The research focus of the Department of Biosciences is to understand fundamental biological processes from molecular and cellular level to population and ecosystem level. The Department has one Centre of Excellence (Centre for Ecological and Evolutionary Synthesis) and four research sections (Aquatic Biology and Toxicology, Biochemistry and Molecular Biology, Genetics and Evolutionary Biology, Physiology and Cell Biology). Furthermore, the IBV is involved in three Strategic Research Initiatives (SRIs) at the Faculty of Mathematics and Natural Sciences: Centre for Computational Inference in Evolutionary Life Science (CELS), Centre for Integrative Microbial Evolution (CIME), and Centre for Integrative Neuroplasticity (CINPLA).

By 15th December 2014, the Department had 49 faculty members, 12 adjunct positions (20% positions), 15 permanent and 5 temporary administrative positions and 42 permanent and 13 temporary technical positions. 106 post docs/researchers and 68 PhD research fellows were employed by December 2014. Additionally the Department this year housed >100 visiting researchers.

There are at any given time about 650 students in total at the undergraduate and graduate levels. 92 master degrees and 22 PhD degrees were awarded were awarded by the Department. We taught a total of 99 courses; 24 bachelor-, 44 master-, 29 PhD-courses as cloned master courses, and 2 PhD courses.

In 2014, our researchers published 331 articles in peer reviewed journals and contributed more than 300 conference papers, reports, media contributions and other professional presentations.

Best teachers in 2014, nominated by the students, were Winnie Eskild and Jens Ådne Rekkedal Haga. The innovation/dissemination award were presented to the iGem team, and Ola T. Westengen et al., Cassandra N. Tier et al. and Melinka A. Butenko et al. were awarded best paper prizes.

The total budget for the Department of Biosciences in 2014 was 343 million NOK, of which 143 million NOK came from external funding sources. Financing of the Department’s external projects is distributed from the Norwegian Research Council (96 million NOK), and other national and international funding (EU, public and private sectors; 47 million NOK).
The Chair’s Comments

2014 demarks the year that Department of Biosciences (Institutt for biovitenskap, IBV) developed from a newborn infant to a curious toddler. Slowly, but surely we are finding our ways, being part of an organization that is under constant changing, incremental change.

The quality of a university department is not the sum of its assets, cash flow or material resources, but rather a reflection of its people. In that regard I feel very fortunate to lead the IBV, because every day I get to work with people that I really enjoy, people who are at the top of their game, the best in their field. I took a quick look at last years “comments” and noticed that I mentioned in particular our success in FRIPRO; and yet again, the IBV was the major recipient of FRIMEDBIO grants in 2014. This is obviously because of a number of outstanding scientists work in the department, but I believe that it is also the result of a positive and collegial culture of support for each other. It is also the result of a work culture where it is recognized that quality of the finished product depends on quality in every link of the chain, whether it be scientific, administrative, technical or financial. In that regard we are fortunate to have a very professional administration whose goal it is to be the best department administration at UiO. This is a culture that we should cherish, but also work to continually improve, just like we try to improve the quality of our research and of our education program. Science is no longer a solitary affair and many research projects need teams of scientist often from different field to be brought to fruition. At the IBV, embedded with the Faculty of Mathematics and Natural Sciences (MN Faculty), we are in a superb position to assemble such teams to tackle important biological questions, and such questions are being tackled at IBV, in the three MN strategic research initiatives, in the departmental prioritized research areas and in other projects.

In 2014 we have had three departmental seminars to discuss the future of our education program. I have really enjoyed these meetings and I am sure that for many faculty members “discovering” a new set of colleagues has been quite interesting. The launch of the new bachelor programs at the MN Faculty has been set to autumn 2017, and there is a lot of work to be done before then. While the education we provide today certainly is of a high international level, tomorrow’s standards are even higher. The data explosion has hit biology and tomorrow’s candidates must get the tools required to cope with this as part of their basic education. Additionally, they need to be equipped for a long and constantly changing work environment. Furthermore, we wish to increase flexibility in our bachelor programs and create a better learning atmosphere. Some changes will go into effect before 2017 and 2014 was the first year that IBV bachelor programs (Biology and MBK) participated in the MN Faculty program seminars. Along with a few professors I participated in the two-day seminar at Sundvollen myself and enjoyed ice-breaking exercises, creative performances, good food and evening games with nearly 150 first year students.

It is my goal that the IBV is an “open” institute that engages and is engaged by society. Participation at “Forskningstorget” is one such event where we can share our interest with others, particularly the younger generation. The theme for Forskningstorget in 2014 was “communication” and our stand attracted many kids (and a molecular biologist department head) that wanted to learn about bird song and dialects. 2014 was also the first year that IBV sponsored a team for iGEM (international Genetically Engineered Machines). An interdisciplinary group of seven students worked in the lab, blogged, presented their project (MicrOrganizer) at many venues and finally went to Boston end of November to participate in the giant jamboree. The iGEM team became somewhat famous early 2015 when they were asked by the University Rector to present their project to Crown Prince Haakon and Crown Princess Mette-Marit at their visit to University of Oslo.

On the following pages you will find the wrap up of year 2014 at our department. This year’s annual report differs from the previous one as it the first annual report organized according the new sections at IBV. Another sign of incremental change.
Board and committees

**Board**

Department chair
Finn-Eirik Johansen

Scientific staff representatives
Asbjørn Vøllestad
Marianne Fynh

External scientific representative
Dag L. Aksnes (UiB)

Technical and administrative staff representative
Hans Borg

Temporary scientific staff representatives
Øystein Langangen
Åshild Vik

Student representatives
Ina Hodnebrug
Jonfinn Blix Knudsen

Deputy representatives, scientific staff
Kristian Prydz
Josefin Titelman

Deputy representatives, technical and administrative staff
Kathrine Schou
Agnethe B. Salvesen

Deputy representatives, temporary scientific staff
Synnøve Botnen
Øystein Langangen

Deputy student representatives
Julie S. P. Knudsen
Håkon Høgset

**Committees and workgroups**

**Employment committee, PhD students and post docs**
Norbert Roos (chair), Helene M. Lampe, Øystein Langangen

**Education committee**
Uwe Klein (chair), Tom Andersen, Glenn-Peter Sætre, Anneleen Kool (NHM), Håkon Hogset (student representative), Brit Vike (student representative), Agnethe B. Salvesen (secretary)

**PhD program committee**
Håvard Kauserud (chair), Pål Falnes, Katrine Borgå, Glenn-Peter Sætre, Kristian Prydz, Sumera Majid (secretary)

**Master and Bachelor program committees**
*Biology*: Glenn-Peter Sætre (chair), Stein Fredriksen, Ketil Hylland, Helene Lampe, Anneleen Kool (NHM), Mathilde Hauge Skarsjø (student representative), Andreas Otterbeck (student representative), Lise Bækenes, Agnethe B. Salvesen
*Molecular biology, biochemistry and physiology*:
Uwe Klein (chair), Jon Nissen-Meyer, Kristian Gundersen, Lieblein Røsæg (student representative), Bernt Wu (student representative), Torill Rørvæit, Kyrre Grøtan

**Dissemination workgroup**
Tone Gregers (chair), Klaus Høiland, Einar Størness (NHM), Kristin Glørstad Tsigaridas, Tore Oldeide Elgvin, Tore Wallem, Ivan M. Winje, Agnethe Salvesen/Kyrre Grotan, Fredrik Ellingsen (student representative), Inger K. Volden (student representative)

**Local working enviroment committee**
Finn-Eirik Johansen (chair), Maren Onsrud, Marit Ledsaak, Cecile Mathiesen, Mali Ramsfjell (student representative), Moreiro Engh (student representative), Jan Erik Olsen (TA, observer), Kathrine Schou (secretary)

**Safety representatives**
Ibrahim Hujaleh, Marit Ledsaak, Helene Lampe, Nanna W. Steen, Cecile Mathiesen, Johan Erlund, Marit Langrekken
2 Finances

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| Transferred to 2015 | 46 647 000| 5 858 000| 12 143 000| 2 205 000| 26 441 000 |
| Allocated funds 31.12.2014 | -23 998 000| -9 650 000| -12 143 000| -2 205 000| -26 441 000 |
| **Balance 31.12.2014** | -3 792 000| -3 792 000| 0 | 0 | 0 |

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 sections and CoE-Centre for Ecological and Evolutionary Synthesis

#### Aquatic Biology and Toxicology (AQUA)
- S. Kaartvedt
- B. Edvardsen
- T. Andersen
- K. Borgå
- S. Fredriksen
- D. Hessen
- K. Hylland
- H.E. Karlsen
- D. Klaveness
- H.P. Leinaas
- J. Titelman
- K.I. Ugland
- S. Brubak
- R. Amundsen
- B. Kaasa
- P.J. Færøvig (50%)

#### Genetics and Evolutionary Biology (EVOGENE)
- P.E. Grini
- K. Shalchian-Tabrizi
- T. Schumacher
- H. Kauserud
- K. Holland
- J.M. Koomey
- R. Aalen
- D. Linke
- C. Mathiesen
- R. Fallet
- S.H. Engebretsen

#### Centre for Ecological and Evolutionary Synthesis (CEES)
- N.C. Stenseth
- S. Jentoft
- A.K. Brysting
- T. Ergon
- T. Hansen
- G. Hestmark
- K.S. Jakobsen
- H.M. Lampe
- A. Mysterud
- T. Slagsvold
- G.P. Sætre
- A. Vallevold
- A. Herland
- L. Nederbragt (80%)
- E.R. Nørlé (60%)
- M. Selander Hansen
- M. Skage
- A. Tooming-Kluenderud
- N. Winger Steen
- PE. Kistiansen
- S. Kistenich
- H. Lehtes (20%)
- A. Moen
- R. Ose
- R. Sivaganesh (50%)
- M. Ledsaaak
- S. Qu
- A. Hofgaard
- T. Kungervik Larsen
- B. Mathiesen
- K. Ore (60%)
- M. Saljakova
- F. Skjeldal

#### Biochemistry and Molecular Biology (BMB)
- Fahri Saatcioglu
- P. Falnes
- T. Kristensen
- J. Nissen-Meyer
- W. Eskild
- K.K. Andersson
- O. Stokke Gabrielsen
- I. Sandlie
- H. Aarnes
- U. Klein
- L.H. Haugen
- A. Hofgaard
- T. Kungervik Larsen
- B. Mathiesen
- K. Ore (60%)
- M. Saljakova
- F. Skjeldal

#### Physiology and Cell Biology (FYSCELL)
- Marianne Fyhn
- K. Prydz
- K. Gundersen
- G. Nilsen
- G. Griffiths
- O. Bakke
- N. Roos

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*Figure 2 Research sections and CoE-Centre for Ecological and Evolutionary Synthesis (per 15.12)*
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.

**CEES in brief**

CEES has now only three more years to go as a Centre of Excellence (CoE) within the current 2007–2017 funding period. All indicators show promise for what we might expect during the latter part of this 10-year period – and beyond. We continue to keep up our good publication record and to obtain good external financial support for our work.

In 2014, CEES consisted of 161 members (including core staff, post docs and researchers, PhDs, research assistants, technical and administrative staff, and master’s students). In addition, 15 guests stayed for more than one month, and 21 guests for less than one month. The members and guests represented 34 nationalities. The Centre has a core group of 16 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. CEES is chaired by Professor Nils Chr. Stenseth.

CEES supervised 34 master’s and 29 PhD students in 2014, and was also involved in the teaching of 7 PhD/master’s courses and 3 bachelor’s courses. 7 new PhD students were employed, and 4 PhD students and 13 master’s students completed their degrees. The CEES graduate school held its annual conference at Holmen Fjordhotell with 137 delegates.

Approximately 94 MNOK of the total budget of 152 MNOK came from the 56 externally funded research projects conducted by CEES. Most of the projects were funded through the Research Council of Norway. CEES is also involved in various EU-funded projects. 18 new projects were started in 2014.

CEES members published 159 articles in peer reviewed journals and 17 books/book chapters/reports in 2014. The majority of these results lie within the core scope of CEES. 178 talks at conferences were conducted. The centre hosted 71 guest speakers, primarily from abroad.

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 topics of the Colloquia are as follows: **Colloquium 1**: Selection and evolvability: Concepts, measurements and statistics. **Colloquium 2**: Bridging the gap between genomics and evolutionary biology. **Colloquium 3**: The ecology and evolution of infectious diseases with an environmental reservoir. **Colloquium 4**: Integration of ecology and evolution: A synthesis.

The annual student conference

The CEES Annual Student Conference is a compulsory event that provides a good forum for students to hone their communication and presentation skills in a professional setting. This year the conference was held October 21.–22. at Holmen Fjordhotell with 143 delegates. For the first time, the CEES Scientific Advisory Board (SAB) was present at the conference. Including a few talks by senior scientists, 65 talks were given.

Communication of science

An important goal of CEES is to communicate its research and findings, as well as to increase the appreciation and understanding of science. Our

*This is an extract of the CEES annual report. The complete report is published at www.mn.uio.no/cees/english/about/documents/
aim is to reach both Norwegian and international audiences. A central part of our scientific outreach is the open seminars with high-profile researchers and communicators of science, held both on the university campus and at public venues such as Oslo’s House of Literature (Litteraturhuset). For the ninth year in a row, the annual events of Darwin Day and the Kristine Bonnevie Lectures on Evolutionary Biology were held, the latter constituting a regular part of the university’s annual anniversary day. In 2014, the topic for Darwin Day (12 February) was “The major transitions in evolution: From the origin of life to the emergence of language”, and featured lectures by Stefan Bengtson, Terrence W. Deacon, William F. Martin, Adam Rutherford, Nathan Sanders and Eörs Szathmáry. The Kristine Bonnevie Lecture on Evolutionary Biology (September 2.) by Hopi Hoekstra from Harvard University was titled “Digging for genes that affect behavior”. It was preceded by the lecture “On the relationship between science and philosophy” by Massimo Pigliucci from The City College of New York.

The synthesis “Bridging the gaps” has become a trademark of CEES – fitting very well with our overall aim of bringing ecological and evolutionary thinking closer together. CEES has been successful in getting classically trained, organismic-oriented scientists (focusing on both ecological and evolutionary processes) to work together with genomics-oriented scientists. That in itself is an achievement we are very proud of, and we consider it a major accomplishment. To a large extent it has been made possible by the work within Colloquium 2 (“Bridging the gap between genomics and evolutionary biology”) and the subsequent work building upon that colloquium. Our work on the ecology and evolution of cod populations and on the hybrid speciation in sparrows – both part of Colloquium 2 – are prime examples of the integration of ecological and evolutionary thinking. Another such example is the work that we are conducting on plague. This is part of Colloquium 3 (“The ecology and evolution of infectious diseases within an environmental reservoir”). Much exciting synthesis work is currently taking place in that colloquium. The decision to establish a modern ancient DNA laboratory, to be officially opened April 2015, will certainly facilitate this work. Colloquium 4 (“Integration of ecology and evolution”) is the final colloquium of CEES, within which the synthesis work is to be concluded. Within this colloquium we are bringing together paleobiological work, experimental microbial work, and theoretical work. The synthesis work within this colloquium has received additional external funding, greatly facilitating it. Few if any other research groups cover such a broad range of competence in the quest to understand how evolutionary and ecological processes are mutually interwoven and lead to macroevolutionary dynamics.
SCIENTIFIC HIGHLIGHTS

The evolution of reproductive isolation during hybrid speciation

Natural hybridization is currently receiving much attention in evolutionary biology. Aided by novel sequencing technologies, researchers are discovering that a great number of sexually reproducing taxa previously thought to be good biological species exhibit genetic signals of admixture, and that the levels of gene exchange in natural systems are higher than previously appreciated. Even our own species has been shown to harbor a complex reticulate history involving several admixture events with archaic humans, including the Neanderthals whose genetic material some of us still carry with us today.

Among the more spectacular outcomes of natural hybridization is hybrid speciation. During this process a novel taxon arises through interbreeding between existing taxa, and develops reproductive barriers against them. Though recognized as a potentially vital contributor to biological diversification, questions regarding how reproductive isolation can develop during this mode of speciation and whether “special” and possibly unlikely circumstances are required, have made its evolutionary importance unclear.

In two recent papers published in *PLoS Genetics* (Trier & Hermansen et al. 2014) and *Molecular Ecology* (Hermansen et al. 2014), CEES researchers have shed important light on this problem. By means of genetic analyses they have shown that the hybrid Italian sparrow (*Passer italiae*) is reproductively isolated from its parent species, the house sparrow (*Passer domesticus*) and the Spanish sparrow (*Passer hispaniolensis*), through the sorting of preexisting genetic incompatibilities in the form of sex-linked and mito-nuclear incompatibilities. In short, a subset of the incompatibilities that separate the parent species from each other has become sorted in the hybrid genome in such a way that they act as reproductive barriers against the house sparrow, while another subset is acting as reproductive barriers against the Spanish sparrow.

This is the first time post-zygotic barriers in the form of genetic incompatibilities have been shown to isolate a hybrid taxon. The studies therefore show that hybrid speciation may be driven by mechanisms similar to those involved in non-hybrid speciation, but with the formation of two geographically separated species boundaries instead of one. Hence, hybrid speciation can occur without the need of invoking “special” processes, and may therefore be more important for the diversification of life on earth than has previously been thought.

Interestingly, the findings presented in the two papers suggest that the mito-nuclear incompatibilities that contribute to isolation between the hybrid taxon and one of its parents, as well as between the parent species, result from genomic conflict in the form of the so-called ‘mother’s curse’. ‘Mother’s curse’ is the phenomenon that female beneficial mutations in mitochondria that are harmful to males can spread due to the maternal inheritance of mitochondria. This sets up a selective sieve that allows for the build-up of male-detrimental mutations, which in turn selects for suppressor alleles that restore male fitness. Mismatches between mitochondrial alleles and nuclear suppressor alleles lead to detrimental effects in hybrids whose parents differ in mito-nuclear system. In female-heterogametic taxa (ZZ/ZW), Z-linked genes spend two-thirds of their time in the male lineage, and suppressor alleles are therefore expected to be disproportionately situated on the Z chromosome. Such an overrepresentation of Z-linked genes with mitochondrial function among the candidate reproductive isolation loci shifting alongside the mitochondria at species range boundaries is exactly what the CEES researchers have found. As such, in addition to adding to our understanding of hybrid speciation, these papers also add to our understanding of reproductive isolation in general as they are the first to empirically indicate a direct role for ‘mother’s curse’ in the origin of any species, hybrid or not.

Phenotypic variation and species interactions in a hybrid species complex

One of the most famous examples of adaptive
radiations, the case of Darwin’s finches (Geospiza), has long fascinated biologists. In particular, the pronounced diversity in beak morphology of the different species that occupy the Galapagos archipelago and its role in species interactions, via competition and hybridization, confirm the functional versatility and evolutionary significance of the avian beak.

Previously, in a paper published in Heredity (Eroukhmanoff et al. 2013), CEES researchers similarly emphasized the importance of beak morphology in local adaptation to environmental pressures in the Italian sparrow. Beak dimensions covary strongly with precipitation regimes. However, little was known about the role of beak morphology in the context of species interactions in this hybrid species complex. In a recent paper published in Evolutionary Biology (Eroukhmanoff et al. 2014), CEES researchers show that, in two different contact zones, one between the hybrid Italian sparrow and one of its parent species, the Spanish sparrow, and one between the two parent species, the architecture of beak morphology changes in sympathy in both the parent and the hybrid species. Phenotypic integration between beak dimensions decreases significantly where two species co-occur. Hence, these beak dimensions may effectively be able to respond in an independent fashion to different selective pressures and allow for rapid changes in overall shape of the beak in sympathy.

Although beak integration is generally conserved across species, interactions between closely related species can apparently lead to a redistribution of variation between beak dimensions relative to allopatric populations of the same species. Such a flexible architecture of beak morphology may promote the coexistence of these species when they overlap geographically, through divergence in beak shape that reduces niche overlap and hence competition.

Summarized by Jo Skeie Hermansen and Fabrice Eroukhmanoff
Weather, space use and harvesting of red deer

Most cervid populations in Europe and North America are managed through some form of selective harvesting, which has a large influence on the population growth rate. Management actions such as age- and sex-specific quotas give rise to most of the selectivity, but hunter preferences also play a role. In addition, harvesting selectivity may arise indirectly, i.e. through animal behaviour, where the differential use of open and closed habitats can make the animals more or less prone to being harvested. As the different sexes and age groups are expected to behave differently, the differential movement patterns can give rise to variation in their associated probabilities of being harvested. Open habitats such as farmland are more exposed to harsh weather, and periods of heavy precipitation or low temperatures can cause cervids to seek cover in closed habitats and thus utilise open habitat to a lesser extent.

For hunters, periods of extreme cold or heavy precipitation can constitute less attractive hunting weather than warmer and drier conditions. Moonlight is also known to influence hunting success in predator-prey interactions, and may also affect harvesting vulnerability in cervids, as well as hunter effort through increased invisibility. However, how prevailing weather affects harvesting selectivity and off-take indirectly through changes in individual animal and hunter behaviour has received little attention in the literature.

We used harvest data from red deer (Cervus elaphus) to investigate how weather and habitat characteristics affect behavioural decisions of animals and their hunters throughout the hunting season. More specifically, we looked at how sex and age class, temperature, precipitation, moon phase and day of week affect the probability of being harvested on farmland (open habitat), hunter effort, and the overall harvest numbers.

In general, the effect of fall weather conditions and habitat characteristics on hunter effort and harvest numbers varied through the season. I.e., the effect of temperature on total harvest numbers was negative mid- and late-season, with no effect early in the season. We also found higher harvest numbers (figure 1) and hunter effort during the full moon late in the season, as well as a consistently higher hunter effort during weekends than on weekdays (figure 2). Yearlings showed the highest variation in the probability of being harvested on farmland through the season, and the results were similar for both males and females.

This study is among the first to highlight that weather may affect harvesting patterns and off-take indirectly through animal and hunter behaviour. The interaction effects of weather and space use on hunter behaviour are complicated, yet nevertheless seem less important than hunter
preference and quotas in determining hunter selection and harvest off-take. We argue that taking into consideration the variation in hunter behaviour is important when forming management rules for sustainable harvesting.

*Summarized by Inger Maren Rivrud and Atle Mysterud*

Ancient genomics, whereby whole genome sequence data are obtained from historical biological material, can provide a unique snapshot of past genetic variation. Such data can be used to detect signatures of natural selection, allowing an improved understanding of the processes that underlie genetic adaptation in wild populations.

We have formed an international collaboration with the Institute of Marine Research (Norway), Fisheries and Oceans (Canada), and the Marine Research Institute (Iceland) to investigate the potential of natural selection in highly exploited Atlantic cod populations using ancient DNA (aDNA) samples (e.g. figure 1) of up to 100 years old.

Working with aDNA samples is not always straightforward. For instance, it is well recognized that systematic sequence bias in aDNA data can be introduced due to laboratory protocols and postmortem degradation. Postmortem degradation leads to cytosine deamination and increased fragmentation at purine positions, and choice of polymerase affects GC content and fragment length. Additionally, specific ligation protocols select against DNA fragments that start with a thymine residue, and can promote hairpin formation leading to palindromic sequence artifacts (Star et al. 2014). Nevertheless, species-specific genome architecture is not often considered to affect aDNA data.

We observed an unusually high proportion of simple AC and AG microsatellite dinucleotide repeats when analyzing Atlantic cod aDNA data from samples over 70 years old, with up to 40% of all bases solely consisting of repeats (Star et al. 2014). These microsatellites are problematic as they lead to reduced alignment success and decrease the economy of sequencing aDNA samples. We investigated the natural abundance of these specific repeats in the Atlantic cod genome (Star et al. 2011) and found that it contains an order of magnitude more (nearly 9%) of these repeats than other species (figure 2). We therefore wondered if this high endogenous repeat content was causal for its overrepresentation in the aDNA sequencing data. In a recent paper (Star et al. submitted), we show that amplification conditions strongly influence the relative proportion of these types of repeats. Moreover, the proportion of these repeats can be altered through the inclusion of artificially
made repetitive oligonucleotides during the amplification of WGS libraries generated from aDNA samples. Based on these results, we propose that self-priming of short, fragmented repeats is the predominant process leading to the preferential amplification of AC and AG repeats. Our data provide a fundamental observation that the specific genome architecture of a particular species – in this case Atlantic cod – interferes with a widely used aDNA library preparation protocol.

*Summarized by Bastiaan Star*

*Historic specimen of a juvenile Atlantic cod (Gadus morhua)*

**Dinucleotide repeat content in vertebrate assemblies.** The amount of AC and AG dinucleotide repeats was obtained using Tandem Repeat Finder (TRF, version 407b) in 63 vertebrate genome assemblies (Ensembl, release 76). Estimates were divided by total assembly size, excluding undetermined bases. Assemblies with more extreme repeat content are indicated. (Star et al. submitted).


**NorMER**

**NorMER** is a Nordic Centre of Excellence that 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 program of primary research, implemented by PhDs and postdocs in a system of collaborative projects, with 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: a) evaluate climate effects on Nordic marine ecosystems, b) build new tools for predicting biological consequences of climate change, and c) 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

NorMER is primarily supported with funding from Nordforsk, on behalf of the Top-level Research Initiative (TRI), and from each of the main partners. NorMER is administered by CEES.

**GreenMAR**

**GreenMAR** is a project funded by NordForsk that studies the complexities of the marine systems in the Nordic region using multiple interacting approaches. This region is host to some of the largest commercial fish stocks in the world. These fish stocks are not only important for coastal communities, but for the Nordic societies as a whole, and indeed on a global scale.

More specifically, GreenMAR investigates to what extent the ecological and social components of complex marine systems are capable of adapting to growing stress factors. Marine ecosystems are under particular pressure due to fishing and increased human activity, such as maritime transport, oil exploitation, and coastal development. Overfishing, habitat destruction, nitrification and freshwater run-off are just a few examples of man-made stress factors that act in concert with climate change and threaten the viability of our oceans. By furthering our understanding of these issues, GreenMAR seeks to provide corresponding management recommendations in order to improve harvesting strategies and ensure green growth. The fundamental challenge of green growth is to use renewable natural resources more efficiently, while ensuring that they retain their functionality.

In order to achieve its aims, GreenMAR relies on both multidisciplinary and interdisciplinary approaches. As an interdisciplinary Nordic research team, GreenMAR joins forces with researchers in the USA, Russia, and the Netherlands, along with one of the largest Nordic fishing companies. Climatologists and oceanographers provide state-of-the-art models on how climate affects sea surface temperature, ocean circulation and freshwater run-off. These models will be combined with large-scale ecological time-series to unravel ecological key mechanisms and detect critical thresholds. Sociologists will perform in-depth studies in order to quantify fishermen’s knowledge about the marine system and ability to adapt to changes. These insights will be integrated in social-ecological models to quantify how systemic properties, such as resilience, sustainability, and viability will be affected by climate change. In parallel, bio-economic models will be developed to predict the economic effects of climate change and to investigate how industry and regulation can adapt in a cost effective way. Together, such a multidisciplinary approach provides knowledge to ensure the sustainable management of our oceans, as a necessity and a catalyst for green growth.

**NorMER**

GreenMAR is administered by CEES.
The section for Aquatic biology and toxicology (AQUA) was established in January 2014 and includes personnel from 4 former sections at the Department of Biosciences. The section consists of 2 associate professors, 10 full professors, 4 adjunct professors and 4 technicians, 9 PhD research fellows, and 2 postdocs/researchers. The section also houses master students from the programs Marine Biology and Limnology, Ecology and Evolution, and Toxicology.

Research and teaching in the section focus on freshwater and marine ecosystems, with the toxicology group also including studies on terrestrial organisms and human toxicology. Marine and freshwater ecosystems differ in physical and chemical properties, in biological complexity and research traditions, but there are also many similarities, and the same ecological and evolutionary driving forces and principles apply. AQUA aims at gaining new insight by merging knowledge and research traditions from the marine and limnetic sub-disciplines.

The research addresses processes from the molecular and cellular level to populations and ecosystems, and how organisms and ecosystems are affected by a range of ambient factors, including anthropogenic impacts of pollution and climate change. The range of organisms encompass viruses, bacteria, benthic algae, phytoplankton and other protists, sea grasses, zooplankton, fish, seabirds and marine mammals, covering taxonomy, ecology, behavior, toxicology and interactions through food webs and host-pathogen interactions. The research is performed both locally and globally, spanning habitats from the Arctic to Antarctica, as well as tropical waters.

Several of the research activities cover a range of ecosystems and organisms, e.g. how impact of terrestrial catchments may affect freshwater and marine ecosystems via runoff of various compounds.

Carbon fluxes and biogeochemistry
A large activity that links freshwater and marine activities together concerns the role of catchment properties and climatic effects on the flux of dissolved organic carbon (DOC) to lakes and coastal waters. There is currently a strong increase in DOC in surface waters which causes light limitation, reduced productivity and community changes. Associated with this are also studies on fluxes of other key elements from land to aquatic systems, such as phosphorus, nitrogen, iron, silicate and calcium. Many of these elements show strong trends of increase (Fe, N), while notably Ca is decreasing strongly. This again affects a suite
Research of ecosystem properties, including productivity and food webs at large. Related to this is also an ongoing work of modeling activities to assess the impacts of climate change on these parameters, and also lake temperature, stratification, freezing and ice-off. Remote sensing and time series forms part of this, hence GIS-tools and heavy computational efforts forms part of these activities.

**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 subarctic 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 focused 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.

The interaction between life history traits and multiple stressors, including toxicants, is a prioritized research field at AQUA. Life-history variation under multiple stressors is addressed through several PhD projects, both from an ecological and ecotoxicological point of view. The effect of life history variation on contaminant accumulation is also in focus.

**Biodiversity**

The access to large and unique datasets on diversity of phytoplankton, zooplankton and fish from thousands of lakes is the basis for several activities, projects and papers. 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 and is 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.
Marine protist biodiversity has been addressed in European coastal localities, including the Oslofjord, using 454 pyrosequencing and bioinformatics. Also, the diversity of marine flagellates in the phylum Haptophyta and their seasonal dynamics in relation to environmental factors incl. viruses have been explored by 454 pyrosequencing and supplemented with electron microscopy. A large unknown diversity among haptophytes has been revealed compared to previous records by microscopy and some represent novel and unknown branches on the tree of life. Also the seasonal nano- and pico-plankton protist and virus diversity have been addressed, studying possible influence of viruses on phytoplankton composition as well as examining the potential of high throughput sequencing to monitor toxic algae. Recently started arctic projects include metagenomics and metabarcoding studies of viruses, bacteria and protists to reveal players and processes. Finally, patterns in biodiversity and models for estimation of species abundance and species richness data have been addressed for a range of different ecosystems and taxonomic groups.

**Algal/protist systematics and evolution**

Morphological and molecular data have been combined in describing several new microalgal species and to revise the taxonomy within haptophytes. Harmful algae have been studied for decades and 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. A microarray assay for the monitoring of toxic marine algal species has been developed, now under patenting and ready for commercialisation. Molecular probes specific for toxic algae in the genera Dinophysis, Phalacroma and Pseudochattonella have been developed for the microarray assay and applied on samples collected from outer Oslofjorden. Molecular probes detecting the algal neurotoxin saxitoxin was also applied using qPCR.
Other projects have examined the effect of changing environmental parameters such as nutrient availability and temperature increase on marine phytoplankton of the type coccolithophores (Haptophyta). Culture experiments have been used to observe changes in the production of inorganic and organic carbon, important components of the biogeochemical carbon cycle. Furthermore, coccoliths formation has been studied using different microscopic techniques.

**Pelagic ecology and behavior**

The research focuses on different aspects of plankton interactions, dynamics and diversity in pelagic habitats both in lakes and marine systems. Studies address both productivity, diversity and community or food web in plankton organisms (both autotrophs and heterotrophs), and how plankton community composition and abundances varies in time and space as a function of environmental forcing. Advantages both for the freshwater and marine studies are access to a wide range of lakes in the vicinity of Oslo as well as easily accessible, sheltered and deep fjord locations. For the lakes studies, both use of large datasets as well as experimental studies have been applied and these activities are linked to several large national and international projects.

Experimental marine studies have addressed small-scale behavioral interactions in crustaceans, mainly copepods. Further experiments conducted at Drøbak Biological Station and at UiO have addressed how predation risk affects copepod male reproductive strategies and other life history investments in marine zooplankton. Projects addressing the hearing abilities and behavioral responses in fish, cephalopods and crustaceans have continued at the Biological station in Drøbak, observing responses (video) to acoustic stimuli. The aim of these studies is to understand how predation has influenced the evolution of acoustic-lateral sense organs in fish and marine invertebrates. Related studies investigate the impacts of seismic noise on fish and marine mammals, aiming to understand how behavior is affected by
high intensity sound pulses such as from seismic exploration activities, monopiling etc.

Acoustic studies (echosounders) on mesopelagic fish have aimed at assessing their global distribution and abundance, as well as to compare their biology in the oligotrophic, clear and warm Red Sea with mesopelagic fish in murkier and seasonally variably Norwegian waters. Acoustic data have also been used in assessments of jellyfish swimming behavior.

**Benthic ecology and interactions**

Benthic ecology and interactions primarily focus on macroalgae and seagrasses, but also include studies on microalgae. Ecological study of macroalgal systems have been carried out 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*). A focus in 2014 was on how climate change affects sea urchin populations along the Norwegian coast. By use of molecular methods, connectivity between sea urchin populations was studied. The section is also involved in a global network on kelp and climate change. Furthermore, macroalgae from rocky coasts have been addressed at sites around Spitsbergen.

Seagrasses are higher plants with a worldwide distribution, and the studies have included exploring the biodiversity and community structure of a seagrass bed in the Red Sea, Saudi Arabia. Additionally, the micro- and macroflora and fauna, and fish, in addition to food webs have been investigated. Microalgal strains have been isolated, genetically characterised and systematically placed and includes new species for science. Microalgae in sandy shores have been addressed at sites around Spitsbergen.

**Toxicology** is a popular MSc study program, and more than 30 master students have been supervised at any one time over the past decade. The research in toxicology and ecotoxicology spans from in vitro mechanistic studies with primary cell cultures, through exposure studies with fish and marine invertebrates to mesocosm studies of pelagic and sediment processes, and understanding of environmental and ecological processes affecting food web accumulation of contaminants. Recent projects include a characterization of effects caused by oil spills, measurement of genotoxicity in marine organisms from mussels to polar bears, effects of climate change on food web biomagnification of contaminants, bioaccumulation and effects in Arctic seabirds. In addition to using small-scale, high-throughput experimental models such as primary cell cultures, AQUA 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. The section is also in the forefront in bioaccumulation research on legacy and emerging contaminants, combining field observations, multivariate statistics and mechanistic modelling to make stronger links between ecological and contaminant research. In 2014 there was an increasing activity in arctic ecotoxicology, both due to the strong polar research profile of a recently employed professor, and by expanding the focusing on the abovementioned mechanisms of genotoxicity and DNA repair to Arctic marine mammals. 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. There are ongoing projects on ringed seal, polar bear and beluga.

Scientific collaboration, representation and outreach
At IBV, the program collaborates with EVOGENE and CEES on phytoplankton ecology and evolution. At UiO, we collaborate with Dept. of Pharmacy and the Biotechnology Centre on bioprospecting from microalgae and on fish physiology and electron microscopy. Nationally, we collaborate with UiB on pelagic and benthic ecology, microbiology and biodiversity, and IMR on pelagic ecology and fish and marine invertebrate behavior to acoustic stimuli. The latter also includes cooperation with Statoil. Collaborations with NTNU, UNIS and Norwegian Polar Institute include polar biology and toxicology and with NTNU also on terrestrial arthropods. There is a well-developed collaboration with NIVA, including on toxicology. Other main national collaborators in toxicology were the National Institute for Public Health and Norwegian College for Veterinary Sciences, the latter also including terrestrial arthropods.

Nordic cooperation involves SLU, and the Universities of Uppsala and Umeå, Sweden, for limnological research, SYKE, Finland for Baltic Sea research and the University of Aarhus and Odense, Denmark on sensory ecology.

We also cooperate with leading Universities and marine biological research institutes in Europe (e.g. Oxford, England; AWI, Germany; CNRS, France; ICM Spain, University of Lecce, Italy), as well as with institutions in Asia, New Zealand, South Africa and USA, through EU and national projects. The toxicology group has close collaboration with human toxicological research groups and ecotoxicological research groups. 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.

International cooperation on ecological stoichiometry involves several US universities including Arizona State and Minnesota, as well as European colleagues in Brest (France), Linz (Austria), Oldenburg, and Munich (both Germany). 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.

Scientists at AQUA chaired and contributed to international working and expert groups, coordinate international projects, have chaired and contributed to a range of national and international organizations and contributed substantially towards international processes, particularly in marine environmental issues, occupational toxicology and risk assessment. Marine botanists at AQUA led the red list working group for The Norwegian Biodiversity Information Centre (Artsdatabanken), led the species name committees for microalgae, were responsible for updating the national species lists and made a risk assessment of the introduction of non-indigenous kelp and were appointed to the Board for Norwegian Algal Society.

Our staff regularly participates in outreach activities such as TV, radio and newspapers. The program supports yearly participation at conferences for scientists, students and technicians.

The publication record in 2014 was 48 peer-reviewed international scientific journal papers.
Section for Genetics and Evolutionary Biology (EVOGENE)

www.mn.uio.no/ibv/english/research/sections/evogene

The Section for Genetics and Evolutionary Biology (EVOGENE) is the only section at the Department of Biosciences that has members from both the former Departments of Biology and of Molecular Biosciences, and includes 9 faculty staff, 1 adjunct professor, 3 technicians, 14 PhD research fellows and 19 post docs/researchers. The EVOGENE section is particularly fit to generate cross-disciplinary synergy, in line with the intentions for creating the new department. EVOGENE provides a research and learning environment where a broad spectrum of basic biological disciplines is represented. Genetics, ecology and developmental biology are seen in an evolutionary perspective. The organism as a whole has a central position in both research and teaching. The main focus is on the relationship between phenotype and genotype - in populations and a broad ecological setting - or in mechanistic nano-biology relations in developmental biology and microbiology. In the merger of classical and molecular genetics with epigenetics and evolution, the research activities in the section are cross disciplinary.

In the strategic plan for 2014 the section aimed at improved research infrastructure and increased research funding, recruitment of highly qualified students and researchers, and promotion of attractive social settings to consolidate the members of the section. These goals have clearly been fulfilled.

To foster interaction and collaboration between the research groups in the new section, physical close localization of the research groups has been prioritized. To achieve this it has been decided to move some groups. Additionally, the lab infrastructure has been upgraded to better fit the needs of the whole section. New labs for molecular work are underway, and a core microbial culturing facility is operating. The section therefore welcomes and is actively involved in the planning of an upgraded and state-of-the-art Plant Growth Center at the department.

Funding, recruitment and research achievements

Eight projects from the EVOGENE section were funded by the Research Council of Norway in the 2014 application round for free projects (FRIPRO), including three young investigator grants and three personal postdoctoral positions. This implicates the recruitment of some of Norway’s most talented young researchers who may have potential for successful ERC starting grant applications. Given the hard competition this is particularly encouraging.

The success of the young investigators as well as the recruitment of two new permanent professors will strengthen central areas of EVOGENE’s research focus, i.e. mechanisms and evolution of bacterial adhesion to eukaryotic cells, micro- and mycobiome diversity, ecology and evolution, and plant molecular genetics and epigenetics. Genotype-phenotype relationship is analyzed in the model plant Arabidopsis thaliana by studying the epigenetic mechanisms of imprinting and dissection of the function of proteins involved in chromatin modifications that regulate gene expression and keep transposable elements silenced. The plant molecular genetics group has also been very successful in elucidating the genetic basis floral organ abscission, by identifying a peptide-ligand receptor pair, Inflorescence Deficient in Abscission (IDA) and its receptors, the leucine-rich repeat receptor-like kinases (LRR RLKs) HAESA (HAE) and HAESA-LIKE2 (HSL2), controlling the shedding of organs. The IDA gene is encoding a short prepro-protein that is processed to a 12 amino acid hydroxyprolinated peptide which, based on biochemical evidence, binds and activates its receptors. (The Plant Cell Perspective paper describing this was among the five papers awarded the Department’s “Best papers of 2014” price.) This generates a signalling cascade resulting in the expression of cell wall remodeling and degradation enzymes. Activation of LRR RLK receptors upon binding of secreted peptides is emerging as major mechanism of cell-to-cell communication in plants.
IDa-Hae/Hsl2 control cell separation events. A) The binding of the peptide ligand IDa to its receptors Hae and Hsl2 induce expression of cell wall remodeling (CWR) enzymes. B) IDa-Hae/Hsl2 is involved in cell separation during floral organ abscission after pollination has taken place, and facilitates the emergence of lateral root primordia by separating cell in the overlying layers.

Although there are hundreds of genes encoding receptors and secreted peptides, less than a dozen have been matched. Intriguingly, IDa/IDL-Hae/Hsl signalling is also at work in cell separation processes in the root. IDa and its receptors control separation of the endodermal, cortical and epidermal cells overlying lateral root primordia and facilitate their emergence. Preliminary evidence suggest that this signalling module is involved in numerous cell-separation processes, like root cap sloughing, germination and seed dispersal, not only in Arabidopsis but also in other species, including important crops. Based on this assumption the plant group has joined forces with experts in phylogenetics and botany in the EvoGene section to elucidate the evolution of cell separation processes and the IDa-Hae/Hsl signalling system. This exemplifies the potential for synergy in this new section.

Research centers
EVOGENE hosts the Centre for Epigenetics, Development and Evolution (CEDE) and members of EvoGene are also central in prioritized inter-disciplinary research activities at the Faculty of Mathematics and Natural Sciences, Centre for Integrative Microbial Evolution (CIME) and Centre for Computational Inference in Evolutionary Life Science (CELS).

The Centre for Epigenetics, Development and Evolution (CEDE) is a new “prioritized research area” at the Department of Biosciences and an initiative to strengthen research in evolutionary developmental biology (evodevo) at the University of Oslo. The vision is to develop a strong and integrated research environment to identify the basic structure, evolution and outcome of the genotype-phenotype relation on all levels from molecule to whole organism based on perspectives from Waddington’s epigenetics and modern evodevo. It is a goal to strengthen developmental biology and establish evodevo as a research discipline at UiO with a comparative macroevolutionary perspective and emphasis on modelling and systems biology.

Microbial evolution comprises a continuum of processes occurring with differing tempo and pace. In some cases such as in the context of eukaryotic microbes, the macroevolutionary time frame involves hundreds of thousands if not millions of years. In the case of prokaryotes, one can discuss changes happening at both the macro- and microevolutionary levels with time frames that may involve time spans from thousands of years to decades. The shortest time frames for microbial evolution are manifest in the genesis and
dissemination of antimicrobial resistance determinants where events are developing on a time scale of a few years to months. Each of these systems provides unique opportunities and challenges to understanding and elucidating the mechanisms driving microbial evolution. Moreover, the basic tools for unravelling these systems exploit shared technologies encompassing genomic and post-genomic technologies, bioinformatics and molecular-based phenotypic analyses. The center is integrative due to the recognition that common molecular mechanisms are operative and that sub-disciplines of microbial biology no longer are isolated fields of study.

The mission of CIME is ultimately to understand how microorganisms evolve and function as a result of interactions at the molecular, cellular, and community levels. Microbes are members of complex communities. It is through the study of interactions between microorganisms and their environment that we can elucidate the roles and relationships of genetic and phenotypic variation in shaping long- and short-term evolutionary processes, spanning the continuum of evolutionary time ranging from organelle development, via adaptation of microbial communities and the molecular origin of pathogenicity, to antimicrobial resistance, which is currently emerging as a serious threat to global human health. To achieve this, we will execute cutting-edge research in microbiology by uniting different biological and biomedical disciplines. Our strength is to combine expertise in organismal, evolutionary and molecular biology. A portfolio of selectively chosen model systems enables us to address fundamental questions on microbial biology in novel ways. In conjunction with this, we aim to develop new, advanced methodologies to assist these studies. It is essential that CIME bridge the cross-disciplinary barriers to create and foster an integrated approach to addressing fundamental questions in biology. The overarching goal is to generate an environment in which scientific excellence can be developed, maintained and fostered.

EVOGENE’s contribution to CIME is largely focused on bacterial surface organelles required for adhesion to and colonization of human cells. Genetic, biochemical and structural analysis is used to study the biosynthesis, composition and structure of pili, the molecular basis for pilus secretion, growth and retraction (required for cellular locomotion), and binding of bacteria to human tissue. An important discovery has been glycosylation of proteins in Neisseria gonorrhoea which contribute too excessive variation in on the surface of the bacteria making it difficult for the host immune system to recognize them.

In Yersinia spp. and enteropathogenic E. coli that can cause serious epidemics in humans, Invasin and Intimin are well known adhesin virulence factors. A novel mechanism for secretion to the cell surface, termed inverse autotransport, has been established by EVOGENE researchers. This

**Intimin-expressing E. coli binding to HeLa cells.**

*Inverse autotransport. The beta-barrel is inserted into the outer membrane (point 1), and secretion of the passenger begins with the formation of the hairpin (point 2) at the N-terminus of the extracellular region, and folding of individual domains of the extracellular region at the cell surface provide the free energy for the export of the polypeptide (point 3). The C-terminus is secreted last to yield a fully folded and functional adhesin (point 4).*
mechanism proceeds via a hairpin intermediate, where the extracellular portion (the passenger) of the protein is secreted in a stepwise manner through the pore of a beta-barrel domain.

The Centre for Computational Inference in Evolutionary Life Science (CELS) will address fundamental biological questions related to the genotype-phenotype paradigm in an evolutionary context using a computational inference approach. CELS brings together strong research environments in biology and statistical and computational methods for data analysis, and will address fundamental biological questions related to the genotype-phenotype paradigm, how the environment affects genome evolution, and development of methods for integrated analysis of genomic and other biotic and abiotic data. The overarching goal of CELS is to bring together biology, statistics and computational sciences and thereby paving the way for the development of groundbreaking bioinformatical and statistical methodology and for biological sciences. CELS’ aim is to develop interdisciplinary research activities generating science of true interest for statisticians, bioinformaticians and biologists. CELS has a systems biology perspective, thus different types of data should be integrated in a common framework to make it possible to establish links, associations and causality with respect to the underlying biological processes.

Scientific and social events
Late in March 2014, almost 60 EVOGENE participants packed their bags and went on a two-day seminar at the research station in Drøbak. The event kicked-off the newly formed section and in addition to scientific presentations from all faculty staff, an emphasis was put on work environment related issues and the organization of the section. Last not least, the retreat was a big success in terms of building social and scientific bonds within the section.

The participation in the international synthetic biology competition iGEM (“international Genetically Engineered Machine”) has become an important teaching activity within EVOGENE. Within the competition, students engineer signalling circuits and combine biosynthetic activities using standardized biological parts. In 2014, the student team was awarded a bronze medal at the international iGEM finals in Boston.

Several journal clubs are active in the section, e.g for evodevo, epigenetics, mycology and environmental microbial diversity, and the section has run a weekly seminar series.

The 2nd Oslo Epigenetics Symposium was arranged by Paul Grini (EVOGENE) and Ragnhild Eskeland (BMB) (oslo.epigentics.no) 9 - 11 April 2014. More than 200 participants from all over the world could enjoy some of the most renowned researchers in the field, covering topics from chromatin structure and nuclear dynamics to epigenetic inheritance. Also the public showed great interest in the event, and more than 150 people participated in the public lecture and debate “Epigenetic inheritance - what is the impact”, held at the historic ceremonial hall at the University.

Lamarckian word cloud: Epigenetic inheritance is often associated with Lamarck and his famous giraffes. In the public lecture of Oslo Epigenetics Symposium, a panel of experts discussed the impact of epigenetics on our understanding of inheritance.
Section for Biochemistry and Molecular Biology (BMB)

The Section for Biochemistry and Molecular Biology (BMB) consists of faculty members from the previous Cell Biology, Protein, Integrative Biology and Gene programs, altogether 11 permanent scientific staff (FVA) and 15 project leaders/post-doctoral fellows/researchers, as well as research assistants, PhD students, and master students, in total approximately 70 people.

The research in the section is dedicated to investigations of biochemical and molecular mechanisms underlying various biological structures and processes, such as DNA/protein structure and function, immune regulation, chromatin structure, and gene expression, in organisms from bacteria to mammals. Some of the areas that are covered include specific genes and whole genomes, how they are structured and control the development of whole organisms, enzymatic nucleic acid modifications and their role in gene expression, transcription factors, structural and functional analyses of key proteins in the cell, such as metal proteins, how antibodies work and can be improved, how antibacterial peptides function, how male and female hormones work in mammals, and key signalling pathways in cancer cells. Advanced instrumentation and analytical methods are used in all these studies.

The section has the responsibility for courses in biochemistry, molecular biology, bioinformatics, plant physiology, and cancer biology, and partly in biostatistics, in the bachelor program as well as more specific and advanced topics in the master program, including laboratory courses in biochemistry/molecular biology, physical biochemistry, general and advanced immunology, advanced cancer biology and eukaryotic genes and genomes. The know-how and expertise that the section represents are highly relevant for the other sections at IBV, and also for research in other scientific fields. To a large extent biochemistry and molecular biology have influenced fields like biotechnology, medicine, pharmacy, nutrition research, chemistry, biophysics and agricultural sciences, and are of importance for community areas like medicine and health, agriculture, fishery and knowledge-based industry.

Some recent research highlights

Some of the ongoing research in the section include studies of the 3D structures of peptides and proteins using NMR and X-ray crystallography, as well as advanced spectrometric techniques, elucidating the mode of action of lactobacterial antimicrobial peptides, screening of bacterial mutants of interest by whole genome sequencing, the study of protein-ligand interactions, studies on enzymes involved in methylation of proteins and methylation/demethylation of nucleic acids, immunoglobulin engineering, genetic and epigenetic mechanisms of transcription factor action, and molecular mechanisms of male/female specific hormones in health and disease states.

As an example, the Sandlie group studies the structure and function of antibodies and T-cell receptors, the specific detecting molecules of the adaptive immune system. The purpose of the work is to engineer antibodies and antibody derived molecules to be used in therapy and as research reagents. Furthermore, one antibody receptor, the neonatal Fc receptor (FcRn), also binds albumin; thus the group studies how FcRn binding regulates the serum half-life and biodistribution of albumin and molecules bound to albumin.

FcRn regulates serum half-life of albumin and IgG. The residues shown are involved in albumin binding. The tryptophan residues shown in red make hydrophobic contacts with albumin. Histidine 166 in human and histidine 168 in rat FcRn regulate the pH dependence of the interaction.
Proteins in blood are short lived and normally degrade within a few hours or days, but the two most abundant proteins, IgG and albumin, are rescued from degradation and have half-lives of three weeks. The rescue mechanism depends on their interaction with the neonatal Fc receptor (FcRn), and it is crucial to understand how FcRn rescues IgG and albumin, and to transfer long half-life to therapeutics, using the same mechanism. The Sandlie lab has worked in collaboration with Novozymes Ltd, UK, which has filed several patent applications and developed the Veltis® technology, a set of human albumin variants with greatly increased binding affinity for FcRn. Biopharmaceuticals fused to a new albumin variant can have half-life of months, which will decrease dosing frequency and toxic side effects of drugs. In 2014, Sandlie group reported on the fine mapping of the albumin FcRn interactions.

Various lines of work in the section are devoted to structural and functional characterization of proteins. An example of this is the work in the Falnes group which aims to unravel the biochemical function of various enzymes for which no function has so far been assigned. The work focuses on enzymes involved in DNA/RNA demethylation, tRNA modification and protein methylation, and since 2010, they have assigned a function to six previously uncharacterized human enzymes (Sorge Møller et al., MCB, 2010, van den Born et al., Nature Commun., 2011, Kernstock et al. Nature Commun., 2012, Jakobsson et al., IBC, 2013, Davydova et al., IBC, 2014). Malecki et al. (JBC, 2015). A strong current focus is on protein lysine methylation, as the lab recently discovered a new family of lysine specific methyltransferases, consisting of ten human members. The substrates of these enzymes encompass molecular chaperones (VCP and Hsp70), translation factors (eEF2), calmodulin, DNA repair proteins (Kin17) and mitochondrial proteins (ETFβ) suggesting that they have widespread important functions in the cell.

Another line of work in the section with significant progress in 2014 involves hormonal regulation of transcription and intracellular signalling pathways in cancer cells. Androgens, male sex hormones, bind to an intracellular receptor, the androgen receptor (AR), that belongs to a superfamily of ligand-activated transcription factors and affect the phenotype of the cell through modulation of gene transcription. It is well established that AR signalling is critical for normal prostate physiology, but also in prostate cancer in all its phases. The Saatcioglu group discovered a molecular switch that regulates stress induced reactive oxygen species (ROS) production in pro-
tate cancer cells. This switch is modulated by the AR induced six transmembrane protein STAMP2 expression, which is found in the endoplasmic reticulum and shuttles between the Golgi and the plasma membrane. STAMP2 reduces iron, regulates NADPH levels, as well as affecting levels of the transcription factor ATF4 that is involved in stress signaling (Jin et al., 2015). Through these activities, STAMP2 is essential for prostate cell growth in vitro and in vivo. Furthermore, systemic nanoliposomal STAMP2 siRNA delivery results in profound regression of human prostate tumors growing in immunodeficient mice, suggesting that it could be a bona fide therapeutic target for prostate cancer (Jin et al., 2015).

Another line of significant progress from 2014 has been by the Metalloproteins group which combines different biochemical and biophysical methods to study the structure and function of metallo-, radical- and redox proteins. A special focus is on proteins involved in oxygen activation and electron transfer. In 2014 the group continued studies on different di-metal, haem, and flavin proteins. One of these systems is ribonucleotide reductase, which reduces the ribonucleotides to deoxyribonucleotides. A highlight was that the group solved the structure of a protein complex between ribonucleotide reductase NrdF and its redox partner protein NrdI. The NrdI activates the NrdF by shuttling a superoxide to the NrdF active site through a closed channel generated by the complex. It was also shown that this channel is regulated by the type of metal atoms used by NrdF.

The crystal structure of the complex between ribonucleotide reductase NrdF and the flavodoxin-like protein NrdI from Bacillus cereus.

BMB also organized, in collaboration with Norwegian Centre of Molecular Medicine, Oslo Prostate Cancer Symposium (OPCAS) 2014 (14-16 May, 2014) which featured world leaders in the basic biology and translational/clinical aspects of prostate cancer. Norwegian Minister of Health, Mr. Bent Høie gave a talk, as well as some other research leaders in Norway and abroad. About 140 scientists, clinicians, and students from 17 different countries attended.
The Section for Physiology and Cell biology (FYSCELL) is a research and learning environment which focuses on the way in which living animals, including humans, function, and how living organisms adapt to their environment on a molecular, cellular, organic and individual level. The understanding of cellular processes and physiological function of living animals, including humans, is key in the section’s research and teaching efforts. The section includes seven permanent scientific staff, five adjunct professors, seven engineers and more than 40 PhDs and post-doctoral research fellows and 15 master students. Our research interests range from understanding fundamental principles of cell biology and physiological processes to the interface with biomedicine to develop improved treatments of diseases, and spans multiple levels from posttranslational modification of proteins to mechanisms of complex behaviours. Molecular mechanisms of cell trafficking and membrane function are essential to understand how proteins are transported to specific locations within the cell or on the cell membrane where they play key roles in e.g. cellular signalling and immune regulation. Infection biology, identifying mechanisms on how bio-nanoparticles can be used to carry drugs for improved treatment of disease in animal models is an active research area. Other focus areas are neurobiology and comparative physiology with investigations on muscle biology, hypoxia tolerance in vertebrates, information processing and brain plasticity. In addition to model organisms such as rodents, zebra- and medaka-fish, we utilize biodiversity, i.e. animal models with anatomical or physiological characters that make them superior for studying particular functions.

**Muscle memory**

Understanding the molecular mechanisms of how muscle activity alters muscle properties such as speed, endurance and strength/size is the research focus of Kristian Gundersen’s research group. Recently the group has described the biological foundation for the phenomenon of muscle memory, the finding that previously strength-trained individuals easily regain strength. Upon resuming training cell nuclei in the muscle fibers are not being lost during detraining and inactivity such as believed previously. By *in vivo* imaging methods they showed that strength training seems to recruit new muscle nuclei form stem cells, and these nuclei seems to be permanent. Furthermore, the group recently demonstrated that anabolic steroids recruit nuclei and hence doping might have permanent effects. The group also works on several transcription factor systems such as myogenic helix-loop-helix molecules, PPARδ, and HIF-1.
Adaptations to extreme conditions
Investigations on comparative respiratory and circulatory physiology and comparative neurobiology have been the research focus of Göran Nilsson’s group for some 20 years. Three areas are presently in focus: 1) Mechanisms that allows vertebrates to survive with little or no oxygen; 2) Effects of elevated temperature and CO₂ on respiratory performance in fish; 3) Brain correlates to social behaviour and stress in fish. The methods used in these projects include molecular procedures such as cloning and sequencing of relevant genes, in vitro expression of relevant proteins, expression analysis of mRNA (micro arrays and real-time PCR) and proteins (2D gels and Western blot). Physiological studies are done using respirometry, in vivo and in vitro cardiovascular measurements, microdialysis, electrophysiology, and immunohistochemistry.

At least half of all projects are carried out through international collaborations, and our collaborators include research groups in Europe, Canada, USA, Australia, South Africa, Namibia and Abu Dhabi. National collaborators range from the Department of Thorax Surgery at Ullevål Hospital to the Norwegian Aquaculture industry. This research group has contributed articles in international journals that has been cited over 6000 times, and about 20 books or book chapters. In addition, the findings are regularly presented in both national and international news media and science magazines.

Mechanisms of hypoxia and anoxia tolerance
Adaptations to variable oxygen levels in the brain, heart and respiratory organs are studied in various vertebrates. Of special interest are those animals that show an extraordinary high tolerance to anoxia. These include the crucian carp (no: karuss) and freshwater turtles of the genera Trachemys and Chrysemys. Obviously, the existence of such species shows that evolution solved the problem of anoxic survival millions of years ago - something that medical science has attempted to do with very limited success during the last decades. It may be relevant to point out that anoxia related diseases are the most common causes of death in the western world.

Some key findings in these projects include the demonstration of a vertebrate heart that maintain cardiac output without any oxygen, revealing the capacity of fish to remodel their gills in response to ambient oxygen levels, characterization of the molecular mechanisms of ethanol production in a vertebrate, and demonstrating that animals can use GABA-mediated endogenous anaesthesia to reduce brain energy use.

Fish in a warmer future: effects of elevated temperature and \( \text{CO}_2 \) on respiratory performance in coral reef fish and Atlantic salmon
After having studied the ability of coral reef fish to cope with low oxygen levels, the focus is now turned to effects of elevated temperatures and \( \text{CO}_2 \) on brain function and the aerobic scope of fish. Aerobic scope is the difference between resting and maximal rate of oxygen uptake and determines how much energy can be devoted to activities like feeding and reproduction. So far, the results show that some coral reef fish lose virtually all of their aerobic scope when exposed to a 3 °C increase in water temperature, and this situation can be worsened by an increase in the water \( \text{CO}_2 \) level corresponding to that estimated to occur in about 100 years. The group has recently shown that neurotransmitter function in fish brain can be directly affected by a near-future increase in water \( \text{CO}_2 \) level, with drastic effects of behaviour.

A research grant from NFR-HAVBRUK, has allowed these studies to include temperature effects on aerobic scope in Atlantic salmon from different latitudes (from Bretagne to Finnmark), allowing us to evaluate how this important aquaculture species will cope with a warmer future.

Brain correlates to social behaviour and stress in fish
Several years ago we could show that brain monoaminergic neurotransmitters, particularly serotonin and dopamine are intimately connected to stress reactions in fish, including socially induced stress. Our focus is now on the role of neurogenesis (formation of new brain cells) in stress reactions in fish and how neurogenesis is controlled. These studies, which are largely carried out in collaboration with the Norwegian University of Life Sciences and Uppsala University, have shown that stress reduces neurogenesis in the brain of salmonid fish, and that cortisol appears to play a key modulatory role in fish neurogenesis.

Neurobiology
A major challenge in neuroscience is to understand neural mechanisms underlying complex behaviours. How we perceive the world is heavily
influenced by our previous experiences and state of mind. After embryonic development of neural circuits, adequate sensory experiences are necessary to refine the neural circuit into a functional unit that can serve its purpose. During this time of postnatal development, the juvenile brain is especially sensitive to stimulation and complete reorganization of brain areas can occur e.g. with short periods of sensory deprivation during this period. Such critical period plasticity ends quite abruptly when the animal turns into adulthood when brain plasticity is significantly reduced compared to the juvenile state. What are the mechanisms limiting adult plasticity and how can new memories form in seconds at the same time as long-term memories are stored for long periods of time? These are questions addressed in projects headed by Marianne Fyhn where we investigate underlying principles of brain plasticity and information processing during sensory perception, defensive behaviours and learning and memory processing.

To achieve this we use behavioural paradigms in combination with electrophysiological recordings of large populations of neurons, two-photon laser-scanning microscopy of genetically labelled neurons through a chronic cranial window, and genetic tools for cell type-specific genetic interference (optogenetics) of neural activity.

In order to understand sensory information processing in awake behaving animals we use primarily the visual system as a model structure. Whereas most of what we know about the workings of the visual system is revealed through investigations of anaesthetised animals we study the processes as they appear in the awake and behaving animal. Comparing the activity of neurons during anesthesia and behaviour reveals fundamental differences in neural processing. The visual system is also the most studied brain region for critical period plasticity and we therefore experimentally induce activity-dependent plasticity by sensory manipulations or by learning paradigms. This allows for direct assessments of plasticity processes as they occur in the brain and we can study cell-type specific and neural network contributions to these processes. A research focus of the group has lately been to investigate a potential substrate for limiting adult brain plasticity and stabilization of memories in the brain, namely perineuronal nets, a special type of condensed extracellular matrix molecules. These structures condense around a group of inhibitory neurons that play a key role in information processing and synchronizing neural activity. They are shown to play a role in brain plasticity and learning in some brain areas. We investigate their roles in activity dependent plasticity in the visual system of the brain as well as in the structures of the brain involved with encoding of episodic memories, the hippocampus and entorhinal cortex. The latter brain areas are where spatially tuned neurons underlying our sense of direction are found. The Nobel Prize in Physiology or Medicine 2014 was awarded to J O’Keefe (University College London) and MB and E Moser (NTNU) for the discoveries of ‘place cells’ in the hippocampus and ‘grid cells’ in the entorhinal cortex. How perineuronal nets are involved in memory processing in these brain areas remain unknown and is a key interest in our research projects.

In order to understand the mechanisms of brain function, multilevel analyses is necessary from molecular mechanisms to the complex computations of neurons in neural networks. We have therefore teamed up with research groups in computational physics and mathematics in a newly established interdisciplinary research initiative, Center for Integrative Neuroplasticity (CINPLA, see below) supported by the MN faculty. In CINPLA we use computational modelling in combination with empirical data to understand brain function at multiple scales.

Specialized extracellular matrix molecules (green) condense around a specific neurons (red) in the brain.
Nanoparticles for improved treatment of diseases using the zebrafish

Normal administration of drugs used to treat diseases such as cancer or tuberculosis involves systemic treatment where the drugs reach the target sites as well as the rest of the body. This leads to many side effects, including drug toxicity. An attractive alternative involves encapsulating the drugs inside biodegradable nanoparticles (NPs) made, for example from polymers, lipids or peptides. These NPs are then targeted by various mechanisms to the diseased sites, thereby greatly reducing side effects and also the dosing frequency. Although a few NPs are on the market to treat humans, mostly for cancer, there are many technical barriers that need to be overcome. We have introduced the transparent zebrafish embryo as a model that allows fluorescent NPs and diseased cells to be simultaneously visualized in real time, at high resolution. For this we have focused (with our collaborators) on three different diseases: 1) Tuberculosis, using the fish TB pathogen *Mycobacterium marinum*; 2) Human cancer cells, which when injected into the zebrafish embryos form tumors, and 3) A set of bacterial diseases of aquaculture fish caused by different species of *Francisella* bacteria.

In intracellular membrane traffic in immune cells

The endocytic pathway in cells is divided into different compartments according to their function and membrane associated proteins. To ensure directionality and communication between these compartments they are specifically regulated through their intra endosomal interaction.

The research group of Oddmund Bakke, a member of the CoE CIR (Centre of immune regulation, http://www.med.uio.no/cir/) has for many years studied the specific communication between the endosomal compartments, how they “mature” and how they interact and which addresses or sorting signals the molecules contain to enter intracellular compartments. To study this we use live cell imaging and measure the dynamic life of endosomes by fluorescently labelling our proteins of interest. By doing this we have discovered an intricate set of downstream and upstream endosomal feedback mechanisms that can specifically regulate the fate of important cell membrane receptors and control immunological functions of immune cells.

In immune cells which contain both the MHCI and the MHCIi molecules, we have studied how these molecules are sorted and meet foreign or endogenous antigens. This information we have used to engineer a protein that contain cancer specific epitopes, and this leads to increased immunity towards the cancer antigen. In collaboration with the University Hospital the plan is to follow up this potential cancer vaccine by clinical studies and test whether an observed biological response in our experiments can also lead to a clinical response in cancer patients.

In addition, we work on the molecular regulatory mechanisms of intracellular transport, a study lead by Cinzia Progida and we have found how cellular migration is combined with molecules involved in intracellular membrane traffic (see highlights below). Migration is an essential property of the immune dendritic cells and to elucidate properties of this cell is a main project goal of for our research group.

Glycobiology and cell polarity

Most proteins are modified after synthesis by glycans (complex sugars like N-glycans, O-glycans and glycosaminoglycans) in the secretory pathway, in order to regulate transport pathways and functions. Glycan structures associated to proteins may promote or limit cancer, inflammation and other immunological processes. Furthermore, glycan-modified proteins in the central nervous system seem to play a role in regulating brain plasticity and neuronal function. The glycan part of several glycoproteins and proteoglycans is shown to be responsible for their localization to the correct cell surface in epithelial cells and neurons.

The research group of Kristian Prydz studies cellular mechanisms of glycosylation in the secretory pathway of epithelial cells and skin fibroblasts. The latter are derived from patients with genetic defects in a variety of glycosylation mechanisms. In epithelial cells they have discovered that heparan sulfate proteoglycans moving through a specialized basolateral secretory route are prioritized with respect to sulfation, when the supply of nucleotide sulfate (PAPS) gets low. The underlying mechanisms are investigated. In skin fibroblasts a subunit of the oligosaccharyl transferase (OST) complex that seems to regulate the supply of
N-glycans is studied. Both projects study mechanisms that are highly relevant in comparison of normal and transformed cancer cells.

**Research highlights**
The span in research activities in FYSCELL is reflected in the two projects described below that both were published in high ranked journals in their fields. The first describes the molecular mechanisms of intracellular transports and their links to organization of the cell’s cytoskeleton. The second project reports how an expected increase in water temperature affects physiological parameters such as heart function in salmon populations.

**Rab GTPases: roles in membrane trafficking and beyond**
A cell is a small living unit made up of different subunits, called organelles, which contribute together in keeping it alive. All the organelles, in order to ensure the correct functioning of a cell, need to be connected to communicate and exchange their content. Rab proteins are master regulators of this process, known as “intracellular trafficking”. More than 60 Rab proteins are described in human cells, and each Rab plays a different role in the intracellular transport. We have previously reported that the function of one of this protein, Rab7b, is the regulation of the transport from endosomes to the Golgi apparatus. To obtain a better understanding of Rab7b function, we recently searched for proteins that interact with Rab7b, helping it to perform its function. Using the Yeast Two–Hybrid technology, we discovered that Rab7b directly interacts with the motor protein myosin II. We demonstrated that this interaction is important for the transport of Rab7b-positive endosomes, as myosin II depletion or inhibition alters Rab7b dynamics. Interestingly, depletion of Rab7b destroys the actin cytoskeleton and inhibits cell migration and cell adhesion, indicating that Rab7b is also important for actin organisation and for several processes where actin cytoskeleton remodelling is involved. Taken together, our work identifies a new and unexpected role for Rab proteins in the organisation of the actin cytoskeleton and points to thus-far-undescribed links between intracellular transport and cytoskeleton dynamics.

**Fish physiology under global change**
The Nilsson research group has for a long time studied adaptations to variable oxygen levels in fish, particularly in the brain, heart and respiratory organs. This has involved both a fish from our cold north, the crucian carp, which shows an extreme tolerance to low oxygen levels, and can survive without any oxygen for months during the cold winter, and fish from tropical reefs. A recent project that rendered Cathrine Fagernes her PhD in 2014 is focused on the exotic capacity of the crucian carp to produce ethanol rather than lactic acid when making energy anaerobically. A key finding in Cathrine’s project was that a genome duplication event a few million years ago allowed evolution to play with extra copies of the genes coding for the pyruvate dehydrogenase complex. Some of these copies have mutated into a pyruvate decarboxylase – the first ever found in a vertebrate. This enzyme has acquired a function allowing ethanol production through a pathway largely analogous to that found in brewers’ yeast - a remarkable example of convergent evolution.
Over the last years, the research group has also studied how fish will cope with a warmer and more acidified future. The studies have included collaborations with Australian and Canadian research groups and involved both tropical and temperate fishes. It soon became clear that some coral reef fish lose virtually all of their scope for oxygen uptake when exposed to a 3 °C increase in water temperature, and this situation can be worsened by an increase in the water CO₂ level corresponding to that estimated to occur in about 100 years. A particularly worrying aspect of the results was that a doubling of the water CO₂ content lead to striking neural and behavioural changes in the fishes due to interference with neurotransmitter functions. A research grant from NFR-HAVBRUK, allowed these studies to include temperature effects on heart function in Atlantic salmon from its southernmost and northernmost distribution limits. Here the results gave some hope for the future since their paper published in Nature Communications in 2014 showed that salmon from Bretagne in France and salmon from Finnmark in northern Norway virtually have the same tolerance to high temperatures, at least when it comes to heart function. Indeed, the hearts of the Finnmark population appeared to function quite well at water temperatures as high as 27 °C.

Infrastructure
Advanced microscopy and imaging techniques are central to many of the research projects and core facilities for sub-cellular imaging, the national infrastructure platform, NorMIC Oslo, including electron microscopy (EM lab) is located in the section. The facility is part of Nor Biomaging a national network aiming at strengthening imaging in Norway. Nor Biomaging is a member of EuroBioImaging, an ESFRI network set up to strengthen imaging within Europe. Nor Biomaging is organized in a network with nodes in all university cities in Norway, and together these nodes cover all present modalities within molecular imaging. The NorMIC Imaging Platform at the Institute for Biosciences (IBV) together with its sister node the Radium Hospital in Oslo are specialized microscopy units for the study of live and fixed cells. Partly due to an infrastructure RCN grant we have an excellent instrumentation park including several confocal laser scanning microscopes, total internal reflection (TIRF) microscopy, electron microscopy (EM), sensitive wide-field fluorescence microscopy and optical tweezers.

The organization of the Imaging Platform as a core facility implies that all researchers in Norway are welcome users at equal terms through our booking system. The Imaging Platform offers courses, expertise, use of confocal instruments after booking/availability (new users will need to go through training/assessment procedure) and access to immuno-EM techniques.

Scientific collaboration, representation and outreach
Scientific work in the FYSCELL is regularly presented at international conferences and our researchers are invited to give talks about their research at national and international conferences, universities, societies and organizations as well as national media and the daily press.


The crucian carp – a Norwegian fish that has been found to make its own ethanol in a way very similar to that used by breweries.
Center for Integrative Neuroplasticity (CINPLA) is a strategic research initiative bringing together experimental neurobiology and computational physics in order to understand fundamental principles of brain plasticity and information processing.

CINPLA is composed of researchers from the IBV, Department of Physics, Department of Informatics and associated partners from the Medical Faculty and from the Norwegian University of Life Sciences. CINPLA is a platform for an integrated experimental, computational, and theoretical approach to address neural plasticity at multiple levels. The scientific goal is to identify and characterize molecular, cellular, and network contributions to plasticity and to develop computational and theoretical tools to understand these processes on multiple scales. In order to achieve this, CINPLA integrates experimental biology and computational modelling through collaborative PhD projects that promote interdisciplinary interactions and deliver groundbreaking research. CINPLA’s efforts are strongly anchored to develop and improve education in life sciences. Several of the CINPLA researchers are key contributors to the MN flagship project ‘Computing in Science Education’ (CSE) which has succeeded to include computing as natural tool for students in physics, mathematics and informatics from the first semester. CINPLA will contribute to implement CSE in the bachelor programs at the IBV in order to increase understanding of the mathematical and physical principles underlying biological processes as well as obtain generic computational tools that are essential professional skills in research or elsewhere in society. The four PhD students that were hired in 2014 will use their compulsory work to implement the educational program ‘Computing in Science Education’ in the bachelor and master programs at IBV.

MODIPROT is an IBV initiative to initiate new and further develop existing projects in the area of co- and post-translational modification of proteins. Most plant and animal proteins are modified during or after synthesis of their polypeptide chains in the ribosomes. Such modifications may be reversible or irreversible and can direct the proteins to the correct cellular or bodily compartment and/or fine-tune the biological activity of enzymes, hormones and other proteins or influence their half-time. The most common modifications are acetylation, glycosylation, methylation, phosphorylation, sumoylation, ubiquitinylation and various modifications by lipid structures. MODIPROT is motivated by and takes advantage of the establishment and continuous development of the mass spectrometry (MS) proteomics unit, since many of these modifications may be precisely detected by MS. The imaging facility is also of use for several existing and potential MODIPROT projects.

Göran Nilsson and Kristian Prydz (leader) are MODIPROT participants from Section of Physiology and Cell Biology, while Winnie Eskild, Pål Falnes, Odd Gabrielsen, Fahri Saatcioglu, Inger Sandlie and Bernd Thiede are participants from Biochemistry and Molecular Biology.

The first MODIPROT PhD student, Ravi Adusumalli, started in September 2014 and the next student will start in the summer of 2015.
The Department of Biosciences at the University of Oslo is, in terms of the number of students and courses offered, the largest bioscience department in Norway. We offer two Bachelor’s degree programs, 3 Master’s degree programs and PhD degree.

Altogether 24 different bachelor and 44 master courses, 29 PhD courses as cloned master courses and 2 PhD courses were given in 2014.

A new master course in 2014 was the preparation for and participation in the IGEM -International Genetically Engineered Machine. Five students from IBV and other departments at the MN Faculty attended the course and the competition in Boston. This was a big success and the team met a lot of attention at UiO and in the press.

The department also focuses attention on internationalization, and we encourage our students to take semesters abroad. In 2014 IBV had 29 (24 Erasmus) incoming exchange students, and 7 (3 Erasmus) of our students were taking courses outside UiO.

### IBV Courses in 2014

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<tr>
<th>Course</th>
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<tr>
<td><strong>Bachelor courses</strong></td>
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<tr>
<td>BIO1000 - Grunnkurs i biologi</td>
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<tr>
<td>BIO1010 - Human atferdsøkologi</td>
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<td>BIO1200 - Biologisk mangfold</td>
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<td>BIO2100 - Generell økologi</td>
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<td>BIO2120 - Evolusjonsbiologi</td>
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<td>BIO2140 - Molekylærobio og biologiske metoder</td>
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<td>MBV1050 - Biokjemi I - Biomolekylers struktur og funksjon</td>
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<td>MNKOM3000 - Formidling og vitenskapsjournalistikk</td>
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<td>BIO5000/BIO4001 - Introduksjonskurs for masterstudenter</td>
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The Bachelor’s degree programs

Both Bachelor’s degree programs provide a broad understanding of biology and impart basic knowledge of natural sciences, such as mathematics, statistics and chemistry. The biology program later on emphasizes biodiversity, structure and function of organisms, interactions between organisms and their environment (ecology) and evolutionary processes. In the molecular biology and biological chemistry program emphasis is put on chemistry to orient towards biochemistry, or molecular, micro- and cell biology. Laboratory and field work are important parts of our Bachelor’s degree programs. 94 students enrolled in the Biology program, whereas 100 students enrolled in the Molecular biology program in 2014.
The Master’s degree programs

IBV offers three Master’s degree programs: Biology, Molecular biosciences, and Biodiversity and systematics. In the Biology program there are three options: Ecology and evolution, Marine biology and limnology, and Toxicology. In the Molecular biosciences program there are also three options: Biochemistry, Molecular biology and Physiology. Additionally we also offer master specialization in biology and molecular biology for students at the Educational studies program.

The Nordic master’s program in biodiversity and systematics - NABiS - is a consortium aimed at providing students with the taxonomic skills and awareness needed to work within conservation and biodiversity in the future. The universities involved in the program are University of Gothenburg, University of Lund, Natural History Museum of Denmark, Uppsala University, Aarhus University, Swedish Museum of Natural History, Norwegian University of Science and Technology, Tromsø University Museum and University of Oslo.

The Master’s degree programs consist of courses and a science based thesis, both parts corresponding to 60 credits (for students enrolled in the Educational Studies program the thesis corresponds to 30 credits). The thesis shall provide skills within field and/or laboratory work, statistical analysis, report based writing, and research presentation.

91 students (listed below) achieved their Master’s degree at the Department of Biosciences in 2014. 88 enrolled in the Master’s programs, see figure 4.

Figure 4 Number of Master’s students enrolled at IBV 2011-2014
Masters in Molecular Biosciences 2014

Tine Norman Alver  
A physiological strength exercise model for rats

Markus Wächter  
Effects of subunit 8 deficiency of the conserved oligomeric Golgi complex on proteoglycan synthesis

Panpan You  
Human Neil DNA glycosylases - crystal screening, biochemical characterization and inhibitor screening

Lars Mørland Knudsen  
Role of the endolysosomal and autophagosomal pathways in degradation of the gap junction protein connexin 43

Gro Herredsvela Rørvik  
AI-2 communication in Staphylococcus epidermidis: A study on possible effects of thiophenones

Øyvind Pernell Haugen  
Does a dysfunctional heart alter excitatory synapses in the hippocampus?

Gro Kummeneje Presthus  
DNA methylation super negatives -identification of a new subgroup of colorectal cancer

Ignacio Cuervo Torre  
A study of the interaction between the chromatin remodeler CHD3 and the SUMO network

Åse Marie Moen  
O-GlcNAc-signaling in the anoxia-tolerant crucian carp heart and brain

Sima Zolfaghari  
Investigation of p21 expression in melanoma

Gunn-Helen Øiseth Moen  
Role of Interferon-γ in the inflammatory response following disc herniation -A study of nociception and genetic susceptibility in acute lumbar radicular pain

May-Kristin Torp  
Molecular Control of Apoptosis during Anoxia and Re-oxygenation in Crucian Carp Brain - Comparative Studies of Laboratory and Naturally Exposed Fish

Eva Katrin Moen Berger  
Piscirickettsia salmonis: characterization and infection in the zebrafish model

Dingli Dai  
The relationship between Cdt1 and pre-RC formation after UVC irradiation in early G1 phase in fission yeast

Herman Evensen  
Function of a novel protein, Pah1, in the G1/S checkpoint in fission yeast

Hedda Johannessen  
The Assasin Recombinant single-chain Fv production of the anti-tumour antibody 14F7

Max Zachrisson Totland  
Regulation of the gap junction protein connexin 43 by the E3 ubiquitin ligases Smurf1 and -2

Kia Wee Tan  
Pharmacological activation of serotonergic activity in Atlantic salmon (Salmo salar): A model of chronic stress
Flavia Söllner  Studies of ATF7IP as a novel interaction partner of c-Myb - epigenetic repressor or co-activator?
Katrine Wickstrøm  Cellular effects of Th-227
Jeannette Nilsen  Affinity maturation of a T cell receptor by use of phage display
Daniel Pitz Jacobsen  Intervertebral disc herniation, spinal nociceptive signaling and proinflammatory mediators
Tomasz Konopka  Proteoglycan characterization in COG7-deficient cells
Rikke Rollum  Prevalence of Borrelia burgdorferi sensu lato in Ixodes ricinus ticks in Scandinavia
Ane Brenna  Identification of novel epigenetic masterkeys in cancer - with potential diagnostic value
Mira Børstad  CD4+ TH-cell epitope discovery by combinatorial phage display of MHC class II. A proof of principle study
Astri Frafjord  Using immune cells for prognosis in non-small cell lung cancer
Helge André Dahl  Characterization of the novel human protein methyltransferase METTL20
Karin Svensson  The role of evectin-2 and its binding partner PS in toxin transport
Morten Luhr  Exploring the relationship between ER stress and autophagy in prostate cancer cells
Linn Kymre  Structure-function relationship of Shiga toxins; Role of the A-subunit in complex stability and endocytosis
Martin Berner Mc Adam  Protein X, a link between Invariant Chain and Myosin II
Nafisa Batool Afzal  Expression of the bacterial ectB gene in the chloroplast of Chlamydomonas reinhardtii
Maria Dehli Vigeland  Exploring the functional relevance of genetic regions associated with rheumatoid arthritis
Filip Nikolaysen  Molecular mechanisms for antibody-induced endocytosis of ErbB2
Anna Maria Eriksson  Molecular characterization of the C-type lectin like domain family 16A (CLEC16A)
Margrete Langmyhr  TIP60 – a selective inhibitor of activated c-Myb
Maryam Kalantarian  Genetic and molecular analysis of the functional role of the AGL36 MADS-box Type I transcription factor
Heidi Dietrichson Pharo  Quantitative methylation-specific PCR - optimization and application
Margrethe Stoltenberg  The effect of intermittent hypoxia on Hypoxia inducible factor 1α in rat skeletal muscle

Carina Beatrice Vibe  Nanoparticle-based delivery of efflux pump inhibitors and antibiotics to treat mycobacterial infections

Ingvild Falkum Ullmann  An investigation of the functional role of the MADS-box γ and MADS-box α type I transcription factors: AGAMOUS-LIKE 28 and AGAMOUS-LIKE 36

Michelle Lu Sætersmoen  Effects of steroid hormones on the expression of Ca2+ activated K+ channels in in vitro pituitary cells of Atlantic cod (Gadus morhua)

Heidi Korsmo  Immune Cell Composition in Human Non-Small Cell Lung Cancer

Line Nateland  MBD proteins - possible links between DNA methylation and histone modification in Arabidopsis thaliana

Ingerid Ørjansen Kirkeleite  The role of LBD proteins in floral organ abscission

Education studies’ thesis:

Victoria Holck  Expression of the bacterial ectC gene in the chloroplast of Chlamydomonas reinhardtii

Sandra Nøkkevangen  Preferred visually evoked spatial and temporal frequencies in primary visual cortex of alert and anesthetized rats

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Masters in Biology 2014

Elisabeth Wiig  Variation in armour of three-spine stickleback

Maria Rundhaugen Tesaker  Male plumage variation and its role in reproductive isolation between house sparrows (Passer domesticus) and Italian sparrows (P. italiae) & A new method for quantifying colours of Passer sparrows using digital imaging in the field

Helga Bårdsdatter Kristiansen  Characterization of marine fungal communities using next generation sequencing techniques

Karina Margrethe Hauan  Identification and Modulation of Esterases Involved in the Metabolism of Heroin

Jørgen Kvernhaugen Norum  Habitat use by roe deer (Capreolus capreolus) under the predation risk of lynx (Lynx lynx) and humans: A life in the squeeze between two contrasting predators

Anne Marie Dalen  Population dynamics, size hierarchy and neighbour interactions of early colonizing plants in a Norwegian glacier foreland
<table>
<thead>
<tr>
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<td>June Susanne Berg</td>
<td><em>Population Dynamics, Size Hierarchy and Neighbour Interactions of Early Colonizing Vascular Plants in a Norwegian Glacier Foreland</em></td>
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<td>Kristine Dobbe</td>
<td><em>Are sperm characters related to genetic diversity in the bluethroat (Luscinia svecica)</em></td>
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<td>Katrine Heggeset</td>
<td><em>Antagonistic effects of vitamin A on vitamin D and the development of colon cancer</em></td>
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<td>Line Holen</td>
<td><em>Root associated fungi on Chimaphila umbellata in south-eastern Norway</em></td>
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<td>Marie Kristine Brandrud</td>
<td><em>Polyploidy and ecotype variation in Cochlearia officinalis L. and related species</em></td>
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<td>Hege Lyngvær Mathisen</td>
<td><em>Er avvikende celler av Prymnesium polylepis mer motstandsdyktige mot virusangrep enn typiske celler?</em></td>
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<td>Laszlo Fodor</td>
<td><em>Dinoflagellate diversity and dynamics in Outer Oslofjorden as revealed by molecular methods</em></td>
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<td>Ola Tobias Hafslund</td>
<td><em>Effekt av temperatur og fosforkonsentrasjon på celle- og genomstørrelse av Chlamydomonas reinhardti</em></td>
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<td>Ane Solland Kvinge</td>
<td><em>Gene Expression in the Early Development stages in Populations of European Grayling (Thymallus thymallus)</em></td>
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<td>Anne Luise Ribeiro</td>
<td><em>Effects of North Sea Oil on Biotransformation and Immune Responses in Juvenile Atlantic Cod (Gadus morhua)</em></td>
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<td>Eskild Hagenes</td>
<td><em>Genotoxic effects of exposure to carbon nanotubes in human lung cells</em></td>
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<td>Ole Edvard Bjørge</td>
<td><em>Ny informasjon om Sørishavets Fangst av blåkval (Balaenoptera musculus) basert på loggbøker</em></td>
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<td>Tonje Cecilie Urskog</td>
<td><em>Nematode infestation in flatfish in the inner and middle Oslofjord</em></td>
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<td>Benjamin Hanssen</td>
<td><em>Consequences of Selective Harvesting a Small Temperate Fish Species Displaying Strong Male Dimorphism, the Corkwing Wrasse (Symphodus melops)</em></td>
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<td>Anna-Marie Winter</td>
<td><em>Effects of phytoplankton diversity and fertilisation on primary production - The utility of bio-optical production estimates as response parameters in natural phytoplankton experiments</em></td>
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<td>Kun Chen</td>
<td><em>Effects of Different Temperatures and Exposure Times on the survival and DNA Damage of Collembolans (Springtails) in Response to Esfenvalerate (Sumi-Alpha) Soil Exposure</em></td>
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<td>Parandis Majlesi</td>
<td>Tool-use in excavation of underground food by captive chimpanzees (Pan troglodytes): Implication for wild chimpanzee behavior</td>
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<td>The Effect of Hybridization on Beak Morphology in the House Sparrow (Passer domesticus) and Italian Sparrow (P. italica)</td>
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<td>Audun Storset</td>
<td>Immunfunksjon og biotransformasjon hos piggvar (Scophtalmus maximus) eksponert for den vannløselige fraksjonen av Ekofisk råolje</td>
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<td>Testing Species Boundaries in the Staphylinid Beetle Genus Mocyta (Insecta, Coleoptera, Staphylinidae)</td>
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<td>Ella Thoen</td>
<td>Fine-scale spatial structure of root-associated fungi within a single plant root system</td>
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<td>Exposure of juvenile Atlantic cod (Gadus morhua) to water-accommodated fractions of Arabian light crude oil: Biotransformation and DNA damage</td>
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<td>Tage Bratrud</td>
<td>Effekter av miljøgifter på torsk (Gadus morhua) fra indre Oslofjord</td>
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<td>Arthur A. Blørstad Haraldsen</td>
<td>Protist diversity across a marine – freshwater gradient with a special focus on the X-cell parasite</td>
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<td>Stein Hegvik</td>
<td>Acoustic startle responses in European sprat (Sprattus sprattus L.) and diploid versus triploid Atlantic salmon fry (Salmo salar L.)</td>
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<td>Salinity-induced phenotypic plasticity in lateral bony plate number of the threespine stickleback (Gasterosteus aculeatus)</td>
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<td>Sperm Morphology, Sperm Motility and Paternity Success in the Bluethroat (Luscinia s. svecica)</td>
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<td>Lena Sareisian</td>
<td>Global DNA methylation and persistent organic pollutants in ringed seals (Phoca hispida) from Svalbard and the Baltic Sea</td>
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<td>Mildrid Elvik Svoen</td>
<td>Optimal habitats enhance establishment, but do not influence gender frequencies or genetic diversity of Silene acaulis in Svalbard (Norway)</td>
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<td>Øystein Loftus</td>
<td>The genus Pleuranthodium (K.Schum.) R.M.Sm. (Zingiberaceae): taxonomy and phylogeny</td>
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<td>Helena Båserud Mathisen</td>
<td>Cardamoms of South East Asia: phylogeny and taxonomy of the genus Elettaria Maton</td>
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<td>Pål Amdal Magnusson</td>
<td>Oxidative stress as a mechanism for silver particle toxicity</td>
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The doctoral program builds upon a Master’s degree in biology or molecular biosciences. The study is intended for those who want to qualify for academic positions or other occupations demanding high professional qualifications. The PhD study normally last from three to four years. 22 candidates defended their degrees in 2014:

- **Lars Qviller**
  - The distribution of ticks and large hosts relations in a northern forest ecosystem

- **Lilia S. Ulanova**
  - Towards prevention and treatment of infectious diseases of aquaculture

- **Federico Fenaroli**
  - Single and mixture toxicity of biocides to soil invertebrates – from the laboratory to the field scale

- **Santosh Phuyal**
  - Composition and cellular release of exosomes from cancer cells

- **Jon Halvor Jonsrud Knutsen**
  - Mechanisms regulating the G1-S transition in fission yeast

- **Nagham Therese Asp**
  - Regulation of ErbB2 and ErbB3 growth factor receptors in human breast cancer

- **Marta Hammerstad**
  - Structural and Functional Studies of Proteins in the Class Ib Ribonucleotide Reductase System

- **Kaare Bjerregard-Andersen**
  - Structural and biophysical studies of the mammalian Na+ dependent Cl–HCO₃ exchanger NCBE and the bacterial enzyme isatin hydrolase

- **Ha Thi Ngo**
  - The interplay between environmental contaminants, genes and diet in obesity and intestinal cancer

- **Gro Elise Rødland**
  - Regulation of stress-responsive pathways in fission yeast

- **Elianne Sirnæs Egge**
  - Diversity and seasonal dynamics of haptophytes in the Skagerrak revealed by high-throughput sequencing

- **Martin Malmstrøm**
  - On the origin and evolution of the alternative adaptive immune system in Order Gadiformes

- **Huma Siddiqui**
  - Urinary DNA analyses - approaches towards non-invasive, high throughput molecular analysis and diagnostics

- **Harri Mikael Itkonen**
  - Glycosylation in prostate cancer

- **Cathrine Elisabeth Fagernes**
  - Molecular background of ethanol production in anoxia tolerant fish

- **Ola Tweite Reid Westengen**
  - Seeds of adaptation

- **Silje Anda**
  - Cellular asymmetry in the fission yeast Schizosaccharomyces pombe

- **Ingrid Marie Egner**
  - A cellular memory mechanism in muscle

- **Unni Vik**
  - Scale dependent community patterns of microbes associated with ectomycorrhizal root systems

- **Camilla With Fagerli**
  - Processes influencing sea urchin (Strongylocentrotus droebachiensis) populations and kelp forest recovery in overgrazed areas in Norway

- **Mazyar Yazdani**
  - In vitro, in ovo and in vivo models for cytotoxicity, oxidative stress, neurotoxicity and DNA damage

- **Maja Krzewinska**
  - Human origins and migrations in Norway inferred from ancient and modern DNA analysis
The Student Administration Office

The student administration office has five persons that are eager to help making studies at IBV as interesting and rewarding as possible. We are dedicated to giving our new students a feeling of confidence and belonging from day one, and is arranging a buddy week bursting with professional and social content before the proper studies begin. All new students got an USB stick with important information and a welcoming letter from the Head of Department.

The Faculty announced that it would be possible to apply for money to enhance social activities offered and the course quality with regard to materials and teaching methods, and IBV received 85 000 NOK in 2014. The money has been spent on the following:

- Gift cards to Oracles that meet for extra sessions before exams, 10 000 NOK
- Breakfast and trips during the semester start week, 20 000 NOK
- Free coffee for students with the student administration and scientific staff, once a week, 15 000 NOK
- Christmas or New Year party for the bachelor students, 20 000 NOK
- Course in study techniques, 10 000 NOK
- Mentor for new bachelor students, 10 000 NOK

The University of Oslo announced that it would be easy to podcast lectures during the autumn semester of 2013. IBV therefore started to podcasting lectures from BIO1000 as a trial project in 2013, and in 2014 we offered podcasts for the courses MBV1010, MBV2050, BIO2120, BIO1000, BIO3081 and BIO2150. The feedback from students was that they appreciated that the lectures were podcasted, and we will continue to offer podcasts of lectures.

The student administration office, together with scientific staff, the Laboratory School in Biology and students participate in the Dissemination group. The group coordinates department representation in events like “Åpen dag”, “Faglig pedagogisk dag”, “Forskningstorget” etc., and encourage staff to disseminate scientific results in arenas that are important for recruiting new students.
The Phytotron is an advanced plant growth facility allowing studying plants in various environments and climates. The facility comprises 22 growth rooms and 3 greenhouses totalling climate-controlled growth areas to about 900 m². The phytotron area also includes laboratories, course rooms, cold and freezer rooms, seminar room, offices and machinery/technical rooms.

In 2014 the Phytotron was primarily used in UiO projects by researchers from the Department of Biosciences (IBV) and the Natural History Museum/Botanical Garden. External users came from research institutions and companies. The Park services of UiO used the Phytotron for winter storage of cold-sensitive plants and for growing plants for the summer season.

Personnel
Manager: Associate Professor Uwe Klein
Technicians: Ingrid Johansen, Marit Langrekken and Per Rudidalen

Finances
Operation of the Phytotron is financed by user fees. Internal users from the Department of Biosciences and the Natural History Museum pay a nominal fee while external users pay a fee that covers the running expenses.

Courses and education
The Phytotron has two course rooms adjacent to climate-controllable growth chambers and laboratories. In 2014 about 250 bachelor students have taken laboratory courses in MBV1020, BIO2140 and BIO2150.
In addition to practical courses taught in the Phytotron itself, the facility provided plant material for several other courses at IBV. The plant collection has also been used in exhibitions, guided tours, and research projects.

**Research projects**
Most phytotron rooms are used by master students, PhD students, and post-docs to grow plants for their respective projects. On average about 4 master students, 4 PhD students, and 3 post docs have been using rooms in 2014. A large part of the facility has been allocated to growth and analysis of gene modified organisms (GMO plants). As the latter activities have increased over the years, future plans for the area include an expansion of the GMO space.

**Operation**
Growth chambers were fully booked in 2014. Most users have long term projects that allow us to schedule the use of growth rooms in advance.

Use of phytotron and daylight rooms has been affected by partial replacement of the roof and by upgrading of electrical parts, both causing downtime. This work is ongoing and will continue through most of 2015.

**Cooperation with commercial partners**
The Phytotron has long time research cooperations with the Norwegian company “Norsk Wax” and the Swedish forest industry to develop mechanical means to protect spruce plug plants against attacks by snout beetles. Waxing of plant stems before planting them in the wild is a particularly promising approach that has been proven to be successful in field studies. The “WeevilSTOP” project that is supported by grants from the EU to a consortium of 15 partners from 9 European countries will end in 2015.
The Animal Facility

The Animal Facility underwent major renovation four years ago and is now a fully modern animal facility. The facility houses mainly mice, rats, hens, but also other species used in our research activity. In the aquarium part of the facility we generally house stickleback, cod, crucian carp and other carp species, rainbow trout, trout, salmon, and also the popular model organisms zebrafish and medaka.

In 2014, 4000 animals/fishes were housed in the section. The new clean section of the facility is now filled up, and there was a need to increase the capacity. We have 3 new scandtainer hoods to achieve this. The main users of the facility is the Section for Physiology and Cell Biology, represented by Kristian Gundersen’s and Marianne Fyhn’s groups and Section for Biochemistry and Molecular Biology, represented by Fahri Saatcioglu’s group. Other users are Winnie Eskild with small rodents, and Dag Hessen/ Marwa Jalal with hens. Espen Borgå Johansen fra HiOA is also a major user of the animal facility.

The personnel in the animal facility also participated in field work with Karl Ugland and helped master students catching fish for collection of parasites.

The aquarium section had some repairs in 2014, and all pressure tanks got new metal stands and outlet pipes that improved the water pressure into the aquarium rooms. The salt water parameters are now good due to a complete water exchange. In the marine system we added bactoballs to remove nitrit and a pH computer has been installed. To obtain satisfactory sea water quality we have installed a protein skimmer to remove nitrate. The water from the medaka and sebrafish rooms is now passing through an installed tank with chlorine to avoid eggs and fish to pass into the sewage system.

A new stickleback fish facility for Asbjørn Vøllestad’s group was set up in 2013. This project was terminated in in 2014, however, the facility will be used by Göran Nilsson in the near future. The other large users of the aquarium section are the groups of Göran Nilsson, Finn Arne Weltzien, Ketil Hylland, Fahruk Chaudry, Gareth Griffith and Knut Erik Tollefsen, NIVA.
Experimental Lab Facilities

The Department has the past years made major improvements in their experimental infrastructure by further re-organization of laboratories, co-localizing instruments and last, but not least improving the HSE standards.

**Microlab**

http://www.mn.uio.no/ibv/english/research/groups/merg/infrastructur/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 eukaryotes that cannot be cultured and their parasites. As more than 90% of microorganisms cannot be cultured, it is of great importance for us to provide the best possible facilities for studies of such organisms. Material brought in from the field can be handles in a special lab, where cells and samples can be prepared before culturing or DNA/RNA extraction can be done in other labs.

**CEES DNA lab**

http://www.mn.uio.no/cees/english/research/about/infrastructure/dna-lab.html

The CEES 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 CEES DNA lab is open to users from the Department of Biosciences, and is at present actively used by CEES and EVOGENE.

**The NMR laboratory**

http://www.uio.no/english/research/interfaculty-research-areas/mls/research-support/core-facilities/biomolecular-nmr-spectroscopy/

The Biomolecular Nuclear Magnetic Resonance (NMR) Spectroscopy laboratory at the Department of Biosciences is physically situated in the Department of Chemistry. It is equipped with one 600 MHz Bruker Advance II NMR instrument that is co-owned by the Norwegian Veterinary School, Norwegian University of Life Sciences (UMB) and University of Oslo (UiO). The instrumentation is well suited for studies of peptides, proteins, RNA, DNA and carbohydrates. Per Eugen Kristiansen is employed as a research scientist and assists research groups in structure determination by NMR- and Circular Dichroism- (CD-) spectroscopy.

The NMR laboratory is involved in teaching of master and PhD students. The laboratory is responsible for the NMR lectures in MBV4020 - Methods in molecular biology and biochemistry II. The Biomolecular NMR laboratory is a member of the research school BioStruct and gives the two national courses in NMR spectroscopy MBV9510 - BIOSTRUCT - Biomolecular NMR spectroscopy and MBV9520 - BIOSTRUCT - Advanced Biomolecular NMR.
Ongoing research projects

- Structure determination of antimicrobial peptides in collaboration with Professor Jon Nissen-Meyer and Professor Dzung Diep at NMB
- Structure determination and ligand interactions of hItk SH3 domain is studied in collaboration with Professor Anne Spurkland at Institute of Basic Medical Sciences
- Characterization of lipopolysaccharide binding to the E. coli heat-labile enterotoxin in collaboration with Ute Krengel at Department of Chemistry
- Determination of the structure and function of slice-specific variant of protein kinase A cbeta2 in collaboration with Professor Bjørn Skålhegg at Institute of Basic Medical Sciences

The Clyconor Mass Spectrometry Unit
http://www.mn.uio.no/ibv/english/research/about/infrastructure/ms/

The Mass Spectrometry Unit at IBV established in 2008 has the goal to facilitate MS analysis of clinical and biological samples by offering state-of-the-art instrumentation and MS expertise in preparing, analyzing, and interpretation of experimental data within and outside the department. Current mass spectrometry instrumentation includes a high resolution Thermo LTQ-Orbitrap XL mass spectrometer with an Agilent Nano 2D HPLC system. Additionally, the unit has two data analysis workstations including the Maxquant and Proteome Discoverer search engines, and in-house software to search for peptide matches after unspecific protease cleavages. Methods have been developed for the analyses of glycopeptides, as well as for complex mixtures of oligosaccharides and for peptides with other focused modifications.

The major focuses in 2014 were different kind of protein modification, methylation, glycosylation and ADP ribosylation.

In addition to project related to the department, several external users from the other departments at UiO, Canada and the National Veterinary Institute in Oslo visited the MS Unit for sample analysis in 2014.
The Norwegian Sequencing Centre (NSC)

www.sequencing.uio.no

The Norwegian Sequencing Centre (NSC) has two equal nodes hosted by the Centre for Ecological and Evolutionary Synthesis (CEES) at the Department of Biosciences, and the Department of Medical Genetics (DMG) at Oslo University Hospital and the University of Oslo. Due to this large funding from the National Financing Initiative for Research Infrastructure (INFRASTRUKTUR) of the research Council of Norway, NSC is from 2014 on the National Roadmap for research infrastructures and large national projects.

Offered sequencing applications
NSC offers the Norwegian research community access to a broad range of high-throughput sequencing technologies (HTS) and applications. We possess state-of-the-art facilities and provide services covering most applications within the deep sequencing field, 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, and base modification detection for smaller genomes.

Platform updates
In 2014, two Illumina HiSeq2500’s were purchased for the CEES node, and a HiSeq2000 and a NextSeq500 for the OUS node. These provide higher sequencing throughput and more flexibility in handling different projects. At present, we have the following instruments available: 3 x Illumina HiSeq 2500, 1 x Illumina HiSeq2000, 1 x Illumina NextSeq500, 3 x Illumina MiSeq, 1 x Pacific Biosciences RSII. This is by far the largest instrument park for HTS in Norway. In addition, the NSC has a considerable infrastructure of supporting hardware to increase throughput and automation (Hamilton robot, Beckmann Biomek FX robot, Beckmann SpriWorks robot, two Pippin Prep instruments, Covaris DNA sonicators, etc).

A Laboratory Information Management System (LIMS) has been acquired. The System is a web and GUI based software that is used for sample tracking, automation and reporting. Installation and training will commence early in 2015. Finally, two new staff were hired in 2014 to strengthen the NSC team.

Instrument upgrades
HTS technology is developing fast, and NSC has implemented important upgrades on our current instruments in order to continuously provide “state-of-the-art” service. The Illumina HiSeq instruments have been upgraded to version 4 chemistry, increasing throughput (delivering up 1 Tbase of data in a single run), while reducing run time. New chemistry for the Pacific Biosciences RS II enabled another significant increase in read length and thus throughput.

Decommissioning GS FLX from Roche/454
NSC has decommissioned its two 454/Roche GS FLX instruments in May 2014, due to high cost per base, laborious preparation procedures and decreased interest from our users. As alternatives to 454 sequencing we offer Pacific Biosciences RS II (long reads), and Illumina MiSeq (amplicons).

Offered services
Services include project consultation, sample preparation, and running the sequencing reactions on the DNA sequencers, together with quality assessment of the data. For projects sequenced on Illumina instruments, mapping of the data to a reference is performed. For bacterial PacBio projects, we continue to deliver fully assembled genomes to our users. In addition to de novo genomes, base modification analyses can be provided for bacterial and fungal genomes sequenced on PacBio RS II. NSC may also offer advice on analysis software tools. For more advanced pro-
jects, users are referred to bioinformatics services/help desks (such as ELIXIR), or to research collaborations when appropriate. The submission of projects is handled through our website (www.sequencing.uio.no) where there is a single contact point for both nodes (CEES and DMG), to help ensure that the optimal technology is applied for each project.

Sequencing activity
In 2014, the total number of samples sequenced almost doubled compared to 2013. In total, about 6500 different samples were sequenced at NSC, representing samples from close to 250 research groups – mostly from Norway, but also from several other European countries. The largest fraction of the samples was run on the Illumina platform (HiSeq/MiSeq). However, the number of samples sequenced on PacBio is steadily growing.

Large projects
Currently, the largest project that NSC is performing sequencing for is the Aqua Genome (AG) Project – led by CEES. In the AG project, 1000 individuals of Atlantic cod (Gadus morhua) will be sequenced with Illumina technology. The AG project started in 2014 but will remain a large focus in 2015. We anticipate that large projects will be increasingly important for NSC in the future, and for the next year we have several such projects in the pipeline – both within biomedical and biological research.

Outreach
We have been involved in organizing a two-week, hands-on course on “High Throughput Sequencing technologies and Bioinformatics Analysis”, held at UiO in collaboration with the Computational Life Science initiative (CLSi), the FUGE/ELIXIR Bioinformatics platform, and the Norwegian Genomics Core Facility.
The Electron Microscopy Laboratory (EM-Lab)

The EM-Lab was established in 1966 and has the last 45 years contributed to more than 900 publications (including master and PhD theses). The equipment of the laboratory has an estimated value of NOK 25-30 million and is, due to its methodological resources, the largest EM laboratory in Norway for the biological, molecular and biomedical sciences. Presently the laboratory includes 4 electron microscopes. Three are transmission microscopes, (CM200, CM100 and a CM12) and a scanning electron microscope Hitachi S-4800. One of the transmission microscopes is a standard instrument while the others are fitted with various types of auxiliary equipment that allows the use of advanced and special techniques for elemental analysis, cryotechniques and high resolution imaging. Images are captured digitally on high resolution, Olympus (Quemesa) cameras.

In addition the laboratory is equipped with a large and varied selection of preparation equipment that covers most of the techniques that presently are used. The resources of the laboratory, both with regard to personnel and equipment, are available to all scientists at the Faculty of Mathematics and Natural Sciences, although molecular biologists and biologists are given priority. PhD students, guest researchers and master students may perform EM investigations pursuant to an agreement between their supervisor and the head of the laboratory. External users are welcome as long as the capacity of the laboratory allows this. In addition to being a service provider, the EM-Lab is developing new electron microscopic methods.

The laboratory primarily analyses biological samples, but may also be used to solve problems within other fields. The laboratory organizes a annual course in electron microscopy (MBV4110/9110) that is a part of the master study program of molecular biology, biochemistry and physiology. More advanced courses in high resolution electron microscopy and cryotechniques are organized when needed.

The laboratory has one permanent scientific position and two technical positions.
The NorMIC Imaging Platform at the Department of Biosciences is a specialized microscopy unit for the subcellular study of living and fixed cells. The unit is in addition a part of the UiO imaging platform NorMIC Oslo, a FUGE supported facility. The aim of NorMIC is to strengthen and develop research in functional genomics in Norway. NorMIC is organized in a network with nodes in Bergen, Oslo, Stavanger, Tromsø and Trondheim, and together these nodes cover all present modalities within molecular imaging.

The organization of the Imaging Platform as a core facility implies that all researchers in Norway are welcome users at equal terms through our booking system. The Imaging Platform offers courses, expertise, use of confocal instruments after booking/availability (new users will need to go through training/assessment procedure) and access to immuno-EM techniques. The platform offers access to a range of advanced light microscopes including confocal laser scanning instruments, spinning disk confocal, TIRF, optical tweezers, and high-content wide-field fluorescence systems. The instrumentation is optimized for live imaging of a variety of biological samples from bacteria to cells to whole zebrafish embryos.

**Equipment**

1) **Olympus FluoView 1000 inverted IX81 confocal laser scanning microscope**

The Platform has two inverted FluoView 1000 instruments, both specialized for the study of living cells, with incubators for maintaining 37°C and CO₂ supply. These are equipped with four laser lines and thus may detect four different fluorochromes. One instrument is equipped with a SIM scanner to allow fast and specific bleaching experiments, and this makes the microscope well suited for advanced techniques like FRAP, FLIP, FRET and photoactivation. The other instrument has a motorized stage for repeated imaging of multiple locations on a sample over time, and high speed autofocus to correct for drift during long time courses.

2) **Olympus FluoView 1000 upright BX61WI confocal laser scanning microscope**

This upright system is suitable for the study of fixed cell samples as well as for living animals. The microscope has water immersion as well as oil immersion objectives with a large working distance, making it suitable also deeper imaging of tissues and whole organisms such as zebrafish embryos.

3) **Andor Revolution XD spinning disk confocal microscope**

The spinning disk microscope enables live climate-controlled imaging of very rapid events, with three laser lines. The detector EMCCD camera has a high signal/noise ratio that can record up to 300 pictures per second, making the instrument ideal for recording living cells with a low photo toxicity threshold, and for the time lapse study of cellular processes in 3D.

4) **Scan^R high throughput immunofluorescence microscope**

The high throughput Scan^R system enables imaging of a wide range of sample formats with automated image acquisition and analysis. It can image hundreds of thousands of events in live or fixed samples, providing the opportunity to screen chemical or siRNA libraries and generate highly statistically robust quantitative results.

5) **Total Internal reflection fluorescent (TIRF) microscope**

The Leica DML6000B TIRF is specialized for the live study of membrane events with up to 100x objective magnification, 3 laser lines, EMCCD camera, and peristaltic perfusion system for real time addition of stimuli. This instrument also offers high speed parallel TIRF and epifluorescence imaging.
6) Optical tweezers
The JPK optical tweezers/micromanipulation, combined with a Nikon confocal imaging system, offers 3 laser lines, multiple traps with high trap stiffness, nanometer-position control and a quadrant photodiode for detection of fast dynamics and calibration for quantification of forces. This system enables users to quantify forces involved in cellular processes, as well as micromanipulating particles and organelles either intracellular in vitro or in a cell-free system.

7) Imaris software (visualization and data analysis)
Data sets from microscopy of living cells in 3D or 4D often comprise several gigabytes of data. Specialized high-end computers with specific software are needed to handle such large data sets. For analysis and 3D reconstruction Imaris from Bitplane is a software module that specifically can handle these large 3D and 4D data sets and is necessary to interpret data from the different microscope platforms.

Users
Approximately 100 researchers used the platform actively in 2014, from many groups at our department from different departments at the University and visitors from abroad. The microscope platform has additionally worked as a demonstration site for both Andor and Olympus.

Lectures and courses
In addition to the yearly IBV courses that include imaging (MBV1010 and MBV4030), we hosted the annual European Light Microscopy Meeting (ELMI) in May 2014, an international event attracting up to 400 imaging specialists from around the world.
The Two Photon Imaging Lab

The two photon imaging lab at the IBV is a specialized microscope unit for two photon laser scanning microscopy (2PLSM). The lab is run by Marianne Fyhn, Section for Physiology and Cell Biology. The two microscopes (Sutter MOM) are flexible and can easily be adjusted to the imaging of different specimens. The microscopes are funded by the UiO (AVIT and IBV) and by the NorMic Imaging Platform. A challenge with microscopy of living tissue is the strong light scatter of all biological tissue which blurs an image with traditional linear (one-photon) microscopy. With two-photon microscopy on the other hand, the image is reconstructed from the light generated when two photons arrive simultaneously at a molecule and combine their energies to promote the molecule to an excited state. Thus, all photons detected originate from the structure of interest resulting in high resolution images as deep as 1 mm into the tissue. The development of two-photon laser scanning microscopy combined with fluorescence labeling techniques has opened for imaging studies of e.g. cellular function in organs such as the brain, hearth and organ systems (e.g. fish larvae) in living animals that previously were only possible post mortem. To date, the scopes at the IBV have served studies investigating brain function in mice and fish. Studies of other model systems are under planning.

Cell specific genetic targeting of neurons (a) In vivo imaging of neurons expressing the genetically encoded Ca2+-sensor. (b) In vivo image of dendrites of layer III cortical cells expressing a red fluorescent protein (TdToma) and GFP expression coupled to PSD-95 which is localized in synaptic connections (spines) (c) Shadow images of cell bodies in layer III (ca. 300 µm below dura mater) after pressure injection of a fluorescent dye (Alexa 594) into the extracellular space. With the pipette tip gently touching the cell soma, the cell immediately fills with pipette solution during current injection. (d) In vivo imaging of a dendritic branch expressing GFP.

Investigation of in vivo processes in the live medaka fish larvae using 2PLSM. A) the fluorescent dye is injected (blue lines) into the brain of the larvae and single cells are seen as shadow images. B) When the dye is injected into the cerebrospinal fluid it stays in the spinal cord and blood vessels (red arrows) and cells are visualized.
Central Engineering Workshop

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

The Central Engineering Workshop mainly serves the Department of Biosciences, though it also undertakes construction work for external organizations 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 for research projects, and also carries out construction and repair work in mechanics, electronics 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 the engineering workshop!

In 2014, the workshop had full order lists and many interesting and challenging assignments. A total of 147 projects of varying complexity were undertaken for the Biosciences department. Many of our tasks in 2014 as in 2013 were related to physiology, in both rodents an fish experiments. News in 2014 is that we got a new employee, Jan Kristiansen. He is graduated within fine mechanics and has 38 years work experience. Mads Granberg changed job after having worked at IBV for eight years and is now working at the workshop at the Faculty of Medicine. 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 equipment and machinery.

The personnel
Hans Borg, chief engineer
Johan Erland, principal engineer
Stein Høydahl, senior engineer
Jan Kristiansen, principal engineer
Bjørn Langrekken, principal engineer

Costs
Researchers from IBV pay NOK 200 per job and 35% of material costs.

Cars
The workshop administers 5 cars; 4 Toyota Hiace and 1 Ford Transit Connect. The cars can be lent to employees at IBV. To rent the cars, go to http://www.mn.uio.no/ibv/for-ansatte/arbeidss­totte/bilbestilling/
Research Vessels

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

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 Biosciences, Physics and Geosciences all use the research vessels both for research and educational purposes. They are also used in collaborative projects with other national and international research institutions. In addition, the research vessels are rented by external institutions that carry out research, environmental monitoring and environmental consulting. The vessels have their main mooring at Lysaker with docks as well as equipment storage, engineering, office and briefing facilities.

Ship equipment and design are tailored for research activity, but also works quite well for teaching purposes. The vessels have in recent years been modified to ensure that equipment can be changed rapidly in accordance to the needs of the users. Trawling, use of submersible acoustic sensors, large and heavy grabs and corers, as well as deployment of large monitoring buoys are some of the tasks.

A recent status report has shown the range and scope of the use of the vessels and their importance for research and scientific production in the last five years, both in marine ecology and ecotoxicology. The vessels are used for four bachelor courses, seven master courses as well as for collection of material for many master and PhD projects. In recent years, this means that 160-170 students participate annually in courses at the bachelor level where vessels are an integral part. Corresponding figures for master courses are 80-90 students. The vessels provide the University with an unique opportunity to produce students who have good expertise in field work including methods and instruments.

In the period 2008-2014 there were >40 completed master’s theses and 16 PhD projects that would not have been possible without the vessels. Projects where the vessels have been an integral part resulting in articles in scientific journals in the period 2008-2014 count about 10 articles per year.

Activities
The main users in 2014 were, in addition to courses, Department of Biosciences (AQUA: Stein Kaartvedt, Josefin Titelman, Wenche Eikrem and Ketil Hylland), Department of Geosciences (Elisabeth Alve, Eyvind Aas) and external users (NIVA, NGI, Statnett, Rambøll, Norconsult).

F/F Bjørn Føyn has mainly been used for college courses and to some extent for field work in Drøbak. The activity in 2014 was at the same level as in previous years.

Organization
The Faculty of Mathematics and Natural Sciences has appointed a board which is responsible for the use and maintenance of the vessels. The board has four members, the chair being directly appointed by the Faculty; Ketil Hylland (chair), Elisabeth Alve, Josefin Titelman and the captain Sindre Holm.

Applications for vessel time, sailing schedules and daily use is coordinated by the captain. The staff is employed by the Department of Biosciences: Sindre Holm – captain, Jan Sundøy – assistant captain and Tom Opsahl – engineer.

Use, management and maintenance
The use and management of the vessels have been stable in 2014. There have not been any sudden cancellations, and the vessels are being kept in good order with regards to both yearly and long-term maintenance. The routine maintenance is the responsibility of the crew.

The Workshop at the Department contributes heavily with mechanical repairs and maintenance towards the vessels and their equipment. There have been no accidents or damages involving people or equipment in 2014.
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.

Research projects at the station in 2014 were:

School visits
The Research Station has for more than 40 years offered different types of 1-2 days of field courses in marine biology. This popular activity was continued in 2014 with a total of 27 days of field courses for 25 school classes, i.e. 428 pupils and 41 teachers. 5 school classes stayed overnight at Tollboden.
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.

Development
Plans for expansion and future development of the station have been developed and are currently in review. In October 2014 UiO and the Drøbak Marine Station participated in a collaborative application to The Research Council in Norway for funding of infrastructure upgrades in order for the station to join the EMBRC network along with The SARS-centre in Bergen, The Norwegian University of Life Sciences (NMBU) and The Norwegian Institute for Water Research (NIVA). At Drøbak Marine Station a new facility (see photo below) for increased saltwater aquaria and teaching facilities are in the planning.

Finn Jørgen Walvig’s Research Foundation.
In his memory, the former long-time (37 years) station director Finn Jørgen Walvig (1925-2009) established a substantial research foundation at Unifor (UiO) with the purpose to stimulate and support basic aquatic research carried out at his beloved Marine Research Station in Drøbak. Grants from the foundation were available for the second time in 2014.

Tollboden. The building is from 1825 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.
Finse Alpine Research Center

The Research Center 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 center. The center is managed by Department of Biosciences at UiO, and UiB contributes to the operating costs. The Estate Department at UiO is responsible for the buildings. The center 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 takes part in a EU-funded infrastructure network of currently 71 circum arctic terrestrial field stations/bases (see http://www.eu-interact.org/), and provide transnational access grants to researchers from other EU member states or associated states. Further information about the center is available on the station’s website: http://www.finse.uio.no.

Operation and administration
The daily operation and administration of the center is carried out by the director, Torbjørn Ergon and the manager, Erika Leslie, both from the Dept. of Biosciences at UiO. 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. In 2014, the board members were:

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: Vigdis Vandvik)
Technical Representative, UiO: Hans Borg (deputy: Johan Erland)
Technical Representative, UiB: Solfrid Hjelmtveit (deputy: Knut Helge Jensen)

For the sixth consecutive year, the center employed a summer assistant for maintenance work and assistance in the practical operation of the center (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 Tafo a/s at the Course and Conference Unit works well and will be continued.

Research activity
The number of working days in connection with research activities at the station in 2014 was 342 (279 overnight stays). 93% of the research working days took place during the summer months of June, July, August and September. In total 37 persons from 12 institutions used the station for research activities during 2014. Most researchers came from UiO (10 persons, 104 working days), while researchers from the Norwegian University of Life Sciences lay down more working days at the station (8 persons, 145 working days). Of the 10 researchers/students/assistants from UiO, 10 came from Department of Biosciences (89 working days), one came from Department of Geosciences (8 working days), and one came from Natural History Museum (6 working days). Other research institutions using the station were (number of persons in parenthesis): Hradec Kralove University, Tsjekkia (4), Norwegian Institute for Nature Research (4), University of Bergen (3), Lancaster University (2), University of Rostock (2), Biology Center ASCR, Tsjekkia (1), Charles University Prague (1), Imperial College (1), Museum and gallery of Orlice mountains, Tsjekkia (1), and Norwegian Radiation Protection Authority (1).

A brief description of each research project at the center and a list of publications are published on the center’s website: www.finse.uio.no/research/
Courses and seminars
A total of 1316 overnight stays and 384 persons were registered in connection with courses, seminars and meetings in the course and conference unit of the center. The course and conference unit was in use during 68 days throughout the year.

The following regular university field courses were held at the center (chronological order):

- Atmospheric physics (GEF 2200), UiO (3 days in March, 8 participants)
- Snow, Snow Hydrology and Avalanches (GEO 4430), UiO (3 days in March, 14 participants)
- Alpine Ecology (BIO 259), University of Birmingham (8 days in July, 30 participants)
- Biodiversity (BIO 1200), UiO (3 groups of 5 days in July/Aug, 78 participants)
- Physical Geography (GEO 1010), UiO (7 days in August, 90 participants)
- Quaternary Geology (GEOL 106), UiB (8 days in August/September, 60 participants)
- Limnology II (BIO 4390), UiO (4 days in August, 4 participants)
- Glacial and periglacial geomorphology (GEO 4410), UiO (7 days in September, 7 participants)

The station also housed three other academic events in 2014:

- Seminar, Department of Biology, UiB (2 days in March, 14 participants)
- CRYOMET seminar, Dept. of Geosciences, UiO (3 days in April, 14 participants)
- “Fægridagane”, Biology teachers’ course in alpine ecology, Skolelaboratoriet, UiB (4 days in July, 20 participants)

Other activities and outreach
The station is part of an EU-funded network of now 71 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 meets about twice yearly. The network also administers a Transnational Access research funding scheme and coordination of joint research and monitoring programs and outreach. In 2014, the station hosted three research groups (7 researchers for a total of 48 work days) through this scheme. The EU-funding period ended in December 2014. An application to continue and extend the network was submitted to EU’s Horizon 2020 program, but was unfortunately not funded. However, we were invited to submit a revise the application, which will be reviewed in the autumn.

The center participates in the Finse Forum, where representatives from local business, NGO’s and local governments meet twice a year. Several school classes and a scout group visited the station and were given an introduction to alpine ecology. With assistance from the Department’s Science communication adviser (Tore Oldeide Elgvin) we initiated a section for public outreach on our web-pages: http://www.finse.uio.no/natur-og-historie/. An editorial board has been established that will solicit and edit contributions to these webpages. Short versions of the articles will also be laminated and mounted on the station’s notice board along the Old Navy road (Rallarveien) next to the station, and thus be available for thousands of bikers passing every year during the summer months.

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 using the cabin. During the most busy summer weeks, Garpen is used for extra accommodation for researchers and summer employees at the station. In 2014 the cabin was used in 98 days. The station also has a lease agreement with landowners in Ulvik to have access of the Torbjørnstølen cabin for similar purposes.

Technical upgrades
GR-bygg completed work on the roof on the buildings, in addition to various repair and upgrade work.
Laboratory School in Biology

www.mn.uio.no/ibv/om/skolelab

During 2014 the school lab has been involved in several projects both within teaching, dissemination and research. Almost 700 pupils have been visiting the school lab and almost 200 teachers have attended different courses. We are proud of our achievements for 2014 however we aim to reach even higher in 2015. We firmly believe that our activities contribute to greater focus on UiO and IBV as an institution for higher education.

The school lab acts as a link between the school and higher education and our aim is to ensure that teaching biology at IBV holds a high scientific level and at the same time is based and build on the biology curricula in school. In this way we aim to ensure that the transition from school to higher education is as smooth as possible for the students without sacrificing the professional and scientific quality of our education.

The following people have been employed at the Laboratory School of Biology in 2014:

- Tone Fredsvik Gregers; 100% permanent position as “førstelektor”.
- Kristin Glørstad Tsigaridas; 100% temporary position. Kristin is a teacher (lektor) at Ullern videregående skole
- Cato Tandberg; Oslo and Akershus University College of Applied Sciences: hired in 20% position from September
- Ivan Myhre Winje; PhD student from the Section of Physiology and Cell Biology has teaching duties in the Laboratory School.
- Pernille Nilsson; PhD student from Centre for Ecological and Evolutionary Synthesis has teaching duties in the Laboratory School.

The Laboratory School resource group consists of Halvor Aarnes (IBV), Tom Andersen (IBV), Pål Fallnes (IBV, sabbatical in 2014) and Doris Jorde (Norwegian Centre for Science Education). The resource group had only one meeting during 2014, December 17th.

Teacher training (without exam and study points)

We aim to perform teacher training in biology for teachers in upper secondary school, both practical and theoretical courses. In 2014 we received a total of 182 teachers divided between 8 courses. The following courses have been arranged:

Course in biotechnology for teachers, January

In collaboration with the Norwegian Biotechnology Advisory Board we arranged a two-day course in biotechnology and bioethics. The course was divided in a theoretical and a practical part. The theoretical part contained several lectures with invited speakers and the topics ranged from vaccines, gene modified plants and insects and ethical aspects of biotechnology. During the practical part we performed two different experiments: “detection of GMO using PCR” and “detection of HPV antibodies using ELISA”. The teachers were also offered to visit different laboratories at IBV, The Radium Hospital, The Biotechnology Centre of Oslo and The Norwegian Institute of Public Health. The leader of the Norwegian Biotechnology Advisory Board, Kristin Halvorsen also attended the course one day.

Course in “Text in Biology”, March and November

Biology 2 is far the most difficult exam to obtain good results and teachers often find it challenging to train their students in writing scientific biology; therefore we arranged a one-day theoretical course in biology texts already in 2013. Here we discussed strategies and ways to prepare the students towards the exam. The course was very popular and we were asked to arrange the course again in 2014. We arranged the course twice, both times fully booked.

Seminar in biology 2 exam from spring 2014, August

We arranged a 3-hour seminar about the biology 2 exam from spring 2014 for biology teachers where the results, answers, misconceptions and challenges were discussed. Kirsten Fiskum from The Norwegian Directorate for Education and Training gave an overview of the process of making the central given exam in Biology 2.
Course in experimental design and reports, teachers from Hersleb vgs, October
7 teachers from Hersleb vgs attended a 2 times half-day course in experimental design and training in writing skills focusing on how to write lab reports.

Techniques in immunology, Natural Science Conference 2014, October
During the “Natural Science Conference 2014” arranged by the Norwegian Centre for Science Education, the Laboratory School contributed with a teacher’s practical course in immunological techniques. 17 teachers attended the course.

Course in cell respiration and photosynthesis, October
In 2014 we arranged a one-day course performing easy and low-cost experiments in cell respiration and photosynthesis. The feedback from teachers attending the course was: “Excellent! This is so easy I can even perform it with my 10-year old”.

Course in cell biology and microscopy, December
In this course we studied structure and function of different eukaryotic cell types using light microscopy: plant cells from Elodea and red onion, blood cells, skin and muscle cells, and we performed different experiments illustrating structure and function. Membrane transport was central in almost all experiments which is important in the curricula after 10th grade and in biology 1. Frode Skjeldal gave a lecture in live cell imaging.

Continuing education and training (with exam and study points)
From August 2014 we could offer a continuing education and training programme for teachers in natural sciences. In collaboration with the Laboratory School of physics, chemistry and the Natural History Museum in Oslo we have designed and developed a 30-study point course (NAT2010V and NAT2020V) in natural science level 2 (Naturfag 2) for teachers teaching 8th -11th grade. The first part, from August to December, contained physics and general chemistry (NAT2010V) and was closed with a 15-study points exam 10th of December. Organic chemistry and biology (NAT 2020V) will be closed with a 15-study points exam on 10th of June 2015. The course is arranged as three parallel groups containing approximately 20 teachers in each group from all over the country.

School visits
In collaboration with some of the research groups at the Department, the school lab has developed several educational units designed for school visits. These units disseminate some of the research performed at the different sections and are also linked to the curricula for Natural Science and Biology 1 and -2. During 2014 we could offer one new unit in X-linked inheritance concerning haemophilia A. Some of the courses have been very popular among pupils in Upper Secondary School, but we also received visits from classes from 10th grade. In 2014, 492 pupils from 27 different schools attended the different courses offered. In comparison 9 different schools visited the school lab in 2013. The pupils are mainly from Oslo and Akershus however we also receive visits from Oppland (Valdres and Dokka Vgs), Telemark (Rjukan Vgs), Hedemark (Storsteigen Vgs) and Sogn og Fjordane (Nordfjordeid Vgs).

The following courses were offered in 2014:

Transformation of E. coli
We transform the bacteria E.coli with a gene from the jellyfish Aequora victoria that codes for Green Fluorescent Protein (GFP). The pupils are introduced to GMO, gene regulation and selection. 11 classes 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. 5 classes have attended this course.

Cystic fibrosis - a gene test
The pupils learn about genetic testing of the autosomal recessive disease cystic fibrosis. They perform restriction digestion of different DNA samples and make a pedigree based on the results. 4 classes have attended this course.

X-linked inheritance - a gene test
The pupils learn about genetic testing of the X-linked recessive disease Hemophilia A. As for cystic fibrosis, they perform restriction digestion of different DNA sample and make a pedigree based on the results. The course was new autumn 2014 and 1 class has attended this course.
Photosynthesis
In this course the pupils are introduced to photosynthesis through experiments with the green algae Scenedesmus quadricauda. The level of photosynthesis is investigated by varying the intensity or wavelength of the light in addition to varying amount of light and cell density. A hydrogen carbonate indicator measures the level of photosynthesis. 3 classes attended the course.

Cell respiration
In this course the pupils study anaerobe respiration in yeast. By using different concentrations of sugar they investigate the respiration efficiency by measuring the level of CO₂ production. 2 classes attended the course.

Lectures
Teachers also contact us for lectures and campus tours without the practical lab experiment. In 2014 Anne K. Brysting and Klaus Høiland both contributed with lectures for pupils from 2 different classes.

Oslo municipality and UiO collaboration, Hersleb Vgs
Collaboration between UiO and Hersleb vgs was initiated spring 2014. The school reopened after several years of renovation in August 2014 as a new Upper Secondary School with specific focus on biology and geosciences. Together with the Natural History Museum in Oslo we contributed and supported different parts of the teaching in natural science. 4 classes of approximately 30 students each came in November and performed gene testing of cystic fibrosis. 7 teachers attended our newly developed science-writing course in October.

Ungforsk
Ungforsk is a 2-day event at UiO where 10th graders from Oslo and Akershus are invited to a day full of science research activities. 180 10th graders from 6 different schools came to the school lab for a 45 minutes “crash course” in DNA isolation. All the students made their own DNA necklace which they could bring home.

Student information and campus tour
The Faculty of Mathematics and Natural Sciences has 2 biology students in their student recruitment program. We have collaboration with the faculty where we offer one-hour student information and a tour at the biology building and the campus in conjunction with the school visits. The feedback from the pupils and teachers are solely positive and is part of the faculty’s recruitment strategy. All visiting schools received this program in 2014.

Teaching
NAT 2000 is a course held by the Department of teacher education and school research, Faculty of educational sciences. The Laboratory School has contributed in both planning and teaching this course. In addition, we have written a compendium for use in the course. NAT2000 is a collaboration between the School laboratories in chemistry, physics and biology, and gives the students a practical introduction to natural science.

The Laboratory school was also asked to give a lecture at the new master course BIO4001.

Research in didactics
In collaboration with the Norwegian Center for Science Education and the Department of Teacher Education and School Research (ILS) we applied in 2013 for funding to a project where we aimed to investigate the education of biology teachers at UiO with particular interest in the pedagogical and didactic education (PPU). We were granted with 50000 NOK from the KiS (Kunnskap i skolen)-program at the Faculty of Educational Sciences. The project was initiated in 2014 and a questionnaire was developed and sent to all Upper Secondary Schools in Norway in September 2014. 314 teachers answered the questionnaire and the results are highly interesting, however they need proper analysis and interpretations. We therefore applied for additional funding to continue the project in 2015. We have been further granted with 30000 NOK.

We aim to understand the background of biology teachers, their level of knowledge and teaching methods (both lab and field work) in order to contribute to better education of, not only biology students at the Department of Biosciences (IBV),
but also natural science teacher-students (lektorstudenter) in general at UiO. The results will be presented both at IBV, ILS and the Norwegian Center for Science Education during 2015.

**Dissemination of biological research – Bio-Thursday**
In collaboration with the science library we arrange Bio-Thursday last Thursday each month. Different scientists from the Department of Biosciences contribute with popular scientific talks. The talks are streamed live and are available for download. The scientists who contributed in 2014 were Professor Glenn-Peter Sætre, Professor Kejtil S. Jacobsen and researcher Melinka A. Butenko. The Bio-Thursdays continue in 2015.

**Visit from politicians**
November 11th we had a visit from the school council in Oslo, Anniken Hauglie. She attended one of our visits from Hersleb Vgs and joined the students in performing gene testing. She stayed for approximately 45 minutes.

**Participation in externally working group designated by The Norwegian Directorate for Education and Training**

The assignment for the working group have been to deliver a report that will give decision-makers a platform of knowledge about the common core subject natural science and the programme subjects biology, chemistry, physics, geosciences and, technology and theory of research (teknologi og forskningslære).

**Media**
We had two different media coverage in 2014:

To videregående skoler under UiOs vinger (Uniforum)

Gode gener for biologi (Dagsavisen)

**Social media**
We are both on Facebook and twitter:
www.facebook.com/skolelab
twitter.com/Skolelab
The Biological Students’ Committee (BFU)

www.biologiskfagutvalg.com
www.facebook.com/pages/Biologisk-fagutvalg/83335434364547

The Biological Students’ Committee (Biologisk Fagutvalg, BFU) is a student body for undergraduate and graduate students connected to the Department of Biosciences (IBV). BFU works to create and maintain a good academic and social environment for all students.

2014 was a particularly proud year for BFU, as Studentsamskipnaden i Oslo og Akershus (SiO) and the University of Oslo named the committee “Student organization of the year”! The main argument for the award was BFUs strong contribution in making students feel affiliated with IBV, through social and academic events, and the buddy week.

Speaking of the buddy week, this was a great success in 2014. The week welcomes new students with interesting lectures, social events, competitions, excursions and parties. Many fantastic buddies made a great job integrating the new students!

One of the traditional events hosted by BFU in 2014 were the weekly breakfasts “Frokost hos Kristine”, which serve free food and a lecture. The breakfasts were as popular as ever, and funding from the Student Parliament allowed for a great improvement of the food offered. BFU was also responsible for two interesting debates: “Climate efforts - a threat to the Norwegian environment?” in May and “How to be a responsible consumer?” in November.

Some of the excursions hosted by BFU were part of an “extended buddy week” in the spring semester, which seeks to further socialize first year students. The program included a trip to Tusenfryd, a “Night at the museum” and a ceremony to congratulate the first year students on being one step closer to becoming true biologists. The “Night at the museum” was a new concept, where students learned about some of the strange things in “Studiesamlingen” while drinking and eating pizza. The event was very popular and was repeated in September.

BFU also arranged a biodiversity mapping trip with SABIMA, a mushroom hike and a fossil expedition. “Biografen” continued to host movie nights, and screened movies such as “Into the Wild”, “The Mask” and “Sharknado”.

In February, a winter party was hosted together with FuMBV, with lots of tapas and fun. The collaboration with FuMBV continued in June with a summer party to close up the academic year. In October, new students were invited to party along at “Biologisk Aften”. Smaller parties were also held, further from the IBV, at the semiannual BFU hosted cabin trips.

Continuing the success from 2013, a career day was arranged in 2014 as well, together with FuMBV. A broad specter of different institutions and businesses showed up, and interesting speeches, free pizza and happy students made the day complete.

As is the case every year, BFU put down important work through student representatives in significant boards and groups at IBV in 2014. The committee also organized exam preparations in all the biggest biology subjects. In December, a voting took place among biology students to name the lecturer of the year. Biologist Jens Ådne Haga won the polling, and was awarded “The Golden Pointer” by BFU at the IBV Christmas party.

On a final note, BFU encourages all employees at IBV to attend the committees’ events, to allow for improved communication and socialization between researchers and students.
The Student Committee for Molecular Biosciences

fuimbv.com

The Student Committee for Molecular Biosciences is a body for students studying molecular biology, physiology and biological chemistry at an undergraduate and graduate level. The primary goal of the Committee is to maintain a good social and academic environment for the students.

The Committee organizes several social events for the students, some once and others several times per semester. It is important to the members of the committee that these events are available for all the students. The Committee is selling lab coats to help fund the events, and we also receive funds from the department and the faculty.

The most popular event so far is the Board Game night. This has become a huge success, and is held three to four times each semester. We provide board games, snacks and beverages, and on some occasions free pizza. It is a casual and fun way for student from the entire department to get to know each other and take a break from the daily grind.

Another event we have had several times in 2014 is the IBV - Soda/Beer. It is an event where students get to meet each other in a casual environment. Two to three times per semester the Committee invites students to join us at a bar or café in Oslo, creating “togetherness”. Quizzes will be next.

Our biggest social events during the year are the winter party, summer party, the buddy week for new students, and cabin trips. The winter party was held in February in the Kristine Bonnevie canteen, together with BFU, and included a tapas dinner, singing, dancing, and a live band. Over 100 students attended. The summer party was also organized together with BFU, and was held at a Mexican restaurant. It included a great dinner, speeches from the leaders of the two student Committees, and the student advisors handed out flowers to the graduating students. First year students were given a small microscope as a prize for their good work in finishing the first year of their bachelor’s degree.

At the beginning of the fall semester the Committee helped the “buddies” arrange a fun and inviting week for the students starting their bachelor studies in Molecular Biosciences. This included several fun games and quizzes, parties, dinners, lunches, and tours of the campus. It is a very important week, and the Committee works hard to make the new students feel welcome, and get to know each other, the campus and some of Oslo.

The cabin trip was held in the fall of 2014, and it was very popular among the students. Almost 50 people joined the Committee to a cabin in Nordmarka, outside Oslo. The trip consisted of a good dinner, fun games and a lot of socializing among students across grades. It was a nice way to ensure that new (and old) students met new people.

Academically the Committee helps the students by arranging oracle service before final exams, where the students may ask a professor or student fellow last minute questions. Fruit, cookies and beverages are served at the oracle, and the professors/fellows are rewarded for their help.
Health, Safety and Environment

New HSE team
After the reorganization of IBV per January 2014 a new HSE organization was established, with one HSE coordinator (HSE-c) and 6 dedicated local HSE coordinators (HSE-i) making up the new HSE team. They will support the head of the department and section leaders in their HSE work. The purpose of local HSE-team is to assist employees at different levels in fulfillment of their HSE responsibilities.

The HMS team at IBV consists of (section):

- Anders Moen (BMB)
- Anders Herland (CEES) – special focus on fieldwork HME
- Berit Kaasa (AQUA)
- Cecilie Mathiesen (EVOGENE)
- Nanna Winger Steen (CEES)
- Tove Klungvik Larsen (FYSCELL)

The HSE Focus in 2014 was HSE training.

Systematic HSE work at IBV
- The Management HSE review was conducted and presented for the IBV-board and to the section leaders.
- There have been three meetings in the local working environment committee (LWEC). The agendas and the minutes from these meetings are published at the Departments web pages.
- Risk assessment continues
- First part of ARK - work environment and satisfaction surveys – was conducted in 2014, action plan follow-ups will continue into 2015.
- Reports of injuries, accidents and HSE deviations at the Department have been low and probably a bit inadequate through the years. The importance of reporting deviations has been emphasized, resulting in more incident report in 2014 than previous years.
- The section leaders made sure that the safety inspections were carried out in all sections.

Risk assessment – working in the laboratories
After the Labour Inspection Authority (LIA) inspection at IBV in 2013, the Department was credited for the work that has been done regarding HSE in the last years, specially the LIA was interested to see how the work with risk assessments continues. That is why IBV has continued the focus getting the risk assessment in place. “A well functioning system for risk assessment should be established and incorporated as a natural part of all activities at the department”. This has resulted in more than 123 new risk assessments conducted in 2014 making a total of 200 published working procedures with step by step risk assessment.
Safety inspections 2014
Safety inspections are an important part of the systematic HSE work and a tool for improving the work environment. The IWEC and HMS-team recommended the following focus areas:

- HSE training procedure – do staff and student know the HSE system at UiO?
- Ergonomics – office workplace

The section leaders headed the safety inspections, in addition the safety representatives, technical staff and the HSE coordinator participated. Written reports were made. While the inspection showed that there are more than 97% of the staff knew where to find safety installation and safety equipment, only 37% had taken the mandatory safety courses and 60% had satisfying knowledge about the HSE system at UiO. There will be a focus in 2015 to improve these numbers.

HSE training
The management at the department, HSE-team, safety representatives and the HSE coordinator have taken the HSE necessary foundation courses arranged by UiO. Many new employees have taken the UiO HSE courses in dangerous work and fire safety.

IBV has taken part in the E-teaching program initiated by the MN-faculty. This aims at improving the quality of the HMS-training dramatically.

HSE information
The HSE web pages were redesign by HSE-team with help from HMS UiO in 2014. The paper based HSE handbook is obsolete and replaced by UiO HSE system SN-BS OHSAS 18001:2007 with UiO procedure and tools in addition to local IBV procedures, making the HSE system electronic. The SOP and risk assessment has been made available for the UiO community.

IBVs HSE price 2014
The AQUA section was awarded the HMS-price 2014. At AQUA they have established a local documented HMS training for all new students. The course consists of a 3 hour session, with emphasis on relevant and necessary HSE for the work that the students will do in the section. This is an initiative which involves the whole section. Special thanks to Bente Edvardsen, Berit Kaasa, Sissel Brubak, Stein Kaartvedt, Stein Fredriksen and Per-Johan Færøvig for their contribution.
## RCN projects

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<td>Partners and Networks - Peptide Ligand-Receptor signaling in cell separation processes in plants</td>
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<td>Developing methods for study of redox proteins by combining synchrotron radiation (e.g. mcystallography) and single-crystal spectroscopy</td>
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<td>Seasonal to decadal Changes Affecting Marine Productivity: an Interdisciplinary investigation</td>
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<td>Development of biodegradable nanobeads as vaccines against tuberculosis</td>
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<td>Development of nanoparticle based therapies against tuberculosis in the zebrafish model</td>
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Vaccination against intracellular bacterial pathogens for aquaculture - Delprosjekt
Griffiths, G. W. RCN 2014-2017

Exploiting the Roles and Epigenetic Mechanisms of Imprinting in Seed Development
Grini, P. E. RCN 2012-2016

The muscle excitation-transcription coupling
Gundersen, K. RCN 2009-2014

From Racial typology to DNA sequencing: Race and ethnicity and the science of human genetic variation 1945-2012, NFR 220741
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Jakobsen, K.S. RCN 2013-2017

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Adaptation or plasticity as response to large scale translocations and harvesting over a climatic gradient in the marine ecosystem?

Collective behaviour of penned herring: Observing the collective
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Klaveness, D. RCN/Andre 2012-2015

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Glycan evolution in a bacterial model system of protein glycosylation
Koomey, M. RCN 2012-2016

Membrane nanotube formation model system of protein glycosylation
Koster, G. RCN 2012-2016
<table>
<thead>
<tr>
<th>Title</th>
<th>Author(s)</th>
<th>Funding</th>
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<tr>
<td>Phanerozoic diversification: linking observation and process</td>
<td>Liow, L.H.</td>
<td>RCN</td>
<td>2014-2018</td>
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<td>Genetic architecture in Drosophila - The role of the</td>
<td>Martinsen, L.</td>
<td>RCN</td>
<td>2011-2014</td>
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<td>LAND: Partial migration of red deer and tick</td>
<td>Mysterud, A.</td>
<td>RCN</td>
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<td>LAND: Delimiting functional management units for partially migratory deer populations</td>
<td>Mysterud, A.</td>
<td>RCN</td>
<td>2014-2018</td>
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<td>(MANECO) Managing ecosystem services in low alpine cultural landscapes</td>
<td>Mysterud, A.</td>
<td>RCN/</td>
<td>2012-2014</td>
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<tr>
<td>Biogeographic and population analyses of Thermotogales bacteria from hydrocarbon-rich environments</td>
<td>Nesbø, C.</td>
<td>RCN</td>
<td>2008-2015</td>
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<td>LAND: Pollination, an ecosystem service affected by climate change</td>
<td>Nielsen, A.</td>
<td>RCN</td>
<td>2014-2017</td>
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<td>Evolutionary ecology and hydrology - the effects of stream flow dynamics on the white-throated dipper</td>
<td>Nilsson, A.</td>
<td>RCN</td>
<td>2013-2016</td>
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<td>Genome dynamics in early eukaryotic evolution: importance of enigmatic lineages</td>
<td>Orr, R.</td>
<td>RCN</td>
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<td>Traffic through and around the Golgi apparatus in epithelia-determine the apical and basolateral surface glycoproteomes</td>
<td>Prydz, K.</td>
<td>RCN</td>
<td>2010-2014</td>
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<td>Toxic Algae: Taxonomy, Quantification and Early Warning</td>
<td>Roos, N.</td>
<td>RNC/NIVA</td>
<td>2010-2014</td>
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<td>Development of novel drugs for prostate cancer</td>
<td>Saatcioglu, F.</td>
<td>RCN</td>
<td>2004-2017</td>
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<td>Centre for Immune Regulation (CIR)</td>
<td>Sandlie, I.</td>
<td>RCN</td>
<td>2007-2017</td>
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<td>New perspective on IgG function</td>
<td>Sandlie, I.</td>
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<td>A novel targeted mucosal vaccine</td>
<td>Sandlie, I.</td>
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<td>InHouse: The genomic and physiological basis of invasiveness in a harmful house-invader</td>
<td>Skrede, I.</td>
<td>RCN</td>
<td>2013-2017</td>
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<tr>
<td>Centre for Ecological and Evolutionary Synthesis (CEES)</td>
<td>Stenseth, N.C.</td>
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<td>Flexibility and constraints in animal movement</td>
<td>Stenseth, N.C.</td>
<td>RCN</td>
<td>2010-2014</td>
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<td>Fisheries induced evolution in Atlantic cod</td>
<td>Stenseth, N.C.</td>
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<td>Strengthening the adaptive capacity of institutions in fisheries</td>
<td>Stenseth, N.C.</td>
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<td>Bringing together evolution and ecology through the Red Queen perspective</td>
<td>Stenseth, N.C.</td>
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<td>Climate Changes and Zoonotic Epidemiology in Wildlife Systems (ZEWS)</td>
<td>Stenseth, N.C.</td>
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<td>Red Queen coevolution in multispecies communities</td>
<td>Stenseth, N.C.</td>
<td>RCN</td>
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<td>ADMAR Adaptive management of living marine resources by integrating different data sources and key ecological processes</td>
<td>Stenseth, N.C.</td>
<td>RCN/HI</td>
<td>2010-2015</td>
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<td>Managing resource and area conflicts in the coastal zone, exemplified by cod on the Skagerrak coast, NFR 216410/010</td>
<td>Stenseth, N.C.</td>
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<td>Norwegian Marine Data Centre (NMDC)</td>
<td>Stenseth, N.C.</td>
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<td>SYMBIOSES - Constructing an integrated modelling framework for decision support in ecosystem-based management: case study Lofoten/Barents Sea</td>
<td>Stenseth, N.C.</td>
<td>RCN/Akvaplan-NIVA</td>
<td>2011-2014</td>
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<td>Behavioral responses to risk and uncertainty among Norwegian cod</td>
<td>Stenseth, N.C.</td>
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<td>Norwegian fishers - NFR 224818</td>
<td>Stenseth, N.C.</td>
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<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>
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Other public sector/private sector projects

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<td>The intracellular pathway for MHC II antigen presentation</td>
<td>Bakke, O.</td>
<td>Kreftforeningen</td>
<td>2010-2015</td>
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<td>Professor II - avtale</td>
<td>Brech, A.</td>
<td>CCB, UiO</td>
<td>2012-2017</td>
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<td>Forsker II - avtale</td>
<td>Bruusgaard, J.</td>
<td>Atlantis medisinske høgskole</td>
<td>2013-2014</td>
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<td>Vindkraft rein - Vindkraftverks innvirkning på reindrift i forhold til fremtid</td>
<td>Colman, J.</td>
<td>NVE, Div. finansører</td>
<td>2004-2015</td>
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<td>The role of two histone H2A.Z variants in normal development and cancer</td>
<td>Eskeland, R.</td>
<td>Kreftforeningen</td>
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<td>Chromatin organisation in cancer</td>
<td>Eskeland, R.</td>
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<td>Functional studies of cancer relevant methylases, demethylases, and hydroxylases</td>
<td>Falnes P.</td>
<td>Kreftforeningen</td>
<td>2011-2017</td>
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<tr>
<td>GEN-TARE: Riskikurverdiering ved utsetting av ikke-stedegen tare</td>
<td>Fredriksen, S.</td>
<td>Miljødirektoratet</td>
<td>2014-2014</td>
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<td>OncoMyb: A classical oncogene - a novel network - Myb, SUMO, chromatin and partners - role in oncogenic activation</td>
<td>Gabrielsen, O. S.</td>
<td>Kreftforeningen</td>
<td>2014-2016</td>
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<td>Professor II - Johannes Gjerstad</td>
<td>Gjerstad, J.</td>
<td>STAM, Statens arbeidsmiljøinstitutt</td>
<td>2009-2017</td>
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<td>Nanobeads against cancer</td>
<td>Griffiths, G. W.</td>
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<td>Oslo Epigenetics Symposium 2014</td>
<td>Grini, P. E.</td>
<td>Diverse finansører</td>
<td>2010-2014</td>
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<td>Instrumentering av grønmøker og sildemøker i Vest Agder 2014</td>
<td>Helberg, M.</td>
<td>Polarinstituttet</td>
<td>2014-2014</td>
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<td>Miljøgifter i en urban fjord</td>
<td>Helberg, M.</td>
<td>NIVA/Miljødirektoratet</td>
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<td>Fisk i indre Oslofjord</td>
<td>Hylland, K.</td>
<td>Fagrådet</td>
<td>2013-2014</td>
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Walvig gave: Karlsen, H.E. Privat gave 2010-2015
Elucidation of biological nanoparticle formation mechanism: Linke, D. VISTA-DNVA 2014-2017
Professor II - avtale: Lothe, R. Oslo universitetssykehus, CCB-UiO 2006-2015
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Beitvaner Sau - Alveld: Mysterud, I. Pylkeskommuner 2001-2015
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Oslo Prostate Cancer Symposium 2014: Saatcioglu, F. Diverse/PCF/RCN 2013-2014
Molecular mechanisms of androgen action: Saatcioglu, F. Kreftforeningen 2014-2018
Samarbeidsavtale mellom Nextera og IBV: Sandlie, I. Nextera 2012-2017
Professor II - avtale: Sandvig, K. Oslo universitetssykehus 2006-2015
Assessment of the effects of oil exposure on the population dynamics and abundances of Atlantic cod and haddock using stat-space models: Stenseth, N.C. VISTA-DNVA 2012-2014

### International projects

<table>
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<td>MedPlag - The medieval plagues: ecology, transmission modalities and routes of the infections</td>
<td>Bramanti, B.</td>
<td>EU/ERC</td>
<td>2013-2018</td>
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<td>INTERACT - International Network for Terrestrial Research and Monitoring in the Arctic - Research infrastructures for Polar research</td>
<td>Ergon, T. H.</td>
<td>EU</td>
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<td>WeevilSTOP - 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>
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<td>State of the art ultra-structural analysis of pathogen-containing compartments</td>
<td>Griffiths, G. W.</td>
<td>Deutsche Forschungsgemeinschaft, DFG</td>
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<td>Ultrastrukturelle Analyse von intrazelluläre pathogene Bakterien umschliessende Zellkompartmente mit modernster Technologie</td>
<td>Griffiths, G. W.</td>
<td>Deutsche Forschungsgemeinschaft, DFG</td>
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<td>Drinking water treatment adaptation to increasing levels of DOM and changing DOM quality under climate change</td>
<td>Hessen, D.O.</td>
<td>NordForsk/NIVA</td>
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<td>CodS - restaurering og forvaltning av torsk i Skagerrak/Kattegat</td>
<td>Jentoft, S.</td>
<td>INTERREG IVA/HI</td>
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<td>Project Title</td>
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<td>FunDisTrait - Fungal conservation genetics: species traits and dispersal</td>
<td>Kauserud, H.</td>
<td>EU</td>
<td>2014-2016</td>
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<td>BIOFUN EMP265 Biodiversity in the dark: High-throughput sequence analyses of Arctic fungal communities</td>
<td>Kauserud, H.</td>
<td>EØS - University of Tartu</td>
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<td>Declining size - a general response to climate warming in Arctic fauna (DWARF)</td>
<td>Leinaas, H.P.</td>
<td>EØS - Instytut Oceanologii PAN</td>
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<td>Identification and evaluation of peptides for active and passive immunization against Pseudomonas aeruginosa</td>
<td>Linke, D.</td>
<td>Deutsche Forschungsgemeinschaft, DFG</td>
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<td>Application of behavioural genetics to improve animal welfare in the breeding program of arctic harr</td>
<td>Nilsson, G. E.</td>
<td>Sveriges Lantbruksuniversitet</td>
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<td>Yogic breathing exercises as an adjunct therapy for cancer - A randomized controlled trial of the Yogic Science of Breath</td>
<td>Saatcioglu, F.</td>
<td>Flere finansører</td>
<td>2008-2015</td>
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<td>CICHLIDX - An integrative approach towards the understanding of an adaptive radiation of East African cichlid fishes</td>
<td>Salzburger, W.</td>
<td>EU/ERC</td>
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<td>PlagueEco2Geno - Reconstructing the imprint of ecology on the genetic phylogeography of the Plague in Central Asia and China - 302329</td>
<td>Stenseth, N. C.</td>
<td>EU</td>
<td>2012-2014</td>
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</tbody>
</table>
Articles in peer-reviewed journals


APPENDIX


Hammerstad, M., Rehr, Å. K., Andersen, N. H., Graslund, A., Högberg, M., Andersson, K. K. (2014) The class Ib ribonucleotide reductase...


Knutsen, H., Jorde, P. E., Blanco, E., Ole, E., Pereyra, R. T., Sannes, H., Dahl, M., Andre,


Rácz, S. E., De Araújo, E. P., Jensen, E., Mostek, C., Morrow, J. J., Van Hove, M. L., Bianucci, R.,


Saldamando-Benjumea, C. I., Estrada-Piedrahita, K., Velasquez-Velez, M. I., Bailey, R. I. (2014) Assortative mating and lack of temporality between corn and rice strains of Spodoptera frugiperda (Lepidoptera, Noctuidae) from Central


Books, book chapters and reports


Staff per 15.12.2014

Chair
Johansen, Finn-Eirik

Chair (CEES)
Stenseth, Nils C.

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Andersen, Tom
Andersson, Kristoffer
Bakke, Oddmund
Borgå, Katrine
Brysting, Anne K.
Edvardsen, Bente
Eskild, Winnie
Falnes, Pål
Fredriksen, Stein
Gabrielsen, Odd Stokke
Griffiths, Gareth W.
Grini, Paul E.
Gundersen, Kristian
Hagelberg, Erika
Hansen, Thomas F.
Hessen, Dag O.
Hestmark, Geir
Hylland, Ketil D. E.
Heiland, Klaus
Jakobsen, Kjetill S.
Kaartvedt, Stein
Kauserud, Hävard
Klavness, Dag
Koomey, John M.
Kristensen, Tom A.
Lampe, Helene M.
Leinaas, Hans Petter
Linke, Dirk
Mysterud, Atle
Nilsson, Göran E.
Nissen-Meyer, Jon
Prydz, Kristian
Roos, Norbert
Saaticioglu, Fahri
Sandlie, Inger
Schumacher, Trond
Schalchian-Tabrizi, Kamran

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Fyhn, Marianne
Karlsen, Hans Erik
Klein, Uwe
Tittelman, Josefin

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Micci, Francesca
Myklebost, Ola
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Bagheri, Farn Shahtla
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Bjerkan, Katrine
Boessenkool, Sanne
Bramanti, Barbara
Bramsiepe, Jonathan
Bruegaard, Jo C.
Bråte, Jon
Butenko, Melinka A.
Colman, Jonathan E.
Corthay, Alexandre
Davey, Marie Louise
De Muinck, Eric
Dick, Gunnar
Diekert, Florian K.
Durant, Joel M.
Easterday, William R.
Egge, Elianne S.
Egner, Ingrid Marie
Eikeset, Anne M.
Eroukhmanoff, Fabrice
Eskeland, Ragnhild
Evensen, Lasse
Fagernes, Cathrine E.
Fischer, Barbara
Flydal, Kjetil
Fuss, Janina
Haverkamp, Thomas
Herrmann, Ullrich
Hersleth, Hans-Petter
Hess, Jaqueline
Heyward, Cathrine A.
Hildahl, Jon Paul
Hjermann, Dag Øystein
Ho, Angela Y.Y.
Holen, Øystein H.
Hutchings, Jeffrey
Hänsch, Stephanie
Jakobsson, Magnus
Jin, Yixin
Jorde, Per Erik
Kaurud, Kyrre Linné
Knutsen, Olav Sigurd
Koster, Gerbrand
Langangen, Øystein
Larsen, Søren
Lei, Peng
Liow, Lee Hsiang
Llope, Marcos
Løset, Geir Åge
Malecki, Jezdzej M.
Malmstrøm, Martin

Matschiner, Michael
Maurice, Sudi
Mensali, Nadia
Meshesha, Anagaw A.
Mora, Ortiz A.C.
Nadratowska-Wesolowska, Beata
Nenseth, Hatice Z.
Nielson, Anders
Nilsson, Anna
Nilsson, Sjannie L.
Olsen, Esben Moland
Oppegård, Camilla
Orr, Russell
Ottersen, Geir
Progida, Cinzia A.M.
Püllmann, Nora
Reitan, Trond
Repnik, Urska
Richter, Andrés P.
Rivrud, Inger M.
Rogers, Lauren
Rueness, Eli K.
Salzburger, Walter
Schmid, Boris Valentijn
Shi, Chunlin
Skrede, Inger
Star, Bastiaan
Starrfelt, Jostein
Stige, Leif Chr.
Svensungnes, Thomas O.
Sørensen, Christina
Tesikova, Martina
Tomina, Koji
Trosvik, Pål
Udatha, Dasaradhi
von Leeuwen, Casper
Veerabadran,
Balasundaram
Veiseth, Silje Veie
Vervaeke, Koen G.A.
Vik, Unni
Vik, Åshild
Vindenes, Yngvild
Voje, Kjetil Lysne
Vollsnes, Ane V.
Whittington, Jason
Wigestrand, Mattis B.
Yang, Hong
Øverli, Øyvind

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Gregers, Tone F.
Tsigaridas, Kristin G.

PhD students
Adusumalli, Ravi
Aileni, Vinay K.
Baalsrud, Helle T.
Bengtsetn, Mads
Berg, Paul R.
Bernt, Malin C.
Bjørbaekmo, Marit M.
Bjorbækmo, Marit M.
Botnen, Synnøve
Chauhan, Nandini
Cloete, Claudine C.
Cuervo, Ignacio
Distefano, Marita B.
Ekblad, Bie
Elgvin, Tore Oldeide
Foss, Stian
Fosslie, Madeleine L.
Fuglerud, Bettina M.
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Gudim, Ingvild
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Hitchcock, Daniel J.
Hjelseth, Ieva A.
Hobbi, Morbarhan M.
Hornslien, Karina S.
Isaksen, Elisabeth T.
Johannessen, Ida M.
Khomich, Maryia
Kong, Xiang Yi
Krøberød, Anders K.
Kucera, Ana
Kvile, Kristina Ø,
Lai, Floriana
Lensjø, Kristian K.
Liljegren, Mikkel M.
Lofstad, Marie
Lundstrøm, Marlene
Mayer, Christine
Michalik, Marcin
Neumann, Ralf S.
Nilssen, Pernille
Nunes, De C Mateus D.
Olsbu, Inger K.
Riiser, Even S.
Romagnoni, Giovanni
Sahlin, Andresa S.
Sand, Kine M.K.
Scot, Mark A.
Solbakken, Monica H.
Speth, Martin
Stadniczenko, Sandra
Stø, Ida M.
Thoen, Ella
Thormar, Jonas G.
Thrane, Jan-Erik
Toliagić, Olja
Trier, Cassandra N.
Tysseng, Linn I.
Tørresen, Ole Kristian
Varadharaajan, Srinidhi
Wang, Natasa
Wildhagen, Mari
Wijne, Ivan
Winter, Anna-Marie
Wolf, Raoul
Wrobel, Agnieszka
Aas, Anders B.
Aasebø, Ida E. J.

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