ICELAND

THE FOURTH NATIONAL REPORT TO THE CONVENTION ON BIOLOGICAL DIVERSITY

MINISTRY FOR THE ENVIRONMENT AND NATURAL RESOURCES

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TO THE CONVENTION ON BIOLOGICAL DIVERSITY

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Executive summary

The first Icelandic strategy for protection and sustainable use of biological diversity was adopted by the Government in 2008. The implementation of the strategy is based on an Action Plan approved in 2010. So far a number of actions have been completed and others are in good progress. Implementation of the Convention on Biological Diversity in Iceland is at large based on the Nature Conservation Legislation and a National Nature Conservation Strategy published every fifth year. In addition the Strategy and Action Plan for Sustainable Development contains a number of goals and actions directly addressing biological diversity and sustainable use of its components.

The main focus in Iceland for protection of biodiversity has been to increase our current knowledge on the biological diversity in Iceland and to secure protection of species in danger or threatened by extinction and to set aside land for protection of species in a network of protected areas. Iceland has been greatly affected by human induces degradation and subsequent soil erosion accelerated by natural causes such as harsh climate and volcanic activities. Loss of vegetation and natural habitats and eventually ecosystem services has been a long standing issue and reclamation, restoration of degraded land and prevention of habitat loss is an important subject in the biodiversity strategy.

Chapter 1

BIOLOGICAL DIVERSITY IN ICELAND

Overview

Iceland is located on the Mid-Atlantic Ridge, approximately 290 km east of Greenland and 970 km west of Norway, at the junction where the tectonic plates of North America and Eurasia meet. Large and mountainous, Iceland is Europe's second largest island and the third largest in the Atlantic Ocean, encompassing a land area of about 103,000 square kilometres, a coastline of 4,970 kilometres and an exclusive economic zone of 200 nautical miles which extends through 758,000 square kilometres of the surrounding ocean. Since part of the Gulf Stream flows along its southern and western coasts, the country enjoys a warmer climate than its northerly position would indicate. Its geographic isolation results in a flora and fauna typical for islands, with low species diversity but in many instances high numbers of individuals.

Due to the geothermal hot spot beneath central Iceland and the divergent movement of the tectonic plates to each side, volcanic eruptions are relatively frequent, averaging twice per decade. Very few other countries have lava fields that are as prevalent and extensive as those in Iceland. The porous nature of lava and ash and the rugged landscape can affect species composition and abundance, while the generally high precipitation and slow evaporation lead to high groundwater levels and a variety of freshwater ecosystems. Spring-fed freshwater systems, characterised by purity, a low mineral content and considerable stability in temperature and flow, are common and usually have more species diversity than glacial rivers.

As for Iceland's marine environment, its fairly high productivity is caused both by a temperature-driven blending of sunlit surface water with cooler, nutrient rich deep water and by the mixing of cold and warm ocean currents. While numerous species inhabit the seas around Iceland, the marine ecosystem is dominated, like the island itself, by rather few species which are nevertheless very abundant. About 25 species are important commercially, though only a handful predominate in catches. Of these, the cod alone has nearly always provided more than half of Iceland's export earnings for marine products. In recent decades, total fish catches have fluctuated between 1 and 2 million tons per year.

Iceland is a geologically young country. Its most ancient existing rock, found in the West Fjords, is only around 16-17 million years old, whereas the world's oldest known rock is over 3,700 million years old. The island's comparatively short geological history compared to that of the continents means that fossils are rather rare. However, lignite appears between many of Iceland's Tertiary basalt strata, and the Tjörnes peninsula presents substantial sedimentary beds with a great variety of fossils. These beds contain the island's oldest marine deposits, 3.5 million years in age.

Certain parts of the country are distinguished by their abundance of geothermal water and diversity of geothermal areas. Within volcanic zones, high-temperature fields are connected to active volcanoes, but outside of these zones there are low-temperature areas related to intrusions which are slowly cooling and emanating heat deep in the bedrock.

Although many other countries have geothermal areas, they seldom appear in such concentration as here.

The Ice Age started about 3 million years ago. Since then, cold periods have alternated with warm periods such as the current one, which began around 11,000 years ago. In the lowlands, the Iceland of today generally enjoys a cool temperate climate (i.e. average July temperatures above 10°C and those of January above -3°C), while the highlands are subject to a polar climate (i.e. average July temperatures below 10°C and those of January below -3°C). The annual lowland precipitation ranges from 400 to 2,000 mm, highest on the south coast (1,500 to 2,000 mm) and lowest in the northeast (400 to 600 mm).

Cold and warm ocean currents meet in the seas off Iceland. The western branch of the Gulf Stream (with temperatures of approximately 6–8°C) reaches the country on its south coast, continues to skirt the island by heading first west and then north, and finally passes east along the north coast. Arriving from the Arctic Ocean, the cold East Greenland Current (around 0°C) runs south along the east coast of Greenland. Off Iceland's West Fjords, one branch of this current veers east to flow past North Iceland and then travels south along the island's east coast. Where the cold and warm ocean currents meet near Iceland, nutrient-rich seawater rises to the surface from deep down and provides favourable conditions for phytoplankton, which in turn serve as the foundation for a flourishing marine and littoral biota.

A great variety and number of freshwater habitats are found in Iceland. Since precipitation is high and evaporation low, the island has an abundance of surface water and groundwater. Partly for this reason, erosive forces also work rapidly, so that sediment transport is a more important factor than in most parts of the world. Groundwater can be either cool or warm, but in both cases it has its origin as precipitation which percolated down into bedrock and may later surface again at a cool or warm spring. Springs in lava fields form a particular type of ecosystem, distinguished by purity, a high mineral content and stability in regard to temperature and current. Whereas groundwater is extremely important as a resource for human consumption, rivers and geothermal reserves also comprise valuable energy sources.

Although volcanic activity has been the basic source of rock strata and other deposits, climate has also played a major role in shaping the landscape. Iceland's heavy precipitation results in powerful rivers which cut incisively through the land, while the combination of precipitation and a cold climate sustains glaciers as a major erosive force. If all of these factors are put together, Iceland's unique qualities become more obvious: glaciers, geothermal water, volcanic activity, earthquakes, rivers, the ocean, winds and frost heaving – as well as the combination of these forces – are all continuously reshaping the island.

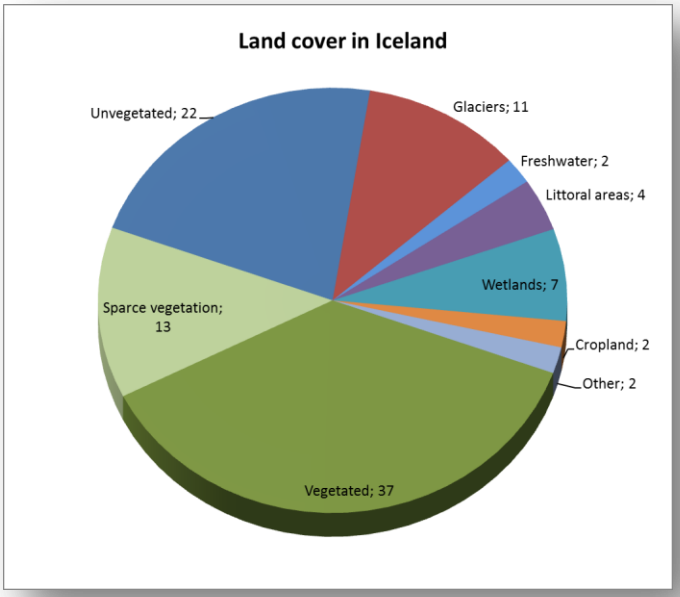

Figure 1. Land cover in Iceland according to the CORINE system of the European Environment Agency.

While it is safe to assert that most

of the species in Iceland's terrestrial and freshwater ecosystems have arrived since the close of the last cold period of the Ice Age, a few species of plants and animals may possibly have survived through that period in ice-free areas. Isolated by the ocean, Iceland probably received only an occasional, accidental influx of organisms, until humans began to have an impact. The 11,000 years which have elapsed since the glaciation actually represent only a brief moment in evolutionary history, practically too short for any new species to evolve. This means that native or distinctly Icelandic species are rare, and the biota is much less complex than it would otherwise have become, in view of the island's climate and fertility. Despite this, we are aware of at least four species of invertebrates found only in Iceland, two of which are midges and the other two groundwater amphipods. All of these are freshwater species, pinpointing the importance of freshwater in Icelandic ecology. In addition, several species of hot spring bacteria have been discovered that are unique to Iceland. Because the island is situated at the intersection between Eurasia and North America and between the Far North and the temperate zones, Icelandic species originate from every direction, although the great majority comes from northern Europe.

Terrestrial biodiversity

About one-third of the island is covered with continuous vegetation of some sort, of which about 1.2% is made up of birch woods or scrub. The remaining two-thirds consist of sparsely vegetated or barren areas, gravelly ground, glaciers and streams or lakes. The Icelandic flora of today stands in stark contrast to what the first settlers found less than 1200 years ago; at that time, two-thirds of the country is thought to have been fully vegetated, with woods or scrub (mostly birch) covering up to a quarter of the land. Since then, Iceland's vegetation has declined drastically, because of the destruction of woodlands, soil erosion and decreasing fertility.

Major categories of flora and fauna	Species in each category
Mammals	26
Nesting birds	76
Fishes	340
Insects	1,290
Arachnids	96
Mollusca	appr. 500
Other invertebrates	appr. 1,700
Vascular plants	438
Mosses	606
Lichens	715
Algae	1,450
Fungi	2,100

Table 1. Major groups of flora and fauna in Iceland and the number of species in each group.

The pollen record from the first decades of Iceland's settlement, from AD 870 to 900, confirms a rapid decline in birch and the spread of grasses – a trend which has continued to this day. As early as 1100, more than 90% of the original Icelandic forest had disappeared and by 1700 the soil had been blown or washed away from about 40% of the surfaces originally covered. Vast gravelly expanses were created which had previously been vegetated. Ecosystem degradation remains one of the country's most serious environmental problems; vast expanses have been over-exploited and transformed into desert, while erosion rates have been magnified by volcanic activity and harsh weather conditions. In the face of these problems, the Soil Conservation Service of Iceland was founded in 1907. Now under the Ministry for the Environment, this agency's main tasks are to combat desertification, sand encroachment and other forms of soil erosion; to promote sustainable land use; and to reclaim and restore degraded land.

According to data from the Icelandic Institute of Natural History, the country's flora includes at least 480 vascular plants and ferns (Pteridophytes), 606 mosses, 715 lichens and some 2,100 fungi. Around 1,450 species of terrestrial and aquatic algae have been listed in total. Whereas the number of vascular plants in the Icelandic flora is low, compared with regions east of the country that are of the same size and latitude, Iceland

has similar numbers of non-vascular plant species (mosses, lichens, fungi and algae). In fact, mosses and fungi are much more prominent in the plant kingdom here than in most parts of the world, partly due to the prevalence of young lava fields. On the whole, native Icelandic vegetation is low-growing, with few woody plants. Only the downy birch, *Betula pubescens*, forms natural forests, interspersed with individual rowan trees. Tea-leaved willow, on the other hand, often grows into expanses of scrub. A fertile algae belt along the coastline supports an abundance of littoral life.

Among the geothermal fields, both low- and high-temperature areas harbour unique biotas, which are in many places threatened by exploitation. A limited overview exists of the country's geothermal area's biota, but the natural conditions, including the biota, in these areas are being assessed in relation to the preparation of the Icelandic Master Plan for Hydro and Geothermal Energy Resources.

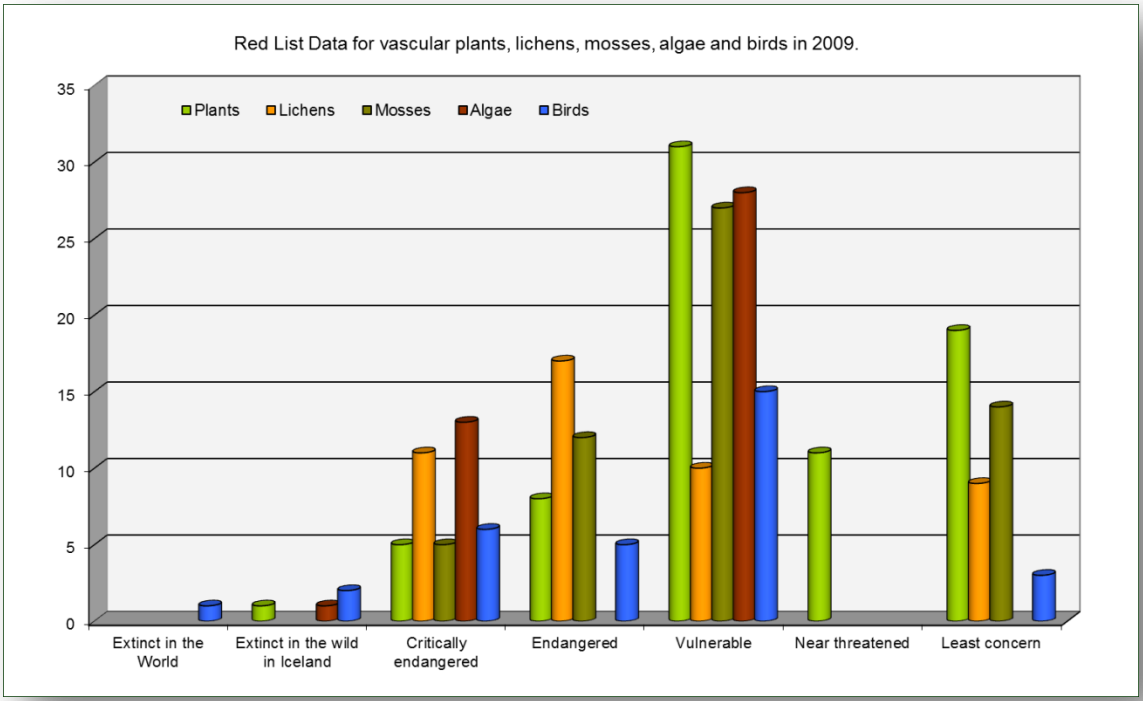

Figure 2. Red list classifications and the current red list status in Iceland of birds, vascular plants, lichens, mosses and algae. The data on birds is from 2000 and that on vascular plants from 2007; the other data is from 1996. Data source: Icelandic Institute of Natural History.

The list of threatened vascular plants from 1996 was reviewed in 2007, following intensive research and monitoring of endangered plants. Some changes were made to the list, so that 294 species are currently red listed for Iceland. However, red data listings for lichens, mosses, algae and birds have not yet been reviewed. The red list for birds was published in 2000 and contains 32 species of breeding birds, approximately 42% of the breeding species.

The Icelandic Institute of Natural History red list includes 79 species of vascular plants (of which 31 are under legal protection), 67 lichens, 74 mosses and 42 marine algae species.

Vegetation mapping has been on going in Iceland for a long time. In recent years Icelandic vegetation maps have been used, along with information on the fauna (birds and invertebrates) and inorganic environmental factors, to classify the country's nature into

specific categories, called habitat types. So far over twenty habitat types have been defined in the highlands, but lowland habitats still need defining. Some of the already defined habitat types are considered to have a high general conservation value or to be unique. Three might be mentioned: firstly, a lava field habitat characterised by the moss *Racometrium lanuginosum* and the lichen *Stereocaulon vesuvianum*; secondly, habitat typified by snow beds and heathlands; and thirdly, a dwarf-shrub heath habitat. Both of the latter habitats are found on Aeolian deposits and typically host a highly diverse community of plants and animals.

Whereas the Arctic fox is Iceland's only native terrestrial mammal, the field mouse, house mouse, rat, mink, reindeer and rabbit have been brought to the island by humans, either intentionally or unintentionally. In addition, harbour seals and grey seals come on land to pup.

Birds are certainly the most noticeable part of Iceland’s animal kingdom. About 75 species normally nest in this country, according to information from the Institute of Natural History, though probably over 100 have nested here at least once. Among the regular nesters, 20 stay in Iceland throughout the year, while the others are migratory. Finally, an additional nine bird species visit regularly when migrating or over the winter, and can be a prominent feature of Icelandic nature at those times. Compared to nearby countries, Iceland has a high proportion of seabirds, moorland birds and members of the duck family, *Anatidae*, but has a low proportion of passerines and raptors. Several bird species have become extinct in Iceland. One of these was the great auk, which became extinct when the world's last two known specimens were killed on Eldey Island off southwest Iceland in 1844. The water rail and little auk, on the other hand, remain common in other countries despite having disappeared as nesters.

Although relatively few avian species nest in this country, the number of individuals is often high, so that in some cases the Icelandic stock can account for a high proportion of the European or even global population. Within the arena of international cooperation, such instances are referred to as responsibility species. Taking a 30% share of the European stock as the criterion, Iceland bears high responsibility for at least 16 avian species, including the whooper swan, razorbill, pink-footed goose, Barrow's goldeneye, guillemot, whimbrel and great skua. About 30 nesting species are on the Institute of Natural History's red list. These include quite common birds, such as Brünnich's guillemot and the greater black-backed gull; in such cases, the reason for the listing is that the stocks have suffered abnormal losses over a short period.

Although Iceland's total number of invertebrates (insects, arthropods, annelids, nematodes, other soil organisms, etc.) is unknown, a total of about 1,400 terrestrial and freshwater species have been described, according to information from the Institute of Natural History. About three-quarters of these 1,400 species are insects, of which dipterans (373 species), hymenopterans (256) and beetles (239) represent the most diverse groups. In any case, a great deal of work remains in order to compile a conclusive overview of invertebrate terrestrial and freshwater fauna, so that its characteristics can be considered in relation to the faunas of other countries and so that the need for protecting any particular species can be discussed scientifically.

Through the centuries, the climate, landscape and biota have significantly influenced where Icelanders chose to take residence and how they utilised the environment. Conversely, their presence and use of the island have greatly influenced both the landscape and biota. The economic sector which has had the most influence on biodiversity is agriculture. During most of the country's history, summer pastures and grassy areas for haymaking were, in addition to potential winter grazing, the factors

which mattered most for the residents of inland areas. Sheep grazing has contributed substantially to the decline and loss of vegetation which have been occurring ever since the island was settled. A growing population and developing economy have led to the expansion of towns and the emergence of holiday villages, as well as to more extensive transportation networks. More recently, many wetlands in lower reaches have been drained to serve as agricultural hayfields, while villages and large towns have been spreading out. Afforestation with imported tree species has gained ground in the past couple of decades, becoming a special economic sector. An act has been passed which ties afforestation programs to individual regions; these programs are expected to result in a doubling of lowland forest cover during coming decades.

A cultural landscape can foster a unique ecosystem which people feel must be protected for itself. The protection of such landscapes may also be justified on cultural grounds, so that people today as well as future generations will receive a chance to appreciate and understand the life of past generations.

Approximately one-fifth of Iceland's total land area is suitable for producing fodder and raising livestock. Around 6% of this usable land is currently cultivated, with the remainder devoted to grazing or left undeveloped. For the most part, the country's meat and dairy products are consumed domestically. While the principal crops have traditionally been hay, potatoes and other root vegetables, the cultivation of crops such as barley and oats has increased rapidly in the last ten years and is now gaining importance. Vegetables and flowers are generally grown in greenhouses that are heated with geothermal hot water and steam.

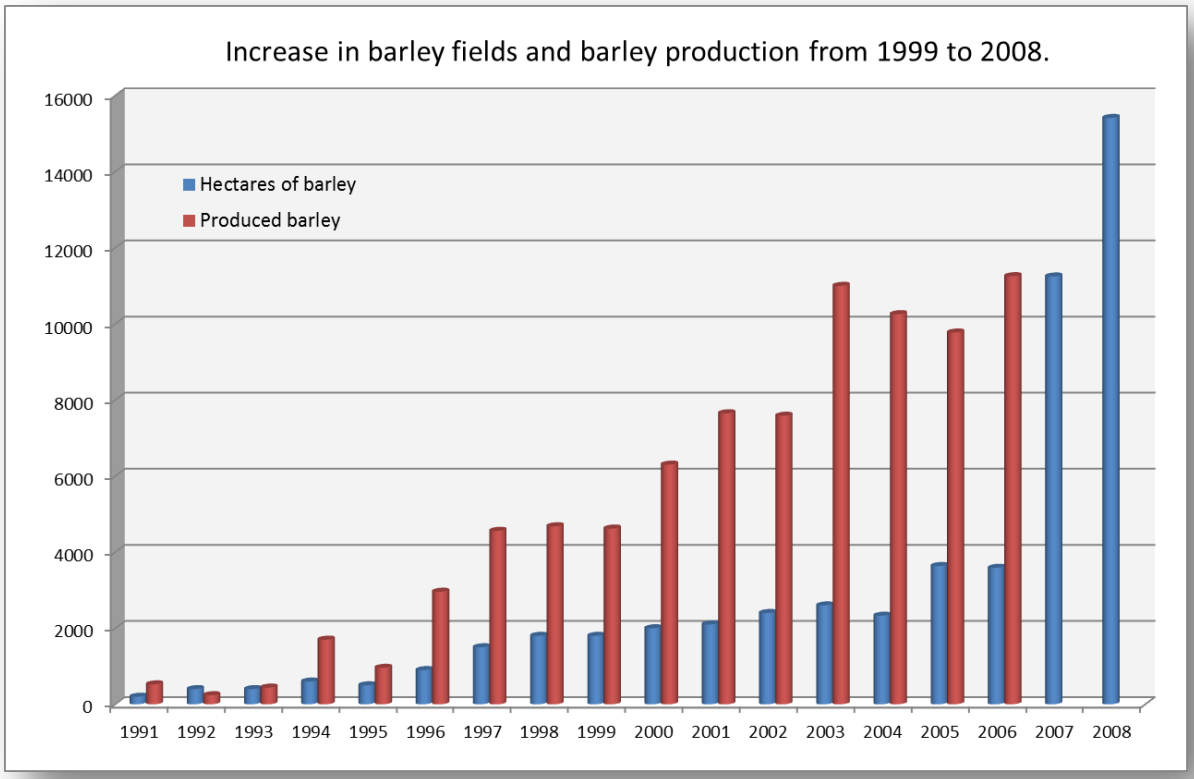

Figure 3. Development of barley fields and barley production from 1990 to 2008, barley produced in tones.

Located in the lowlands, agriculture is practiced all around the island, although the principal areas of contiguous farmland lie in South Iceland and the middle of North

Iceland. If pork and poultry production are ignored, agricultural operations have generally consisted of a family farm on which cattle, sheep and frequently horses were raised. In recent years, operations have increasingly become more specialized, with a clear trend towards larger and fewer farms, at least in dairy production. Horse breeding has also been on the increase. Raising livestock in Iceland depends primarily on summertime grazing and on harvesting hay for winter feed. While grass remains the most important fodder, more and more barley, legumes and other types of fodder crops have been cultivated over the past decade.

The livestock and plant breeds used for farming represent important genetic resources. Unique stocks and genotypes among Iceland's agricultural plants have been collected, register and preserve for the past few decades. Many of these stocks are being maintained through traditional cultivation and special collection plots, while genetic material from the country's agricultural plants is also stored at the Nordic Gene Bank. The Icelandic chicken, a breed originating with the island's settlers well over 1100 years ago, is now maintained and protected by a special organisation, and subsidies are granted to support the old Icelandic goat breed, which has reached critically low numbers.

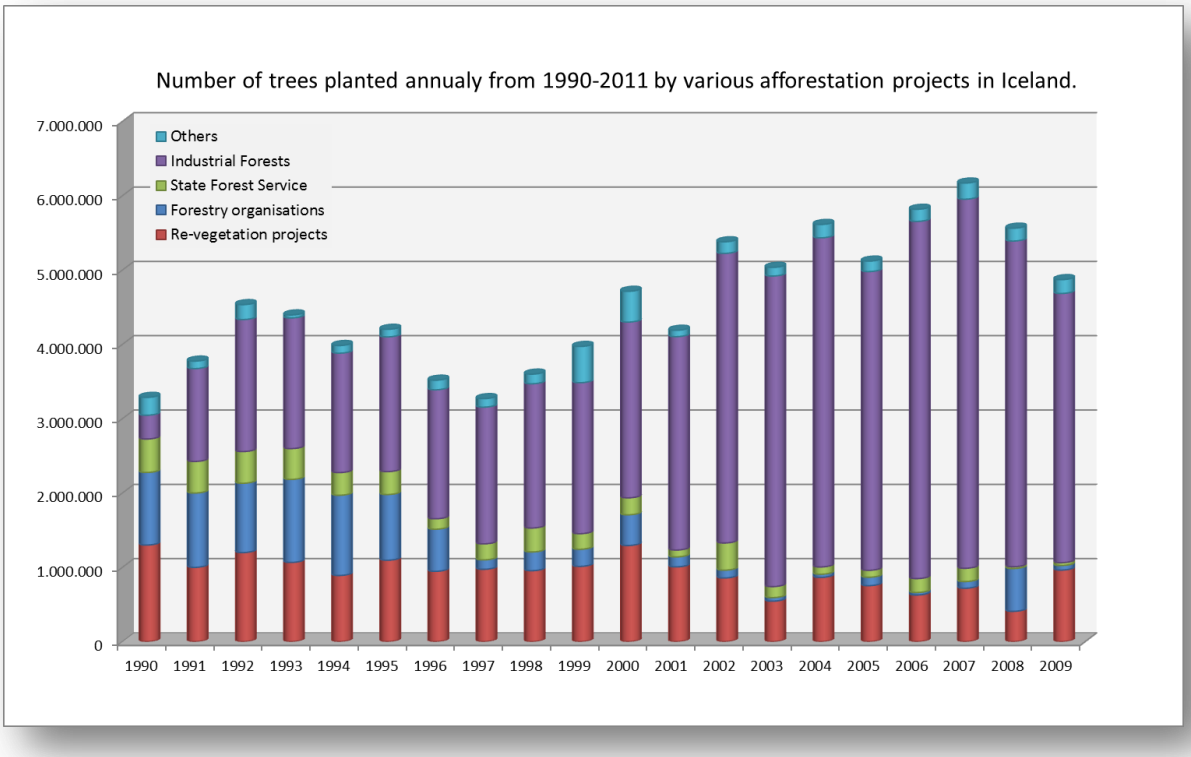

Figure 4. Number of tree seedlings planted annually in Iceland from 1990 to 2009 by different projects. Source: Skógræktarritið 1991-2010.

Organised forestry is considered to have originated in Iceland in 1899. In the 1990s, there was a considerable increase in tree planting through afforestation, from an average of around 1 million seedlings annually in the 1980s to 4 million annually in the 1990s and 5 million annually in the first nine years of the 21st century. In terms of surface area, around 1,100-1,900 ha were afforested annually between 1990 and 2009. Native birch plantings have increased somewhat as a proportion of total afforestation, and account only for 24% of the seedlings planted from 1990 to 2009. Despite how limited the beginnings of state-supported afforestation on farms and privately owned land were in 1970, this arrangement has now become Iceland's main channel for afforestation activities, comprising about

80% of current afforestation efforts. The total area of forest and other wooded land, as reported in the 2010 country report for the FAO Forest Resource Assessment, was estimated to be 1% of the country's total land area, having increased from 110,000 hectares in 2005 to 116,000 hectares in 2010. These totals include two major planting projects which covered 30,000 ha (28%) and 36,000 ha (31%) respectively.

Both native and imported tree species are being recorded for afforestation purposes, as well as being improved by selection and breeding. It is important to increase the knowledge of genetic resources of the native forests in Iceland's afforestation work and to safeguard these resources in groves and woodlands throughout the country.

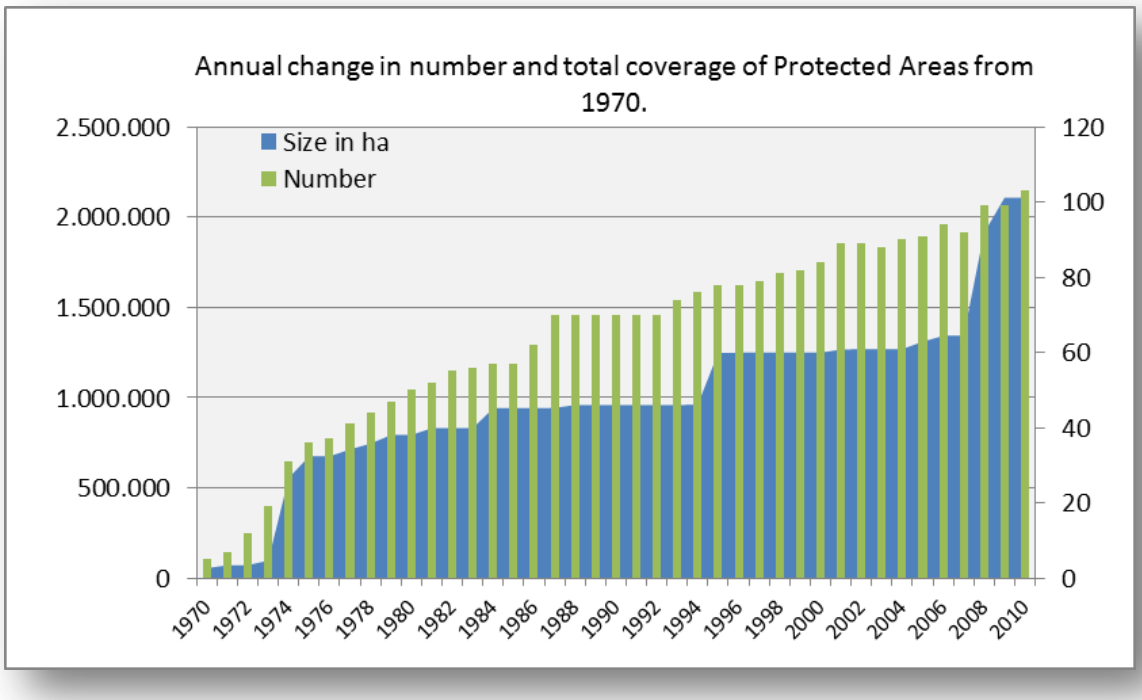

Figure 5. The columns show the number and annual development in the number of Protected Areas from 1970 to 2010. The blue section shows developments in the total number of hectares under protection.

In 2010 there are 101 protected areas in Iceland, covering approximately 21,000 km^2 or land equivalent to about 20% of the island. This includes 75 areas that contribute much to protecting biological diversity and other 24 sites, covering around 56 km^2, which mainly serve a geological purpose but contribute also to conservation of biological diversity. The Nature Conservation Strategy (NCS) for the period 2009-2013, including the NCS for 2004-2008, emphasises areas that are important for protecting biological diversity, mainly endangered plant species, migratory birds and habitat types in the central highlands. In addition to proposing 21 new protected areas, this strategy recommends the protection throughout Iceland of 24 species of vascular plants, 45 species of mosses, 90 species of lichens and 3 invertebrate species. The goals expressed in the Nature Conservation Strategy for 2013 would increase the coverage of protected areas to over 25% of the terrestrial area and the number of protected areas to 118.

Freshwater biodiversity

Iceland has five native freshwater fish species. These include three salmonid species – the Atlantic salmon (*Salmo salar*), brown trout (*Salmo trutta*) and Arctic char (*Salvelinus alpinus*) – with the latter two existing as both migratory and resident populations. The other two species are the European eel (*Anquilla anquilla*) and three-spined stickleback

(*Gasterosteus aculeatus*). Of all five species, the salmon is most important economically. As well as these, a sixth species, the rainbow trout (*Oncorhynchus mykiss*), has spread out from aquaculture, while a seventh, the flounder (*Platichthys flesus*), seems to be establishing itself in estuaries of South and West Iceland. The remaining aquatic organisms worth mentioning are 146 species of rotifers, about 120 aquatic insects, 89 crayfish, 26 annelids and 10 water mites. A lot of work needs to be carried out before any overview becomes available of the number of Icelandic freshwater species, but they can be estimated as at least 2,000. Of these, microscopic diatoms, green algae, rotifers and nematodes probably comprise the most numerous groups. A similar shortage of information applies to Iceland's main species of freshwater microorganisms.

Icelandic rivers are of varying types, being fed by springs, glacial melt or direct run-off from various types of bedrock. All of these kinds of rivers may in places mix with geothermal water. These factors encourage a diverse biota, and many special characteristics of the island's aquatic biota may be traced to the diversity of habitats. The high acidity and mineral content of the waters fed by Icelandic springs stems from their underground water sources, in the porous, relatively soluble rock of the country's volcanic zone. The steady flow in such spring waters guarantees stability for organisms in this habitat, while a stream bed composed of rough, uneven lava has a considerable surface area and cavities and can thus provide home and shelter to a multitude of organisms. Research has in fact demonstrated that Iceland's richest and most diverse aquatic biotas are to be found in spring waters situated over lava beds.

Despite the high diversity of Icelandic freshwater habitats, the island's freshwater environment is occupied by a small number of species, compared to countries abroad. The reason for this is clearly the isolation of the island. However, its diverse environment has apparently encouraged the evolution of unique variations within freshwater species. One of these species is the Arctic char, of which numerous kinds have been discovered, including four clearly distinct subspecies in Þingvallavatn lake; each of these four has adapted to different habitats and living patterns within the lake.

In any given Icelandic river, the salmon fishing season may last for up to three and a half months, scheduled during the period of 20 May to 30 September. The daily fishing times may include a total of 12 hours, between dawn and sunset, with fishing never permitted between 3 a.m. and 7 a.m. In most Icelandic rivers, fishing may only be carried out with a rod and line, the number of rods used in each river being fixed by the Institute of Freshwater Fisheries. The rule of thumb for deciding the number of rods allowed is to aim for an average of one fish per day per rod. In some rivers, however, further restrictions are set on the bait that is allowed.

Marine salmon fishing is generally prohibited in Icelandic waters and salmon nets are only used in major glacial rivers. Fishing rights accompany the ownership of land adjacent to a river. The landowners are usually farmers and, together with any other fishing-right owners in the river system, they form a fishery association to manage exploitation of the fish stocks within the framework set by law. Usually this association rents or leases the fishing rights to angling clubs or directly to individual anglers, leading to an average value per fish which is at least ten times higher than the prices of fish sold for food.

Daily catches are recorded in a special logbook, normally located at the fishing lodge. Access to records on all of the information requested for each individual fish is of immense benefit to science and fisheries management. At the end of each fishing season, these logbooks are collected by the Institute of Freshwater Fisheries, which then processes the data. The logbooks are then returned to the fisheries associations, together

with new logbooks, before the start of the next fishing season. While national catch statistics have been compiled in this way since 1974, for some of its rivers Iceland has statistical information reaching back to the 18th century.

Work started in 1992 on an overall assessment of the Icelandic freshwater biota, conducted as a collaborative venture between the Natural History Museum of Kópavogur, the University of Iceland, Hólar University College and the Institute of Freshwater Fisheries. These institutions, along with others, are also researching the country's rivers, together with the ecosystems of ponds.

Marine and coastal biodiversity

The marine biota surrounding Iceland is not as isolated from that of comparable ocean regions as the country's terrestrial and freshwater biota is. The seas off Iceland are characterised by the collision of cold and warm currents, resulting in a mixing of seawater which creates living conditions for substantial stocks of zoo- and phytoplankton, rich and diverse benthic communities, and high-yielding fishing grounds.

Marine algae are generally divided into two main groups: benthic algae and planktonic algae. Benthic algae grow in a rather narrow coastal belt, lying from the high-water mark down to a depth of approximately 50 m, though this belt may go deeper where the sea is clear and there is sufficient sunlight. Planktonic algae, on the other hand, consist mostly of tiny unicellular organisms that occupy the upper layers of the sea. In spite of being invisible to the eye, their number and biomass is huge, with the Marine Research Institute estimating their annual productivity inside the Icelandic fisheries jurisdiction to amount to about 120 million tonnes of pure carbon per year. Although some 260 species of benthic algae are known around Iceland, no overview exists of the number of planktonic algae species in the sea.

According to information from the Marine Research Institute, around 270 fish species have been discovered in Iceland's exclusive economic zone, and at least 150 of these are known to spawn within this zone. Whereas most of these are temperate marine species which spawn in shallow waters (such as cod, haddock, saithe, herring and flatfish), some of them are of Arctic origin (such as capelin and the Greenland halibut). Of all these fish species, only just over 20 are caught to any extent. The fish stocks with the greatest economic significance are cod, haddock, saithe, redfish, capelin, herring and a few flatfish species, while shrimps, together with langoustines and the Iceland scallop, have been the most important invertebrates.

Iceland is the world's twelfth largest fishing nation, and exports nearly all its catch. Although the country's fishery is still one of the main economic sectors and the main pillar of the export business, the marine sector has fallen in relative importance over the last four decades. Nonetheless, in 2008 – the first year in which marine products held a smaller market share than manufactured goods – they still constituted 36.7% of all exports. A comprehensive fisheries management system has been developed that is based on individual transferable quotas. Total allowable catches (TACs) are issued to fishing companies and individuals with the aim of promoting conservation and the efficient utilisation of marine resources. Every commercially important species is managed within this regime. Besides the fisheries management system, a number of other direct, explicit measures are in place to achieve the objectives of the system and to support conservation and sustainability measures.

Even though all of the Icelandic fish species occur in foreign waters, the local populations are often distinct and unconnected to other stocks except in very limited ways. The Icelandic cod stock, for example, is not the same as the North Sea stock. Two herring

stocks occur off the coast of Iceland: the summer-spawning herring, which hatches near this country, and the so-called Norwegian-Icelandic herring, which spawns off Norway but comes to Iceland in search of food.

Two seal species pup on Icelandic shores: the common or harbour seal and the grey seal, although the populations of both have diminished during the past decade. Out at sea, at least seven toothed whales and five baleen whales are common, while about 25 whale species have been sighted in Icelandic waters.

Launched in 1992 to investigate the species composition, distribution and mass of benthic fauna in the seas around Iceland, the extensive BIOICE (Benthic Invertebrates of Icelandic Waters) project is a joint undertaking of the Institute of Natural History, Marine Research Institute and University of Iceland. This project has collected a total of 2,035 benthic fauna species, of which around 845 had till then remained undiscovered off Iceland and 46 been unknown anywhere in the world. The BIOICE project demonstrates that organised research is capable of substantially improving the country's knowledge of its biota.

Extreme ecosystems – biodiversity

Extreme ecosystems are those which have evolved under exceptional environmental conditions, such as high or low temperatures (e.g. hot springs, glaciers), high or low acidity (e.g. various types of hot springs) or heavy pressure (e.g. the deep sea). Under the most extreme conditions, only specialised organisms manage to thrive.

Typical of extreme habitats, the hot spring environment is home to a diverse community of vascular plants, mosses, algae, animals and thermophile microorganisms. The autotrophic producers of hot spring communities consist either of photosynthesising blue-green bacteria or chemotrophic bacteria that are capable of utilising hydrogen or sulphides as an energy source. In extreme ecosystems, the number of species may be considerably lower than in other ecosystems. Often one species, adapted to the extreme conditions on site, is present in great numbers, but is joined by a few other rare species.

As part of Phases I and II of the Icelandic Master Plan for Hydro and Geothermal Energy Resources, the University of Iceland and other bodies have been conducting research on microorganisms and the microbial ecosystems of hot springs and their surroundings. Thus a considerable volume of data is already available but needs to be made accessible through a database.

Knowledge gaps

In some fields, the organised recording and knowledge of Iceland's biota lags considerably behind that of most neighbouring countries. Although the distribution and number of birds, fish, mammals, vascular plants and mosses are already fairly well known, and an attempt is being made through Phase II of the Master Plan for Hydro and Geothermal Energy Resources to improve the knowledge of terrestrial hot-spring ecosystems and geothermal areas, there is a lack of any exhaustive summary of the species richness and distribution of most other groups. In particular, knowledge is inadequate on terrestrial and freshwater algae and on various groups of invertebrates, including those of soils and freshwater, while research is completely missing on prokaryotes in both freshwater and the seas off Iceland.

No matter which of the three organisational levels of biodiversity are considered – genetic, species or ecosystem diversity – considerable knowledge is still needed in every area. Although the insight has gained ground that being aware of the genetic diversity

within a species is crucial for using it sustainably and strengthening its stocks if they are exploited, further research is required.

Taxonomy is the field within biology which deals with the organised classification and recording of species. In recent decades, taxonomy has significantly lost favour among scientists, both in Iceland and abroad. Although the Convention on Biological Diversity specifically emphasises that member states should reverse this trend, very little support for taxonomic activities has been forthcoming.

Since habitat types have only been defined in Iceland's highlands, those in the country's lowlands and sub littoral zones remain unidentified. Considerable work is needed in order to classify ecologically the island's rivers and lakes into water body types. In addition, there is insufficient knowledge of succession and the functioning of communities and ecosystems (for instance in regard to air exchange and chemical processes and to the relationships and competition between organisms).

The stocks of several bird, mammal and fish species which have economic significance or are rare and in need of protection are being monitored regularly, either on a national or regional basis (for example, the original Icelandic breeds of chicken and goat, the reindeer, eagle, ptarmigan, gyrfalcon, minke whale, cod, haddock, capelin, herring and salmonids). The locations of rare plants are also under surveillance. With the exception of a few terrestrial animals and exploitable marine species, stock size and population changes are seldom or only partially known for most Icelandic species.

THREATS TO BIODIVERSITY IN ICELAND

Non-sustainable exploitation

Along with natural catastrophes, it is thought that overgrazing and the unsustainable use of woods and scrubs have played the biggest roles in the reduction and loss of plant cover which has occurred since settlement began in the 9th century. As a consequence of decreasing plant cover, soil erosion occurred on wide expanses of the island. Although the number of sheep reached an all-time high in the middle of the 1970s, their number fell by half between 1975 and 1992 and since then has changed little. Sheep are now put out to graze on open pastures for a shorter season than before, but despite this and their decrease in number, some of the country's grazing commons are still considered overgrazed. The same applies to many horse pastures in the lowlands.

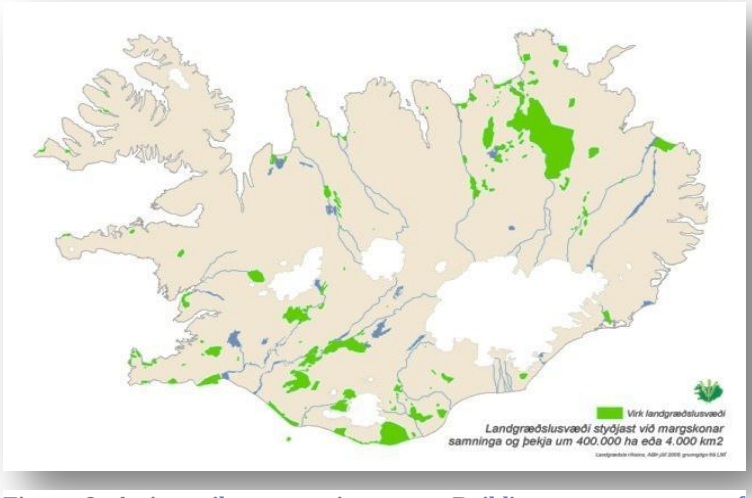

Figure 6. Active soil conservation areas. Building on many types of agreements, soil conservation areas now cover about 400,000 hectares (4,000 km^2). Soil Conservation Service of Iceland; ABÞ, July 2009; based on data from the National Land Survey.

As for the fishing sector, Iceland has also experienced some consequences of non-sustainable exploitation. Herring populations in the country's fishing grounds collapsed in the

late 1960s, following over-fishing and a drop in seawater temperatures. Since then, two of these populations have grown and reached their previous levels, with one of them now achieving a historical peak. In regard to stocks of demersal fish, their condition varies: for instance, the cod stock has decreased considerably, while that of haddock has increased. While demersal fish catches exceeded the advice of scientists for many years, the authorities have in the last ten years generally followed the advice of the Marine Research Institute when setting total allowable catches for the most important fish stocks.

Destruction and impairment of habitats

Since settlement started in the 9th century, the country's native birch woods and scrub have been starkly reduced, so that they now only cover about 1.2% of Iceland, whereas they are thought to have covered around a quarter of it when settlement commenced. The conclusion is that less than 5% of the original birch woodlands still exist today. Only about 17% of these woodlands enjoy protection, and in many places they are being disturbed by such developments as the construction of holiday villages. In connection with the loss of woodlands, erosion began and soil was blown or washed away from broad expanses of land. Extensive measures to revegetate or afforest such land will affect its visual aspects, as well as the living conditions of a wide range of species. Therefore, it is important to ensure that such measures have been thoroughly considered.

In the latter part of the 20th century, wetlands suffered substantial losses due to drainage, leaving only about 3% of the original wetlands in South Iceland and about 18% of those in West Iceland undisturbed, according to research in those two regions of the island. The decline of wetlands is thought to be one of the reasons for the extinction of the water rail in Iceland.

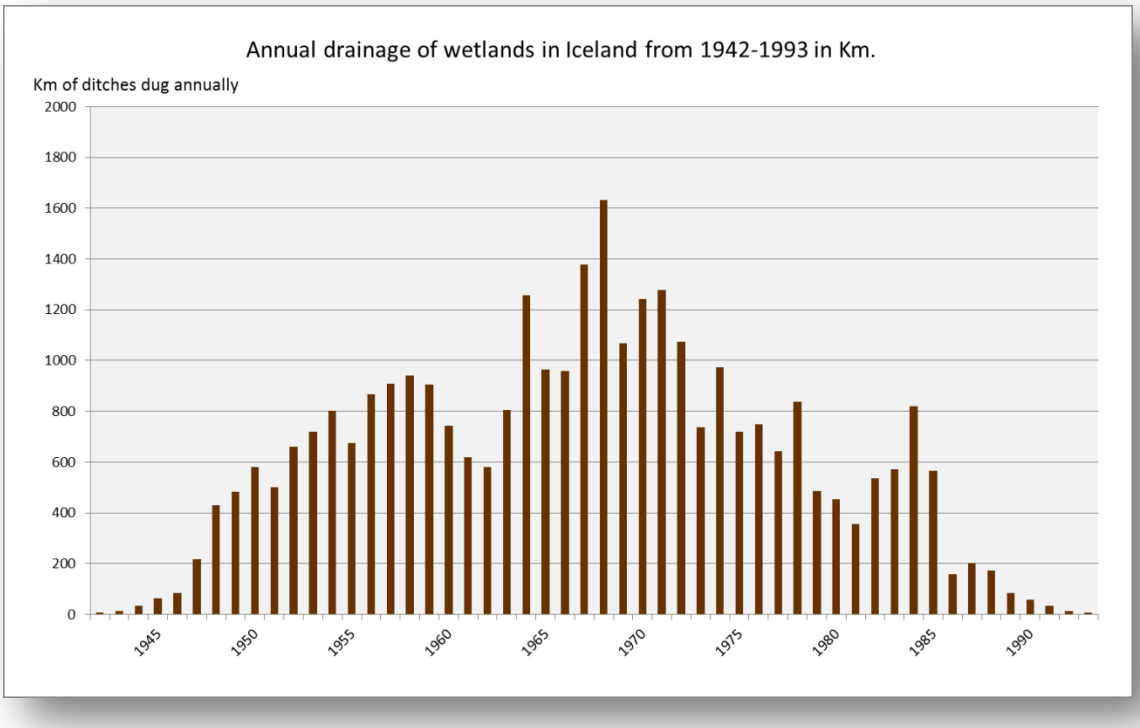

Figure 7. Length of ditches dug annually for wetland drainage from 1942 to 1993. The total ditch length is close to 32,000 Km.

Dams and water reservoirs for hydropower developments have in some cases had a substantial local impact and impinged on the habitats of certain species. One example of this is the impact of harnessing the river Sog on the spawning grounds of the large brown

trout, while another concerns the construction of Kárahnjúkar Power Plant on the nesting grounds of pink-footed geese and the ranges of reindeer. The harnessing of glacial rivers may also have considerable effects far away, as regards shoreline erosion and nutrient transport down to the sea. Most geothermal low-temperature areas in the lowlands have already been disturbed due to the development of geothermal resources for various purposes. There is also great interest in exploiting high-temperature fields, even though geothermal power plants may have a significant negative impact on the unique biota of these areas.

Building roads does have considerable affect in some areas and new roads across fjords, for instance over Gilsfjörður, and not allowing for full tidal water exchange will profoundly impact the existing fjord biota on the inland side of the road.

According to resent scientific findings, a large part of the coral areas and sponge communities that were known to have once existed on the island shelf have either disappeared or been reduced to a mere fraction of their earlier dimensions. On the other hand, sponge communities can be found in many places outside of fishing areas, both in the Denmark Strait and over the Reykjanes Ridge, and research indicates that areas with abundant coral are mostly to be found on the slopes of the island shelf.

Pollution

Although the ocean waters encircling Iceland are among the purest known anywhere, measurable amounts of pollutants are found in Icelandic marine catches. Some of the pollutants can be traced to human activities in this country, but the great majority are brought by air or ocean currents from elsewhere, often from distant lands. The concentration of pollutants in Icelandic marine catches is generally below maximum levels and even seems to be dropping, partly because of stricter procedures in this country but primarily because many other countries have tightened their regulations on releasing pollutants into the sea.

Minimising the pollution which results from human activities is of vital importance to any nation which bases its livelihood to a large degree on the use of living ocean resources. Added to its negative impacts on the growth and productivity of individual populations, pollution might have a negative impact on the market value of Icelandic marine produce, since consumers and governments are continually demanding more product wholesomeness. Shipwrecks and oil spills may have a heavy local impact on the marine and littoral biota.

On land, the pollution most likely to affect the biota is caused by the unsatisfactory disposal of sewage or the disposal and distribution of waste. Stress on the biota has increased due to urban spread and the development of holiday villages, along with an increasing supply of sewage which may result in eutrophication (nutrient over-enrichment) of nearby freshwater ecosystems. Finally, the utilisation of geothermal energy can lead to pollution because of the steam and run-off water.

Climate change

Climate change will have a multitude of effects on global biodiversity. It is generally believed that biome and species distribution areas will shift from the equator towards the two poles as the climate warms, and individual species will undergo a variety of changes in life expectancies, living patterns and behaviour. A 2007 report by the United Nations' Intergovernmental Panel on Climate Change (IPCC) estimates that up to 50% of the species which have been specifically investigated for these factors have already been affected by climate change. A further opinion expressed by the panel is that 20-30% of all

the world's species may become extinct if average global temperatures rise by 1.5-2.0°C during this century.

In fact, the earth's biota influences the climate both directly and indirectly, for instance in terms of shelter, transpiration and carbon sequestration. This means that biodiversity may play an important role in human efforts to prevent or adapt to climate change.

A report about the effects of climate change on Icelandic nature is to be published in the spring of 2008.

Invasive alien species

According to the Convention on Biological Diversity, an invasive alien species is one which has been introduced into a new environment, spreads there without hindrance and causes harm to the existing biota. Even native species may become invasive if conditions change. On a global scale, the increasing distribution of invasive alien species is viewed as one of the prime threats to biodiversity.

A well-known Icelandic example of an invasive alien species which has spread out and caused changes to Iceland's biota is the mink, which has for instance altered bird nesting patterns and led to a loss of farm resources. The Nootka lupine was first brought to Iceland to help revegetate barren, damaged land, but in many areas it has invaded spots of low-growing vegetation, such as those on partly barren gravelly ground and dwarf-shrub heaths. Some other imported species have also spread out and led to changes in the biota and landscape, including cow parsley, which is invasive in fertile soils; rabbits, which have for instance been seen in puffin and Manx shearwater breeding grounds in the Westman Islands; and the diatom *Didymosphenia geminata*, which has been spreading through Icelandic streams and rivers for the past ten years.

Since invasive species are expected to become more problematic for the Far North as the climate warms, there is a need for increasing education about invasive alien species and for setting rules on species imports.

Chapter 2

CURRENT STATUS OF NATIONAL BIODIVERSITY STRATEGIES AND ACTION PLANS

Icelandic National Biodiversity Strategy and Action Plan

The Iceland National Biodiversity Strategy was prepared by the Ministry for the Environment and adopted by the Government of Iceland in 2008. The strategy focuses on a number of priority areas for conservation of biological diversity and sustainable use of its components. Scientific research and knowledge is considered to be the basic foundation for conservation and in that sense strengthening research and monitoring is emphasized. The strategy comprises a number of actions to strengthen the knowledge base and actions for conservation of biological diversity.

The main areas of actions include species oriented conservation measures, new protected areas, restoration of degraded habitats, actions to limit the distribution of Invasive Alien Species and on genetically modified organisms. The Strategy identifies 33 actions under the following ten themes of action.

- Research and documentation
- Monitoring of BD
- Network of Protected Areas
- Protection of endangered species
- Restoration of degraded habitats
- Genetically Modified Organisms
- Invasive Alien Species
- Access to genetic resources
- Conservation and sustainable use of genetic resources
- Education and Communication

Action Plan on Biological Diversity

An Action Plan for implementation of the National Biodiversity Strategy was prepared by the Ministry for the Environment, in cooperation with other relevant ministries, and approved by the Government. The Action Plan contains 49 actions under the themes of action identified in the strategy. A few of the actions have been fulfilled while others are long time actions for up to five to ten years in implementation. Part of the implementation of the NBSAP is incorporated into the National Nature Conservation Strategy set periodically for five years. The current Nature Conservation Strategy which covers the period 2009-2013 contains plans for a number of new protected areas for conservation of biological diversity. The main emphasis of the 2009 NCS is on endangered plant species and areas for plant conservation, especially some red listed species. In addition, the NBS includes proposals for species protection for three terrestrial and freshwater invertebrate species and protected areas for two of the species.

Implementation

Implementation of most of the actions in the Biodiversity Action Plan have been initiated and some are already fully implemented. There are still a number of actions that have not been started in the category of restoration of degraded habitats, but most of them are specific actions to protect birch forests.

Action areas	Number of actions	Actions being implemented	Fully implemented
Research and documentation	5	5	
Monitoring of biodiversity	5	5	
Network of Protected Areas	11	10	3
Protection of endangered species	5	5	
Restoration of degraded habitats	11	1	
Genetically Modified Organisms	2	1	
Invasive Alien Species	5	2	1
Access to genetic resources	1	1	
Conservation and sustainable use of genetic resources	2	2	
Education and Communication	3	2	

The major obstacles in implementation are lack of data on the state of biological diversity in many areas of the country for certain groups. In addition to shortage of data is the limited funding for implementation.

Some of the actions

- A work group will be appointed, whose role will be to formulate proposals for measures to remove lupine plants from areas where they are deemed undesirable and are considered a threat to other parts of the environment, and how those proposals should be prioritised by geographical area.
- Work will be done towards defining, documenting, and charting lowland habitat types.
- Provisions on genetic resources will be included in the Nature Conservation Act during the proposed review of the Act.
- The guidelines of the Convention on Biological Diversity concerning how biodiversity shall be discussed in environmental impact assessments will be used as a reference in preparation of environmental impact assessments.
- Particular emphasis will be placed on education on biodiversity in 2010, which is the UN's International Year of Biodiversity.

Chapter 3

SECTORAL AND CROSS-SECTORAL INTEGRATION OR MAINSTREAMING OF BIODIVERSITY CONSIDERATIONS

Integration of biodiversity considerations

Integration of conservation of biological diversity and sustainable use of its components into other sectors of society is to some extent carried out through *Iceland's National Strategy for Sustainable Development, Welfare for the Future*, first approved in 2002. *Welfare for the Future* creates a framework for the objectives set by the Government with respect to sustainable development at the beginning of the 21st century. The Strategy is reviewed every four years in connection with the Environmental Assembly hosted by the Ministry for the Environment. The strategy presents the Government's emphases concerning conservation and sustainable utilisation of natural resources over the four year period under the objectives set forth in *Welfare for the Future*.

The Environmental Assembly is open to the general public, members of environmental groups, local governments and the business community. Future generations have the same right as present generations to enjoy the bounty of the earth, so future generations need to be included when decisions are taken that affect their future and that of generations yet to come. With this in mind, a special emphasis is on the young people's participation in the Environmental Assembly to promote intergenerational dialogue about Iceland's future development. A separate young people's symposium held concurrent with the latest Assembly sought to answer the quest, "How can Iceland become sustainable?"

The formulation of Icelanders' vision for the future in the spirit of sustainable development is a demanding project; therefore, a single government strategy cannot do it justice. It is a dynamic endeavour that is actually the task of all of society. In order to achieve the goals of sustainable development, it is considered necessary to build on sound scientific knowledge, constant re-evaluation of conditions and priorities, and open and democratic discourse. The Ministry for the Environment strongly emphasises democratic consultation with the public, with companies and non-governmental organisations, and with all those who are concerned about the environment. In order to promote equality and democracy in the discussions at the Environmental Assembly, the general practise is to establish small discussion groups where questions about sustainable development are discussed. The main emphasis during the current period is on sustainable production and consumption and education in sustainable development. Both of these are closely linked to people's awareness of their environment, lifestyle, and sense of the impact of human activity on the environment, and they centre on enhancing knowledge of possible ways to reduce strain on the environment. Other important objectives of the strategy on Welfare for the future include the considerations of protection of components of the Icelandic nature, such as species protection and conservation of habitat types and ecosystems. Defragmentation and reduction of wetlands, birch woodlands and other key ecosystems in Iceland should be avoided and restoration to reclaim wetlands and other important ecosystems should be made where possible. Furthermore the strategy emphasises that

efforts should be made to conserve the biodiversity of Icelandic habitat types and ecosystems by the protection of animals, plants and other organisms, together with their genetic resources and their habitats and that all utilization of living natural resources should be sustainable. It is stated that the precautionary approach and the ecosystem approach should be applied in all operations that may alter or disrupt ecosystems, in order to keep negative impact to a minimum.

Master Plan for hydro and geothermal energy resources in Iceland 1999-2010

The Government of Iceland initiated in 1999 a process with the aim of developing a Master Plan for Hydro and Geothermal Energy Resources for Iceland. The process was formulated on a scientific and impartial basis and has been open to democratic public involvement and scrutiny.

The process was split in two phases; Phase I, 1999-2003, and Phase II, 2004-2010. Phase I concluded with a preliminary ruling due to limited research and data. Phase II was split in two parts; the first was a continuity stage, 2004-2007, responsible for further research and information gathering, but during the second part, 2007-2009, a new steering committee regenerated the evaluation process to be completed by the end of 2009.

Background

Iceland is embraced with extensive resources of hydro and geothermal energy. However, a reasonable portion of these energy resources have been harnessed (approx. 20–25%). Further development of energy production in Iceland will be a challenging task especially with more demanding considerations of environmental impacts. It is the subject of the new master plan for hydro and geothermal energy to evaluate the options for conservation and utilization hydro and geothermal energy.

Policy decisions on land use can have a significant, profound, and prolonged impact on nature, regional development, tourism and outdoor activities, employment, and on society at large. Carefully thought-out decision making will minimise the risk of mistakes and short-sighted undertakings, and enhance co-operation among all partners affected by the decisions taken.

The Two Phases

The first phase of the Master Plan, 1999–2003, evaluated and ranked 20 large-scale hydro-power options, mostly located in the highlands, and the same number of geothermal options in 8 high-temperature areas. The second phase, 2007–2009, adds some 30–40 major hydro and geothermal options. The second phase ranked all the options to produce the final result, based on the latest research and taking into account stakeholders differing criteria. For instance, the second phase includes an evaluation of whether some areas should be conserved completely, without any energy-harnessing activities.

In the Master Plan's preparatory process, proposed power projects were evaluated and categorised on the basis of efficiency, economic profitability, and how they will benefit the economy as a whole. The implications for employment and regional development were also considered, as well as the impact on the environment, nature, and wildlife, landscape, cultural heritage and ancient monuments, grazing and other traditional land use, outdoor activities fishing, and hunting.

Scientific Base

The Master Plan is based on the best available scientific research and information. Furthermore, in order to establish confidence and trust in the process, the public and non-governmental organisations (NGOs) have been informed of the findings of experts (individuals and groups) at all stages of the evaluation process.

In order to facilitate public participation during the first phase, *Landvernd*, the National Association for the Protection of the Icelandic Environment (an NGO), was assigned the task of establishing a forum for discussion and information exchange. This forum was based on an interactive homepage, open meetings, workshops, and co-operation with the media.

The Master Plan's second stage followed a similar path, i.e. with a dedicated homepage (www.rammaaaetlun.is), dialogue with different stakeholders, public meetings, media collaboration, and NGO involvement.

Responsibility for the Project

The Master Plan was jointly initiated by The Ministry of Industry and The Ministry for the Environment, which share responsibility for the project. At the start of the project, the Ministry of Industry, in co-operation with the Ministry of the Environment, established special Steering Committees to lead the programme.

The Steering Committee will categorise the project proposals and identify: on one hand, proposals that appear to be feasible in terms of both their economic implications and their environmental consequences; on the other hand, proposals that, for economic or environmental reasons, should not be carried out, whether for the foreseeable future or only until further impact studies have been made.

The result of this work, which is planned to be finished by the end of 2009, will be a proposed Master Plan for the utilisation of hydro and geothermal energy resources.

An Open Process

All reports are made public in order to make it possible for the public, interested parties, and associations to actively participate in the process. Both the Steering Committee and the Working Groups will receive comments and information from the public during the process. Minutes from the meetings of the Steering Committee are made public and reports on individual projects will be presented in open meetings and made available on this website.

As a result it is seen that the Master Plan will lead to a greater degree of cohesion between viewpoints on the further utilisation of energy resources, different land-use interests, and the conservation of the land and nature.

Chapter 4

PROGRESS TOWARDS THE 2010 TARGET AND IMPLEMENTATION OF THE STRATEGIC PLAN

Protect the components of biodiversity

Goal 1. Promote the conservation of the biological diversity of ecosystems, habitats and biomes

Target 1.1: At least 10% of each of the world's ecological regions effectively conserved.

Currently there are 101 areas protected for nature conservation covering approximately 20% of the country. Terrestrial areas cover approximately 1.5 million hectares, wetlands 226,000 hectares, mountainous areas are approximately 1.6 million hectares and coastal and marine areas 455,000 hectares. Areas protected in accordance with the Nature Conservation Act are divided into the following categories: National Parks, Nature Reserves, Natural Monuments, Habitat Areas and County Parks. A number of protected conservation areas have also been established with a special legislation.

Most of the marine fisheries management areas within the EEZ are set up to control fisheries and secure a sustainable use of the harvested marine resources but not necessarily in order to conserve biological diversity. Five areas have been protected along the southern coast for conservation of cold water corals, in addition to three marine areas protected for biological diversity in accordance with the act on nature conservation.

Target 1.2: Areas of particular importance to biodiversity protected

During the last 5 years emphasis has been on areas with habitats for protection of a number of species of birds, both species that breed in Iceland and also migrating bird species passing through Iceland. Areas to strengthen protection both in terms of abundance and distribution have been selected for the species concerned.

Currently 24 areas are protected for bird conservation, a total of 375.000 hectares. Five new bird areas have been protected in the last 5 years and there are plans for further increase in areas for bird protection especially migrating and marine species.

Goal 2. Promote the conservation of species diversity

Target 2.1: Restore, maintain, or reduce the decline of populations of species of selected taxonomic groups.

There has been a general trend of increase in protected bird species and species that have been endangered such as falcons, the white tailed eagle, grey phalarope and slavonian grebe. Legislation on conservation, protection and hunting of wild birds and wild mammals is currently under review and will be improved if necessary.

The Icelandic falcon (*Falco rusticolus*) has been recovering but the population osculates in an 8-10 year cycle along with the main prey species, the ptarmigan.

The ptarmigan is the most popular game bird in Iceland. The population has a fluctuating cycle of 8-10 years naturally, but the population size has decreased during the last 2-3 decades. Restrictions have been imposed on hunting, the hunting season was shortened considerably and ban on sale of ptarmigans has been in effect since 2005. The ban, suggested voluntary bag limit, propaganda and the fear of a total hunting ban has led to reduced hunting and partial recovery of the ptarmigan population.

The slavonian grebe has been increasing in numbers the last 1-2 decades and has at the same time extended its breeding range in the country.

Target 2.2: Status of threatened species improved.

The white tailed eagle has been recovering due to conservation measures for the last 40-50 years, monitoring and regular watching of the nesting sites during the breeding season. The breeding population is now up to 66 breeding pairs from the 20 pairs around 1964.

A number of threatened bird species have been recovering for the last few years. Protective measures such as wetland restoration and protected areas have been effective for recovery for a number of bird species. Increased public awareness and better information have also been effective.

Coverage of protected areas for conservation of threatened species has increased considerably. Implementation of the Nature Conservation Strategy 2009-2013 will further increase the coverage especially for plants and birds but also for 2-3 species of rare invertebrates that have very limited distribution.

Goal 3. Promote the conservation of genetic diversity

Target 3.1: Genetic diversity of crops, livestock, and of harvested species of trees, fish and wildlife and other valuable species conserved, and associated indigenous and local knowledge maintained.

Due to isolation of most domesticated animals since the time of settlement and to strict rules for import of new breeds of domesticated species the Icelandic breeds differ considerably from the common breeds in Western and Northern Europe.

Management Plans are in place for the Icelandic hen, the goat and the dog and conservation measures for protection of the cow and the Icelandic horse are in place and no import of other breeds is permitted.

The Icelandic dog has been actively bread for a number of years and the population has been increasing and conservation status is considered adequate

The Icelandic goat population is an old breed and is the only domesticated animal that is considered to be threatened according to FAO criteria, with less than 1000 individuals at few farms in the country. A conservation programme has been in place for some years. In order to strengthen conservation measures the Agricultural University is mapping the genetic diversity in the goat population.

Goal 4. Promote sustainable use and consumption.

Target 4.1: Biodiversity-based products derived from sources that are sustainably managed, and production areas managed consistent with the conservation of biodiversity.

Most of Iceland is used for sheep grazing and generally speaking grazing is sustainable except in a few areas. The Soil Conservation Service monitors vegetative state of pastures and the number of sheep and grazing pressure is adjusted according to the vegetative

status in those areas. Badly overgrazed pastures have been closed for grazing and later after re-vegetation of the area it is usually opened again for grazing.

Forestry is based on the native birch and to large extent on alien species. According to national forestry legislation and plans for panting of trees for the next 30 years approximately 5% of low lands will be used for forestry. Current forestry practices can be considered to be inconsistent with the conservation of biodiversity. The native birch forest covers about 1.2% of the country, compared to the presumed 25% at the time of settlement. Due to less grazing pressure in many areas and less stress from other environmental factors the birch forests are recovering remarkably through natural processes and increasing in land cover.

Target 4.2. Unsustainable consumption, of biological resources, or that impacts upon biodiversity, reduced.

According to the Act on conservation, protection and hunting of wild birds and wild mammals all hunting shall be sustainable. Hunters need annual hunting license and all hunting is reported annually.

Unsustainable hunting and consumption of ptarmigan has been reduced considerably the last 10 years. Harvest is regulated and reviewed annually based on monitoring of the population and its development throughout the year.

The puffin population in the southern and south-western part of the country has been declining for 5-6 consecutive years most probably due to environmental factors and reduction in food supply. Hunting in the area has been reduced considerably the last few years.

There has been a general decline in most of the marine bird species during the last 5-10 years according to monitoring and counting of nesting birds in Iceland. The decline is most probably a result of decreased food supply and possibly affected by climate change, but that remains to be verified.

Target 4.3: No species of wild flora or fauna endangered by international trade.

There are two species in Iceland considered to be endangered or threatened by international trade. The falcon and the white-tailed eagle are CITES appendix I listed species and no trade or hunting is allowed. Both species are strictly protected in Iceland and their populations have been increasing in size. No plans are threatened by international trade.

Address threats to biodiversity

Goal 5. Pressures from habitat loss, land use change and degradation, and unsustainable water use, reduced.

Target 5.1. Rate of loss and degradation of natural habitats decreased.

- Trends in extent of selected biomes, ecosystems and habitats
- Trends in abundance and distribution of selected species
- Marine trophic index

Goal 6. Control threats from invasive alien species

Target 6.1. Pathways for major potential alien invasive species controlled.

Pathways for introduction and distribution have not been mapped but there are plans for actions to identify the pathways and to limit new introductions and to eradicate or limit the distribution of already introduced invasive alien species.

Target 6. 2. Management plans in place for major alien species that threaten ecosystems, habitats or species.

The American mink was introduced to Iceland in the early 1930 for fur production but escaped from captivity soon after the introduction. The mink has colonized most suitable habitats throughout the island. Active hunting measures to reduce the distribution and the population size have been carried out since 1957 with little luck. A three year experimental project that seeks to find out if it is possible to eradicate the mink from Iceland or at least reduce its numbers in certain areas is coming to an end. A new management plan for controlling the mink will be based on the result form the experiment.

The nootka lupine was introduced to Iceland over 60 years ago and has turned out to be invasive in most Icelandic habitats. The Ministry for the Environment has adopted a management plan for eradication of the lupine in areas above 400 meters above sea level and in protected areas. Actions in those areas are in preparation and will be started in the summer 2011.

Goal 7. Address challenges to biodiversity from climate change, and pollution

Target 7.1. Maintain and enhance resilience of the components of biodiversity to adapt to climate change.

Connectivity/fragmentation of ecosystems

Target 7.2. Reduce pollution and its impacts on biodiversity.

Water quality is excellent throughout the country and pollution is very little. Monitoring programmes are required in the vicinity of polluting industry and measures are applied to reduce any detected pollution that is considered to be harmful to biodiversity, livestock or human beings.

Maintain goods and services from biodiversity to support human well-being

Goal 8. Maintain capacity of ecosystems to deliver goods and services and support livelihoods

Target 8.1. Capacity of ecosystems to deliver goods and services maintained.

- Biodiversity used in food and medicine (indicator under development)
- Water quality in aquatic ecosystems
- Marine trophic index
- Incidence of Human-induced ecosystem failure

Ecosystems are generally in adequate condition and ecosystem services used sustainably and maintained. Harvest and use of natural recourses is measured and monitored regularly. In the case of over harvest or un-sustainable use, such as grazing and over fishing, management measures have been applied to decrease the pressure and keep harvest within sustainable levels. Water quality is generally good.

Target 8.2. Biological resources that support sustainable livelihoods, local food security and health care, especially of poor people maintained.

- Health and well-being of communities who depend directly on local ecosystem goods and services
- Biodiversity used in food and medicine

Does not apply, but in general the ecosystems and ecosystem services are in adequate shape in this respect.

Protect traditional knowledge, innovations and practices

Goal 9 Maintain socio-cultural diversity of indigenous and local communities

Target 9.1. Protect traditional knowledge, innovations and practices.

- Status and trends of linguistic diversity and numbers of speakers of indigenous languages

Does not apply in Iceland.

Target 9.2. Protect the rights of indigenous and local communities over their traditional knowledge, innovations and practices, including their rights to benefit-sharing.

Not applicable.

Ensure the fair and equitable sharing of benefits arising out of the use of genetic resources

Goal 10. Ensure the fair and equitable sharing of benefits arising out of the use of genetic resources

Target 10.1. All access to genetic resources is in line with the Convention on Biological Diversity and its relevant provisions.

The existing rules on access and benefit sharing only cover access to geothermal bacteria. Further regulation and legal instruments are being developed in connection to revision of the Nature Conservation Act. The revision is supposed to be finished in 2011-2012.

Target 10.2. Benefits arising from the commercial and other utilization of genetic resources shared in a fair and equitable way with the countries providing such resources in line with the Convention on Biological Diversity and its relevant provisions

Currently there are no legal instruments for benefit sharing from the utilization of genetic resources but the issue will be dealt with in revision of the Nature Conservation Act.

Ensure provision of adequate resources

Goal 11: Parties have improved financial, human, scientific, technical and technological capacity to implement the Convention

Target 11.1. New and additional financial resources are transferred to developing country Parties, to allow for the effective implementation of their commitments under the Convention, in accordance with Article 20.

- Official development assistance provided in support of the Convention

This has not been carried out.

Target 11.2. Technology is transferred to developing country Parties, to allow for the effective implementation of their commitments under the Convention, in accordance with its Article 20, paragraph 4.

- Indicator to be developed

The Icelandic development aid programme includes technical and technological issues, and capacity building in the field of fisheries and desertification. There are two International United Nations University programmes supported and run by Iceland, one on fisheries and fisheries management and the other covers the combat against desertification.

Appendix I

INFORMATION CONCERNING REPORTING PARTY AND PREPARATION OF NATIONAL REPORT

A. Reporting Party

Contracting Party	Iceland
National focal point	
Full name of the institution	*Ministry for the Environment, Iceland.*
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Contact officer for national report (if different FROM ABOVE)	
Full name of the institution	
Name and title of contact officer	
Mailing address	
Telephone	
Fax	
E-mail	
Submission	
Signature of officer responsible for submitting national report	
Date of submission	

Annex II

TARGETS OF THE GLOBAL STRATEGY FOR PLANT CONSERVATION

Target 1: A widely accessible working list of known plant species, as a step towards a complete world flora.

The Icelandic Institute of Natural History keeps a checklist of all Icelandic plants and alien plant species found in the natural environment. Checklists of vascular plants, bryophytes, mosses, lichens, fungi and algae, have been completed and are under constant review by botanical experts to keep them up-to-date, and accurate. A new checklist of vascular plants has recently been published by the Institute showing all native plants established before 1750 when floristic work was first started and alien species that most likely have been brought to the country without getting permanently established.[1] Checklists are also available and accessible on the internet.[2] Icelandic botanists have for decades cooperated with Nordic colleagues on the Flora of the Nordic countries.

Target 2: A preliminary assessment of the conservation status of all known plant species, at national, regional and international levels.

Conservation status of protected and threatened vascular plants is well known and is monitored regularly. Distribution and abundance of all other plant species is less known but occurrences in 10X10 km squares is well reported. Measures to protect nationally 24 vascular plant species, 45 species of mosses and 90 lichens species in addition to the 31 plant currently protected are under way along with protection of a number of the most important areas and habitats for plant conservation.

Target 3: Development of models with protocols for plant conservation and sustainable use, based on research and practical experience

Models with protocols for plant conservation and sustainable use have not been developed in. We are currently finalizing vegetation mapping and classification of habitat types. Habitat types in the Central Highlands, above 400 meters above sea level, have been identified and their distribution mapped, but the low land areas remain to be mapped. There are 24 identifies habitat types in the central highlands. As mention before, there are plans to extend the coverage of protected areas for plant conservation in order to create a network of protected areas.

Target 4: At least 10 per cent of each of the world's ecological regions effectively conserved.

Iceland is usually classified to the Arctic region or alpine / sub-arctic region. Protected areas cover approximately 21% of terrestrial land in Iceland with the majority of sites in the mountain areas and wetlands. The 25 protected mountain areas cover app. 861,000 ha while lowland areas are 50 and cover 89,700 ha. Coastal areas are 23 and cover roughly

1 http://www.ni.is/media/midlunogthjonusta/utgafa/Fjolrit_51_140808.pdf

2 http://www.floraislands.is/engflora.htm

353,000 ha while the 8 marine and island areas cover around 34,000 hectares. Terrestrial or marine areas have not been divided into ecological regions and therefore separation of protected areas into ecological regions is not possible at this time. Some of the remaining natural birch forests have been protected in accordance with the Nature Conservation Act or under the forestry act. The current Nature Conservation Strategy for the period 2009-2013 includes a number of important lowland vegetation areas as well as birch forests that will be protected.

Target 5: Protection of 50 per cent of the most important areas for plant diversity assured.

Currently less than 50 per cent of the most important areas for plant conservation are assured within protected areas. With the proposed future protection of areas for plant conservation in the 2009-2013 Nature Conservation Strategy a considerable progress will be made in reaching this target.

Target 6: At least 30 per cent of production lands managed consistent with the conservation of plant diversity.

Grazing land is assessed regularly and managed for sustainable use and grazing pressure adjusted accordingly. Grazing pressure from sheep has decreased considerably the last 2-3 decades as sheep numbers have been halved. The Institute of Natural History, the Soil Conservation Service and the Agricultural University at Hvanneyri have monitored biological diversity in grazing land in 100 different locations in the Northern and Southern part of the country for 13 years in order to predict changes related to grazing and climate change. The Soil Conservation Service co-operates with interested farmers in degraded areas to restore vegetation cover through special programmes.

Target 7: 60 per cent of the world's threatened species conserved in situ.

With full implementation of the Nature Conservation Strategy this target should be fulfilled for Iceland in 2013, both through species protection and area protection, but it remains to be seen if landowners will be supportive of proposed area protection measures.

Target 8: 60 per cent of threatened plant species in accessible *ex situ* collections, preferably in the country of origin, and 10 per cent of them included in recovery and restoration programmes.

Currently about 40% of red listed and protected plants in Iceland are maintained and cultivated in ex-situ conservation in the Botanical Garden in Reykjavík. Further collecting and cultivation of threatened species is planned by the Icelandic Institute of Natural History and the Botanical Garden.

Target 9: 70 per cent of the genetic diversity of crops and other major socio-economically valuable plant species conserved, and associated indigenous and local knowledge maintained.

Conservation status of the most important Icelandic agricultural crop varieties and species have been collected for storage in the Nordic Gen Bank in Svalbard.

Target 10: Management plans in place for at least 100 major alien species that threaten plants, plant communities and associated habitats and ecosystems.

Management plan for two out of 15 alien plants considered to be invasive in Iceland is in place for areas above 400 meters above sea level and in protected areas, including eradication measures.

Target 11: No species of wild flora endangered by international trade.

Icelandic plant species have not been threatened or listed as being threatened by international trade although some species have been traded internationally.

Target 12: 30 percent of plant-based products derived from sources that are sustainably managed.

Plant-based products other than grazing by sheep have not been measured but available information indicates that such use is sustainable.

Target 13: The decline of plant resources, and associated indigenous and local knowledge innovations and practices, that support sustainable livelihoods, local food security and health care, halted.

Not applicable.

Target 14: The importance of plant diversity and the need for its conservation incorporated into communication, education and public awareness programmes.

The Soil Conservation Agency of Iceland has for a long time emphasized conservation of vegetation and sustainable use of natural vegetative resources. In recent years the Agency has included the importance of conservation of biological diversity in all communication and public awareness programmes. Re-vegetating practices have been revised and increasing emphasis has been to use native plants instead of alien plant species and in some cases invasive plants.

Target 15: The number of trained people working with appropriate facilities in plant conservation increased, according to national needs, to achieve the targets of this Strategy.

The national need for trained botanists or botanical experts for plant conservation still remains to be evaluated, but there is obvious lack of expertise in some fields of botany.

Target 16: Networks for plant conservation activities established or strengthened at national, regional and international levels.

Nationally there is cooperation amongst botanical experts, institutions, universities and botanical gardens for activities and monitoring of plants, especially red listed plants. The Nature Conservation Strategy 2009-2013 focuses on creating a network of protected areas for plant conservation.

Annex III

GOALS AND TARGETS OF THE PROGRAMME OF WORK ON PROTECTED AREAS

1.1. To establish and strengthen national and regional systems of protected areas integrated into a global network as a contribution to globally agreed goals.

By 2010, terrestrially and 2012 in the marine area, a global network of comprehensive, representative and effectively managed national and regional protected area system is established as a contribution to the goal of the Strategic Plan of the Convention and the World Summit on Sustainable Development of achieving a significant reduction in the rate of biodiversity loss by 2010; (ii) the Millennium Development Goals – particularly goal 7 on ensuring environmental sustainability; and (iii) the Global Strategy for Plant Conservation

Terrestrial and coastal network of protected areas for nature conservation in Iceland cover approximately 2.1 million hectares and consists of 101 areas of different sizes. Current plans for extension of the coverage include approximately 20 new protected areas of approximately 332,000 ha before 2014. Those areas contribute specially to the conservation of threatened and rare species of plants, waterfowl and rare habitat types in the central highlands.

1.2. To integrate protected areas into broader land- and seascapes and sectors so as to maintain ecological structure and function.

By 2015, all protected areas and protected area systems are integrated into the wider land- and seascape, and relevant sectors, by applying the ecosystem approach and taking into account ecological connectivity[3] and the concept, where appropriate, of ecological networks.

Application of the ecosystem approach has been applied to some extent in designation of protected areas. Ecological character and structure of sites has been considered but integration and sector involvement still needs to be evolved better to fully apply the ecosystem approach as defined in the Malawi principles. Plans for new protected areas up to 2013 are intended to improve the current network of terrestrial protected areas.

Iceland participates in the work of OSPAR to establish a network of marine protected areas. Currently there are 38 marine and coastal areas protected for nature conservation with a number of different conservation objectives while 50 marine fisheries management areas have been managed for conservation and management for fisheries. Each of the MPA's has different function both in terms of management, type of protection, period of time and objectives.

1.3. To establish and strengthen regional networks, transboundary protected areas (TBPAs) and collaboration between neighbouring protected areas across national boundaries.

Establish and strengthen by 2010/2012[4] transboundary protected areas, other forms of collaboration between neighbouring protected areas across national boundaries and

3 The concept of connectivity may not be applicable to all Parties.

4 References to marine protected area networks to be consistent with the target in the WSSD plan of implementation.

regional networks, to enhance the conservation and sustainable use of biological diversity, implementing the ecosystem approach, and improving international cooperation

Does not apply for Iceland except in the marine environment where Iceland cooperates with parties to the OSPAR Convention and members of RFMO's in setting up a network of protected areas and fishing management areas in areas beyond national jurisdiction.

1.4. To substantially improve site-based protected area planning and management.

All protected areas to have effective management in existence by 2012, using participatory and science-based site planning processes that incorporate clear biodiversity objectives, targets, management strategies and monitoring programmes, drawing upon existing methodologies and a long-term management plan with active stakeholder involvement

Conservation and management plans for most of the protected areas have not been set up or are still in preparation. For all new protected areas conservation objectives and management plans will be prepared as a part of protection and management

1.5. To prevent and mitigate the negative impacts of key threats to protected areas.

By 2008, effective mechanisms for identifying and preventing, and/or mitigating the negative impacts of key threats to protected areas are in place.

Rangers and other protected area employees work in several protected areas around Iceland. They identify and reduce the negative impact of possible threats to the conservation value of the area. The Environment Agency receives ranger reports as well as reports from local municipalities about the state of protected areas. Active monitoring is in place in some areas. The Environment Agency reports annually to the Ministry for the Environment about the state of the protected areas in Iceland. Measures are taken to mitigate negative impacts in lieu of these reports.

2.1. To promote equity and benefit-sharing.

Establish by 2008 mechanisms for the equitable sharing of both costs and benefits arising from the establishment and management of protected areas

Mechanisms for this purpose have not been set up.

2.2. To enhance and secure involvement of indigenous and local communities and relevant stakeholders.

Full and effective participation by 2008, of indigenous and local communities, in full respect of their rights and recognition of their responsibilities, consistent with national law and applicable international obligations, and the participation of relevant stakeholders, in the management of existing, and the establishment and management of new, protected areas

Relevant stakeholders[5] have been involved in decision making and management in most of the bigger protected areas established after 1971. Local governments are always consulted in the preparation and establishment of protected areas. In recent years the Environment Agency, which is responsible for protected areas in Iceland, has made contracts with local authorities or relevant organizations to manage protected areas under the auspice of the agency.

5 Indigineous peoples and local communities.

3.1. To provide an enabling policy, institutional and socio-economic environment for protected areas.

By 2008 review and revise policies as appropriate, including use of social and economic valuation and incentives, to provide a supportive enabling environment for more effective establishment and management of protected areas and protected areas systems.

Currently this has not been carried out or any such issues integrated into decision making, establishment nor management of protected areas. There is a change to do this as a part of the on-going revision of the Act on Nature Conservation, but it remains to be seen.

3.2. To build capacity for the planning, establishment and management of protected areas .

By 2010, comprehensive capacity-building programmes and initiatives are implemented to develop knowledge and skills at individual, community and institutional levels, and raise professional standards.

This has been an on-going process and integrated part of the agencies responsible for management of protected areas for the last 40 years. Shortage of funding on the other hand limits the capacity and the initiatives in this work.

3.3. To develop, apply and transfer appropriate technologies for protected areas.

By 2010 the development, validation, and transfer of appropriate technologies and innovative approaches for the effective management of protected areas is substantially improved, taking into account decisions of the Conference of the Parties on technology transfer and cooperation.

There is a constant strive to apply new methods, technology and initiatives to further management of protected areas. There are plans to increase monitoring of threatened species and species and ecosystems within protected areas and to identify any gaps in the network of protected areas. Limited resources on the other hand restrict the amount of new initiatives in this field.

3.4. To ensure financial sustainability of protected areas and national and regional systems of protected areas.

By 2008, sufficient financial, technical and other resources to meet the costs to effectively implement and manage national and regional systems of protected areas are secured, including both from national and international sources, particularly to support the needs of developing countries and countries with economies in transition and Small Island developing States.

Financial sustainability for protected areas in Iceland does hardly exist. Most of the popular protected areas lack funding at the same time as touristic pressure increases and paths deteriorate. For two years now, there has though been some increase in the budget for protected areas and for nature conservation in general. Protected areas are operated and managed as effectively as the budget allows. Iceland has not been able to support programmes on protected areas in other countries.

3.5. To strengthen communication, education and public awareness.

By 2008 public awareness, understanding and appreciation of the importance and benefits of protected areas is significantly increased.

The Environment Agency has a programme in this field and more work is under way, e.g. development of a 5 year education program that includes new brochures, signs, internet information etc. for all the protected areas they have responsibility for.

4.1. To develop and adopt minimum standards and best practices for national and regional protected area systems.

By 2008, standards, criteria, and best practices for planning, selecting, establishing, managing and governance of national and regional systems of protected areas are developed and adopted.

Standards, criteria and best practice for the establishment of protected areas have not been prepared but the establishment of protected areas has been based on the best available scientific information and databanks and systematic evaluation of scientific data on species, their distribution and abundance and conservation status and threats.

4.2. To evaluate and improve the effectiveness of protected areas management.

By 2010**,** frameworks for monitoring, evaluating and reporting protected areas management effectiveness at sites, national and regional systems, and transboundary protected area levels adopted and implemented by Parties

Framework for monitoring, evaluating and reporting the effectiveness of protected areas management has not been developed or put in place yet, but the Environment Agency and the Institute of Natural History are preparing to do so. There is an increasing need to do that, especially with more and more protected areas being managed by other than the Environment Agency, such as local governments and organizations.

4.3. To assess and monitor protected area status and trends.

By 2010, national and regional systems are established to enable effective monitoring of protected-area coverage, status and trends at national, regional and global scales, and to assist in evaluating progress in meeting global biodiversity targets

So far, no evaluation has been carried out to evaluate the effectiveness of protected area management. Framework for monitoring is lacking but standard format for reporting the status of protected areas has been used some time.

4.4 To ensure that scientific knowledge contributes to the establishment and effectiveness of protected areas and protected area systems.

Scientific knowledge relevant to protected areas is further developed as a contribution to their establishment, effectiveness, and management

Scientific databases and knowledge has been the basis for preparation of Nature Conservation Strategies and preparation of new protected areas for the last 10 years. Scientific knowledge needs to be developed further to cover and contribute to effectiveness and management of protected areas.