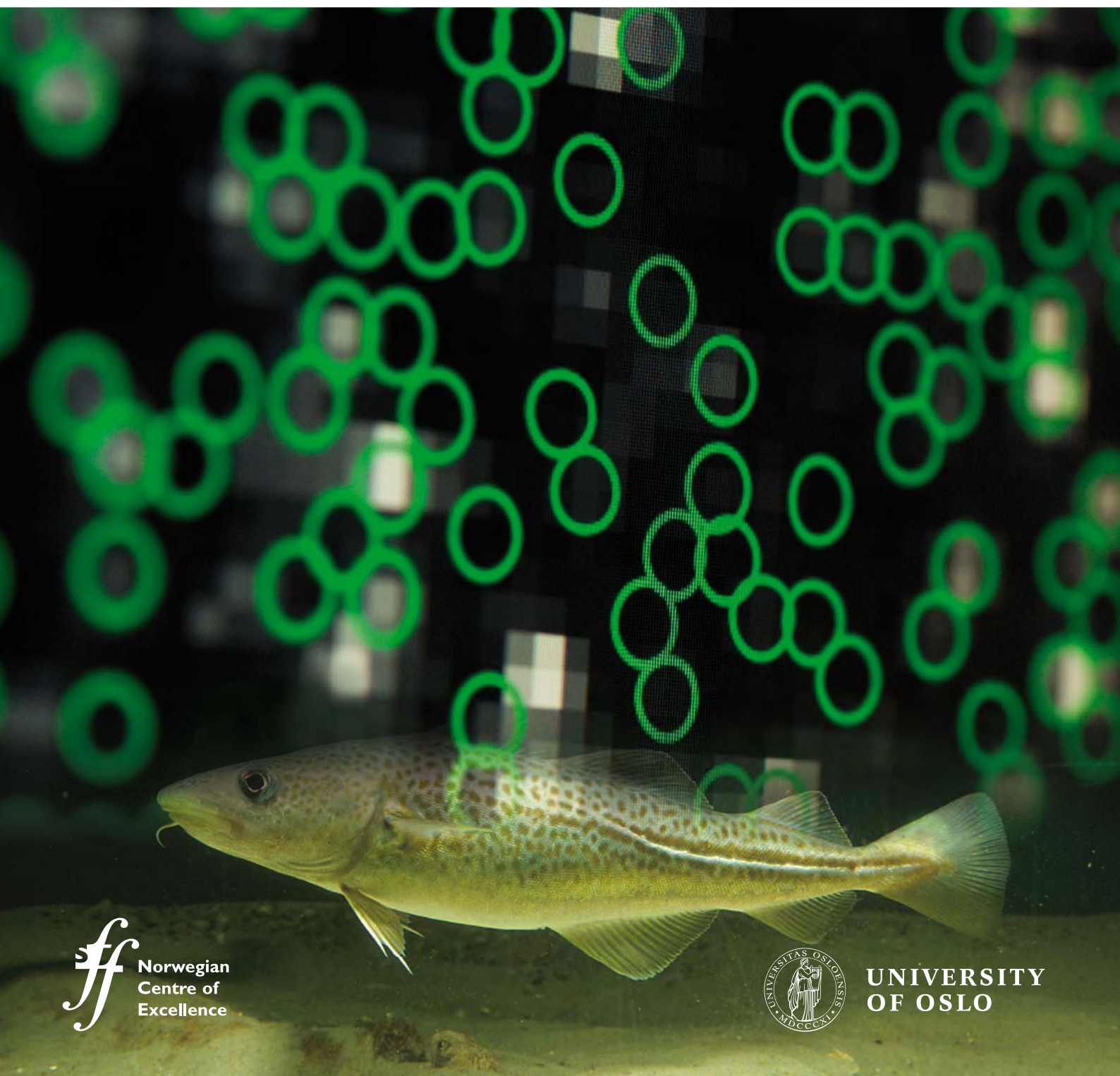


ANNUAL REPORT
2009

CEES

Centre for Ecological and Evolutionary Synthesis





Front photo:

Image obtained by the 454 GS FLX sequencing instrument during the sequencing of the cod genome at CEES. Green circles indicate positions of the cod genome DNA fragments on the sequencing plate. Circles with white pixels indicate "A" bases being read when the image was taken, the intensity of the light is proportional to the number of "A" bases read.

© Olav Heggø

CEES IN BRIEF

The Centre for Ecological and Evolutionary Synthesis, CEES, is chaired by Professor Nils Chr. Stenseth. As of 31 December 2009 CEES consists of 135 members including students, researchers, technical and administrative personnel. The centre has a core group of 20 employees of which 12 are full-time, one is a part-time employee of the Department of Biology, two are employed by the Department of Mathematics, one by the Department of Economy and one by the Institute of Marine Research. One employee is a visiting scientist at the University of Alberta, Canada, and two Kristine Bonnevie Professors are visiting CEES from Tokyo University, Japan, and Florida State University, USA. The CEES staff represented 26 nationalities in 2009.

In 2009, 2 books, 9 book chapters and 121 articles in peer reviewed journals were published by members of the CEES. Most of these results lie within the core scope of the CEES. 69 invited talks and presentations at conferences were presented by CEES members at various international fora. The CEES hosted 66 guest speakers, primarily from abroad. The Centre had 68 international and national visitors (staying at least one week) in 2009.

Approximately 50 MNOK of the total 2009 budget of 120 MNOK came from the 71 externally funded research projects that the CEES undertook in 2009. Most of these were funded through the Research Council of Norway. CEES is also involved in various EU-funded projects, and has a Marie Curie Early Stage Training site. 8 CEES projects were funded by the private sector. 17 new projects were started in 2009.

The CEES maintained a high level of visibility in 2009 both in scientific journals and in the media. The Centre was heavily involved in the celebration of the double anniversary of Charles R. Darwin: 200 years since his birth and 150 years since the publication of *On the Origin of Species*. CEES used this opportunity to communicate science to a broader audience in a series of 20 open events. The topics covered Darwin himself, the history of the theory of evolution and current topics in today's science and public discourse. CEES also contributed with articles and interviews in connection with the anniversary.

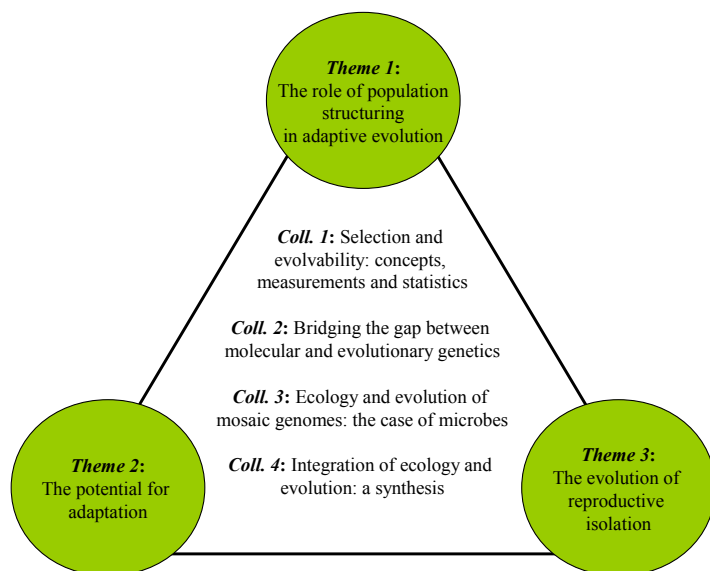
The work of CEES is, as originally planned, structured into *Colloquia* and *Themes*, the former being focused projects each lasting for three years and the latter consisting of ongoing, long-term work that is accommodated within the centre. *Colloquium 1*, focusing on the application of measurement theory to ecology and evolution, has completed its first full year. Several papers are either in press or under review. This *Colloquium* has prompted us to be more conscious regarding how to match data and theoretical concepts and has provided a conceptual platform for much of the work to follow in the years to come at the CEES.

One of the focuses during 2009 has been on the evolutionary effects of harvesting (*Theme 2*), with the start-up of a working group consisting of members that represent a broad range of scientists from the CEES, working both empirically on various species and theoretically.



The completion of the full genome sequence of the Atlantic cod, using our two 454-sequencing machines, received widespread attention from all over the world. With the full genome sequence we have a basis for addressing many interesting biological questions at a detailed genetic level, such as what makes some individuals mature at an earlier age and smaller size – questions relating directly to our more theoretical work on harvest-induced evolution. We expect to make full use of and benefit from this in the coming years. The completion of the Atlantic cod genome and the opportunities that arise from it provide a system in which to interlink all three CEES *Themes*, and proffers a model for *Colloquium 2*, ‘Bridging the gap between molecular and evolutionary genetics’. This will further implement our goal of an integrated Centre.

CEES supervised 35 Master- and 47 PhD-students in 2009, and was also involved in the teaching of 12 PhD/Master courses and 11 Bachelor courses. One new PhD student was employed in 2009, and one PhD student and 14 master students completed their degrees. The CEES graduate school held its yearly conference at Holmen Fjordhotell with 99 delegates.



The structure of the scientific work within CEES.

For further details see section 3.1, page 12.

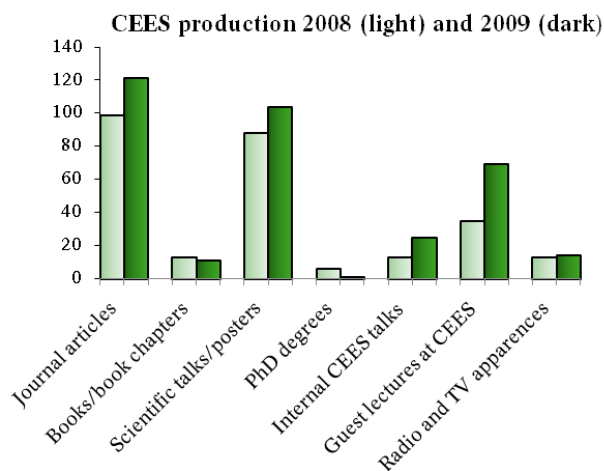
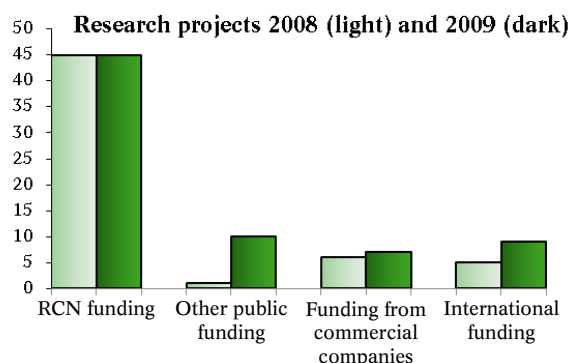
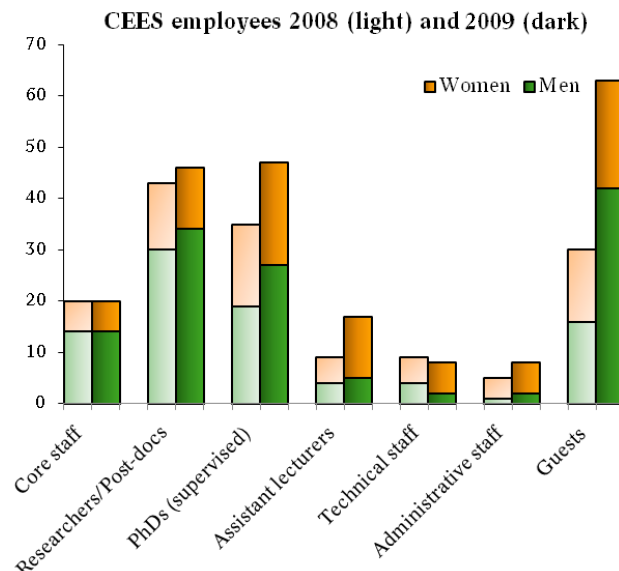


TABLE OF CONTENTS

CEES in brief	3
Table of Contents	5
1 The Chair's comments	6
2 Management and Administration	8
2.1 Administrative structure	8
2.2 Administrative support	8
2.3 The Board and the Scientific Advisory Board	10
3 Scientific activity	12
3.1 Organisation of the research	12
3.2 Scientific highlights in 2009	12
4 Education and research training	24
5 Scientific outreach	26
5.1 The Darwin Expedition	27
6 Gender equalising strategy	28
7 Experimental facilities	29
7.1 DNA and sequencing labs	29
7.2 The Ultra-high Throughput Sequencing Platform	29
7.3 Facilities provided by external parties	30
8 Finances	31
8.1 Accounting principles	31
8.2 Revenues and expenditures 2009, Budgeted revenues and expenditures 2010	32
9 Appendices	33
9.1 CEES-members	33
9.2 Guests of CEES in 2009	37
9.3 Associated research projects and other services	39
9.4 CEES events	42
9.5 Product lists	46

1 THE CHAIR'S COMMENTS

Another successful year has passed. 2009 was our second full year, a dynamic time full of exciting events and many new scientific findings. If I was to single out one of the many highlights, I would point to the sequencing of the cod genome, an event that was noticed all over the world. This was performed in the CEES labs under the leadership of Kjetill S. Jakobsen. Obtaining the full sequence of the cod genome is of course only the beginning, a move towards using modern technologies as a basis for answering population biological and evolutionary questions, such as what makes some individuals mature at a given size and age? These are issues of key interest in both aquaculture and harvest-induced selection.

Colloquium 1 (focusing on 'Selection and evolvability: concepts, measurement and statistics') completed its first full year. The *Colloquium* leaders, Thomas Hansen and Tore Schweder received several guest researchers in association with this work, including two Kristine Bonnevie Professors, David Houle and Hirohisa Kishino. Several manuscripts have been submitted to top level journals. I anticipate that these papers will receive much attention when published. During this year we further learnt how to organise such focused *Colloquia* within the centre, raising the expectations for the next *Colloquium* (which will focus on bridging the gap between molecular biology/genomics and classical evolutionary biology) starting in mid 2010.

The Scientific Advisory Board (SAB) had its annual meeting on 5th September 2009. Whilst pleased with the progress made since the preceding year, they felt that much remains to be done in order to achieve a fully integrated centre working towards the synthesis of ecology and evolution, and to fully take advantage of the broad spectrum of expertise and competence housed within the centre. Among their suggestions was to organise one or more internal conferences aimed at focusing our activities. The concentration on "harvesting-induced evolution" is a direct result of the SAB discussion. We are currently working on their suggestions and will report on this in future annual reports.

The 2009 SAB meeting was Gordon Orians' last as a SAB member; due to other commitments he has had to step down, but will continue as a corresponding member. I would like to take this opportunity to thank Gordon for his dedicated work that has helped CEES become a true Centre of Excellence. In this tenor, I am also pleased to welcome Tim Coulson from Imperial College, London as a new SAB member. Not only does he cover some of the same fields as Gordon, he also brings expertise in several additional areas of key concern to CEES. We are very much looking forward to working with him on the further development of the Centre.





Charles R. Darwin – and his contribution to science and humanities – was celebrated all over the world in 2009. A broad range of events was organised through CEES, all of which were very well attended both internally by people from the University, and externally. I'm very thankful to the several national and international lecturers who contributed to making this a remarkable year for showcasing not only Darwin, but a whole gamut of interesting questions related to the science we perform today.

There is a growing number of journal clubs and discussion groups at CEES all of which contribute to bringing its members closer together, and thereby take advantage of our comprehensive array of expertise. The groups running in 2009 were the Behavioural Ecology Forum, the Measurement Theory Forum (*Colloquium 1*), and the Thursday Lunch Club (focusing on evolutionary ecology). We intend to add to these in the coming months.

Both the Board and SAB continue to assist us in the further development of CEES. This is partly done through meetings, particularly with the two chairs, Reidun Sirevåg (Chair of the Board) and Rita Colwell (Chair of the SAB). I am grateful for the time and effort they devote to help us improve our performances (See also 2.3).

Thanks. It is my great pleasure to thank all of our scientists (at all levels) for their hard and highly dedicated work. Without you, there would be no Centre of Excellence. I am also grateful for the outstanding work done by our technical and administrative staff; you make it much easier to accomplish our research at CEES.

Nils Chr. Stenseth

2 MANAGEMENT AND ADMINISTRATION

The CEES is established as a Centre of Excellence (CoE) by The Research Council of Norway (RCN). It is hosted by the Department of Biology under the Faculty of Mathematics and Natural Sciences at the University of Oslo (UiO). RCN and UiO are, with regard to core funding, our main financial contributors and constitute the final reporting entities that define the guidelines under which we are to operate. The Department of Biology is responsible for our work and for most of the administrative support functions.

2.1 Administrative structure

The centre is run on a daily basis by the Chair, Professor Nils Chr. Stenseth, the Deputy Chair, Researcher Eli K. Rueness, and the CEES administrative team. At weekly meetings all running and strategic issues are dealt with. Regarding scientific progress within the centre, the Deputy Chair and the Chair liaise closely on a daily basis.

In order to facilitate the running of the CEES, and to provide a good cooperative relationship between our host, The Department of Biology, and CEES, delegations have been implemented from the Head of Department to the CEES Chair and from the Head of Administration at the Department to the Head of Administration at CEES. The Chair and the Head of Administration at CEES are also part of the management team at the Department, participating in weekly meetings with the Department head and his team.

The CEES Core (see 9.1.1) consists of the faculty members having committed themselves to allocate their research time to the centre. The Core serve as an advisory group for the Chair. Within this advisory group we find the *Theme* and *Colloquia* leaders, who are responsible for the scientific progress within their respective *Themes/Colloquia*. The Core meets approximately every second month.

Professor Atle Mysterud has been appointed to be in charge of running administration of fieldwork related resources, while a CEES Lab Board has been appointed to administer the running of the CEES laboratories. In 2009 the lab board consisted of Kjetill S. Jakobsen, Eli K. Rueness, Anne K. Brysting, Ave Tooming-Klunderud and Nanna W. Steen. For the full mandate, see: www.cees.uio.no/research/facilities.

2.2 Administrative support

In 2009 the CEES administration was led by Katinka E. Grønli, Gry Gundersen and Kari B. Rygg. The administration prepares general correspondence, the budget, accounting figures and reports. It is in charge of the daily routines, is involved in handling the CEES personnel and assists in general communication, the development of proposals for external funding and in running the CEES website. It also facilitates meetings and conferences, and in 2009 Tore Wallem was responsible for scientific outreach, facilitating all the events given during the Darwin celebrations, along with administrative support functions.

The Department of Biology has allocated two full-time Advisors in research administration to the centre. In 2009 Gry Gundersen and Kari Beate Rygg held these positions. They assist in conducting full budgets for new applications according to the UiO standard, making contracts between UiO and external partners for running and implementing projects, developing proposals and in the reporting of existing projects. They also assist in all matters related to the administrative support functions within the centre. In 2009 they also stepped in as leaders of the CEES administration team during the maternity leave of Katinka E. Grønli.

Senior Executive Officer Eva Ingrid Grøttland was employed to provide personnel and financial support functions. CEES and The Department of Biology have employed two Higher Executive Officers, Jayne Patricia Lambrou (50 %) and Tore Wallem, and one Executive Officer, Morten Kjeldseth Pettersen, to deal with the preparation of financial transactions, the development of our website, general scientific outreach, facilitation of conferences and meetings and the general infrastructure at CEES. They also assist with travel arrangements and reimbursement procedures, housing and general bureaucratic matters for guests and new employees.

First line services are run primarily by The Department of Biology; these include telephone- mail-, reception- and accessory services and the purchase of usual running equipment.

All financial transactions are jointly authorised by Nils Chr. Stenseth and either Katinka E. Grønli or Eva Ingrid Grøttland. The resolutions are executed by the economy section at The Department of Biology, which also provides help with

budgets and accounting analysis, reports etc. Kjetil Bråthen was responsible for the accounting analysis of CEES in 2009. As of June 2009, Bråthen has been permitted to jointly authorise financial transactions with Stenseth, provided the transactions are below 50 000 NOK.

General IT support is provided by the Department of Molecular Biosciences.

All administrative support required for the students (from Bachelor to PhD level) is provided by the Department where the students are enrolled. For most of our students that is the Department of Biology. An exception is the running of our

Marie Curie Early Early Stage Training Fellows (MCEST), which is supported administratively by Gry Gundersen and Katinka E. Grønli.

Front line personnel support is provided by Katinka E. Grønli and Eva Ingrid Grøttland, but professional handling of personnel matters (contracts, payment routines etc.), is provided by the Faculty of Mathematics and Natural Sciences administration. Bente Schjoldager is allocated as the responsible body for all CEES matters.

A secure electronic archive system is provided by the Faculty of Mathematics and Natural Sciences administration.



Marine iguana (*Amblyrhynchus cristatus*) © The Darwin Expedition (see 5.1, page 27)

2.3 The Board and the Scientific Advisory Board

The CEES Board is an administrative body that meets approximately twice a year to focus on strategic and control functions as well as approving budgets, accounts and annual reports. 2009 CEES Board members are listed in the table to the right. For more details, including its mandate, see the CEES web pages and the CEES annual report of 2007.

The Board	Specialisation and home institution
Reidun Sirevåg (Chair)	Microbiologist, University of Oslo and General secretary of the Norwegian Academy of Science and Letters
Sven-Axel Bengtson	Ecologist, Lund University, Sweden
Rolf A. Ims	Ecologist, University of Tromsø, Norway
Bernt Øksendal	Mathematician, Centre of Mathematics for Applications, a CoE at the University of Oslo
Trond Schumacher	Chair of Department of Biology, University of Oslo
Tyge Greibrokk	Professor, Department of Chemistry and member of the Faculty Board, Faculty of Mathematics and Natural Sciences, University of Oslo

Comments by the Board Chair: Reidun Sirevåg

The CEES board has had two meetings in 2009, the first on March 18th and the second on September 9th. At the March meeting, the Board approved the selection/ranking process and decisions regarding appointments, but based on the experience so far, it was decided that in future, only one referee committee was sufficient to ensure quality. The Board is pleased with the principles behind the budget, but spent some time discussing the form and presentation of the budget and expenditures.

At the September meeting, budget and accounting were discussed. Although there is very little to criticize with regard to the various posts on the budget, there is still room for improvement in the way the accounting and budget are presented. It is important that the various financial sources are presented in a clear manner to the board. The centre leader, Nils Chr. Stenseth, has been active in getting more funding to CEES from other sources and the Board has approved these efforts.

The scientific production of CEES as a whole is high in number as well as in quality, and the number of excellent foreign scientists working at the centre is impressive. As a result of the acquisition of a high speed DNA-sequencer which is operating extremely well at CEES, the genome of the cod was sequenced in 2009. This was conveyed not only to the scientific community but to the general public as well.

During 2009, CEES also played a major role in the Norwegian celebrations of the Darwin Year by organising lectures and discussions, not only at the University level but also for the public in general.

The meeting in September was held only a few days after the Scientific Advisory Board (SAB) met on September 5th. At this important SAB meeting, board member Sven Axel Bengtson and myself were present. We also attended a meeting in which the leaders of the different *Themes/Colloquia* presented themselves to the members of SAB. As a result of the discussions after the presentations, SAB has given specific advice regarding the need to improve the communication within CEES, which in the opinion of SAB was not optimal.

During the discussions at this meeting several ideas were presented from SAB members in order to give advice on these points. The most important suggestions were presented in the Summary of the Scientific Advisory Board meeting. The CEES Board will follow closely how these various recommendations and suggestions are implemented and followed up by CEES, and discuss this issue at the next meeting.

Professor Gordon Orians resigned from SAB for personal reasons in 2009. The Board invited Professor Tim Coulson, Imperial College, London to serve after him, and we are pleased to report that he has accepted.

It is my over all impression that this sizable centre of excellence has been well integrated in the Department of Biology as well as in the Faculty of Mathematics and Natural sciences.

The CEES Scientific Advisory Board (SAB) is appointed by the Board of the CEES. The primary request to the SAB is to critically investigate and compare our research plan with our actual work and progress, and to guide and advise, should changes or additions be implemented in the plan. In 2009 the SAB held a meeting which took place during the CEES conference on Ecology and Evolution, 3-5 September. Discussions were concentrated on the scientific focus of CEES and how to achieve meaningful progress within the *Themes* and real integration, synergism and synthesis. The SAB also discussed how to organise the daily running of the scientific activities within the CEES to provide optimal communication and focus.

The Scientific Advisory Board	Specialisation and home institution
Rita R. Colwell (Chair)	Microbiologist, University of Maryland, US
Tim Coulson (from 7 Sept. 2009)	Imperial College, London, UK
David R. Brillinger	Statistician, University of California, Berkeley, US
Edward J. Feil	Microbiologist, University of Bath, UK
Barbara Mable	Evolutionary Biologist, University of Glasgow, UK
Anne Magurran	Behavioural Ecologist, University of St. Andrews, UK
Gordon H. Orians (until 7 Sept. 2009)	Evolutionary Biologist, University of Washington, Seattle, US
Gordon H. Orians (Corresponding member from 7 Sept. 2009)	Evolutionary Biologist, University of Washington, Seattle, US

Comments by the Scientific Advisory Board Chair: Rita R. Colwell

The progress being made by the CEES team continues to be impressive and the Scientific Advisory Board complimented the Chair, Staff, and Scientists of the Centre. Specifically, the Scientific Advisory Board was pleased to find greater depth in the thematic research and a stronger focus for the Centre research. A recommendation was made to integrate genomics with the other activities and to articulate clearly the questions that genomics can effectively and productively answer.

A need for integration and synergism was recognized by the SAB. Even though several inter-theme journal clubs help to integrate the Centre, larger conceptual thinking will enable the Centre to become a true Centre of Excellence and not just another Centre fostering superb research.

More of the individual projects are diversifying the Centre's activities but attention must be paid to avert competition, instead of collaboration and integration, arising among the groups.

Priorities must be set and a result may be that some projects and/or activities will be phased out, but greater strength will be achieved for the major themes if good strategic prioritizing is implemented. CEES has clearly developed well but it needs to communicate its many successes to its constituents and its funding agency. It might be useful to develop a comparative matrix of peer institutions/universities globally to meet this particular challenge.

In summary, CEES is making great strides and its research and outreach activities are clearly globally competitive and bring credit to the university and the country.

3 SCIENTIFIC ACTIVITY

3.1 Organisation of the research

As a team we target numerous obstacles for an ecological and evolutionary synthesis using old and new data from the field and the lab. Our research is organised around three mutually dependent *Themes*:

- 1) The role of population structuring in adaptive evolution. This year we have focused on effects of habitat fragmentation, on early stages of genetic diversification and on the ecology of microbial communities.
- 2) The potential for adaptation. In 2009 we particularly focused on human induced evolution, e.g. effects of size selective hunting and fishing.
- 3) The evolution of reproductive isolation. We have chosen to focus mainly on genetic aspects of reproductive isolation in 2009.

Within each research *Theme*, there is a demand for integration of ecological realism into evolutionary theory, and for evolutionary thinking into ecological modelling. In order to face problems of integrative work, such as conceptual and semantic confusion, and to promote communication across the various research fields (that each have their own limiting assumptions), we will assign targeted projects in the form of four multidisciplinary *Colloquia*, each of three-year duration. Here we will bring together staff and visiting scientists with experience from a wide range of biological and methodological systems. Each *Colloquium* will make an excellent setting for inviting highly qualified scientists to collaborate and thus contribute to the overall objectives of the centre. The topics of the *Colloquia* are:

- 1) Selection and evolvability: Concepts, measurements and statistical modelling.
- 2) Bridging the gap between molecular genetics and evolutionary genetics.
- 3) Ecology and evolution of mosaic genomes: The case of microbes.
- 4) Integration of ecology and evolution: A synthesis.

3.2 Scientific highlights in 2009

3.2.1 Colloquium 1: Selection and Evolvability: Concepts, measurements and statistical modelling

(Involving Thomas F. Hansen and others)

This *Colloquium* is focused on conceptual, statistical, and theoretical issues concerned with quantification in biology, with special emphasis on evolutionary biology. It involves the collaboration of David Houle (Florida State University), Günter Wagner (Yale University), and Hirohisa Kishino (Tokyo University).

Formal measurement theory is a mathematical discipline that studies the relationship between data and reality, but it has seldom been used in biology. Our goal is to analyze the quantification of central concepts in evolutionary biology, ecology and genetics (such as constraint, fitness, rate of evolution, dispersal and competition). For each concept, we examine the theoretical context and models that provide it with meaning, and then we examine the ways in which the concept is quantified, and look at the statistical methods and problems involved with its study.

We discuss problems regarding scaling and transformations, along with those regarding comparison across traits and species in meta-analyses and comparative studies. We put particular focus on situations where there is a conflict between the theoretical process models that motivated the research, and the statistical methods that are used to analyze the data. While statistical quantification of data is common, the exact link of the statistics to theoretical parameters is often tenuous, and theoretical meaningfulness may be further obscured by transformations of the data, significance testing, etc.

David Houle spent a year in Oslo from summer 2008 to summer 2009 as a Kristine Bonnevie professor and Günter Wagner and Hirohisa Kishino had two shorter visits during the same period. During Dr. Houle's visit we had a weekly seminar where we discussed papers and projects related to the overall goal of the *Colloquium*.

So far, the scientific output from the *Colloquium* has been rich, but also diffuse in that it is spread over a large number of papers and projects from the *Colloquium* members, their

students and collaborators. A prominent result is a large review paper by Houle, Wagner, Pélabon and Hansen on measurement theory, which is currently in review in *Quarterly Review of Biology*. Wagner has also written a theory paper (in press) on the measurement theory of fitness, which has been strongly influenced by his participation in the *Colloquium*. The ideas of the *Colloquium* have also motivated several project applications, including the recently-funded RCN project 'The evolvability of allometry' run by Christophe Pélabon at NTNU with Hansen and Houle as collaborators.

Both Houle and Wagner also plan extended visits in 2010. Our goal of writing an edited, or even an "unedited" book remains, but will probably not be realised before 2011, as we prefer to progress with smaller projects at this stage. Three examples of such smaller projects are: (1) A meta-analysis of the effects of scaling on quantitative genetic measures of genetic variation by Hansen, Pélabon and Houle, which will be submitted for publication within 2010. (2) A collaboration between Hansen and Stevan Arnold who participated in the *Colloquium* workshop in 2008, and his student Josef Uyeda on 'Resolving the paradox of stasis' based on studying time-scale effects on evolution rates. (3) Work on the measurement of allometry involving Hansen, Pélabon, Wagner, Houle and CEES PhD student Kjetil Voje. The ideas of the *Colloquium* have also been instrumental in Hansen's RCN-funded project on statistical methods for estimating genetic architecture, which has led to several publications by post docs Arnaud Le Rouzic and Mihaela Pavlicev.

Further reading:

Houle, D., C. Pélabon, G. P. Wagner, & T. F. Hansen. Measurement and meaning in biology. *The Quarterly Review of Biology* (in review)

Wagner, G. P. 2010. The measurement theory of fitness. *Evolution* (in press)

3.2.2 Ecological and evolutionary effects of harvesting. Can management counter the selection pressures of trophy hunting? (Theme 2)

(Involving Atle Mysterud and Richard Bischof)

There is growing concern regarding the evolutionary consequences of human harvesting on phenotypic trait quality in wild populations. Undesirable consequences are especially likely with trophy hunting because of its strong bias for specific phenotypic trait values, such as large antlers in cervids and horns in bovids. Selective hunting can cause a decline in a trophy trait over time if it is heritable, thereby reducing the long-term sustainability of the activity itself. How can we build a sustainable trophy hunting tradition without the negative trait-altering effects?

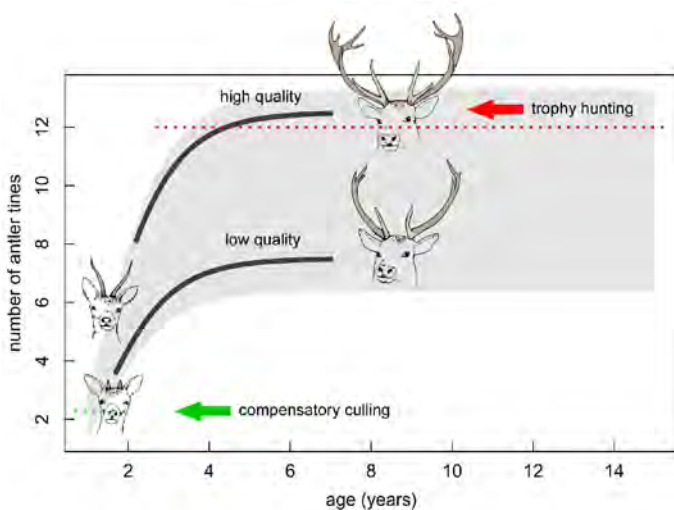
We used an individual-based model to explore whether selective compensatory culling of "low quality" individuals at an early life stage can facilitate sustainability, as suggested by information from managed game populations in eastern and central Europe. Our model was rooted in empirical data on red deer, where heritability of sexual ornaments has been confirmed and phenotypic quality can be assessed by antler size in individuals as young as 1 year.

Simulations showed that targeted culling of low quality yearlings could counter the selective effects of trophy hunting on the distribution of the affected trait (e.g. antler or horn size) in prime-aged individuals. The simulation approach allowed us to verify responses as evolutionary changes in trait values rather than short-term consequences of altered age structure and viability selection.



Red deer © Erling Meisingset

3 SCIENTIFIC ACTIVITY



We thus provide a theoretical basis for how trophy hunting management can become evolutionarily enlightened. This has far reaching implications, as income from trophy hunting is often channelled into local conservation efforts and rural economies, also demonstrating the potential applied value of the work conducted at CEES.

Further reading:

Mysterud, A., and Bischof, R. 2010. Can compensatory culling offset undesirable evolutionary consequences of trophy hunting? *Journal of Animal Ecology* 79: 148-160

3.2.3 Fishing can lead to increased variance in fitness-related traits (Theme 2)

(Involving Asbjørn Vøllestad, Eric Edeline and others)

Using time-series data from the Windermere pike (*Esox lucius*) we have earlier shown that a consideration of the relative strengths and directions of multiple selective pressures is needed to fully understand ecological dynamics. In Windermere, selective harvesting of large pike with gillnets generates directional selection towards smaller body size and slower growth, while natural selection (chiefly cannibalism) favours larger pike. Further, it is expected that harvest leading to size truncation may induce decrease trait variability, depress the capacity to respond to environmental change and ultimately impair population persistence. However, size truncation and decreased trait variability in exploited populations often remain unverified assumptions. We investigated these assumptions for the Windermere pike where the fishery clearly induces disruptive and not directional selection, leading not to decreased but *increased* variability in somatic growth rate and size-at-age. Hence, knowing the exact form of selection is necessary to correctly infer the mechanisms through which harvesting affects phenotypes

and demography in natural populations. From a management perspective, disruptive selection provides a comprehensive tool for preservation of natural genetic variation and sustainable exploitation of natural resources. This study also emphasized the importance of understanding the exact form and strength of selection before drawing conclusions on the evolutionary effects of harvesting.

Further reading:

Edeline, E., Le Rouzic, A., Winfield, I.J., Fletcher, J.M., James, J.B., Stenseth, N.C., & Vøllestad, L.A. 2009. Harvest-induced disruptive selection increases variance in fitness-related traits. *Proceedings of the Royal Society B* 276: 4163-4171

3.2.4 Population ecology of bacterial communities (Theme 1)

(Involving Pål Trosvik, Nils Chr. Stenseth and others)

Prokaryotes (bacteria and archaea) occupy all known habitats on earth, and globally they constitute an amount of organic carbon estimated to rival that of plants. Their collective activities have a vast impact on the environment, as they form the basis for the plant's major biogeochemical cycles. It is therefore of great scientific interest to understand how these microbes interact with one another and with the external environment.

In the course of evolution, bacteria have formed intimate relationships with multicellular organisms. Bacteria thrive in the light organs of many marine animals endowing these with the ability to bioluminesce. They live in the tissues of worms and molluscs helping these animals to extract energy from volcanic chemicals in habitats that would otherwise be



Chemostat © Pål Trosvik

inaccessible to metazoan creatures. In the guts of ruminants and termites communities of prokaryotes break down food particles that would otherwise be indigestible. In fact, the digestive tracts of all animals, humans included, are home to rich and diverse communities of microbes that are vital to the well being of the organisms. On the other hand many bacteria are infamous for being pathogenic agents, being a very important factor in the mortality of humans, livestock and animals in general.

In spite of the general importance of microbes in health and environmental issues, relatively little is known about how their communities function in terms of traditional ecology. This is partly due to technical difficulties inherent to the study of such communities, but also to a historical divide between the fields of general macroecology and microbiology. Traditionally, the main focus of microbiologists has been on molecular biology and the physiology of pathogenic species, whereas less attention has been paid to more general problems such as species interactions, population dynamics and community stability. In the case of the human gut microbiota these are issues of potentially great importance. This microbial community is involved in physiological functions such as immunity, development of the intestine and energy metabolism. The human gut microbiota has also been implicated in pathologies such as allergy, colon cancer, inflammatory bowel disease and obesity.

At the CEES we have taken a general ecological approach to the analysis of bacterial communities. We have conducted experiments with bacterial species representing the main components of the human gut microbiota (Bacteriodes, Proteobacteria, Firmicutes and Actinobacteria), growing them together in chemostats and collecting time series data both of population and physiochemical variables. As the experiment progressed the community was found to spontaneously conform to the phylum level composition of the healthy adult gut flora. Analysis of the time series data identified a network of interactions both within and between species, and these interactions were found to be more important to community development than physiochemical variables such as pH or RedOx potential. The analysis also indicated which innocuous species were in direct competition with less benevolent species, a finding of potential use in the design of preventive or therapeutic strategies. Similar results were obtained in a study using bacterial population data from the guts of infants that were followed for a year or more.

As relevant data on microbial communities become more easily obtainable, studying the ecology of these potentially very complex and important ecosystems is likely to become an ever more important focus of future research.

Further reading:

Trosvik P., Rudi K., Strætkvern K.O., Jakobsen K.S., Næs T. and Stenseth N.C. (2010) Web of interactions in an experimental gut microbiota. *Environmental Microbiology* (in press)

Trosvik P., Stenseth N.C., Rudi K. (2010) Convergent temporal dynamics of the human infant gut microbiota. *The ISME Journal* 4(2): 151-158

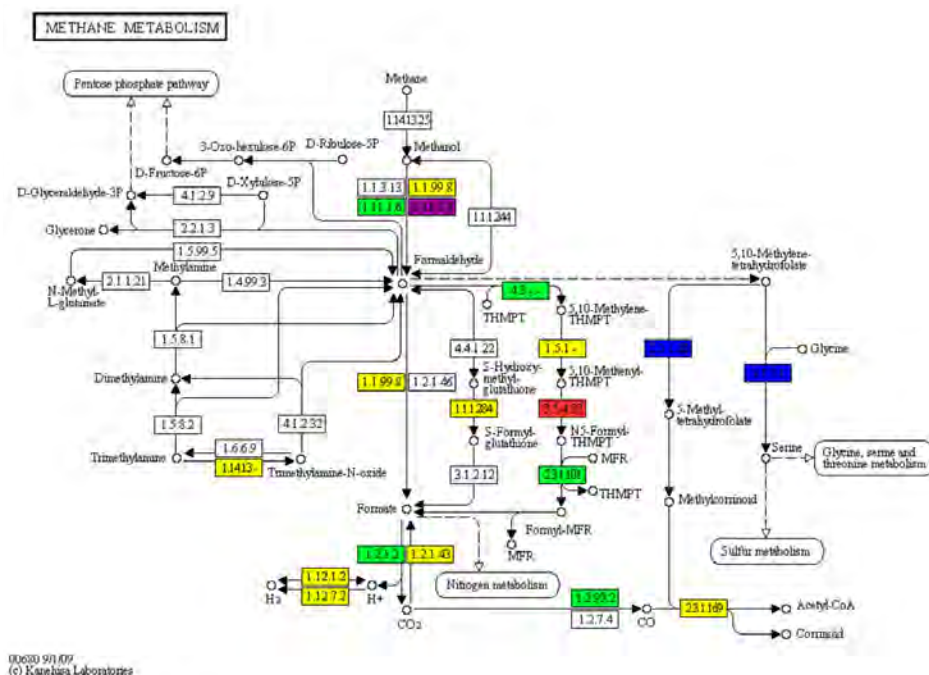
3.2.5 Microbial metagenomics – a new way to understand microbial communities (Theme 1)

(Involving Thomas Haverkamp, Kjetill S. Jakobsen and others)

High throughput sequencing of DNA extracted from sediments in the Barents Sea

We have reconstructed the metabolism of microbes living in the sediments of the mud volcano Håkon Mosby (HMMV, 1250 m deep on the seafloor south of Svalbard at 72°N) by 454 pyrosequencing of DNA from this site and subsequent bioinformatics analysis. Due to the enormous number of parallel sequence reads it is possible to find the bacterial identity (or close relatives) of the sequences obtained and thus determine the microbial species living at the seafloor at 1250 m depth. Essentially, the sequences obtained represent a random selection of genes, but the different gene segments found are correlated with the abundance of the particular organism in the sediment sample. We have therefore been able to determine the metabolic reactions taking place in this environment where no (or very) little light occurs and where a substantial part of the ecosystem is dependent on methane and other hydrocarbons leaking from the HMMV site. This has been achieved by using a series of computer programs, along with database assignment of sequences. Our data showed carbon fixation-, reversed methanogenesis-, nitrogen fixation- and sulphur reduction metabolic pathways. These reactions take place in a bacterial community consisting of both archaea and eubacteria. The processes involved are both anaerobic and aerobic, and it is likely that eubacteria and archaea cooperate in carrying out the metabolic processes. Our data show that there exists a very complex community at around 0 degrees Celsius in complete darkness, a community of microorganisms capable of using hydrocarbons as a carbon source and of fixing CO₂ without light as an energy source by using the enzyme *rubisco* (the enzyme that plants use for photosynthesis). These findings have implications for future marine bioprospecting as well as oil and gas exploration.

3 SCIENTIFIC ACTIVITY



Schematic diagram of methane metabolism. The enzymes identified in the metagenomic investigation of HMMV are shown by colors. The different colors represent the various microbial groups identified in the metagenome. The scheme illustrates that eubacteria and archaea cooperate in the utilization of methane. The process generates CO₂ and links to nitrogen and sulphur metabolisms are shown. (From Håvelsrud, Haverkamp, Rike, Kristensen and Jakobsen, in review)

3.2.6 The early stages of adaptive divergence in grayling: rapid establishment of spatial population structure (Theme 1 & 2)

(Involving Nicola Barson, Asbjørn Vøllestad and others)

The lake Lesjaskogsvatnet, Norway, was colonized by grayling *Thymallus thymallus* around 1880 and in the following 130 years the grayling have established spawning populations in more than 20 of the tributaries to the lake. Owing to profound temperature differences among tributaries, we expect to find significant genetic and phenotypic differentiation between grayling spawning in different tributaries, despite the short divergence time and lack of obvious isolation barriers. One reason for this is that grayling tend to spawn in the tributary where they were originally born ("homing"), opening the possibility for rapid local adaptation, given divergent selection pressures. By sampling spawning fish from a number of tributaries and genotyping each fish using a set of microsatellite markers we have investigated the population structure, focusing on spatial distance and temporal differences in spawning time as structuring forces. We found a significant isolation-by-distance signature, indicating that there is gene flow between populations, with the level of gene flow decreasing with geographic distance. On the other hand there was no significant differentiation between populations spawning early or late in the season (i.e. spawning in warm or cold streams). The population structure that has developed during these 130 years can be due to processes such as genetic drift, founder events and bottlenecks, as well

as adaptation driven by divergent selection pressures. We are now studying these alternatives in more detail with preliminary results indicating that all of these processes have been important.

Further reading:

Barson, N.J., Haugen, T.O., Vøllestad, L.A., & Primmer, C.R. 2009. Contemporary isolation-by-distance, but not isolation-by-time, among demes of European grayling (*Thymallus thymallus*, Linnaeus) with recent common ancestors. *Evolution* 63: 549-556



Grayling © Jan Ohlberger

3.2.7 Combining genetic and ecological measures of population structuring – conservation of the Ethiopian Mountain Nyala. (Theme 1)

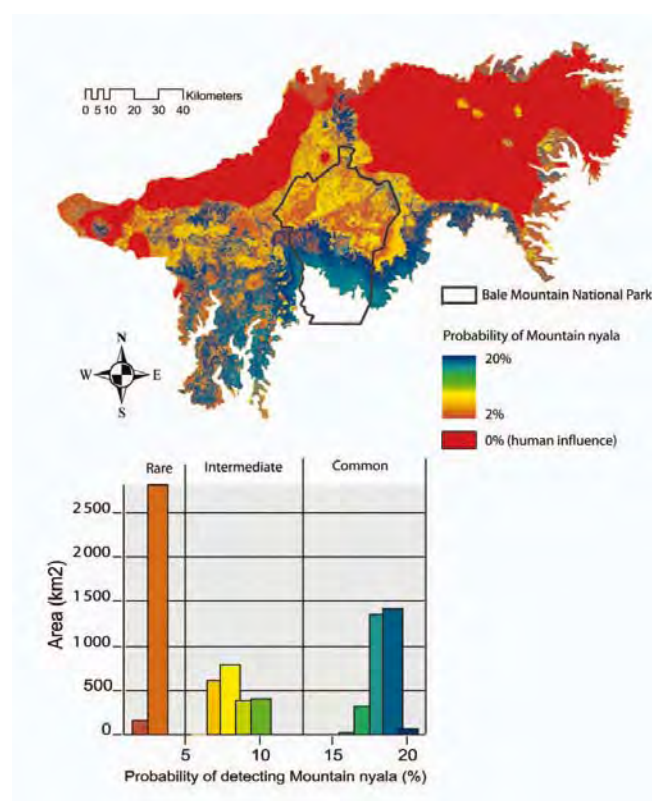
(Involving Anagaw Atickem Meshesha, Leif Egil Loe and Eli K. Rueness)

The global human population increase is considered the mother of all environmental problems and is particularly high in developing countries. In Ethiopia rapid human population growth in combination with famine and political unrest has put enormous pressure on the remaining pockets of unused land and resulted in extensive fragmentation of wildlife habitat over the last decades. At the same time the highlands of Ethiopia host endemic wildlife including the Mountain Nyala (*Tragelaphus buxtoni*). This large antelope is listed as endangered by the International Union for Conservation of Nature (IUCN), but is nevertheless a highly valued trophy game species. We are studying the current state of habitat fragmentation and gene flow in the Mountain Nyala in its last stronghold, the Bale Massif. As genetic diversity is a prerequisite for adaptive evolution, study of broad scale spatial variation is imperative to identify areas that merit special conservation attention.



Ethiopian mountain Nyala © Leif Egil Loe

In 2008 19 nyalas (10 males and 9 females) were marked with GPS and radio collars in Bale Mountains National Park and we have since monitored their movement rates and habitat selection. The data obtained will be used to analyse to what degree the collared animals display avoidance behaviour towards human settlements, ultimately aiming at quantifying the maximum human density that is tolerable to the nyala. We have estimated the total population size of the Mountain Nyala in the Bale Mountains to be 4023 individuals (95 % CI: 2832 – 6368), which is higher than previous estimates. We found that the Mountain Nyala avoided areas of high human influence and that only 30 % of the total population lived within the national park, while 55 % was found in trophy hunting concessions. The abundance of nyalas was 3.7 times higher in areas under surveillance by professional scouts regardless of whether in a national park or hunting concession. As much of the park consists of inferior nyala habitat we recommend that the adjacent forested areas should be incorporated into the protected area. Al-



Habitat suitability map for Mountain Nyala. Red colour resemble unsuitable areas with more than 50 % influence of humans (6442 km²). The distribution of probabilities is tri-modal and we defined each probability group as rare (2-5 % probability of pellet occurrence per plot; 2980 km²), intermediate (6-10 %; 2183 km²), or common (16-20 %; 3169 km²).

3 SCIENTIFIC ACTIVITY

though no negative effect of trophy hunting on abundance was detected, it is too early to conclude that trophy hunting is sustainable due to the short history in the studied populations.

Population genetic data contains information about connectivity among subpopulations. Such data will thus be valuable in assessing the extent of fragmentation in the Mountain Nyala. Moreover, possible loss of genetic diversity in small isolated populations may be detected. Genetic studies of the Mountain Nyala have not yet been performed; we have therefore optimized genetic markers for both mitochondrial DNA sequencing and microsatellite genotyping. A total of almost 600 faecal samples have been collected from the entire distribution range and the genetic analysis is expected to be complete by the summer of 2010.

3.2.8 Population biology of passerine birds (Theme 2)

(Involving Luis Cadahia, Ane Eriksen, Jan Hušek, Endre Knudsen, Lars Erik Johannessen, Antonieta Labra, Helene Lampe, Anna Nilsson, Tore Slagsvold and Nils Christian Stenseth)

At CEES, we study climate effects on migration and breeding phenology, population fluctuations and demographic factors, such as chick production. The population size of the pied flycatcher is declining in many parts of Europe, and it may be caused by a mismatch between breeding time and the time of peak abundance of food. We are addressing the problem by recording the phenology of insects along an altitudinal gradient of study sites close to Oslo, and also conducting an experiment manipulating hatching time by swapping clutches between nests. We are monitoring the post-fledging movements of tit families, with the working hypothesis that the families are able to track the environmental phenology, and move to areas and habitats with later

insect development to exploit better foraging conditions. By filming at tit nests, we have shown that the amount of green caterpillars in the diet decreases with season but increases with altitude, verifying important assumptions under the mismatch hypothesis.

We are collecting blood from whole cohorts of pied flycatchers and tits with the intention to study genetic aspects of migration. In particular, we plan to study the 'clock' gene, which seems to be involved in the adaptation to seasonal environments across a range of animal taxa. The great tit and the blue tit are partial migrants, making our study populations offer a unique opportunity to study selection at the individual level, such as the fitness consequences of particular genotypes in relation to the severity of the winter climate and the earliness of the spring. We have also studied the impact of season and social challenge on testosterone and corticosterone levels in a resident territorial bird (the nuthatch).

As part of an international collaboration, a plumage signal (patches of white feathers) is compared between populations of pied flycatchers, and isotopes in feathers are used to determine where these birds have been overwintering, when these feathers have been moulted and the new ones developed.

Further reading:

Landys M.M., Goymann W., Schwabl I., Trapschuh M., Slagsvold T. 2010. Impact of season and social challenge on testosterone and corticosterone levels in a year-round territorial bird. *Hormones and Behaviour* (in press)

3.2.9 Effects of social environment on behaviour in birds (Theme 2)

(Involving Rosa M. de Ayala, Ane Eriksen, Lars Erik Johannessen, Helene Lampe, Tore Slagsvold and Leif Christian Stige)

Learning and plasticity have been seen both as drivers and constraints on evolution. Most studies of learning have focused on animals in captivity. We have developed a method of experimental cross-fostering of birds in the wild in which young birds are reared by heterospecific foster parents. This gives the opportunity to study effects of early learning on different aspects of the behaviour of free-living passerine birds. Cross-fostering of great tit nestlings to blue tit foster parents and vice versa has proven early learning to be of importance for a number of adult traits, such as species recognition and sexual preferences. The cross-fostered birds become mixed singers, producing a combination of great tit



and blue tit songs, both in terms of song type repertoire, and temporal and frequency parameters of the song. However, this is also the case if pied flycatcher males are raised by blue tit or great tit foster parents, although the pied flycatchers do not become sexually imprinted on their heterospecific host. Hence, song used in mate choice may respond much easier to environmental change than mate choice itself. Changes in song by learning may thus serve as an essential first step in hybridization and speciation processes.

Pied flycatchers change their song on a short-term basis. We therefore also performed playback experiments to control birds (*not* cross-fostered) to see if they could learn song from new a 'neighbour', as adults. In addition we presented live birds to males to study how intrusions or visits by other flycatchers may change aspects of their song.

Sex allocation theory states that parents should adjust their offspring sex ratio according to the expected fitness returns from sons and daughters. Recent studies indicate that such adaptive manipulation of offspring sex ratio is achievable, and that it may relate to e.g. morphological characters. Less is known on the significance of behavioural traits. Appar-

ently, our cross-fostering of tits resulted in some aberrant adult behaviours, e.g. in terms of reduced social dominance rank in winter, aberrant song in spring, and reduced level of male mate guarding in the fertile period of the female. Contrary to expectation, we found that broods with at least one cross-fostered parent contained significantly more sons than did control broods. We have also studied mate guarding behaviour of cross-fostered tits and controls.

We have also recorded nestling growth and plumage colour (using spectrometer), the latter variable reflecting richness of carotenoids in the diet. We want to study how nutrition and the social rearing conditions may affect behaviour, rate of local recruitment, survival and life time reproductive success of cross-fostered as well as control birds.

Ecological theory says that the foraging niches of closely related species are separated, facilitating co-existence by reducing competition for food. However, little is known of how individuals come to adopt their foraging niche, whether it is innate or learned. We have previously shown, by cross-fostering between species, that in blue tits and great tits early learning causes a shift in the foraging behaviour during au-



Blue tit © Kari Kleiven

3 SCIENTIFIC ACTIVITY

tumn and early spring, in the direction of the foster species. Filming at nests has shown that the same occurs in the breeding season, judging from the prey items provided by cross-fostered parents, and controls, to their young. We also show that the influence of early learning lasts for life (foraging conservatism). The study shows that cultural transmission through early learning is fundamental to the realization of the ecological niche, and suggests a mechanism to explain habitat preferences.

Size and type of prey may be a constraint for chick feeding. Experimental research of this suggests that these constraints may help to explain why there are so few obligate brood parasites in birds (less than 1 %), and why raptors have evolved reversed sexual dimorphism in body size, which has been a puzzle to humans for hundreds of years. We have also studied the communication between parents and young, manipulating one of the signals used (colour of the flanges of the bill), and also tried to explain a gender bias in food provisioning from differences in prey size.

Further reading:

Eriksen A., Lampe H., Slagsvold T. 2009. Interspecific cross-fostering affects song acquisition but not mate choice in pied flycatchers, *Ficedula hypoleuca*. *Animal Behaviour* 78: 857-863

Johannessen L.E., Kristiansen L., Hansen B.T., Slagsvold T. 2009. Facultative adjustment of brood sex ratio in response to indirect manipulation of behaviour. *Ethology* 115: 1057-1065

Slagsvold T., Sonerud G.A., Grønlien H., Stige L.C. 2010. Handling and ingestion of prey in raptors in relation to their feeding niches: implications for understanding prey selection. *Journal of Avian Biology* (in press)

Wiebe K.L., Slagsvold T. 2009. Mouth coloration in nestling birds: increasing detection or signalling quality? *Animal Behaviour* 78: 1413-1420

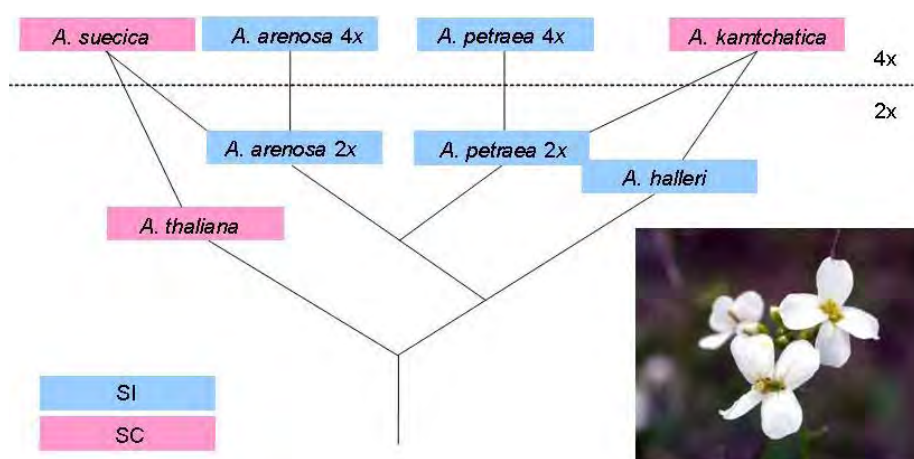
Wiebe K.L., Slagsvold T. 2009. Parental sex differences in food allocation to junior brood members as mediated by prey size. *Ethology* 115: 49-58

3.2.10 Polyploid evolution: The effect of genome duplication on s-allele diversity and gene expression (Theme 3)

(Involving Marte H. Jørgensen, Kjetill S. Jakobsen, Thomas Marcussen and Anne Brysting)

Many natural and domesticated plant species are hybrids which have undergone whole-genome duplication (polyploidy). Molecular analyses suggest that the genomes of most (> 90 %) of the present-day flowering plants retain evidence of one or more ancient genome-wide duplications, and that numerous species have been through more recent polyploidization events. Polyploidy may have large effects on both the ecology and evolution of a certain lineage. Though not as common in animals as in plants, polyploidy does occur in several animal groups (e.g., fishes, insects and amphibians). As part of a larger focus on the evolutionary effects of polyploidy in both plants and animals, we are currently focusing on the evolution of polyploid species within the plant genus *Arabidopsis* (rockcress) in the cabbage family (Brassicaceae).

Polyploidy is often coupled with a change in breeding system, either a loss of sexual reproduction or a higher degree of self-fertilization than in diploids. Diploid *A. petraea* plants have a sporophytic self-incompatibility system (SSI) in which outcrossing is ensured by a self-recognition phenotype of both pollen and stigma. As part of a project in which we are studying the effect of polyploidy on this mechanism, CEES funding has allowed us to genotype a huge number of diploid and polyploid plants for SSI alleles using 454 sequencing. We are in the initial phase of testing the first tagged PCR products on the GS FLX sequencing platform.



The model genus *Arabidopsis* includes both diploid (2x) and polyploid (4x) species. In addition to ploidy level, the plants also differ in ecological requirements and in breeding system. Some are self-compatible (SC), whereas others are self-incompatible (SI). As *A. thaliana* is the geneticists' favourite model plant, a great variety of molecular methods are available to study the effect of genome duplication on ecology and breeding system.

A key issue in the evolution of polyploids is the fate of duplicated genes, but our knowledge on this subject to date is limited especially regarding natural model systems. CEES funding has made it possible for us to analyse gene expression differences resulting from genome duplication by comparing diploid and polyploid *Arabidopsis*. We are in the initial phase of mRNA extraction and cDNA synthesis from floral buds, which will be used for construction of solid phase (454) cDNA libraries and in-depth sequencing of the transcriptome (i.e. the genes that are being actively expressed in the floral buds).

3.2.11 Modelling phenotypic evolution by stochastic differential equations with latent layers (*Colloquium 1*)

(Involving Trond Reitan and Tore Schweder in cooperation with Jorijntje Henderiks, Uppsala University)

Jorijntje Henderiks has developed a unique dataset of size measurement of marine micro fossils. Body size of *Coccolithus*, a unicellular marine alga, is estimated by the largest diameter in the almost elliptically shaped calcite platelet called a coccolith. Individual coccoliths were measured by light microscopy. A total of 205 sediment samples were considered. The resulting dataset contains 19 899 size measurements distributed over six time series over nearly 60 million years at different locations: two in the North- and two in South Atlantic, one in the Indian ocean, and one in the Pacific. Each sample is timed, with age from nearly 60 million years ago until recent.

To understand and measure the phenotypic evolution in *Coccolithus* a statistical model was established. A basic notion in the model is a fitness curve pulling the population towards its centre. The fitness curve itself is, however, allowed to change over time according to temperature and other environmental conditions. In the model there is one fitness curve for each of the six locations. These fitness curves evolve in a more or less correlated way. Mathematically this is modelled as a vector-valued Gaussian process of dimension 18 (3 layers: population, fitness, and underlying environment, and 6 locations). It is convenient to treat time as continuous since the time steps between observations vary within each of the 6 series, and between. There are almost as many parameters in this model as there are observations. To make statistical estimation possible, and to make the estimated parameters interpretable, the parameters were restricted in various ways in a total of 703 versions of the basic model. All the models were fitted to the observed data by using the Kalman filter to calculate the likelihood function, and they were compared with respect to predictive performance by Bayesian methods.

Coccolithus is found to have evolution in at least two layers, and most likely in three layers. When ranking the 723 models by performance, the ranking is tight at the upper end and the top-ranking models share certain properties: the long-term equilibrium size is practically equal, and is about 7.4 micrometers. *Coccolithus* populations are rather quickly pulled towards fitness optimum (half-time around 1000 years), and fitness responds rather quickly to environmental changes (half-time around 10 000 years)

In addition to the empirical study, mathematical and statistical issues have been studied for vector-valued processes governed by linear stochastic differential equations. One issue has been that of causal relationships between component processes. The causal flow in the models considered has been directional, and a graph such as a phylogenetic tree can be drawn to characterize the causal structure. We prove that a sub-process is Markovian if and only if it constitutes an ancestral part of the causal tree.

Further reading:

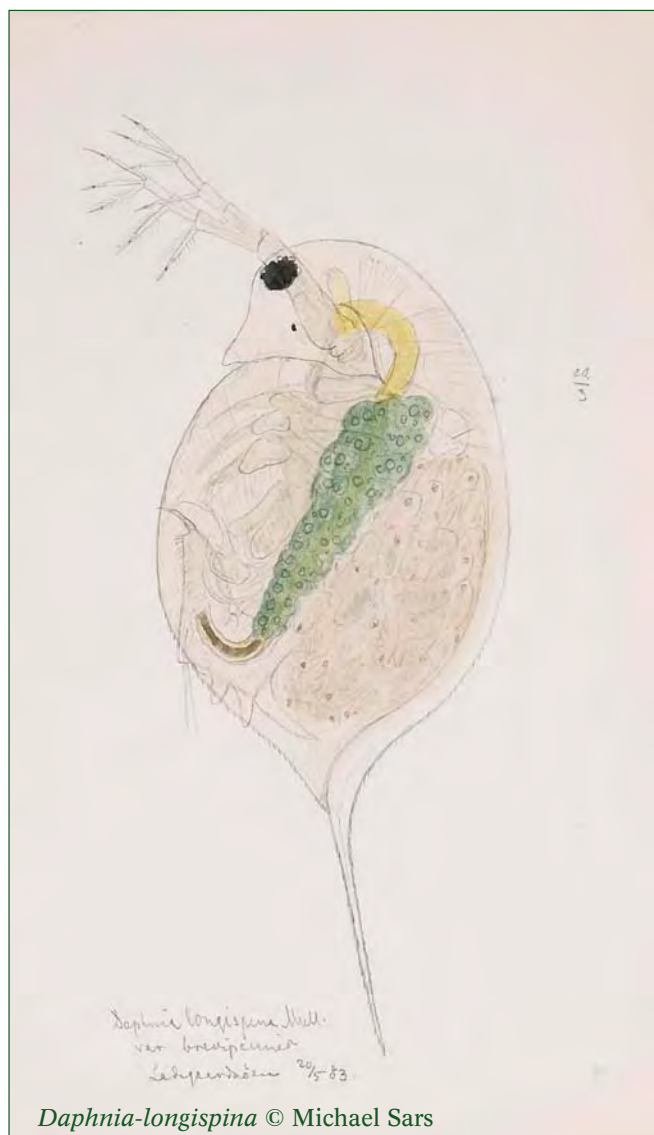
Reitan, T., Schweder, T. and Henderiks, J. (2010) Modelling Evolution by Stochastic Differential (manuscript)

3.2.12 Genome size, evolution and speciation (*Theme 3*)

(Involving Dag O. Hessen, Jonas Persson and others)

Genome size varies tremendously both within and among taxa, and strong correlations between genome size and various physiological and ecological attributes of organisms suggest that it is a key trait of organisms, yet the causalities remains vague. Projects related to this topic address the evolutionary drivers for small or large genomes, and the consequences for metabolism, growth, life cycle strategies and speciation. One study explored how genome size is related to key physiological and ecological properties in five large orders of crustaceans where genome size range more than two orders of magnitude. Small genome size and small cell size are, in general terms, most likely consequences of evolutionary adaptations to high metabolic rate and high growth rate (i.e. “r-selected” traits) combined with an evolutionary reallocation of phosphorous from DNA to RNA. In other cases, such as for large genomes at low temperatures, causal direction between large genomes and low growth rates is not straightforward. A most intriguing finding is that differences in body size seem to reflect increased cell numbers within some orders and different cell size in others. This has large implications for the developmental control and evolution of body size, and could thus also be an important driver for fast speciation without involving the coding regions of

3 SCIENTIFIC ACTIVITY



DNA. More rigorous studies are required in order to draw conclusions in this matter, and this goal is currently being pursued under a new RCN-funded project.

Further reading:

Hessen, D.O. and Persson, J. Genome size as a determinant of growth and life history traits in crustaceans. *Biological Journal of the Linnean Society* 98: 393-399.

Hessen, D.O., Jeyasingh, P.J., Neiman, M. and Weider, L.J. Genome streamlining and the elemental costs of growth. *Trends in Ecology & Evolution* 25: 75-80 (published online 2009)

3.2.13 Sequencing of the Atlantic cod genome (Across all Themes and Colloquium 2)

(Involving Trine B. Rounge, Martin Malmström, Lex Nederbragt, Ave Tooming-Klunderud, Monica H Solbakken, Mari Espelund, Morten Skage, Tina Graceline, Bastiaan Star, Unni Grimholt, Sissel Jentoft, Nils Chr. Stenseth and Kjetill S. Jakobsen, all from CEES. Also involving The GenoFisk consortium (UMB, Nofima Marin, UiB, IMR, NTNU, NVH, HiBo and UiT) and international collaboration partners (454 Life Sciences, USA, Sanger/EBI, Cambridge, UK and Max Planck Institute, Germany).)

Atlantic cod (*Gadus morhua*) is one of the most economically important fish species and is an emerging aquaculture species. Cod research has a strong tradition at CEES, in particular research related to population biology and genetics.

In the fall of 2008 CEES was awarded 10 million NOK by the Research Council of Norway (RCN) under the FUGE GenoFisk programme in order to sequence the 930 Mb Atlantic cod genome (www.codgenome.no). The gross sequencing effort was accomplished between January and May 2009 using next-generation sequencing technology (454/Roche). The assembled genome is currently being annotated by Ensembl in Hinxton, UK. In addition to the sequencing of genomic DNA, we have sequenced transcriptomic DNA (which contains the expressed variants of genes) and metagenomic DNA (which contains sequences of bacteria, fungi, parasites or other organisms associated with cod). Preliminary data suggest that Atlantic cod has approximately 25 000 genes, a number comparable to that found in humans. Ongoing analyses aim to identify the variability in the genome and utilize this information to identify genes linked to functional traits. Our genome analyses have already revealed a remarkable finding: the Atlantic cod has a unique immune system that is distinct from any other species sequenced to date. More surprises are probably in store. Current research focuses on the adaptability of Atlantic cod to temperature and oxygen uptake, and on factors that influence growth and maturation. All this knowledge is highly relevant for aquaculture production and the management of cod stocks.

Atlantic cod is present over a large geographic range and local differences between distinct populations of cod are known to be profound. Coastal cod of southern Norway, for instance, are phenotypically and genetically different from cod in the Barents and the Baltic Seas. The current assembly does not capture these local differences, despite being a leap forward in cod genomics. We are therefore aiming to sample specimens from several different Atlantic cod populations in order to characterize the genome-wide genetic variation that is present in cod.

The existence of a reference genome of cod allows us to acquire and compare complete individual cod genomes with relative ease. Moreover, with access to the annotated genome, we can focus on selected genes such as those involved in the immune system, development, stress and specific genes that we expect to be associated with a particular phenotype. We will also obtain gene expression data from the various populations and phenotypes. These activities will be coupled with the CEES *Colloquium 2* programme which is under development; in this *Colloquium* we will gather a multidisciplinary group of scientists such as ecologists, population geneticists, theoretical biologists and molecular biologists with the overall aim of improving our understanding of the relationship between the genotype and phenotype of cod.



Atlantic cod © Olav Heggø



Cod sequencing group at CEES © Olav Heggø

4 EDUCATION AND RESEARCH TRAINING

Our permanent scientific staff is involved with teaching at all levels, and we are committed to the education of excellent candidates for future positions. Rather than building our own educational programme at bachelor and master level, we are involved in the basic education delivered by our host Department (the Department of Biology) as well as other units of the University (e.g. Mathematics and Economics). In 2009 we contributed to the teaching of 11 Bachelor courses and 12 Master/PhD courses. 35 master students were supervised by CEES members.



Participants at the annual conference for Master and PhD students © Trond Reitan



The graduate school and the student conference at Holmen Fjordhotell

A main goal of CEES is to offer a professional and interdisciplinary training programme, organised within a Graduate School (a status which CEES has been awarded by the UiO). The broad range of experience and skills at the CoE allows us to offer a unique interdisciplinary PhD training programme in which participants benefit from a stimulating international environment. Students work in research teams, are supervised by two core members, and follow a personal career development plan.

The CEES receives annual funding (NOK 50 000) which partly finances the costs incurred by our annual conference for Master and PhD students. In 2009 the conference was held at Holmen Fjordhotell, where 23 students presented their work.

The Marie Curie Early Stage Training (EST)

The Marie Curie Early Stage Training on Ecological and Evolutionary Response to Climate Variation (CEES-MCO) is also an important part of our research education programme. A total of 11 PhD students (7 short-term and 4 long-term) will stay at CEES during the 48 month project period from 2006 to 2010. In 2009 4 full-time PhD students were engaged at CEES-MCO. The candidates have been very successful during their stay at the centre. During 2009 our long-term Marie Curie EST students co-authored a total of 5 published papers. All of the students have already completed their PhD degree or will do so in 2010. The programme has also promoted international cooperation among our scientists and the home institutions of our visiting PhD students.

Journal clubs

CEES arranges four different Journal Clubs:

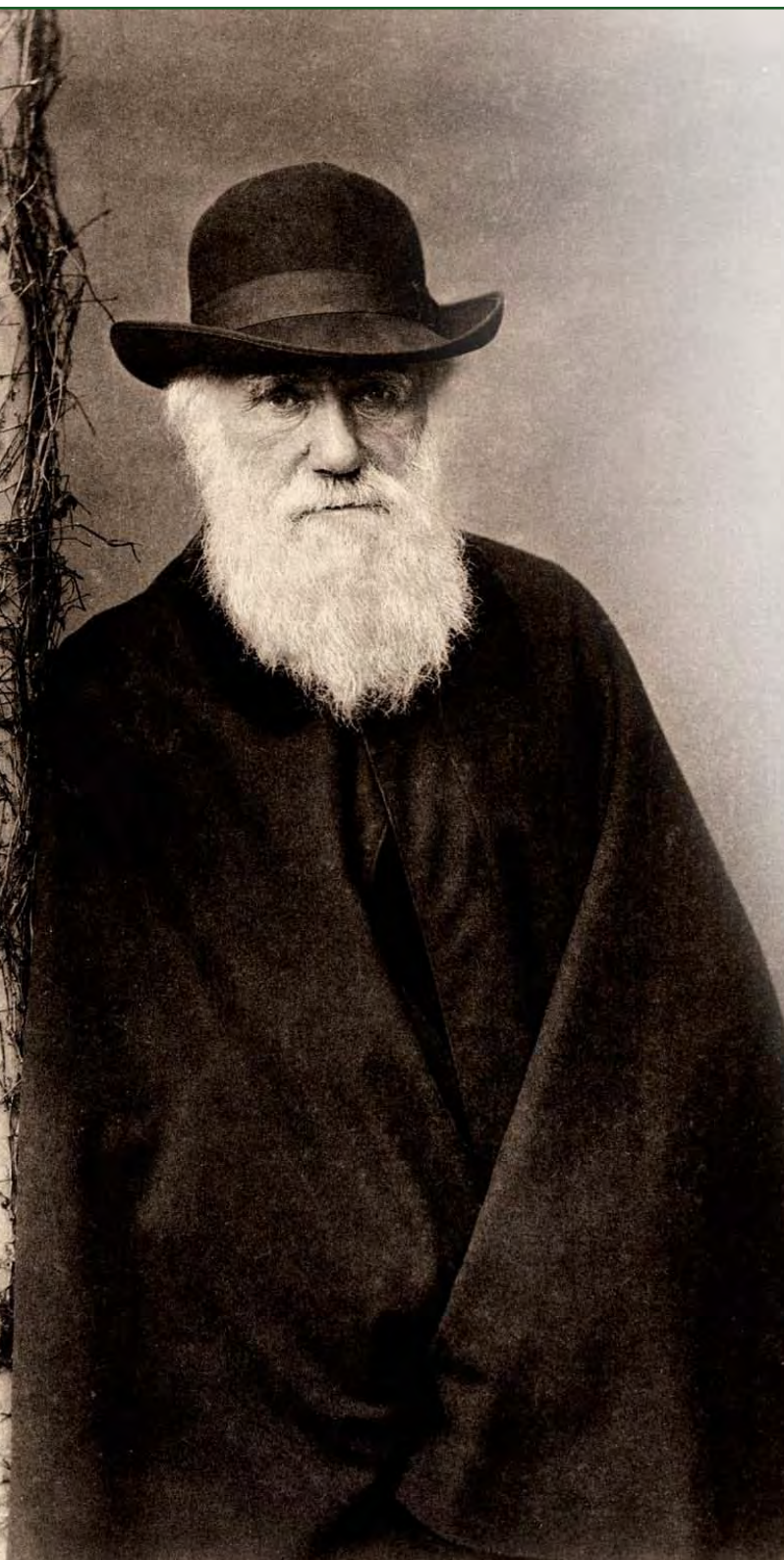
- Behavioural Ecology Forum: 12 sessions were held in 2009.
- Measurement Theory Forum: 3 sessions were held in spring 2009.
- Speciation Forum: 11 sessions were held in 2009.
- The Thursday Lunch Club (evolutionary ecology): 27 sessions were held in 2009

These journal clubs (www.cees.uio.no/calendar/internal-events/journal-clubs) stimulate critical reading of scientific papers and provide an opportunity for students to keep updated with their own subject areas as well as related scientific fields. Participating students (including the MC-fellows) choose relevant papers that focus on scientific challenges within the field of ecology and evolution.

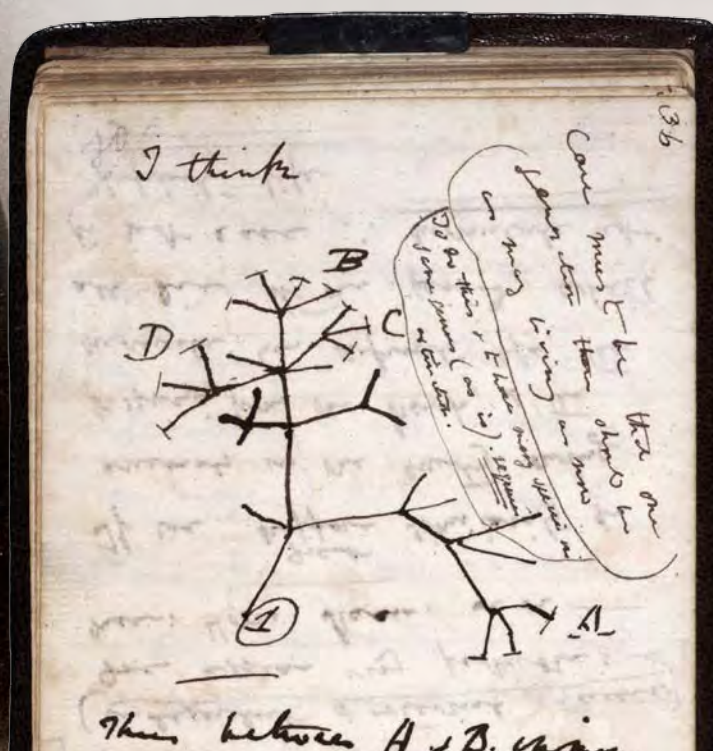
Late lunch talks

The Late Lunch Talk seminar series (www.cees.uio.no/calendar/internal-events/late-lunch-talks), is a forum where employees, visiting scientists and students at CEES present and discuss their work and ideas. The format is informal, with the objective being the facilitation of stimulating, topical discussions. 27 sessions were held in 2009.

5 SCIENTIFIC OUTREACH



CEES works towards increased awareness of science in the general population. 2009 was a special year in this regard, as the double anniversary of Charles R. Darwin (200 years since his birth and 150 years since the publication of *On the Origin of Species*) generated a lot of interest both in the media and the public. CEES used this opportunity to reach a broad audience in a series of 20 events which were open for all. The topics covered Darwin himself, the history of the theory of evolution and current topics in today's science and public discourse. The annual Darwin Day was expanded to a two full-day seminar with a programme that included highly regarded international scientists, and was well attended. The annual Kristine Bonnevie Lecture on Evolutionary Biology was held by Barbara Rosemary Grant from Princeton University on the topic of 'Evolution in Darwin's Finches'. Several of the seminars were held at a public location in down town Oslo (The House of Literature). The lecture by the philosopher Daniel C. Dennett drew the largest audience (over 400) and most of the events drew well over 100 people. For the full list of invited guest speakers, see 9.4.2 Seminars with invited speakers.



5.1 The Darwin Expedition

The Darwin Expedition is a science communication project initiated and implemented by Tore Oldeide Elgvin, Kjetil Lysne Voje and Jens Ådne Rekkedal Haga while students at the CEES. The project formed part of the Norwegian celebrations of the Darwin year 2009. The aim of the venture was to educate and inspire people, especially young people, to the wonders, opportunities and possibilities in science, and in evolutionary biology in particular.

The Darwin Expedition followed in Charles Darwin's footsteps in South America during the winter of 2008-09, and delivered lectures and talks at various schools and institutions around Norway upon its return in 2009. During the National Science Week in 2009 the expedition gave presentations at the Universities of Oslo, Stavanger and Trondheim and University Colleges in Akershus and Stord. The expedition members have given a total of more than 30 talks and presentations for approximately 4 000 people.

Funding was received from a large number of public and private institutions and sponsors including the Research Council of Norway, the Freedom of Expression Foundation and the University of Oslo. The expedition also received invaluable help and support from staff and students at the University of Oslo.

The media coverage currently counts around 170 stories in various formats, mainly via NRK. NRK included a section of the Darwin Expedition when they collected highlights from the history of the science communication TV-show '*Schrödinger's katt*' for its 20th anniversary on 4 February 2010.

The expedition's efforts and achievements were awarded the Department of Biology's annual Science Communication award of 2009 and the *Darwin Award* 2009.

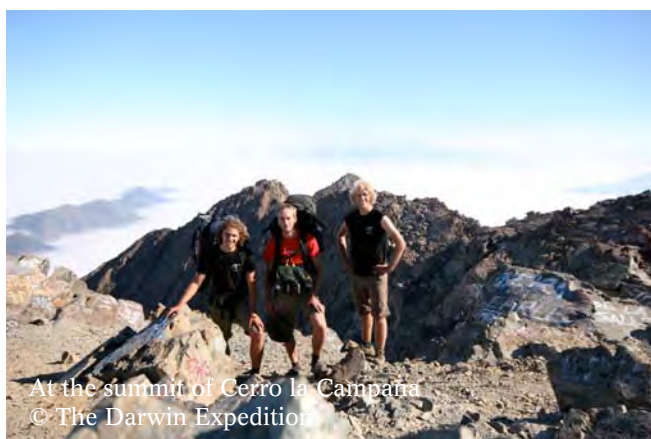
The School Tour and other parts of the project will continue in 2010.



Digging out an extinct Glyptodont
© The Darwin Expedition



Marine Iguana (*Amblyrhynchus cristatus*)
© The Darwin Expedition



At the summit of Cerro la Campana
© The Darwin Expedition



Galapagos tortoise (*Geochelone nigra*)
© The Darwin Expedition

6 GENDER EQUALISING STRATEGY

Equalising the gender balance in high-rank academic positions is a priority of both the Research Council of Norway and the University of Oslo. CEES has implemented several guidelines to counter “the leaky pipeline” of women through the academic hierarchy, from Master level, through PhD and post-doc levels to tenured scientific staff. At the CEES, we use a dual approach to attract and keep female scientists, partly optimizing the conditions for our female students and staff and partly emphasizing female role models.

To optimise conditions for female scientists who may temporarily be unable to perform their normal activities in the lab, UiO funding has been secured for a lab technician to assist female scientists. Furthermore, we have continued from 2008 our dedication to awarding scholarships for transitional engagements, enabling female candidates to further their scientific careers. In 2009, 7 people received such support, from 1 to 12 months, from the CEES. Four master students obtained stipends to write manuscripts based on their thesis (Maria Guldbrandsen, Mali Skogen, Maria Aasen and Unni Vik). Two PhD students received short-term extensions to their positions (Huma Siddiqui and Rosa Mary de Ayala Mondero; Mondero finished her PhD in 2009). One researcher (Antonietta Labra) received funding and published 3 papers during her scholarship. Labra is currently engaged in a post doc position at the CEES. Lee Hsiang Liow was

appointed as a CEES researcher on RCN gender equalising funds. We will use the position as model for future tenure track positions; this will provide a measure of recruitment strategy for female scientists. Three female scientists participated in a project leader training course for post docs/researchers at the Department. Furthermore, Deputy Chair of CEES (Eli K Rueness) and Deputy Chair of the Department (Anne K Brysting) participate in the research leader training program of the University of Oslo. The CEES received 100 000 NOK from UiO and 800 000 NOK from RCN in gender equalising funds, and used more than 1 860 000 NOK on these engagements in 2009.

The CEES Board and Scientific Advisory Board are chaired by female scientists, providing female role models for our staff. The Deputy Chair is female, two of the three *Themes* are co-chaired by female scientists and one of the four *Colloquia* is chaired by a female scientist. The Kristine Bonnevie lecture was held by Professor Barbara Rosemary Grant with Camilla Schreiner as an introductory speaker. Liow and our two female associate professors II's (20 % positions), have published 5 papers for CEES in 2009. They have also been involved in supervising students, and have participated in international and internal scientific meetings and conferences as well as the CEES journal clubs.



Ave Tooming-Klunderud operating the 454-sequencing machine © Olav Heggø

7 EXPERIMENTAL FACILITIES

7.1 DNA and sequencing labs

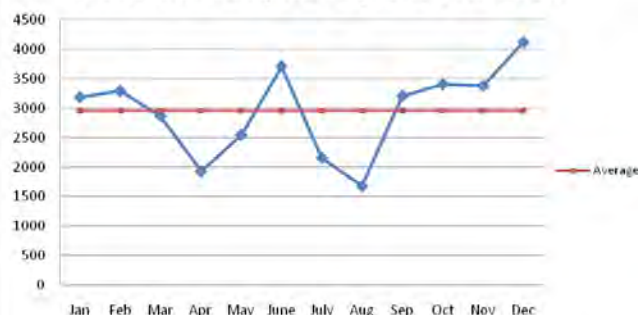
The CEES Lab (www.cees.uio.no/research/facilities/dna-lab) has an infrastructure consisting of an isolation lab, separate PCR facilities, post PCR and DNA sequencing labs. In addition there is a dedicated lab for class 2 security research. The lab is fully equipped for DNA and RNA extraction for all type of animal and plant tissues including blood, faeces and ancient DNA. It contains all of the basic instrumentation of a modern molecular biology laboratory including equipment for gene cloning, genomic libraries, real-time PCR, DNA/RNA quantification (Nanodrop spectrophotometer for µl volumes) and chip-based analysis of DNA, RNA and protein (Agilent Bioanalyzer). The CEES Lab implemented a fully automated DNA extraction protocol in 2009 for the Biomek 2000 and purchased a Gen-Mole benchtop instrument for automated nucleic acid purification. The lab had 37 users during 2009 (affiliated to CEES/Bio), and guests from Germany, Iran and Mexico.

The ABI lab (www.bio.uio.no/ABI-lab) is a collaboration between the Departments of Biology and Molecular Biosciences. The lab is situated at CEES and has two ABI 3730 capillary electrophoresis sequencers, each currently equipped with 48 capillaries. The ABI instruments provide DNA sequencing and fragment analysis, and function as a service lab for the various research groups and institutes, as well as affiliated organizations and departments. The ABI-service lab has been functional since July 2005.

The ABI lab implemented a fully automated dye-terminator removal protocol in 2009, based on paramagnetic beads and a Biomek 3000 automated workstation.



Number of samples sequenced in 2009



The annual turnover of the ABI-service lab was almost 1 MNOK in 2009. A total of 35 457 samples were sequenced by the ABI lab during 2009 with an average of 2955 samples every month. The graph shows the number of samples sequenced monthly at the ABI lab during 2009.

7.2 The Ultra-high Throughput Sequencing Platform

CEES obtained a Roche/454 GS FLX sequencing instrument (www.cees.uio.no/utsp) November 2007 as a part of the FUGE-sponsored Ultra-high Throughput Sequencing Platform UTSP (FUGE - National Technology Platform). UTSP is a member of the Norwegian High-Throughput Sequencing Centre (NSC, www.sequencing.uio.no), a consolidation of the Illumina Genome Analyzer II (GAII) sequencing platform at Institute of Medical Genetics (IMG) and the UTSP at CEES, which are both members of the Norwegian Genotyping and Sequencing Consortium (NGSC, www.ngsc.no). The NSC was able to secure funding worth 23 MNOK from the Norwegian Research Council for a three-year continuation of the platforms, and expansion in the direction of third-generation sequencing.

The UTSP 454 sequencing service lab has been functional since January 2008. In October 2008, the UTSP service lab was upgraded for sequencing using GS FLX Titanium chemistry (900 000-1 300 000 reads, read length of 400-450 bases, in total 360-560 million bases per plate), further increasing the throughput of sequencing.

In 2009, 105 samples for different research environments were sequenced (32 % more relative to 2008) in 95 runs. In total, 36.8 Gigabases (36 800 million bases) of sequence was obtained.

7 EXPERIMENTAL FACILITIES

A large fraction of the UTSP sequencing effort in 2009 was in relation to the cod genome project (www.codgenome.no), for which the UTSP is the main sequencing partner. 72 of the runs in 2009 were for the cod project. Because of the sequencing volume of this project, we borrowed a second GS FLX Titanium instrument from Roche Norway.

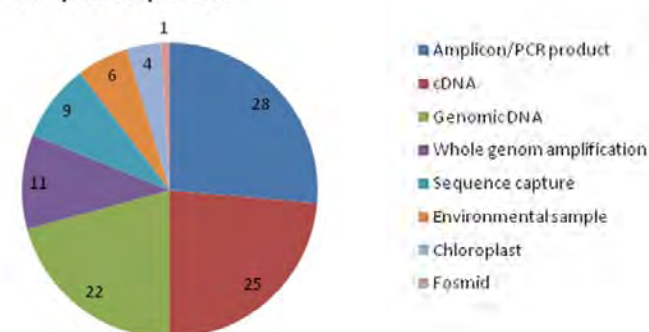
During 2009, we have sequenced different types of samples for several projects involving:

- *de novo* and re-sequencing of whole genomes (bacteria and eukaryotic organisms)
- sequencing of BACs and fosmids
- metagenomics analysis of environmental samples
- transcriptome analysis (sequencing of cDNA samples)
- sequencing of PCR products

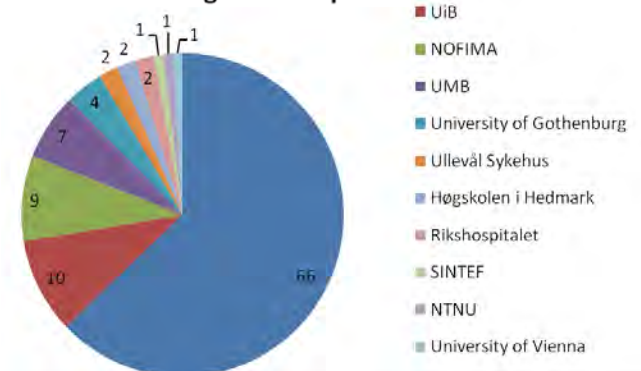
Sequenced samples were mostly from UiO researchers, though we have users from a number of Norwegian universities and institutions, as well as abroad (Sweden, Austria). The platform offers bioinformatic analysis of the sequence data, both through the UiO Bioportal (www.biportal.uio.no), where users can start downstream analysis using software specifically made for 454 sequencing data, as well as collaborative projects on a per-case basis.

In summary: the UTSP lab is performing well and experiencing increased demand, a trend we foresee continuing in 2010. With dedicated personnel for operating the instrument and bioinformatics support, we can offer excellent sequencing results to our users. The platform is open to all research environments.

Samples sequenced



Institutional origin of samples



7.3 Facilities provided by external parties

Facilities provided to CEES members by external parties includes the Alpine Research Centre at Finse, the Biological Research Station at Drøbak, the Flødevigen Research Station, the Landscape Ecology Field Station of Evenstad, the University of Oslo research vessels, the Aquarium and animal facilities, the Phytotron and the Bioportal. For more information on these facilities, see our web pages.

8 FINANCES

8.1 Accounting principles

Funding to the CEES is obtained primarily from RCN (approximately 10 MNOK in core-funding per year) and UiO (2 MNOK per year plus several positions) as well as funding through other sources defined as “own funding”. Our own funding can be divided into EU-funding and other international funding, funding from other RCN projects, other national public funding and that from commercial companies.

Expenditures are divided into salary costs, indirect costs, equipment, travel and representation, R&D services and miscellaneous expenses (mainly running expenses for laboratory and fieldwork).

In addition to revenues and expenditures that are accounted for, we also have those that are non-accounted for. These are mainly defined as the efforts of personnel that work within CEES, but receive their salaries from other parties. The value of these services is calculated using the official UiO budgeting procedures. In 2010 these costs will be partially transferred to accounted revenues/expenditures due to a new financial system that has been implemented by the University of Oslo in the fall of 2009. Future accounting reports will therefore not be fully comparable with the ones given for 2007-2009.

In this report we present accounting figures for 2009 and budget for 2010.



Gulls in sea © J. Manuel Hidalgo

8.2 Revenues and expenditures 2009/Budgeted revenues and expenditures 2010

Total funding			Accounted revenues			Other revenues								
Figures 2009		Budgeted figures 2010	Figures 2009		Budgeted figures 2010	Non accounted revenues 2009		Budgeted UiO effort 2010 ¹						
RCN-CoE		10 096	26 761	10 096	14 572			12 189						
UiO		31 085	6 186	5 567	6 186	25 518								
RCN – CEES related projects		43 986	50 182	43 986	46 068			4 114						
Other public funding, national		231	93	231	115			-22						
International funding		19 191	1 767	4 374	1 674	14 817		93						
Funding from commercial companies		1 084	2 496	1 084	2 038			458						
Transferred revenues from 2008		14 439	10 047	14 439	10 047									
Total funding		120 112	97 532	79 777	80 700	40 335		16 832						
Accounted expenses 2009 (Acc og)/Budgeted expenses 2010 (Bud 10)														
Total	RCN-CoE		UiO		RCN - CEES related proj.		Other public fund. national		International funding		Funding from commercial companies			
	Acc og	Bud 10	Acc og	Bud 10	Acc og	Bud 10	Acc og	Bud 10	Acc og	Bud 10	Acc og	Bud 10		
Salary expenses	31 707	38 851	7 763	15 090	3 214	3 243	16 375	17 527	203	48	3 581	2 021	571	922
Indirect costs	6 291	20 578	1 031	8 321	829	791	3 936	10 393	51	36	363	281	81	756
R&D services	13 146	10 828	67		50	100	13 029	10 728						
Equipment	5 243	9 292		200	7		5 236	9 076				16		
Running costs	11 943	9 853	1 497	3 098	1 083	1 015	8 362	4 421	59	31	482	571	460	717
Travel and representation ²	1 400	1 400	159	100	1 241	1 300								
Total	69 730	90 802	10 517	26 809	6 424	6 449	46 938	52 145	313	115	4 426	2 889	1 112	2 395
Non-accounted expenses 2009 (Naccog)														
	Naccog		Naccog		Naccog		Naccog		Naccog		Naccog		Naccog	
Salary expenses	20 652				12 919						7 733			
Indirect costs	19 683				12 599						7 084			
Total	40 335				25 518						14 817			
Balance 2009/Budgeted Balance 2010														
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
Revenues	105 673	87 485	10 096	26 761	31 085	6 186	43 986	50 182	231	93	19 191	1 767	1 084	2 496
Transf. reveuunes	14 439	10 047	1 380	959	1 514	657	9 628	6 676	104	22	1 446	1 394	367	339
Total expenses	110 065	90 802	10 517	26 809	31 942	6 449	46 938	52 145	313	115	19 243	2 889	1 112	2 395
Balance	10 047	6 730	959	911	657	394	6 676	4 713	22	0	1 394	272	339	440

All figures are given in 1000 NOK. ¹⁾ The University of Oslo has included the effort of personnell employed by the University (previously reported as part of the 'Non accounted revenues and expenses') in their budgets. Hence, we hereby report figures for these budgeted incomes for 2010 under 'Budgeted UiO effort'. The expenses for 'UiO effort' are reported under 'Salary expenses' and 'Indirect costs'. No budget for 'Non accounted revenues and expenses' is given for 2010. ²⁾ 'Travel and representation' is included in 'Runnings costs' for all funding sources except RCN-CoE and UiO.

9 APPENDICES

9.1 CEES-members

9.1.1 Core scientific staff

Name	Nationality	Position	Period	Funding	CEES share (%)
Brysting, Anne K	Norway	Assoc. Professor	Oct. 2007 -	UiO, Bio	75
Grimholt, Unni	Norway	Researcher	Oct. 2007 - Dec. 2010	RCN	100
Hansen, Thomas F	Norway	Professor	Oct. 2007 -	UiO, Bio	75
Hessen, Dag O	Norway	Professor	Oct. 2007 -	UiO, Bio	75
Hjort, Nils Lid	Norway	Professor	Oct. 2007 -	UiO, Math	25
Houle, David	USA	KB Professor	May 2008 - May 2009	RCN, CoE	100
Jakobsen, Kjetill S	Norway	Professor	Oct. 2007 -	UiO, Bio	50
Kishino, Hirohisa	Japan	KB Professor II	Jan. 2008 - Dec. 2009	RCN, CoE	10
Lampe, Helene M	Norway	Professor	Oct. 2007 -	UiO, Bio	75
Mysterud, Atle	Norway	Professor	Oct. 2007 -	UiO, Bio	75
Nesbø, Camilla L	Norway	Researcher	Oct. 2007 - Aug. 2012	RCN	100
Ottersen, Geir	Norway	Senior Scientist	Oct. 2007 -	IMR	25
Rueness, Eli K	Norway	Researcher/CEES Deputy Chair	Oct. 2007 - Sep. 2012	RCN, CoE	100
Schweder, Tore	Norway	Professor	Oct. 2007 -	UiO, Econ	65
Slagsvold, Tore	Norway	Professor	Oct. 2007 -	UiO, Bio	75
Stenseth, Nils Chr.	Norway	Professor/CEES Chair	Oct. 2007 -	RCN, CoE	100
Storvik, Geir	Norway	Professor	Oct. 2007 -	UiO, Math	38
Sætre, Glenn-Peter	Norway	Professor	Oct. 2007 -	UiO, Bio	75
Viljugrein, Hildegunn	Norway	Assoc. Professor II	Oct. 2007 - Jan. 2011	The National Veterinary Institute	20
Vøllestad, L. Asbjørn	Norway	Professor	Oct. 2007 -	UiO, Bio	75

9.1.2 Post docs and Researchers

Name	Nationality	Position	Period	Funding	CEES share (%)
Barson, Nicola Jane	UK	Postdoc res. fellow	Oct. 2007 - Dec. 2009	RCN	100
Brinch, Christian	Norway	Researcher	Jan. 2008 - Dec. 2010	RCN, CoE	20
Cromsigt, Joris P G M	Netherlands	Researcher	July 2009 - June 2011	EU, MC*	100
De Ayala Monedero, Rosa M	Spain	Researcher	Feb. 2009 - Feb. 2010	UiO, Bio/RCN, CoE	100
Donali, Espen	Norway	Researcher	May 2008 - May 2009	RCN	100
Durant, Joel M	France	Researcher	Oct. 2007 - Apr. 2011	RCN	100
Edeline, Eric	France	Researcher	Oct. 2007 - Aug. 2010	RCN	30
Espelund, Mari	Norway	Researcher	Oct. 2007 - Aug. 2009	RCN	100
Evans, Anna Kathinka D	Norway	Researcher	Dec. 2009 - Sep. 2010	IMR/RCN	100

9 APPENDICES

Name	Nationality	Position	Period	Funding	CEES share (%)
Guillot, Gilles	France	Postdoc res. fellow	Oct. 2007 - Aug. 2009	RCN	100
Gundersen, Hege	Norway	Researcher	Dec. 2008 - Sep. 2012	RCN, CoE	20
Haverkamp, Thomas H	Netherlands	Researcher	July 2009 - Dec. 2009	RCN	100
Hidalgo Roldan, J Manuel	Spain	Researcher/Postdoc res. fellow	May 2008 - May 2011	RCN, CoE/EU, MC*	100
Hjermann, Dag Ø	Norway	Researcher	Oct. 2007 - Jan. 2011	RCN	100
Holen, Øistein H	Norway	Postdoc res. fellow / Researcher	Oct. 2007 - Sep. 2012	UiO, Bio/RCN, CoE	100
Johannessen, Lars Erik	Norway	Researcher	Oct. 2007 - Apr. 2009	RCN	100
Jorde, Per Erik	Norway	Researcher	Oct. 2007 - Dec. 2010	RCN	100
Kettle, Anthony J B	UK	Postdoc res. fellow	Aug. 2008 - Jan. 2009	RCN	100
Knutsen, Halvor	Norway	Researcher	Oct. 2007 - Dec. 2009	IMR	5
Labra, Antonieta	Chile	Researcher/Postdoc res. fellow	Oct. 2007 - May 2012	RCN, CoE	100
Langangen, Øystein	Norway	Postdoc res. fellow	Mar. 2009 - Feb 2011	RCN	100
Le Rouzic, Arnaud	France	Researcher/Postdoc res. Fellow	Oct. 2007 - Dec. 2009	RCN/EU, MC*	100
Liow, Lee Hsiang	Singapore	Researcher	Oct. 2007 - Dec. 2011	RCN, CoE	100
Llope, Marcos	Spain	Researcher/Postdoc res. fellow	Oct. 2007 - Sep. 2009	EU, MC*/RCN	100
Loe, Leif Egil	Norway	Researcher	Oct. 2007 - Dec. 2011	RCN	100
Marcussen, Thomas	Norway	Postdoc res. fellow	Oct. 2007 - Dec. 2009	RCN/RCN, CoE	100
Nederbragt, Alexander	Netherlands	Researcher/Postdoc res. fellow	Oct. 2007 - Dec. 2010	GENPOINT	100
Nielsen, Anders	Norway	Postdoc res. fellow	July 2009 - June 2012	RCN	100
Ohlberger, Jan	Germany	Postdoc res. fellow	Apr. 2009 - Mar. 2011	RCN	100
Olsen, Esben M	Norway	Researcher	Oct. 2007 - Dec. 2009	IMR	5
Otero Villar, Jaime	Spain	Postdoc res. fellow	May 2008 - Apr. 2011	RCN	100
Pavlicev, Mihaela	Slovenia	Postdoc res. fellow	Dec. 2008 - Nov. 2010	RCN	100
Persson, Jonas	Sweden	Postdoc res. fellow	Dec. 2009 - Dec. 2011	RCN	100
Reitan, Trond	Norway	Postdoc res. fellow	Feb. 2009 - Feb. 2012	RCN, CoE	100
Richter, Andries P	Netherlands	Researcher	Jun. 2009 - Sep. 2009	EU	100
Rounge, Trine B	Norway	Postdoc res. fellow	Aug. 2008 - July 2011	RCN	100
Rouyer, Tristan A	France	Researcher/Postdoc res. Fellow	May 2009 - Aug. 2011	RCN	100
Seligmann, Hervé	Luxembourg	Postdoc res. fellow	May 2008 - Apr. 2010	UiO, Bio	100
Star, Bastiaan	Netherlands	Researcher/Postdoc res. fellow	Sep. 2008 - Sep. 2011	RCN	100
Stige, Leif Christian	Norway	Researcher	Oct. 2007 - Mar. 2010	RCN	100
Stüken, Anke C	Germany	Postdoc res. fellow	July 2009 - Dec. 2009	RCN	100
Sæther, Stein Are	Norway	Researcher	Oct. 2007 - Dec. 2011	RCN, CoE	100
Tooming-Klunderud, Ave	Norway	Postdoc res. fellow	Jan. 2008 - Jan. 2011	RCN	100
Trosvik, Pål	Norway	Researcher	Oct. 2008 - Dec. 2011	UiO, Bio	100
Van Donk, Ellen	Netherlands	Assoc. Professor II	Oct. 2007 -	UiO, Bio	20
Østbye, Kjartan	Norway	Postdoc res. fellow	Oct. 2007 - Mar. 2010	RCN, CoE	100

* Marie Curie individual fellowship

9.1.3 PhD students

Name	Nationality	Position	Period	Funding	CEES share (%)
Atickem, Anagaw	Ethiopia	Research fellow	Jan. 2008 - Dec. 2009	NUFU	100
Ben Ari, Tamara M.	France	Research fellow	Oct. 2007 - May 2010	EU, MC-EST*	100
de Muinck, Eric	USA	Research fellow	Oct. 2008 - Sep. 2011	The Norw. Inst. of Public Health	50
Diekert, Florian K	Germany	Research fellow	Apr. 2008 - Jun. 2011	Hydro/RCN	100
Eikeset, Anne M	Norway	Research fellow	Oct. 2007 - May 2010	RCN, CoE	100
Eriksen, Ane	Norway	Research fellow	Oct. 2007 - Sep. 2010	UiO, Bio	75
Godvik, Inger M R	Norway	Research fellow	Sep. 2008 - Aug. 2012	UiO, CoE	75
Heier, Lise	Norway	Research fellow	Oct. 2007 - Sep. 2010	UiO, Bio	75
Holmen, Johannes	Norway	Research fellow	Oct. 2007 - Dec. 2009	None	100
Husek, Jan	Czech Rep.	Research fellow	Oct. 2008 - Sep. 2012	UiO, CoE	75
Junge, Claudia	Germany	Research fellow	Oct. 2007 - Aug. 2010	EU, MC-EST*	100
Jørgensen, Marte	Norway	Research fellow	Oct. 2007 - Mar. 2010	UiO, Bio	75
Kausrud, Kyrre	Norway	Research fellow	Oct. 2007 - May 2010	The Norw. Forest and Landscape Inst./RCN, CoE	100
Knudsen, Endre	Norway	Research fellow	Oct. 2007 - Apr. 2010	UiO, Bio	75
Malmstrøm, Martin	Norway	Research fellow	Jan. 2009 - Dec. 2012	UiO, EMBIO	75
Minge, Marianne Aa	Norway	Research fellow	Oct. 2007 - Feb. 2010	UiO, Bio	100
Moe, Therese F	Norway	Research fellow	Oct. 2007 - Aug. 2010	UiO, Bio	75
Moland, Even	Norway	Research fellow	Oct. 2007 - Feb. 2010	RCN	100
Sabarros, Philippe S	France	Research fellow	Oct. 2007 - May 2010	EU, MC-EST*	100
Sadykov, Alexander	Russia	Research fellow	Oct. 2007 - May 2010	EU, MC-EST*	100
Sadykova, Dinara	Russia	Research fellow	Oct. 2007 - Jul. 2010	RCN	100
Serbezov, Dimitar	Bulgaria	Research fellow	Oct. 2007 - Dec. 2009	RCN/None	100
Siddiqui, Huma	Norway	Research fellow	Oct. 2007 - Feb. 2009	GENPOINT	100
Skog, Anna	Norway	Research fellow	Oct. 2007 - Dec. 2009	None	5
Svenningsen, Thomas O	Norway	Research fellow	Oct. 2007 - Apr. 2010	UiO, Bio	75
Taugbøl, Annette	Norway	Research fellow	Oct. 2008 - Sep. 2012	UiO, CoE	75
Voje, Kjetil L	Norway	Research fellow	Aug. 2008 - Jul. 2012	UiO, CoE	75
Westengen, Ola	Norway	Research fellow	Sep. 2008 - Aug. 2012	UiO, SUM	50

*Marie Curie Early Stage Research Training Site

9 APPENDICES

9.1.4 Assistant lecturers

Name	Nationality	Position	Period	Funding	CEES share (%)
Agier, Lydiane	France	Assistant lecturer	Apr. 2009 - Jun. 2009	EU	100
Asmyhr, Maria G	Norway	Assistant lecturer	Jul. 2008 - Aug. 2009	UiO/RCN, CoE	50
Arias Sanchez, Flor I	Mexico	Assistant lecturer	Nov. 2009 - Dec. 2009	RCN	100
Bjærke, Oda	Norway	Assistant lecturer	Jan. 2009 - Feb. 2009	UiO, CoE	100
Bærum, Kim Magnus	Norway	Assistant lecturer	Mar. 2009 - Sep. 2009	RCN, CoE	100
Easterday, William Ryan	USA	Assistant lecturer	Sep. 2009 - Sep. 2010	UiO, Bio	100
Egge, Elianne S	Norway	Assistant lecturer	Jan. 2009 - Feb. 2009	RCN, CoE	100
Hermansen, Jo S	Norway	Assistant lecturer	Nov. 2009 - Dec. 2009	RCN	100
Hoel, Cecilia	Norway	Assistant lecturer	Jun. 2009 - Jul. 2009	UiO, Bio	100
Kjøhl, Mariken	Norway	Assistant lecturer	Jul. 2009 - Dec. 2009	UN/FAO	50
Muluneh, Sebelewengel	Ethiopia	Assistant lecturer	May 2009 - Sep. 2009	RCN, CoE	40
Skogen, Mali H	Norway	Assistant lecturer	Sep. 2009 - Nov. 2009	RCN, CoE	100
Stiffel, Melaine	Germany	Assistant lecturer	Jul. 2009 - Sep. 2009	RCN, CoE	100
Thomassen, Gaute	Norway	Assistant lecturer	Jul. 2009 - Sep. 2009	RCN, CoE	100
Vik, Unni	Norway	Assistant lecturer	Jul. 2009 - Aug. 2009	UiO/RCN	100
Qviller, Lars	Norway	Assistant lecturer	Dec. 2008 - Nov. 2009	UiO, Bio	100
Aasen, Maria	Norway	Assistant lecturer	Sep. 2009 - Oct. 2009	UiO, Bio/RCN, CoE	100

9.1.5 Administrative and technical support staff

Name	Nationality	Position	Period	Funding	CEES share (%)
Bakke, Hege G	Norway	Principal engineer	Jan. 2008 - Feb. 2011	RCN	100
Espelund, Mari	Norway	Head engineer	Sep. 2009 - Aug. 2010	UiO, CoE	100
Gaup, H Junita	Norway	Head engineer	Jun. 2008 - May 2012	UiO, CoE	100
Gundersen, Gry	Norway	Advisor	Oct. 2007 - Sep. 2011	UiO, Bio	100
Grønli, Katinka E	Norway	Head of Admin.	Oct. 2007 - Sep. 2012	RCN, CoE	100
Grøttland, Eva I	Norway	Principal exec. officer	Apr. 2009 - Mar. 2011	RCN	100
Herland, Anders	Norway	Principal engineer	Jan. 2008 -	UiO, Bio	100
Jentoft, Sissel	Norway	Advisor	Jun. 2009 - Jun. 2010	UiO, Bio	100
Lambrou, Jayne P	UK	Higher exec. officer	May 2009 - Apr. 2010	RCN, CoE	50
Nerli, Emelita R	Norway	Chief research techn.	Oct. 2007 -	UiO, Bio	50
Pettersen, Morten K	Norway	Exec. officer	Jun. 2009 - Jun. 2010	UiO, Bio	100
Rygg, Kari B	Norway	Advisor	May 2008 - Dec. 2010	UiO, Bio	100
Solbakken, Monica H	Norway	Principal engineer	Dec. 2008 - Nov. 2010	RCN	100
Skage, Morten	Norway	Head engineer	May 2008 - Apr. 2011	RCN	100
Steen, Nanna W	Norway	Head engineer	Oct. 2007 -	UiO, Bio	90
Wallem, Tore	Norway	Higher exec. officer	Dec. 2007 - Mar. 2011	UiO, CoE	100

9.2 Guests of CEEs in 2009

9.2.1 Longer research visits (>1 month)

Name	Nationality	Home institution	Period
Akbari, Akbar	Norway	Department of informatics, UiO	Oct. 2009 - Dec. 2009
Blenckner, Thorsten	Germany	Stockholm University	Apr. 2009 - May 2009
Boessenkool, Sanne	Netherlands	University of Otago	Jan. 2009 - Mar. 2009
Bsor, Tamar	Israel	Tel Aviv University	May 2009 - Jun. 2009
Cadahia, Luis	Spain	University of Alicante	Jun. 2009 - Dec. 2009
Fierst, Janna	USA	Florida State University	May 2008 - Apr. 2009
Frigstad, Helene	Norway	University of Bergen	Jan. 2009 - Dec. 2009
Gahr, Anja	Germany	University of Oslo	Apr. 2009 - Dec. 2009
Griffin, Donald	USA	Florida State University	Jul. 2008 - Jul. 2010
Grzes, Irena	Poland	Jagiellonian University in Krakow	Aug. 2009 - Dec. 2009
Haas, Fredrik	Sweden	Lund University	Nov. 2009 - Dec. 2011
Harstad, Håvard	Norway	Norwegian School of Veterinary Science	Sep. 2009 - Mar. 2009
Kettle, Anthony James	Great Britain	University of East Anglia	Aug. 2008 - Jan. 2009
Koyano, Hitoshi	Japan	Tokyo University	Feb. 2009 - Mar. 2009
Lindegren, Martin O	Sweden	Lund University	Jun. 2009 - Jul. 2009
Machu, Eric	France	Institut de Recherche pour le Développement	Mar. 2008 - Feb. 2010
Marks, Jessica	Norway	University of Bergen	Jan. 2009 - Dec. 2009
Maselli, Valeria	Italy	Università degli Studi 'Federice II' di Napoli	Feb. 2009 - Mar. 2009
McBryan, Angela	USA	Arizona State University	Jun. 2009 - Jul. 2009
McCarty, John Paul	USA	University of Nebraska – Omaha	Aug. 2008 - May 2009
McCrackin, Michelle Lynn	USA	Arizona State University	Jun. 2009 - Dec. 2009
Meisingset, Erling	Norway	Norwegian Institute for Agricultural and Environmental Research	Jan. 2009 - Dec. 2009
Neerinckx, Simon	Netherlands	University of Antwerp	Jul. 2009 - Sep. 2009
Nilsson, Anna	Sweden	Lund University	Mar. 2008 - Dec. 2009
Persson, Jonas	Sweden	Uppsala University	May 2008 - Nov. 2009
Pettersen, Ruben Alexander	Norway	Natural History Museum	Aug. 2009 - Dec. 2009
Poyatos, Juan	Spain	Consejo Superior de Investigaciones Científicas	Aug. 2009 - Dec. 2009
Pulkkinen, Katja A	Finland	University of Jyväskylä	Jan. 2009 - Jun. 2009
Riahi, Sepand	Iran	Ferdowsi University of Marashad	Sep. 2009 - Dec. 2009
Rogers, Lauren	USA	University of Washington	Aug. 2009 - Feb. 2010
Sivertsen, Therese	Norway	University of Oslo	Sep. 2009 - Mar. 2010
Tian, Huidong	China	Chinese Academy of Sciences	Jul. 2008 - Jul. 2009
Uyeda, Josef	USA	Oregon State University	Aug. 2009 - Dec. 2009
van Beest, Floris	Netherlands	Hedmark University College	Jan. 2009 - Dec. 2009
Wiebe, Karen	Canada	University of Saskatchewan	Mar. 2009 - Apr. 2009
Wolfenbarger, Lillian La Reesa	USA	University of Nebraska – Omaha	Aug. 2008 - May 2009
Xu, Lei	China	Chinese Academy of Sciences	Jul. 2008 - Jul. 2009

9 APPENDICES

9.2.2 Short term guests (>1 week <1 month)

Name	Nationality	Home institution	Period
Bengtson, Sven-Axel	Sweden	Lund University	Sep. 2009 - Sep. 2009
Bonenfant, Christophe	France	Centre national de la recherche scientifique	Jun. 2009 - Jul. 2009 Nov. 2009 - Nov. 2009
Boutin, Stan	Canada	University of Alberta	Sep. 2009 - Sep. 2009
Brillinger, David	Canada	Berkeley University of California	Sep. 2009 - Sep. 2009
Büntgen, Ulf	Germany	University of Bern	Sep. 2009 - Sep. 2009
Castro, Jose Alvarez	Spain	University of Santiago de Compostela	Nov. 2009 - Nov. 2009
Cazelles, Bernard	France	Ecole normale supérieure	Jun. 2009 - Jun. 2009
Cromsigt, Joris	Netherlands	Białowieża National Park	Feb. 2009 - Feb. 2009
Dhondt, Andre	Belgium	Cornell University	Sep. 2009 - Sep. 2009
Gautron, Martin	France	École nationale supérieure des arts décoratifs	Dec. 2009 - Dec. 2009
Grant, Barbara	UK	Princeton University	Sep. 2009 - Sep. 2009
Grant, Peter	UK	Princeton University	Sep. 2009 - Sep. 2009
Hammerstein, Peter	Germany	Humboldt University	Sep. 2009 - Sep. 2009
Ims, Rolf	Norge	University of Tromsø	Sep. 2009 - Sep. 2009
Langvatn, Rolf	Norge	The Norwegian University of Science and Technology	Sep. 2009 - Sep. 2009
Le Maho, Yvon	France	Centre national de la recherche scientifique	Sep. 2009 - Sep. 2009
Leirs, Herwig	Belgium	University of Antwerp	Sep. 2009 - Sep. 2009
Lindegren, Martin Olof	Sweden	Technical University of Denmark	Aug. 2009 - Aug. 2009 Sep. 2009 - Sep. 2009
Magurran, Anne	UK	University of St Andrews	Sep. 2009 - Sep. 2009
Orians, Gordon	USA	University of Washington	Sep. 2009 - Sep. 2009
Richter, Andries	Netherlands	Wageningen University	Dec. 2009 - Dec. 2009
Samia, Noelle	USA	Northwestern University	Apr. 2009 - May 2009 Sep. 2009 - Sep. 2009
Stieffel, Melanie	Germany	University of Rostock	May 2009 - May 2009
Tong, Howell	Hong Kong	London School of Economics	Sep. 2009 - Sep. 2009
Tryjanowski, Piotr	Poland	Poznań University of Life Sciences	Sep. 2009 - Oct. 2009
Vallin, Niclas	Sweden	Uppsala University	Nov. 2009 - Nov. 2009

9.3 Associated research projects and other services

9.3.1 Other research projects

RCN-projects

Name	Project leader	Funding	Start	End
National resources for genomics, functional genomics and health research in Atlantic salmon and Atlantic cod	Grimholt, Unni	RCN	2007	2010
Host-virus interactions in Atlantic salmon	Grimholt, Unni	RCN	2007	2011
Spatial economic analysis in wildlife management	Gundersen, Hege	RCN	2005	2009
Long term consequences of interspecific cross-fostering in the wild	Hansen, Bo Terning	RCN	2005	2009
Statistical tools for studying genetic architecture	Hansen, Thomas F.	RCN	2007	2011
A Measurement-Theoretic Approach to the Estimation of Genetic Architecture and its Effects on Evolvability	Hansen, Thomas F.	RCN	2009	2010
Biogeochemistry in Northern Watersheds, a Reactor in Global Change	Hessen, Dag O.	RCN	2005	2010
Evolution of chloroplast replacements	Jakobsen, Kjetill S.	RCN	2004	2009
Evolution of chloroplasts: addressing the genomic processes behind acquisition of secondary and tertiary organelles	Jakobsen, Kjetill S.	RCN	2005	2010
Algal toxins & polyunsaturated fatty acids: a polyketide genomic approach to safe and efficient utilisation of microalgae in bioproduction	Jakobsen, Kjetill S.	RCN	2006	2010
Allopolyploid evolution in plants: patterns and processes within the genus <i>Viola</i>	Jakobsen, Kjetill S.	RCN	2006	2009
Ultra-high throughput sequencing platform	Jakobsen, Kjetill S.	RCN	2007	2013
Genome sequencing of cod by exclusive uses of ultra high-throughput sequencing technology	Jakobsen, Kjetill S.	RCN	2008	2011
Processes in the life history and dynamics of managed ungulate populations	Mysterud, Atle	RCN	2004	2010
Natural and farmed habitat as a basis for production of red deer in Norway	Mysterud, Atle	RCN	2007	2012
Land: Long-term ecological effects of sheep grazing in alpine ecosystems and its intergration with management.	Mysterud, Atle	RCN	2008	2012
The ecology and economy of sheep production under climate change	Mysterud, Atle	RCN	2009	2012
Biogeographic and population analyses of Thermotogales bacteria from hydrocarbon-rich environments	Nesbø, Camilla	RCN	2008	2013
Integrated statistical analysis based on likelihood and confidence: applications to the hare-lynx cycles and the status of bowhead whales	Schweder, Tore	RCN	2004	2010
Hybridization in birds as studied by cross-fostering in the wild	Slagsvold, Tore	RCN	2004	2009
Møbius 2000/NCS-Price/RCN-Aurora	Stenseth, Nils Chr.	RCN	2000	2010
ErNoclima - Collaborative network - French-Norwegian Climate-Ecology	Stenseth, Nils Chr.	RCN	2004	2009

9 APPENDICES

Economically and ecologically sustainable fisheries management: optimising fish harvest while conserving seabird diversity	Stenseth, Nils Chr.	RCN	2005	2009
Long-term Effects of Oil accidents on the pelagic ecosystem of the Norwegian and Barents Seas	Stenseth, Nils Chr.	RCN	2006	2010
Fishery-Induced Changes in Vital Components of a Large Pike Population	Stenseth, Nils Chr.	RCN	2006	2009
Functional genomics of phenotype plasticity of cod: a national consortium - GENOFISK	Stenseth, Nils Chr.	RCN	2007	2010
Linking physics and biology - Structuring of cod populations in the North Sea/Skagerrak water-system	Stenseth, Nils Chr.	RCN	2007	2012
The possible role of zooplankton in modulating ecosystem effects of acute oil spills in the Norwegian and Barents Seas	Stenseth, Nils Chr.	RCN	2007	2010
Ultra High throughput sequencing national platform	Stenseth, Nils Chr.	RCN	2007	2009
Unravelling population connectivity for sustainable fisheries in the Deep Sea (EuroDEEP)	Stenseth, Nils Chr.	RCN	2007	2010
The genetic architecture of reproductive isolation	Stenseth, Nils Chr.	RCN	2008	2009
I kjølvannet av ideen som forandret verden	Stenseth, Nils Chr.	RCN	2008	2009
Oceanography and Match-mismatch	Stenseth, Nils Chr.	RCN	2008	2011
Match-mismatching og trophic levels as a structuring force of ecosystems	Stenseth, Nils Chr.	RCN	2008	2011
Darwinjubileet 2009 – temakvelder	Stenseth, Nils Chr.	RCN	2008	2010
Norwegian Russian Cooperation in estimating the cost structure of the Northeast Arctic cod	Stenseth, Nils Chr.	RCN	2009	2010
"Researchers' Night", 25 September 2009	Stenseth, Nils Chr.	RCN	2009	2010
Response of trophic relationships to climate change	Stenseth, Nils Chr.	RCN	2009	2010
Comparison of Marine Ecosystems of Norway and the US	Stenseth, Nils Chr.	RCN	2009	2013
Signal evolution: adaptation and constraint	Sætre, Glenn-Peter	RCN	2006	2009
Magnetoreception and magnetic compass orientation in the long distance migration of the European eel	Vøllestad, L. Asbjørn	RCN	2004	2009
Sticklebacks (<i>Gasterosteus aculeatus</i> L.) on the Norwegian coast: fresh water colonisation, divergence rates and adaptive speciation	Vøllestad, L. Asbjørn	RCN	2006	2009
The early stages of adoptive divergence: the speed of evolution	Vøllestad, L. Asbjørn	RCN	2007	2010
Modelling ecosystems under climate change: Windermere as a model lake system	Vøllestad, L. Asbjørn	RCN	2008	2011
VANN: Declining long-term trends in Atlantic salmon abundance: inferring mechanisms using catch data for Norway and Scotland	Vøllestad, L. Asbjørn	RCN	2008	2011

Other public sector based projects

Name	Project leader	Funding	Start	End
Platform for Viral Aquamedicine	Grimholt, Unni	RCN/The National Veterinary Institute	2009	2012
Can nuisance growth of the aquatic macrophyte <i>Juncus bulbosus</i> be related to elevated nitrogen deposition as well as hydropower regulations?	Hessen, Dag O. and Andersen, Tom	RCN/NIVA	2007	2011
High throughput sequencing of deep sea metagenomes 6503	Jakobsen, Kjetill	Statoil/VISTA	2009	2012
Sustainable use of husbandry: Ecological effects of sheep grazing in alpine habitats	Mysterud, Atle	Municipalities/ Statskog	2000	2009
Socio-economic effects of fisheries-induced evolution	Stenseth, Nils Chr.	RCN/UiB	2008	2011
Arctic and sub-Arctic climate system and ecological response to the early 20th century warming	Stenseth, Nils Chr.	RCN/NERSC	2009	2012
MPAs in coastal Skagerrak: a model system for understanding lobster demography and successful introduction of MPAs in temperate waters	Stenseth, Nils Chr.	RCN/IMR	2006	2009
MARINERA Marine phylogeographic structuring	Stenseth, Nils Chr.	RCN/IMR	2009	2012
PITRO III - Gr2 - Ecological modelling, interdisciplinary methodology and climatic variation in Africa	Stenseth, Nils Chr.	SIU	2009	2012
Status og bestandsutvikling for norsk ål	Vøllestad, L. Asbjørn	Directorate for Nature Management	2007	2009

Projects funded by commercial companies

Name	Project leader	Funding	Start	End
Marine Ecosystem Response to a Changing Climate	Hessen, Dag	RCN/The Bjerknes Centre	2008	2011
Towards a better understanding of bloom forming toxic cyanobacteria	Jakobsen, Kjetill S.	RCN/NIVA	2009	2012
Tools for Microbial Nucleic Acid Sample Preparation for Diagnostic and Genomic Analyses	Jakobsen, Kjetill S.	RCN/Genpoint	2005	2009
Effects of oil spills in the water column. Economic consequences for the fisheries	Stenseth, Nils Chr.	Statoil	2007	2010
BIOSEA II: Risk assessment and biomonitoring in the arctic. Wp1b: links from individuals to populations (pandalus model study)	Stenseth, Nils Chr.	IRIS	2008	2009
A design document for Decision Support Tool (DST) for Impact Analysis	Stenseth, Nils Chr.	Akvaplan-niva	2009	2010
Spatiotemporal dynamics of introduced bark beetles: resource competition, invasion risk and management	Stenseth, Nils Chr.	RCN/The Norw. Forest and Landscape Inst.	2006	2009

9 APPENDICES

International projects

Name	Project leader	Funding	Start	End
PIEF-GA-2008-220538 Statistical Tools for studying genetic architecture (stsga)	Hansen, Thomas F.	EU	2008	2011
Ecological and Evolutionary Response to Climatic Variation - Marie Curie Early Stage Research Training in Oslo (CEES-MCO)	Stenseth, Nils Chr.	EU, Marie Curie-EST	2005	2011
Plankton Dynamics and Global Change: the North Sea Regime Shift	Stenseth, Nils Chr.	EU, Marie Curie-Intra European Fellowship	2006	2010
Fisheries-induced Evolution (FinE)	Stenseth, Nils Chr.	EU, IAASA Austria	2007	2011
Regime shift in the Black Sea, a population dynamics and wavelet approach.	Stenseth, Nils Chr.	EU	2008	2009
PIEF-GA-2008-220947 Spatial Heterogeneity og Resources: a mediator	Stenseth, Nils Chr.	EU	2009	2012
PIEF-GA-2009-235962 EVOLBIRD - Demographic strategies	Stenseth, Nils Chr.	EU	2009	2013
EU 236549 PIEF-GA 2009 Ecological and evolutionary dynamics of juvenescent marine populations EVOLHAKE	Stenseth, Nils Chr.	EU	2009	2012
Climate Change Impacts on Pollination Services	Stenseth, Nils Chr.	UN, FAO	2009	2010

9.4 CEES events

9.4.1 Scientific events

CEES *Theme/Colloquium* Progress Seminar. CEES, 2 February, 9 February, 9 March 2009

Metagenome Meeting. Ullevål University Hospital, Oslo, 25 May 2009

Opening seminar of The Norwegian High-Throughput Sequencing Centre. Oslo, 22 June 2009

A conference on Ecology and Evolution. The Norwegian Academy of Science and Letters, Oslo, 3-5 September 2009

CEES Student Conference. Holmen Fjordhotell, Nesbru, 15-16 September 2009

Workshop/colloquium in *EstimateS* and related software for estimating biodiversity. CEES, 8 October 2009

Genofisk meeting - The Cod Genome Project. Gardermoen, 14 October 2009



9.4.2 Seminars with invited speakers

Name	Title and date of presentation
Leimar, Olof	The evolution of transgenerational integration of information in fluctuating environments. 9 January
Büntgen, Ulf	Climatic triggers of plague dynamics over the last millennium. 14 January
Naess, Arvid	A study of stochastic lotka-volterra models by path integration methods. 16 January
Wolf, Jason	A genetic perspective on intraspecific interactions. 22 January
Persson, Inga-Lill	Impact of Cervids on Biodiversity, Ecosystem Processes and Wildlife. 23 January
Rikvold, Per Arne	Some statistical-physics inspired models in evolution and ecology. 28 January
Chan, Kung-Sik	Nonlinear spatio-temporal analysis and ecology – recent advances and challenges. 30 January
Cromsigt, Joris	Dynamics of grazing lawn formation in African savanna grasslands: an experimental test of the role of scale-dependent processes. 6 February
Rainey, Paul B	Experimental evolution of a bet-hedging strategy. 10 February
Stenseth, Nils Chr. (1, 3); Powell, David (2); Miller, Jon D (4); Lister, Adrian M (5); Rainey, Paul (6); Pfeifer, Rolf (7); Krause, Johannes (8, 13); Miller, Cory (9); Moser, Edvard (10); Sigmund, Karl (11); Hammerstein, Peter (12)	(1) Darwin's influence on our understanding of life (2) Greetings from Darwin's homeland (3) Announcing the book "Darwin: verden ble aldri den samme" ("Darwin: the world would never be the same again") (4) The public acceptance of evolution in Europe and the United States (5) The fossil record and Darwin's theory of evolution (6) The evolution of individuality (7) Self-organization, embodiment, and biologically inspired robotics (8) A Genomic View of Human Origins (9) Evolution, behaviour and primate cortex: the behavioural neurobiology of vocal communication (10) Finding the way – an evolutionarily conserved brain function (11) Evolution of cooperation, especially in Humans (12) The impact of Darwinian thought on decision theory and the behavioral sciences (13) Discussion on the Complete Sequencing of the Neanderthal Genome 11-12 February (Darwin Day)
Begon, Mike	Thomas Malthus and Connecting population dynamics and evolution. 13 February (Darwin Year)
Young, Jeremy	Infinitely abundant fossils - the unique evolutionary record of planktonic microfossils - and some new perspectives from molecular studies. 13 February (Darwin year)
Brown, James H	Metabolism is to ecology as genetics is to evolution? 16 February
Ciudad, Isaac Salazar	Developmental ordination of tooth populational and within individual morphological variation. 25 February
Wagner, Günter P	Evolution of gene regulation and the origin of pregnancy in mammals. 27 February
Aasland, Tora; May, Robert M	The scientific community and climate change. 11 March
Arukwe, Augustine	Estrogen receptor hijacking by dioxin-like AhR-agonists in fish – A rule or an exception? 13 March
Amundsen, Hans E F (1); Rosing, Minik Thorleif (2); McLoughlin, Nicola (3)	(1) Taking the search for life on Mars down to Earth (2) The Earth - A life's work: The accomplishments of 4 billion years of Darwinian evolution (3) Darwin's lost world - the co-evolution of microbial life and our planet 20 March (Darwin year)
Bruton, David L (1); Rosing, Minik Thorleif (2); McLoughlin, Nicola (3)	(1) Introduction (2) The Earth - A life's work: The accomplishments of 4 billion years of Darwinian evolution (3) Darwin's lost world - the co-evolution of microbial life and our planet 20 March, Evening (Darwin Year)
Ruse, Michael	Is Darwinism Past its 'sell-by' date? 17 April (Darwin Year)
van Dongen, Stefan	All you wanted to know about asymmetry but were afraid to ask. 24 April
Dankel, Dorothy	Harvest control rules as a quantitative tool for integrated fisheries management. 27 April
Svensson, Erik	Dragonflies and damselflies as model organisms in ecology and evolution. 8 May
Bagheri, Homayoun C	Division of labor and multicellularity in the early evolution of life. 15 May

9 APPENDICES

Johannesson, Hanna	The mating-type chromosome of the filamentous ascomycete <i>Neurospora tetrasperma</i> as a simple model for early sex chromosome evolution. 20 May
Szathmáry, Eörs	The hard problems of the origin of life. 5 June (Darwin Year)
Cazelles, Bernard	Taking into account the spatial dimension in the analysis of non-stationary epidemics: The case of Dengue. 12 June
Fjeldså, Jon	The largest avian radiation - The Passeriformes as a model group for understanding global patterns of biological diversification. 19 June
Schneider, Stephen H; Root, Terry L	Can a Copenhagen protocol avoid dangerous climate change? 28 August
Miller, Geoffrey (1); Ottesen, Vibeke Kennair (2)	(1) Sex, mutations, and marketing (2) Sex differences in physical violence - a product of sexual selection? 31 August (Darwin Year)
Ottersen, Ole Petter (1); Schreiner, Camilla (2); Grant, Barbara Rosemary (3)	(1) Opening remarks (2) To study or not to study biology (3) Evolution in Darwin's finches 2 September (The Kristine Bonnevie lecture on evolutionary biology)
Moore, James R (1); Eikeset, Anne Maria (2); Jentoft, Svein (3)	(1) Darwin's sacred cause (2) Hvorfor krymper torsken? Evolusjon og bærekraftig utnyttelse av torsk i Barentshavet (3) Bærekraft og utvikling - en balansekunst 18 September (Opening of the Norwegian Science Week, co-organised with The Research Council of Norway)
Lønning, Inge; Elgarøy, Øystein; Brekke, Torkel	Darwin og religion (Darwin and religion). 23 September (Darwin Year)
Turner, Wendy C	The ecology of environmentally-transmitted diseases in ungulates of Etosha National Park, Namibia: gastrointestinal parasites, anthrax and host foraging behaviour. 25 September
Elgvin, Tore Oldeide; Voje, Kjetil Lysne	Researchers' night: Darwinekspedisjonen (The Darwin expedition). 25 September (Darwin Year)
Hernandez-Aguilar, Adriana	Chimpanzees in a dry, open, and seasonal habitat: Ugalla, Tanzania. 28 September
Tryjanowski, Piotr	The Indian Ocean dipole and European avifauna. Why NAO and ENSO are not enough and why we need something more? 2 October
Møller, Anders	Darwin's ethical dilemmas. 9 October
Ritt, Nikolaus (1); Hurford, James R (2)	(1) 'Drifts' and 'conspiracies' in language history: the explanatory potential of evolutionary accounts (2) The contributions of storage, computation and pragmatics to the evolution of syntax 21 October (Darwin Year)
Pélabon, Christophe	Genetic and evolutionary consequences of different captive breeding regimes in the Guppy. 23 October
Dennett, Daniel C	The evolution of "Why". 23 October (Darwin Year)
Davidson, William S	AsalBase - an integration of genomic resources for Atlantic salmon. 29 October
Laubichler, Manfred D (1); Gouyon, Pierre-Henri (2)	(1) From Lamarck to Darwin and beyond (2) From the chain of beings to the tree of life 30 October (Darwin Year)
Takasu, Fugo	A spatial territory game in continuous space. 6 November
Andersson, Malte	Evolution of Classical Polyandry. 13 November
Padian, Kevin	How dinosaurs grew and how we know. 20 November (Darwin Year)
Padian, Kevin (1); Elster, Jon (2)	(1) Darwin's Enduring Legacy – and some enduring myths. (2) Darwin's impact on the social sciences 20 November (Darwin Year)
Osberg, Sigurd (1); Padian, Kevin (2)	(1) Skapelse og evolusjon. Forholdet mellom skapertro og naturvitenskap hos Fredrik Petersen (Prof. Fredrik Petersens attempt to mediate between Creation and Evolution). (2) Evolution, 'Intelligent Design', and the state of Creationism in the US. 21 November (Darwin Year)
Bernatchez, Louis	On the origin of species: Recent contribution from the ecological genomics of whitefish. 27 November
Løvlie, Hanne	Sexual selection in the fowl: sperm competition, incest and personality. 4 December
Haile-Selassie, Yohannes	Human Origins: 150 years after Charles Darwin. 11 December (Darwin Year)

9.4.3 Internal CEES seminars

Name	Title and date of presentation
Eriksen, Ane; Lampe, Helene; de Ayala, Rosa Mary and Slagsvold, Tore	Advances in behavioural ecology of birds: report from 2008. 26 January
Qviller, Lars	Ecological response to sea level fluctuations in the Upper Ordovician of Langesund, Norway. 23 February
Junge, Claudia and Taugbøl, Annette	A wrap-up of a Nordic Marine Academy course on "Applying microsatellite techniques to aquatic systems". 2 March
Guillot, Gilles	Statistical inference of population structure from quantitative traits and genetic neutral markers data. 10 March
Kausrud, Kyrre	Gods, groups and genes: an essay on evolution and human morality. 23 March
Egge, Elianne Sirnæs	Matrix population models as a means to assess effects of density dependence and toxicant exposure on fish populations. 30 March
Husek, Jan	Something for the ornithologists? Analyzing large-scale spatio-temporal variability in passerine nest survival and implications for population biology studies. 20 April
Stiffel, Melanie	Acoustical investigations of social behaviours of the Northern Resident orca community (<i>Orcinus orca</i>). 30 April
Reitan, Trond	Modelling phenotypic evolution using stochastic differential equations (with applications for Coccolith data). 11 May
Ottersen, Geir	Trying to explain recruitment variability in major North Sea fish stocks. 18 May
Liow, Lee Hsiang	Do Plankton like each other, hot water or salty water better, and in which order? And who cares anyway? 8 June
Ben Ari, Tamara	Social Epidemiology: A snapshot of health disparities and inequalities in the US. 3 August
Grimholt, Unni	MHC and evolution. 21 August
Poyatos, Juan F.	Are there principles organizing Biological Systems? 31 August
Seligmann, Hervé	Whole organism properties and molecular/genomic data: research directions using museum collections. 21 September
Langangen, Øystein	"Nature is smarter than you are" or how to use evolutionary theory to count fish. 5 October
Pavlicev, Mihaela	The relationship between pleiotropy and evolvability. 12 October
Nielsen, Anders	On plant-pollinator systems. 19 October
Haverkamp, Thomas	The Håkon Mosby Mud Volcano metagenome. 26 October
Ohlberger, Jan	A physiological pathway in fish speciation. 2 November
Sadykov, Alexander	Some facts that you have always known about the dynamics of populations, but there was no suitable occasion to look at them all together. 9 November
Hessen, Dag O.	Genome size evolution and its effects on growth, metabolism and speciation. 16 November
Nederbragt, Lex and Kausrud, Kyrre	The added value of within-CEES cooperation: a statistical analysis of bacterial genome assemblies based on 454 pyrosequencing data. 30 November
Atickem, Anagaw	Debates on the taxonomic status of African savannah monkeys and its implication in wildlife conservation. 7 December
Junge, Claudia	Genetic diversity of basking sharks (<i>Cetorhinus maximus</i>) - a message from Norway. 14 December

9.5 Product lists

9.5.1 Books and book chapters

Bonenfant, C., J. M. Gaillard, T. Coulson, M. Festa-Bianchet, A. Loison, M. Garel, L. E. Loe, P. Blanchard, N. Pettorelli, N. Owen-Smith, J. Du Toit & P. Duncan. (2009). Empirical Evidence of Density-Dependence in Populations of Large Herbivores. In: H. Caswell (ed.) *Advances in Ecological Research, Volume 41*. San Diego: Elsevier Academic Press pp. 313-357 (ISBN: 978-0-12-374925-3)

Ergon, T., N. G. Yoccoz & J. D. Nichols (2009). Estimating Latent Time of Maturation and Survival Costs of Reproduction in Continuous Time from Capture-Recapture Data. In: D. L. Thomson, E. G. Cooch & M. J. Conroy (eds.) *Modeling Demographic Processes in Marked Populations*. New York: Springer pp. 173-197 (ISBN: 978-0-387-78150-1)

Hansen, T. F. (2009). Etter neodarwinismen: Hovedtrekk i evolusjonsteorien 1959-2009 In: D. O. Hessen, T. Lie & N. C. Stenseth (eds.) *Darwin: Verden ble aldri den samme*. Oslo: Gyldendal Litteratur pp. 83-129 (ISBN: 978-82-05-39034-8)

Hessen, D. O. (2009). *Livet. En kort reise gjennom fire milliarder år*. Oslo: Cappelen Damm AS. (ISBN: 978-82-02-30760-8) 153 p.

Hessen, D. O. (2009). Angsten for Darwin. In: D. O. Hessen, T. Lie & N. C. Stenseth (eds.) *Darwin: Verden ble aldri den samme*. Oslo: Gyldendal Litteratur pp. 381-402 (ISBN: 978-82-05-39034-8)

Hessen, D. O., T. Lie & N. C. Stenseth (2009). *Darwin: verden ble aldri den samme*. Oslo: Gyldendal Litteratur (ISBN: 978-82-05-39034-8) 405 p.

Jørgensen, M. H. & T. Carlsen (2009). Opp av asken. In: Magne Riiseng (ed.) *Året i bilder 2008*. Oslo: Cappelen Damm AS pp. 156-161 (ISBN: 978-82-02-29246)

Lampe, H. M. & S. Östlund-Nilsson (2009). Animal navigation in air and water. In: B.G. Briså & B. Lavold (eds.) *Kompassrosen - Orientering mot nord*. Oslo: Nasjonalbiblioteket pp. 28-39 (ISBN: 978-82-7965-100-0)

McCleave, J. D. & E. Edeline (2009). Diadromy as a conditional strategy: patterns and drivers of eel movements in continental habitats. In: A.J. Haro, K.L. Smith, R.A. Rutifson, C.M. Moffitt, R.J. Klauda, M.J. Dadswell, R.A. Cunjak, J.E. Cooper, K.L. Beal & T.S. Avery (eds.) *Challenges for Diadromous Fishes in a Dynamic Global Environment*. American Fisheries Society Symposium 69. Herndon: American Fisheries Society pp. 97-119 (ISBN: 978-1-934874-08-0)

Pettersen, A. R., E. Moland, E. M. Olsen & J. A. Knutsen (2009). Lobster Reserves in Coastal Skagerrak - An Integrated Analysis of the Implementation Process. In: E. Mokness, E. Dahl & J. Støttrup (eds.) *Integrated Coastal Zone Management*. London: Wiley-Blackwell Publishing Ltd pp. 178-188 (ISBN: 978-1-4051-3950-2)

Rueness, E. K. (2009). Et ikon blir til. In: D. O. Hessen, T. Lie & N. C. Stenseth (eds.) *Darwin: Verden ble aldri den samme*. Oslo: Gyldendal Litteratur pp. 17-42 (ISBN: 978-82-05-39034-8)

9.5.2 Publications in peer reviewed journals

Adamik, P., J. Husek & J. Cepak (2009) Rapid decline of common cuckoo, *Cuculus canorus* parasitism in Red-backed shrikes *Lanius collurio*. *Ardea*, **97**(1): 17-22.

Aguilar, P. M., A. Labra & H. M. Niemeyer (2009) Chemical self-recognition in the lizard *Liolaemus fitzgeraldi*. *Journal of ethology*, **27**(1): 181-184.

Aksnes, D. W. & D. O. Hessen (2009) The structure and development of polar research (1981-2007): a publication-based approach. *Arctic Antarctic and Alpine Research*, **41**(2): 155-163.

Andersen, O., S. W. Dahle, S. van Nes, T. Bardal, A. Tooming-Klunderud, E. Kjorsvik & T. F. Galloway (2009) Differential spatio-temporal expression and functional diversification of the myogenic regulatory factors MyoD1 and MyoD2 in Atlantic halibut (*Hippoglossus hippoglossus*). *Comparative Biochemistry and Physiology B-Biochemistry & Molecular Biology*, **154**(1): 93-101.

Arístegui, J., E. D. Barton, X. A. Álvarez-Salgado, A. M. P. Santos, F. G. Figueiras, S. Kifani, S. Hernández-León, E. Mason, E. Machu & H. Demarcq (2009) Sub-regional ecosystem variability in the Canary Current upwelling. *Progress in Oceanography*, **83**(1-4): 33-48.

Armbruster, W. S., C. Pélabon, T. F. Hansen & G. H. Bolstad (2009) Macroevolutionary patterns of pollination accuracy: a comparison of three genera. *New Phytologist*, **183**(3): 600-617.

Armbruster, W. S., T. F. Hansen, C. Pélabon, R. Pérez-Barrales & J. Maad (2009) The adaptive accuracy of flowers: measurement and microevolutionary patterns. *Annals of Botany*, **103**(9): 1529-1545.

Barson, N. J., J. Cable & C. van Oosterhout (2009) Population genetic analysis of microsatellite variation of guppies (*Poecilia reticulata*) in Trinidad and Tobago: evidence for a dynamic source-sink metapopulation structure, founder events and population bottlenecks. *Journal of Evolutionary Biology*, **22**, 485-497.

Barson, N. J., T. O. Haugen, L. A. Vøllestad & C. R. Primmer (2009) Contemporary isolation-by-distance, but not isolation-by-time, among demes of European grayling (*Thymallus thymallus*, Linnaeus) with recent common ancestors. *Evolution*, **63**(2): 549-556.

Beaune, D., C. Le Bohec, F. Lucas, M. Gauthier-Clerc & Y. Le Maho (2009) Stomach stones in king penguin chicks. *Polar Biology*, **32**(4): 593-597.

- Bischof**, R., A. **Mysterud** & J. E. Swenson (2009) With or without equations: what are the do's and don'ts of hunting? *Biology Letters*, **5**(2): 213-213.
- Bischof**, R., J. E. Swenson, N. G. Yoccoz, A. **Mysterud** & O. Gimenez (2009) The magnitude and selectivity of natural and multiple anthropogenic mortality causes in hunted brown bears. *Journal of Animal Ecology*, **78**(3): 656-665.
- Boessenkool**, S., B. **Star**, J. M. Waters & P. J. Seddon (2009) Multilocus assignment analyses reveal multiple units and rare migration events in the recently expanded yellow-eyed penguin (*Megadyptes antipodes*). *Molecular Ecology*, **18**(11): 2390-2400.
- Boessenkool**, S., J. J. Austin, T. H. Worthy, P. Scofield, A. Cooper, P. J. Seddon & J. M. Waters (2009) Relict or colonizer? Extinction and range expansion of penguins in southern New Zealand. *Proceedings of the Royal Society B-Biological Sciences*, **276**(1658): 815-821.
- Brodin**, A. & F. **Haas** (2009) Hybrid zone maintenance by non-adaptive mate choice. *Evolutionary Ecology*, **23**: 17-29.
- Bull**, J., E. B. Nilsen, A. **Mysterud** & E. J. Milner-Gulland (2009) Survival on the border: A population model to evaluate management options for Norway's wolves. *Wildlife Biology*, **15**(4): 412-424.
- Burki**, F., Y. Inagaki, J. Bråte, J. M. Archibald, P. J. Keeling, T. Cavalier-Smith, M. Sakaguchi, T. Hashimoto, A. Horak, S. Kumar, D. Klaveness, K. S. **Jakobsen**, J. Pawlowski & K. Shalchian-Tabrizi (2009) Large-Scale phylogenomic analyses reveal that two enigmatic protist lineages, telonemia and centroheliozoa, are related to photosynthetic chromalveolates. *Genome Biology and Evolution*, **1**(1): 231-238.
- Cadahía**, L., P. López-López, V. Urios, A. Soutullo & J. J. Negro (2009) Natal dispersal and recruitment of two Bonelli's Eagles *Aquila fasciata*: a four-year satellite tracking study. *Acta Ornithologica*, **44**(2): 193-198.
- Cadahía**, L., W. Pinsker, J. J. Negro, M. **Pavlicev**, V. Urios & E. Haring (2009) Repeated sequence homogenization between the control and pseudo-control regions in the mitochondrial genomes of the subfamily *aquilinae*. *Journal of Experimental Zoology Part B-Molecular and Developmental Evolution*, **312B**(3): 171-185.
- Calhim**, S., H. M. **Lampe**, T. **Slagsvold** & T. R. Birkhead (2009) Selection on sperm morphology under relaxed sperm competition in a wild passerine bird. *Biology Letters*, **5**(1): 58-61.
- Cartes**, J., J. M. **Hidalgo** Roldan, V. Papiol, E. Massuti & J. Moranta (2009) Changes in the diet and feeding of the hake *Merluccius merluccius* at the shelf-break of the Balearic Islands: Influence of the mesopelagic-boundary community. *Deep Sea Research Part I: Oceanographic Research Papers*, **26**: 344-365.
- Caspers, B. A., C. **Junge**, M. Weitere & S. Steinfartz (2009) Habitat adaptation rather than genetic distance correlates with female preference in fire salamanders (*Salamandra salamandra*). *Frontiers in Zoology*, **6**(13): Electronic article.
- Chan**, K. S., H. Tong & N. C. **Stenseth** (2009) Analyzing short time series data from periodically fluctuating rodent populations by threshold models: A nearest block bootstrap approach. *Science in China Series A: Mathematics*, **52**(6): 1085-1106.
- Colles**, A., L. H. **Liow** & A. Prinzing (2009) Are specialists at risk under environmental change? Neoecological, paleoecological and phylogenetic approaches. *Ecology Letters*, **12**(8): 849-863.
- Colman**, J. E., A. **Mysterud**, N. H. Jørgensen & S. R. Moe (2009) Active land use improves reindeer pastures: evidence from a patch choice experiment. *Journal of Zoology*, **279**(4): 358-363.
- Durant**, J. M., D. Ø. **Hjermann**, M. Frederiksen, J. B. Charrassin, Y. Le Maho, P. S. **Sabarros**, R. J. M. Crawford & N. C. **Stenseth** (2009) Pros and cons of using seabirds as ecological indicators. *Climate Research*, **39**, 115-129.
- Duriez**, O., S. A. **Sæther**, B. J. Ens, R. Choquet, R. Pradel, R. H. D. Lambeck & M. Klaasen (2009) Estimating survival and movements using both live and dead recoveries: a case study of oystercatchers confronted with habitat change. *Journal of Applied Ecology*, **46**(1): 144-153.
- Edeline**, E., A. **Le Rouzic**, I. J. Winfield, J. M. Fletcher, J. B. James, N. C. **Stenseth** & L. A. **Vøllestad** (2009) Harvest-induced disruptive selection increases variance in fitness-related traits. *Proceedings of the Royal Society of London. Biological Sciences*, **276**(1676): 4163-4171.
- Elser**, J. J., T. Andersen, J. S. Baron, A. K. Bergstrom, M. Jansson, M. Kyle, K. R. Nydick, L. Steger & D. O. **Hessen** (2009) Shifts in lake N:P stoichiometry and nutrient limitation driven by atmospheric nitrogen deposition. *Science*, **326**(5954): 835-837.
- Eriksen**, A., H. M. **Lampe** & T. **Slagsvold** (2009) Interspecific cross-fostering affects song acquisition but not mate choice in pied flycatchers, *Ficedula hypoleuca*. *Animal Behaviour*, **78**(4): 857-863.
- Eriksen**, A., P. Wabakken, B. Zimmermann, H. P. Andreasen, J. M. Arnemo, H. **Gundersen**, J. **Milner**, O. Liberg, J. Linnell, H. C. Pedersen, H. Sand, E. J. Solberg & T. Storaas (2009) Encounter frequencies between GPS-collared wolves (*Canis lupus*) and moose (*Alces alces*) in a Scandinavian wolf territory. *Ecological research*, **24**(3): 547-557.
- Evju**, M., G. Austrheim, R. Halvorsen & A. **Mysterud** (2009) Grazing responses in herbs in relation to herbivore selectivity and plant traits in an alpine ecosystem. *Oecologia*, **161**(1): 77-85.

- Fjellheim, S., M. H. **Jørgensen**, M. Kjos & L. Borgen (2009) A molecular study of hybridization and homoploid hybrid speciation in *Argyranthemum* (Asteraceae) on Tenerife, the Canary Islands. *Botanical journal of the Linnean Society*, **159**(1): 19-31.
- Gharbi, K., K. A. Glover, L. C. Stone, E. S. McDonald, L. Matthews, U. **Grimholt** & M. J. Stear (2009) Genetic dissection of MHC-associated susceptibility to *Lepeophtheirus salmonis* in Atlantic salmon. *BMC Genetics*, **10**(20): 20-29.
- Godvik**, I. M. R., L. E. **Loe**, J. O. Vik, V. Veiberg, R. Langvatn & A. **Mysterud** (2009) Temporal scales, trade-offs, and functional responses in red deer habitat selection. *Ecology*, **90**(3): 699-710.
- Gregersen, F., L. A. **Vøllestad**, E. M. **Olsen** & T. **Haugen** (2009) Sibling-size variation in brown trout *Salmo trutta* in relation to egg size and stream size. *Journal of Fish Biology*, **74**(6): 1259-1268.
- Grimholt**, U., R. Johansen & A. J. Smith (2009) A review of the need and possible uses for genetically standardized Atlantic salmon (*Salmo salar*) in research. *Laboratory Animals*, **43**(2): 121-126.
- Guillot**, G. & F. Santos (2009) A computer program to simulate multilocus genotype data with spatially auto-correlated allele frequencies. *Molecular Ecology Resources*, **9**(4): 1112-1120.
- Guillot**, G. & M. Foll (2009) Correcting for ascertainment bias in the inference of population structure. *Bioinformatics*, **25**(4): 552-554.
- Guillot**, G. (2009) On the inference of spatial structure from population genetics data. *Bioinformatics*, **25**(14): 1796-1801.
- Guillot**, G. (2009) Response to comment on "On the inference of spatial structure from population genetics data". *Bioinformatics*, **25**(14): 1805-1806.
- Guillot**, G., N. Lorén & M. Rudemo (2009) Spatial prediction of weed intensities from exact count data and image-based estimates. *Journal of the Royal Statistical Society: Series C (Applied Statistics)*, **58**(4): 525-542.
- Guillot**, G., R. Leblois, A. Coulon & A. C. Frantz (2009) Statistical methods in spatial genetics. *Molecular Ecology*, **18**(23): 4734-4756.
- Haas**, F., M. A. Pointer, N. Saino, A. Brodin, N. I. Mundy & B. Hansson (2009) An analysis of population genetic differentiation and genotype - phenotype association across the hybrid zone of carrion and hooded crows using microsatellites and MC1R. *Molecular Ecology*, **18**(2): 294-305.
- Hansen**, B. T., L. E. **Johannessen** & T. **Slagsvold** (2009) Interspecific cross-fostering affects mate guarding behaviour in great tits (*Parus major*). *Behaviour*, **146**(10): 1349-1361.
- Hansen**, T. F. & D. **Houle** (2009) Corrigendum. *Journal of Evolutionary Biology*, **22**(4): 913-915.
- Heggenes, J., K. H. Roed, P. E. **Jorde** & Å. Brabrand (2009) Dynamic micro-geographic and temporal genetic diversity in vertebrates: the case of lake-spawning populations of brown trout (*Salmo trutta*). *Molecular Ecology*, **18**(6): 1100-1111.
- Hegland, S. J., A. **Nielsen**, A. Lazaro, A. L. Bjerknes & Ø. Totland (2009) How does climate warming affect plant-pollinator interactions? *Ecology Letters*, **12**(2): 184-195.
- Helland, I. P., L. A. **Vøllestad**, J. Freyhof & T. Mehner (2009) Morphological differences between two ecologically similar sympatric fishes. *Journal of Fish Biology*, **75**(10): 2756-2767.
- Hemp, C., K. L. **Voje**, K. G. Heller & A. Hemp (2009) Biogeography, phylogeny and acoustics of the flightless bush-crickets of the East African genus *Monticolaria* Sjöstedt, 1909, with the description of a new species (Orthoptera: Phaneropterinae). *Zoological Journal of the Linnean Society*, **156**(3): 494-506.
- Hessen**, D. O. & J. **Persson** (2009) Genome size as a determinant of growth and life-history traits in crustaceans. *Biological Journal of the Linnean Society*, **98**(2): 393-399.
- Hessen**, D. O. (2009) Rasjonalitet. *Tidsskrift for Norsk Psykologforening*, **46**(8): 792-793.
- Hidalgo**, M., E. Massuti, B. Guijarro, J. Moranta, L. Cianelli, J. Lloret, P. Oliver & N. C. **Stenseth** (2009) Population effects and changes in life history traits in relation to phase transitions induced by long-term fishery harvesting: European hake (*Merluccius merluccius*) off the Balearic Islands. *Canadian Journal of Fisheries and Aquatic Sciences*, **66**(8): 1355-1370.
- Hidalgo**, M., J. Tomas, J. Moranta & B. Morales-Nin (2009) Intra-annual recruitment events of a shelf species around an island system in the NW Mediterranean. *Estuarine Coastal and Shelf Science*, **83**(2): 227-238.
- Hollis**, B. D., J. **Fierst** & D. **Houle** (2009) Sexual selection accelerates the elimination of a deleterious mutant in *Drosophila melanogaster*. *Evolution*, **63**(2): 324-333.
- Holmen**, J., L. A. **Vøllestad**, K. S. **Jakobsen** & C. R. Primmer (2009) Cross-species amplification of 36 cyprinid microsatellite loci in *Phoxinus phoxinus* (L.) and *Scardinius erythrophthalmus* (L.). *BMC Research Notes*, **2**(248): Electronic journal.
- Holmengen, N., K. L. Seip, M. Boyce & N. C. **Stenseth** (2009) Predator-prey coupling: interaction between mink *Mustela vison* and muskrat *Ondatra zibethicus* across Canada. *Oikos*, **118**(3): 440-448.
- Hoset, K. S., J. F. Le Galliard & G. **Gundersen** (2009) Demographic responses to a mild winter in enclosed vole populations. *Population Ecology*, **51**(2): 279-288.

- Husek, J., P. Adamik, J. Cepak & P. Tryjanowski** (2009) The influence of climate and population size on the distribution of breeding dates in the red-backed shrike (*Lanius collurio*). *Annales Zoologici Fennici*, **46**(6): 439-450.
- Johannessen, L. E., L. Kristiansen, B. T. Hansen & T. Slagsvold** (2009) Facultative adjustment of brood sex ratio in response to indirect manipulation of behaviour. *Ethology*, **115**(11): 1057-1065.
- Johansen, S. D., D. H. Coucheron, M. Andreassen, B. O. Karlsen, T. Furmanek, T. E. Jorgensen, A. Emblem, R. Breines, J. T. Nordeide, T. Moum, A. J. Nederbragt, N. C. Stenseth & K. S. Jakobsen** (2009) Large-scale sequence analyses of Atlantic cod. *New Biotechnology*, **25**(5): 263-271.
- Junge, C., C. R. Primmer, L. A. Vøllestad & E. H. Leder** (2009) Isolation and characterization of 19 new microsatellites for European grayling, *Thymallus thymallus* (Linnaeus, 1758), and their cross-amplification in four other salmonid species. *Conservation Genetics Resources*. Published online.
- Knutsen, H., P. E. Jorde, H. Sannæs, A. R. Hoelzel, O. A. Bergstad, S. Stefanni, T. Johansen & N. C. Stenseth** (2009) Bathymetric barriers promoting genetic structure in the deepwater demersal fish tusk (*Brosme brosme*). *Molecular Ecology*, **18**(15): 3151-3162.
- Kristoffersen, A. B., H. Viljugrein, R. T. Kongtorp, E. Brun & P. A. Jansen** (2009) Risk factors for pancreas disease (PD) outbreaks in farmed Atlantic salmon and rainbow trout in Norway during 2003-2007. *Preventive Veterinary Medicine*, **90**(1-2): 127-136.
- Kuhl, A., A. Mysterud, I. A. Grachev, A. B. Bekenov, B. S. Ubushaev, A. A. Lushchekina & E. J. Milner-Gulland** (2009) Monitoring population productivity in the saiga antelope. *Animal Conservation*, **12**(4): 355-363.
- Labra, A., J. Pienaar & T. F. Hansen** (2009) Evolution of thermal physiology in Liolaemus lizards: adaptation, phylogenetic inertia, and niche tracking. *American Naturalist*, **174**(2): 204-220.
- Lampe, H. M. & T. Slagsvold** (2009) Selection on sperm morphology under relaxed sperm competition in a wild passerine bird. *Biology Letters*, **5**(1): 58-61.
- Lattman, H., L. Lindblom, J. E. Mattsson, P. Milberg, M. Skage & S. Ekman** (2009) Estimating the dispersal capacity of the rare lichen *Cliostomum corrugatum*. *Biological Conservation*, **142**(8): 1870-1878.
- Lavandero, B., A. Labra, C. C. Ramirez, H. M. Niemeyer & E. Fuentes-Contreras** (2009) Species richness of herbivorous insects on Nothofagus trees in South America and New Zealand: The importance of chemical attributes of the host. *Basic and Applied Ecology*, **10**(1): 10-18.
- Lehtonen, P. K., T. Laaksonen, A. V. Artemyev, E. Belskii, C. Both, S. Bures, A. V. Bushuev, I. Krams, J. Moreno, M. Magi, A. Nord, J. Potti, P. A. Ravussin, P. M. Sirkia, G. P. Saetre & C. R. Primmer** (2009) Geographic patterns of genetic differentiation and plumage colour variation are different in the pied flycatcher (*Ficedula hypoleuca*). *Molecular Ecology*, **18**(21): 4463-4476.
- Lindegren, M. O., C. Möllmann, A. Nielsen & N. C. Stenseth** (2009) Preventing the collapse of the Baltic cod stock through an ecosystem-based management approach. *Proceedings of the National Academy of Science of the United States of America*, **106**(34): 14722-14727.
- Liow, L. H., M. Fortelius, K. Lintulaakso, H. Mannila & N. C. Stenseth** (2009) Lower extinction risk in sleep-or-hide mammals. *American Naturalist*, **173**(2): 264-272.
- Llope, M., K. S. Chan, L. Ciannelli, P. C. Reid, L. C. Stige & N. C. Stenseth** (2009) Effects of environmental conditions on the seasonal distribution of phytoplankton biomass in the North Sea. *Limnology and Oceanography*, **54**(2): 512-524.
- Loe, L. E., A. Mysterud, V. Veiberg & R. Langvatn** (2009) Negative density-dependent emigration of males in an increasing red deer population. *Proceedings of the Royal Society B-Biological Sciences*, **276**(1667): 2581-2587.
- Lyche, J. L., B. Stavik, V. Berg, K. S. Jakobsen, N. C. Stenseth & E. Ropstad** (2009) Transcriptional regulation in liver and testis associated with developmental and reproductive effects in male zebrafish exposed to natural mixtures of persistent organic pollutants (POP). *Journal of Toxicology and Environmental Health*, **72**(3-4): 112-130.
- Machu, E., O. Ettahiri, S. Kifani, A. Benazzouz, A. Makoui & H. Demarcq** (2009) Environmental control of the recruitment of sardines (*Sardina pilchardus*) over the western Saharan shelf between 1995 and 2002: a coupled physical/biogeochemical modelling experiment. *Fisheries Oceanography*, **18**(5): 287-300.
- Martinez-Jauregui, M., A. San Miguel-Ayanz, A. Mysterud, C. Rodriguez-Vigal, T. Clutton-Brock, R. Langvatn & T. Coulson** (2009) Are local weather, NDVI and NAO consistent determinants of red deer weight across three contrasting European countries? *Global Change Biology*, **15**(7): 1727-1738.
- Minge, M. A., J. Silberman, R. Orr, T. Cavalier-Smith, K. Shalchian-Tabrizi, F. Burki, Å. Skjæveland & K. S. Jakobsen** (2009) Evolutionary position of breviate amoebae and the primary eukaryote divergence. *Proceedings of the Royal Society of London. Biological Sciences*, **276**(1657): 597-604.
- Mobaek, R., A. Mysterud, L. E. Loe, O. Holand & G. Austrheim** (2009) Density dependent and temporal variability in habitat selection by a large herbivore; an experimental approach. *Oikos*, **118**(2): 209-218.

- Mysterud, A., K. H. Roed, O. Holand, N. G. Yoccoz & M. Nieminen** (2009) Age-related gestation length adjustment in a large iteroparous mammal at northern latitude. *Journal of Animal Ecology*, **78**(5): 1002-1006.
- Mysterud, A., N. G. Yoccoz & R. Langvatn** (2009) Maturation trends in red deer females over 39 years in harvested populations. *Journal of Animal Ecology*, **78**(3): 595-599.
- Nesbø, C. L., E. Baptiste, B. Curtis, H. Dahle, P. Lopez, D. Macleod, M. Dłutek, S. Bowman, O. Zhaxybayeva, N. K. Birkeland & W. F. Doolittle** (2009) The genome of *Thermosiphon africanus* TCF52B: Lateral genetic connections to the Firmicutes and Archaea. *Journal of Bacteriology*, **191**(6): 1974-1978.
- Nilsen, E. B., A. Skonhoft, A. Mysterud, J. M. Milner, E. J. Solberg, H. P. Andreassen & N. C. Stenseth** (2009) The role of ecological and economic factors in the management of a spatially structured moose *Alces alces* population. *Wildlife Biology*, **15**(1): 10-23.
- Nilsson, A. L. K. & M. I. Sandell** (2009) Stress hormone dynamics: an adaptation to migration? *Biology Letters*, **5**(4): 480-483.
- Nordström, J., P. Kjellander, H. Andrén & A. Mysterud** (2009) Can supplemental feeding of red foxes *Vulpes vulpes* increase roe deer *Capreolus capreolus* recruitment in the boreal forest? *Wildlife Biology*, **15**(2): 222-227.
- Nourizadeh-Lillabadi, R., J. L. Lyche, C. Almaas, B. Stavik, S. J. Moe, M. Aleksandersen, V. Berg, K. S. Jakobsen, N. C. Stenseth, J. U. Skare, P. Alestrom & E. Ropstad** (2009) Transcriptional regulation in liver and testis associated with developmental and reproductive effects in male zebrafish exposed to natural mixtures of persistent organic pollutants (POP). *Journal of Toxicology and Environmental Health*, **72**(3-4): 112-130.
- Olsen, E. M., S. M. Carlson, J. Gjøsæter & N. C. Stenseth** (2009) Nine decades of decreasing phenotypic variability in Atlantic cod. *Ecology Letters*, **12**(7): 622-631.
- Patil, V., J. Bråte, K. Shalchian-Tabrizi & K. S. Jakobsen** (2009) Revisiting the Phylogenetic Position of *Synchroma grande*. *Journal of Eukaryotic Microbiology*, **56**(4): 394-396.
- Pavlicev, M. & W. Mayer** (2009) Fast radiation of the subfamily Lacertinae (Reptilia: Lacertidae): History or methodical artefact? *Molecular Phylogenetics and Evolution*, **52**(3): 727-734.
- Pavlicev, M., G. P. Wagner & J. M. Cheverud** (2009) Measuring evolutionary constraints through the dimensionality of the phenotype: adjusted bootstrap method to estimate rank of phenotypic covariance matrices. *Evolutionary Biology*, **36**(3): 339-353.
- Payne, M. R., E. M. C. Hatfield, M. Dickey-Collas, T. Falken- haug, A. Gallego, J. Groger, P. Licandro, M. Llope, P. Munk, C. Rockmann, J. O. Schmidt & R. D. M. Nash** (2009) Recruitment in a changing environment: the 2000s North Sea herring recruitment failure. *ICES Journal of Marine Science*, **66**(2): 272-277.
- Petersen-Overleir, A. & T. Reitan** (2009) Bayesian analysis of stage-fall-discharge models for gauging stations affected by variable backwater. *Hydrological Processes*, **23**(21): 3057-3074.
- Reimers, E., L. E. Loe, S. Eftestøl, J. E. Colman & B. Dahle** (2009) Effects of hunting on response behaviours of wild reindeer. *Journal of Wildlife Management*, **73**(6): 844-851.
- Riisberg, I., R. Orr, R. Kluge, K. Shalchian-Tabrizi, H. A. Bowers, P. Vishwanath, B. Edvardsen & K. S. Jakobsen** (2009) Seven gene phylogeny of heterokonts. *Protist*, **160**(2): 191-204.
- Rounge, T. B., T. Rohrlack, A. J. Nederbragt, T. Kristensen & K. S. Jakobsen** (2009) A genome-wide analysis of non-ribosomal peptide synthetase gene clusters and their peptides in a *Planktothrix rubescens* strain. *BMC Genomics*, **10**(396): Electronic journal.
- Sabarros, P. S., F. Ménard, J. J. Lévênez, E. Tew-Kai & J. F. Ternon** (2009) Mesoscale eddies influence distribution and aggregation patterns of micronekton in the Mozambique Channel. *Marine Ecology Progress Series*, **395**: 101-107.
- Sadykova, D. & T. Schweder** (2009) Migration ranks for bowhead whales (*Balaena mysticetus*) at Barrow in spring. *Journal of Cetacean Research and Management*, **11**(1): 17-22.
- Sadykova, D., J. Skurdal, A. Sadykov, T. Taugbol & D. O. Hessen** (2009) Modelling crayfish population dynamics using catch data: A size-structured model. *Ecological Modelling*, **220**(20): 2727-2733.
- Schneider, M., H. Sannaes, P. E. Jorde & H. Knutsen** (2009) Isolation and characterisation of 11 microsatellite loci in the abyssal carapine grenadier *Coryphaenoides carapinus* (Actinopterygii, Macrouridae) and cross-amplification in two other deep-sea macrourid species. *Conservation Genetics*, **10**(6): 1869-1871.
- Servedio, M. R., S. A. Sæther & G. P. Sætre** (2009) Reinforcement and learning. *Evolutionary Ecology*, **23**(1): 109-123.
- Siddiqui, H., A. J. Nederbragt & K. S. Jakobsen** (2009) A solid-phase method for preparing human DNA from urine for diagnostic purposes. *Clinical Biochemistry*, **42**(10-11): 1128-1135.

- Skog, A., F. E. Zachos, E. K. **Rueness**, P. G. D. Feulner, A. **Mysterud**, R. Langvatn, R. Lorenzini, S. S. Hmwe, I. Lehoczy, G. B. Hartl, N. C. **Stenseth** & K. S. **Jakobsen** (2009) Phylogeography of red deer (*Cervus elaphus*) in Europe. *Journal of Biogeography*, **36**(1): 66-77.
- Snall, T., R. E. Benestad & N. C. **Stenseth** (2009) Expected future plague levels in a wildlife host under different scenarios of climate change. *Global Change Biology*, **15**(2): 500-507.
- Soininen, E. M., A. Valentini, E. Coissac, C. Miquel, L. Gielly, C. Brochmann, A. K. **Brytting**, J. H. **Sønstebo**, R. A. Ims, N. G. Yoccoz & P. Taberlet (2009) Analysing diet of small herbivores: the efficiency of DNA barcoding coupled with high-throughput pyrosequencing for deciphering the composition of complex plant mixtures. *Frontiers in Zoology*, **6**(16): Published online.
- Sparks, T. H., A. Menzel & N. C. **Stenseth** (2009) European cooperation in plant phenology. *Climate Research*, **39**(3): 175-177.
- Stenseth**, N. C. & E. S. Dunlop (2009) Evolution unnatural selection. *Nature*, **457**(7231): 803-804.
- Stenseth**, N. C. & K. L. **Voje** (2009) Easter Island: climate change might have contributed to past cultural and societal changes. *Climate Research*, **39**(2): 111-114.
- Stige**, L. C., D. L. Lajus, K. S. Chan, P. Dalpadado, S. L. Basedow, I. Berchenko & N. C. **Stenseth** (2009) Climatic forcing of zooplankton dynamics is stronger during low densities of planktivorous fish. *Limnology and Oceanography*, **54**(4): 1025-1036.
- Storvik, B., G. **Storvik** & R. Fjortoft (2009) On the combination of multisensor data using meta-gaussian distributions. *Transactions on Geoscience and Remote Sensing*, **47**(7): 2372-2379.
- Stüken**, A., R. J. Campbell, A. Quesada, A. Sukenik, P. K. Dadheech & C. Wiedner (2009) Genetic and morphological characterization of four putative cylindrospermopsin producing species of the cyanobacterial genera *Anabaena* and *Aphanizomenon*. *Journal of Plankton Research*, **31**(5): 465-480.
- Svenningsen**, T. O. & E. **Kisdi** (2009) Evolutionary branching of virulence in a single-infection model. *Journal of Theoretical Biology*, **257**(3): 408-418.
- Sæther**, S. A., J. S. **Hermansen**, T. Borge, E. Hjelle & G. P. **Sætre** (2009) Molecular genetics of the Italian sparrow: a separate species, a variety of house sparrow or Spanish sparrow, or a hybrid? *Ecologia Urbana*, **21**(1): 26-27.
- van der Wal, R. & D. O. **Hessen** (2009) Analogous aquatic and terrestrial food webs in the high Arctic: The structuring force of a harsh climate. *Perspectives in plant ecology, evolution and systematics*, **11**(3): 231-240.
- Veiberg, V., A. **Mysterud**, R. J. Irvine, W. Sormo & R. Langvatn (2009) Increased mass of reticulo-rumen tissue and contents with advancing age in Svalbard reindeer. *Journal of Zoology*, **278**(1): 15-23.
- Viljugrein**, H., A. Staalstrøm, J. Molvær, H. A. Urke & P. A. Jansen (2009) Integration of hydrodynamics into a statistical model on the spread of pancreas disease (PD) in salmon farming. *Diseases of Aquatic Organisms*, **88**: 35-44.
- Vishwanath, P., J. Bråte, K. Shalchian-Tabrizi & K. S. **Jakobsen** (2009) Revisiting the Phylogenetic Position of *Synchroma grande*. *Journal of Eukaryotic Microbiology*, **56**(4): 394-396.
- Voje**, K. L., C. Hemp, Ø. Flagstad, G. P. **Sætre** & N. C. **Stenseth** (2009) Climatic change as an engine for speciation in flightless Orthoptera species inhabiting African mountains. *Molecular Ecology*, **18**(1): 93-108.
- Vøllestad**, L. A., D. Hirst, J. H. L'Abée-Lund, J. D. Armstrong, J. C. MacLean, A. F. Youngson & N. C. **Stenseth** (2009) Divergent trends in anadromous salmonid populations in Norwegian and Scottish rivers. *Proceedings of the Royal Society of London. Biological Sciences*, **276**(1659): 1021-1027.
- Wiebe**, K. L. & T. **Slagsvold** (2009) Mouth coloration in nestling birds: increasing detection or signalling quality? *Animal Behaviour*, **78**(6): 1413-1420.
- Wiebe**, K. L. & T. **Slagsvold** (2009) Parental sex differences in food allocation to junior brood members as mediated by prey size. *Ethology*, **115**(1): 49-58.
- Wiley, C., A. Qvarnström, G. Andersson, B. Borge & G. P. **Sætre** (2009) Postzygotic isolation over multiple generations of hybrid descendants in a natural hybrid zone: how well do single-generation estimates reflect reproductive isolation? *Evolution*, **63**(7): 1731-1739.
- Zhang, Z. B., B. Cazelles, H. D. **Tian**, L. C. **Stige**, A. Brauning & N. C. **Stenseth** (2009) Periodic temperature-associated drought/flood drives locust plagues in China. *Proceedings of the Royal Society B-Biological Sciences*, **276**(1658): 823-831.
- Zhaxybayeva, O., K. S. Swithers, P. Lapierre, G. P. Fournier, D. M. Bickhart, R. T. Deboy, K. E. Nelson, C. L. **Nesbø**, W. F. Doolittle, J. P. Gogarten & K. M. Noll (2009) On the chimeric nature, thermophilic origin, and phylogenetic placement of the Thermotogales. *Proceedings of the National Academy of Sciences of the United States of America*, **106**(14): 5865-5870.
- Økland, B., O. Skarpaas & K. **Kausrud** (2009) Threshold facilitations of interacting species. *Population Ecology*, **51**(4): 513-523.

9.5.3 Theses defence

Akbari, Akbar. 5 June 2009. Studies on Macromolecule separation: Applying image and signal processing methods to improve accuracy in DNA Analysis. Faculty of Informatics, University of Oslo.

9.5.4 External scientific talks and posters by CEES members

Adamik, P., J. **Husek** & J. Cepak. Bird ringing records as an overlooked source of long-term phenological data. 7th Conference of the European Ornithologists' Union, Zurich, Switzerland. 21-26 August 2009

Björgeas, H. H., M. H. Jørgensen & A. K. Brysting. Diploid and tetraploid *Parnassia palustris*: One or more taxa in a circumpolar context? Do different genetic lineages correspond to ploidy levels? Do polyploid plants have an adaptive advantage compared to diploid plants? Polyploidization, plant fitness and trophic interactions workshop, University of Fribourg, Switzerland. 7-8 September 2009.

Cardinale, M., V. Bartolino, M. **Llope**, L. Maiorano, M. Skold & J. Hågberg. Historical distribution (1901-2007) of Plaice in the Kattegat-Skagerrak and implications for stock management and conservation. Oceans Past II, Multidisciplinary Perspectives on the History and Future of Marine Animal Populations, Vancouver, Canada. 26-28 May 2009

Diekert, F. K. Catch shares do not prevent growth overfishing. 17th Annual Conference of the European Association of Environmental and Resource Economists, Amsterdam, the Netherlands. 24-27 June 2009

Diekert, F. K. Target the right fish! The importance of gear selectivity as a control variable. Workshop on Age-structured Models in Bioeconomics, Trondheim, Norway. 12-13 August 2009

Diekert, F. K. The importance of considering age-structure for successful ITQ management. 19th Conference of the European Association of Fisheries Economists, Valetta, Malta. 6-8 July 2009.

Dingsør, G. E., G. Huse & M. **Llope**. Spatial distribution and population dynamics of herring and cod in the North Sea. Symposium on Rebuilding Depleted Fish Stocks - Biology, Ecology, Social Science and Management Strategies, Warnemünde, Germany. 3-6 November 2009.

Durant, J. M. Trophic interactions and climate change. Invited lecture, Norwegian Polar Institute, Tromsø, Norway. 18 August 2009.

Durant, J. M., D. Ø. Hjermann & N. C. Stenseth. Reversing the match-mismatch relationship: the prey point of view. International Council for Exploration of the Sea (ICES) Annual Science Conference, Berlin, Germany. 21-25 September 2009.

Durant, J. M., C. Le Bohec, D. Ø. Hjermann, N. C. Stenseth & P. S. Sabarros. The King Penguin under climate changes: trend and sensitivity. 10th International Conference: The Seabird Group, Bruges, Belgium. 27-30 March 2009.

Edeline, E. Harvest-induced disruptive selection increases variance in fitness-related traits. Conference on Fish Evolution, Berlin, Germany. 23-25 November 2009.

Epp, L., **S. Boessenkool**, E. Bellemain, A. Esposito, V. Gusarov, A. Johnsen, H. Kauserud, A. K. **Brysting**, H. Stenøien, E. Willerslev, E. Coissac, P. Taberlet & C. Brochmann. BarFrost – A new project for reconstructing past ecosystems by bar-coding DNA from permafrost. 3rd International Barcode of Life Conference, Mexico City, Mexico. 10-12 November 2009.

Eriksen, A., T. Slagsvold & H. M. Lampe. Adult song learning – are pied flycatchers open-ended learners? 31st International Ethological Conference, Rennes, France. 19-24 August 2009.

Grimholt, U., A. J. Nederbragt, T. B. Rounge, M. Malmstrøm, B. Star, A. Tooming-Klunderud, M. Skage, S. Jentoft, H. J. Gaup, H. Bakke, M. H. Solbakken & K. S. Jakobsen. The cod genome project. 3rd International Workshop on Fish Genomes, Cambridge, U.K. 13-14 March 2009.

Guillot, G. Clustering models in population biology. 9th International Workshop on Objective Bayesian Methodology, Philadelphia, USA. 5-8 June 2009.

Guillot, G. Landscape genetics analysis with the Geneland program. American Genetics Society Annual Symposium, Rhode Island, USA. 8-11 June 2009.

Hermansen, J. S., S. A. Sæther, T. Borge, E. Hjelle, T. O. Elgvin & G. P. Sætre. Is the Italian sparrow a result of hybrid speciation? European Society for Evolutionary Biology (ESEB) 12th Congress, Turin, Italy. 24-29 August 2009.

Hidalgo, M. Implicaciones de procesos de juvenescencia en stocks de merluza del Atlántico y el Mediterráneo. I Simposio Iberoamericano de ecología reproductiva, reclutamiento y pesquerías, Vigo, Spain. 24-27 November 2009.

Hidalgo, M., T. A. Rouyer, E. Massuti, J. Moranta, B. Guijarro & N. C. Stenseth. A combined effect of climate and fishery harvesting triggered a shift in a hake (*Merluccius merluccius*) population of the NW Mediterranean. 3rd GLOBEC Open Science Meeting - Marine ecosystems: from function to prediction. Victoria, Canada. 22-26 June 2009.

Hidalgo, M., T. A. Rouyer, E. Massuti, J. Moranta, B. Guijarro & N. C. Stenseth. (2009) A shift in a hake (*Merluccius merluccius*) population of the NW Mediterranean induced by a combined effect of climate and fishery harvesting. International Council for Exploration of the Sea (ICES) Annual Science Conference, Berlin, Germany. 21-25 September 2009.

- Hidalgo, M., Y. Gusdal, G. E. Dingsør, L. Ciannelli, D. Ø. Hjermann, G. Ottersen, L. C. Stige, I. Fossum, A. Melsom & N. C. Stenseth.** Combining hydrographical particles-tracking models with spatial analyses to evaluate spatial dynamics of cod larvae and 0-group in the Barents Sea. International Council for Exploration of the Sea (ICES) Annual Science Conference, Berlin, Germany. 21-25 September 2009.
- Hidalgo, M., Y. Gusdal, G. E. Dingsør, L. Ciannelli, D. Ø. Hjermann, G. Ottersen, L. C. Stige, I. Fossum, A. Melsom & N. C. Stenseth.** Relative contribution of oceanographic conditions and spawning aggregations to cod larvae and 0-group seascape in the Barents Sea under different climatic scenario. 3rd GLOBEC Open Science Meeting - Marine ecosystems: from function to prediction, Victoria, Canada. 22-26 June 2009.
- Hjermann, D. Ø.** 2048: Året vi tar den siste fisken? Invited lecture, Natural History Museum Saturday Seminar, Oslo, Norway. 5 December 2009.
- Hjermann, D. Ø., B. Bogstad, G. E. Dingsør, H. Gjøsæter, G. Ottersen, A. M. Eikeset & N. C. Stenseth.** Trophic interactions affecting a key ecosystem component: a multi-stage analysis of the recruitment of the Barents Sea capelin. International Council for Exploration of the Sea (ICES) Annual Science Conference, Berlin, Germany. 21-25 September 2009.
- Hjermann, D. Ø., M. Hidalgo, A. M. Eikeset, Y. Gusdal, G. E. Dingsør, L. Ciannelli, G. Ottersen, L. C. Stige, I. Fossum, A. Melsom & N. C. Stenseth.** Nordøst-arktisk torsk: effekter av klima, fiskeri-indusert evolusjon og artsinteraksjoner gjennom torskens livssyklus. Havet og Kysten - konferanse, Holmen, Norway. 29-30 April 2009.
- Iriarte, A., G. Aravena, I. Uriarte, F. Villate, M. Llope & N. C. Stenseth.** Modelling the effect of temperature and chlorophyll - a on dissolved oxygen in two contrasting estuaries of the Bay of Biscay. 3rd GLOBEC Open Science Meeting - Marine ecosystems: from function to prediction, Victoria, Canada. 22-26 June 2009.
- Jakobsen, K. S.** Torskegenometets anvendelse i odling. Nationell Vattenbrukskonferens, Lysekil, Sweden. 8-9 October 2009.
- Junge, C. & L. Bachmann.** Genetic diversity of basking sharks (*Cetorhinus maximus*) - a North Atlantic perspective and its global relevance. European Elasmobranch Association (EEA) Conference, Palma de Mallorca, Mallorca. 19-22 November 2009.
- Junge, C., K. Hindar, L. A. Vøllestad & J. Museth.** Evaluating consequences of habitat fragmentation on two culturally important salmonids: a snapshot before damming. Conservation Genetics Conference: Integrating Population Genetics and Conservation Biology, Trondheim, Norway. 23-26 May 2009.
- Junge, C., M. Stiffel & L. Bachmann.** Mitochondrial DNA diversity in North Atlantic basking sharks. International Conference on Evolutionary Ecology of Fishes - Diversification, Adaptation and Speciation, Berlin, Germany. 23-25 November 2009.
- Junge, C., N. J. Barson, T. O. Haugen, E. H. Leder, C. R. Primmer, G. P. Sætre & L. A. Vøllestad.** Assessing the implications of metapopulation dynamics for selection in recently established grayling populations. European Society for Evolutionary Biology (ESEB) 12th Congress, Turin, Italy. 24-29 August 2009.
- Junge, C., N. J. Barson, T. O. Haugen, E. H. Leder, C. R. Primmer, G. P. Sætre & L. A. Vøllestad.** Metapopulation dynamics and its implications for local adaptation in a salmonid. International Conference on Evolutionary Ecology of Fishes-Diversification, Adaptation and Speciation, Berlin, Germany. 23-25 November 2009.
- Jørgensen, M. H.** Reticulations and introgression in an Arabidopsis suture zone. Arabidopsis Molecular Ecology Group (AMEGO) Workshop, Reykjavik, Iceland. 14-18 August 2009.
- Jørgensen, M. H., R. Schmickl, M. Koch & A. K. Brysting.** Reticulations and introgression in an Arabidopsis suture zone. International Conference on Polyploidy, Hybridization and Biodiversity, Saint Malo, France, 17-20 May 2009.
- Lambrou, J. P. & H. M. Lampe.** Song responses to intruding males and prospecting females in the pied flycatcher, *Ficedula hypoleuca*. 31st International Ethological Conference, Rennes, France. 18-24 August 2009.
- Liow, L. H. & B. Hannisdal.** Inferring climatic and biotic forcing of diversity and the global rise of species. 9th North American Paleontological Convention, Cincinnati, USA. 21-26 June 2009.
- Liow, L. H.** Extinction vulnerability, declines and extinctions: learning from the big and the small. Invited lecture, Department of Geology weekly seminar, University of Helsinki, Finland. 31 March 2009.
- Liow, L. H.** Merits and problems of using molecular phylogenies of the fossil record in inferring density-dependent diversification. Invited lecture, 'Museum fuer Naturkunde', Berlin, Germany. 10-11 November 2009.
- Liow, L. H.** Rises and declines as substitutes for speciation and extinction - getting closer to patterns that matter for the processes we care about. Society for Systematic Biologists Annual Meeting, Idaho, USA. 12-16 June 2009.
- Liow, L. H.** The Future of Palaeontology (Panel discussion). North American Paleontological Convention, Ohio, USA. 21-26 June 2009.

- Llope, M.** Assessing the stability of trophic relationships in marine food webs, the Black and North Seas as case studies. Symposium: Drivers of regime shifts in aquatic systems: case-specific or universal? Wageningen, the Netherlands. 24 September 2009.
- Llope, M., G. M. Daskalov, T. A. Rouyer, K.S. Chan & N. C. Stenseth.** Predicting regime shifts under different scenarios in the Black Sea. 3rd GLOBEC Open Science Meeting - Marine ecosystems: from function to prediction. Victoria, Canada. 22-26 June 2009.
- Llope, M., P. Licandro, K.-S. Chan & N. C. Stenseth.** Spatio-temporal shift in the plankton trophic interactions in the North Sea over the last 50 years. ASLO Aquatic Sciences Meeting, Nice, France. 25-30 January 2009.
- Nederbragt, A. J.** High-Throughput Sequencing Services at the University of Oslo. Seminar: Next generation sequencing – bioinformatics. Invited lecture, NTNU, Trondheim, Norway. 29 September 2009.
- Nederbragt, A. J.** Processing high throughput sequence data from environmental samples using MEGAN. Meeting: Nordforsk Network Fungi in Boreal Forest Soils. Oslo, Norway. 28 January 2009.
- Nederbragt, A. J.** The Cod Genome project. 3rd EMEA Genome Sequencer FLX User Conference, Lisbon, Portugal. 15-17 June 2009.
- Nederbragt, A. J.** Ultra-high throughput sequencing: providing the raw data. Norwegian Biochemical Society Contact Meeting, Røros, Norway. 29 January–1 February 2009.
- Nilsson, A.** Bird migration and climate change. Invited lecture, John Moore's University, Liverpool, UK. 30 September 2009.
- Ohlberger, J.** A physiological pathway in coregonid speciation. International Conference on Evolutionary Ecology of Fishes, Berlin, Germany. 23-25 November 2009.
- Ottersen, G.** Hvorfor blir fisken mindre? – hvordan fangst og fiske endrer bestandene. Invited lecture, Natural History Museum Saturday Seminar, Oslo, Norway. 5 December 2009.
- Ottersen, G.** Retrospective studies: time series analyses of cod and climate. 3rd GLOBEC Open Science Meeting - Marine ecosystems: from function to prediction. Victoria, Canada. 22-26 June 2009.
- Ottersen, G.** Spawning stock and recruitment relationship in North Sea cod shaped by food and climate. 3rd GLOBEC Open Science Meeting - Marine ecosystems: from function to prediction. Victoria, Canada. 22-26 June 2009.
- Ottersen, G.** Svikt i rekrutteringen til store fiskebestander i Nordsjøen – hvorfor? Havet og Kysten – konferanse, Holmen, Norway. 29-30 April 2009.
- Pavlicev, M.** Evolution of modularity: directional selection and epistasis. Society for Integrative and Comparative Biology (SICB) Annual Meeting, Boston, USA. 3-7 January 2009.
- Pavlicev, M.** Genetic variation in pleiotropy: aligning the lines of least resistance with selection. Invited lecture, Committee on Evolutionary Biology, University of Chicago, USA. 1 December 2009.
- Pettersen, C. E., M. H. Jørgensen, I. Nordal & A. K. Brysting,** (2009) Independent immigration history of the West Norwegian populations of *Dryas octopetala* and *Arabidopsis lyrata* ssp. *petraea*? Arabidopsis Molecular Ecology Group (AMEGO) Workshop, Reykjavik, Iceland. 14-18 August 2009.
- Rueness, E. K., M. G. Asmyhr, A. M. Atickem & N. C. Stenseth.** Stool as a tool for mapping mammalian diversity. 10th International Mammalogical Congress, Mendoza, Argentina. 9-14 August 2009.
- Sabarros, P. S., S. Bertrand, D. Grémillet, L. Pichegru, J. Coetzee, N. M. Twatwa, N. C. Stenseth & E. Machu.** Seabird foraging movements: Cape gannets (*Morus capensis*) in South Africa. Seabird Group 10th International Conference, Bruges, Belgium. 27-30 March 2009.
- Serbezov, D., L. Bernatchez, E. M. Olsen & L. A. Vøllestad.** Inferring parentage by combining genetic and non-genetic data in a Bayesian framework: brown trout as an example. International Conference on Evolutionary Ecology of Fishes - Diversification, Adaptation and Speciation, Berlin, Germany. 23-25 November 2009.
- Star, B.** The Atlantic Cod Genome Project. Ecological Genomics Workshop, Bertinoro, Italy. 19-24 October 2009.
- Stige, L. C., G. Ottersen, P. Dalpadado, D. Ø. Hjermann & N. C. Stenseth.** Vil mulig dødelighet av dyreplankton etter et oljeutslipp påvirke fiskepopulasjoner? Havet og Kysten – konferanse, Holmen, Norway. 29-30 April 2009.
- Svennungsen, T. O., Ø. H. Holen & O. Leimar.** Inducible defences: continuous reaction norms or threshold traits. 12th Conference of the European Society for Evolutionary Biology, Torino, Italy. 24-29 August 2009.
- Sæther, S. A.** Dobbeltbekkasinens hemmelige liv. Invited lecture, Norsk Ornitologisk Forening, Oslo, Norway. 13 October 2009.
- Sæther, S. A.** Molecular genetics of the Italian Sparrow: a separate species, a variety of House Sparrow or Spanish Sparrow, or a hybrid? International Conference on Biology and Conservation of Sparrows, Pisa, Italy. 20 March 2009.

Sæther, S. A., S. Hogner, T. Borge, T. Bruvik & G. P. Sætre. Speciation and sex-linked genomic islands of divergence in a flycatcher radiation. 12th Conference of the European Society for Evolutionary Biology, Torino, Italy. 24-29 August 2009.

Sæther, S. A. & G. P. Sætre. Evolution of reproductive isolation in birds. Invited lecture, Ferdowsi University of Mashhad, Iran. 14 June 2009.

Sætre, G. P. & S. A. Sæther. Genetics of speciation in *Ficedula* flycatchers. Invited lecture, Ferdowsi University of Mashhad, Iran. 23 June 2009.

Sætre, G. P. Evolutionary consequences of hybridization in birds. Invited lecture, University of Uppsala, Sweden. 29 September 2009.

Sætre, G. P. Mating behaviour in flycatcher hybrid zones - divergence, convergence and the process of speciation. 12th Conference of the European Society for Evolutionary Biology, Torino, Italy. 24-29 August 2009.

Taugbøl, A., K. Østbye, U. Grimholt & L. A. Vøllestad. Looks are not everything-Do female sticklebacks smell their way to quality? 6th International Conference on Stickleback Behaviour and Evolution, Leicester, UK. 13-17 July 2009.

Tooming-Klunderud, A. Cod Genome Project. Roche Nordic User Meeting, Stockholm, Sweden. 9 November 2009.

Tooming-Klunderud, A., A. J. Nederbragt, M. Skage & K. S. Jakobsen. The Ultra-high Throughput Sequencing Platform at the University of Oslo. The Norwegian Biochemical Society Contact Meeting, Røros, Norway. 29 January–1 February 2009.

Viljugrein, H., P. A. Jansen, A. Staalstrøm, J. Molvær & H. A. Urke. Integration of hydrodynamics into a statistical model on the spread of pancreas disease in salmon farming. XIIth Conference of the International Society for Veterinary Epidemiology and Economics, Durban, South Africa. 10-14 August 2009.

Villar, J. O., A. J. Jensen, J. H. L'Abée-Lund, N. C. Stenseth, G. O. Storvik & L. A. Vøllestad. Factors affecting year-to-year and within river variability of one-sea-winter Atlantic salmon in Norwegian rivers. International Council for Exploration of the Sea (ICES) Annual Science Conference, Berlin, Germany. 21-25 September 2009.

Vøllestad, L. A. Brown trout in small forest streams: some results from long term mark-recapture studies. Invited lecture, Karlstad University, Norway. 10 March 2009.

Vøllestad, L. A. Helse hos vill ferskvannsfisk? Noen tanker basert hovedsakelig på langtidsstudier av aure. Helsesituasjonen hos vill fisk - oppdager vi endringene? Meeting. Gardermoen, Norway. 24-25 March 2009.

Vøllestad, L. A. Marine biology/aquatic biology. Invited lecture, Arkitektur- og Designhøgskolen i Oslo, Norway. 26 January 2009.

Østbye, K. Adaptive radiation of the Norwegian threespine stickleback. Invited lecture, Stanford University, California, USA. 26 July–5 August 2009.

Østbye, K., L. A. Vøllestad, T. F. Hansen, I. R. Arnaud & L. Bernatchez. Population structure and phenotypic patterns in the threespine stickleback along a salinity gradient in south-eastern Norway. Fisheries Society of the British Isles Annual Conference, Leicester, UK. 13-17 July 2009.

Østbye, K., L. Bernatchez & L. A. Vøllestad. Association between lateral plate morphs and Eda gene QTLs in threespine sticklebacks along a salinity gradient in Norway. Conference on fish evolution, Berlin, Germany. 23-25 November 2009.

Østbye, K., T. Klepaker, L. A. Vøllestad & L. Bernatchez. Pelvic anti-predator armour reduction in a threespine stickleback population. European Society for Evolutionary Biology (ESEB) 12th Congress, Turin, Italy. 24-29 August 2009.

9.5.5 Press coverage

In 2009, CEES was extensively featured in various media items including TV, radio and newspaper articles. Most of these can be viewed via the CEES web pages.



CEES

photo © Olav Heggo

Dept. of Biology
University of Oslo
P.O. Box 1066 Blindern
NO-0316 Oslo, Norway

Phone: +47 22 85 44 00
Fax: +47 22 85 40 01

cees-post@bio.uio.no
www.cees.uio.no

design | easy.no

$$\begin{aligned}
 A^*(D_1, D_2) &= \frac{\partial}{\partial D_1} \left[\frac{\ln[F(D_1)] - \ln[F(D_2)]}{S(D_2) - S(D_1)} \right] \\
 &= \frac{\left(\frac{d}{dD_1} \ln[F(D_1)] \right) (S(D_2) - S(D_1)) + \left(\frac{d}{dD_1} S(D_1) \right) (\ln[F(D_1)] - \ln[F(D_2)])}{(S(D_2) - S(D_1))^2} \\
 &= \frac{\frac{d}{dD_1} \ln[F(D_1)] + \left(\frac{d}{dD_1} S(D_1) \right) \left(\frac{\ln[F(D_1)] - \ln[F(D_2)]}{S(D_2) - S(D_1)} \right)}{S(D_2) - S(D_1)} \\
 &= \frac{\frac{d}{dD_1} \ln[F(D_1)] + \left(\frac{d}{dD_1} S(D_1) \right) A^*(D_1, D_2)}{S(D_2) - S(D_1)}
 \end{aligned}$$