

Strategic Research Area

Biodiversity and Ecosystem Services in Changing Climate

Strategic plan 2016-2020

The vision of BECC is to provide a world-leading research environment, bringing together excellent research and training at Lund University and the University of Gothenburg, with the aim of addressing society's growing need for scientific knowledge to inform the integration of biodiversity and ecosystem services dimensions in policy formulation and decision-making, regionally and globally, in the face of a rapidly changing world.

BECC's strategy for the next five years is to:

- Develop science, economics and political science research on and for the integration of an ecosystem service dimension in decision-making and policy formulation. This will be achieved by supporting existing disciplinary research groups and by developing internationally-competitive interdisciplinary research.
- Strengthen leading research groups through international recruitments and career-advancement opportunities for early-career researchers.
- Enhance the impact and visibility of BECC research in international networks and platforms for research, synthesis and assessment.
- Initiate and perform cross-cutting research based on deepened interdisciplinary expertise and new stakeholder interactions.
- Support the development and application of joint infrastructure, with a particular emphasis on internationally prominent infrastructures such as ICOS and MAX-IV.
- Develop cooperation with society and contribute to the strategic relevance and dissemination of BECC research, *inter alia* by aligning ongoing research to societal interest in achieving ecosystem-based climate adaptation and a green economy.
- Develop research training via the ClimBEco research school, and increase the scientific quality of relevant undergraduate education programmes, for example through the establishment of an international Masters programme.

Background

Development of the field since 2010

The concept of ecosystem services has gained focus in recent years, reflecting the recognition that large-scale societal impacts on landscapes, ecosystems and the climate are threatening ecosystem processes of fundamental importance for economic growth and human well-being. The research area builds on studies of natural processes and human impacts. Disciplinary research methodology plays a fundamental role, but the ecosystem service concept is also inherently interdisciplinary, fields such as ecology, economics and political science offering critical and complementary perspectives on the valuation of ecosystem services and the knowledge necessary as a basis for their integration in decision-making. Trans-disciplinary studies bringing together researchers and users contribute additional input to the practical implementation of research findings in policies and management.

Ecosystem services research has advanced and broadened as a field since 2010. Key elements include new methodologies for process studies, such as spectroscopic methods based on synchrotron light for the study of soil processes, and molecular genetics methods for the study of landscape processes. Knowledge of biodiversity-function relationships in agroecosystems and forests has increased, but key gaps remain concerning the role of biodiversity for economically-important ecosystem services. A growing research focus concerns the synergies and trade-offs between ethical versus production-oriented conservation strategies. Various schemes for the quantification and valuation of ecosystem services have been proposed. Mechanisms such as Payment for Ecosystem Services have gained much attention, but may be criticised on the grounds that they overlook cultural and intangible values of ecosystems. An active area of research concerns the development of integrated models for assessing the efficacy of ecosystem management, policies and adaptation measures. Increasingly, studies address multiple ecosystem services and the possible synergies and trade-offs between them, include spatially-explicit scenarios, and account for ecological and societal interactions in a landscape context. New tools for scenario development, such as agent-based models, are emerging.

Research on ecosystem services is attracting increasing attention from decision makers. Syntheses and assessments such as the latest IPCC report, the Aichi Biodiversity Targets of the Convention on Biological Diversity, and the Sustainable Development Goals proposed to supersede the Millennium Development Goals of the UN exhibit a pronounced ecosystem services perspective. The Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), was established in 2012 as a global body for assessing the state of the Earth's biodiversity, its ecosystems and the essential services they provide to society. It is being supported by regional and national initiatives. In Sweden, a Government Commission "Making the Value of Ecosystem Services Visible," identified an urgent need for research to improve the knowledge base on ecosystem processes, their monetary value, and the effects of policy instruments, in order to inform the science-based management of ecosystems. Green Infrastructure is an increasingly widespread term that denotes the vision to integrate biodiversity and ecosystem services dimensions in physical planning, for example at the regional and municipal level.

New challenges for research and the role of BECC

Ecosystem services and biodiversity are central to addressing the Grand Challenges identified by the international research community that underpin Future Earth – the new international umbrella programme for research on the causes and impacts of global change. A major challenge for research lies in the combination of basic and applied research within multiple fields, needed to tackle global change in all its complexity, and propose solutions. There is a need for integrative research that strives to combine an increased understanding of underlying physical and societal processes with the incorporation of such understanding in decision-making and policy formulation. Alongside such solution-oriented research, there is a need for complementary studies taking a critical and reflective perspective. Clearly, this requires the participation of a variety of disciplines. BECC has worked strategically to facilitate knowledge-exchange among scientists, engineers and social scientists, and likewise between researchers and stakeholders. By gathering successful, disciplinary research teams and providing incentives and a supportive culture to promote interactions between them, BECC is in a unique position to tackle challenges demanding an interdisciplinary approach, targeted towards societal knowledge needs.

Interdisciplinarity is an area of expertise in its own right. Recognising this, BECC is building capacity within cross-cutting fields such as ecological-economic modelling, and supporting the initiation of trans-disciplinary projects linking researchers to users. To fulfil its vision of becoming a world-leading centre for interdisciplinary, societally-relevant research it will be critical for BECC to continue both to nurture the disciplinary research teams and promote their interdisciplinary integration.

Ecosystem compartments and processes are interconnected in time and space; measurements and observations are insufficient to fully characterise system complexity. Predicting the impacts of changes in climate, land use and other driving forces thereby depends on the use of models that integrate process knowledge with observational data to relate drivers to impacts, describe underlying mechanisms and expose knowledge gaps. Models are used, for example, to scale up local measurements to regional or global scale, to inform decision-making by simulating changes in response to alternative interventions or management practices, or as a platform to facilitate dialogue between researchers and stakeholders. The usefulness of models as tools for decision support is often hindered by the lack of an explicit treatment of uncertainty. Methods for generating future scenarios accounting for the coupling among social, economic and environmental trends are a fruitful area for development. In particular, there is a need for a new generation of integrated assessment tools that account for the impacts of socio-economic changes on ecosystems, but also the feedbacks of ecosystem changes mediated by management, policy measures and economic decision-making. Through the combination of leading expertise in ecosystem modelling, governance, ecological economics and agent-based modelling, BECC has the potential to make significant contributions in this area, especially with the addition of new in-house expertise in integrated modelling.

Concentrations of greenhouse gases in the atmosphere are regulated by biogeochemical processes linked to global cycles of, in particular, carbon, nitrogen and phosphorus. Living organisms ranging from soil and water-borne microbes to human beings influence and carry out biogeochemical exchanges, thereby controlling net emissions of greenhouse gases and exports of nutrients from ecosystems to the atmosphere, watersheds and other reservoirs. Despite decades of intensive research, critical knowledge gaps hinder robust predictions of future changes in the carbon cycle. One such area concerns knowledge of the microbially-mediated processes governing the turnover and transformation of litter and organic matter in soils. Traditional macroscopic methods have proven insufficient to fully characterise the chemistry of soil carbon turnover. BECC is well-placed to meet tomorrow's challenges in this area, hosting internationally-recognised research within several branches of carbon cycle research, linking to world-class infrastructure including ICOS (Integrated Carbon Observation System) and the MAX-IV synchrotron facility.

Rising CO₂ concentrations in the atmosphere are the most certain aspect of ongoing and future global change. Critical knowledge gaps remain concerning the physiological effects of elevated CO₂ concentrations on plants and ecosystems. BECC is already active within the research area addressing elevated CO₂ effects on ecosystems, as part of an international network encompassing a new generation of FACE experiments.

An increasing demand for food and fibre leading to intensified agriculture and forest production may be expected to negatively impact other ecosystem services and biodiversity. A key challenge will be to identify solutions for a green economy that balance and exploit potential synergies between biodiversity and various classes of ecosystem services, including

agricultural and forest yields. However, current models are weak in their ability to predict the impacts of climate and landscape changes on biodiversity, while empirical evidence for hypothesised systematic effects of biodiversity changes on ecosystem functioning remains sparse and contradictory. More generally, there is a need to highlight synergies and conflicts between different ecosystem services, and among alternative policies, for example green production, climate adaptation, cultural values and conservation of rare species. BECC is in a strong position to make headway on these issues by deploying interdisciplinary research well-integrated with international efforts, combining studies striving for an improved understanding of ecosystem processes, biodiversity conservation, ecosystem and economic modelling, alongside analysis of policy, societal processes and institutions. The development of landscape ecology and landscape genetics research opens for a unique potential to develop studies striving to identify synergies between conservation and provision of ecosystem services. An increased integration between existing research areas on forestry, agriculture and water resources would help make BECC a comprehensive platform for knowledge to inform ecosystem-based climate adaptation.

Strategy for maintaining and building excellence

Effort in the first phase of BECC has concentrated on developing a common focus and establishing interactions between researchers from a range of disciplines at Lund University and University of Gothenburg. In the next phase, BECC will continue to develop as a dynamic research environment, stimulating and supporting collaborative, cross-cutting research by acting as a common arena for researchers from participating research groups and departments. Activities such as seminars and workshops, funding instruments such as BECC's guest researcher programme, and services such as the provision of professional support for science-stakeholder interactions will facilitate inter- and trans-disciplinary collaboration and add value to the strong research credentials of individual researcher teams.

By helping to spawn new collaborations and interactions, and supporting their initial activities, BECC generates leverage for raising external grants and helps strengthen the profile and visibility of ecosystem and climate-related research within participating departments and faculties. The long-term evolution of the environment and its alignment with international research goals will be encouraged by supporting efforts by individual researchers and groups to raise funding for ongoing and new areas of research, including the ambition to coordinate major international (e.g. Horizon 2020) and national (e.g. Mistra) projects. An increased visibility of BECC will be promoted, for instance through participation in international networks such as Future Earth. On a more general level, BECC will endeavour to secure resources for ecosystem and biodiversity-related research by engaging in the consultation processes of national and European funding agencies.

The engagement and expertise of participating researchers are fundamental to meeting future challenges faced by BECC. To promote excellence, we will seek to complement existing areas of expertise through international recruitments, to support and encourage early-career researchers in obtaining start-up and advancement funding (e.g. ERC starting grants), and to develop leadership skills and experience among young faculty in preparation for a generation shift. A commitment to the promotion of equal opportunities will underlie all such efforts.

BECC will review and work to secure access to needed research infrastructure. Existing links to ICOS and MAX-IV will be reinforced and usage encouraged.

BECC will continue to encourage the development of integrative methodology for the analysis of biophysical and socio-economic aspects of global change. Interdisciplinary expertise will be enhanced by engaging with leading international researchers in relevant fields, for example through guest researcher visits and recruitments in consultation with hosting departments. Support will also be provided to researchers interested in developing their interdisciplinary credentials. The thematic clusters of BECC have proven effective as arenas for cross-disciplinary dialogue and for initiating collaboration. In the upcoming phase, a revised, problem-oriented cluster organisation will encourage interaction around major societal and scientific challenges.

Strategy for education and training

The research school ClimBEco is a joint initiative of BECC and the SRA MERGE which gathers students engaged in doctoral research focused on climate, biodiversity and ecosystem services, offering them an interdisciplinary perspective and a network of peers and mentors. ClimBEco will be further developed through the creation of an international summer school, the establishment of links to the European Knowledge and Innovation Community Climate-KIC (see below), by attracting international graduate students to its courses, and by utilising ClimBEco as a platform for attracting international research school funding.

An envisaged international Masters programme in conjunction with the SRA MERGE will enhance and enable a more direct contribution of BECC research and expertise to second-cycle studies. BECC will work to promote cooperation among existing programmes (subjects) concerning Masters dissertations, will encourage the development of cross-subject courses at Masters and postgraduate levels, and will work with involved departments to identify needs for and support the recruitment of new research and teaching staff.

Relationship to other research environments

BECC complements other research environments at Lund University, for example in the context of affiliated projects and programmes, e.g. Linnaeus Centres of Excellence, major national projects (Formas Strong Research Environments, KAW projects, Mistra programmes) and international projects and programmes (Nordic Centres of Excellence, EU/ERA-Net projects). Through cooperation in the context of its affiliated projects and programmes, BECC aims to contribute to the development of the involved research teams, securing their continuation, and to initiate new collaborations. In addition, BECC cooperates with other Strategic Research Areas, most notably MERGE (climate models) and eSSENCE (e-science), and with the international umbrella programme Earth System Governance. Cooperation with MERGE is of particular strategic relevance; complementary research foci – development of new and better tools for climate projections in MERGE versus climate change impacts on ecosystems in BECC – giving rise to obvious synergy. In the context of Lund University's Sustainability Forum, BECC interacts with a wide range of research clusters and networks across Lund University.

Interactions with other universities, society and industry

BECC builds on complementary strengths at Lund University and the University of Gothenburg; for example, environmental economics in Gothenburg and political science in Lund. A sizeable number of joint projects involving researchers from both universities have been initiated in the first phase of BECC. The universities jointly coordinate the research

school ClimBEco and will initiate closer cooperation around undergraduate education in the coming period. Cooperation with societal actors is further enhanced through cooperation with GMV (Chalmers and Gothenburg Universities' organisation for the promotion of research, education and societal interactions in the area of environment and sustainable development).

By acting as an umbrella organisation to a diversity of different research groups, BECC is able to mediate, stimulate and facilitate contacts with stakeholders to identify new research problems, produce research syntheses and establish joint projects. BECC will continue to develop a dialogue with key representatives of government agencies, businesses, branch organisations and other actors from local to European level.

BECC focuses on the development of interdisciplinary research in close cooperation with agencies and businesses around "green economy" and "ecosystem-based climate adaptation". Aspects include investigations of conditions facing agriculture, forestry and the water sector in a changing climate, how adaptation within these sectors may serve to mitigate negative impacts of climate changes, and how alternative management strategies may affect marketable and shared ecosystem services. Lund University's newly-initiated involvement in Climate-KIC provides new opportunities for societal interactions by gathering researchers and businesses in a common network for climate-related and knowledge-based innovation. BECC will work to secure funding for so-called industry PhD studentships and explore the possibility to establish a Vinnova Competence Centre for needs-motivated excellent research.

Researchers throughout BECC are active as experts on advisory bodies and panels from local to national, European and global levels. BECC will work to ensure the engagement of a new generation of researchers as experts in contexts such as the IPCC and IPBES, while simultaneously promoting an increased visibility of researchers' services as scientific experts. Further development of the Communication Office and related services within BECC will offer professional support to researchers in their interactions with agencies and businesses, for example by aiding in the organisation of workshops, production of research syntheses and popular science materials. The function of the Communication Office in directly informing stakeholders, the research community and the general public of the activities and achievements of BECC will likewise be further supported and developed.

BECC within the university organisation

The key to BECC's success is its framing as an integrated environment targeted towards long-term development and scientific goals. Continued and stable support from the university and faculty leadership are a key to continued and deepened success, reaping the harvest of investments already made.

BECC, like other SRA's at Lund University, has developed to become an important node for research and dissemination, yet does not have a formalised place within the organisational hierarchy of the university. BECC will strive to uphold communication channels to university and faculty leaderships, ensuring that BECC is consulted as a partner in strategic decision making at all levels: university, faculty and department.

The university leadership can contribute to BECC's visibility and continued development by adopting strategies to uphold and develop the university's profile in environmental and sustainability research, by showcasing interdisciplinary research and related education programmes and by removing barriers to interdisciplinary collaboration.

The Centre for Environment and Climate Research (CEC) will be of continued importance in providing an organisational base and administrative service to BECC, including CEC's Communication Office and support for stakeholder interactions. It would also be valuable for CEC to invest in building up targeted expertise in interdisciplinary research. CEC may also provide practical support in the preparation of major funding applications, and support joint initiatives with ClimBEco and the Sustainability Forum.

Appendix – about BECC

The strategic research area (SRA) BECC develops research targeting consideration and enhancement of ecosystem services in a world undergoing rapid climate change and biodiversity loss. BECC researchers study how human impacts on the climate and ecosystems influence biodiversity and ecosystem functioning from local to global scales, and how such knowledge may inform mitigation and adaptation decisions in the face of such changes.

BECC is a young research environment encompassing more than 200 researchers in a wide range of fields at Lund University and the University of Gothenburg. In the last five years, BECC has undergone strong development within the participating disciplines and by building interdisciplinary links among them integrating modelling and empirical studies and bridging ecosystem studies to research on policy and governance. An increasing proportion of the research is carried out in cooperation with stakeholders.

BECC's strength and potential is underpinned by the existing successful research groups it brings together to create a stimulating academic environment. The funding managed by BECC has been channelled to the creation of common resources to facilitate societal interactions, meeting places and opportunities for interdisciplinary interactions, financial support for new research – in particular pilot studies ahead of new external project proposals – strategic recruitments and a platform for postgraduate training and networking. These investments have spawned developments expected to support and enhance the quality and relevance of the collective output of BECC for many years to come, while aligning the research increasingly towards the needs of Swedish and global society for scientific knowledge to guide decision-making in the face of a changing environment.