Biodiversity projects in Vattenfall

Focus on a greener world

VATTENFALL

Content

Latest update: February 2021

Enhancing biodiversity

A living planet relies on a diverse nature and the complex web of species that underpin the functioning of the ecosystems. Biodiversity provides fundamental and important services like climate regulation, carbon sequestration and pollination. Today, human activities continue to put enormous pressure on nature, and we see that the current rate of extinction is only accelerating. As a society, and as an energy company, we rely on the many goods and services provided by nature, and it is therefore critical that we act upon the challenges we are facing.

At Vattenfall, nature protection and biodiversity is embedded in our daily business, permit processes and R&D activities. To steer our efforts in the most efficient way we have a long-term 2030-ambition to strive towards Net Positive Impact on biodiversity and we have several strategic targets to deliver on our overarching ambition.

This brochure summarizes a selection of projects and initiatives within our biodiversity work. There is a broad range of projects ranging from forefront biodiversity research programs to small scale measures that enhance biodiversity locally at our different sites. Some initiatives are connected to permits and legal obligations while some are done on a voluntary basis.

With this brochure we want to share some of the things we do, and we hope to inspire.

Our efforts to protect nature and biodiversity will continue and we would like to invite other companies, organisations and authorities to collaboration and exchange knowledge. Together we can make great things for a greener world.

1. Biodiversity projects in hydro power

The implementation of the European Water Frame Directive (WFD), Habitats Directive and Eel Regulation have influence on Swedish hydropower. Our goal is to achieve an environmental adaptation of hydro power in a balance between the national demands of renewable energy and the Swedish and European environmental goals. Vattenfall has, together with seven other hydro power companies, established a fund where we and the other companies will invest 10 billion SEK over a 20-year period. The work has only just begun, and we will continue to see a strong focus on biodiversity for the next coming 20 years. We carry out several different types of measures, such as building fish ladders, removing fish migration obstacles and protecting valuable nature. We also invest in research and development to find sustainable solutions for the future.

1.1. Restoration of Juktån

Juktån is a regulated tributary to Ume River in northern Sweden. In the first half of the 20th century it was used as a float way for timber transport to the sawmills at the coast. The waterways were cleared from rocks, boulders and debris and piers were built to straighten the waterways to allow the timber floating. The negative ecological impact on the aquatic environment was extensive as spawning and nursery areas for stream living fish were destroyed.

A project to restore Juktån started in 2016 by Vattenfall, University of Umeå, Samverkan Umeälven and other power companies. The aim of the project has been to restore the negative impact from timber floating and adapt the river's morphology to the reduced flow due to hydropower regulation. Important goals were to regain spawning areas for trout and grayling, to increase stream habitats areas, and increase Juktån's potential as an attractive area for fishing and recreation. The restoration process was finished during the autumn 2020 and Vattenfall was at that time granted permit to change the minimum flow pattern flow to imitate a more natural seasonal distribution. During 2021-2025 we will monitor the ecological effects of the project.

Photographer: Åsa Widén

1.2. Voluntary protected areas

Photographer: Bengt Hemström

We protect rare and endangered species in several voluntary protected areas. Voluntary protected areas are sites with very high, and sometimes unique, biodiversity values. Through this voluntary initiative we preserve and manage biodiversity, but we also enhance recreation values and inform the public about the values in the different locations. In our protected areas we have species like the fairy slipper, moonwort, the lady's slipper and witches cauldron. We have four areas in northern Sweden located along the Lule River and one area located along the river Dalälven.

Our newest protected area, "Kungsådran Älvkarleby", was inaugurated in June 2018. The area was chosen by Vattenfall because of its unique combination of calcareous soil that gives rise to a rich flora, older trees, and its location near the river Dalälven. The path crossing the area has interpretive signs about the special flora that is found in the area.

1.3. Making eel migration safer

Photo: Vattenfall

We are testing a system that aims to predict the time when eels migrate at two of our hydro power stations in the Netherlands (2019). Eels follow the river to the Sargasso Sea when spawning has started. Silver eels migrate in groups and respond, among other things, to pheromones in the water which indicate the time for migration. The solution being tested is a kind of aquarium connected to the river water. Eels in the Migromat® are implanted with animal-friendly chips and fitted with transponders. By tracking the eels' activity, we can better predict the timing of migration, enabling us to turn the turbines off so the eels can pass the power station safely. This will both increase eel survival and minimise production loss.

1.4. Northern Europe's largest Eco hydraulics laboratory

Laxeleratorn. Photographer: David Aldvén

"Laxeleratorn" is a unique, large-scale laboratory for hydro power related environmental and hydraulic experiments. It is located in Vattenfall's Älvkarleby Laboratory in Sweden and was inaugurated in 2019. Here we combine expert knowledge of biology and hydraulics to find solutions that allow safe passage for fish pass powerplants with minimal effects on production. The main projects conducted in Laxeleratorn has been focused on innovations for downstream fish migration, such as bubble curtains and flexible nets to avoid turbine passage. We have also studied effects of hydropeaking on fish behaviour. The work with downstream solutions will continue during 2020, as well as studies on upstream passage solutions.

1.5. Fish are mapped with AI technology

To ensure that the fish passage works efficiently, Vattenfall has started a project to improve the biodiversity of watercourses with new technology. In the project we use a variant of artificial intelligence (AI) where the program is trained on a large image material that directly analyses images of migratory fish filmed underwater. In a first phase of the project, the algorithm will be trained on properties such as size and direction of passing fish, if it is salmon or not, if it is farmed or wild salmon and if the fish has fungal infections or not. In phase two, the algorithm will also be trained in distinguishing between salmon and trout, determining the size of the fish and possibly also including more species and identifying returning individuals (2020).

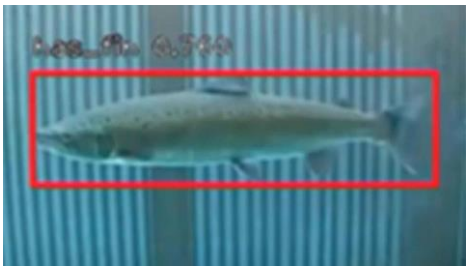


Photo: Vattenfall Vattenkraft

We have many ongoing research projects and pilot studies investigating different solutions. Here are two other examples:

- **eDNA**- In the fall of 2020, R&D collected water samples in the river Dalälven in Älvkarleby with the purpose of analysing the presence of different species of fish by collecting DNA fragments from the river. The samples are analysed at a

laboratory where they enhance the DNA fragments from the water and derive a list of fish species that are present in the river. The expectation is to learn which fish species that can pass certain natural migration obstacles, and which are naturally hindered from upstream migration. The information can then help in the decision making and designing of a fish passage, as well as determining the ecological status of the river with regards to fish.

- **Modelling of attraction flow** to find a solution to increase passage efficiency for spawning migrating salmon and seatrout in the old river channel downstream the Stornorrfors hydro power station in the Ume River (2020).
- **Up- and downstream migration-** In the river Dalälven we are investigating what environmental flows that are needed to preserve and restore important aquatic and terrestrial environments along the river. We are also investigating how we best facilitate safe fish passage for up- and downstream migrating fish species in the river. This is done in to make sure that our powerplants reach the standards of the new environmental requirements for the river (2021).
- **Attraction flow**- At R&D, we recently launched an attraction flow raft in the river Dalälven outside our laboratory in Älvkarleby. The purpose was to evaluate the flow created by the pumps. During spring 2021, the raft will be launched again, timed with the upstream migration of salmon and trout. The aim is to investigate how well we can attract fish into a side reach and away from the turbine outlets. By studying behavioural changes due to the attraction flow, we hope to gain knew knowledge on how to best position and dimension attraction flows in order to guide fish past hydropower plants.
- **Net as guidance barrier-** During spring 2021, R&D will assess a net as a guidance barrier for fish. The net will be 200 meters long and 2,5 meters deep. During the experiments we will follow salmon smolts with high resolution 3D-telemetry to study how well they are being guided to follow the net during their downstream migration towards the sea. Nets as a guiding structure has many advantages compared to conventional trash racks both in terms of cost and weight, and a successful result would give us a new tool for fish guidance at our hydropower plants.
- **“Dancing” rods**- Another alternative as a guidance barrier that we are looking into is floating rods. Floating/swimming rods have a strong floating force and when attached vertically from the bottom in streaming water they move in an irregular and potentially, for fish, deterrent way. The anticipation is that fish don’t want to swim through the dancing rods but instead make their way along the barrier, to find the safe way down the river.

1.6. Building fish ladders

At several hydro power stations, for example Stornorrfors (Ume River), Hietamankoski and Leuhunkoski (Kymmene River), we have constructed fish ladders and increase passage capacity for migrating fish such as salmon and sea trout.

In Sweden, more than 12 000 salmon migrated past our power plant in Stornorrfors during 2020 using one of Europe’s most modern fish ladders. The fish ladder provides opportunities to migrate both up and down the river. Upstream migrating fish can reach their spawning areas in the river Vindelälven. In addition, extensive 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. In collaboration with the Swedish Agricultural University, Vattenfall also analyses how the passage of fish through Stornorrfors can be improved.

1.7. Biotope restoration and species protection

Biotope restoration and species protection is an important part in the environmental adaptation of hydro power. Here are some examples of projects:

- Vattenfall is supporting the Natural Resources Institute Finland in their research about the **Saimaa salmon**. The Saimaa salmon is an important part of Finland's natural heritage and the research focuses on restoring their natural life cycle.
- Vattenfall is a part of the project "Eels on wheels" where we together with several other hydro power owners trap and transport of spawning migrating **European eel** past hydro power stations in the Göta River between Lake Vänern and the sea (2020).
- Biotope restoration of tributaries to the river Upperudsälven and Lule River to improve conditions for the **Noble crayfish**, freshwater pearl mussel, trout and grayling (2020).
- Environmental adaptation of an overflow dam in Purkijaur in the river Lilla Luleälven to improve conditions for **trout and grayling** (2020).
- Reintroduction of **sea trout** (ReTrout project) by stocking of roe in restored tributaries to the Vindelälven river (2020).
- In 2020, a new fishway was taken into use in central Finland and the construction of another fish way was started. The fishways are located approx. 20 km from each other and the aim is to free the route for **brown trout**.
- During 2021-2022 Vattenfall will support 'The **lesser white-fronted goose** Project' which is a project lead by the Swedish Hunter's Association in collaboration with the foundation Nordens Ark and the Ornithological Society in Norrbotten. Sweden is home to EU's only breeding population of the lesser white-fronted goose and the project has worked to prevent the extinction of the species since the mid-1970s. Vattenfall supports the project by sponsoring specially designed transmitters that will be used to follow the individuals that has been brought up and released in the wild. The transmitters are charged by solar cells and if the weather is good, you can get many positions per day, which gives us the opportunity to map the birds' movements in detail. The mapping of movements is a very important piece of the puzzle to evaluate the effectiveness of the measures have on the lesser white-fronted goose population.

1.8. Salmon compensatory stocking

In Sweden, power companies that operate hydropower plants are obliged to breed and stock fish to compensate for the reproduction areas that are destroyed. Vattenfall's largest fish farm is in Heden, 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 breed in total 1,3 million salmon and sea trout each year to release into the rivers we regulate for hydropower production.

1.9. Projects funded by Bra Miljöval

When Vattenfall sells electricity marked Good Environmental Choice, money is set aside to an environmental fund that can be used to improve aquatic biodiversity. Throughout the years the environmental fund has helped restoring nature and provided natural habitats for animals. Below is a few of the project examples:

- **Restoring Lule River**
  In the Lule River we have co-financed restoration of tributaries since 2014. The Lule River tributary, Flarkån, which was heavily affected by the timber floating era was restored during 2014-2015. During 2017-2022 the tributaries Pärlälven and Linabäcken are being restored. Spawning grounds and riparian environments

have been recreated for the benefit of grayling, trout and the endangered freshwater pearl mussel. Pärlälven (the Pearl River) was historically known as having the richest population of freshwater pearl mussel in northern Europe. But the populations were heavily depleted by pearl fishing and later by forestry and timber floating which have affected nearly all the Lule Rivers larger tributaries.

- **LIV in lower river Dalälven**
  The purpose of the project has been to investigate the lower parts of the river Dalälven's potential for salmon and trout production and, through surveys, to increase the knowledge of the river's fish stocks and its habitats. The project has provided information how to restore a natural reproduction of salmon and sea trout in the lower parts of the river.
- **Floating island for black-throated diver in a hydropower reservoir in the river Indalsälven**
  The project has built and deployed a floating island in the Indalsälven upstream of the hydro power plant Midskog, where the water level variations in the hydropower reservoir adversely affect the breeding of the black-throated diver. The nesting has proven to be successful on the floating island.

Photographer: Göran Ekström

- **Measures for Noble crayfish in river Upperudsälven**
  A successful reintroduction of species is dependent on that suitable habitats are available or could be restored. In the southwest of Sweden one project have been carried out and one is ongoing to improve the situation for the acutely endangered Noble Crayfish. Measures are carried out to improve survival of juvenile crayfish by creating protection and hiding places in the watercourses (2020).

Photographer: Erik Sparrevik

2. Biodiversity projects within wind power

In developing both onshore and offshore wind power we strive for co-existence with a rich natural environment, including protected species and habitats. In doing so, we:

- Implement the necessary mitigation measures to ensure there will be no significant impacts on biodiversity;
- Consider opportunities to make improvements to local biodiversity; and
- Invest in research to close knowledge gaps on the environmental impacts of wind farms and how these can be most efficiently mitigated.

Below follow some concrete examples of how this is realised in a practical context.

2.1. Biodiversity measures at Ray Wind Farm

Our Ray Wind Farm in England comprises a variety of habitats typical of an upland setting including coniferous woodland, blanket bog, wet and dry heath, acid grassland and waterways. Here we have successfully conducted mitigation measures during construction for many different types of species and habitats. These support a diverse range of wildlife including several rare or protected species: red squirrel, badger, otter, bats, reptiles, white clawed crayfish, and several owl and raptor species including barn owl, merlin, hen harrier and goshawk.

Ray Wind Farm. Peter Skelton/KGPhotography

Following construction of the wind farm, a range of operational monitoring measures have been undertaken to ensure that the ecological sensitivities present within the site are being maintained and enhanced where possible. This includes dedicated breeding bird surveys, monitoring bat populations and activity around the turbines, and checks on habitat within priority areas of the wind farm.

A merlin chick at Ray Wind Farm. Photo: Vattenfall

2.2. Peatland habitat management at UK windfarms

Peatland restoration has been completed at Ray Wind Farm (England) in 2017 and is currently being completed at Pen y Cymoedd (Wales) and Clashindarroch (Scotland) Wind Farms as part of their individual Habitat Management Plans (HMP). The most significant of these restoration projects is associated with Pen y Cymoedd where Vattenfall has invested £3m to the scheme and has also partnered with the South Wales Lost Peatlands Project meaning it is one of the biggest restoration projects of its kind in the country.

A significant aspect of peat restoration within these HMPs is to improve and enhance the upland habitats within the site and is typically achieved by ditch blocking and/or ground smoothing. Existing drainage systems and plough furrows associated with former forestry or agricultural works are infilled and the water table is raised.

Photo: Vattenfall

Peatlands have the potential to be a natural solution to reducing greenhouse gas emissions and are a huge store of carbon. By enhancing these habitats, it will not only increase the biodiversity within the site but also reverse erosion and create carbon sinks. In addition, wider ecosystem services are also expected such as reducing the flood risk to downstream settlements by improving the storage of water and reducing rapid surges along erosion channels.

2.3. Coexistence with capercaillies

In Bruzaholm wind farm, Sweden, a new method for coexistence between capercaillie and wind power has been developed as part of the permit process for the new wind farm. The solution is based on a declaration of intent with the landowner to adjust forestry methods so that the capercaillie population is in focus. This means that, among other things, so-called "skirt spruces" are saved, which protect capercaillies from predators. Another commitment is not to clear-cut the area and save larger deciduous trees. This is an important part of the permit in Bruzaholm that Vattenfall received in April 2020 and the measures will support protection of capercaillies.

2.4. Testing systems to manage collision risk for eagles

Being long-lived and slowly reproducing, eagles may be relatively more vulnerable to increased mortality from wind farms than many other bird species. This makes mitigation measures key area for wind farm development and identifying the necessary mitigation measures to secure the protection of the species of particular importance.

White-tailed eagle. Photographer: NatureEyes

With the purpose of exploring the possibilities to develop and operate wind farms in an area with presence of eagles, Vattenfall is involved in a test and documentation of the efficacy of a camera and AI based system (Identiflight) for closing down turbines when eagles are in risk of colliding. The project aims to test the detection and identification efficiency of the system for Golden and White-tailed eagles, and to understand how the operation and production of a wind farm would be affected by adopting the system. The project is a collaborative project conducted at the Vattenfall and Slite Vind wind farms at Näsudden on the island of Gotland, Sweden.

2.5. Understanding the ability of geese and cranes to avoid colliding with wind turbines

Having a good understanding of bird collision risk, and measures that might be adopted to mitigate that risk, is essential to ensure that renewables development targets can be reached without affecting the viability of populations of sensitive species. This requires robust studies conducted at operating wind farms, and this was what we did at the Klim Wind Farm in Denmark.

Common crane. Photographer: Henrik Haaning Nielsen

The Klim Wind Farm is passed by thousands of pink-footed geese commuting between roosting and feeding areas morning and evening, and the area is used for feeding by up to several hundred common cranes.

The study, which was the most comprehensive to date in Denmark, was designed to document and quantify the number of collisions and the degree to which the birds adapted their flights paths to the presence of the turbines. The results showed that both pink-footed geese and common cranes did very well in avoiding the turbine blades – much better than expected in fact, providing valuable evidence for future wind farm development.

2.6. Artificial reefs

When building offshore wind farms in soft-bottom environments, a layer of stones is usually placed around the foundations to avoid erosion (scour) of the surrounding seabed and to ensure the stability of the foundation. To better understand the ecological function and potentials of these scour-protection stone beds, Vattenfall worked together with the National Institute of Aquatic Resources at the Technical University of Denmark (DTU Aqua) to conduct an exhaustive review of the available literature on scour protection and artificial reefs with particular focus on fish communities.

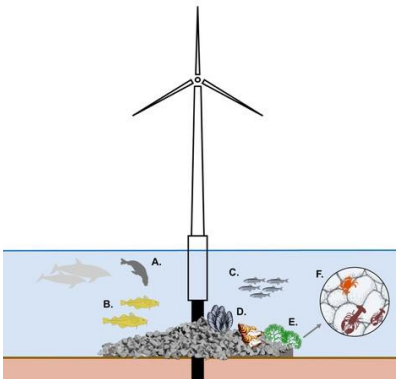


Image comes from 'Glarou, M.; Zrust, M.; Svendsen, J.C. Using Artificial-Reef Knowledge to Enhance the Ecological Function of Offshore Wind Turbine Foundations: Implications for Fish Abundance and Diversity. J. Mar. Sci. Eng. 2020, 8, 332'.

The review concluded that the scour protection does indeed function as artificial reefs, with increased abundance and diversity of species after establishment of the structures, providing shelter and food for fish, such as the Atlantic cod. The study also points to potential ways of further increasing the ecological benefits of the wind farm reefs, which will be valuable in considering potentials to optimise scour protection from a biodiversity perspective.

With this in mind, Vattenfall submitted a 'nature inclusive design' plan for the Hollandse Kust Zuid Wind Farm to the Dutch authorities. This plan includes adding large rocks to the regular scour protection to increase habitat complexity to further increase the ecological benefits for Atlantic cod and other species.

2.7. Documenting seabird flight behaviour in an offshore wind farm

Black-legged kittiwake. Photographer: NatureEyes

At the European Offshore Wind Deployment Centre (EOWDC) located in Aberdeen Bay, Scotland, a EUR 3 million research and monitoring programme has been set up to improve the evidence base for planning and impact assessment for future of offshore wind farms.

Under this programme, there is currently a study undergoing aiming at documenting exactly how well seabirds like gannets, kittiwakes and herring gulls do in avoiding colliding with offshore wind turbines when commuting between breeding colonies on the coast and offshore feeding areas. The study uses automated recording of flight behaviour using state of the art combined radar and video tracking technology and will run into 2021.

For a full overview of the EOWDC scientific research and monitoring programme, including research as well on bottlenose dolphins, the seabirds razorbills and auks and on salmon and sea trout, please visit the EOWDC website. The programme was awarded in the Sustainable Development category at the Nature of Scotland Awards in 2018.

2.8. Predicting the effects of offshore wind farms on Gannets

Concerns have been raised that large-scale offshore wind farm development may impact the gannet, a large and iconic seabird species for which the UK holds the largest breeding colony in the world on Bass Rock, Scotland. It is known that the gannet tends to avoid entering offshore wind farms, but some do, and for those there might be a small risk of colliding with the wind turbines.

Gannets.

To better understand the interactions between gannets and offshore wind farms, and to improve current models for assessing impacts, Vattenfall is co funding a PhD at Leeds University, with MacArthur Green as a further partner. The PhD student has been conducting field work at the Bass Rock colony, and stand on a wealth of existing data from that site and beyond, using new and very promising modelling techniques to help better understand the decision making, responses and potential consequences of wind farms within the foraging ranges of the gannet.

2.9. Effects of piling noise on harbour porpoise in the German North Sea

DanTysk. Photographer: Paul Langrock

Vattenfall and 10 other offshore wind developers joined up to conduct an accumulated analysis of monitoring data from wind farms constructed in the German Bight between 2009-2016 to better understand how wind farm installation and operation may have affected harbour porpoise in this area. The harbour porpoise is a small whale species, abundant and widely distributed in European waters including the North Sea, but also a species subject to a high level of protection.

The project, called GESCHA, was conducted in two steps (2009-2013: GESCHA 1 and 2014-2016 GESCHA 2), focussed on quantifying patterns in responses of harbour porpoise to piling noise during wind farm construction and changes in their overall numbers in the German North Sea.

Vattenfall's DanTysk and Sandbank wind farms, as most of the other wind farms included in the study, adopted extensive and well-functioning noise mitigation measures to reduce underwater noise levels. The results of the accumulated analysis showed that harbour porpoise responded to the piling noise at considerable distances but that they also returned relatively quickly when piling stopped. Also, it was found that harbour porpoise numbers in the German North Sea area had remained stable during the period of extensive wind farm construction activity.

2.10. The DEPONS project

It is well known that harbour porpoise is affected by piling noise from the installation of offshore wind farm foundations at large distances, but what are the consequences for the individuals affected and for the population? And what about the cumulative impacts of an increasing offshore wind farm development in the North Sea?

These were the questions the DEPONS project, one of the most ambitious and ground-breaking research projects initiated under the Vattenfall Wind Environmental R&D programme to date, set out to answer. Started in collaboration with Aarhus University, Denmark, in 2012, and since greatly expanded based on wider industry co-funding, the project was successfully completed in 2019

The outcome is an evidence-based modelling tool that can be used in impact assessments and planning decisions to inform mitigation measures to ensure wind farm expansion without affecting the long/term viability of the harbour porpoise population. The model is open source and fully documented and substantiated by a long list of peer-reviewed papers published in scientific journals.

Porpoise. Photographer: Lars H Hansen

3. Biodiversity in the distribution network

For Vattenfall Eldistribution, the conservation of biodiversity is one of the most important environmental aspects, both in permit processes and within maintenance of the operations. The power line corridors are important for maintaining a green infrastructure in the landscape and how they are managed impact several rare and endangered species.

3.1. Biodiversity enhancement in power line corridors

Photo: Vattenfall

The recurring clearance work in the power lines can create and maintain open meadow-like fields, which can serve as important habitats for many threatened species. In our power line corridors, we have for example found the rare butterfly marsh fritillary (Vulnerable according to the IUCN red list). Over the past few decades, the marsh fritillary population has faced rapid decline and become endangered because of landscape and climate changes. With GIS (Geographic Information System) and field inventories, we have mapped 1800 km of power line corridors and we have found important biodiversity hotspots. For these hotspots we then have developed adjusted clearance plans (2020).

3.2. Pilot projects with goats in power line corridors

Photo: Vattenfall

At Lidingö in Stockholm, we have been part of a pilot project where a new way to clear the power line corridors was tested. Here, goats are used instead of machines to keep the landscape open which is also having positive effects on biodiversity (2019).

3.3. Buzzing bees in Gotland

During the work of renovating an existing power line in Gotland, Sweden, a sand bed has been created to help endangered bees. GEAB's power lines in Stånga, Gotland, is in fact one of Sweden's best habitats for sand-living solitary bees. Vegetation in the power lines has been removed and replaced by open sandy areas to create habitats and nests for these endangered species. The project was initiated by and conducted in collaboration with the County Administrative Board in Gotland.

To increase awareness and to enlighten employees that they could help bees in their gardens, the project has also been communicated internally. Small bee nests can easily be created by removing vegetation in parts of the garden so that sandy areas are exposed.

Before and after measures in Stånga, Gotland. Photographer: David Lundgren.

4. Biodiversity measures connected to our heat operations

Our Heat operations are often located close to people in urban areas. The land we own in connection to our power plants can therefore be used to benefit urban ecology as well as the people living in the surroundings.

4.1. Urban gardens in Berlin

Vattenfall is helping to preserve a "green Berlin" by creating urban gardens around heat power plants. These gardens are open to everyone to use for planting and relaxation. Urban gardens create an oasis in the middle of town and contribute to a more sustainable society. In Berlin we have also provided space for bee colonies in our fenced substations, which is helping to address the widespread problem of declining bee populations.

Photo: Vattenfall

Seedlings for our urban gardens at the power plant in Mitte and “Neue Grünstraße” are locally cultivated in a greenhouse at the power plant Reuter which also supplies required heating. In cooperation with TU Berlin, public seminars on wild bees are offered in our green garden.

4.2. The fish ladder in Geesthacht

As a compensation measure for the Moorburg power plant in Hamburg, a big fish ladder was built upstream in Geesthacht in 2010. Geesthacht's fish ladder is 550 meters long and 16 meters wide. In order to pass through it completely, the fish must cross about 50 water pools, each about nine centimetres higher than the one before. As each fish is counted and we know that more than two million fish have now migrated through the ladder since 2010 and around 50 different fish species have been observed.

4.3. Grazing sheep in Klingenberg

Every year from May to October more than 30 sheep (heather sheep and Skudde sheep) graze on the ~2000m² in connection to the Klingenberg power plant in Berlin.

4.4. 130 trees for Berlin

In cooperation with the senate administration of Berlin 600 new trees were planted across the city. Vattenfall donated 130 trees to support biodiversity, cleaner air, local commitment and a greener Berlin (2020).

Berlin city. Photographer: Felix Odell

5. Biodiversity measures connected to our nuclear power operations

Vattenfall runs nuclear operations in Forsmark and Ringhals in Sweden and we are also part-owner of SKB who are accountable for responsible management of radioactive waste from nuclear power plants in Sweden. Our biodiversity work within nuclear encompass both complex ecological investigations, permit related biodiversity measures for the operation and research.

5.1. New habitats for pool frogs in Forsmark

When Svensk Kärnbränslehantering AB (SKB) are building the nuclear fuel repository in Forsmark, a pond in which pool frogs are known to live, at least historically, will need to be filled in. The pool frog is on the national endangered list and it is a legal requirement to ensure measures to protect the frogs. SKB has created new habitats in the form of ponds (six new ponds) and a frog hotel has also been built as a bonus. The hotel stands two meters above ground level and offers shelter from frost during winter.
An inventory in 2015 showed that the pool frogs have found the new ponds. During the inventory small frogs were found in at least three of the newly dug ponds.

A pool frog. Photographer: Anders Löfgren, EcoAnalytica

SKB's green forestry plan is another example of biodiversity work in the Forsmark area. In forest areas with high natural values we have adapted a management plan to preserve and enhance biodiversity. We have, for example, made targeted efforts to enhance conditions for a population of the protected orchid lady's slipper. The lady's slipper is found in open forest areas, hence careful clearance and maintenance is needed to prevent overgrowth.

SKB has, as a part of the Uppsala County Administrative Board's initiative 'Roadmap for a sustainable county', signed so-called "sustainability promises" to strengthen biodiversity (2020). Building the final repository in Forsmark involves several ecological dimensions and it is something that SKB has worked extensively with for a long time.

5.2. Biotope assessment for nuclear fuel suppliers

In addition to including biodiversity considerations early on in environmental impact assessments and permit processes we also calculate the effects on biodiversity when we do life cycle assessments. Since biodiversity is not normally included in a standard life cycle assessment, we have developed our own methodology, together with external ecology experts. 'The Biotope Method' accounts for the size of different natural habitats that are used and impacted by our operations. In our Environmental Product Declaration (EPD) we have, besides biotope assessments for our own operations, also a biotope

assessment for two of our nuclear fuel suppliers (the Rössing mine is situated in the Namibian desert and the Olympic Dam is situated in the inland of South Australia).

5.3. Return of fish and control of invasive species on Ringhals

Cooling water is necessary for the 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. Fish and other smaller species, such as jellyfish and seaweed, that come with the sea water are therefore taken up in a special cleaning facility. The species that are found are then returned to the sea via a common sewer pipe that empties into the sea at a depth of 10 meters. We follow up the procedure and the result shows that eels have a particularly high survival rate (86% survive).

As part of the environmental permit in Ringhals, there is since 2011 also a biological control program for invasive species. Flora and fauna inventories are conducted in several different locations along the coast to discover alien species that do not belong in these costal ecosystems. Sampling is also taking place inside Ringhals where there is an open pool and a cooling water tunnel that is part of the system that handles the cooling water. Within the control program, the Asian blue crab (Hemigrapsus sanguineus) have been caught on several occasions. According to the Swedish Marine and Water Management Authority, the Asian blue crab is potentially invasive. It is feared that the blue crab may establish on the Swedish west coast as it has a high reproduction rate and it can withstand large fluctuations, both in terms of salinity and temperature. It also requires a lot of food, which means that it could compete with native crab species. When invasive species are found, Ringhals immediately reports to the County Administrative Board in Halland. The findings are also reported to a database to make the data available to other authorities, researchers etc.

5.4. Supporting pollinators in Forsmark

The industrial area connected to our nuclear power plant in Forsmark, Sweden, consist of a variety of habitats and soil types, including coniferous and mixed forests, open areas of grass as well as sand, gravel and excavated masses. The topography shifts moderately throughout the industrial area and there are sites with sunny and windy features as well as sites that are more sheltered. All these habitats and features exist in a rather small area, which increase the potential to do effective measures for different types of pollinating species.

Forsmark. Photographer: Elin Bergqvist

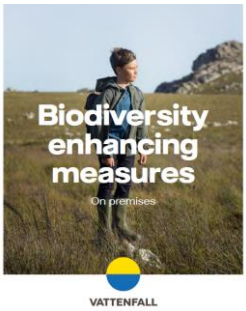
Therefore, we have decided to focus our biodiversity efforts on different measures to increase pollination. We will do this by planting different species of trees, shrubs and herbs within the Forsmark industrial area. The goal is to achieve a variation among different flowering plants throughout the growing season, and hence, provide a continuous supply of food for pollinators. The activity also includes construction of habitats for the insects, which will mainly be done by placing out dead wood at suitable locations inside the industrial area.

The goal is also to engage employees at Forsmark to be involved in this work and a number have already registered their interest to join the initiative. The next step in the projects is to select the sites with most potential for biodiversity measures and the start preparing for planting (2021). The initiative is a part of our “sustainability commitments” in the Uppsala County Administrative Board’s initiative ‘Roadmap for a sustainable county’.

6. Other biodiversity examples

6.1. Biodiversity enhancing measures in our office premises

In Vattenfall we want to make sure that our office premises constitute, as far as possible, an extension of and a connection between habitats. Therefore, we have set a target to work with biodiversity enhancing measures connected to our offices and we have also developed a catalogue of ideas for initiatives that can support nature and biodiversity at our many different premises. The catalogue of ideas is available at vattenfall.com and we want to share it also to inspire others.



6.2. Vattenfall Umweltstiftung

Through our environmental foundation in Germany – Vattenfall Umweltstiftung – we have supported approximately 200 different environmental projects since the foundation was established in 1994. The foundation is a non-profit organisation from which schools, associations, nature protection groups and other NGOs can apply for grants. The projects mainly focus on urban areas, environmental education, restoration of water courses and re-naturalisation and one subject the foundation is paying special attention to is biodiversity. The development of biotopes, the protection of endangered species and awareness raising is something the foundation considers to be indispensable.

Here are some examples of projects supported by Vattenfall Umweltstiftung:

Creating bat wintering refugia
In an old cellar, which was used by people to store food, winder refugia for bats has been created since the cave has not been used for a long time. These types of environments are however optimal for bats as shelter during the cold seasons. In an old cellar in Goldisthal, Germany, the cave was cleaned from old material and hanging nests with cavities were built for the bats. Also, a very special door was built offering entrance for bats and other small animals like amphibians and reptiles.

Photo: Vattenfall Umweltstiftung

The Brandenburg Bee Initiative

Photo: Vattenfall Umweltstiftung

This initiative promotes urban greening projects on more than 50 sites during a period of three years (2018-2020). The greening projects do not only promote urban biodiversity and climate benefits connected to green areas, but is also contribute to clean air, human health and recreation. People who visit the areas can gather a colourful flower bouquet, which is explicitly permitted.

Re-wetting the Roggendorfer Moor
By water-storing measures and extensification of farming, a peatland area in the biosphere reserve Schaalsee (South-East of Hamburg) has transformed into a species-rich wetland offering valuable reproduction areas for endangered species (2019).

Photo: Vattenfall Umweltstiftung

6.3. Honeybees, wild bees and bee flowers

More than 80 per cent of the plants on Earth depend on pollination through bees and other pollinators and Vattenfall supports biodiversity in various ways. Since 2013 there are honeybees at 30 different locations e.g. at Vattenfall power plants, on the roof of our office building at Chausseestraße and at substations of Stromnetz Berlin. This spring another beehive will be started at the Klingenberg power plant.

Also, in the Wieringermeer wind farm (WRM) project in the Netherlands we have worked to enhance local biodiversity. We have together with organization “I Love Beeing” placed two beehives for wild bees at the site in the spring 2020. Before the beehives were placed, bee flowers and herbs were sown around the office to provide food for the bees. As the bees also need the honey they produce as food, it is not for sale but kept in the hives.

The beehives are at the Wieringermeer wind park until construction is complete. During the winter where bees are less sensitive to transportation, they will ten taken to their new home area close to the O&M service building. This is only of many initiatives at the WRM construction site to connect with the surrounding nature to make a positive and sustainable impact.

Photo: Vattenfall