

Forestry in a treeless land

Thröstur Eysteinnsson

Director of Development

Iceland Forest Service, Miðvangi 2-4, IS-700 Egilsstaðir, Iceland throstur@skogur.is

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Among the first things that visitors to Iceland usually notice are that it is not as warm as where they came from and there is a lack of forests in the landscape. Logically, they connect these two facts and come to the conclusion that Iceland is too cold for forests. This impression is often reinforced when they see the “forests” of low-growing and crooked native birch. However, over a century of forestry activity has proven that this is not the case, that it is past land-use and not climate that explains the treeless landscape. In fact, forests grow as well in Iceland as they do in parts of the world where forestry is a major industry.

Forest history

Fossil evidence indicates that Iceland was forested to a considerable extent during the mid to late Tertiary (5-15 million years ago), with tree genera including *Metasequoia*, *Magnolia*, *Sassafras* and many others, indicating that the climate was warm-temperate. By the late Pliocene, shortly before the onset of Pleistocene glaciations, coniferous forests predominated including *Pinus*, *Picea*, *Abies*, *Larix*, *Betula* and *Alnus*, indicative of a boreal climate.

With succeeding glaciations, the Icelandic flora has become ever more species-poor. *Pinus* survived (or was able to return after) the first few glacial periods up to about 1.1 million years ago and fossil evidence of *Alnus* is found during interglacials to about 500,000 years ago. The only forest forming tree species to survive/return to the present interglacial is *Betula pubescens*. Other native tree species found in Icelandic forests are *Sorbus Aucuparia*, which is uncommon, and the extremely rare *Populus tremula* (found in only 7 locations) along with *Salix phylicifolia*, which sometimes reaches tree size but is usually a shrub.

At the time of human settlement over 1100 years ago, birch forest and woodland probably covered 25-40% of Iceland's land area. The relatively tall (to 15 m) birch forests of sheltered valleys graded to birch and willow scrub toward the coast, on exposed sites and wetland areas and to willow tundra at high elevations.

As in agrarian societies everywhere, the settlers began by cutting down the forests and burning scrubland to create fields and grazing land. Sheep were important as a source of wool from the outset, but by 1300 they had become a staple source of food for Icelanders as well. Sheep grazing prevented regeneration of the birchwoods after cutting and/or burning and the area of woodland declined rapidly.

The extent of Icelandic birchwoods probably reached a post-glacial minimum, or about 1% cover based on total land area, during the early 20th century. Even though economic, technical and agricultural improvements in the mid 20th century alleviated the need to utilise birch for fuel or fodder, increases in sheep numbers and high levels of summer grazing continue to prevent natural extension of woodlands outside of protected areas.

Today, birchwoods are not economically important as a source of wood or fodder, although birch forests are popular recreation areas. Birchwoods are also important from an ecological perspective as remnants of an ecosystem that once covered much of Iceland and as the source of organisms to colonise new woodlands where birch is being used in afforestation, thereby reclaiming the birch ecosystem.

Forestry

Organised forestry is considered to have started in Iceland in 1899 with the planting of the “Pine Stand” at Thingvellir. Forestry efforts focussed on protecting birch forest remnants during the first half of the 20th century, with several forest areas being acquired by the Iceland Forest Service (IFS) for that purpose. They, along with more recently acquired afforestation areas and experimental forests comprise the National Forest system today.

During the past 50 years, emphasis has been on afforestation through planting trees. Planting by forestry societies and the IFS increased greatly during the 1950's, reaching over 1.5 million seedlings per year during 1960-'62. The principal species planted were exotic conifers: *Picea abies*, *Picea sitchensis*, *Pinus sylvestris*, *Pinus contorta* and *Larix sibirica*. Planting declined after 1963 and remained at 500,000 to 1 million seedlings annually from 1963 to 1989. The period from 1950 to 1990 was a time when a great deal of experience was gained through experimenting with different exotic species and provenances.

Afforestation through planting has increased again since 1990 to over 6 million seedlings in 2004, which corresponds to an increase in planted area of 1000-1500 ha per year. Planting of native birch has been increasing proportionate to the total, comprising as much as 30% of seedlings planted in some years. *Larix sukaczewii* (*syn. L. sibirica var. sukaczewii*) is planted to roughly the same extent as native birch, followed by *Picea sitchensis*, *Pinus contorta* and *Populus trichocarpa*. These 5 species comprise about 90% of the trees planted in Iceland, with over 20 other species comprising the remaining 10%.

The IFS planted roughly half the trees planted in Iceland up to 1990, mostly on Forest Service lands. With the exception of some early direct seeding trials, this however included practically no birch since most IFS enclosures were established around remnants of birchwoods where natural regeneration was usually sufficient. For example, the area of birch cover in Hallormsstadur National Forest increased by 130 ha from 1906 to 1995 without a single birch tree being planted and in spite of 200 ha being converted to conifer forest. The total extension of birch within the enclosure was around 330 ha in 90 years, or an average of 3.7 ha per year, more than doubling the original forest area.

The other half of trees planted up to 1990 was planted by forestry societies, which were mostly involved in afforestation of treeless land. Since 1990, forestry societies have been the main actors in the Land Reclamation Forest project, a co-operative project between the Icelandic Forestry Association (an umbrella organisation for the local forestry societies), the Forest Service, the Soil Conservation Service (both state agencies) and the Ministry of Agriculture, within which about 1 million seedlings are planted annually. The aim is to afforest eroded or degraded land and 40-75% of

seedlings planted annually have been native birch even though it is not always the most effective tree species at reclaiming degraded or eroded land.

From its limited beginnings in 1970, state supported afforestation on farms has become the main channel for afforestation activity in Iceland, comprising about 80% of the afforestation effort today. Originally, only farms located within the best areas for afforestation were eligible to participate and the only goal was establishment of plantations for wood production. Since the mid 1990's, state support for farm afforestation has spread to all parts of Iceland and afforestation goals have become variable resulting in increased use of native birch and other non-timber species.

Laws pertaining to forestry reflect the fact that forests form a very small part of the Icelandic landscape, the main policy points being that existing forests should be protected and afforestation of treeless land is encouraged. These goals have been in effect since the first Forestry Act of 1907. The goal of increasing forest cover through afforestation is re-affirmed in the Regional Afforestation Projects Act of 1999, where for the first time a concrete goal of 5% forest and woodland cover of lowlands within 40 years is set.

In recent years, checks have been put into place regarding certain aspects of forestry through the Environmental Impact Assessment Act and a regulation regarding use of exotic plant species. These legal instruments are the results of EU directives; in other words not the result of a perceived need within Iceland to put checks on forestry. Because of the costs involved, the Environmental Impact Assessment Act effectively puts a ceiling of 200 ha on the size of afforestation areas and prevents or at least discourages afforestation within protected areas.

The forestry sector

The IFS

The Iceland Forest Service (IFS) was established in 1907. It is the state forestry authority in Iceland and is under the Ministry of Agriculture. The IFS manages over 40 national forests throughout Iceland, totalling about 7000 ha or 5% of Icelandic forests and woodlands. The majority of forest and woodland area within the national forests is protected native birch woodland, but there are also cultivated forests of various species, experimental forests, arboreta and outdoor recreation areas including 4 campgrounds. The national forests employ a full-time staff of around 30 people.

Until recently, the IFS was the main producer of tree seedlings in Iceland, as between 1950 and 1990 the main emphasis of the IFS was on afforestation through planting. Tree planting has now become a minor part of IFS activities and seedling production has been privatised.

Iceland Forest Research, located at Mógilsá near Reykjavik, is the research division of the IFS. Traditionally, species and provenance trials have been the mainstay of forest research in Iceland and they are still important. In the last ten years however, ecology has become an increasingly important field of study with a wide range of topics being looked at, including carbon and nutrient cycles, establishment problems, insect pests and pathogens and the effects of afforestation on plant and animal communities. Other recent research topics include growth and yield studies, climatic mapping and

historical and social aspects of forestry. For the majority of research projects, emphasis is placed on them being directly applicable to forest management planning and practice. Iceland Forest Research has a professional staff of 15.

Forestry extension and education is another function of the IFS. As an example, 7 primary schools have become Forest Schools through a project headed by the IFS to integrate aspects of forests and forestry into all parts of the school curriculum. Each of these schools has adopted a forest stand within walking distance of the school that serves as an extra “classroom”.

Regional Afforestation Projects

Starting with Héraðsskógar in 1991, six Regional Afforestation Projects (RAPs) have now been established to cover all of Iceland. They are governmental “mini-agencies” under the Ministry of Agriculture but financially independent of the IFS. The function of RAPs is to manage the government grants scheme for afforestation on farms, each in its own region of the country. This includes making contracts with landowners, production of afforestation plans, co-ordinating seedling production and distribution, education and extension (usually in co-operation with the IFS) and distributing the grants.

Each farm afforestation grant covers 97% of establishment costs, including fencing, roads, site preparation, planting and the first thinning. It is the individual landowner who owns the resulting woodlots or forest stands and bears all legal responsibility. The landowners also usually do the planting, thereby receiving part of the grant as compensation for work. A forest-farmer afforesting a large tract of land can earn what amounts to as much as 2-3 months wages per year.

The six RAPs were responsible for roughly 75% of planting in Iceland in 2004. Around 650 farms currently participate in afforestation and/or establishing shelterbelts and there is a waiting list to join of about 500. This is a total of over ¼ of Icelandic farms.

Forestry Societies

The Icelandic Forestry Association (IFA) was formed in 1930 and is an umbrella organisation for 57 local forestry societies. These are non-governmental volunteer organisations of people interested in afforestation. Their efforts are mostly concentrated around towns and villages, but some own quite large tracts of forest land and some of the oldest cultivated forests originally grown on treeless land belong to forestry societies.

Besides the Land Reclamation Forests program mentioned earlier, local forestry societies are mostly concerned with managing older forests and woodlands for outdoor recreation, some grow Christmas trees, some have small tree nurseries and one owns a large commercial nursery.

The IFA publishes the journal *Icelandic Forestry*, which comes out in two volumes annually. It is the main forestry publication in Iceland and contains a mix of scientific papers and more general articles. They also offer short courses in forestry related subjects, an annual lecture series and forests walks aimed at increasing public knowledge of and interest in forestry. The IFA has roughly 7000 members, or about

2.5% of the Icelandic population, making it by far the largest NGO in matters having to do with the environment.

The Forest Owners Association

The Icelandic Forest Owners Association (FOA) was formed in 1998 as a union to represent the views and concerns of forest owners. It has a membership of over 700, consisting mostly of forest owners participating in the RAPs. As a young organisation, it is still in the process of defining itself. The FOA has a volunteer board of directors, a very small budget, no employees and no headquarters. A significant part of the board's efforts to date have been in lobbying for increased funding for forestry.

Soil Conservation Service

The Soil Conservation Service (SCS) is the sister organisation to the IFS. It works to prevent soil erosion and revegetate eroded land. In recent years, use of woody plants in land reclamation has increased, especially native birch and willows.

Afforestation objectives and afforestation planning

In general, Icelandic afforestation is planned and cultivated forests managed with multiple-use objectives. These objectives can best be described based on the four principle functions of forests: ecological (ecosystem processes, habitats, wildlife), economic (wood production, non-wood products), protective (soil and water conservation, shelter, sequestering CO₂) and social (recreation, spiritual).

In forest planning and management, greater emphasis is often placed on one or two of these functions and less emphasis on others, without ignoring them entirely however. Within the RAPs, the majority of afforestation plans to date emphasize timber production as a primary goal within areas where timber production is possible, the main timber species being *Larix sukaczewii*, *Picea sitchensis* and *Pinus contorta*. In peripheral areas, emphasis is on protective functions and in some cases ecological restoration, where the main species is native *Betula pubescens*, or on establishing shelterbelts. A few plans have been drawn up emphasizing wildlife value, improved grazing for livestock and outdoor recreation as well.

The Iceland Forest Service has put forth a set of guidelines to afforestation planners. Some points from these guidelines are:

- Tree species planted should be selected based primarily on site conditions and the goals of afforestation on that site.
- Planting of exotics within natural woodlands is discouraged. Instead planting should be directed toward treeless land to increase the total forest area.
- Wetlands should not be drained for afforestation.
- Care should be taken to avoid planting on sites of special value. These include sites where rare species have been found or rare habitat types, archaeological sites, special landscape features and much-visited sites with scenic vistas.
- Planting species mixtures rather than monocultures is recommended.
- Forest edges should be designed specifically so that the cultivated forest blends as well as possible into the landscape.

A combination of protective and social functions is the aim of Land Reclamation Forests. Since they are mostly close to population centres, these forests will become

the most used outdoor recreation areas in Iceland. In fact, two forest areas originally cultivated on treeless land in the 1950's and 60's, one near Reykjavik and the other near Akureyri, annually receive over 400,000 visits, well over the entire population of Iceland.

The management goal for the majority of national forests (IFS lands) is simply protection of native forest and woodland ecosystems. Outdoor recreation, timber production, ecosystem restoration and research are also main goals in some IFS lands, whereas erosion control and reclamation are the main aims on land managed by the SCS.

There are no forests managed only for carbon sequestration nor are there any plans for afforestation specifically for that purpose. However, carbon sequestration can be one of the management objectives of multiple-use cultivated forests.

So how is it going?

Over a century of forestry activity in Iceland has yielded several positive results and developments. We prevented the destruction of the last remnants of natural forests. We gained experience in forest management and cultivation of a number of tree species. We gained scientifically based knowledge of the best provenances to use and where to plant them. We have a great deal of knowledge and experience with afforestation of treeless land. Without a doubt, the most important outcome is that there has been a change in attitude of the Icelandic people. A century ago, most Icelanders had never seen a tree. Fifty years ago, few Icelanders believed that trees of any size to speak of could grow in Iceland. Planting trees was the harmless hobby of a few eccentrics, but forests for timber production were out of the question. Today, forestry for timber production, land reclamation and amenity is being carried out by thousands of people all over Iceland.

However, 100 years of forestry have not resulted in much extension of forest area. The native birch woodlands have expanded through natural regeneration within fenced areas but there has been little or no expansion in areas not specifically protected from grazing. Thus, natural expansion of birchwoods has been very limited and will continue to be so as long as the tradition of uncontrolled sheep grazing continues.

For several reasons, planting has not resulted in large land areas being afforested either, compared to the area of potential forest land in Iceland. Up to the mid 1980s, land was not available for afforestation because of competition by other land use, especially grazing. Forest establishment is expensive and few individuals have the financial resources to invest in afforesting large amounts of land. Planting by forestry societies was always constrained by lack of money as was planting by the IFS. State afforestation grants were first offered in the early 1970s but were extremely limited until the 1990s. Due to these constraints, afforestation of relatively large areas has only started within the last 15 years. However, the fact remains that Iceland has a very small population (290,000) compared to the size of the country (103,000 km², of which at least 30,000 km² can potentially be afforested). For this reason alone, afforestation through planting, as a proportion of total land area, will proceed slowly. Total afforestation planting has been 1000-1500 ha per year during the last 10 years

and is likely to be close to 2000 ha (20 km²) in the year 2004, the most to date. At that rate, it will take 50 years to plant trees on 1% of Iceland's land area.

The good growth of several tree species has probably been most important in changing people's attitude towards forestry. The native *Betula pubescens* generally grows slowly, rarely reaching more than 14 m in height and the mean annual increment is almost always well below 1 m³/ha/yr. Based on this, it is no wonder that people did not consider forestry to be a realistic possibility in Iceland. Several exotic species planted in the 1950s and earlier, including *Picea abies*, *P. engelmannii*, *P. glauca*, *Pinus cembra*, *Abies lasiocarpa*, *Betula pendula* and *Pseudotsuga menziesii* are reasonably well adapted to Icelandic conditions, have good form and will all grow to be much larger than the native birch. The tallest trees of all these species are between 15 and 20 m in height and they will all grow to well over 20 m in the coming years. With the exception of *Pseudotsuga menziesii*, they are all used to a limited extent in Icelandic forestry, but are not among the major species because of their relatively slow growth or limited experience with them.

The major species used in forestry are, in addition to the native *Betula pubescens*, *Larix sukaczewii*, *Picea sitchensis*, *Pinus contorta* and *Populus trichocarpa*. They have all reached at least 20 m in height and show mean annual increments ranging from 5 to 15 m³/ha/yr. Based on growth curves, *Larix sukaczewii* and *Pinus contorta* will certainly reach 25 m height on good sites by age 100 years and *Picea sitchensis* and *Populus trichocarpa* at least 30m.

The future

Aspects that the forestry sector has some control over, such as planting trees, could possibly lead to a doubling of forest and woodland area of Iceland within the next half century, although that is by no means certain. However, other factors are likely to have greater and more far-reaching effects. Land-use change, specifically a decline in sheep farming, is likely to result in increased natural regeneration and extension of birchwoods to areas that have been treeless for centuries. Climate change (global warming) could conceivably lead to far greater change. A warmer climate would allow both natural extension of woodland and afforestation through planting to reach areas at higher elevations than has been possible previously, expanding the potential forest area and allowing us to reclaim large areas of eroded land to woodland.

The future of Icelandic forestry is bright. The main obstacle, the psychological one, has been overcome. In comparison, financial and technical obstacles are easy to deal with.

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