



**VATTENFALL**

# **Biodiversity Projects**

**Contributing to a Nature-Inclusive Energy Transition**



Biodiversity is an integral part of the way we work at Vattenfall. We believe that the energy transition must be nature inclusive. Therefore, we strive to minimize biodiversity loss, enhance ecosystems wherever possible, and invest in research and development. This brochure highlights the practical measures we have implemented to uphold these commitments.

**VATTENFALL** 



# Content overview



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# Biodiversity projects in hydropower

The European Water Framework Directive, Habitats Directive, and Eel Regulation impact Swedish hydropower. Our goal is to balance renewable energy demands with environmental goals. Vattenfall and seven hydropower companies have created a fund, investing 10 billion SEK over 20 years. We will focus on biodiversity for the next 20 years. In 2023, we launched a biodiversity program, investing 65 million SEK in R&D for sustainable solutions. This program complements our ongoing biodiversity and hydropower research, specifically targeting large-scale regulated rivers.



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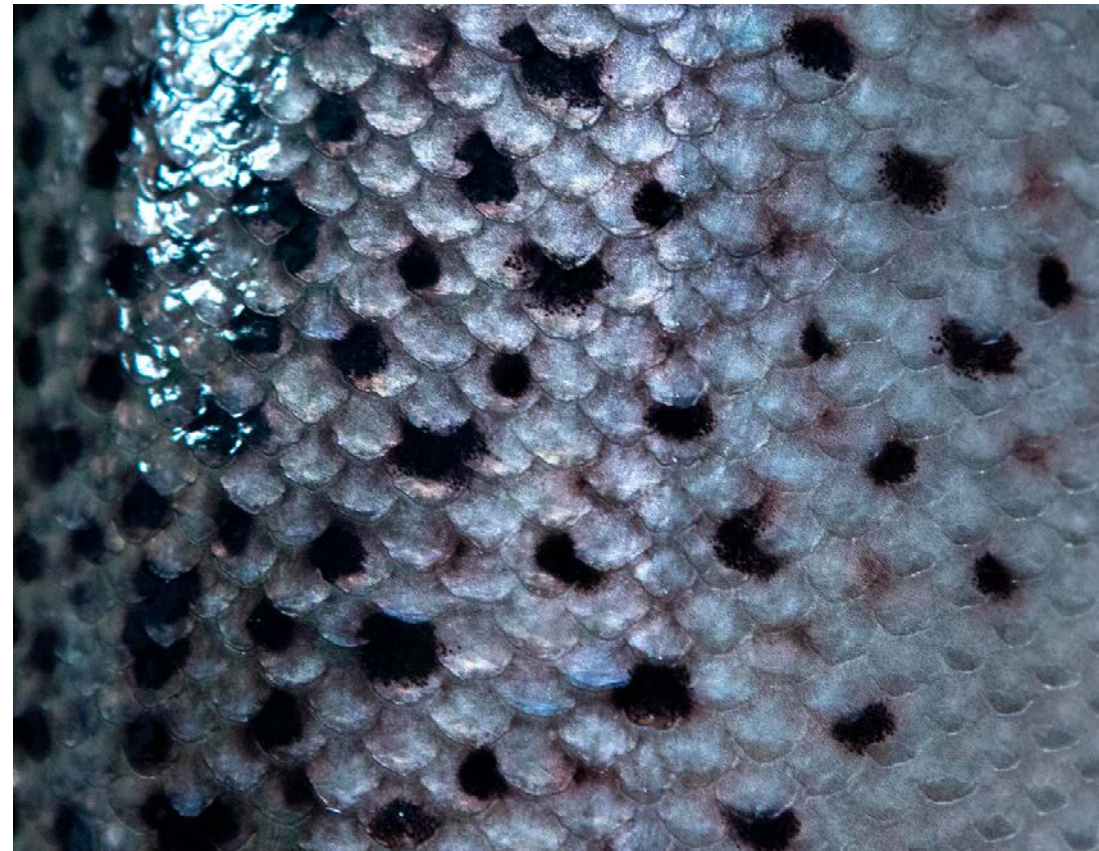


# Restoration of Juktån

- 📍 Juktån river, Sweden
- 🐟 Trout and grayling
- 📍 Restore spawning areas
- 📅 2016-2025

In the early 20th century, the river Juktån served as a timber transport route, leading to significant disruption of the aquatic environment. The clearing of waterways for timber floating and the construction of piers damaged spawning and nursery areas for stream-dwelling fish. In the late 1960s, the Juktån power station was completed, which diverted most of the river's flow and further impacted the aquatic ecosystems.

In 2016, Vattenfall, University of Umeå, Samverkan Umeälven, and other power companies initiated a project to restore Juktån. The goals included restoring spawning areas for trout and grayling, increasing stream habitat areas, and enhancing Juktån's appeal as a fishing and recreational site. The restoration was completed in autumn 2020, and the ecological effects will be monitored until 2025.



# Voluntary protected areas around hydro plants

- 📍 Sweden, along the rivers Luleälven and Dalälven
- 🌿 Fairy slipper, moonwort, lady's slipper, and witches cauldron
- 🎯 Preserve and manage biodiversity, enhance recreational values
- 📅 Continuous

The properties around Vattenfall's hydropower plants hold high biodiversity values as they are not impacted by operations. To protect rare and endangered species, Vattenfall has established voluntary protected areas with unique biodiversity values.

There are four protected areas in northern Sweden along the river Luleälven and one along the river Dalälven called "Kungsådran Älvkarleby." These areas host botanical species like the fairy slipper, moonwort, lady's slipper, and witches cauldron. The initiative aims to preserve biodiversity and enhance recreational values by improving access, putting up information signs, building a bird tower, and adding interpretive signs at path crossings to inform and guide visitors to the species that can be spotted along the walk.





# Laxeleratorn: exploring innovative solutions for safe fish passage

- 📍 Vattenfall's Älvkarleby Laboratory, Sweden
- 🐟 Eel and post-spawning salmon (kelt)
- 🎯 Solutions for up and downstream fish migration
- 📅 Continuous

Over the next 20 years, all Swedish hydropower production will be environmentally tested and equipped to meet modern environmental standards. The challenge is to find solutions that reduce negative effects on ecosystems and biodiversity while minimizing the impact on electricity generation.

In 2019, Vattenfall invested in “Laxeleratorn,” a large-scale laboratory for hydropower-related environmental and hydraulic experiments. The facility focuses on innovations for safe fish passage, including intake racks, “dancing rods,” and bubble curtains. Research has been conducted on the efficiency of various guidance solutions, eel behaviour, and the reaction of post-spawning salmon (kelt) to changes in water conditions to establish design criteria for bypass systems.





# Building fish ladders at hydropower stations

- 📍 Sweden and Finland
- 🐟 Migrating fish
- 🎯 Improve fish migration
- 📅 Continuous

Hydropower plants create barriers in rivers, limiting the ability of migrating fish species to travel upstream and downstream. Migrating fish like salmon and sea trout face challenges in passing through hydropower stations, impacting their ability to reach spawning areas.

Fish ladders have been constructed at several hydropower stations, including Stornorrfors (Ume River), Hietamankoski, and Leuhunkoski (Kymmene River), to increase passage capacity for migrating fish.

In 2024, over 7,836 salmon and 312 sea trouts passed through the Stornorrfors fish ladder on their way to spawning areas in the river Vindelälven. Additional measures have been taken to facilitate fish migration in the old riverbed downstream of the hydropower plant. The 300-meter-long ladder was put into operation in 2010. Vattenfall is, in collaboration with the Swedish University of Agricultural Sciences (SLU), also analyses how the downstream passage of fish through Stornorrfors can be improved.





# Ensuring efficient fish passage: mapping fish using AI

- 📍 Stornorrfors hydropower plant, Northern Sweden
- 🐟 Salmon and trout
- 📍 Efficient fish passage and monitor fish population health
- 📅 Continuous

To ensure that the fish passage works efficiently, Vattenfall initiated a project to test how artificial intelligence (AI) can be used to monitor the effectiveness of fishways. An AI program was developed and trained on a substantial image dataset to directly analyse images of migratory fish captured underwater.

The AI-based fish recognition system is deployed at the fish ladder in the Stornorrfors hydropower plant in northern Sweden, where it counts and registers attributes of individual salmon and trout. The algorithm has been progressively refined each

season and now provides real-time fish monitoring data through an online dashboard.

The latest enhancement allows for measuring the size of fish, facilitating pattern visualization on a heatmap and assessing the health of the fish population. The collected data also offer insights into the behaviour of the fish, such as swimming patterns, group dynamics, and gender identification. By analysing this data, assertions can be made about the state of the fish population and strategies for its improvement can be devised.





# Ensuring safe fish passage: guiding fish using pumps

- 📍 Edsforsen, Sweden
- 🐟 Salmon
- 🎯 Divert fish from swimming into the turbines
- 📅 Continuous

At large hydropower plants, guiding fish is highly complex and conventional intake racks are often expensive and not a feasible solution. As part of our work with R&D, we are therefore continuously evaluating how new technology can help to guide fish away from high-mortality passages and towards safer routes.

We have tested different solutions, one example being large pumps that can be used to create a jet flow that guides fish in the right direction. In late 2024, a large pump (9 m<sup>3</sup>/s) was tested at Edsforsen hydropower plant and the guiding efficiency is being evaluated by the Swedish University of Agricultural Science.



Photo: Jesper Myhr



# Biotope restoration and species protection

- 📍 Sweden and Finland
- 🐟 Saimaa salmon, eel, noble crayfish, freshwater pearl mussel, trout, grayling, kestrels and bats.
- 🌐 Support species and their living environments around hydropower operations
- 📅 Continuous

Biotope restoration and species protection play a vital role in adapting hydropower to the environment. New initiatives are continually being explored to enhance the conservation efforts and support the diverse eco-systems around hydropower operations. Here are some examples of biotope restoration projects for key species:

**Saimaa salmon:** Supporting research by the Natural Resources Institute Finland to restore the natural life cycle of this important species.

**European eels:** Part of the “Krafttag ål” project, involving the transport of spawning European eel past hydropower stations in the river Göta älv (ongoing).

**Noble crayfish, freshwater pearl mussel, trout, and grayling:** Engagement in biotope restoration of tributaries to the river Upperudsälven.

**Sea trout:** Participated in the ReTrout project to reintroduce sea trout by stocking roe in restored tributaries to the river Vindelälven.

**Kestrels and bats:** In 2023, Vattenfall Hydro Germany was awarded a certificate for species protection on buildings by Kulturbund, an acknowledged nature conservation association, honouring our actions for the protection of kestrels and bats at our Hohenwarte and Eichicht sites.



# Conservation of lesser white-fronted goose in Sweden

- 📍 Ritsem, Northern Sweden
- 🦆 Lesser white-fronted goose
- 🕒 Support long-term conservation of the species
- 📅 2021-ongoing

The population of the lesser white-fronted goose has steadily declined since the 1940s, making it one of the most globally threatened bird species in Sweden. Conservation efforts have been ongoing since the mid-1970s by authorities and organisation, and the areas where Vattenfall has many of its hydro operations are home to the EU's only breeding population of this species.

Vattenfall has supported conservation efforts by sponsoring specially designed transmitters powered by solar cells to track geese raised in captivity and released into the wild. In 2024, Vattenfall continued to support the project by assisting with stocking and monitoring the geese on site. The conservation project, "Projekt Fjällgås," is led by the Swedish Hunter's Association in collaboration with the foundation Nordens Ark and the Ornithological Society in Norrbotten.





# Salmon compensatory stocking

- 📍 Northern Sweden
- 🐟 Salmon
- 🎯 Sustain fish populations
- 📅 Continuous

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Hydropower 1

In Sweden, power companies that operate hydro-power plants are obliged to breed and stock fish to compensate for the reproduction areas lost as a result of hydropower regulation. Vattenfall has several fish farms, and the largest fish farm is in Heden, in the Lule River. Every year, Vattenfall releases 550.000 salmon smolts, 100.000 sea trout and 12.000 trout in the Lule River. In Sweden we stock in total 1,3 million salmon and sea trout each year.



# Projects funded by Bra Miljöval

- 📍 Sweden
- 🐟 Aquatic species
- 🌐 Enhance aquatic biodiversity
- 📅 Continuous

When Vattenfall sells electricity labelled 'Good Environmental Choice', funds are allocated to an environmental fund to enhance aquatic biodiversity. Over the years, this fund has helped restore nature and create habitats for threatened species. Here are a few project examples:

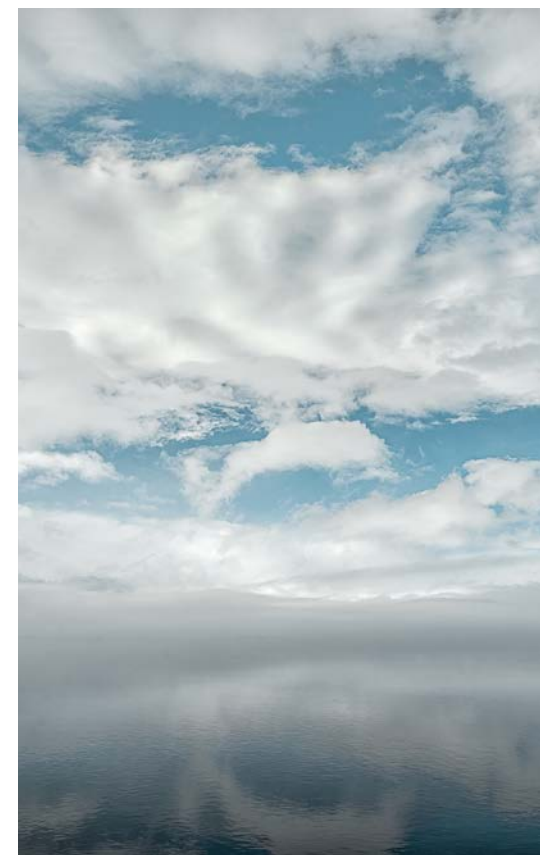
**Restoring tributaries to Lule River:** Since 2014, Vattenfall has co-financed restoration of spawning grounds and riparian environments, benefitting grayling, trout, and freshwater pearl mussels. Major projects included Flarkån, Pärlälven, and Linabäcken.

**LIV in lower river Dalälven:** This project has been investigating potential for salmon and trout production and how to restore a natural reproduction of salmon and sea trout.

**Floating island for black-throated diver in the Indalsälven:** The project has built and deployed a floating island in the Indalsälven upstream of the hydropower plant Midskog.

**Measures for Noble crayfish in Upperudsälven, Rävmarksälven and Älgeröälven:** In the southwest of Sweden we have had two projects to improve the situation for the acutely endangered Noble Crayfish. During 2022, 7300 crayfish juvenile and 1-3 year old noble crayfish were reintroduction in these restored areas.

**Reintroduction and restoration of habitats for freshwater pearl mussel:** In 2022, a project began in Rolfsån with the goal to support the reintroduction of freshwater pearl mussels by infecting host fish with glochidia larvae in combination with restoring aquatic habitats.





# Eel recovery in Elbe river, Germany

📍 Elbe river, Germany

🐟 European eel

🎯 Positively influence the fish population with a special focus on European eel

📅 2014-2025

In the area of the Geesthacht pumped storage plant, above the Geesthacht fish ladder, the Elbe serves as a lower basin for the pumped storage operation.

The operation of the pumped storage plant can negatively impact the fish population, particularly the sensitive European eel species.

A fish-friendly operational model has been implemented, reducing pump activities during August and September to positively influence the fish population. Additionally, an agreement with the local environmental ministry provides financial support since 2015 dedicated to recovery measures for the European eel, aiming to stabilize eel stocks in the Elbe River. In Q1 2025 the ministry will provide Vattenfall a report with the efficiency of the stocking measures, to decide the further financial support.







## 2

# Biodiversity projects within offshore wind, onshore wind, and solar and batteries

In developing and operating wind, solar, and battery projects, we strive for co-existence with a rich natural environment, including protected species and habitats. We do this by:

- Minimising impact on biodiversity and ecosystems through the project lifecycle
  - Implementing Nature Inclusive Design and collaborate with partners to regenerate or restore ecosystems
- Consolidate the knowledge base and scientifically test innovative solutions to further increase positive outcomes for biodiversity and ecosystems

This chapter follows some concrete examples of how this is realised in a practical context.



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# Mapping bat movements offshore: The Kattegat West Baltic Bats Project (KABAP)

- 📍 Kattegat Sea and Southwest Baltic
- 🦇 Bats (nathusius' pipistrelle, common noctule, parti-coloured bat, and soprano pipistrelle)
- 📍 Understand bat movements and mitigate collision risks through curtailment procedures
- 📅 2023-2025

Understanding bat movements over the sea between Denmark, Sweden, and the German Baltic coasts is crucial for offshore wind farm impact assessments and informing curtailment procedures to mitigate collision risks. However, current knowledge in this area remains limited. To address this gap, the Kattegat West Baltic Bats Project (KABAP) coordinates multiple site-specific studies and compiles data to develop a comprehensive geographical overview of bat migration patterns in spring and autumn.

The project focuses on most common bat species in the area, such as Nathusius' pipistrelle, common noctule, parti-coloured bat, and soprano pipistrelle. As bats are primarily nocturnal,

their monitoring relies on recording calls with bat detectors.

In 2023, a large number of bat detectors were successfully installed on buoys and structures across the Kattegat Sea and the Southwest Baltic, west of the Island of Bornholm to collect data on bat movements. The data have been processed and analyzed during 2024 and 2025. The data will contribute to two major offshore bat studies conducted by DCE-Aarhus University. One study examines the distribution of bats in Danish waters, while the other investigates interactions between bat occurrences, weather parameters, and turbine operational status to assess the need for curtailments that minimise collision risks.





# Tracking seabirds non-breeding season movements and behaviour

- 📍 Aberdeen Bay, Scotland
- 🐦 Seabirds (razorbill and guillemot)
- 🎯 Understand seabird migration patterns
- 📅 2017-2022

Understanding where seabirds from specific colonies spend the non-breeding season is crucial for assessing the potential impacts of new offshore wind farms. This helps identify overlaps between seabird habitats and wind farm sites, informing impact assessments and planning. To gather this information for razorbills and the guillemots, several hundred birds across numerous colonies in Scotland and Northern England were fitted with light logger tags. The results showed that razorbills tended to winter in the same area of the North Sea, while guillemots had colony-specific wintering areas.

The final report is available here: [Final report](#)

The seabird study was part of a larger EUR 3 million research and monitoring programme connected to the European Offshore Wind Deployment Centre (EOWDC) in Aberdeen Bay, Scotland. The programme was established to improve the evidence base for planning and impact assessment of future offshore wind farms. The programme is now completed, and the final reports have been published - for a full overview of the programme, please visit the [EOWDC website](#).



# Adapting flight paths: a study on seabird behaviour around wind turbines

- 📍 Aberdeen Bay, Scotland
- 🦅 Seabirds (gannets, kittiwakes, and herring gulls)
- 📍 Document the effect of the wind farm on seabird flight patterns
- 📅 2019-2022

Flight behaviour is another topic that has been studied as part of the European Offshore Wind Deployment Centre (EOWDC) research and monitoring programme.

Using a combined radar and video tracking technology, the study collected data on seabirds – such as gannets, kittiwakes, and herring gulls – to observe how they adjusted their flight behaviour to the presence of wind turbines during the breeding and post-breeding periods. The study area is home to numerous coastal seabird, with birds commuting to offshore feeding areas that sometimes lie near the wind farm. Results showed that seabirds actively avoided flying near the turbines and frequently adapted their flight paths to avoid crossing the rotating blades.

The final report is available here: [Final report](#)





# Advancing seabird collision risk assessment: a flight tracking AI project

- 📍 Aberdeen Bay, Scotland
- 🐦 Seabirds
- 🎯 Improve collision risk predictions
- 📅 2023-2024

Existing technologies have fallen short in documenting three dimensional flight tracks of seabirds near wind turbines, as shown by the European Offshore Wind Deployment Centre (EOWDC) seabird study. Accurate, objective evidence on close-range behaviour is crucial for reliably predicting collision risks for new wind farms.

To address this gap, a collaborative project was initiated with the Norwegian start-up spoor.ai to trial innovative technology that combines video cameras with Artificial Intelligence (AI). The British Trust for Ornithology (BTO) provided scientific validation, and a panel of key stakeholder experts was established to ensure high-quality outcomes.

Four cameras were installed in the EOWDC wind farm to collect data during 2023. Both on-site, observer-based and offsite, drone-based validation trials were conducted. The results are expected to be published in spring 2025.



# Enhancing marine biodiversity: nature inclusive design Hollandse Kust Zuid

- 📍 Hollandse Kust Zuid (HKZ), Netherlands
- 🌊 Marine life
- 🎯 Enhance biodiversity and evaluate benefits of Nature Inclusive Design (NID) measures
- 📅 2021–present

Nature-inclusive design is an approach in offshore wind that aims to boost ecological functions by integrating features into wind farm structures, making them more suitable for native species.

At the Hollandse Kust Zuid (HKZ) offshore wind farm in the Netherlands, Vattenfall has implemented measures to enhance biodiversity as part of its permit obligations. Each foundation has water replenishment holes to allow marine life to move freely in and out of the foundation, and large rocks were added to the scour protection at nine locations to increase habitat complexity.

Vattenfall will monitor biodiversity development after 2, 6, and 11 years. In 2023, Vattenfall joined the KOBINE project, funded by the Ministry of Agriculture, Nature, and Food Quality, to assess the costs and benefits of nature-inclusive policies. One case study focuses on the rock reefs at HKZ, with initial results on biodiversity expected in 2025.





# Nature conservation efforts at Windplanblauw: artificial reefs and resting areas

📍 Flevoland, The Netherlands

🐟 Freshwater species (fish, mussels, and great crested grebe)

🎯 Mitigate impact on local wildlife

📅 2019–ongoing

Windplanblauw is a wind energy project located in the municipalities of Dronten and Lelystad in the northwest corner of the province of Flevoland in central Netherlands. This unique project features onshore installations and offshore installations in the shallow waters of Lake IJsselmeer. Approved in November 2019, the entire wind farm was fully commissioned by 2024.

Ecological considerations have been part of the project from the outset. Situated within a Natura 2000 site, Windplanblauw adheres to the European bird and habitat directives to protect biodiversity.

To mitigate the impact on local wildlife, several measures have been implemented.

These include establishing a designated resting area for the great crested grebe along the IJsselmeerdijk, which is closed off to shipping for a length of 7.8 km, about 200 reef balls made of eco-friendly and pH-neutral concrete have been deployed on the lake bottom near the wind farm. These structures provide a substrate for mussels and create habitat for freshwater fish species, in turn potentially enhancing the food supply for the great crested grebe and other waterfowl.



# Supporting seabird breeding: compensation measures at Norfolk Vanguard Wind Farms

- 📍 North Sea - English Norfolk coast
- 🦅 Seabirds (kittiwakes and lesser black-backed gulls)
- 🎯 Enhance the breeding productivity of local seabird populations
- 📅 2023 and ongoing (now taken over by RWE)

During the development of the two large-scale offshore wind farms off the Norfolk coast in the North Sea (acquired by RWE in 2024), Vattenfall voluntarily introduced measures to enhance the breeding success of local seabirds. Although the collision risk for seabirds is low, concerns remain about potential cumulative effects across many offshore wind farms. Specific measures were implemented to help mitigate potential impacts on species that have experienced dramatic population declines over recent decades - namely, kittiwakes and lesser black-backed gulls, both of which are of particular concern.

For kittiwakes, artificial breeding structures, known as “kittiwake hotels,” were constructed in Lowestoft Harbour. These structures, designed in consultation with experts from Natural England, RSPB, East Suffolk Council and the Marine Management Organisation, provide optimal breeding conditions for kittiwakes, and can accommodate up to 430 breeding pairs. For lesser black-backed gulls, predator-proof fencing was installed at the breeding colony at the Alde-Ore Estuary bird protection area to reduce predation pressure from foxes and other predators.





# Sustainable food production at Scandinavia's largest offshore wind farm

- 📍 Danish Kriegers Flak, Denmark
- 🌊 Marine ecosystems
- 🎯 Combining aquaculture with wind farms
- 📅 2023-2026

At Vattenfall's Danish Kriegers Flak offshore wind farm (DKF), Danish researchers are testing the multi-use concept of producing sustainable food while generating fossil-free energy. The project WIN@sea investigates the practical aspects of combining the aquaculture of seaweed and mussels with wind energy production.

Seaweed was successfully harvested in June 2024 at the DKF wind farm. Both mussels and seaweed are currently growing, with a second harvest event expected in May-June 2025. The project will use the practical learnings from the pilot to assess risks and opportunities of scaling up aquaculture practise in wind farms that can help regenerate marine ecosystems in the Baltic Sea and the North Sea.

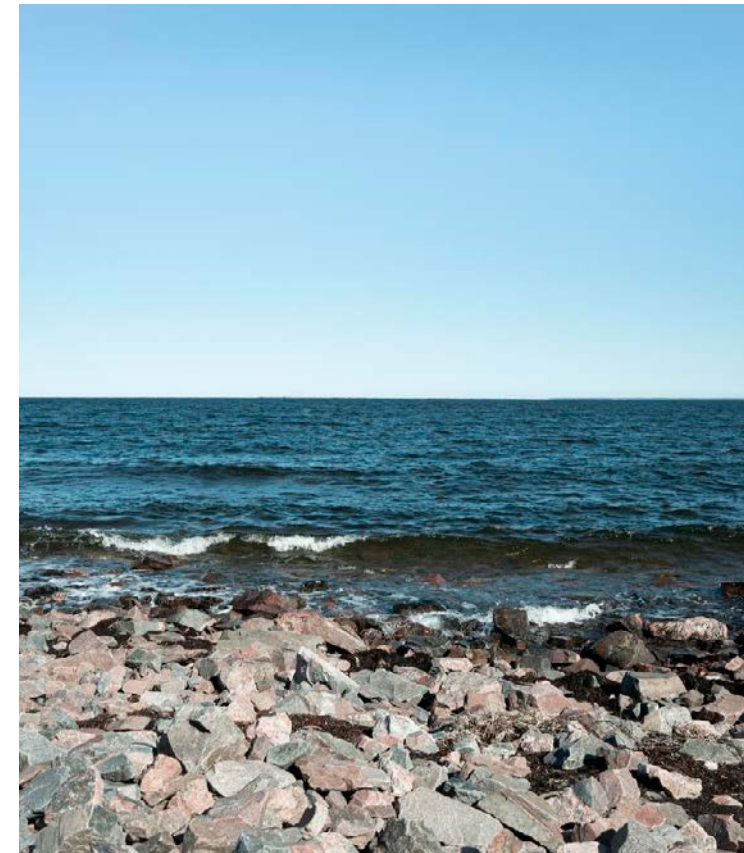


# Enhancing marine life and mitigating coastal erosion with stone reefs

- 📍 Island of Samsø, Denmark
- 🌿 Marine fauna and flora, coastal ecosystems
- 🔍 Investigate coastal stone reefs as a solution for coastal erosion and to support marine life.
- 📅 2021-2028

Assessing nature-based solutions to mitigate biodiversity impacts from offshore wind requires a broad perspective that extends beyond the wind farm, recognising that areas outside the operational zone offer opportunities for more effective and beneficial biodiversity interventions. To assess the potential of nature-based solutions, Vattenfall is actively following and co-funding with Velux Foundation, the BARREEF project, led by the National Institute of Aquatic Resources at the Technical University of Denmark (DTU Aqua).

A pilot on Samsø Island, Denmark, will test whether a stone reef deployed in 2025 can provide coastal protection while creating habitats for marine life. Coastal erosion is an increasingly important societal challenge, and traditional methods like beach nourishment can damage coastal ecosystems and exacerbate climate impacts. In contrast, deploying coastal stone reefs has the potential to absorb wave energy, while also benefitting marine biodiversity. The project also involves discussions with local stakeholders and authorities to minimize harmful practices and improve climate resilience.





# Impact of offshore windfarm decommissioning on marine biodiversity

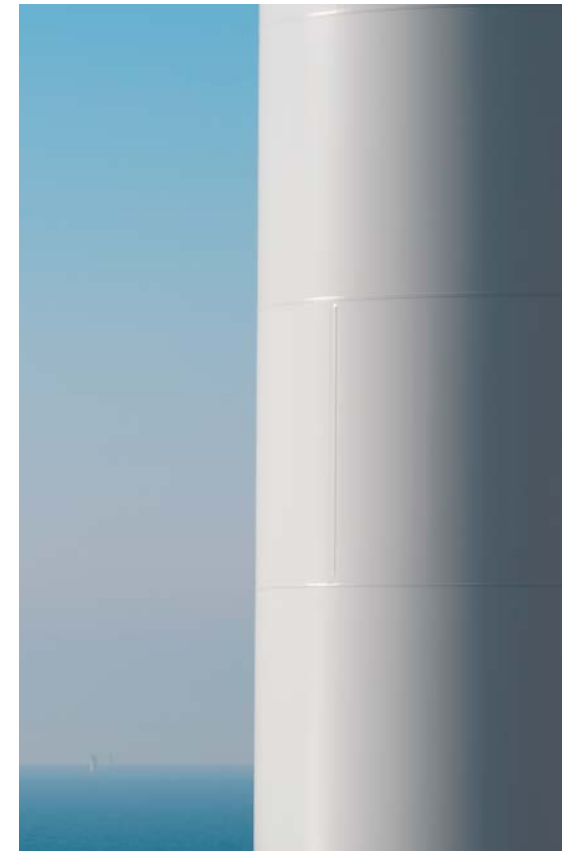
- 📍 Denmark
- 🐚 Benthic species (blue mussels, anemones, and reef-building worms)
- 🎯 Analyse the impact of decommissioning offshore windfarms on marine biodiversity
- 📅 2022-2025

Offshore wind foundations create habitats that support benthic species such as blue mussels, anemones, and the reef-building worm *Sabellaria alveolata*. These species provide important ecosystem functions. However, current legislation mandates the complete removal of these structures at decommissioning, removing these habitat and associated biodiversity.

This conflict underscores the need to assess biodiversity impacts. In response, the Technical University of Denmark and Vattenfall have partnered to analyse the impact of various offshore windfarms decommissioning scenarios on marine biodiversity. A PhD project has been initiated to develop a model that estimates these impacts and better integrates marine biodiversity into life

cycle assessments, supporting scientifically based decisions on whether to completely remove wind turbine structures or leave parts of the foundations in place.

Additionally, the project examines the social acceptance of partial removal as a decommissioning option, leaving some structural elements at sea to maintain the artificial reef. An extensive survey of the Danish population will present respondents with varying levels of information on the reef effect and the potential climate benefits of removing and recycling these structures. The study aims to determine how the provision of information influences social acceptance of different decommissioning options. Scientific papers are currently under preparation, with publication expected in 2025 and 2026.



# Exploring potential electromagnetic disturbance in wild porpoises

- 📍 Great Belt, Kattegat Sea
- 🐬 Harbour porpoises
- 🎯 Investigate the effects of electromagnetic fields on harbour porpoises
- 📅 2024-2025

There is critical knowledge gap concerning the potential impact of electromagnetic fields (EMF) on marine mammals amid increasing electrical cable installation and other human activities in marine environments. This research project aims to determine whether EMF from underwater infrastructure may disturb harbour porpoises.

In the first stage of the project, completed in June 2024, it was established that the proximity of underwater power cables can be detected through electromagnetic anomalies in biologging data from tagged porpoises, indicating some level of electromagnetic exposure in wild porpoises.

In the second stage, starting in January 2025, additional lab experiments will be conducted at Fjord&Bælt, where harbour porpoises in captivity are trained to work voluntarily in various research projects. The animals are never subjected to any form of punishment, whether verbal or physical. The animal trainers are guided to ensure that the animals can participate in various projects responsibly. Porpoises will be exposed to a range of EMF, and their behaviour will be observed. The results will then be used to model and quantify potential harbour porpoise EMF disturbance ranges surrounding existing EMF infrastructure. Results of the first stage of the project are expected to be submitted for peer-review publication in 2025.





# Coexisting with Capercaillie: innovative forestry methods at Bruzaholm wind farm

- 📍 Bruzaholm wind farm, Sweden
- 🦉 Capercaillie
- 🎯 Develop a method for coexistence between capercaillie and monitor wildlife in capercaillie habitats
- 📅 2022-2025

At the Bruzaholm wind farm in Sweden, a new approach for balancing wind power and Capercaillie conservation was developed as part of the permit process in 2020. This solution involves a declaration of intent with the landowner to adjust forestry practises to benefit the capercaillie population – preserving “skirt spruces” to protect the birds from predators and avoiding clear-cutting the area and retaining larger deciduous trees.

To increase our understanding of the species and its boreal habitats, Vattenfall launched a project led by the Swedish University of Agricultural Science. The project use

AI-based software to monitor wildlife in capercaillie habitats at four sites across Sweden. Monitoring began in 2023 using remote cameras, audio recorders, and GPS-tracking, with the first phase of the monitoring concluding in 2024, yielding promising results.

Preliminary findings show high accuracy for both camera (95%) and acoustic (90%) monitoring and provide detailed insights into peak vocalisation periods, enabling more efficient future monitoring. Reports and scientific papers are currently under preparation, with publication expected in 2025.



# Protecting eagles: testing AI-based system for mitigating collision risks

- 📍 Gotland, Sweden
- 🦅 Eagles (golden and white-tailed eagles)
- 🎯 Protect eagles from wind farm-related mortality, test system to detect and preventing eagle collisions
- 📅 2019-2022

Because eagles are long-lived and reproduce slowly, their populations are more vulnerable to fatalities compared to other bird species. Therefore, effective mitigation measures are essential during wind farm development to protect these species.

A previous study indicated that implementing such measures would result in only approximately 1% loss in annual energy production. To explore the possibilities of developing and operating wind farms in areas with eagle presence, Vattenfall tested a

camera and Artificial Intelligence based system (Identiflight) designed to shut down turbines when eagles are at risk of colliding. The system demonstrated high detection and identification efficiency for Golden and White-tailed eagles.

The project was a collaborative effort between the Swedish Energy Agency, GVP, the County of Gotland, and Vattenfall, conducted at the Vattenfall and Slite Vind wind farms at Näsudden on the island of Gotland.



# Enhancing bird safety: increasing turbine visibility to reduce collision risk

- 📍 Norway and the Netherlands
- 🦅 Birds (white-tailed eagles and willow ptarmigan)
- 🎯 Testing of colouring as a means to reduce collision risk
- 📅 2012-2025

Increasing turbine visibility to birds is one strategy to reduce collision risks, and it is an approach that we are interested in exploring. Vattenfall participated in the INTACT project on Smøla, testing innovative measures to enhance turbine visibility. Painting one rotor blade black and the tower base black showed promising results, particularly for species such as white-tailed eagles and willow ptarmigan.

Building on these findings, Vattenfall has entered a new collaborative research project in the Netherlands to further test the black blade measure (more information can be found [here](#)) and recently started a project with Oxford University to understand the potential of alternative colours and patterns on turbines blades.





# Protecting upland wildlife: mitigation and monitoring efforts at Ray Wind Farm

- 📍 Ray Wind Farm, United Kingdom
- 🐾 Mammals, birds, reptiles and invertebrates
- 🌐 Biodiversity mitigation during construction and operation
- 📅 2015–ongoing

Ray Wind Farm in England encompasses diverse upland habitats, including coniferous woodland, blanket bog, wet and dry heath, acid grassland, and waterways. During construction, effective mitigation measures were implemented to support a wide range of wildlife, including several rare and protected species.

The site hosts species such as red squirrels, badgers, otters, bats, reptiles, white-clawed crayfish, and several owl and raptor species, such as barn owls, merlins, and goshawks.

Protecting these species from construction impact was crucial, and the habitat management plan was a key component of the wind farm's permit.

Following construction, operational monitoring and mitigation has been undertaken to maintain and enhance the site's ecological sensitivities. This includes managing moorland habitats, conducting dedicated breeding bird surveys, protecting sensitive nest sites and implementing targeted monitoring and mitigation for bat populations.



# Flower-rich grassland initiative at Princess Ariane Wind Farm

📍 Wieringermeer, Netherlands

🐝 Grassland species

🎯 Repurpose agricultural land for biodiversity enhancement

📅 2022-2024

Vattenfall's Princess Ariane Windfarm (Wieringermeer) is located in an agricultural region in the Netherlands. The installation of cables and turbines imposed land use restrictions that rendered some farmland unsuitable for traditional agriculture. Consequently, Vattenfall repurposed part of this land - including the service centre area - to enhance biodiversity. Four hectares have been converted into flower-rich grassland, and in 2024, some of the land leased to a local farmer was transitioned to ecological farming.



# Restoring peatlands: forest to bog transformation in the UK

- 📍 Clashindarroch and Pen y Cymoedd, United Kingdom
- 🌿 Peatland habitats
- 🎯 Restore peatland ecosystems and increase biodiversity
- 📅 2019-2042

At two sites in the UK, Vattenfall has been converting land previously under commercial conifer plantations into open peatland habitats. The smaller project at Clashindarroch in Scotland (approximately 35 ha) was completed in early 2022, while a larger-scale restoration at Pen y Cymoedd in Wales - spanning up to 1500 ha - began in late 2021 and will continue for several years.

At Pen y Cymoedd, Vattenfall is investing £3m in the project and has partnered with the neighbouring Lost Peatlands of South Wales Project, making it one of the largest restoration initiatives of its kind in the country.

Although both projects are mandated by the permits, Vattenfall has also voluntarily funded a three-year research programme at Swansea University to assess the risks and opportunities of wind farm development and peatland restoration on forested peatlands.

Peat restoration within these Habitat Management Plans involves ditch blocking and ground smoothing to raise the water table - an essential step in re-establishing a functioning peat bog. Healthy peatlands can reduce greenhouse gas emissions, store carbon, and increase biodiversity.





# Enhancing ecosystem services: multi-functional land use initiatives in solar projects

- 📍 Netherlands, northeast Germany
- 🐾 Smaller mammals, birds, and insects
- 🌐 Enable multi-functional land use
- 📅 2024-ongoing

At Vattenfall's solar farms, efforts are underway to enable multi-functional land use by combining fossil-free ambitions with broader sustainability objectives such as agriculture, soil restoration, nature conservation, and climate adaptation.

In northeast Germany, the Tützpatz project is pioneering agrivoltaics. From 2025, one area will host approximately 15,000 chickens while two other areas will remain under conventional agriculture. In addition to planting native shrubs, Vattenfall will establish a flower meadow spanning around two and a half hectares.

In the Netherlands, several pilot projects aim to increase the provision of ecosystem services. For example, the Symbizon partnership - in collaboration with academic and industry organisations - is exploring the integration of cultivation for organic food production between solar panels. Furthermore, in the Netherlands, Vattenfall supports the development of an Eco-certified Solar Label to recognise good biodiversity practices and outcomes during development and operation.





3

# Biodiversity in the distribution network

For Vattenfall Distribution, the conservation of biodiversity is one of the most important environmental aspects, both in permit processes and in the maintenance of the operations.



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# Biodiversity enhancement in power line corridors: strategic maintenance and conservation efforts

- 📍 Middle and northern Sweden
- 🐝 Grassland species and pollinators
- 🌍 Enhance biodiversity in power line corridors
- 📅 2017-2026

Vattenfall's regular clearing of power line corridors is crucial for reliable power transmission. Despite environmental impacts, these clearings create habitats for grassland species, including threatened ones. Research underscores the importance of these corridors in green infrastructure as traditional grasslands decline.

In 2017 and 2019, Vattenfall conducted a GIS-based analysis to identify biodiversity hotspots in its power line corridors. The analysis identified 1,600 km of potentially valuable grassland out of a total of 8,600 km in middle and northern Sweden. Field studies and biodiversity assessments were then conducted to validate and prioritize these hotspots.

The field studies documented habitats and species, classifying 980 hotspots covering about 250 km. Vattenfall's maintenance routine involves clearing power line corridors every eighth year and patrol paths every fourth year. Insights from the hotspot identification led to tailored maintenance plans for each hotspot to enhance biodiversity, e.g., through the creation of glades, widening patrol paths and removing the cut material as well as special trimming and thinning out to prevent overgrowth. The measures aim to favour, among others, bumblebees, bees, and butterflies. By 2024, 61% of the hotspots had tailored maintenance, with a target of 100% by 2026.



# Ecological compensation in overhead line project

📍 Stockholm, Sweden

🦋 Birds, insects, amphibians, plants, and fungi

🎯 Enhance the reserves' natural values with compensatory measures

📅 2024-2026

Vattenfall Eldistribution AB is undertaking a capacity enhancement of the regional network in Stockholm County, which includes the construction of two new overhead lines in Huddinge Municipality. The lines need to pass through several municipal nature reserves.

To minimize the impact on the natural values of the reserves, early dialogue was initiated with the municipal ecologist and reserve manager to collaborate on appropriate measures. Preventive measures such as the placement of power line towers and transport routes have been developed. Despite this, the construction involves intrusion into the reserves and requires compensation measures. The older forest areas that are felled cannot be replaced, but other

natural values can be strengthened and expanded to make the reserves more resilient to future changes.

A number of compensation measures have been established, including the construction of livestock fences to expand natural pastures, the placement of birdhouses for species such as swifts, kestrels, and tawny owls, the creation of stone piles for wheatears, and the veteranization of trees to create habitats for birds, insects, bats, lichens, and mosses. Sand beds are created to benefit ground-nesting wild bees, and hibernation sites for amphibians are planned. The work on compensation measures will be carried out in parallel with the construction of the power lines and handed over to Huddinge Municipality for future operation and maintenance.



# Biodiversity enhancement at substations: strategic measures for pollinators

- 📍 Sweden
- 🐝 Pollinators (bumblebees, bees, and butterflies)
- 🎯 Conduct biodiversity enhancement measures at substations
- 📅 2022-2024

In recent years, the decline in pollinators like wild bees and bumblebees has threatened biodiversity and ecosystem health. Many of our substation sites across Sweden offer opportunities to enhance biodiversity and benefit these pollinators.

In 2022 and 2023, a GIS-based analysis of 90 substations assessed their potential for biodiversity enhancement. Factors like proximity to species, historical land use, and the surrounding environment were considered. Sixteen of these stations were selected for detailed field visits, and the conclusion was that maintenance practices at some stations could be adapted to benefit various species of bumblebees, bees, and butterflies.

During 2024, customized maintenance instructions were developed for five of the substations and implemented on four of them. Each contractor in charge of maintenance received detailed instructions on how the areas around the substations should be maintained to promote biodiversity, such as when lawns should be mowed, which trees and bushes should be pruned, and which ruderal areas should be disturbed by scraping. Valuable flora and fauna were identified at two station areas, prompting additional measures such as the creation of sand beds for bumblebees and wild bees. The goal for 2030 is to have carried out measures at 20 substations.





# Creating habitats for endangered bees: sand bed initiative at Gotland, Sweden

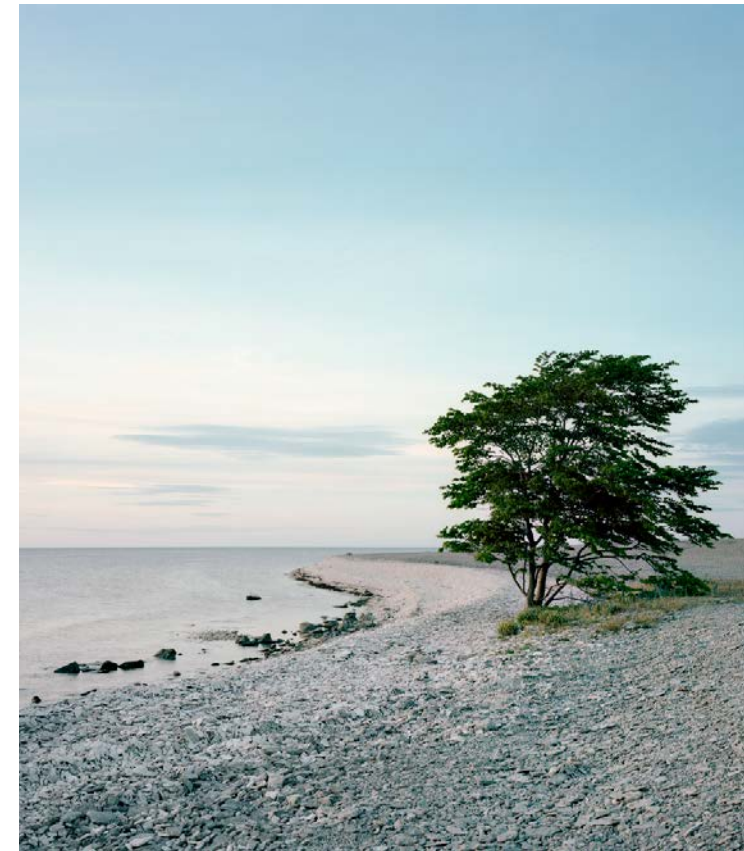
- 📍 Gotland, Sweden
- 🐝 Sand-living solitary bees
- 🎯 Create habitats and nests for endangered sand-living solitary bees
- 📅 2019

Sand-living solitary bees are fascinating creatures that play a crucial role in our ecosystems. Unlike honey bees or bumblebees, solitary bees nest alone, often underground, and many people know very little about them.

These bees are endangered due to habitat loss from human activities like industrial agriculture and urbanization, climate change, and threats from parasites and invasive species, posing significant risks to their survival.

During the renovation of a power line in Gotland, Sweden, a sand bed was

created to help endangered bees. Vegetation was removed and replaced by open sandy areas to create habitats and nests for these species. GEAB's power lines in Stånga, Gotland, are among Sweden's best habitats for sand-living solitary bees. The project, initiated in collaboration with the County Administrative Board in Gotland, also aimed to increase awareness among employees, encouraging them to create small bee nests in their gardens by removing vegetation in some parts to expose sandy areas.





4

# Biodiversity measures connected to our heat operations





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# Biodiversity enhancement in an industrial landscape

- 📍 Diemen, Netherlands
- 🐛 Insects, plants, and birds
- 🌍 Nature protection and enhancement
- 📅 Continuous

Our Heat operations are often situated near urban areas, and the land surrounding our power plants can be utilised to support urban ecology. In Diemen, we have collaborated with FREE Nature (Foundation for Restoring European Ecosystems) to manage two nature reserves (unused industrial land) located around our power plant.

Together with FREE Nature, we continuously seek opportunities to support local wildlife. Ecologists conduct annual visits to monitor the animals and plants. Additionally, we have Highland cows grazing on unused industrial land. These cows are conservation grazers, meaning they help maintain and restore natural habitats. By grazing in a controlled manner, they aim to manage vegetation, prevent overgrowth, and support biodiversity.



# Sustainable biomass sourcing

- 📍 Sweden and the Netherlands
- 🚫 No specific species
- 🌐 Ensure environmentally and socially sustainable biomass sourcing
- 📅 Continuous

Biomass is a crucial energy source and a key component in the effort to phase out fossil fuels. Ensuring environmentally and socially sustainable biomass sourcing is of the highest priority to minimize environmental impact while maximizing resource efficiency.

The biomass used in our power plants must be sustainably produced in accordance with the Renewable Energy Directive and national legislation. As a first priority, we source locally and we commit to use bio-based recycled fuels, forest residues or residual products

(e.g. from forest, pulp- and paper industry) to ensure that high-quality wood is not used for heat production.

In addition, Vattenfall also trades biomass for third parties and all biomass sold through Vattenfall Energy Trading is certified by the SBP, Forest Stewardship Council, and ENplus. As a founding member of the SBP, Vattenfall Energy Trading has been involved in developing global sustainability standards for biomass and continues to support the program by relying on SBP- and/or FSC-certified suppliers.







5

# Biodiversity measures connected to our nuclear power operations

Vattenfall runs nuclear operations in Forsmark and Ringhals in Sweden, and we are also part-owners of SKB, who are accountable for responsible management of radioactive waste from nuclear power plants in Sweden. Our biodiversity work within nuclear encompasses both complex ecological investigations and permit related biodiversity measures as well as voluntary measures to enhance biodiversity.





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# New habitats for pool frogs & forest management in Forsmark

- 📍 Forsmark, Sweden
- 🐸 Pool frog, crested newts, and orchids
- 🎯 Mitigate impact from building the final nuclear fuel repository
- 📅 Continuous

When the Swedish Nuclear Fuel and Waste Management company (SKB) establishes the nuclear fuel repository in Forsmark, a pond which is home to endangered pool frogs will be filled. To protect the frogs, SKB has created six new ponds years before the impact to strengthen the conditions for this and other amphibian species, ensuring that the population of pool frogs continues to exist in the area. As an add-on, a hibernacula or 'frog hotel' was built to provide shelter for the frogs during winter. Before the pond infilling starts, amphibians living in the pond are caught and transferred to the new ponds.

This relocation project has been going on for two years and will continue during 2025. So far, about 170 pool frogs and 390

great crested newts have been relocated. In addition, SKB has also developed a forestry plan aiming to enhance biodiversity around Forsmark and preserve high-value forest areas. Efforts include, for example, maintaining habitats for the protected lady's slipper orchid through targeted clearance and maintenance.

We are participating in a regional initiative by the County Administrative Board called "Roadmap for a sustainable county" where SKB during 2024 has signed five so-called "sustainability promises" showing our commitment to protecting biodiversity. Building the final repository in Forsmark involves extensive ecological work, which SKB has been committed to for a long time.



Photo: SKB

# Supporting pollinators in Forsmark

- 📍 Forsmark, Sweden
- 🐝 Pollinating insects
- 🌍 Support local biodiversity by taking active measures
- 📅 Continuous

The industrial area at the nuclear power plant in Forsmark includes diverse habitats like coniferous forests, open grasslands, and sand. The topography also shifts throughout the industrial area. All these habitats and features exist in a rather small area, which increases the potential to do effective measures for different types of pollinating species.

Initial site visits identified areas for enhancing pollinator diversity, and several biodiversity measures were implemented between 2022-2023. This included creating new nesting

habitats, two fauna depots, a bee hotel and a sandbank. Grass cutting routines were also adjusted to allow full-season blooming and parts of the lawn were replaced with wildflower seeds.

In 2025, practices will continue to be maintained, including routines for how grass is cut and bushes cleared, as well as improvements to the sandbank created in 2023. Additional actions are planned but not yet confirmed and a follow-up inventory is planned in 2026. This project supports the Uppsala County Administrative Board's 'Roadmap for a sustainable county'.





# Biodiversity assessment for nuclear fuel suppliers

- 📍 Globally
- 🚫 No specific species
- 🎯 Mitigate supply chain impacts and risks
- 📅 Continuous

Biodiversity is not only a topic related to our own operations but also something that we address in connection with our supply chain. For nuclear fuel sourcing, we have included a biodiversity assessment on the uranium mining as part of our Environmental Product Declaration for electricity from nuclear power.

Potential impact on biodiversity is qualitatively described based on available material such as Environmental Impact Assessments, the mining companies' environmental programmes, information from open databases of the areas of flora and fauna including for example rare species, as well as the effect of land use changes mentioned earlier.

Biodiversity will continue to be an integrated part in the sourcing process of uranium. All Vattenfall's current and potential uranium suppliers are assessed from a biodiversity risk perspective, and new suppliers are expected to demonstrate how they consider biodiversity and apply the mitigation hierarchy if their operations are located in or near areas with high biodiversity, i.e., nationally appointed areas of high biodiversity importance, areas with vulnerable and threatened species, formally protected areas, etc.



# Return of fish and control of invasive species at Ringhals

📍 Ringhals, Sweden

🌿 Aquatic species

🎯 Mitigate biodiversity impacts and control of invasive species

📅 2011–ongoing

Cooling water is necessary for electricity production at Ringhals and it is taken from the sea via two intake channels to the nuclear power plant. Although most fish can swim against the current, the cooling water evidently comes with animals and plants that are normally found in the sea.

To minimise the impacts, species that are found are returned to the sea via a common sewer pipe that empties into the sea at a depth of 10 meters. This procedure is followed-up carefully, and the result shows that eels have a particularly high survival rate (86% survive).

Since 2011, a biological control program for invasive species has also been part of the ecological monitoring at Ringhals and it is carried out by the Swedish University of Agricultural Sciences (SLU). Surveys along the coast and inside the nuclear plant have identified invasive species like Asian blue crab, the Pacific oyster and several invasive algae species. Findings are reported to the County Administrative Board in Halland and documented in a database for authorities and researchers.





6

# Other biodiversity examples





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# Biodiversity enhancing measures in our office premises

- 📍 United Kingdom, Germany, Netherlands and Sweden
- 🐝 Various species
- 🎯 Enhance biodiversity around our offices
- 📅 2020-ongoing

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At Vattenfall, we aim to integrate our office premises with natural habitats. We therefore work to implement different types of measures that are suitable for both urban areas and for offices that are surrounded by more green space.

Some of the measures that we have implemented over the years include installation of insect houses, planting native wildflowers, establishing green roofs, replacing standard tiles to grass concrete tiles in parking lots, installing bird and bat nests, planting trees and bushes as well as veteranisation of trees to create old tree structures, mimicking habitats that favour red-listed species.

We have implemented measures in Sweden (Ringhals, Trollhättan, Älvkarleby), Germany (Berlin, Hamburg), the Netherlands (Slootdorp, Zoeterwoude) and United Kingdom (Hexham and Penzance).



# Vattenfall Umweltstiftung

📍 Germany

🐛 Various species

🎯 Support local biodiversity project and education

📅 1994–ongoing

The Vattenfall Umweltstiftung, an independent German environmental foundation managed by Vattenfall, has supported over 220 environmental projects since 1994. This non-profit organization offers grants to schools, associations, nature protection groups, and other NGOs for projects often with a strong emphasis on biodiversity. The foundation received the “Protection of Species Award 2021” from the initiative “Artenschutz in Franken®” for its efforts in protecting endangered species like wild bees and bats. The following are examples of projects supported by the foundation:

**Re-settlement of endemic species:** A project where kindergarten and school children have been involved in re-settling brown trout, minnows, and fire salamanders in streams around Wernigerode.

**Creating urban gardens:** A project in collaboration with a Hamburg association that helps young people in social work programs.

**Forest development:** A project aiming to create a mixed forest with near-natural structures and endemic tree species. This aims to make the forest more resilient to climate change and promote woodland ecosystems.





# Quantifying and valuing biodiversity

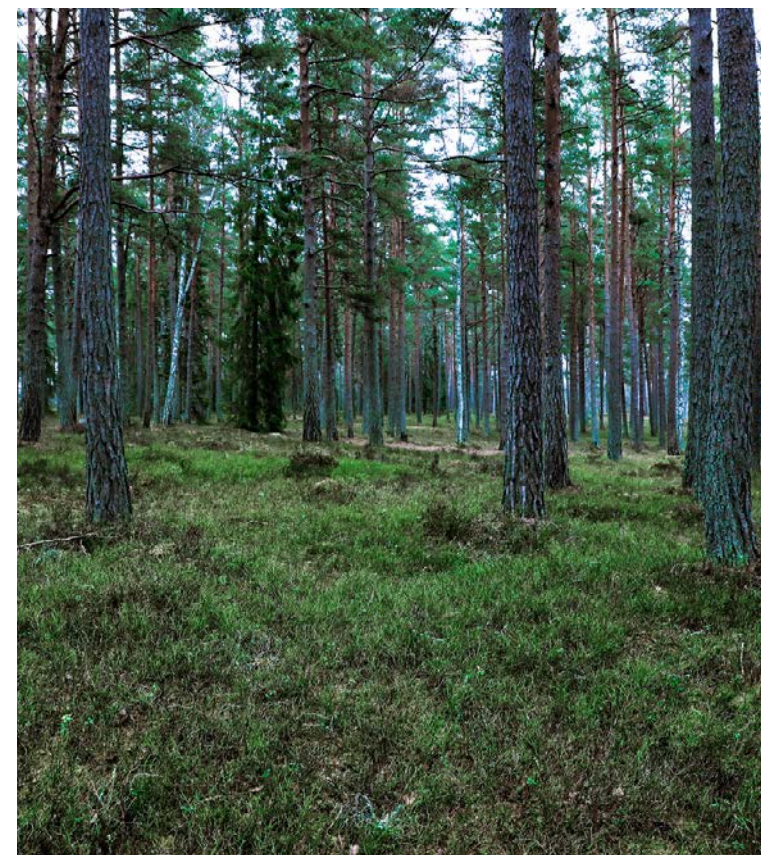
- 📍 The Nordics
- 🦋 No specific species
- 🎯 Developing a tool for quantifying and valuing biodiversity
- 📅 2020-2025

Measuring biodiversity with a single indicator is a challenge since biodiversity is complex. At the same time, there is an increased pressure on businesses to be more transparent and report biodiversity indicators.

To find a way forward, Vattenfall has been part of a cross-sector business initiative to develop a calculation model that can help companies quantify and communicate their impact on biodiversity. This model is called CLIMB (Changing Land use Impact on Biodiversity) and it was officially launched in September 2023 after approximately three years of work.

During 2024-2025, Vattenfall will pilot test the tool in several projects and see how we can use such a metric in our biodiversity work and we will continue to be a part of standardization of the tool.

CLIMB received the Sustainability Achievement of the Year 2023 award from the Network for Sustainable Business (Hållbart Näringsliv) recognizing its significant contribution to sustainability.



# Nature photo app contest

- 📍 Available for all Vattenfall countries
- 🚫 No specific species
- 📍 Raise awareness around biodiversity and collect biodiversity information
- 📅 2021-ongoing

Biodiversity has not gained as much attention as climate change, but it is important to build awareness around the importance of healthy ecosystems and a rich flora and fauna. To enhance internal awareness, Vattenfall has created a user-friendly app accessible to all employees, allowing them to share photos and videos of nature at diverse locations throughout the company's operations.

The primary goal is to enhance awareness, advance scientific knowledge, and promote environmental protection. Additionally, the app allows employees to participate in the annual Nature Photography Contest, where an internal jury selects the best images for people to vote on. A range of photographs have been submitted, showcasing nature on Vattenfall's sites.



Photo: Frank Buchcik