



CEES

Centre for Ecological and Evolutionary Synthesis

CENTRE FOR ECOLOGICAL AND EVOLUTIONARY SYNTHESIS (CEES)
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The Centre for Ecological and Evolutionary Synthesis (CEES) combines a broad spectrum of disciplines (such as population biology, statistical and mathematical modelling and genomics) to foster the concept of ecology as a driving force of evolution via selective processes, with a corresponding influence of evolutionary changes on ecology.

CEES was awarded status as a national Centre of Excellence by the Research Council of Norway in 2007. The Centre is based at the Department of Biology, University of Oslo and consists of more than 150 members representing more than 20 nationalities. CEES annually publishes around 120 articles in peer reviewed journals, including distinguished international publications such as *Nature*, *Science* and *Proceedings of the National Academy of Science*. Its researchers have received prizes both for their research and for popularizing science.

Challenge

Today, anthropogenic impacts on biological systems are of great concern to politicians, academics, and the general public alike. In order to discern how such distortion of the environment may affect future flora and fauna, a greater awareness is needed of how ecology determines the course of evolution, which, in turn, determines future ecological dynamics. Furthermore, these impacts increasingly affect the ability to predict the availability of natural resources upon which people socially and economically depend. Cross-disciplinary efforts are required to make scientifically informed decisions to sustain important natural resources.

Synthesis

Through a unique integration of population ecologists and evolutionary biologists, the Centre is engaged in the challenging quest to bring more ecological thinking into evolutionary biology, and more evolutionary thinking into ecology. To improve the political and social relevance of this work, CEES also embraces a variety of disciplines outside of biology, such as statistics and economics, and actively engages with managers, policy makers, and public health representatives regarding scientific issues.

Research

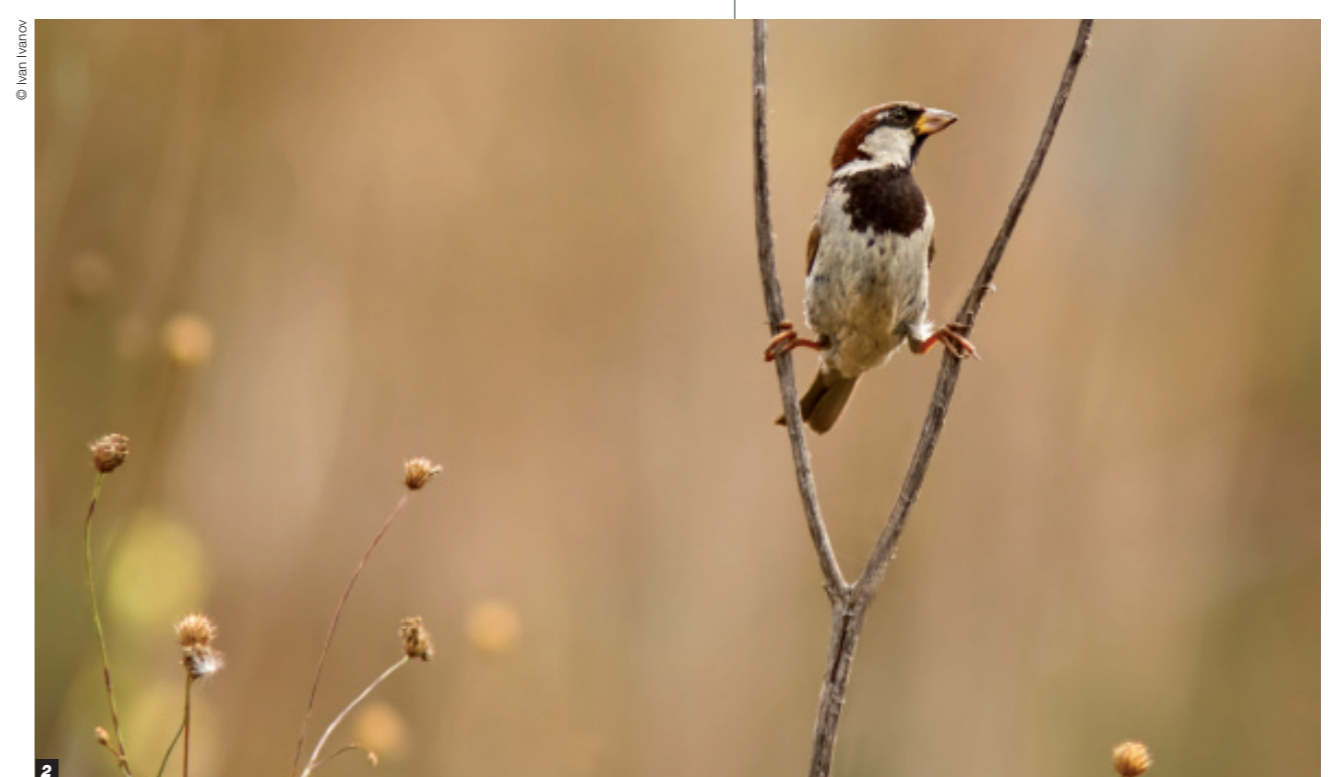
The research at CEES encompasses birds, fish, mammals, plants and micro-organisms. Access to advanced genetic facilities, combined with strong evolutionary biology expertise, is now being used as a basis for solving population biological and evolutionary puzzles, such as what makes some individuals mature at a given size and age, and what can genetic patterns say about an organism's ability to handle major ecological changes. CEES also recognizes that ecological systems are affected by a combination of physical, biological and socioeconomic factors, and cross-disciplinary approaches are needed to identify how they

can be managed or preserved. To achieve this, the application of expertise from multiple disciplines is applied to classical ecological and evolutionary questions.

Other focal points of research at CEES include empirical and theoretical molecular biology exploring the molecular evolution, persistence, and distribution of disease pathogens. Model systems include expanding our understanding of what drives co-evolutionary processes (e.g., Red Queen Dynamics), and international collaboration on the dynamics of the plague bacterium (*Yersinia pestis*, the causative agent of plague, including the Black Death), which continues to be a global health problem and threat (bioterrorism).

Training

The Centre has established a supportive international environment for young researchers with journal clubs, frequent student presentations, mini-symposiums involving eminent international scientists, and an annual student conference. Distinguished scientists from around the world give regular guest lectures and interact productively with colleagues at CEES. The Centre also provides a supportive environment for sending young



researchers internationally for training at workshops, courses, scientific meetings, and collaborating institutions.

The Sequencing of the Cod Genome: A Unique Resource for Merging Genomics & Life History Biology

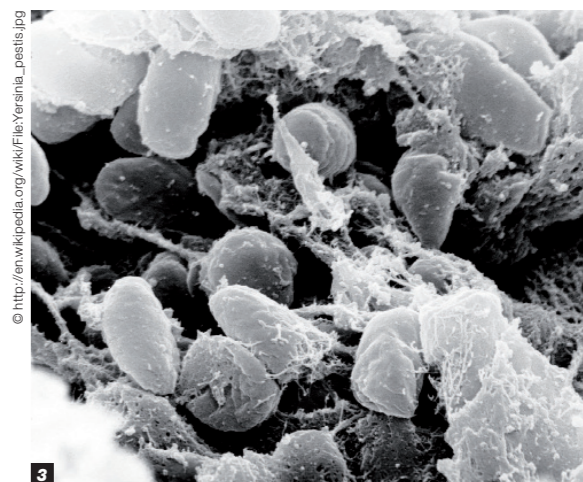
One of the Centre's recent achievements was the sequencing of the cod genome, which will change fundamental ideas about the evolution of the immune system in vertebrates. These results are published in the September 8, 2011 issue of *Nature*. Atlantic cod (*Gadus morhua*) has lost the genes that are essential for the function of the major histocompatibility complex (MHC) II pathway. In humans, the malfunction of this pathway leads to severe disease or even death. Atlantic cod, however, are not exceptionally susceptible to disease under natural conditions. Other genes in the Atlantic cod genome are far more numerous than expected, indicating that Atlantic cod relies relatively more on these genes for its immune response and has developed unique mechanisms to deal with bacterial infections. For example, a highly expanded number of MHC I genes and Toll-like receptor (TLR) genes were found. Through the cod genome

project considerable competence has been built up at the Centre, and the possibility to do large-scale re-sequencing efforts at low costs, in combination with robust statistical genetics and bioinformatics tools, will offer unique opportunities to further study biologically relevant questions related to Atlantic cod.

NorMER

CEES now also leads a new Nordic Centre of Excellence for Research on Marine Ecosystems and Resources under Climate Change (NorMER; www.normer.org). NorMER brings together the expertise of leading research groups from all of the Nordic countries, and several North American institutions, to implement a collective and multidisciplinary research strategy to explore the biological, economic, and management consequences of

global climate change on fisheries resources throughout the Nordic region. It will achieve this through a unique programme of primary research, designed to train PhDs and postdocs in a system of collaborative projects, with a focus on the Atlantic cod. Together, NorMER researchers will: (1) evaluate climate effects on Nordic marine ecosystems, (2) build new tools for predicting biological consequences of climate change, and (3) quantify impacts on profit, employment, and harvesting of cod. This research on cod will then be a platform to extend this knowledge to other marine systems.



1. Atlantic cod – sequenced by CEES and the focus of NorMER.

2. Italian Sparrow – a “new” species that is a hybrid between the house sparrow and the Spanish sparrow.

3. *Yersinia pestis* – the plague bacterium.