Summary Aquatic and Terrestial environments, SLU

Aquatic data-driven life science at SLU

SLU provides a strong and cohesive research environment for data-driven and AI-supported aquatic life science with genomics, biodiversity, and advanced sensing technologies as fundamental components. The three Departments of Wildlife, Fish and Environmental Science, Aquatic Resources, and Aquatic Sciences and Assessment together offer a uniquely comprehensive and highly integrated research environment with infrastructure and expertise spanning from advanced molecular analyses to aquatic field research, and machine learning. The departments also host unique datasets generated through national and regional environmental monitoring programmes. Altogether, the aquatic research environment at SLU offers ideal conditions for forward-looking DDLS research.

The infrastructure and expertise fall into two complementary research lines. Frontier innovations in aquatic field research, fully aligned with the DDLS mission, focus on the digital transformation and automation of marine and freshwater ecological monitoring. This includes autonomous data collection using fixed sensors and sensor-equipped sailing drones, machine-learning-based computer vision for automated seabird monitoring, controlled aquatic experiments, and state-of-the-art fish telemetry, biologging, and video-based behavioural analyses. Such systems enable unprecedented resolution in understanding ecological interactions across environments, as well as species' responses to anthropogenic pressures such as pollution of the aquatic environment, climate change and microplastics.

Genomics and bioinformatics, fully aligned with DDLS Evolution and Biodiversity, integrates analyses that span from genomes to transcriptomes for addressing fundamental questions related to adaptation, dispersal, speciation and ecology of aquatic species. Advanced bioinformatics tools are developed and applied to link genomic variation to ecological and evolutionary processes and to more broadly assess biodiversity. The molecular data that we use come from environments such as lakes, oceans, the deep biosphere, wetlands, wastewaters and polar environments. New types of data are also generated from microbial single-cell genomes and transcriptomes, metaproteomes and metabolomes, along with new bioinformatic tools to interpret such multi-omics data.

Across departments, unique infrastructures support these research activities, including the Swedish Infrastructure for Ecosystem Science (SITES), the Swedish Research Vessel Infrastructure for Marine Research (SWERVE). Technical and computational capacity is extensive with high-performance workstations for advanced modelling, machine learning, simulation, and visualization, supported by SLU's robust IT infrastructure and access to national HPC resources via NAISS. We also have in-house storage and computational resources optimized for AI/ML workflows, strengthened through long-term collaboration with AI Sweden, NBIS and SBDI.

Research is highly collaborative context with extensive partnerships with other universities, industry, national agencies, NGOs, and international networks.

Terrestrial data-driven life science at SLU

SLU provides a strong and cohesive research environment for data-driven and AI-supported terrestrial life science, with biodiversity, evolution, ecosystem processes, and sustainable land use as fundamental components. The environment brings together research on forests, soils, plants, microorganisms and wildlife in a uniquely integrated setting that spans from molecular analyses to large-scale landscape monitoring and ecological field studies, tightly linked to machine learning, remote sensing and automated data collection. The environment is built on exceptionally strong long-term datasets from national inventories of forests, soils and landscapes, as well as large-scale wildlife monitoring programmes, providing outstanding opportunities for forward-looking DDLS research.

The infrastructure and expertise fall into two complementary research lines. Frontier innovations in terrestrial ecological monitoring focus on large-scale, automated observation of organisms and ecosystems using camera traps, acoustic recorders, drones, biologging and remote sensing. Machine learning is used extensively for automated species identification, population assessments, behavioural analyses and monitoring of habitat change and restoration outcomes across managed and natural landscapes. These approaches are closely integrated with national environmental monitoring, adaptive wildlife management and large citizen science initiatives.

Genomics, molecular ecology and bioinformatics form the second core research line and are fully aligned with DDLS Evolution and Biodiversity. Here, eDNA, pangenomes, population genomics, transcriptomics, metabolomics and multi-omics approaches are used to address fundamental questions related to adaptation, dispersal, species interactions, ecosystem functioning and biodiversity change in terrestrial systems. Advanced bioinformatic and machine-learning methods are developed and applied in close interaction between experimental biology, field ecology and computational research.

Technical and computational capacity is supported by a combination of local bioinformatics and GPU resources and access to national high-performance computing through NAISS and SciLifeLab Data Centre, with close integration of NBIS support. This enables both rapid method development and large-scale analyses of genomic, spatial, image-based and sensor-derived data.

Research is conducted in a highly collaborative context with extensive partnerships with universities, industry, government agencies and international research networks. A large share of the work is performed in applied settings, and research results are directly used in nature conservation, climate adaptation, sustainable forestry and agriculture, and biodiversity and wildlife management, giving the terrestrial research environment at SLU a very strong societal relevance and impact.