REYKJAVÍK BIODIVERSITY POLICY

Department of Environment and Planning,
City of Reykjavík.

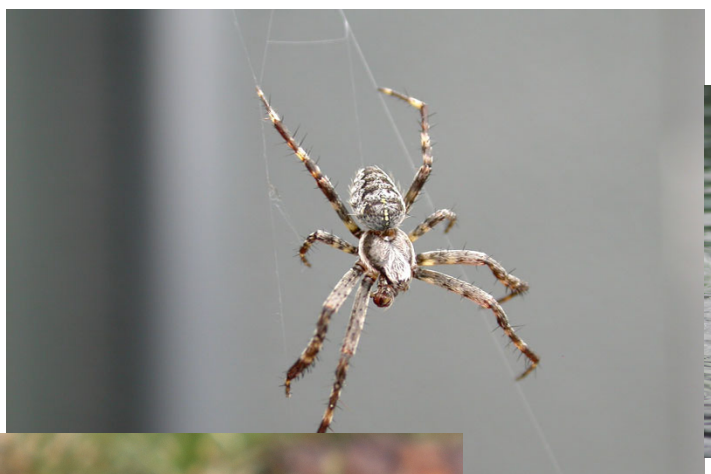
Mayor's address

The creation and approval of the Reykjavík Biodiversity Policy is a momentous and joyous occasion. This policy represents an ambitious statement which aim is to safeguard and promote biodiversity in the city with protective and restorative measures, research, monitoring and education. The Reykjavík municipality is an area rich with wild nature and diverse ecosystems, from the rocky shores and mudflats, to the abundant lakes and rivers, heathlands and forests as well as parks and gardens within the urban areas themselves – there is life everywhere !

Some of the ecosystems in the city are biologically important on an international scale while others provide the citizens with valuable services and are fundamental for maintaining environmental quality. It can never be overstated how fulfilling, invigorating and nourishing it is for city-people to experience living nature first hand. Thus, we must guarantee that biodiversity is taken into consideration at all stages of city planning and management. Biodiversity is also a key element in the context of climate change, both regarding carbon binding in forests and wetlands as well as nature-based solutions for climate change adaptation. Much is gained by supporting biodiversity within the city with purposeful actions and a clear vision for the future.

Dagur B. Eggertsson, Mayor of Reykjavík

Reykjavík is full of life...



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Introduction

Biodiversity in Reykjavík

Reykjavík, the capital of Iceland, is a city enriched by nature – scenic landscapes where mountains meet the ocean on the horizon, unique geological formations including lava flows and craters, and last but not least a diverse array of wildlife and vegetation. Numerous and varied ecosystems hosting multiple types of organisms are found within the city borders. These include rocky kelp shores, tidal mudflats, grassy wetlands, salmon rivers, nutrient-rich lakes, mossy meadows, barren heathlands of volcanic sand and birch forests, some in a relatively pristine condition. The more developed urban areas are also home to a rich biodiversity where gardens, cemeteries and agricultural areas are rich in greenery, and the streets, rooftops and harbours of the city also teem with life. Life finds its place wherever it can. Combined, these diverse habitats provide a unique whole which is the biodiversity of Reykjavík.

Biodiversity is a fundamental factor in the health and proper function of urban ecosystems. Healthy ecosystems are essential for establishing and maintaining good environmental quality which is highly valued by people living in urban areas. Ecosystem services are often mentioned in this context, and they include air and water purification, buffering of floods and water, soil-retention, heat, noise and wind reduction, provision of raw materials including food and finally cultural, educational and spiritual experiences. Living organisms are crucial in providing and maintaining these services.

WHAT IS BIODIVERSITY?

Biodiversity or biological diversity is a concept used in natural sciences to define the variety and complexity of all living things.
The concept is multifold but at its core it refers to the spectre of living organisms and their interactions and thus includes:

- **The diversity of species and other taxonomical units of organisms.**
- **The interspecific diversity, both ecological and molecular or genetic.**
- **The diversity in composition and function of organismal communities and ecosystems.**[1]

Biodiversity can be addressed in various contexts such as geographical and temporal, on either a grand or small scale. In urban settings biodiversity can exist in unique compositions encountered in small areas such as private gardens, small water bodies, individual street trees and industrial sites.

Maintaining a healthy biodiversity is crucial for our subsistence on the planet. Nevertheless, biodiversity is severely threatened by human activities that are directly or indirectly causing increased habitat destruction, populations decline and species extinction at an alarming rate.[2] A positive sign is that governing bodies across the world are showing more interest in addressing this issue and public awareness is increasing as the stakes become clearer. In particular, urban biodiversity and its importance is steadily gaining more notice, as do the diverse arguments for its value, such as:

- **Access to nature in urban areas increases public health, provides inspiration for artists and scientists, attracts tourism and boosts real estate value.**[3]
- **Healthy ecosystems improve urban air and water quality, provide shelter from wind and heat and decrease flood-risks from flooding.**[4]
- **Ethical arguments for nature's right to exist on its own terms.**

Biodiversity in Reykjavík

1. The Lake in Central Reykjavík and the nearby Vatnsmýri Wetland Reserve are hotspots for waterfowl like whooper swans, geese and various duck species.

2. The southern shoreline of Reykjavík is characterized by seaweed- covered rocks home to intertidal invertebrates, i.e. polychaetes, crustaceans and snails.

3. The Öskjuhlíð area has a large planted conifer forest and is home to songbirds like redpolls, blackbirds and redwings. Feral rabbits are also abundant.

4. All year round Kollafjörður Bay attracts seabirds, such as cormorants, eiders, many gull and duck species and in summer arctic terns, fulmars and puffins.

5. At Laugarás and other rocky outcrops in the city a rich diversity of flowering plants and moss and lichen species grows on the volcanic rock-bed.

6. Elliðaár Rivers are home to a sturdy population of Atlantic salmon. Brown trout and Arctic charr are found in Elliiðavatn Lake.

7. Viðey Island is a good place to find seashore plants such as the oysterplant, the European searocket and the sea sandwort.

8. With increasing mean annual temperatures and vegetation cover, new insect species colonize the city every year. Recent arrivals include the tree bumblebee.

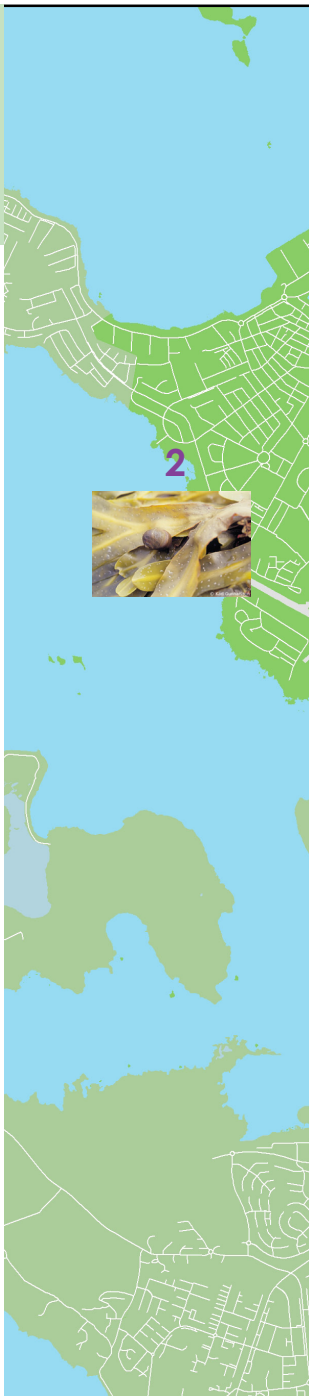
9. The tidal mud flats of Blikastaðakró and Grafarvogur are important feeding sites for migratory birds like red knot, sanderling and brent geese.

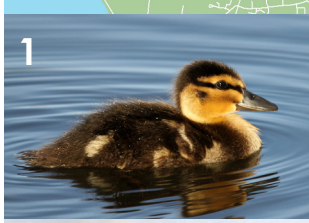
10. Ravens and ptarmigans are most abundant in the city during winter, particularly in the suburbs of eastern Reykjavík.

11. Freshwater insects, such as water beetles, are common in Lake Rauðavatn

12. The Lake Ellliðavatn area is the largest wetland area in Reykjavík. Many bird species breed there including ducks, waders, swans and divers.

13. Woodland and heath plant communities are typical for the Heiðmörk area.



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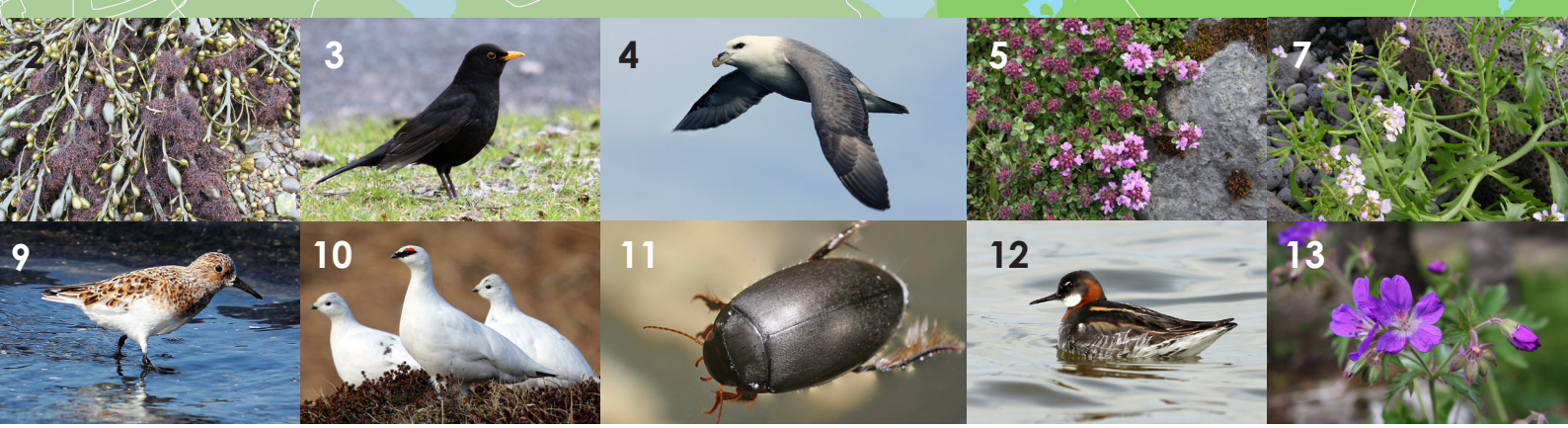
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THE UNITED NATIONS CONVENTION ON BIOLOGICAL DIVERSITY

Protecting biodiversity is an international endeavour and the principal venue for discussion and decision-making is the U. N. Convention on Biological Diversity. Since its inauguration in 1992, 168 member nations across the world have agreed to reach common goals with various measures. The convention consists of numerous clauses and obligations addressing various issues including habitat conservation and species protection measures and operations targeting invasive species.[5]

Iceland is a member of the convention and has thus agreed to various obligations regarding the protection, monitoring and sustainable harvesting of the native biodiversity.[1] Relevant Icelandic laws, regulations and action plans have been influenced by and adapted to the goals and terminology of the convention. These include municipal plans i.e. relating to sustainable development.

Cities have a huge impact on biodiversity both on a local and global scale. This includes negative impact as the growth and activity of cities is the cause of pollution and habitat degradation. Cities, however, also provide positive impact on biodiversity being centres of knowledge, research and innovation as well as supporting activism promoting measures to protect and strengthen biodiversity. Many cities have developed and implemented their own biodiversity strategies thus supporting the goals of the U.N. convention.

Background for policy-making

It is of vital importance to develop the biodiversity policy according to relevant guidelines, standards and regulations, both international and national, if it is to result in a professional and efficient working plan with well-defined goals and actions. The participation of Iceland in The United Nations Convention on Biological Diversity (see left) is elemental for the City of Reykjavík's policy-making as well as its manifestation in legislation and other environmental policies.

The most important Icelandic legislation acts[6] regarding biodiversity are:

- **The Nature Conservation Act.**
- **Protection and Hunting of Wild Species Act.**
- **Adaptation to CITES Act.**
- **Animal Welfare Act.**
- **Genetically Modified Organisms Act.**
- **Public Health and Pollution Control Act.**
- **Environmental Impact Assessment Act.**
- **Planning and Building Act.**

A fundamental element to ensure the success of the policy is in clear accordance with other environmental policies and plans that the City of Reykjavík has already approved. Of current plans, the Reykjavík Municipal Plan 2010-2030 and the Environmental Resource Policy are particularly important .[7] Other plans of importance regard more specific issues such as climate change, transportation, nature protection areas, waste management, forestry etc. Participation in treaties and resolutions provides important context as well particularly regarding the collaboration and sharing of information. Among others Reykjavík is a member of the Aalborg Charter[8] and the Covenant of Mayors[9]

The process of policy-making

Preparation for the construction of a biodiversity policy for the City of Reykjavík began in the Department of Environment and Planning in early 2014. A special report was effected, outlining the main premises and pathways and described the theoretical framework. In April 2014 the City of Reykjavík Council of Environment and Planning formally agreed to start the policy-making process and appointed a working group including five elected representatives of the Council and city officials specialized in the subject. The main role of the working group was to identify the main components of the proposed policy, shape its goals, define and classify crucial actions and operations and analyse measures and tools for implementation.

The working group discussed the status of biodiversity in the Reykjavík area, looked at the base of knowledge and recent research, identified major threats as well as opportunities and visited key areas that are home to habitats of high conservation value or renowned for their biodiversity. To shape the policy goals relevant legislation and regulations were reviewed and ideas were compared and measured against other environmental policies implemented by the city. Special emphasis was on examining policies and action plans of other cities and municipalities across the world, both with regard to general focus and content but also to organisation and presentation.

The working group received input and advice from the Ministry for the Environment and Natural Resources, government organisations specializing in the topic as well as from numerous stakeholders and collaborators such as neighbouring municipalities.

Goals

Setting clear, concise and realistic goals is a key element of any successful policy. Biodiversity is a challenging topic with a broad scope that has distinct connections to various aspects of city organisation and management, mostly environmental issues but also other fields such as development and education.
The policy encompasses six main goals presenting the fundamental vision of the policy which is to ensure the importance of biodiversity as a key factor in the city system resulting in a visible impact on the nature of Reykjavík. Communicated to and shared by the citizens, this vision will also influence their actions and opinions and lead to general increase in wellbeing and happiness.

The six main goals are explained more thoroughly on the following pages and connected to relevant and necessary projects. Sometimes these projects are classified into a few key categories representing the major paths of action. These goals and their designated projects are shaped and influenced by the key messages and focus points of the U. N. Convention on Biological Diversity, and particularly by the goals and actions defined in the realisation plan for the participation of Iceland in the convention. Additionally they are shaped by the other fundamental principles described in previous chapters, but they also clearly reflect the unique attributes that characterize a biodiversity policy in an urban setting.

OVERVIEW OF POLICY GOALS

1. Assembling, analysing and communicating knowledge of biodiversity in Reykjavík.

2. Ensuring that the status of biodiversity in the city remains strong.

3. Identification of and combat against threats to biodiversity in the city.

4. Promotion of biodiversity using diverse communication and education measures.

5. Ensuring that biodiversity is thoroughly integrated into relevant activities and operations of the city.

6. That Reykjavík is a leader among cities with regard to biodiversity.

1. Assembling, analysing and communicating knowledge of biodiversity in Reykjavík

Knowledge of the characteristics and status of biodiversity in Reykjavík is a fundamental prerequisite for any major decisions and actions. As in any policy, the gathering of, analysing and presenting reliable data about key elements is thus a pivotal and essential part of the project. Professional insight and up-to-date recognition and knowledge of methods and theory are pre-eminent as is a capable workforce. The optimal solution for the City of Reykjavík is collaboration with scientists, technicians, data analysts and field workers experienced in biodiversity-related projects. These can be provided by both public and private research organisations or even individuals to support the research and monitoring provided by the environmental officials of the city departments.

Sea Thrift is a common plant in Reykjavík, especially in sandy habitats.

PROJECTS

Analysing and mapping major ecosystems and habitat types in Reykjavík.

Mapping the diversity and distribution of key species groups and individual species.

Classifying and estimating the value of ecosystem services in Reykjavík.

Evaluating the status of biodiversity in the operations and management of the City of Reykjavík.

Investigating and measuring the knowledge of citizens about biodiversity and their ideas of its value.

Mapping current research and knowledge about the biodiversity in Reykjavík in relevant institutes.

Ensuring the storing, sharing and use of biodiversity data and information.

2. Ensuring that the status of biodiversity in the city remains strong.

To maintain an overall healthy biodiversity in a city, the welfare of individual species and species communities and the stability and security of ecosystems, must be addressed. Urban environments are distinctive and conditions can differ greatly from more remote, pristine areas. Nevertheless, a diverse array of flora and fauna is found in cities and natural cycles are maintained, often quite traditionally and predictably, both in areas with original nature elements as well as in fully man-made areas. The situation of a given place can be unique and call for specific measures. Sometimes, preserving a particular condition is of primary importance, in others recapturing a previous state is desired, and finally some places allow for a diverse input of living things and the generation of novel communities. The policy addresses these three main elements by defining projects under the terms conservation, restoration and habitat increase/invigoration.

Tidal mudflats in Reykjavík are important feeding sites for visiting migrants such as this sanderling travelling to Canada. These mudflats have a high conservation value.

2a) Conservation measures

Protecting areas that host diverse communities of organisms and conservation measures for individual species or habitat types are among the most important actions taken to support biodiversity. Reykjavík has a number of protected areas, but the arrangement and thus strength of conservation differs between areas. Currently, there are no areas in the city that are federally protected because of biodiversity. Many biodiverse areas are, however, identified in the municipal plan as local areas of conservation. The long-term stability and security of protected areas needs to be secured and their numbers preferably increased.

PROJECTS

Identification of those habitat types and species that require protection in Reykjavík.

Evaluation of the status and definition of protected areas and defining actions of improvement in a formal conservation plan.

Monitoring vulnerable species and habitat types.

Identification and mapping of ecosystems that provide key services and evaluation of their conservation value.

Maintaing connections between key habitats to ensure ecosystem stability and distributional options for flora and fauna.

IMPORTANT HABITATS FOR WILDLIFE

FRESHWATER FISH IN RIVERS AND LAKES

Six rivers reach the ocean in the Reykjavík area, as do several smaller creeks. Three of the rivers are salmon rivers and popular for fly-fishing. These are the Elliðaár River system, Leirvogsá River and Úlfarsá River. Salmon-harvesting in these rivers is completely sustainable and the salmon population remains at a healthy size despite the proximity to residential areas and large roads.10 Survival of healthy populations of migratory freshwater fish in urban areas without interventions is extremely rare. In addition to the Atlantic salmon, brown trout is also common in the rivers and some of the smaller creeks.
Many small lakes are found in the Reykjavík area and most of them host populations of freshwater fish. The largest of these lakes, Lake Elliðavatn, hosts both arctic char and brown trout populations and three-spined stickleback are common in most water bodies. A diverse community of small benthic and pelagic invertebrates and algae is the foundation for the survival of these fish populations. It is imperative that these freshwater ecosystems remain stable and pollution-free.

A young salmon. Salmon is found in three rivers in Reykjavík.

HABITATS FOR BIRDS IN REYKJAVÍK

Birdlife is diverse and prominent in Reykjavík, with numerous important bird habitats found within the city borders. Among those, the tidal mudflats along the northern coast in Grafarvogur and Blikastaðakró are probably the most significant. These mudflats are visited by thousands of migrating waders in spring and autumn. Some are Icelandic breeders like black-tailed godwits, golden plovers, redshanks and dunlins but others are stopping over on their way to or from their breeding sites near the North Pole in Greenland and Canada. These include red knots, sanderlings and dunlins from Greenland.[11] Other important areas for birds include the lakes in eastern Reykjavík, like Lake Elliðavatn and Lake Rauðavatn, the wetlands along the rivers Bugða and Úlfarsá, the mossy heathlands east of the city, planted conifer forests in parks and gardens and last but not least islands and skerries in the inner Faxaflói Bay where seabirds like puffin and eider ducks breed in high numbers.

Puffin colonies are found on the islands Akurey, Andríðsey and Lundey.

2b) Restoration measures

Restoring ecosystems from a degraded state to a healthier state can be a powerful act to boost biodiversity. Restorative measures aim to reclaim or at least approach previous conditions of an area before its decline. These measures can incorporate the transport of individual species to locations they previously inhabited, rebuilding ecosystem attributes that have been lost or diminished, such as vegetation cover, water quality or soil characteristics. Restoration can also be more complete, such as regenerating whole ecosystems that have been lost or drastically diminished. Restoring wetlands that have been drained for agricultural purposes is a good example. Restorative measures are complex and challenging and require ample time and patience before changes are seen, but within a few years the benefits can be immense for individual species and communities.

Wetland areas are rather few in Reykjavík and none are extensive. One of the largest is Starmýri close to Lake Reynisvatn in eastern Reykjavík. Opportunities for wetland restoration are on the other hand numerous.

PROJECTS

Identification and mapping of opportunities for ecosystem restoration.

Supporting populations of species that are decreasing in numbers or have shrinking ranges.

Halting decline in biodiversity in specified areas by supporting self-restoration of ecosystems.

VATNSMÝRI NATURE RESERVE

Arctic terns breed in Vatnsmýri.

Reykjavíkurtjörn - commonly known as Tjörnin or "The Pond" is a natural freshwater ecosystem in downtown Reykjavík. The water that feeds the Pond comes from the wetland in Vatnsmýri, a formerly large wetland system that now has shrunk and is limited to a small area between the domestic airport, a large road system and the university area. It is a delicate area with a high conservation value that has been hugely impacted by the growth of the city. A nature reserve for birds was established there in the late 20th century and recently restorative measures have improved the flow of water through the system, increased the cover of native wetland vegetation and improved breeding conditions for various bird species including the arctic tern, greylag goose, mallard, teal, gadwall, tufted duck and numerous wader species.[12]

2c) Increase and invigoration of habitats

In recent years biodiversity and its requirements in urban design has enjoyed ever increasing interest and greater emphasis has been given to the inclusion of biodiversity with the aim that organisms not only survive but flourish within the man-made landscape of cities. In highly dense places, demand for access to nature or at least green areas with a sample of flora and fauna is growing. Answering this demand requires innovative solutions which form the base for the growing field of green infrastructure design.
Any sort of green space, large or small, within the cityscape can be classified as green infrastructure. These include parks, gardens, trees and hedgerows along streets and paths, green roofs, climbers, flowerbeds etc. Creating connections between these green areas is vital as regards establishing biodiversity because that ensures the distribution of species otherwise subject to isolation with increasing vulnerability of populations.[13] Additionally, blue infrastructure such as ponds, dykes and water runoff pathways can provide habitats for

Small green spaces within residential areas can be hotspots for urban biodiversity. Diverse and dense plant cover can provide microhabitats for birds, insects, fungi etc.

PROJECTS

Ensuring that city planning and urban design protocols incorporate biodiversity at all relevant stages.

Increasing the number of green roofs, climbers and other types of green infrastructure.

Ensuring that strategies in management of open spaces, forestry and planting benefit biodiversity.

Improving and increasing breeding, feeding and resting sites for birds and other animals.

The implementation of water runoff solutions that also benefit biodiversity.

The tree bumblebee is a recent member of the Icelandic insect fauna and is commonly seen in private gardens in Reykjavík. [14]

3. Identification of and combat against threats to biodiversity in the city

The decline of biodiversity is among the most severe environmental challenges of modern times. Unfortunately, it is largely caused by the immense growth of cities and their utilization of valuable resources. The greatest threats to biodiversity are therefore easily identified and visible in the urban landscape although the impact of urban life reaches far beyond city borders. There are, however, ample opportunities within cities to diminish or even remove threats to biodiversity.

3a) Habitat degradation

Habitat degradation and destruction is the greatest threat to biodiversity both on a local and global scale since it has a direct impact on the range of species and their options to disperse which in many cases leads to severe population decline or extinction. In urban areas the demand for land for development is high so habitats for biodiversity are often rapidly depleted.
The most powerful action to combat habitat degradation is to protect areas from further disturbances and restore already degraded habitats. It is, however, not always feasible to spare habitats from disturbance in which case it is crucial to limit the damage as much as possible. Various counter-measures can be beneficial and monitoring which prevents construction to cause unnecessary soil or vegetation disturbance, is of utmost importance. During development, the classification of areas for use and/or protection based on biodiversity information is also fundamental in ensuring the safety of key areas.

PROJECTS

Assessment of how development and land use impacts biodiversity and causes habitat degradation.

Assessment of how construction and management of city land impacts biodiversity and causes habitat degradation.

Monitoring and prevention of unnecessary degradation of habitats.

Defining and developing counter-measures when some habitat degradation is unavoidable.

Heathland with dominant moss and lichen vegetation is a habitat type that has declined in Reykjavík.

3b) Pollution

Pollution of various kinds (air pollution, water pollution, soil pollution) can cause great harm to urban biodiversity, by disrupting natural functions of ecosystems and directly killing organisms.
Most pollution-preventive measures are beneficial to biodiversity, particularly if taken close to nature areas of high importance for biodiversity.
Potential environmental pollution in Reykjavík is monitored carefully by the Public Health Authority of Reykjavík which also regulates the activity of polluting industries as part of a strict health- and safety control.[15] Some pollution can, however, be difficult to detect and monitor as it builds up slowly, such as the accumulation of heavy metals in water bodies and the effects of plastic pollution on various ecosystems as well as pollution that impacts the behaviour of animals such as light and noise pollution.
It is imperative to prevent and react swiftly to pollution to be able to reduce its impact on biodiversity, particularly in areas of high concern.

Rocky seashores are among the most biodiverse ecosystems but are vulnerable to pollution.

PROJECTS

Identification and evaluation of the effects of pollution including air pollution, water pollution, waste pollution, light and noise pollution on biodiversity.

Prevention and removal of pollution that negatively impacts biodiversity, both within the city and on a larger scale.

Educating citizens about the effects of pollution on biodiversity and about preventive measures.

MONITORING COASTAL WATERS

The waste water system of Reykjavík underwent a monumental renovation at the end of the 20th century with the installation of waste water treatment plants and pumping stations at different sites along the city shoreline. These measures momentously improved the condition of the natural shoreline by eliminating waste pollution. The local intertidal biodiversity benefited greatly from this and today the rocky shores of Reykjavík are home to a thriving diversity of animals and algae and a popular destination for outdoor-loving citizens. The Public Health Authority of Reykjavík meticulously monitors the seawater quality along the coast by regular sample-taking at 11 different sites and measuring levels of coli-bacteria.[15]

3c) Invasive species

Invasive exotic species can be a great threat to local biodiversity, especially in urban areas . Many exotic species are imported to Iceland, where some of them distribute into the wild and become invasive. The diversity of exotic plant species is particularly high in Reykjavík where they have been planted in gardens and parks. The ranges of many of them are expanding, but only a few are capable of replacing the native flora and are thus considered invasive. These include the cow parsley (*Anthriscus sylvestris*) and the Nootka lupine (*Lupinus nootkaensis*).[16] The number of exotic animals that are settling in or near the city is also increasing, both on land and along the coast. These include insects, molluscs and crustaceans. It is important to carefully monitor the numbers and distribution of potentially invasive species.

Persian hogweed - Hogweed are common invasive species in the city.

PROJECTS

Identification of invasive species in Reykjavík and mapping their distributions.

Defining actions aimed at removing invasive plants or limiting their distribution.

Educating citizens about invasive species, their impact on biodiversity and why they are a risk.

INVASIVE HOGWEED IN REYKJAVÍK

Hogweed (*Heracleum*) is a genus of impressively large, decorative plants that today are recognized as exotic invasive species, forbidden by law to import or plant. Previously, however, hogweed was a popular garden plant and its descendants are still found around the city both in private and public gardens. Recently, improving conditions for growth have caused an increase in self-distribution of hogweed. The three hogweed species found in the city are an ecological threat as their size and aggressive growth patterns causes the retreat of other plants. Hogweed can also be harmful to people as the plant sap burns the skin and can cause extreme photosensitivity. Serious cases of burns among both citizens and city employees are increasing and as a result the city has recently initiated a specific eradication program with primary emphasis on plants found in playground areas.[17]

3d) Climate change

Climate change induced by human activity is one of the greatest environmental hazards of our times. Human life and welfare is jeopardized by extreme weather events and rising sea levels. These hazards also affect biodiversity. Delicate ecosystems relying on fragile equilibriums are particularly at risk, as even minute changes in temperature, rainfall, saturation of chemicals etc., put them in grave danger. Changes in species abundance and composition can create drastic shifts in ecosystem stability and cause extinction of species. Healthier and sturdier ecosystems are more capable of adapting to these changes.

Cities play an increasingly important role in mitigating climate change by reducing their carbon emissions, for example by boosting public transport, using alternative energy sources, changing land-use policies and sustainably utilizing natural resources.9 Of no less importance is to strengthen the adaptation of cities to climate change. Biodiversity is crucial, both for measures of mitigation and adaptation as forests and wetlands are powerful carbon sinks and soil and vegetation reduces risks from flooding and landslides.

PROJECTS

Identification of the impact of climate change on biodiversity in Reykjavík.

Supporting the adaptive abilities of biodiversity to events resulting from climate change.

Supporting biodiversity that enables carbon storage and improves resilience of cities.

INCREASING CARBON STORAGE BENEFITS BIODIVERSITY

Supporting and enlarging healthy ecosystems rich in biomass and biodiversity such as forests and grassy wetlands is a powerful, yet natural process of binding and storing carbon from the atmosphere and thus mitigating climate change. The Reykjavík Municipality has implemented a tree cultivation policy that focuses on increasing the number and size of forested areas and the number of individual trees within the cityscape. These measures also increase air quality and provide improved shelter from wind and noise. Increased emphasis on forestry in the outskirts of the city is also a long-time goal as presented in the 2010-2030 Municipal Plan for Reykjavíki.[7] Restoring natural wetlands is another effective way to increase carbon storage. Old agricultural areas in the Úlfarsárdalur area in eastern Reykjavík provide opportunities for wetland restoration. Both forests and wetlands are important habitats for biodiversity particularly plants, birds and insects.

4. Promotion of biodiversity using diverse communication and education measures.

Increasing public awareness and interest in biodiversity is a key factor in implementing a successful policy and can also result in greater appreciation and respect for nature. As the target groups are highly diverse ranging from schoolchildren to stake holders creating and utilizing diverse, interactive and engaging education and communication strategies are paramount. All information to be communicated on the status of local biodiversity must be based on reliable scientific data but it is equally important that messages are delivered in a clear, straightforward and consistent manner. The topic of biodiversity is foreign to many and it is important that all elements are clearly explained – from species diversity to ecosystem components – in both local and global context when necessary. Graphic media such as maps, diagrams and interactive software are very helpful as are various on-site education events.

REYKJAVÍK-TEEMING WITH LIFE

Reykjavík - teeming with life, is a public education project focusing on local biodiversity that was launched in 2013[18]. The project has organised multiple public outdoor education events on topics like birds, local flora, seashore animals etc., arranged specific school and pre-school trips, as well as supervised production of educational brochures and installation of informative signposts in nature areas.

Reykjavík
Iðandi af lífi

PROJECTS

Providing public education about the diverse biodiversity of Reykjavík with various measures.

Communicating information about the status of biodiversity in Reykjavík.

Encouragement of public participation in relevant biodiversity projects.

Access to nature is important for most people but not everyone is aware of the diversity of life in their local environment or how biodiversity impacts their daily life. Interest in public volunteering at the local level is increasing and could be highly beneficial for various biodiversity-related projects.
The City of Reykjavík has for years provided a variety of public education opportunities about environmental issues, involving city institutions and using diversemedia and venues. Education for children and youth has been in particular focus and sustainable education is a specific goal in the new environmental and resource policy of the city. The Reykjavík Nature School, The Reykjavík Municipal Work School, Reykjavík Botanical Gardens, Reykjavík Farm Zoo, Reykjavík City Library, Reykjavík Forestry Association and other city institutions have been active participants in various education programmes in addition to the participation of local primary schools and pre-schools.

5. The integration of biodiversity into relevant activities and operations of the city.

Biodiversity may seem a highly specialized topic within the environmental field but a closer look unveils clear and important connections to numerous activities and operations run by the municipality. Therefore, coordination and integration is essential when implementing relevant actions of the policy. A plan to protect an important habitat will, for example, not be fully successful if not connected to relevant development plans of the area or if a nearby polluting industry and its effects on the habitat are not carefully monitored. Another example is that actions to decrease the effects of plastic pollution on marine biodiversity cannot be limited to on-site activities but must also include measures to increase public recycling and consumer awareness.

It is important that key messages of the biodiversity policy are considered and included in other city policies and plans where suitable as well as in relevant activities of different operational bodies within the city organisation. Regular and well defined cooperation and communication between departments and offices is essential and should be carefully monitored.

Already, many official city-run projects dealing with a variety of issues are highly beneficial to biodiversity. These include the legally binding role of the Public Health Authority of Reykjavík to monitor air and water pollution and the activities of polluting industries, ambitious waste management plans, increased emphasis on densification to halt sprawl, plans in forestry etc.

PROJECTS

Ensuring that biodiversity goals are incorporated into development plans for both parks and other open spaces as well as built areas.

Monitoring, regulating and limiting the negative effects of development and building projects on biodiversity.

Integrating biodiversity goals with other official environmental policies of the city.

Decreasing negative effects of city management and operations on biodiversity.

Implementing the policy with a clear, concise action plan with temporal goals, providing needed funding and a regular evaluation of the progress.

6. That Reykjavík is a leader among cities with regard to biodiversity.

This new policy provides the City of Reykjavík with the opportunity to become a leading body in the field of biodiversity among municipalities both locally and globally. That said, it is of great value to seek advice and information from experienced parties, during the implementation of the policy. Other Icelandic municipalities may not have a biodiversity policy but they are often more experienced with particular issues, such as eradicating invasive plant species. Some projects also have better chances of success through establishing cooperation with neighbouring municipalities or even at a national scale. This makes sense as biodiversity is rarely limited by regional borders.
Participating in collaborative international projects is a great way to strengthen the implementation of policy goals as it provides useful information and even a framework for specific actions. Such participation can facilitate progress since it often demands following a particular timeline and the achievement of measurable results at regular intervals.

International focus on biodiversity is growing, particularly at the municipal level. Many projects are directly connected to the Convention on Biological Diversity but more and more international institutions, companies and societies, both in the public, private and NGO sector are confronting the issue. Many parties are focusing on the importance of urban biodiversity in relation to an array of relevant fields like public health, architecture and design, economics and education, most commonly in the context of sustainability and resilience.[5,19]

PROJECTS

Encouragement and support of innovative ideas that benefit biodiversity.

Engaging in modern technological and ideological solutions when implementing key policy actions.

Participation in cooperative projects with other municipalities, public, private and NGO organisations.

Participation in collaborative international projects dealing with various aspects of biodiversity.

A dunlin in winter. The dunlin is a migratory wader so its welfare depends on the awareness and cooperation of numerous countries.

Policy implementation

It is crucial for the success of a policy to rigorously and thoroughly monitor its implementation but also that all involved parties share the ownership and thus responsibility. For the City of Reykjavík, this means that various departments, offices and other administrative and operational entities work together to ensure the efficiency and impact of key projects. One way is projecting policy messages and goals into specific checklists and process guidelines as well as interconnecting securely between different policies and plans that share common goals and methods. A biodiversity policy is strongly linked to other environmental policies dealing with issues like climate change, waste management, planning and land use as well as education policies, public health, horticulture and more. Visibility and outreach is also pivotal to ensure that key messages reach their destination.

Action plan

Accompanying the Reykjavík biodiversity policy is a specific action plan but a clear, precise and well-organised action plan is a fundamental tool in the implementation process. The action plan carefully follows the goals and projects defined in the policy itself. This ensures that all parts of the policy are treated equally.
The actions listed in the plan include both long-term broad-ranging projects as well as more specifically defined short-term actions. The overall timeframe for the action plan is five years.

The action plan emphasises diverse solutions, focused approach and efficient execution and partnership and teamwork of different parties is of particular importance. Shared ownership and responsibility ensures that actions are integrated into annual and financial plans of the appropriate municipal institutions and offices. Many policy projects are ongoing or already part of the regular city operation and only need to be redefined in relation to the biodiversity policy goals or strengthened in terms of resources. Other projects are new and may call for changes in focus or direction and demand specific funding.
The key to a successful implementation process is that it follows an objective and democratic pathway, with facts and goals clearly and concisely presented and with consultation and collaboration as a prime focus during all stages. The Department of Environment and Planning for the City of Reykjavík will have main responsibility for the implementation and execution of the policy, in particular the Division of Parks and Nature.

Measuring success

Evaluating the success of policy implementation requires careful monitoring of all actions, and the establishment of indicators that measure key variables, preferably in a quantifiable manner. These variables may represent the response of particular ecosystems or organisms to beneficial actions such as restorative or protective measures, or be spatial variables that demonstrate the effects of policy goals on planning and development. Another key element to monitor success is to anticipate problems that may arise and prevent them with counteractions. Success must always be evaluated both with regard to long-term and short-term goals in mind and be based on professional understanding of the topic at hand. Assistance and advice from scientists specialized in biodiversity and other

knowledgeable parties is necessary for the evaluation process. Establishing a knowledge base on the status of local biodiversity, at least in key areas, should be a priority to guarantee enlightened decision-making. Success evaluation should be performed both by those responsible and by neutral parties.

Promotion and communication

The policy has to be visible and comprehensible for its messages to be apprehended and its goals to be reached. Therefore it is vital to promote and communicate the policy's content and vision in a clear and concise manner. Target groups vary from stakeholders like companies, landowners and government institutions to public groups from schoolchildren to whole neighbourhood societies. It is important to engage in diverse communication strategies and modify the topical content based on the target groups and the specific goals in question. The policy as it is presented in this document will be available in print and on the City website both in Icelandic and English.

Appendix: Geological diversity

Eldborg crater in Bláfjöll

The main focus of the Reykjavík biodiversity policy is on biological subjects such as organisms and ecosystems and this is reflected in its goals and actions. However, biodiversity is only one key element of the local environment which also includes geologicial diversity, landscape diversity, water, weather and other physical features. These physical features combined with the biological entites together form diverse units at various scales, large and small, that we generally call nature. It is vital to address and include these other aspects of nature when shaping and implementing the actions of the biodiversity policy.

Geological diversity is of particular importance as geological features of various kinds are so prominent and characteristic in the nature of Iceland rendering its unique appearance and reputation. The Reykjavík area is no exception, as its geology is exceptionally diverse and reflects an eventful geological history that includes frequent volcanic activity including explosive eruptions and lava flows, as well as diverse erosion events including water and wind erosion and most importantly glacial erosion during the last ice age. The bedrock and sediments in Reykjavík are of young age, the oldest rocks only about 1.6-3 million years old. Even younger basalt rocks and tuff formations from the last glacial period are particularly prominent in the Reykjavík bedrock and landscape. Sediment rock is not common, however the Fossvogur marine sediments, which date back to the end of the final ice age, are among the best studied sediments in Iceland and are famous for their fossils. Rock formations that display evidence of the movement of glaciers during glacial and warm periods, both their retreat and advance, are common on hilly outcrops such as Öskjuhlíð.

Some younger volcanic formations are also found in Reykjavík, including the Leitahraun lava flow in Elliðaárdalur and the Rauðhólar pseudocraters that were both formed around 5000 years ago in the same volcanic eruption. Volcanic formations are especially common in Bláfjallafólkvangur, a protected area east of the city. These include lava fields and caves as well as the large crater Eldborg and are part of the large volcanically active Reykjanes belt. Geothermal hot springs are also found in Reykjavík and indeed give the city its name as Reykjavík literally means "Smoky Bay".
Geological formations in Reykjavík are relatively well known and mapped. Many of them are situated within protected areas.

Many of the necessary actions defined within the Reykjavík biodiversity policy are also relevant for ambitions to protect, maintain and increase awareness about geological diversity. Conservation measures and decisions regarding land use must take into consideration the impact on both biodiversity and geological diversity. Geological features can often easily be incorporated into landscape design, even within built areas. In addition, maintaining essential physical features of a geological origin such as various soil and substrate types are pivotal for biodiversity, illustrating the clear connections between these different elements of nature.
Thus, various actions for the protection of geological diversity will be included in the action plan for the biodiversity policy.

Marine sediments in Fossvogur.

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