty of Mathematics and Natural Sciences. When limiting the calculation to this faculty, the proportion would be much higher.

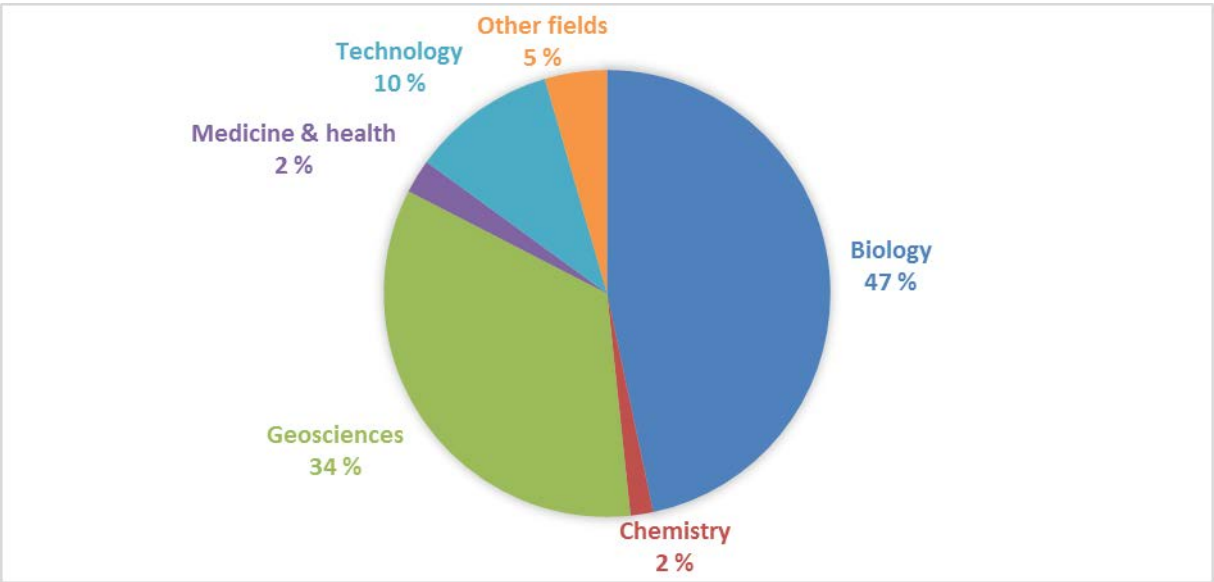
Figure 2. Marine sciences' share of of UiB's total publication output,* 2004-2013



* Based on publication points.

As would be expected, biology and geosciences account for the large majority of the marine publications (Figure 3). The proportion is particularly high for biology, 47 per cent, while geosciences has a proportion of 34 per cent. Technology, where petroleum related research is included, has a proportion of 10 per cent.

Figure 3. The scientific profile of marine sciences, proportion of publications* by discipline, total 2004-13.

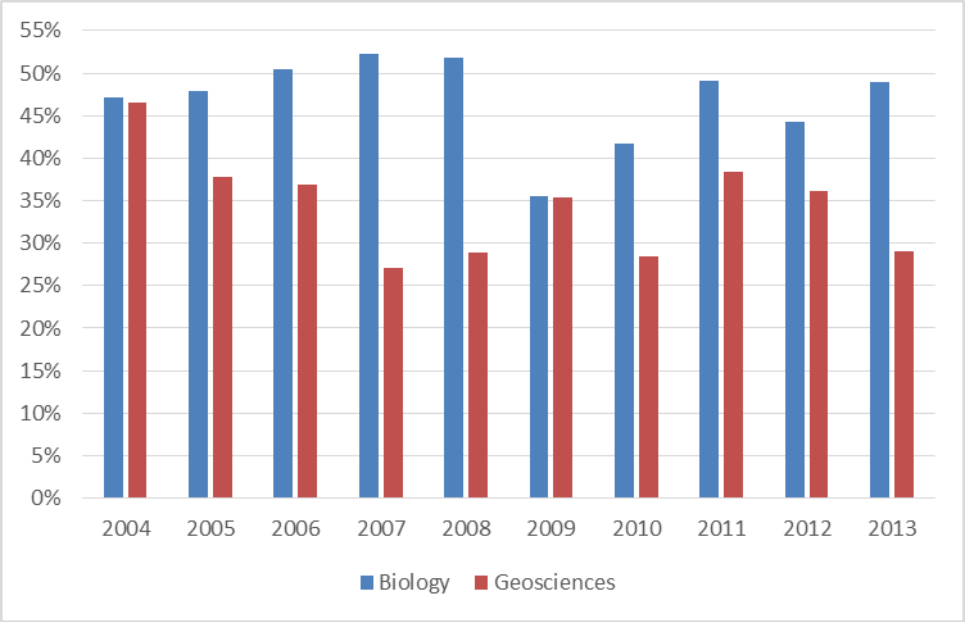


* Based on publication points.

The proportions have also been calculated on an annual basis for biology and geosciences (Figure 4). This figure shows quite large annual variations and no systematic tendency in

terms of increase or decline can be identified. Biology has accounted for a proportion of marine sciences varying from 36 to 52 per cent, and geosicences from 27 to 47 per cent.

Figure 4. Proportion of publications* within marine biology and geosciences, UiB, 2004-2013

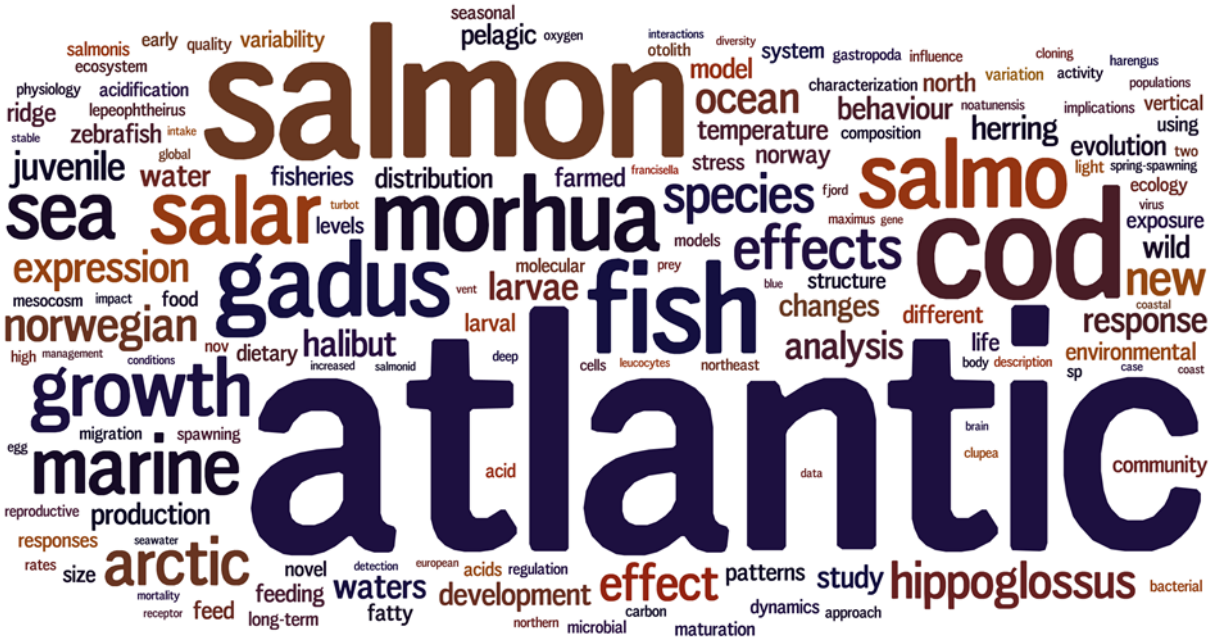


* Based on publication points.

The present report describes the marine sciences by quantitative indicators. Such an approach provides little direct information on the actual content of the research carried out at UiB. This has to be analysed by other methods. Some indications of the content of the research can be obtained by analysing the title of the publications quantitatively based on word frequencies of title words. The results for the marine science publications from 2009-2013 are presented as clouds of words in Figures 5-7 (separate figures for biology, geosciences and technology). In the figure the size of a word is proportional to the number of times the word appears in the titles (common words like *and, of, a, the,* etc. have been deleted).

Figure 6 shows the word cloud for biology. The figure clearly suggests that Atlantic salmon (*Salmo salar*) and Atlantic cod (*Gadus morhua)* have been the major species in the scientific profile of UiB's marine biology.

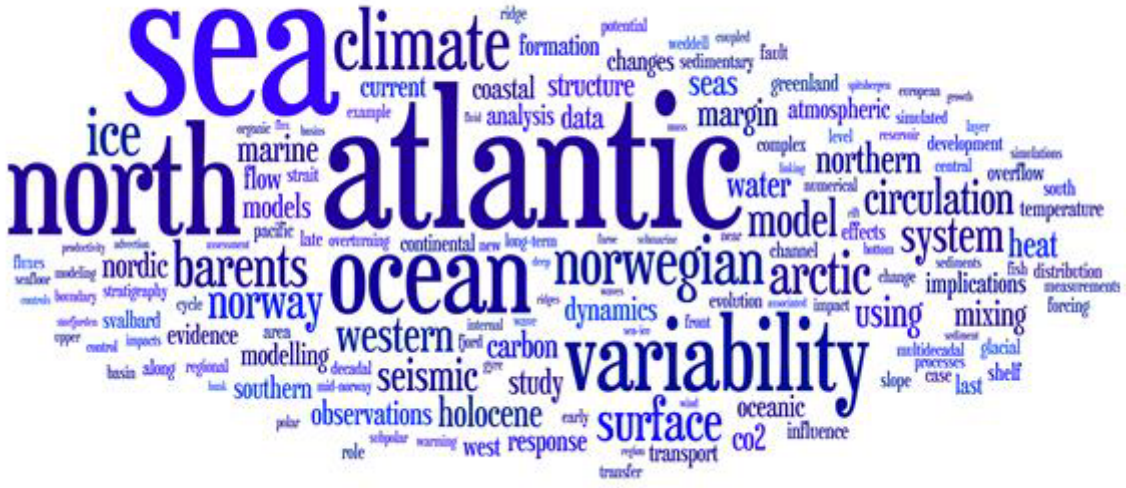
Figure 5. Most frequently appearing words in UiB's marine publication titles, biology, 2009-2013.



Source, software: wordle.net.

Figure 6 gives a similar profile for geosciences. Also in this field, Atlantic is the most frequently appearing word, followed by sea and north.

Figure 6. Most frequently appearing words in UiB's marine publication titles, geosciences, 2009-2013.



Source, software: wordle.net.

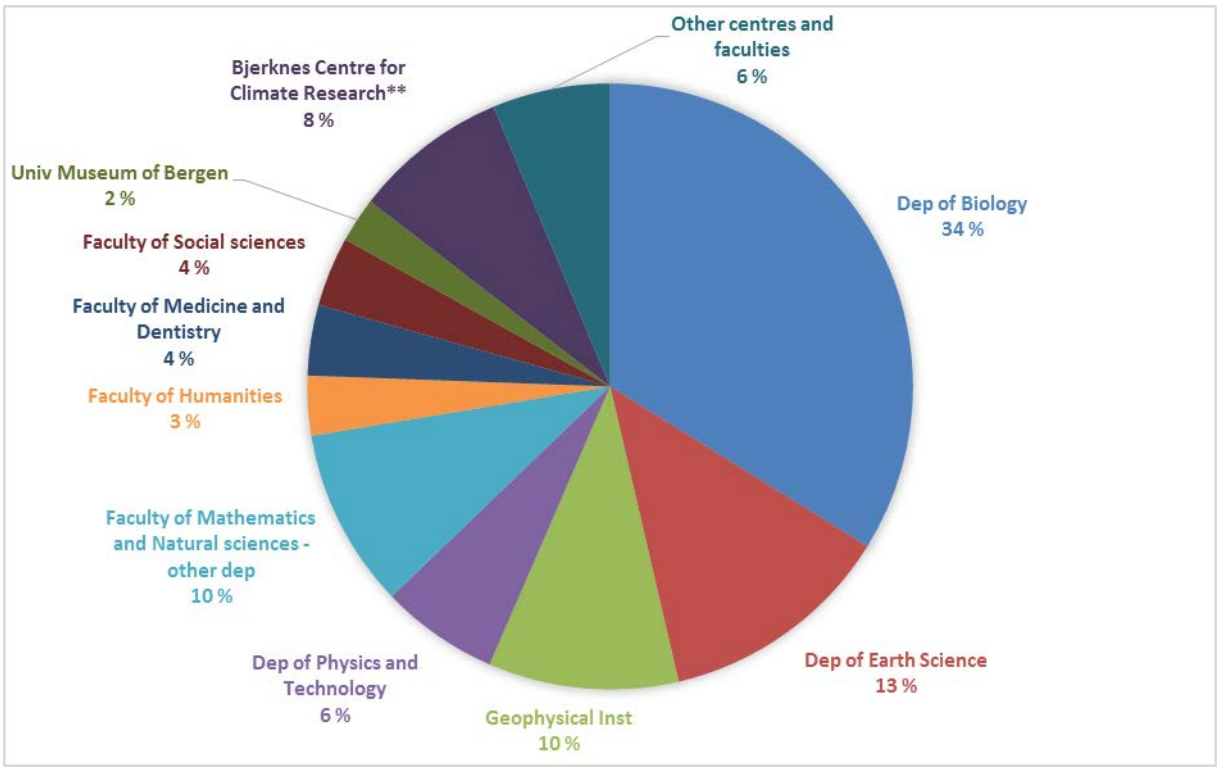
For technology, we find at the top of the list various concepts related to petroleum science and engineering (Figure 7).

Figure 7. Most frequently appearing words in UiB's marine publication titles, technology, 2009-2013

Source, software: wordle.net.

The large majority of the marine science at the University of Bergen is conducted at the Faculty of Mathematics and Natural Sciences. The analysis shows the Faculty produced 85 per cent of UiB's publication output in marine sciences during the period 2009-13. Figure 8 shows the proportions for the largest contributing departments. The Department of Biology is the largest and contributed to one third of the total publication output. The Department of Earth Science, Geophysical Institute and Bjerknes Centre for Climate Research had proportions of 13, 10 and 8 per cent, respectively. As shown in the figure, there are contributions to marine science from most of the other faculties at UiB.

Figure 8. Contribution to marine research by departments and faculties. Proportion of publications 2009-13.*



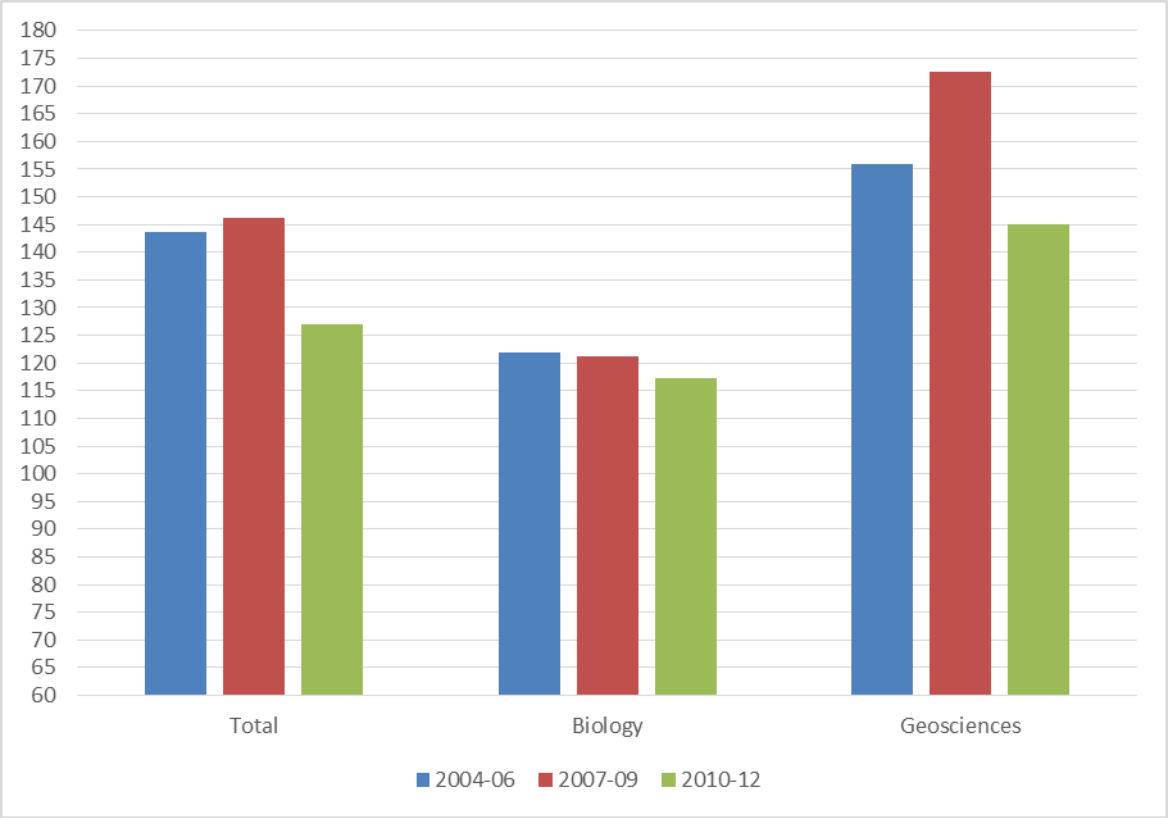
* Based on publication points. Only the largest departments in terms of publication output are shown separately in the figure.

** Only publication shares from the UiB part of the Bjerknes Centre included.

We have calculated citation indicators for the publications from three three-years periods: 2004-06, 2007-09 and 2010-12. In figure 9, the relative citation index is shown for marine sciences in total and for the two largest fields, biology and geosciences. Overall, the marine science publications have been cited significantly higher than the field normalised world-average, particularly during the two first periods. The publications from the 2007-09 period have been cited 46 per cent more than the world average (citation index 146). In 2010-12 the citation index declined to 127. In comparison, the citation index for Norwegian science in total is 130 (2009-12 average) and for UiB in total 126 (2010-11 average).

The figure shows that the publications within geosciences on average have been cited significantly higher than the biology publications. Geosciences have obtained a citation index varying from 145 to 173, and biology from 117 to 122. In both fields, the citation index is lowest in the most recent period (2010-12).

Figure 9. Relative citation index in marine sciences 2004-2012.* Total, biology and geosciences.

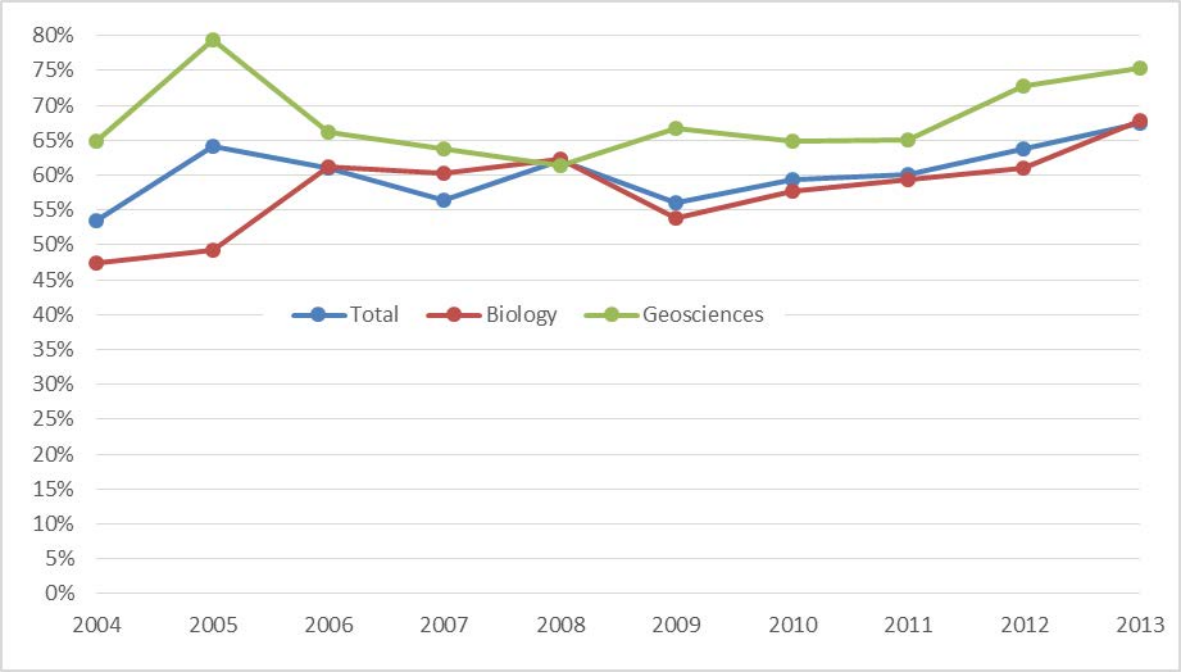


* Based on the publications from the period 2004-2012 and accumulated citations to these publications through 2013. World-average = 100. Only articles indexed in Web of Science are included in the calculations.

Co-authorship is a commonly used indicator of research collaboration. When researchers from different institutions together author a publication, this indicates that the research has involved collaboration. On this basis co-authorship can be used as indicator of national and international collaboration. Increasing collaboration in publications is an international phenomenon and is one of the most important changes in publication behaviour among scientists during the last decades, particularly within the natural sciences.

The collaboration profile of UiB's marine research has been studied based on data on international co-authorship (i.e. publications with author addresses both from UiB and other institutions). Of all the marine publications (2004-2013), 60 per cent had co-authors from other countries. Thus, the extent of international collaboration is wide, apparently involving the majority of the marine research. The proportion of international collaboration has varied from 54 per cent to 67 per cent during the 10 year period, with an increasing trend (Figure 10). In 2013 the proportion was 67 per cent. The proportion has been somewhat higher in geosciences than in biology. In geosciences, 75 per cent of the publication had foreign co-authors in 2013, compared with 68 per cent in biology.

Figure 10. Proportion of articles with international collaboration,* marine sciences, 2004-2013. Total, biology and geosciences.



* Only articles indexed in Web of Science are included in the calculations.

Which countries are the most important collaboration countries for UiB? To answer this, the distribution of co-authorship by country has been studied. Table 1 shows the frequencies of co-authorship for the nations that comprise UiB's main collaboration partners from 2009 to 2013 in marine biology and geosciences. In both fields, the USA is the most important collaboration nation. Almost one quarter (24% or 107 articles) of the UiB articles in geosciences had co-authors from the USA.

Table 1. Collaboration by country 2009–2013. Number and proportion of the article production with co-authors from the respective countries.* Marine Science, selected fields (biology and geosciences*)

BIOLOGY			GEOSCIENCES		
Country	No articles	Proportion	Country	No articles	Proportion
USA	86	13%	USA	107	24%
UK	66	10%	UK	100	22%
Germany	59	9%	Germany	97	22%
Iceland	49	7%	France	60	13%
Sweden	48	7%	Canada	27	6%
Denmark	44	7%	Sweden	25	6%
France	43	6%	Denmark	24	5%
Spain	42	6%	Netherlands	22	5%
Netherlands	31	5%	Switzerland	18	4%
Canada	30	5%	Spain	18	4%
Austria	30	5%	China	16	4%
Italy	21	3%	Australia	15	3%
Japan	20	3%	Japan	13	3%
Australia	20	3%	Russia	13	3%

* Only articles indexed in Web of Science are included in the calculations.

** Only countries with more than 19 and 12 collaborative articles, respectively, are shown in the table.

List of tables

Table 1.1 Funding for the strategic priority of marine research at UiB, 2004-2013, in million Norwegian kroner 22

Table 1.2 The Members of the Evaluation Panel 24

Table 1.3 Departments/centres included in the evaluation 26

Table 2.1 Academic personnel in marine studies (research and/or teaching), 2004-2013..... 30

Table 2.2 Total expenditure for marine research by source, 2004-2013 (in million Norwegian kroner) 33

Table 2.3 Master's degree programmes offering education in marine subjects, 2004-2013 34

Table 2.4 Linkages between UiB and local academic partner institutions, 2004-2013..... 37

Table 3.1 Collaboration by country 2009–2013. Number and proportion of the article production with co-authors from the respective countries.* Marine Science, selected fields (biology and geosciences*) 43

List of figures

Figure 1.1 The organisation of marine research and education at the University of Bergen 18

Figure 1.2 The Bergen marine research landscape 19

Figure 2.1 Effort for marine R&D in the university system of Bergen 2011 by funding sources. Per cent. 32

Figure 3.1 Number of publications and publication points, marine sciences, UiB, 2004-2013. 41

Figure 3.2 Contribution to marine research by departments and faculties. Proportion of publications 2009-13.* 42

Figure 3.3 Proportion of articles with international collaboration,* marine sciences, 2004-2013. Total, biology and geosciences. 43