2012
DEPARTMENT OF BIOLOGY ANNUAL REPORT

UiO: University of Oslo
CONTENT

1 Organization and Management ........................................ page 6
2 Finances ........................................................................ page 8
3 Research ........................................................................ page 9
4 Degrees and Courses ....................................................... page 31
5 Infrastructure ................................................................... page 37
6 Appendix .......................................................................... page 58

Front cover: Droplet on grass © J. Thormar
Back cover: Dissection of root tips of Bistorta vivipara © U. Vik
The Department of Biology was established in 1985 with the merging of several smaller biological departments located in Kristine Bonnevie’s House at the Blindern Campus. In 2004, the Department was reorganized into two divisions: the new Department of Biology and the Department of Molecular Biosciences (which was merged with the Department of Biochemistry). In 2007, the Department was awarded a Centre of Excellence (CoE): the Centre for Ecological and Evolutionary Synthesis (CEES).

The Department is organized into three research programmes: the Molecular Evolution Research Group (MERG), Marine Biology and Integrative biology, along with the CoE-CEES. CoE-CEES, MERG and the Toxicology group are strategic research areas within the Faculty of Mathematics and Natural Sciences.

By 31st December 2012, the Department of Biology contained 28 permanent academic staff, 8 ‘II-positions’ (professors and adjunct professors in 20% positions), 10 permanent- and 3 temporary administrative positions and 21.3 permanent- and 5.5 temporary technical positions. The temporary administrative and technical positions are all engaged at CoE-CEES. 57 postdocs/researchers and 40 research fellows were employed by December 2012. Additionally the Department this year housed > 100 visiting researchers.

In the fall semester, there were approximately 200 bachelor students, 80 master students and 69 PhD students actively enrolled at the Department. 34 Master degrees and 7 PhD degrees were awarded by the Department. We taught a total of 37 courses; 10 Bachelor, 26 Master og 1 PhD courses.

In 2012, our researchers published 269 articles in peer reviewed journals and contributed more than 200 conference papers, reports, media contributions and other professional presentations.

The total budget for the Department of Biology in 2012 was 206 million NOK, of which 84 million NOK was from external funding sources. Financing of the Department’s external projects is distributed from the Norwegian Research Council (57 million NOK), and other national and international funding (EU, public and private sectors, international funding; 27 million NOK).
2012 has been a busy year. A lot of work has been done to ensure a good transition into the new department – Department of Biosciences (IBV) - , so that it rapidly would emerge as a well-adapted research and education centre in Biosciences. The trail for the faculty’s educational and research strategy has been worked out, and we have also got the guidelines with regard to structure and management for the faculty’s departments. Locally, project groups have worked hard to make recommendations for the transition to a new department with a new structure and management model.

In the last decade the driving force of the international research communities has been towards an establishment of larger trans-disciplinary units, in order to ensure excellent education and research. Improved methods for observation and analysis of biological and biochemical processes and systems have provided a basis for gradually better integration of the disciplines to what today is emphasized as “integrative” or “systems” biology, leaving the traditional biology as a part of the greater commitment to “life sciences”. We have all experienced that frontier research and access to funding sources require increased scientific collaboration across life science areas, that also include disciplines such as chemistry, medicine, geological sciences and informatics.

A development that has required the establishment of research teams with unique as well as a basic cross-disciplinary expertise. Our department has taken responsibility to contribute to this development. We have systematically invested in excellent and modern infrastructure for experimental research and education within organismic biology, refurnished and redesigned common laboratory facilities, as well as upgraded well-functioning field stations and research vessels.

By merging into the Department of Biosciences we excel by providing a comprehensive scientific and educational cover. Our research programs and Centre of Excellence (CEES) have during the last years gained knowledge and experience in new collaborations and interactions, and are well equipped for the challenges of the transition. The ability to interact and seek new scientific consolidations is eminent to ensure the new department will stand out as place for leading national and international education and research. A place where students and employees thrive and enjoy being a part of a modern scientific team! An extended collaboration with other research programs at the new department and at the faculty, as well as with the surrounding independent research institutes, will further excel to an innovative academic research and educational department.

To ensure a good and creative working environment and attract highly qualified staff is highly dependent on efficient recruitment processes according to identified needs. Due to the demographic structure of our employees, specially the permanent scientific staff, this process must commence and be adapted to the department’s scientific strategy in the forthcoming year.

Before closing I would like to highlight some of the numbers and trends from this and previous reports that describes the development processes we have undergone the last years, without further need for analysis and comments (see table 1 and figure 10):

- We earn more than ever
- We have more PhD students, post docs and engineers than ever before
- We produce more
- The house rent has increased
- Our dependence on and our skills to get external funding is surpassing previous years
- The overhead from external funding is what is increasingly keeping the wheels turning

I have had the pleasure of leading the Department of Biology through the last decade. It has been a challenging and meaningful task. I cannot hide the fact that at times it has been challenging to keep up with external (and internal) pressure and the continuous changes in terms and conditions. To me it has been prominent to justifiably oversee and interpret the reality and development, in order to decrease the pressure on every employee with regards to demands and ability to adapt, when it is required. I feel that we have succeeded in securing our scientific activities as well as keeping up with our engagement and position in the different arenas where we have contributed.
As I am retiring as head of department it is my desire that this work and progress will continue. I wish you all the best for the future.

“Takk for meg!”

Trond Schumacher | Department Chair

Table 1

<table>
<thead>
<tr>
<th>Department of Biology</th>
<th>2 005</th>
<th>2009</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INCOME</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transferred from previous year</td>
<td>-1 588</td>
<td>-1 363</td>
<td>-3 325</td>
</tr>
<tr>
<td>Basis (from MNF/UIO)</td>
<td>67 649</td>
<td>81 040</td>
<td>88 846</td>
</tr>
<tr>
<td>Overhead external projects</td>
<td>3 000</td>
<td>10 120</td>
<td>14 600</td>
</tr>
<tr>
<td>Starting grants</td>
<td>1 136</td>
<td>1 069</td>
<td></td>
</tr>
<tr>
<td><strong>REVENUES TOTAL</strong></td>
<td>70 197</td>
<td>90 866</td>
<td>100 122</td>
</tr>
</tbody>
</table>

| **EXPENSES - SALARY (internal positions) COSTS:** |       |      |      |
| Permanent scientific staff | -19 815 | -25 211 | -26 016 |
| Postdocs                   | -785   | -912  | -2 499 |
| PhDs                       | -3 447 | -9 852 | -13 066 |
| Technical staff            | -9 204 | -12 488 | -14 958 |
| Administrative staff       | -3 312 | -5 381 | -6 763 |
| Welfare reimbursement      | 1 000  | 2 000  |      |
| **SALARY TOTAL**           | -36 564 | -52 644 | -61 302 |

| **EDUCATION**             |       |      |      |
| Running expenses bachelor | -1 530 | -1 400 | -1 800 |
| Running expenses master   | -1 125 | -1 214 | -1 300 |
| External examiners/theses defence | -650  | -960  | -980  |
| **EDUCATION TOTAL**       | -3 305 | -3 760 | -4 080 |

| **RESEARCH**              |       |      |      |
| Running expenses PhDs/postdocs | -350  | -400  | -350  |
| Running expenses research programmes/scientists | -2 756 | -3 450 | -1 650 |
| Publication reward         | -1 000 |      |      |
| **RESEARCH TOTAL**        | -4 306 | -6 180 | -3 775 |

| Competence planning/HSE   | -598   |      | -350  |
| Units of infrastructure   | -598   |      |      |
| CEES running expenses     | -2 000 | -2 000 | -2 000 |
| Operating costs           | -2 000 | -2 000 | -2 000 |
| Rent                      | -20 591 | -25 689 | -29 371 |
| **EXPENSES TOTAL**        | -70 461 | -93 437 | -103 278 |

| **BALANCE**               | -264   | -2 057 | -3 156 |

| **EXTERNAL FUNDING**      |       |      |      |
| NRC                       | 27 700 | 51 090 | 54 973 |
| EU                        | 4 791  | 5 661  | 5 157  |
| Others                    | 8 906  | 14 834 | 9 415  |
Organization and Management

Department Chair and Deputy Chair

Head of Studies

CoE Centre Chair

Head of Administration

Board

Department management

HSE Coordinator

Technical and Administrative Staff

Research and Education

Finse Alpine Research Centre

Drobak Marine Research Centre

Research Vessels

Phytotron

Central Engineering Workshop

CoE-Centre for Ecological and Evolutionary Synthesis (CEES)

Integrative Biology (IB)

Marine Biology (MB)

Microbial Evolution Research Group (MERG)
Board and committees

Board

Trond Schumacher  
(Department chair)

Anne K. Brysting  
(Deputy chair)

Tore Slagsvold  
(Scientific staff representative)

Eirik Framstad  
(External scientific representative)

Hans Borg  
(Technical and administrative staff representative)

Nanna W. Steen  
(Technical and administrative staff representative)

Jon Bråte  
(Temporary scientific staff representative)

Mali Ramsfjell  
(Student representative)

Frode Nyborg  
(Student representative)

Stein Fredriksen  
(Deputy representative, scientific staff)

Anders Krabberød  
(Deputy representative, temporary scientific staff)

Berit Kaasa  
(Deputy representative, technical and administrative staff)

Kari Beate Rygg  
(Deputy representative, technical and administrative staff)

Jonfinn Knutsen  
(Deputy student representative)

Line Røsæg  
(Deputy student representative)

Committees and workgroups

Employment committee, PhD students and post docs
Hans Erik Karlsen (chair), Helene M. Lampe, Trine Rounge

PhD Program Committee
Anne K. Brysting (chair), Tom Andersen, Helén Sophie Haugen

Master and Bachelor Program Committee
Glenn-Peter Sætre (chair), Kjetil Hylland, Helene Lampe, Stein Fredriksen, Magnus Popp (NHM), Anna Wisborg Blix, Helga Bårdsdatter Kristiansen, Lise Bekenes

LWEC IMBV and BIO
Finn-Eirik Johansen (IMBV; chair), Kristian Prydz (deputy chair; IMBV), Maren Onsrud, Stein Fredriksen, Norbert Roos/Marit Ledsaak (IMBV), Cecilie Mathiesen/Agnethe B. Salvesen, Karianne Fornes (student representative), Sunniva M. Stette (IMBV, student representative), Viggo Stangeby-Nilsen (TA, observer), Bodil K. Pedersen (secretary)

HSE Project Group
Bodil K. Pedersen (chair), Stein Fredriksen, Monica H. Solbakken, Cecilie Mathiesen/Agnethe B. Salvesen, Kristian Prydz (IMBV), Paul Grini (IMBV), Norbert Roos/marit Ledsaak (IMBV)

Safety representatives
Cecilie Mathiesen/Agnethe B. Salvesen (chief safety representative), Hege Bakke, Stein Fredriksen, Tom Andersen, Marit Langrekkken, Johan Erland

SOP pilot project group
Cecilie Mathiesen, Hege Bakke, Sissel Brubak, Berit Kaasa, Kathrine Schou, Nanna W. Steen

BIO solidarity group
Bodil K. Pedersen (chair), Glenn-Peter Sætre, Tor Fredrik Holth, Gry Gundersen, Johan Erland, Cecilie Mathiesen, Berit Kaasa, Kristian Prydz (IMBV), Melinka Butenko (IMBV), Steinar Mortensen (IMBV), Einar E. H. Hansen (IMBV)

Transition group (appointed by the Faculty to work with the merging of IMBV and BIO)
Trond Schumacher (chair), Finn-Eirik Johansen, Mona Bratlie, Anne K. Brysting, Paul E. Grini, Kathrine Schou, Steinar Mortensen, Frode Nyborg, Håkon Hegset, Kate Bronndal, Maren Onsrud, Agnethe B. Salvesen, Ole Martin Nodenes, Svein Stølen
## Finances

### Balance 31.12.2011

<table>
<thead>
<tr>
<th></th>
<th>BIO total</th>
<th>Basis</th>
<th>RCN</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income</td>
<td>-217 000</td>
<td>-217 000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Transferred from 2011</td>
<td>16 779 000</td>
<td>2 363 000</td>
<td>7 865 000</td>
<td>6 551 000</td>
</tr>
<tr>
<td>Basis</td>
<td>55 830 000</td>
<td>55 830 000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>House Rental</td>
<td>28 574 000</td>
<td>28 574 000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other UoO</td>
<td>4 371 000</td>
<td>4 371 000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MLS</td>
<td>2 505 000</td>
<td>2 505 000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research Council of Norway (NFR)</td>
<td>47 426 000</td>
<td>47 426 000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EU</td>
<td>3 448 000</td>
<td></td>
<td>3 448 000</td>
<td></td>
</tr>
<tr>
<td>Other international donations</td>
<td>8 870 000</td>
<td>8 870 000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other external funding</td>
<td>8 114 000</td>
<td>8 114 000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Welfare reimbursement</td>
<td>2 927 000</td>
<td>2 513 000</td>
<td>404 000</td>
<td>10 000</td>
</tr>
<tr>
<td>Overhead</td>
<td>14 164 000</td>
<td>14 164 000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income research vessels</td>
<td>1 247 000</td>
<td>1 247 000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income research laboratories</td>
<td>4 540 000</td>
<td>4 540 000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income other research services</td>
<td>1 674 000</td>
<td>1 674 000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Various earnings</td>
<td>5 638 000</td>
<td>4 610 000</td>
<td>1 028 000</td>
<td></td>
</tr>
<tr>
<td>Totale inntekter</td>
<td>206 107 000</td>
<td>122 391 000</td>
<td>56 723 000</td>
<td>26 993 000</td>
</tr>
</tbody>
</table>

### Expenses

<table>
<thead>
<tr>
<th></th>
<th>BIO total</th>
<th>Basis</th>
<th>RCN</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salary</td>
<td>103 809 000</td>
<td>65 474 000</td>
<td>29 134 000</td>
<td>9 201 000</td>
</tr>
<tr>
<td>House rental</td>
<td>28 574 000</td>
<td>28 574 000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Running expenses</td>
<td>28 683 000</td>
<td>17 070 000</td>
<td>8 068 000</td>
<td>3 545 000</td>
</tr>
<tr>
<td>Equipment</td>
<td>10 972 000</td>
<td>3 122 000</td>
<td>7 409 000</td>
<td>441 000</td>
</tr>
<tr>
<td>Overhead</td>
<td>14 164 000</td>
<td>1 166 000</td>
<td>10 113 000</td>
<td>2 885 000</td>
</tr>
<tr>
<td>Total expenses</td>
<td>186 202 000</td>
<td>115 406 000</td>
<td>54 724 000</td>
<td>16 972 000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>BIO total</th>
<th>Basis</th>
<th>RCN</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transferred to 2013</td>
<td>19 905 000</td>
<td>6 985 000</td>
<td>1 999 000</td>
<td>10 921 000</td>
</tr>
<tr>
<td>Allocated funds 31.12.2012</td>
<td>-20 731 000</td>
<td>-7 811 000</td>
<td>-1 999 000</td>
<td>-10 921 000</td>
</tr>
<tr>
<td>Balance 31.12.2012</td>
<td>-826 000</td>
<td>-826 000</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

---

**Figure 1a** Salary, running expenses, equipment costs and overhead as parts of basis expenses

**Figure 1b** Salary, running expenses, equipment costs and overhead as parts of external project expenses
Research programs and CoE-Centre for Ecological and Evolutionary Synthesis

**CoE: Centre for Ecological and Evolutionary Synthesis (CEES)**
- N.C. Stenseth
- A. Brysting
- T. Hansen
- D. Hessen
- K. Jakobsen
- H. Lampe
- A. Mysterud
- T. Slagsvold
- G-P. Sætre
- A. Vøllestad
- H. Viljugrein (II)
- M.H.S. Hansen
- A. Herland
- E.R. Nerli 30%
- M. Skage
- N.W. Steen
- A. Tooming-Klunderud

**Integrative Biology (IB)**
- T. Andersen
- K. Hylland
- T. Ergon
- A.B. Eriksen
- G. Hestmark
- H.P. Leinaas
- H. Aarnes
- L. Sverdrup (II)
- G.D. Villanger (II)
- S. Øvrebo (II)

**Marine Biology (MB)**
- S. Fredriksen
- B. Edvardsen
- H.E. Karlsen
- S. Kaartvedt
- K.I. Ugland
- J. Tiellman
- W. Eikrem (II)
- K.M. Norderhaug (II)

**Microbial Evolution Research Group (MERG)**
- K. Shalchian-Tabrizi
- E. Hagelberg
- K. Holand
- H. Kauerud
- D. Klaveness
- I. Nordal
- T. Vråstad (II)
- C. Mathiesen 100%
- E.R. Nerli 30%
- K. Schou 100%
- M. Ursin 50%

---

**Figure 2 Department Research Programs and CoE (per 15.12)**

**Figure 3 Department employees (per 15.12) - (m) men, (w) women**
The Centre for Ecological and Evolutionary Synthesis (CEES) combines a broad spectrum of disciplines (such as population biology, statistical and mathematical modelling, and genomics) to foster the concept of ecology as a driving force of evolution via selective processes, with a corresponding influence of evolutionary changes on ecology.

In 2012, CEES consisted of 164 members (including core staff, postdocs and researchers, PhDs, research assistants, technical and administrative staff, and Masters students). In addition, 27 guests stayed for more than one month, and 25 guests for less than one month. The members and guests represented 26 nationalities. The Centre has a core group of 18 employees (two are employed by the Department of Mathematics, one by the Department of Economy and one by the Institute of Marine Research). One employee is a visiting scientist at the University of Alberta, Canada, and one Kristine Bonnevie Professor (from the Norwegian University of Life Sciences) has been working with us. CEES is chaired by Professor Nils Chr. Stenseth.

CEES supervised 35 Master and 28 PhD students in 2012, and was also involved in the teaching of 10 PhD/Master courses and 3 Bachelor courses. 4 new PhD students were employed, and 2 PhD students and 12 Masters students completed their degrees. CEES members published 169 articles in peer reviewed journals and 21 books/book chapters/reports in 2012. The majority of these results lie within the core scope of CEES. 158 talks at conferences were given. The Centre hosted 46 guest speakers, primarily from abroad. Approximately 62 MNOK of the total 2012 budget of 131 MNOK came from the 51 externally funded research projects conducted by CEES in 2012. Most of these were funded through the Research Council of Norway. CEES is also involved in various EU-funded projects. 13 new projects were started in 2012.

The work of CEES is structured into Colloquia and Themes, the former being focused projects each lasting for three years and the latter consisting of on-going, long-term work that is accommodated within the Centre. The Themes are Theme 1: The role of population structuring in adaptive evolution. Theme 2: The potential for adaptation. Theme 3: The evolution of reproductive isolation. The work within the Colloquia is progressing very well and serves increasingly as a gluing-together mechanism: more and more members of CEES

*This is an extract of the CEES annual report. The complete report is published at http://www.mn.uio.no/cees/english/about/documents/2012.pdf
are involved in Colloquium 2 (Evolutionary biology and genomics) and Colloquium 3 (The ecology and evolution of infectious diseases within an environmental reservoir). The former Colloquium is coming towards the end of its three year period, whereas the latter is just getting started. The final Colloquium, Colloquium 4 (Integration of ecology and evolution), is also getting started: the focus within this Colloquium is work on the Red Queen coevolutionary dynamics. It has had a flying start thanks to two larger grants from the Research Council of Norway.

The success of our young members contributes very much to the success of CEES. They are increasingly active – not the least through the various versions of the Late Lunch Talks (LLTs), and the already high level of the presentations at the CEES Annual Student Conference in October is increasing every year. These activities, run and dominated by the young researchers, contribute profoundly to the Centre and the gluing together of the members: they keep the Centre operating as one unit.

**SCIENTIFIC HIGHLIGHTS**

**The evolution of the immune system of Atlantic cod**

In 2011 we published a first version of the Atlantic cod (*Gadus morhua*) genome, which highlighted fundamental differences in the immune system of Atlantic cod. In contrast to other jawed vertebrates, Atlantic cod does not contain the genes essential for the function of the major histocompatibility complex (MHC) II, whereas other immune genes (e.g. MHC I and Toll-like receptor (TLR) genes) are far more numerous than expected. These expansions in other immune genes are an indication that Atlantic cod relies relatively more on these genes for its immune response.

Nevertheless, so far, Atlantic cod is the only vetebrate in which these observations have been made, hence we cannot exclude the possibility that the loss of MHC II is not functionally connected to the expansions of the MHC I and TLR genes. It is crucial for our understanding of the evolution of this unusual immune system that we comprehend if and how these phenomena are connected. We discussed these ideas in a hypothesis paper (Star and Jentoft, *BioEssays* 2012), which was featured on the front cover of BioEssays. In this paper several lines of research are proposed that can further enhance our understanding of the evolution and functionality of the immune system of Atlantic cod. In fact, this paper provided the basis for a new research proposal entitled “Functional and comparative immunology of a teleost’s world without MHC II”, which was awarded funding through the FRIMEDBIO programme of the Research Council of Norway (RCN). This programme is highly competitive, and had an approval rate of less than 7 % in 2012.

The aims of the research proposal are three-fold: First, the group will sequence a range of teleost lineages to investigate the evolutionary origin of the Atlantic cod immune system. The aim will be to associate biological or environmental factors to the loss of MHC II, and to investigate the necessity for alternative immunological strategies to emerge. Second, through in vitro and in vivo immunological experiments, the group will provide a deeper understanding of the basic function of this immune system, potentially uncovering novel immune functionality at the gene or pathway level. The final aim is to investigate whether the loss of MHC II has an effect on the composition of the microbial community in teleosts, which would emphasise the important role of host-pathogen co-evolutionary dynamics. This last effort has already resulted in a manuscript investigating the diversity of the community composition of intestinal microbiota in individual Atlantic cod specimens, which has currently been submitted to *BMC Microbiology*. Overall, the ongoing work at CEES will generate a deeper understanding about the diversity and evolution of the vertebrate immune system, widening a perspective that has so far been restricted by the preferential use of mammalian model systems.

**Small-scale movement and population structure in stream-living brown trout**

Many animals move among habitats, and even smallscale dispersal of individuals between habitat patches may have strong implications for population dynamics and structure. Movement and gene flow have been studied extensively for a large number of taxa, but usually at large geographic scales and over long time periods. Usually, the studies are based either on mark-recapture methods or by using genetic inferences.
Here, we use long-term mark-recapture data combined with extensive genotyping and parentage assignment to investigate the importance of small-scale location change of resident brown trout (Salmo trutta) in a small stream (1500 m). The data cover ca. 10 years of observations.

During the first summer, juvenile fish dispersed downstream (mean displacement 200 m), with smaller juveniles dispersing longer distances. Downstream movement was also predominant during the first winter. Older fish moved little, but they tended to move slightly downstream during winter and slightly upstream during summer. In total, this limited (small range) dispersal resulted in a significant isolation-by-distance (IBD) structure for young fish, but not for older age groups or for mature fish. This IBD signal indicates that pairs of trout of the same cohort that are found close together tend to be more genetically similar than pairs that are far apart. Overall, between-site genetic differentiation was stronger for the younger age classes, and the signal decayed with age, indicating that the genetic structure observed in the stream is mainly driven by spatial aggregation of close relatives.

Aggregation of close kin in space may expose different families to variable selection and may even lead to genotype–environment correlations. This may lead to increased genetic variability within the population, even if some variation is lost locally.

**Cannibalism may alter food web structure and ecological diversity**

Cannibalism is a surprisingly common phenomenon in nature. Cannibalistic behaviour is exhibited by a variety of animals in aquatic and terrestrial ecosystems, including organisms as diverse as insects, mites, snails, sharks, fishes, frogs, reptiles, birds, and mammals. Previous studies have mainly looked at the effects of cannibalism on the species itself, such as changes in growth and mortality rates. We were interested in the consequences of this behaviour for other species in the

_Sampling of trout in Bellbekken, Norway © L. Asbjørn Vøllestad_
food web that directly prey upon or compete with a cannibalistic species.

We developed a mathematical model describing the biomass dynamics of a consumer species in which juveniles and adults, the two life-stages of the population, feed on different resources. Additionally, adults may show cannibalistic behaviour by preying upon conspecific juveniles. We then analysed if the presence of cannibalism facilitated or hampered the invasion by direct predators or competitors into the food web.

Our results show that cannibalism within a population leads to a change in the distribution of individuals or biomass between the life-stages (here juveniles and adults), which alters the conditions for the invasion and persistence of direct competitors or predators. The findings suggest that cannibalism has the potential to promote biological diversity through facilitating coexistence within a community.

The study is one of the first to investigate the broader implications of cannibalistic behaviour, and highlights how ecological interactions within species can have profound effects on other components of the food web. It further indicates that cannibalistic interactions may determine how food webs respond to human impacts such as size-selective exploitation, which has the potential to reduce cannibalism between exploited adults and their juvenile prey.

Allometry: Evolving trait or neglected constraint?
The increasing awareness of slow and sluggish evolution has made it interesting for biologists to look for factors that hinder evolution in natural populations. One reason why organisms may fail to adapt can be due to how individual traits are constrained by genetic correlations. Correlations among traits are the foundation for the early-suggested hypothesis explaining why many traits of an organism scale with overall size according to simple power laws, commonly referred to as allometric scaling relationships.

Allometric scaling relationships are usually very similar across related taxa. One suggested explanation for this similarity of scaling is that it ensures functional traitsize combinations in organisms of different sizes. An alternative explanation is that development of the common Bauplan of organisms puts constraints on the ability of traits to change and evolve independently of each other. Although allometry as a concept within the study of morphology and evolutionary biology was formulated almost a hundred years ago, many of the hypotheses relating to whether allometry may constrain trait evolution remain substantially untested, due to various conceptual and statistical misunderstandings.

We have started to formalise hypotheses for how allometry may constrain trait evolution. Part of this work is to reanalyse hundreds of empirical estimates of within-species allometries from various taxa, to investigate if and how such scaling relationships evolve. We have used new developments within phylogenetic comparative methods to test specific hypotheses of whether allometric scaling relationships are shaped by adaptation, and at which rate this adaptive process proceeds. Results so far indicate that allometric scaling relationships evolve on million-year time scales, but that the adaptive process is slow. Such slow-evolving trait relationships may constrain the independent evolution of traits on shorter time scales. The constraining effect of allometry is exemplified by our finding that freshwater threespine stickleback (Gasterosteus aculeatus) populations originating 15,000 years ago have diversified in phenotypic directions predictable from allometric scaling relationships.

Colloquium 3: The ecology and evolution of infectious diseases with an environmental reservoir
Bacterial pathogens such as Yersinia pestis (plague) and Bacillus anthracis (anthrax) are excellent model organisms to study the effects of ecology on genetic evolution outside of the laboratory. Both pathogens can cause large-scale lethal epidemics in their wildlife host populations and can persist within an area for long periods of time (either in the soil or in vector species). Therefore, they are likely to exert a sufficiently strong enough selection pressure on host population dynamics, host innate resistance, and/or their own virulence, that the effects of this selection pressure are detectable in their genome. Studies on Francisella tularensis (tularemia) and Borrelia spp. (Lyme disease) tie in with the plague and anthrax work to develop theoretical studies on the evolution of virulence.
Work on Colloquium 3 is funded in part through the European Research Council (ERC) Advanced Grant of Dr. Barbara Bramanti: The medieval plagues: ecology, transmission modalities and routes of the infections, the RCN NORKLIMA grant Climate Changes and Zoonotic Epidemiology in Wildlife Systems (ZEWS), and the MLS PhD grant Evolution of the host immunity and immune responses to plague.

**Plague**: The rich body of historic documentation of plague outbreaks is combined at CEES with climate-dependent ecological factors, to provide the broader phylogeographic context in which to interpret medieval human plague epidemiology and ancient DNA sequencing data. Furthermore, the co-evolution between the plague bacterium and its rodent hosts is studied in terms of immunogenetics and host population dynamics. Studying plague throughout its full biological range - from its molecular interactions within rodent hosts to the role of these same rodents in the pandemics of the last millennia - generates fundamentally new insights into plague dynamics.

**Anthrax**: B. anthracis is another potentially extremely virulent pathogen that has primarily been studied within its hosts and in laboratory settings, but little is still known about the environmental stages of its life cycle. Yet the long periods the bacteria spends outside of the host is crucial to its transmission and epidemiology. Our work therefore focuses on the persistence, behavior and transmission routes of B. anthracis outside of its hosts, and on developing models for the resulting epidemiology and impact on host species.

**TAroB**: The Archive of Bio-organisms (TAroB) is a collaboration between CEES and the Department of Informatics at UiO, aimed at making an integrative database linking system. The purpose is to facilitate research needing an ecologically annotated genetic sequence database, linking existing genetic toolkits with common ecological tools. By explicitly linking genetic information to time, space, and environment, the enormous advances in genetics and genomics can be harnessed by ecologists, epidemiologists, and theoretical evolutionary biologists who are not geneticists themselves. In addition, geneticists are enabled and encouraged to link their work to natural systems.

*Kyrre L. Kausrud sampling Anthrax in Etosha National Park, Northern Namibia*
Colloquium 4: Integration of ecology and evolution: Palaeobiology and the Red Queen Hypothesis

Integrating ecology and evolution is a central activity at CEES. Species distributions and taxon relative abundance, as observed from the fossil record, are the result of both ecological and evolutionary processes. An area of active research at CEES in 2012, continuing into 2013, has been to understand the drivers leading to such longterm patterns. A team of CEES researchers and associates found that changes in atmospheric CO2 drove the evolution of body size and controlled the commonness and geographic extent of an ecologically important group of marine plankton (coccolithophores) over the last 50 million years (Hannisdal et al. *Global Change Ecology* 2012).

Together with an international team of marine biologists and palaeobiologists, Liow, a researcher at CEES, contributed to a prominent review that summarized what we know about background extinction rates of different clades of marine organisms, and the implications of these varying rates for marine conservation today (Harnik et al. *Trends in Ecology and Evolution* 2012). In addition, Liow was selected to contribute to an international meeting, held at Oxford University, to identify 50 priority questions to guide the future palaeoecological research agenda. Because the fossil record is so complicated, careful modelling of both biological and geological (including sampling) processes are vital. In a technical publication describing the simultaneous estimation of occupancy and sampling, Liow showed the utility of importing approaches developed in statistical ecology into palaeontological analyses (Liow *Paleobiology* 2013).

Research directly catered to the Red Queen hypothesis continues at CEES, where we have now started to study competitive overgrowth in fossil colonial encrusting bryozoan, in collaboration with Paul Taylor at the Natural History Museum in London. Theoretical and experimental (bacterial) approaches continue to be developed, to tease apart contributions of biotic interactions and environmental forcing to evolutionary changes.

---

*Figure 4 The Department’s external funding development 2009-2012*
NorMER brings together the expertise of leading research groups from all Nordic countries, and several North American institutions, to implement a collective and multidisciplinary research strategy to explore the biological, economic, and management consequences of global climate change on fisheries resources. It will achieve this through a unique programme of primary research, implemented by PhDs and Postdocs in a system of collaborative projects, with a focus on the Atlantic cod (*Gadus morhua*). Though our Nordic focus is on cod, this research is intended to be a platform to extend this knowledge to other marine systems.

The aims of NorMER are:

1. Perform effect studies to:
   1. evaluate climate effects on Nordic marine ecosystems,
   2. Build new tools for predicting biological consequences of climate change, and
   3. quantify impacts on profit, employment, and harvesting.
2. Create an effective training environment for young researchers.
3. Develop a team of outstanding global quality.
4. Link to industry and policy managers.
5. Update marine ecosystem management policies to sustain healthy fisheries.

Comments from the Chair of NorMER, Nils Chr. Stenseth (excerpt)

We have been through our first full year as a ‘Nordic Centre for Research on Marine Ecosystems and Resources under Climate Change’ (NorMER), a Nordic Centre of Excellence focusing on training Young Researchers (PhDs and Postdocs) within the topic of how climate change is affecting marine systems – from ecology and evolution, to economics and management. Although our perspective is general, we are focusing on cod (*Gadus morhua*) as our model organism because we believe this will make it easier to integrate the different disciplines involved within NorMER: all NorMER members will have one common marine system over which they can combine and apply their diverse expertise. Having observed the developments during the first year, I feel confident that we are on the right track relative to our ambitions of being a truly Nordic Centre of Excellence. First of all, we have secured good funding. Second, we have established an excellent team of Young Researchers (YR) – both PhDs and Postdocs. Third, there is an excellent interdisciplinary interaction among the YR. Fourth, the 10 core partner nodes work well together to develop a well-integrated virtual centre. Fifth, we are being provided with good feedback from our Centre Advisory Panel (CAP). NorMER is indeed developing into a successful, fully integrated pan-Nordic centre. Already after only one year, we see clearly how NorMER creates a platform for growing a new generation of interdisciplinary Young Researchers with experience in combining physical, biological, social and economic aspects of marine ecosystem science and management. These interdisciplinary Young Researchers are being trained by specialists of various disciplines in a collaborative environment. This is being achieved, in part, through visits lasting for several months at partner institutions. Besides providing PhD students and Postdocs with valuable interdisciplinary training, this shared exchange with scientists from the collaborating institutions in the Nordic countries will contribute to bringing our various scientific groups closer together. In addition, the Young Researchers are organising activities among themselves – activities which will further develop their interdisciplinary training and their scientific collaboration skills. Altogether, this will lead to, I am confident, a stronger Nordic position on leading scientific endeavors both in Europe and globally.

Excerpt from the NorMER annual report for 2012. The report can be read in full at normer.org.
The main research areas within IB are human toxicology and ecotoxicology, life history traits, limnology, marine and freshwater ecology, population biology, environmental modelling, ecological stoichiometry ecophysiology and lichen taxonomy. The program, established in its present form in 2007, comprises seven professors, three adjunct professors, three postdoctoral fellows, three technical staff, 14 internal and 9 external PhDs. Six PhDs with IB supervisors defended their work in 2012. Toxicology is one of three MSc study programs in biology, and IB staff supervises around a fourth of all master students at the Department (more than 20 annually). IB scientific staff is responsible for all courses in toxicology and ecotoxicology, and heavily involved in other courses both at bachelor and master levels.

Two of the IB scientific staff were on sabbatical spring 2012 (Ergon in New Zealand and Hylland in Spain).

The publication record for the programme has been consistently high the last years and IB scientific staff contributed to around 20 peer-reviewed publications in 2012, 3 of which were in “level 2” journals.

The research in toxicology and ecotoxicology spans in vitro mechanistic studies with primary cell cultures, through exposure studies with fish and marine invertebrates to mesocosm studies of pelagic and sediment processes. Recent projects have addressed interactions between environmental pressures such as eutrophication, hazardous substances and oil in their impacts in marine ecosystems (the RCN-funded project INTERACT, under publication), a characterisation of effects caused by oil spills (the project Pristine Arctic, funded by the Nordic Council of Ministers), measurement of genotoxicity in marine organisms from mussels to polar bears, as well as trophic transfer of nanoparticles in a simple aquatic food-chain. In addition to using small-scale, high-throughput experimental models such as primary cell cultures, the group is at the forefront in developing and using sediment micro- and mesocosms, short- and long-term fish experimental systems with different exposure pathways, caging experiments and pelagic mesocosms. In 2012 there was an increasing activity in arctic ecotoxicology, mainly focusing on the above-mentioned mechanisms of genotoxicity and DNA repair. A collaboration with CEA in Grenoble led to the use of chip technology to investigate the ability of fish, invertebrate and seal cells to repair specific DNA lesions. This activity has been strengthened through hiring an adjunct assistant professor in this research area. There was preliminary research on ringed seal in 2012, to be continued with projects on polar bear and beluga in 2013 and 2014.

Ecological stoichiometry builds on the concept that all living organisms are constructed over the same general template. Originating within limnology, ecological stoichiometry is now recognized as an important integrative principle across a range of biological disciplines, from cell physiology to global biogeochemical cycles, with applications in cancer research and astrobiology.

Recognizing that vital rates and stoichiometry are linked through the causal chain of growth rate, protein synthesis, ribosome density, and cellular P content has recently led to a partial merge between the metabolic theory of ecology and ecological stoichiometry. The main contribution to ecological stoichiometry is the focus on interactions between temperature and food stoichiometry comparing several phylogenetically distant organism groups. In the stoichiometric approach to ecology there is often a focus on how imbalances between carbon fixation and mineral nutrient acquisition in autotrophs can lead to reduced growth efficiency in herbivores. In a recent project, we explore how the same stoichiometric principles can be applied for optimizing the lipid yield in experimental biofuel reactors.

Research on linking life history to effects of environmental variation combines studies of tolerance to climate stress (ecophysiology), phenotypic plasticity in life history traits (acclimation, thermal reaction norms), phenology and spatial...
heterogeneity with population dynamics and species interactions. Studies are done in experimental model systems as well as in the field, with terrestrial arthropods and in freshwater systems. Climate change impact on the Arctic and sub-arctic soil systems have been studied in a long-term project with main focus to understand basic mechanisms underlying differential responses of species/species assemblages on environmental change, including effects on species invasion. Marine copepods (Calanus spp.) are used as model organisms to study the relation between genome- and body size in micro- and macro-evolutionary patterns among animals from contrasting thermal environments. Another project has focussed on dispersal of ticks and tick borne pathogens by birds, which represent an increasing challenge in Norway due to environmental changes. Morphological (cuticular) adaptation to different climatic conditions in Collembola is used in collaboration with nano-technologists to understand (evolution of) structures determining their superhydrophobic characteristics.

Lakes are ideal systems for testing predictions and responses related to biodiversity and ecosystem functioning, since they are units with well-defined boundaries, as inverted islands isolated by land. A strong east-west gradient in both phytoplankton and zooplankton species richness makes a longitudinal transect across Norway and Sweden a natural laboratory for investigating effects of biodiversity on natural lake ecosystem functioning. The relationships between species pool saturation, ecosystem functioning, and vulnerability to bioinvasions is studied by field sampling of natural biodiversity gradients, classical and molecular measures of phyto- and zooplankton
biodiversity, and up-scaling by predictive modelling tools. Statistical modelling is used to disentangle effects of multiple stressors like eutrophication, climate change, and invading species on the ecosystem services of lakes.

**Integrative research.** There is clearly a potential to develop cross-disciplinary projects by integrating and combining the research areas represented within the programme and this activity was continued in 2012.

The INTERACT project referred to above is one such project where ecotoxicology, ecophysiology, marine ecology and environmental modelling were needed. A second integrating activity within the programme involves measurement of DNA-damage in terrestrial or aquatic model organisms (collembolans, *Daphnia* sp., Rotifera) in relation to natural stressors such as desiccation (terrestrial), temperature stress, food availability or food composition. Methods have been developed to measure DNA damage with the very small volumes available and further experiments are underway. The studies aim at clarifying underlying mechanisms for the vulnerability of species towards environmental changes and how individual fitness may have consequences for population development. The scope of the research includes environmental factors such as (micro-)climate, habitat, nutrient stoichiometry and the influence of stressors such as oil and xenobiotics.

In order to understand effects at population and community levels, experimental approaches also incorporate habitat heterogeneity, habitat fragmentation and demographic changes. The competence within the programme makes it possible to investigate links between individual health and performance, population growth and the dynamics of species assemblages. Life history traits, such as growth rate, age and size at maturity are relevant response variables in a focus on phenotypic responses, but also important determinants of population responses. Species-specific differences in these responses may have great effects on species interactions, and thus on community structure and ecosystem functioning. An important challenge is to improve our understanding of direct compared to indirect effects of environmental variables and why related species may react very differently on environmental changes.

The experimental nature of the research activity in the program requires terrestrial and aquatic model systems that are amenable to manipulation. The scientific staff has extensive experience with relevant species and systems, e.g. collembolans, rotifers, cladocerans, selected plant species, fish and sediment-dwelling organisms. There is work in progress to establish compact and flexible exposure systems, which may be designed for experimental studies at high degree of complexity, including multi-species interaction and interaction between environmental variables. The chosen model organisms are currently used in experiments in simplified cultures and in micro- and mesocosms, as well as in field studies and field experiments. The existing expertise in molecular and cellular methods within the programme will be used to understand mechanisms underlying individual responses to environmental perturbation such as climate change, desiccation and changes in food quantity and quality. There is an ongoing research activity on DNA and membrane damage in collembolans and a research project on the heritability of DNA repair efficiency and oxidative stress defence mechanisms in *Daphnia* was initiated in 2012.

As will be apparent, much of the research activity within the program concerns the effects of environmental changes on natural biodiversity and human health, issues clearly relevant to society. As a consequence, there has been an increasing need for toxicologists in Norwegian society over the past decade, and following graduation (MSc), most candidates in toxicology or ecotoxicology have rapidly found employment with national or regional environmental management organisations, research institutes, consultants or industry.

**Scientific collaboration, representation and outreach**

The toxicology group has close collaboration with human toxicological research groups and ecotoxicological research groups. The main national collaborators have been the National Institute for Public Health (genotoxicity), Norwegian College for Veterinary Sciences (microarray, autoradiography, reproductive toxicology), Norwegian Institute for Water Research (toxicity testing, food-web modelling, sediment processes, analytical chemistry, passive samplers), NTNU (courses, teaching), Polar Institute (arctic ecotoxicology)
and the University of Bergen (pelagic ecology). In addition to a well-established ICES network, including marine research institutes from most European countries with an Atlantic coastline (Cefas, IFREMER, Marine Scotland, von Thünen Institut, DFO, Deltares, IEO, AZTI), the group collaborates on a regular basis with colleagues at universities in Ancona, Bilbao, Göteborg, Odense, Porto, Stockholm, Reykjavik and Zagreb. A close collaboration with Icelandic colleagues was developed in 2012, involving research studies at the field station in Sandgerði. The leader of the group currently chairs an international project (ICON) based on the ICES network, the results of which will be published in 2013. The national and international collaboration has ensured high-quality projects and has been used a mechanism for exchange of methods and training of MSc- and PhD-candidates.

Members of the group have chaired and contributed to a range of national and international organizations and have contributed substantially towards international processes, particularly in marine environmental issues, occupational toxicology and risk assessment. In addition to ad hoc advice to national authorities and membership in national expert groups on offshore monitoring and sample banking, this has included contributions to OECD, ICES, OSPAR, JRC and EU working groups and committees over the past years. Particularly in toxicology and ecotoxicology, the group was in 2012 involved in public meetings on topics such as mixture toxicity, pesticide use and environmental consequences of mining activities.

National collaboration in aquatic ecology involves first and foremost other programmes at our department (CEES, MERG, MARIN), but also UMB, HiT, NINA, and NIVA on the freshwater side, and UiB and NTNU on the marine. Nordic cooperation involves SLU, and the Universities of Uppsala and Umeå, Sweden, for limnological research, and SYKE, Finland for Baltic sea research. International cooperation on ecological stoichiometry involves several US universities including Arizona State and Minnesota, as well as European colleagues in Brest (France), Lunz (Austria), Oldenburg, and Munich (both Germany).

National collaboration on terrestrial arthropods involves UMB and Norwegian School of Veterinary Science (SAK-project). Through a Norway-South Africa collaborative framework there has been close integration of projects between Norway, South Africa, Sweden and France with a focus on climate adaptation, life history, population biology and biodiversity of springtails. The main partners are Centre for Invasion Biology, Stellenbosch University, Department of Ecology, Swedish University of Agricultural Sciences and Museum National d’Histoire Naturelle, Paris. The project on collembolan cuticle is a collaboration with Department of Engineering Design and Materials, Norwegian University of Science and Technology.
The Marine Biology Program research activities focus on different aspects within the field, with main emphasis on pelagic and benthic ecology, biodiversity, algal systematics, and behaviour. MB consists of 4 professors (Fredriksen, Ugland, Edvardsen on sabbatical at CNRS, France spring 2012 and Kaartvedt on long term leave to KAUST, Saudi Arabia), 2 associate professors (Karlsen, Titelman on maternal leave), 2 adjunct professors (Eikrem and Norderhaug). Two post docs are associated to the program (Dittami, Gerecht), 6 internal and 4 external PhD students, 14 master students (of which 6 finished in 2012), 2 technicians (Amundsen, Brubak) and 5 emeriti. MB scientific staff is responsible for the marine biology curriculum at bachelor and masters levels. MB staff are also heavily involved in other bachelor courses.

The program has contributed to the understanding of systematics and evolution of marine species, their interactions, and response to their environment, patterns of marine diversity, and how the structure of marine assemblages relates to the functioning of such ecosystems. The research spans all along the Norwegian coastline (> 100 000 km), and extends to polar and tropical seas. The research is conducted in the field and in the laboratory, using observational and experimental approaches. Our expertise ranges from molecular techniques, advanced microscopy and video tracking to acoustics and community studies, in addition to statistical analyses and modelling. The basic research carried out in the program has implications for ecosystem understanding and thereby ultimately management of marine resources.

Pelagic ecology and behaviour
Because Kaartvedt is on a longer leave and Titelman has been on a maternal leave the activity in this field has been strongly reduced in 2012. However, some activities have continued.

The research focuses on different aspects of plankton interactions, dynamics and diversity in pelagic habitats. Studies address responses of individual plankton organisms, and how plankton community composition and abundances varies in time and space as a function of environmental forcing. Advantage of easily accessible, sheltered and deep fjord locations have been important. Another research focus has been on small-scale behavioural interactions in crustaceans, mainly copepods. Experiments have been conducted at Drøbak Biological Station and Kristineberg by PhD stud. Bjaerke in collaboration with Titelman and staff at Univ. Gothenburg to study the risk and reproductive investments in marine zooplankton.

The biology of mesopelagic fish in the oligotrophic and warm Red Sea has been compared with mesopelagic fish in the murkier and seasonally productive Norwegian waters. This work is driven by Kaartvedt from KAUST and on visits to Norway.
At the Biological Station in Drøbak the project led by Karlsen studying reactions of fish to sound has continued. Setups where behavioural responses can be observed (video) in response to acoustic stimuli have been developed. The aim is to understand how predation has influenced the evolution of peripheral senses in fish and zooplankton. The group also investigates the impacts of seismic noise on fish and marine mammals, aiming to understand how predation has influenced the evolution of peripheral hearing mechanisms in fish (mainly), and how the behaviour of different groups of fish is affected by high intensity sound pulses such as from seismic exploration activities, monopiling etc. These activities are of high relevance to ongoing oil activities and the search for new oil fields.

**Biodiversity**

Ugland has worked with patterns in biodiversity and the model for estimation of species abundance distributions (SADs). The model has shown to be useful for a range of different ecosystems and has been applied to fungal, plant, macroalgal and plankton communities to study community structures and estimate species richness.

His research has also focused on population dynamics, biology of seals (diet, parasites and lipid composition), fish biology, biodiversity and detection of disturbance on communities due to human activity.

Edvardsen, Eikrem and co-workers have explored the marine protist biodiversity at seven European coastal localities within the EU project BioMarks by 454 pyrosequencing, bioinformatics, and advanced microscopy. In this project MB staff have a responsibility for field samplings and microscopy in Norway and 454-analyses of the microalgal phylum Haptophyta. In the NRC-project HAPTO-DIV haptophyte diversity and seasonal dynamics in relation to environmental factors are explored by 454 pyrosequencing and electron microscopy. Samples have been collected monthly from outer Oslofjorden from R/V Trygve Braarud during two years and from Raunefjorden, as well as in the Southern Ocean and Arctic. A large unknown diversity among haptophytes has been revealed in all localities examined. Most sequences could not be assigned to a cultured and sequenced species, and some may represent new and unknown branches on the tree of life. Some species are present at all times whereas most coccolithophorids were recorded mainly during summer and autumn with high salinities and temperatures.

**Benthic ecology and interactions**

Benthic ecology and interactions focus on two main topics. One is the ecological study of macroalgal systems to elucidate why large areas of kelp forests (*Laminaria hyperborea*) have disappeared and have been replaced by enormous amounts of green sea urchins (*Strongylocentrotus droebachiensis*). This part is run by Fredriksen and Norderhaug, in cooperation with other institutions in Norway and abroad.

The second focus is on seagrass and is run by Fredriksen and Thormar (PhD student). Seagrasses are a group of higher plants with a worldwide distribution. A follow up experiment of the global ZEN project was conducted in summer 2012. Our part of the experiment was conducted in close cooperation with Swedish colleagues from Kristineberg (Sven Lovén Centre for Marine Sciences).

Nordic Seagrass Network arranged a workshop at Finnøy, NW Norway, for PhD students and seagrass researchers from Nordic countries where Fredriksen (as a teacher) and Thormar (as a PhD student) participated.

In November three of the staff (Edvardsen, Eikrem and Fredriksen) together with two researchers from NIVA, joined Kaartvedt at KAUST in order to explore the biodiversity and community structure of a seagrass bed in the Red Sea. The approach was to investigate micro- and macroflora and fauna, and fish, in addition to food web studies.

**Algal/protist systematics and evolution**

Algal taxonomy, phylogeny and evolution are research areas with collaboration between the research programs MB, MERG and CEES. The MB group, run by Edvardsen, Eikrem, Dittami and co-workers, has described several new micro-algal species and combined morphological and molecular data to systematically place new species, and to revise the taxonomy within haptophytes. Harmful algae that bloom in Norwegian coastal waters and elsewhere have been studied.
for decades. These studies include morphological and genetic characterization and phylogeny, genetic diversity and distribution, molecular probe development for detection and monitoring, culture experiments to clarify growth preferences and toxicity, and genomic analyses of genes expressed. All expressed genes (EST-library) were obtained and analysed of the fish-killing flagellate *Pseudochattonella farcimen*. We found genes and pathways that could be related to the ichthyotoxic effect, and several genes that may have been acquired by horizontal gene transfer in a common ancestor with brown algae. A high number of genes have functions related to cell communication and signalling. The research has been performed through the EU-project MIDTAL, the RCN projects ToxAlgae and HAPTODIV and UiO projects. Within MIDTAL a microarray assay for the monitoring of toxic marine algal species has been developed, now ready for commercialisation. Molecular probes specific for toxic algae in the genera *Dinophysis*, *Phalacroma* and *Pseudochattonella* have been developed for the microarray assay, which has been applied on 2 years of monthly samples collected from outer Oslofjorden. The results from the assay corresponded well with microscopical observations.

In the RCN project Phytoscale the effect of climate change on coccolithophorid scale formation and growth is undertaken by culture experiments by Gerecht.

**Scientific collaboration, representation and outreach**

The program has a close collaboration with MERG and CEES on protist and cyanobacterial evolution and genomics, and with IB on algal physiology, plankton ecology and modelling. We collaborate with GI on benthic soft bottom systems, FI on marine biochemistry and IMBV on fish physiology and electron microscopy. There is a well-developed collaboration with several researchers at NIVA, both in research and education. The two adjunct professors come from NIVA. Other close collaborators are IMR on pelagic ecology; VI on harmful algae; UiB on pelagic and benthic ecology and biodiversity; and NTNU, UNIS and Norwegian Polar Institute on polar biology.

We also cooperate with leading marine biological research institutes in Europe, Asia and USA, through EU and national projects. The program supports yearly participation at conferences for scientists, students and technicians.

Our staff regularly participates in outreach activities such as TV, radio and newspapers. Publication is in international journals, and in popular scientific journals and books. The publication record in 2012 remained high with 29 peer-reviewed papers.

Members of MB lead (Edvardsen) or are members (Eikrem, Fredriksen) of species name committees for micro- and macroalgae at The Norwegian Biodiversity Information Centre (Artsdatabanken), responsible for updating the national species lists. In 2012 the European Marine Biology Symposium (EMBS) was held in Arendal, Norway, and Fredriksen was part of the national organizing committee. Fredriksen was appointed as member of the Strategic advisory board for Institute of Marine Research (IMR) and Edvardsen in the Board for Norwegian Algal Society.
Microbial Evolution Research Group (MERG)

www.mn.uio.no/ibv/forskning/grupper/merg

The research group MERG integrates ecological and evolutionary approaches to solve basic questions in microbial biology. We aim at answering ecological and evolutionary questions related to microorganisms, i.e. bacteria, fungi and unicellular eukaryotes (protists), and also address theoretical and methodological approaches to solve challenging questions within health, environment, climate, energy, and food production. MERG has a scientific staff of 4 professors, 2 associate professors, 1 adjunct associate professor, 6 post docs, 2 engineers and 1 infrastructure project leader. In addition, we have 15 PhD fellows and 11 master students as part of the group.

The MERG staff has experiences from fieldbiology, stoichiometry, bioinformatics, genetics, taxonomy, systematics, mycology, protistology, general microbiology, limnology, ecology, evolutionary biology and statistics. Our research and teaching are interdisciplinary and aim at creating synergies across a wide range of sub-disciplines.

Microbial functioning
We use various –omics approaches (e.g. metagenomics, transcriptomics, metabolomics) to investigate the function of microorganisms in their natural habitats, and how the genomes have been shaped by ecology of the microorganisms over time. For instance we use metagenomic approaches for comparing microbial diversity at the sea floor and in oil reservoirs in order to understand which organisms (and their relative proportions) and which genes (i.e.; biochemistry) are present in different deep sea sediment ecosystems and oil reservoirs. We study genomes and transcriptomes of cyanobacteria and eukaryote algae with particular focus on toxin producing genes and gene clusters in relation to molecular function, the ecology of the organisms, and horizontal gene transfer processes. These studies also aim at understanding evolution of genes and genomic rearrangements. Toxic compounds and potential toxic algae are characterized and connected to projects for development of detection assays for harmful organisms and their compounds.

Microbial diversity
Several projects in the past have focused on revealing unknown microbial diversity (both prokaryotes and eukaryotes) by applying PCR on environmental sampled DNA. Beside marine habitats we have investigated freshwater lakes, terrestrial systems and air born spores. We have recently moved our attention to eukaryote microorganisms that act as symbionts and parasites in plants, marine animals and planktonic heterotrophic protists. These studies have revealed a tremendously large diversity that has been unknown. We have published new implemented next generation sequencing technologies. Another development is the use of whole genome amplification of single cells that are uncultivated. By picking cells from marine environments and optimizing this molecular approach we have been able to reveal both the host and symbiont diversity in selected groups of eukaryotes.

Phylogeny and evolutionary genomics
We study evolutionary relationships and classification, from species to domains of life, by using molecular and morphological data. Over the last few years we have applied phylogenetic, genomic and transcriptomic approaches to resolve major questions about the Tree of Life and character evolution and transitions and innovations in the history of life. We have investigated the relationships of supergroups and the origin of enigmatic Radiolarians eukaryote lineages (Ministeria, Brevia-ta, Telonemia and Collocidion), resulting in articles that suggest substantial revisions of the eukaryote Tree of Life. We also address evolutionary questions that played key roles in the transition from unicellular to multicellular animal and plant life. We study speciation processes among eukaryote and prokaryote microorganisms and the evolution of chloroplasts, mainly secondary and tertiary plastids among dinoflagellates, by including species and specimens from different habitats and environments. We have revealed that differences among habitats, such as for instance fresh water and the oceans, constitute a substantial barrier against dispersal and hence are a major constraint in speciation processes among organisms living in
such habitats. We have inferred the phylogeny of prokaryotes and identified ecotypes among cyanobacteria and habitat-specific distribution of SAR11 bacteria.

**Microbial populations and communities**

Microbial communities, their structure and dynamics, are analyzed using high throughput sequencing techniques in combination with traditional synecological approaches. Examples of such analyses include exploration of fungal communities in the plant rhizosphere, within living plants (endophytes) and within dead wood. We analyze the population and biogeographic structure of microorganisms and try to find out at which spatial scales microorganisms are structured and dispersed. We study interactions between microorganisms, such as symbiosis and parasitism, and how abiotic (e.g. climatic changes) and biotic factors (e.g. parasitism) affect and regulate the spatial-temporal characteristics of microbial populations. One of the projects aim at understanding the interaction between strains of fungi and cyanobacteria, e.g. interactions between cyanobacterial ecotypes and chytrid fungi. A project on the biology of the X-cell parasite, recently funded by the Research Council of Norway, has been initiated and already recruited one Postdoc, Phd and three master students. The project is headed by Dag Klaveness and involves several external scientists, including David Bass from Natural History Museum London, Mark Freeman from University of Malaya and Haakon Hansen from Norwegian Veterinary Institute.

**Bioinformatics, molecular methods and databases**

From its early emergence, MERG has focused on bioinformatics, and in integrating novel computational and molecular methods into our research. We have developed bioinformatic applications useful for ecological and evolutionary studies and built databases applicable for fungal species identification. These pipelines and applications, including applications for identification of genes, taxa, functional annotation, gene and genome comparisons, multiple sequence alignments and multigene phylogenies, make surveys of environmental DNA and phylogenomics more feasible to researchers in the field. The projects have resulted in papers and publically available services. Recently, we have developed better tools for diversity surveys of environmental DNA samples and for genomic studies of single cell. In 2012 we developed two such applications and pipelines. Both of these are available on Bioportal. The BIR pipeline (Kumar et al.) was developed to automate some of the most time consuming operations in the field of phylogenomics, which are to: 1) identify useful sequences, 2) find the right ortholog gene copy, 3) generate single gene alignments for all sequences intended for a supermatrix, 4) generate phylogenetic trees from each single gene alignments. The pipeline allows integration of newly generated sequences into manually curated single gene alignments. The other application we made is named BLASTGrubber (Neumann et al.). Its main function is to process the output from BLAST searches in the new sequencing era. The program is composed of a blast pipeline installed on Bioportal and a standalone program which imports the BLAST output and displays the content of a BLAST output file. It has several useful functionalities, such as text-mining, condensed matrix representation of the BLAST statistics and taxonomic ordering of the data.

**Major achievements in 2012**

2012 was the most productive year of MERG since we established the group in 2007. As the productivity barometer shows (Fig. 5), we have had a substantial increase in the productivity the last year, compared with the two earlier years.

![Comparing performance 2010 - 2012](image)
The productivity is measured by a scoring system named Jippi, which is implemented as web-based form where all participants can register their daily activity (http://www.mn.uio.no/ibv/english/research/groups/merg/about-merg/jippi/). The Jippi scoring system is divided into several categories, including publication of articles, dissemination to the public, application for external grants and health-safety-security actions. All registered activity gives a certain score – a Jippi score – which we summarize every month and year. Based on the incoming scores, we celebrate the most productive MERGer of the month (see above picture). In 2012 we achieved 133,572 JIPPI points, which is an remarkable 17% increase from 2011.

The Jippi King postdoc Tor Carlsen is celebrated for the highest Jippi score. Kilde: Uniforum

Fig. 6. Graphs showing an increase in number of papers with more than two MERG authors

![Graph showing increase in number of papers](image-url)
Collodictyon constitutes a new branch in the tree of life, distinct from all of the major groups of eukaryotes, and one of the earliest diverging eukaryotes that have been described so far. See Zhao et al. 2012 in Molecular Biology and Evolution, for details.

The Jippi report for 2012 says that we published 30 articles. Several of our papers have a clear cross-disciplinary profile where different types of expertise have been combined to achieve common goals. More than ever, we succeeded in co-publication of two or more MERG participants in 2012 (Fig. 6).


International conference Protist2012

A joint annual meetings of the International Society of Protistology and International Society of Evolutionary Protistology was organized by MERG at University of Oslo campus in 29 July – 3 August 2012. The conference was named Protist2012, and covered a broad range of research topics within protistology, from taxonomy and phylogenomics, to evolutionary biology and cell biology. It covered both on autotrophic algae, heterotrophs and parasites. There were 212 delegates at the conference and had 5 symposiums including 28 talks and parallel sessions with 75 talks.
Experimental Lab Facilities

The Department of Biology has the past years made major improvements in their experimental infrastructure by further re-organization of laboratories, co-localising instruments, improving the HSE standards and support from a larger community with similar interest. Service and maintenance of equipment is expensive. This is covered by the bench-fee and managed by various facilities. Ordering consumables is time consuming, but because basic consumables are covered by the bench-fee, less time is spend on ordering. Hence the Experimental facilities at the Department promote more efficient use of your time and resources.

Microlab
The Microlab is established for storage and growth of microbial cells of prokaryotes and eukaryote species as well as viruses, and other kind of cell tissues from multicellular organisms such as animals and plants. Currently the Microlab is used for research on algae, fungi, protozoa, several bacterial strains and salmon cells.

The lab is developed for experimental studies under class II safety conditions. Dedicated labs for studies of interactions between different organisms are provided for community studies. A separate room is set up for single cell studies providing stringent conditions to prevent contamination. This lab is at present used for studies of unculturable eukaryotes and their parasites. As more than 90% of microorganisms cannot be cultured, it is of most importance for us to provide best possible facilities for studies of such organisms. Material brought in from field can be handled in a special lab, where cells and samples can be prepared before culturing or DNA/RNA extractions can be done in other labs.

DNA lab
The DNA lab is a molecular research core facility and is fully equipped for DNA and RNA extraction from various types of bacteria, protists, algae, fungi, and animal and plant tissues (including blood, faeces, and ancient DNA). It contains all the basic instrumentation of a modern molecular biology laboratory, including equipment for gene cloning, genomic libraries, real-time PCR, DNA/RNA quantification, and chip-based analysis of DNA, RNA, and protein. The annual turnover of the DNA lab was 397 000 NOK in 2012, and 60 researchers used the lab.

ABI lab
The ABI lab is a DNA sequencing core facility shared between the Department of Biology and the Department of Molecular Biosciences. The lab functions as a sequencing service lab (Sanger sequencing) for all research groups at the Department of Biosciences, as well as other institutes at UiO, within Norway, and abroad. The ABI-service lab has operated since July 2005.

The ABI lab is a fully equipped laboratory with two ABI PRISM® 3730 Genetic Analysers, each with 48 capillaries and providing DNA sequencing and fragment analysis. The ABI lab implemented automated dye-terminator removal protocol in 2009, based on paramagnetic beads and a Biomek® 3000 Laboratory Automation Workstation. We also have ten different PCR-machines, shared by the CEES lab, including three Eppendorf master cycler ep gradient S and a MJ Research Tetrad PTC-225 Thermo Cycler. The annual turnover of the ABI-service lab exceeded 1 MNOK in 2012, and approximately 28 000 samples were sequenced.
The Norwegian Sequencing Centre (NSC)

www.sequencing.uio.no

The Norwegian Sequencing Centre (NSC) has two equal partners (two nodes): the Department of Biosciences at the University of Oslo, and the Department of Medical Genetics (DMG) at Oslo University Hospital and the University of Oslo.

NSC provides services within all different applications of deep sequencing technology, e.g. de novo sequencing, exome sequencing, sequencing of ancient DNA and other degraded DNA samples, as well as transcriptome-, miRNA-, amplicon-, bisulphite- and chromatin immunoprecipitation (ChIP)-sequencing. Services include project advice, sample preparation, and running the sequencing reactions on our DNA sequencers. In addition, we provide a limited amount of “generic” bioinformatics services. For more advanced projects, users of specific bioinformatics services are referred to core facilities in bioinformatics, or to research collaborations when appropriate. Projects are handled on a “first come – first served” basis. Submission of projects is handled through our website (sequencing.uio.no) where there is one mailbox covering both nodes to help assure that the optimal technology is applied for each project type.

Funding of NSC through the INFRAstructure programme (RCN), as well as UiO’s programme for advanced scientific equipment (AVIT), has made it possible to keep up with the very rapid development within high throughput sequencing (HTS), for example by implementing new instruments and technologies (e.g. PacBio RS, Ion Torrent PGM and Ion Proton). At present, we have the following instruments that represent the major sequencing technologies available: 2 x Roche 454 (GS-FLX), 1 x Illumina HiSeq 2000, 1 x Illumina HiSeq 2500, 2 x Illumina MiSeq, 1 x Pacific Biosciences RS, 1 x Ion Torrent PGM, and 1 x Ion Proton. The HiSeq instruments are the workhorses with large sequencing capacities, while the MiSeq and the PGM are well suited for smaller sequencing projects and have the benefit of faster turn-around times. In addition, the NSC has a multitude of automation equipment (such as Hamilton, Beckmann Biomek FXs, Beckmann SpriWorks and Pippin Prep).

In 2012, a total of about 1500 different samples have been run at NSC, altogether representing samples from more than 100 research groups, mostly from Norway, but also from several other European countries (see the figure for more information). A bulk part of the total samples has been run on the Illumina platform (HiSeq/MiSeq), however there is still a high demand for 454-sequencing – and so for the time being it is the best option for amplicon sequencing of PCR products longer than 200-300 bp. A key advantage is that we can provide users with the full range of different applications at our Centre. Overall, the number of users of NSC services is steadily growing.

The HTS technology development is moving ahead quickly, and we have carried out several important upgrades on our different instruments. Such upgrades are crucial for continuously providing “state-of-the-art” service. In that respect, one of the two 454 sequencers has been upgraded to provide extra long reads (750 bp – 1000 bp). Further, there have been multiple upgrades of the PacBio RS technology since we first purchased the instrument, i.e. both with regards to the instrument and chemicals/kits – resulting in longer reads (mean ~3-3.8 kb and up to 25 kb).

An important factor for a successful implementation of the PacBio technology has been ongoing in-house projects, such as sequencing the Atlantic cod genome with PacBio (to 10x coverage) – with the aim of improving the assembly statistics. This has given valuable hands-on-experience with the PacBio technology and bioinformatics analyses of such data.
Outreach: As an annual event we arrange a one day seminar entitled “High-throughput Sequencing – Applications and Analyses”, and invite international high profile lecturers within the field of deep sequencing. This year’s event took place on the 6th of December. Further, we have been involved in organising two courses held here at UiO in collaboration with the Computational Life Science initiative (CLSi), the FUGE Bioinformatics platform and the Norwegian Genomics Consortium. For more information please see: sequencing.uio.no/news.

Figure 7 Overview of sequencing activities at NSC. a) Cumulative gigabases of sequences produced per quarter, b) Distribution of institutional background of users (samples): UiO = University of Oslo, OUS = Oslo University Hospital, NTNU = Norwegian University of Science and Technology, UiB = University of Bergen, UiT = University of Tromsø, UMB = Norwegian University of Life Sciences, VI= Norwegian Veterinary Institute. c) Yearly number of peer-reviewed articles based on data delivered by the NSC. d) Distribution of species (samples) sequenced.
Teaching

The Department of Biology awards the Bachelor’s, Master’s and PhD degrees in biology, and teaches courses at all levels. External students also take our courses as part of their study programs. This mainly applies to students at IMBV and students following the Educational Studies program in Natural Sciences. In 2012 we taught 37 courses; 10 Bachelor, 26 Master- and 1 PhD-course. Figure X shows the total number of credit production from 2009 to 2012.

Figure 8 Credit production from 2008 to 2011

Bachelor’s degree program

The Bachelor’s degree program provides a broad understanding of biology and imparts basic knowledge of natural sciences, such as mathematics, statistics and chemistry. The cornerstones of the program are the study of biodiversity, the structure and function of organisms, interactions between organisms and their environment (ecology) and evolution processes. Laboratory and field work are also emphasized in the Bachelor’s degree program. In 2012 we taught 10 Bachelor courses, where 6 were compulsory courses for the Bachelor’s degree. 88 students enrolled in the program in 2012.
Master’s degree programs

The Department offers one Master’s degree program with three programme options which are Ecology and Evolution, Marine Biology and Limnology, and Toxicology. Additionally we offer Master specializations in biology for students at the Educational Studies program. The Master’s degree program consists of courses corresponding to 60 credits and a science based thesis corresponding to 60 credits (for the students enrolled in the Educational Studies program, the thesis corresponds to 30 credits). The thesis shall provide skills within field and laboratory work, report based writing, statistical analysis and research presentation.

The number of students admitted to the Master’s degree program and the different programme options are shown in figure x, and the 2012 Master candidates and their thesis titles are listed below. The number of Master students per 31.12 was 80.

PhD study

The doctoral program builds upon a Master’s degree in biology. The study is intended for those who want to qualify for academic positions or other occupations demanding high professional qualifications. The PhD study lasts for 3 years.

7 candidates defended their degrees in 2012. Per 31.12.2012 the Department had 69 PhD students.

Student advisors

The department has 3 student advisors who administrate the programs, deal with admissions, organize the courses and exams and provide student counseling among other tasks.
Semester start at the Department of Biology

We are dedicated to give our new students a feeling of confidence and belonging from the first day of the study, and offer them a buddy week bursting with professional and social content before the proper studies begin. All new students are assigned to a buddy group, and together they participate in the myriad of activities. We start with an information session where they are told all that is important to remember in student life. Then follows the solemn welcome ceremony at University Square where Rector welcomes all new students. The Department of Biology is also known for its “Arthropodakalas” (prawn feast). The Department Head and several of the professors at the department participate to get to know the new students and dissect shellfish. The buddy week also includes tours, lectures and guided tours at Kristine Bonnevie’s house and on campus. The University organizes several concerts, buddy games and barbecues. The Department is known to have many good buddies who take good care of the new students. Our program for the buddy week has been used as an example for several other departments at the University.
Courses given at the Department per 31.12.2012

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO1000</td>
<td>Elementary biology</td>
<td>10</td>
</tr>
<tr>
<td>BIO1010</td>
<td>Human behavioural ecology</td>
<td>10</td>
</tr>
<tr>
<td>BIO1200</td>
<td>Biodiversity</td>
<td>20</td>
</tr>
<tr>
<td>BIO1200A</td>
<td>Biodiversity</td>
<td>10</td>
</tr>
<tr>
<td>BIO2100</td>
<td>General ecology</td>
<td>10</td>
</tr>
<tr>
<td>BIO2120</td>
<td>Evolutionary biology</td>
<td>10</td>
</tr>
<tr>
<td>BIO2140</td>
<td>Molecular biology and biological methods</td>
<td>20</td>
</tr>
<tr>
<td>BIO2150</td>
<td>Biostatistics and study design</td>
<td>20</td>
</tr>
<tr>
<td>BIO2150A</td>
<td>Biostatistics</td>
<td>10</td>
</tr>
<tr>
<td>BIO3081</td>
<td>Animal behavior 1</td>
<td>10</td>
</tr>
<tr>
<td>BIO4005</td>
<td>Primate Behavior and Ecology</td>
<td>10</td>
</tr>
<tr>
<td>BIO4021</td>
<td>Methods of gradient analysis</td>
<td>10</td>
</tr>
<tr>
<td>BIO4091</td>
<td>Animal behavior 2</td>
<td>10</td>
</tr>
<tr>
<td>BIO4115</td>
<td>Distribution modelling</td>
<td>10</td>
</tr>
<tr>
<td>BIO4140</td>
<td>Life-history strategies and climate effects</td>
<td>10</td>
</tr>
<tr>
<td>BIO4150</td>
<td>Conservation and management biology</td>
<td>10</td>
</tr>
<tr>
<td>BIO4170</td>
<td>Recent literature in microbial evolutionary genomics</td>
<td>5</td>
</tr>
<tr>
<td>BIO4200</td>
<td>Molecular evolution</td>
<td>10</td>
</tr>
<tr>
<td>BIO4210</td>
<td>Classification and phylogeny</td>
<td>10</td>
</tr>
<tr>
<td>BIO4230</td>
<td>Biogeography and biodiversity</td>
<td>10</td>
</tr>
<tr>
<td>BIO4240</td>
<td>Evolution and systematics of organismal groups: animal kingdom</td>
<td>10</td>
</tr>
<tr>
<td>BIO4250</td>
<td>Evolution and systematics of organismal groups: plant kingdom</td>
<td>10</td>
</tr>
<tr>
<td>BIO4270</td>
<td>Evolution and language</td>
<td>10</td>
</tr>
<tr>
<td>BIO4301</td>
<td>Marine benthic ecology</td>
<td>10</td>
</tr>
<tr>
<td>BIO4310</td>
<td>Limnology I</td>
<td>10</td>
</tr>
<tr>
<td>BIO4320</td>
<td>Systematics and ecology of marine algae</td>
<td>10</td>
</tr>
<tr>
<td>BIO4331</td>
<td>Marine environmental issues</td>
<td>10</td>
</tr>
<tr>
<td>BIO4350</td>
<td>Marine mammals</td>
<td>10</td>
</tr>
<tr>
<td>BIO4371</td>
<td>Fish ecology</td>
<td>10</td>
</tr>
<tr>
<td>BIO4390</td>
<td>Limnology II</td>
<td>10</td>
</tr>
<tr>
<td>BIO4400</td>
<td>Marine pelagic ecology</td>
<td>10</td>
</tr>
<tr>
<td>BIO4500</td>
<td>General toxicology</td>
<td>10</td>
</tr>
<tr>
<td>BIO4530</td>
<td>Regulatory toxicology</td>
<td>5</td>
</tr>
<tr>
<td>BIO4540</td>
<td>Human toxicology</td>
<td>10</td>
</tr>
<tr>
<td>BIO4550</td>
<td>Ecotoxicology</td>
<td>10</td>
</tr>
<tr>
<td>BIO5000</td>
<td>Introductory course for Master students</td>
<td>5</td>
</tr>
<tr>
<td>MNSES9100</td>
<td>Science, Ethics and Society</td>
<td>5</td>
</tr>
</tbody>
</table>
Master candidates 2012

Siri Birkeland
“Rare to be warm in Svalbard: An ecological and genetic snapshot of four red listed plant species”

Lisa Maria Lindsøe
“Humoral immunity and oxidative stress in black-legged kittiwake (Rissa tridactyla) and common eider (Somateria mollissima) from Svalbard – related to bioaccumulated organochlorine contaminants”

Marte Kristin Rosnes
“Effects of phosphorus limitation and temperature changes on the life history of Daphnia magna”

Idunn Elisabeth Borgen Skjetne
“Conservation genetics and ecology of four red listed vascular plant species in the high arctic archipelago of Svalbard”

Stine Dreyer
“Cranium size and fitness measures in a wild population of great tits (Parus major)”

Ida Marie Bardalen Fløystad
“An analysis of the population structure of white whales (Delphinapterus leucas) in Svalbard”

Mari Sjøberg
“Lung Carcinogenesis. Chemically induced in vitro transformation of human bronchial epithelial cells”

Lene Christensen
“Temporal variation of arctic marine picophytoplankton focusing on Micromonas pusilla (Mamielophyceae)”

Hans Olav Oftedal Sømme
“The effect of marinas on infaunal communities in Zostera marina meadows and unvegetated sediments”

Are Sigurdsen
“Size change in brachiopods and trilobites of the Oslo Region during the Ordovician and during the Ordovician-Silurian transition. Evidence of Cope’s Rule and the Lilliput Effect?”

Nina Værøy
“Begroingsalger i utløpselvene fra Finsevatn og Flakavatn”

Hanne Kildemo
“RNA expression in sperm as markers of sperm quality”

Jan-Erik Thrane
“Bio-optical estimates of primary productivity in Scandinavian lakes”

Peter Jørgen Tønnessen Haddeland
“The breeding system of the European grayling (Thymallus thymallus) – a genetic perspective”

Cassandra Trier
“Cyto-nuclear and sex-linked incompatibilities isolate the hybrid Italian sparrow (Passer italica) from its parent species”

Maria Fernanda Gonzales Rojas
“The role of interspecific competition and hybridization in phenotypic evolution of Passer sparrows”

Mats Brockstedt Huserbråten
“Movement, spillover and gene flow within a network of northern marine reserves”

Marc Jürgen Silberberger
“The influence of mechanical habitat disturbance on the infauna of Zostera marina L. meadows”

Relindis Ghai Njah
“DNA damage in Atlantic cod (Gadus morhua) tissues”

Rune Skarsbø Heimdal
“Using 454 sequencing for exploring diversity, host specificity and tissue specificity of the fungal genus Galerina associated with four boreal mosses”

Kristoffer Glosli Bergland
“Effekter av miljøgifter på torsk (Gadus morhua) i indre Oslofjord”
Karin Raamat
“Nematode infestation in flatfish in the outer Oslofjord”

Ida Gedde
“Effects of PAHs on the Atlantic salmon (Salmo salar) hepatocytes”

Tina Arntsen
“Variation in expression of genes involved in osmoregulation in the threespine stickleback (Gasterosteus aculeatus) when exposed to different levels of salinity”

Merethe Andersen
“What is maintaining variation in personalities in wild populations of great tits and blue tits”

Julie Døvle Johansen
“Nematode infection in harbour seals (Phoca vitulina) at two sites; Sandøy and Hvaler, Norway”

Vetle Malmer Stigum
“The effect of light and temperature on lipid production in microalgae”

Ane Mari Bjørnæs
“The enigmatic Bale monkey: Can new analyses shed light on the phylogeny of the Chlorocebus genus?”

Lena Jørgensen-Kaur
“Genotoksicitet av 5-hydroxymetylfurfural i transgene LacZ mus med mutasjon i adenomatøs polyposis coli”

Susanna Emmika Lybæk
“Hosts and pathogens of Ixodes ricinus in Norway”

Even Stensrud
“Allopatric speciation and multi-trait variation in the common chaffinch (Fringilla coelebs) complex”

Kirsti Roksvåg
“Reparasjon av oksidative DNA-skader i spermatogonier og sertoliceeller fra neonatale mus”

Anna Wisborg Blix
“Feedback processes in grazing ecosystems: Are sheep grazing in alpine habitats?”

Silje Larsen Rekdal
“Population Structure of Bowhead Whales (Balaena mysticetus) in Disko Bay, West Greenland”

Blue tit nest © M. Aasen
Phytotron

www.mn.uio.no/ibv/forskning/om/infrastruktur/ftyotronen

Phytotrons are a complex form of controlled environment facility providing a multiplicity of environmental conditions. The Phytotron at Department of Biology operates in such a way that a wide range of factors can be studied simultaneously and plant experiments can be conducted in varying growth environments and climate zones ranging from arctic to tropical climate types. The Phytotron consists of about 900 m² climate controlled growth areas in addition to laboratories, course rooms, cold rooms and freezer rooms, seminar room, offices and machinery/technical rooms.

The main users of the Phytotron for 2012 were primarily Departments at UiO, as Department of Biology, Department of Molecular Biosciences (IMBV), School of Pharmacy and Natural History Museum/Botanical Garden for conducting their different research projects. However teaching, laboratory courses, work with plant collections from tropical areas, cultivation of special plant materials with regard to particularly courses, exhibitions, different arrangements and guided tours in the facilities have also been important activities in the Phytotron in 2012.

The UiO Park has used the Phytotron for winter storage of cold sensitive plants from the Park at Blindern campus and the Herb Garden at the Department of Biology. In spring time the Phytotron was used for pre cultivation of some plant species for the new summer season in the Herb Garden and the Park.

In addition research institutions and companies in Norway and from abroad have used the Phytotron. These institutions are represented by the University of Life Sciences (Ås, Norway), Nofima (the Food Research Institute, Ås, Norway) NINA (Norwegian Institute for Nature research, Trondheim, Norway), the Swedish University of Agricultural Sciences (SLU, Uppsala, Sweden), Helmut Schröder Baumschulen (Ellerbek, Germany), Norsk Wax A/S (Larvik, Norway) and Technological Institute A/S (Oslo, Norway).

A good work environment is important for the staff and the users of the Phytotron and one precaution is that the use of pesticides to fight pests on the plants are reduced to a minimum and is replaced by biological and mechanical control.

Personnel
Manager: Associate professor Aud Berglen Eriksen
Technicians: Ingrid Johansen, (70% position), Marit Langrekkken, Øyvind Rise and Per Rudidalen. Per Rudidalen reached the retirement age in December 2012.

Finances
Operating costs are financed through user payments (rental fees). The internal users, the Department of Biology, Department of Molecular Biosciences and the Botanical Garden pay a low cost, while external users (other UiO departments, universities, companies and research institutions) pay running costs.

Courses and education
In the Phytotron two course laboratories are adjacent to the climate control growth chambers and other laboratory facilities. About 250 bachelor students have followed the laboratory courses in MBV1020, BIO2140 and BIO2150 in the Phytotron.

In addition to courses given in the Phytotron, plant materials used in other courses are cultivated in the Phytotron and the collections of plants are used both for teaching, exhibitions, guided tours, research projects. The Phytotron is used for outreached purposes, like school visits.

In 2012 the plants from these collections and special cultivated plants were used as a part of different exhibitions in the Science library, at the opening of the new Sciences library and at public lectures in connection with the Nobel Peace Prize 2012. The global event, the Fascination of Plants Day, launched under the umbrella of European Plant Science Organisation (EPSO), was arranged for the first time May 18th. At the University of Oslo exhibitions were organized in the Botanical Garden/Museum (Tøyen) and at the Department of Biology, Blindern. At Blindern campus guided tours were given several times during the day in the University Park and the Herb Garden. Exhi-
Exhibitions at the Department of Biology displayed exotic fruits and plants, tropical crop plants, medical plants, effect of the day length of flower initiation and demonstrated the art of making Bonsai plants. The Phytotron was responsible for the different plant material used in the exhibitions at Blindern.

Number of Master and PhD candidates; papers, talks and posters
The number of candidates, talks and posters related to Phytotron projects in 2012 were: 4 PhD’s, 3 MSc, 14 papers, 27 talks and posters, 4 books, 6 popular sciences talks/media and 1 guest researcher.

Operation
The Phytotron facilities have been fully booked in 2012. Most users are from the Department of Biology, IMBV and NHM/Botanical Garden. The users normally have long term projects, which give a good overview of the use of the Phytotron for the next years. The new EU project Weevil STOP which will continue for a three years period. Large parts of the climate controlled growth areas will be occupied by such long term projects in the years to come.

Research projects
Many research projects at the Department of Biology combine field studies and controlled Phytotron experiments to investigate the effects of factors such as climate, pollutions, nutrition and evolution. The focus of the different studies can be based on observations and measurements at the whole organism level to the molecular level. The Phytotron’s flexibility and scientific span is clearly illustrated in the list of the research projects which have been conducted during 2012.
Related projects:

1. The Seeds of Adaptation in the face of climate change. Assessing gene flow in maize at the local and global scale.


3. Epigenetic causes for endosperm breakdown acting as a postzygotic hybridization barrier (postdoc visit from SLU Uppsala).

4. Genetic diversity in Sorghum and associations with cultural and ecological variables in Tanzania, Africa (Master project).

5. Polyploidy and ecotype variation in the Cochlearia officinalis complex (Master project)


7. Ecophysiological studies in the genus Ledebouria (Hyacinthaceae).

8. Molecular and morphological studies in cultivated Guinea yams and their wild relatives in Ethiopia. The phylogenetic relation between the wild and the cultivated plants.


10. Revising the family Amaryllidaceae for Flora of Namibia.

11. From food to waste to food

12. In vivo dynamics of plant response to tropospheric ozone

13. Effect of different waxes on Norway spruce and grafted grape vine plants

14. Damaging effect of low level of water soluble oil components on the DNA common mussel (Mytilus edulis) in relation to oil from the North Sea, Nigeria and Arabia.

15. Effect of temperature, rain and flooded soil on the baking quality of different wheat varieties

Natural History Museum, Botanical Garden

Researchers at the Botanical Garden (Tøyen) and the Department of Biology have for many years collaborated in research projects where the plant growth experiments are carried out in the Phytotron. This cooperation has been followed up by the National Centre for Biosystematics, Natural History Museum at Tøyen. The projects are prevalingly related to polar research. Migration of different plant species to the Polar region, especially to Svalbard after the last Ice period, long distance migration in the Polar Regions and development of species in arctic plants has been addressed.

Related projects:

1. EC Integrated Project, ECOCHANGE: Challenges in assessing and forecasting biodiversity and ecosystem changes in Europe

2. Cryptic speciation in arctic plants
Department of Molecular Biosciences
The Phytotron has one closed section with laboratories (50 m²) and environmentally controlled growth rooms (80 m²) for experiments and cultivation of genetic modified plants (GMP). This section has a S3 security level and has been used for the last 15 years for experiments with the model-plant Arabidopsis thaliana. Four research groups at the Department of Biosciences use this facilities for their long term research projects ranging from, epigenetic mechanisms in seed development, novel imprinting mechanism and epigenetic mechanism in seed development and cell separation processes and comparison of different processes in plants.

Cooperation with commercial partners
The Phytotron has for a long time collaborated with the Norwegian company “Norsk Wax” and a Swedish plant nursery to find a mechanical way to protect spruce plug plants against pine Weevil. The first two growing seasons after planting are particularly critical. Without protection against the insects up to 100 % of the planted seedlings in the field can be seriously damaged. An environmentally friendly and toxicologically safe solution have been developed, covering the lower part of the plant stem with wax before the plants are planted in the field and one application with wax is enough for two growth seasons. Treatments with insecticide have to be repeated and the insecticide (Merit Forest) used to day is harmful to bees and in Norway not allowed to use in the field. From 2012 this work will continue in the EU project:

“Development of a cost-effective and sustainable insecticide-free plant protection method, eliminating widespread catastrophic damage in the forestry caused by the pine weevil Hylobius abietis” (WeevilSTOP). In this EU-projects 15 partners from 9 European countries will co-operate.

Related projects:
1. Dissection of Epigenetic Mechanisms and Transcriptional Networks in Seed Development
2. Characterization of plant associated AlkB-like demethylases
3. Genomic dissection of seed development.
5. The Imprinted Seed: Explaining the Roles and Epigenetic Mechanisms of Imprinting in Seed Development.
7. Dissection and comparison of cell separation processes in plants.
8. Shaping active and silent chromatin: The role of CW-domain chromatin proteins

Laboratory experiment to test the protection effect of wax against pine weevil attack. The experiment was conducted at Department of Ecology, Unit of Forest entomology, Swedish University of Agricultural Sciences, Uppsala, Sweden, with wax treated spruce plug plants from The Phytotron and Swedish pine weevil collected in the forest. © A.B. Eriksen
Central Engineering Workshop

www.mn.uio.no/ibv/tjenester/sentralverkstedet

The Central Engineering Workshop mainly serves the two biological departments (Department of Biology and Department of Molecular Biosciences), though it also undertakes construction work for external organisations such as Veritas, NIVA and NINA.

Our workshop stands out due to the close proximity to the research groups and the broad-ranged skills of the team. The workshop mainly assists in developing new equipment to science, and also carries out construction and repair work in mechanics and electronics, glass blowing and welding. The workshop is usually contacted when the user is faced with difficulties in buying necessary equipment. If you have a bright idea and need help to build equipment to prove your theory, do get in touch with us!

In 2012, the workshop had full order lists and many interesting and challenging assignments. A total of 143 projects of varying complexity were undertaken for the biological departments. Many of our tasks in 2012 as in 2011 were in the field of physiology, related to both rat and fish experiments. Two of the staff members were in Italy a week in spring 2012 to assist in a bird field-project there.

As in previous years, the workshop has had a close collaboration with the workshop at the Faculty of Medicine, where we conduct CNC processing. These two workshops have complementary equipments and machinery.

The personnel
Hans Borg, chief Engineer
Johan Erland, principal engineer
Mads Granberg, senior engineer
Stein Høydahl, senior engineer
Bjørn Langrekken, principal engineer

Costs
Researchers from the two biological departments pay NOK 200 per job and 35% of material costs.

Cars
The workshop administrates 5 cars; 4 Toyota Hiace and 1 Ford Transit Connect. The cars can be lent to employees at the Department of Biology and IMBV. To rent the cars, go to http://www.mn.uio.no/bio/tjenester/sentralverkstedet/bilbestilling

Gradient incubator used in algal research, developed at the workshop © Bjørn Langrekken
Research vessels

The Faculty of Mathematics and Natural Sciences at the University of Oslo has two research vessels in the Oslofjord: F/F Trygve Braarud (70 ft) and F/F Bjørn Føyn (40 ft). The Departments of Biology, Physics and Geosciences all use the research vessels both for research and educational purposes. They are also utilized in collaborative projects with other national and international research institutions. The research vessels are additionally rented by external institutions that carry out research, environmental monitoring and environmental consulting. The vessels have their main mooring at Lysaker with docks and equipment storage-, engineering-, office and briefing facilities.

The design and equipment of the vessels have been made mainly with research in mind, but also works quite well for teaching purposes. The vessels have in recent years been prepped so that equipment can be changed rapidly in accordance to the needs of the users. Some of the tasks include trawling, the use of submergible acoustic sensors, large and heavy grabs and corers and the launch of large buoys for surveillance. The equipment and instruments are tested and developed in cooperation with private firms, exposing the crew and researchers to fresh knowledge and skills.

Activities
The vessels have been utilised extensively in connection with students' fieldwork, courses and research projects. Main UiO and external users in 2012 were Department of Geosciences represented by Elisabeth Alve and Eyvind Aas, Department of Biology (now Department of Biosciences) represented by Bente Edvardsen and Ketil Hylland (for projects in the inner and outer Oslofjord), and research institutes such as NIVA, NGI and NGU.

F/F Bjørn Føyn has mainly been used for school courses and in some extent for field work in Drøbak.

Board and Staff
The Faculty of Mathematics and Natural Sciences have appointed a board which is responsible for the use and maintenance of the vessels. The board consists of four members, with the head being directly appointed by the Faculty. A temporary board has been in effect from 2010. The members are Ketil Hylland (Chair), Elisabeth Alve, Josefin Titelman and captain Sindre Holm.

3 of the staff at the Department of Biology are authorized to manage the vessels. These are: Sindre Holm who is the Main Ship’s Captain, Jan Sundøy who is Ship’s Captain and engineer Tom Erik Baade. These people together with a regular crew of temps contribute to maintaining high activities.

Use and Management
The use and management of the vessels has been satisfactory in 2012 and has been kept up to the mark. There have not been any sudden cancellations. The vessels are being kept in good order in regards to both yearly and long term maintenance. The routine maintenance is the responsibility of the crew. There is a great demand for service and maintenance on tools and equipment. This has become a considerable expenditure. In 2012 a new CTD was intalled for use onboard TB.

The Engineering Workshop at the Department contributes heavily with mechanical repairs and maintenance towards the vessels and their equipment. They conduct mechanical first aid which prevents postponed or cancelled voyages. There have been no accidents or damages involving people or equipment.
Geology students studying sediments with living and dead foraminifera in the Oslofjord. The material is collected with a Gemini-corer © Sindre Holm

**Goals**

The Board and the crew work towards maintaining the vessels as well as making them into a safe work environment for the various users. The goal is to equip the vessels to the level which is purposeful and satisfactory for the users from the University. This also makes the vessels attractive for external users. Health and Safety regulations are actively followed and implemented. The running and maintenance of the vessels in an ethical, secure and well organized manner is of great concern to all involved.
The Marine research station in Drøbak was established as a field station in 1894 and includes the original research station (Biologen) and a course centre (Tollboden). Both the research station and the course centre are today protected historic buildings in the heritage conservation zone in the city of Drøbak.

The Marine field station Drøbak (research station since 1894). © Hans Erik Karlsen

Personnel and Board
Director: Associate professor, Hans Erik Karlsen
Technicians 2012: Grete Sørnes (12 months 50% position), Jens Ådne Rekkedal Haga (1 month summer field assistant and 1 month project research assistant).

In addition, a number of students were engaged as field course assistants throughout the year.

The board (01.10.2012 to 31.09.2013) consists of:

Courses and seminar activity
Tollboden was closed between 01.01.12 until 10.04.12 because of water sprinkling work. The Research station was closed between 19.01.12 until 09.06.12 due to modifications of the fire sprinkling system.

A total of 1259 overnight stays were registered at Tollboden in connection with courses, seminars and meetings, and 2336 persons visited the research station in 2012, and in all 11 guest researchers stayed at the station. Teaching activities in 2012 included 9 UiO field courses, 2 UMB field courses, 1 SABIMA field course and 2 international university field courses. Seminars and meetings totalled 2 from UiO and 4 from external research institutions. The scientific outreach consisted of contributions about the marine Oslo fjord fauna in local news media as well as the field station being the setting for the NRK series “Skaperverket” which introduced and for the second time in Norway elected hagfish (Myxine glutinosa) as the most representative Norwegian animal. M. glutinosa was in fact proposed to replace the lion in the national weapon shield (see illustration below).
School visits
The Research Station has for more than 40 years offered different types of 1-3 days field courses in marine biology. This popular activity was continued in 2012 with a total of 27 days of field courses for 21 school classes, i.e. 331 pupils and 35 teachers.

Facilities
The Research station is equipped with seawater inlet, aquaria and culture facilities enabling studies of marine flora and fauna under controlled conditions. The station has a microscopy lab with sophisticated fluorescence microscopes and image analyzing software, a chemical analysis lab, cold storage facilities, seawater filtration system, air compressor for scuba cylinders, 3 small boats, field equipment and a marine sample collection. The station is additionally furnished with all relevant teaching aids for course and seminar activity. Tollboden has a seminar room, kitchen, laboratory and beds for 24 people. The laboratory is equipped with microscopes and stereo microscopes. It is seawater inlet and 2 aquaria for studies of marine flora and fauna nearby the house.

Restoration and development
In 2012 both Tollboden and The Research Station received state of the art water-fog sprinkler systems to secure the old buildings from fire. In 2012 Hans Erik Karlsen has worked in a committee with members from the Norwegian School of Veterinary Science, UMB and NIVA to modernize and develop the marine research facilities at NIVA’s field station at Solbergstrand and the UiO station in Drøbak to satisfy future research infrastructural needs.

“Sparebankstiftelsen” donated NOK 200.000,- to Tollboden to buy seven new Primo Star microscopes (1 with a photo tube) and one Axio Lab A1 microscope with a photo tube from Zeiss.

A new Terhi Nordic 6012 with a 9,9 hp Yamaha engine was bought for use by researchers and general visitors without boat drivers licence.

Tollboden. The building is from 1855 and was a Customs Station until 1962. UiO took over the building in 1963, and it has since then been a course and conference centre. © Hans Erik Karlsen.
The Research Centre at Finse is formally owned by the University of Oslo (UiO), but the funding to build the station was originally given on the condition that the University of Bergen (UiB) should have equal rights to the centre. The centre is managed by Department of Biosciences at UiO, and UiB contributes to the operating costs. The Technical Division at UiO is responsible for the buildings. The centre has two main buildings: a Research Unit with laboratories and 14 beds, and a Course and Conference Unit with 44 beds. Research and teaching connected with the MN Faculties of both UiO and UiB have priority, but the research station is also much used by other research institutions from Norway and abroad. The station has a board consisting of two scientific representatives and one technical representative from both UiO and UiB. The board is appointed by the Department of Biosciences, UiO and the MN Faculty at UiB. News and information about the activities of the centre are updated regularly on the station’s website: [http://www.finse.uio.no](http://www.finse.uio.no).

**Operation and administration**

The daily operation and administration of the centre is carried out by the Director, Torbjørn Ergon and the Manager, Erika Leslie, both from the Dept. of Biosciences at UiO. In 2012, the board of the station consisted of:

Chair: Atle Nesje, UiB (deputy: Göran Högstedt)
Scientific Representative, UiO, and vice leader: Geir Hestmark (deputy: Klaus Høiland) Scientific Representative, UiO: Dag Klaveness (deputy: Ole Humlum) Scientific Representative, UiB: Aage Paus, UiB (deputy: Vidis Vandvik)
Technical Representative, UiO: Hans Borg (deputy: Johan Erland)
Technical Representative, UiB: Solfrid Hjelmtveit (deputy: Knut Helge Jensen)

For the fourth consecutive year, the centre employed a summer assistant for maintenance work and assistance in the practical operation of the centre (e.g. transportation, cleaning, etc.). Users of the research station also had the opportunity to hire the assistant at a fixed hourly rate covering employment costs.

The catering agreement with Tajo a/s at the Course and Conference Unit works well for all parties and will be continued.

**Research activity**

The number of working days in connection with research activities at the station in 2012 was 450 (362 overnight stays). This excludes 75 working days by the summer assistant, who in part worked as a research assistant. 88% of the research working days took place during the summer months of June, July, August and September. In total 208 working days were registered in connection with maintenance and operation of the field station.

In total 53 persons from 12 institutions used the station for research activities during 2012. The station was used mostly by researchers and students from UiO (15 persons), Norwegian University of Life Sciences (12 persons) and UiB (11 persons). Of the 15 researchers/students from UiO, 6 came from Department of Biology and 9 came from Department of Geosciences. Other research institutions using the station were (number of persons in parenthesis): Norwegian University of Science and Technology (4), Norwegian Institute for Nature Research (3), University of Amsterdam (2), University of Southampton (2), Swedish University of Agricultural Sciences (1), Norwegian Radiation Protection Authority (1), Hedmark University College (1) and Senckenberg Research Institute, Germany (1).

Two research groups from the universities of Amsterdam and Southampton received funding from the INTERACT Transnational Access Programme to work at the station in 2012 (in total 4 persons and 16 working days). As the only station in southern Scandinavia, we are secured funding to host research groups at the station over the next two years, and negotiations to extend the programme is under way (see below).
A brief description of each research project at the centre and a list of publications are published on the centre’s website: http://www.finse.uio.no/research/

Courses and seminar activity
A total of 1572 overnight stays and 425 persons were registered in connection with courses, seminars and meetings in the course and conference unit of the centre.

The following regular university field courses was held at the centre (chronological order):

- Winter Ecology (BIO344), UiB (6 days in April, 20 participants)
- Alpine Ecology (BIO259), University of Birmingham (7 days in July, 30 participants)
- Biological Diversity (BIO1200), UiO (3 groups of 5 days in July/Aug, 82 participants)
- Physical Geography (GEO1010), UiO (2 groups of 3 days in August, 79 participants)
- Quaternary Geology (GEOL106), UiB (5 days in August, 46 participants)
- Alpine Ecology (BIO343), UiB (7 days in September, 23 participants)
- Glacial and periglacial geomorphology (GEO4410), UiO (2 days in September, 13 participants).

The station also housed 3 other academic events:

- Two pre-conference workshops in connection with International Statistical Ecology Conference (4 days in June/July, 46 participants)
- “Fægridagene” – a biology course for teachers organized by Skolelabben at UiB (5 days in July, 19 participants)
- Nordic Summer school in Climate Change Effects (NordForsk research training PhD course; 7 days in September, 38 participants).

In addition, the course and conference unit was used for a seminar by the Technical Division at UiO (3 days in March, 15 persons) and a seminar by the Oslo University Hospital (Rikshospitalet) (3 days in March, 14 participants).

Other activities
The station is part of an EU-funded network of 33 circum-arctic terrestrial field stations in the Scandinavian countries (including Spitsbergen), Russia, Alaska, Canada, Greenland, Iceland, Faroe Islands and Scotland (see http://www.eu-interact.org/). The leaders of the stations participate in a Station Managers Forum that meet about twice yearly. A Station Catalogue was completed in 2012 (downloadable here http://www.eu-interact.org/station-managers-forum/report-deliverables/station-catalogue/), and a hand-book on ‘Best practices of Station Management and Administration at Arctic Research Infrastructures’ is under way.

The centre participates in the Finse Forum, where representatives from local business, NGO’s and local governments meet twice a year. The director of the station also took part in meeting initiated by Hallingskarvet Nasjonalparkstyre to discuss public outreach and information about the national park.

Annexes
The Garpen cabin, which belongs to the research station, is rented out on a daily basis to staff and students at UiO and UiB. The cabin has been renovated over the last years, and there has been increased interest in renting the cabin. In 2012 the cabin was used in 158 days. During the most busy summer weeks, Garpen is used for extra accommodation for researchers and summer employees at the station. The station also has a lease agreement with landowners in Ulvik to have access of the Torbjørnstølen cabin for similar purposes.
Laboratory School in Biology

The following people have been employed at the Laboratory School in Biology in 2012:

- Maria Sviland 100% position
- Helen S. Haugen 60% position January to May
- Linn Kristin Aasen Akslen 50% position August to December

The School laboratory resource group consists of:

- Halvor Aarnes, Department of Biology
- Ola Olav Sand, Department of Molecular Biosciences
- Pål Fallnes, Department of Molecular Biosciences
- Anders Isnes, Norwegian Centre for Science Education
- Camilla Torsæther, Education Agency of Oslo municipality

Teacher training

Our main aim is teacher training in Biology for teachers in Upper Secondary School. In 2012 we received a total of 121 teachers divided between 7 courses. In all of our courses we train practical skills combined with lectures. The following course has been arranged:

Course in Biostatistics, January

Lars Qviller and Maria Sviland held this course in Trondheim. The aim of the course was to introduce basic concepts in statistics. During the course our goal was to achieve enhanced understanding of variation and how to read results from science. The course had major emphasis on practical exercises with examples from biology.

Seminar in human nutrition and health, March

The relationship between nutrition and health among humans has got much attention in the curriculum both in Lower Secondary School and in Upper Secondary School. At the same time television and newspapers are full of different advice according to both healthy and unhealthy nutrition. We invited people that talked about health and nutrition for a one-day seminar.

Gene technology, March

The course gave an introduction to main technics in gene technology. We focused on both simple technics that can be used in education and more advanced technics used in science. One part of the course was practical work in our laboratory. People from the departments who contributed to the course were Bjørn H. Lindqvist, Tom Kistensen, Reidun Sirevåg, Helen Haugen, Ingrid Marie Egner, Kjetill S. Jakobsen and Anne Krag Brysting. This course was a two-day event.

Microbiology, April

As a part of Gunnar Dicks work with educational units for the subject Technology and research, a two-day course was arranged. The laboratory work focused on how we can use bacteria for research and biotechnology. Reidun Sirevåg and Gunnar Dick were responsible for the lectures in the course. This course was also held in November 2011.

Evening lessons for teachers in Cell Biology, August - September

The evening lessons consisted of three talks; prokaryotic cells, eukaryotic cells and cell transport. The talks were meant to give the teachers increased knowledge in these topics. Reidun Sirevåg, Linn Kristin Aasen Akslen and Olav Sand contributed with talks.

From research aspirant to the young researcher, September

The course gave an introduction to basic concepts within biostatistics and how to do simple calculations in statistics. During the course our main goal was to achieve enhanced understanding of variation and how to read results from science. The course had major emphasis on practical exercises with examples from biology. Kirsten Borse Halvorsen from the Science library contributed with a talk about the research process from gaining information to submitted articles. Part of this course was also held in Trondheim in January.
The human immune system, September
This course had main focus on the human immune system and practical work in the laboratory. In the laboratory we worked with a technique called ELISA that is used to detect different types of antibodies in a blood sample. We also analyzed proteins with Western blotting and detected them with antibodies. Tone Gregers contributed with a talk in this course.

School visits
Together with some of the BIO and IMBV research programs, the School Laboratory has created various educational units. These courses disseminate some of the program research, and have been very popular among pupils in Upper Secondary School. In 2012, a total of 252 pupils visited us.

Phylogeny among Primates
The pupils learn about the molecular basis for phylogeny, illustrated by doing laboratory work and by doing search on the webpage NCBI to find DNA sequences, which they use to construct phylogenetic trees. 61 pupils have attended this course.

Transformation of E. coli
We transform the bacteria E. coli with a gene from the jellyfish Aequara victoria that codes for Green Fluorescent Protein (GFP). 63 pupils have attended this course.

Detecting HIV by the Enzyme-linked immunosorbent assay (ELISA-method)
In this course we use the ELISA-method to illustrate important principals in immunology. Our context is detection of HIV-antibodies. 108 pupils have attended this course.

Cystic fibrosis - a gene test
The pupils learn about genetic testing of Cystic fibrosis. 10 pupils have attended this course.

Recombinant DNA-technology
In this course the pupils learn about how to do recombinant DNA-technology. 10 pupils have attended this course.

Contribution to other activities
The School laboratory has also been involved in

Researcher’s days
In cooperation with Microbial Evolution Research Group we had a stand that focused on Collodictyon. The findings of this little microorganism in Årungen can give us knowledge of early stages on life on earth.

Open day
Teachers were invited to our laboratory to use ELISA-method to illustrate important principals in immunology. Our context was detection of HIV-antibodies.

National conference of teacher education in Natural Sciences
We invited teachers to the laboratory to transform the bacteria E. coli with a gene from the jellyfish Aequara victoria that codes for Green Fluorescent Protein (GFP).

Teaching
NAT2000 is a course held by the Department of Teacher Education and School Research, Faculty of Educational Sciences. The School laboratory has contributed in both planning and teaching this course. In addition, the School Laboratory has written a compendium for use in the course. NAT2000 is collaboration between the School laboratories in Chemistry, Physics and Biology.
The Biology Library, situated in Kristine Bonnevies hus for 40 years, was in 2012 merged with the department libraries of astrophysics, chemistry, geology, physical geography and geophysics, mathematics, pharmacy, and physics, to form the Science Library in Vilhelm Bjerknes' hus. The Science Library also includes informatics in Ole-Johan Dahl's hus, and Natural History Museum library in the Geological Museum at Tøyen. The Science Library supports researchers and students at the Faculty of Mathematics and Natural Sciences. The Department of Biology and the Department of Molecular Biosciences will continue to be among our main collaborators.

The library’s goal is to provide students and researchers with the best possible access to information and scientific material. The library’s regularly updated subject websites provide easy access to relevant resources in biology and biochemistry. We communicate with the departments about the subject specific priorities.

We offer courses in literature database knowledge, scientific communication, the publication process, academic integrity for students, and reference management. The goal of our courses is optimal academic information literacy. The Science Library courses for the students at BIO and IMBV are mainly integrated into the departments’ course programs. We also hold courses for students and staff on request, and offer personal support.

The Science Library is a dynamic arena for debates and discussion about science and mathematics, their role in public life and their importance for societal development. Science Debate events are arranged in partnership with Fritt Ord (The Freedom of Expression Foundation).

**Library staff 2012**

Berit Johansen (senior librarian, library manager)
Edel Bøhn (executive officer)
Kirsten Borse Haraldsen (academic librarian)
Heidi S. Konestabo (senior academic librarian)
Kyrre T. Låberg (academic librarian/executive officer)
Martin Knudsen Tvete (assistant)

In the Science Library the staff is organized in groups working with specific areas, e.g. maintaining collections, digital subscriptions, researcher support, information literacy teaching, library routines, and science communication. Furthermore, dynamic teams maintain the daily routines in the library. Heidi Sjursen Konestabo and Kirsten Borse Haraldsen are subject librarians for BIO and IMBV, while Live Rasmussen is the Head Librarian for the Science Library.
Collection and finance 2012

During 2012 we have acquired about 4600 electronic books in science. Among these, new books in biosciences from publishers such as Elsevier, Wiley-Blackwell, Oxford and Springer are included. We also bought about 2100 printed books this year. The University Library used about 60 mill. NOK on databases, e-journals, e-books, printed journals and printed books in 2012.

We have continued a few printed subscriptions of current journals, such as Nature, Science and some Norwegian journals. However, most of our journal subscriptions are now found only as e-journals.

Book loans still constitute a large portion of the library activity, also loans to and from other libraries. We had a total of 10797 loans during 2012.

Teaching 2012

Integrated student courses at the Department of Biology and Department of Molecular Biosciences:

**BIO 5000**
The library is running the introductory course for master students in biology (BIO5000) in collaboration with the Student Administration Office. BIO5000 is set up as an intensive week course at the beginning of both spring and fall semesters. The course includes an exam, and a written submission by the students of project proposals for their master thesis. The students hold a lecture on their thesis for the next semester’s BIO5000 students. The thesis project description is approved with formal structure and references by the library. About 40 students attend this course every autumn semester, and 10-20 students every spring semester.

**MBV4010**
The library part in MBV4010 includes 2 half days of computer labs and lectures. The library’s contribution is included in the MBV4010 mandatory lab journals, which are approved by the Department of Molecular Biosciences course managers. About 50 students attend this course every autumn semester.

**BIO1000**
The Science Library is included in the BIO1000 laboratory portfolio. The course includes a talk with discussion about academic integrity, and a lab about the library and BIBSYS (“Bjørnelabben”). A total of 240 students received 2 hours course and tour of the Science Library’s collections.

Open courses and courses on request

We offer an introductory course in EndNote for employees and PhD students at the faculty, and we participate in the “Lynkursdagene” arranged by USIT every semester. We contribute to BIO4210 (Phylogeny and Classification) and to Laboratory School in Biology in a science course for high school teachers. We are also engaged as master student supervisors.
The opening of the Science Library on the 14th of March 2012 was celebrated with talks, entertainment, exhibitions, baroque music and invited guests. The Department of Biology was a great contributor, providing presentations, exhibition items from “Studiesamlingen” and the Phytotron, forensic lab (Laboratory school), Daphnia lab and Biofilm.

Although much of our collection is now online, students used the physical facilities in the Biology Library, and they continued to do so in the Science Library. The Science Library is a great success as a modern arena for students to learn, read, work in groups and meet the scientific society. The Science Library had 174,779 visitors during 2012.

Several events of Science Debate in cooperation with Fritt Ord were arranged during 2012, also in alliance with among others the Seminar of Science Studies, Rector Ole Petter Ottersen, and Norsk Biologforening with “Biokonferansen 2012”. The Science Library is also the host of NRK’s “Abels tårn” with “Vaffel og Vitenskap” every Friday at 10.03 am in Vilhelm Bjerknes’ hus.
The Biological Students’ Committee

www.biologiskfagutvalg.com

The Biological students’ Committee (Biologisk Fagutvalg) is a student body for undergraduate and graduate students affiliated with the Department of Biology. The BFU works to create and maintain a good academic and social environment for biology students.

The representatives from the BFU work on behalf of the biology students, and in favor of their best interests. The group has two weekly events: “The Biographer” (Biografen) which presents different films or documentaries with biological relevance, and “Breakfast with Kristine”, a popular science lecture with a complimentary breakfast. We also have a bimonthly debate “Fertile Friday”, which discusses relevant themes in biology. This year's discussion topics have been Organic farming, Predator-control policy in Norway and GMO’s.

The group also organizes several field outings per year, such as a mushroom trip with Trond Schumaker and Klaus Høiland and a fossil hunting trip, this year, with master student Aubrey Roberts.

In August, the BFU organizes the week for welcoming new bachelor students. Each year we have social events as well as short lectures on biological topics by professors, master students or from our Institute. We also wish to emphasize as early on as possible why we need biologists and encourage new students to think about what they want with their education, and what kind of tools they need to get there.

More social events include parties for biology and molecular biology students in the biology cantina. In the spring term we organize a carnival, and in the autumn term we organize a party with a live band. We also organized a Christmas party for the bachelor students. During the evening we had a lecture about tropical botany with Axel Dahlberg Poulsen and live music later on. In addition to organizing social events and activities for the students, the BFU distribute locker space in the biology building’s basement.

This year’s “Golden Pointer” award went to Halvor Aarnes for his great lectures in BIO 2150 and the plant physiology part in MBV 1020. The award was received at the Christmas Parties for the Department of Biology and the Department of Molecular Biosciences.
Health, Security and Environment

The joint HSE project 2010-2012 at Department of Biology (BIO) and Department of molecular Biosciences (IMBV), started in 2010 were decided to be continued from July 2012 – December 2013. The aim of the project is to obtain a more systematic and structured HSE work at the departments.

Risk assessment, handling chemicals and work environment are the chosen focus areas in the action plan for HSE 2012-2014 at BIO and IMBV. The action plan has been followed up through the year.

Systematic HSE work
There have been four meetings in the local working environment committee (LWEC) at BIO and IMBV. The agenda for the meetings and the reports are published at the Departments web pages.

HSE dialog meetings for the head of the two departments, the two chief safety representatives and the HSE coordinator have been conducted as planned.

The local group for emergency work had one meeting with a training program for emergency units and the local emergency plan were updated in agreement with the revised emergency plan for the University of Oslo.

As part of the standard OHSAS 18001 for Work environment introduced at UiO in 2012, the Management review for HSE was conducted for the first time in December.

The Vision for the HSE work:
“A safe study and work environment for students and staff will inspire both research and study activities at the department. Through common responsibilities, involvement and contribution a thriving department is created.”

Goals, strategies and action plan for the HSE project:
http://www.mn.uio.no/ibv/om/hms/hms-mal-og-handlingsplaner/hms-handlingsplaner/

The HSE project 2010-2012 continued from July 2012 to December 2013
Through the year there have been about nine meetings in the HSE project group. Quarterly reports were made for the 1st half of 2012. For the second half of 2012 a HSE - work report were prepared for the Transition group at IBV and the management at BIO and IMBV.

After evaluating the BIO-SOP pilot project in January a “BIO-SOP project 2012-2013” were started with the aim of developing Standard operating procedures (SOP) with risk assessment at the Department.
The HSE project was responsible for planning and arranging the “tidy up day” on 27th September. The result was better order and tidiness and a lot of old chemicals were also removed from the building. The day ended with social activities and a pizza party for the participants.

Safety inspections 2012
Safety inspections are an important part of the systematic HSE work and a tool for improving the work environment. The LWEC decided that the safety inspections in 2012 should focus on:

- Follow up the safety inspections from 2011 (handling of chemicals, labeling and responsibility in the laboratories, order and tidiness),
- HSE-training and documentation
- Risk assessment.

The safety inspections were carried through as planned with the laboratory areas as first priority. The head of the scientific center and programs, the chief safety representatives, other safety representatives, technical staff and the HSE coordinator took part in the inspections. Written reports were made for the safety inspections at CEES, IB, MB, MERG, and the Phytotron, the engineering workshop, the administration and Laboratory School in Biology. There were no safety inspections at Drøbak biological station and Finse Alpine Research Center this year. In the reports good HSE work and follow up of the safety inspections from 2011 were recognized. Problems were pointed out, necessary corrective measures were suggested, responsible persons and the time limit for the improvement work were specified.

Inspection from Norwegian authorities
The Norwegian Directorate of Health made an inspection at laboratories with contained use of Gene Modified Organisms (GMO-plants and GMM – microorganisms). Suggested measures have been conducted.

Risk assessment and risk analysis
Norwegian law and regulations as “Internkontroll-forskriften” demand that UiO and the Department should have a systematic approach to HSE tasks, perform surveys in problem areas, perform risk assessments, make priorities, follow up and document the HSE work. That is why a main focus at the department in 2012 was Risk assessment and why one of the goals set by the HSE project is: “A well functioning system for risk assessment with a convenient emergency plan should be established and incorporated as a natural part of all activities at the department”.

On behalf of the technical department at UiO the company Rambøll conducted a risk analysis at Kristine Bonnevies house, BIO and IMBV, in May. The following report suggested some room for improvement in different areas. No very serious problems were revealed.

The “BIO-SOP project 2012-2013” started firstly mapping the needs for Standard operating procedures (SOP) with risk assessment at the Department and then developing SOP’s for hazardous laboratory procedures. SOP’s are important for the quality assurance work in the laboratories and will be useful in teaching situations and can ensure that the right information is given.

A procedure for risk assessment of Master student projects is adopted at the Department.

HSE training
The Faculty of Mathematics and Natural sciences (MN-faculty) are responsible for giving basic HSE information and training to Bachelor and Master students. HSE information specific for the different courses at the Department is always included in the introduction of each course. Before access to laboratories students must have specific information and training and sign the form “HSE training for working in the laboratories”.

The management at the department, safety representatives and the HSE coordinator have taken part in different HSE seminars arranged by the MN-faculty and by UiO. New module based HSE courses for employees at UiO were introduced in the autumn of 2012. This will give employees a better understanding and training in different HSE topics especially regarding hazardous working situations.

HSE information
The HSE handbook has been updated both in Norwegian and English editions. Printed copies were distributed to all laboratories.
The HSE web pages at the Department are developed in the frame decided by the MN-faculty in 2011 and are continuously being updated and supplemented.

Some HSE information was given in general meetings and in connection with the safety inspections and the “tidy up day”.

Psychosocial work environment
Samholdsgruppa-BIO with the mission of suggesting measures for better “team spirit” and feeling of togetherness at the Department suggested a plan for team building activities, a new plan for arranging general meetings and for social activities at BIO. One meeting with a “relevant BIO” topic was arranged in the spring, and in August a summer party. Due to the merging process of BIO and IMBV the Samholdsgruppa-BIO and the similar group at IMBV merged during summer to “Samholdsgruppa – BIO/IMBV”. The mandate for the group was suggestions for team building and a common organizational culture at the new Department of Biosciences. A report with numerous suggestions was submitted to the management and the Transition group at IBV in November.

The annual Performance talk/appraisal is an opportunity for good dialog between employees and the management particularly for the purpose of maintaining a good psychosocial work environment. Most of the employees at the Department have had the annual Performance talk during 2012.

Reporting injuries, accidents and HSE deviations
Reports of injuries, accidents and HSE deviations at the Department have been low and probably a bit to inadequate through the years. The importance of reporting deviations has been emphasized. In 2012 three injuries or accidents have been reported and six deviation without personal injury for BIO and IMBV.

HSE investigations
A survey (internet-based form) of the work environment at office workplaces were conducted in the spring.

The HSE-group conducted comprehensive investigations when preparing the HSE-work report for the Transition group at IBV. The group searched for differences at BIO and IMBV in HSE-training and documentation, HSE handbooks and overall procedures, the specific procedures in the different laboratories, handling of chemicals, system for risk assessment, handling of risk waste and other HSE relevant topics.

The organization and status of the ECOonline work at BIO and IMBV have been examined. (ECOonline is an internet based system for MSDS - material safety data sheets)

HSE cooperation with others at UiO
New standardized laboratory journals suggested by the MERG group at BIO was approved by the MN-faculty and were distributed in 2012.

The HSE coordinator has been a member of the MN-HSE-project with the purpose of developing and conducting a program for HSE training for Bachelor and Master students.

Managers, safety representatives and the HSE coordinator at BIO have participated in different HSE seminars and HSE networking at MN-faculty and at UiO.

After the safety inspections and when necessary there have been meetings with the local Technical department for good cooperation and for dealing with repair needs in the building.

There have been two cooperating projects with the Technical department in 2012:

New key cylinders and keys in Kristine Bonnevåe’s house were installed with the intention of better safety for employees and all valuables in the building.

New and updated information boards and better information in the building. The first permanent boards will be put up in January 2013.
Vegetation ecological observations and insect catchment during the Bio 1200 field course at Finse, Hardangervidda © U. Vik
## RCN projects

<table>
<thead>
<tr>
<th>Name</th>
<th>Project leader</th>
<th>Funding</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biodiversity, community saturation and ecosystem function in lakes</td>
<td>Andersen, T.</td>
<td>RCN</td>
<td>2010-2013</td>
</tr>
<tr>
<td>Wildfire effects effects on biogeochemistry of soil and surface water</td>
<td>Andersen, T.</td>
<td>RCN</td>
<td>2010-2012</td>
</tr>
<tr>
<td>Regulatory RNA and the origin of multicellularity</td>
<td>Bråte, Jon</td>
<td>RCN</td>
<td>2012-2015</td>
</tr>
<tr>
<td>Diversity and dynamics of marine haptophytes</td>
<td>Edvardsen, B.</td>
<td>RCN</td>
<td>2009-2013</td>
</tr>
<tr>
<td>Application of a new principle to combat infectious salmon anemia</td>
<td>Grimholt, U.</td>
<td>RCN</td>
<td>2011-2013</td>
</tr>
<tr>
<td>Phytoplankton size: Climatic adaptation and long-term evolution</td>
<td>Henderiks, J.</td>
<td>RCN</td>
<td>2010-2014</td>
</tr>
<tr>
<td>Genome size, cell size and growth; searching for the causal links</td>
<td>Hessen, D.O.</td>
<td>RCN</td>
<td>2010-2013</td>
</tr>
<tr>
<td>Spatiotemporal variability in mortality and growth of fish larvae in the Lofoten-Barents Sea ecosystem</td>
<td>Hjermann, D.</td>
<td>RCN</td>
<td>2010-2013</td>
</tr>
<tr>
<td>iCod: Integrative environmental genomics of cod</td>
<td>Hylland, K.</td>
<td>RCN</td>
<td>2009-2012</td>
</tr>
<tr>
<td>Norwegian High-Throughput Sequencing Centre</td>
<td>Jakobsen, K.S.</td>
<td>RCN</td>
<td>2010-2017</td>
</tr>
<tr>
<td>Translating the cod genome for aquaculture</td>
<td>Jakobsen, K.S.</td>
<td>RCN</td>
<td>2010-2014</td>
</tr>
<tr>
<td>Ultra-high throughput sequencing platform</td>
<td>Jakobsen, K.S.</td>
<td>RCN</td>
<td>2008-2012</td>
</tr>
<tr>
<td>Speciation processes in fungi examined through experimental and empirical approaches</td>
<td>Kauserud, H.</td>
<td>RCN</td>
<td>2008-2012</td>
</tr>
<tr>
<td>X-cell parasites: an emerging threat to marine fish</td>
<td>Klaveness, D.</td>
<td>RCN</td>
<td>2012-2015</td>
</tr>
<tr>
<td>Genetic architecture in Drosophila - The role of the Y chromosome in gene expression across the genome</td>
<td>Martinsen, L.</td>
<td>RCN</td>
<td>2011-2014</td>
</tr>
<tr>
<td>Partial migration of red deer and tick distribution at the altitudinal colonization border</td>
<td>Mysterud, A.</td>
<td>RCN</td>
<td>2011-2015</td>
</tr>
<tr>
<td>The ecology and economy of sheep production under climate change</td>
<td>Mysterud, A.</td>
<td>RCN</td>
<td>2009-2012</td>
</tr>
<tr>
<td>Biogeographic and population analyses of Thermotogales bacteria from hydrocarbon-rich environments</td>
<td>Nesbe, C.</td>
<td>RCN</td>
<td>2008-2014</td>
</tr>
<tr>
<td>Centre for Ecological and Evolutionary Synthesis</td>
<td>Stenseth, N.C.</td>
<td>RCN</td>
<td>2007-2017</td>
</tr>
<tr>
<td>Comparison of Marine Ecosystems of Norway and the US</td>
<td>Stenseth, N.C.</td>
<td>RCN</td>
<td>2009-2012</td>
</tr>
<tr>
<td>Flexibility and constraints in animal movement patterns: ecology, evolution and annual cycles</td>
<td>Stenseth, N.C.</td>
<td>RCN</td>
<td>2010-2014</td>
</tr>
<tr>
<td>Strengthening the adaptive capacity of institutions in fisheries</td>
<td>Stenseth, N.C.</td>
<td>RCN</td>
<td>2012-2015</td>
</tr>
<tr>
<td>Bringing together evolution and ecology through the Red Queen Perspective</td>
<td>Stenseth, N.C.</td>
<td>RCN</td>
<td>2012-2016</td>
</tr>
<tr>
<td>On the evolutionary genomics and behavioural ecology of homoploid hybrid speciation in Passer sparrows</td>
<td>Sætre, G.P.</td>
<td>RCN</td>
<td>2011-2014</td>
</tr>
<tr>
<td>Title</td>
<td>Authors</td>
<td>Funding</td>
<td>Duration</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-----------------------</td>
<td>------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Modelling ecosystems under climate change: Windermere as a model lake system</td>
<td>Vøllestad, L.A.</td>
<td>RCN</td>
<td>2008-2012</td>
</tr>
<tr>
<td>Tracking signatures of adaptive diversification during postglacial colonization: the build-up of genomic isolation</td>
<td>Vøllestad, L.A.</td>
<td>RCN</td>
<td>2010-2014</td>
</tr>
<tr>
<td>Underprosjekt Nitrarnes in soil and freshwater, hovedprosjekt Kjemisk institutt 430235</td>
<td>Hessen, D.O.</td>
<td>RCN</td>
<td>2011-2012</td>
</tr>
<tr>
<td>Genome sequencing of cod by exclusive uses of ultra high-throughput sequencing technology</td>
<td>Jakobsen, K.S.</td>
<td>RCN</td>
<td>2008-2012</td>
</tr>
<tr>
<td>Fisheries induced evolution in Atlantic cod investigated by ancient and historic samples</td>
<td>Stenseth, N.C.</td>
<td>RCN</td>
<td>2011-2014</td>
</tr>
<tr>
<td>Match-mismatching of trophic levels as a structuring force of ecosystems</td>
<td>Stenseth, N.C.</td>
<td>RCN</td>
<td>2008-2012</td>
</tr>
<tr>
<td>Bærekraftig Rekefiske</td>
<td>Stenseth, N.C.</td>
<td>RCN/HI</td>
<td>2012</td>
</tr>
<tr>
<td>Collective behaviour of penned herring: Observing the collective behaviour and investigating the effect of various sound stimuli</td>
<td>Karlsen, H.E.</td>
<td>RCN/IMR</td>
<td>2011-2014</td>
</tr>
<tr>
<td>Adaptive management of living marine resources by integrating different data sources and key ecological processes: A joint efford by IMR and CEES</td>
<td>Stenseth, N.C.</td>
<td>RCN/IMR</td>
<td>2010-2015</td>
</tr>
<tr>
<td>National research infrastructure Norwegian Marine Data centre NMDC</td>
<td>Stenseth, N.C.</td>
<td>RCN/IMR</td>
<td>2012-2022</td>
</tr>
<tr>
<td>Managing resource and area conflicts in the coastal zone, exemplified by cod on the Skagerrak coast</td>
<td>Stenseth, N.C.</td>
<td>RCN/IMR</td>
<td>2012-2014</td>
</tr>
<tr>
<td>Combined effects of ocean acidification, climate change and oil related discharges</td>
<td>Hjermann, D.</td>
<td>RCN/IRIS</td>
<td>2010-2013</td>
</tr>
<tr>
<td>Watershed EUTROphication management through system oriented process modelling of Pressures, Impacts and Abatement actions</td>
<td>Andersen, T.</td>
<td>RCN/Kjemisk Inst.</td>
<td>2009-2013</td>
</tr>
<tr>
<td>Watershed Eutrophication management in China through system oriented process modelling of Pressures, Impacts and Abatement actions</td>
<td>Andersen, T.</td>
<td>RCN/Kjemisk Inst.</td>
<td>2011-2014</td>
</tr>
<tr>
<td>Challenges towards sustainable aquafeeds-plant nutrients and contaminants interactions. Use of biological models and indicators</td>
<td>Hylland, K.</td>
<td>RCN/NIFES</td>
<td>2011-2015</td>
</tr>
<tr>
<td>Toxic algae: taxonomy, quantification and early warning</td>
<td>Edvardsen, B.</td>
<td>RCN/NIVA</td>
<td>2010-2013</td>
</tr>
<tr>
<td>Can nuisance growth of the aquatic macrophyte Juncus bulbosus be related to elevated nitrogen deposition as well as hydropower regulations?</td>
<td>Hessen, D.O; Andersen, T.</td>
<td>RCN/NIVA</td>
<td>2007-2012</td>
</tr>
<tr>
<td>Toxicity profiling of the major EU transported HNS and oil types</td>
<td>Hylland, K.</td>
<td>RCN/NIVA</td>
<td>2009-2012</td>
</tr>
<tr>
<td>Towards a better understanding of bloom forming toxic cyanobacteria</td>
<td>Jakobsen, K.S.</td>
<td>RCN/NIVA</td>
<td>2009-2012</td>
</tr>
<tr>
<td>Pre-project for cabel-based ocean observatory</td>
<td>Kaartvedt, S.</td>
<td>RCN/Norsk næringsliv</td>
<td>2010-2014</td>
</tr>
<tr>
<td>Managing ecosystem services in low alpine cultural landscapes through livestock grazing</td>
<td>Mysterud, A.</td>
<td>RCN/NTNU</td>
<td>2012-2014</td>
</tr>
<tr>
<td>Platform for Viral Aquamedicine</td>
<td>Grimholt, U.</td>
<td>RCN/VI</td>
<td>2009-2012</td>
</tr>
</tbody>
</table>
### International projects

<table>
<thead>
<tr>
<th>Name</th>
<th>Project leader</th>
<th>Funding</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOMARKS: Biodiversity of Marine eukaryotes</td>
<td>Edvardsen, B.</td>
<td>biodivERSA ERA NET</td>
<td>2009-2013</td>
</tr>
<tr>
<td>Plague And Natural Hosts - Evolutionary Interactions. ESF Exploratory Workshop</td>
<td>Stenseth, N.C.</td>
<td>ESF</td>
<td>2012</td>
</tr>
<tr>
<td>Behaviour and speciation - ESF FROSpecs workshop</td>
<td>Sætre, G.P.</td>
<td>ESF</td>
<td></td>
</tr>
<tr>
<td>Microarrays for the detection of toxic algae</td>
<td>Edvardsen, B.</td>
<td>EU</td>
<td>2008-2012</td>
</tr>
<tr>
<td>International Network for Terrestrial Research and Monitoring in the Arctic - INTERACT</td>
<td>Ergon, T.</td>
<td>EU</td>
<td>2011-2014</td>
</tr>
<tr>
<td>Development of a cost-effective and sustainable insecticide-free plant protection method, eliminating widespread catastrophic damage in the forestry caused by the pine weevil Hylobius abietis</td>
<td>Eriksen, A.B.</td>
<td>EU</td>
<td>2012-2015</td>
</tr>
<tr>
<td>Demographic strategies under climate variation: a study on Arctic and Antarctic seabirds</td>
<td>Stenseth, N.C.</td>
<td>EU</td>
<td>2010-2012</td>
</tr>
<tr>
<td>Timing of bird migration under climate change: phenotype plasticity, microevolutionary response or both?</td>
<td>Stenseth, N.C.</td>
<td>EU</td>
<td>2011-2013</td>
</tr>
<tr>
<td>Evolutionary response of two African Rodent species (Hystrix sp) to climate change: the study of the past as an estimate of the future</td>
<td>Stenseth, N.C.</td>
<td>EU</td>
<td>2011-2013</td>
</tr>
<tr>
<td>Social complexity in Resource Management</td>
<td>Stenseth, N.C.</td>
<td>EU</td>
<td>2011-2013</td>
</tr>
<tr>
<td>CIIF Explained phenological change and its consequences for bird populations</td>
<td>Stenseth, N.C.</td>
<td>EU</td>
<td>2012-2013</td>
</tr>
<tr>
<td>Reconstructing the imprint of ecology on the genetic phyleogeography of the Plague in Central Asia and China</td>
<td>Stenseth, N.C.</td>
<td>EU</td>
<td>2012-2014</td>
</tr>
<tr>
<td>EcoScenarios - Developing seasonal and spatial foodweb models through novel statistical modelling - tools for constructing scenarios under future global change</td>
<td>Stenseth, N.C.</td>
<td>EUR-OCEANS Consortium</td>
<td>2010-2012</td>
</tr>
<tr>
<td>Climate change effects on marine ecosystems and resource economics (NorMer)</td>
<td>Stenseth, N.C.</td>
<td>NordForsk</td>
<td>2011-2015</td>
</tr>
<tr>
<td>Research Training Course - Effect Studies and Adaptation to Climate Change</td>
<td>Stenseth, N.C.</td>
<td>NordForsk</td>
<td>2012</td>
</tr>
</tbody>
</table>
### Other public sector/private sector projects

<table>
<thead>
<tr>
<th>Name</th>
<th>Project leader</th>
<th>Funding</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Navnelister på mikroalger til Artsnavnebasen</td>
<td>Edvardsen, B.</td>
<td>Artsdatabanken</td>
<td>2012</td>
</tr>
<tr>
<td>Gavebevilgning Sparebankstiftelsen DnB</td>
<td>Karlsen, H.E.</td>
<td>DNB</td>
<td>2011-2012</td>
</tr>
<tr>
<td>Barcoding of polychaetes and nematodes</td>
<td>Thormar, J.</td>
<td>DNVA</td>
<td>2011-2012</td>
</tr>
<tr>
<td>Fisk i indre Oslofjord</td>
<td>Hylland, K.</td>
<td>Fagrådet</td>
<td>2011-2012</td>
</tr>
<tr>
<td>Beitevaner; Alvaldprosjekt</td>
<td>Mysterud, I.</td>
<td>Fylkes-kommuner</td>
<td>2001-2013</td>
</tr>
<tr>
<td>Link populations to food-chain</td>
<td>Hjermann, D.</td>
<td>IRIS</td>
<td>2012-2014</td>
</tr>
<tr>
<td>Tobis og støypåvirkning</td>
<td>Karlsen, H.E.</td>
<td>KLIF</td>
<td>2011-2012</td>
</tr>
<tr>
<td>Effekter av miljøgifter på fisk i indre Oslofjord (Biomarkører)</td>
<td>Hylland, K.</td>
<td>NIVA</td>
<td>2011-2013</td>
</tr>
<tr>
<td>Det norsk havabborprosjektet</td>
<td>Colman, J.</td>
<td>Norsk næringsliv/UMB</td>
<td>2006-2012</td>
</tr>
<tr>
<td>Tidspunkt for smoltutfuendring i lakseelver: en global modell</td>
<td>Vøllestad, L.A.</td>
<td>NVE</td>
<td>2012</td>
</tr>
<tr>
<td>Vindkraftverks innvirkning på reindrift</td>
<td>Colman, J.</td>
<td>NVE/diverse kraftelskaper m.fl.</td>
<td>2004-2013</td>
</tr>
<tr>
<td>Finn Jørgen Walvigs dødsbo</td>
<td>Karlsen, H.E.</td>
<td>Priv</td>
<td>2010-2013</td>
</tr>
<tr>
<td>Ecological modelling, interdisciplinary methodology and climatic variation in Africa</td>
<td>Stenseth, N.C.</td>
<td>SIU</td>
<td>2009-2013</td>
</tr>
<tr>
<td>Professorat II Toksikologi</td>
<td>Øvrebe, S.</td>
<td>STAMI</td>
<td>2001-2013</td>
</tr>
<tr>
<td>High throughput sequencing of deep sea metagenomes</td>
<td>Jakobsen, K.S.</td>
<td>STATOIL/VISTA</td>
<td>2009-2012</td>
</tr>
<tr>
<td>Utvikling av et nytt modellsystem innen polyploid planteevolution: skjøebsukst (Cochlearia)</td>
<td>Brysting, A.K.</td>
<td>UNIFOR</td>
<td>2012-2013</td>
</tr>
<tr>
<td>Assessment of the effects of oil exposure on the population dynamics and abundances of Atlantic cod and haddock using stat-space models</td>
<td>Stenseth, N.C.</td>
<td>VISTA</td>
<td>2012-2014</td>
</tr>
</tbody>
</table>
Publications

Articles in peer-reviewed journals


Godiksen, Jane Amtoft; Borgstrøm, Reidar; Dempson, JB; Kohler, J.; Nordeng, Hans; Power, M.; Stien, Audun; Svenning, Martin. Spring climate and summer otolith growth in juvenile Arctic char, Salvelinus alpinus. Environmental Biology of Fishes 2012; Volum 95. s. 309-321


Books, book chapters and reports


---

**Fig 10** Percent of publications published in high, medium and low quality journal
## Staff per 15.12.2012

### Chair
Chair
Schumacher, Trond

### Chair (CEES)
Chair (CEES)
Stenseth, Nils C.

### Professors
Professors
Andersen, Tom
Edvardsen, Bente
Fredriksen, Stein
Hagelberg, Erika
Hansen, Thomas F.
Hessen, Dag O.
Hestmark, Geir
Hylland, Ketil D. E.
Heiland, Klaudia
Jakobsen, Kjetil S.
Klaveness, Dag
Lampe, Helene M.
Leinaas, Hans Petter
Mysterud, Atle
Nordal, Inger
Slagsvold, Tore
Sætre, Glenn-Peter
Ugland, Karl
Vøllestad, Asbjørn
Aarnes, Halvor

### Associate professors
Associate professors
Brysting, Anne
Ergon, Torbjørn
Karlsen, Hans Erik
Kauserud, Håvard
Shalchian-Tabrizi, Kamran
Titelman, Josef

### Lecturer
Lecturer
Sviland, Maria

### PhD students
PhD students
Areskoug, Veronika
Baaalsrud, Helle Tessand
Balasundaram, Sudhagar V.
Berg, Pauls Ragnar
Bjorbaekmo, Marit M.
Bjørke, Oda
Egge, Elianne Sirnæs
Elvgin, Tore Oldeide
Gran, Sandra
Greys, Agirdas
Helberg, Morten
Hermansen, Jo Skeie
Jalal, Marwa
Khomich, Maryia
Krabberød, Anders K.
Krzewinska, Maja
Kvile, Kristina Ø.
Lenderink, Andrea
Lillegren, Mikkel Meyn
Malmstrøm, Martin
Mazzarella, Anne V. B.
Neumann, Ralf Stefan
Orr, Russell

### Post docs/researchers
Post docs/researchers
Aleme, Diress Tsegaye
Bailey, Richard Ian
Boessenkool, Sanne
Bråte, Jon
Cadahia, Luis
Colman, Jonathan Edward
Diekert, Florian Klaus
Durant, Joel Marcel
Easterday, William Ryan
Eftestøl, Sindre
Eikset, Anne Maria
Falk-Petersen, Jannike
Fischer, Barbara
Flydal, Kjetil
Færovig, Per-Johan
Gaustad, Arild Olsen
Gerecht, Andrea Cornelia
Grimbolt, Unni
Gundersen, Hege
Haverkamp, Thomas H.
Henderiks, Iordanite
Hernandez-Aguilar, Raquel Adriana
Hjermann, Dag Øystein
Holen, Øistein Haugsten
Holth, Tor Fredrik
Hutchings, Jeffrey
Jorde, Per Erik
Kausrud, Kyrre Linné
Kjesbu, Olav Sigurd
Knudsen, Endre
Knutsen, Halvor
Langangen, Øystein
Larsen, Sørø
Linden, Torsten Andreas
Liow, Lee Hsiang
Mangot, Jean-Francois
Martinsen, Lene
Nesbøe, Camilla Lothe
Nilsson, Anna
Olsen, Esben Moland
Rasconi, Serena
Richter, Andries Peter
Rogers, Lauren
Ruenness, Eli Knispel
Salzburger, Walter
Schmid, Boris Valentijn
Star, Bastiaan
Stige, Leif Christian
Svannungsen, Thomas Owens
Trostvik, Pål
Trucchi, Emiliano
Villar, Jaime Otero
Vindenes, Yngvild
Vojte, Kjetil Lyns
Vollsnes, Anke Victoria
Whittington, Jason
Østbye, Kjartan

### Adjunct professors
Adjunct professors
Kaartvedt, Stein
Øvrebø, Steinar

### Adjunct assistant professors
Adjunct assistant professors
Eikrem, Wenche
Norderhaug, Kjell Magnus
Sverdrup, Line
Viljugrein, Hildegunn
Qviller, Lars
Rivrud, Inger M.
Romagnoni, Giovanni
Sengupta, Sagnik
Sogge, Hanne
Solbakken, Monica H.
Stomperudhaugen, Eirin S.
Taubøl, Anette
Thormar, Jonas G.
Throne
Tominaga, Koji
Trier, Cassandra Nicole
Tørrresen, Ole Kristian
van Son, Thijs Christian
Vik, Unni
Yazdani, Mazyar
Zhao, Sen

Research assistants
Bjørnæs, Ane Mari
Krishnappe, Yathin S.
Meshesha, Anagaw

Technical staff
Amundsen, Rita
Bakke, Hege
Borg, Hans
Brubak, Sissel
De Munck, Eric
Erlend, Johan
Granberg, Mads
Hansen, Marianne H.
Herland, Anders
Holm, Sindre L.
Høydahl, Stein
Johansen, Ingrid
Kaasa, Berit
Langrekkken, Bjørn
Langrekkken, Marit
Leslie, Erik Anita
Mathiesen, Bård
Mathiesen, Cecilie
Nederbragt, Alexander J.
Nerli, Emelita R.
Opsahl, Tom
Pedersen, Bodil K.
Rise, Øyvind
Schou, Kathrine
Skage, Morten
Steen, Nanna Winger
Sundøy, Jan A.
Svendsen, Gro Kind
Thorbek, Birgitte L.G.
Tooming-Klunderud, Ave
Ursin, Mette K. B.

Administrative staff
Bogojev, Sibinka
Bråthen, Kjetil
Bøkenes, Lise
Engh, Aasta K.
Gundersen, Gry
Haugen, Helen
Jentoft, Sissel
Majid, Sumera
Onsrud, Maren
Rygg, Kari
Salvesen, Agnethe
Smith, Mari E.
Thomsen, Camilla Signe
Wallem, Tore

Professor/Assistant professor emeriti
Andersen, Thorvin
Hasle, Grete Rytter
Eriksen, Aud B.
Mysterud, Ivar
Rueness, Jan
Ryvarden, Leif
Schram, Thomas
Stenersen, Jørgen
Throndsen, Jahn
Wielgolaski, Frans E.

Others
Mysterud, Iver
Ottersen, Geir