Chapter 24
Iceland

Arnór Snorrason

24.1 The Icelandic National Forest Inventory

24.1.1 History and Objectives

The Icelandic National Forest Inventory was initiated in 2001 (Snorrason and Kjartansson 2004). After four years of preparation, data sampling on field plots started in the spring of 2005. While the data sampled is used to produce valuable information for many purposes, the primary reason for starting National Forest Inventory (NFI) was the need for reliable annual data to report to the United Nation Framework Convention on Climate Change (UNFCCC). In recent years NFI data has been the backbone in data delivery to other international forest data sampling and reporting as the Forest Resource Assessment (FRA) of the Food and Agriculture Organization of the United Nations (FAO) and the State of Europe's Forest (SoEF) of the FOREST EUROPE organisation (Snorrason 2010). With increasing demand for wood, wood removals and utilisation from the steadily growing new forest estate, the role of the NFI as information source of current and future growing stock is the key of quantifying the available forest resources.

24.1.2 Sampling Methods and Periodicity

The inventory design has not changed since the first NFI. Taking notice of good advice from European specialists at the collaboration platform of COST Action E43 it was decided to use a continuous inventory with a five year cycle for the cultivated

A. Snorrason (✉)
Icelandic Forest Research, 116 Reykjavík, Iceland
e-mail: arnor@skogur.is

C. Vidal et al. (eds.), *National Forest Inventories*,
DOI 10.1007/978-3-319-44015-6_24

forest (CF). Cultivated forests are defined as all forest initiated by tree plantation or direct seeding or forests originating from these forests. For the natural birch (*Betula pubescens* Ehrh.) woodland (NBW) a discrete five year inventory with a ten year interval between sampling cycle was chosen. For both classes a systematic plot sampling system was chosen but with different grid densities. In the case of cultivated forest a 0.5 × 1.0 km grid is used but for the natural birch woodland 1.5 × 3.0 km grid. Every intersection of the two grids overlapping maps of CF or NBW is visited in the field and a single circular plot is established. These maps cover all areas of forest and other wooded land. In total, 899 intersections were visited in the last five year cycle of the CF (2010–2014), of which 814 had plots that were fully or partially inside forest. In the NBW 312 intersections were visited and 210 plots established in the first inventory (2005–2009).

24.1.3 Data Collection

Stand and environmental data are collected on 200 m^2 plots both in CF and NBW. These attributes can be broadly classified into three classes:

1. Topographical data: topographical placement, topographical form, slope, aspect, Topex (to horizon and to 50 m distance)
2. Site classification: Height or species classes of forest areas, different treeless spaces inside forest (less than 0.5 ha or narrower than 20 m) or outside forest. If necessary plot is divided by mapping into subplots by site classes
3. Site description:
   (a) Management data: Forest owner, forest manager, management practices, thinning status, planting type, scarification and drainage.
   (b) Environmental data: Vegetation class, cover and indicators, soil type, soil depth and bedrock, etc.
   (c) Forest classification: Original land type (UNFCCC classes), forest class at mature state (FAO and UNFCCC classes).
   (d) Current state of forest: Age, mean height and diameter, species composition, crown coverage and storeys and thinning status.
4. Dead wood measurements: All dead wood meeting minimal size (d = 10 cm, l = 1 m) is located and measured.

Data sampling for trees and stumps are different between CF and NBW. In the case of CF they are measured and located on plots where the size is adjusted to the density of trees between 25 and 200 m^2, having at least 20 or more living trees inside the "tree measurement plot". In NBW concentric rings are used. On the plot all trees are sampled and measured for: diameter, height, species, vitality, stem straightness, damages, etc. If the plot has not been measured within the last 5–10 years, a subsample of trees is measured for height growth and/or diameter growth by coring. If the planting year of the plantation is available from official records it is used to

calculate plot age. If not, the age is either estimated by whorl counting on young trees or by coring on older ones. More information on sampling design and the sample plot measurements is to be found in Snorrason (2010).

Biomass above ground (and below ground in some cases) and stem volume is estimated for all trees measured on the plot by using country specific single-tree biomass and volume functions (Snorrason and Einarsson 2006; Bjarnadottir et al. 2007; Jónsson 2007). Biomass on each plot or subplot is summed up and scaled by the rate between the sampling unit and the plot area, 50 ha for CF and 250 ha for NBW for each whole plot.

24.2 Land Use and Forest Resources

24.2.1 Classification of Land and Forests

24.2.1.1 General Classifications

The main sources of information in this report are from the recently completed country report for the FAO FRA2015 process and the joint FOREST EUROPE/UNECE/FAO Questionnaire on pan-European quantitative indicators for Sustainable Forest Management, which has been prepared and will be used in the report of State of Europe's Forest 2015 (SoEF 2015).

The Icelandic National Forest Inventory is only responsible for mapping and measuring forest and other wooded land. Land use and land cover classification outside forest is conducted by other institutions. Spatial land cover classification for Iceland as a whole has been done recently under the Corine project of European Environmental Agency (Árnason and Matthíasson 2009). A broader land use classification is carried out annually in the National Inventory Report to the UNFCCC (NIR UNFCCC) (Hallsdóttir et al. 2013). In these two reports the forest definitions used are not comparable. When reporting to the FAO and FOREST EUROPE the FAO (2004) global forest definition is used. In the NIR UNFCCC, the forest definition is altered for one variable, tree height. Instead of using 5 m as minimum height at maturity 2 m was chosen by Icelandic authorities as minimum height at maturity (Ministry for the Environment 2006). Table 24.1 shows land use classes as reported in latest NIR UNFCCC for the year 2011.

In 2011, the total forest area according to the UNFCCC was 133,000 ha covering 1.3 % of the country. The shrubland part of the natural birch woodland covers 51,000 ha. The total forest and other wooded land were 184,000 ha in 2011.

Table 24.2 gives an overview of how different forest subclasses are reported in international reports. No official forest definition has been adopted in Iceland but the natural birch woodland has always be named "skógur" by the people, which is the Nordic name for forest although less than 10 % of these woodland can be defined as forest internationally. In a Gallup poll carried out ten years ago people

Table 24.1 Land use classification in year 2011 (NIR UNFCCC 2013)

Classes/Subclasses	Area (1000 ha)	Area (%)
Settlement	**52**	**0.5**
Forest land	**133**	**1.3**
Natural birch forest	96	0.9
Cultivated forest	38	0.4
Cropland	**129**	**1.3**
On mineral soil	71	0.7
Drained wetland	58	0.6
Wetland	**715**	**6.9**
Lakes and rivers	260	2.5
Reservoirs	58	0.6
Other wetlands	397	3.9
Grassland	**5260**	**51.1**
Natural birch shrubland	51	0.5
Other grassland	4569	44.4
Drained wetland	344	3.3
Revegetated land	252	2.5
Abadoned cropland	44	0.4
Other land	**4000**	**38.9**
Glaciers and perpetual snow	1087	10.6
Other "other land"	2913	28.3
Sum	10,288	100

Table 24.2 Forest area by forest subclasses used in international reporting (2010)

Forest sub-class	FAO and SoEF	Area (1000 ha)	Classification	Area (1000 ha)	UNFCCC
Natural birch woodland	Forest	10.7	≥5 m at maturity	10.7	Forest
	Other wooded land	84.4	2–5 m at maturity	84.4	Forest
	Other wooded land	50.6	≤2 m at maturity	50.6	Grassland/shrubland
Cultivated forest	Forest	32.0	≥5 m at maturity	32.0	Forest
	Other wooded land	4.3	2–5 m at maturity	4.3	Forest
Total forest	Forest	42.7		131.4	Forest
	Other wooded land	139.3		50.6	Grassland/shrubland

where asked about what height trees has to have to be considered a forest (IMG Gallup 2004). The mean height resulted in 2.26 m so the definition used when reporting to UNFCCC seems to suit Iceland well as a country definition. On the other hand the NFI sample data is organised in such a way that facilitates analyses using international minimal height definition of 5 m at maturity in situ. Woodland reaching 2 to 5 m height at maturity is either classified as "Other wooded land" when reporting to FAO FRA or FOREST EUROPE SoEF or as "Forest" when reporting to UNFCCC.

In this chapter the FAO definition of forest is the basis of the statistics presented. The class other wooded land is rarely used for wood utilisation as the stature, stem quality or growth does not meet criteria of economical or sustainable usage. According to the NFI results for the period 2010 to 2014, the permanently unstocked area of cultivated forest is 9 % of the gross area of the forest or around 4000 ha. Trees can be found outside forest in two land use classes:

1. Agricultural land as shelterbelt and tree groups with area under 0.5 ha
2. Urban areas as trees in parks, in home gardens and as tree rows and single trees in streets.

In the FRA2010 an estimate of "Other land with tree cover" is calculated by using results from a sample plot inventory of trees in the urban area of the capital of Iceland, Reykjavik (Viðarsson and Snorrason 2012). It showed that the mean canopy cover of trees was 9.9 % of the total urban area of the city. It will exceed 10 % cover and can then be defined as "Other land with tree cover". Most of the trees are grown in private gardens in areas defined in the CORINE land classification system as "Discontinuous urban fabric". Discontinuous urban fabric was estimated in the Icelandic CORINE project to be 8900 ha in the year 2000 and 9700 ha in the year 2006. The same figure was assumed for 2010 as further expansion of rural areas has halted after the economic crisis in 2008.

24.2.1.2 Classification by Ownership Category

The ownership structure of forest (42,700 ha) for the year 2010 is as follows; 34 % in public ownership (state and municipalities), 16 % by private institution's (mostly forest associations) and 50 % by private individuals (farmers and land owners).

24.2.1.3 Forest Management and Cutting System

Cultivated forests in Iceland follow the traditional Nordic management scheme of even-aged stands. As plantations dominate the age distribution within stands is little to none. On the other hand are the natural birch forests that are managed for wood utilisation uneven-aged. The cutting system in use is selective cutting and has been practised since the establishment of the forestry authority at the beginning of the 20th century.

Table 24.3 Area estimate of main tree species in Icelandic forest covering more than 1000 ha

Species	Area (1000 ha)
Native mountain birch (*Betula pubescens*)	18.2
Siberian larch (*Larix sibirica*)	8.6
Sitka spruce (*Picea sitchensins*)	4.9
Lodgepole pine (*Pinus contorta*)	4.7
Black cottonwood (*Populus trichocarpa*)	2.9

24.2.1.4 Legal and Other Restrictions of Wood Use

According to the 1950 Icelandic forest act clear cutting is not allowed without permission from the head of the Iceland Forest Service (Forest Director), which is the forest authority of Iceland (Alþingi 1950). Permission will only be given if the land will be used for crop cultivation or if afforestation of an alternative area equivalent in size of land is to be conducted not later than two years from the time of the clear cut. Only thinnings approved by the official forest ranger are allowed. In addition about 10 % of the natural birch woodland as a whole is protected in nature reserves and national parks and as such will not be available for wood supply.

24.2.1.5 Further Classification of Forests

Table 24.3 shows the area by species canopy cover ratio of main tree species in the Icelandic forest as reported in SoEF 2015 for the year 2010. The native mountain birch (*Betula pubescens* Ehrh.) is the most common tree species present, accounting for 18,200 ha. The natural birch woodland has 10,700 ha of native mountain birch. In the cultivated forest, Siberian larch (*Larix sibirica* Ledeb.) has the highest coverage of 8600 ha and the native mountain birch is the second most common species.

24.2.2 Wood Resources and Their Use

24.2.2.1 Standing Stock, Increment and Drain

In both FRA 2015 and SoEF 2015 reports the growing stock of forest and other wooded land was estimated. Growing stock definition used was the same as defined by FAO (2015); with a minimum diameter at breast height (dbh) of 10 cm, top included, branches and stump excluded. The share of the growing stock by species in 2010 is listed in Table 24.4.

In the natural birch forest only a small portion of the state owned forest, managed by the Icelandic Forest Service, is used for wood supply. Approximately 400 ha are currently used and another 400 ha could be used in the future. Together this is only 7 % of the area of the natural birch forest. Most of the 52,000 m^3 of the

Table 24.4 Growing stock estimated in the year 2010 in thousand m^3 over bark

Species	Growing stock (1000 m^3)	Growing stock (%)
Siberian larch	59	20.1
Sitka spruce	54	18.4
Native mountain birch	52	17.7
Lodgepole pine	45	15.4
Black cottonwood	37	12.6
Norway spruce	23	7.8
Remaining species	23	7.8
Total	293	100

Table 24.5 Annual production in m^3 of roundwood by wood use (2010)

Wood use	Volume (m^3)	Volume (%)
Industrial roundwood	**3113**	**75**
Sawnwood	50	1
Roundwood	2863	69
Chips and shaving	200	5
Firewood	**1022**	**25**
Birch	246	6
Other species	776	19
Total	4135	100

growing stock of birch wood listed in Table 24.4 are therefore considered unavailable for wood supply.

Annual increment of the cultivated forest was estimated to be 33,500 m^3 in 2010. This is the growth of the living trees but trees measured five years ago that have been cut or died in the meantime are excluded so one has to consider this estimate as net annual increment.

The total drain of wood stock has not been estimated but the net drain in 2010 of commercial wood production was 4135 m^3 or 12 % of the net increment of the cultivated forest (Table 24.5). Taking into account the skewed age distribution of cultivated forests in Iceland the utilisation rate is not unreasonable for sustainable management.

24.2.2.2 Tree Species and Their Commercial Use

It has been estimated that before human settlement in the 9th century AD the natural birch woodland was one of the main terrestrial ecosystem types in Iceland with a cover of 2.8 million ha or 28 % of the land area (Sigurðsson 1977; Aradottir and Arnalds 2001). Most of this woodland cover has been lost due primarily to anthropogenic activity as land use change, grazing and over-exploitation of wood (Bjarnason 1974). As listed in Table 24.2 above the area of natural birch woodland

is currently estimated at 145,700 ha. That is an increase in area from the estimate of 125,000 ha in a survey done in 1972–1975 (Sigurðsson and Bjarnason 1977) but only 5 % of the coverage at settlement. The natural birch woodland, as already mentioned, are of low stature (Jónsson 2004), so wood utilisation was restricted mainly to charcoal making and fire wood use. The charcoal making was directly linked to iron utilisation from peat and sharpening of scythes, which faded away in mid nineteenth century (Gudbergsson 1998). Extensive firewood utilisation lasted longer but at the beginning of the World War II it started to decline and ceased in the mid twentieth century. The average annual fire wood utilisation from 1888 to 1950 was around 1000 metric ton of wood. Due to the low biomass and biomass growth it has been stated that this utilisation was not sustainable and coupled with continuous grazing lead to reduction of the natural birch woodland until the middle of last century (Gudbergsson 1998). From 1950 the Iceland Forest Service continued a restricted selection cutting of 200 m^3 of wood from natural birch forest (Hallanaro and Pylvänäinen 2002). Since the 1970s wood from the natural birch forest has been used as firewood for amenity fireplaces, as a smoking wood, fence poles and in later time as firewood for culinary ovens.

Historically, the other domestic source of wood was driftwood. Although it has been confirmed to be valuable source of wood in centuries, especially for construction, no references about annual usage are available (Kristjánsson 1980).

The use of industrial roundwood from Icelandic forests is a recent occurrence and connected to the cultivation of introduced tree species that can grow faster than the native birch with straight stems into usable dimensions for sawn wood and other industrial wood. Planting of introduced tree species did not start in earnest until after the World War II, slowly increasing and peaking in 2007 when over 6 million seedlings were planted resulting in 1800 ha of plantations.

In the 1970s small fence pole production started with early thinning's of larch plantations. In the same period sporadic sawn wood production began but it was not until 2005 that industrial roundwood production exceeded 500 m^3. When a ferrosilicon plant started to buy domestic wood chips to raise the carbon content of the metal in 2010 the industrial roundwood production increased to new levels of over 4000 m^3 and are still increasing.

Firewood usage also increased upward in 2010 when a wood heating facility was installed in Hallormsstaður forest in east Iceland. The heating facility is mostly driven by larch wood from commercial thinning's in plantations located in the neighbourhood.

The annual production of commercial roundwood of different products is shown in Table 24.5 for the year 2010 (Gunnarsson 2011). The main user of industrial roundwood and chips of species other than birch is the ferrosilicon industry. Sawnwood production is only 2 % of the industrial roundwood production. Wood from birch is still mostly from selective cuttings in natural forest but the ratio of birch wood coming from cultivated forest is increasing.

The demand for domestic wood products started after the financial crisis in 2008 when the value of the domestic currency dropped and currency restrictions were enacted. Industries that were dependent on basic wood products as the ferrosilicon

plant and shaving industries for animal bedding were willing to purchase domestic wood for prices that made first commercial thinning profitable.

As most of the cultivated forests are young, final cuttings are very rare. Forest stands are only removed if there is a need due to unsuccessful silviculture or to make way for another land use, which is mainly construction connected to settlements. Wood production is therefore still driven by commercial thinnings, either first or second thinning.

24.3 Assessment of Wood Resources

24.3.1 Forest Available for Wood Supply

24.3.1.1 Assessment of Restrictions

The main source of FAWS, the cultivated forest is not under any legal restriction of wood utilisation other than the sustainable principles in the forest act mentioned previously. With an increasing area of cultivated forest the FAWS ratio will increase. However, the role of the natural birch forest as a source of wood will reduce and more of the native woodlands will probably be designated for environmental protection.

24.3.1.2 Estimation

The cultivated forests are the main source of available wood. Although the majority of cultivated forests are available for wood supply some are not. To assess the availability of cultivated forest for wood supply two variables are assessed in the NFI regarding FAWS (Snorrason 2013).

The first variable classified in the NFI plots is use. In each use class a fixed ratio of FAWS was set taking into count the nature of each class. The net forest area and the proportion of available wood supply for each use class are presented in Table 24.6. Small open areas without trees inside forests (less than 20 m wide or under 0.5 ha) are estimated to 12 % of the gross forest area in the measuring period 2009–2013. Accordingly the gross forest area estimated in 2011 was 38,000 ha. Another variable classifies the NFI plot by the management authority which is used for the classification of FAWS in Table 24.7.

Different management authorities use different management objectives. For example the land reclamation afforestation has a rather low utilisation rate as the main goal of this type of afforestation is not wood production. The tree species planted are often native birch or willows and not suited to wood utilisation. The areas chosen are in addition sometimes in remote places without good connection to the road network.

Table 24.6 Classification of the stocked cultivated forest area (both forest and other wooded land by FAO (2004) definition) by use and FAWS ratio (2011)

Use class	Net area (ha)	FAWS (%)	FAWS area (ha)
Multiple forestry	14,800	80	11,840
Wood production	5520	95	5240
Land reclamation	5740	20	1150
Recreation	4930	60	2960
Summerhouse lots	1500	0	0
Research areas	280	60	170
Christmas trees	190	0	0
Shelter	290	20	60
Other usage	50	40	20
Total	33,300	64	21,440

Table 24.7 Classification of the stocked cultivated forest area by and management authority and FAWS ratio (2011)

Management authority	Net area (ha)	FAWS (%)	FAWS area (ha)
Iceland Forest Service (state)	3340	80	2670
Forest associations	5050	60	3030
Regional forest project—East	5620	90	5060
Regional forest project—East coast	360	80	290
Regional forest project—South	2020	80	1620
Regional forest project—West	2530	80	2020
Regional forest project—Northwest	1510	55	830
Regional forest project—North	4100	80	3280
Land reclamation afforestation	2390	40	960
The Soil Conservation Service (state)	560	10	60
Mt. Hekla afforestation	60	10	10
Production forests on farmland	930	90	840
Other private forest	2890	10	290
Municipalities	1940	60	1160
Total	33,300	66	22,120

The main result from this analysis was that both variables give similar results, FAWS are assessed to be about 65 % cultivated forest in Iceland. This result was used when assessing FAWS in the SoEF2015.

The FAWS ratio in the usage classification was used to calculate the growing stock available for wood supply. Out of the 0.29 million m^3 of total growing stock estimated in 2010, 0.17 million m^3 or 59 % were assessed as available for wood supply. On the cultivated forest with total growing stock of 0.26 million m^3 and FAWS stock of 0.17 million m^3 the FAWS ratio was a bit higher than the area based ratio or 66 %.

In the FAWS portion of the cultivated forest the net annual increment was estimated to be 23,700 m^3 which was 70 % of the total. Those forest areas available for wood supply have a higher productivity than the cultivated forest as a whole.

24.3.2 Wood Quality

24.3.2.1 Stem Quality and Assortments

Each tree measured on the NFI sample plot that has reached 2 m height is classified into five categories regarding stem straightness:

- A1: 5 m straight stem
- A: 3 m straight stem
- B: 2 m straight stem
- C1: Lightly bended stem
- C: Crooked and/or forked stem.

Stemwood in Classes A and B can be used as sawn timber to various degree of utilisation ratio. As shown in Table 24.5, sawnwood plays a minor role in the current wood market. Classes A1, A, B and C1 can primarily be used in ferrosilicon and the bedding industries. Class C are only usable locally in traditional fire wood production.

24.3.2.2 Assessment and Measurement

In the wood usage analysis already mentioned (Snorrason 2013) analyses of various height classes in the cultivated forest show that with increased top height better quality classes occur more frequently as shown in Table 24.8. This is as a result of the implementation of both pre-commercial and commercial thinning's which have been practiced more frequent in the ≥10 m classes than in the 5–10 m class or 44 and 13 % respectively. Only 17 % of the cultivated forest has reached top height 5 m or more (Table 24.8).

Table 24.8 Stem quality in two top height classes in the cultivated forest

Top height class	Net area (ha)	Stem quality classes (% area)				
		A1	A	B	C1	C
5–10 m	4700	12	14	14	37	23
≥10 m	1000	21	14	14	31	20

24.3.2.3 Estimation and Models

Newly made taper functions for lodgepole pine and Siberian larch (Heidarsson and Pukkala 2011) together with simulation model for temporal development of volume (Heiðarsson and Pukkala 2012) make it possible to estimate current and future merchantable wood output divided into different assortments. These functions and models have been applied locally in east Iceland (Heiðarsson and Pukkala 2012) and in north Iceland (Davíðsson 2012) but not on country level using data of the NFI.

24.3.3 Assessment of Change

24.3.3.1 Assessment and Measurement

With steady afforestation, ageing of the current cultivated forests and increasing domestic wood demand it is rather reasonable to assume that FAWS will increase, both in stock and as a ratio of total growing stock. This tendency can be noticed in the data delivered from Iceland to the ongoing FOREST EUROPE (2015) program as seen in Fig. 24.1. Growing stock has significantly increased since 1990 and the FAWS ratio of total has steadily increased from being 39 % in 1990, 49 % in 2000, 54 % in 2005, 59 % in 2010 and 65 % in 2015.

24.3.3.2 Estimation of Increment

As all NFI plots are permanent, volume or biomass increment is estimated at tree level by comparing the current size with the size five years ago. This is possible as the position of every tree on the plot is recorded. Although currently possible, increment measurements on trees that have been removed through felling or

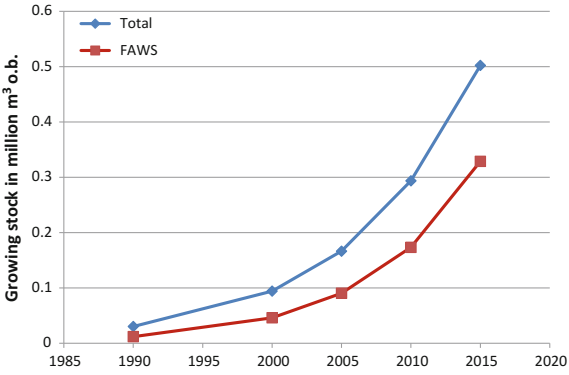

Fig. 24.1 Chronological change in growing stock in Icelandic forests

mortality have not yet been estimated on the plot as the second round of the NFI has only recently been completed. For that reason gross increment estimation has not yet been carried out but will be in the near future.

24.3.3.3 Estimation of Drain

As already mentioned has drain estimation on the plot level not yet been carried out although the data sampled allow such estimation. In the annual NIR to the UNFCCC only woody biomass removed from the forest and sold on a marked are reported as a drain and in that case as losses of carbon stock (Hallsdóttir et al. 2013).

24.3.4 Other Wooded Land and Trees Outside Forest

24.3.4.1 Assessment and Measurement

The area of other wooded land is estimated to be 139,300 ha, more than three times the area of forest (Table 24.2). On the contrary growing stock in other wooded land was estimated only 32,000 m^3 in 2010 which is 11 % of growing stock in forest in the same year. Although the growing stock can be found in other wooded land it can be stated that commercial wood utilisation is not realistic, especially in the natural birch woodland, where the growing stock is 0.2 m^3/ha. The majority, or 97 %, of other wooded land is natural birch woodland.

Trees outside forest such as trees in urban areas are another source of biomass. Just to give some glimpse of the annual amount of woody biomass collected from urban areas in the capital Reykjavík and surrounding municipalities (about 64 % of the population is living in this area), 6000 metric tonnes of woody biomass was gathered in the year of 2013 (SORPA 2014). This biomass is used to make a fertile soil-mixture called Molta.

24.3.4.2 Estimation

The Icelandic NFI includes areas that are defined as Other Wooded Land (OWL). In the category of cultivated forest OWL occurs sporadically (Table 24.2). These areas are treated the same as forest and plots are laid out in the same manner as in the forest part, including tree assessment. In the Natural Birch woodland the proportion of OWL is much larger (Table 24.2) but both forest and OWL are measured in the same way. Further information of measurement methodology is to be found in Snorrason (2010).

References

Alþingi (1950) Lög um Skógrækt (The Forest Act). http://www.althingi.is/lagas/143b/1955003.html Accessed 2 Feb 2016

Aradottir AL, Arnalds O (2001) Ecosystem degradation of birch woodlands in Iceland. In: Wielgolaski FE (ed) Nordic Mountain birch Ecosystems. UNESCO and Partheon Publishing, Paris and Carnforth, pp 293–306

Árnason K, Matthíasson I (2009) Corine Land Cover 2006, Corine Land Cover 2000 and Corine Land Cover-Changes in Iceland. National Land Survey of Iceland, Akranes

Bjarnadottir B, Inghammar AC, Brinker M-M, Sigurdsson BD (2007) Single tree biomass and volume functions for young Siberian larch trees (*Larix sibirica*) in eastern Iceland. Icel Agric Sci 20:125–135

Bjarnason H (1974) Athugasemdir við sögu Íslendinga í sambandi við eyðingu skóglendis (Notifications on the history of Iceland regarding deforestation). Ársrit Skógræktarfélags Íslands: 30-43

Davíðsson B (2012) The present and future resource situation in larch (*Larix sukaczewii*) and lodgepole pine (*Pinus contorta*) stands in Eyjafjördur, northern Iceland. MSc thesis, Norwegian University of Life Science

FAO (2004) Global Forest Resources Assessment Update 2005: terms and definitions (final version). Forest Resources Assessment Programme Working Paper 83/E, FAO Forestry Department, Rome

FAO (2015) Food and Agriculture Organization of the United Nations. Global forest resources assessment 2015: main report. How are the world's forests changing? www.fao.org/forestry/fra. Accessed 4 Feb 2016

FOREST EUROPE (2015) State of Europe's Forests 2015. Europe's status & trends in sustainable forest management in Europe. Forest Europe Liaison Unit Madrid; United Nations Economic Commission for Europe; Food and Agriculture Organization of the United Nations

Gudbergsson G (1998) Hrís og annað eldsneyti (Brushwood and other fuel). Skógræktarritið 23–31

Gunnarsson E (2011) Skógræktarárið 2010 (The forestry year of 2010). Skógræktarritið 2:96–101

Hallanaro E-L, Pylvänäinen M (2002) Forest. Nature in Northen Europe—biodiversity in a changing environment. Nordic Council of Ministers, Copenhagen, pp 209–222

Hallsdóttir BS, Wöll C, Guðmundsson J, Snorrason A, Þórsson J (2013) Emission of greenhouse gases in Iceland from 1990 to 2011 National Inventory Report 2013, UST-2013:06. Environment Agency of Iceland. http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/7383.php. Accessed 2 Feb 2016

Heidarsson L, Pukkala T (2011) Taper functions for lodgepole pine (*Pinus contorta*) and Siberian larch (*Larix sibirica*) in Iceland. Ice Agric Sci 24:3–11

Heiðarsson L, Pukkala T (2012) Models for simulating the temporal development of Siberian larch (*Larix sibirica*) plantations in Hallormsstaður Iceland. Ice Agric Sci 25:13–23

IMG Gallup (2004) Skógræktarkönnun 2004 (Forestry opinion poll 2004). Viðhorfskönnun ágúst-september 2004

Jónsson TH (2004) Stature of Sub-arctic Birch in relation to growth rate, lifespan and tree form. Ann Bot-London 94:753–762

Jónsson JÁ (2007) Áhrif skógræktaraðgerða á viðarvöxt og flæði kolefnis í asparskógi (The influence of management intervention on growth and carbon fluxes in poplar plantation). Master thesis, Háskóli Íslands, Reykjavík

Kristjánsson L (1980) Rekaviður (Driftwood). In: Kristjánsson L (ed) Íslenskir sjávarhættir I. Bókaútgáfa Menningarsjóðs, Reykjavík, pp 197–305

Ministry for the Environment (2006) Iceland's initial report under the kyoto protocol. http://unfccc.int/files/national_reports/initial_reports_under_the_kyoto_protocol/application/msword/initial_report_-_iceland.doc

Sigurðsson S (1977) Birki á Íslandi (útbreiðsla og ástand) (Birch in Iceland (distribution and condition)). In: Skógarmál. Edda hf, Reykjavík, pp 146–172
Sigurðsson S, Bjarnason H (1977) Skóglendi á Íslandi - Athuganir á stærð þess og ástandi. (Woodland in Iceland – Observations on area and condition) Skógrækt ríkisins - Skógræktarfélag Íslands, Reykjavík
Snorrason A (2010) National Forest Inventories reports: Iceland. In: Tomppo E, Gschwantner T, Lawrence M, McRoberts RE (eds) National Forest Inventories—pathways for common reporting. Springer, Berlin, pp 277–289
Snorrason A (2013) Þéttleiki, viðargæði og tegundaskipting í ræktuðum skógum á Íslandi – áhrif á umhirðu á komandi árum (Density, wood quality and partition of tree species in cultivated forest in Iceland – influence of management in the nearest future). In: Oddsdóttir E, Sigurbjartsdóttir Ó, Sigurðsson BD (eds) Fagráðstefna skógræktar, Hallormsstaður, 12-14. mars. Rannsóknastöð skógræktar Mógilsá, pp 11–20
Snorrason A, Kjartansson BÞ (2004) Íslensk skógarúttekt. Verkefni um landsúttekt á skóglendum á Íslandi. Kynning og fyrstu niðurstöður (Icelandic Forest Inventory (Project on National Forest Inventory in Iceland. Presentation of first results). Skógræktarritið 2:101–108
Snorrason A, Einarsson SF (2006) Single-tree biomass and stem volume functions for eleven tree species used in Icelandic forestry. Ice Agric Sci 19:15–24
SORPA (2014) Ársskýrsla Sorpu 2013 (Annual report of Sorpa 2013). Reykjavík. http://www.sorpa.is/files/arsskyrslur/arsskyrsla_sorpa_2013_net.pdf. Accessed 2 Feb 2016
Viðarsson GJ, Snorrason A (2012) Kolefnisforði og kolefnisbinding trjágróðurs í byggðum hverfum Reykjavíkurborgar (Carbon pool and carbon sequestration in trees in settlement in Reykjavik city). Skógræktarritið 1:41–46