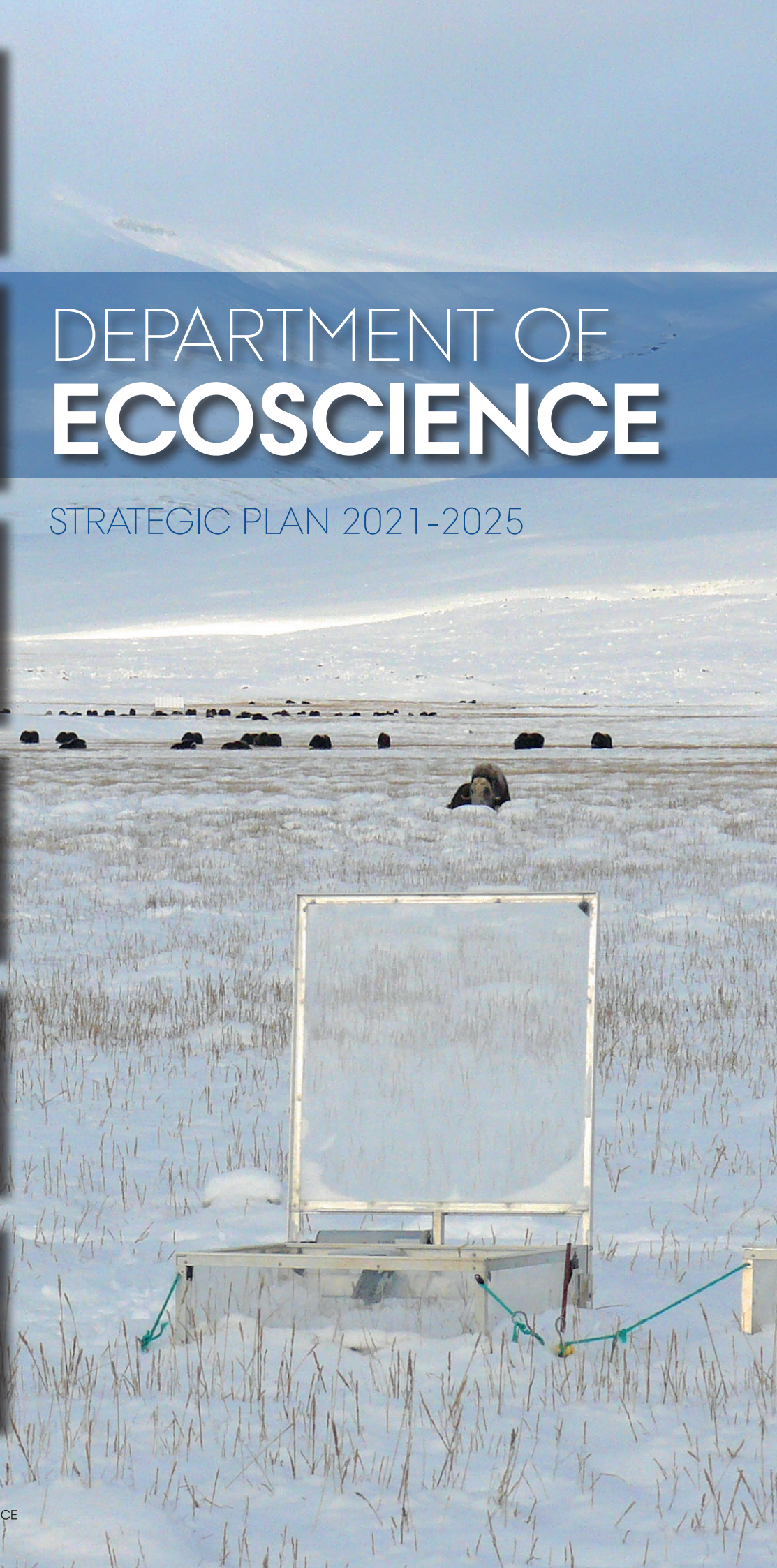


# DEPARTMENT OF ECOSCIENCE

STRATEGIC PLAN 2021-2025



AARHUS  
UNIVERSITY  
DEPARTMENT OF ECOSCIENCE



# DEPARTMENT OF **ECOSCIENCE**

## STRATEGIC PLAN 2021-2025

### MISSION

The Department of Ecoscience (ECOS) conducts applied and basic research at the highest international level, focusing on nature and the environment. The department covers marine, freshwater and terrestrial ecosystems and also has a special focus on the Arctic environment and nature. The department provides research-based knowledge to solve societal challenges by providing consultancy to government agencies and through business collaboration. The department participates in the training of the next generation of researchers and nature managers and contributes to the public debate with relevant knowledge and popular research communication.

### VISION

The Department of Ecoscience wants to be the leader in Denmark re. environmental research and consultancy within the ecology, dynamics and state of ecosystems. The department will achieve this through excellent and solution-oriented research and by being the preferred consultancy and collaboration partner for the public sector and businesses in relation to the state of nature and the environment on land and in water in Denmark and the Arctic and will play a central part in relation to the rest of the world. During the strategy period, the department will further develop and expand its range of courses at Bachelor's, Master's and Ph.D. level. The Department of Ecoscience will be an attractive place to work for both Danish and international employees and students.





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# 1 Overall objectives for the strategy period

The Department of Ecosciences' efforts to achieve this vision are supported by a number of overall goals for the strategy period within the areas of *Research, Consultancy and Business Collaboration, Teaching and Popular Research Communication, Talent Development and Recruitment* as well as *Values and Work Environment*:

## Research

- The Department of Ecoscience will be a national and international leader in ecosystem research in nature, biodiversity, physical-chemical processes and management biology in a broad sense.
- The department wishes to be known for its high publication rates in high-ranking journals, but also for regularly publishing in top journals within the department's core academic areas.
- The department will ensure a position as a sought-after and recognised partner in the strongest environment-related academic communities, primarily in Europe, but also globally.
- The department wishes to play a key role in regards to maintaining Aarhus University's position at the absolute top in connection with international rankings in regards to research related to nature and the environment.
- The department will build an e-infrastructure to ensure the capacity to complete digitisation of the research process from data acquisition (sensors and biologgers), data storage, data management, workflows for analyses and modelling and digital communication of research results and knowledge sharing.

## Consultancy and Business Collaboration

- The Department of Ecoscience wishes to maintain a position as the preferred adviser to Danish and Greenlandic authorities and the Danish business community within the field of nature and the environment on the basis of top-quality research-based consultancy.
- The department also wishes to expand its international consultancy activities on the basis of knowledge building from strong strategic research.
- The department will maintain and further develop its business network and collaboration, including continuing to be open to sharing research infrastructure, start collaborating on industrial Ph.D./postdocs and contributing to targeted continuing education programmes.

## Teaching and Popular Research Communication

- The Department of Ecoscience will work together with the Department of Biology and relevant departments at the Faculty of Technical Sciences (TECH) to maintain and expand the courses offered at Bachelor and Master's degree level within the department's academic strengths.
- The department wishes to make its research and consultancy results generally available on all relevant media in order to strengthen interest in nature, biodiversity and the environment. The department will contribute facts and knowledge that can qualify the public debate and, thus, support a knowledge-based society and democratic processes.

### Talent Development and Recruitment

- The department will strengthen the recruitment of highly qualified Danish and international Ph.D. students, postdocs, researchers and assistant professors. ECOS will increasingly contribute to educating talents who will be able to achieve attractive positions at Danish and foreign universities, in government agencies and private companies. The department sees it as a mission to contribute to capacity building in countries with weak research infrastructure and inadequate environmental management through contributions to talent development from such countries.
- The department will significantly increase the number of students affiliated with the department's Ph.D. degree programme under the Graduate School for Technological Sciences (GSTS). The target is an intake of 15-20 students per year at the end of the strategy period.

### Values and Work Environment

- The department must be characterised by a work and study environment encompassing mutual respect, recognition and co-responsibility and promote an environment in which we pull together and respect each other and pay attention to both our own and our colleagues' well-being.
- The department is, and wishes to continue to be, an active, dynamic and inspiring workplace with exciting challenges, enthusiastic colleagues and academic opportunities for development. The department wishes to support employees in creating a good balance between their work and home lives and to maintain and attract talented and committed staff, where freedom, creativity and respect for the long-term perspective are core values.
- The department wishes to actively contribute to Aarhus University's goal of promoting diversity at all levels as well as be a diverse and inclusive workplace in which all employees – regardless of gender, age, nationality, religion, disability or sexual orientation – have equal rights and opportunities in their work and career paths.



## 2 About the strategy – a new beginning

As of January 1, 2020, the Department of Bioscience was split into two in connection with the division of the Faculty of Science and Technology into the two faculties, Technical Sciences (TECH) and Natural Sciences (NAT). In the process, part of the department was placed in NAT and part in TECH. For several reasons, including the change of the department head, the name change for the part under TECH was not carried out, and the department continued to use the name Bioscience. In October 2021, Bioscience changed its name to the Department of Ecoscience.

In 2022, Ecoscience's places of employment in Jutland (Silkeborg and Kalø) will relocate to Campus Aarhus, and the department will then only have two places of employment: Roskilde and Campus Aarhus.

This strategy therefore represents a new beginning and reflects the need for the department to settle in a new faculty and in a new physical framework. The relocation will allow for increased and closer collaboration with, among others, the engineering and agro departments and with the Department of Biology. We will also be closer to the study environment, which will provide opportunities to increase the recruitment of students and contributions to teaching. However, the relocation also means that two well-functioning workplaces will be shut down in order to be integrated on campus. Therefore, the strategy is also designed to help create a new, well-functioning unit at the campus in Aarhus and to ensure that the collaboration with the place of employment in Roskilde is maintained and strengthened, so that the department continues to appear as one strong unified unit despite the geographical division.

Below, the strategy is described from two different perspectives: the vertical one, with academic strengths based on the ecosystem approach that also forms the basis for the department's division into sections, and the horizontal one, with important interdisciplinary themes.

### Academic Strengths

The department's ecosystem approach is reflected in the overall division into four academic strengths, which also form the framework for the sections. The strengths are not strictly divided and have much overlap, which is also reflected in the department's research (Fig. 1). The four areas of strength are: Terrestrial ecosystems, Freshwater ecosystems, Marine ecosystems and the Arctic. The latter covers terrestrial, freshwater and marine ecosystems, but focuses on the Arctic and, especially, Greenland.

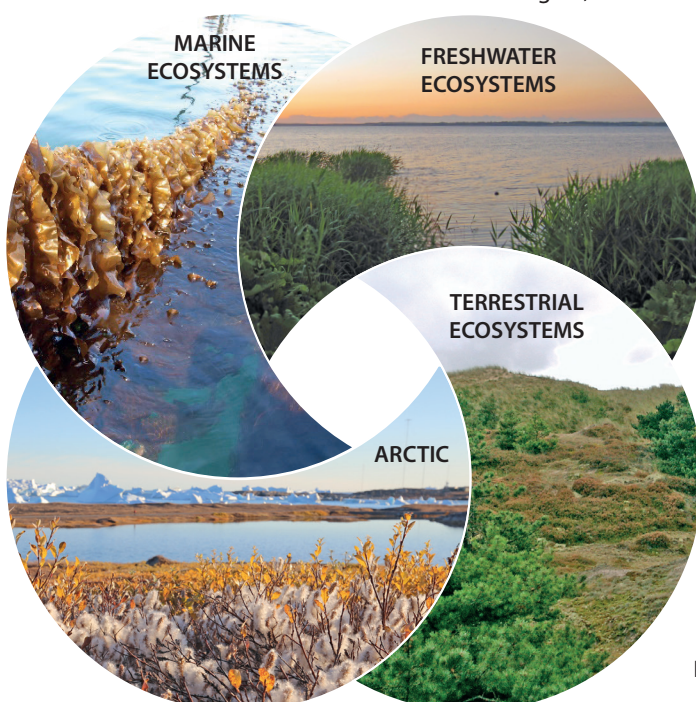


Figure 1. The department's four academic areas of strength.

### Interdisciplinary research themes

Across the 4 academic strengths, the department works with research themes or approaches that are often shared or common to the areas of strength.

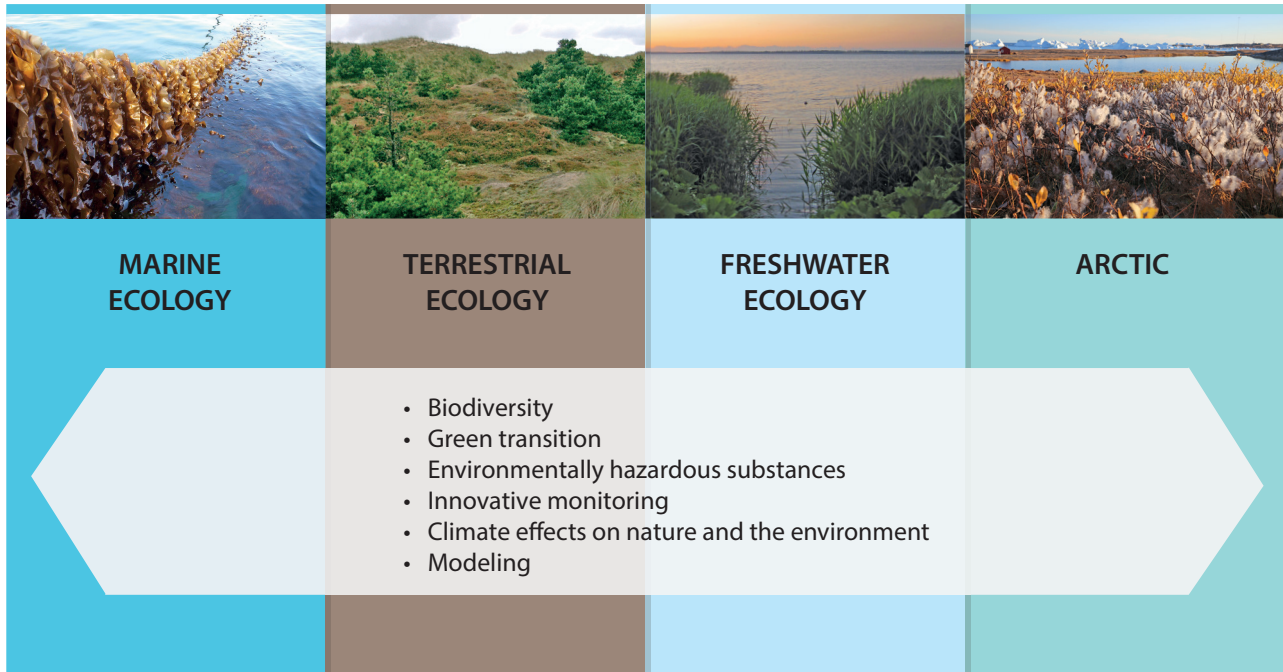


Figure 2. The department's research themes across the four areas of strength

The overall goals are implemented internally in a number of **specific** strategic initiatives that will be launched during the strategy period. These initiatives will focus on improving Ecoscience as a workplace, building infrastructure, internal centre or network formation as well as the development of external partnerships, which together must support the overall strategic aim. The initiatives can therefore be divided into *ECOS as a workplace, Infrastructure, Research and education collaboration and New centres and research platforms*.

### The strategy in context

The strategy can stand alone, but it must be accompanied by a number of internal documents to support and anchor the department in implementing its vision and goals:

1. Specific strategic initiatives
2. Implementation plan that reflects the specific strategic initiatives
3. Recruitment plan to ensure resources for the implementation of the strategic initiatives
4. Set of values "ECOS as a workplace"
5. The Department of Ecoscience's self-assessment, which is a status of the department's current situation (Dec. 2021) in relation to the joint TECH strategy.

In order to ensure the connection between Ecoscience's strategy further up at both faculty and university level, there is a direct correlation between the goals presented in this strategy and the targets in Technical Sciences' Strategy 2025 and Aarhus University's Strategy 2025.

Thus, the department's overall objectives for the strategy period support the four milestones in Technical Sciences' strategy: The overall objectives for research support benchmark 2, *"Recognised research, strengthened entrepreneurship, public sector consultancy and talent development"*. The objectives for consultancy and business collaboration support benchmark 1, *"Prioritisation and development of new partnerships and other collaborations"*, and benchmark 2, *"Recognised research, strengthened entrepreneurship, public sector consultancy and talent development"*. The objectives for teaching and popular research communication support benchmark 3, *"Engage our students in the challenges of society"*. The goals for talent development and recruitment support TECH benchmark 2, *"Recognised research, strengthened entrepreneurship, public sector consultancy and talent development"*, and benchmark 3, *"Engage our students in the challenges of society"*. ECOS' objectives for values and work environment are fundamental to achieving both Technical Sciences' ambition and all four benchmarks, but they specifically address TECH benchmark 4, *"Joint responsibility for openness, cooperation, co-ordination and development while trusting and respecting each other"*.

Finally, ECOS' strategy supports many items on the UN's list of World Goals for Sustainable Development. This applies in particular to World Goals 15 (Life on Land), 14 (Life in the Sea), 13 (Climate action) and 4 (Quality Education). In addition, to a lesser extent, the department's research and consultancy services contribute to a number of the other World Goals, e.g. 6 (Clean water and Sanitation), 7 (Sustainable energy) and 11 (Sustainable cities and local communities).



## 3 Academic Strengths

### Terrestrial Ecology

The world is in the midst of a biodiversity crisis in which nature's biodiversity is in decline. The department works with cost-effective strategies for the necessary regulation and conflict management of human activities with the view of ensuring a diverse and rich nature.

Our research contributes to developing strategies for green transition and sustainable production in agriculture and forestry, including focusing on nature-based solutions. The department develops tools for effective and cost-efficient nature conservation and works with methods for solving conflicts between nature and disturbances, e.g. from hunting and outdoor recreation. The department is home to the topic centre 'Dry nature and species' under the national monitoring programme NOVANA, and we are responsible for methodological development, analysis of data and annual reporting on the state of nature.

The department has strong competencies within the fields of biodiversity, species and nature conservation on land. Research is conducted into the state and development of nature, the interplay between plants, animals, fungi, microorganisms and the surrounding environment. The department's research includes studies on how human activities and natural processes affect biodiversity or individual species, with particular focus on endangered nature. The research is based on the fact that nature and the resources available to the species are under pressure from production, industrial plants and buildings and are affected by pesticides and nutrients, invasive species, disturbances, hunting, recreational activities and climate change. In general, we work with nature management and its anchoring and legitimacy, including involving citizens in the formulation of key issues and in the production of knowledge, including citizen science. We study conflict species and issues surrounding people's relation to nature and the use of nature and emphasize an interdisciplinary approach in research.

We will develop new concepts and methods to describe and monitor nature and its species and work in a process-oriented manner with the factors that affect it. This knowledge will be used to develop methods for nature management with a focus on preserving or increasing the biodiversity of natural ecosystems. We will also develop methods for cost-effective planning and development of sustainable solutions for species management in collaboration with the public sector, citizens and research institutions.





### Marine ecology

Over the past century, people have had a significant impact on the marine ecosystems. This will continue in the coming years, not least through the green transition focus on intensified use of Danish and international marine areas.

Nutrient supply from land, the atmosphere and other marine areas changes productivity and food chains in the marine environment. Overfishing affects the marine food chains, and trawling destroys plant and animal communities on the seabed. Noise from construction activities (e.g. offshore wind parks and energy islands) and ships particularly affect marine mammals that are at the top of the food chain and are particularly vulnerable, but the other marine ecosystems are also affected by these extensive activities. Climate change, environmentally hazardous substances, marine waste and plastics, recreational activities, shipping and physical constructions are other examples of human-induced influences to the marine environment that have increased in recent decades.

The marine areas are protected through a number of EU directives and international conventions, which are monitored through, among other things, the national monitoring programme for the aquatic environment and nature (NOVANA), where the department manages the marine topic centre.

The Department of Ecoscience works with understanding the structure and function of marine ecosystems across different systems, from the coastal zone to the open marine areas, from the Arctic through temperate to tropical systems. We have special focus on distinguishing between changes caused by natural variations and changes caused by human activity. In order to do this, the department develops tools and methods to assess the state of the marine environment and to determine and analyse the factors that affect the dynamics and health of the ocean. This includes monitoring, experimental work, development of indicators, statistical, spatial, agent-based and dynamic models, habitat mapping and area planning, and the development and use of new innovative and automated measurement methods, data loggers, satellite telemetry, remote sensing, etc. In addition, we work on understanding how sustainable nature-based solutions can contribute to promoting carbon retention, biodiversity, etc. through the protection, restoration and sustainable use of marine ecosystems.

The department will be a national leader in knowledge to support sustainable management of marine ecosystems and populations with strong research groups in the fields of oceanography, nutrient turnover, behavioural biology, bio-acoustics, biodiversity, food webs, environmentally hazardous substances, waste and other pollution. We will enhance and further develop our current position of strength and deliver relevant, new knowledge to the public, businesses, government agencies and policy makers. We want to be an international leader in the modelling of anthropogenic disturbances (including underwater noise), climate change and other stress factors affecting marine mammals at population level.

### Freshwater ecology

Freshwater is a crucial resource e.g. for drinking water, agricultural production, support for biodiversity and many forms of recreation. However, our freshwater areas are under constant pressure due to increased supply of nutrients, pesticides, heavy metals and other pollution components from households, industry and agriculture.

The freshwaters are protected through the Nature Conservation Act, the Water Framework Directive and the Habitats Directive, and we are the topic centre for the national monitoring programme NOVANA. The department plays a key role in providing consultancy on the fulfilment of the objectives set for protection and evaluating potential new threats and mitigation measures. We combine monitoring data, experimental data and calculations from modelling tools to achieve better system understanding and to develop sustainable management, taking into account both the environment and society. The department's goal is to expand the use of technological advances, such as the Internet of Things (IoT) and Artificial Intelligence (AI), to collect, process and publish environmental data – also in real time.

The department has a unique research environment at the highest international level within aquatic freshwater biology and ecology, which covers streams, lakes, ponds and surrounding rural areas (catchments) that direct water to the freshwater areas – including both natural and constructed wetlands. An important element of the research is the unique long time series retrieved through field studies and from the department's test facilities in Lemming with constructed mini-ecosystems in which pelagic abiotic and biotic dynamics can be studied under controlled and manipulated conditions.

The department studies and measures biological and chemical processes in freshwater ecosystems as well as the interplay between nutrients, environmentally hazardous substances and biological structure. The research covers topics such as lake and stream restoration, nutrient dynamics, greenhouse gases, biodiversity and the interplay between catchment and freshwater areas. In addition, the department focuses on developing and using empirical and dynamic modelling tools to calculate, among other things, the leaching of nitrogen and phosphorus from fields and the transportation to streams and further on to the marine environment.

The department wishes to strengthen the interplay between ecology and hydrology in the model work carried out in order to strengthen the models' use as decision-making support in future climate and load scenarios. The department will strengthen its competences with regard to the importance of ponds, small lakes and other wetlands in nutrient dynamics, as well as the absorption and release of greenhouse gases.



### The Arctic

Global warming is happening more than twice as fast in the Arctic as in the rest of the northern hemisphere. This, as well as changing infrastructural interests, including natural resources and new shipping lanes, affects the Arctic ecosystems and their populations with increasing complexity and leads to highly altered living conditions for plants, animals and humans. There is therefore a great need to understand and be able to predict the effect of these influences on processes and living conditions, both in the short and long term. With the ice sheet melting, potentially large deposits of raw materials, an extremely vulnerable environment and a geopolitically central location, Greenland is particularly in the spotlight.

For decades, the department has had an internationally leading role in Arctic research, monitoring and consultancy, with a focus on studies of Arctic nature and the environment in general in the Arctic and, especially, in Greenland, where the department contributes knowledge transfer through collaboration and consultancy to Greenland's self-government, including the Greenland Institute of Natural Resources. With this geographical focus, the Arctic area of strength spans widely academically across the trophic levels, from microbes to plants to animals and birds, and from individual to population and ecosystem level in marine, fresh and terrestrial ecosystems. We provide consultancy to the Greenlandic (and Danish) authorities on environmental issues related to raw materials activities (in particular mining operations) as well as on both terrestrial and marine nature protection, e.g. on the strain and effects of environmentally harmful substances in relation to ecosystem health (OneHealth), with particular focus on the health of marine mammals and humans. Another key research area is the effects of climate change on Arctic ecosystems and their environment, among other things through the use of biodiversity mapping, bio logging, demography, movement ecology, energy flows and their link to the population level.

The department runs the interdisciplinary and internationally recognised research station Zackenberg and manages several of the central research and monitoring programmes in Greenland and the Arctic (e.g. GEM, CBMP, AMAP and PAME).

We will develop an understanding of biogeochemical, biogeophysical and biological processes in the Arctic through a multidisciplinary and experimental approach from microbial to ecosystem level and thereby create insight into ecosystem feedbacks and functions as well as Arctic biodiversity and population dynamics. The department will maintain our central role as an adviser to Greenland on environmental issues in the field of mineral resources and our leading role and strong academic environment in climate effects on Arctic ecosystems under the auspices of the relevant international bodies (e.g. UNEP, ICES, OSPAR).



## 4 Interdisciplinary research themes

The department has a number of interdisciplinary research themes that transcend the four areas of strength. Following is a brief description of our current work and the department's expectations for developments in these areas.

### Biodiversity

The department has a strong position within the field of international biodiversity research and at a national level has a leading role in research-based consultancy and knowledge sharing in the field of evidence-based and cost-effective conservation and management of biodiversity across all habitats in Denmark.

The interdisciplinary research focuses on how ecological framework conditions, historical conditions, natural processes and human-induced changes to nature and the environment affect biodiversity in the sea, lakes, streams and on land. The department explores the underlying ecological and evolutionary mechanisms, and work is being done to understand the significance of humans on biodiversity and ecosystems. There is a special focus on what the current climate change and other global anthropogenic environmental changes mean for biodiversity. The conditions in the Arctic are particularly important because changes there are taking place rapidly. The department contributes to international forums that focus on biodiversity. They include, for example, IPBES (Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services) and CBMP (Circumpolar Biodiversity Monitoring Program). The department is responsible for maintaining the Danish Red List, which is regularly adjusted according to the IUCN guidelines (International Union for Conservation of Nature). The centres SESS and CAN (see description below) develop tools for modelling and management of species and populations

The department studies biodiversity patterns at small and large scale in both space and time. This is done, for example, by developing methods for measuring, condition evaluation and statistical modelling of biodiversity in large multivariate datasets, through agent-based modelling of populations in dynamic landscapes and by developing and using advanced remote sensing and genome-based techniques, e.g. the use of drones, LiDAR and techniques such as eDNA. New concepts are being developed to describe and monitor biodiversity, and these are used in our work to develop sustainable solutions for the benefit of nature and biodiversity.

### Green transition

Danish agriculture occupies almost 2/3 of the Danish land area, while freshwater and marine fish farms can have a major environmental impact locally. The Danish agricultural and food sector is one of the most resource-optimised in the world and, despite the ongoing green transition, it still has a number of consequences for the climate, the environment and biodiversity, just as new green transition solutions in themselves can impact the environment. The transition of food production in Denmark must therefore be achieved through the use of existing knowledge and new research.

The department conducts research into and provides consultancy on the environmental effects of e.g. pesticides, excipients, genetically modified organisms (GMOs), nitrogen and phosphorus, reduced soil tillage, conservation agriculture, fallowing etc. Through laboratory and field experiments as well as modelling, we study how current and changed agricultural practices affect both nature and the environment and potentially contribute resources to biodiversity and to climate adaptation and mitigation solutions, and monitoring is carried out as part of the national monitoring programme for water and nature (NOVANA).





We contribute to the green transition of agriculture by, among other things, evaluating the potential and effect of measures to reduce nutrient loss and greenhouse gas emissions (e.g. drainage, constructed wetlands, saturated buffer zones, removal of lowland soils, etc.). The department's research also contributes to illustrating the natural and environmental content related to various forms of farming in forestry and agriculture, including, for example, the importance of pesticides in the biodiversity of wild pollinators. The department provides consultancy on the possible environmental consequences of green transition, including, for example, construction activities and operation of offshore wind parks, energy islands and other new initiatives. We conduct research on aquatic food production and feed in order to shed light on the possibilities of nature-based solutions that can alleviate increased local nutrient loads and, at the same time, help to bind climate gases such as carbon dioxide. Among other things, these marine instruments include eel grass meadows, seaweed forests and mollusc farms.

#### Environmentally hazardous substances

We work with the occurrence, spread, bioaccumulation and toxic effects of environmentally hazardous substances on individuals, populations and entire ecosystems, including the possible impact on humans. The department has relevant and strong research profiles within the fields of ecotoxicology, biology, environmental chemistry, toxicology and modelling, which makes it possible to map causal-effect contexts at the molecular, individual, population and ecosystem level. Combined with a solid insight into risk and impact assessments, this enables research-based consultancy at the highest possible level. Thus, the department participates in a number of international forums focusing on contaminants in, for example, the Baltic Sea (HELCOM), the North Sea (OSPAR), the Arctic (AMAP, PAME) and globally (ICES). Researchers also participate in EU-based working groups related to environmentally hazardous substances in EFSA (pesticides), EMA (pharmaceuticals) and the IAEA (radioactive waste).

The department works with all types of environmentally hazardous substances, e.g. heavy metals, radioactive substances, organic toxins, pesticides, pharmaceuticals, nanoparticles and microplastics. The department covers all levels of the food chains from microorganisms, such as fungi, algae and bacteria, to the largest marine mammals. The work includes the development and use of monitoring and assessment tools, such as molecular and genetic omics techniques and bioindicators that can shed light on the significance of the detected levels of environmentally hazardous substances and marine waste. The department analyses spatial and temporal trends and effects of environmentally hazardous substances by using models for increased process understanding.

Ecophysiological studies provide increased understanding of the interplay between environmentally hazardous substances and other (natural) stressors linked to e.g. climate change, including drought and cold.

The department wishes to expand its teaching in the field of risk and impact assessments of environmentally hazardous substances through advanced interdisciplinary collaboration. This includes closer collaboration with the engineering departments and the Department of Environmental Science.

#### **Innovative monitoring**

The department participates in monitoring of the environment across the terrestrial, freshwater and marine areas in Denmark and Greenland. The monitoring provides data for the department's research and consultancy and is compiled into national and international databases. These data are essential for analyses and models that can lead to useful and socially relevant knowledge about the state, development and resilience of ecosystems to impacts.

Methods in environmental monitoring are often conservative (i.e. tested and reliable), but may be outdated in relation to recent technologies and requirements. Thus, there is a need to upgrade existing monitoring programmes (e.g. NOVANA and GEM and environmental monitoring at mines in Greenland) by testing and implementing new technologies that can lead to both efficiency gains and a quality boost as well as greater spatial coverage in the long term.

In the coming strategy period, the department will therefore focus on developing and/or testing new and intelligent monitoring methods for use across ecosystems and geography. Among other things, these methods include smart development within eDNA, drones and ROVs, mobile platforms for broad ecosystem monitoring, logging systems, IoT sensors, energy supply for automatic measurement stations, remote sensing and image recognition techniques, telemetry, game cameras, acoustic sensors, counts (satellite/aircraft/drones), and new types of laboratory analyses (isotopes, laser ablation, FTIR, etc.)

#### **Climate effects on nature and the environment**

Climate change and its importance for the ecology, function and structure of ecosystems across terrestrial, limnic and marine environments is absolutely central to all of the department's strengths, whether in Denmark or in the Arctic or elsewhere on the planet. Climate change can act with both negative and positive consequences to ecosystems and population distribution and living conditions. In order to understand and model the future development of the effect of human activities on organisms and the environment, it is therefore crucial to include the impact of climate change on ecosystem dynamics.

The department's inclusion of climate change in research, monitoring, education and consultancy spans over direct impacts from rising temperatures and changing precipitation patterns and changes in water, carbon and energy balances to the more indirect impacts from changed food availability or increased shipping to possible thresholds (tipping points), which can lead to irreversible changes. The department also focuses on the interplay between climate change and pollution and diseases in both Denmark and the Arctic.

The Arctic is, and will continue to be, affected more quickly and more severely by global climate change than lower latitude areas, and therefore the department's Arctic area of strength has particularly strong focus on the significance of climate change for ecosystems and the living conditions of the local population. We are strongly involved in cross-disciplinary research projects that provide new insight into the dynamics of the overall social and ecological system and point to development potential in a rapidly changing Arctic (see also the Arctic area of strength above).

In connection with the development of solution-oriented initiatives in relation to the climate challenges, the department is involved in the assessment of the effects of, for example, marine instruments such as seaweed cultivation, changed land use in agriculture, etc., which can bind or change the emission of climate gases (see also Green transition above).

### Modelling

Models increase understanding of the systems we work with and contribute to creating new knowledge by combining data and hypotheses. In many cases, models can also be used for risk assessments and scenario analyses and therefore potentially have major societal significance. Models are used at all structural levels, from genes to individuals, populations and species to habitats, nutrient cycles and complex systems. As other research, model output is associated with uncertainty, which is why we aim to make this visible e.g. through hierarchical statistical models.

In most cases, the models are based on data collected in the department through the national monitoring programmes or our other research projects, and they are therefore closely linked to the development of innovative monitoring techniques (see above). A wide range of different approaches are applied, from statistical models to dynamic flow models for nutrient cycles, modelling of populations and demographic processes as well as advanced agent-based simulations. As the development of complex models that can be used in management requires a lot of computer power and advanced programming, this development can be strengthened through closer collaboration with engineering and IT environments at AU.

Among the many model development projects at the Department of Ecoscience, a few are listed here to give an impression of their diversity: Use of monitoring data from fields and streams to develop models for leaching and the catchment model SWAT. In the marine area, monitoring data is used to develop models for hydrodynamics, sediment transport, biogeochemistry and to grow seaweed and shellfish. We use physiologically based pharmacokinetic (PBPK) models to assess the effect of environmental toxins on different organisms. In the field of population biology, agent-based population models and spatial statistical analyses are e.g. used to simulate the factors that affect the behaviour and health of individuals and, thereby, the population development and the distribution of the animals (see more under centres, SESS). Within adaptive management, complex socio-organic agent-based simulations are being developed, which will be used as decision-making and implementation tools in the management of key species throughout landscapes (see more under centres, SESS and CAN).



## 5 About the department

### Organisation

Up to mid-2022, the Department of Ecoscience covers three locations in Roskilde, Silkeborg and Kalø. The department will then merge into two geographical locations, as the units in Silkeborg and Kalø will relocate to the campus in Aarhus.

There are a total of approx. 275 employees in the department (in 2021), of which some 100 work in Roskilde, and almost 165 employees will be situated at AU Campus Aarhus. There are five sections in Roskilde and 6 in Aarhus. The sections in Aarhus are divided into an aquatic cluster with the three sections that mainly work with topics related to freshwater and marine issues, and a terrestrial cluster with the three sections that mainly work with terrestrial issues.

Of the almost 275 employees, nearly 200 are permanent staff, just over 15 are Ph.D. students, almost 20 are postdocs and almost 40 are employed in other forms of fixed-term appointments.

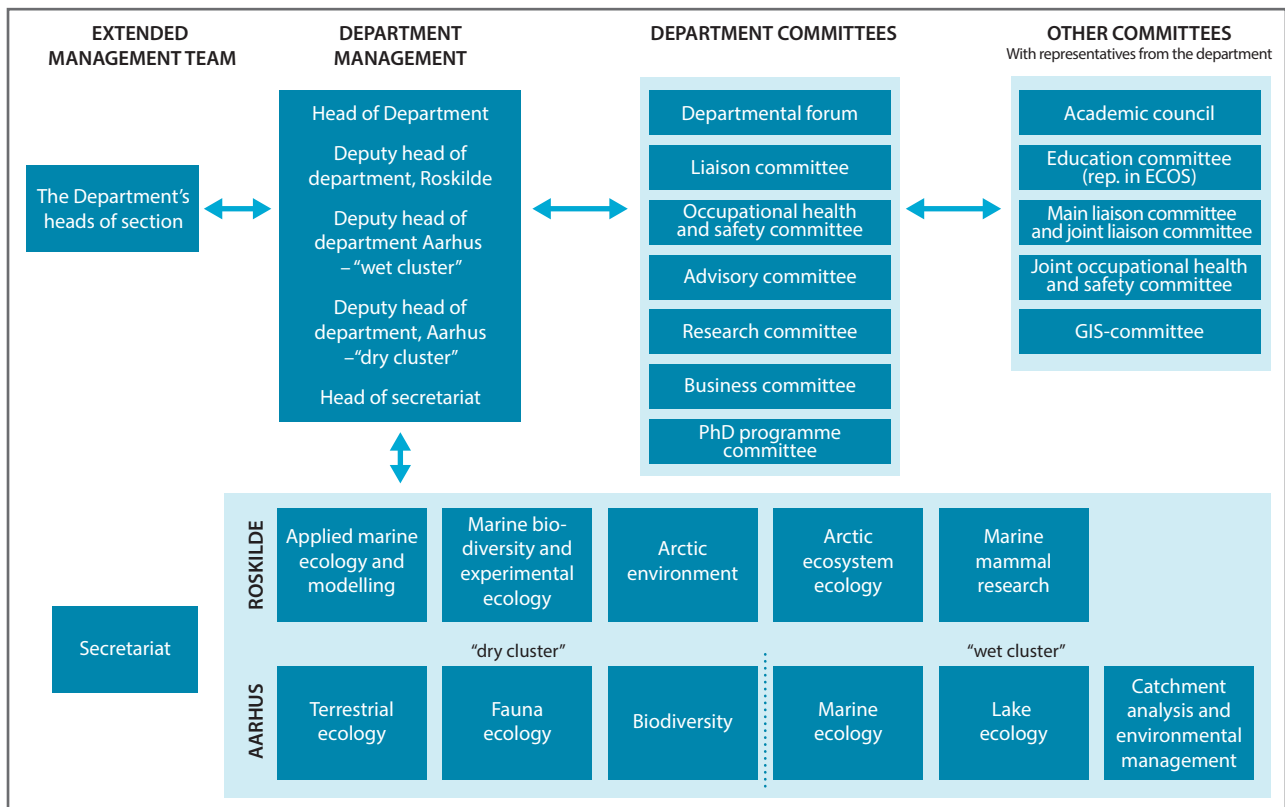


Figure 3. The department's organisation

### Management

The departmental management consists of the head of department, the secretariat manager and three deputy heads of department. The three deputy heads of department each function as daily managers of one of the department's places of employment. The overall management group in the department also includes the department's eleven heads of section.

### Centres

The department manages a number of interdisciplinary centres that have a research and cooperation scope beyond the boundaries of the department.



- Centre for Adaptive Nature Management (**CAN**). Sustainable solutions in nature management carried out in the interplay between nature managers, citizens and researchers and continuously adapted to common goals and the state of the natural resource.
- Social-Ecological Systems Simulation Centre (**SESS**). Develops simulation tools to assess the environmental, sociological and financial consequences of land management in complex landscapes.
- The Centre for Water Technology (**WATEC**) works with municipal wastewater purification, process control and the management and restoration of surface water and groundwater. The centre is an entry point for innovative collaboration between industry, business and public research.

In addition, the department participates actively in a number of national and international centres, including IClimate, the Arctic Centre (ARC) and Centre for Circular Economy (CBIO).



### The centre unit DCE - Danish Centre for Environment and Energy

DCE - Danish Centre for Environment and Energy serves as a gateway for government agencies, industry, special interest organisations and the general public to Aarhus University's academic environments in the fields of nature, the environment and energy, including the Department of Ecoscience. The centre unit publishes reports and notes prepared by researchers in the department and coordinates and contributes to assuring the quality of the department's research-based consultancy to ministries and other requesters of consultancy regarding environment and energy. As of 2021, the centre unit has eleven employees and a director, and they are located both in Roskilde and with the aquatic cluster in Jutland.

### Infrastructure

The department has a strong infrastructure that supports the research, consultancy and teaching activities that are carried out. The infrastructure includes well-equipped research labs, an isotope laboratory with, among other things, a gamma spectrometer, stream and lake-mesocosmos facilities in test facilities at Lemming, the experimental area in Hygum and algae cultivation facilities in connection with the Kattegatcenter. The department has received a large grant for a new machine for inductively coupled plasma mass spectrometry (MCI-ICPMS-MS), which during the strategy period will become part of a large metal laboratory. In addition, Ecoscience operates the research station Zackenberg in Northeast Greenland.



